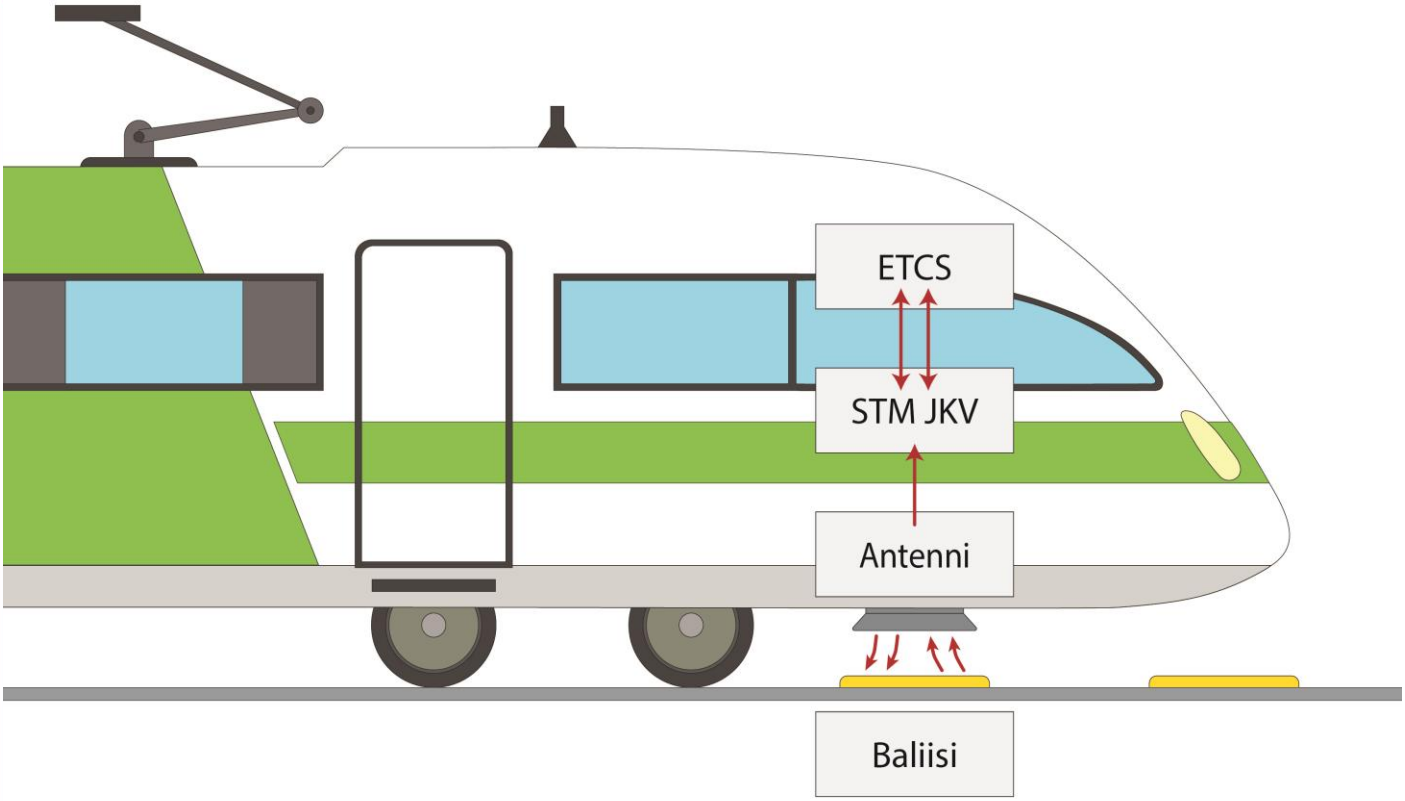
Väyläviraston ohjeita
32/2023

Väylävirasto
Trafikledsverket

Junakulunvalvontajärjestelmän veturilaite sovitustiedonsiirtomoduuli STM JKV

Kansallinen vaatimuseritelmä ERTMS/ETCS-perusversioon 3



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Kohdistuvuus
STM, JKV, kansalliset vaatimukset

Voimassa
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Asiasanat
STM, sovitustiedonsiirtomoduuli, JKV, ERTMS, ETCS

Junakulunvalvontajärjestelmän veturilaite sovitustiedonsiirtomoduuli STM JKV

Väylävirasto julkaisee ”Junakulunvalvontajärjestelmän veturilaite sovitustiedonsiirtomoduuli STM JKV - Kansallinen vaatimuseritelmä ERTMS/ETCS-perusversioon 3”, joka on uudistettu vaatimusmääritelmäkokoelma, käytettäväksi kansallisena vaatimuseritelmänä nykyisen ERTMS/ETCS-perusversion 3:n mukaisten STM-sovitustiedonsiirtomoduulituotteiden hyväksymisessä valtion rataverkolle.

Vetokaluston veturilaitteena STM JKV -sovitustiedonsiirtomoduulituote liitetään ERTMS/ETCS-veturilaitteisiin. Tämä toiminnallinen kokonaisuus mahdollistaa sujuvien tasonvaihtojen avulla liikennöinnin sekä junakulunvalvonta JKV:n luokan B järjestelmän mukaisilla ratalaitteilla varustetuilla radoilla, että ERTMS/ETCS-junakulunvalvontajärjestelmän luokan A mukaisilla ratalaitteilla varustetuilla rataosuuksilla.

Osastonjohtaja, tekniikka ja ympäristö — Minna Torkkeli
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Ohje on osa Väyläviraston turvallisuusjohtamisjärjestelmää rautatietoimintojen osalta.

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Guideline

13 June, 2023 VÄYLÄ/4026/06.04.01/2023

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Concerns	Valid from
STM, JKV, national requirements	1 July, 2023

Onboard Unit for the Automatic Train Protection System JKV (ATP-VR/RHK), the Specific Transmission Module STM JKV

The Finnish Transport Infrastructure Agency (FTIA) publishes "Onboard Unit for the Automatic Train Protection System JKV (ATP-VR/RHK), the Specific Transmission Module STM JKV - National requirements specification for ERTMS/ETCS baseline 3", which is a renewed collection of the requirements definitions, to be used as a national requirements specification for the approval of STM Specific Transmission Module products according to the current ERTMS/ETCS baseline 3 for the Finnish state railway network.

As an on-board unit for tractive stock, the STM JKV Specific Transmission Module product is connected to the ERTMS/ETCS on-board equipment. This functional entity enables, with smooth level transitions, train traffic on tracks equipped with trackside equipment according to JKV (ATP-VR/RHK) class B system, or on track sections with trackside equipment according to class A of the ERTMS/ETCS.

Departmental Director, Engineering and Environment	Minna Torkkeli
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This guideline is part of the Finnish Transport Infrastructure Agency's safety management system for railway operations.
Feedback and inquiries can be directed to the document's contact person (firstname.lastname@vayla.fi) or to the Finnish Transport Infrastructure Agency's feedback channel for technical and safety guidelines (teknisetjaturvallisuusohjeet@vayla.fi).

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Esipuhe

Tämä vaatimuseritelmä määrittelee kansalliset vaatimukset Suomen valtion rataverkon junakulunvalvontajärjestelmässä (JKV) toimivalle, ERTMS/ETCS-perusversion 3 kanssa yhteensopivalle sovitustiedonsiirtomoduulille STM JKV. Vaatimuseritelmä jakautuu toiminnallisiin, yleisiin ja RAMS-vaatimuksiin.

Väyläviraston työn tilaajana ja ohjaajana toimi Aki Härkönen. Ohjetyön toteuttajana toimi Sweco Finland Oy, jossa ohjeen kokoajana toimi Matti Tulikoura. Lisäksi asiantuntijoina toimivat Harry Nyström, Jouni Lehmusto ja Ari Julku (VR Fleetcare). Ohjejulkaisu sisältää muutoshistorian.

Helsingissä kesäkuussa 2023

Väylävirasto
Ratojen kunnossapito-osasto

Preamble

This requirement specification defines the national requirements for the Specific Transmission Module STM JKV, compatible with ERTMS/ETCS baseline 3, to be used with with Automatic Train Protection System JKV (ATP-VR/RHK) of the Finnish state railway network. The requirements specification is divided into functional, general and RAMS specifications.

This requirements writing task by the Finnish Transport Infrastructure Agency was commissioned and supervised by Mr Aki Härkönen. Consulting company Sweco Finland Oy acted as the implementer of the guidelines, and Mr Matti Tulikoura was the compiler. In addition, Mr Harry Nyström, Mr Jouni Lehmusto and Mr Ari Julku (VR Fleetcare) acted as experts. The publication contains a document modification history.

In Helsinki, June 2023

Finnish Transport Infrastructure Agency
Railway Maintenance Deparment

ATP-VR/RHK STM BL3 FUNCTIONAL REQUIREMENTS SPECIFICATION (FRS)
ATP-VR/RHK STM BL3 GRS
ATP-VR/RHK STM BL3 RAMS

FRS & GRS & RAMS ATP-VR/RHK STM BL3 CONTENTS

Document Modification History

2.0	Second version	17.05.2023	M. Tulikoura	H. Nyström A. Julku J. Lehmusto	A. Härkönen
1.0	First version	29.10.2020	N. Lindfors	A. Härkönen A. Julku J. Lehmusto	M. Torkkeli
Version	Modification	Valid from	Prepared	Checked	Approved

Section 1 – ATP-VR RHK STM BL3 FRS & GRS & RAMS Table of Contents

Table of Contents for the ATP-VR/RHK STM FRS & GRS & RAMS (this document)

Section 2 – ATP-VR RHK STM BL3 FRS & GRS & RAMS Description

The purpose and background of the ATP-VR/RHK STM FRS & GRS & RAMS documentation

Section 3 –ATP-VR/RHK STM BL3 FRS Part 1

The Functional Requirements Specification Part 1 – System Introduction

Section 4 – ATP-VR/RHK STM BL3 FRS Part 2

The Functional Requirements Specification Part 2 – Information Flow Track-Train

Section 5 – ATP-VR/RHK STM BL3 FRS Part 3

The Functional Requirements Specification Part 3 – Supervision

Section 6 – ATP-VR/RHK STM BL3 FRS Part 4

The Functional Requirements Specification Part 4 – Air Gap

Section 7 – ATP-VR/RHK STM BL3 FRS Part 5

The Functional Requirements Specification Part 5 - Braking and Auxiliary Functions

Section 8 – ATP-VR/RHK STM BL3 GRS

The General Technical Requirements Specification (GRS)

Section 9 – ATP-VR/RHK STM BL3 RAMS

The Reliability, Availability, Maintainability and Safety (RAMS) specification

ATP-VR/RHK STM BL3 FUNCTIONAL REQUIREMENTS SPECIFICATION (FRS)

ATP-VR/RHK STM BL3 GRS

ATP-VR/RHK STM BL3 RAMS

FRS & GRS & RAMS ATP-VR/RHK STM BL3 DESCRIPTION

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2.0	Second version	17.05.2023	M. Tulikoura	H. Nyström A. Julku J. Lehmusto	A. Härkönen
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Version	Modification	Valid from	Prepared	Checked	Approved

Definitions and abbreviations

Note For definitions and abbreviations, refer to document [ATP-VR/RHK STM BL3 Functional Requirements Specification - PART 1 - System Introduction], Chapters 7 and 8.

BACKGROUND

Note ATP-VR/RHK Functional Requirements Specification (FRS) for the STM2N project was originally set up by VR-Track Ltd. in 2002 based on Swedish BV ATC2 STM FRS as part of Nordic co-operation between Finland, Sweden and Norway (at the time RHK/BV/JBV).

Note The Finnish STM2N FRS concept was updated during 2006 - 2007 from STM European (STM-E) to STM National (STM-N).

Note The Finnish STM2N FRS & GRS & RAMS was updated during 2010-2011 and resulted in ATP-VR/RHK STM-N FRS & GRS & RAMS.

Note The ATP-VR/RHK STM-N FRS & GRS & RAMS draft version was introduced to technical experts of different stakeholders at the 'Finnish Transport Agency Technical expert seminar held in June 2011. The draft version was made available for comments during June 2011 - November 2011.

Note The official version of ATP-VR/RHK STM-N FRS & STM-N GRS & STM-N RAMS version 1.0 was published by the Finnish Transport Agency on 20.12.2011. This document was supplemented by three Addendums in 2016 and 2019. The last published Addendum 1.2 replaces the previously published Addendums 1 and 1.1.

Note Due to future needs for the STM-N product to be used in the future rolling stock equipped with the ETCS Baseline 3, an update of the FRS documentation was carried out in 2020. This update was prepared in cooperation with Sweco Infra & Rail, VR Fleetcare and Hitachi Rail. The draft version was made available for comments during August-September 2020.

Note Due to some errors, ambiguity and inconsistencies found in the requirement specification, an update of the specification was carried out in 2022-2023. This update was prepared in cooperation with Sweco, VR Fleetcare and Hitachi Rail. The draft version was made available for comments to several stakeholders in March 2023, and all comments are taken into consideration in the final version.

DESCRIPTION

Note This chapter describes the Finnish Specific Transmission Module (STM Baseline 3) FRS & GRS & RAMS documents background and purpose. Additional guidance is provided how to interpret the content.

Note The requirements set in the FRS & GRS & RAMS Baseline 3 documents are applicable for the ATP-VR/RHK STM BL3. The requirements are solely meant for the STM used in railway network in Finland and all the numbered requirements must be fulfilled.

Note The functional requirements are marked with index [F X] where F indicates a requirement and X indicates the unique number (ID) of the requirement.

Note The generic technical requirements are marked with index [G X] where G indicates a requirement and X indicates the unique number (ID) of the requirement.

Note The RAMS requirements are marked with index [R X] where R indicates a requirement and X indicates the unique number (ID) of the requirement.

Note Informative content is marked with index [Note]. Explanations and notes are not numbered. This information will not be regarded as requirements.

Note ATP-VR/RHK STM BL3 Functional Requirements Specification specifies national requirements for ATP-VR/RHK STM. European ERTMS/ETCS Technical Specifications of Interoperability and related Subsets or vehicle integration specific requirements may override the requirements specified in the ATP-VR/RHK STM BL3 FRS & GRS & RAMS documents.

Note The requirements set in the FRS & GRS & RAMS documents are applicable if similar functionality and equal or better safety performance cannot be obtained and demonstrated by vehicle specific requirements and implementation.

Note Exceptions from the ATP-VR/RHK STM BL3 requirements must be stated and justified in any case.

Note If not otherwise specified separately, the currently valid revision of referenced subsets / specifications / standards must be used (dated references are avoided in the documents).

Note Applicable valid document revisions must be agreed by National Safety Authority (NSA).

ATP-VR/RHK STM BL3 FUNCTIONAL REQUIREMENTS SPECIFICATION

PART 1

SYSTEM INTRODUCTION

Document Modification History

2.0	Second version	17.05.2023	M. Tulikoura	H. Nyström A. Julku J. Lehmusto	A. Härkönen
1.0	First version	29.10.2020	N. Lindfors	A. Härkönen A. Julku J. Lehmusto	M. Torkkeli
Version	Modification	Valid from	Prepared	Checked	Approved

TABLE OF CONTENTS

Definitions and abbreviations

Note For definitions and abbreviations, refer to [Chapter 7] and [Chapter 8].

Note For the ETCS Glossary of Terms and Abbreviations refer to [SUBSET-023].

Scope

Note This part of FRS gives introduction to the Specific Transmission Module National (STM, Baseline 3) for ATP-VR/RHK system.

Note The content of this part is informative.

SYSTEM OVERVIEW

1.1 ATP system

Note

The Automatic Train Protection (ATP) is a system that supervises the running of the train when the train has passed a permissive signal of signalling system. Part of the ATP system, the ATP on-board system, performs the one main safety supervision function without train driver intervention: If the driver does not reduce speed sufficiently or exceeds the calculated supervised speed the ATP-system shall apply the service brakes and, if necessary, the emergency brakes of the train. This way the ATP system effectively prevents collision and derailment of trains.

In order to perform the supervision function the ATP on-board system needs access to ATP trackside information such as signal aspects, speed restrictions, distances, gradients etc. The information is given via track-mounted balises at Information Locations (IL). In the Finnish ATP-VR/RHK system one IL always consists of two balises and the target point information must be always transmitted to the ATP on-board system 2400 m or 3600 m (depending on line specific speed) before the target point. The ATP supervision information called Balise Telegrams is transmitted to the antenna mounted underneath the train via the interface called Air Gap. The transmission energy for the track-mounted balises is given by the on-board train antenna.

For the supervision function the ATP on-board system also needs information of train characteristics such as train type, length, weight, brakes etc. This data is transmitted to the system via the Driver Machine Interface (DMI) by the driver.

ATP system in Finland is called ATP-VR/RHK based on Bombardier EBICAB 900 technology, using JGA29001 balises or Ansaldo STS technology's L34000 minitransponders. The ATP-VR/RHK is defined in the ERA document "List of CCS Class B systems" and covers balises and other ATP-VR/RHK products from existing suppliers. In this FRS document term ATP refers to ATP-VR/RHK.

In order to take benefit of the European ERTMS/ETCS, a Specific Transmission Module (STM) is needed to link the existing, national trackside ATP equipment/information to the new ERTMS/ETCS on-board equipment to achieve the necessary national ATP functionality. The STM module is compatible with the existing national Finnish ATP system (ATP-VR/RHK) and is part of the ETCS on-board equipment. STM is specifically designed to function like the ATP-VR/RHK on-board system. The hardware architecture of the on-board equipment as specified by the ETCS specifications, allows operation within the existing national infrastructure by reception of all information from the balises of the national ATP system.

Overview of the ATP system including ETCS and STM on-board is shown in Figure 1/1. The ATP on-board system interfaces with on-board equipment such as tachometer, brake system, cab controls, recorder units etc.

Note

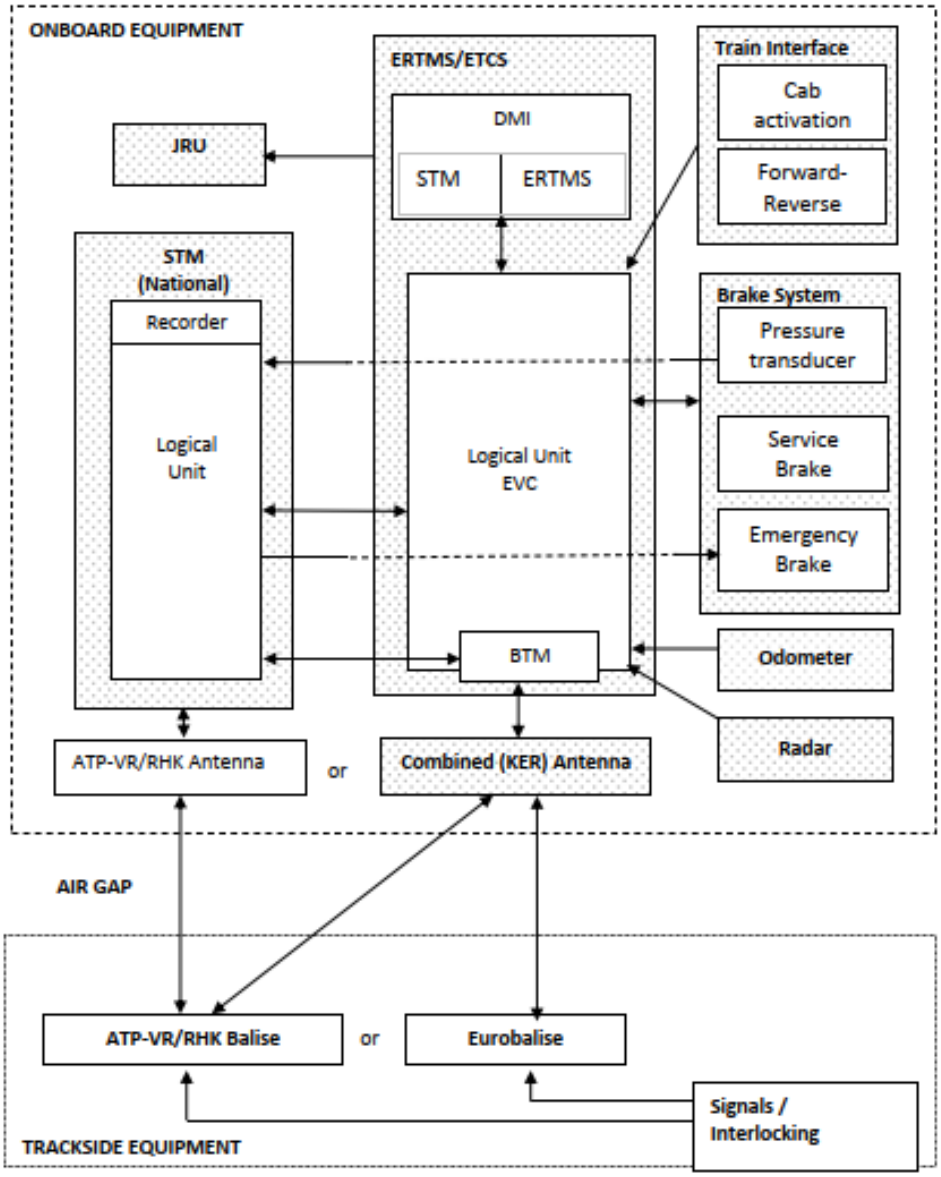


Figure 1/1. Overview of the ATP system with ETCS and STM on-board

Note For more detailed description refer to [SUBSET-035 Chapter 5].

1.2 Driver Machine Interface (DMI)

Note The DMI displays necessary system information and gives appropriate alerts, including:

- Display of permitted speed, target speed and distance to supervision target point of the train.
- Display of target signal is at 2-3 signalling sections ahead.
- Display of the type of a target point, speed restriction or point speed restriction.
- It warns the driver when route ahead is to occupied track.
- It warns the driver at approaching stop signals or speed restrictions.
- It warns the driver in two steps in case of overspeeding.
- It displays the driver when ATP has applied service braking or emergency braking.
- It alerts the driver if a stop aspect is passed or critical calculated speed is exceeded (which results in emergency braking).
- It displays the possibility to release ATP braking.
- It displays and warns in case of any ATP system faults.
- etc.

1.3 Train data

Note The train data used for supervision by the STM on-board system includes:

- brake type (JL)
- maximum permitted speed of the train (SNJ/V_{TRAIN})
- brake weight percentage (JPP, describing the braking capacity of the train)
- train length (PIT)
- PT code (train specific)
- weather (track surface) condition data (KELI)
- tilting/non-tilting information

Note More detailed train data information refer to [FRS Part 3 Supervision].

2. ATP-VR/RHK SUPERVISION PRINCIPLE

2.1 Balise telegrams

Note At the information location of the ATP-VR/RHK system, there are always two balises at a fixed distance from each other. The trackside configuration of the balise telegram determines how the balise telegram is handled in the on-board ATP system.

The trackside balises are named A balise and B balise. With respect to the operating direction of an information location operating in one direction, the first balise is the A balise and the second one the B balise. In both balises of the information location (e.g. at signal points), the telegram information content is the same, except for the configuration A/B. Normally, the B balise telegram is handled. It is also possible to configure the information location as operating in both directions, e.g. at a location where the speed restriction starts in one direction and ends in another. At such a location, the A balise telegram relates to a train running in the direction of the information location (reading first the A balise telegram) and the B balise telegram to a train running in the opposite direction. There can be four different types of balise telegrams (signal, repeater signal, warning board and speed board). The type determines how the information transmitted by the balise telegram is interpreted in the on-board ATP system.

The information coded into a specific place in the balise telegram is handled according to its place and the information location. A code in the balise telegram corresponds e.g. to a specific speed or distance. The speeds, distances, etc. corresponding to the hexadecimal values are defined in the tables in the air-gap specification.

The information locations have been given 5-digit IDs, the purpose of which is in part to ensure that the train will find in the track all the information locations relating to it. The principle to ensure the integrity of the information locations along the line is called information location linking chain. On the other hand, IDs are used to help find the faulty location in the case of a balise failure.

2.2 Speed supervision

Note The ATP on-board equipment calculates, based on the train data and received balise telegrams, the braking curves to all the target points ahead, as the information has been received in balise telegrams. The most restrictive target point is displayed to the driver and supervised, including configured safety margin, by the ATP on-board system. In addition to the most restrictive target point and related braking curve, the ATP on-board system supervises that various speed limits (e.g. ceiling speed, train or line specific maximum speed, railway switch speed) are not exceeded.

3. ATP-VR/RHK MODES

3.1 Start-up

Note After initial testing of the on-board equipment and feeding of the train data, the ATP-VR/RHK on-board equipment switches by default to the non-equipped area mode. At the same time, an initial speed restriction of 35 km/h is given, which is cancelled when ATP-VR/RHK on-board system switches to the fully equipped area mode or the driver cancels the restriction by pressing the speed increase button.

3.2 Non-equipped area

Note In the non-equipped area mode, ATP on-board system supervises the train specific speed or national maximum permitted speed in non-equipped area. ATP reads the information transmitted by the balises encountered in the track. If there are speed restriction balises in the non-equipped area in the track, ATP supervises all the speed restriction information received as well as e.g. the signal information received from repeater signals. The distance and speed displays light up, however, only after the train has passed into the fully equipped area.

3.3 Fully equipped area

Note ATP switches to the fully equipped area mode on encountering the first signal balises. The distance and speed displays light up according to the balise telegrams read. ATP leaves the fully equipped area mode only according to the information transmitted by boundary balises. The displays also react to certain balise errors.

In the fully equipped area, there are two special ATP functions: the reserved track function and the left-hand track function. Where configured for the trackside signalling system interlocking rules, it is permitted to set up the route on a reserved track. ATP supervises a switch point as target point on receiving a reserved track balise telegram. After the switch, the DMI and its text display warns the driver that the track is reserved. After a stop, the normal non-equipped area mode can be resumed by pressing the speed increase button. The left-hand track function is only used in situations where the train passes a dark signal onto a left-hand track without line block system. This function is not used in STM on-board implementation (non-equipped area is used instead).

3.4 Construction area

Note ATP can switch to the construction area mode both from the fully equipped and the non-equipped area mode on receiving a balise telegram. The balise telegrams read in the construction area are not handled, and the DMI text display indicates construction area. In the construction area, the train specific maximum speed, the speed given by the boundary balises or national maximum speed in construction area is supervised as maximum permitted speed. The construction area ends when ATP receives a telegram from the boundary balises and switches to the non-equipped area mode and, after encountering possible signal balises, on to the fully equipped area mode.

3.5 Other country area

Note The ATP-VR/RHK system also comprises the other country function, which is so far not used in Finland. This function corresponds to the construction area function, except for the text display, which is the same as for the non-equipped area. The purpose of the other country function is to inform the ATP and the driver about transition to other ATP system line.

4. HANDLING BALISE TELEGRAMS

4.1 Checking the telegram and identifying the information location

Note In addition to 180 information bits, the balise telegram comprises control, synchronisation and CRC bits, the purpose of which is to ensure that the balise telegram has been read correctly. The balise telegram can be accepted after data checking. After accepting the balise telegram, the information location formed by two balises must still be identified before the handling of the balise telegram can continue. The balises must be at a specified distance from each other and from other balises, and the configurations of the information locations must match.

4.2 Handling signal telegram

Note In addition to the linking chain information, the balise telegram transmitted by a signal gives information on the signal point, the target signal and the next two switches. The information received from a new signal point replaces all the information received from the previous signal points, except for switch information, which is already used for ceiling speed supervision.

4.3 Handling repeater signal telegram

Note The balise telegram transmitted by a repeater signal corresponds to the signal telegram, except for the configuration of the information location. The repeater signal telegram is checked for faults more lightly than the signal telegram, but an acceptable telegram is handled in the same way as the signal telegram, except for the main signal information, which is never accepted from the repeater signal.

A special case of the repeater signal is the linking repeater, which can be used to change information on the distance to the next main signal and on its control speed. The switch information transmitted by the linking repeater is handled in the same way as the switch information transmitted by the repeater signals and signals.

4.4 Handling speed board telegram

Note The balise telegram transmitted by a speed board starts or ends the speed restriction. Generally, the speed restriction also has warning board balises. In addition to the type of speed restriction, the speed board telegram also gives information on speed. This is however, not mandatory information e.g. in telegrams which end the speed restriction.

Type of speed restriction:

- M1: mandatory speed restriction, which can only be ended by giving a new M1 speed restriction
- M2: mandatory speed restriction
- M3: mandatory speed restriction, no train length supervision
- C1: curve restriction; for tilting train speed given in the balise telegram x 1,50
- C2: curve restriction; for tilting train speed given in the balise telegram x 1,25
- LCP1-3: speed restrictions at controlled level-crossings, no train length supervision
- LZ: landslide zone restriction
- TS1-15: train-specific restrictions, valid as determined by the PT code
- BUA: boundary of the non-equipped area
- BCA: boundary of the construction area
- BOC: boundary of other country
- SRe: boundary balises, used to indicate the end point of switch area
- ODO: balises for checking wheel diameter set-up

4.5 Handling warning board telegram

Note The warning board telegram provides necessary advance information on the speed restriction ahead. In addition to the linking chain information, the following information is always transmitted: restricted speed, type of speed restriction, and gradient as far as the starting point of the restriction. Except for certain types of speed restrictions, the warning board telegram must also give the length of the restriction. If the length has been given, the information provided by the warning board telegram alone is sufficient for supervising the restriction. If at the target distance (+/- 10%), defined in the warning board telegram, from the warning board balises there are in the track speed board balises meaning the same type of restriction and distance, the information on the length of the speed restriction transmitted by the warning board balises is not used. Instead, the length of the speed restriction is determined by the speed board balises. Certain speed restrictions must always also have speed board balises.

For the following types of speed restrictions, only warning board balises are used:

- dVinc and dVdec: possibility of exceeding the speed or decreasing the speed to a specific range for heavy trains and on specific distances; valid for trains determined by the PT code.
- TRSw and TRSt are types of restriction the validity of which is influenced by switches in the track before the start of the restriction point.

For several types of speed restrictions, speed restriction cancellation balises can also be used on the distance supervised by the speed

restriction balises. The cancellation message is given at the warning board, and the distance and speed given in the cancellation message must match with the cancellation message received earlier so that the restriction can be cancelled.

4.6 Handling target signal message

Note

The target signal message provides information on the next signals. It always gives the distance to the next main signal, as well as the release speed of the next main signal. The type of message determines how other information transmitted by the target signal message is interpreted. For the distances given in the message, the corresponding gradient information is also given.

The types of messages are as follows:

- next main signal at stop, fixed release speed
- next main signal at stop, calculated release speed
- main signal after the next main signal or the next after that at stop
- no restrictive signal information
- reserved track
- speed to be dropped in advance of the main signal after the next main signal, no other restrictive signal information

As fixed release speed, 10 or 35 km/h is given. If another release speed has been programmed into the balise telegram, it is replaced by 10 km/h, and a fault alarm is given. The calculated release speed message also gives the fixed release speed, as well as the length of the overlap distance. If the driver activates the calculated release speed e.g. by applying the brake, the on-board equipment calculates the release speed corresponding to the train data and overlap distance. This speed, which can be a speed divisible by five within the range 10-80 km/h, is used when approaching the signal.

Route length can be deduced from the target signal message. ATP prepares for the braking distance needed based on the information given in the target signal message.

4.7 Handling main signal message

Note

Main signal information (= line speed) is only programmed into the balise telegrams of the main signals. If ATP-VR/RHK starts on open line e.g. at a target signal, the balise telegram of the target signal may also contain main signal information. Such an information location is handled within ATP-VR/RHK as a main signal. The speed restriction given by the main signal must be handled as a speed restriction which continues as far as the next main signal and ends without train length supervision.

4.8 Handling switch information

Note

The signal and repeater signal balises can transmit information on two switch (switch) areas ahead. New information always replaces all the switch information received earlier, except for switches that are used for ceiling speed supervision. Switch information must always include information on the speed restriction, the distance to the starting point of the switch, and gradient. Normally, the length of the switch is also given, except when using Switch Restriction ends balises (SRe). The balise telegram can also give information on speed after switch, which replaces the line speed given by the signal after switch and train-length supervision. Speed after switch cannot be given if the length of the switch has not been given.

Using certain PT codes, the supervised switch speeds can be reduced below the switch speeds given in the balise telegrams.

If switch information is not available, the switch information fields in the balise telegram are left at default. It is therefore important that the switch information fields are accepted for updating to correspond only to the information received from the information locations which have transmitted a telegram of the correct type.

5. SUPERVISION OF LINKING INFORMATION

Note

In order to ensure safety, all the Information Locations permanently installed on the track are linked together (linking chain). The balise telegram gives the ID of the next information location (if possible) and the distance to it. If the transmitted ID of next location does not match with the information received earlier or the next location is not found within the distance given (+ tolerance distance partly dependent of the linking distance), ATP concludes that the location is missing from the track and accordingly displays balise error.

All the main signals have been linked correspondingly; however, in this case tolerance is tighter. If the main signal balises are not found within the given tolerance balise error is displayed and activated.

6. BALISE ERRORS

Note The balise errors are divided into five (5) error categories, depending on the influence of the error. Balise error 1 is only a fault indication. Balise errors 2-5 cause always braking and a supervised speed restriction. The displays are turned off, if necessary, and part of the supervisions are removed according to the error category.

The balise errors and the speed restrictions caused by them are valid as follows:

- Balise error 1: no braking, indication disappears at the next main signal
- Balise error 2: indication and restriction are removed at the next main signal
- Balise error 3: indication and restriction after the train has run 3600 m
- Balise error 4: indication and restriction are removed at the next main signal
- Balise error 5: indication and restriction after the train has run 3600 m and passed the next main signal

The balise errors are classified according to their safety impact on the whole system. For example, balise error 4 means that information relating to the signals is missing and balise error 5 that an information location is missing.

7. DEFINITIONS

Note The definitions are valid for the FRS, GRS and RAMS documents and used for the purpose of these documents.

Table 1/1. Definitions

Expression	**Explanation**
ATP-VR/RHK	National class B legacy ATP system used in Finland.
Balise	A passive transponder mounted on the track which can communicate with a train passing over it.
Button	Button or similar control object in DMI which can be pressed/activated by driver to initiate a function.
Cancelled	Speed restriction is cancelled (no linking towards next IL shall be supervised).
Ceiling Speed	Most restrictive value of the speed limit of the train or speed limit of the track. Note: After ESP end speed is considered as ceiling speed.
Combined Antenna	Euroantenna (also called KER antenna) used by both STM and ETCS for reading ATP-VR/RHK and Eurobalises.
Dedicated Antenna	Antenna used by STM for reading ATP-VR/RHK balises
Distance Controlled Restriction	A speed limit starting at the target point, which shall be terminated after the length of restriction and can not be updated by any speed board.
Encoder	Wayside equipment for national KER systems reading signal aspect or route information and translating this to information such that the KER Balise can transmit the corresponding KER telegram to a passing train.
End Speed	Target Speed when no Release Speed is used, otherwise Release Speed. For the stop aspect (also by level crossing and landslide) it is release speed.
End Speed Position	A point before target where C-curve speed goes below end speed + braking marginal. After ESP permitted speed is target speed or release speed (stop aspect).
Eurobalise	A balise that fulfils [SUBSET-036] requirements
European Railway Traffic Management System	The European Railway Traffic Management System (ERTMS) is made up of all the train borne, track side and line side equip-

Expression	Explanation
	ment necessary for supervising and controlling the train operation according to the traffic conditions based on the appropriate Level of Application.
European Train Control System	The European Train Control System (ETCS) is a subset of ERTMS providing a level of protection against over speed and overrun depending upon the capability of the line side infrastructure.
Fault Reaction Function	Safety reaction of the system to a detected fault.
Full Service Braking	High brake force level (170 kPa).
Hazard	A condition that could lead to an accident
Information Location	A place on track where information is transmitted from trackside devices to on-board via two balises.
Lamp	Indicator in DMI which can be seen by the driver.
Lamp button	Indicator in DMI which can be seen by the driver and which has related button which can be pressed/activated by the driver to initiate a function according to the indication.
Linking	A function to ensure the presence of expected signal or board balise groups. If a group is missing, balise error will occur.
Most Restrictive End Speed	The target with the closest stop point for which ceiling speed supervision is performed (i.e. ESP passed).
Most Restrictive Target Curve	The target with the closest stop point where the curve supervision is performed (i.e. ESP not passed).
Normal Service Braking	Low brake force level (100 kPa).
On-board ATP	Consists of an On-board computer, driver's interfaces and train interface functions. It communicates with the On-board Transmission System.
On-board transmission system	Consists of antenna unit(s) (for Magnetic Transponder Technology), and BTM function(s). It functionally matches the air gap interface and the On-board ERTMS/ETCS Kernel.
Permitted Speed	Most restrictive speed of all current supervised speeds (including e.g. Ceiling Speed and Most Restrictive Target Curve).
Release Speed	Maximum allowed speed to approach a stop signal. Release speed can be either constant (10 or 35 km/h) or variable (10-

Expression	**Explanation**
	80 km/h) calculated by the STM. Release speed is also used by level crossing or landslide.
Risk	The probable rate of occurrence of a hazard causing harm and the degree of severity of that harm
Speed Restriction	Speed limit caused by properties of the track.
Speed board controlled restriction	A speed limit starting at a speed board, which is updated or terminated at another speed board.
Start-up Zone	System state after start-up, when supervision direction has not been established and can be changed without limitations.
STM	Specific Transmission Module National used in Finland.
Stop Point	A point where the extrapolation of D-curve reaches speed 0.
Switch	A railway turnout.
Switch Restriction	Speed limit caused by properties of a switch.
Switch Speed	Allowed speed on the switch.
Tele-powering	The method used for powering a balise from an antenna unit through the air gap
Text indication	An indication displayed to the driver in the DMI with related text information.
Text message	A text message displayed to the driver in the DMI.
Target Point	Point, where the target speed must be reached. Distance to target point from signal point is given in balise message and distance to target point from current position is derived based on odometer distance measurement.
Target speed	Speed limit at a restriction ahead.
Traction cut-off	Traction power cut-off interface (part of ETCS TIU).
Valid telegram	Balise telegram containing correctly checked information received from the Balise.

8. ABBREVIATIONS

Note The abbreviations are valid for FRS, GRS and RAMS documents.

Table 2/1. Abbreviations

Abbreviation	**Explanation**
ATC2	Automatic Train Control system used in Sweden/Norway
ATP	Automatic Train Protection system
ATP-VR/RHK	National class B legacy ATP system used in Finland
b_{ACT}	Retardation from actual braking
b_{FSB}	Retardation from actual braking proportioned to full SB
b_{MTU}	Retardation constant for motor train units
b_{STM}	Retardation from STM train data
BCA	Border to Construction Area
BCAe	End of Construction Area
BCH	Bose Chadhuri Hocquenghem
BF1-5	Balise Failures 1-5
BHC	Border to Home Country
BOC	Border to Other Country
BTM	Balise Transmission Module
BUA	Border to Unequipped (Non-Equipped) Area
C1	Curve 1 Restriction
C1c	Cancellation of Curve 1 Restriction
C1e	End of Curve 1 Restriction
C2	Curve 2 Restriction
C2c	Cancellation of Curve 2 Restriction
C2e	End of Curve 2 Restriction
CO	Configuration (STM state)
CRC	Cyclic Redundancy Check
CS	Cold Standby (STM state)
d_o	Length of the overlap
DA	Data Available (STM state)
Db	Basic distance
DE	Data Entry (STM state)
DG	Deferred Go
Dl	Linking distance
DMI	Driver Machine Interface
DMU	Diesel Multiple Unit
DS	Deferred Stop
dVdec	Delta speed decrement
dVinc	Delta speed increment
Dx	Distance to first switch or to second switch or to restriction point
Dy	Length of first switch or of second switch or of restriction

Abbreviation	**Explanation**
EB	Emergency Brake
EC	European Commission
EMU	Electric Multiple Unit
EO	ETCS order
ERTMS	European Railway Traffic Management System
ESP	End Speed Point
ETB	Error Telegram Board
ETCS	European Train Control System
ETS	Error Telegram Signal
EVC	European Vital Computer
FA	Failure (STM state)
FFFIS	Form Fit Functional Interface Specification
FIFO	First In, First Out
FRS	Functional Requirements Specification
FS	Full Supervision (ETCS mode)
FTIA	The Finnish Transport and Infrastructure Agency (in Finnish: Väylävirasto)
g	Track gradient
g_o	Overlap gradient
G	Brake type, slow
Gb	Basic gradient
GRS	General Technical Requirements Specification
Gx	Gradient to first switch or to second switch or to restriction point
HS	Hot Standby (STM state)
Ic	Current position identity
IL	Information Location
In	Next position identity
IS	Isolation (ETCS mode)
I/F	Interface
JNO	Train Number Data
JRU	Juridical Recorder Unit
k_S	Rail surface condition coefficient
k_V	Velocity dependant coefficient for disk brake
KELI	Coefficient for weather and/or surface conditions
KER	KVB, Ebicab, RSDD (National legacy ATP systems)
KVB	French ATP system
l	Train length
LCP	Level Crossing Protection
LCP1	Level Crossing Protection 1

Abbreviation	**Explanation**
LCP1c	Cancellation of Level Crossing Protection 1
LCP1e	End of Level Crossing Protection 1
LCP2	Level Crossing Protection 2
LCP2c	Cancellation of Level Crossing Protection 2
LCP2e	End of Level Crossing Protection 2
LCP3	Level Crossing Protection 3
LCP3c	Cancellation of Level Crossing Protection 3
LCP3e	End of Level Crossing Protection 3
LZ	Landslide Zone
LZc	Cancellation of Landslide Zone
LZe	End of Landslide Zone
M1	Mandatory Restriction 1
M2	Mandatory Restriction 2
M2c	Cancellation of Mandatory Restriction 2
M2e	End of Mandatory Restriction 2
M3	Mandatory Restriction 3
M3c	Cancellation of Mandatory Restriction 3
M3e	End of Mandatory Restriction 3
Ms	Stop message
MRT	Most Restrictive Target
MTBF	Mean Time Between Failures
MTBM	Mean Time Between Maintenance
MTTM	Mean Time to Maintain
MTTR	Mean Time to Repair
NL	Non-Leading (ETCS mode)
NP	No Power (ETCS mode)
NSA	National Safety Authority

ODO	Automatic distance measurement check
ODOe	Automatic distance measurement check end
OS	Overlap Stop (in balise telegram)
OS	On Sight (ETCS mode)
OS	Operating System
OTP	Opposite Track Passage
P	Brake type, fast
P_{INT}	Current brake pressure
PO	Power On (STM state)
P_{REF}	Reference brake pressure
PT	Special train characteristics code (in train data)
PT	Post trip (ETCS mode)
p_0	Brake rate constant
R	Brake type, efficient fast (in train data)
R	Nibble (in balise telegram)
RAMS	Reliability, Availability, Maintainability, Safety
RF	Radio Frequency
RHK	Ratahallintokeskus (Finnish Rail Administration) - currently known as Väylävirasto (FTIA)
RSS	Release Speed Stop
RSDD	Italian ATP system
RT	Reserved track
RV	Reversing (ETCS mode)
s_{A0}	Prewarning curve A0
s_A	Warning curve A
s_B	Additional warning curve B
s_C	Service brake intervention curve C
s_D	Service brake curve D
s_E	Emergency brake curve E
s_0	Safety distance for stop signal
s_s	Stop point
s_t	Target location
SB	Service Brake
SB	Standby (ETCS mode)
Sb	Speed board
SE	STM European (former ETCS mode)
SF	System Failure (ETCS mode)
SH	Shunting (ETCS mode)
SL	Sleeping (ETCS mode)
Sn	Maximum permitted train speed term used in Finland (in Finnish: sallittu nopeus)
SN	STM National (ETCS mode)
SNJ	ETCS train speed data
SR	Staff Responsible (ETCS mode)
SR	Switch Restriction

SRe	End of Switch Restriction
SRS	System Requirement Specification
Sth	ETCS maximum speed
STM	Specific Transmission Module
STM2N	STM national for ATP-VR/RHK by Hitachi
t_a	Delay coefficient for accelerating train
t_b	Brake time delay
t_s	Delay coefficient for program execution
TB	Emergency braking delay Time
THR	Tolerable Hazard Rate
TIU	Train Interface Unit
TR	Trip (ETCS mode)
Traficom	The Finnish Transport and Communications Agency (the Finnish NSA)
TRSt	Temporary Restriction, Straight route
TRSte	Temporary Restriction, Straight route (end)
TRSw	Temporary Restriction, Switch
TRSwe	Temporary Restriction, Switch (end)
TS1	PT-restriction 1
TS1c	Cancellation of PT-restriction 1
TS1e	End of PT-restriction 1
TS10	PT-restriction 10
TS10c	Cancellation of PT-restriction 10
TS10e	End of PT-restriction 10
TS11	PT-restriction 11
TS11c	Cancellation of PT-restriction 11
TS11e	End of PT-restriction 11
TS12	PT-restriction 12
TS12c	Cancellation of PT-restriction 12
TS12e	End of PT-restriction 12
TS13	PT-restriction 13
TS13c	Cancellation of PT-restriction 13
TS13e	End of PT-restriction 13
TS14	PT-restriction 14
TS14c	Cancellation of PT-restriction 14
TS14e	End of PT-restriction 14
TS15	PT-restriction 15
TS15c	Cancellation of PT-restriction 15
TS15e	End of PT-restriction 15
TS2	PT-restriction 2
TS2c	Cancellation of PT-restriction 2
TS2e	End of PT-restriction 2
TS3	PT-restriction 3
TS3c	Cancellation of PT-restriction 3
TS3e	End of PT-restriction 3
TS4	PT-restriction 4
TS4c	Cancellation of PT-restriction 4

TS4e	End of PT-restriction 4
TS5	PT-restriction 5
TS5c	Cancellation of PT-restriction 5
TS5e	End of PT-restriction 5
TS6	PT-restriction 6
TS6c	Cancellation of PT-restriction 6
TS6e	End of PT-restriction 6
TS7	PT-restriction 7
TS7c	Cancellation of PT-restriction 7
TS7e	End of PT-restriction 7
TS8	PT-restriction 8
TS8c	Cancellation of PT-restriction 8
TS8e	End of PT-restriction 8
TS9	PT-restriction 9
TS9c	Cancellation of PT-restriction 9
TS9e	End of PT-restriction 9
TSI	Technical Specification for Interoperability
TSx	PT-restriction (x category)
TRSw	Temporary Restriction Switch
TRSt	Temporary Restriction Straight track
UN	Unfitted (ETCS mode)
v_C	Current speed
v_{C1}	Retardation calculation start speed
v_{C2}	Retardation calculation stop speed
v_{END}	End speed
v_{ERR}	Speed limit after balise error
V_{INV}	Intervention speed
Vl	Line speed
V_{LINE}	Line speed
v_{MAX}	Current maximum permitted speed
v_{PERMIT}	Permitted speed
v_R	Release speed
v_{REL}	Release speed
Vt	Target speed
v_{TARGET}	Target speeds from signals and warning boards
v_{TRAIN}	Maximum permitted speed allowed for the train
v_{TRACK}	Maximum permitted speed allowed on the track
V_{START}	Start speed
Vx	Second switch restriction
Vy	Speed after first switch
Vy	Speed after second switch
W	Overspeed warning limit
Wb	Warning Board
Δp	Measured pressure drop

Δp_{AVE}	Average pressure drop
λ	Brake weight percent
#	Balise information location shall not be included in linking chain
*	Cancelled value in Balise Telegram

ATP-VR/RHK STM BL3 FUNCTIONAL REQUIREMENTS SPECIFICATION (FRS)

PART 2

FRS & GRS & RAMS
ATP-VR/RHK STM BL3
INFORMATION FLOW
TRACK-TRAIN

Document Modification History

2.0	Second version	17.05.2023	M. Tulikoura	H. Nyström A. Julku J. Lehmusto	A. Härkönen
1.0	First version	29.10.2020	N. Lindfors	A. Härkönen A. Julku J. Lehmusto	
Version	Modification	Valid from	Prepared	Checked	Approved

TABLE OF CONTENTS

Definitions and abbreviations

Note For definitions and abbreviations, refer to document [ATP-VR/RHK STM BL3 Functional Requirements Specification - PART 1 - System Introduction], Chapters 7 and 8.

Scope

Note This part of FRS specifies the following Specific Transmission Module National functions for ATP-VR/RHK:

- Balise reading
- Balise telegram evaluation and identification
- Balise transmission system (Air Gap)
- Appendixes regarding coding and content of balise telegram

Note For an overview of the ATP-VR/RHK STM system, refer to document [ATP-VR/RHK STM BL3 Functional Requirements Specification - PART 1 - System Introduction].

1 GENERAL VIEW OF THE BALISE TELEGRAM PROCESSING

Note The general view of the Balise Telegram processing for STM is shown below (Figure 1/2):

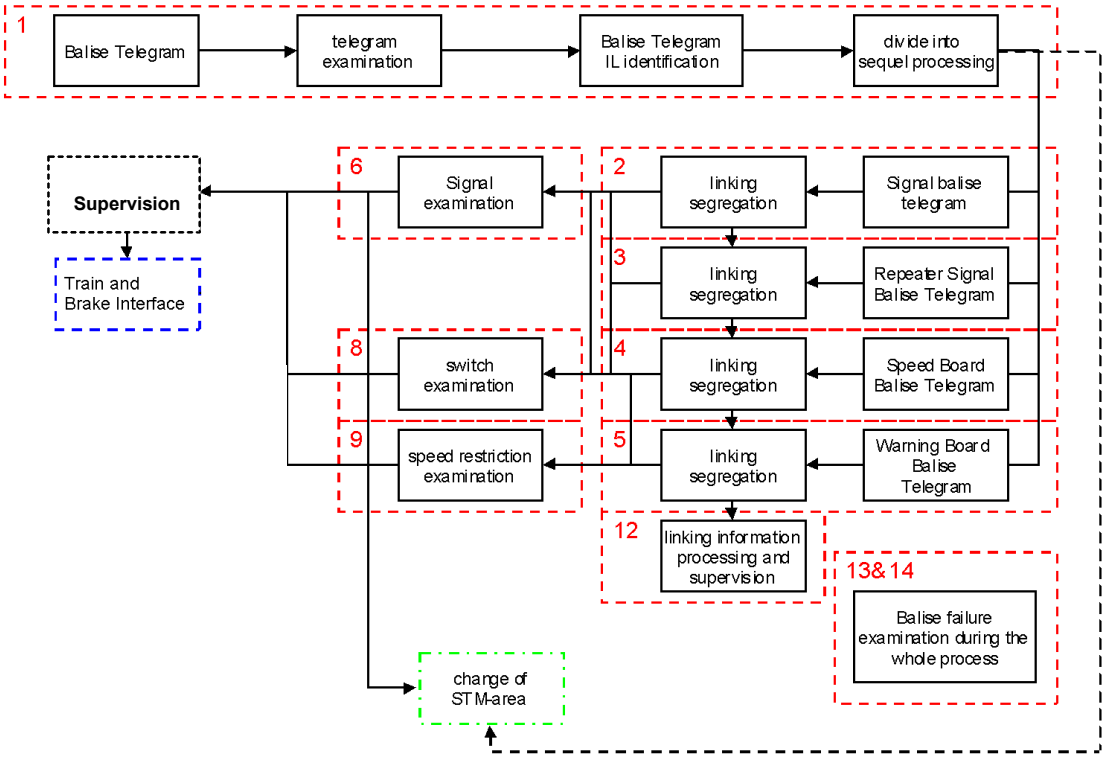


Figure 1/2. STM Balise Telegram processing

Note The figure is an overview of the process of balise telegram handling and related Supervision functions and events. Exact process is specified in related chapters and processing diagrams.

Note STM area change is part of Supervision functions, refer to [FRS Supervision] for more details.

Note Reading instructions

The document describes processing of a Balise Telegram. Exception: In phases 1.2 -1.5 there is descriptions for pre-processing of both Balise Telegrams of one Information Location (IL).

Information of balise telegram is divided into different phases according to several conditions.

The way of presenting of legal values of a nibble:

- 'R0 = 2'; only value 2 is legal
- 'R0 = 2, 3 or B'; values 2, 3 and $B are legal
- 'R3 = 9 – D'; values 9, $A, $B, $C and $D are legal

The way of presenting of legal values of two nibbles:

- 'R16-R17 = 3B'; only value 3 of R16 and value B of R17 are legal
- R18-R19 = 12-8E; all combinations of R18 and R19 values between value 12 (R18 is 1 and R19 is 2) and 8E (R18 is 8 and R19 is $E) are legal: 12, 13…21,22,…8D and 8E

Note In the processing diagrams the reference number in parenthesis () indicates the corresponding requirement. For example, a reference number (2) inside the diagram in the beginning of chapter 6.5 relates to a requirement, which has header marking 6.5.2.

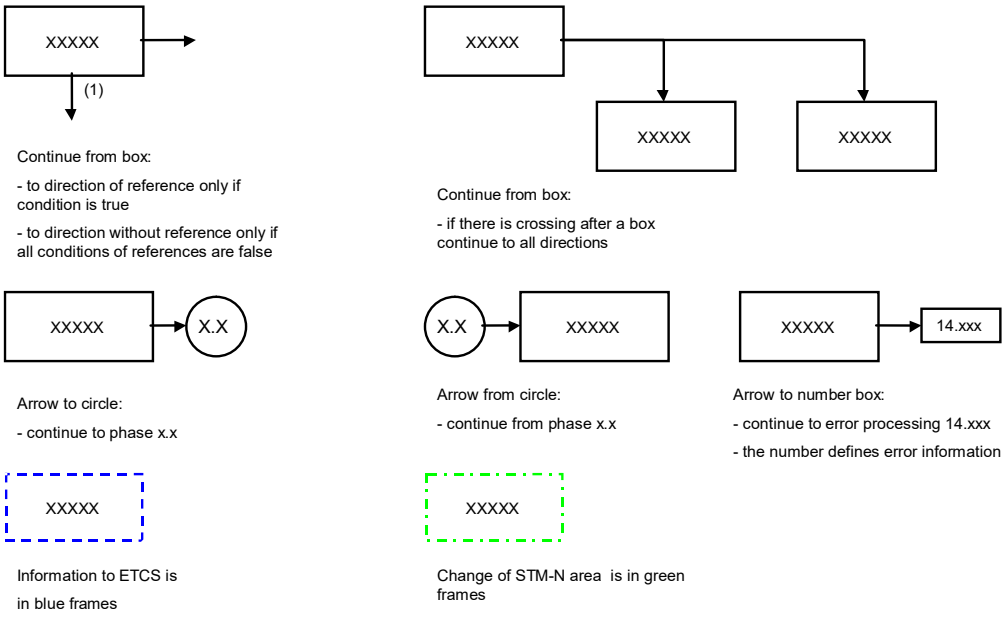
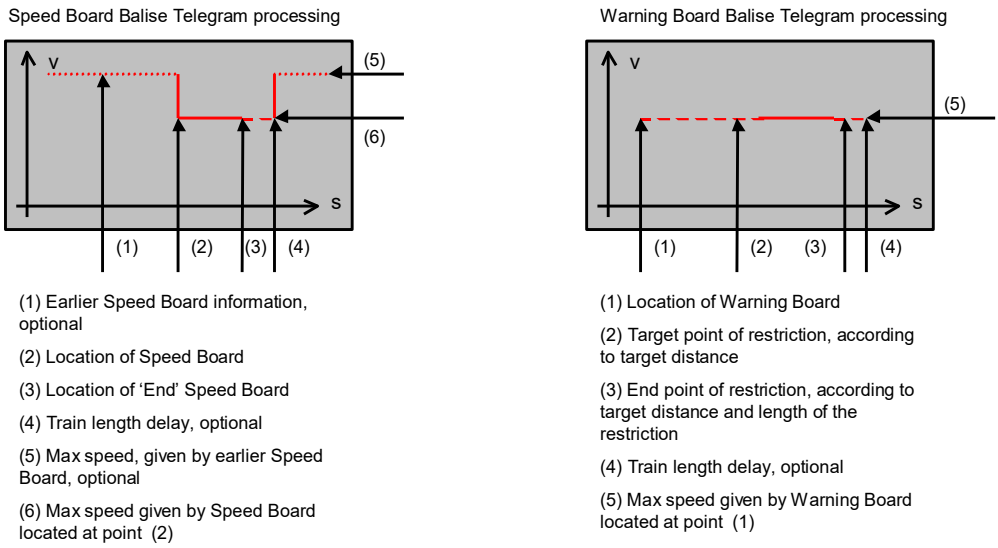


Figure 2/2. Diagram notations



(1) Earlier Speed Board information, optional

(2) Location of Speed Board

(3) Location of 'End' Speed Board

(4) Train length delay, optional

(5) Max speed, given by earlier Speed Board, optional

(6) Max speed given by Speed Board located at point (2)

(1) Location of Warning Board

(2) Target point of restriction, according to target distance

(3) End point of restriction, according to target distance and length of the restriction

(4) Train length delay, optional

(5) Max speed given by Warning Board located at point (1)

Figure 3/2. Diagram notations

1.1 Checking of Balise Telegram

F 3000

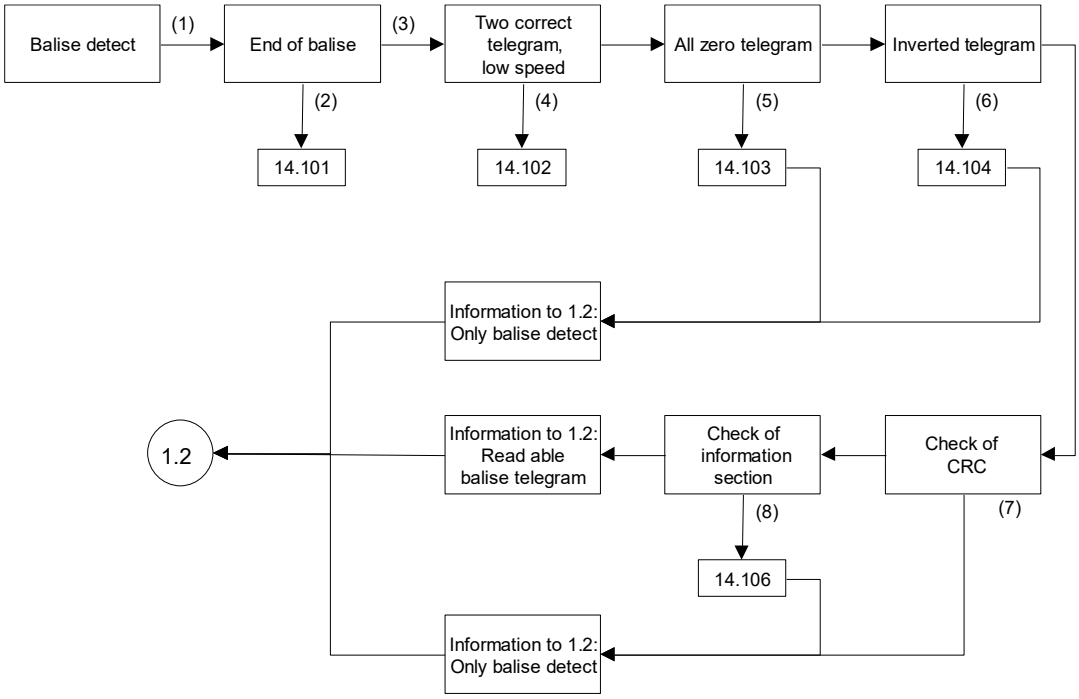


Figure 4/2. Checking of Balise Telegram

Note With regard to check of CRC refer also to [FRS Air Gap].

F 3001 **1.1.1**
Balise detect [FRS Air Gap, Chapter 2.1.1].

F 3002 **1.1.2**
If the time between balise detect and balise end is same or longer than 40% estimated passage time (according to contact length and speed) or more than 1250 bits has been received and no CRC has been obtained; then the data comes from faulty balise, balise error 14.101 and information to 1.2: detect only Balise detect [FRS Air Gap, Chapter 2.1.8].

When in 'Construction Area' or in 'Other Country Area', the processing of balise telegram is ended and balise error indication, braking and speed restriction are ignored.

F 3003 **1.1.3**
End of balise Balise detect [FRS Air Gap, Chapter 2.1.2].

F 3004 **1.1.4**
At slow speed of less than 5km/h: At least two correct balise telegram shall be read from each balise, if not: balise error 14.102.

When in 'Construction Area' or in 'Other Country Area', the processing of balise telegram is ended and balise error indication, braking and speed restriction are ignored.

F 3005 **1.1.5**
If all bits in telegram are 0, then balise error 14.103 and information to 1.2: detect only Balise detect [FRS Air Gap, Chapter 2.1.7].

If IL is not complete when detecting balise, then balise error 14.103 is suppressed. Balise error 14.103 is suppressed for group valid for opposite direction.

F 3006 **1.1.6**
If the third check bit $\neq 1$ [telegram is inverted], then balise error 14.104 and information to 1.2: detect only Balise detect [FRS Air Gap, Chapter 2.1.6].

If IL is not complete when detecting balise, then balise error 14.104 is suppressed. Balise error 14.104 is suppressed for group valid for opposite direction.

F 3007 **1.1.7**
If Error in CRC-code or an unreadable CRC [FRS Air Gap, Chapter 12], then information to 1.2: only balise detect (unreadable balise).

F 3008 **1.1.8**
If illegal values of information nibble (0 or F), then balise error 14.106 and information to 1.2: detect only. Balise error indication is ignored in 'Construction Area' or in 'Other Country Area'.

1.2 Pre-processing of the Balise Telegram

F 3009

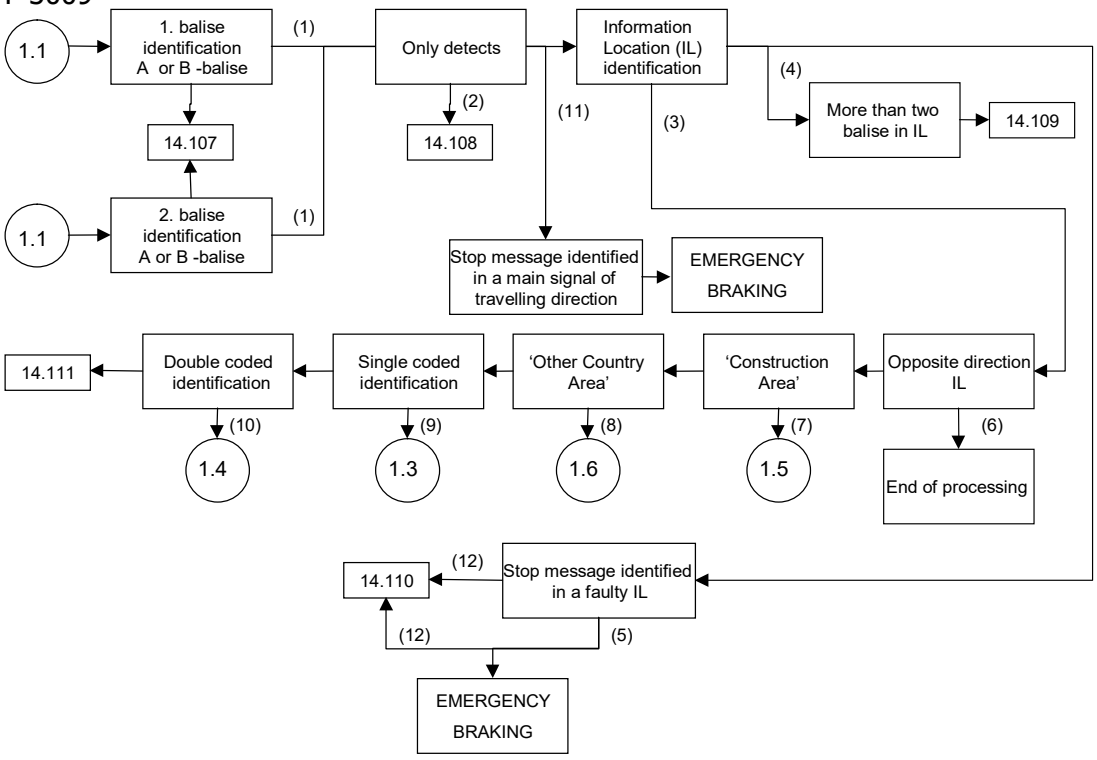


Figure 5/2. Pre-Processing of Balise Telegram

F 3010 **1.2.1**
R0 = 2, 3 or B and R1 = 1 or 2 [Balise No 1, 2 or 2(2) + Single or Double] or unreadable telegram received OR STM is in 'Construction Area' or in 'Other Country Area'.

F 3011 **1.2.2**
Two 'only balise detect' from IL.

When in 'Construction Area' or in 'Other Country Area', the processing of balise telegram is ended and balise error indication, braking and speed restriction are ignored.

F 3012 **1.2.3**
A and B balise (or A and balise detect or B and balise detect) identified within 2-4 m of each other.

Note For more details about balise distances used in Finland, refer to [RATO 10 - Junien kulunvalvonta JKV - Liikennevirasto].

F 3013 **1.2.4**
More than two balises in 9 m.

When in 'Construction Area' or in 'Other Country Area', the processing of balise telegram is ended and balise error indication, braking and speed restriction are ignored.

Note In case two balise groups are located too close to each other, only one balise error 14.109 is generated.

F 3014 **1.2.5**
In the read balise R0 = 2, 3 and R1 = 2 and R2 = 1 and R16 = 1 and R17 = 1. Faulty IL and emergency braking are ignored in Construction Area or in 'Other Country Area '. [A or B balise of main signal at stop aspect].

F 3015 **1.2.6**
R0 = 3 in 1st balise and R0 = 2 in 2nd balise [Balise B + A, opposite direction] OR
R0 = 3 in 1st balise and only detect 2nd balise [Balise B + balise detect, opposite direction] OR
Only detect 1st balise and (R0 = 2 and R1=2) in 2nd balise [balise detect + Balise A, double coded, opposite direction] OR
Only detect 1st balise and (R0 = 2, R1=1 and R2=2) in 2nd balise [balise detect + Balise A, single coded, repeater signal, opposite direction].

F 3016 **1.2.7**
While STM is in 'Construction Area', skip to phase 1.5

F 3017 **1.2.8**
While STM is in 'Other Country Area', skip to phase 1.6

F 3018 **1.2.9**
In each readable balise R1 = 1 [Single coded balise group].

F 3019 **1.2.10**
In each readable balise R1 = 2 [Double coded balise group].

F 3538 **1.2.11**
In the first read balise R0 = 2, R1 = 2, R2 = 1, R16 = 1 and R17 = 1. Emergency braking is ignored in Construction Area or in Other Country Area and in first 5 meters after startup [Main signal of current direction at stop aspect].

F 3540 **1.2.12**
The processing of balise telegram is ended and balise error indication, braking and speed restriction are ignored, if only one balise is detected in 5 meters after start up.

1.3 Processing of Single coded IL

F 3020

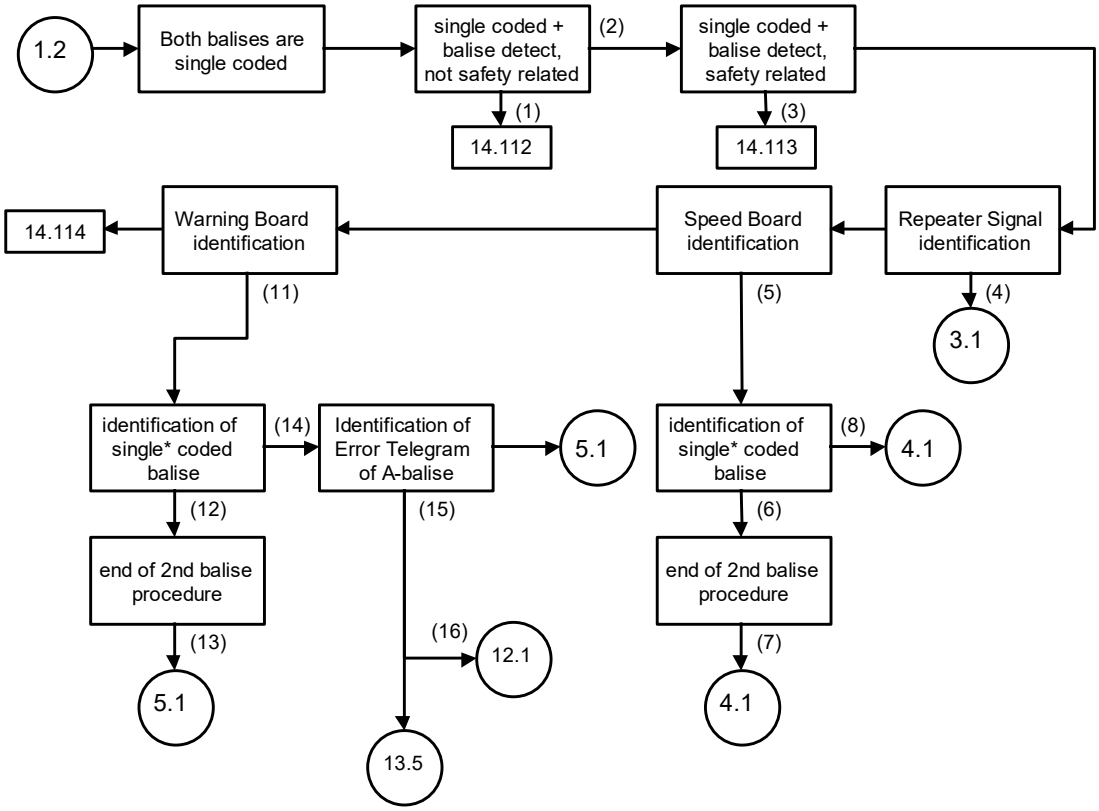


Figure 6/2. Processing of Single coded IL

F 3021 **1.3.1**

If (R0 = 2 and R1 = 1) in 1st balise and only detect 2nd balise [Balise A, single coded and balise detect] OR
If (R0 = B) in 1st balise and only detect 2nd balise [Balise B, single*-coded and balise detect] OR
If only detect 1st balise and (R0 = 3, R1 = 1, R2 = 2 and R3 = E) in 2nd balise [balise detect + repeater marker] OR
If only detect 1st balise and (R0 = 3, R1 = 1, R2 = 4 and R3 = E) in 2nd balise [balise detect + warning board marker] AND
If time to read balise (according to speed) is equal or longer than time needed to read two whole balise telegram from a balise, then balise error 14.112. [FRS Air Gap 2.1.9].

F 3022 **1.3.2**
Reserved

F 3023 **1.3.3**
If only detect 1st balise and R0 = B in 2nd balise [balise detect + single*-coded] OR
If only detect 1st balise and (R0 = 2, R1 = 1 and R2 ≠ 2) in 2nd balise [balise detect + else than Repeater Signal A], then balise error 14.113

F 3024 **1.3.4**
In each readable balise R2 = 2 [Repeater Signal].

F 3025 **1.3.5**
In each readable balise R2 = 3 [Speed board].

F 3026 **1.3.6**
R0 = B in 1st balise [Balise No 2(2), single *].

F 3027 **1.3.7**
Only information from 1st balise shall be processed in 4.1

F 3028 **1.3.8**
R0 = 2 in 1st balise. Only information from 1st balise shall be processed in 4.1 [Balise A].

F 3029 **1.3.9**
Reserved

F 3030 **1.3.10**
Reserved

F 3031 **1.3.11**
In each readable balise R2 = 4 [Warning board].

F 3032 **1.3.12**
R0 = B in 1st balise [Balise No 2(2), single *]

F 3033 **1.3.13**
Only information from 1st balise shall be processed in 5.1

F 3034 **1.3.14**
R0 = 2 in 1st balise [Balise A], only processing of information of A-balise shall be continued.

F 3035 **1.3.15**
In A-balise telegram R3 ≠1 [Speed Board].

F 3036 **1.3.16**
R4-R15 shall be processed in 12.1 [Linking]

1.4 Processing of Double coded IL

F 3037

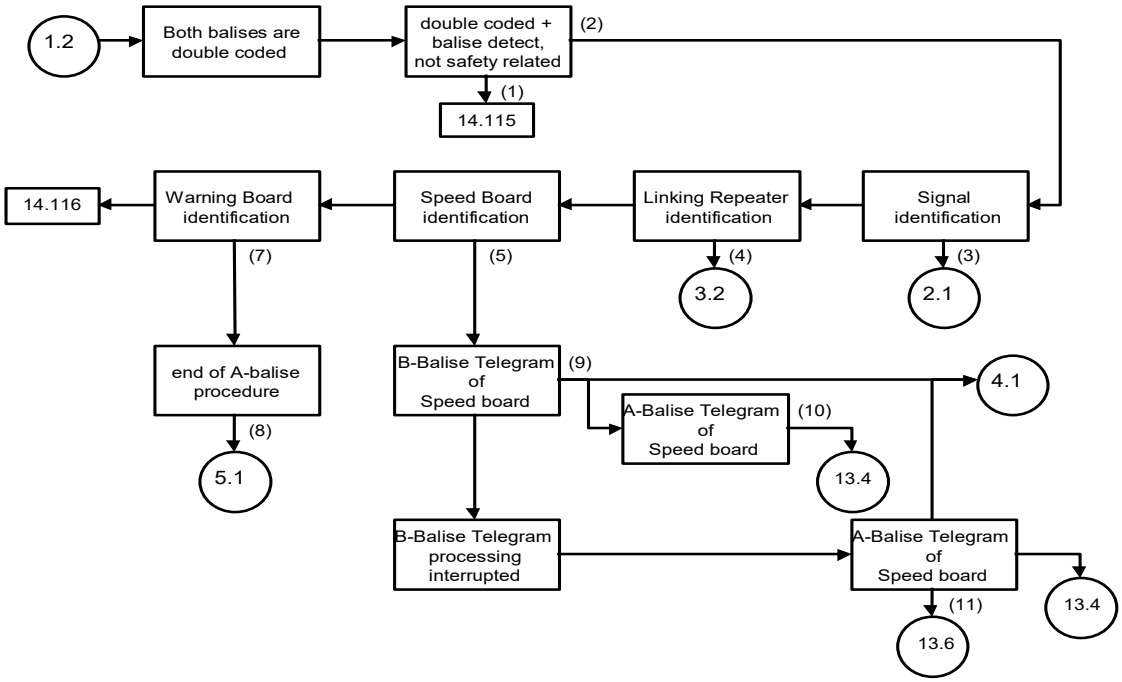


Figure 7/2. Processing of Double coded IL

F 3038 **1.4.1**
If (R0 = 2 and R1 = 2) in 1st balise and only detect 2nd balise [Balise A, double coded and balise detect] OR
If only detect 1st balise and (R0 = 3 and R1 = 2) in 2nd balise [balise detect + Balise B, double coded] AND
If time to read balise (according to speed) is equal or longer than time needed to read two whole balise telegram from a balise, then balise error 14.115 [FRS Air Gap 2.1.9].

F 3039 **1.4.2**
Reserved

F 3040 **1.4.3**
In each readable balise R2 = 1 [Signal].

F 3041 **1.4.4**
If R2 = 2 and R3 = 8 in both balises [Linking repeater], telegram of B-balise is processed in 3.2 OR
If R2 = 2 and R3 = 8 in A-balise [Linking repeater] and unreadable telegram received from B-balise, telegram of A-balise is processed in 3.2
OR
If R2 = 2 and R3 = 8 in B-balise [Linking repeater] and unreadable telegram received from A-balise, telegram of B-balise is processed in 3.2.

F 3042 **1.4.5**

In each readable balise R2 = 3 [Speed board].

F 3043 **1.4.6**
Reserved

F 3044 **1.4.7**
In each readable balise R2 = 4 [Warning board].

F 3045 **1.4.8**
Only information of B-balise shall be processed in 5.1 Information of A-balise shall be processed in 5.1, if B-balise was only detect.

F 3522 **1.4.9**
R3 = 1 [Speed board]

F 3523 **1.4.10**
R3 ≠ 1 [≠ Speed Board]

F 3524 **1.4.11**
R3 ≠ 1 [≠ Speed Board]

1.5 Processing of the Balise Telegram in 'Construction area' – state

F 3046

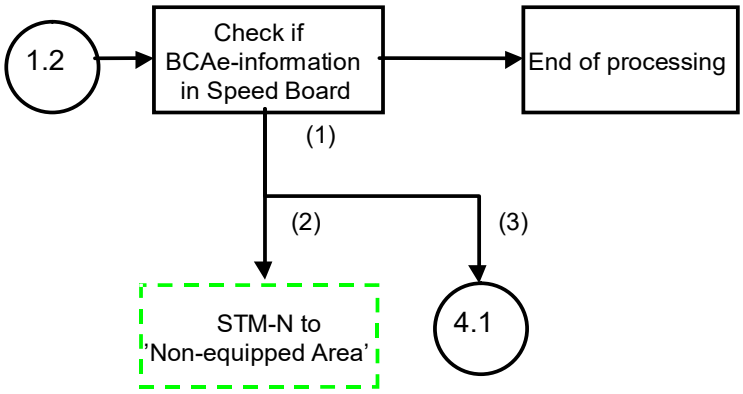


Figure 8/2. Processing of the Balise Telegram in 'Construction area' - state

F 3047 **1.5.1**
R2 = 3 and R16-R17 = 39 in 1st balise [Speed board with BCAe]
OR
If unreadable telegram is received from 1st balise: R0 = 3, R1 = 2, R2 = 3 and R16-R17 = 39 in 2nd balise [Double coded B-balise: Speed board with BCAe]

F 3048 **1.5.2**
STM to 'Non-equipped Area' and end of BCA-restriction without train length delay

F 3049 **1.5.3**
Information from 1st balise shall be processed in 4.1

1.6 Processing of the Balise Telegram in 'Other Country' – state

F 3050

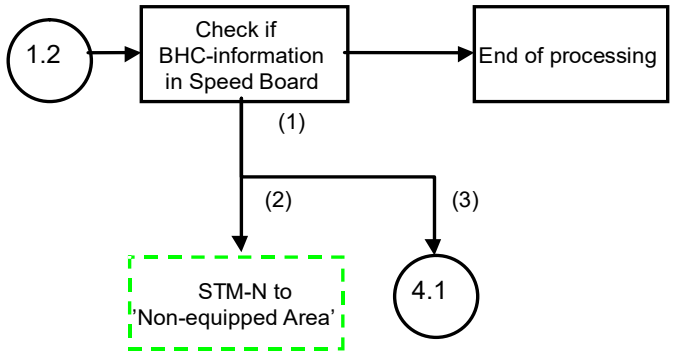


Figure 9/2. Processing of the Balise Telegram in 'Other Country' - state

F 3051 **1.6.1**
R2 = 3 and R16-R17 = 3B in 1st balise [Speed board with BHC] OR If unreadable telegram is received from 1st balise: R0 = 3, R1 = 2, R2 = 3 and R16-R17 = 3B in 2nd balise [Double coded B-balise: Speed board with BHC]

F 3052 **1.6.2**
STM to 'Non-equipped Area' and end of BOC-restriction without train length delay

F 3053 **1.6.3**
Information from 1st balise shall be processed in 4.1

2 SIGNAL BALISE

2.1 Signal Balise Telegram processing

F 3054

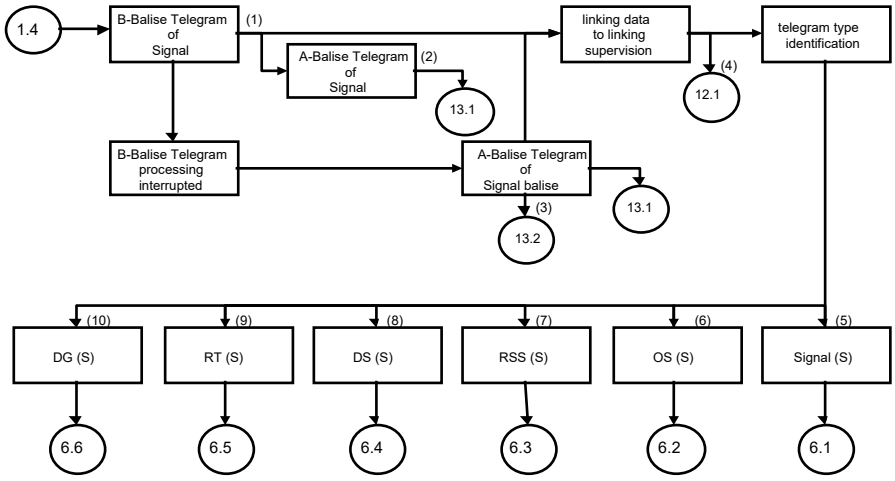


Figure 10/2. Signal Balise Telegram processing

F 3055 **2.1.1**
R3 = 1-6 [Signal, OS, RSS, DS, RT or DG]

F 3056 **2.1.2**
R3 ≠ 1-6 [≠ Signal, OS, RSS, DS, RT or DG]

F 3057 **2.1.3**
R3 = 1-6 [Signal, OS, RSS, DS, RT or DG]

F 3058 **2.1.4**
R4-R8 Ic, R9-R13 In, R14-R15 Dl, R20-R21 Db and R23-R27 In to the linking supervision, phase 12.1

F 3059 **2.1.5**
R3 = 1 [Signal]

F 3060 **2.1.6**
R3 = 2 [OS]

F 3061 **2.1.7**
R3 = 3 [RSS]

F 3062 **2.1.8**
R3 = 4 [DS]

F 3063 **2.1.9**
R3 = 5 [RT]

F 3064 **2.1.10**
R3 = 6 [DG]

3 REPEATER SIGNAL BALISE

3.1 Repeater Signal Balise Telegram processing

F 3065

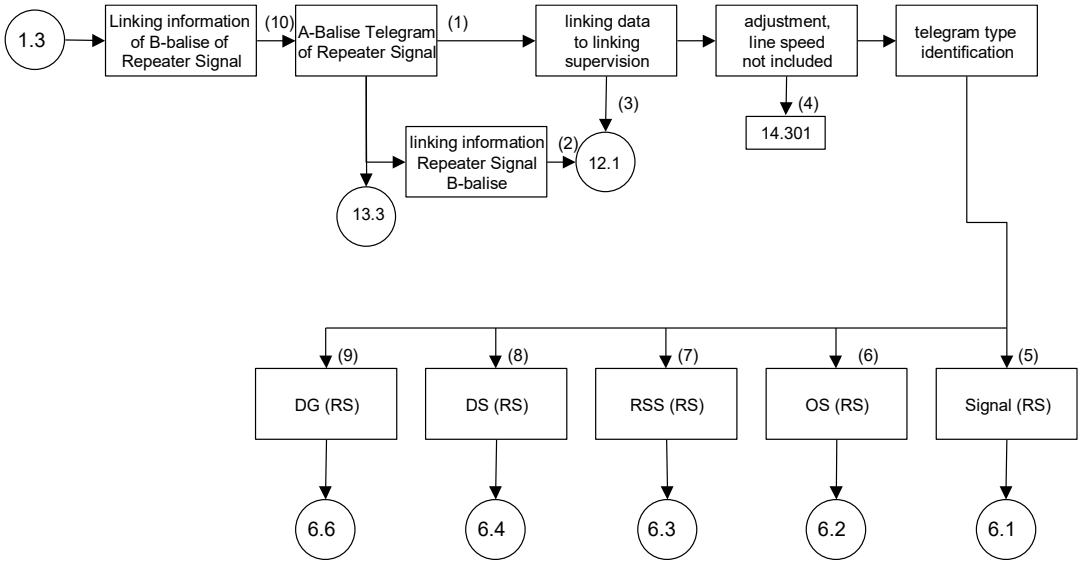


Figure 11/2. Repeater Signal Balise Telegram processing

F 3066 **3.1.1**
R3=1-6 [Rep.signal, OS, RSS, DS, RT or DG]

F 3067 **3.1.2**
Remove R4-R8 Ic, R9-R13 In and R14-R15 Dl to the linking supervision, phase 12.1

F 3068 **3.1.3**
Remove R4-R8 Ic, R9-R13 In, R14-R15 Dl, R20-R21 Db and R23-R27 Dl to the linking supervision, phase 12.1

F 3069 **3.1.4**
R16-R17 ≠ EE [Main signal line speed ≠ Cancelled] and line speed is not used in supervision

F 3070 **3.1.5**
R3 = 1 [Rep.signal]

F 3071 **3.1.6**
R3 = 2 [OS]

F 3072 **3.1.7**
R3 = 3 [RSS]

F 3073 **3.1.8**
R3 = 4 [DS]

F 3074 **3.1.9**
R3 = 6 [DG]

F 3534 **3.1.10**
Checking of the linking information of B-balise. If R9-R15 of B-balise = EEEEEEE, then information "No linking information in B-balise".

3.2 Linking Repeater Balise Telegram processing

F 3075

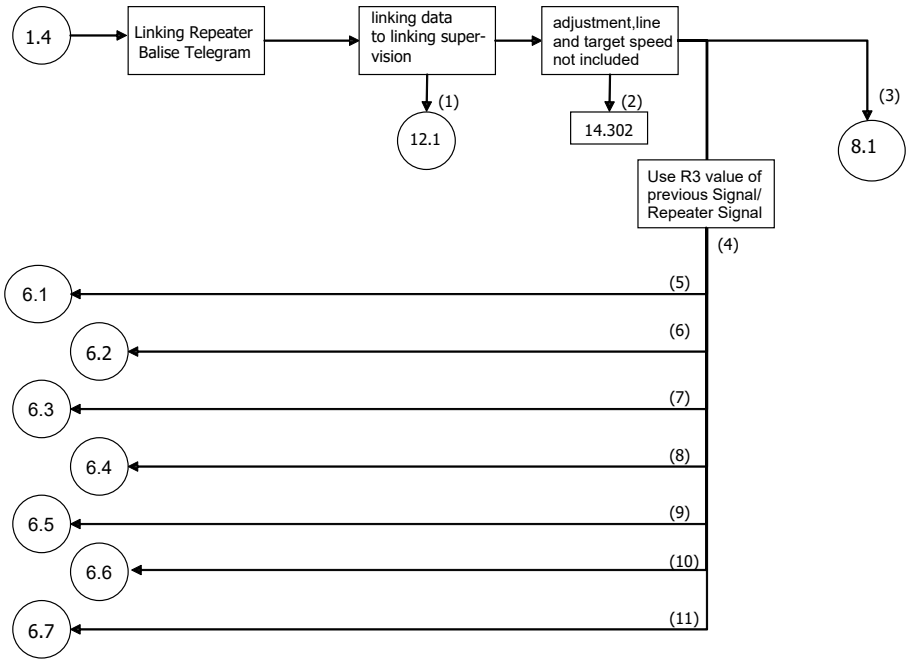


Figure 12/2. Linking Repeater Balise Telegram processing

F 3076 **3.2.1**
Remove R4-R8 Ic, R9-R13 In, R14-R15 Dl, R20-R21 Db and R23-R27 In to the linking supervision, phase 12.1

F 3077 **3.2.2**
R16-R17 or R18-R19 ≠ EE [Line or target speed ≠ Cancelled] OR R20-R21 ≠ 11-EC, then balise error 14.302

F 3078 **3.2.3**
R31-R44 [switch restriction data] used for switch restriction super-vision,
phase 8.1

F 3079 **3.2.4**

In processing of Linking Repeater, R3 value of previous correct read and processed Signal or Repeater Signal (which one is processed latest) telegram is used. If latest Signal or Repeater Signal was incorrect, information of Linking Repeater is not used for updating of MA.

F 3080 **3.2.5**
If in previous Signal or Rep. Signal R3 = 1[Signal or Rep.signal], remove
R20-R21 [basic distance] and R28-R29 [Release speed] to phase 6.1

F 3081 **3.2.6**
If in previous Signal or Rep. Signal R3 = 2 [OS], remove R20-R21 [Basic distance] and R28-R29 [Release speed] to phase 6.2

F 3082 **3.2.7**
If in previous Signal or Rep. Signal R3 = 3 [RSS], remove R20-R21 [Basic distance] and R28-R29 [Release speed] to phase 6.3

F 3083 **3.2.8**
If in previous Signal or Rep. Signal R3 = 4 [DS], remove R20-R21 [Basic distance] and R28-R29 [Release speed] to phase 6.4

F 3084 **3.2.9**
If in previous Signal R3 = 5 [RT], remove R20-R21 [Basic distance] and
R28-R29 [Release speed] to phase 6.5

F 3085 **3.2.10**
If in previous Signal or Rep. Signal R3 = 6 [DG], remove R20-R21 [Basic distance] and R28-R29 [Release speed] to phase 6.6

F 3086 **3.2.11**
R3 = 1, 2, 4 or 6 [Signal/Rep.signal, OS, DS or DG], remove R20-R21 [basic distance] and R28-R29 [stop message] to Braking curve calculation and maximum permitted speed supervision.

F 3087 **3.2.12**
Reserved

4 SPEED BOARD

4.1 Speed Board Balise Telegram processing

F 3088

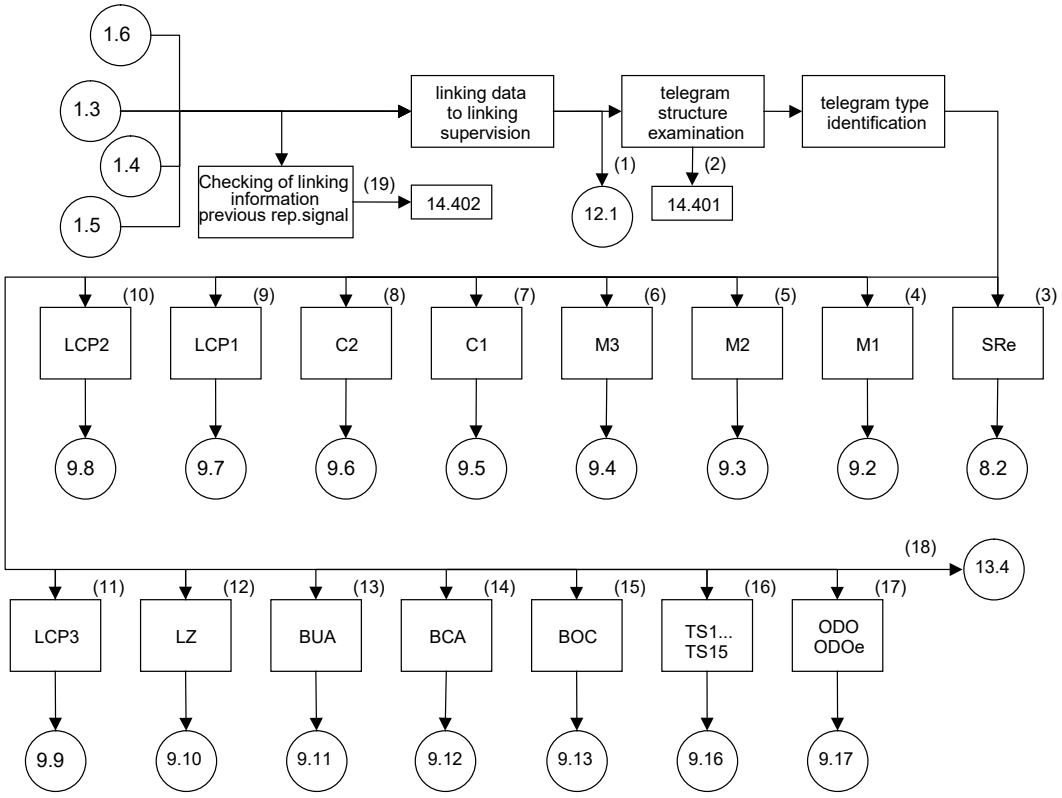


Figure 13/2. Speed Board Balise Telegram processing

F 3089 **4.1.1**

Remove R4-R8 Ic, R9-R13 In and R14-R15 Dl [Position identities & linking distance] to linking supervision, phase 8.1

F 3090 **4.1.2**

Speed Board Balise Telegram construction checked; if

- R16-17 = EE [Restriction type 1 is cancelled] OR
- (R22-23 ≠ EE and R20-21 = EE) [Restriction type 2 is cancelled, but not Speed 2] OR
- (R26-27 ≠ EE and R24-25 = EE) [Restriction type 3 is cancelled, but not Speed 3] OR
- (R30-31 ≠ EE and R28-29 = EE) [Restriction type 4 is cancelled, but not Speed 4] OR
- (R20-R21 ≠ EE and R16-R17 = EE) [Restriction type 1 is cancelled but not type 2] OR
- (R24-R25 ≠ EE and R20-R21 = EE) [Restriction type 2 is cancelled but not type 3] OR
- (R28-R29 ≠ EE and R24-R25 = EE) [Restriction type 3 is cancelled but not type 4],

then balise error 14.401 [Balise error].

F 3091 **4.1.3**
If R16-R17 = 11, then remove to phase 8.2 OR
If R20-R21 = 11, then remove to phase 8.2 OR
If R24-R25 = 11, then remove to phase 8.2 OR
If R28-R29 = 11, then remove to phase 8.2 OR
[If Restr. type 1, 2, 3 or 4 = SRe, then move the Restr. type].

F 3092 **4.1.4**
If R16-R17 = 16, then remove it and R18-R19 to phase 9.2 OR
If R20-R21 = 16, then remove it and R22-R23 to phase 9.2 OR
If R24-R25 = 16, then remove it and R26-R27 to phase 9.2 OR
If R28-R29 = 16, then remove it and R30-R31 to phase 9.2
[If Restr. type 1, 2, 3 or 4 = M1, then move the related Speed restr.].

F 3093 **4.1.5**
If R16-R17 = 17, 18 or 25, then remove it and R18-R19 to phase 9.3 OR
If R20-R21 = 17, 18 or 25, then remove it and R22-R23 to phase 9.3 OR
If R24-R25 = 17, 18 or 25, then remove it and R26-R27 to phase 9.3 OR
If R28-R29 = 17, 18 or 25, then remove it and R30-R31 to phase 9.3
[If Restr. type 1, 2, 3 or 4 = M2, M2e or M2c, then move the related Speed restr.].

F 3094 **4.1.6**
If R16-R17 = 2C, 2D or 2E, then remove it and R18-R19 to phase 9.4 OR
If R20-R21 = 2C, 2D or 2E, then remove it and R22-R23 to phase 9.4 OR
If R24-R25 = 2C, 2D or 2E, then remove it and R26-R27 to phase 9.4 OR
If R28-R29 = 2C, 2D or 2E, then remove it and R30-R31 to phase 9.4
[If Restr. type 1, 2, 3 or 4 = M3, M3c or M3e, then move the related Speed restr.].

F 3095 **4.1.7**
If R16-R17 = 19, 1B or 26, then remove it and R18-R19 to phase 9.5 OR
If R20-R21 = 19, 1B or 26, then remove it and R22-R23 to phase 9.5 OR
If R24-R25 = 19, 1B or 26, then remove it and R26-R27 to phase 9.5, OR
If R28-R29 = 19, 1B or 26, then remove it and R30-R31 to phase 9.5
[If Restr. type 1, 2, 3 or 4 = C1, C1e or C1c, then move the related Speed restr.].

F 3096 **4.1.8**

If R16-R17 = 1A, 1C or 27, then remove it and R18-R19 to phase 9.6 OR
If R20-R21 = 1A, 1C or 27, then remove it and R22-R23 to phase 9.6 OR
If R24-R25 = 1A, 1C or 27, then remove it and R26-R27 to phase 9.6 OR,
If R28-R29 = 1A, 1C or 27, then remove it and R30-R31 to phase 9.6
[If Restr. type 1, 2, 3 or 4 = C2, C2e or C2c, then move the related Speed restr.].

F 3097 **4.1.9**
If R16-R17 = 1D, 22 or 28, then remove it and R18-R19 to phase 9.7 OR
If R20-R21 = 1D, 22 or 28, remove it and R22-R23 to phase 9.7 OR
If R24-R25 = 1D, 22 or 28, then remove it and R26-R27 to phase 9.7, OR
If R28-R29 = 1D, 22 or 28, then remove it and R30-R31 to phase 9.7
[If Restr. type 1, 2, 3 or 4 = LCP1, LCP1c or LCP1e, then move the related Speed restr.].

F 3098 **4.1.10**
If R16-R17 = 1E, 23 or 29, then remove it and R18-R19 to phase 9.8 OR
If R20-R21 = 1E, 23 or 29, then remove it and R22-R23 to phase 9.8 OR
If R24-R25 = 1E, 23 or 29, then remove it and R26-R27 to phase 9.8 OR
If R28-R29 = 1E, 23 or 29, then remove it and R30-R31 to phase 9.8
[If Restr. type 1, 2, 3 or 4 = LCP2, LCP2c or LCP2e, then move the related Speed restr.].

F 3099 **4.1.11**
If R16-R17 = 21, 24 or 2A, then remove it and R18-R19 to phase 9.9 OR
If R20-R21 = 21, 24 or 2A, then remove it and R22-R23 to phase 9.9 OR
If R24-R25 = 21, 24 or 2A, then remove it and R26-R27 to phase 9.9 OR
If R28-R29 = 21, 24 or 2A, then remove it and R30-R31 to phase 9.9
[If Restr. type 1, 2, 3 or 4 = LCP3, LCP3c or LCP3e, then move the related Speed restr.].

F 3100 **4.1.12**
If R16-R17 = 33, 34 or 35, then remove it and R18-R19 to phase 9.10 OR
If R20-R21 = 33, 34 or 35, then remove it and R22-R23 to phase 9.10 OR
If R24-R25 = 33, 34 or 35, then remove it and R26-R27 to phase 9.10 OR

If R28-R29 = 33, 34 or 35, then remove it and R30-R31 to phase 9.10
[If Restr. type 1, 2, 3 or 4 = LZ, LZc or LZe, then move the related Speed restr.].

F 3101 **4.1.13**
If R16-R17 = 37, then remove it and R18-R19 to phase 9.11 OR
If R20-R21 = 37, then remove it and R22-R23 to phase 9.11 OR
If R24-R25 = 37, then remove it and R26-R27 to phase 9.11 OR
If R28-R29 = 37, then remove it and R30-R31 to phase 9.11
[If Restr. type 1, 2, 3 or 4 = BUA, then move the related Speed restr.].

F 3102 **4.1.14**
If R16-R17 = 38 or 39, then remove it and R18-R19 to phase 9.12 OR
If R20-R21 = 38 or 39, then remove it and R22-R23 to phase 9.12 OR
If R24-R25 = 38 or 39, then remove it and R26-R27 to phase 9.12 OR
If R28-R29 = 38 or 39, then remove it and R30-R31 to phase 9.12
[If Restr. type 1, 2, 3 or 4 = BCA or BCAe, then move the related Speed restr.].

F 3103 **4.1.15**
If R16-R17 = 3A or 3B, then remove it and R18-R19 to phase 9.13 OR
If R20-R21 = 3A or 3B, then remove it and R22-R23 to phase 9.13 OR
If R24-R25 = 3A or 3B, then remove it and R26-R27 to phase 9.13 OR
If R28-R29 = 3A or 3B, then remove it and R30-R31 to phase 9.13
[If Restr. type 1, 2, 3 or 4 = BOC or BHC, then move the related Speed restr.].

F 3104 **4.1.16**
If R16-R17 = 91-AD or C1- D4, then remove it and R18-R19 to phase 9.14 OR
If R20-R21 = 91-AD or C1- D4, then remove it and R22-R23 to phase 9.14 OR
If R24-R25 = 91-AD or C1- D4, then remove it and R26-R27 to phase 9.14, OR
If R28-R29 = 91-AD or C1- D4, then remove it and R30-R31 to phase 9.14
[If Restr. type 1, 2, 3 or 4 = TS1…TS15, TS1c…TS15c or TS1e…TS15e, then move the related Speed restr.].

F 3105 **4.1.17**
If R16-R17 = 3C or 3D, then remove it to phase 9.17 OR
If R20-R21 = 3C or 3D, then remove it to phase 9.17 OR
If R24-R25 = 3C or 3D, then remove it to phase 9.17, OR
If R28-R29 = 3C or 3D, then remove it to phase 9.17 [If Restr. type 1, 2, 3 or 4 = ODO or ODOe, then move the related Speed restr.].

F 3106 **4.1.18**

R16-R17, If R20-R21, R22-R23 or If R28-R29 ≠ as defined in Restriction Types -table [If Restr. type 1, 2, 3 or 4 ≠ pre-defined values] OR
R16-R17, R20-R21, R22-R23 or R28-R29 = 12, 13, 14 or B1-B4 [If Restr. type 1, 2, 3 or 4 = dVinc, dVdec, OTP, TRSw, TRSt, TRSwe or TRSTe] remove to phase 13.4 [Error telegram processing, Speed Board].

F 3535 **4.1.19**

If previous IL was Repeater Signal and there was no linking information B-balise AND R14-R15 ≠ ED [Linking distance ≠ Not included in linking chain], then balise error 14.402.

5 WARNING BOARD

5.1 Processing of Warning Board Balise Telegram

F 3107

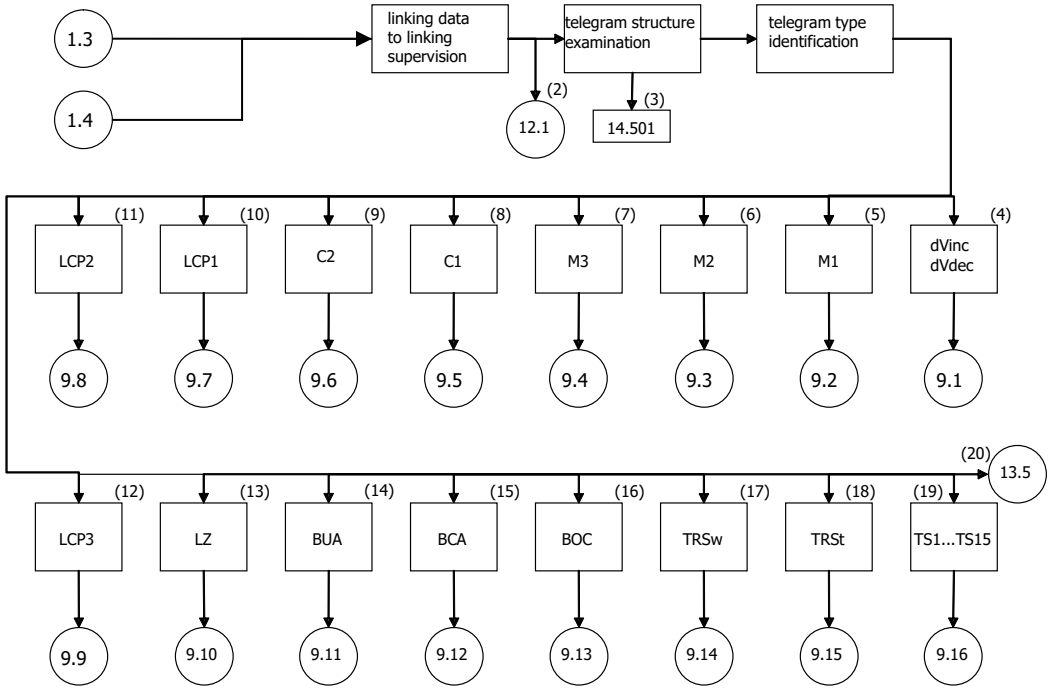


Figure 14/2. Warning Board Balise Telegram processing

F 3108 **5.1.1**
Reserved

F 3109 **5.1.2**
Remove R4-R8 Ic, R9-R13 In and R14-R15 Dl to linking supervision, phase 12.1

F 3110 **5.1.3**
Checking of the Warning Board telegram structure, if:

- R16-17 = EE [Restr 1 is cancelled] OR
- (R36-37 ≠ EE and R27-28 = EE) [Restr 2 is cancelled but not Restr 3] OR
- (R16-R17 = EE and R18-R19 ≠ EE) [Restr 1 is cancelled but not its speed value] OR
- (R27-R28 ≠ EE and R29-R30 = EE) [Restr 2 is available but its speed is cancelled] OR
- (R27-R28 = EE and R29-R30 ≠ EE) [Restr 2 is cancelled but not its speed value] OR
- (R36-R37 ≠ EE and R38-R39 = EE) [Restr 3 is available but its speed is cancelled] OR

- (R36-R37 = EE and R38-R39 ≠ EE) [Restr 3 is cancelled but not its speed value],

then balise error 14.501 [Balise error].

F 3111 **5.1.4**
If R16-R17 = 12 or 13, then remove R18-R26 to phase 9.1 OR
If R27-R28 = 12 or 13, then remove R29-R35 to phase 9.1 OR
If R36-R37 = 12 or 13, then remove R38-R44 to phase 9.1
[If Speed restr 1, 2 or 3 = dVinc or dVdec, move Speed, Distance, Length and Gradient. If Speed restr 1, move also, Speed after restriction].

F 3112 **5.1.5**
If R16-R17 = 16, then remove R18-R26 to phase 9.2 OR
If R27-R28 = 16, then remove R29-R35 to phase 9.2 OR
If R36-R37 = 16, then remove R38-R44 to phase 9.2
[If Speed restr 1, 2 or 3 = M1, move Speed, Distance, Length and Gradient. If Speed restr 1, move also, Speed after restriction].

F 3113 **5.1.6**
If R16-R17 = 17 or 25, then remove R18-R26 to phase 9.3 OR
If R27-R28 = 17 or 25, then remove R29-R35 to phase 9.3 OR
If R36-R37 = 17 or 25, then remove R38-R44 to phase 9.3
[If Speed restr 1, 2 or 3 = M2 or M2c, move Speed, Distance, Length and Gradient. If Speed restr 1, move also, Speed after restriction].

F 3114 **5.1.7**
If R16-R17 = 2C or 2D, then remove R18-R26 to phase 9.4 OR
If R27-R28 = 2C or 2D, then remove R29-R35 to phase 9.4 OR
If R36-R37 = 2C or 2D, then remove R38-R44 to phase 9.4
[If Speed restr 1, 2 or 3 = M3 or M3c, move Speed, Distance, Length and Gradient. If Speed restr 1, move also, Speed after restriction].

F 3115 **5.1.8**
If R16-R17 = 19 or 26, then remove R18-R26 to phase 9.5 OR
If R27-R28 = 19 or 26, then remove R29-R35 to phase 9.5 OR
If R36-R37 = 19 or 26, then remove R38-R44 to phase 9.5
[If Speed restr 1, 2 or 3 = C1 or C1c, move Speed, Distance, Length and Gradient. If Speed restr 1, move also, Speed after restriction].

F 3116 **5.1.9**
If R16-R17 = 1A or 27, then remove R18-R26 to phase 9.6 OR
If R27-R28 = 1A or 27, then remove R29-R35 to phase 9.6 OR
If R36-R37 = 1A or 27, then remove R38-R44 to phase 9.6
[If Speed restr 1, 2 or 3 = C2 or C2c, move Speed, Distance, Length and Gradient. If Speed restr 1, move also, Speed after restriction].

F 3117 **5.1.10**
If R16-R17 = 1D or 22, then remove R18-R26 to phase 9.7 OR

If R27-R28 = 1D or 22, then remove R29-R35 to phase 9.7 OR
If R36-R37 = 1D or 22, then remove R38-R44 to phase 9.7
[If Speed restr 1, 2 or 3 = LCP1 or LCP1c, move Speed, Distance, Length and Gradient. If Speed restr 1, move also, Speed after restriction].

F 3118 **5.1.11**
If R16-R17 = 1E or 23, then remove R18-R26 to phase 9.8 OR
If R27-R28 = 1E or 23, then remove R29-R35 to phase 9.8 OR
If R36-R37 = 1E or 23, then remove R38-R44 to phase 9.8
[If Speed restr 1, 2 or 3 = LCP2 or LCP2c, move Speed, Distance, Length and Gradient. If Speed restr 1, move also, Speed after restriction].

F 3119 **5.1.12**
If R16-R17 = 21 or 24, then remove R18-R26 to phase 9.9 OR
If R27-R28 = 21 or 24, then remove R29-R35 to phase 9.9 OR
If R36-R37 = 21 or 24, then remove R38-R44 to phase 9.9
[If Speed restr 1, 2 or 3 = LCP3 or LCP3c, move Speed, Distance, Length and Gradient. If Speed restr 1, move also, Speed after restriction].

F 3120 **5.1.13**
If R16-R17 = 33 or 34, then remove R18-R26 to phase 9.10 OR
If R27-R28 = 33 or 34, then remove R29-R35 to phase 9.10 OR
If R36-R37 = 33 or 34, then remove R38-R44 to phase 9.10
[If Speed restr 1, 2 or 3 = LZ or LZc, move Speed, Distance, Length and Gradient. If Speed restr 1, move also, Speed after restriction].

F 3121 **5.1.14**
If R16-R17 = 37, then remove R18-R26 to phase 9.11 OR
If R27-R28 = 37, then remove R29-R35 to phase 9.11 OR
f R36-R37 = 37, then remove R38-R44 to phase 9.11
[If Speed restr 1, 2 or 3 = BUA, move Speed, Distance, Length and Gradient. If Speed restr 1, move also, Speed after restriction].

F 3122 **5.1.15**
If R16-R17 = 38, then remove R18-R26 to phase 9.12 OR
If R27-R28 = 38, then remove R29-R35 to phase 9.12 OR
If R36-R37 = 38, then remove R38-R44 to phase 9.12
[If Speed restr 1, 2 or 3 = BCA, move Speed, Distance, Length and Gradient. If Speed restr 1, move also, Speed after restriction].

F 3123 **5.1.16**
If R16-R17 = 3A, then remove R18-R26 to phase 9.13 OR
If R27-R28 = 3A, then remove R29-R35 to phase 9.13 OR
If R36-R37 = 3A, then remove R38-R44 to phase 9.13
[If Speed restr 1, 2 or 3 = BOC, move Speed, Distance, Length and Gradient. If Speed restr 1, move also, Speed after restriction].

F 3124 **5.1.17**
If R16-R17 = B1, then remove R18-R26 to phase 9.14 OR
If R27-R28 = B1, then remove R29-R35 to phase 9.14 OR

If R36-R37 = B1, then remove R38-R44 to phase 9.14
[If Speed restr 1, 2 or 3 = TRSw, move Speed, Distance, Length and Gradient. If Speed restr 1, move also, Speed after restriction].

F 3125 **5.1.18**
If R16-R17 = B2, then remove R18-R26 to phase 9.15 OR
If R27-R28 = B2, then remove R29-R35 to phase 9.15 OR
If R36-R37 = B2, then remove R38-R44 to phase 9.15
[If Speed restr 1, 2 or 3 = TRSt or TRSte, move Speed, Distance, Length and Gradient. If Speed restr 1, move also, Speed after restriction].

F 3126 **5.1.19**
If R16-R17 = 91-A4 or C1-CC, then remove R18-R26 to phase 9.16 OR
If R27-R28 = 91-A4 or C1-CC, then remove R29-R35 to phase 9.16 OR
If R36-R37 = 91-A4 or C1-CC, then remove R38-R44 to phase 9.16
[If Speed restr 1, 2 or 3 = TS1...TS15, move Speed, Distance, Length and Gradient. If Speed restr 1, move also, Speed after restriction].

F 3127 **5.1.20**
If R16-R17, R27-28 or R36-37 ≠ as defined in Restriction Types -table
[If Restr. type 1, 2 or 3 ≠ pre-defined values] OR
R16-R17, R27-28 or R36-37 = 11, 14, 18, 1B, 1C, 28-2A, 2D, 2E, 35, 39, 3B-3D, A5-AD, B3, B4 or CD-D4 [If Restr. type 1, 2 or 3 = SRe, OTP, BHC, ODO or End of restriction: M2e, M3e, C1e, C2e, LCP1e...LCP3e, LZe, BCAe, ODOe, TS1e...TS15e],
then remove to phase 13.5 [Error telegram processing, Warning Board].

F 3536 **5.1.21**
If previous IL was Repeater Signal and there was no linking information B-balise AND R14-R15 ≠ ED [Linking distance ≠ Not included in linking chain], then balise error 14.502.

6 PROCESSING OF TELEGRAMS

6.1 Processing of Signal-telegram

F 3128

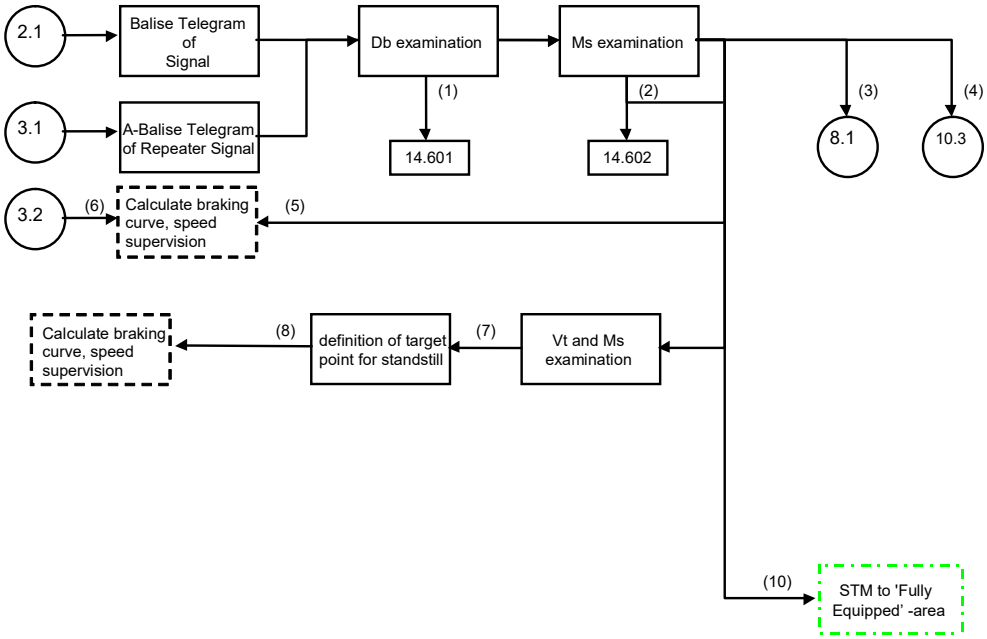


Figure 15/2. Processing of Signal-telegram

Note Enter if R3 = Signal or Repeater signal.

Note Stop message = Release speed.

F 3129 **6.1.1**
R2 = 1 and R16-R17 ≠ (11-8E or EE) [Line speed for signal ≠ 0…555 km/h or ≠ cancelled] OR
R18-R19 ≠ (12-8E or EE) [Target speed ≠ 5…555 km/h or ≠ cancelled] OR
R20-R21 ≠ 11-EC [Basic distance ≠ 5...11600 m],
then balise error 14.601

F 3130 **6.1.2**
If R28-R29 ≠ 13 or 18 [Stop message speed ≠ 10 or 35 km/h], then use value 13 instead given value of R28-R29 +5 km/h [Release speed = 15 km/h] and balise error 14.602

F 3131 **6.1.3**
R31-R44 (switch restriction data) used for switch restriction supervision, phase 8.1 [SR1...SR2].

F 3132 **6.1.4**
R18-R19 and R20-R21 [Target speed and Basic distance] to Braking curve calculation and maximum permitted speed supervision.

F 3133 **6.1.5**
Main Signal speed = R16-R17 to Braking curve calculation and maximum permitted speed supervision.

F 3134 **6.1.6**
Braking curve calculation and maximum permitted speed supervision before activation of calculated release speed:
Target distance = R20-R21 from [FRS Air Gap (Long Distance)]
Main Signal speed = R16-R17
Distant Signal speed = Expect Stop
Release speed = R18-R19 from [FRS Air Gap (Long Speed)]

Braking curve calculation and maximum permitted speed supervision after activation of calculated release speed:
Target distance = R20-R21 from [FRS Air Gap (Long Distance)]
Main Signal speed = R16-R17
Distant Signal speed = Expect Stop
Release speed = calculate release speed for overlap which distance =
R28-R29 from [FRS Air Gap (Long Distance)]

F 3135 **6.1.7**
R18-R19 and R28-R29 ≠ EE [Target speed and Stop message are not Cancelled].

F 3136 **6.1.8**
Braking curve calculation and maximum permitted speed supervision:
Target distance = R20-R21 from [FRS Air Gap (Long Distance)]
Main Signal speed = R16-R17
Distant Signal speed = Expect Stop
Release speed = R28-R29 from [FRS Air Gap (Long Speed)].

F 3137 **6.1.9**
Reserved

F 3138 **6.1.10**
Change of STM to 'Fully Equipped Area' if was not before.
End of BUA-restriction without train length delay.

6.2 Processing of OS-telegram (Overlap Stop)

F 3139

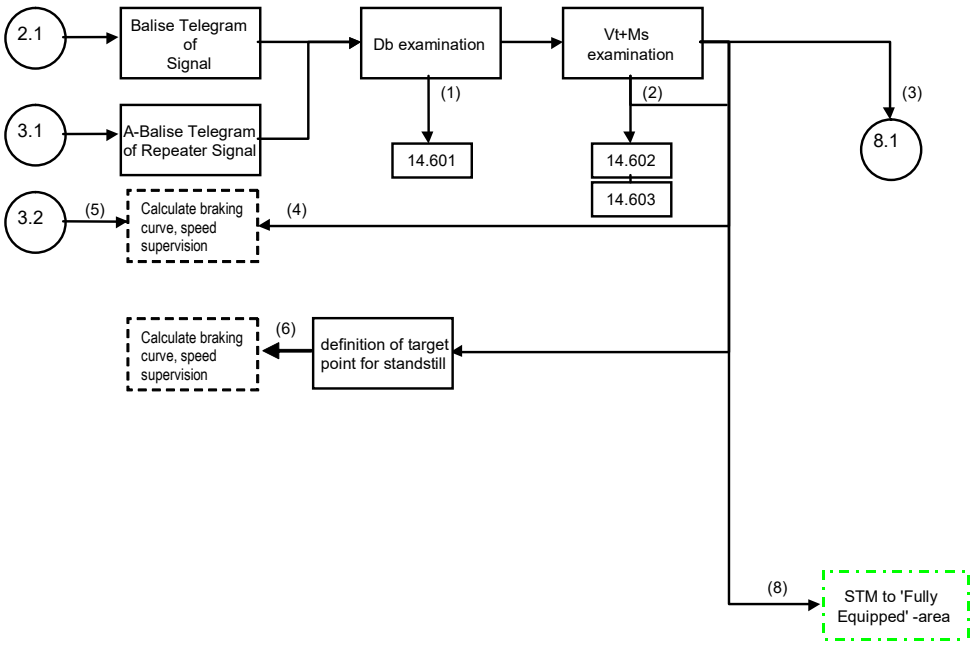


Figure 16/2. Processing of OS-telegram

F 3140 **6.2.1**
R2 = 1 and R16-R17 ≠ (11-8E or EE) [Line speed for signal ≠ 0…555 km/h or ≠ cancelled] OR
R20-R21 ≠ 11-EC [Basic distance ≠ 5...11600 m], then balise error 14.601

F 3141 **6.2.2**
If R18-R19 ≠ 13 or 18 [Release speed ≠ 10 or 35 km/h], then use value 13 instead given value of R18-R19 +5 km/h [Release speed = 15 km/h] and balise error 14.602 OR
If R28-R29 ≠ 11-5D [Overlap, Stop message distance ≠ 5...1000 m], then balise error 14.603

F 3142 **6.2.3**
R31-R44 (switch restriction data) used for switch restriction supervision, phase 8.1 [SR1...SR2].

F 3143 **6.2.4**
Braking curve calculation and maximum permitted speed supervision before activation of calculated release speed:
Target distance = R20-R21 from [FRS Air Gap (Long Distance)]
Main Signal speed = R16-R17
Distant Signal speed = Expect Stop
Release speed = R18-R19 from [FRS Air Gap (Long Speed)]

Braking curve calculation and maximum permitted speed supervision after activation of calculated release speed:
Target distance = R20-R21 from [FRS Air Gap (Long Distance)]
Main Signal speed = R16-R17
Distant Signal speed = Expect Stop
Release speed = calculate release speed for overlap which distance = R28-R29 from [FRS Air Gap (Long Distance)]

F 3144 **6.2.5**
Braking curve calculation and maximum permitted speed supervision:
Target distance = R20-R21 brought from phase 3.2 [FRS Air Gap (Long Distance)]
All other information as previously received.

F 3145 **6.2.6**
Braking curve calculation and maximum permitted speed supervision, if calculated release speed is not activated before standstill:
Target distance = R20-R21 from [FRS Air Gap (Long Distance)]
Main Signal speed = R16-R17
Distant Signal speed = Expect Stop
Release speed = R18-R19 from [FRS Air Gap (Long Speed)]

Braking curve calculation and maximum permitted speed supervision, if calculated release speed is activated before standstill:
Target distance = R20-R21 from [FRS Air Gap (Long Distance)]
Main Signal speed = R16-R17
Permitted speed at the limit of authority = 35 km/h
Distant Signal speed = Expect Stop
Release speed = calculated release speed for overlap which distance = R28-R29 from [FRS Air Gap (Long Distance)]

F 3146 **6.2.7**
Reserved

F 3147 **6.2.8**
Change of STM to 'Fully Equipped Area' if was not before. End of BUA-restriction without train length delay.

6.3 Processing of RSS-telegram (Release Speed Stop)

F 3148

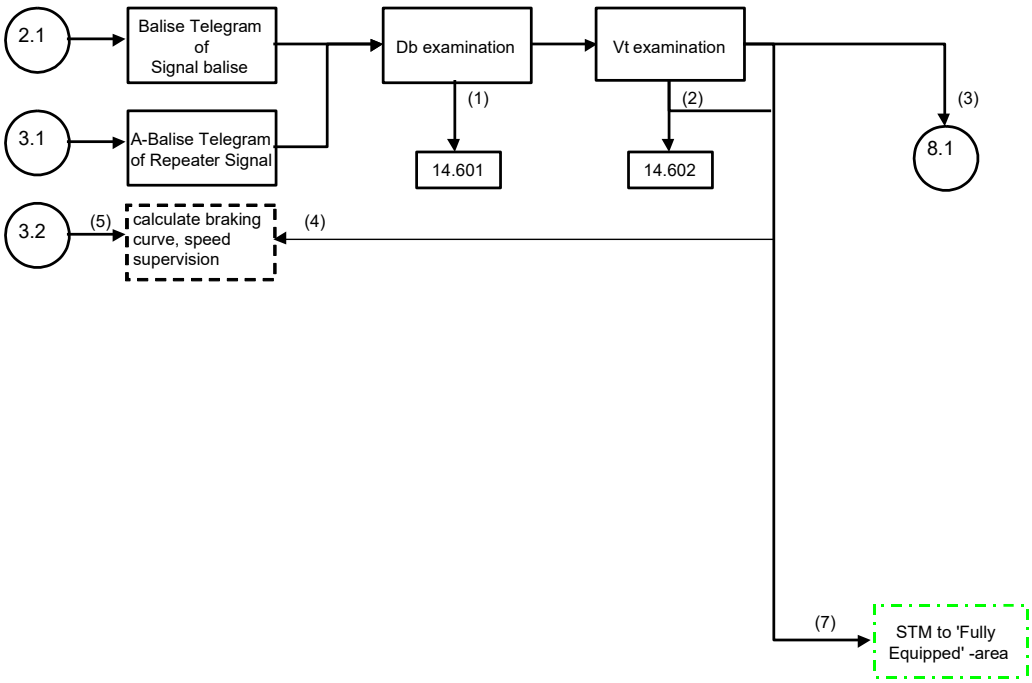


Figure 17/2. Processing of RSS-telegram

F 3149 **6.3.1**
R2 = 1 and R16-R17 ≠ (11-8E or EE) [Line speed for signal ≠ 0…555 km/h or cancelled] OR
R20-R21 ≠ 11-EC [Basic distance ≠ 5...11600 m], then balise error 14.601

F 3150 **6.3.2**
R18-R19 ≠ 13 or 18 [Release speed ≠ 10 or 35 km/h], use value 13 instead given value of R18-R19 + 5 km/h [Release speed = 15 km/h] and balise error 14.602

F 3151 **6.3.3**
R31-R44 (switch restriction data) used for switch restriction supervision, phase 8.1 [SR1...SR2].

F 3152 **6.3.4**
Braking curve calculation and maximum permitted speed supervision:
Target distance = R20-R21 from [FRS Air Gap, Long Distance]
Main Signal speed = R16-R17
Distant Signal speed = Expect Stop
Release speed = R18-R19 from [FRS Air Gap, Long Speed].

F 3153 **6.3.5**

Braking curve calculation and maximum permitted speed supervision:
Target distance = R20-R21 brought from phase 3.2 [FRS Air Gap, Long Distance]
All other information as previously received.

F 3154 **6.3.6**
Reserved

F 3155 **6.3.7**
Change of STM to 'Fully Equipped Area' if was not before. End of BUA-restriction without train length delay.

6.4 Processing of DS-telegram (Deferred Stop)

F 3156

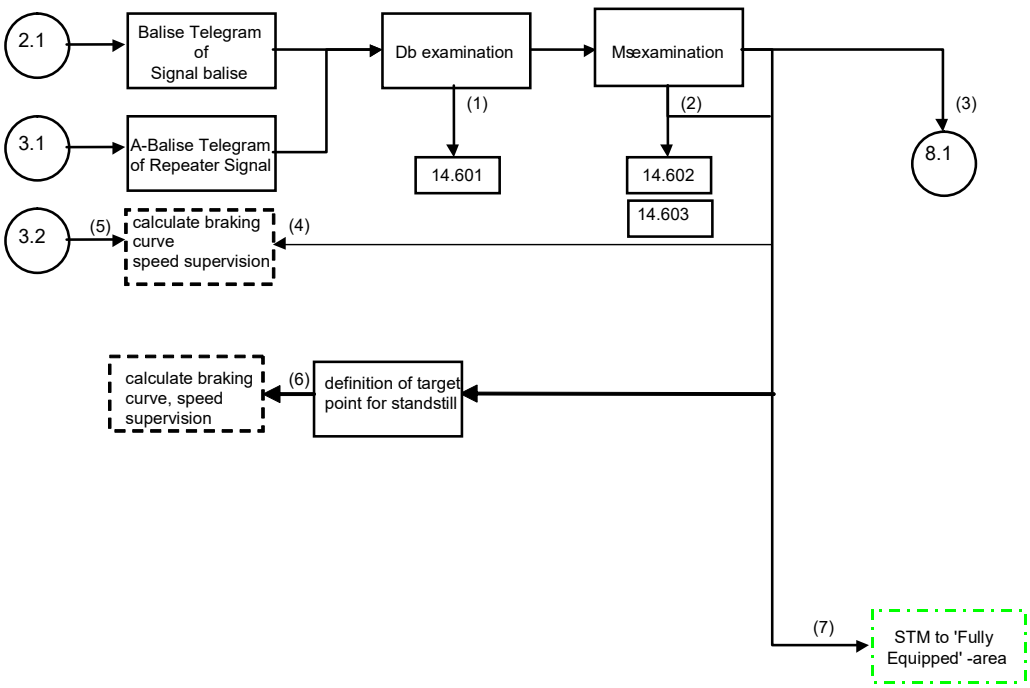


Figure 18/2. Processing of DS-telegram

F 3157 **6.4.1**
R2 = 1 and R16-R17 ≠ (11-8E or EE) [Line speed for signal ≠ 0…555 km/h or ≠ cancelled] OR
R20-R21 ≠ 11-EC [Basic distance ≠ 5...11600 m], then balise error 14.601

F 3158 **6.4.2**
If R18-R19 ≠ 13 or 18 [Release speed ≠ 10 or 35 km/h], then use value 13 instead given value of R18-R19 +5 km/h [Release speed = 15 km/h] and balise error 14.602 OR
If R28-R29 ≠ 11-EC [Stop message distance ≠ 5...11600 m], then balise error 14.603

F 3159 **6.4.3**
R31-R44 (switch restriction data) used for switch restriction supervision, phase 8.1 [SR1...SR2].

F 3160 **6.4.4**
Braking curve calculation and maximum permitted speed supervision:
Target distance = R20-R21 from [FRS Air Gap, Long Distance] + R28-R29 from [FRS Air Gap, Long Speed]
Main Signal speed = R16-R17
Distant Signal speed = Expect Stop
Release speed = R18-R19 from [FRS Air Gap, Long Speed].

F 3161 **6.4.5**
Braking curve calculation and maximum permitted speed supervision:
Target distance = R20-R21 brought from phase 3.2 [FRS Air Gap, Long Distance]
All other information as previously received.

F 3162 **6.4.6**
Braking curve calculation and maximum permitted speed supervision:
Target distance = R20-R21 from [FRS Air Gap, Long Distance]
Main Signal speed = R16-R17
Distant Signal speed = Expect Stop
Release speed = R18-R19 from [FRS Air Gap, Long Speed] + 5 km/h.

F 3163 **6.4.7**
Reserved

F 3164 **6.4.8**
Change of STM to 'Fully Equipped Area' if was not before. End of BUA-restriction without train length delay.

6.5 Processing of RT-telegram (Reserved Track stop)

F 3165

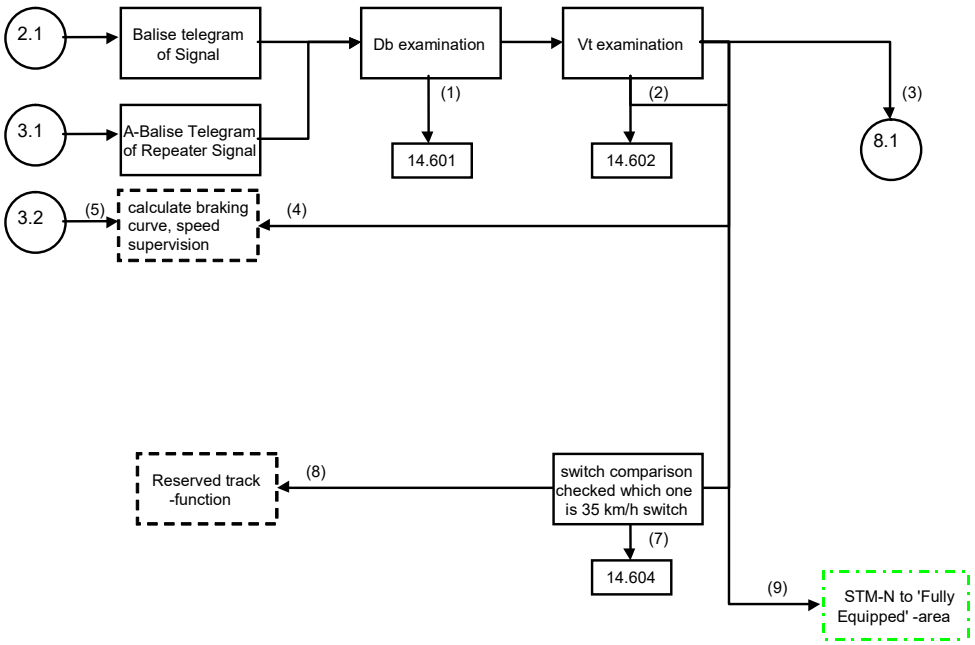


Figure 19/2. Processing of RT-telegram

F 3166 **6.5.1**
R2 = 1 and R16-R17 ≠ (11-8E or EE) [Line speed for signal ≠ 0…555 km/h or ≠ cancelled] OR
R20-R21 ≠ 11-EC [Basic distance ≠ 5...11600 m], then balise error 14.601

F 3167 **6.5.2**
If R18-R19 ≠ 13 or 18 [Release speed ≠ 10 or 35 km/h], then use value 13 instead given value of R18-R19 +5 km/h [Release speed = 15 km/h] and balise error 14.602

F 3168 **6.5.3**
R31-R44 (switch restriction data) used for switch restriction supervision, phase 8.1 [SR1...SR2].

F 3169 **6.5.4**
Braking curve calculation and maximum permitted speed supervision:
Target distance = R20-R21 from [FRS Air Gap, Long Distance]
Main Signal speed = R16-R17
Distant Signal speed = Expect Stop
Release speed = R18-R19 from [FRS Air Gap, Long Speed]

F 3170 **6.5.5**
Braking curve calculation and maximum permitted speed supervision:
Target distance = brought from phase 3.2 [FRS Air Gap, Long Distance]

All other information as previously received

F 3171 **6.5.6**
Reserved

F 3172 **6.5.7**
R31 and R38 ≠ 1 or 2 [SR1 and SR2 target speeds ≠ 35 km/h] OR
If R31 = 1 or 2 and R32-R33 > R20-R21 [Switch restriction 1 = 35 km/h and distance to switch is longer than Basic Distance] OR
If R38 = 1 or 2 and R39-R40 > R20-R21 [Switch restriction 2 = 35 km/h and distance to switch is longer than Basic Distance], then balise error 14.604

F 3173 **6.5.8**
If R31 = 2 [SR1 target speed = 35 km/h], change to Reserved track function after the distance determined by R32-R33 in [FRS Air Gap, Long Distance] has been passed, elseR31 ≠ 2 and R38 = 2 [SR1 target speed ≠ 35 and SR2 target speed = 35 km/h], change to Reserved track function after the distance determined by R39-R40 in [FRS Air Gap, Long Distance] has been passed [SUPERVISION 6.3].

F 3174 **6.5.9**
Change of STM to 'Fully Equipped Area' if was not before. End of BUA-restriction without train length delay.

6.6 Processing of DG-telegram (Deferred Go)

F 3175

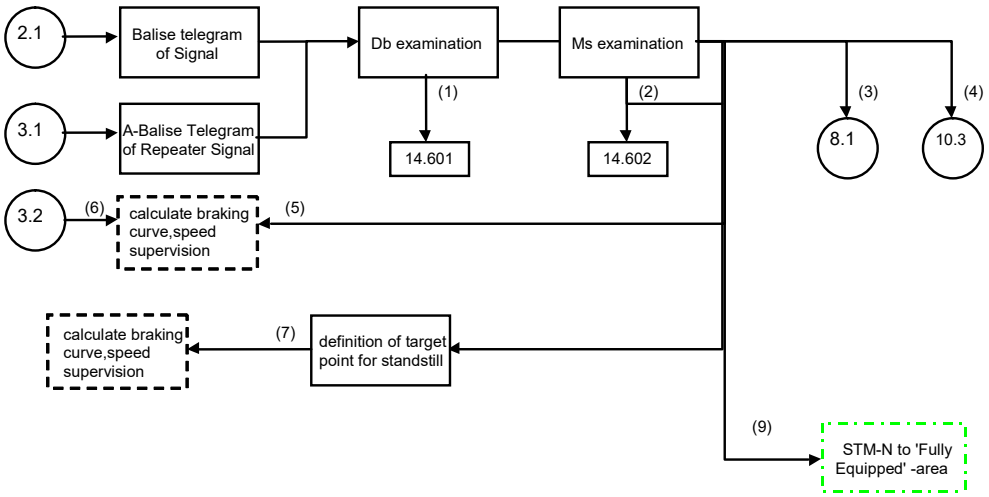


Figure 20/2. Processing of DG-telegram

F 3176 **6.6.1**
R2 = 1 and R16-R17 ≠ (11-8E or EE) [Line speed for signal ≠ 0…555 km/h or ≠ cancelled] OR
R18-R19 ≠ 12-8E [Target speed ≠ 5…555 km/h] OR
R20-R21 ≠ 11-EC [Basic distance ≠ 5...11600 m], then balise error 14.601

F 3177 **6.6.2**
If R28-R29 ≠ 11-EC [Stop message distance ≠ 5...11600 m], then balise error 14.603

F 3178 **6.6.3**
R31-R44 (switch restriction data) used for switch restriction supervision, phase 8.1 [SR1...SR2].

F 3179 **6.6.4**
R18-R19, R20-R21 and R28-R29 [Target speed, Basic distance and Stop message] to Braking curve calculation and maximum permitted speed supervision.

F 3180 **6.6.5**
Braking curve calculation and maximum permitted speed supervision:
Main Signal speed = R16-R17

F 3181 **6.6.6**
Braking curve calculation and maximum permitted speed supervision:
Target distance = R20-R21 brought from phase 3.2, from [FRS Air Gap, Long Distance]
All other information as previously received.

F 3182 **6.6.7**
Braking curve calculation and maximum permitted speed supervision:
Target distance = R20-R21 from [FRS Air Gap, Long Distance]
Main Signal speed = R16-R17
Distant Signal speed = Expect Stop
Release speed = 10 km/h

F 3183 **6.6.8**
Reserved

F 3184 **6.6.9**
Change of STM to 'Fully Equipped Area' if was not before. End of BUA-restriction without train length delay.

F 3185 Reserved

F 3186 Reserved

F 3187 Reserved

7 RESERVED

Note This page is left intentionally empty.

8 SWITCH

8.1 Processing of Switch information

F 3188

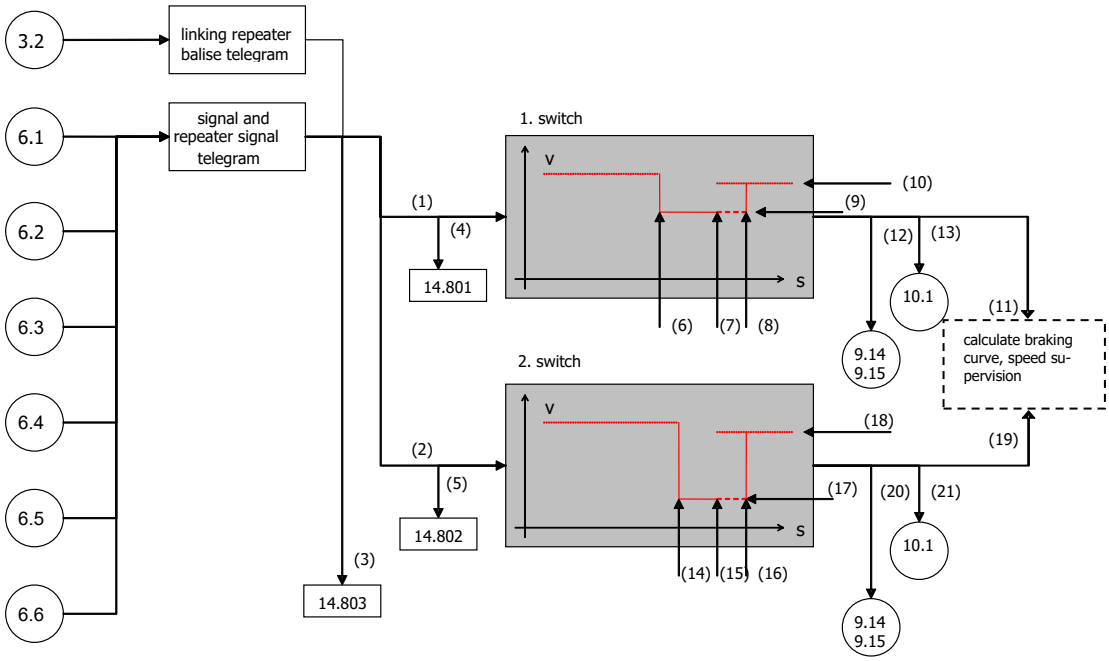


Figure 21/2. Processing of Switch information

F 3189 **8.1.1**
Processing of nibbles R31-R37 [SR1].

F 3190 **8.1.2**
Processing of nibbles R38-R44 [SR2].

F 3191 **8.1.3**
(R31 = E or R32-R33 = EE) [SR1 speed or SR1 distance is Cancelled...] and (R38 ≠ E or R39-R40 ≠ EE) [...but SR2 speed or distance is not Cancelled].

F 3192 **8.1.4**
If (R31 = E or R32-R33 = EE) [SR1 speed or SR1 distance is Cancelled...] and (R34 ≠ 6 or R35 ≠ E or R36-R37 ≠ EE) [...but SR1 gradient is not -5 or SR1 length or speed after switch is not Cancelled]
OR
If (R32-R33 ≠ 11-EC or EE) or (R36-R37 ≠ 12-8E) [SR1 speed or SR1 distance is illegal] OR
If R35 = E and R36-R37 ≠ EE [SR1 length is cancelled but Speed after switch is not Cancelled]
Then balise error 14.801

F 3193 **8.1.5**

If (R38 = E or R39-R40 = EE) [SR2 speed or SR2 distance is Cancelled...] and (R41 ≠ 6 or R42 ≠ E or R43-R44 ≠ EE) [...but SR2 gradient is not -5 or SR2 length or speed after switch is not Cancelled] OR
If (R39-R40 ≠ 11-EC, EE) or (R43-R44 ≠ 12-8E) [SR2 speed or SR2 distance is illegal] OR
If R42 = E and R43-R44 ≠ EE [SR2 length is cancelled but Speed after switch is not Cancelled]
If R39-R40 < R32-R33 [SR2 distance < SR1 distance]
Then balise error 14.802

F 3194 **8.1.6**
Distance to switch = balise location + (R32-R33 from [FRS Air Gap, Long Distance]) [SR1 distance].

F 3195 **8.1.7**
End of switch area = balise location + (R32-R33 from [FRS Air Gap, Long Distance]) + (R35 from [FRS Air Gap, Short Distance]). [SR1 distance + length]
If R35 = E, restriction is valid until SRe-balise is reached, phase 8.2 [SR1 length Cancelled].

F 3196 **8.1.8**
Switch restriction is aborted after train length delay.

F 3197 **8.1.9**
R31 [SR1 target speed = 20...160 km/h] from [FRS Air Gap, Short Speed], exceptions:
If i2 = 1 in PT-code, value 2 of R31 shall be processed as 20 km/h [Change SR1 speed from 35 to 20]
If i3 = 1 in PT-code, values 4 and 5 of R31 shall be processed as 60 km/h [Change SR1 speed from 70 or 80 to 60 km/h].

F 3198 **8.1.10**
If R31 = 2 and R36-R37 = 18 and bit2 of PT-code is active, then R36-R37 = 20 km/h [if switch speed = 35 km/h, speed after switch is 35 km/h and bit2 active in PT-code, then speed after switch is 20 km/h] OR
If R31 = 4 and R36-R37 = 21 or 23 and bit3 of PT-code is active, then R36-R37 = 60 km/h [if switch speed = 70 km/h, speed after switch is 70 or 80 km/h and bit3 active in PT-code, then speed after switch is 60 km/h] OR
If R31 = 5 and R36-R37 = 23 and bit3 of PT-code is active, then R36-R37 = 60 km/h [if switch speed = 80 km/h, speed after switch is 80 km/h and bit3 active in PT-code, then speed after switch is 60 km/h] else
Speed after switch = R36-R37 [keep original speed after switch].

F 3199 **8.1.11**
Update Braking curve calculation and maximum permitted speed supervision at end point of switch restriction:
Main signal speed = speed after switch. Main signal speed is not updated, if previous main signal was passed at stop aspect.

F 3200 **8.1.12**
Remove information about switch under supervision to phase 9.14 and 9.15

F 3201 **8.1.13**
Information of the 1st switch to Braking curve calculation and maximum permitted speed supervision.

F 3202 **8.1.14**
Distance to switch = balise location + (R39-R40 from [FRS Air Gap, Long Distance]) [SR2 distance].

F 3203 **8.1.15**
End of switch area = balise location + (R39-R40 from [FRS Air Gap, Long Distance]) + (R42 from [FRS Air Gap, Short Distance]). If R35 = E, restriction is valid until SRe-balise is reached, phase 8.2 [SR2 distance + length].

F 3204 **8.1.16**
Switch restriction is aborted after train length delay.

F 3205 **8.1.17**
R38 [SR1 target speed = 20...160 km/h] from [FRS Air Gap, Short Speed], exceptions:
If i2 = 1 in PT-code, value 2 of R38 shall be processed as 20 km/h. [Change SR1 speed from 35 to 20]
If i3 = 1 in PT-code, values 4 and 5 of R38 shall be processed as 60 km/h. [Change SR1 speed from 70 or 80 to 60 km/h].

F 3206 **8.1.18**
If R38 = 2 and R43-R44 = 18 and bit2 of PT-code is active, then R43-R44 = 20 km/h [if switch speed = 35 km/h, speed after switch is 35 km/h and bit2 active in PT-code, then speed after switch is 20 km/h] OR
If R38 = 4 and R43-R44 = 21 or 23 and bit3 of PT-code is active, then R43-R44 = 60 km/h [if switch speed = 70 km/h, speed after switch is 70 or 80 km/h and bit3 active in PT-code, then speed after switch is 60 km/h] OR
If R38 = 5 and R43-R44 = 23 and bit3 of PT-code is active, then R43-R44 = 60 km/h [if switch speed = 80 km/h, speed after switch is 80 km/h and bit3 active in PT-code, then speed after switch is 60 km/h] else
Speed after switch = R43-R44 [keep original speed after switch].

F 3207 **8.1.19**
Update Braking curve calculation and maximum permitted speed supervision at end point of switch restriction: Main signal speed = speed after switch. Main signal speed is not updated, if previous main signal was passed at stop aspect.

F 3208 **8.1.20**
Remove information about switch under supervision to phase 9.14 and 9.15

F 3209 **8.1.21**
Information of 2nd switch to Braking curve calculation and maximum permitted speed supervision.

8.2 Processing of SRe - telegram

F 3210

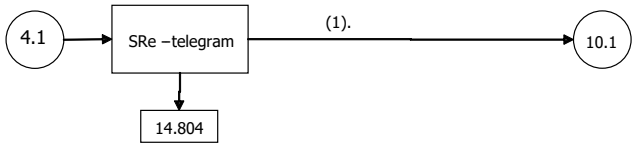


Figure 22/2. Processing of SRe - telegram

F 3211 **8.2.1**
- R16-R17 = 11 and R18-R20 = EE OR
- R20-R21 = 11 and R22-R23 = EE OR
- R24-R25 = 11 and R26-R27 = EE OR
- R28-R29 = 11 and R30-R31 = EE [Restr type 1, 2, 3 or 4 = SRe, and its Restr speed = Cancelled]

9 PROCESSING OF RESTRICTIONS

9.1 Processing of deltaV - restriction

F 3212

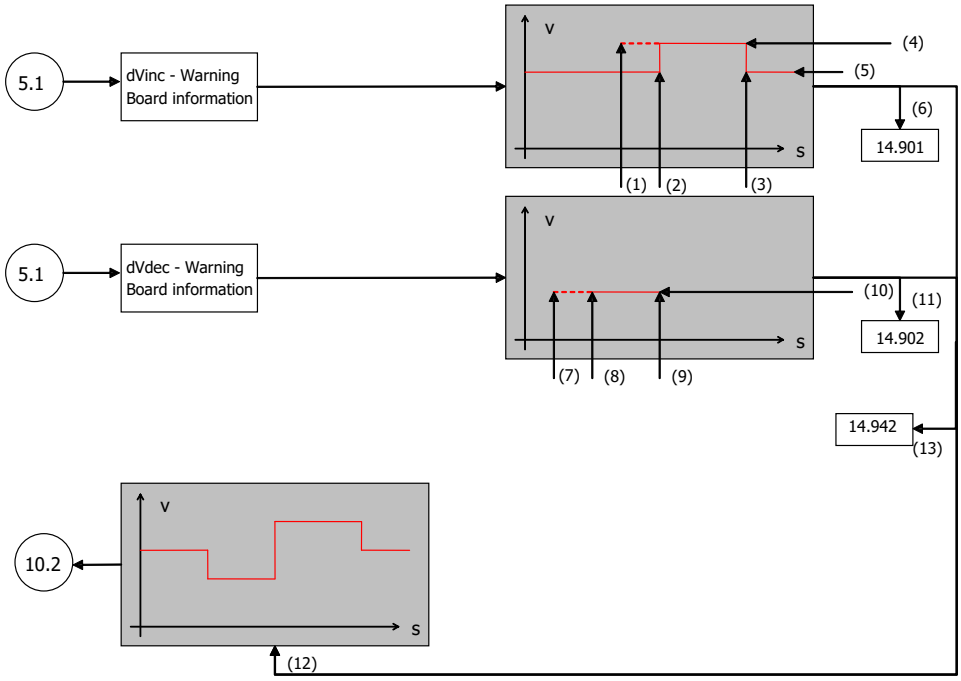


Figure 23/2. Processing of deltaV - restriction

Note Enter with Restr type 1, 2 or 3 = dVdec or dVinc.

Note dVinc is valid only for trains with bit1 active in PT-code. An extra restriction (=entered speed) is set valid. See also [Chapter 9.16].

F 3213 **9.1.1**
dVinc-Warning board information = balise location. If there have been another Warning board, which is aiming same restriction (type, speed and target point is same), latter Warning board is processed as a repeater.

F 3214 **9.1.2**
End of extra restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]) [Restr type 1, 2 or 3 distance].

F 3215 **9.1.3**
Start of extra restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]) + (R23-R24, R34-R35

or R43-R44 from [FRS Air Gap, Long Distance]) [Restr type 1, 2 or 3 distance + length].

F 3216 **9.1.4**
Extra restriction is cancelled while dVinc-restriction is valid.

F 3217 **9.1.5**
Extra restriction = Entered speed - 10 km/h.

F 3218 **9.1.6**
- R18-R19, R29-R30 or R38-R39 ≠ 13 [Speed restr 1, 2 or 3 ≠ 10 km/h] OR
- R23-R24, R34-R35 or R43-R44 ≠ 11-EC [Length of restr 1, 2 or 3 ≠ 5...11600 m] OR
- R16-R17 = 12 and R25-R26 ≠ EE
[Speed after restriction 1 ≠ Cancelled].

F 3219 **9.1.7**
dVdec-Warning board information = balise location. If there have been another Warning board, which is aiming same restriction (type, speed and target point is same), latter Warning board is processed as a repeater.

F 3220 **9.1.8**
Start of extra restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]) [Restr type 1, 2 or 3 distance].

F 3221 **9.1.9**
End of extra restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]) + (R23-R24, R34-R35 or R43-R44 from [FRS Air Gap, Long Distance]) [Restr type 1, 2 or 3 distance + length].

F 3222 **9.1.10**
Entered speed - R18-R19, R29-R30 or R38-R39 from [FRS Air Gap, Long Speed].

F 3223 **9.1.11**
- R18-R19, R29-R30 or R38-R39 ≠ 13, 15 or 17 [Speed restr 1, 2 or 3 ≠ 10, 20 or 30 km/h] OR
- R23-R24, R34-R35 or R43-R44 ≠ 11-EC [Length of restr 1, 2 or 3 ≠ 5...11600 m] OR
- R16-R17 = 13 and R25-R26 ≠ EE
[Rest. type = deltaV and Speed after restriction 1 ≠ Cancelled].

F 3224 **9.1.12**
Speeds permitted by delta-speed-restriction shall be gathered and the most restrictive information to Braking curve calculation and maximum permitted speed supervision.

F 6010 **9.1.13**

When receiving if a dVinc or dVdec WB, which is not a repeater, is received, and another delta-speed-restriction already exists, error 14.942 is generated.

9.2 Processing of M1-restriction

F 3225

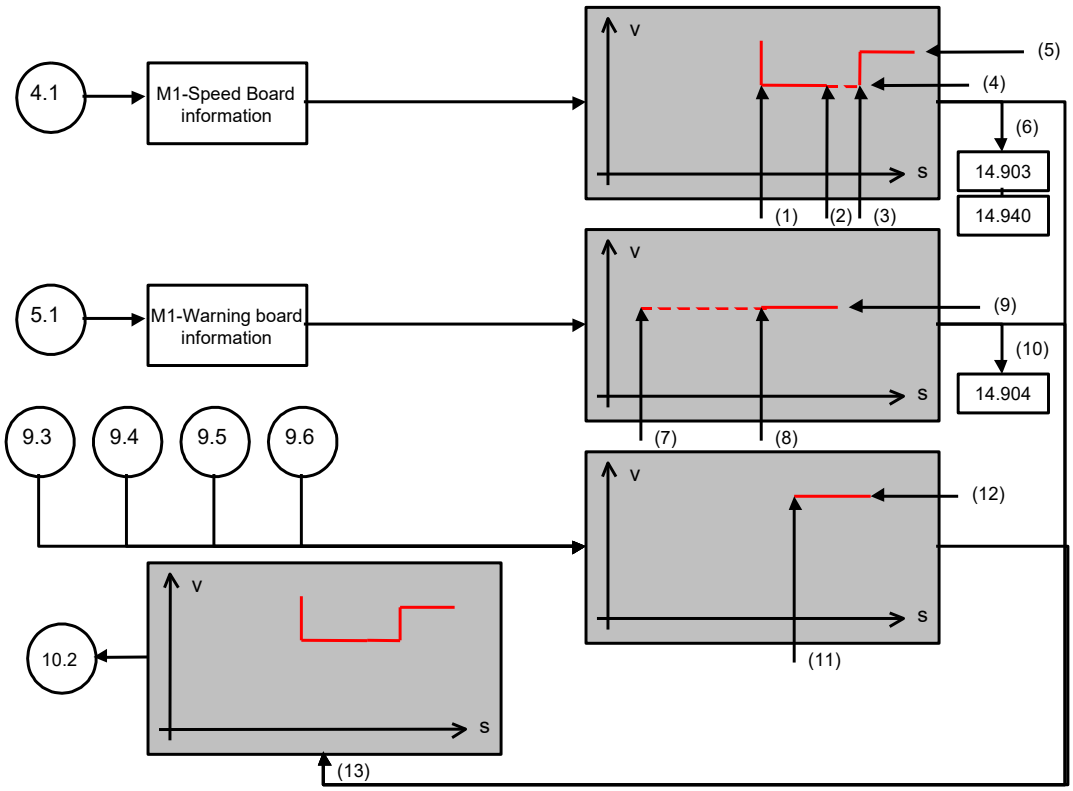


Figure 24/2. Processing of M1 - restriction

Note Enter with:
Restr type 1, 2, 3 or 4 = M1 from speed board, or with
Restr type 1, 2 or 3 = M1 from warning board

F 3226 **9.2.1**

M1-Speed Board information; beginning of the new M1-restriction and the end of the previous one. Start point is M1-Speed Board location.

F 3227 **9.2.2**
M1-Speed Board information; beginning of the new M1-restriction and the end of the previous one. Start point is M1-Speed Board location.

F 3228 **9.2.3**
M1-restriction ends after new M1-Speed Board with higher speed and after train length delay.

F 3229 **9.2.4**
M1- Speed Board information R18-R19, R22-R23, R26-R27 or R30-R31 from [FRS Air Gap, Long Speed], which is valid until new M1-value is received (train length delay supervision when required). [Speed restr 1, 2, 3 or 4].

F 3230 **9.2.5**
M1- Speed Board information R18-R19, R22-R23, R26-R27 or R30-R31 from [FRS Air Gap, Long Speed], which is valid until new M1-value is received (train length delay supervision when required). [Speed restr 1, 2, 3 or 4].

F 3231 **9.2.6**
If R18-R19, R22-R23, R26-R27 or R30-R31 ≠ 12-8E
[Speed restr ≠ 5...555 km/h], then balise error 14.903
If Speed board with same type but different speed than Warning board at target point of Warning board (+/-10 %), then balise error 14.940

F 3232 **9.2.7**
M1-Warning board information = balise location. If there have been another Warning board, which is aiming same restriction (type, speed and target point is same), latter Warning board is processed as a repeater.

F 3233 **9.2.8**
Start of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]) [Restr type 1, 2 or 3 distance].

F 3234 **9.2.9**
M1-information R18-R19, R29-R30 or R38-R39 [Speed restr 1, 2 or 3 from Wb] from [FRS Air Gap, Long Speed].

F3235 **9.2.10**
- R18-R19, R29-R30 or R38-R39 ≠ 12-8E
[Speed restr ≠ 5...555 km/h from Wb] OR
- some other M1-restrictions Warning boards are located on the target distance (if speed is identical and start of the restriction is located in +/- 10% tolerance of the speed restriction, Warning boards repeat the previous information -> no fail) OR
- Lack of Speed Board during the target distance (+/- 10%) OR
- R16-R17 = 16 and R25-R26 ≠ EE
[Rest. type = M1 and Speed after restr 1 ≠ Cancelled].

F 3236 **9.2.11**
New M1-restriction starts at end point of M2, M3, C1 or C2 -restriction if 'speed after restriction' is given.

F3237 **9.2.12**
Speed of restriction is given in M2, M3, C1 or C2 -warning board telegram.

F 3238 **9.2.13**
Speeds permitted by M1-restriction shall be gathered and the most restrictive information to Braking curve calculation and maximum permitted speed supervision.

9.3 Processing of M2-restriction

F 3239

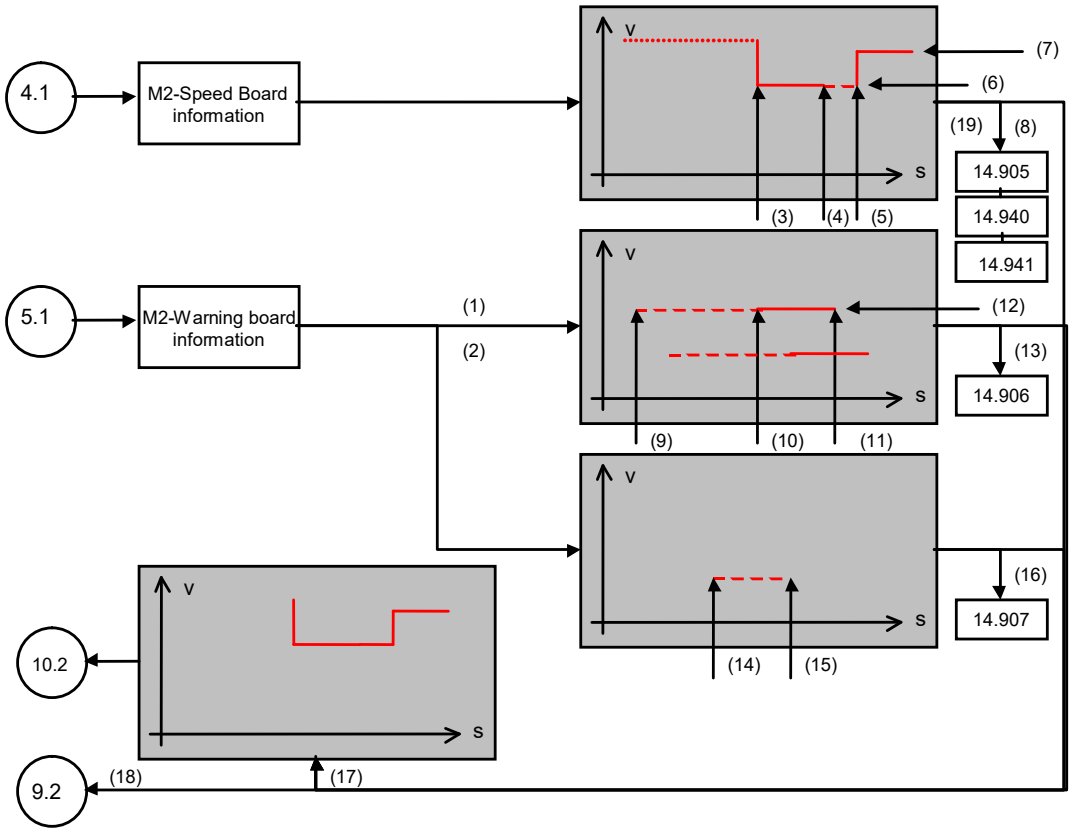


Figure 25/2. Processing of M2 - restriction

Note Enter with:
Restr type 1, 2 or 3 = M2 or M2c from warning board or with
Restr type 1, 2, 3 or 4 = M2, M2c or M2e from speed board.

F 3240 **9.3.1**
R16-R17, R27-R28 or R36-R37 = 17 [Restr type 1, 2 or 3 = M2 from Wb].

F 3241 **9.3.2**
R16-R17, R27-R28 or R36-R37 = 25 [Restr type 1, 2 or 3 = M2c from Wb].

F 3242 **9.3.3**

M2-Speed Board information:
R16-R17, R20-R21, R24-R25 or R28-R29 = 17 (M2-Speed Board information). Start of new M2-restriction. [Restr type 1, 2, 3 or 4 = M2 from Sb] OR
R16-R17, R20-R21, R24-R25 or R28-R29 = 25 (M2c-Speed Board information). Restriction given by Warning Board shall be cancelled by M2c Speed Board with out train length delay [Restr type 1, 2, 3 or 4 = M2c from Sb] if:

- Speed information from M2-Warning Board correspond to Speed information of M2c-Speed Board and
- M2c-Speed Board is located in target point of M2-Warning Board (+/-10% of target distance) and
- M2-restriction has not been started by M2-Speed Board

F 3243 **9.3.4**

R16-R17, R20-R21, R24-R25 or R28-R29 = 18 (M2e-Speed Board information, terminates the initiated M2-restriction according to rules in [F 8000]) [Restr type 1, 2, 3 or 4 = M2e from Sb].

F 3244 **9.3.5**

The M2-restriction ends after M2e-Speed Board is accepted according to rules in [F 8000] and train length delay.

F 3245 **9.3.6**

M2- Speed Board information R18-R19, R22-R23, R26-R27 or R30-R31 from [FRS Air Gap, Long Speed] [Speed restr 1, 2, 3 or 4 from Sb], which is valid until it is the most restrictive M2-information and M2e-information is received, and during train length delay supervision when required.

F 3246 **9.3.7**

M2e-information. Terminates the most restrictive M2-restriction initiated by M2-restriction regardless of M2e-speed information (train length delay supervision) [Restr type 1, 2, 3 or 4 = M2e from Sb].

F 3247 **9.3.8**

If R18-R19, R22-R23, R26-R27 or R30-R31 ≠ 12-8E [Speed restr 1, 2, 3 or 4 = 5...555 km/h from Sb], then balise error 14.905
If Speed board with same type but different speed than Warning board at target point of Warning board (+/-10 %), then balise error 14.940

F 3248 **9.3.9**

M2-Warning board information = balise location.
[Restr type 1, 2 or 3 = M2 from Wb] If there have been another Warning board, which is aiming same restriction (type, speed and target point is same), latter Warning board is processed as a repeater.

F 3249 **9.3.10**
Start of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]) [Restr 1, 2 or 3 distance].

F 3250 **9.3.11**
End of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]) + (R23-R24, R34-R35 or R43-R44 from [FRS Air Gap, Long Distance]) [Restr 1, 2 or 3 distance + length].

Note If there is Speed Board information on start point of restriction (+/- 10% of target distance) with same type and speed, 'length of restriction' -information of warning board is not used. End point of restriction is indicated by Speed Board balises.

F 3251 **9.3.12**
Value of M2-information R18-R19, R29-R30 or R38-R39 from [FRS Air Gap, Long Speed].

F 3252 **9.3.13**
- R18-R19, R29-R30 or R38-R39 ≠ 12-8E [Speed restr 1, 2 or 3 = 5...555 km/h] OR
- R23-R24, R34-R35 or R43-R44 ≠ 11-EC
[Restr length 1, 2 or 3 ≠ 5...11600 m]

F 3253 **9.3.14**
M2c-Warning Board information = balise location

F 3254 **9.3.15**
M2-restriction, which starting point is located in +/- 10% tolerance of M2c-speed restriction starting point and which have same speed information as M2c has, shall be cancelled. Start of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance])

F 3255 **9.3.16**
- R18-R19, R29-R30 or R38-R39 ≠ 12-8E [Speed restr 1, 2 or 3 = 5...555 km/h] OR
- R23-R24, R34-R35 or R43-R44 ≠ 11-EC
[Restr length 1, 2 or 3 ≠ 5...11600 m

F 3256 **9.3.17**
Speeds permitted by M2-restrictions shall be gathered and the most restrictive information to Braking curve calculation and maximum permitted speed supervision.

F 3257 **9.3.18**
If R16-R17 = 17 and R25-R26 ≠ EE then 'Speed after restriction' (R25-R26 from [FRS Air Gap, Long Speed]) is moved to M1-restriction supervision. [M2-restriction is Restriction 1 in Warning Board telegram and 'Speed after restriction' is given]

F 8000 **9.3.19**

If end of Sb controlled restriction of type M2 is received the following rule apply:

- Only End boards without speed (when one speed board stored) and with matching speed (both when one and several speed boards of the category stored) are accepted to end a stored restriction.
- Accepted End board ends all restrictions with same category and speed.

Balise error (14.941) appears if:

1) at least two speed boards of same category and different speeds are stored and end board of same category without speed is received, or
2) there is one or more speed board stored and end board of same category with speed is received and speed doesn't match to none of stored speed board.

9.4 Processing of M3 - restriction

F 3258

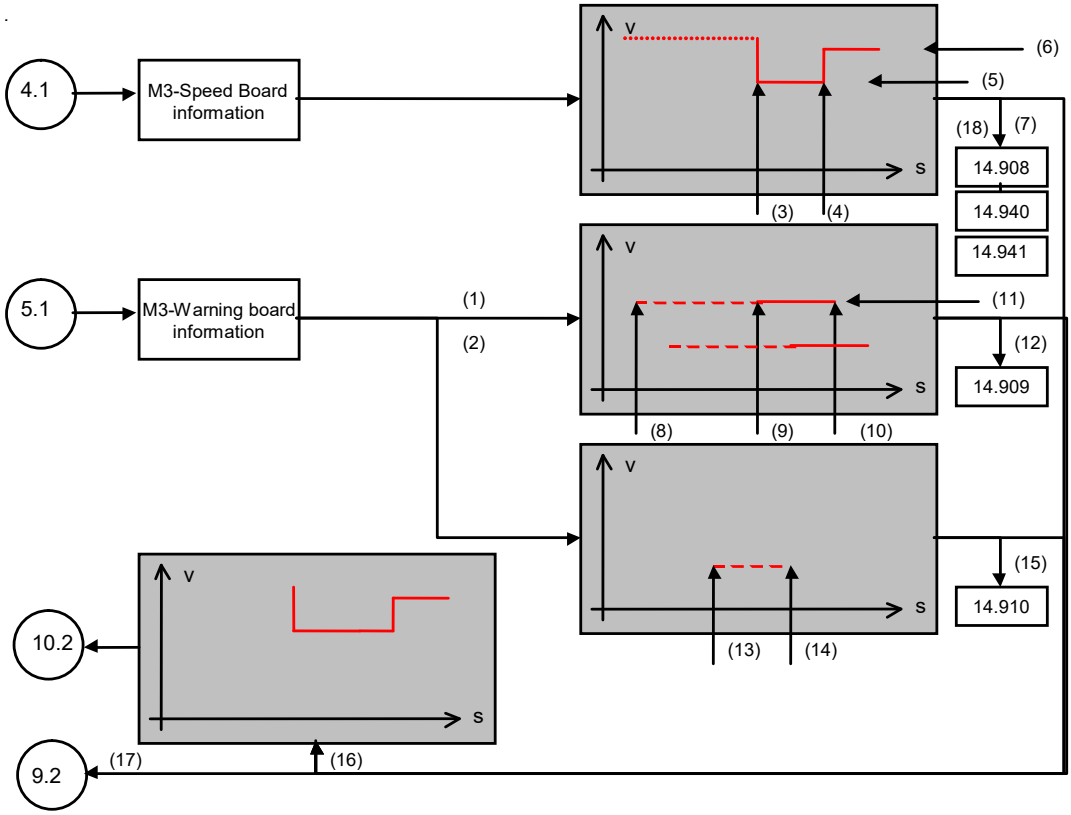


Figure 26/2. Processing of M3 - restriction

Note Enter with:
Restr type 1, 2 or 3 = M3 or M3c from warning board, or with
Restr type 1, 2, 3 or 4 = M3, M3c or M3e from speed board.

F 3259 **9.4.1**

R16-R17, R27-R28 or R36-R37 = 2C [Restr type 1, 2 or 3 = M3 from Wb].

F 3260 **9.4.2**
R16-R17, R27-R28 or R36-R37 = 2D [Restr type 1, 2 or 3 = M3c from Wb].

F 3261 **9.4.3**
M3-Speed Board information:
R16-R17, R20-R21, R24-R25 or R28-R29 = 2C (M3-Speed Board information). Start of new M3-restriction. [Restr type 1, 2, 3 or 4 = M2 from Sb] OR
R16-R17, R20-R21, R24-R25 or R28-R29 = 2D (M3c-Speed Board information). Restriction given by Warning Board shall be cancelled by M3c Speed Board with out train length delay [Restr type 1, 2, 3 or 4 = M3c from Sb] if:

- Speed information from M3-Warning Board correspond to Speed information of M3c-Speed Board and
- M3c-Speed Board is located in target point of M3-Warning Board (+/-10% of target distance) and
- M3-restriction has not been started by M3-Speed Board

F 3262 **9.4.4**
R16-R17, R20-R21, R24-R25 or R28-R29 = 2E (M3e-Speed Board information, terminates the most restrictive M3-restriction initiated by M3-restriction regardless of M3e-speed information, no train length delay). [Restr type 1, 2, 3 or 4 = M3e from Sb].

F 3263 **9.4.5**
M3-Speed Board information R18-R19, R22-R23, R26-R27 or R30-R31 from [FRS Air Gap, Long Speed], which is valid until M3e-information is received and accepted according to rules in [F 6001]. [Speed restr 1, 2, 3 or 4 from Sb].

F 3264 **9.4.6**
M3e-information. Terminates the initiated M3-restriction according to rules in [F 6001]. [Restr type 1, 2, 3 or 4 = M3e from Sb].

F 3265 **9.4.7**
If R18-R19, R22-R23, R26-R27 or R30-R31 ≠ 12-8E
[Speed restr 1, 2, 3 or 4 = 5...555 km/h from Sb], then balise error 14.908
If Speed board with same type but different speed than Warning board at target point of Warning board (+/-10 %), then balise error 14.940

F 3266 **9.4.8**
M3-Warning board information = balise location
[Restr type 1, 2 or 3 = M3 from Wb] If there have been another Warning board, which is aiming same restriction (type, speed and target point is same), latter Warning board is processed as a repeater.

F 3267 **9.4.9**

Start of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]) [Restr 1, 2 or 3 distance].

F 3268 **9.4.10**
End of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]) + (R23-R24, R34-R35 or R43-R44 from [FRS Air Gap, Long Distance]).

Note If there is Speed Board information on start point of restriction (+/- 10% of target distance) with same type and speed, 'length of restriction' -information of warning board is not used. End point of restriction is indicated by Speed Board balises [Restr 1, 2 or 3 distance + length].

F 3269 **9.4.11**
M3-information R18-R19, R29-R30 or R38-R39 from [FRS Air Gap, Long Speed].

F 3270 **9.4.12**
- R18-R19, R29-R30 or R38-R39 ≠ 12-8E [Speed restr 1, 2 or 3 = 5...555 km/h] OR
- R23-R24, R34-R35 or R43-R44 ≠ 11-EC [Restr length 1, 2 or 3 ≠ 5...11600 m] OR
R25-R26 ≠ 12-8E or EE, then balise error 14.909

F 3271 **9.4.13**
M3c-Warning Board information = balise location.

F 3272 **9.4.14**
M3-restriction, which starting point is located in +/- 10% tolerance of M3c-speed restriction starting point and which have same speed information as M3c has, shall be cancelled. Start of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]).

F 3273 **9.4.15**
- R18-R19, R29-R30 or R38-R39 ≠ 12-8E [Speed restr 1, 2 or 3 = 5...555 km/h] OR
- R23-R24, R34-R35 or R43-R44 ≠ 11-EC [Restr length 1, 2 or 3 ≠ 5...11600 m].

F 3274 **9.4.16**
Speeds permitted by M3-restrictions shall be gathered and the most restrictive information to Braking curve calculation and maximum permitted speed supervision.

F 3275 **9.4.17**
If R16-R17 = 2C and R25-R26 ≠ EE then 'Speed after restriction' (R25-R26 from [FRS Air Gap, Long Speed]) is moved to M1-restriction supervision. [M3-restriction is Restriction 1 in Warning Board telegram and 'Speed after restriction' is given]

F 6001 **9.4.18**

If end of Sb controlled restriction of type M3 is received the following rule apply:

- Only End boards without speed (when one speed board stored) and with matching speed (both when one and several speed boards of the category stored) are accepted to end a stored restriction.
- Accepted End board ends all restrictions with same category and speed.

Balise error (14.941) appears if:

1) at least two speed boards of same category and different speeds are stored and end board of same category without speed is received, or
2) there is one or more speed board stored and end board of same category with speed is received and speed doesn't match to none of stored speed board.

9.5 Processing of C1 - restriction

F 3276

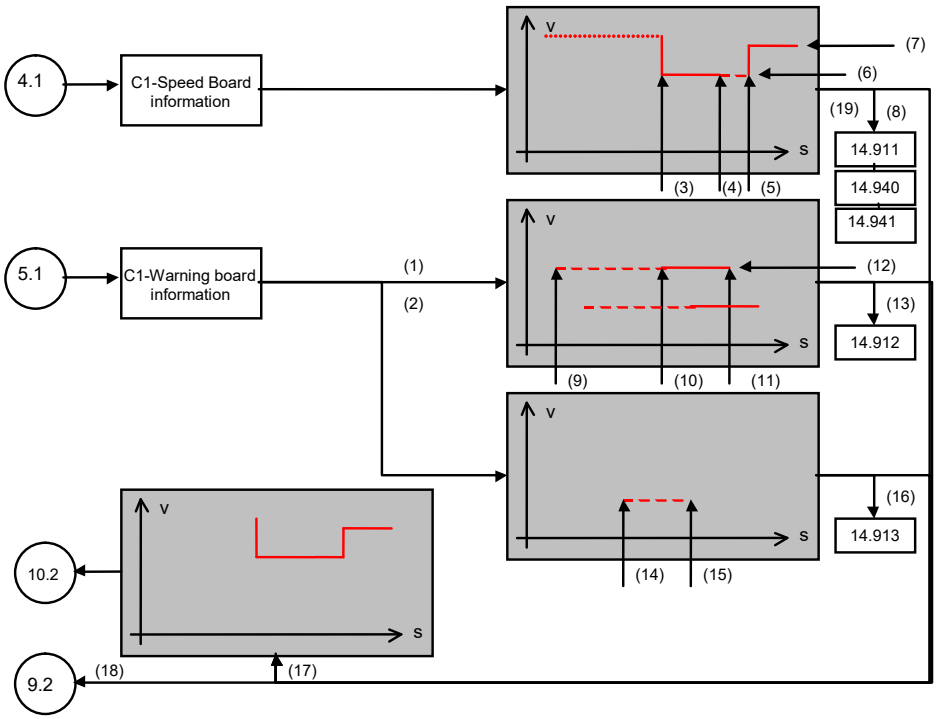


Figure 27/2. Processing of C1 - restriction

Note Enter with:
Restr type 1, 2 or 3 = C1 or C1c from warning board, or with
Restr type 1, 2, 3 or 4 = C1, C1c or C1e from speed board.

F 3277 **9.5.1**
R16-R17, R27-R28 or R36-R37 = 19 [Restr type 1, 2 or 3 = C1 in Wb].

F 3278 **9.5.2**
R16-R17, R27-R28 or R36-R37 = 26 [Restr type 1, 2 or 3 = C1c in Wb].

F 3279 **9.5.3**
C1-Speed Board information:
R16-R17, R20-R21, R24-R25 or R28-R29 = 19 (C1-Speed Board information). Start of new C1-restriction. [Restr type 1, 2, 3 or 4 = C1 from Sb] OR
R16-R17, R20-R21, R24-R25 or R28-R29 = 26 (C1c-Speed Board information). Restriction given by Warning Board shall be cancelled by C1c Speed Board with out train length delay [Restr type 1, 2, 3 or 4 = C1c from Sb] if:

- Speed information from C1-Warning Board correspond to Speed information of C1c-Speed Board and
- C1c-Speed Board is located in target point of C1-Warning Board (+/-10% of target distance) and
- C1-restriction has not been started by C1-Speed Board

F 3280 **9.5.4**
R16-R17, R20-R21, R24-R25 or R28-R29 = 1B (C1e-Speed Board information, terminates the initiated C1-restriction according to rules in [F 6002].) [Restr type 1, 2, 3 or 4 = C1e].

F 3281 **9.5.5**
The C1-restriction ends after C1e-Speed Board is accepted according to rules in [F 6002] and train length delay.

F 3282 **9.5.6**
C1- Speed Board information R18-R19, R22-R23, R26-R27 or R30-R31 from [FRS Air Gap, Long Speed] [Speed restr 1, 2, 3 or 4], which is valid until it is the most restrictive C1-information and C1e-information is received, and during train length delay supervision when required. Speed of 'Not tilting train' = table value, speed of 'Tilting train' = table value x 1,5.

F 3283 **9.5.7**
C1e-information [Restr type 1, 2, 3 or 4 = C1e]. Terminates the most restrictive C1-restriction initiated by C1-Speed Board balise regardless of C1e-speed information (train length delay supervision).

F 3284 **9.5.8**
If R18-R19, R22-R23, R26-R27 or R30-R31 ≠ 12-8E [Speed restr ≠ 5...555 km/h from Sb], then balise error14.911
If Speed board with same type but different speed than Warning board at target point of Warning board (+/-10 %), then balise error 14.940

F 3285 **9.5.9**
C1-Warning board information = balise location. If there have been another Warning board, which is aiming same restriction (type, speed and target point is same), latter Warning board is processed as a repeater.

F 3286 **9.5.10**
Start of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]) [Restr 1, 2 or 3 distance from Wb].

F 3287 **9.5.11**
End of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]) + (R23-R24, R34-R35 or R43-R44 from [FRS Air Gap, Long Distance])
[Restr 1, 2 or 3 distance + length from Wb].

Note If there is Speed Board information on start point of restriction (+/- 10% of target distance) with same type and speed, 'length of restriction' -information of warning board is not used. End point of restriction is indicated by Speed Board balises.

F 3288 **9.5.12**
C1-information R18-R19, R29-R30 or R38-R39 from [FRS Air Gap, Long Speed] [Speed restr 1, 2 or 3 from Wb] Speed of 'Not tilting train' = table value, speed of 'Tilting train' = table value x 1,5.

F 3289 **9.5.13**
- R18-R19, R29-R30 or R38-R39 ≠ 12-8E [Speed restr 1, 2 or 3 = 5...555 km/h] OR
- R23-R24, R34-R35 or R43-R44 ≠ 11-EC
- [Restr length 1, 2 or 3 ≠ 5...11600 m] OR
R25-R26 ≠ 12-8E or EE, then balise error 14.912

F 3290 **9.5.14**
C1c-Warning board information = balise location [Restr 1, 2 or 3 = C1c].

F 3291 **9.5.15**
C1-restriction, which starting point is located in +/- 10% tolerance of C1c-speed restriction starting point and which have same speed information as C1c has, shall be cancelled. Start of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]).

F 3292 **9.5.16**
- R18-R19, R29-R30 or R38-R39 ≠ 12-8E [Speed restr 1, 2 or 3 = 5...555 km/h] OR
- R23-R24, R34-R35 or R43-R44 ≠ 11-EC [Restr length 1, 2 or 3 ≠ 5...11600 m].

F 3293 **9.5.17**
Speeds permitted by C1-restrictions shall be gathered and the most restrictive information to Braking curve calculation and maximum permitted speed supervision.

F 3294 **9.5.18**

If R16-R17 = 19 and R25-R26 ≠ EE then 'Speed after restriction' (R25-R26 from [FRS Air Gap, Long Speed]) is moved to M1-restriction supervision. [C1-restriction is Restriction 1 in Warning Board telegram and 'Speed after restriction' is given].

F 6002 **9.5.19**

If end of Sb controlled restriction of type C1 is received the following rule apply:

- Only End boards without speed (when one speed board stored) and with matching speed (both when one and several speed boards of the category stored) are accepted to end a stored restriction.
- Accepted End board ends all restrictions with same category and speed.

Balise error (14.941) appears if:

1) at least two speed boards of same category and different speeds are stored and end board of same category without speed is received, or
2) there is one or more speed board stored and end board of same category with speed is received and speed doesn't match to none of stored speed board.

9.6 Processing of C2 - restriction

F 3295

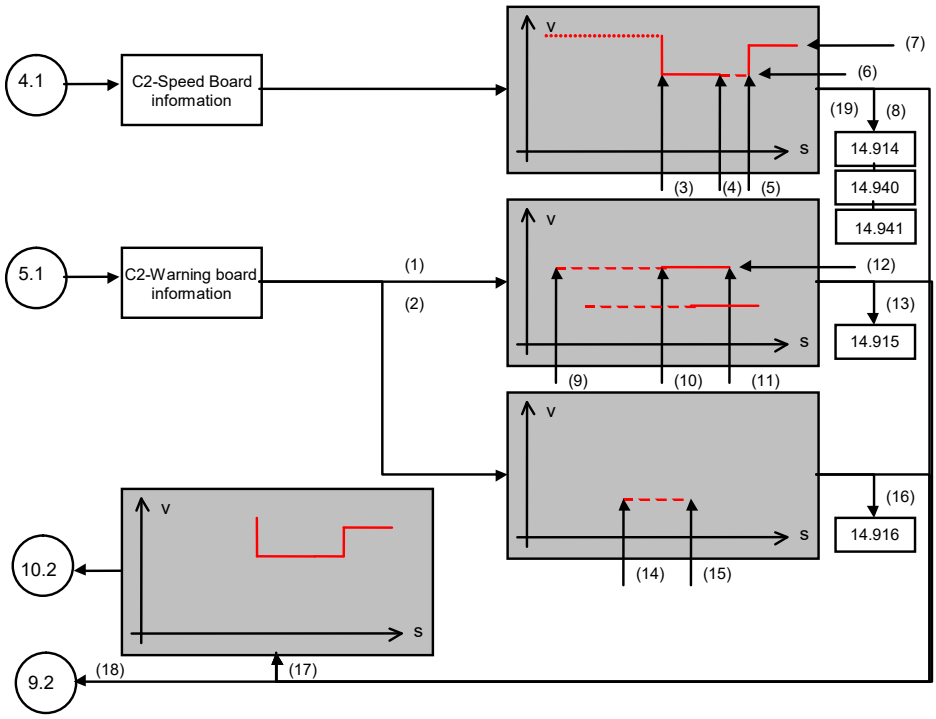


Figure 28/2. Processing of C2 - restriction

Note Enter with:
Restr type 1, 2 or 3 = C2 or C2c from warning board, or with

Restr type 1, 2, 3 or 4 = C2, C2c or C2e from speed board.

F 3296 **9.6.1**
R16-R17, R27-R28 or R36-R37 = 1A [Restr type 1, 2 or 3 = C2 in Wb].

F 3297 **9.6.2**
R16-R17, R27-R28 or R36-R37 = 27[Restr type 1, 2 or 3 = C2c in Wb].

F 3298 **9.6.3**
C2-Speed Board information:
R16-R17, R20-R21, R24-R25 or R28-R29 = 1A (C2-Speed Board information). Start of new C2-restriction. [Restr type 1, 2, 3 or 4 = C2 from Sb] OR
R16-R17, R20-R21, R24-R25 or R28-R29 = 2C (C2c-Speed Board information). Restriction given by Warning Board shall be cancelled by C2c Speed Board with out train length delay [Restr type 1, 2, 3 or 4 = C2c from Sb] if:

- Speed information from C2-Warning Board correspond to Speed information of C2c-Speed Board and
- C2c-Speed Board is located in target point of C2-Warning Board (+/-10% of target distance) and
- C2-restriction has not been started by C2-Speed Board

F 3299 **9.6.4**
R16-R17, R20-R21, R24-R25 or R28-R29 = 1C (C2e-Speed Board information, terminates the initiated C2-restriction according to rules in [F 6003].) [Restr type 1, 2, 3 or 4 = C2e].

F 3300 **9.6.5**
The C2-restriction ends after C2e-Speed Board is accepted according to rules in [F 6003] and train length delay.

F 3301 **9.6.6**
C2- Speed Board information R18-R19, R22-R23, R26-R27 or R30-R31 from [FRS Air Gap, Long Speed] [Speed restr 1, 2, 3 or 4], which is valid until it is the most restrictive C2-information and C2e-information is received, and during train length delay supervision when required. Speed of 'Not tilting train' = table value, speed of 'Tilting train' = table value x 1,25.

F 3302 **9.6.7**
C2e-information. Terminates the most restrictive C2-restriction initiated by
C2-Speed Board balise regardless of C2e-speed information (train length delay supervision).

F 3303 **9.6.8**
If R18-R19, R22-R23, R26-R27 or R30-R31 ≠ 12-8E
[Speed restr ≠ 5...555 km/h from Sb], then balise error14.914

If Speed board with same type but different speed than Warning board at target point of Warning board (+/-10 %), then balise error 14.940

F 3304 **9.6.9**
C2-Warning board information = balise location. If there have been another Warning board, which is aiming same restriction (type, speed and target point is same), latter Warning board is processed as a repeater.

F 3305 **9.6.10**
Start of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]) [Restr 1, 2 or 3 distance from Wb].

F 3306 **9.6.11**
End of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]) + (R23-R24, R34-R35 or R43-R44 from [FRS Air Gap, Long Distance]) [Restr 1, 2 or 3 distance + length from Wb].

Note If there is Speed Board information on start point of restriction (+/-10% of target distance) with same type and speed, 'length of restriction' -information of warning board is not used. End point of restriction is indicated by Speed Board balises.

F 3307 **9.6.12**
C2-information R18-R19, R29-R30 or R38-R39 from [FRS Air Gap, Long Speed] [Speed restr 1, 2 or 3 from Wb] Speed of 'Not tilting train' = table value, speed of 'Tilting train' = table value x 1,25.

F 3308 **9.6.13**
- R18-R19, R29-R30 or R38-R39 ≠ 12-8E [Speed restr 1, 2 or 3 = 5...555 km/h] OR
- R23-R24, R34-R35 or R43-R44 ≠ 11-EC [Restr length 1, 2 or 3 ≠ 5...11600 m] OR
R25-R26 ≠ 12-8E or EE, then balise error 14.915

F 3309 **9.6.14**
C2c-Warning Board information = balise location [Restr 1, 2 or 3 = C1c].

F 3310 **9.6.15**
C2-restriction, which starting point is located in +/- 10% tolerance of
C2c-speed restriction starting point and which have same speed information as C2c has, shall be cancelled. Start of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]).

F 3311 **9.6.16**
- R18-R19, R29-R30 or R38-R39 ≠ 12-8E [Speed restr 1, 2 or 3 = 5...555 km/h] OR

- R23-R24, R34-R35 or R43-R44 ≠ 11-EC [Restr length 1, 2 or 3 ≠ 5...11600 m].

F 3312 **9.6.17**
Speeds permitted by C2-restrictions shall be gathered and the most restrictive information to Braking curve calculation and maximum permitted speed supervision.

F 3313 **9.6.18**
If R16-R17 = 1A and R25-R26 ≠ EE then 'Speed after restriction' (R25-R26 from [FRS Air Gap, Long Speed]) is moved to M1-restriction supervision. [C2-restriction is Restriction 1 in Warning Board telegram and 'Speed after restriction' is given].

F 6003 **9.6.19**
If end of Sb controlled restriction of type C2 is received the following rule apply:

- Only End boards without speed (when one speed board stored) and with matching speed (both when one and several speed boards of the category stored) are accepted to end a stored restriction.
- Accepted End board ends all restrictions with same category and speed.

Balise error (14.941) appears if:
1) at least two speed boards of same category and different speeds are stored and end board of same category without speed is received, or
2) there is one or more speed board stored and end board of same category with speed is received and speed doesn't match to none of stored speed board.

9.7 Processing of LCP1 - restriction

F 3314

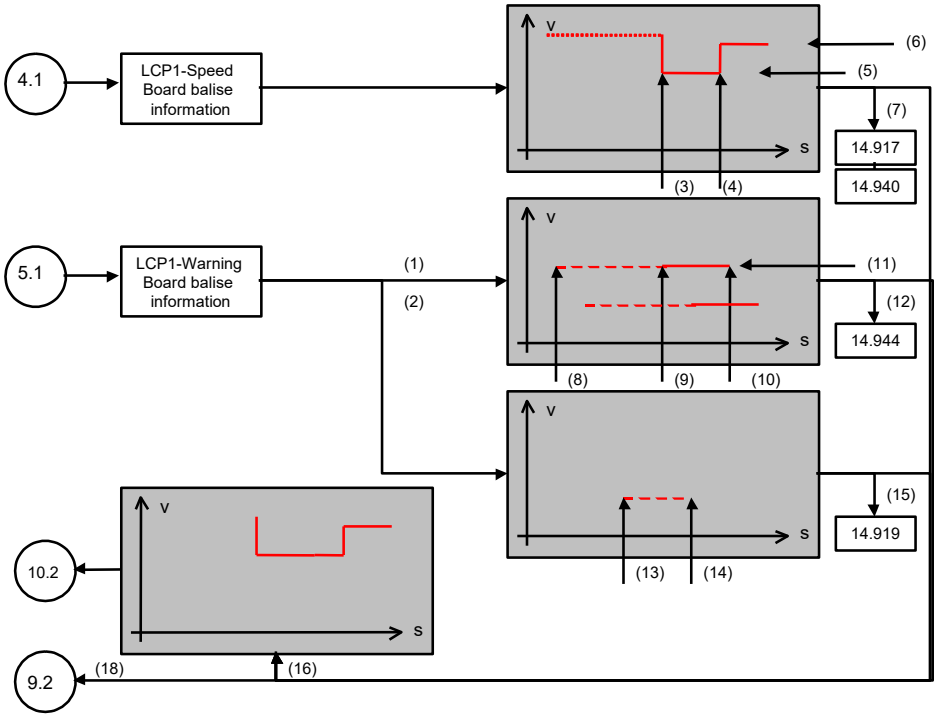


Figure 29/2. Processing of LCP1 - restriction

Note Enter with:
Restr type 1, 2 or 3 = LCP1 or LCP1c from warning board,
or with
Restr type 1, 2, 3 or 4 = LCP1, LCP1c or LCP1e from speed board.

F 3315 **9.7.1**
R16-R17, R27-R28 or R36-R37 = 1D[Restr type 1, 2 or 3 = LCP1 from Wb].

F 3316 **9.7.2**
R16-R17, R27-R28 or R36-R37 = 22 [Restr type 1, 2 or 3 = LCP1c from Wb].

F 3317 **9.7.3**
LCP1-Speed Board information:
R16-R17, R20-R21, R24-R25 or R28-R29 = 1D (LCP1-Speed Board information). Start of new LCP1-restriction. [Restr type 1, 2, 3 or 4 = LCP1 from Sb] OR
R16-R17, R20-R21, R24-R25 or R28-R29 = 22 (LCP1c-Speed Board information). Restriction given by Warning Board shall be cancelled by LCP1c Speed Board with out train length delay [Restr type 1, 2, 3 or 4 = LCP1c from Sb] if:

- Speed information from LCP1-Warning Board correspond to Speed information of LCP1c-Speed Board and
- LCP1c-Speed Board is located in target point of LCP1-Warning Board (+/-10% of target distance) and
- LCP1-restriction has not been started by LCP1-Speed Board

F 3318 **9.7.4**
R16-R17, R20-R21, R24-R25 or R28-R29 = 28 (LCP1e-Speed Board information, ends LCP1-restriction, no train length delay supervision) [Restr type 1, 2, 3 or 4 = LCP1e from Sb].

F 3319 **9.7.5**
LCP1- Speed Board information R18-R19, R22-R23, R26-R27 or R30-R31 from [FRS Air Gap, Long Speed] [Speed restr 1, 2, 3 or 4 from Sb], which is valid until LCP1e-information is received.

F 3320 **9.7.6**
LCP1e-information. Ends LCP1-restriction regardless of speed information [Restr type 1, 2, 3 or 4 = LCP1e from Sb].

F 3321 **9.7.7**
If R18-R19, R22-R23, R26-R27 or R30-R31 ≠ 12-8E [Speed restr 1, 2, 3 or 4 ≠ 5...555 km/h from Sb] OR
If new LCP1-information that is not related to the present LCP1- restriction is received before previous LCP1-restriction has ended, then balise error 14.917

F 3322 **9.7.8**
LCP1-Warning Board information = balise location. If there have been another Warning board, which is aiming same restriction (type, speed and target point is same), latter Warning board is processed as a repeater.

F 3323 **9.7.9**
Start of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]) [Restr 1, 2 or 3 distance].

F 3324 **9.7.10**
End of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]) + (R23-R24, R34-R35 or R43-R44 from [FRS Air Gap, Long Distance]) [Restr 1, 2 or 3 distance + length].

Note If there is Speed Board information on start point of restriction (+/- 10% of target distance) with same type and speed, 'length of restriction' -information of warning board is not used. End point of restriction is indicated by Speed Board balises.

F 3325 **9.7.11**
LCP1-information R18-R19, R29-R30 or R38-R39 from [FRS Air Gap, Long Speed] [Speed restr 1, 2 or 3].

F 3326 **9.7.12**
- R18-R19, R29-R30 or R38-R39 ≠ 12-8E [Speed restr 1, 2 or 3 = 5...555 km/h] OR
- R23-R24, R34-R35 or R43-R44 ≠ 11-EC [Restr length 1, 2 or 3 ≠ 5...11600 m] OR
- R16-R17 = 1D or 22 and R25-R26 ≠ EE [Rest. type = LCP1 and Speed after restriction 1 ≠ Cancelled]

- New LCP1-information that is not related to the present LCP1- restriction is received before previous LCP1 has ended.

F 3327 **9.7.13**
LCP1c-Warning Board information = balise location.

F 3328 **9.7.14**
LCP1-restriction, which starting point is located in +/- 10% tolerance of
LCP1c-speed restriction starting point and which have same speed information as LCP1c has, shall be cancelled. Start of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]).

F 3329 **9.7.15**
- R18-R19, R29-R30 or R38-R39 ≠ 12-8E [Speed restr 1, 2 or 3 = 5...555 km/h] OR
- R23-R24, R34-R35 or R43-R44 ≠ 11-EC [Restr length 1, 2 or 3 ≠ 5...11600 m].

F3330 **9.7.16**
Speeds permitted by LCP1-restrictions shall be gathered and the most restrictive information to Braking curve calculation and maximum permitted speed supervision

9.8 Processing of LCP2 - restriction

F 3331

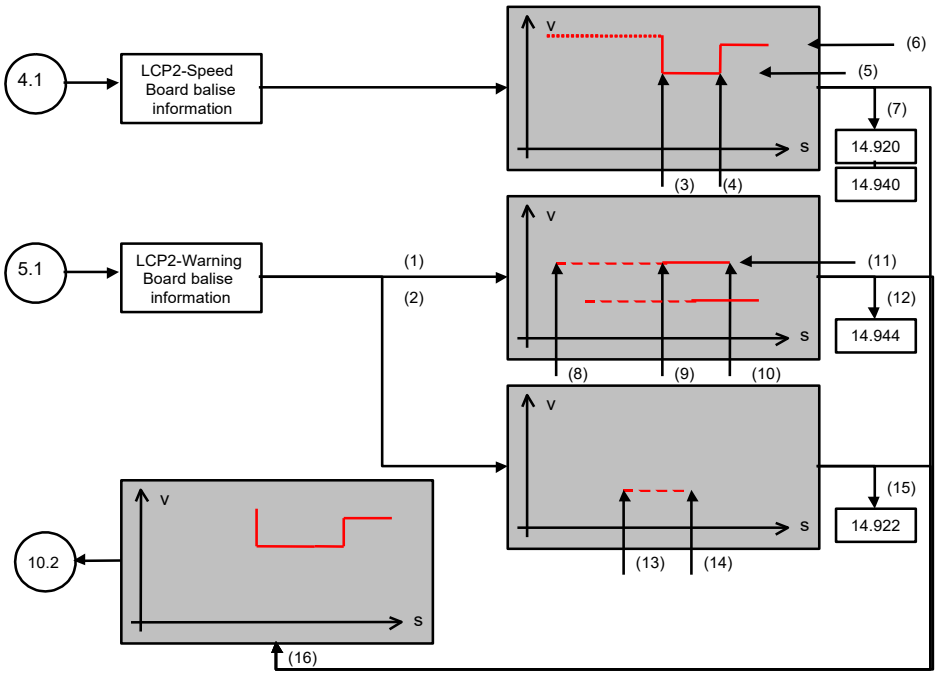


Figure 30/2. Processing of LCP2 - restriction

Note Enter with:

Restr type 1, 2 or 3 = LCP2 or LCP2c from warning board, or with Restr type 1, 2, 3 or 4 = LCP2, LCP2c or LCP2e from speed board.

F 3332 **9.8.1**
R16-R17, R27-R28 or R36-R37 = 1E [Restr type 1, 2 or 3 = LCP2 from Wb].

F 3333 **9.8.2**
R16-R17, R27-R28 or R36-R37 = 23 [Restr type 1, 2 or 3 = LCP2c from Wb].

F 3334 **9.8.3**
LCP2-Speed Board information:
R16-R17, R20-R21, R24-R25 or R28-R29 = 1E (LCP2-Speed Board information). Start of new LCP2-restriction. [Restr type 1, 2, 3 or 4 = LCP2 from Sb] OR
R16-R17, R20-R21, R24-R25 or R28-R29 = 23 (LCP2c-Speed Board information). Restriction given by Warning Board shall be cancelled by LCP2c Speed Board with out train length delay [Restr type 1, 2, 3 or 4 = LCP2c from Sb] if:

- Speed information from LCP2-Warning Board correspond to Speed information of LCP2c-Speed Board and
- LCP2c-Speed Board is located in target point of LCP2-Warning Board (+/-10% of target distance) and
- LCP2-restriction has not been started by LCP2-Speed Board

F 3335 **9.8.4**
R16-R17, R20-R21, R24-R25 or R28-R29 = 29 (LCP2e- Speed Board information, ends LCP2-restriction, no train length delay supervision) [Restr type 1, 2, 3 or 4 = LCP2e from Sb].

F 3336 **9.8.5**
LCP2- Speed Board information R18-R19, R22-R23, R26-R27 or R30-R31 from [FRS Air Gap, Long Speed], which is valid until LCP2e-information is received. [Speed restr 1, 2, 3 or 4 from Sb].

F 3337 **9.8.6**
LCP2e-information. Ends LCP2-restriction regardless of speed information [Restr type 1, 2, 3 or 4 = LCP2e from Sb].

F 3338 **9.8.7**
If R18-R19, R22-R23, R26-R27 or R30-R31 ≠ 12-8E [Speed restr 1, 2, 3 or 4 ≠ 5...555 km/h from Sb] OR
If new LCP2-information that is not related to the present LCP2- restriction is received before previous LCP2-restriction has ended, then balise error 14.920

F 3339 **9.8.8**
LCP2-Warning Board information = balise location. If there have been another Warning board, which is aiming same restriction (type, speed and target point is same), latter Warning board is processed as a repeater.

F 3340 **9.8.9**
Start of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]) [Restr 1, 2 or 3 distance].

F 3341 **9.8.10**
End of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]) + (R23-R24, R34-R35 or R43-R44 from [FRS Air Gap, Long Distance]) [Restr 1, 2 or 3 distance + length].

Note If there is Speed Board information on start point of restriction (+/- 10% of target distance) with same type and speed, 'length of restriction' -information of warning board is not used. End point of restriction is indicated by Speed Board balises.

F 3342 **9.8.11**
LCP2-information R18-R19, R29-R30 or R38-R39 from [FRS Air Gap, Long Speed] [Speed restr 1, 2 or 3].

F 3343 **9.8.12**
- R18-R19, R29-R30 or R38-R39 ≠ 12-8E [Speed restr 1, 2 or 3 = 5...555 km/h] OR
- R23-R24, R34-R35 or R43-R44 ≠ 11-EC [Restr length 1, 2 or 3 ≠ 5...11600 m] OR
- R16-R17 = 1E or 22 and R25-R26 ≠ EE [Rest. type = LCP2 and Speed after restriction 1 ≠ Cancelled]
-New LCP2-information that is not related to the present LCP2- restriction is received before previous LCP2 has ended.

F 3344 **9.8.13**
LCP2c-Warning Board information = balise location.

F 3345 **9.8.14**
LCP2-restriction, which starting point is located in +/- 10% tolerance of LCP2c-speed restriction starting point and which have same speed information as LCP2c has, shall be cancelled. Start of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]).

F 3346 **9.8.15**
- R18-R19, R29-R30 or R38-R39 ≠ 12-8E [Speed restr 1, 2 or 3 = 5...555 km/h] OR
- R23-R24, R34-R35 or R43-R44 ≠ 11-EC [Restr length 1, 2 or 3 ≠ 5...11600 m].

F 3347 **9.8.16**
Speeds permitted by LCP2-restrictions shall be gathered and the most restrictive information to Braking curve calculation and maximum permitted speed supervision

9.9 Processing of LCP3 - restriction

F 3348

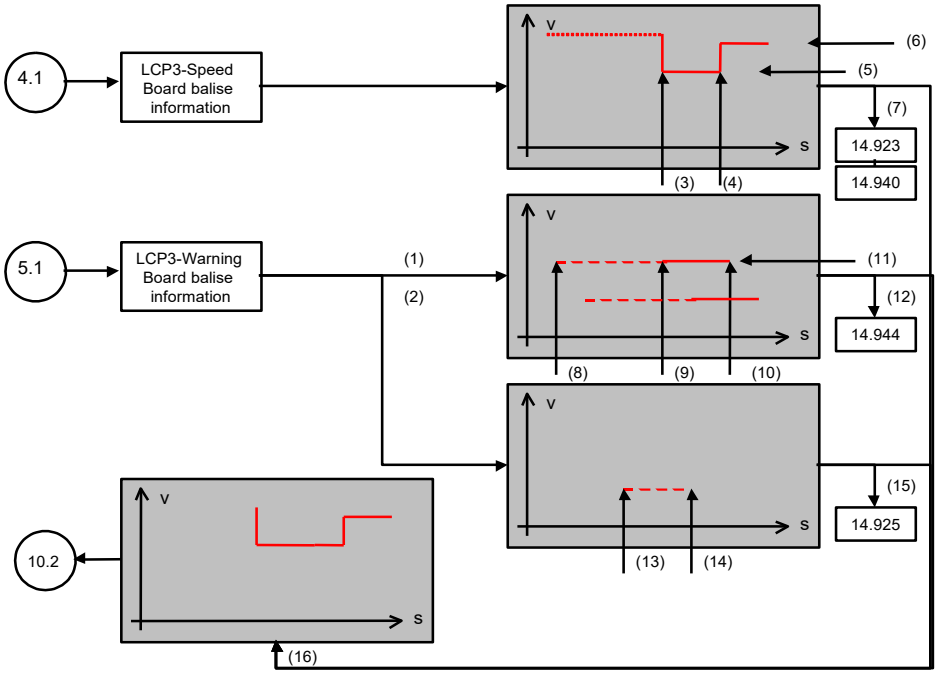


Figure 31/2. Processing of LCP3 - restriction

Note Enter with:
Restr type 1, 2 or 3 = LCP3 or LCP3c from warning board, or with
Restr type 1, 2, 3 or 4 = LCP3, LCP3c or LCP3e from speed board

F 3349 **9.9.1**
R16-R17, R27-R28 or R36-R37 = 21 [Restr type 1, 2 or 3 = LCP3 from Wb].

F 3350 **9.9.2**
R16-R17, R27-R28 or R36-R37 = 24 [Restr type 1, 2 or 3 = LCP3c from Wb].

F 3351 **9.9.3**
LCP3-Speed Board information:
R16-R17, R20-R21, R24-R25 or R28-R29 = 21 (LCP3-Speed Board information). Start of new LCP3-restriction. [Restr type 1, 2, 3 or 4 = LCP3 from Sb] OR
R16-R17, R20-R21, R24-R25 or R28-R29 = 24 (LCP3c-Speed Board information). Restriction given by Warning Board shall be cancelled by LCP3c Speed Board with out train length delay [Restr type 1, 2, 3 or 4 = LCP3c from Sb] if:

- Speed information from LCP3-Warning Board correspond to Speed information of LCP3c-Speed Board and
- LCP3c-Speed Board is located in target point of LCP3-Warning Board (+/-10% of target distance) and
- LCP3-restriction has not been started by LCP3-Speed Board

F 3352 **9.9.4**

R16-R17, R20-R21, R24-R25 or R28-R29 = 2A (LCP3e-Speed Board information, ends LCP3-restriction, no train length delay supervision) [Restr type 1, 2, 3 or 4 = LCP3e from Sb].

F 3353 **9.9.5**
LCP3- Speed Board information R18-R19, R22-R23, R26-R27 or R30-R31 from [FRS Air Gap, Long Speed], which is valid until LCP3e-information is received. [Speed restr 1, 2, 3 or 4 from Sb].

F 3354 **9.9.6**
LCP3e-information. Ends LCP3-restriction regardless of speed information.

F 3355 **9.9.7**
If R18-R19, R22-R23, R26-R27 or R30-R31 ≠ 12-8E [Speed restr 1, 2, 3 or 4 ≠ 5...555 km/h from Sb] OR
If new LCP3-information that is not related to the present LCP3- restriction is received before previous LCP3-restriction has ended, then balise error 14.923

F 3356 **9.9.8**
LCP3-Warning Board information = balise location. If there have been another Warning board, which is aiming same restriction (type, speed and target point is same), latter Warning board is processed as a repeater.

F 3357 **9.9.9**
Start of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]) [Restr 1, 2 or 3 distance].

F 3358 **9.9.10**
End of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]) + (R23-R24, R34-R35 or R43-R44 from [FRS Air Gap, Long Distance]) [Restr 1, 2 or 3 distance + length].

Note If there is Speed Board information on start point of restriction (+/- 10% of target distance) with same type and speed, 'length of restriction' -information of warning board is not used. End point of restriction is indicated by Speed Board balises.

F 3359 **9.9.11**
LCP3-information R18-R19, R29-R30 or R38-R39 from [FRS Air Gap, Long Speed] [Speed restr 1, 2 or 3].

F 3360 **9.9.12**
- R18-R19, R29-R30 or R38-R39 ≠ 12-8E [Speed restr 1, 2 or 3 = 5...555 km/h] OR
- R23-R24, R34-R35 or R43-R44 ≠ 11-EC [Restr length 1, 2 or 3 ≠ 5...11600 m] OR
- R16-R17 = 21 or 24 and R25-R26 ≠ EE [Rest. type = LCP3 and Speed after restriction 1 ≠ Cancelled]

- New LCP3-information that is not related to the present LCP3- restriction is received before previous LCP3 has ended.

F 3361 **9.9.13**
LCP3c-Warning Board information = balise location.

F 3362 **9.9.14**
LCP3-restriction, which starting point is located in +/- 10% tolerance of LCP3c-speed restriction starting point and which have same speed information as LCP3c has, shall be cancelled. Start of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]).

F 3363 **9.9.15**
- R18-R19, R29-R30 or R38-R39 ≠ 12-8E [Speed restr 1, 2 or 3 = 5...555 km/h] OR
- R23-R24, R34-R35 or R43-R44 ≠ 11-EC [Restr length 1, 2 or 3 ≠ 5...11600 m].

F 3364 **9.9.16**
Speeds permitted by LCP3-restrictions shall be gathered and the most restrictive information to Braking curve calculation and maximum permitted speed supervision

9.10 Processing of LZ - restriction

F 3365

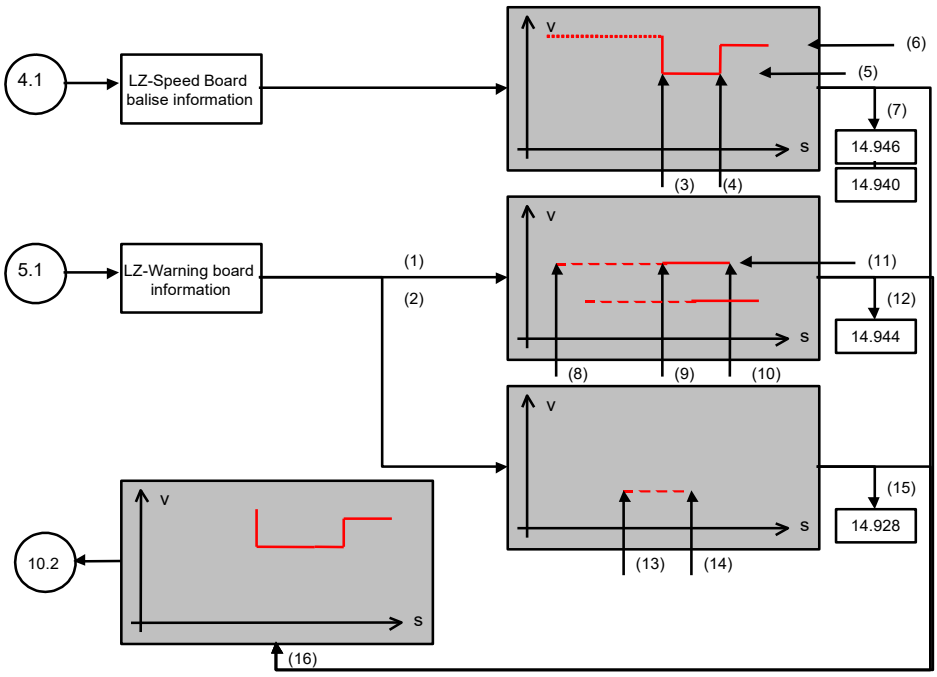


Figure 32/2. Processing of LZ - restriction

Note Enter with:
Restr type 1, 2 or 3 = LZ or LZc from warning board, or with Restr type 1, 2, 3 or 4 = LZ, LZc or LZe from speed board.

F 3366 **9.10.1**
R16-R17, R27-R28 or R36-R37 = 33 [Restr type 1, 2 or 3 = LZ from Wb].

F 3367 **9.10.2**
R16-R17, R27-R28 or R36-R37 = 34 [Restr type 1, 2 or 3 = LZc from Wb].

F 3368 **9.10.3**
LZ-Speed Board information:
R16-R17, R20-R21, R24-R25 or R28-R29 = 33 (LZ-Speed Board information). Start of new LZ-restriction. [Restr type 1, 2, 3 or 4 = LZ from Sb] OR
R16-R17, R20-R21, R24-R25 or R28-R29 = 34 (LZc-Speed Board information). Restriction given by Warning Board shall be cancelled by LZc Speed Board with out train length delay [Restr type 1, 2, 3 or 4 = LZc from Sb] if:

- Speed information from LZ-Warning Board correspond to Speed information of LZc-Speed Board and
- LZc-Speed Board is located in target point of LZ-Warning Board (+/-10% of target distance) and
- LZ-restriction has not been started by LZ-Speed Board

F 3369 **9.10.4**
R16-R17, R20-R21, R24-R25 or R28-R29 = 35 (LZe-Speed Board information, ends LZ-restriction, no train length delay supervision) [Restr type 1, 2, 3 or 4 = LZe from Sb].

F 3370 **9.10.5**
LZ- Speed Board information R18-R19, R22-R23, R26-R27 or R30-R31 from [FRS Air Gap, Long Speed], which is valid until LZe-information is received [Speed restr 1, 2, 3 or 4].

F 3371 **9.10.6**
LZe-information [Restr type 1, 2, 3 or 4 = LZe from Sb] Ends LZ-restriction regardless of speed information.

F 3372 **9.10.7**
If R18-R19, R22-R23, R26-R27 or R30-R31 $\neq$ 12-8E
[Speed restr 1, 2, 3 or 4 = 5...555 km/h from Sb] OR
If new LZ-information that is not related to the present LZ- restriction is received before previous LZ-restriction has ended, then balise error 14.926
If Speed board with same type but different speed than Warning board at target point of Warning board (+/-10 %), then balise error 14.940

F 3373 **9.10.8**
LZ-Warning Board information = balise location
[Restr type 1, 2 or 3 = LZ from Wb]. If there have been another Warning board, which is aiming same restriction (type, speed and

target point is same), latter Warning board is processed as a repeater.

F 3374 **9.10.9**
Start of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]) [Restr 1, 2 or 3 distance].

F 3375 **9.10.10**
End of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]) + (R23-R24, R34-R35 or R43-R44 from [FRS Air Gap, Long Distance]). [Restr 1, 2 or 3 distance + length].

F 3376 **9.10.11**
LZ-information R18-R19, R29-R30 or R38-R39 from [FRS Air Gap, Long Speed].

F 3532 **9.10.12**
- R18-R19, R29-R30 or R38-R39 ≠ 12-8E [Speed restr 1, 2 or 3 ≠ 5...555 km/h] OR
- R23-R24, R34-R35 or R43-R44 ≠ 11-EC [Restr length 1, 2 or 3 ≠ 5...11600 m] OR
- R16-R17 = 33 or 34 and R25-R26 ≠ EE [Rest. type = LZ and Speed after restriction 1 ≠ Cancelled] OR
- New LZ-information that is not related to the present LZ- restriction is received before previous LZ has ended OR
- Lack of Speed Board during the target distance (+/- 10%)

F 3377 **9.10.13**
LZc-Warning Board information = balise location.

F 3378 **9.10.14**
LZ-restriction, which starting point is located in +/- 10% tolerance of LZ-speed restriction starting point and which have same speed information as LZ has, shall be cancelled. Start of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]).

F 3379 **9.10.15**
- R18-R19, R29-R30 or R38-R39 ≠ 12-8E
[Speed restr 1, 2 or 3 = 5...555 km/h] OR
- R23-R24, R34-R35 or R43-R44 ≠ 11-EC
[Restr length 1, 2 or 3 ≠ 5...11600 m].

F 3380 **9.10.16**
Speeds permitted by LZ-restrictions shall be gathered and the most restrictive information to Braking curve calculation and maximum permitted speed supervision.

9.11 Processing of BUA - restriction

F 3381

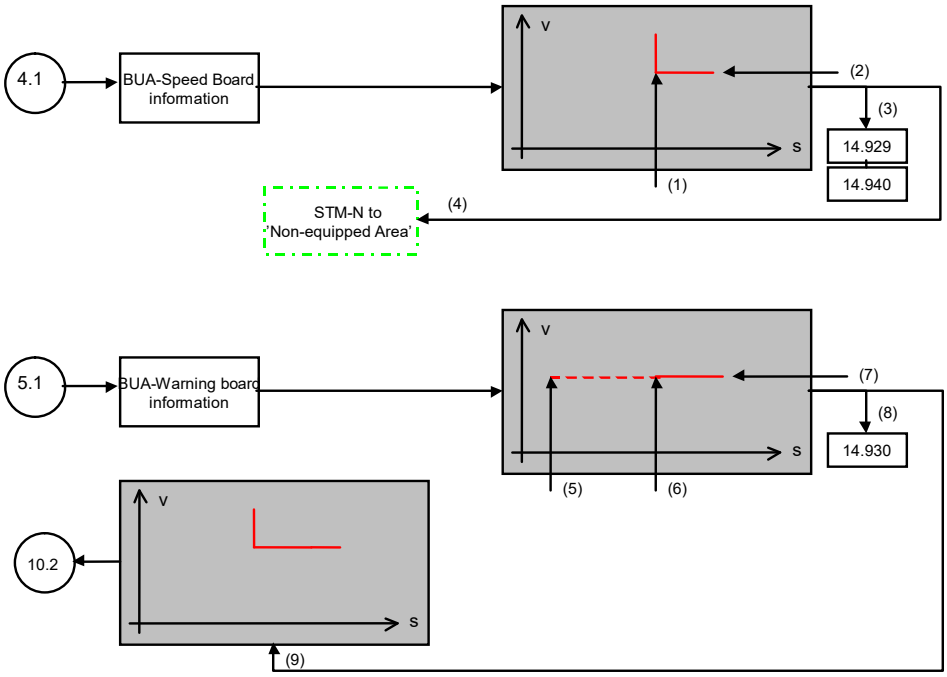


Figure 33/2. Processing of BUA - restriction

Note — Enter with:
Restr type 1, 2 or 3 = BUA from warning board, or with Restr type 1 = BUA from speed board.

F 3382 **9.11.1**
BUA-Speed Board information, start point of restriction = balise location. [Restr type 1 = BUA from Sb].

F 3383 **9.11.2**
BUA- Speed Board information, R18-R19 from [FRS Air Gap, Long Speed] [Speed restr 1], which is valid while STM is in "Non-equipped Area".

F 3384 **9.11.3**
If R18-R19 ≠ 12-8E [Speed restr 1 = 0…555 km/h], then balise error 14.929
If Speed board with same type but different speed than Warning board at target point of Warning board (+/-10 %), then balise error 14.940

F 3385 **9.11.4**
STM transfers to "Non-equipped Area". All restrictions excepting BUA-speed restriction shall be terminated without train length delay supervision. Restrictions caused by balise errors shall be terminated.

F 3386 **9.11.5**
BUA-Warning board information = balise location [Restr type 1 = BUA from Wb]. If there have been another Warning board, which is aiming same restriction (type, speed and target point is same), latter Warning board is processed as a repeater.

F 3387 **9.11.6**
Start of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]) [Restr type 1, 2 or 3 = BUA from Wb].

F 3388 **9.11.7**
BUA-information R18-R19, R29-R30 or R38-R39 from [FRS Air Gap, Long Speed] [Speed restr 1, 2 or 3 = 5...555 km/h].

F 3389 **9.11.8**
- R18-R19, R29-R30 or R38-R39 ≠ 12-8E [Speed restr 1, 2 or 3 = 5...555 km/h] OR
- R16-R17 = 37 and R25-R26 ≠ EE [Rest. type = BUA and Speed after restriction 1 ≠ Cancelled] OR
- Lack of Speed Board during the target distance (+/- 10%)

F 3390 **9.11.9**
Speeds permitted by BUA-restrictions shall be gathered and the most restrictive information to Braking curve calculation and maximum permitted speed supervision.

9.12 Processing of BCA-restriction

F 3391

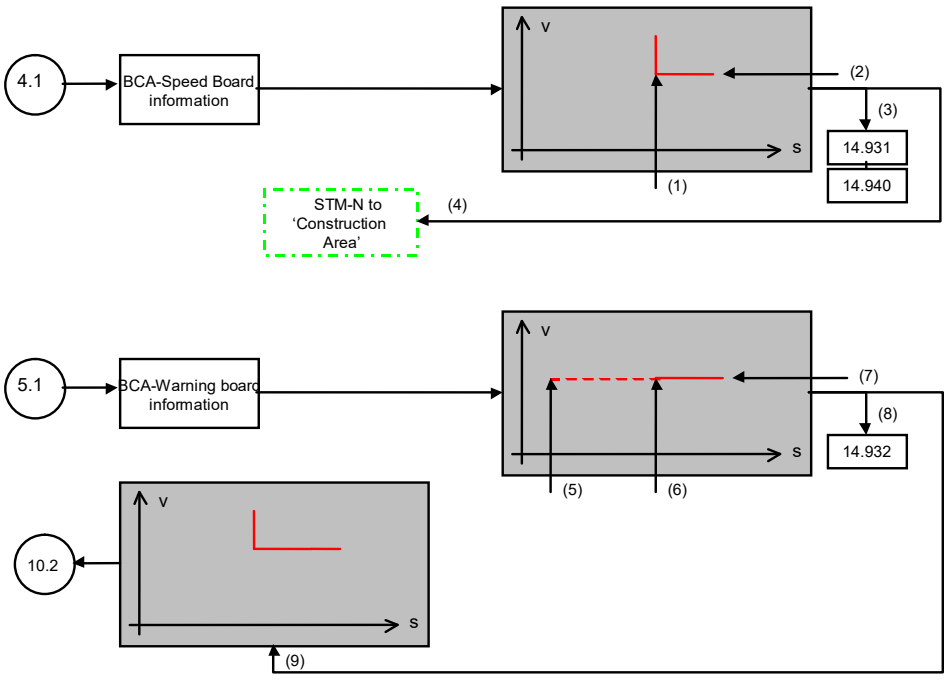


Figure 34/2. Processing of BCA - restriction

Note Enter with:
Restr type 1, 2 or 3 = BCA from warning board, or with
Restr type 1 = BCA or BCAe from speed board.

F 3392 **9.12.1**
BCA-Speed Board information, start point of restriction = balise location.

F 3393 **9.12.2**
BCA- Speed Board information, R18-R19 from [FRS Air Gap, Long Speed] [Restr type 1 = BCA from Sb], which is valid while STM is in "ATP Construction Area".

F 3394 **9.12.3**
If R18-R19 ≠ 12-8E[Speed restr 1 ≠ 5...555 km/h from Sb], then balise error 14.931
If Speed board with same type but different speed than Warning board at target point of Warning board (+/-10 %), then balise error 14.940

F 3395 **9.12.4**
STM transfers to "ATP Construction Area". All restrictions excepting BCA-speed restriction shall be terminated without train length delay supervision. Restrictions caused by balise errors shall be terminated.

F 3396 **9.12.5**
BCA-Warning Board information = balise location. If there have been another Warning board, which is aiming same restriction (type, speed and target point is same), latter Warning board is processed as a repeater.

F 3397 **9.12.6**
Start of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]).

F 3398 **9.12.7**
BCA-information R18-R19, R29-R30 or R38-R39 from [FRS Air Gap, Long Speed].

F 3399 **9.12.8**
- R18-R19, R29-R30 or R38-R39 ≠ 12-8E [Speed restr 1, 2 or 3 = 5...555 km/h] OR
- R16-R17 = 38 and R25-R26 ≠ EE [Rest. type = BCA and Speed after restriction 1 ≠ Cancelled] OR
- Lack of Speed Board during the target distance (+/- 10%)

F 3400 **9.12.9**
Speeds permitted by BCA-restrictions shall be gathered and the most restrictive information to Braking curve calculation and maximum permitted speed supervision.

9.13 Processing of BOC-restriction

F 3401

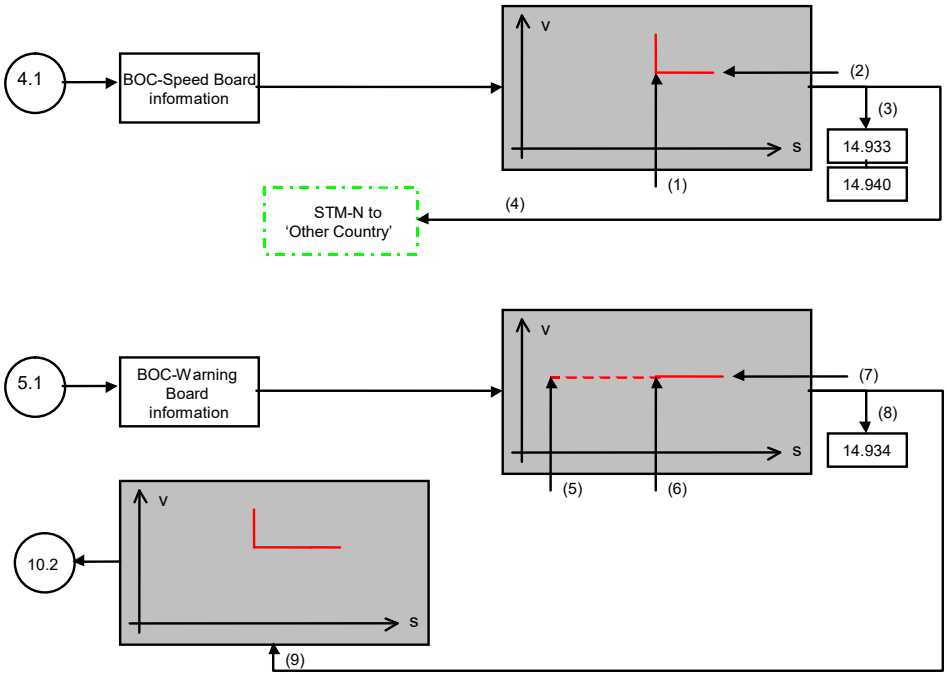


Figure 35/2. Processing of BOC - restriction

Note Enter with:
Restr type 1, 2 or 3 = BOC from warning board, or with
Restr type 1 = BOC or BHC from speed board.

F 3402 **9.13.1**
BOC-Speed Board information, start point of restriction = balise location.

F 3403 **9.13.2**
BOC- Speed Board information, R18-R19 from [FRS Air Gap, Long Speed] [Restr type 1 = BOC from Sb], which is valid while STM is in "ATP Other Country Area".

F 3404 **9.13.3**
If R18-R19 ≠ EE [Speed restr 1 ≠ 5...555 km/h from Sb], then balise error 14.933
If Speed board with same type but different speed than Warning board at target point of Warning board (+/-10 %), then balise error 14.940

F 3405 **9.13.4**
STM transfers to "Other Country Area". All restrictions excepting BOC-speed restriction shall be terminated without train length delay supervision. Restrictions caused by balise errors shall be terminated.

F 3406 **9.13.5**
BOC-Warning Board information = balise location [Restr type 1, 2 or 3 = BCA]. If there have been another Warning board, which is aiming same restriction (type, speed and target point is same), latter Warning board is processed as a repeater.

F 3407 **9.13.6**
Start of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]) [Restr type 1, 2 or 3 = BCA from Wb].

F 3408 **9.13.7**
BOC-information R18-R19, R29-R30 or R38-R39 from [FRS Air Gap, Long Speed] [Speed restr 1, 2 or 3 from Wb].

F 3409 **9.13.8**
- R18-R19, R29-R30 or R38-R39 ≠ 12-8E [Speed restr 1, 2 or 3 = 5...555 km/h] OR
- R16-R17 = 3A and R25-R26 ≠ EE [Rest. type = BOC and Speed after restriction 1 ≠ Cancelled] OR
- Lack of Speed Board during the target distance (+/- 10%)

F 3410 **9.13.9**
Speeds permitted by BOC-restrictions shall be gathered and the most restrictive information to Braking curve calculation and maximum permitted speed supervision.

9.14 Processing of TRSw-restriction

F 3411

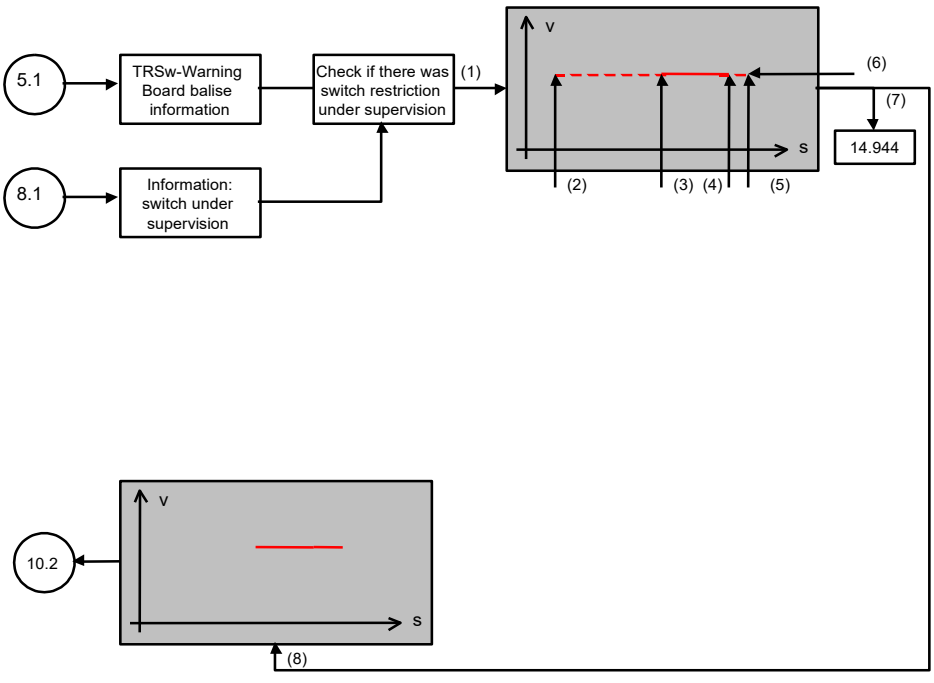


Figure 36/2. Processing of TRSw - restriction

Note Enter with:
Restr type 1, 2 or 3 = TRSw from warning board.

F 3412 **9.14.1**
A TRSw -restriction is valid when a target position of a switch restriction is located within the target distance (+10%) of the TRSw. The switch restriction can be received before or after the TRSw is received. Valid TRSw-restriction shall be supervised even though switch information would be terminated during the target distance.

F 3413 **9.14.2**
TRSw -Warning Board information = balise location
[Restr type 1, 2 or 3 = TRSw]. If there have been another Warning board, which is aiming same restriction (type, speed and target point is same), latter Warning board is processed as a repeater.

F 3414 **9.14.3**
Start of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]) [Restr type 1, 2 or 3 = TRSw]

F 3415 **9.14.4**
End of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]) + (R23-R24, R34-R35 or R43-R44 from [FRS Air Gap, Long Distance]).

F 3416 **9.14.5**
Speed permitted by TRSw-restriction shall become affective after train length delay.

F 3417 **9.14.6**
TRSw-information R18-R19, R29-R30 or R38-R39 from [FRS Air Gap, Long Speed].

F 3418 **9.14.7**
If:
- R18-R19, R29-R30 or R38-R39 ≠ 12-8E [Speed restr 1, 2 or 3 = 5...555 km/h] OR
- R23-R24, R34-R35 or R43-R44 ≠ 11-EC [Restr length 1, 2 or 3 ≠ 5...11600 m] OR
- R16-R17 = B1 and R25-R26 ≠ EE [Rest. type = TRSw and Speed after restriction 1 ≠ Cancelled] OR
- Warning board of some other TRSw-restriction is located on the target distance of TRSw (if speed and type are identical and start of the restriction is located in +/- 10% tolerance of the speed restriction, Warning boards repeat the previous information and trigger no failure) then balise error 14.944

F 3419 **9.14.8**
Speeds permitted by TRSw-restrictions shall be gathered and the most restrictive information to Braking curve calculation and maximum permitted speed supervision.

9.15 Processing of TRSt - restriction

F 3420

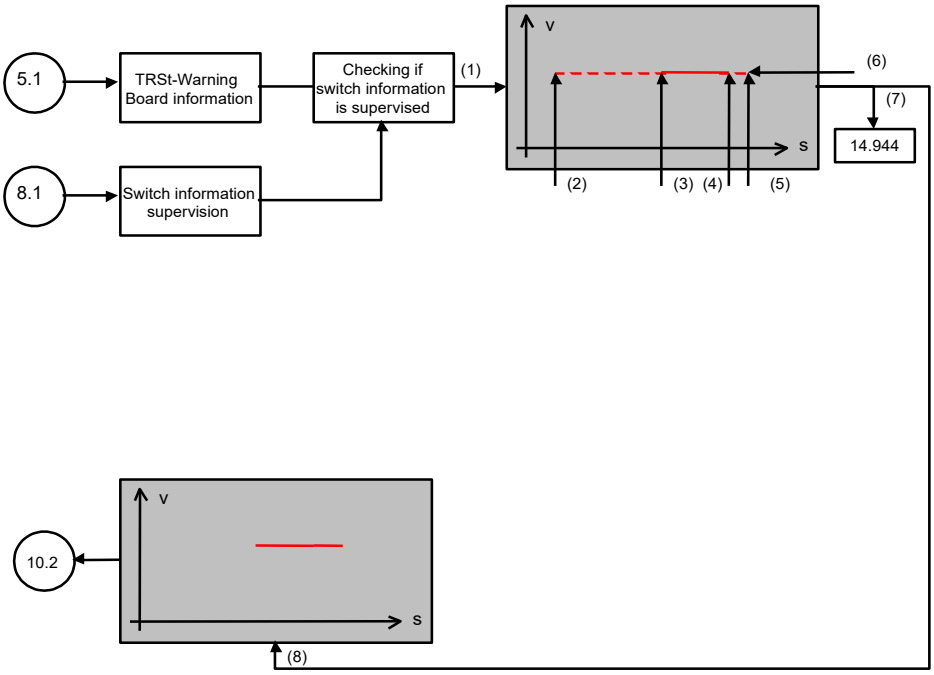


Figure 37/2. Processing of TRSt - restriction

Note Enter with: Restr type 1, 2 or 3 = TRSt from warning board.

F 3421 **9.15.1**
A TRSt -restriction is valid if no start point of a swich restriction is located within the target distance +10% of the TRSt. This evaluation shall be made at the reception of the TRSt restriction. Valid TRSt-restriction shall be supervised even though there would come switch information during the target distance.

F 3422 **9.15.2**
TRS -Warning Board information = balise location
[Restr type 1, 2 or 3 = TRSt]. If there have been another Warning board, which is aiming same restriction (type, speed and target point is same), latter Warning board is processed as a repeater.

F 3423 **9.15.3**
Start of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]) [Restr type 1, 2 or 3 = TRSt].

F 3424 **9.15.4**
End of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]) + (R23-R24, R34-R35 or R43-R44 from [FRS Air Gap, Long Distance]).

F 3425 **9.15.5**

Speed permitted by TRSt-restriction shall become affective after train length delay.

F 3426 **9.15.6**
TRSt-information R18-R19, R29-R30 or R38-R39 from [FRS Air Gap, Long Speed].

F 3427 **9.15.7**
- R18-R19, R29-R30 or R38-R39 ≠ 12-8E [Speed restr 1, 2 or 3 ≠ 5...555 km/h] OR
- R23-R24, R34-R35 or R43-R44 ≠ 11-EC [Restr length 1, 2 or 3 ≠ 5...11600 m] OR
- R16-R17 = B2 and R25-R26 ≠ EE [Rest. type = TRSt and Speed after restriction 1 ≠ Cancelled] OR
- Warning board of some other TRSt-restriction is located on the target distance of TRSt (if speed and type are identical and start of the restriction is located in +/- 10% tolerance of the speed restriction, Warning boards repeat the previous information and trigger no failure)
Then balise error 14.944.

F 3428 **9.15.8**
Speeds permitted by TRSw-restrictions shall be gathered and the most restrictive information to Braking curve calculation and maximum permitted speed supervision.

9.16 Processing of TS1...TS15 - restriction (PT-code)

F 3429 Digits (bits) of the PT-code shall form the speed restrictions:

1st number			2nd number			3rd number			4th number			5th number		
i15	i14	i13	i12	i11	i10	i9	i8	i7	i6	i5	i4	i3	i2	i1
TS15	TS14	TS13	TS12	TS11	TS10	TS9	TS8	TS7	TS6	TS5	TS4	TS3	TS2	TS1

Note Example: If PT-code is 26310, are digits i14, i12, i11, i8, i7 and i4 ones (bit 1). Thus, restrictions TS4, TS7, TS8, TS11, TS12 and TS14 shall be supervised.

F 3430 Values corresponding to TS-restriction are:

	TS 1	TS 2	TS 3	TS 4	TS 5	TS 6	TS 7	TS 8	TS 9	TS 10	TS 11	TS 12	TS 13	TS 14	TS 15
TS	91	92	93	94	95	96	97	98	99	C1	C2	C3	C4	C5	C6
TSe	A5	A6	A7	A8	A9	AA	AB	AC	AD	CD	CE	D1	D2	D3	D4
TSc	9A	9B	9C	9D	9E	A1	A2	A3	A4	C7	C8	C9	CA	CB	CC

F 3431 All TS-restrictions shall be processed as single speed restriction irrespective of different combinations valid for the train.

Note If bit1 in PT-code of the train is active:
- All deltaV restrictions and TS1 restrictions shall be supervised

- ETCS-maximum speed = speed entered by driver + 10 km/h
- An extra restriction (= entered speed) is set to active and processed in braking curve and max speed supervision
- The extra restriction is cancelled while train is in deltaV-restriction area (information given by balises) See also [Chapter 9.1]

F 3432

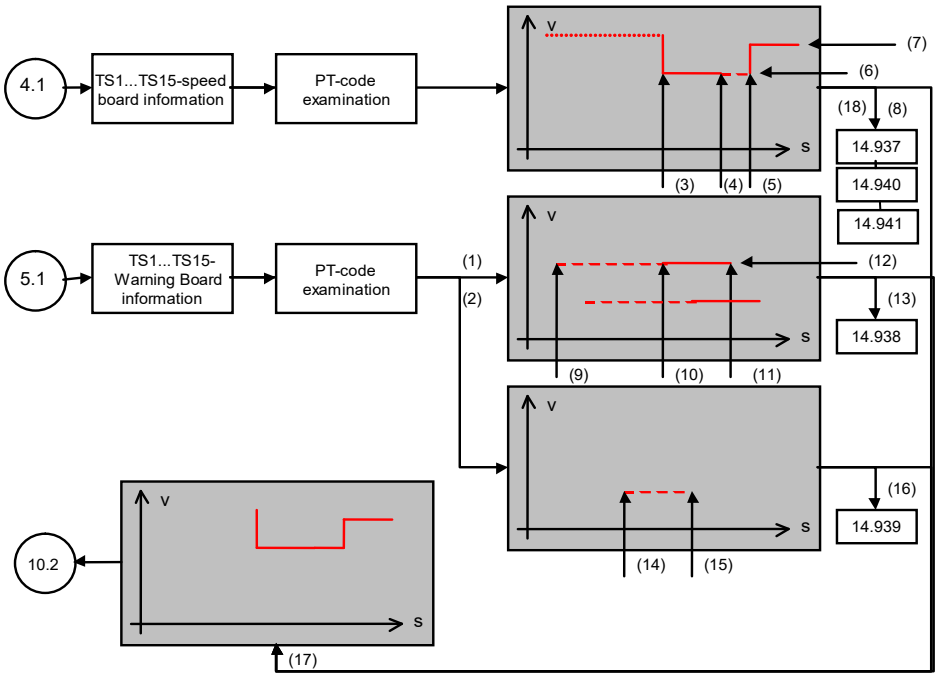


Figure 38/2. Processing of TS1…TS15 - restriction (PT-code)

Note Enter with:
Restr type 1, 2 or 3 = TS1...TS15 or TS1c...TS15c from warning board, or with
Restr type 1, 2, 3 or 4 = TS1...TS15, TS1c...TS15c or TS1e...TS15e from speed board

F 3433 **9.16.1**
R16-R17, R27-R28 or R36-R37 = 91-99 or C1-C6
[Restr type 1, 2 or 3 = TS1…TS15 from Wb].

F 3434 **9.16.2**
R16-R17, R27-R28 or R36-R37 = 9A-A4 or C7-CC
[Restr type 1, 2 or 3 = TS1c....TS15c from Wb].

F 3435 **9.16.3**
TS1...TS15-Speed Board information:
R16-R17, R20-R21, R24-R25 or R28-R29 = 91-99 or C1-C6
(TS1...TS15-Speed Board information) Start of new TS1...TS15-restriction [Restr type 1, 2, 3 or 4 = TS1...TS15 from Sb] OR

R16-R17, R20-R21, R24-R25 or R28-R29 = 9A-A4 or C7-CC (TS1c...TS15c-Speed Board information) Restriction given by Warning Board shall be cancelled by TS1c...TS15c Speed Board with out train length delay [Restr type 1, 2, 3 or 4 = TS1c...TS15c from Sb]
If:
Speed information from TS1...TS15-Warning Board corresponds to Speed information of TS1c...TS15c-Speed Board AND
TS1c...TS15c-Speed Board is located in target point of TS1...TS15-Warning Board (+/-10% of target distance) AND
TS1...TS15-restriction has not been started by TS1...TS15-Speed Board.

F 3436 **9.16.4**
R16-R17, R20-R21, R24-R25 or R28-R29 = A5-AD or CD-D4 (TS1...TS15e-Speed Board information [Restr type 1, 2, 3 or 4 = TS1e..TS15e from Sb], shall end the corresponding TS1...TS15-restriction activated by TS1...TS15-Warning board according to rules in [F 6004]).

F 3437 **9.16.5**
The TS1…TS15-restriction ends after corresponding End Speed Board is accepted according to rules in [F 6004] and train length delay.

F 3438 **9.16.6**
TS1...TS15- Speed Board information R18-R19, R22-R23, R26-R27 or R30-R31 from [FRS Air Gap, Long Speed] [Speed restr 1, 2, 3 or 4 from Sb], which is valid until corresponding TS1...TS15e information is received according to rules in [F 6004] (train length delay supervision when required).

F 3439 **9.16.7**
TS1...TS15e-information [Restr type 1, 2, 3 or 4 = TS1e...TS15e from Sb]. Ends the TS1...TS15-restriction activated by TS1...TS15-Warning board according to rules in [F 6004] (train length delay supervision).

F 3440 **9.16.8**
If R18-R19, R22-R23, R26-R27 or R30-R31 ≠ 12-8E [Speed restr 1, 2 or 3 ≠ 5...555 km/h from Sb], then balise error 14.937
If Speed board with same type but different speed than Warning board at target point of Warning board (+/-10 %), then balise error 14.940

F 3441 **9.16.9**
TS1...TS15-Warning board information = balise location [Restr type 1, 2 or 3 = TS1...TS15 from Wb]. If there have been another Warning board, which is aiming same restriction (type, speed and target point is same), latter Warning board is processed as a repeater.

F 3442 **9.16.10**

Start of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]) [Restr 1, 2 or 3 distance].

F 3443 **9.16.11**
End of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance]) + (R23-R24, R34-R35 or R43-R44 from [FRS Air Gap, Long Distance]) [Restr 1, 2 or 3 distance + length].

Note If there is Speed Board information on start point of restriction (+/- 10% of target distance) with same type and speed, 'length of restriction' -information of warning board is not used. End point of restriction is indicated by Speed Board balises.

F 3444 **9.16.12**
TS1...TS15-information R18-R19, R29-R30 or R38-R39 from [FRS Air Gap, Long Speed] [Speed restr 1, 2 or 3 from Wb].

F 3445 **9.16.13**
- R18-R19, R29-R30 or R38-R39 ≠ 12-8E [Speed restr 1, 2 or 3 = 5...555 km/h] OR
- R23-R24, R34-R35 or R43-R44 ≠ 11-EC [Restr length 1, 2 or 3 ≠ 5...11600 m] OR
- R16-R17 = 91-99 or C1-C6 and R25-R26 ≠ EE [Rest. type = TS1...TS15 and Speed after restriction 1 ≠ Cancelled].

F 3446 **9.16.14**
TS1...TS15c-Warning board information = balise location [Restr type 1, 2 or 3 = TS1c...TS15c from Wb].

F 3447 **9.16.15**
TS1...TS15-restriction, which starting point is located in +/- 10% tolerance of TS1...TS15c-speed restriction starting point and which have same speed information as TSxc has, shall be cancelled. Start of restriction = balise location + (R20-R21, R31-R32 or R40-R41 from [FRS Air Gap, Long Distance] [Restr 1, 2 or 3 distance].

F 3448 **9.16.16**
- R18-R19, R29-R30 or R38-R39 ≠ 12-8E [Speed restr 1, 2 or 3 = 5...555 km/h] OR
- R23-R24, R34-R35 or R43-R44 ≠ 11-EC [Restr length 1, 2 or 3 ≠ 5...11600 m].

F 3449 **9.16.17**
Speeds permitted by TS1...TS15-restrictions shall be gathered and the most restrictive information to Braking curve calculation and maximum permitted speed supervision.

F 6004 **9.16.18**
If end of Sb controlled restriction of type TS1-15 is received the following rule apply:

- Only End boards without speed (when one speed board stored) and with matching speed (both when one and several speed boards of the category stored) are accepted to end a stored restriction.
- Accepted End board ends all restrictions with same category and speed.

Balise error (14.941) appears if:

1) at least two speed boards of same category and different speeds are stored and end board of same category without speed is received, or
2) there is one or more speed board stored and end board of same category with speed is received and speed doesn't match to none of stored speed board.

9.17 Odometer Control – function

F 3450

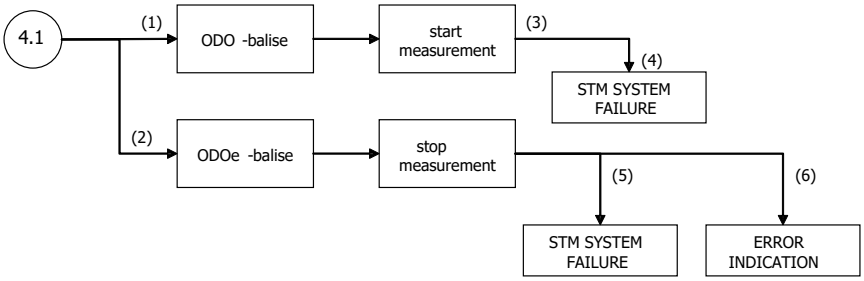


Figure 39/2. Odometer control - function

F 3451 **9.17.1**
R16-R17 = 3Cor R20-R21 = 3C or R24-R25 = 3C or R28-R29 = 3C [Restr type 1, 2, 3 or 4 = ODO from Sb].

F 3452 **9.17.2**
R16-R17 = 3D or R20-R21 = 3D or R24-R25 = 3D or R28-R29 = 3D [Restr type 1, 2, 3 or 4 = ODOe from Sb].

F 3453 **9.17.3**
Measurement shall be interrupted if train is braking > 30kPa in 2s or train acceleration > 2,5 m/s2.

F 3454 **9.17.4**
No ODOe-balises in 1200 m distance

F 3455 **9.17.5**
Result of the measurement is less than 900 m

F 3456 **9.17.6**
Result of the measurement is 900-979 or 1021-1200 m

10 SPEED RESTRICTION

10.1 Switch information

F 3457

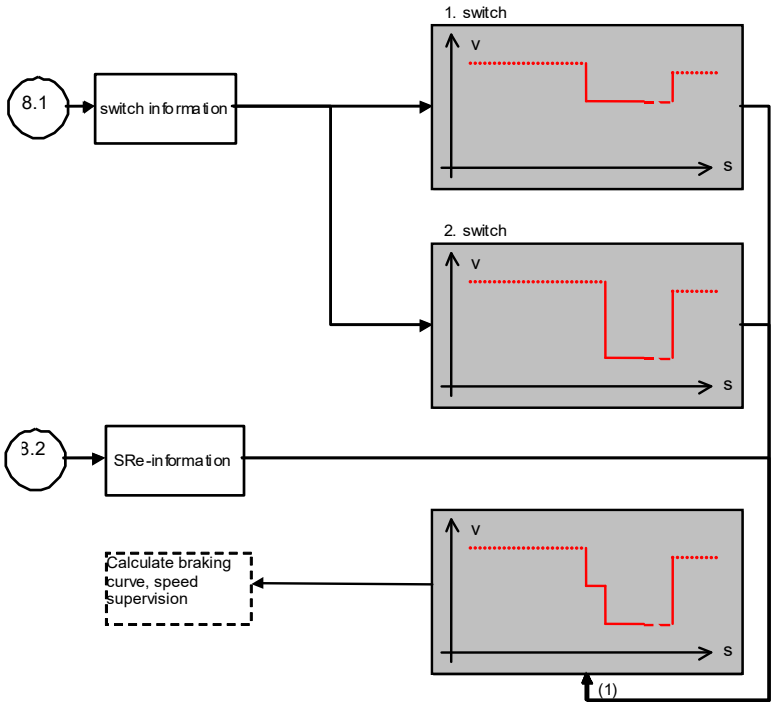


Figure 40/2. Switch information

F 3458 **10.1.1**
Received and previous switch information shall be gathered and the most restrictive information to Braking curve calculation and maximum permitted speed supervision.

F 3459 Gathering:
- If switch information from switch 2 is given in Balise Telegram shall it be gathered with switch 1 information
- New switch information received from balises shall compensate completely all previously received switch information, exception when the start of the previous restriction has been achieved or it is less than 100 meters away
- If the length of the switch area has not been defined in the Balise Telegram shall the restriction be valid as long as no SRe-information is received from speed restriction balises

10.2 Speed Restriction information

F 3460

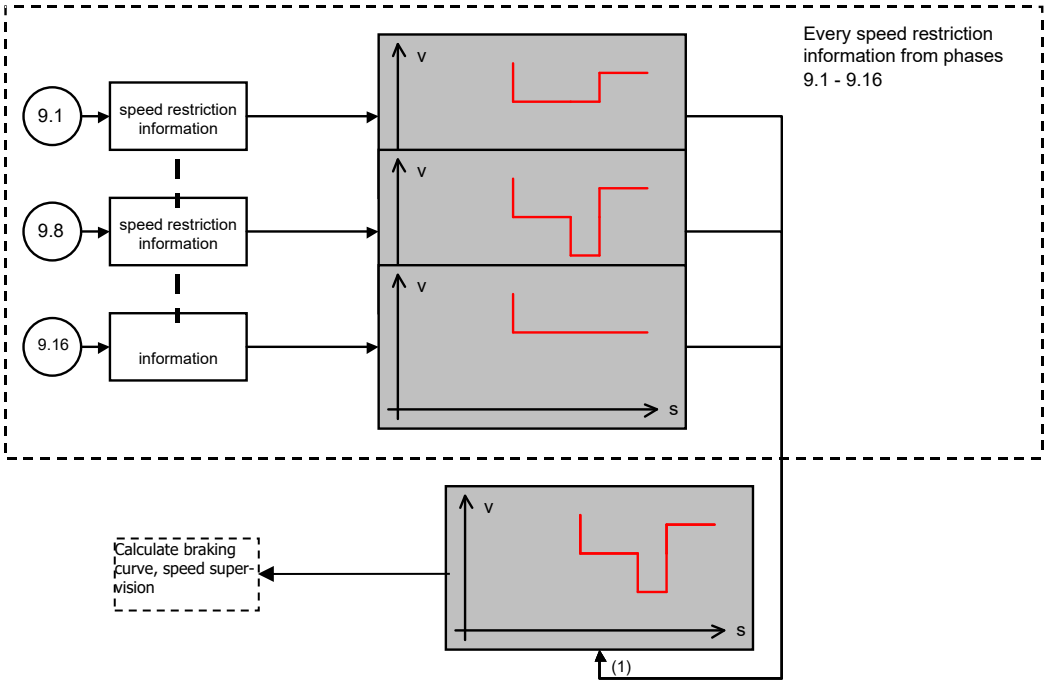


Figure 41/2. Speed restriction information

F 3461 **10.2.1**
Speed restrictions from phases 9.1 - 9.16 to be gathered and most restrictive information to Braking curve calculation and maximum permitted speed supervision

10.3 Signal information

Note

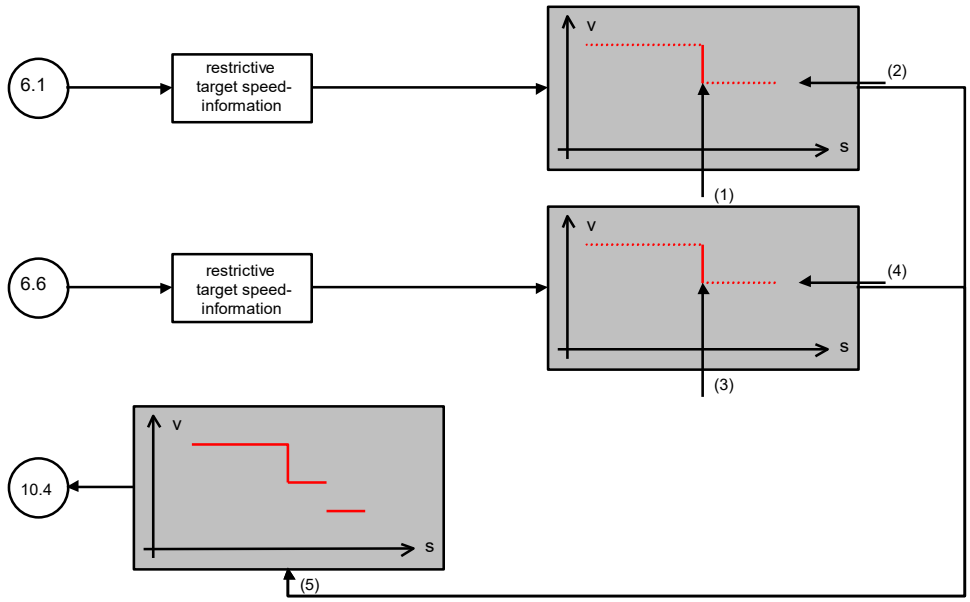


Figure 42/2. Signal information

F 3462 **10.3.1**
Restrictive Target Speed given by Signal-telegram: start of restriction = balise location + R20-R21 from [FRS Air Gap, Long Distance].

F 3463 **10.3.2**
Speed = R18-R19 from [FRS Air Gap, Long Distance]

Note Length of the restriction is determined by Line Speed, not by Target Speed of Signal-telegram

F 3464 **10.3.3**
Restrictive Target Speed given by DG-telegram: start of restriction = balise location + R20-R21 from [FRS Air Gap, Long Distance] + R28-R29 from [FRS Air Gap, Long Distance]

F 3465 **10.3.4**
Speed = R18-R19 from [FRS Air Gap, Long Distance]

Note Length of the restriction is determined by Line Speed, not by Target Speed of DG-telegram.

F 3466 **10.3.5**
Signal information will be gathered and the most restrictive information to Braking curve calculation and maximum permitted speed supervision

F 3467 Reserved

F 3468 Reserved

11 RESERVED

F 3469 Reserved

F 3470 Reserved

F 3471 Reserved

F 3472 Reserved

F 3473 Reserved

F 3474 Reserved

F 3475 Reserved

F 3476 Reserved

F 3477 Reserved

12 LINKING SUPERVISION

F 3478

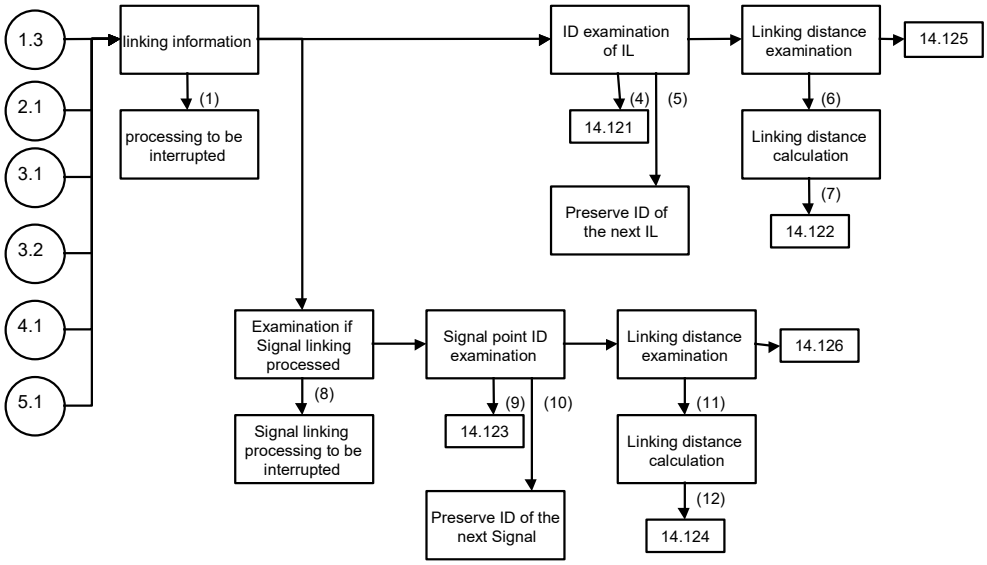


Figure 43/2. Linking Supervision

F 3479 **12.1.1**
If R2 ≠ 1 or 2 and R14-R15 = ED [Linking distance = Not included 3326in linking chain], linking information of the IL is not handled
OR
B-balise repeater signal doesn't include linking information (and A-balise has ETSX-telegram), linking information chain is cut off.

F 3480 **12.1.2**
Reserved

F 3481 **12.1.3**
Reserved

F 3482 **12.1.4**
R4-R8 [Current pos Id] compared with R9-R13 [Next pos Id] information received from previous IL. Remove to balise failure examination phase 14.121 if not agreed. Faulty is ignored if R9-R13 (of previous IL) = EEEEE [Next pos Id, default]

F 3483 **12.1.5**
Preserve R9-R13 for ID examination of the next IL [Next pos Id]

F 3484 **12.1.6**
R14-R15 = 11-EC [Linking distance = 5...11600 m]

F 3485 **12.1.7**
If linking distance is passed with 100 m + 20% without a new IL with linking information, then balise error 14.122

F 3486 **12.1.8**

R2 ≠ 1 or 2 [Signal or Rep. signal]

F 3487 **12.1.9**
Compare R4-R8 [Current pos Id] with R23-R27 [Next signal Id] information received from previous Signal/Repeater Signal IL, if R16-R17 = 12-8E [Main signal line speed = 5...555 km/h]. If data not agreed remove to balise failure examination phase 14.123 Faulty is ignored if R23-R27 (of previous Signal/Repeater signal IL) = EEEEE [Next signal Id, default]

F 3488 **12.1.10**
Preserve R23-R27 [Next pos Id] for ID examination of the next IL

F 3489 **12.1.11**
R20-R21 = 11-EC [Basic distance = 5...11600 m]

F 3490 **12.1.12**
If basic distance is passed with 100 m + 10% without main signal IL, then balise error 14.124

13 PROCESSING OF ERROR TELEGRAMS

F 3533 The balise error 14.001 is given if the balise telegram contains a nibble value which is defined as illegal value or not defined at all in used table.

13.1 Error telegram processing, Signal, one error telegram

F 3491

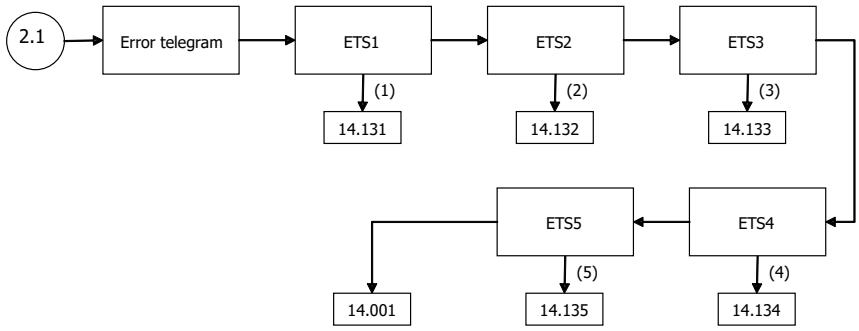


Figure 44/2. Error telegram processing, Signal, one error telegram

F 3492 **13.1.1**
R3 = 9 [ETS1]

F 3493 **13.1.2**
R3 = A [ETS2]

F 3494 **13.1.3**
R3 = B [ETS3]

F 3495 **13.1.4**
R3 = C [ETS4]

F 3496 **13.1.5**
R3 = D [ETS5]

13.2 Error telegram processing, Signal, two error telegrams

F 3497

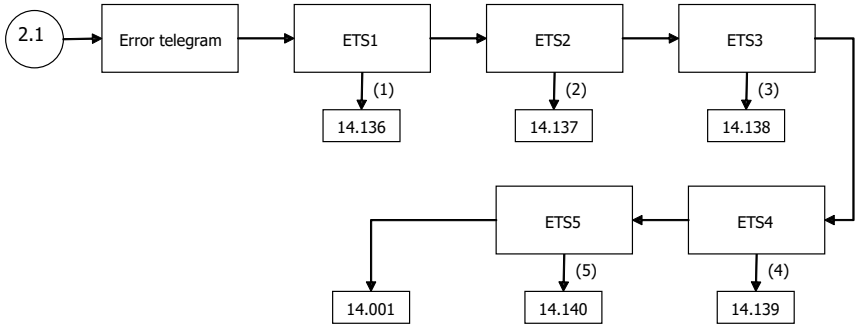


Figure 45/2. Error telegram processing, Signal, two error telegrams

F 3498 **13.2.1**
R3 = 9 [ETS1]

F 3499 **13.2.2**
R3 = A [ETS2]

F 3500 **13.2.3**
R3 = B [ETS3]

F 3501 **13.2.4**
R3 = C [ETS4]

F 3502 **13.2.5**
R3 = D [ETS5]

13.3 Error telegram processing, Repeater Signal

F 3503

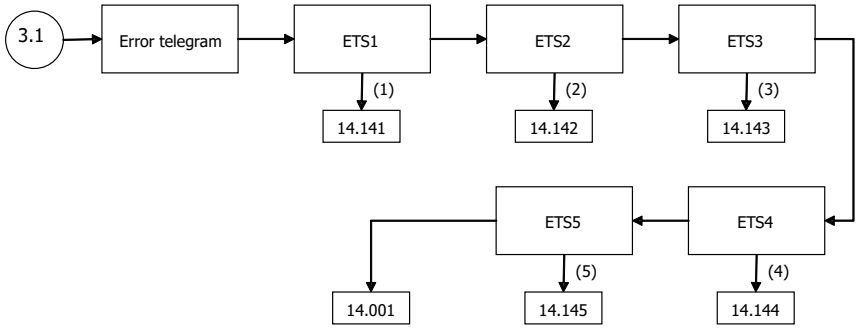


Figure 46/2. Error telegram processing, Repeater Signal

F 3504 **13.3.1**
R3 = 9 [ETS1]

F 3505 **13.3.2**
R3 = A [ETS2]

F 3506 **13.3.3**
R3 = B [ETS3]

F 3507 **13.3.4**
R3 = C [ETS4]

F 3508 **13.3.5**
R3 = D [ETS5]

13.4 Error telegram processing, Speed Board

F 3509

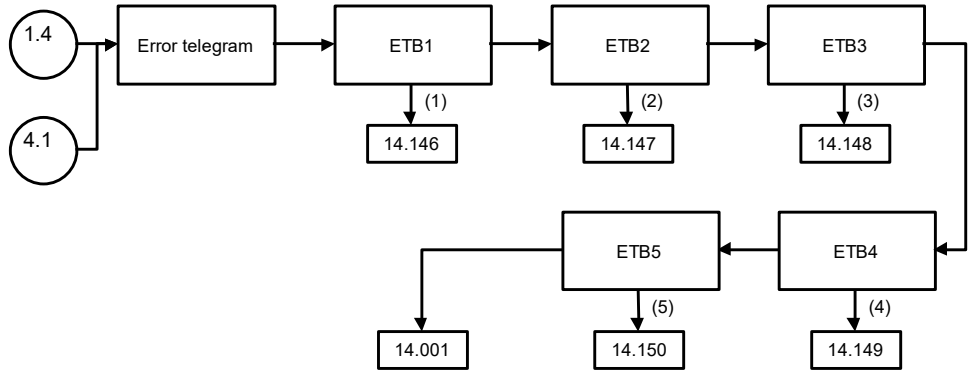


Figure 47/2. Error telegram processing, Speed board

F 3510 **13.4.1**
R3 = 9 [ETB1]

F 3511 **13.4.2**
R3 = A [ETB2]

F 3512 **13.4.3**
R3 = B [ETB3]

F 3513 **13.4.4**
R3 = C [ETB4]

F 3514 **13.4.5**
R3 = D [ETB5]

13.5 Error telegram processing, Warning Board

F 3515

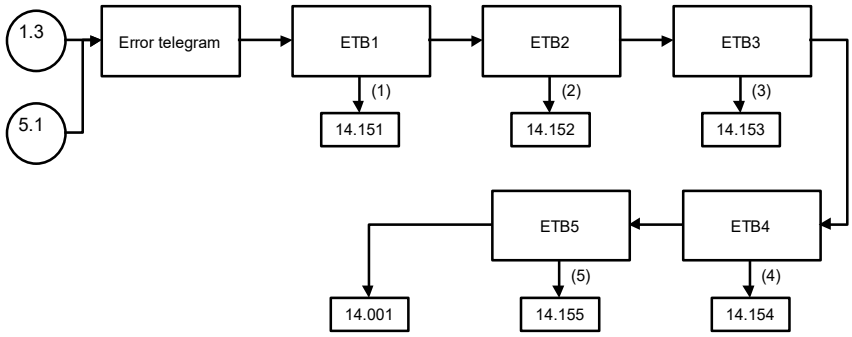


Figure 48/2. Error telegram processing, Warning Board

F 3516 **13.5.1**
R3 = 9 [ETB1]

F 3517 **13.5.2**
R3 = A [ETB2]

F 3518 **13.5.3**
R3 = B [ETB3]

F 3519 **13.5.4**
R3 = C [ETB4]

F 3520 **13.5.5**
R3 = D [ETB5]

13.6 Error telegram processing, Speed Board, two error telegrams

F 3525

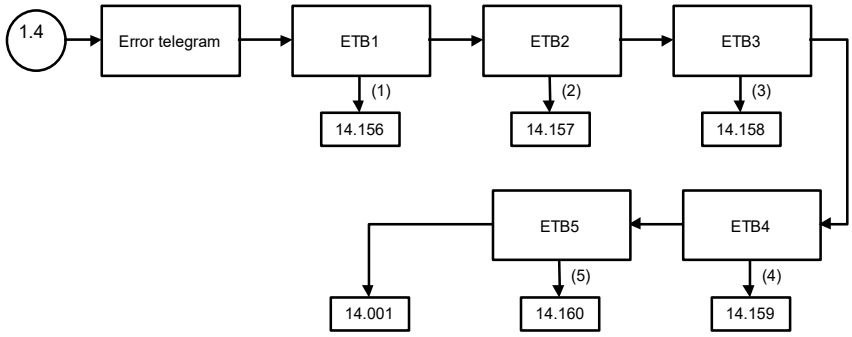


Figure 49/2. Error telegram processing, Speed Board, two error telegrams

F 3526 **13.6.1**
R3 = 9 [ETB1]

F 3527 **13.6.2**
R3 = A [ETB2]

F 3528 **13.6.3**
R3 = B [ETB3]

F 3529 **13.6.4**
R3 = C [ETB4]

F 3530 **13.6.5**
R3 = D [ETB5]

14 PROCESSING OF BALISE ERRORS

F 3521 Enter here only if a balise error has been detected

Table 1/2. Balise errors

Balise Error	Reference	Error Grade	Error Code	ID	Textual info	Teksti-informaatio (Finnish)
14.001	13.1-13.5	5	1	ID of current IL	Illegal nibble value	Luvaton puolitavun arvo
14.101	1.1	5	2	ID of readable balise	Faulty balise	Viallinen baliisi
14.102	1.1	5	3	ID of readable balise	Reading error in lows peed	Baliisin lukuvirhe pienellä nopeudella
14.103	1.1	1	4	ID of readable balise	All zero telegram	Sanoman kaikki arvot nollia
14.104	1.1	1	5	ID of readable balise	Inverted telegram	Käänteinensanoma
14.105	-	-	6	Not used	Not used	Ei käytössä
14.106	1.1	5	7	ID of readable balise	Bit error in information section	Bitti virhe informaatio-osassa
14.107	1.2	5	8	ID of current IL	Illegal value of R0 or R1	Luvaton R0 tai R1 arvo
14.108	1.2	5	9	0	Detects only	Baliisit havaittu, ei sanomaa
14.109	1.2	5	10	ID of readable balise	Too man balises in IL	Liian monta baliisia IP:ssä
14.110	1.2	5	11	ID of readable balise	Only one balise in IL	Vain yksi baliisi IP:ssä
14.111	1.2	5	12	ID of current IL	Incorrect structure in IL	Virheellinen IP kokoonpano
14.112	1.3	1	13	ID of readable balise	Single coded +balise detect in medium speed	Single-koodattu ja lukukelvoton baliisi
14.113	1.3	3	14	ID of readable balise	Single* coded +balise detect	Single*-koodattu ja lukukelvoton baliisi
14.114	1.3	5	15	ID of current IL	Error in single-coded IL	Virhe single-koodatussa IP:ssä
14.115	1.4	1	16	ID of readable balise	Double coded +balise detect in medium speed	Double-koodattuja lukukelvoton baliisi
14.116	1.4	5	17	ID of current IL	Error in Double-coded IL	Virhe double-koodatussa IP:ssä
14.301	3.1	2	18	ID of current IL	Vl in repeater signal	Vl toistopisteellä
14.302	3.2	2	19	ID of current IL	Vl or Vt in linking repeater	Vl tai Vt matkanpidennyksellä
14.401	4.1	3	20	ID of current IL	Incorrect type of speed board	Virheellinen nopeusmerkkityyppi
14.501	5.1	3	21	ID of current IL	Incorrect type of warningboard	Virheellinen etumerkkityyppi
14.601	6.1-6.6	4	22	ID of current IL	Faulty Vl or Vt	Virheellinen Vl tai Vt
14.602	6.1-6.6	1	23	ID of current IL	Incorrect release speed	Väärä valvontanopeus
Balise Error	**Reference**	**Error Grade**	**Error Code**	**ID**	**Textual info**	**Teksti-informaatio (Finnish)**
14.603	6.2, 6.4	4	103	ID of current IL	Ms distance missing	Ms etäisyys puuttuu
14.604	6.5	4	24	ID of current IL	35km/h switch missingin RT-tel	35km/h vaihde puuttuu RT-san.
14.605	-	4	115	ID of current IL	FaultyVl,Vt,Ms	Virheellinen nopeustieto
14.801	8.1	4	25	ID of current IL	1st switch information faulty	1.vaihteen tiedot puutteelliset
14.802	8.1	4	26	ID of current IL	2nd switch information faulty	2.vaihteen tiedot puutteelliset
14.803	8.1	4	27	ID of current IL	1st switch information missing	1.vaihde puuttuu
14.804	8.2	1	28	ID of current IL	Speed information in SRe-balise	Sre baliiseissa nopeustieto
14.805	-	4	113	ID of current IL	Switch restriction overflow	Liian monta vaihderajoitusta
14.901	9.1	3	29	ID of current IL	Fault in dVinc-balise	Virhe dVinc-baliiseissa

14.902	9.1	3	30	ID of current IL	Fault in dVdec-balise	Virhe dVdec-baliiseissa
14.903	9.2	3	31	ID of current IL	Fault in M1 speed board	Virhe M1-nop.merkkibalii-seissa
14.904	9.2	3	32	ID of current IL	Fault in M1 warning board	Virhe M1-etum.baliiseissa
14.905	9.3	3	33	ID of current IL	Fault in M2 speed board	Virhe M2-nop.m.baliiseissa
14.906	9.3	3	34	ID of current IL	Fault in M2 warning board	Virhe M2-etum.baliiseissa
14.907	9.3	3	35	ID of current IL	Fault in M2c warning board	Virhe M2c-etum.Baliiseissa
14.908	9.4	3	36	ID of current IL	Fault in M3 speed board	Virhe M3-nop.m.baliiseissa
14.909	9.4	3	37	ID of current IL	Fault in M3 warning board	Virhe M3-etum.baliiseissa
14.910	9.4	3	38	ID of current IL	Fault in M3c warning board	Virhe M3c-etum.Baliiseissa
14.911	9.5	3	39	ID of current IL	Fault in C1 speed board	Virhe C1-nop.m.baliiseissa
14.912	9.5	3	40	ID of current IL	Fault in C1 warning board	Virhe C1-etum.baliiseissa
14.913	9.5	3	41	ID of current IL	Fault in C1c warning board	Virhe C1c-etum.Baliiseissa
14.914	9.6	3	42	ID of current IL	Fault in C2 speed board	Virhe C2-nop.m.baliiseissa
14.915	9.6	3	43	ID of current IL	Fault in C2 warning board	Virhe C2-etum.baliiseissa
14.916	9.6	3	44	ID of current IL	Fault in C2c warning board	Virhe C2c-etum.Baliiseissa
14.917	9.7	3	45	ID of current IL	Fault in LCP1 speed board	Virhe LCP1-nop.m.baliiseissa
Balise Error	**Reference**	**Error Grade**	**Error Code**	**ID**	**Textual info**	**Teksti-informaatio (Finnish)**
14.919	9.7	3	47	ID of current IL	Fault in LCP1c warning board	Virhe LCP1c-etum.Baliiseissa
14.920	9.8	3	48	ID of current IL	Fault in LCP2 speed board	Virhe LCP2-nop.m.baliiseissa
14.922	9.8	3	50	ID of current IL	Fault in LCP2c warning board	Virhe LCP2c-etum.Baliiseissa
14.923	9.9	3	51	ID of current IL	Fault in LCP3 speed board	Virhe LCP3-nop.m.baliiseissa
14.925	9.9	3	53	ID of current IL	Fault in LCP3c warning board	Virhe LCP3c-etum.Baliiseissa
14.926	9.10	3	54	ID of current IL	Fault in LZ speed board	Virhe LZ-nop.m.baliiseissa
14.928	9.10	3	56	ID of current IL	Fault in LZc warning board	Virhe LZc-etum.Baliiseissa
14.929	9.11	3	57	ID of current IL	Fault in BUA speed board	Virhe BUA-nop.m.baliiseissa
14.930	9.11	3	58	ID of current IL	FaultinBUAwarning board	Virhe BUA-etum.Baliiseissa
14.931	9.12	3	59	ID of current IL	Fault in BCA speed board	Virhe BCA-nop.m.baliiseissa
14.932	9.12	3	60	ID of current IL	Fault in BCA warning board	Virhe BCA-etum.Baliiseissa
14.933	9.13	3	61	ID of current IL	Fault in BOC speed board	Virhe BOC-nop.m.baliiseissa
14.934	9.13	3	62	ID of current IL	Fault in BOC warning board	Virhe BOC-etum.Baliiseissa
14.937	9.16	3	65	ID of current IL	Fault in TSx speed board	Virhe TSx-nop.m.baliiseissa
14.938	9.16	3	66	ID of current IL	Fault in TSx warning board	Virhe TSx-etum.Baliiseissa
14.939	9.16	3	67	ID of current IL	Fault in TSxc warning board	Virhe TSxc-etum.Baliiseissa
14.940	9.2-9.13, 9.16	2	68	ID of current IL (Speedboard)	Wb and Sb mismatch	Etum.- ja nopeusmerkkibaliisien nopeus ei täsmää
14.941	9.3-9.6, 9.16	1	108	ID of current IL	End speed is missing or mismatch	'Endspeed' puuttuu tai ei täsmää
14.942	9.1	2	109	ID of current IL	Received multiple delta speed warning board	Virhe DeltaV-etum.Baliiseissa
14.943	-	2	110	ID of current IL	Speed board restriction overflow	SB liikaarajoituksia
14.944	9.7, 9.8, 9.9, 9.10, 9.14, 9.15	2	111	ID of current IL	Warning board restriction over-flow	WB liikaarajoituksia
Balise Error	**Reference**	**Error Grade**	**Error Code**	**ID**	**Textual info**	**Teksti-informaatio (Finnish)**
14.121	12.1	5	69	ID of current IL	Faulty IL ID	Väärä IPID
14.122	12.1	5	70	ID of current IL	IL missing	IP puuttuu
14.123	12.1	4	71	ID of current IL	Faulty signal ID	Väärä opastin ID

14.124	12.1	4	72	ID of last red signal	Signal missing	Opastin puuttuu
14.125	12.1	5	104	ID of current IL	Illegal IL linking distance	Virheellinen ketjutusmatka
14.126	12.1	4	105	ID of current IL	Illegal signal IL linking distance	Virheellinen opastinketjutusmatka
14.131	13.1	1	73	ID of current IL	Invalid signal aspect	Väärä opastekäsite
14.132	13.1	1	74	ID of current IL	Unstable input	Epävakaa sisääntulo
14.133	13.1	1	75	ID of current IL	Blink Frequency Error	Väärä vilkkutaajuus
14.134	13.1	1	76	ID of current IL	Power Failure	Virransyöttövika
14.135	13.1	1	77	ID of current IL	Balise default	Baliisin vakiosanoma
14.136	13.2	4	78	ID of current IL	Invalid signal aspect	Väärä opastekäsite
14.137	13.2	4	79	ID of current IL	Unstable input	Epävakaa sisääntulo
14.138	13.2	4	80	ID of current IL	Blink Frequency Error	Väärä vilkkutaajuus
14.139	13.2	4	81	ID of current IL	Power Failure	Virransyöttövika
14.140	13.2	4	82	ID of current IL	Balise default	Baliisien vakiosanoma
14.141	13.3	1	83	ID of current IL	Invalid signal aspect	Väärä opastekäsite
14.142	13.3	1	84	ID of current IL	Unstable input	Epävakaa sisääntulo
14.143	13.3	1	85	ID of current IL	Blink Frequency Error	Väärä vilkkutaajuus
14.144	13.3	1	86	ID of current IL	PowerFailure	Virransyöttövika
14.145	13.3	1	87	ID of current IL	Balise default	Baliisin vakiosanoma
14.146	13.4	1	88	ID of current IL	Invalid signal aspect	Väärä opastekäsite
14.147	13.4	1	89	ID of current IL	Unstable input	Epävakaa sisääntulo
14.148	13.4	1	90	ID of current IL	Blink Frequency Error	Väärä vilkkutaajuus
14.149	13.4	1	91	ID of current IL	Power Failure	Virransyöttövika
14.150	13.4	1	92	ID of current IL	Balise default	Baliisin vakiosanoma
Balise Error	**Reference**	**Error Grade**	**Error Code**	**ID**	**Textual info**	**Teksti-informaatio (Finnish)**
14.151	13.5	3	93	ID of current IL	Invalid signal aspect	Väärä opastekäsite
14.152	13.5	3	94	ID of current IL	Unstable input	Epävakaa sisääntulo
14.153	13.5	3	95	ID of current IL	Blink Frequency Error	Väärä vilkkutaajuus
14.154	13.5	3	96	ID of current IL	Power Failure	Virransyöttövika
14.155	13.5	3	97	ID of current IL	Balise default	Baliisien vakiosanoma
14.156	13.6	3	98	ID of current IL	Invalid signal aspect	Väärä opastekäsite
14.157	13.6	3	99	ID of current IL	Unstable input	Epävakaa sisääntulo
14.158	13.6	3	100	ID of current IL	Blink Frequency Error	Väärä vilkkutaajuus
14.159	13.6	3	101	ID of current IL	Power Failure	Virransyöttövika
14.160	13.6	3	102	ID of current IL	Balise default	Baliisien vakiosanoma
14.402	4.1	1	106	ID of current IL	No linking information in B-balise of previous Repeater signal	Ketjutustiedot puuttuvat edellisen toistopisteen B-baliisista
14.502	5.1	1	107	ID of current IL	No linking information in B-balise of previous Repeater signal	Ketjutustiedot puuttuvat edellisen toistopisteen B-baliisista
14.945	-	5	112	ID of current IL	Balise error overflow	Liikaa baliisivikoja
14.946	-	3	114	ID of current IL	Fault in SRe, ODO or ODOe speed board	Virhe SRe, ODO tai ODOe nop.merkkibaliiseissa

Note Column ID defines which balise ID shall be displayed with the balise error textual info.

Note ATP-VR/RHK system onboard balise error codes are described in [RATO 10 Amendment - JKV-järjestelmän baliisivikatilanteet - Liikennevirasto]. The document is primarily intended for managing fault situations and to give information about the probable reasons of fault situations. The error codes described for ATP-VR/RHK are not as detailed as in this table.

ATP-VR/RHK STM BL3 FUNCTIONAL REQUIREMENTS SPECIFICATION (FRS)

PART 3

SUPERVISION

Document Modification History

2.0	Second version		17.05.2023	M. Tulikoura	H. Nyström A. Julku J. Lehmusto	A. Härkönen
1.0	First version		29.10.2020	N. Lindfors	A. Härkönen A. Julku J. Lehmusto	M. Torkkeli
Version	Modification		Valid from	Prepared	Checked	Approved

TABLE OF CONTENTS

Definitions and abbreviations

Note For definitions and abbreviations, refer to document [ATP-VR/RHK STM BL3 Functional Requirements Specification - PART 1 - System Introduction], Chapters 7 and 8.

1. INTRODUCTION

1.1 Scope

Note This part of FRS specifies the following Specific Transmission Module National functions for ATP-VR/RHK:

- **Train data entry.** Which STM train data there is, and how the data is input to the on-board system.
- **STM states.** Which states the STM can operate in, how the STM supervision and the STM indications work, and the conditions for transitions between the different states.
- **Travel directions.**
- **Area types.** Which area types the STM can be in, how the STM supervision and the STM indications works, and the conditions for transitions between the different area types.
- **Target speed information.** How the STM handles target speed information at different types of restrictions.
- **Speed restrictions.** The meaning of speed restrictions, and how the different speed restriction categories are handled.
- **Speed supervision.** Supervising the max. allowed speed for the train. This can be either constant speed (ceiling speed) or limited speed (braking curves) supervision.
- **Braking curves.** Different types of warning and braking curves calculation and actions for them.
- **Indications.** What the indications on the DMI can sound and look like.

Note For an overview of the ATP-VR/RHK STM system, refer to document [ATP-VR/RHK STM Functional Requirements Specification - PART 1 - System Introduction].

1.2 General

F 4000 The ETCS with STM shall be an onboard system that continuously supervises the running of the train. It shall warn the driver in case of over speeding and approaching stop signals or speed restrictions. If the driver does not reduce speed sufficiently, the system shall apply brakes.

F 4001 The system shall not intervene as long as the driver drives according to regulations.

Note In order to perform the supervising functions the system needs access to track information such as signal aspects, speed restrictions, distances, gradients, etc. Refer to [FRS Air Gap] and [FRS Information Flow Track-Train] for more details.

2. HANDLING OF TRAIN DATA

2.1 STM Train Data

Note Requirements for STM train data are given in [SUBSET-035 Specific Transmission Module FFFIS].

Note The entry of Specific STM Data should be avoided. Where possible, automatic translation will be implemented on the STM side. [SUBSET-035 Specific Transmission Module FFFIS]

F 7001 The train data shall be requested by the STM via the DMI when:
a) STM start-up test has been finished successfully and
b) Train is in standstill and
c) Driver selects STM train data entry via the DMI

F 7002 The STM shall keep the entered train data in memory after entry until the system is powered off.

F 7003 The memorized train data shall be reset and/or requested to be confirmed by the STM via the DMI:
1) After ETCS shunting mode is left
2) After another driver's desk is selected

Note Reset and/or confirmation request of memorized train data is not applicable when shunting mode is activated.

F 5001 STM train data shall be entered by the driver via the ETCS DMI panel.

Note STM data input procedure:
1) the STM requests STM train data entry
2) the ETCS handles the input from the driver DMI and informs the STM
3) the STM will accept or reject given data

Note There is a number of ETCS train data such as ETCS max speed or train length, data that describe the braking capacity of the train etc. that is entered by the driver.

F 5002 STM shall utilize the appropriate entered ETCS train data.

F 5003 Whenever possible, the same train data shall not be "double entered" as ETCS and STM data.

Note Exception: Brake type (G/P/R) and brake percentage shall be entered in the STM train data [F 5019].

2.1.1 ETCS Train Data

F 2002 The following ETCS train data shall be received and processed by the STM:

a) Brake position (only used as default value for STM train data)
b) Train length
c) Brake percentage (only used as default value for STM train data)
d) ETCS max. speed
e) Cant defiency (only used as value for tilting train)

F 9030 STM train data shall, when ETCS train data has not been received, be

a) Brake position as freight train G
b) Train length 1500 m
c) Brake percentage 30 %
d) ETCS max. speed 50 km/h

F 7004 If the ETCS train data except cant deficiency which is received and processed by the STM is changed, the STM train data shall be checked/changed by the driver.

F 9031 If not checked/changed [F 7004] within STM state DA, STM shall apply low level Service Brake and sends a text message.

F 9032 STM shall allow the driver to release brakes after STM train data is entered.

F 9033 If not checked/changed [F 7004], the STM shall use the ETCS train data as follows:

a) Brake position as [F 9035]
b) Train length as received from ETCS
c) Brake percentage as [F 9036]
d) ETCS max speed as received from ETCS

Note The previous requirement is needed e.g. at level transition without validated STM train data.

F 9034 If not checked/changed [F 7004] within STM state HS, STM shall send a text message.

Note This gives the driver the possibility to stop and enter STM data before the level transition.

2.1.2 Procedure for entering STM train data

Note Requirements for entering STM train data are given in [SUBSET-035 Specific Transmission Module FFFIS].

F 2004 Reserved

F 2005 Reserved

F 2006 Reserved

F 2007 Reserved

F 5005 The train data is entered by the driver using the DMI

F 5006 Reserved

F 5007 The DMI shall indicate the required data to be entered.

Note Data request and entry must be unambiguous not to confuse the driver.

F 5008 New re-entry shall be requested immediately if the entered data is invalid.

F 5009 Reserved

Note After the train data entry sequence is complete the validation sequence for the entered data will be initiated by the ETCS. During validation the driver will have possibility to correct the data which correction activates a new validation sequence.

F 5010 Reserved

F 5011 Reserved

F 5012 After train data entry and validation the start restriction shall be supervised and indicated.

F 5013 Rail surface condition "KELI" shall not be possible to update if target supervision is ongoing and train is moving.

F 7005 At standstill the rail surface condition "KELI" can be updated and the update will be valid for all existing targets. New surface value also affects already calculated release speed to be recalculated with new surface condition.

F 5014 Train data shall be possible to be checked by the driver via data view procedure.

F 5015 Reserved

F 5016 Reserved

F 5017 Reserved

F 5018 Reserved

F 5019

Table 1/3. STM train data shall be entered according to following sequence:

Header of data item	Train data to be entered and the margin limits
JL	Brake type G, P, R or type of the train is DMU/EMU (see Note)
JPP	Brake percentage in steps of 1 % between 6 – 250 %
KELI	KELI 1 = 1 (optimal dry rail surface conditions) KELI 2 = 0,875 KELI 3 = 0,75 (worst slippery wet rail conditions)
PT	Code for special features of the train. Code is given by five digits, each of them 0 - 7 (see Note).

Note DMU/EMU train types include Sm1-2, Sm3, Sm4, Sm5, Sm6 and Dm12.

F 9035 Default values for STM brake types G, P, R shall be acquired from ETCS brake position as follows:
STM brake type G is default value from ETCS brake position freight train G
STM brake type P is default value from ETCS brake position freight train P
STM brake type R is default value from ETCS brake position passenger train P

F 9036 Default value for STM brake percentage shall be ETCS brake percentage value (if known) else the latest used value.

Note Although ETCS brake percentage is used as a default value, STM needs a separate entry for brake percentage because current ETCS Subset-026 specifies minimum brake percentage as 30 % but certain trains in Finland needs lower values.

F 9037 Default value for STM KELI shall be the last used value (if entered) else KELI 3.

F9038 Default value for STM PT shall be the last validated value (if entered) else PT-code 77776.

Note Possibility of unintended default value input should be considered when designing data entry procedure.

F 5020 According to the brake type (JL) the data entry sequence varies as follows:

- R, P, G -type: all the STM train data shall be entered (JL, JPP, KELI, PT)
- DMU/EMU train types: only JL, KELI and PT shall be entered

2.1.3 STM train data acceptance conditions

F 2008 Train data entry shall only be accepted:
a) if the entered data is reasonable, and
b) if the entered data has been validated by the driver.

F 2009 The STM data entry procedure shall not be finished until all train data is accepted.

F 2010 Corrections and alterations shall be done by driver's request.

2.2 PT code - special train characteristics

2.2.1 General

Note Some parts of the line may have restrictions for certain train types. For instance, additional restrictions are needed for trains with high axle load and trains with loading gauge, etc. STM can supervised this kind of restrictions (named as TS restrictions) to affected trains by matching the IL information to the train specific code (named as PT code), which is a part of the train data.

Note For example, switch restriction can be reduced from 35 km/h down to 20 km/h. Also switch restriction can be reduced from 80 or 70 km/h down to 60 km/h. For more information refer to [FRS Section 4 Part 2 "Information Flow Track – Train"].

F 2011 When a TSx speed restriction IL indicates a train specific code x, that is the same as for the passing train, the restriction applies. If the code does not match, the restriction is not applied. STM permits speed increase after the whole train has left the restriction zone.

F 2012 Speed increase permission for heavy trains before uphill shall be given with restriction type dV_{inc}. Speed decreasing request for heavy train before downhill shall be given by restriction type dV_{dec}.

Note For more information refer to [FRS Section 4 Part 2 "Information Flow Track – Train"].

Note ETCS max speed shall be given as maximum speed according speed during uphill (dV_{ink} speed). This must be managed by the driver instructions. [F 2115]

F 2013 Reserved

2.2.2 Entry of special PT train characteristics

F 2014 Entering special PT train characteristics shall be done in connection with the normal STM train data entry procedure.

2.2.2.1 Normal train

Note For a normal train the driver will enter a value corresponding to no speed restrictions for high axle load, loading gauge, etc.

2.2.2.2 Special train

Note The entry of a special PT code requires normally that the driver set the PT code to a certain train specific value.

F 2015 The bit pattern of the PT code shall be decoded as follows:

Table 3/3. PT bits

1.digit			2.digit			3.digit			4.digit			5.digit		
i15	i14	i13	i12	i11	i10	i9	i8	i7	i6	i5	i4	i3	i2	i1
TS15	TS14	TS13	TS12	TS11	TS10	TS9	TS8	TS7	TS6	TS5	TS4	TS3	TS2	TS1

Note The entered decimal value is "26310" which makes the bits i14, i12, i11, i8, i7 and i4 for bit 1. Thus, following restrictions are supervised: TS14, TS12, TS11, TS8, TS7 and TS4. For more information refer to [FRS Section 4 Part 2 "Information Flow Track-Train"].

2.3 Tilting Train

F 2304 The STM value shall be non-tilting when ETCS train data cant deficiency (NC_CDTRAIN) is from 0 mm to < 245 mm (FG 1-4, FP 1-4, PASS 1-3 and TILT 1-4) or brake type is P or G or EMU train type is not Sm3 or not Sm6.

F 2305 The STM value shall be tilting when ETCS train data cant deficiency (NC_CDTRAIN) is 245–300 mm (TILT 5-7) and when brake type is R or EMU train type is Sm3 or Sm6.

F 2306 During STM states not DA value tilting/non-tilting shall be updated according to
[F 2304] and [F 2305] without driver action.

Note STM will change value tilting/non-tilting according to ETCS train data cant deficiency when STM state changes from DA.

F 9020 The requirements [F 9021 – 9023] shall be valid if ETCS cant deficiency (NC_CDTRAIN) is changed.

F 9021 In STM state DA update to non-tilting [F 2304] shall be carried into effect instantly at standstill.

F 9022 In STM state DA update to non-tilting [F 2304] shall be carried into effect instantly after there is no curve objects in target speed supervision while train is running.

F 9023 In STM state DA update to tilting [F 2305] shall be carried into effect instantly.

F 9024 The requirements [F 6007, F 6011, F 9025 and F 9026] shall be executed by STM menu buttons in STM state DA.

F 6007 Non-tilting train value shall always be possible to change to tilting.

F 6011 Running tilting train value shall not be allowed to be changed to non-tilting train if there are curve restriction objects in target supervision (ESP is not passed).

F 9025 At standstill the tilting train value can be changed to non-tilting and the update will be valid for all existing curve speed targets.

F 9026 Change of tilting/non-tilting train is applicable only when brake type is R or EMU train type is Sm3 or Sm6.

F 9027 Tilting shall be indicated for the driver when in use.

F 2016 Reserved

F 2017 Reserved

F 2018 Reserved

F 2019 Reserved

F 2020 Reserved

F 2003 Reserved

F 5004 Reserved

2.4 Rail surface conditions

F 9050 While running in ETCS area STM shall set its own surface condition as "KELI 1" when ETCS adhesion is set to "non slippery".

F 9051 While running in ETCS area STM shall set its own surface condition as "KELI 3" when ETCS adhesion is set to "slippery".

F 9052 Surface condition shall be indicated for the driver 30 sec. after level transition from ETCS to STM area has occurred.

3. STM STATES

3.1 General

Note Refer to the valid ERTMS/ETCS BL3 specifications for definitions of the STM states.

Note STM equipment can work in eight different states, which affect the functioning of the system. This section describes the various STM states, how supervision is carried out and how transition between the states takes place.

Note The STM state machine – with the states Power On, Configuration, Data Entry, Cold Standby, Hot Standby, Data available, Failure and No Power are functioning in both an activated or de-activated cab.

Note There are also sub-states relating to the travel direction:
1. Direction of travel not established.
2. Direction of travel established.

Note There are also sub-states relating to the supervision direction:
1. Direction of supervision not established.
2. Direction of supervision established.

Note There are also sub-states relating to the STM areas:
1. non-equipped area
2. fully equipped area
3. construction area
4. other country area

F 2021 Reserved

F 2022 Reserved

F 2023 The STM shall log its current state (PO, CO, FA, etc.), unless this is performed by the ETCS.

Note The STM can be isolated by setting the STM isolation switch to Off-position. The STM computers may, however, ~~are~~ still be powered.

3.1.1 System Conditions Overview

3.1.1.1 ETCS levels

Note Refer to [SUBSET-026-2 System Requirements Specification, Chapter 2, Basic System Description]

Note

Table 4/3. ETS levels

Level	Track information from	Train location/integrity information
0	-	-
NTC	National balises (Eurobalises for level transitions)	Track circuits or axle counters
1	Eurobalises (optionally infill from Euroloop or Radio)	Track circuits or axle counters
2	Eurobalises, Euroradio and RBC	Track circuits or axle counters
3	Eurobalises, Euroradio and RBC	Information received from the train

3.1.1.2 ETCS modes

Note

Table 5/3. ETCS modes

Mode	Meaning	Used in ETCS level(s)
UN	Unfitted	0
SN	STM National	NTC
SH	Shunting	0...3
PS	Passive Shunting	
FS	Full Supervision	1...3
LS	Limited Supervis-ion	
TR	Trip	
PT	Post Trip	
OS	On Sight	
RV	Reversing	
SR	Staff Responsible	
SB	Stand By	All
SL	Sleeping	
NL	Non Leading	
NP	No Power	
IS	Isolation	
SF	System Failure	

3.1.1.3 STM states

Note

Table 6/3. STM states

State	Meaning
CO	Configuration
CS	Cold Standby
DA	Data Available
DE	Data Entry
FA	Failure
HS	Hot Standby
PO	Power On
NP	No Power

3.2 STM states overview

F 2024 Reserved

Note The STM states are defined in [SUBSET-035 Specific Transmission Module FFFIS].

Note

Table 7/3. STM states, informative

STM State [1]		**STM Function**[2]	**STM Function**[3]
PO	No Power	None	
PO	Power On	Establish communication STM self-test	
CO	Configuration	Receive configuration and Train data from ETCS to STM Wait for level selection JKV	Receive configuration and Train data from ETCS to STM Wait for level selection ETCS L 0/1/2/3 or [4]
DE	Data Entry	Receive STM train data	
CS	Cold Standby	Wait for ETCS Order to HS	Passive: Wait for border to ATP-VR/RHK STM area[5]
HS	Hot Standby	Wait for ETCS Order to DA -	Passive: Read balises and wait for transition request (to DA) [5]
DA	Data Available (with sub-states)	Supervision of signals, boards, areas etc. or sub-state Resting[6]	-
FA	Failure	System error alarm	

Explanations to the table:
1) Many of these states are also possible while the cab is de-activated
2) Start of Mission by the driver ETCS Level NTC
3) Start of Mission by the driver ETCS Level 0 or 1 or 2 or 3
4) The ETCS mode is Sleeping or Non-Leading
5) ETCS Level is 0 or 1 or 2 or 3
6) ETCS mode is Sleeping or Non-Leading

3.2.1 Overview of state transitions

Note STM states transitions are defined in related table [SUBSET-035 Specific Transmission Module FFFIS Chapter 7.3.2.1].

Note

Table 8/3. STM states transitions

NP	< 15	< 15	< 15	< 15	< 15	< 15	< 15
1 >	**PO**						
	2 >	**CO**					
		3 >	**DE**				
		4a >	4a >	**CS**	< 4a	< 4a < 4b	
				6 >	**HS**		
				9 >	9 >	**DA**	
	16 > 17 >	16 > 17 >	16 > 17 >	16 > 17 >	16 > 17 >	16 > 17 >	**FA**

Explanations to the above table:

1 STM is powered on
2 ETCS order "Configuration"
3 ETCS order "Data Entry"
4a ETCS unconditional order "Cold Standby"
4b (ETCS conditional order "Cold Standby" has been received) AND (STM
does not or no more report National Trip Procedure)
6 ETCS order "Hot Standby"
9 ETCS order "Data Available"
15 STM is powered off
16 ETCS order "Failure"
17 The STM decides itself to go in FA state

3.2.2 STM - ETCS communication

F 2025 Reserved

3.2.3 ETCS Level Transitions

Note

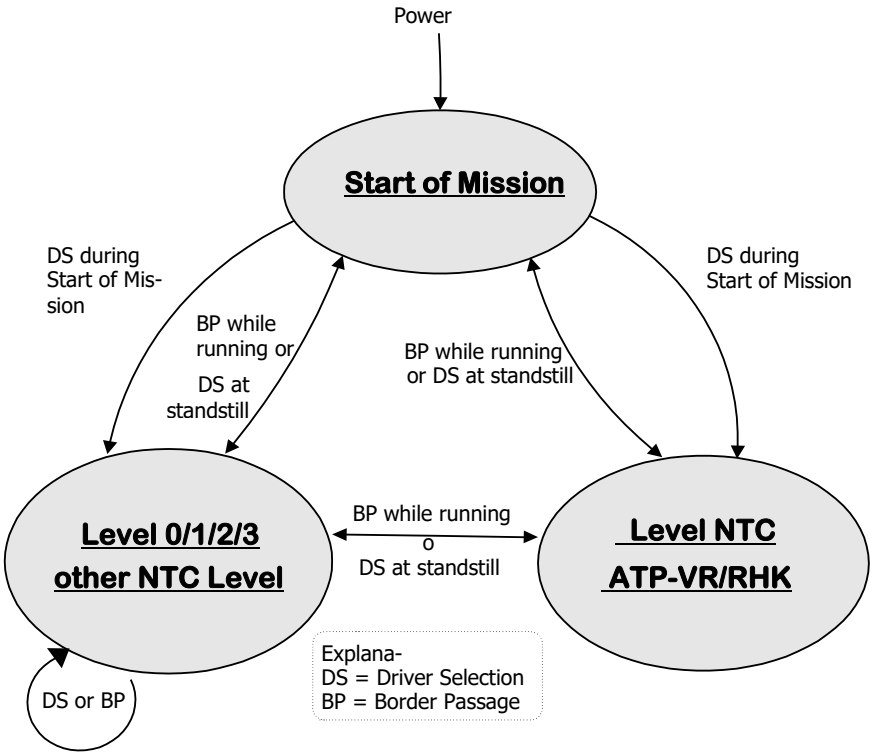


Figure 1/3. ETCS Level Transitions overview

3.2.4 Start-up in, or entering, ATP-VR/RHK area

Note [Table 9/3] is informative examples. Refer to [SUBSET-035 Specific Transmission Module FFFIS] for more details.

Note

Table 9/3. Level/Mode/State change procedures

ETCS Level	ETCS Mode	ATP-VR/RHK STM State	STM (or driver) function	Comment
-	NP	NP, No power	None	Start of Mission in STM area
-	SB	PO, Power On CO, Configuration	STM self-test Enter driver ID Select STM	
ATP-VR/RHK NTC		CO, Configuration DE, Data Entry CS, Cold Standby HS, Hot Standby	Enter ETCS train data Enter STM train data Select Start	
	SN	DA, Data Available	STM supervision	

ETCS Level	ETCS Mode	ATP-VR/RHK STM State	STM (or driver) function	Comment
Other NTC	SN	CS, Cold Standby	Passive, other STM active	Leaving other STM area Entering STM area
		HS, Hot Standby	Be ready, close to the border Take Over, other STM passive	
ATP-VR/RHK NTC	SN	DA, Data Available	STM supervision	
L0	UN	CS, Cold Standby	Passive	Leaving L0 area (ETCS Unfitted) Entering STM area
		HS, Hot Standby	Be ready, close to the border Take over	
ATP-VR/RHK NTC	SN	DA, Data Available	STM supervision	
L1, L2 or L3	FS, LS, TR, PT, SH, PS, RV, SR or SR	CS, Cold Standby	Passive	Leaving L1, L2 or L3 Entering STM area
		HS, Hot Standby	Be ready, close to the border If not in Trip mode: take over	
ATP-VR/RHK NTC	SN	DA, Data Available	STM supervision	

3.3 No Power state (NP)

Note This state is used when the STM is turned off (unpowered). This is not a software state since no STM software is running when the STM is unpowered. Refer to [SUBSET-035 Specific Transmission Module FFFIS] for more details.

Note The STM will not have any function in this state, neither supervision nor braking. It will be possible to run the train as usual, using other on-board equipment (ETCS On-board with/without other STM's). Refer to [SUBSET-035 Specific Transmission Module FFFIS] for more details.

F 2026 Reserved

F 2027 Reserved

3.4 Power On state (PO)

Note This state is activated every time when the STM is powered, also after power reset, which may occur after a STM failure. A STM self-test is then performed. Refer to [SUBSET-035 Specific Transmission Module FFFIS] for more details.

F 2028 Reserved

Note When a previously failed STM reports PO state to the ETCS Onboard, the ETCS will no longer behave as if it was fitted at all with this STM. This allows for a restart of the STM without restarting the ETCS. [SUBSET-035 Specific Transmission Module FFFIS]

Note The ETCS On-board (if not in the ETCS modes No Power, Isolation or System Failure Mode) will accept STMs entering the bus at any time, except if there was a final disconnection with the entering STM. [SUBSET-065 Specific Transmission Module FFFIS]

F 2029 Reserved

F 2030 Reserved

F 2031 The STM shall be passive in the following ways:

a) STM antenna not energised except for test purposes.
b) No supervision (only internal checks).
c) No indications on the DMI.
d) No STM braking.

Note Once in PO state, the STM will performs it's self-tests and take the initiative to open communication with the ETCS and synchronize the Safe Time Layer. Refer to [SUBSET-035 Specific Transmission Module FFFIS] for more details.

Note The communication is started by exchanging version numbers. The STM version will be identified by a compatibility number of the following format: X.Y.Z, where X, Y and Z are any number between 0 and 255. For more details, refer to [SUBSET-035 Specific Transmission Module FFFIS].

F 2032 Self-tests which shall not require communication with the driver shall be performed in PO state.

Note Refer to the Data Entry state for such tests that need response from the driver.

3.5 STM Self-tests

Note The STM can perform self-tests in all states PO, CO, DE, CS, HS and DA according to supplier.

F 2033 The STM self-test (start-up test) shall be performed. The self-test, which shall ensure that the STM equipment is fault-free and able to communicate with the ETCS, shall halt if a failure is detected.

Note The STM self-test is performed according to supplier specification

F 2295 The system shall have fail-safe fault reaction in all STM states if a failure is detected by the diagnostics.

Note Fail-safe fault reaction could involve, depending on STM operational state and data, alarm, normal/full service braking, emergency braking and rejection of new targets depending on the criticality of the fault. STM interfaces and consequential ETCS fault reactions must be considered.

F 2034 In connection with the self-test, communication shall be established with the ETCS. This communication shall continue until the STM is turned off (No Power), an ETCS communication error occurs, or the STM enters the Failure state.

F 7006 After having successfully established ETCS communication, in case of communication error with the ETCS, the STM shall have fail-safe fault reaction in all STM states.

Note The mechanisms and limit values for communication error detection are defined in related ETCS specifications e.g. [SUBSET-056 STM FFFIS Safe Time Layer] and [SUBSET-057 STM FFFIS Safe Link Layer]

F 2035 Current self-test position and error indication shall be shown.

Note The indication is according to supplier specification.

Note For the STM functions that need to be tested (e.g. the national transmission channel, the brake access), the ETCS on-board provides a specified test procedure: the STM Test Procedure. Refer to [SUBSET-035 Specific Transmission Module FFFIS] for more details.

F 2041 Reserved

F 2042 Reserved

F 2043 Reserved

F 2044 Reserved

Note For certain test procedure, the STM may ask the driver for extra confirmation by means of Specific STM Data entry request during STM Data Entry. Refer to [SUBSET-035 Specific Transmission Module FFFIS].

F 2045 Reserved

F 7008 Reserved

Note For details about the STM brake tests refer to [FRS Part 5 Braking and Auxiliary Functions].

F 7009 The STM transmission test for the dedicated antenna shall be performed as part of STM Test Procedure.

Note The STM will perform the transmission test even if the antenna is positioned directly above a balise.

F 2046 Reserved

F 2047 Reserved

F 2048 Reserved

3.6 Configuration State (CO)

Note The purpose of this state is to exchange configuration data between the STM and the ETCS On-board. This includes ETCS train data which is entered by the driver. Refer to [SUBSET-035 Specific Transmission Module FFFIS].

Note The ETCS On-board sends the following information to STM's during the configuration:

- Odometer parameters
- Status / Availability of the train interface (TIU) signals
- Status / Availability of the brake interface (BIU) signals
- Maximum time delay for the ETCS to process the receiving the service and emegency brake commands.
- ETCS train data and parameters.

F 2036 Reserved

F 2037 The STM shall wait for order from the ETCS to finish the Configuration state. STM shall be passive in the following ways:

a) STM antenna not energised except for test purposes.
b) No supervision (only some internal checks).
c) No indications on the DMI.
d) No STM braking.

Note Some internal checks can still be performed.

3.7 STM Data Entry state (DE) or function

Note This STM Data Entry state is intended for STM train data entry. It normally takes place after the ETCS train data entry in the previous state CO. Refer to [SUBSET-035 Specific Transmission Module FFFIS].

Note State DE can be skipped during the Start of Mission procedure in the following cases:

- cab is activated and the driver has selected another ETCS area and the driver skips STM train data entry. STM goes to state CS and stays there
- Another cab is activated (not this one) and the driver has selected another ETCS area. The STM goes directly to state CS and stays there.
- Another cab is activated and the driver has selected ATP-VR/RHK STM area. The STM proceeds via states CS and HS to state DA (sub-state DA Resting).

Note Data Entry should not be skipped when the cab is activated in another ETCS area, since the entered STM train data might be needed after a possible border passage into ATP-VR/RHK area. After DE, the STM goes to state CS and stays there, waiting for border passage announcement.

F 2038 Reserved

F 2039 Reserved

F 2040 Reserved

Note ETCS and STM data Entry can also be performed in STM states DA, CS and HS. This can be requested by the driver without any transition to Data Entry state.

Note ongoing ETCS performs standstill supervision when data entry function is

F 7007 If Data Entry function was called from CS, HS or DA state, the normal tasks of this state shall also be performed and the DE function shall not affect any speed supervision or other state related functions.

F 2049 When the STM exits the Data Entry function, it shall keep its present state (Data Available, Hot Standby or Cold Standby)

Note Entry of the STM train data will be handled according to [SUBSET-035 Specific Transmission Module FFFIS]. The actual data entry is managed by the ETCS.

3.8 Cold Standby state (CS)

Note Function in Cold Standby: The STM is passive but keeps waiting for any transition order from the ETCS. Refer to [SUBSET-035 Specific Transmission Module FFFIS].

F 2050 Reserved

F 2051 Reserved

Note When entering Cold Standby, the STM will maintain the connection with the ETCS On-board (the STM Control Function). Refer to [SUBSET-035 Specific Transmission Module FFFIS].

Note The STM may close the connections with some or all of the other ETCS on-board functions (Train Interface, Brake Interface, DMI and Juridical Recorder). Refer to [SUBSET-035 Specific Transmission Module FFFIS].

F 2052 The STM shall keep on waiting for a state transition order from the ETCS. Otherwise, the STM shall be passive in the following ways:
a) STM antenna not energised except for test purposes.
b) No supervision (only some internal checks).
c) No indications on the DMI.
d) No STM braking.

Note The train is permitted to start running by the ETCS as soon as the driver selects Start by button.

3.9 Hot Standby state (HS)

Note Hot Standby is used as a temporary state in the following cases:
1) During the Start of Mission procedure in ATP-VR/RHK STM area.
2) While the train is approaching the ATP-VR/RHK STM border from another area and it is time for the STM to start reading balises in order to be ready for the take-over.

F 2053 Reserved

F 2054 The following shall be performed if not in ETCS mode SB/SL/NL:

a) All passed balises shall be read, and all balise data shall be checked, stored and processed (but not supervised) by the STM.
b) No STM speed supervision
c) No STM indications on the DMI.
d) No STM braking.
e) The STM shall start sending valid information about speed indicators, speed bars and other indicators to the ETCS.

Note Case e) is to avoid a temporary indication gap at the ATP-VR/RHK STM take-over (state transition to DA).

Note Train Data Entry can be activated as a temporary procedure.

F 7010 In Hot Standby, possible balise errors shall be handled in the following ways:

a) The STM shall memorize detected balise errors.
b) The STM shall memorize related balise error messages.
c) Relevant supervision information shall be deleted.

Note This information is neither indicated nor supervised until the STM enters Data Available.

Note The ETCS will supervise a braking curve towards the valid STM target speed level. This must be ensured by Eurobalises (or via radio communication) before the border.

Note The STM does not have to inform ETCS when it is ready for a state transition to Data Available.

Note Refer to [SUBSET-035 Specific Transmission Module FFFIS] for more details.

3.10 Data Available state (DA)

Note Data Available state is only used in ATP-VR/RHK area.

F 2055 Reserved

Note Data Available (sub-state Normal or Resting) is entered in the following cases:

Transition from:	When:
Cold Standby (CS)	Passing the border to ATP-VR/RHK area without a preceding announcement and receiving ETCS order "DA" caused by Eurobalise passage. *Note.* This entry is only used if the announcement Eurobalise group is missing or not read for some reason.
Hot Standby (HS)	The train is starting up in ATP-VR/RHK area with an activated cab and the STM receives the ETCS order "DA" when the driver has selected Start by the button.
	Passing border to ATP-VR/RHK area and receiving an unconditional ETCS order "DA" caused by Eurobalise passage.
	Passing border to ATP-VR/RHK area and receiving a conditional ETCS order "DA" caused by Eurobalise passage. *Note.* This order is not given until an ETCS train trip situation has been dealt with and finished.

Note In DA Normal, the STM handles and supervises all available information (mainly from passed national balise groups) and controls DMI indications.

Note Data Available (sub-state Normal or Resting) is exited in the following cases:

Transition to:	When:
Cold Standby (CS)	Leaving ATP-VR/RHK STM area when receiving an unconditional ETCS order "CS" at the border.
	Leaving ATP-VR/RHK STM area when receiving a conditional[1)] ETCS order "CS" at the border.
	Leaving ATP-VR/RHK STM area when the driver selects another ETCS level. This can only occur with an activated cab.
Failure (FA)	System failure detected by the STM
No Power (NP)	The STM is turned off

[1)] When an STM in DA state receives a Conditional CS state transition order, the STM will be allowed to stay in DA state as long as a national trip situation is processed by this STM until the STM reports CS to the ETCS on-board.

Note For a transition to/from STM area from/to any other area, the maximum allowed speed in the new area must be provided in advance in order to provide a smooth transition.

Note Refer also to [SUBSET-035 Specific Transmission Module FFFIS].

3.11 Sub-states in Data Available (DA)

3.11.1 General

Note There are three sub-states in DA:

1) DA Normal. Normal operation in ATP-VR/RHK area. The STM will supervise every passed national balise group together with a number of special functions e.g. start restriction.
2) DA Resting. This is a passive state, used in ATP-VR/RHK area when the train is operated from another cab and

- the cab is de-activated (ETCS Sleeping mode SL), or
- the cab is used in a manually operated slave engine (ETCS Non-Leading mode, NL).

3.11.2 Sub-state DA Normal

Note This is the normal STM state where all the handling of signal information, speed restrictions and STM areas takes place.

F 2056 DA Normal, which is only be used when the cab is activated in ATP-VR/RHK area, shall be entered in the following cases:

Transition from:	When:
Hot Standby HS	DA is entered for the first time in Start of Mission, or at Border passage after border announcement (ETCS mode changes to SN (ATP-VR/RHK))
Cold Standby CS	DA is entered for the first time at Border passage, where the border announcement eurobalises were missing or faulty (ETCS mode changes to SN (ATP-VR/RHK))
DA Resting	The cab is activated (ETCS mode changes from SB/SL/NL to SN (ATP-VR/RHK))

F 2057 Reserved

Note STM status messages could be necessary to indicate e.g. tests to be done.

Note The V_{START} speed limit for start-up restriction is 35 km/h (refer to the Chapter 6 [Special Functions]).

F 2058 The STM shall handle and supervise all available information (mainly from passed balise groups) and requests ETCS applying brakes and DMI indications.

Note Received balise information is checked, decoded, stored and supervised.

Note The STM speed profile and the DMI indications will be complete to the extent that the present STM area and received balise information allows.

F 7011 DA Normal shall be exited in the following cases:

Transition to:	When:
Cold Standby CS	Transition from (ATP-VR/RHK) NTC level to another ETCS level. This transition may be caused by driver selection or a conditional or unconditional ETCS order.
DA Resting	The cab is de-activated or changed to a "slave-engine" cab (ETCS mode changed from SN to SB, SL or NL)

3.11.3 Sub-state DA Resting

F 2059 DA Resting shall be entered in the following cases, provided that the train is in or enters ATP-VR/RHK STM area.

Transition from:	When (within or entering ATP-VR/RHK area):
Hot Standby HS	Changed from an activated cab to a de-activated or "slave-engine" cab (ETCS mode = SL or NL) during Start of Mission or at a level transition.
DA Normal	Changed from an activated cab (ETCS mode = SN) to a de-activated or "slave-engine" cab (ETCS mode = SB, SL or NL)

F 2060 The STM shall be passive in the following ways:
a) STM antenna not energised except for test purposes.
b) No speed supervision
c) No STM braking.
d) No indications on the DMI.

Note ETCS on-board allows access to the train interface functions in Sleeping and/or Non-leading mode.
Refer also to [SUBSET-035 Specific Transmission Module FFFIS].

F 7012 DA Resting shall be exited in the following cases:

Transition to:	When:
DA Normal	The cab is activated in ATP-VR/RHK NTC level (ETCS mode changed from SB/SL/NL to SN) and the conditions of Cold Standby do not apply.
Cold Standby (CS)	The (ATP-VR/RHK) NTC level is changed to another ETCS level at border passage, but another cab is activated (ETCS mode SL or NL).

3.12 Failure state (FA)

Note The STM Failure state (FA) is used when an STM detects system error or ETCS orders STM to go to failure state.

Note Example to enter FA state ETCS-STM communication error or time-out.

Note The only way to exit from this error state is by performing an STM power off and restart. Note that it is possible to restart a failed STM without restarting the ETCS.

F 2067 Reserved

F 2068 Reserved

Note If possible, the STM will send an appropriate error message to the ETCS On-board and reports the ETCS about its own FA state.

Note Due to a failure of the STM itself it may not be possible to inform the ETCS. It is the responsibility of the ETCS to take appropriate action, should the contact with an active STM be completely lost.

F 2069 Reserved

Note The STM do not send messages any more on the bus, except to report FA state to the ETCS.

Note If the STM reports FA state, or is identified by the ETCS On-board as failed, then the ETCS On-board will consider that STM max speed = 0. The purpose is to try to prevent the train to enter in an STM area while this STM is failed.

Note As an exception, if a passive STM (which is not in DA) fails, no braking is performed by the ETCS. Restart of the STM is permitted.

F 2070 The STM shall be completely passive in the FA state.

F 2071 Reserved

F 2072 Reserved

Note Once the STM Control Function of ETCS On-board is aware of a failed STM, the ETCS On-board will behave as if the On-board was not fitted at all with this STM.

Note Refer also to [SUBSET-035 Specific Transmission Module FFFIS].

3.13 Travel Direction modes

3.13.1 Established Travel Direction Mode

3.13.1.1 Enter Established Travel Direction Mode

F 2073 Establish travel direction mode and change travel direction when:
a) Immediately after start-up when direction of travel is changed (i.e. is changed directly as long as not travelled more than 250 meters since start-up or not passed first main signal with a clear aspect), or
b) Travelling 250 m in the same direction after change of direction, or
c) After passing a main signal with a clear aspect.

3.13.1.2 Function during reversing in Established Travel Direction Mode

F 2074 Supervision: Reversing a distance that is less than 250 m shall result in all new balise information being ignored, with the exception of the following:
1) End/Beginning of ATP Construction Area,
2) Main signal at Stop (emergency brake action),
3) Reserved
4) Beginning of Other Country Area / End of Other Country Area

F 2075 Stored target distances for braking curves and stored linking distances shall be increased/decreased, depending on the direction of movement.

F 2076 Speed display (speed bars) shall be updated when reversing and an f1 audible signal of 1 sec duration shall be given.

F 2077 Reserved

F 2078 If the train moves more than 5 m opposite to travel direction, the STM shall start a 35 km/h ceiling speed supervision. This speed restriction shall be removed by pressing the speed increase button.

F 7014 During reversing:
a) Indications, based on earlier received balise groups (while travelling in the forward direction), shall be given.
b) Indications, based on new information from special balise groups [F 2074], shall be given.

F 2079 Resumption of the forward direction before the train has reversed for a distance no greater than 250 m shall result in the previously entered information being displayed and supervised again.

F 7015 Resumption of the forward direction before the train has reversed for a distance no greater than 250 m shall result in immediate deletion of information referring to the reverse direction, except information from special balise groups, see [F 2074].

3.13.1.3 Function after 250 m reversing in Established Travel Direction Mode

F 2080 Reversing for more than 250 m shall result in the STM changing the direction of travel, which means that the present reverse direction shall be re-defined as the new, nominal direction. All balise information will then be deleted, with exception of:
a) End/Beginning of ATP Construction Area.
b) End/beginning of ATP Other Country Area.

F 2081 After reversing for more than 250 m the STM shall change to Non-Equipped Area (unless already there). Supervision shall be managed as in Non-Equipped area.

Exception: ATP Construction or Other Country Area will be entered if Beginning of ATP Construction or Beginning of Other Country Area balise group was previously passed.

3.13.1.4 Exit Established Travel Direction Mode

F 2082 STM mode shall change to: "Non-Established Travel Direction Mode", following a new ATP start-up.

Note

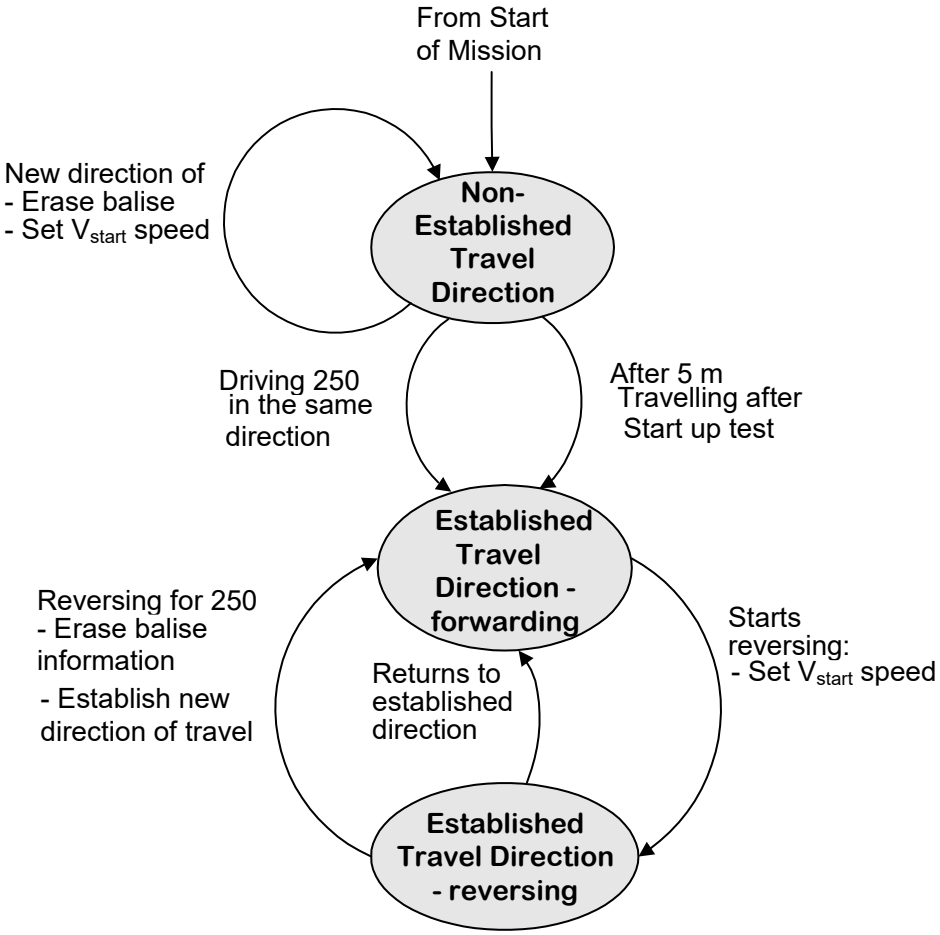


Figure 4/3. Transitions between travel direction modes

4 STM AREA CATEGORIES

4.1 General

Note A train equipped with ATP can come into contact with a variety of differently equipped sections on the line that will affect the functions of the system.

Note A train can be in a different area category than that of the area currently occupied. This can be the result of balise errors or recent start-up of the on-board ATP system.

Note In the following text, "area category" reflects the on-board state of this parameter, and not necessarily the actual area category of the section of the line.

Note Change in area category will only take place as a result of balise information, in contrast to changes in the STM state which are primarily initiated internally on-board.

Note The following figure 5/3 shows area categories and possible transitions between the various areas.

Note Area categories:

- Non-Equipped Area (In Finnish: Varustamaton alue)
- Fully Equipped Area (In Finnish: Varustettu alue)
- Construction Area (In Finnish: JKV-rakennusalue)
- Other Country Area (In Finnish: Vieraan järjestelmän alue)

F 2083 The STM areas shall only work while the STM is in the Data Available state. When entering Data Available, the present area shall be determined by possibly stored balise information, which can be none or there could be stored balise information.

Note Stored balise information can be missing after start-up and stored balise information can be present when changing from Hot Standby to Data Available state at the ATP-VR/RHK area border.

F 2084 Reserved

F 2085 The maximum permitted speed V_{TRAIN} of the train shall be supervised in all STM area categories.

4.1.1 Area transitions

Note

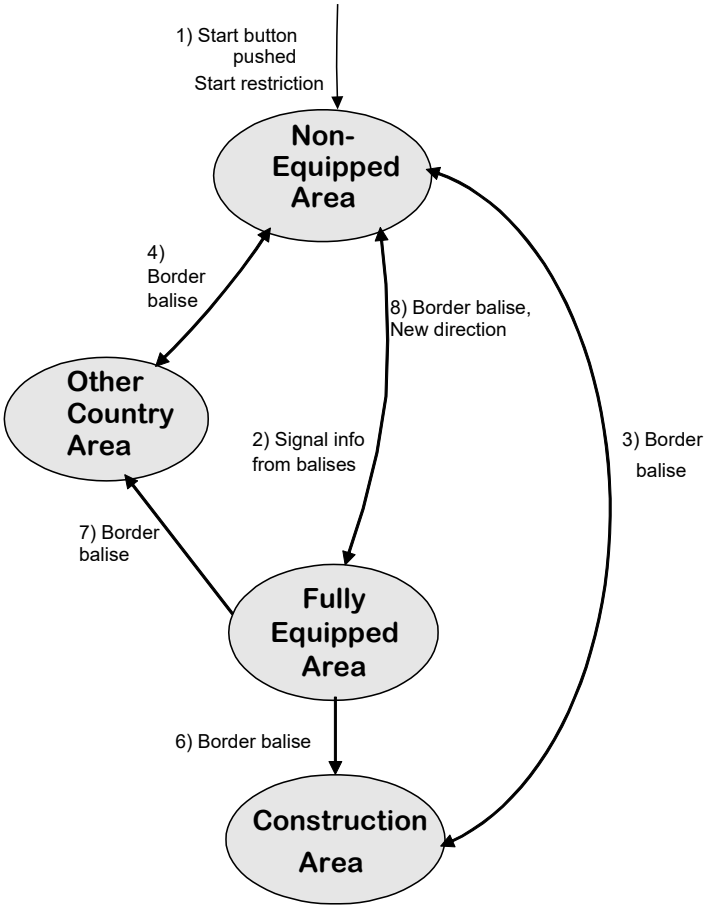


Figure 5/3. Area transitions

Note The transition numbers in the figure 5/3 refer to the transition tables in the following chapters 4.2 – 4.5.

4.1.2 Area indications

Note

Table 10/3. Area Indications Overview

Area	Max speed bar	Target speed bar	Type	Indication
Construction	Off	Off	Flashing	"RAK. ALUE"
Equipped	On	On	Static	None
Non-Equipped	Off	Off	Static	"- - -"
Other country	Off	Off	Static	"MUU MAA"

4.2 Non-Equipped Area

Note This area is used in non-ATP territories. There can be speed board, warning board or repeater signal balises in a non-equipped area.

Note The transition numbers in the following tables refer to the transition diagram [Figure 5/3].

F 2086 Non-Equipped Area shall be entered according to the following conditions:

Transition from:	When:
Start of Mission (1)	When the start-up procedure is finished (when Data Entry is completed and the Start button pushed by the driver)
Fully Equipped Area (8)	Passing a border to Non-Equipped Area
	Establishing a new direction of travel
ATP Construction Area (3)	Passing End of ATP Construction Area balise group
onhan Other Country Area (4)	Passing End of Other Country Area balise group

F 2087 Reserved

F 2088 When the train passes the border balises from Fully Equipped Area to Non-Equipped Area the ATP border text indication "JKV RAJA" shall be shown for 7 seconds and an audible signal is given (signal f1).

F 2089 The maximum permitted speed of the train shall be supervised according to the lowest of following speeds:

a) the speed limit indicated by the border balises (not always given), or
b) the max. entered train speed V_{TRAIN}, or
c) the 120 km/h maximum non-equipped area speed.

F 2090 When entering Data Available from Hot Standby and BUA information has already been received, the supervision of the 120 km/h maximum speed or BUA speed shall be supervised.

Note Without a signal there will be a start-up restriction supervised.

F 2091 The speed bars shall be extinguished, and the Non-Equipped Area shall be indicated.

Note ATP-VR/RHK system text indication is "- - - ".

F 2092 All information given by balises shall be supervised but there are no speed or distance displays for driver. Only text information shall be shown.

Note Examples of ATP-VR/RHK system text indications are "NOP.RAJ." etc.

F 7016 Non-equipped area shall be exited according to the following conditions:

Transition to:	When:
Fully Equipped Area (2)	Passing a main and/or distant signal
ATP Construction Area (3)	Passing beginning of ATP Construction Area balise group
Other Country Area (4)	Passing beginning of Other Country Area balise group

4.3 Fully Equipped Area

Note The transition numbers in the following tables refer to the transition diagram [Figure 5/3].

F 7017 Fully Equipped Area shall be entered according to the following table:

Transition from:	When:
Non-equipped area (2)	Passing a main or distant signal

F 2093 The above conditions shall activate full speed display after entering Fully Equipped Area. This means that the speed and target distance bars shall be displayed regardless of speed levels. The condition is that signal information is available.

F 2094 In the Fully Equipped Area complete supervision shall be active, and the current max and target speed and distance shall be shown.

F 2095 The max speed and target indications shall always be shown except during special cases i.e. after balise error grades 3-5 or passing stop signal or reserved track.

F 7018 Fully equipped area shall be exited according to following conditions:

Transition to:	When:
Non-Equipped Area (8)	Passing a border to Non-Equipped Area
	Establishing new direction of travel (after 250 m reversing)
ATP Construction Area (6)	Passing beginning of ATP Construction Area balise group
Other Country Area (7)	Passing beginning of Other Country Area balise group

4.4 ATP Construction Area

Note The transition numbers in the following tables refer to the transition diagram [Figure 5/3].

F 2096 ATP Construction Area shall be entered in the following ways:

Transition from:	When:
Non-Equipped Area (3)	Passing beginning of ATP Construction Area balise group
Fully Equipped Area (6)	

F 2097 When the train passes the border beginning of ATP Construction Area balises the ATP border text indication "JKV RAJA" shall be shown for 7 seconds and an audible signal shall be given (signal f1).

F 2098 All balise groups shall be ignored except End of ATP Construction Area.

F 2099 No balise error alarms shall be given.

F 2100 The speed bars and the target distance bar shall be extinguished.

F 2101 The ATP Construction Area text indication "RAK. ALUE" shall be displayed flashing.

F 2102 The maximum permitted speed of the train shall be supervised according to the lowest of following speeds:

a) the speed limit indicated by the border balises (not always given), or
b) the max. entered train speed V_{TRAIN}, or
c) the 120 km/h maximum construction area speed.

F 7019 ATP Construction Area shall be exited in the following ways:

Transition to:	When:
Non-Equipped Area (3)	Passing an end of ATP Construction Area balise group

4.5 Other Country Area

Note The transition numbers in the following tables refer to the transition diagram [Figure 5/3].

F 7020 Other Country Area shall be entered according to the following conditions:

Transition from:	When:
Non-Equipped Area (4)	Passing a border to Other Country Area balise group
Fully Equipped Area (7)	Passing a border to Other Country Area balise group

F 2103 Reserved

F 2104 When the train passes the border beginning of Other Country Area balises the ATP border text indication "JKV RAJA" shall be shown for 7 seconds and an audible signal shall be given (signal f1).

F 2105 All balise groups shall be ignored except End of Other Country Area and speed boards.

F 2106 No balise error alarms shall be given.

F 2107 The speed bars and the target distance bar shall be extinguished.

F 2108 The Other Country Area text indication "MUU MAA" shall be displayed.

F 7021 Other Country Area shall be exited in the following ways:

Transition to:	**When:**
Non-Equipped Area (4)	Passing a End of Other Country Area balise group

F 7022 Reserved

5 HANDLING OF MAXIMUM PERMITTED SPEED

5.1 Various speed limits

F 2115 Following speed limits shall be handled by the STM:

Table 11/3. Speed limits

No	Name	Meaning
1.	V_{TRAIN}	Maximum permitted speed of the train *(Sn, from ETCS train data)*. Value from ETCS shall be reduced by 10 km/h when last PT code digit is 1 or 3 or 5 or 7.
2.	V_{START}	35 km/h speed limit after ATP start-up. Can be 0 km/h while waiting for train data.
3.	V_{TARGET}	Target speeds from signals and warning boards. Information given in advance for switch and speed restrictions as well as stop signals.
4.	V_{LINE} V_{C1} V_{C2} etc.	Speed restrictions (speed limits), received from the most recent warning or speed board or signal. Categories: - Line speed, - C1 or C2, curve speed - etc.
5.	$V_{RELEASE}$	Release speed at which the train can approach signal at Stop.
6.	V_{END}	Target Speed when no Release Speed is used, otherwise Release Speed. For the stop aspect (also by level crossing and landslide) it is release speed.
7.	V_{ERR}	80 km/h or 60km/h speed limit after balise error grades 2-5

F 2116 Reserved

5.2 Exceeding of curve speed limits

F 2117 The basic speed limit from a speed or warning board of categories C_1 shall be increased by percentage value of 50, if type of train is "tilting train".

F 2118 The basic speed limit from a speed or warning board of categories C_2 shall be increased by percentage value of 25, if type of train is "tilting train".

F 2296 The STM shall round the increased speed limit supervision and indication to the closest (lower) 5 km/h increment, if type of train is "tilting train".

5.3 Display

Note The current maximum permitted speed (V_{MAX}) is displayed by the DMI, unless the speed bars are extinguished by the STM according to the rules that apply for the different areas.

F 2119 Reserved

5.3.1 The train length delay function

F 2120 Information concerning increase of the permitted speed (V_{MAX}) shall be detected by the on-board system when the leading engine passes the point of speed increase.

F 2121 To prevent the rear of the train from travelling too fast, the introduction of the increase in speed shall be delayed until the whole length of the train has passed the point of increase.

F 2122 Exceptions to [F 2121] shall apply for:

- Max speed of the train (V_{TRAIN}),
- 35 km/h Start restriction,
- Line speed,
- Stop signal target updated,
- 50 km/h Stop passage speed restriction,
- Speed restriction of Non-equipped, Construction or Other Country Area,
- 35 km/h Reversing restriction,
- Start of dV_{inc} area and end of dV_{dec} restriction,
- M3, LCP and LZ-restrictions,
- Cancelled speed restrictions,
- Cancelled switch restriction before End speed position.

F 2123 Reserved

F 2109 Reserved

F 2110 Reserved

F 2111 Reserved

F 2114 Reserved

6 SPECIAL FUNCTIONS

F 2124 The following functions (chapters 6.1 – 6.5) shall work in Data Available (DA Normal) but not in any other state.

6.1 Start speed restriction 35 km/h

F 2131 The V_{START} speed limit shall be set to 35 km/h if any of these conditions apply:

a) DA Normal is entered from Cold Standby, Hot Standby or DA Resting, and there is no signal information stored (main and/or distant signal information).
b) When driving direction has changed in start-up zone.

F 2132 Start speed restriction text indication "SN 35" shall be displayed on the DMI.

F 2133 When entering Data Available from Hot Standby and signal information has already been received, the start restriction shall not be activated at all.

Note This is the case at border passage into ATP-VR/RHK STM area.

F 2134 The start restriction shall be finished at main or distant signal passage without train length delay.

F 2135 The system shall remain in start restriction state until one of the following happens:
a) The speed increase button is pressed. Then the system transits to Non-Equipped Area mode.
b) The train passes a signal information location, i.e. the system receives a balise telegram with signal information. Then the system transits to Fully Equipped Area mode.
c) The train passes Beginning of Other Country Area speed board
d) The train passes Beginning of ATP Construction Area speed board

6.2 Reserved Track

Note A reserved track means that the train route is not free to the end point. To set a train route on a reserved track is a special command on the interlocking system. After setting this train route the signals indicate a switch speed of 35 km/h. The ATP activates the reserved track function at the last main signal before the reserved track.

6.2.1 Entering a reserved track

F 2136 The STM shall enter a reserved track at the following balise information:

a) Signal information (R2 = 1), and
b) RT, Reserved Track (R3 = 5).

Note In this case, the balise information contains a switch restriction of 35 km/h (R31 = 2). Example, with the mentioned nibbles underlined:
2215 D2EB 13A2 C113 1913 637E EEEE EE62 137E EEEE E6EE E343 38CA E6B0 45D7 56F4
Contents: Signal with V_{TRACK} = 40 km/h, V_{TARGET} = 10 km/h which is the release speed of the next main signal, and the target distance 1100 m, First switch restriction = 35 km/h (R31 = 2) with the target distance 25 m.

6.2.2 Supervision and display on a reserved track

6.2.2.1 During the target distance to the target switch point

F 7023 When receiving Reserved Track - balise telegram from signal balises:
target speed of the switch restriction shall be supervised to target point
reserved track text information shall be shown
at target point of 35 km/h switch all indications shall be turned off and reserved track text indication starts to blink
after target point switch restriction shall be supervised as ceiling speed.

Note Switch restriction of 35 km/h switch can be lowered to 20 km/h by specific train data (PT code).

Note All received balise information is supervised normally. The STM supervises also the target speed of the switch restriction, which is 35 km/h.

F 2137 The reserved track indication "VAR. RAIDE" shall be shown.

6.2.2.2 After the 35 km/h target switch point

F 2138 Reserved

F 2139 The reserved track text indication shall start flashing.

F 2140 The speed and distance bars shall be extinguished.

Note This applies also if there is a supervised restrictive target speed (lower than the present max speed).

6.2.3 Leaving a reserved track

F 2141 The Reserved Track function shall be released and normal indications resumed, if the following conditions are fulfilled:

a) the train at standstill and the driver presses the increase speed button, or
b) the train has passed signal balise group with main signal information.

6.3 Stop Passage

6.3.1 General

Note Stop signal passages are handled by the STM and the ETCS in co-operation. At every unauthorized stop signal passage, the STM sends a stop message which immediately causes ETCS emergency braking. STM activates emergency brakes by using the redundant direct emergency brake interface. Brake release cannot be performed until the train has stopped.

Note Stop signal passage can also be authorized according to certain rules, see below.

F 2142 A received balise message shall always be interpreted as a stop signal if the following conditions are fulfilled:
a) The balise telegram has no BCH code errors, and
b) there is signal information (R2 = 1), and
c) the main signal line speed VTRACK = 0 km/h (R16-R17 = $11), and
d) the balise is not detected as opposite direction (the group is intended for current direction or is a single balise).

Note This applies regardless of the contents of the other nibbles (correct or not).

Note Example, with the mentioned nibbles underlined:
22<u>1</u>1 485C 1685 C172 <u>11</u>EE EE6E EEEE EE6E EE6E EEEE E6EE E683 951D E582 A229 3E8C

F 2143 If the travel direction of the train has been determined, every stop signal balise group shall be handled within 0.5 s after the passage of
1) Balises A + B, and
- both balises are correct and readable.

2) Balises A + B, and
- only one balise is readable, and
- the IL can still be defined as valid for the present direction (first balise is an A-balise or second balise is a B-balise).

3) One balise is correct and readable, and
- the other balise is missing, and
- the IL can not be clearly defined as valid for the present direction.

F 2144 Reserved

6.3.2 Unauthorized stop passage

F 2146 Reserved

F 2147 At every unauthorized stop signal passage, the STM shall immediately send emergency brake command to ETCS and the STM shall apply emergency braking using the direct emergency brake interface.

F 2148 Braking shall be released at standstill by pressing Acknowledge Stop Passage button "SEIS KUITT." and then Brake Release button "JARR. IRR:"

Note This applies both to EB and SB.

F 9040 When unauthorized stop signal passage has occurred, STM shall repeatedly send "National Trip procedure" packet to ETCS until Acknowledge Stop Passage button is pressed by the driver.

Note The purpose with this packet is to inform ETCS to go to ETCS mode TRIP, if the STM "is in trip situation" when a level transition balise to ETCS area is passed.

F 2149 Braking shall be avoided by using Authorized Stop Passage button "SEIS OHI".

Note See Authorized Stop Passage in [Chapter 6.3.3].

Note The requirements [F 2147] to [F 2149] refer both to ETCS and STM emergency brake control.

F 2150 The STM shall command ETCS to release brakes when conditions according to [F 2148] are fulfilled.

F 2151 After an unauthorized stop signal passage, the following information shall be sent to braking curve calculation and maximum permitted speed supervision as soon as the train has stopped, and the brakes have been released:

a) Speed restriction 50 km/h until the next main signal
b) No distant signal speed

Processing of balise telegram of main signal is ended after stop signal passage. Supervision of IL and signal linking chain is cancelled.

F 2152 Target and permitted speed and distance indications shall be turned off and unauthorized stop passage indication "SEIS OHI" shall be shown. If there are lower speed restrictions given by balises, they shall be supervised without target speed and distant indications.

F 2153 Reserved

6.3.3 Authorized stop passage

F 2154 Conditions for an authorized stop passage shall be as below (no emergency braking action):

a) If the authorized stop passage button "SEIS OHI" (not available on the normal menu) is pressed before the stop signal, and
b) The train speed does not exceed 50 km/h, and
c) Less than 30 seconds have elapsed since the button was pressed.

Note Braking curves and release speed (if any exists) are supervised normally until train passes main signal.

F 9041 If STM state is HS and ETCS mode changes to Trip after passing a stop signal, or if a stop signal is passed while ETCS mode equals to Trip, the stop signal passage shall be handled as a permitted stop signal passage.

F 9042 If the STM has been ordered from Hot Standby to Cold Standby and after this is ordered directly from Cold Standby to Data Available, the STM supervision shall be according to an authorized stop signal passage when entering Data Available.

Note Justification for the requirement is that a stop signal may have been passed in the transition area.

F 2155 If all conditions for an authorized stop passage are fulfilled, the STM shall permit stop passage, and calculate Braking Curves and maximum Speed Supervision by using:

a) Speed restriction 50 km/h, and
b) No distant signal speed.

Processing of balise telegram of main signal is ended after stop signal passage. Supervision of IL and signal linking chain is cancelled.

F 2156 The stop passage permission shall be erased when:

a) A main signal is passed (regardless of aspect), or
b) 30 s has elapsed since the authorized stop passage button was pressed.

F 2157 The authorized stop passage text indication "SEIS OHI" shall be displayed as long as the stop passage permission is valid. Indication shall start flashing and authorized stop passage button shall be available 10 seconds before the permission expires because of 30 s time-out.

F 2158 The 30 s stop passage permission timer shall be restarted upon following conditions:

a) 20...29 s has elapsed (flashing lamp), and
b) the authorized stop passage button is pressed again, and

c) the train speed is 50 km/h or below.

F 2159 If the conditions for stop passage permission are not fulfilled, there shall instead be an unauthorized stop signal passage as specified in [F 2147 to F2148].

6.3.4 Supervision after stop passage

F 2160 After passing a stop signal speed restriction 50 km/h shall be supervised.

F 2161 After passing a stop signal, a next main signal with clear aspect shall terminate the 50 km/h speed restriction and extinguishes "SEIS OHI" indication.

6.3.5 Indication after a stop passage

F 2162 Until the brakes have been released after an unauthorized stop passage, indication "STM JARR" shall be displayed.

F 2163 Reserved

Note After brake release or after an authorized stop passage, the following two requirements will be fulfilled by the STM until a new Proceed main signal is passed.

F 2164 The passed stop indication "SEIS OHI" shall be displayed.

F 2165 The permitted and target speed and distance bars shall be extinguished

6.4 Balise Error

Note Different balise error situations with related error messages are listed in [FRS Information Flow Track-Train, Table 1/2].

F2273 Balise error 1 shall only have an error indication. Balise errors 2-5 cause service braking and speed restriction (V_{ERR}) of 80 km/h, or 60km/h with brake type G. Brakes can be released at speed limit or, if speed is lower than that, 2 seconds after braking. The higher error type number, the more balise information will be erased. Balise error grades 3, 4 and 5 also extinguishes the speed bars.

F 2274 Balise error grade 1:

- only indication to the next main signal, at least 10 sec.
- no braking or speed restriction
- no effects to supervisions or stored balise information
- if erroneous IL is single coded and error is given because of ETS or ETB telegram, IL linking chain is broken at erroneous IL

F 2275 Balise error grade 2:
- braking and speed restriction
- no effects to supervisions or stored balise information
- error function is on to the next main signal, at least 10 sec.

F 2276 Balise error grade 3:
- braking and speed restriction
- error function is on 3600 m
- IL linking chain is broken

F 2277 Balise error grade 4:
- braking and speed restriction
- error function is on to the next main signal, at least 10 sec.
- IL linking chain and signal linking chain are broken

F 2278 Balise error grade 5:
- braking and speed restriction
- error function is on 3600 m and to the next main signal
- IL linking chain and signal linking chain are broken

F 2279 Balise error grades 3-5:
- Existing supervisions shall be supervised to the target point and to be removed from the register after that; for example: switch restriction shall be supervised to the target point in case of balise error, but length of the restriction area is not supervised
- In case of balise error shall permitted speed, target speed and target distance indicators be extinguished.

F 2280 Actions at balise errors shall be according to [Table12/3].

Table 12/3. Actions in balise errors

Balise error grade	Indications turned off	Speed restriction of balise error (note)	Delete speed restriction information	Delete signal information	Error indication		
					At least 10 s	To next main signal	At next 3,6 km
1	-	-	-	-	Yes	Yes	-
2	-	Yes	-	-	Yes	Yes	-
3	Yes	Yes	Yes	-	-	-	Yes
4	Yes	Yes	-	Yes	Yes	Yes	-
5	Yes	Yes	Yes	Yes	-	Yes	Yes

F 6005 For indications when multiple balise errors have occurred the following rules apply:

- A flashing balise error has priority over a fixed.
- If several balise errors are flashing the one with highest error grade is displayed.
- If several balise errors are fixed the one with highest error grade is displayed.

6.5 Information to the ETCS

Note Refer to [Subset-035 Specific Transmission Module FFFIS]

F 2167 Reserved

F 2168 Reserved

F 2169 Reserved

F 2170 Reserved

F 2125 Reserved

F 2126 Reserved

F 2127 Reserved

F 2128 Reserved

F 2129 Reserved

F 2130 Reserved

F 2145 Reserved

7 SPEED RESTRICTIONS

7.1 General

Note Supervision of deceleration to a new, lower speed level will commence when passing a distant signal or warning board with a restrictive target speed.

Note This section describes how different kinds of target information are handled by the STM and rules of updating old target speed information. STM selects the most restrictive target speed information.

7.2 Signal related information

7.2.1 Overview

Note

Table 13/3. Signal related balise groups

INFORMATION LOCATION (IL)		Record Id R2	Record Id R3	Line speed R16-R17	Target speed R18-R19
Signal	Combined signal	1	1...6	0...555 km/h	0...555 km/h
	Single main signal		1		Cancelled
Repeater signal	Repeater distant signal	2	1...6	Cancelled	0...555 km/h
	Linking repeater		8		Cancelled
Speed board	End of Switch Restrictions (SRe)	3	1	*)	–

*) One of R16-R17, R20-R21, R24-R25 or R28-R29 = SRe.

Note The following information can be received from a signal or a repeater signal IL:

a) Identity of this IL and of next IL and next main signal IL (basic target distance)
b) Linking distance to next IL and to next main signal
c) Line speed V_{LINE}
d) Target speed V_{TARGET}
e) Deferment distance
f) Release speed V_{REL}
g) Length of overlap
h) Reserved Track (RT)
i) Switch restrictions 1 and 2 (SR1, SR2)
j) Gradient information (GR)

7.2.2 Signals and Repeater signals

Note The type of the balise telegram is the only difference between the balise telegram of a repeater signal (R2 = 2) and the balise telegram of a signal (R2 = 1). There is never main signal information in the balise telegram of the repeater signal. Balise error handling of the repeater signal is also more simple than the error handling of the balise telegram of the signal.

F 2171 A correct telegram of repeater signal type shall be handled in the same way as a balise telegram of signal type.

Note A special case of repeater signals is linking repeater. Basic distance (distance to the next main signal) has to be given in the balise telegram of the linking repeater. Target speed can not be given by a linking repeater.

F 2172 A received linking repeater message shall be used to update basic distance, release speed, gradients and switch restrictions.

F 2173 An earlier given linking distance shall be updated by a new one when passing a signal, repeater signal or linking repeater IL.

F 2174 If a stop message (release speed) is given by a linking repeater IL, it shall be used to update the release speed of the next main signal.

Note This is only used if the distant signal target speed is (or is changed to) Expect Stop.

F 2175 Switch restrictions shall be handled in the same way as in [F 2171] to [F2174], regardless of which type of IL they are given by (signal, repeater signal or linking repeater).

7.2.3 Main signal information

Note Only main signals (R2 = Signal) have line speed information.

Note Line speed V_{LINE} can be updated by:

1) A main signal IL (R2 = Signal)
2) Speed after first switch (after the length of the switch point), from a signal or repeater signal IL
3) Speed after second switch (after the length of the switch point), from a signal or repeater signal IL

F 2176 Existing line speed shall always be updated and replaced by new main signal line speed information.

F 2177 The line speed V_{LINE} shall be supervised without train length delay.

Note See also the special function Stop signal passage.

7.2.4 Distant signal information

7.2.4.1 General

F 2178 Distant signal information is used to calculate braking curves. The type of the telegram defines how distant signal information shall be used:

1) Signal or Repeater signal:
   - The Basic distance nibbles (R20-21) give Target distance
   - The Basic gradient nibble (R22) gives Target gradient
   - The Target speed nibbles (R18-19) give line speed at next main signal
   - The Stop message nibbles (R28-29) give Release speed of the next main signal
2) Overlap Stop (OS):
   - The Basic distance nibbles (R20-21) give Target distance
   - The Basic gradient nibble (R22) gives Target gradient
   - The Target speed nibbles (R18-19) give Release speed (of the next main signal, shall only be used if the train stops before the next signal
   - Target supervision as Expect Stop
   - The Stop message nibbles (R28-30) give Length and gradient of overlap which shall only be used for calculated Release speed
3) Release Speed Stop (RSS):
   - The Basic distance nibbles (R20-21) give Target distance
   - The Basic gradient nibble (R22) gives Target gradient
   - The Target speed nibbles (R18-19) give Release speed of the next main signal
   - Target supervision as Expect Stop
   - The Stop message is not given (R28-30 cancelled)
4) Deferred Stop (DS):
   - The Basic distance (R20-21) + Stop message (R28-29) give Target distance
   - The Basic gradient nibble (R22) gives gradient for the next main signal
   - The Stop message nibble (R30) gives Target gradient for the stop signal
   - The Target speed nibbles (R18-19) give Release speed of the next main signal
   - Target supervision as Expect Stop to the main signal behind the next main signal
5) Reserved Track Stop (RT):

- The Basic distance nibbles (R20-21) give Target distance
- The Basic gradient nibble (R22) gives Target gradient
- The Target speed nibbles (R18-19) give Release speed of the next main signal
- Target supervision as Expect Stop
- Stop message is not given (R28-30 is cancelled)
- Switch restriction = 35 km/h is mandatory

6) Deferred Go (DG):

- The Basic distance (R20-21) + Stop message (R28-29) give Target distance
- The Basic gradient nibble (R22) gives gradient for the next main signal
- The Stop message nibble (R30) gives Target gradient for the target signal
- The Target speed nibbles (R18-19) give line speed at the main signal behind the next main signal (as target)

Note

Table 14/3. Signal information: Target speed and Stop message

<table>
<tr><th colspan="2">Record identification</th><th>Target speed (km/h)</th><th>Stop message</th></tr>
<tr><th>R2</th><th>R3</th><th>R18 - R19</th><th>R28 - R29</th></tr>
<tr><td rowspan="5">Signal</td><td>Signal</td><td>Line speed at next main signal</td><td>Release speed (km/h) at next main signal</td></tr>
<tr><td>DG</td><td>Line speed at target main signal</td><td rowspan="2">Deferment distance (m)</td></tr>
<tr><td>DS</td><td rowspan="3">Release speed at next main signal as Expect Stop</td></tr>
<tr><td>OS</td><td>Overlap (m)</td></tr>
<tr><td>RSS, RT</td><td>Cancelled</td></tr>
<tr><td rowspan="5">Repeater signal</td><td>Linking repeater</td><td>Cancelled</td><td rowspan="2">Release speed (km/h) at next main signal</td></tr>
<tr><td>Repeater Signal</td><td>Line speed at next main signal</td></tr>
<tr><td>DG</td><td>Line speed at target main signal</td><td rowspan="2">Deferment distance (m)</td></tr>
<tr><td>DS</td><td rowspan="3">Release speed at next main signal as Expect Stop</td></tr>
<tr><td>OS</td><td>Overlap (m)</td></tr>
<tr><td>RSS, RT</td><td>Cancelled</td></tr>
</table>

Note The target distance is used for updating the length of supervised train movement to target point.

F 2179 Reserved

F 2180 Reserved

7.2.4.2 Updating of distant signal information

F 2181 Existing distant signal information shall always be
a) updated and replaced by new distant signal information from signals or repeater signals (R2 = 1 or 2).
b) erased when passing a signal (R2 = 1) without distant signal target speed information (R18-R19 = Cancelled).

F 2182 At Expect Proceed (R3 = Signal, Repeater signal or DG), the stop message shall be interpreted as release speed at the next main signal and saved together with the other braking curve information.

Note This release speed is only used if the train stops before the next main signal, see [F 2183].

F 2183 If the train has received a signal with distant signal information, DS or DG balise telegram and it stops, the next main signal shall be supervised as Expect Stop.

7.2.4.3 Expect Stop distant signal message (RSS or OS)

F 2185 Reserved

F 2186 Reserved

F 2187 Reserved

Note

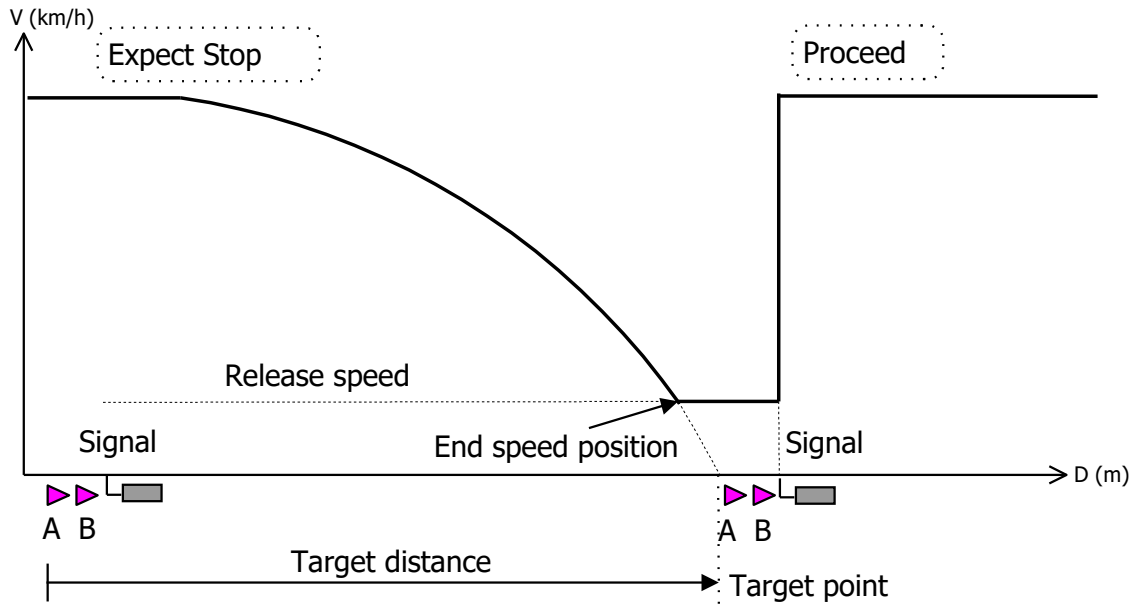


Figure 6/3. Supervision of an Expect Stop distant signal message

7.2.4.4 Deferred Stop (DS)

Note A Deferred Stop braking curve (where the target speed is Expect Stop), is meant for use mainly in association with advanced signalling, replacing reduction of target speeds by stages.

Note

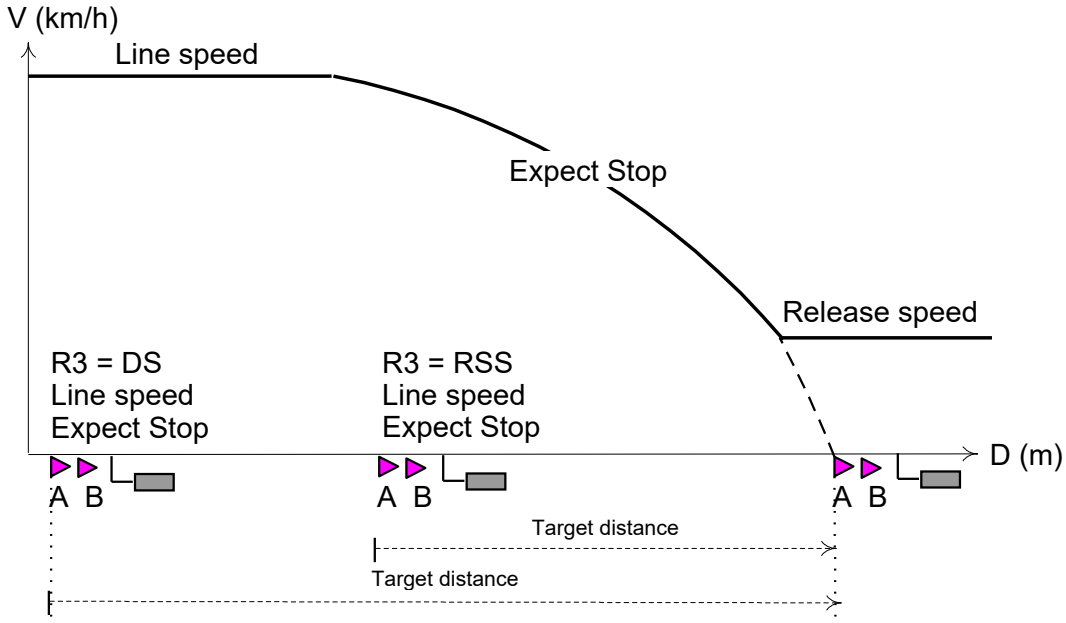


Figure 7/3. Deferred Stop

7.2.4.5 Deferred Go (DG)

Note A Deferred Go braking curve (where the target speed is reduced line speed), is like the Deferred Stop meant for use mainly in association with advanced signalling, replacing reduction of target speeds by stages.

Note

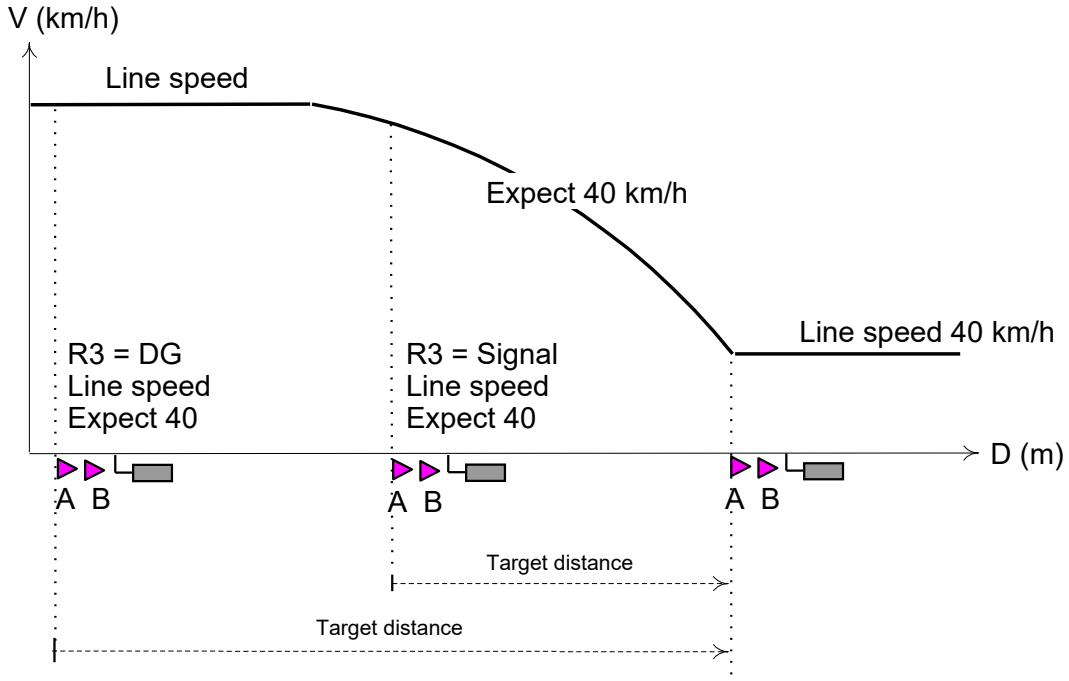


Figure 8/3. Deferred Go

7.2.4.6 Reserved Track stop (RT)

Note When receiving a Reserved Track balise telegram from signal balises the following will be performed:

- The supervision is normal until the train passes the target point of the first switch. The DMI will then display the reserved track indication "VAR. RAIDE".
- At the target point of the first switch, all indications are turned off and the reserved track indication starts to blink. After that, only the switch speed is supervised as ceiling speed.
- When train is at standstill the increase speed button "NOP. KOH." can be pressed to return to normal supervision.

Note Refer to the Chapter 6 [Special Functions] for more details.

7.2.5 Switch restrictions (SR1, SR2)

7.2.5.1 General

Note Information about restrictions for one or two switch points ahead (SR1, SR2) is given by signal balises. These restrictions can either be finished after a given length or by speed board balises (SRe).

Note

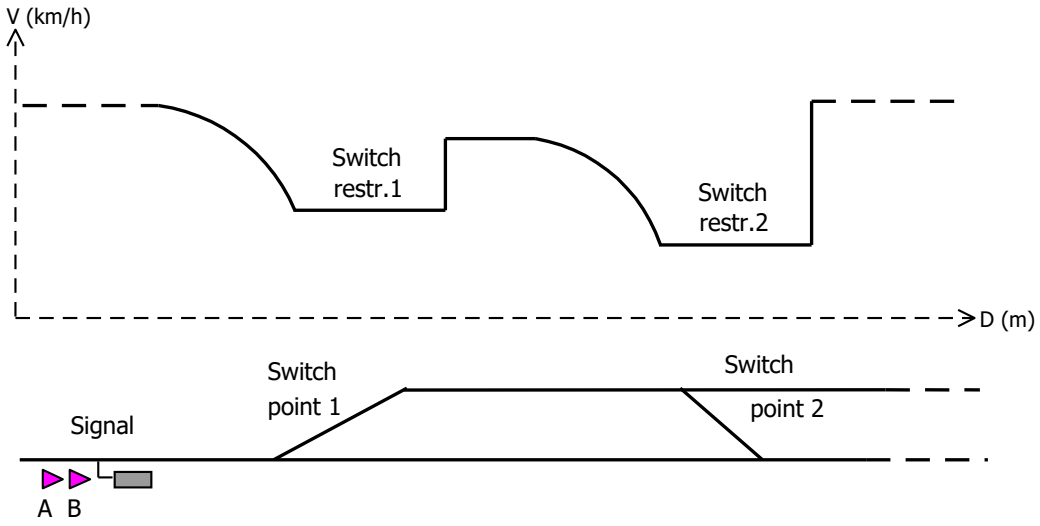


Figure 9/3. Switch restrictions

F 2188 Reserved

F 2189 There shall be max. 14 switch restrictions in supervision at the same time.

Note Balise error is generated in case maximum number of switch restrictions is violated (e.g. restriction overflow). For more details, refer to [FRS Part 2 Information Flow Track-Train].

7.2.5.2 Switch restriction information

F 2190 Speed of switch restriction shall be affected by PT code in the following ways:

1) If switch restriction is 35 km/h and bit 2 of PT code is activated, a switch restriction of 35 km/h and speed after switch 35 km/h shall be changed to a restriction of 20 km/h.
2) If switch restriction is 70 km/h or 80 km/h and bit 3 of PT code is activated, restrictions of switch and speed after switch 70 km/h and 80 km/h shall be changed to restriction of 60 km/h.

Note In the balise telegram, there can be also a "speed after switch" restriction. This can be equal or higher than the speed of the switch restriction.

F 2191 Line speed given by main signal shall be replaced by the restriction at end point of switch restriction (speed after switch).

F 2192 Reserved

7.2.5.3 Updating of switch restrictions

F 2193 Switch restriction target information shall be updated according to the following rules:

a) Switch restriction information is repeated in every signal, repeater signal and linking repeater balise group all the way to the ESP of the switch restriction.
b) At repetition the new message replaces the old one
c) A signal, repeater signal and linking repeater balise group without switch information along the way to ESP of the switch restriction deletes all stored switch restriction immediately.

7.2.5.4 Termination of switch restrictions

F 2194 If a switch restriction is given with length, this restriction shall be terminated when the whole train has passed this length.

F 2195 If a switch restriction is given without length, the restriction shall be supervised with train length delay after the train passes balises, containing "Switch Restriction end" information (SRe). SRe information shall end all switch restrictions given without length in spite of speed of restriction.

Note SRe-type (Switch Restriction end) is only used in speed boards. There is a possibility to use SRe-balises to indicate the exact position of the end point of a switch restriction.

7.3 Board related information

7.3.1 Overview

Note Warning and speed board balise groups may contain these restriction types:

Table 15/3. Warning and speed board information

Warning board	**Speed board**	**Meaning**
dVinc, dVdec	Not used	Delta-speed increase/decrease
M1, M2, M2c, M3, M3c	M1, M2, M2e, M3, M3e	Mandatory 1...3
C1, C1c, C2, C2c	C1, C1e, C2, C2e	Curve 1...2
LCP1, LCP1c, LCP2, LCP2c, LCP3, LCP3c	LCP1, LCP1e, LCP2, LCP2e, LCP3, LCP3e	Level Crossing Protection 1...3
LZ, LZc	LZ, LZe	Landslide Zone
BUA, BCA, BOC	BUA, BCA, BCAe, BOC, BHC,	Border for Unequipped Area/ Construction Area/Other or Home Country
TRSw, TRSt	TRSw, TRSt, TRSwe, TRSte	Track Route Specific, diverging/straight
TS1...TS15, TS1c...TS15c	TS1...TS15, TS1e...TS15e	Train Specific 1...15
Not used	SRe	End of switch restriction
Not used	ODO, ODOe	Start/End odometer control area

Explanations: XXc = Cancelled XX
YYe = End of YY.

Note The type determines how the restriction is handled. For example, all restriction types has not train length delay.

F 2303 There can be several speed restrictions of each restriction type in target speed supervision at the same time, as shown in the following table [Table 16/3].

Table 16/3. Number of restrictions per type

Warning Board	Number of restrictions per type	Restriction types
	0	ODO
	1	dVinc, dVdec, LCP1, LCP2, LCP3, LZ, BUA, BCA, BOC, TRSw, TRSt, TS1...TS15
	6	M1, M2, M3, C1, C2
Speed Board	Number of restrictions per type	Restriction types
	0	dVinc, dVdec, TRSw, TRSt
	1	M1, ODO, LCP1, LCP2, LCP3, LZ, BUA, BCA, BOC, TS1...TS15
	6	M2, M3, C1, C2

Note Restriction types XXc and YYe (cancelled XX and end of YY) are not applicable for the Table 16/3 and thus not shown.

Note For area border restriction types BUA, BCA, BOC there can be only one of these types for speed boards.

Note The STM must have the performance to concurrently supervise numerous restrictions.

Note Balise error is generated in case minimum or maximum number of restrictions is violated (e.g. restriction overflow). For more details, refer to [FRS Information Flow Track-Train].

7.3.2 Updating and finishing of board restrictions

7.3.2.1 General

Note A warning board initiated target speed supervision of a certain speed restriction type can be

1) cancelled when passing a warning board repeater IL with a cancelled message (XXc) for this speed restriction type, if it is aiming at the same target point.
2) updated (repeated) when passing a warning board repeater IL of the same type, if it is aiming at the same target point and gives the same target speed.
3) changed to max speed supervision when the target distance expires or when passing a speed board IL of the same type at the target point.

Note A warning or speed board initiated max speed supervision can be

1) updated (increased) when passing a new speed board IL.
2) terminated when the restriction length expires or when passing an end balise IL (XXe).

Note Exceptions from these general rules are mentioned in this sub-section. Refer also to [FRS Part 2 Information Flow Track-Train] for every special case.

F 2196 Speed restrictions shall be handled in two different ways. This shall be determined at latest when 110% of the target distance has expired.

1) Distance controlled restriction: A speed limit that starts at the target point shall be terminated after the length of restriction and shall not be updated by any speed board. If a warning board with same type and speed and target distance of 5 m is detected on restriction area of the distance controlled restriction, the new warning board is handled as a repeater warning board of the previous warning board.
2) Speed board controlled restriction: A speed limit that starts at a speed board, shall be updated or terminated at another speed board.

Exceptions:

1) The mandatory restriction M1 requires always start speed board and M1 shall never be terminated by end speed board.
2) Area restrictions Landslide, Construction area and Other country areas always requires start and end speed boards
3) Unequipped area restriction always requires start speed board
4) Delta-speed and Track Route Specific Restrictions shall not be speed board controlled.

F 2197 If a speed board IL with the same type and speed as an existing, supervised restriction is passed before 90 % or after 110 % of the existing target distance, the information from this speed board shall be regarded as independent from the existing restriction.

Note

Table 17/3. How restrictions are updated, cancelled, started and ended

Restr. type [5]	Action: / At:	Target speed: Repeat / Rep. Wb [1]	Target speed: Cancel [3] / Rep. Wb [1]	Target speed: Cancel / Sb [4]	Max speed, distance controlled: Start / Target point	Max speed, distance controlled: End / End point	Max speed, speed board controlled: Start / Sb [2]	Max speed, speed board controlled: Update Repeat [8] / Sb [8]	Max speed, speed board controlled: End [3] / Sb	Train length delay (at speed increase)
Mandatory M1 [6]		Y	N	N	N	N	O	Y	N	Y [7]
Mandatory M2		Y	Y	Y	Y	Y	Y	A	Y	Y
Mandatory M3		Y	Y	Y	Y	Y	Y	A	Y	N
Curve C1-2		Y	Y	Y	Y	Y	Y	A	Y	Y
Train specific TS1-2-...-15		Y	Y	Y	Y	Y	Y	A [10]	Y	Y
Level Crossing LCP1-2-3		Y	Y	Y	Y	Y	Y	A [10]	Y	N
Landslide Zone LZ		Y	Y	Y	N	N	O	A [10]	O	N
Delta-speed dVdec, dVinc		Y	N	N	Y	Y	N	N	N	N
Track Route Specific TRSw, TRSt		Y	N	N	Y	Y	N	N	N	Y
Area BUA, BCA or BOC		Y	N	N	N	N	O	N	O [9]	N

Explanations:
Y = Possible, N = Not possible, O = Obligatory, A = Added as a separate restriction

1) Wb of the same type and target speed (or cancelled) and aiming at 90...110% of the original target distance
2) Sb of the same type and speed and located at 90...110% of the original target distance
3) Cancelled Wb of the same type and speed and aiming at 90...110% of the original target distance
4) Cancelled Sb of the same type and speed and located at 90...110% of the original target distance
5) Target speed and distance first given by Warning board
6) Can also be updated by Speed after restriction given by an M2, M3, C1 or C2 Warning board
7) No train length delay when updated by Speed after restriction
8) Of the same speed (except for M1) and type as the existing restriction
9) Except for BUA

10) If the new speed is lower than the stored speed, the stored restriction is deleted. Only for train specific restriction type: if the new speed is higher than the stored speed, the stored restriction shall be ended with train length supervision.

7.3.2.2 General rule for repeater warning board IL

Note A repeater warning board can only be used if it gives the same type and target speed as the previous warning board and aims at the same target point (within 90...110% of the original target distance).

7.3.2.3 General rule for cancelled repeater warning board IL

Note The following rule applies for those speed restrictions where you can give cancelled (XXc) messages. Refer to the [FRS Part 4 Air Gap] for more details.

Note A cancelling repeater warning board can only be used if it gives the same type and target speed as the previous warning board and aims at the same target point (within 90...110% of the original target distance). A cancelling repeater warning board will be located between the warning board and the target point.

Note A repeater warning board will not terminate the supervision once a speed board has been passed.

Note A cancelling speed board at the target point will also cancel the target speed supervision.

Note Exceptions: No cancellation for the M1, dVinc, dVdec, TRSw, TRSt and Area restriction types.

7.3.2.4 General rule for speed board IL at the target point

Note A warning board initiated target speed supervision is changed to ceiling speed supervision when the target distance expires.

Note A warning board initiated target speed supervision is changed to ceiling speed supervision or cancelled when passing a speed board IL of the same type and speed (or cancelled), provided that 90...100% of the original target distance has expired.

Note Exceptions: No speed boards for dVinc and dVdec.

Note Exceptions: No cancellation for the M1, dVinc, dVdec, TRSw, TRSt and Area restriction types.

7.3.2.5 General rule for updating or repeating speed boards

Note A speed board-controlled restriction can be updated by a speed board if the restriction type is M1.

F 2198 Other restriction types than M1 can be repeated by a speed board. The repeating speed board restriction shall be terminated with an end of restriction board. If more than one restriction is supervised, restriction shall be terminated only in case of matching speed information.

Note Repeating other restriction types can be necessary to supervise correctly trains started within restriction area.

Note

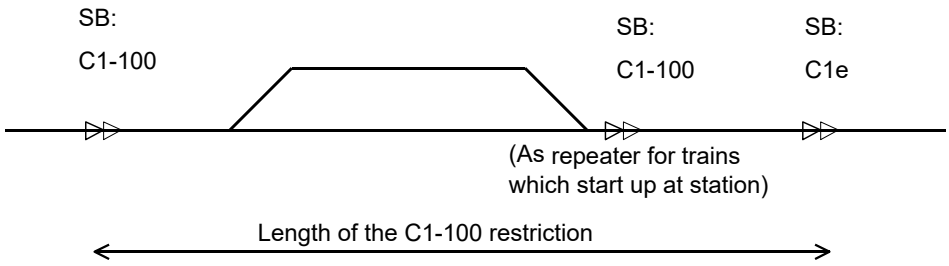


Figure 10/3. Repeating and ending of a single C1 restriction

7.3.3 Mandatory restriction 1 (M1)

Note Mandatory restriction type 1 is obeyed by all trains. M1 is speed which can never be terminated, only changed to another value (there must be a new speed board at every change point). The M1 uses train length delay.

Note A M1 target speed supervision is changed to ceiling speed supervision when the target distance expires and when passing an M1 speed board at the target point.

Note The M1 speed can be updated:

1) By a new M1 speed board.
2) After length of restriction by a warning board that gives a speed after restriction (R25-R26) together with M2, M3, C1 or C2 restriction information.

Note The M1 max speed can never be removed by any cancelled board or end board (these restriction types do not exist).

7.3.4 Mandatory restrictions 2 and 3 (M2, M3)

Note The Mandatory restrictions types 2 and 3 are obeyed by all trains. It is possible to cancel or terminate these restrictions. The M2 uses train length delay but the M3 does not.

Note An M2 or M3 target speed is cancelled when passing a cancelled warning or speed board of the same speed and type (M2c or M3c) referring to the same target point.

Note There are two ways of starting and ending M2 or M3 restriction:
1) Target speed is changed to ceiling speed when the target distance expires. After that, the restriction will be terminated when its length expires.
2) Target speed is changed to ceiling speed when passing a speed board at the target point. After that, the restriction can be terminated when passing an end board (M2e, M3e).

7.3.5 Curve restrictions (C1, C2)

Note The curve restrictions types 1 and 2 are useful when passing curves that allow tilting trains to keep higher speed than other trains. Restrictions C1 and C2 use train length delay.

Note If the train type is Tilting, the STM increases the C1 target speeds by 50 % and the C2 target speeds by 25 %.

Note A C1 or C2 target speed is cancelled when passing a cancelled warning or speed board of the same speed and type (C1c or C2c) referring to the same target point.

Note There are two ways of starting and ending C1 or C2 restriction.
1) A C1 or C2 target speed is changed to ceiling speed when the target distance expires. After that, the restriction can be terminated when its length expires.
2) A C1 or C2 target speed is changed to ceiling speed when passing a C1 or C2 speed board at the target point. After that, the restriction can be terminated when passing an end board IL (C1e, C2e).

7.3.6 Train specific restrictions (TS)

Note The Train specific restrictions are useful on places where certain trains need restricted speed depending on train type. The Train specific restriction number n is only obeyed by those trains which corresponding PT code bit number n is set (= 1). Restrictions TS1-15 use train length delay.

Note A TSn (n = 1...15) target speed is cancelled when passing a cancelled warning or speed board of the same speed and type (TS1c, TS2c etc), referring to the same target point.

Note There are two ways of starting and ending a Train specific restriction:
1) A TSn target speed is changed to ceiling speed when the target distance expires. After that, the restriction can be terminated when its length expires.

2) A TSn target speed is changed to ceiling speed when passing a corresponding TSn speed board at the target point. After that, the restriction can be terminated when passing an end board with the corresponding type (TS1e, TS2e ... TS15e).

7.3.7 Level Crossing Protection (LCP)

Note There are three types of level crossing speed restrictions, LCP1, LCP2 and LCP3. A level crossing restriction is only activated if level crossing protection is non-active. The LCP warning board, which is connected to an encoder, indicates either that the restriction is necessary or cancelled. If necessary, the STM will receive a balise telegram with the following information:

a) Type of restriction (LCP1, 2 or 3)
b) Release (restriction) speed (10-80 km/h)
c) Target distance
d) Gradient to the target point
e) Length of restriction

Note LCPn (n = 1, 2 or 3) is cancelled when passing a cancelled warning or speed board of the same speed and type (LCP1c, LCP2c or LCP3c) referring to the same target point.

Note LCP release speed is supervised as ceiling speed when the target distance expires or when passing an LCP speed board at the target point.

Note After that, the restriction can be terminated without train length delay when its length expires or when passing an end board IL (LCP1e, LCP2e or LCP3e).

F 2199 When passing an LCP warning board, the STM shall setup a restriction with a target speed = 0 km/h and a release speed with indications according to the received balise telegram.

Note At the end speed point the STM supervision will change to release speed supervision.

F 2200 Reserved

Note An LCPn restriction can be started and ended in two ways:

1) The target speed is changed to a ceiling speed when passing the target point for stopping. Restriction is terminated without train length delay after the given length of restriction.
2) The target speed is changed to ceiling speed if a related speed board is passed at the target point for stopping. Restriction is terminated without train length delay when an end speed board is detected.

Note STM will not notice the difference between braking curve for target speed 0 km/h and braking curve for release speed.

F 2203 Reserved

7.3.8 Landslide Zone (LZ)

Note Display and supervision after an LZ warning board is carried out in a similar manner as when passing a level crossing warning board that gives a release speed.

Note If given release speed is greater than 40 km/h or is not given, default value 10 km/h is used. This applies also to the handling of the release point.

Note A landslide zone is announced by a warning board that is connected to an encoder. There is an LZ speed board at the beginning and another one (LZe) at the end of the landslide zone.

F 2204 Reserved

Note If no landslide has occurred the received balise telegram does not contain any landslide restriction.

7.3.8.1 Supervision after passing landslide speed board

F 2205 The target speed shall always be set to 0 km/h when passing a landslide warning board.

Note There can be only one LZ restriction at a time in target speed supervision.

F 2206 The target speed supervision shall be performed in a similar way as the supervision of Level Crossing restrictions.

F 2207 Reserved

F 2209 Reserved

F 2282 At every unauthorized landslide speed board passage, the STM shall immediately issue a service brake order.

F 2283 Braking shall be released at standstill by pressing first landslide acknowledgement button "SORT. KUITT." and then brake release button "JARR. IRR."

7.3.8.2 Authorised landslide speed board passage

F 2284 Braking shall be avoided by pressing landslide override button "SORTUMA OHI" before landslide speed board.

F 2287 Conditions for an authorised landslide speed board passage shall be as below (no service braking):

- If the landslide override button (not available on the normal menu) is pressed before the landslide speed board, and
- The train speed does not exceed the release speed from a previous warning board, or the speed of the landslide speed board, while passing the balises, and
- Less than 30 seconds have elapsed since the button was pressed.

F 2288 The landslide speed board passage permission shall be erased when:

1) A landslide speed board, or a cancelled landslide speed board is passed.
2) 30 s has elapsed since the landslide override button was pressed.

F 2289 The indication "SORTUMA" shall be lit as long as the landslide passage permission is valid. It shall start flashing 10 seconds before the permission expires because of time-out.

F2291 If the conditions for landslide speed board passage permission are not fulfilled, there shall instead be an unauthorized landslide speed board passage as specified in [F 2282] - [F 2283] and [F 2286].

F2290 The 30 s landslide speed board passage permission timer shall be restarted upon following conditions:

a) 20...29 s has elapsed (flashing indication), and
b) landslide override button is pressed again.

F2292 After passing a landslide speed board, the speed board speed shall be supervised.

7.3.8.3 Unauthorized landslide speed board passage

F 2208 When entering a landslide zone (passing a landslide speed board "at stop"), the STM shall command service braking to standstill. Refer to [F 2282 and 2283]

F 2286 After an unauthorized landslide speed board passage, landslide indication "SORTUMA" is shown until "landslide end" information is detected.

F2293 After brake release or after an authorised landslide speed board passage, the following requirement [F 2294] shall be fulfilled by the STM until a landslide end speed board is passed.

F2294 The landslide indication "SORTUMA" shall be shown in a way that attracts the driver's attention. This may be done e.g. with a white text on a red background.

7.3.9 Delta speed restriction (dVinc, dVdec)

7.3.9.1 Delta speed restriction dVinc

F 2210 Trains with bit 1 active in PT-code shall be allowed to run at higher speed in dVinc areas.

Note

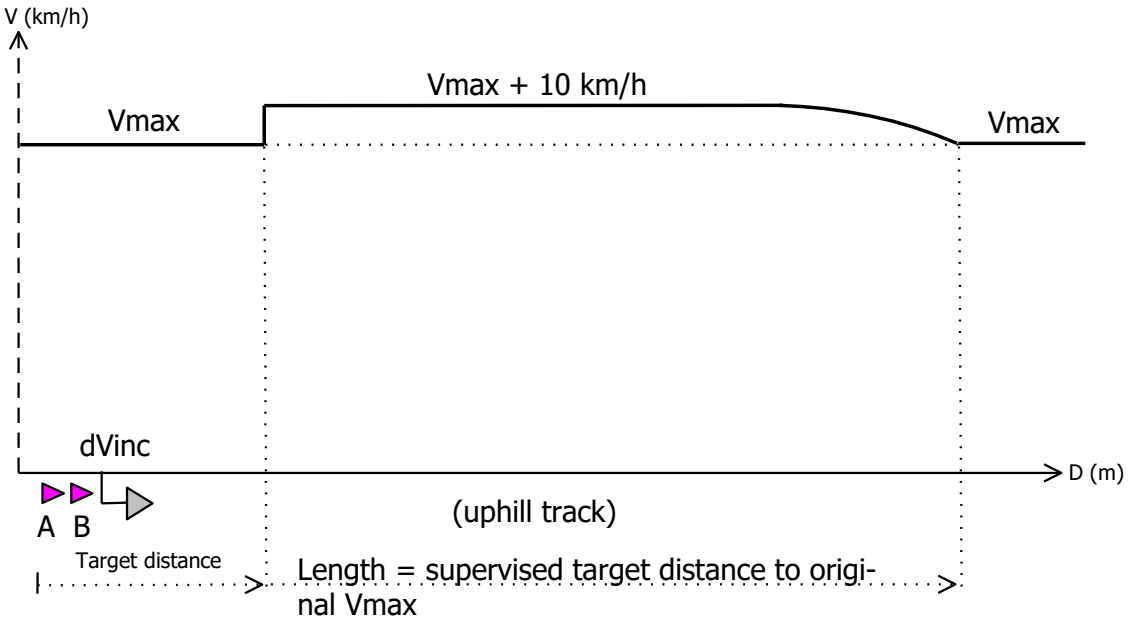


Figure 11/3. Delta-speed increase

Note When the ETCS max speed is entered at start-up, the driver is instructed to enter 10 km/h higher max speed than similar train without PT code bit1 active.

F 2211 When the target distance of a dVinc balise is passed the train max. speed V_{TRAIN} shall be increased by 10 km/h until the length of the restriction is passed.

7.3.9.2 Delta speed restriction dVdec

F 2212 Train max. speed V_{TRAIN} shall be decreased by speed given in the balise telegram (10, 20 or 30 km/h). Restriction shall be started after target distance and it is valid until length of restriction is passed without train length delay. Restriction type of dVdec shall be valid for trains with bit 1 active in PT-code.

7.3.9.3 Route Specific Restrictions (TRSw, TRSt)

Note TRSw restrictions are used on diverged routes and TRSt restrictions on straight routes both with train length delay.

Note A TRS restriction can be used when a restriction is needed for one route but not for the other, and the target distance after the switch is too short for a warning board to enable a smooth deceleration down to the target speed.

Note The condition for TRSw restriction (a diverged route) is that the starting point of the first or second switch restriction is located within 0...110% of the original TRSw target distance. Otherwise the route will be regarded as straight. The signal that gives the switch restriction can be passed before or after the TRSw warning board.

Note

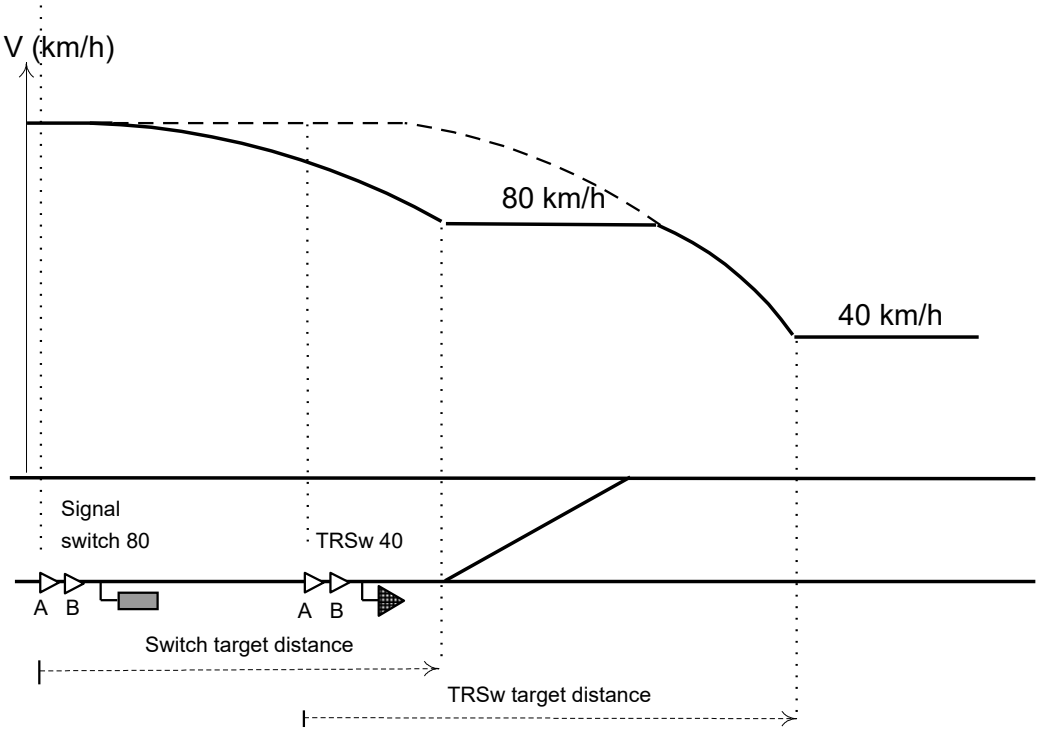


Figure12/3. Example of a TRSw restriction

F 2213 The STM shall activate or erase TRS restrictions according to [Table 18/3].

Table 18/3. Determining the state of a TRS restriction

Passage of IL or other point	Restr. type	TRSw		TRSt	
	Restriction state	New or Passive	Active	New or Passive	Active
Wb is passed and there was no previous signal or repeater signal		P	NA	A	NA
Wb is passed and there was a previous signal or repeater signal, giving a diverged route		A	NA	P	NA
Wb is passed and there was a previous signal or repeater signal, giving a straight route		P	NA	A	NA
A signal or repeater signal is passed after the Wb, giving a diverged route		A	A	P	A
A signal or repeater signal is passed after the Wb, giving a straight route		P	A	A	A
The target point is passed		P	A	P	A

Note The TRSw restriction is activated if there is a target point of switch restriction between the TRSw warning board and the target point (0...110% of target distance). The switch restriction can be given by a signal or repeater signal before or after TRSw warning board. If the restriction is activated once, it will be valid even the switch restriction would be cancelled.

Note The TRSt restriction is activated if there is no target point of switch restriction between the TRSt warning board and the target point (0..110% of target distance). The only way to avoid a TRSt restriction is to give a switch restriction by a signal or repeater signal before the TRSt warning board. If the restriction is activated once, it will be valid even if a new switch restriction appears.

Note An active TRS target speed cannot be cancelled (cancelled restriction types do not exist).

Note There is one way of starting and ending a TRS restriction. An active TRSw or TRSt target speed is changed to ceiling speed when the target distance expires. After that, the restriction shall be terminated when its length expires.

7.3.10 Area restrictions (BUA, BCA, BOC)

Note The Area restrictions are activated when passing the corresponding area border and terminated when leaving the area.

Note These restrictions are started when passing a BUA, BCA or BOC speed board at the target point. BUA will be terminated when entering another area. BCA and BOC will be terminated when passing an end board.

Note See also the description of the STM areas.

7.3.10.1 Area restriction for Unequipped area (BUA)

Note The Unequipped area target speed can be given by a BUA warning board.

The restriction is terminated without train length delay as soon as another area is entered. This can occur at signal passage (Fully equipped area) or at a BCA or BOC border (Construction Area or Other Country).

F 2214 Entering Unequipped area by passing a BUA speed board without speed information, the Area speed shall be set to 120 km/h. The Area speed is also activated after ATP start-up.

Note Without a signal there will be a start-up restriction supervised.

7.3.10.2 Area restriction for Construction Area (BCA)

Note The Construction Area target speed can be given by a BCA warning board.

F 2215 The restriction shall terminated when passing the border balises from Construction Area to unequipped area (BCAe speed board).

7.3.10.3 Area restriction for Other Country (BOC)

Note The Other Country restriction can be given by a BOC warning board.

F 2299 The restriction shall be terminated when passing the Home Country border balises (BHC speed board) to unequipped area.

F 2184 Reserved

F 2201 Reserved

F 2202 Reserved

8 INDICATIONS

8.1 General

Note The DMI is mainly controlled by the ETCS, but the STM is able to request special indications, buttons or text messages, and can also extinguish certain ETCS indications. Display of maximum permitted speed, target speed and release speed is performed by the ETCS with speed bars of different size and colour. The STM text indications are in Finnish.

Note When in Level NTC, the STM can use the DMI objects also used by the ETCS On-board. If so, the semantics and actions associated with the DMI objects are the same as for Levels 0, 1, 2 and 3. [SUBSET-035 Specific Transmission Module FFFIS]

Note The STM indications on the DMI should differ as little as possible from the specified ETCS indications (at the ETCS levels 0-3).

Note The ETCS will handle requests of DMI indications from the STM in Hot Standby and Data Available. [SUBSET-035 Specific Transmission Module FFFIS]

Note Regarding indications and buttons, following are not fully specified within this document:

- Specific icons or caption texts
- Button menus
- Colours of indicators and buttons
- Display priorities for indicators and buttons

8.1.1 Priority of text messages

F 2216 Text messages are shown in FIFO principle at a given time. It shall be possible to scroll line by line down to view older messages and up to view more recent messages.
The amount of lines for text messages and any text message prioritization or buffering shall follow the European requirements for the ETCS DMI.

F 7034 In case more text message rows are generated than could be displayed, all the text messages shall be displayed for a minimum supplier specific display time long enough to allow the train driver to actually see the message.

8.2 Special indications

8.2.1 Data entry indications

Note STM train data input and display is handled in ETCS DMI. Constraints caused by ETCS related specifications e.g. [SUBSET-035 Specific Transmission Module FFFIS] must be observed.

F 2217 While the driver is entering STM specific train data, the related text indication shall be displayed.

F 2218 While the driver is checking STM specific train data, the related text indication shall be displayed.

F 2219 Reserved

F 2220 Reserved

F 2221 Reserved

F 2222 Reserved

F 2223 Reserved

8.2.2 Speed and distance bars

Note The bars on the DMI indicate target speed (with possible release speed), max speed and remaining target distance.

Note The speed bars are extinguished in the following cases:
1) In unequipped area, ATP Construction area and Other country area, see [Chapter 4]
2) After stop passage.
3) Following certain balise errors [Chapter 6.4]

F 2224 ATP target distance to end of movement authority shall be indicated to signal at stop aspect according to information of balise telegram.

8.2.3 Acknowledgements

Note The STM can request an Acknowledgement by supplying the ETCS DMI function with a string of text to be shown to the driver and a request for acknowledgement. [SUBSET-035 Specific Transmission Module FFFIS]

F 2225 All text messages from the STM shall be displayed in the order of their reception.

Note A message, which requires driver acknowledgement is not hidden behind a message, which does not require a driver acknowledgement. [SUBSET-035 Specific Transmission Module FFFIS]

Note At any time, only one message to be acknowledged is displayed to the driver by the ETCS DMI function. Justification: This is for ergonomic reason. If more than one messages are pending for acknowledgement, the ETCS On-board will store those messages to be acknowledged and display them in the order they have been received (FIFO). [SUBSET-035 Specific Transmission Module FFFIS]

F 2226 Reserved

F 2227 All text messages from the STM shall be deleted only by the STM which requested the text message.

Note The only exception from this requirement is when the STM is no more active.

8.2.4 Balise error indications

F 2228 Balise errors shall be indicated including the related ID, error grade and error code [FRS Information Flow Track-Train, F 3521].

Note ID is displayed in 5 digits and if the identity is shorter than 5 digits, blanks or zeros should be presented.

Note Format of the displayed balise error message is i.e. "BV1-107 ID-09806", where 107 is error code and 09806 is balise group ID number.

F 2229 Reserved

F 2230 Reserved

F 2231 Reserved

8.2.5 Service indications

Note Special service information can be viewed and selected by requesting Service functions.

F 2301 Service functions shall be activated when the driver pushes the service function button.

8.3 Text messages

8.3.1 General

Note The STM can request a text message by supplying the ETCS DMI function with a

string of text to be shown to the driver. [SUBSET-035 Specific Transmission Module FFFIS]

F 2232 The STM shall display up to three lines of 20 characters each on the DMI.

F 2233 The newest message shall appear on the top line and when other messages arrive, all previous messages shall be shifted one line downwards.

Note Lines available are ETCS DMI depended.

Note The text messages hidden are possible to be scrolled into view by the buttons on the DMI.

F 2234 The STM text messages shall be displayed in Finnish.

F 2235 Reserved

F 2236 STM failure messages shall be obligatory text messages.

F 7036 Reserved

8.3.2 Summary of STM error messages

Note

Table 19/3. STM error messages

Error Message	Error Cause
BV1-xxx ID-yyyyy	Balise failure 1, error code xxx and ID yyyyy
BV2-xxx ID-yyyyy	Balise failure 2, error code xxx and ID yyyyy
BV3-xxx ID-yyyyy	Balise failure 3, error code xxx and ID yyyyy
BV4-xxx ID-yyyyy	Balise failure 4, error code xxx and ID yyyyy
BV5-xxx ID-yyyyy	Balise failure 5, error code xxx and ID yyyyy
Matkamittausvirhe 1	Faulty result of a long-distance measurement check
Matkamittausvirhe 2	Faulty result of a short distance measurement check
Paineanturivika 1	Pressure sensor failure 1 high
Paineanturivika 2	Pressure sensor failure 2 low
Pääsäiliön alipaine	Low pressure in main air reservoir
Paineennousun esto	Pressure increase prevented
Käyttöjarruvika	Service brake failure
Käyttöjarru-relevika	Service brake level error

Note Balise error codes must be displayed according to [F 3521].

Note Text messages could be implemented as indications instead of text messages.

8.4 Indications and buttons on the DMI

Note

Table 20/3. Summary of STM indications and buttons

NAME (descriptive)	Handled by:
STM buttons	
TARKASTUS (STM-data enter check) button	STM
KORJAUS (STM-data correction) button	STM
NOPEUDEN KOHOTUS (speed increase) button	STM
SEIS OHI KUITTAUS (acknowledge stop passage EB) button	STM
SORTUMA OHI KUITTAUS (acknowledge landslide passage EB) button	STM
IRROTUS SALLITTU (ATP braking release allowed) button	STM
STM indicators	
BALIISIVIKA (balise failure)	STM
SEIS OHI (STM stop signal passage)	STM
SORTUMA (Landslide Zone, LZ)	STM
VARATTU RAIDE (Reserved Track lamp, RT)	STM
JKV-JARRUTUS (ATP braking)	STM
IRROTUS SALLITTU (ATP braking release allowed)	STM
(OPTIONAL) JKV-ALUE (ATP-VR/RHK area)	STM
VARUSTAMATON ALUE (ATP-VR/RHK non-equipped area)	STM
JKV-RAKENNUSALUE (ATP-VR/RHK area under construction)	STM
MUU MAA ALUE (Other country area)	STM
SORTUMA (Landslide Zone, LZ)	STM
TASORISTEYS (Level Crossing Protection, LCP)	STM
NOPEUSRAJOITUS (Speed restriction, not LZ/LCP)	STM
VAIHDE (Switch restriction)	STM
Others	
TESTI (STM start-up / operational tests) button	STM
KELI (Rail surface conditions) button	STM
KALLISTUVAKORI JUNA (Tilting train) button	STM
MATKANMITTAUS (Distance meter check) button	STM
HIDASTUVUUDEN TARKISTUS (Retardation check) button	STM
HUOLTOTILA (Service screen) button	STM
(OPTIONAL) lamps / buttons (e.g. for the maintenance and special functions)	STM

Note The descriptive name may not be identical to the indication on the DMI.

8.4.1 Buttons

F 2237 Reserved

F 2238 Each DMI button shall have a caption text.

F 2239 Reserved

Note If a local feedback from the STM & ETCS DMI is implemented, it will give to the driver the information that the button is pressed. [SUBSET-035 Specific Transmission Module FFFIS]

8.4.2 Indicators

F 2240 Reserved

F 2241 Each indicator shall be displayed with an icon, or (if the icon is not available) with a caption text (lamp/button name).

F 2242 ATP system failure alarm shall be indicated.

Note STM system failure alarms will be indicated by the ETCS.

F 2243 A flashing indication on (or beside) a button shall be acknowledged by pressing this button. An indication that is lit continuously shall not be available for acknowledgement.

F 2244 All STM buttons do not have to be active at the same time. A button shall not be passive unless pressing the button is of no use under the present circumstances.

F 2245 Reserved

Note ETCS DMI will report button push and release events to the STM. [SUBSET-035 Specific Transmission Module FFFIS]

Note The following requirements include only those indications and buttons that are handled by the STM.

8.4.3 STM indicators

8.4.3.1 Balise error indication

F 2246 The balise error indicator "BAL.V" shall start flashing when the onboard ATP system detects an error in the balise information.

F 2247 The balise error indication shall flash for at least 10 sec and shall then be steady.

F 2248 The balise error indication shall be switched off when supervision of balise error handling function is terminated.

8.4.3.2 Stop passage indication

F 2249 The stop passage indication shall be lit after every STM controlled stop signal passage.

Note In the ATP-VR/RHK system stop passage indication is "SEIS OHI".

8.4.3.3 Reserved track indication

F 2250 The reserved track indication shall be lit when approaching an occupied track.

Note In the ATP-VR/RHK system reserved track indication is "VARAT RAIDE".

8.4.3.4 Area indication

F 2251 Indications about different areas shall be yellow and inform when the train is on certain ATP-VR/RHK area.

8.4.3.5 ACKNOWLEDGE button

F 2252 The acknowledge button shall be used for STM controlled acknowledgements.

Note The acknowledge button flashes when an acknowledgement is expected by the STM.

Note Acknowledge button is displayed in ETCS DMI but controlled by the STM.

8.4.3.6 Train data entry button

F 2255 Reserved

F 2256 Reserved

8.4.3.7 Speed increase button

F 2261 Speed increase button shall be activated after STM start-up test when entering STM state DA.

F 2262 Speed increase button shall be activated after 5 m reversing.

F 2263 The button shall be switched off when the driver presses the speed increase button.

F 2264 After start-up test the button shall be switched off when passing main or distant signal.

8.4.3.8 Optional buttons

F 2265 It shall be possible to use optional button(s) for service or special function purposes.

8.5 Audible warnings

F 6009 [Table The STM warning tones f1 and f2 and shall be initiated according to 21/3]:

Table 21/3. STM warning tones

Sound definition and initiation	Priority	Duration of sound	Number of sound segments	Frequency of segment	Duration of segment
Warning tone f1 - used to pay drivers attention when a new indication regarding supervision appears - target or release speed changes - target distance decreases >100m or increases >300m	4	discrete 1 sec	1	1 kHz	1 sec
Warning tone f1 - used to pay drivers attention when constant speed increases - used to pay drivers attention when permitted speed increases due to curve supervision to one target terminates	5	discrete 500 ms	1	1 kHz	500 ms
Warning tone f2 - during overspeed - alarm initiated by B-curve - STM-N braking is applied - alarm initiated by A-curve in case SB test is needed	2	continuous	-	1 / 0 kHz	250/250 ms

F 2266 Reserved

F 2267 Reserved

F 2268 Reserved

F 2270 A series of three audible f2 signals having a 2 sec duration and an interval of 1 sec shall be activated to indicate balise error alarms.

F 2298 Reserved

F 2271 Reserved

F 2269 Reserved

F 2272 Reserved

Note STM Failure State (FA) audible warning cannot be handled by STM in the Failure State but is announced in the ETCS DMI. This requirement refers to ETCS specifications for system failures which could be detected by STM without entering Failure State.

F 2253 Reserved

F 2257 Reserved

F 2258 Reserved

F 2259 Reserved

F 2260 Reserved

9 SUPERVISING CEILING SPEED

9.1 General

Note Track quality, gradient, length of points, track maintenance work and other such exceptional variables have their effect on the highest permitted speed v_{TRACK} on specific track section.

Note The individual features (for example braking capability) of each train have also their affect for the highest permitted speed of the train v_{TRAIN}. This speed among the other train specific data shall be entered to the STM by the driver via DMI.

F 5021 The STM shall supervise the lowest speed value v_{TRACK} or v_{TRAIN}. See [Figure 13/3].

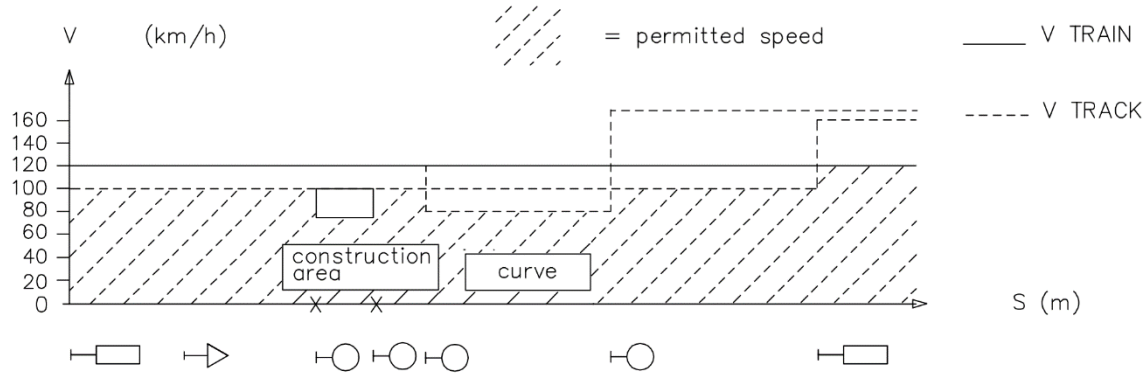


Figure 13/3. Ceiling speed supervision

F 5022 The permitted speed (v_{TRACK} or v_{TRAIN}) shall be indicated on the permitted speed indicator only on the fully equipped ATP area.

F 5023 If permitted speed (v_{MAX}) is exceeded alarm and service braking shall follow according to the [Table 22/3]:

Table 22/3. Permitted speed supervision limits

Speed (v_{TRAIN} or v_{TRACK})	Alarm limit	Service brake limit
< 50 km/h	+ 3 km/h	+ 5 km/h
≥ 50 km/h	+ 5 km/h	+ 10 km/h

F 5024 Exceeding the alarm limit sound alarm f2 and overspeed text indication "YLINOP." shall follow on the DMI.

F 5025 If the service brake limit is exceeded and brakes are applied, the alarm f2 and text indication "STM JARR" shall be removed when train speed decreases below alarm limit.

F 5026 If the service brake limit is not exceeded, the alarm f2 and text indication "YLINOP." shall be removed when train speed is below permitted speed.

Note Emergency braking is not applied during constant speed supervision.

Note ATP-VR/RHK STM braking is specified in [FRS Part 5 "Braking and Auxiliary Functions"].

10 SUPERVISING BRAKING CURVE SPEED

Note The STM receives information about coming restrictions from signal and warning board balises. This information is given so early that even a train with poor brakes can decrease its speed to the target value within the target distance.

Note Balises will give all the needed information about the restriction (target speed and distance, restriction length, gradient and speed after restriction if needed)

F 7024 Restricted speed information shall be stored in memory as long as the information is needed for supervision functions.

F 7025 Restriction information can be updated within the target distance.

F 7026 The target speed supervision shall also be combined with other (train or track) speed supervisions to continuously control the highest permitted speed of the train.

F 7027 Speed information received from distant signal or warning board shall be stored in memory as well as the information of target distance and gradient. Information from a distant signal shall be stored until the corresponding main signal balises are passed.

11 BRAKING CURVE CALCULATION

11.1 General

Note On the basis of the track and the train data the STM calculates a safe speed profile, which the train has to follow to be able to reach the target speed at the target location. This brake profile indicates the trains braking ability and how the train speed changes related to braking time. The curve is calculated by distance, driver's behaviour as applied braking force, surface conditions etc. The turning point of a service brake curve lies normally by a signal/speed limit. If not enough braking is applied by the driver the STM will apply brakes to ensure that the target speed shouldn't be exceeded.

F 5027 The system shall supervise simultaneously the most restrictive braking curve and the lowest of various ceiling speeds.

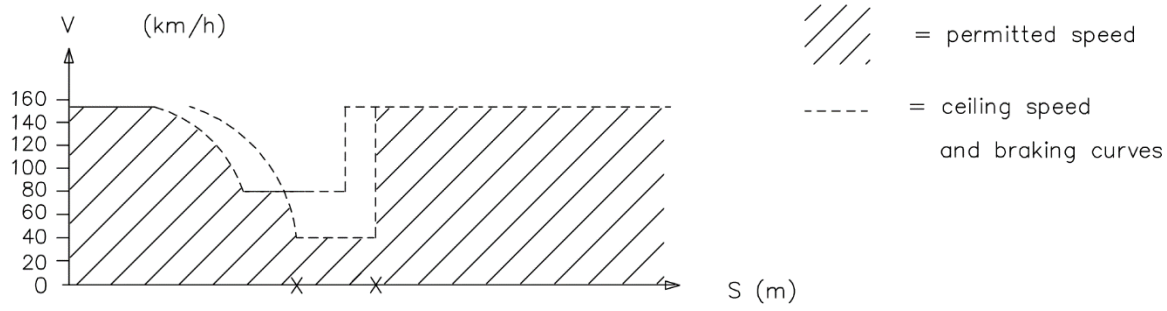


Figure. 14/3. Selection of most restrictive braking curve and lowest ceiling speed

Note

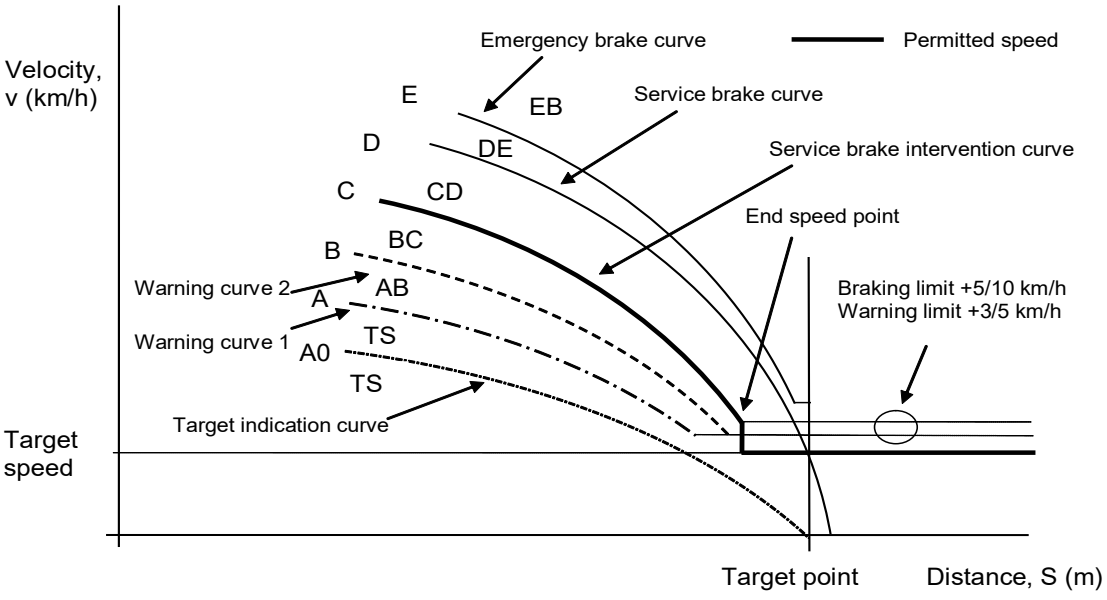


Figure 15/3. Braking curves

11.2 Selection of the most restrictive target

F 5028 The stop point shall be calculated for every target:

$$s_s = s_t + v_{TARGET}^2 / (2 \cdot b_{STM})$$

s_t = target location (m)
v_{TARGET} = target speed (m/s)
b_{STM} = retardation (m/s^2)

F 5029 The most restrictive target shall be the one with the nearest stop point.

Note After reaching the ESP of the supervised target it will be supervised as end speed.

Note When several targets exist at the same time the next target behind end speed supervised target will be become the most restrictive curve.

F 6008 Once train speed goes below balise error speed + brake limit or train has passed end speed position, error speed shall be supervised end speed.

F 5030 Only the target with target speed lower than the actual ceiling speed can be selected. Thus the target with closest stop point, which is not suppressed by the current ceiling speed, shall be selected.

F 5031 A restriction with the target speed equal to the ceiling speed shall be selected if the ceiling speed and the end speed originate from the same target. This is to avoid that the restriction suppressed its own brake curve indication after the end speed position.

F 5032 If the most restrictive end speed or curve is due to a speed restriction, a point restriction or a brake curve due to a balise error and there is a stop signal behind that target, the stop point of the signal shall be moved closer for the length of the s_o factor. The target speed of the selected restriction (not the current train speed) shall be used as input to the s_o calculation for selecting the most restrictive target.

F 5033 The actual target point (distance) of the signal shall be the original. The above specified reposting of the stop point concerns only selection and supervising of the most restrictive target.

F 5034 If the stop point of the signal after addition of the so factor becomes closer than the stop point of the speed restriction, the stop signal shall be selected as the most restrictive target.

F 5035 If the stop points of two or more restrictions are equal the most restrictive of them shall be selected according to priority list:

1. Lowest target speed
2. Distant signals
3. Warning board
4. Reserved track
5. Switch
6. Balise error

Note Number 1 implies that speed restrictions are prioritised internally according to target speed.

Note ETCS ODO subsystem position measurement accuracy has to be taken into consideration when the equality of two or more stop points is defined.

11.3 Service brake curve (D)

F 5036 D-curve shall meet the target point at target speed.

F 5037 Service brake curve (D) in fig. 3 is calculated as:

$$S_D = \frac{v_C^2 - v_{TARGET}^2}{2 \cdot B_{STM}}$$

s_D = distance of the curve to the target point (m)
v_C = current speed of the train (m/s)
v_{TARGET} = target speed (m/s)
b_{STM} = retardation (m/s^2)

The retardation is calculated by the STM from data that the driver enters into the system. The calculation shall be done every time when target information is received. The calculation formulas are different depending on the brake type as follows a) to c):

F 5038 a) Brake type R and v_{TRAIN} >120 km/h; full service brake (pressure drop 170 kPa)

$$b_{STM} = \frac{7 \cdot \lambda + 100}{1000} \cdot k_v \cdot k_s + 0{,}01 \cdot g$$

λ = brake weight percentage (%) = JPP entered by driver
g = track gradient (‰)
k_s = coefficient for rail surface condition (KELI) en tered by a driver

KELI 1 -> k_s = 1,00
KELI 2 -> k_s = 0,875
KELI 3 -> k_s = 0,75

k_v = coefficient for velocity force dependency in disc brakes:

Table 23/3. Coefficient k_v

v_C (km/h)	k_v
0 - 150	1
151 - 160	0,989
161 - 170	0,978
171 - 180	0,967
181 - 190	0,956
191 - 200	0,945
201 - 210	0,934
211 - 220	0,923
221 - 230	0,912
231 - 240	0,901
241 - 250	0,890
251 - max	0,879

F 5039 b) Brake type G/P or R (v_{TRAIN} ≤120 km/h); normal service brake (pressure drop 100 kPa)

$$b_{STM} = \frac{5 \cdot \lambda + 100}{1000} \cdot k_v \cdot k_s + 0{,}01 \cdot g$$

F 5040 c) Brake type DMU/EMU; normal service brake (pressure drop 100 kPa, v_{TRAIN} ≤120km/h) or full service brake (pressure drop 170 kPa, v_{TRAIN}>120 km/h)

$$b_{STM} = b_{mtu} \cdot k_v \cdot k_s + 0{,}01 \cdot g$$

b_{MTU} = coefficient depending on the type of the motor train unit:

Note DMU/EMU train types include Sm1-2, Sm3, Sm4, Sm5, Sm6 and Dm12.

Note The b_{MTU} coefficient for current motorized wagon types is as follows:

Sm1-2: 0,80 m/s^2
Sm3: 1,05 m/s^2
Sm4: 1,10 m/s^2
Sm5: 1,20 m/s^2
Sm6: 1,10 m/s^2
Dm12: 0,80 m/s^2

11.4 Service brake intervention curve (C)

F 5041 As the train passes the service brake intervention curve (C) the STM shall apply the service brake regardless of whether the driver has already begun braking or not.

Note The braking force is controlled by having a pressure measurement signal from brake pipe (pressure transducer) or from brake cylinder (pressure switch on Sm1-2, Sm4, Sm5). STM controls the service brake as described in [FRS Part 5 "Braking and Auxiliary Functions"].

F 5042 The C curve moves according to braking carried out by the driver

$$s_C = s_D + v_C \cdot \left(t_s + t_a + t_b \cdot \left(1 - \frac{\Delta p}{p_0} \right) \right) + s_0$$

Δp = pressure decrease applied by the driver (>25 kPa within 2 s);
if $\Delta p > p_0$ then $\Delta p = p_0$
p_0 = pressure drop in brake pipe corresponding to the needed braking grade (100 or 170 kPa); (for brake types of DMU's/EMU's, which have a short brake time delay, the term $(1 - \Delta p / p_0)$ is excluded)
t_s = constant system program execution delay of 1 sec
t_a = for an accelerating train a constant delay of 5 sec if the acceleration is >0,2 m/s^2 during 1 sec when passing the warning curve A, otherwise it shall be 0.
t_b = brake time delay (s); see below a) to c)
s_o = so called safety margin before signal (m); see below a) to c) (used only with signals "at stop")

Note Current brake types of DMU's/EMU's, which have a short brake time delay, include Sm1-2, Sm4, Sm5 and Dm12.

F 5043 a) Brake time delay for brake types R and P:

$t_b = 4 + l / 80$ (l = length of the train (m))

$s_o = 10 + 5 \cdot v_C$ (s_o max. 200 m)

F 5044 b) Brake time delay for brake type G:

$t_b = 8 + l / 200$
$s_o = 10 + 7 \cdot v_C$ (s_o max. 120 m)

F 5045 c) Brake time delay for brake types for DMU/EMU train types:

t_b = value depending on the type of brakes

s_o = value depending on the type of brakes

Note brakes For DMU/EMU train types, t_b = value depending on the type of

Sm1-2:	2,5 sec
Sm3:	4,0 sec
Sm4:	3,0 sec
Sm5:	3,0 sec
Sm6:	6,0 sec
Dm12:	3,0 sec

Note brakes For DMU/EMU train types, s_o = value depending on the type of

Sm1-2:	$10 + 2 \cdot v_C$	(max. 70 m)
Sm3:	$10 + 5 \cdot v_C$	(max. 200 m)
Sm4:	$10 + 5 \cdot v_C$	(max. 200 m)
Sm5:	$10 + 5 \cdot v_C$	(max. 200 m)
Sm6	$10 + 5 \cdot v_C$	(max. 200 m)
Dm12:	$10 + 2 \cdot v_C$	(max. 70 m)

F 5046 Permitted speed indicator indicates the momentarily speed that is permitted. The indicated permitted speed must never be lower than the target or release speed. By approaching the target point the indicator shall follow the warning curve (curve A) calculated without braking term ($1 - \Delta p / p_0$) and without acceleration term (t_a) according to:

$$v_{permit} = -p + \sqrt{p^2 + q}$$

(Note: the negative root is ignored)

(Note: s_{TD} in the following formulas is current target distance)

If signal at stop:

If $s_0 > s_{0max}$:

$$p = b \cdot (t_s + t_a + t_b + 2)$$

or

$$p = b \cdot (t_s + t_a + t_b + 5)$$

or

$$p = b \cdot (t_s + t_a + t_b + 7)$$

(Note: 2 or 5 or 7 depending on the S_0 -formulas of the train category)

If $s_{TD} \geq 10$:

$$q = 2 \cdot b \cdot (s_{TD} - 10) + v_{TARGET}2$$

else (when $s_{TD} < 10$):

$q = v_{TARGET}2$

else (when $s_0 \leq s_{0max}$) :

$p = b \cdot (t_s + t_a + t_b)$

If $s_{TD} \geq s_{0max}$:

$q = 2 \cdot b \cdot (s_{TD} - s_{0max}) + v_{TARGET}2$

(Note: in the above formula the term $\cdot s_D$ is removed)

else (when $s_{TD} < s_{0max}$):

$q = v_{TARGET}2$

else (when without s_0):

$p = b * (t_s + t_a + t_b)$

$q = 2 \cdot b \cdot s_{TD} + v_{TARGET}2$

F 5047 Service brakes shall be applied as long as the train speed is higher than end speed + braking limit.

F 5048 After ESP service brake supervision shall be according to constant speed supervision.

11.5 Warning curves (A0, A and B)

F 5049 Eight (8) seconds before service brake intervention curve C the driver shall be warned by a tone f1 and braking request text indication "JARRUTA" shall be indicated on the DMI. In this case there shall be enough time for the driver to brake the train.

The A curve is calculated as

$s_A = s_C + 8 \cdot v_C$

s_A = distance of the curve A to the target point (m)
s_C = service brake intervention curve including the term $(1 - \Delta p / p_0)$

Note If service brake test is not performed then warning tone f2 will be used. See [F 6009].

F 5050 The braking request text indication shall disappear as the speed of the train goes below curve A (i.e. hysteresis of at least 1 sec):

$s_A = s_C + (8+1) \cdot v_C$

s_C = service brake intervention curve *excl.* the term $(1 - \Delta p / p_0)$

F 5051 If the driver has not yet carried out a sufficient braking the driver shall be warned according to the curve s_B (braking is not strong enough) by a blinking braking request text indication "JARRUTA" and by continuous tone f2.

$s_B = s_C + 4 \cdot v_C$

s_B = distance of the curve B to the target point (m)
s_C = service brake intervention curve *incl.* the term $(1 - \Delta p / p_0)$

F 5052 The tone f2 shall be cancelled and the blinking braking request text indication "JARRUTA" shall be replaced by fixed braking request text indication "JARRUTA" as the speed of the train goes below curve B (i.e. hysteresis of at least 1 sec):

$s_B = s_C + (4+1) \cdot v_c$

s_C = service brake intervention curve *excl.* the term $(1 - \Delta p / p_0)$

F 5053 Warnings (A and B) shall not be initiated if train speed is below end speed + alarm limit.

F 5054 After ESP alarm text braking request text indication shall be suppressed and replaced by the text "YLINOPEUS" according to constant speed supervision.

F 5055 Additionally 13 sec before service brake intervention curve there is a prewarning curve (curve A_o) used only for controlling target indication on the DMI:

$s_{Ao} = s_C + 13 \cdot v_C$

s_C = service brake intervention curve *incl.* the term $(1 - \Delta p / p_0)$

Note With curve A_o no actions when returning to the safe side of the curve.

11.6 Emergency brake curve (E)

F 5056 As a safety function the STM applies emergency brakes if the train will pass the emergency brake curve E:

$s_E = s_D - 2 \cdot v_C$ (if $s_D \geq 2 \cdot v_C$)

$$s_E = 0 \text{ (if } s_D < 2 \cdot v_C)$$

F 5057 Emergency brake shall be applied if speed exceeds E curve and speed is at least end speed + 15 km/h.

Note When the target point is passed ceiling speed is supervised without emergency brake function.

11.7 Release speed

Note Release speed is used for signals indicating "stop", level crossings and landslides.

F 7028 Release speed shall be given either as a fixed value in a balise telegram or it can be calculated by STM depending on train data and existing overlap.

F 5058 As the target speed is 0, speed shall be monitored downwards to the release speed valid for the target. This means that the braking can not be released until the speed of the train will be under alarm limit of the release speed.

F 5059 In case of a variable (STM calculated) release speed (v_R) the formula is:

$$v_R = \sqrt{b_0^2 + t_b + 2 \cdot b_0 \cdot d_0} - b_0 \cdot t_b$$

$b_0 = b_{STM} + 0{,}01 \cdot g_o$
b_{STM} = retardation (m/s2)
g_0 = gradient of the overlap area (‰)
t_b = brake time delay (s)
d_0 = length of the overlap area (m)

F 5060 The calculated release speed shall be shown in steps of 1.

F 5061 Rounding of the calculated release speed shall be done downwards.

Note Rounding is executed using units km/h in steps of 1.

F 5062 Possibility for using calculated release speed shall be given via balise telegram. This telegram gives the variables d_o and g_o. The possibility shall be indicated to the driver on the DMI.

F 2297 If calculated release speed is used an Overlap Stop is received in balise telegram the speed increase button "NOP.KOH." shall be displayed.

F 5063 Activation of calculated release speed shall be done by the driver by pressing the speed increase button before passing ESP for constant release speed.

Note If activated by driver, the activation extinguishes the speed increase indication before passing ESP.

F 7029 If an Overlap Stop is received in balise telegram and calculated release speed is below or equal to 35 km/h, the calculated release speed shall be valid automatically, without driver action.

Note Release speed over 35 km/h requires activation by the driver according to [F 5063].

F 5064 If the calculation is not activated the release speed shall be constant as given by the balise telegram.

Note Also in this case the indication is extinguished when passing the ESP for constant release speed.

F 5065 If the train stops before the main signal and before activation of the calculated release speed, the constant release speed shall be valid.

F 5066 If the train stops before the main signal and after activation of the calculated release speed the following shall be valid:
- if calculated release speed was ≤ 35, the calculated value shall be valid
- if calculated release speed was > 35, the release speed shall be set to 35

11.8 Indications during target supervision

F 5067 The most restrictive target (MRT, which includes speed, distance and type of the target) shall be indicated to the driver on the DMI.

F 5068 If there are several targets whose ESP's are passed and one of targets is a stop signal, this target (stop signal) shall be indicated.

F 5069 Changing indications to the new, most restrictive target shall be done when one of the following conditions is fulfilled:
- the ESP of the current MRT and A_0 curve of the next target have been passed
- the target point of the current MRT has been passed
- the next restrictive target starts to reduce the permissive speed indication

F 5070 If the MRT is a stop signal the next restrictive target shall not be indicated before the signal balises has been passed.

F 5071 If the MRT is a level crossing, a landslide or a reserved track the next restrictive target shall not be indicated before target point has been passed.

F 5072 The permitted speed indicator shall indicate the lowest of most restrictive braking curve or most restrictive ceiling speed.

F 7033 Reserved

F 5091 Reserved

ATP-VR/RHK STM BL3 FUNCTIONAL REQUIREMENTS SPECIFICATION (FRS)

PART 4

AIR GAP

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TABLE OF CONTENTS

Definitions and abbreviations

Note For definitions and abbreviations, refer to document [ATP-VR/RHK STM BL3 Functional Requirements Specification - PART 1 - System Introduction], Chapters 7 and 8.

1 INTRODUCTION

1.1 Scope

Note This part of FRS specifies the following Specific Transmission Module national functions for ATP-VR/RHK:

- Balise reading
- Balise telegram evaluation and identification
- Balise transmission system (Air Gap)
- Appendixes regarding coding and content of balise telegram

Note For an overview of the ATP-VR/RHK STM system, refer to document [ATP-VR/RHK STM BL3 Functional Requirements Specification - PART 1 - System Introduction].

Note Some of the requirements in this document are applicable only to dedicated national STM antenna. Refer to [SUBSET-100 Interface G specification] and [SUBSET-101 Interface K specification] and other related ETCS specifications for details about Euroantenna implementation.

1.2 General

F 4002 The ETCS with STM system shall be a continuously supervising system using intermittent updating, which means that the speed is continuously supervised but the track information is given to the vehicle at so-called information locations.

Note An information location (an IL) consists of two balises mounted in the track.

F 4003 An STM antenna mounted underneath the vehicle shall continuously send an activation signal towards the ground.

Note When a balise receives this signal it responds by transmitting a balise telegram, containing necessary track information.

F 4004 Reserved

Note Due to the general-purpose design of the balise it is possible to use the same type of balise both for fixed and variable information.

F 4005 Reserved

Note One IL is associated with one kind of signalling object in the track, such as a signal, a repeater signal, a speed board, a warning board, etc.

F 4006 Reserved

Note The used balise telegram format has a total of 180 vital information bits, which is normally sufficient for transmitting all information that is associated with one running direction. The reason for having two balises is mainly to indicate the valid running direction, which is determined by the way the two balises are coded. The information capacity of the second balise is therefore used for two other purposes:

- It repeats the information of the first balise for the reason of higher availability, in a situation where one of the balises should be unreadable
- It transmits information that is valid for the opposite direction

2 BALISE TELEGRAM

2.1 Evaluate transponder data

F 4007 The evaluation of the transponder telegram shall be done in a number of steps. The first step is to detect if there is any activity on the antenna, i.e., look for any incoming zeroes. If there is any activity there is a possibility of it being caused by a transponder. To verify that there is a transponder and not noise, the activity has to last for a certain period depending on the train speed.

2.1.1 Beginning of transponder

F 4008 The beginning of transponder defines the start of a transponder present area. A beginning of transponder criterion is defined in order to determine the beginning of a transponder passage with the best possible accuracy.

F 4009 The beginning of transponder criterion uses the most recently received data. The data is observed through a moving window called the transponder present window. The window is moved along 16 bits at the time. The evaluation continues until the begin criterion is fulfilled. The check for beginning of transponder is disabled during transponder present until the end of transponder is detected. The beginning of transponder criterion is based upon the ratio of 0's and 1's on the transponder link. The begin criterion is:

- Length of beginning of transponder window = 48 bits
- At least on bit per 16 should be '0' in each of the three sub words.

2.1.2 End of transponder

F 4010 The end of transponder defines the end of the transponder present area. The end criterion is defined to determine the end of a transponder passage with the best possible accuracy. The end criterion is based upon the ratio of 0's and 1's in the transponder data. End of transponder and beginning of transponder shall not use overlapping data i.e., End of transponder comes at least 48 bits after beginning of transponder. The end criterion is:

- Length of begging of transponder window = 48 bits
- At most 2 bits per 16 should be '0' in each of the three sub words.

2.1.3 Maximum transponder contact length

F 4011 To ensure that all transponder telegrams are completed a maximum transponder contact length shall be assumed. This distance shall be supervised and measured from the first beginning for the transponder. The supervision shall be disabled at low speed not to cause false errors.

Note For ATP-VR/RHK system typical contact length in train movement direction is 0,7 … 0,9 m and worst-case contact length is approximately 0,5 m.

F 9003 The system shall check that no balise contact persists for more than
a) 10 m, when speed is less than 6 km/h
b) 1,7 m, when speed is greater than or equal to 6 km/h

F 9004 In case of too long contact distance, the error shall be handled as stated below.
1. A transmission error indication shall be sent.
2. The STM shall always order full-service braking.
3. The STM shall erase all balise information, but this shall not cause any STM emergency braking.
4. The STM shall allow brake release when the train stops.
5. STM Failure state (FA) shall be entered if the problem persists after the driver presses the brake release button.

2.1.4 Evaluate Telegrams

F 4012 The CRC code is cyclic and therefore a valid CRC may be found anywhere within the incoming bit stream. A valid CRC shall be declared after 255 bits plus 2 bits delay after the beginning of an error free section of the transponder telegram. During a transponder passage the CRC may not be valid in sections due to noise or a change of transponder telegram. Transponder telegram with valid CRC shall be forwarded. This is also the case even if there has been a telegram change during the Transponder passage. The last readable balise telegram with a valid CRC from a balise shall be processed.

F 4013 The data section used for detecting beginning of transponder shall not be discarded and may be part of a valid telegram.

2.1.5 Check and Alignment of Telegrams

F 4014 When a Valid CRC is obtained, the corresponding telegram (255 bits) shall be CRC checked by software. At this stage the Telegram should be time stamped. The start position of the telegram must be calculated since the reception of the telegram is only bit synchronised and not frame synchronised, i.e., the start of the information part of the telegram is unknown at this stage.

2.1.6 Detection of Inverted Telegrams

F 4015 An erroneous transponder may be transmitting inverted telegrams. This shall be detected by checking the last of the three control bits in the transponder telegram after the telegram has been aligned. In the case of a transponder transmitting inverted telegrams, this check bit is 0. All three control bits are protected against noise by

the CRC code. Inverted telegram shall be handled as a balise error [FRS Part 2 Information Flow Track-Train 1.1.6].

2.1.7 Detection of All Zero Telegram

F 4016 If a transponder telegram with all zero bits is detected, the telegram shall be handled as a balise error [FRS Part 2 Information Flow Track-Train 1.1.5].

2.1.8 Faulty Transponder

F 4017 If a valid CRC is not obtained between beginning of transponder and end of transponder, the received data either comes from a faulty transponder or the telegram is corrupted by noise. If the elapsed time between beginning of transponder and end of transponder is much shorter than what is expected for a functioning transponder, the data is deemed to be a noise disturbance (but it could be a faulty transponder). Once beginning of transponder is detected, the time required to pass the transponder shall be computed from the current speed.

F 4018 Data received from beginning of transponder till end of transponder will always be classified as either transponder telegram, transponder detect or noise.

F 4019 Criterion for Faulty Transponder:

- If the time between Beginning of transponder and End of transponder is longer than or equal to 40 % of the estimated passage time (based on a transponder contact length) or more than 1250 bits has been received and no valid CRC has been obtained, then the data comes from a Faulty Transponder.

F 4020 Criterion for noise:

- If the time between Beginning of transponder and End of transponder is less than 40 % of the estimated passage time and less than 1250 bits has been received and no valid CRC has been obtained, then the data is caused by noise and is ignore.

F 4021 Requirements for accepted telegram and for detected balise:

Table 1/4. Balise telegram and transponder detect criteria

Valid CRC	>1250 bits	>40 % transponder	Cause
Yes	X	X	Transponder Telegram
No	Yes	X	Transponder Detect
No	No	Yes	Transponder Detect
No	No	No	Noise

2.1.9 Influence of speed to handling of balise telegrams

F 4022 Balise telegram can change during passing of antenna. The balise telegram doesn’t include the right CRC-code in this case. The speed, when it is possible to read balise telegram twice correctly, shall be defined. The definition of the speed shall cover all balise and antenna combinations.

F 4023 The defined speed shall defect to balise error handling of "unreadable telegram received" cases [FRS Part 2 Information Flow Track-Train 1.3.1 and 1.4.1].

3 TRANSMISSION SYSTEM (AIR GAP)

3.1 Vehicle antenna

F 4024 The transmit antenna shall continuously send the signal of specified frequency.

Note The conditions to allow turning on antenna transmission are defined in [F 9005, F 9006] for dedicated STM antenna. When using combined antenna, ETCS manages the antenna transmission function.

F 4025 The power of signal shall be from 20 watts to 25 watts.

F 4026 The signal shall transmit energy and train clock (50 kHz) information to the balise.

F 4027 The signal frequency shall be 27 115 $\pm$ 5 kHz and the amplitude shall be modulated with the train clock frequency of 50 kHz. If the toggling signal 27 095 kHz $\pm$ 5 kHz is capable to perform as required, it can be also used.

F 4028 The modulation depth of signal shall be at least 94 % (>25 dB). If the modulation depth 50-100 % is capable to meet STM performance requirements, this can be also used.

3.2 The receiver antenna

F 4029 The Antenna shall receive the 50 kHz modulated 4,5 MHz signal which is sent from balise.

F 4030 The Antenna's transmission function shall be tested with a test signal. The test shall be executed so often that the safety requirements of ATP shall be fulfilled.

Note This in general applies both to dedicated national STM antenna and combined antenna (KER antenna used via interface K).

F9001 When using a dedicated STM antenna:
a) Every 50:th ms the transmission functions shall be checked, i.e. the balise reading ability.
b) There shall be a test function for this purpose, which shall check that:

- The output level from the transmitter is enough to activate passed balises, and
- That the sensitivity of the receiver is enough to detect passed ATP-VR/RHK balises.

c) The STM shall ensure that the test function works at the appropriate points of time to ensure that the safety requirements of ATP are fulfilled.

d) If the transmitter is ON and one or more test function replies are lacking, the error shall be handled as stated below.

- A transmission error text message shall be sent.
- The STM shall always order full-service braking.
- The STM shall erase all balise information, but this shall not cause any STM emergency braking.
- The STM shall allow brake release when the train is stationary.
- Failure state (FA) shall be entered if the problem persists when the driver presses the button for brake release.

Note If the transmitter is turned off, the test function will not work.

Note Different test interval could be justified based on detailed safety analysis, considering also [F 4030].

F 9005 When using a dedicated STM antenna, the transmitter shall be in operation (active) when any of these conditions apply:
a) The cab is active and the direction controller is in Forward/Reverse position (not in Neutral position), or
b) The train is rolling, or
c) There is balise contact.

F 9006 When using a dedicated STM antenna, the transmitter shut-down function shall be delayed by 10 s..

F 9002 Reserved

3.3 Track side balise

F 4031 Reserved

Note The trackside balise is passive and powered via 27 MHz signal from the vehicle antenna.

F 4032 Reserved

Note The 27 MHz is also amplitude modulated at 50 kHz to provide a reference clock, the train clock.

F 4033 Reserved

Note The balise transmits the serial link data to the vehicle a data rate of 50 kHz, clocked via the 50 kHz train clock (figure 1).

F 4034 The balise to vehicle carrier frequency is 4,5 MHz. When transmitting a "0" ~~a~~ balise LC circuit is energized and continues to oscillate for 20 μ-seconds [Figure 2/4 Chapter 14]. The ATP Antenna and Transmission unit shall receive and decode this.

3.4 Balise technical data

3.4.1 Properties of received RF signal

F 4035 Reserved

Note Signal frequency is 27,115 MHz, modulation depth is 50 – 100 % and pulse rate is 50 kHz.

F 4036 Reserved

F 4037 RF off time, related to modulation, shall be 2 - 3 μs.

F 4038 Reserved

3.4.2 Transmission

F 4039 Reserved

Note Transmission frequency is 4,4 - 4,6 MHz.

3.5 Distance

F 4040 The dedicated antenna shall be capable to read ATP-VR/RHK balises when the distance between the top of the rail and mounting plane of antenna is 400 mm +60 mm/-120 mm.

Note The distance of the mounting plane of the balise and the top of the rail is 150 mm +20 mm/-20 mm.

Note Other distance could be acceptable based on demonstration of functionality (e.g. test evidence and analysis), if requirements for Finnish structure gauge are fulfilled.

F 4041 Two balises whose distance, measured from the centre point to centre point, is 2,3-3,5 m shall be processed as a complete balise group.

F 4042 Two balises whose distance, measured from the centre point to centre point, is more than 10,5 m shall belong into separate balise group.

F 4043 Distance calculation from balise to balise shall be measured from the centre point to centre point of balises.

F 4044 Distance measurement from information point shall be started in relation to an A balise of a passed balise group.

Note For more details about balise distances used in Finland, refer to [RATO 10 - Junien kulunvalvonta JKV, Väyläviraston julkaisu].

3.6 Programmable parameters

F 4045 Reserved

Note Telegram length can be 8-256 bits.

F 4046 Reserved

Note Time out value can be 2 - 64 train clock pulses (40 µs - 1,28 ms).

F 4047 Reserved

Note Default telegram can be 8-256 bits

3.7 Reading and decoding of the balise telegram

3.7.1 General

F 4048 The balise telegram code format shall be a modified BCH block code (BCH Bose Chaudhuri Hocquenghem).

F 4049 Balise detect:
- At least 1 bit per 16 should be '0' in each of the three 16-bit sub-words.

F 4050 End of balise:
- At most 2 bits per 16 should be '0' in each of the three 16-bit sub-words.

F 4051 The STM shall manage that:
a) Each received telegram consists of 180 data bits, 64 bit CRC, 8 synchronization bits and 3 check bits, totally 255 bits.
b) With the used clock frequency 50 kHz (period time 20 µs), the transmission time per telegram will be 5.1 ms.

3.7.2 Information part

F 4052 Information field (180 bits) is subdivided into 45 x 4 bits nibbles.

F 4053 Reserved

Note First nibble is numbered N0, and the last nibble is numbered N44.

F 4054 All nibbles may be coded with values from 1 to 14. The 0 and 15 values shall be illegal in this system.

Note More information about the structure of information part in [Chapters 4-14].

3.7.3 Control bits

F 4055 The two first control bits shall be used for optimizing the distribution of 0 and 1 in the CRC part of the telegram and can be ignored.

F 4056 The last Control bit for Inverted Telegram shall be 1 bit. This should be set (1) for all telegrams. If this bit is 0, the Telegram has been bit inverted and shall be considerably faulty.

3.7.4 Synchronizing bits

F 4057 Telegram shall be synchronized by using two synchronization nibbles.

3.7.5 Cyclic redundancy code part

F 4058 A 64 bit CRC-code shall protect the message against errors.

Note See also [Chapters 4-14].

4 CODING OF TELEGRAM (APPENDIX 1)

F 4059 Reserved

Note Balise telegram shall consist of 180 information bits. Information is separated to four bits long half words (nibble).

Note The "Conversion instructions" Sheet tells where you find conversion instructions (LD = Long distance table, SD = Short distance table, LS = Long speed table SS = Short speed table).

4.1 Balise Identification

F 4060 Every information type shall include seven identification nibbles, which are decoded according to table 2/4.

F 4061

Table 2/4. Balise Identification

Nibble no.	Name	Length of nibbles	Length of bits	Explanation	Conversion instructions
R0	Cb a	1 nibble	4 bits	Balise identification	Chapter 5 Balise identification
R1	Cb b	1 nibble	4 bits	Balise identification	Chapter 5 Balise identification
R2	Cr a	1 nibble	4 bits	Record identification	Chapter 6 Record identification values Cr a and Cr b
R3	Cr b	1 nibble	4 bits	Record identification	Chapter 6 Record identification values Cr a and Cr b
R4 - R8	Ic	5 nibbles	20 bits	Current position identity	Chapter 11 The Function Hex to Dec Conversion Formula
R9 - R13	In	5 nibbles	20 bits	Next position identity	Chapter 11 The Function Hex to Dec Conversion Formula
R14 - R15	Dl	2 nibbles	8 bits	Linking distance	Chapter 8 Distance Tables

4.2 Information Record

F 4062 There shall be several possible telegrams with different construction.

Possible telegrams are:

1) Signal
2) Repeat signal

3) Speed board
4) Warning board

4.3 Signal information

F 4063 Signal Information Record shall be according to table [3/4].

Table 3/4. Signal Information

Nibble no.	Name	Length of nibbles	Length of bits	Explanation	Conversion instructions
R16 - R17	Vl	2 nibbles	8	Line speed	Chapter 7, Long Distance
R18 - R19	Vt	2 nibbles	8	Target speed	Chapter 7, Long Speed
R20 - R21	Db	2 nibbles	8	Basic distance	Chapter 8, Long Distance
R22	Gb	1 nibble	4	Basic gradient	Chapter 9, Gradient Table
R23 - R27	In	5 nibbles	20	Next signal identity	Chapter 11, The Function Hex to Dec Conversion Formula
R28 - R29	Ms	2 nibbles	8	Stop message (Distance or speed)	Chapter 8, Long Distance/Chapter 7, Long Speed
R30	Vx	1 nibble	4	Stop message gradient	Chapter 9, Gradient Table
R31	Vx	1 nibble	4	First Switch Restriction	Chapter 7, Short Speed
R32 - R33	Dx	2 nibbles	8	Distance to first Switch	Chapter 8, Long Distance
R34	Gx	1 nibble	4	Gradient to first Switch	Chapter 9, Gradient Table
R35	Dy	1 nibble	4	Length of first Switch	Chapter 8, Short Distance
R36 - R37	Vy	2 nibbles	8	Speed after first Switch	Chapter 7, Long Speed
R38	Vx	1 nibble	4	Second Switch Restriction	Chapter 7, Short Speed
R39 – R40	Dx	2 nibbles	8	Distance to second Switch	Chapter 8, Long Distance
R41	Gx	1 nibble	4	Gradient to second Switch	Chapter 9, Gradient Table
R42	Dy	1 nibble	4	Length of second Switch	Chapter 8, Short Distance
R43 – R44	Vy	2 nibbles	8	Speed after second Switch	Chapter 7, Long Speed

4.4 Repeater Signal

F 4064 Repeater Signal Information Record shall consist of the same fields as a Signal Information Record.

4.5 Speed Board

F 4065 Speed Board Information Record shall be according to [Table 4/4].

Table 4/4. Speed Board Information

Nibble no.	Name	Length of nibbles	Length of bits	Explanation	Conversion instructions
R16 - R17	Tx	2 nibbles	8 bits	Type of restriction 1.	Chapter 10 Restriction Types
R18 - R19	Vx	2 nibbles	8 bits	Speed restriction 1.	Chapter 7, Long Speed
R20 - R21	Tx	2 nibbles	8 bits	Type of restriction 2.	Chapter 10 Restriction Types
R22 - R23	Vx	2 nibbles	8 bits	Speed restriction 2.	Chapter 7, Long Speed
R24 - R25	Tx	2 nibbles	8 bits	Type of restriction 3.	Chapter 10 Restriction Types
R26 - R27	Vx	2 nibbles	8 bits	Speed restriction 3.	Chapter 7, Long Speed
R28 - R29	Tx	2 nibbles	8 bits	Type of restriction 4.	Chapter 10 Restriction Types
R30 - R31	Vx	2 nibbles	8 bits	Speed restriction 4.	Chapter 7, Long Speed

4.6 Warning board

F 4066 Warning Board Information Record shall be according to [Table 5/4].

Table 5/4. Warning Board Information

Nibble no.	Name	Length of nibbles	Length of bits	Explanation	Conversion instructions
R16 - R17	Tx	2 nibbles	8 bits	Type of restriction 1.	Chapter 10 Restriction Types
R18 - R19	Vx	2 nibbles	8 bits	Speed restriction 1.	Chapter 7, Long Speed
R20 - R21	Dx	2 nibbles	8 bits	Distance to restriction point 1.	Chapter 8, Long Distance
R22	Gx	1 nibble	4 bits	Gradient to restriction point 1.	Chapter 9, Gradient Table
R23 - R24	Dy	2 nibbles	8 bits	Length of restriction point 1.	Chapter 8, Long Distance
R25 - R26	Vy	2 nibbles	8 bits	Speed after restriction 1.	Chapter 7, Long Speed
R27 - R28	Tx	2 nibbles	8 bits	Type of restriction 2.	Chapter 10 Restriction Types
R29 - R30	Vx	2 nibbles	8 bits	Speed restriction 2.	Chapter 7, Long Speed
R31 - R32	Dx	2 nibbles	8 bits	Distance to restriction point 2.	Chapter 8, Long Distance

R33	Gx	1 nibble	4 bits	Gradient to restriction point 2.	Chapter 9, Gradient Table
R34 - R35	Dy	2 nibbles	8 bits	Length of restriction point 2.	Chapter 8, Long Distance
R36 - R37	Tx	2 nibbles	8 bits	Type of restriction 3.	Chapter 10 Restriction Types
R38 - R39	Vx	2 nibbles	8 bits	Speed restriction 3.	Chapter 7, Long Speed
R40 - R41	Dx	2 nibbles	8 bits	Distance to restriction point 3.	Chapter 8, Long Distance
R42	Gx	1 nibble	4 bits	Gradient to restriction point 3.	Chapter 9, Gradient Table
R43 - R44	Dy	2 nibbles	8 bits	Length of restriction point 3.	Chapter 8, Long Distance

F 4067 Reserved

5 BALISE IDENTIFICATION (APPENDIX 2)

F 4068 Every Balise telegram contains two identification nibbles and shall be interpreted according to [Table 6/4].

Table 6/4. Balise Identification nibbles (R0 and R1)

Cb a (R0)	Interpretation
1	*not used*
2	1(2) The first out of two Balises
3	2(2) The second out of two Balises
4	*not used*
5	*not used*
6	*not used*
7	*not used*
8	*not used*
9	*not used*
A	*not used*
B	2(2)* Combined IL. Tells that the IL contains one Balise with information valid for downstream direction and one Balise with information for upstream direction.
C	*not used*
D	*not used*
E	*not used*

Cb b (R1)	Interpretation
1	Single
2	Double
3	*not used*
4	*not used*
5	*not used*
6	*not used*
7	*not used*
8	*not used*
9	*not used*
A	*not used*
B	*not used*
C	*not used*
D	*not used*
E	*not used*

6 RECORD IDENTIFICATION VALUES Cr a AND Cr b (APPENDIX 3)

F 4069 Every Balise telegram contains the two nibbles Cr a and Cr b. These two determine how to interpret the rest of the information. These two shall be interpreted according to [Table 7/4].

F 4070 The Balise Identification nibbles Cr a and Cr b shall be according to [Table 7/4].

Table 7/4. Balise Identification nibbles (R2 and R3)

Cr b (R3)	Cr a (R2) 1	2	3	4	5…D	E
1	Signal	Rep.signal	Speed board	Warn. board	-	-
2	OS	OS	-	-	-	-
3	RSS	RSS	-	-	-	-
4	DS	DS	-	-	-	-
5	RT	RT	-	-	-	-
6	DG	DG	-	-	-	-
7	-	-	-	-	-	-
8	-	Link rep.	-	-	-	-
9	ETS1	ETS1	ETB1	ETB1	-	-
A	ETS2	ETS2	ETB2	ETB2	-	-
B	ETS3	ETS3	ETB3	ETB3	-	-
C	ETS4	ETS4	ETB4	ETB4	-	-
D	ETS5	ETS5	ETB5	ETB5	-	-
E	-	Rep. marker	-	W.B. marker	-	Cancelled
	Reserved	**Reserved**	**Reserved**	**Reserved**	**Not in use**	**Reserved**

OS	Overlap Stop
RSS	Release Speed Stop
DS	Deferred Stop
RT	Reserved Track stop
DG	Deferred Go
Link rep.	Linking Repeater
–	Illegal

F 4071 The error telegrams shall be predefined and not possible to choose or edit.

ETS1	Invalid Signal Aspect
ETS2	Unstable Input
ETS3	Blink Frequency Error
ETS4	Power Failure in decoder
ETS5	Transponder default (No input from encoder)

Note ETS is an abbreviation for error telegram signal, and ETB means error telegram board.

Note A controllable Speed Board or Warning board may transmit one of the default error telegrams ETB1 - 5 "Error Transponder board".

F 4072 The ETB category shall be the same as for ETS.

7 SPEED TABLES (APPENDIX 4)

F 4073 Speed tables shall be used to convert speed Hex nibble value to speed integer value.

7.1 Short Speed table (SS)

F 4074 Short Speed table [Table 8/4] shall be used when speed of switch restriction area is defined.

Table 8/4. Short Speed table

Short Speed table		
Nibble value		Speed value
Hex	Dec	
1	1	35
2	2	35 (20)(1)
3	3	40
4	4	70 (60)(2)
5	5	80 (60)(2)
6	6	90
7	7	110
8	8	120
9	9	130
A	10	140
B	11	160
C	12	50
D	13	60
E	14	Cancelled (*)

(1) Speed value can be changed to speed 20 km/h by bit 2 of PT-code.
(2) Speed value can be changed to speed 60 km/h by bit 3 of PT-code.

Note Speed value is not affected by PT-code.

7.2 Long Speed table (LS)

F 4075 Long Speed table shall be used when following speeds are defined:

- Line speed
- Target speed
- Stop message speed
- Speed after switch
- Restrictions speed

F 4076 Long Speed shall be according to [Table 9/4].

Table 9/4. Long Speed table

		First Nibble (a)													
Second Nibble (b)		1	2	3	4	5	6	7	8	9	A	B	C	D	E
	1	0	70	140	210	280	350	420	490	Illegal	Illegal	Illegal	Illegal	Illegal	Illegal
	2	5	75	145	215	285	355	425	495	Illegal	Illegal	Illegal	Illegal	Illegal	Illegal
	3	10	80	150	220	290	360	430	500	Illegal	Illegal	Illegal	Illegal	Illegal	Illegal
	4	15	85	155	225	295	365	435	505	Illegal	Illegal	Illegal	Illegal	Illegal	Illegal
	5	20	90	160	230	300	370	440	510	Illegal	Illegal	Illegal	Illegal	Illegal	Illegal
	6	25	95	165	235	305	375	445	515	Illegal	Illegal	Illegal	Illegal	Illegal	Illegal
	7	30	100	170	240	310	380	450	520	Illegal	Illegal	Illegal	Illegal	Illegal	Illegal
	8	35	105	175	245	315	385	455	525	Illegal	Illegal	Illegal	Illegal	Illegal	Illegal
	9	40	110	180	250	320	390	460	530	Illegal	Illegal	Illegal	Illegal	Illegal	Illegal
	A	45	115	185	255	325	395	465	535	Illegal	Illegal	Illegal	Illegal	Illegal	Illegal
	B	50	120	190	260	330	400	470	540	Illegal	Illegal	Illegal	Illegal	Illegal	Illegal
	C	55	125	195	265	335	405	475	545	Illegal	Illegal	Illegal	Illegal	Illegal	Illegal
	D	60	130	200	270	340	410	480	550	Illegal	Illegal	Illegal	Illegal	Illegal	Illegal
	E	65	135	205	275	345	415	485	555	Illegal	Illegal	Illegal	Illegal	Illegal	**Cancelled**

8 DISTANCE TABLES (APPENDIX 5)

F 4077 Distance tables shall be used to convert Hex nibble value to integer value.

Note All distance values are in meters.

8.1 Short Distance table (SD)

F 4078 Short distance table [Table 10/4] shall be used when length of switch is defined.

Table 10/4. Short Distance table

Short Distance table		
Nibble value		Distance
Hex	Dec	Value / m
1	1	30
2	2	60
3	3	90
4	4	120
5	5	150
6	6	200
7	7	250
8	8	300
9	9	350
A	10	400
B	11	600
C	12	800
D	13	1000
E	14	**Cancelled**

8.2 Long Distance table (LD)

F 4079 Long distance table shall be used when following distances are defined:

- Linking distance to next Balise point
- Basic distance to next signal (information) point
- Distance to all restriction start points
- Length of all restrictions

F 4080 Long Distance shall be according to [Table 11/4].

Table 11/4. Long Distance table

		First Nibble (a)													
Second Nibble (b)		1	2	3	4	5	6	7	8	9	A	B	C	D	E
	1	5	175	350	525	700	1050	1400	2100	3500	4900	6300	7700	9100	10500
	2	13	188	363	538	725	1075	1450	2200	3600	5000	6400	7800	9200	10600
	3	25	200	375	550	750	1100	1500	2300	3700	5100	6500	7900	9300	10700
	4	38	213	388	563	775	1125	1550	2400	3800	5200	6600	8000	9400	10800
	5	50	225	400	575	800	1150	1600	2500	3900	5300	6700	8100	9500	10900
	6	63	238	413	588	825	1175	1650	2600	4000	5400	6800	8200	9600	11000
	7	75	250	425	600	850	1200	1700	2700	4100	5500	6900	8300	9700	11100
	8	88	263	438	613	875	1225	1750	2800	4200	5600	7000	8400	9800	11200
	9	100	245	450	625	900	1250	1800	2900	4300	5700	7100	8500	9900	11300
	A	113	288	463	638	925	1275	1850	3000	4400	5800	7200	8600	10000	11400
	B	125	300	475	650	950	1300	1900	3100	4500	5900	7300	8700	10100	11500
	C	138	313	488	663	975	1325	1950	3200	4600	6000	7400	8800	10200	11600
	D	150	325	500	675	1000	1350	2000	3300	4700	6100	7500	8900	10300	**#**
	E	163	338	513	688	1025	1375	2050	3400	4800	6200	7600	9000	10400	**Can-celled**

F 4081 **#** The Balise information point shall not be included in linking chain. Linking distance information is not provided.

9 GRADIENT TABLE (APPENDIX 6)

9.1 Gradient table

F 4082 Gradient table [Table 12/4] shall be used when there is defined gradient to target point.

Note Values are in parts per thousand (‰).

Table 12/4. Gradient table

Gradient table		
Nibble value		Gradient value / ‰
Hex	Dec	
1	1	-18
2	2	-15
3	3	-13
4	4	-10
5	5	-8
6	6	-5
7	7	-3
8	8	0
9	9	2
A	10	5
B	11	-22
C	12	-27
D	13	-33
E	14	-40

10 RESTRICTION TYPES (APPENDIX 7)

10.1 Restrictions

F 4083 It shall be possible to use several restriction types.

Note The next table tells how to define the used restriction.

10.2 Restriction Types

F 4084 Restriction Types shall be according to [Table 13/4].

Table 13/4. Restriction Types table

		Tx a													
		1	2	3	4	5	6	7	8	9	A	B	C	D	E
Tx b	1	Sre	LCP3		-	-	-	-	-	TS1	TS6c	TRSw	TS10	TS12e	R6x
	2	dVinc	LCP1c		-	-	-	-	-	TS2	TS7c	TRSt	TS11	TS13e	-
	3	dVdec	LCP2c	LZ	-	-	-	-	-	TS3	TS8c	TRSwe	TS12	TS14e	-
	4	OTP	LCP3c	LZc	-	-	-	-	-	TS4	TS9c	TRSte	TS13	TS15e	-
	5	-	M2c	Lze	-	-	-	-	-	TS5	TS1e	-	TS14	-	-
	6	M1	C1c		-	-	-	-	-	TS6	TS2e	-	TS15	-	-
	7	M2	C2c	BUA	-	-	-	-	-	TS7	TS3e	-	TS10c	-	-
	8	M2e	LCP1e	BCA	-	-	-	-	-	TS8	TS4e	-	TS11c	-	-
	9	C1	LCP2e	BCAe	-	-	-	-	-	TS9	TS5e	-	TS12c	-	-
	A	C2	LCP3e	BOC	-	-	-	-	-	TS1c	TS6e	-	TS13c	-	-
	B	C1e		BHC	-	-	-	-	-	TS2c	TS7e	-	TS14c	-	-
	C	C2e	M3	(ODO)	-	-	-	-	-	TS3c	TS8e	-	TS15c	-	-
	D	LCP1	M3c	(ODOe)	-	-	-	-	-	TS4c	TS9e	-	TS10e	-	-
	E	LCP2	M3e	-	-	-	-	-	-	TS5c	-	-	TS11e	-	*

F 4085 Reserved

Note

Table 14/4. Restriction types

Coding in transponder	Explanation
SRe	End of switch restriction
dVinc	Delta Speed Increment
dVdec	Delta Speed Decrement
OTP	Opposite Track Passage
RT	Reserved Track
M1	Mandatory Restriction 1
M2	Mandatory Restriction 2

Coding in transponder	Explanation
M3	Mandatory Restriction 3
M2c	Cancelled Mandatory Restriction 2
M3c	Cancelled Mandatory Restriction 3
M2e	End of Mandatory Restriction 2
M3e	End of Mandatory Restriction 3
C1	Curve 1 Restriction
C2	Curve 2 Restriction
C1c	Cancelled Curve 1 Restriction
C2c	Cancelled Curve 2 Restriction
C1e	End of Curve 1 Restriction
C2e	End of Curve 2 Restriction
LCP1	Level Crossing Protection 1
LCP2	Level Crossing Protection 2
LCP3	Level Crossing Protection 3
LCP1c	Cancelled Level Crossing Protection 1
LCP2c	Cancelled Level Crossing Protection 2
LCP3c	Cancelled Level Crossing Protection 3
LCP1e	End of Level Crossing Protection 1
LCP2e	End of Level Crossing Protection 2
LCP3e	End of Level Crossing Protection 3
LZ	Landslide Zone
LZc	Cancellation of Landslide Zone
LZe	End of Landslide Zone
BUA	Border to Unequipped Area
BCA	Border to Construction Area
BCAe	End of Construction Area
BOC	Border to Other Country
BHC	Border to Home Country
(ODO)	Start of odometer control area
(ODOe)	End of odometer control area
TRSw	Temporary Restriction Switch
TRSt	Temporary Restriction Straight track
TRSwe	End of Temporary Restriction Switch
TRSte	End of Temporary Restriction Straight track
TS1	PT-restrictions 1
TS2	PT-restrictions 2
TS3	PT-restrictions 3
TS4	PT-restrictions 4
TS5	PT-restrictions 5
TS6	PT-restrictions 6
TS7	PT-restrictions 7
TS8	PT-restrictions 8
TS9	PT-restrictions 9
TS10	PT-restrictions 10
TS11	PT-restrictions 11
TS12	PT-restrictions 12
TS13	PT-restrictions 13
TS14	PT-restrictions 14
TS15	PT-restrictions 15
TS1c	Cancelled PT-restrictions 1
TS2c	Cancelled PT-restrictions 2
TS3c	Cancelled PT-restrictions 3
TS4c	Cancelled PT-restrictions 4

Coding in transponder	Explanation
TS5c	Cancelled PT-restrictions 5
TS6c	Cancelled PT-restrictions 6
TS7c	Cancelled PT-restrictions 7
TS8c	Cancelled PT-restrictions 8
TS9c	Cancelled PT-restrictions 9
TS10c	Cancelled PT-restrictions 10
TS11c	Cancelled PT-restrictions 11
TS12c	Cancelled PT-restrictions 12
TS13c	Cancelled PT-restrictions 13
TS14c	Cancelled PT-restrictions 14
TS15c	Cancelled PT-restrictions 15
TS1e	End of PT-restrictions 1
TS2e	End of PT-restrictions 2
TS3e	End of PT-restrictions 3
TS4e	End of PT-restrictions 4
TS5e	End of PT-restrictions 5
TS6e	End of PT-restrictions 6
TS7e	End of PT-restrictions 7
TS8e	End of PT-restrictions 8
TS9e	End of PT-restrictions 9
TS10e	End of PT-restrictions 10
TS11e	End of PT-restrictions 11
TS12e	End of PT-restrictions 12
TS13e	End of PT-restrictions 13
TS14e	End of PT-restrictions 14
TS15e	End of PT-restrictions 15
-	Illegal values
*	Cancelled Restriction

11 THE FUNCTION HEX TO DEC CONVERSION FORMULA (APPENDIX 8)

F 4086 The function Hex to Dec shall be used to convert identity parts of information from nibble format to integer format.

F 4087 Function shall give an error message if illegal nibble values 0 and 15 are found.

F 4088 Valid values shall be from *-1* to *537822*.

F 4089 The *-1* (*EEEEE*h) shall be cancellation value and the *537822* shall be maximum value (*DEEEE*h).

11.1 The Hex to Dec function

F 4090

$$ID = (R4-1) + (R5-1)\cdot 14 + (R6-1)\cdot 14^2 + (R7-1)\cdot 14^3 + (R8-1)\cdot 14^4$$

Note An example:

$$ID_{BIN} = 1000,1010,0010,1110,0001$$
$$\Rightarrow ID_{HEX} = 8A2E1$$
$$\Rightarrow ID_{DEC} = (8-1) + (10-1)\cdot 14 + (2-1)\cdot 14^2 + (14-1)\cdot 14^3 + (1-1)\cdot 14^4 = \underline{\underline{36001}}$$

12 THE BCH CODE OF THE TELEGRAMS AND CODE CHECK WITH THE CRC (APPENDIX 9)

12.1 The BCH code of the balise telegrams

F 4091 The Bose-Chaudhuri-Hochquenghem (BCH) code that is used for the balise telegrams shall contain the following parts:

- The information part is 180 bits long grouped into 45 nibbles of 4 bits each.
- The Cyclic Reduncancy Check (CRC) code part is 64 bits long generated from the basic BCH code.
- Eight bits are used for synchronization purposes.
- Finally there are three fill bits.

12.1.1 Telegram description

F 4092 The balise telegram shall consist of 255 bits (bit No 0...254), divided into 180 information bits, 72 check bits (extended CRC code) and 3 fill bits:

Table 15/4. Telegram description

	EXTENDED CRC			
	DATA FIELD (191 bits)			CRC
	Information	Fill	Synch.	
Size	180 bits = 45 nibbles	3 bits	8 bits	64 bits
Bits	0.....179	180..182	183..190	191.....254

F 4093 The CRC code shall be based upon a modified BCH (255, 191, 17) code. This BCH code shall have a minimum distance of at least 17.

Note This means that 17 bits must be faulty before the code word could erroneously be interpreted as another valid code word.

F 4094 The CRC bits check that the message is complete and valid. For this purpose the following CRC polynomial shall be used:

$$g(x) = x0 + x1 + x2 + x4 + x5 + x6 + x8 + x11 + x12 + x15 + x16 + x17 + x18 + x19 + x21 + x22 + x24 + x25 + x27 + x29 + x30 + x33 + x37 + x38 + x39 + x40 + x41 + x42 + x48 + x49 + x50 + x53 + x54 + x55 + x58 + x59 + x61 + x62 + x64 ,$$

where x**n** means that bit No **n** = 1.

F 4095 The CRC resulting value for checking that message is complete and valid:

Table 16/4. The CRC resulting value

Bits	64	63...48	47...32	31...16	15...0
Binary	1	0110 1100 1110 0111	0000 0111 1110 0010	0110 1011 0110 1111	1001 1001 0111 0111
Hex.	1	6CE7	07E2	6B6F	9977

F 4096 The decoding shall be performed by polynomial division or table look-up.

F 4097 The synchronization bits shall be used to find the beginning and end of the telegram. To do this an 8 bit extension of the CRC code is used, with the polynomial

$f(x) = x^0 + x^1 + x^5 + x^6 + x^8$,
where $x^{\mathbf{n}}$ means that bit No **n** = 1.

F 4098 The CRC resulting value for finding the beginning and end of the telegram:

Table 17/4. The CRC resulting value

Bits	8...0
Binary	1 0110 0011
Hex.	163

F 4099 The telegram shall be divided with this value and the remainder indicates the start position.

F 4100 The three fill bits (also called control or check bits) shall be used to fill up the message to 255 bits. The highest of these bits (bit No 182) shall always be set to 1, in order to make it possible to detect inversion of all bits in the telegram (since this is not detected by the CRC). The two other bits in this field are reserved for controlling the distribution of zeroes and ones in the extended CRC field.

Note Example of an ATP-VR/RHK balise telegram (Information part underlined)

Table 18/4. ATV-VR/RHK balise telegram example

First nibble	R0	R2	R4	R6	R8	R10	R12	R14	R16	R18	R20	R22	R24	R26	R28	R30
First bit	0	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120
Cont	**22**	**11**	**81**	**51**	**2A**	**55**	**12**	**B9**	**2B**	**EE**	**B9**	**6A**	**55**	**12**	**EE**	**6E**
First nibble	R32	R34	R36	R38	R40	R42	R44	R46	R48	R50	R52	R54	R56	R58	R60	R62
First bit	128	136	144	152	160	168	176	184	192	200	208	216	224	232	240	248
Cont	**EE**	**6E**	**EE**	**EE**	**E6**	**EE**	**EA**	**B4**	**83**	**A1**	**4A**	**8C**	**36**	**64**	**29**	**46**

Note The balise telegram consists of exactly 255 bits (No 0...254). In this table an extra bit = 0 has been added at the end of the telegram (bit No 255). Internally in the ATP software, the telegram can be extended by an extra bit in order to obtain exactly 256 bits (32 bytes) but this extra bit does *not* belong to the BCH code (and it is not sent from the balise either).

12.2Code check with the CRC

F 4101 One method to check that the BCH code in the balise telegram is correct shall be the following.

1) Initialize the 64-bit CRC sum to zero.
2) For every bit No of the telegram's Data field (0...191), take corresponding row of the CRC check table (0...191). The contents of every table row are then XOR-ed into the CRC sum, one row at a time.
3) If the resulting value of the CRC sum is equal to the original CRC field of the telegram (bits 192...254), then the telegram code is correct, else not.

Note It is also possible to initialize the CRC-sum to the CRC-field, in which case the correct CRC will be zero after the XOR procedure.

F 4102 The balise telegram composition shall be as follows:

Table 19/4. The balise telegram composition

Field	**D A T A (191 bits incl. synch & fill bits)**	**C R C (64 bits)**
Bits	**0.....190**	**191.....254**

F 4103 The CRC code table (256 • 64 bits) shall be as follows:

Table 20/4. CRC code table

No	0	1	2	3	4	5	6	7
0.	$FF	$FF	$FF	$FF	$FF	$FF	$FF	$FF
1.	$B6	$73	$83	$F1	$35	$B7	$CC	$BB
2.	$ED	$4A	$42	$09	$AF	$6C	$2A	$E6
3.	$76	$A5	$21	$04	$D7	$B6	$15	$73
4.	$8D	$21	$13	$73	$5E	$6C	$C6	$02
5.	$46	$90	$89	$B9	$AF	$36	$63	$01
6.	$95	$3B	$C7	$2D	$E2	$2C	$FD	$3B
7.	$FC	$EE	$60	$67	$C4	$A1	$B2	$26
8.	$7E	$77	$30	$33	$E2	$50	$D9	$13
9.	$89	$48	$1B	$E8	$C4	$9F	$A0	$32
10.	$44	$A4	$0D	$F4	$62	$4F	$D0	$19
11.	$94	$21	$85	$0B	$04	$90	$24	$B7
12.	$FC	$63	$41	$74	$B7	$FF	$DE	$E0
13.	$7E	$31	$A0	$BA	$5B	$FF	$EF	$70
14.	$3F	$18	$D0	$5D	$2D	$FF	$F7	$B8
15.	$1F	$8C	$68	$2E	$96	$FF	$FB	$DC
16.	$0F	$C6	$34	$17	$4B	$7F	$FD	$EE
17.	$07	$E3	$1A	$0B	$A5	$BF	$FE	$F7
18.	$B5	$82	$0E	$F4	$E7	$68	$33	$C0
19.	$5A	$C1	$07	$7A	$73	$B4	$19	$E0
20.	$2D	$60	$83	$BD	$39	$DA	$0C	$F0
21.	$16	$B0	$41	$DE	$9C	$ED	$06	$78
22.	$0B	$58	$20	$EF	$4E	$76	$83	$3C
23.	$05	$AC	$10	$77	$A7	$3B	$41	$9E
24.	$02	$D6	$08	$3B	$D3	$9D	$A0	$CF
25.	$B7	$18	$87	$EC	$DC	$79	$1C	$DC
26.	$5B	$8C	$43	$F6	$6E	$3C	$8E	$6E
27.	$2D	$C6	$21	$FB	$37	$1E	$47	$37
28.	$A0	$90	$93	$0C	$AE	$38	$EF	$20
29.	$50	$48	$49	$86	$57	$1C	$77	$90
30.	$28	$24	$24	$C3	$2B	$8E	$3B	$C8
31.	$14	$12	$12	$61	$95	$C7	$1D	$E4
32.	$0A	$09	$09	$30	$CA	$E3	$8E	$F2
33.	$05	$04	$84	$98	$65	$71	$C7	$79
34.	$B4	$F1	$C1	$BD	$07	$0F	$2F	$07

No	0	1	2	3	4	5	6	7
35.	$EC	$0B	$63	$2F	$B6	$30	$5B	$38
36.	$76	$05	$B1	$97	$DB	$18	$2D	$9C
37.	$3B	$02	$D8	$CB	$ED	$8C	$16	$CE
38.	$1D	$81	$6C	$65	$F6	$C6	$0B	$67
39.	$B8	$B3	$35	$C3	$CE	$D4	$C9	$08
40.	$5C	$59	$9A	$E1	$E7	$6A	$64	$84
41.	$2E	$2C	$CD	$70	$F3	$B5	$32	$42
42.	$17	$16	$66	$B8	$79	$DA	$99	$21
43.	$BD	$F8	$B0	$AD	$09	$5A	$80	$2B
44.	$E8	$8F	$DB	$A7	$B1	$1A	$8C	$AE
45.	$74	$47	$ED	$D3	$D8	$8D	$46	$57
46.	$8C	$50	$75	$18	$D9	$F1	$6F	$90
47.	$46	$28	$3A	$8C	$6C	$F8	$B7	$C8
48.	$23	$14	$1D	$46	$36	$7C	$5B	$E4
49.	$11	$8A	$0E	$A3	$1B	$3E	$2D	$F2
50.	$08	$C5	$07	$51	$8D	$9F	$16	$F9
51.	$B2	$11	$00	$59	$F3	$78	$47	$C7
52.	$EF	$7B	$03	$DD	$CC	$0B	$EF	$58
53.	$77	$BD	$81	$EE	$E6	$05	$F7	$AC
54.	$3B	$DE	$C0	$F7	$73	$02	$FB	$D6
55.	$1D	$EF	$60	$7B	$B9	$81	$7D	$EB
56.	$B8	$84	$33	$CC	$E9	$77	$72	$4E
57.	$5C	$42	$19	$E6	$74	$BB	$B9	$27
58.	$98	$52	$8F	$02	$0F	$EA	$10	$28
59.	$4C	$29	$47	$81	$07	$F5	$08	$14
60.	$26	$14	$A3	$C0	$83	$FA	$84	$0A
61.	$13	$0A	$51	$E0	$41	$FD	$42	$05
62.	$BF	$F6	$AB	$01	$15	$49	$6D	$B9
63.	$E9	$88	$D6	$71	$BF	$13	$7A	$67
64.	$C2	$B7	$E8	$C9	$EA	$3E	$71	$88
65.	$61	$5B	$F4	$64	$F5	$1F	$38	$C4
66.	$30	$AD	$FA	$32	$7A	$8F	$9C	$62
67.	$18	$56	$FD	$19	$3D	$47	$CE	$31
68.	$BA	$58	$FD	$7D	$AB	$14	$2B	$A3
69.	$EB	$5F	$FD	$4F	$E0	$3D	$D9	$6A
70.	$75	$AF	$FE	$A7	$F0	$1E	$EC	$B5

No	0	1	2	3	4	5	6	7
71.	$8C	$A4	$7C	$A2	$CD	$B8	$BA	$E1
72.	$F0	$21	$BD	$A0	$53	$6B	$91	$CB
73.	$CE	$63	$5D	$21	$1C	$02	$04	$5E
74.	$67	$31	$AE	$90	$8E	$01	$02	$2F
75.	$85	$EB	$54	$B9	$72	$B7	$4D	$AC
76.	$42	$F5	$AA	$5C	$B9	$5B	$A6	$D6
77.	$21	$7A	$D5	$2E	$5C	$AD	$D3	$6B
78.	$A6	$CE	$E9	$66	$1B	$E1	$25	$0E
79.	$53	$67	$74	$B3	$0D	$F0	$92	$87
80.	$9F	$C0	$39	$A8	$B3	$4F	$85	$F8
81.	$4F	$E0	$1C	$D4	$59	$A7	$C2	$FC
82.	$27	$F0	$0E	$6A	$2C	$D3	$E1	$7E
83.	$13	$F8	$07	$35	$16	$69	$F0	$BF
84.	$BF	$8F	$80	$6B	$BE	$83	$34	$E4
85.	$5F	$C7	$C0	$35	$DF	$41	$9A	$72
86.	$2F	$E3	$E0	$1A	$EF	$A0	$CD	$39
87.	$A1	$82	$73	$FC	$42	$67	$AA	$27
88.	$E6	$B2	$BA	$0F	$14	$84	$19	$A8
89.	$73	$59	$5D	$07	$8A	$42	$0C	$D4
90.	$39	$AC	$AE	$83	$C5	$21	$06	$6A
91.	$1C	$D6	$57	$41	$E2	$90	$83	$35
92.	$B8	$18	$A8	$51	$C4	$FF	$8D	$21
93.	$EA	$7F	$D7	$D9	$D7	$C8	$0A	$2B
94.	$C3	$4C	$68	$1D	$DE	$53	$C9	$AE
95.	$61	$A6	$34	$0E	$EF	$29	$E4	$D7
96.	$86	$A0	$99	$F6	$42	$23	$3E	$D0
97.	$43	$50	$4C	$FB	$21	$11	$9F	$68
98.	$21	$A8	$26	$7D	$90	$88	$CF	$B4
99.	$10	$D4	$13	$3E	$C8	$44	$67	$DA
100.	$08	$6A	$09	$9F	$64	$22	$33	$ED
101.	$B2	$46	$87	$3E	$87	$A6	$D5	$4D
102.	$EF	$50	$C0	$6E	$76	$64	$A6	$1D
103.	$C1	$DB	$E3	$C6	$0E	$85	$9F	$B5
104.	$D6	$9E	$72	$12	$32	$F5	$03	$61
105.	$DD	$3C	$BA	$F8	$2C	$CD	$4D	$0B
106.	$D8	$ED	$DE	$8D	$23	$D1	$6A	$3E

No	0	1	2	3	4	5	6	7
107.	$6C	$76	$EF	$46	$91	$E8	$B5	$1F
108.	$80	$48	$F4	$52	$7D	$43	$96	$34
109.	$40	$24	$7A	$29	$3E	$A1	$CB	$1A
110.	$20	$12	$3D	$14	$9F	$50	$E5	$8D
111.	$A6	$7A	$9D	$7B	$7A	$1F	$BE	$7D
112.	$E5	$4E	$CD	$4C	$88	$B8	$13	$85
113.	$C4	$D4	$E5	$57	$71	$EB	$C5	$79
114.	$D4	$19	$F1	$5A	$8D	$42	$2E	$07
115.	$DC	$7F	$7B	$5C	$73	$16	$DB	$B8
116.	$6E	$3F	$BD	$AE	$39	$8B	$6D	$DC
117.	$37	$1F	$DE	$D7	$1C	$C5	$B6	$EE
118.	$1B	$8F	$EF	$6B	$8E	$62	$DB	$77
119.	$BB	$B4	$74	$44	$F2	$86	$A1	$00
120.	$5D	$DA	$3A	$22	$79	$43	$50	$80
121.	$2E	$ED	$1D	$11	$3C	$A1	$A8	$40
122.	$17	$76	$8E	$88	$9E	$50	$D4	$20
123.	$0B	$BB	$47	$44	$4F	$28	$6A	$10
124.	$05	$DD	$A3	$A2	$27	$94	$35	$08
125.	$02	$EE	$D1	$D1	$13	$CA	$1A	$84
126.	$01	$77	$68	$E8	$89	$E5	$0D	$42
127.	$00	$BB	$B4	$74	$44	$F2	$86	$A1
128.	$B6	$2E	$59	$CB	$17	$CE	$8F	$EB
129.	$ED	$64	$AF	$14	$BE	$50	$8B	$4E
130.	$76	$B2	$57	$8A	$5F	$28	$45	$A7
131.	$8D	$2A	$A8	$34	$1A	$23	$EE	$68
132.	$46	$95	$54	$1A	$0D	$11	$F7	$34
133.	$23	$4A	$AA	$0D	$06	$88	$FB	$9A
134.	$11	$A5	$55	$06	$83	$44	$7D	$CD
135.	$BE	$A1	$29	$72	$74	$15	$F2	$5D
136.	$E9	$23	$17	$48	$0F	$BD	$35	$95
137.	$C2	$E2	$08	$55	$32	$69	$56	$71
138.	$D7	$02	$87	$DB	$AC	$83	$67	$83
139.	$DD	$F2	$C0	$1C	$E3	$F6	$7F	$7A
140.	$6E	$F9	$60	$0E	$71	$FB	$3F	$BD
141.	$81	$0F	$33	$F6	$0D	$4A	$53	$65
142.	$F6	$F4	$1A	$0A	$33	$12	$E5	$09

No	0	1	2	3	4	5	6	7
143.	$CD	$09	$8E	$F4	$2C	$3E	$BE	$3F
144.	$D0	$F7	$44	$8B	$23	$A8	$93	$A4
145.	$68	$7B	$A2	$45	$91	$D4	$49	$D2
146.	$34	$3D	$D1	$22	$C8	$EA	$24	$E9
147.	$AC	$6D	$6B	$60	$51	$C2	$DE	$CF
148.	$E0	$45	$36	$41	$1D	$56	$A3	$DC
149.	$70	$22	$9B	$20	$8E	$AB	$51	$EE
150.	$38	$11	$4D	$90	$47	$55	$A8	$F7
151.	$AA	$7B	$25	$39	$16	$1D	$18	$C0
152.	$55	$3D	$92	$9C	$8B	$0E	$8C	$60
153.	$2A	$9E	$C9	$4E	$45	$87	$46	$30
154.	$15	$4F	$64	$A7	$22	$C3	$A3	$18
155.	$0A	$A7	$B2	$53	$91	$61	$D1	$8C
156.	$05	$53	$D9	$29	$C8	$B0	$E8	$C6
157.	$02	$A9	$EC	$94	$E4	$58	$74	$63
158.	$B7	$27	$75	$BB	$47	$9B	$F6	$8A
159.	$5B	$93	$BA	$DD	$A3	$CD	$FB	$45
160.	$9B	$BA	$5E	$9F	$E4	$51	$31	$19
161.	$FB	$AE	$AC	$BE	$C7	$9F	$54	$37
162.	$CB	$A4	$D5	$AE	$56	$78	$66	$A0
163.	$65	$D2	$6A	$D7	$2B	$3C	$33	$50
164.	$32	$E9	$35	$6B	$95	$9E	$19	$A8
165.	$19	$74	$9A	$B5	$CA	$CF	$0C	$D4
166.	$0C	$BA	$4D	$5A	$E5	$67	$86	$6A
167.	$06	$5D	$26	$AD	$72	$B3	$C3	$35
168.	$B5	$5D	$10	$A7	$8C	$EE	$2D	$21
169.	$EC	$DD	$0B	$A2	$F3	$C0	$DA	$2B
170.	$C0	$1D	$06	$20	$4C	$57	$A1	$AE
171.	$60	$0E	$83	$10	$26	$2B	$D0	$D7
172.	$86	$74	$C2	$79	$26	$A2	$24	$D0
173.	$43	$3A	$61	$3C	$93	$51	$12	$68
174.	$21	$9D	$30	$9E	$49	$A8	$89	$34
175.	$10	$CE	$98	$4F	$24	$D4	$44	$9A
176.	$08	$67	$4C	$27	$92	$6A	$22	$4D
177.	$B2	$40	$25	$E2	$FC	$82	$DD	$9D
178.	$EF	$53	$91	$00	$4B	$F6	$A2	$75

No	0	1	2	3	4	5	6	7
179.	$C1	$DA	$4B	$71	$10	$4C	$9D	$81
180.	$D6	$9E	$A6	$49	$BD	$91	$82	$7B
181.	$DD	$3C	$D0	$D5	$EB	$7F	$0D	$86
182.	$6E	$9E	$68	$6A	$F5	$BF	$86	$C3
183.	$81	$3C	$B7	$C4	$4F	$68	$0F	$DA
184.	$40	$9E	$5B	$E2	$27	$B4	$07	$ED
185.	$96	$3C	$AE	$00	$26	$6D	$CF	$4D
186.	$FD	$6D	$D4	$F1	$26	$81	$2B	$1D
187.	$C8	$C5	$69	$89	$A6	$F7	$59	$35
188.	$D2	$11	$37	$35	$E6	$CC	$60	$21
189.	$DF	$7B	$18	$6B	$C6	$D1	$FC	$AB
190.	$D9	$CE	$0F	$C4	$D6	$DF	$32	$EE
191.	$6C	$E7	$07	$E2	$6B	$6F	$99	$77
The following part of the table (below) is not used in the CRC check								
192.	$80	$00	$00	$00	$00	$00	$00	$00
193.	$40	$00	$00	$00	$00	$00	$00	$00
194.	$20	$00	$00	$00	$00	$00	$00	$00
195.	$10	$00	$00	$00	$00	$00	$00	$00
196.	$08	$00	$00	$00	$00	$00	$00	$00
197.	$04	$00	$00	$00	$00	$00	$00	$00
198.	$02	$00	$00	$00	$00	$00	$00	$00
199.	$01	$00	$00	$00	$00	$00	$00	$00
200.	$00	$80	$00	$00	$00	$00	$00	$00
201.	$00	$40	$00	$00	$00	$00	$00	$00
202.	$00	$20	$00	$00	$00	$00	$00	$00
203.	$00	$10	$00	$00	$00	$00	$00	$00
204.	$00	$08	$00	$00	$00	$00	$00	$00
205.	$00	$04	$00	$00	$00	$00	$00	$00
206.	$00	$02	$00	$00	$00	$00	$00	$00
207.	$00	$01	$00	$00	$00	$00	$00	$00
208.	$00	$00	$80	$00	$00	$00	$00	$00
209.	$00	$00	$40	$00	$00	$00	$00	$00
210.	$00	$00	$20	$00	$00	$00	$00	$00
211.	$00	$00	$10	$00	$00	$00	$00	$00
212.	$00	$00	$08	$00	$00	$00	$00	$00
213.	$00	$00	$04	$00	$00	$00	$00	$00

No	0	1	2	3	4	5	6	7
214.	$00	$00	$02	$00	$00	$00	$00	$00
215.	$00	$00	$01	$00	$00	$00	$00	$00
216.	$00	$00	$00	$80	$00	$00	$00	$00
217.	$00	$00	$00	$40	$00	$00	$00	$00
218.	$00	$00	$00	$20	$00	$00	$00	$00
219.	$00	$00	$00	$10	$00	$00	$00	$00
220.	$00	$00	$00	$08	$00	$00	$00	$00
221.	$00	$00	$00	$04	$00	$00	$00	$00
222.	$00	$00	$00	$02	$00	$00	$00	$00
223.	$00	$00	$00	$01	$00	$00	$00	$00
224.	$00	$00	$00	$00	$80	$00	$00	$00
225.	$00	$00	$00	$00	$40	$00	$00	$00
226.	$00	$00	$00	$00	$20	$00	$00	$00
227.	$00	$00	$00	$00	$10	$00	$00	$00
228.	$00	$00	$00	$00	$08	$00	$00	$00
229.	$00	$00	$00	$00	$04	$00	$00	$00
230.	$00	$00	$00	$00	$02	$00	$00	$00
231.	$00	$00	$00	$00	$01	$00	$00	$00
232.	$00	$00	$00	$00	$00	$80	$00	$00
233.	$00	$00	$00	$00	$00	$40	$00	$00
234.	$00	$00	$00	$00	$00	$20	$00	$00
235.	$00	$00	$00	$00	$00	$10	$00	$00
236.	$00	$00	$00	$00	$00	$08	$00	$00
237.	$00	$00	$00	$00	$00	$04	$00	$00
238.	$00	$00	$00	$00	$00	$02	$00	$00
239.	$00	$00	$00	$00	$00	$01	$00	$00
240.	$00	$00	$00	$00	$00	$00	$80	$00
241.	$00	$00	$00	$00	$00	$00	$40	$00
242.	$00	$00	$00	$00	$00	$00	$20	$00
243.	$00	$00	$00	$00	$00	$00	$10	$00
244.	$00	$00	$00	$00	$00	$00	$08	$00
245.	$00	$00	$00	$00	$00	$00	$04	$00
246.	$00	$00	$00	$00	$00	$00	$02	$00
247.	$00	$00	$00	$00	$00	$00	$01	$00
248.	$00	$00	$00	$00	$00	$00	$00	$80
249.	$00	$00	$00	$00	$00	$00	$00	$40

No	0	1	2	3	4	5	6	7
250.	$00	$00	$00	$00	$00	$00	$00	$20
251.	$00	$00	$00	$00	$00	$00	$00	$10
252.	$00	$00	$00	$00	$00	$00	$00	$08
253.	$00	$00	$00	$00	$00	$00	$00	$04
254.	$00	$00	$00	$00	$00	$00	$00	$02
255.	$00	$00	$00	$00	$00	$00	$00	$01

13 EXAMPLE (APPENDIX 10)

Note An example of how to decode Balise telegram is given here. In the example the train route is set from main signal P001 to main signal P002.

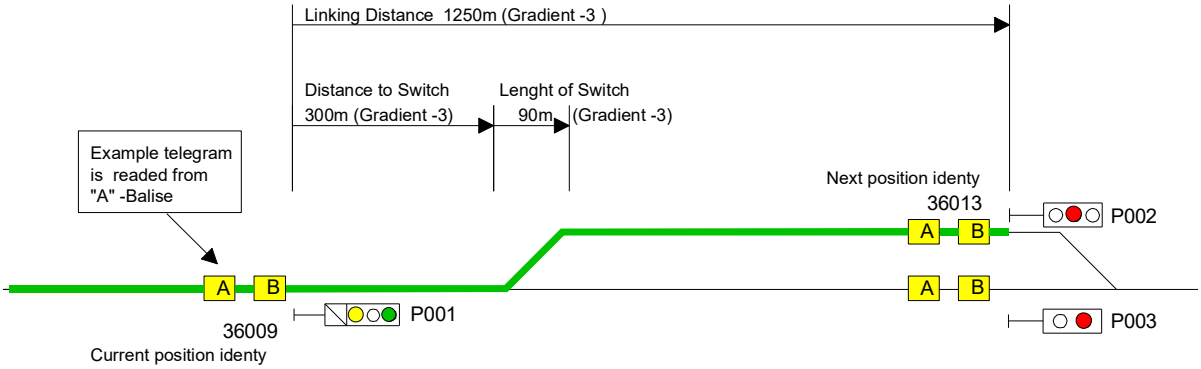

Figure 1/4. An example with train route set

Table 21/4. Example telegram

Nibble	Bin	Hex	Explanation	Instructions	The Conversion
Balise identification					
R0	0010	2	Balise identification	App.2	The first of two balises Double
R1	0010	2			
R2	0001	1	Record identification	App.2	Signal, RSS Release speed stop
R3	0011	3			
R4	0010	2	Current position Identity	App.8	36009
R5	1011	B			
R6	0010	2			
R7	1110	E			
R8	0001	1			
R9	0110	6	Next position Identity	App.8	36013
R10	1011	B			
R11	0010	2			
R12	1110	E			
R13	0001	1			
R14	0110	6	Linking distance	App.5 (LD)	1250 m
R15	1001	9			
The following nibbles are from [Chapter 4, table "Signal information"]					
R16	0011	3	Line speed	App.4 (LS)	140 km/h
R17	0001	1			
R18	0001	1	Target speed	App.4 (LS)	10 km/h
R19	0011	3			
R20	0110	6	Basic distance	App.5 (LD)	1250
R21	1001	9			
R22	0111	7	Basic gradient	App.6	-3
R23	0110	6	Next signal Identity	App.8	36013
R24	1011	B			

Nibble	Bin	Hex	Explanation	Instructions	The Conversion
R25	0010	2			
R26	1110	E			
R27	0001	1			
R28	1110	E	Stop message (Distance or speed)	App. 5(LD)/4(LS)	Cancelled
R29	1110	E			
R30	0110	6	Stop message gradient	App.6	-5
First switch					
R31	0010	2	First switch Restriction	App.4 (SS)	35 km/h
R32	0010	2	Distance to first switch	App.5 (LD)	300 m
R33	1011	B			
R34	0111	7	Gradient to first switch	App.6	-3
R35	0011	3	Length of first switch	App.5 (SD)	90 m
R36	0001	1	Speed after first switch	App.4 (LS)	35 km/h
R37	1000	8			
Second switch					
R38	1110	E	Second switch Restriction	App.4 (SS)	Cancelled
R39	1110	E	Distance to second switch	App.5 (LD)	Cancelled
R40	1110	E			
R41	0110	6	Gradient to second switch	App.6	-5
R42	1110	E	Length of second switch	App.5 (SD)	Cancelled
R43	1110	E	Speed after second switch	App.4 (LS)	Cancelled
R44	1110	E			

Table 22/4. Example telegram

Nibble	Bin	Hex	Explanation	Instructions	The Conversion
CRC, Sync. and Control bits					
R45	0010	2	CRC, Sync. and Control bits		
R46	0111	7			
R47	0011	3			
R48	0010	2			
R49	1110	E			
R50	0010	2			
R51	1110	E			
R52	1011	B			
R53	0011	3			
R54	0101	5			
R55	1000	8			
R56	1000	8			
R57	1010	A			
R58	1000	8			
R59	0101	5			
R60	0000	F			
R61	1100	C			
R62	1110	E			
R63	0110	6			

14 FIGURES (APPENDIX 11)

Note

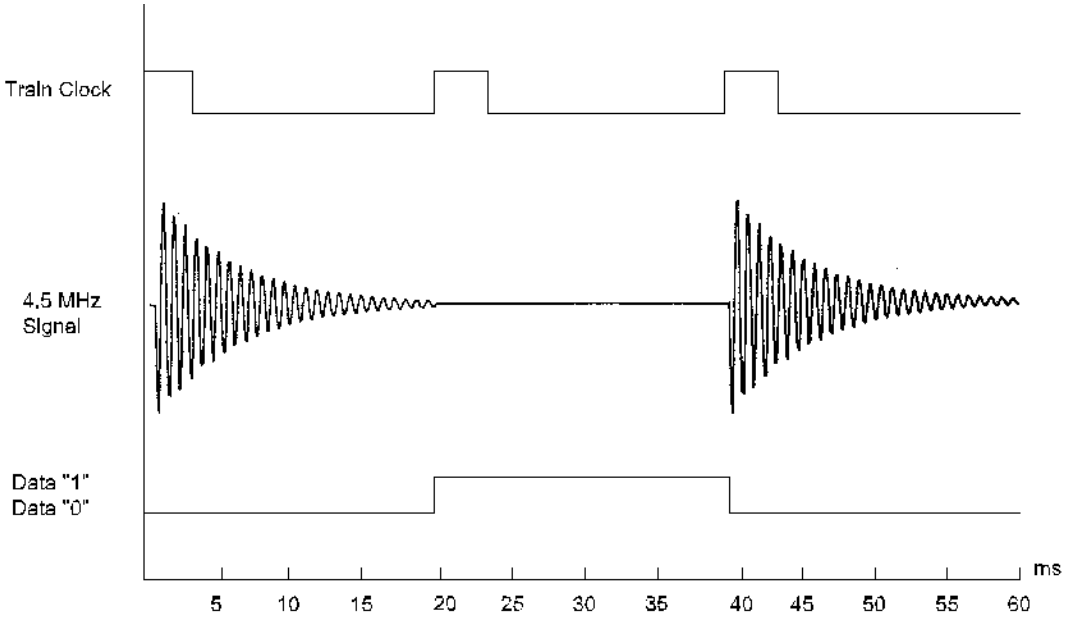

Figure 2/4. The balise transmit the serial link data to the vehicle a data rate of 50 kHz, clocked via the 50 kHz train clock. The balise to vehicle carrier frequency is 4,5 MHz

Note

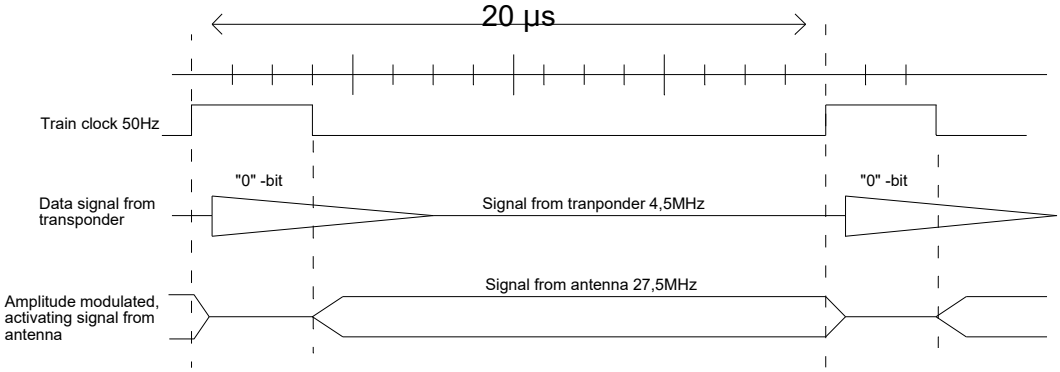

Figure 3/4. The timing diagram of signals. The signals from the transponder and the antenna are amplitude modulated envelope signals. The modulating frequency is gotten from a train clock. In the diagram the transponder is sending logical zeroes.

Note

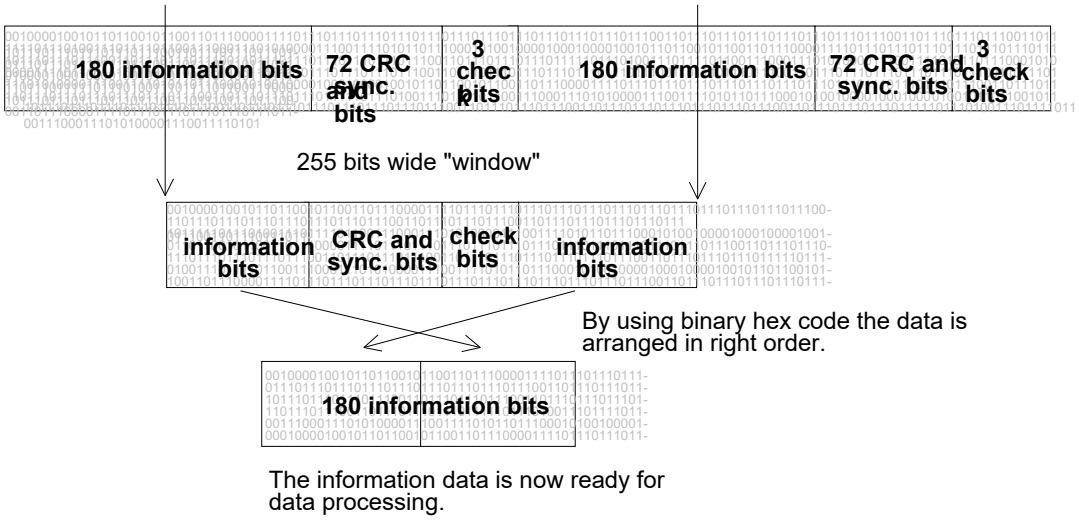

Figure 4/4. The balise telegram code format is a modified binary hex block code. The telegram length is 255 bits of which 180 bits are used carrier for information.

ATP-VR/RHK STM BL3 FUNCTIONAL REQUIREMENTS SPECIFICATION (FRS)

PART 5

BRAKING AND AUXILIARY FUNCTIONS

Document Modification History

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1.0	First version	29.10.2020	N. Lindfors	A. Härkönen A. Julku J. Lehmusto	M. Torkkeli
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TABLE OF CONTENTS

Definitions and abbreviations

Note For definitions and abbreviations, refer to document [ATP-VR/RHK STM Functional Requirements Specification - PART 1 - System Introduction], Chapters 7 and 8.

1 INTRODUCTION

1.1 Scope

Note This part of FRS specifies the following Specific Transmission Module National functions for ATP-VR/RHK:

- Service and emergency braking
- Brake pressure measurement
- Auxiliary functions – Roll-away protection, Distance measurement check, Actual train retardation

Note For an overview of the ATP-VR/RHK STM system, refer to document [ATP-VR/RHK STM Functional Requirements Specification - PART 1 - System Introduction].

2 STM SERVICE BRAKING

2.1 General

Note The ATP-VR/RHK STM system has no direct interface to the brake system for ordering service braking, however, it needs feedback from the service brake system. Feedback is given by STM brake pipe pressure measurement.

F 7032 There shall be two different service brake levels (normal SB = 100 kPa and full SB = 170 kPa) in the system.

Note Normally the lower brake force level (100 kPa) is used. The higher brake force level (170 kPa) is used as the entered speed (v_{TRAIN}) is higher than 120 km/h and brake type is R and the service brake intervention curve (C) is passed.

Note Selection of the service brake level is controlled by the STM via a separate brake adapter interface. Brake adapter interfaces STM to vehicle service brake system.

F 7037 STM shall have an interface to service braking system. Service braking interface shall be implemented in two levels.

Note It must be understood that the ETCS performs the actual service braking on request from the STM. ETCS provides by default only one level of service braking (full).

F 9010 ETCS shall have an interface to service braking system.

F 9011 If ETCS service brake availability status is "Not available", then STM shall enter the failure state (FA).

F 9012 If STM has not requested service brake and ETCS service brake availability status is "Fail" then an error message shall be displayed

F 9013 Service brake command from STM to ETCS shall be "Apply SB"

Note Service brake command "Apply SB, or EB in case the SB fails to be applied" has a risk to get unnecessary emergency braking if ETCS recognise STM normal service brake as "fails to be applied"

2.2 Service brake intervention

Note The STM applies service braking and requests service braking to be performed by the ETCS in the following cases:

1) The maximum permitted speed is exceeded by 5 km/h or 10 km/h (depending on speed) or more, [FRS Supervision F 5023] [F 5076]
2) Unauthorized passage of beginning of a landslide speed board [FRS Supervision F2282] [F 5076]
3) The service brakes intervention curve (C) is passed, regardless of whether the driver has already begun braking or not [FRS Supervision, F 5037 -F 5045, F 5047 - F 5048] [F 5076]

4) At detection of a safety-affecting balise error (BF2, BF3, BF4, BF5) [FRS Supervision, F 2273] [F 5076]
5) Together with emergency braking when ATP applies emergency braking [F 5079]
6) When moved more than 5 m with direction controller neither in forward nor reverse position (roll-away protection) [F 5076]
7) Reserved
8) At detection of odometer failure 1 or 2 [F 7066]
9) At detection of low pressure in main air reservoir [F 7050]
10) At detection of dedicated antenna balise transmission error [FRS Air Gap, F 9001]

F 5076 The STM shall apply service braking when:

1. highest permitted speed is exceeded by 5 km/h or 10 km/h (speed dependant) (normal SB)
2. the service brakes intervention curve (C) is passed (normal SB/full SB)
3. if after a balise fault 2-5 within 5 sec. a brake pressure drop over 60 kPa is not detected and train speed v_C < 90 km/h or v_C < 70 km/h (brake type G) (normal SB)
4. vehicle has moved more than 5 m with direction controller neither in forward nor reverse position (roll-away protection) (normal SB)
5. unauthorized passage of beginning of a landslide speed board (full SB)
6. Reserved
7. testing service brake (normal and full SB)
8. detecting low main air reservoir pressure (normal SB)

2.3 Indications on the DMI

Note When full service braking or normal service braking is applied, a corresponding indication will appear without indication of the service brake level. The f2 warning tone will sound, while the STM braking is applied [FRS Supervision, F 6009, F 2298]. When the service brake may be released the brake release button shall become available [FRS Supervision, F 5077, F 5082, F 5083].

2.4 Releasing service brake

Note Service braking can normally be released reciprocally with brake intervention, i.e. when the train is in a situation such that the brake would not be applied, it will be possible to release it. The driver requests brake release by pressing the brake release button. In certain cases, an additional driver action may be needed to be able to proceed.

F 7038 Generic requirements for releasing the service brake shall be as follows:

a) An STM-ordered service brake shall not be released before the driver has requested this

b) When there is no need for braking anymore, the brake shall be released when the driver requests this by pressing the brake release button

Note During braking curve supervision the STM shall allow the full/normal service brake to be released when the train is in a situation such that the brake would not be applied [FRS Supervision, F 5023, F 5037 , F 5041, F 5042, F 5047, F 5076, F 5077].

Note The STM allows the service brake to be released in these cases:

1. When the train has come to a halt after passing a stop signal [FRS Supervision, F 2148]
2. When the train has come to a halt after passing landslide [FRS Supervision, F 2283, F 5077]
3. After balise error alarm with STM braking, when the train speed has slowed down to balise error speed restriction +5/10 km/h (or after 2 s, if the train speed was below defined (70/90 km/h) speed) [FRS Supervision, F 2273]
4. With max speed supervision, at the defined train speed [FRS Supervision, F 5023]
5. When the train has come to a halt after rolling from stationary with the controller in neutral position [FRS Supervision, F 5076, F 5077]
6. When train has come to a halt after emergency braking [FRS Supervision, F 5076, F 5077]
7. When train has come to a halt after STM area transition has not been acknowledged [FRS Supervision, F 5076, F 5077]
8. After the main air reservoir pressure is detected normal [F 7050]

F 5077 The driver can release service brakes by pressing the button for brake release. To be able to release service braking release conditions shall be fulfilled in each case:

1. by current speed v_C < permitted speed + 3/5 km/h
2. by current speed v_C < end speed + 5/10 km/h and the train has decelerated to the safe side of warning curve (A) or ESP has been passed and current speed v_C < permitted speed + 3/5 km/h
3. after 2 seconds
4. as the train has stopped
5. as the train has stopped
6. as the train has stopped

Note Numbering of cases in [F 5077] is according to numbering of cases in [F 5076].

Note In the ATP-VR/RHK system button for brake release is "JARR IRR".

2.5 Service brake supervision

F 5073 The ATP-VR/RHK STM system shall monitor the applied service braking.

F 7030 As the STM service braking is applied also braking carried out by the driver shall be monitored. STM shall command braking with such a force that braking carried out by the STM and the driver together corresponds at least to needed service brake force.

F 7031 As the pressure in the brake pipe is stabilised the STM shall monitor the pressure and apply more service braking if necessary. If the decrease in brake pressure will be too high the STM shall not increase brake pressure. If the driver decreases braking the STM shall increase the braking correspondingly. If the driver is then increasing braking the STM will not decrease braking.

F 5075 If the service brake control can not prevent pressure increase (> 20 kPa, stable pressure min. 2 s) in the brake pipe the STM shall issue emergency brake for brake types G, P and R.

Note This is an important safety function for Russian wagons with direct release distributor valves (e.g. in case the driver is releasing his own braking).

Note Stable reference pressure must be calculated for the situation where service braking is applied.

F 7039 When service brake is requested, the service brake function shall be considered faulty if:

1. after the set delay time, the defined drop in pressure has not been achieved, or
2. the ETCS service brake availability status is "Fail", or
3. a conflict between service brake level order and actual service brake output is detected.

Note The system will consider service brakes applied when pressure drop in brake pipe is sufficient within brake time delay. [F 5074]

F 7040 If the service brake is faulty [F 7039]:

1. The brake error message shall appear
2. The emergency brake shall be activated, while still retaining the service brake request
3. In this case the emergency braking shall be released according to the same rules that applied to the corresponding service braking

Note The pressure reduction is measured in relation to the initial value measured before the service brake was applied.

3 STM EMERGENCY BRAKING

3.1 General

Note This section deals mainly with the direct STM interface to emergency brake. STM emergency brake orders are given to this interface, but also to the ETCS system via interface FFFIS STM.

F 2112 STM shall have an interface to the emergency braking system.

Note Direct emergency brake interface is necessary for performance reasons, refer to [GRS, G 64].

Note The STM can be isolated by setting the STM isolation switch to Off-position. In this shutdown state the supply to the STM brake circuits is interrupted, at the same time as the emergency brake valve is fed independently of the STM.

3.2 Physical connection

F 7041 The emergency brake output of the STM shall:

1. Shall feed an emergency brake valve connected to the brake pipe
2. Alternatively it shall feed a safety loop in a trainset to achieve equivalent emergency stop function

Note STM emergency brake output connection must be considered from safety point of view in vehicle integration. Alternative solution could be justified based on safety analysis and in this case the other requirements for emergency brake valve output will apply.

F 7042 When emergency brake is required, the STM shall interrupt the coil feeding of the emergency brake valve.

Note The emergency brake valve coil is then de-energised, the valve opens, the brake pressure pipe is emptied and the emergency brake is applied. For installations without brake pipe, the brake cylinders will be pressurized with maximum pressure.

Note The emergency brake valve may also be used as a brake valve for the driver vigilance device (Sifa).

F 7043 When the STM is disabled with the STM isolation switch the emergency brake valve (or safety loop) shall be fed independently of the STM emergency brake output

Note When the STM is in No Power (NP) or Failure (FA) state it may be isolated to avoid emergency braking. The driver vigilance control to emergency braking must be unaffected by this.

Note With loss of power, the emergency brake may be applied.

3.3 Emergency brake control

F 7044 At the same time as the STM applies the emergency brake, the service braking shall be requested to be performed by ETCS system and full service brake level shall be controlled by the STM.

Exception: This shall not be done during STM brake test, see [F 7058].

Note The exception for brake tests is required to detect faulty emergency brake output.

3.4 Emergency brake intervention

Note The STM applies emergency braking if and requests emergency braking by the ETCS in the following cases:

a) The train passes a main signal at stop [FRS Supervision, F 2146].
b) The emergency braking curve E is passed during brake curve supervision and the train speed exceeds defined limit [FRS Supervision, F 5056, F 5057]
c) If the service brake control can not prevent pressure increase in the brake pipe [FRS Supervision, F 5075]
d) During service braking, if the service brake function is considered faulty by the STM [FRS Supervision, F 5078]

Note Exception to a-b: e.g. Construction Area according to STM state behaviour. Refer to [FRS Part 3 "Supervision"] for details of STM states.

Note When a balise failure occurs, service braking is applied [FRS Part 3 "Supervision", F 2273] unless a special case of balise error occurs which will cause emergency braking. Refer to [FRS Part 2 "Information Flow Track-Train"] for details of balise error handling.

Note Exception to a): Stop passage is permitted and specified train speed is not exceeded [FRS Part 3 "Supervision", F 2154].

Note Emergency braking is not applied during constant speed supervision.

F 5078 The emergency brakes shall be applied when

1. service brakes applied by the STM are not functioning within brake time delay (max. 10 sec)
2. train passes the emergency brake curve (E) in target speed supervision
3. unauthorized stop signal passage

Note This applies for both the ETCS emergency brake interface and STM direct emergency brake interface.

F 5079 Together with applied emergency brake also full service brake shall always be applied.

Note This requirement is not valid during EB testing.

Note When the stop signal balises are passed with authorized stop passage button pressed the supervision is according to requirements [FRS Part 3 "Supervision", F 2154 - F 2159].

3.5 Indications on the DMI

Note When emergency braking is applied, a corresponding indication will appear. The f2 warning tone will sound, while the STM braking is applied [FRS Part 3 "Supervision", F 6009 and F 2298]. When the brake may be released the brake release button shall become available.

F 5081 As the STM applies the brakes (service or emergency) a STM braking text indication "STM JARR" shall be displayed on the DMI and alarm f2 given.

F 5082 As the STM allows releasing brakes (service or emergency) the brake release allowed text "IRR.SALL." will be displayed and alarm f2 turned off.

F 5083 When the driver presses the brake release button the brakes will be released and the brake release allowed text indication "JARR.IRR." shall be turned off after the brakes have been released.

3.6 Releasing the emergency brake

Note Emergency braking can normally be released reciprocally with brake intervention, i.e. when the vehicle is in a situation such that the brake would not be applied, it will be possible to release it. Basic rule is that the train must be stationary in order to release emergency brake.

F 5080 Emergency brake shall be released only by the driver when the train is standing still.

Note In the ATP-VR/RHK system "JARR.IRR." button is used for this purpose.

F 7045 When a condition for STM emergency braking has ceased and the train has stopped, the STM emergency braking shall be possible to be released when the driver requests this by pressing the brake release button.

Note ETCS emergency braking could still persist for another reason.

Note If possible, the driver should not be forced to perform more than one action in order to release the brake. This includes all necessary actions (required by the STM, the ETCS or any other trainborne system) to achieve brake release.

3.7 Emergency brake supervision

F 7046 The ATP-VR/RHK STM system shall monitor the applied emergency braking.

F 5074 The system shall consider service brakes applied when pressure drop in brake pipe is at least 60 kPa within brake time delay (or max. 10 sec) and emergency brakes applied when pressure drop is at least 60kPa (brake pipe) / 150kPa (brake cylinder) within time delay 2 sec.

4 BRAKE TESTS

F 7052 The brake test sequence shall wait before the braking starts if the brake pressure is not within acceptable range or the brake pressure is not stable.

Note Acceptable range and stable pressure depends on the brake test type.

4.1 STM-N service brake test

F 7053 Service brake test shall be allowed only when:
a) STM or ETCS emergency braking is not applied, and
b) stable brake pressure is detected.

F 7054 Service brake test with both normal and full service brake level shall be performed.

Note The STM service brake test can be executed as follows:
1. Service braking command shall be sent to the ETCS
2. Service brake level shall be controlled (normal/full SB)
3. No emergency braking order shall be given to the ETCS
4. The pressure (P_{INT}) shall drop after commanding service brake test by at least 60/130 kPa (normal/full SB) below the stable pressure (P_{REF}) measured before braking
5. Service braking command to the ETCS shall be released

F 7055 The STM service brake test shall be considered failed and service brake shall be assigned faulty if a maximum test time has passed since braking started without enough pressure reduction

Note Typically, maximum test time of 15 s and pressure reduction limit of 130 kPa can be used.

F 7056 STM service brake test failure shall be indicated in the DMI and optionally to be acknowledged by the driver. After brake test failure STM shall enter Failure State (FA).

F 9014 SB test shall be performed automatically at least after Start of Mission when entering DA state at standstill.

Note If possible, SB test will be performed during Start of Mission.

F 9015 Successful SB test shall be valid until next cab activation after 8 hours.

F 9007 If no SB test is performed after level transition announcement to the STM area driver shall as soon as possible be informed on the DMI that SB test shall be performed.

Note Warning tone f2 (continuous beep) will be initiated already by A-curve to pay driver's attention to start braking earlier because of STM service brake is not tested. See [F 6009].

F 9008 If no SB test is performed after level transition announcement to the STM area driver shall have option to perform SB test by button on the STM default menu.

Note Conditions to perform SB test will be fulfilled according to [F 7053].

F 9009 If no SB test is performed after level transition to the STM area and train is at standstill SB test shall be performed without driver action.

Note Conditions to perform SB test will be fulfilled according to [F 7053].

4.2 STM direct emergency brake test

F 2113 STM direct emergency braking system interface shall be tested when ETCS Technical Mode = Stand By and (STM is powered on or (if cab is activated and more than 8 h has elapsed since latest Direct Emergency Brake Test)) by supervising drop of pressure in brake pipe. Failed test shall lead to system failure and safe state of STM.

F 7057 STM emergency brake test shall be initiated by STM:

a) at start-up of the STM
b) at cab activation when the STM emergency brake test has not been performed over a defined time period (test interval)

F 7058 STM emergency brake test shall be allowed only when:

a) train is at standstill, and
b) STM braking is not applied, and
c) stable brake pressure is detected, and
d) confirmation to perform EB test is received from ETCS.

Note To ensure that ETCS or no other STM uses the direct emergency brake ETCS should not allow the test to be started (ETCS grants the permission to start the test by packet STM-22)

F 7059 The STM emergency brake test shall be executed as follows:

1. STM direct emergency braking shall be applied
2. No emergency nor service braking order shall be given to the ETCS
3. The pressure (P_{INT}) shall drop within 1,75 seconds after opening of the EB valve for 1,25 seconds by at least 60kPa (brake pipe) / 150 kPa (brake cylinder) below the reference pressure (P_{REF}) measured before opening of the valve, or else the brake test shall fail
4. STM direct emergency braking shall be released (after 1,25 seconds)

F 7060 STM emergency brake test failure shall be indicated in the DMI and STM shall enter Failure State (FA).

Note Once the STM has finished its test procedure, it will send the test result (OK or Not OK) and related text message in ~~as~~ a Specific STM packet to the ETCS. Refer to [SUBSET- 058 FFFIS STM Application Layer].

F 7061 The STM emergency brake test shall be halted if:

a) if the train starts to move, or
b) faulty brake pressure is detected

F 7062 The STM emergency brake test shall be possible to restart if the train is at standstill

5 HANDLING OF BRAKE PRESSURE

5.1 General

F 6006 STM shall be configured to measure either brake pipe or brake cylinder pressure.

Note Vehicles have either a pressure sensor (in the brake pipe) or a brake cylinder pressure monitoring (e.g. EMU types Sm1-2, Sm4 and Sm5) which measures the braking carried out by the driver or STM. By the information thus received the vehicle equipment will decide whether the braking has been sufficient or not.

Note The STM handles two types of pressure:

1. P_{REF} Reference pressure in kPa. The reference pressure corresponds to the last stable measured brake pressure of the train's brake pressure pipe or a converted cylinder pressure. Reference pressure is recalculated frequently according to measured stable pressure.
2. P_{INT} Brake pressure in kPa. This is the current pressure of the train's brake pressure pipe, or a converted cylinder pressure. Decreases during braking with a rate that depends on the train type (brake delay time).

Note By comparing the P_{REF} and P_{INT}, the STM can determine whether braking is in progress or not.

5.2 Transducer in the vehicle

Note A pressure sensor measures the pressure in the brake pipe.

Note The STM interprets the signal from the pressure sensor according to the following table:

Table 1/5 Brake pressure sensor ranges

Description	Pressure
Faulty pressure (high)	> 600 kPa
No braking	500 kPa
Normal service braking	400 kPa
Full service braking	330 kPa
Emergency braking	0 kPa
Faulty pressure (low)	< -50 kPa
Pressure difference	Δ 100 kPa

Note The normal range for brake pressure is approximately 3,3 - 5,8 bar. The necessary accuracy and stability of the brake pressure measurement with regard to braking force calculations and related supervision functions must be considered in vehicle integration.

Note P_{INT} will be set to a value in acceptable range in case of high or low pressure signal. This means out of range pressure signal is not used in calculations nor displayed.

Note If the train does not have a brake pipe, the brake pressure must be obtained from another source and then converted to a suitable pressure value.

5.3 Initializing the reference brake pressure

F 7047 The reference pressure shall be set on starting the STM to the first achieved stable P_{INT} value between 400-600 kPa.

Note Stable in this context means that the pressure has not varied more than ± 20 kPa over last 3 seconds.

5.4 Calculation of reference brake pressure

Note The reference pressure is an internal value which is designed to provide reference level of the last known stable brake pressure.

F 7048 The pressure measured at start shall be used as reference pressure and shall thereafter be adapted to the current pressure according to the following table:

Table 2/5 Calculation of reference brake pressure

Conditions	Actions	Description
$P_{REF} = P_{INT}$	No action	Constant pressure
$P_{REF} < P_{INT}$	P_{REF} increases 3 kPa per 2 sec	Increasing pressure
$P_{REF} > P_{INT} + 25$ kPa	No action	Braking
$P_{INT} + 25$ kPa $> P_{REF} > P_{INT}$	P_{REF} decreases 1 kPa per 2 sec	Decreasing pressure

Note The table [2/5] applies only if the calculation is performed frequently enough to differentiate between braking and decreasing pressure.

F 7049 Reference brake pressure (P_{GPRref}) for brake types G, P and R:

a) when service braking is applied, reference brake pressure shall be calculated as average value of measured values during the 2 seconds stable state checking interval. If average pressure value is at least 10 kPa lower than current reference value for a defined time this shall be considered as the new reference value. Only the lower values are accepted as new reference values.
b) when service braking is not applied, reference brake pressure shall be calculated as normally

Note Reference brake pressure (P_{GPRref}) is needed for [F 5075].

5.5 Main air reservoir pressure

F 7050 If main air reservoir pressure is detected low, an error shall be indicated and service braking (normal SB) shall be applied.

Note Exception to this requirement may be justified when specific brake system is considered during vehicle integration.

Note Main air reservoir pressure is monitored in order to ensure the braking capability of train as an additional safety feature.

5.6 Error indications

F 7051 The pressure sensor failure indication shall be given if the pressure measured is below defined low limit or above defined high limit.

Note Refer to [Table 1/5] for information about low and high limit for pressure.

Note High pressure alarm is triggered after 30 seconds delay and low pressure alarm is triggered after 2 seconds delay.

6 ROLL-AWAY PROTECTION

Note This function prevents a train from rolling away without a driver.

F 7063 Service braking shall be applied if all following conditions are fulfilled:

a) The train has been stationary during ≥1 second and
b) Then begins rolling up to 5 m, and
c) The direction controller is in the Neutral position.

F 7064 The roll-away protection shall be indicated while the service braking is applied until the brakes have been released by the driver.

Note Roll-away protection text indication is "LIIKE-ESTO".

F 7065 The service braking shall immediately be released when the brake release button is pressed by driver and the conditions for service brake release are fulfilled.

Note See [Chapter 2.4] for details about conditions for service brake release.

7 AUTOMATIC DISTANCE MEASUREMENT CHECK

Note If special distance measurement check balises (ODO and ODOe balises) are placed along the track, an automatic distance measurement check is performed in passing trains. The check is made over a distance of nominally 1000 m. An ODO balise is placed at the beginning, and an ODOe balise at the end.

Note In addition to distance measurement check balise function, separate distance measurement check with manual start/stop counter function is recommended.

F 2166 When an ODO balise is passed, a special distance counter shall be started. When an ODOe balise is passed, or the distance expires, this distance value shall be checked according to the following [Table 3/5].

Table 3/5. Action when ODOe is passed (or not)

No.	ODOe passed after...	Error (%)	Action
a)	< 900 m	< -10,0	System failure - Enter the Failure state
b)	900...979 m	-10,0...-2,1	Service Braking - Indicate ODO failure 2 for short distance measurement (flashing)
c)	980...1020 m	-2,0...+2,0	Ok (no action)
d)	1021…1200 m	+2,1...+20,0	Service Braking - Indicate ODO failure 1 for long distance measurement (flashing)
e)	No ODOe after > 1200 m	> +20,0	System failure - Enter the Failure state

Exceptions: Measurement shall be interrupted if sliding or sliping is detected according to measurement of speed, if driver braking is detected or if train is accelerating.

Note Refer also to [FRS Part 2 "Information Flow Track-Train", F 3453].

Note ODO failure 1 text indication is "MATKAMITTAUSVIRHE 1" and ODO failure 2 text indication is "MATKAMITTAUSVIRHE 2".

F 7066 STM shall apply service braking when failure is detected by ODO distance measurement check.

F 7067 ODO failure indication shall stop flashing 10 s after it was turned on and it shall remain until supervision of ODOe is terminated.

F 7068 If service braking is applied due to ODO fault, service braking shall be released after driver pushes the button for brake release. Supervision of ODOe is terminated when brake is released.

8 CALCULATION OF ACTUAL TRAIN RETARDATION

Note The actual retardation shall be calculated based on the values received from actual braking.

F 5084 The calculation shall be started when pressure drop in brake pipe is > 60 kPa and brake delay time has expired.

F 5085 The measurement continues until the difference between the reference pressure and the brake pipe pressure becomes less than 40 kPa, or until the train has slowed down below 25 km/h. A successful measurement must be at least 4 seconds and measurements shall not continue more than 60 seconds. When pressure decrease > 200 kPa (caused by emergency brake) in 2s, the retardation calculation shall be stopped.

F 5086 Retardation shall be calculated only if calculation time > 4 sec.

F 5087 The actual braking retardation shall be calculated with formula:

$$b_{ACT} = (v_{C1} - v_{C2}) / t$$

v_{C1} = calculation start speed (m/s)
v_{C2} = calculation stop speed (m/s)
t = calculation time (s)

F 5088 The average pressure drop shall be calculated with formula:

$$\Delta p_{AVE} = \Sigma \Delta p / n$$

$\Sigma \Delta p$ = sum of the instantaneous pressure drop values measured at least twice a second during t
n = number of measured pressure values

F 5089 The actual retardation shall be proportioned to the full service braking and this value shall be indicated to the driver:

For brake type DMU1/EMU1 or (R and max train speed > 120):

$$b_{FSB} = b_{ACT} \cdot (150- 20) \text{ kPa} / (\Delta p_{ave} - 20)$$

For brake type DMU2/EMU2 or G or P or (R and max train speed <= 120):

$$b_{FSB} = b_{ACT} \cdot (100 -20) \text{ kPa} / (\Delta p_{ave}- 20)$$

When pressure decrease > 200 kPa (caused by emergency brake) in 2s the retardation calculation is stopped.

Note Brake type DMU1/EMU1 includes Sm3, Sm4, Sm5 or Sm6.

Note Brake type DMU2/EMU2 includes Sm1-2 or Dm12.

F 5090 The calculated retardation value b_{FSB} shall be indicated on driver's request on the DMI. At the same time also retardation b_{STM} estimated from the entered train data shall be indicated for 10 s. This way the retardation values b_{FSB} and b_{STM} can be compared together.

Note b_{FSB} is indicated with "TODxxx" and b_{STM} is indicated with "HIDxxx". If no measured retardation is available, indicated value is "TOD---".

F 5091 Reserved

ATP-VR/RHK STM BL3 GENERAL TECHNICAL REQUIREMENTS SPECIFICATION (GRS)

GRS

Document Modification History

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TABLE OF CONTENTS

Definitions and abbreviations

Note For definitions and abbreviations, refer to document [ATP-VR/RHK STM BL3 Functional Requirements Specification - PART 1 - System Introduction], Chapters 7 and 8.

1 INTRODUCTION

Note This document specifies the general technical requirements for the Specific Transmission Module National, STM. A majority of the listed requirements will form the basis for the development of a generic product that will be used for STM applications in Finland.

Note In this document mandatory requirements are designated Gnn, while additional or alternative requirements are designated Ann.

1.1 Applicable standards

G 1 The STM and development of the STM shall comply with the specification and standards listed below. If the standards are not consistent with the STM requirements, the STM requirements override the standard (with the exception of TSI requirements).

Table 1/G. The specification and standard list

(EU) 2016/919	Control-command and signalling subsystem Technical Specification for Interoperability
(EU) 2019/776	Control-command and signalling subsystem Technical Specification for Interoperability - Amending (EU) 2016/919
(EU) 2019/776	List of mandatory Specifications #3 ETCS Baseline 3 Release 2 and GSM-R Baseline 1

EN 50121	Railway applications – Electromagnetic compatibility
EN 50124	Railway applications – Insulation coordination
EN 50125	Railway applications – Environmental conditions for equipment
EN 50126	Railway applications – Specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS)
EN 50128	Railway applications – Communications, signalling and processing systems – Software for railway control and protection systems.
EN 50129	Railway applications – Safety related electronic systems for signalling.
EN 50155	Railway applications – Electronic equipment used on rolling stock
EN 61373	Railway applications – Rolling stock equipment. Shock and vibration tests

1.2 System definition

Note The Specific Transmission Module National, STM, is an on-board constituent fully defined by its functionality, interfaces and performance. The basic functionality of the STM is specified as a list of requirements in the Functional Requirements Specification (FRS). All other technical requirements, including specifications of interfaces and performance requirements are listed in this document.

Note The following figure defines the STM system borders:

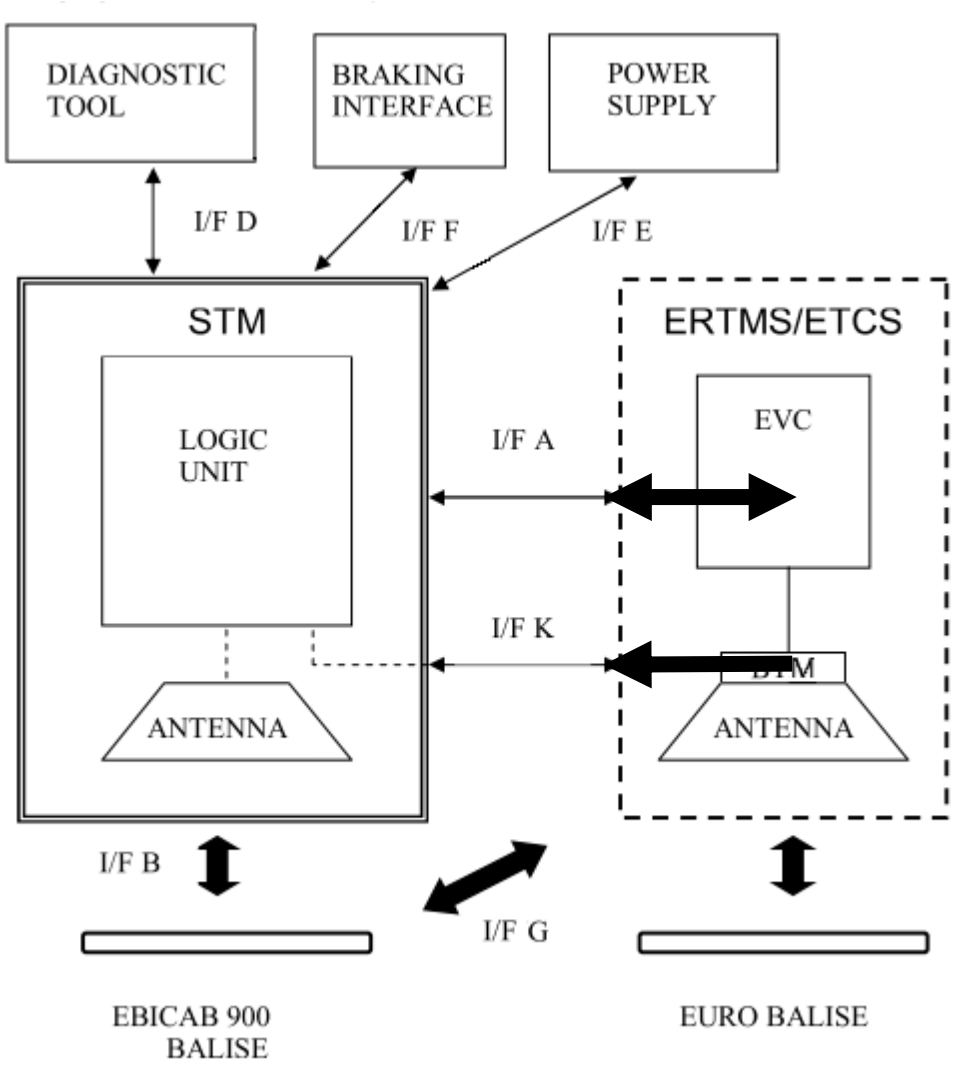

Figure 1 /G STM System borders and interfaces

Note The STM includes the following interfaces:

- Interface A - FFFIS I/F between the STM and ERTMS/ETCS kernel and/or DMI.
- Interface B - FFFIS I/F between the STM dedicated antenna and ATP-VR/RHK Balises.
- Interface D - FFFIS I/F between the STM and a recorder or a diagnostic tool.
- Interface E - FFFIS I/F between the STM and the power supply.
- Interface F - FFFIS I/F between the STM and the braking system.
- Interface K - FFFIS I/F between the STM and a combined ATP/ETCS (KER) Antenna.

Note Interface G is in between trackside and ETCS onboard.

2 INTERFACES

2.1 Interface A

Note Interface A is defined as the basic communication interface between the STM and the ERTMS/ETCS kernel and/or DMI. Depending on the physical arrangement of the STM, requirement G2 or A1 must be fulfilled.

G 2 The STM shall include an Interface A based on the following subsets of the ETCS B3 R2 specification.

- SUBSET–035
- SUBSET–056
- SUBSET–057
- SUBSET–058
- SUBSET–059

Note The interface A is defined and used only in the scope of this FRS, and should not be confused with similarly named interfaces in other requirement specifications (e.g. SUBSET-036)

A 1 **Alternative:** For an internal STM (the STM is integrated in the ETCS hardware) the communication hardware may be omitted and the protocol may be adapted to the actual system structure.

Note The functionality as seen from a user standpoint must still fulfil the following subsets:

- SUBSET-035
- SUBSET-056
- SUBSET-059

Note This does not relieve any requirements in the Control-command and signalling subsystem Technical Specification for Interoperability

2.2 Interface B

Note Interface B is defined as the airgap interface between the STM and ATP-VR/RHK balises.

Note The airgap specification for interface G (UNISIG SUBSET-100 - Interface 'G' Specification) can be applied also to interface B.

A 2 The STM shall include an interface B according to SUBSET-100, alternative see below. The interface shall be designed for full compatibility with all existing balise types in the track system of ATP-VR/RHK.

Alternative: A transmission system that is approved for usage with ATP-VR/RHK can be accepted even if its specification should deviate from SUBSET-100.

2.2.1 Transmission system test function

Note The purpose of the test function is to ensure that the transmission system is able to detect balises. In case of transmission system deficiencies, the system shall immediately revert to a safe behaviour, either braking or giving an alarm. This is described in the FRS Part 2 "Information Flow Track-Train", 3 "Supervision" and 4 "Air Gap".

2.2.2 Telepowering control

A 3 The 27 MHz transmitter of the STM own transmission system shall be turned off when the onboard system is switched off or the train is stationary with direction controller in neutral longer than 10 seconds.

A 4 The STM own transmitter shall be activated when the onboard system is activated and at least one of the following conditions apply:

1. The direction controller is in Forward or Reverse, or the controller has been in any of these positions during the last 10 seconds.
2. The vehicle is moving, or has been moving during the last 10 seconds
3. The antenna is standing over a balise

2.2.3 Condition for balise detect

Note The basis for safe operation of any ATP system is the safe detection of all balises. The detection scheme for the respective system (180-bit Finnish) is described in the FRS Part 4 "Air Gap".

2.2.4 Telegrams

Note Telegram content and synchronisation is described in the FRS Part 2 "Information Flow Track-Train" and Part 4 "Air Gap".

2.2.5 On-board Antenna placement

Note The maximum allowed distance between the antenna in use and the first axle will be 10 meters, otherwise problems can occur with signals going to a stop aspect before the balises have been read. If this distance cannot be kept with a single antenna STM may connect with two antennas or two separate STM units may be used.

2.3 Interface D

Note Interface D is defined as the interface between the STM and a diagnostic tool.

A 5 The STM shall include an interface D. The physical and electrical interface shall make it possible to connect the STM to a serial port or a COM port or a USB port of a standard PC.

Note This requirement does not by itself imply that a STM recorder is mandatory.

2.4 Interface E

Note Interface E is defined as the interface between the STM and the power supply. For an integrated STM interface E is not applicable.

G 7 The STM shall include an interface E.

G 8 The STM equipment shall be powered from the battery of the vehicle.

G 9 The STM shall be fully operable at any of the following battery voltages in the table 2/G.

Table 2/G Battery voltages on the vehicle

Nominal	Variation
24 V	According to EN 50155 Interruption class S2 (10 ms)
(48 V)	
72 V	
110 V	

Note Battery voltages 24 VDC, 72 VDC and 110 VDC are recommended values.

G 10 The equipment shall function adequately with a non-earthed DC supply and with an earth fault which possibly occurring on either side of the two battery poles.

2.5 Interface F

Note Interface F is defined as the interface between the STM and the braking system.

G 62 The STM shall have access to feedback from the braking system.

Note This is necessary to fulfill the braking curve requirements stated in the FRS. The feedback may be physically included in interface F, but as an alternative the STM may use other sources for pressure feedback, as long as it provides the same function.

G 63 Reserved

G 64 A safe direct emergency brake connection shall be implemented onboard. The response time of this brake connection shall be less than 0,5 seconds.

Note This means that the STM has to be able to give an emergency brake order through both interfaces A and F.

A 6 Reserved

2.6 Interface K

Note Interface K is defined as the interface between the STM and the ERTMS/ETCS transmission system. Interface K is mandatory for the use of a combined ATC/ETCS antenna.

A 7 The STM shall include an Interface K according to Subset-101.

Note For an internal STM (the STM is integrated in the ETCS hardware) the requirements may be omitted, and the interface may be adapted to the actual system structure.

Note Interface K is optional requirement in the Control-command and signalling subsystem Technical Specification for Interoperability. It is strongly recommended that Interface K is included in all external STM's. If Interface K is not used, certain functionality being included in the Interface K must then be implemented in the BTM/STM.

2.7 Balise reading

G 12 The STM shall provide means for reading ATP-VR/RHK balises, either via interface B or K.

G 13 Reserved

G 14 Reserved

3 ENVIRONMENT

Note This section specifies the environmental requirements on the STM equipment. Requirements are specified below for:

- ambient temperature
- solar radiation
- humidity
- wind and pressure pulses
- altitude
- water and precipitation
- pollutants and contaminants
- mechanical
- electromagnetic compatibility

3.1 Operational environmental requirements

G 15 The equipment shall have full functionality within the requirements specified below.

Note Full functionality of STM means that no malfunction may arise as a cause of any combination of environmental conditions within the specified requirements.

G 16 If STM is exposed to environmental conditions outside specified requirements, malfunctions that may occur shall not affect the overall safety of the STM.

3.1.1 Ambient temperature

G 17 Reserved

G 68 STM shall fulfil requirements for operating temperature classes according to EN 50155 category OT4 (-40 to +70).

3.1.2 Solar radiation

G 18 Reserved

G 69 STM shall fulfil the requirements for solar radiation according to EN 50125-1.

Note The maximum level of solar radiation is 1120 W/m^2.

3.1.3 Humidity

G 19 Reserved

G 70 STM shall fulfil requirements for humidity according to EN 50125-1.

Note The manufacturer shall state the applicable classifications.

3.1.4 Wind and pressure pulses

G 20 Exposure of permanent crosswinds of 35m/s and exceptional gusts of 50 m/s and duration of 1 second per gust shall not affect the equipment that are placed on the outside of the vehicle. For gusts longer than 1 second, the equipment performance may be affected but without permanent damage.

G 21 Exposure of pressure pulses caused by trains passing in tunnels shall not affect the equipment. Particular local air pressure conditions may exist due to the effects of trains running through a tunnel. However, as a minimum, all equipment shall function correctly when subjected to the following severity of pressure pulse:

$$\Delta P = \pm 5 \text{ kPa}$$

The associated rate of change of pressure is:

$$\Delta P/\Delta t = 1 \text{ kPa/s}$$

3.1.5 Altitude

G 22 The equipment shall not be affected at altitudes between -120 m (below sea level) and 2000 m (above sea level), which corresponds to an air pressure range of approximately 101.3 kPa to 79.5 kPa.

G 71 STM shall fulfil requirements for altitude according to EN 50125-1 (class Ax).

3.1.6 Water and precipitation

G 23 The equipment shall not be affected when subjected to all forms of precipitation. In this respect, considerations shall be given to (but not limited to) the following:

- The effects of snow, ice and hail penetrating equipment housings.
- De-icing with high temperature steam, water or pressure air.
- The effects of snow melting and freezing again.
- Hailstones of a maximum diameter of 15mm.
- Light dew

G 24 Reserved

G 72 STM shall fulfil requirements for water and precipitation according to EN 50125-1.

Note The manufacturer shall state the applicable classifications.

3.1.7 Pollutants and contaminants

G 25 The equipment shall not be affected when being exposed to following chemical pollution in the environment:

- Sulphur dioxide: 0.3 mg/m^3
- Hydrogen sulphide: 0.1 mg/m^3
- Chlorine: 0.01 mg/m^3

- Nitrogen dioxidxe: 0.1 mg/m^3
- Ozone: 0.05 mg/m^3

G 26 The equipment shall not be affected with the debris layers on the balise and under the Antenna unit specified by the table 3/G and 4/G.

Table 3/G. Debris layers on top of the balise

Material	Description	Layer [mm]
Water	Clear	100
	0.1 % NaCl (weight)	100
Snow	Fresh, 0ºC	300*
	Wet, 20 % water	300*
Ice	Non porous	100
Ballast	Stone	100
Sand	Dry	20
	Wet	20
Mud	Without saltwater	50
	With saltwater, 0.5 % NaCl (weight)	10
Iron Ore	Taconite	20
	Magnetite	10
Iron dustº	Braking dust	10
Coal dust	8 % sulphur	10
Oil and Grease		50

*300 mm or up to the bottom of the Antenna unit.
ºA non-conductive mixture of grease and iron oxide which is normally encountered in railway environment.

Table 4/G. Debris under the Antenna unit (for balise)

Material	Description	Layer [mm]	
		Minimum	Maximum
Snow	Fresh, 0ºC	20	top of Balise
	Wet, 20 % water	10	top of Balise
Ice		10	top of Balise
Mud	Without saltwater	10	50
	With saltwater, 0.5 % NaCl (weight)	-	50
Iron Ore	Taconite	-	5
	Magnetite	-	5
Iron dust	Braking dust	2	5
Coal dust	8 % sulphur	-	5
Oil and Grease		2	20

G 27 The manufacturer shall state the performance of the Antenna unit and its maximum allowed debris layers for this antenna.

G 73 STM shall fulfil requirements for pollutants and contaminants according to EN 50125 series standards. The manufacturer shall state the applicable standards with respect to pollution and micro-environmental conditions and the effects of pollution in combination with humidity.

3.1.7.1 Mechanical

G 28 The design shall take into account the impact of ballast and stones up to a diameter of 15 mm.

Note Track ballast can cause serious damage to outdoor equipment attached to the train.

G 29 Trainborne equipment and its mountings shall be capable of withstanding without deterioration or malfunction of all mechanical stresses that occur in service.

3.1.7.2 Vibrations

G 30 The equipment and its mountings shall be designed to withstand the continuous sinusoidal vibration stresses, in all the three major axis as specified in table 5/G.

Table 5/G. Mechanical vibrations for trainborne equipment

Installation location	**Mass of equipment [kg]**	**Frequency range [Hz]**	**Crossover frequency [Hz]**	**Displacement amplitude below crossover frequency [mm]**	**Acceleration amplitude above crossover frequency [m/s²]**
Underframe/body/roof - Directly mounted equipment	> 2000 < 2000	1 - 35 5 - 100	8.2 7.1	0.75 1.5	2 3
Underframe/body/roof - Equipment in frames and boxes	> 30 3 - 30 0.3 - 3 < 0.3	5 - 150	8.2 8.4 8.7 22.5	1.5 2.5 5 1.5	4 7 15 30
Bogie	No limit	5 - 100*	8.3*	7.5*	20*
On the wheel set	No limit	5 - 100	20.5	12	200

*For frequencies above 22 Hz use the following values:
22 - 32 Hz displacement amplitude 1 mm
32 - 100 Hz acceleration amplitude 40 m/s^2

G 74 STM shall fulfil requirements for vibrations according to EN 50155 and EN 61373.

Note The manufacturer shall state the applicable classifications.

3.1.7.3 Shock

G 31 The equipment and mountings shall be designed to withstand the shock stresses specified in table 6/G.

Table 6/G. Mechanical shocks for trainborne equipment

Installation location	Peak value of amplitude / half sine duration*		
	Vertical	Transverse	Longitudinal
Under frame/body/roof – Directly mounted equipment	3g / 30 ms	3g / 30 ms	3g / 100 ms
Under frame/body/roof – Equipment in frames and boxes	3g / 30 ms	3g / 30 ms	5g / 30 ms
Bogie	30g / 18 ms	30g / 18 ms	30g / 18 ms
Wheel set	100g / 6 ms	100g / 6 ms	100g / 6 ms

*Half sine form in accordance with IEC 68.2.27 Test Ea

G 75 STM shall fulfil requirements for shock according to EN 50155 and EN 61373.

Note The manufacturer shall state the applicable classifications.

3.1.7.4 Other acceleration forces

G 32 Trainborne equipment and mountings shall also be capable of functioning when subjected to tilting and centrifugal acceleration forces. The equivalent maximum values of transverse acceleration applied to the body of the vehicle shall be taken as 4 m/s^2 (less than 50 ms duration) or 2 m/s^2 when the duration exceeds 50 ms.

G 33 During traction and braking operations, trainborne equipment shall be capable of functioning when subjected to longitudinal acceleration forces of 7 m/s^2 with duration higher than 50 ms.

3.1.8 Electromagnetic compatibility

G 34 Reserved

G 35 The defined limits for electromagnetic compatibility are valid for all equipment, installations, sub-systems and systems. Furthermore, it shall be ensured that the STM functions correctly when disturbance currents are caused by traction units, either in normal operation or in the event of a failure. Immunity for electromagnet disturbance shall be according to what is specified by EN 50121.

G 76 STM shall fulfil the requirements for electromagnetic combability according to EN 50125-1 and EN 50125-3-2 (to be used in conjunction with the general provisions in EN 50121-1)

Note The manufacturer shall state the applicable classifications.

3.2 Environmental requirements for storage

G 36 Reserved

G 37 Full functionality is not required during storage, but the equipment shall not be damaged temporarily or permanently if the specified conditions below are kept within.

G 38 If STM is exposed to environmental conditions outside specified requirements malfunctions that may occur shall not affect the overall safety of the STM.

G 39 Reserved

G 77 STM shall fulfil requirements for ambient temperature for storage according to EN 50155 category OT6 (-40 to +85).

G 40 Reserved

3.3 CE certificate

G 41 The STM and the used antenna shall be CE marked.

4 TRACKSIDE COMPATIBILITY

G 42 The STM shall be fully compatible with all currently existing types of ATP trackside equipment in Finland. This includes all approved balise types and any combination of balises from existing suppliers.

G 43 Compatibility of interfaces shall be provided by supplier and verified testing, for all existing balise types within the trackside network of Finland. Verification reference shall be made against sufficient number of balises of each type.

G 44 Supplier must state the valid ETCS subsets are used when implementing interfaces.

5 MODULARITY

G 45 The design of the STM shall have a modular approach.

A 46 It shall be possible to install the STM (the logic unit) without the antenna. Information from the balises shall then be available through interface K utilising a combined ATP/ETCS antenna.

A 47 The installation of STM without a dedicated separate STM antenna shall comply with all technical requirements i.e. this type of installation shall have no influence on functionality, performance, safety etc. compared to an installation with a special STM antenna.

G 48 The STM shall have at least 20 % of spare capacity regarding memory size and CPU power in order to make future updates and/or upgrades feasible.

6 DRIVER INTERFACE (DMI)

G 103 The STM shall utilize the ETCS DMI function for driver interface.

6.1 Re-establishment of interrupted DMI connection

G 101 If the connection to the active DMI is interrupted, the STM shall try to re-establish the connection. The STM shall make at least 2 attempts to re-establish the connection.

Note The number of re-connection attempts to the DMI can be a configurable parameter as long as the configured amount is at least 2 attempts and can be executed within the chosen supervised connection interruption time.

G 102 After a maximum of 5 seconds of supervised interrupt in connection, the STM shall go to failure state (FA).

Note The supervised interrupt in connection can be a configurable parameter as long as the configured time is 5 seconds or less.

6.2 Support for redundant DMI

A 101 To implement support for redundant DMI is optional for STM.

A 102 If the STM fails to establish a connection with the active DMI, the STM shall try to establish a connection with the redundant DMI, if it is available.

A 103 If the connection to the active DMI is interrupted, the STM shall try to re-establish the connection. If the STM fails to re-establish the connection to the active DMI after at least 2 attempts, the STM shall try to establish a connection with a redundant DMI if such is available.

Note The number of re-connection attempts to the DMI can be a configurable parameter as long as the configured amount is at least 2 attempts and can be executed within the chosen supervised connection interruption time.

A 104 If the STM fails to establish a connection with both DMIs, the STM shall go to failure state (FA).

7 RECORDER/DIAGNOSTIC TOOL

A 49 It shall be possible to connect, temporarily or permanently, a Recorder and/or a Diagnostic tool to the STM.

A 50 The Recorder analysing tool and the Diagnostic tool shall consist of software applications running on a standard PC with commercially available operating system.

Note Windows operating system is preferred.

7.1 STM Recorder

Note The STM recorder function is divided into two parts namely recording of essential STM data in real-time and analysis of recorded data. The recording of data can be done internally in the STM or externally using a specially designed recorder unit. The recorded data will then afterwards be analysed using a Recorder analysing tool.

A 51 The recorder shall be used for recording events concerning the STM and its functionality.

A 52 Recorded data shall be saved for at least 48 hours or more.

A 53 All input data to the STM and all output data from the STM, including balise information marked with time and position shall be recorded by the STM recorder.

A 54 It shall be possible to select, analyse, display and print out the recorder information, in on-line (real time) or off-line mode, supported by an external PC with a software application. The recorded data may either be stored as "raw data" or as completely formatted data, ready for output to a screen or a printer.

A 55 The following internal information shall be recorded, as a minimum, at the occasions specified:

Table 7/G. STM information recording

Information	Recorded:
STM identity and program version(s)	At start of mission
STM and recorder status	At every change / error
Internal time (in the recorder unit, ≤ 0,5 s resolution)	At every time any other information is recorded
Internal indications used by the STM	At every change
STM condition	STM state + area
Service program indications (optional)	At every change

A 56 Unchanged data shall be stored at regular intervals, even if no change has occurred. This is to enable readout of data from the beginning of memory, even if the originally stored data (e.g. program identity from start-up, or train data) has been overwritten. This repetition shall occur at least every 15 minutes.

7.2 Diagnostic tool

7.2.1 General

A 57 Externally controlled service functions shall be performed during normal STM operation in co-operation with a special Diagnostic tool that can be connected to the STM. The results shall be shown on the screen of the tool (except for tests performed by the STM, as possible braking or display tests).

7.2.2 List of functions and data

A 58 The following data or commands, where as a minimum the mandatory, shall be output by the STM to the Diagnostic tool. The data shall be updated at least once per second.

Table 8/G. STM diagnostic tool data and commands

Mandatory	Service display or function	Comment
X	Train speed	(km/h)
X	Passed balise groups	At least the two latest
X	System data	STM identity and program version
	Train data	Train data, National values
	Odometer	Nom/min/max (m)
	ETCS/STM condition	ETCS mode, STM state, STM area
	Error information	Error messages
	Memory contents	Display contents of memory location or I/O port according to selected address
	Optional functions	Determined by supplier

7.3 Recording to the JRU

Note The response of this recording is to facilitate investigations of hazardous railway events.

G 59 Recording shall be performed to the juridical recording unit of the ETCS, the JRU.

Note Refer also to STM related requirements in [SUBSET-027 - FIS Juridical Recording].

A 60 Reserved

Note Refer also to [SUBSET-026] regarding events to be recorded by the JRU.

8 MECHANICAL CONSTRAINTS

Note The following specifies the mechanical constraints of the STM and the separate antenna used by STM.

8.1 Logic unit

G 61 The STM Logic Unit (LU) cassette frame shall fulfil the following mechanical requirements:

- The LU shall be possible to easily install to the rolling stock either as separate cassette frame or integrated to the ETCS equipment
- Ihe cassette frame shall be designed for 19-inch rack.

Note The total weight of the LU should not exceed 15 kg. If the weight is more than 10 kg, there has to be fixing points also to the bottom support.

8.2 STM antenna

G 65 The STM Antenna (if separate STM antenna is used) shall fulfill the following mechanical requirements:

- The size of the STM Antenna shall not exceed the size of existing antenna for ATP-VR/RHK system.
- The total weight of the Antenna shall not exceed 30 kg.
- The Antenna shall have a specified mechanical attachment to the vehicle so that adaptation to different types of vehicles is easily made.

Note For the antenna this means in practice a maximum size of 645*645*250 mm (L*W*H)

9 PERFORMANCE

G 66 The STM shall be able to discriminate between adjacent balise groups and to promptly detect read and act on balise information if the balises are placed according to National rules.

Note Balise distances according to Infrastructure Managers rules [RATO 10 - Junien kulunvalvonta JKV - Liikennevirasto]

G 67 The STM shall be fully functional for train speeds within the range of 0-300 km/h.

ATP-VR/RHK STM BL3 RELIABILITY, AVAILABILITY, MAINTAINABILITY AND SAFETY (RAMS) REQUIREMENTS SPECIFICATION

RAMS

Document Modification History

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Definitions and abbreviations

Note For definitions and abbreviations, refer to document [ATP-VR/RHK STM Functional Requirements Specification - PART 1 - System Introduction], Chapters 7 and 8.

1. INTRODUCTION

Note The STM module is adapted to the existing national Finnish ATP system (ATP-VR/RHK) and is part of the ETCS on-board equipment.

Note The hardware architecture of the onboard equipment as specified by the ETCS specifications, allows operation within the existing national infrastructure by reception of all information from the balises of the national ATP system.

Note This document specifies the Reliability, Availability, Maintainability and Safety (RAMS) requirements for the STM to be developed for the national railway network equipped with ATP system of the Finnish Railway and specified in the document STM RAMS Requirements.

2. APPLICABLE STANDARDS

R 1 In the design and constructions of the STM, the following standards shall apply:

EN 50126 Railway applications - The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS).

EN 50128 Railway applications - Communications, signalling and processing systems - Software for railway control and protection systems.

EN 50129 Railway applications - Communications, signalling and processing systems - Safety related electronic systems for signalling.

R 2 If the requirements in this document are not consistent with the applicable standards referred to in R1, the requirement in this document shall be applied.

3. RELIABILITY REQUIREMENTS

Note The Reliability requirements for Finnish STM system mission are expressed in terms of Mean Time Between Failures (MTBF). Reliability target figures are categorised in reason to describe the criticality of different failure modes of the system under consideration and to define appropriate requirements.

R 3 The applicable MTBF values for different failure categories shall be as follows:

Table 1/R. MTBF values for different failure categories

Failure category	System failure mode	Effect on operation	MTBF
Immobilising	Total failure	STM operation not possible	1.2×10^5
Service	Critical functional failure	Braking, restart	1.2×10^4
Minor	Non-critical failure	Unscheduled maintenance	8.0×10^3

R 4 The above failure categories are defined as follows:

Immobilising STM switched off, the train shall travel without ATP supervision.

Service STM braking (service or emergency brake) the train. After restart or release permitted, the train travels at original or reduced speed.

Minor STM giving a failure indication to the driver without speed or functional reduction; failure calling for unscheduled maintenance meaning that the failure can be repaired under normal stop-over without influencing vehicle availability.

Note The MTBF values are verified according to performance monitoring criteria.

4. AVAILABILITY REQUIREMENTS

Note The availability of the STM is specified as the time in which STM is in a state to perform its mission.

R 5 The technical availability (A_a) of the STM module shall be at least 0.9999885.

A_a is defined as

$$A_a = \frac{MTBM}{MTBM + MTTM},$$

where MTBM=Mean Time Between Maintenance (hours)

MTTM=Mean Time To Maintenance (hours)

In this case the MTTM takes into account the Mean Time Required To Maintain rolling stock both for preventive and corrective maintenance but not including logistical and administrative delays.

5. MAINTAINABILITY REQUIREMENTS

R 6 Unless otherwise agreed, the STM shall be designed so as not to require regular periodic maintenance. In case of this kind of maintenance, the manufacturer shall specify any necessary or prohibited maintenance procedures and the Mean Time Between (planned) Maintenance (MTBM).

R 7 If maintenance is needed, the Mean Time To Repair (MTTR) shall be less than 2 h.

MTTR is defined as

MTTR = Operational standstill time for the vehicle caused by fault on STM including fault diagnosis time and check out time, but not including logistic delay nor administrative delay.

6. SAFETY REQUIREMENTS

Note Top hazards affecting the ATP onboard include overspeed.

R 8 The Tolerable Hazard Rate (THR) for the STM in the intended applications shall be within the limits of SIL4 according to the currently valid version of EN 50129.

Modifications to the FRS & GRS & RAMS ATP-VR/RHK STM BL3 Requirement Specification

References to Subset-035 (Specific Transmission Module FFFIS)

- BL3 – Subset-035, issue 3.2.0, 16.12.2015 (CCS TSI set of specifications #3)

Requirements that have been updated or added as a correction update in the new FRS & GRS & RAMS ATP-VR/RHK STM BL3 compared to the existing FRS & GRS & RAMS ATP-VR/RHK STM-N (VÄYLÄ/6808/02.01.08/2019) are listed in this document with a short modification note. Only the below mentioned requirements or chapters have been modified.

FRS & GRS & RAMS Requirement Specification Modifications

Section	Chapter	Req.	NOTE	MODIFICATION
1				ATP-VR RHK STM BL3 FRS & GRS & RAMS **Table of Contents**
				Editorial changes
Section	**Chapter**	**Req.**	**NOTE**	**MODIFICATION**
2				ATP-VR RHK STM BL3 FRS & GRS & RAMS **Description**
				Note added
Section	**Chapter**	**Req.**	**NOTE**	**MODIFICATION**
3				ATP-VR/RHK STM BL-3 functional requirements specification (FRS) Part 1: **SYSTEM INTRODUCTION**
Section	**Chapter**	**Req.**	**NOTE**	**MODIFICATION**
4				ATP-VR/RHK STM BL-3 functional requirements specification (FRS) Part 2: **INFORMATION FLOW TRACK-TRAIN**
	9.7	F 3314	Fig 29/2	Figure corrected
	9.8	F 3331	Fig 30/2	Figure corrected
	9.9.	F 3348	Fig 31/2	Figure corrected
	9.10	F 3365	Fig 32/2	Figure corrected
	9.14	F 3411	Fig 36/2	Figure corrected
	9.14.7	F 3418		Requirement corrected
	9.15	F 3420	Fig 37/2	Figure corrected
	9.15.7	F 3427		Requirement corrected
	14	F 3521	Table 1/2	Table x/x corrected

Section	**Chapter**	**Req.**	**NOTE**	**MODIFICATION**
5				ATP-VR/RHK STM BL-3 functional requirements specification (FRS) Part 3: **SUPERVISION**
	3.13.1.2	F 2074		Requirement updated
	3.2.4	-	Table 9/3	Editorial changes
	3.5	F 2035		Editorial changes
	7.2.5.2	F 2190		Requirement updated
	7.3.1	F 2303	Table 16/3	Table 16/3 updated +Note added +Notes removed
	7.3.2.1	F 2196		Requirement updated
	7.3.2.1	F 2197	Table 17/3	Requirement updated, Table 17/3 corrected
	7.3.8.3	F 2294		Requirement updated
	7.3.9.3	F 2213	Note	Note corrected
	8.1.1	F 2216		Requirement updated
	8.4		Table 20/3	Table 20/3 corrected +Table 20/3 rephrased
	8.4.2	F 2242	Note	Note removed
	8.4.2	F 2243		Editorial changes
	8.4.3.1	F 2246		Requirement updated +Note added under Table 20/3
	8.4.3.6	F 2255		Requirement updated
	8.5	F 6009	Table 21/3	Requirement updated
	11.4	F 5045		Requirement updated
	3.1.0	-	Note	Editorial changes
Section	**Chapter**	**Req.**	**NOTE**	**MODIFICATION**
6				ATP-VR/RHK STM BL-3 functional requirements specification (FRS) Part 4: **AIR GAP**
	7.2			Requirement updated
Section	**Chapter**	**Req.**	**NOTE**	**MODIFICATION**
7				ATP-VR/RHK STM BL-3 functional requirements specification (FRS) Part 5: **BRAKING AND AUXILIARY FUNCTIONS**
	2.2			Note updated
	2.2	F 5076		Requirement updated
	2.5	F 7039		Requirement updated
	2.1	F 7032		Editorial change
	2.1	F 9001	to 9010	Editorial changes
	2.1	F 9002	to 9011	Editorial changes
	2.1	F 9003	to 9012	Editorial changes
	2.1	F 9004	to 9013	Editorial changes
	4.1	F 9005	to 9014	Editorial changes
	4.1	F 9006	to 9015	Editorial changes
Section	**Chapter**	**Req.**	**NOTE**	**MODIFICATION**

8				ATP-VR/RHK STM BL-3 general technical requirements specification (**GRS**)
	1.2	G 1	1/G	Figure corrected
	1.2	Note		Editorial changes
	6.1	G 101		Note added
	6.1	G102		Note removed
	2.1	G 2		Requirement updated, Note added
	2.1	A 1		Note corrected
	3.1.2	G 69		Requirement corrected
	3.1.7	G 26		Requirement corrected
	3.1.7.2	G 30		Requirement corrected
	3.1.7.3	G 31		Requirement corrected
	3.1.8	G 76		Requirement corrected
	6.2	A 103		Note added
Section	**Chapter**	**Req.**	**NOTE**	**MODIFICATION**
9				ATP-VR/RHK STM BL-3 reliability, availability, maintainability and safety (**RAMS**) requirements specification
	6	R 8		Requirement updated

STM2N BL3 Functional Requirement Specification (FRS) requirement differences to the STM2N BL2 FRS

References to Subset-035 (Specific Transmission Module FFFIS)

- BL2 – Subset-035, issue 2.1.1, 24.7.2003 (CCS TSI set of specifications #1)
- BL3 – Subset-035, issue 3.2.0, 16.12.2015 (CCS TSI set of specifications #3)

Requirements which have been updated or added in the new FRS & GRS & RAMS ATP-VR/RHK STM BL3 compared to the existing FRS & GRS & RAMS ATP-VR/RHK STM-N (FTA Jnro 544/068/2011, 20.12.2011) and the Addendum 1.2 (VÄYLÄ/8582/06.04.01/2019, 28.2.2019) are listed in this document with a short modification note.

SECTION 1 – ATP-VR RHK STM BL3 FRS&GRS&RAMS Table of Contents

- No changes in the section contents.

SECTION 2 – ATP-VR RHK STM BL3 FRS&GRS&RAMS Description

- This section contains only notes i.e. no requirements.
- Notes are updated.

SECTION 3 – ATP-VR RHK STM BL3 Part 1 "System Introduction"

- This section contains only notes i.e. no requirements.
- Notes are updated.

SECTION 4 – ATP-VR RHK STM BL3 Part 2 "Information Flow Track-Train"

- Requirement modifications are listed in the following table.
- All other requirements in this section stay the same.

Section 4 chapter	Require-ment F xxxx	Modification
14	F 3521	Balise errors 14.106, 14.302, 14.601, 14.940 and 14.942 updated

SECTION 5 – ATP-VR RHK STM BL3 Part 3 "Supervision"

- The major changes in the Part 3 Supervision are:
  - Handling of train data
  - STM shunting removed
- Requirement modifications are listed in the following table.
- All other requirements in this section stay the same.

Section 5 chapter	Require-ment F xxxx	Modification
2,1	F 7003	Requirement updated
2.1	F 5003	Note is updated to correspond BL3 data entry process
2.1.1	F 2002	Requirement updated
2.1.1	F 9030	New requirement
2.1.1	F 7004	Requirement updated
2.1.1	F 9031	New requirement
2.1.1	F 9032	New requirement
2.1.1	F 9033	New requirement
2.1.1	F 9034	New requirement
2.1.2	F 5005	Requirement updated
2.1.2	F 5006	Requirement removed, marked as reserved
2.1.2	F 5009	Requirement removed, marked as reserved and changed as a note for ETCS
2.1.2	F 5010	Requirement removed, marked as reserved
2.1.2	F 5011	Requirement removed, marked as reserved
2.1.2	F 5012	Requirement rephrased
2.1.2	F 5013	Requirement rephrased
2.1.2	F 5016	Requirement removed, marked as reserved
2.1.2	F 5017	Requirement removed, marked as reserved

Section 5 chapter	Require-ment F xxxx	Modification
2.1.2	F 5018	Requirement removed, marked as reserved
2.1.2	F 5019	Table 1/3 updated and unnecessary notes re-moved
2.1.2	F 9035	New requirement
2.1.2	F 9036	New requirement
2.1.2	F 9037	New requirement
2.1.2	F 9038	New requirement
2.1.2	F 5020	Requirement updated
2.1.3	F 2009	Requirement updated
2.2.1	F 2013	Requirement removed, marked as reserved
2.3	F 2304	Requirement updated
2.3	F 2305	Requirement updated
2.3	F 2306	Requirement updated
2.3	F 9020	New requirement
2.3	F 9021	New requirement
2.3	F 9022	New requirement
2.3	F 9023	New requirement
2.3	F 9024	New requirement
2.3	F 6007	Requirement updated
2.3	F 6011	Requirement updated
2.3	F 9025	New requirement
2.3	F 9026	New requirement
2.3	F 9027	New requirement
2.4	F 9050	New requirement
2.4	F 9051	New requirement
2.4	F 9052	New requirement
3.1	F 2023	Requirement updated
3.1.1.1	-	Notes updated
3.1.1.2	-	Note Table 5/3 updated
3.2	-	Note Table 7/3 reformulated
3.2.1	-	Chapter updated
3.2.2	F 2025	Requirement removed, marked as reserved
3.2.3	-	Note Figure 1/3 updated

Section 5 chapter	Require-ment F xxxx	Modification
3.2.4	-	Note Table 9/3 updated
3.4	F 2032	Requirement updated
3.5	F 2035	New note added
3.5	F 2041	Requirement removed, marked as reserved
3.5	F 2044	Requirement removed, marked as reserved
3.5	F 7008	Requirement removed, marked as reserved
3.5	F 7009	Requirement updated
3.6	F 2037	Requirement rephrased
3.8	F 2052	Requirement rephrased
3.11.2	F 2056	Requirement updated
3.11.2	F 2057	Requirement removed, marked as reserved
3.11.2	F 7011	Requirement updated
3.11.3	F 2059	Requirement updated
3.11.3	F 2060	Requirement updated
3.11.3	F 7012	Requirement updated
3.12	F 2070	Requirement updated
4.1	F 2084	Requirement removed, marked as reserved
4.1.1	-	Note Figure 5/3 updated
4.1.2	-	Note Table 10/3 updated
4.2	F 2086	Requirement updated
4.2	F 2087	Requirement removed, marked as reserved
4.2	F 2088	Requirement updated
4.2	F 2089	Requirement updated
4.2	F 2090	Requirement updated
4.2	F 7016	Requirement rephrased
4.3	F 2094	Requirement rephrased
4.3	F 2095	Requirement updated
4.3	F 7018	Requirement updated
4.4	F 2097	Requirement rephrased
4.4	F 2101	Requirement rephrased
4.4	F 2102	Requirement rephrased
4.5	F 2103	Requirement removed, marked as reserved
4.5	F 2104	Requirement rephased

Section 5 chapter	Require-ment F xxxx	Modification
4.5	F 2108	Requirement updated
4.5	F 7022	Requirement removed, marked as reserved
5.1	F 2115	Requirement updated
5.3.1	F 2122	Requirement rephrased
6.1	F 2131	Requirement updated
6.1	F 2132	Requirement rephrased
6.1	F 2134	Requirement rephrased
6.1	F 2135	Requirement updated
6.2.2.1	F 2137	Requirement updated
6.2.3	F 2141	Requirement updated
6.3.2	F 2146	Requirement removed, marked as reserved
6.3.2	F 2148	Requirement rephrased
6.3.2	F 9040	New requirement and note
6.3.2	F 2149	Requirement rephrased
6.3.2	F 2151	Requirement updated
6.3.2	F 2152	Requirement updated
6.3.3	F 2154	Requirement updated
6.3.3	F 9041	New requirement
6.3.3	F 9042	New requirement
6.3.3	F 2155	Requirement updated
6.3.3	F 2157	Requirement updated
6.3.3	F 2159	Requirement updated
6.3.4	F 2160	Requirement updated
6.3.4	F 2161	Requirement updated
6.3.5	F 2162	Requirement updated
6.3.5	F 2164	Requirement updated
6.3.5	F 2165	Requirement updated
6.4	F 2273	Requirement updated
6.4	F 2276	Requirement updated
6.4	F 2277	Requirement updated
6.4	F 2278	Requirement updated
6.4	F 2279	Requirement updated

Section 5 chapter	Require-ment F xxxx	Modification
6.5	F 2167	Requirement removed, marked as reserved, note added
7.2.3	F 2177	Requirement updated
7.2.4.1	F 2178	Requirement and note Table 14/3 updated
7.2.4.2	F 2183	Requirement rephrased
7.2.4.3	-	Note figure 6/3 updated
7.2.4.4	-	Note Figure 7/3 updated
7.2.4.5	-	Note Figure 8/3 updated
7.2.5.1	F 2189	Requirement and note updated
7.2.5.2	F 2190	Requirement updated
7.2.5.2	F 2192	Requirement removed, marked as reserved
7.2.5.3	F 2193	Requirement updated
7.3.1	-	Note Table 15/3
7.3.1	F 2303	Table 16/3 updated
7.3.2.1	F 2196	Requirement updated
7.3.2.1	F 2197	Note Table 17/3 updated
7.3.8.1	F 2283	Requirement updated
7.3.8.2	F 2284	Requirement updated
7.3.8.3	F 2208	Requirement updated
7.3.8.3	F 2286	Requirement updated
7.3.8.3	F 2293	Requirement updated
7.3.8.3	F 2294	Requirement updated
7.3.9.1	F 2210	Requirement rephrased
7.3.9.1	F 2211	Requirement updated
7.3.9.2	F 2212	Requirement updated
8.1.1	F 2216	Requirement updated
8.1.1	F 7034	Requirement updated
8.2.1	F 2220	Requirement removed, marked as reserved
8.2.1	F 2221	Requirement removed, marked as reserved
8.2.1	F 2222	Requirement removed, marked as reserved
8.2.1	F 2223	Requirement removed, marked as reserved
8.2.4	F 2229	Requirement removed, marked as reserved
8.2.4	F 2230	Requirement removed, marked as reserved

Section 5 chapter	Require-ment F xxxx	Modification
8.2.4	F 2231	Requirement removed, marked as reserved
8.2.5	F 2301	Requirement updated
8.3.1	F 2233	Requirement rephrased
8.3.1	F 2235	Requirement removed, marked as reserved
8.3.1	F 7036	Requirement removed; marked as reserved
8.3.2	-	Note Table 19/3 updated
8.4	-	Note Table 20/3 updated
8.4.2	F 2241	Requirement rephrased
8.4.3.1	F 2246	Requirement updated
8.5	F 6009	Requirement updated
8.5	F 2266	Requirement removed; marked as reserved
8.5	F 2298	Requirement removed; marked as reserved
8.5	F 2271	Requirement removed, marked as reserved
8.5	F 2269	Requirement removed, marked as reserved
8.5	F 2272	Requirement removed, marked as reserved
9.1	F 5024	Requirement updated
9.1	F 5025	Requirement updated
9.1	F 5026	Requirement updated
11.3	F 5038	Requirement updated
11.5	F 5049	Requirement updated
11.5	F 5051	Requirement updated
11.5	F 5052	Requirement updated
11.7	F 5060	Requirement updated
11.7	F 2297	Requirement updated

SECTION 6 – ATP-VR RHK STM BL3 Part 4 "Air Gap"

- Requirement modifications are listed in the following table.
- All other requirements in this section stay the same.

Section 6 chapter	Require-ment F xxxx	Modification

3.3	F 4034	Requirement updated

SECTION 7 – ATP-VR RHK STM BL3 Part 5 "Braking and Auxiliary Functions"

- The major changes in the part 5 Braking and Auxiliary Functions are:
  - STM specific test procedure (SB and EB)
- Requirement modifications are listed in the following table.
- All other requirements in this section stay the same.

Section 7 chapter	Require-ment F xxxx	Modification
2.1	F 9001	New requirement
2.1	F 9002	New requirement
2.1	F 9003	New requirement
2.1	F 9004	New requirement
2.2	F 5076	Requirement updated
2.5	F 7039	Requirement updated and second note added
3.1	F 2112	Note is added
3.2	F 7043	Requirement updated
3.5	F 5081	Requirement updated
3.5	F 5082	Requirement updated
3.5	F 5083	Requirement updated
4.1	F 7053	Requirement updated
4.1	F 7055	Requirement and note updated
4.1	F 7056	Requirement updated
4.1	F 9005	New requirement and note
4.1	F 9006	New requirement
4.1	F 9007	New requirement and note
4.1	F 9008	New requirement and note
4.1	F 9009	New requirement and note
4.2	F 2113	Requirement updated and note removed
4.2	F 5078	Requirement and note updated
4.2	F 7060	Requirement updated and note added

Section 7 chapter	Requirement F xxxx	Modification
4.2	F 7061	Requirement updated
4.2	F 7062	Requirement updated
5.4	F 7048	Table 2/5 updated
7	F 2166	Table 3/5 and notes updated

SECTION 8 – ATP-VR RHK STM BL3 "GRS"

- The major changes in the GRS are:
  - Some environmental requirements defined in more detail
- Requirement modifications are listed in the following table.
- All other requirements in this section stay the same.

Section 8 chapter	Requirement G/A xxxx	Modification
1.1	G 1	Requirement table 1/G updated
2.2.2	A 3	Requirement updated
2.4	G 9	Requirement table 2/G updated
3.1.1	G 17	Requirement removed, marked as reserved
3.1.1	G 68	Requirement updated
3.1.2	G 18	Requirement removed, marked as reserved
3.1.2	G 69	Requirement updated
3.1.3	G 19	Requirement removed, marked as reserved
3.1.3	G 70	Requirement updated
3.1.6	G 24	Requirement removed, marked as reserved
3.1.6	G 72	Requirement updated
3.1.7.1	G 28	Requirement updated
3.1.7.2	G 74	Requirement updated
3.1.7.3	G 75	Requirement updated
3.1.8	G 34	Requirement removed, marked as reserved
3.1.8	G 76	Requirement updated

Section 8 chapter	Require-ment G/A xxxx	Modification
3.2	G 36	Requirement removed, marked as reserved
3.2	G 39	Requirement removed, marked as reserved
3.2	G 77	Requirement updated
3.2	G 40	Requirement removed, marked as reserved
6	G 103	New requirement
6.2	A 101	New requirement (as a note in Addendum 1.2)
6.2	A 102	New requirement (as a note in Addendum 1.2)
6.2	A 103	New requirement (as a note in Addendum 1.2)
6.2	A 104	New requirement (as a note in Addendum 1.2)
7.1	A 55	Requirement table 7/G updated
7.3	A 60	Requirement removed, marked as reserved
8.1	G 61	Requirement updated

SECTION 9 – ATP-VR RHK STM BL3 "RAMS"

No requirement updates in this chapter.

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