

ATP-VR/RHK-koodaimen vaatimuseritelmä**ATP-VR/RHK Encoder Requirements Specification**

Liikennevirasto hyväksyy oheisen ATP-VR/RHK-koodaimen vaatimuseritelmän, jonka tarkoitus on toimia teknisenä vaatimusaineistona, jota vastaan rataverkolle käyttöönotettavia tuotteita voidaan kelpuuttaa. Vaatimuseritelmä julkaistaan Liikenneviraston verkkosivujen rautatieturvalaitteiden ohjeistossa. Tämän ohjeen kirjoitustyö ulkoistettiin VR Track Oy Suunnittelulle.

The Finnish Transport Agency (FTA) accepts the attached ATP-VR/RHK Encoder Requirements Specification, which is meant to serve as a set of technical requirements, to be used for validating products that will be adopted into service at Finnish rail network. The set of requirements will be published on Internet site of FTA incorporated into its railway signalling rules. FTA contracted out the writing of this specification to the VR Track Ltd. Consulting.

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JKV-koodaimen (ATP-VR/RHK) vaatimuseritelmä

ATP-VR/RHK-koodaimen toiminnallinen vaatimuseritelmä (FRS)

ATP-VR/RHK-koodaimen yleinen tekninen vaatimuseritelmä (GRS)

ATP-VR/RHK-koodaimen turvallisuus-, vikaantumis- ja hätäprotokollavaatimuseritelmä (SFERS)

Dokumentin versiohistoria

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1.0	Ensimmäinen versio	J. Erra	A. Härkönen L. Matikainen

ATP-VR/RHK-koodaimen vaatimuseritelmä

Osa 1 – Sisällysluettelo

Sisällysluettelo ATP-VR/RHK-koodaimen vaatimuseritelmälle (tämä dokumentti)

Osa 2 – Dokumentin kuvaus

ATP-VR/RHK-koodaimen vaatimuseritelmän tarkoitus, tausta ja soveltamisala

Osa 3 – Johdatus järjestelmään

Introduction of the ATP-VR/RHK Encoder

Osa 4 – ATP-VR/RHK-koodaimen toiminnallinen vaatimuseritelmä

Functional Requirements Specification (FRS)

Osa 5 – ATP-VR/RHK-koodaimen yleinen tekninen vaatimuseritelmä

General Technical Requirements Specification (GRS)

Osa 6 – ATP-VR/RHK-koodaimen turvallisuus-, vikaantumis- ja hätäprotokollavaatimuseritelmä

Safety, Failure and Emergency Protocol Requirement Specification (SFERS)

ATP-VR/RHK Encoder Requirements Specification

Section 1 – Table of Contents

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Section 2 – Document Description

The purpose, background and scope of application of the ATP-VR/RHK ENCODER Requirements Specification documentation

Section 3 – System Introduction

Introduction of the ATP-VR/RHK Encoder

Section 4 – ATP-VR/RHK ENCODER FRS

Functional Requirements Specification (FRS)

Section 5 – ATP-VR/RHK ENCODER GRS

General Technical Requirements Specification (GRS)

Section 6 – ATP-VR/RHK ENCODER SFERS

Safety, Failure and Emergency Protocol Requirement Specification (SFERS)

ATP-VR/RHK Koodain, ATP-VR/RHK Encoder
Vaatimuseritelmä, Requirements Specification

ATP-VR/RHK ENCODER FRS

ATP-VR/RHK ENCODER GRS

ATP-VR/RHK ENCODER SFERS

DOKUMENTIN KUVAUS

DOCUMENT DESCRIPTION

Määritelmät ja lyhenteet

Tässä on esitetty termien ja määritelmien osalta lyhyt englanti-suomi-englanti sanakirja. Tekniset määritelmät ja lyhenteet on kuvattu tarkemmin dokumentin [ATP-VR/RHK ENCODER SECTION 3 System Introduction] kappaleissa 3 ja 4.

Termit ja määritelmät englanti – suomi, Terms and definitions English - Finnish

Balise	baliisi
Encoder	koodain
Information Balise	informaatiobaliisi
Information Location	informaatiopiste
Linking	ketjutus
Switch	vaihde
Telegram	baliisisanoma
Telegram file	baliisisanomien tiedosto

Termit ja määritelmät suomi - englanti, Terms and definitions, Finnish – English

baliisi	Balise
baliisisanoma	Telegram
baliisisanomien tiedosto	Telegram file
informaatiobaliisi	Information Balise
informaatiopiste	Information Location
koodain	Encoder
ketjutus	Linking
vaihde	Switch

1 TAUSTA

ATP-VR/RHK-koodaimen vaatimuseritelmän on laatinut Liikenneviraston toimeksiannosta VR Track Oy vuonna 2014. Eritelmä perustuu Suomen rataverkolla käytössä olleiden ATP-VR/RHK-koodainten ominaisuuksiin.

ATP-VR/RHK-koodaimen vaatimuseritelmän luonnos esitettiin VR Trackin teknisille asiantuntijoille vuoden 2014 keväällä. Dokumenttia kommentoi laaja joukko asiantuntijoita. Seuraavat ihmiset osallistuivat dokumentin laadintaan ja päivittämiseen:

- Johannes Erra / VR Track Oy (laatija)
- Lassi Matikainen / VR Track Oy
- Toni Jukuri / VR Track Oy
- Tomi Kangas / VR Track Oy
- Mikko Asikainen / VR Track Oy
- Mika Paananen / VR Track Oy
- Jari Rönkkö / VR Track Oy
- Jouni Lehmusto / VR Track Oy

Edellä luetellut asiantuntijat eivät edusta kaikkea sitä asiantuntemusta, johon perustuen ATP-VR/RHK-koodaimen vaatimuseritelmä on laadittu, koska muutkin tekniset asiantuntijat ovat suoraan tai epäsuorasti osallistuneet vaatimuseritelmän valmisteluun ja katselmointiin prosessin kuluessa.

2 KUVAUS JA SOVELTAMISALA

Tässä kappaleessa kerrotaan ATP-VR/RHK-koodaimen vaatimuseritelmän taustasta ja tarkoituksesta. Kappaleessa annetaan lisäopastusta dokumentin sisällön tulkitsemiseksi.

Vaitimuseritelmän FRS & GRS & SFERS -dokumenteissa eritellyt vaatimukset koskevat ATP-VR/RHK-koodaimia. Vaatimukset on yksinomaan tarkoitettu koskemaan Suomen valtiollisen rataverkon ATP-VR/RHK-koodaimia.

ATP-VR/RHK-koodainten tulee täyttää kaikki numeroidut vaatimukset, seuraavin ehdoin:

- Poikkeamat numeroiduista vaatimuksesta ovat sallittuja, kun samanarvoinen tai parempi toiminnallisuus ja turvallisuus saavutetaan vaihtoehtoisten ominaisuuksien avulla.
- Poikkeukset ATP-VR/RHK-koodaimelle asetetuista vaatimuksista on kuitenkin ilmoitettava ja perusteltava kaikissa tapauksissa.

ATP-VR/RHK-koodaimen toiminnalliset vaatimukset on merkitty merkintätavalla [F X] missä F tarkoittaa vaatimusta ja X merkitsee kunkin vaatimuksen yksilöityä numeroa (ID).

ATP-VR/RHK-koodaimen yleiset tekniset vaatimukset on merkitty merkintätavalla [G X] missä G tarkoittaa vaatimusta ja X merkitsee kunkin vaatimuksen yksilöityä numeroa (ID).

ATP-VR/RHK-koodaimen turvallisuus-, vikaantumis- ja hätäprotokollavaatimukset on merkitty merkintätavalla [R X] missä R tarkoittaa vaatimusta ja X merkitsee kunkin vaatimuksen yksilöityä numeroa (ID).

Tietoa antava sisältö on merkitty tunnisteella [Note]. Selityksiä ja huomautuksia ei ole numeroitu. Näin merkittyjä tietoja ei tulkita vaatimuksiksi.

ATP-VR/RHK-koodaimen toiminnallinen vaatimuseritelmä määrittelee Liikenneviraston ohjeet ATP-VR/RHK-järjestelmän koodaimia koskien.

Ellei toisin erikseen ole määritelty, tulee vaatimuseritelmistä ja standardeista käyttää kulloinkin voimassa olevaa versiota (päivätyjä viitteitä on vältetty dokumenteissa).

3 KIELI

Tämän ATP-VR/RHK-koodaimen vaatimuseritelmän osat 1 ja 2 on julkaistu suomeksi ja englanniksi. Osat 3-6 on julkaistu ainoastaan englanniksi. Tämän osan alussa on esitetty tärkeimpien ATP-VR/RHK-järjestelmään ja koodaimiin liittyvien termien ja määritelmien käännökset englannista suomeksi ja suomesta englanniksi.

Definitions and abbreviations

For definitions and abbreviations, refer to document [ATP-VR/RHK ENCODER System Introduction], Chapters 3 and 4.

1 BACKGROUND

ATP-VR/RHK ENCODER Requirements Specification has been written by VR Track Ltd. in 2014, on behalf of FTA, based on the properties of ATP-VR/RHK encoders already in use in the Finnish national rail network.

The ATP-VR/RHK ENCODER Requirements Specification draft version was introduced to technical experts of VR Track Ltd during early 2014. The document was commented by a large group of experts. The following people contributed to the editing and updating of the document:

- Johannes Erra / VR Track Oy (editor)
- Lassi Matikainen / VR Track Oy
- Toni Jukuri / VR Track Oy
- Tomi Kangas / VR Track Oy
- Mikko Asikainen / VR Track Oy
- Mika Paananen / VR Track Oy
- Jari Rönkkö / VR Track Oy
- Jouni Lehmusto / VR Track Oy

The people listed above do not represent the full knowledge behind the ATP-VR/RHK ENCODER Requirements Specification as other technical experts have directly or indirectly been involved in the preparation and review of the ATP-VR/RHK ENCODER Requirements Specification during the process as well.

2 DESCRIPTION AND SCOPE OF APPLICATION

This chapter describes the ATP-VR/RHK Encoder Requirement Specification documents background and purpose. Additional guidance is provided in this chapter how to interpret the content.

The requirements set in the FRS & GRS & SFERS documents are applicable for the ATP-VR/RHK Encoders. The requirements are solely meant for the ATP-VR/RHK encoders on the national railway network in Finland.

All the numbered requirements must be fulfilled by an ATP-VR/RHK encoder, with the following conditions:

- Deviations from the numbered requirements are allowed, when equal or better functionality and safety are achieved by other means.
- Exceptions from the ATP-VR/RHK Encoder requirements must be stated and justified in any case.

The ATP-VR/RHK Encoder Functional Requirements are marked with index [F X] where F indicates a requirement and X indicates the unique number (ID) of the requirement.

The ATP-VR/RHK Encoder General Technical Requirements are marked with index [G X] where G indicates a requirement and X indicates the unique number (ID) of the requirement.

The ATP-VR/RHK Encoder SFERS Requirements are marked with index [R X] where R indicates a requirement and X indicates the unique number (ID) of the requirement.

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

ATP-VR/RHK Encoder Functional Requirements Specification specifies FTA guidelines applicable for ATP-VR/RHK Encoders.

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

3 LANGUAGE

Sections 1 and 2 of this ATP-VR/RHK ENCODER Requirements Specification have been published in both Finnish and English. Sections 3 to 6 have only been published in English. The beginning of this section includes a translation of the most important terms and definitions from English to Finnish and from Finnish to English.

ATP-VR/RHK Encoder
Requirements Specification

ATP-VR/RHK ENCODER FRS

ATP-VR/RHK ENCODER GRS

ATP-VR/RHK ENCODER SFERS

SYSTEM INTRODUCTION

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Definitions and abbreviations

For definitions and abbreviations, refer to [Chapter 3] and [Chapter 4].

Scope

This part of ATP-VR/RHK Encoder requirement specification gives introduction to the Encoders for ATP-VR/RHK. The content of this part is informative.

1 ATP SYSTEM OVERVIEW

An Automatic Train Protection (ATP) is a system that supervises the running of the train, including both signals of the signalling system and the permitted speed. Part of the ATP system, the ATP onboard 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 onboard 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 onboard system 2400m (or 3600m depending on line specific speed limit) 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 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 Driver Machine Interface (DMI) by the driver.

ATP system in Finland is called the ATP-VR/RHK based on Bombardier EBICAB 900 technology, using JGA balises or Ansaldo STS technology with minitransponder balises. The definition ATP-VR/RHK is used in the TSI for Control/Command (under the EC interoperability directive) and covers balises and other ATP-VR/RHK products from existing suppliers. In this document term ATP refers to ATP-VR/RHK.

2 ATP-VR/RHK ENCODERS

ATP-VR/RHK Encoders are part of the ATP system, providing the interface between the interlocking system and the ATP transmission system. The Encoder senses the information of the railway lamp signals and control signals in the interlocking system. The lamp signals may be flashing as well as fixed, the control signals may be complementary information from the interlocking system, e. g. point positions. Emanating from those inputs the Encoder selects the corresponding safe telegram out of its memory, and sends the telegram continuously via a serial link to the balises which are located between the rails. The balises send the telegram up to the passing trains.

The Encoder is to be placed in a cabinet near the lamp signal device or in the interlocking room. It is connected to the signal circuit on the primary side, or to the lamp circuit on the secondary side of the signal transformer.

DC signals as well as AC signals can be used as inputs to the Encoder detecting circuits.

The Encoder is fed from a separate power supply.

3 DEFINITIONS

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

Table 1/1. Definitions

Expression	Explanation
Balise	A device that transmits information to the passing train
Encoder	Device that detects interlocking equipment status, and based on those input signals, forms a telegram and sends it to balises or other transmission mediums
Information Balise	Balise which sends information telegrams. Telegram must be evaluated before accepted.
Information Location	A place along the track where information is transmitted from track-side equipment to vehicle via two balises. The balises may be controlled by encoders.
Linking	A function to ensure the presence of expected signal or board balise groups. If a group is missing, balise error will occur.
Switch	A railway turnout.
Telegram	The message created by the encoder and sent by the balise to the train
Telegram file	A data file created by WINTED. A telegram file contains configuration data and all balise telegrams or track circuit telegrams belonging to an information location or a telegram track circuit respectively.

4 ABBREVIATIONS

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

Table 2/1. Abbreviations

Abbreviation	Explanation
AC	Alternate Current
AMI	Alternate Mark Inversion
ATP	Automatic Train Protection system
ATP-VR/RHK	National class B legacy ATP system used in Finland
CRC	Cyclic Redundancy Check
DC	Direct Current
ELU	Encoder Logic Unit
FRS	Functional Requirements Specification
FTA	The Finnish Transport Agency (In Finnish: Liikennevirasto)
GRS	General technical Requirements Specification
IL	Information Location
PCB	Printed Circuit Board
PTE	Programming and Testing Equipment
RAMS	Reliability, Availability, Maintainability, Safety
RHK	Ratahallintokeskus (Finnish Rail Administration) - currently known as Liikennevirasto (FTA)
SFERS	Safety, Failure and Emergency Protocol Requirement Specification
WINTED	WINdows Telegram EDitor, The software tool used when generating telegram files

ATP-VR/RHK ENCODER FUNCTIONAL REQUIREMENTS SPECIFICATION

FRS

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1 INTRODUCTION

Note This part of ATP-VR/RHK Encoder Requirements Specification is the Functional Requirements Specification (FRS), specifying the functional requirements for Encoders on the national Finnish rail network.

2 STRUCTURE

2.1 Lamp Detection Interfaces

- F 101 There shall be lamp detection interfaces, which sense the voltage and current of the signal lamps and measure the true RMS power in each lamp.
- F 102 The detector circuits of the interface shall detect whether the lamp is on or off, and send the information to data conversion.

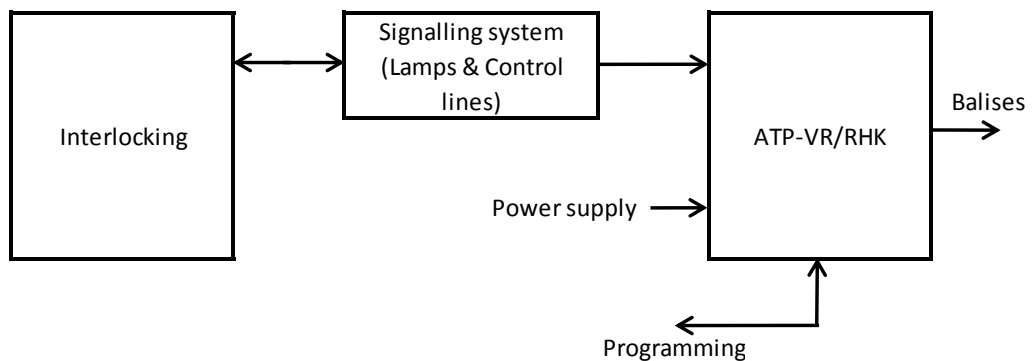
2.2 Encoder Structure

- F 103 The structure of the encoder shall be based on a modular solution.

2.3 Balise Interfaces

- F 104 The encoder shall convert the data for each balise driver on the Balise Interfaces. The data conversion units select, based on the signal aspect from the Lamp Detection Interfaces, the corresponding telegram in its memory. The telegram is sent continuously via the Balise Interface out to the balise.
- F 105 There shall be up to four balise interfaces in an encoder, adapting the signal for the characteristics of the cable to the balise.

Note The encoder as part of the ATP system is presented in picture 1.



Picture 1. ATP-VR/RHK trackside equipment.

3 ENCODER INPUT INTERFACE

- F 106 The Encoder input interface shall be realized on a circuit board.
- F 107 Each Lamp Detection Interface shall be connected to the lamp signals via a connector.
- F 108 There shall be a wire terminal to provide easy connection of the incoming conductors.
- F 109 Any mix-up of the connectors shall be prevented by keying.
- F 110 The Encoder shall be equipped to handle up to 12 lamp/control signals independently.
- F 111 Lamp detection interfaces shall be designed for low lamp voltage (6-36 V AC/DC) or high lamp voltage (24-115 AC/DC).
- F 112 Any mix-up of the boards shall be prevented by different connector types.
- F 113 At least three inputs shall be able to sense flashing lights as well as steady lights or control signals. Other inputs shall be able to sense steady lights or control signals.
- F 114 A lamp detector channel shall measure the RMS power consumed by a lamp or other load, and shall check if the actual power is below or over following thresholds:

≤ 1 W the input is OFF,
≥ 5 W the input is ON.
- Note The thresholds shall be chosen with a sufficient margin between them, to achieve margins for temperature drifting and ageing.
- F 115 The Encoder inputs emanate from railway signal lamps or control signals. When a control signal is to be sensed, the lamp detection interface shall handle the signal in the same way as a lamp signal.
- F 116 Each input signal from signalling system shall be electrically isolated from the others.
- Note Therefore it is possible to connect the same encoder to different physical signal locations.

4 ENCODER CONTROL AND LOGIC CIRCUITS

4.1 General

- F 121 Guided by the state on the signal inputs the balise driver interface shall send out the correct telegram to the appropriate balise.
- F 122 The data conversion shall be capable of handling and storing at least 96 valid and different telegrams and 4 error telegrams.
- F 123 If the signal aspect into the Encoder is not included among those programmed in its memory, or a fault has occurred in the Encoder, the Encoder shall send an error telegram to the balise.
- Note The ATP equipment on the train shall then realize that the Encoder is out of order and make the suitable measures.
- F 124 The data conversion shall have access to all lamp signal inputs and are programmed individually. The inputs shall be able to be combined.
- F 125 The encoder shall contain at least four independent Encoder channels to the boards sending the telegram to the balise.
- F 126 The Encoder shall have a fail-safe design, capable of handling at least three independent failures without any dangerous situation occurring.
- F 127 To complete one telegram all the constituent blocks of the Encoder must co-operate in a correct sequence and all the time agree with each other. Otherwise the output to the balise shall be disabled.
- Note When the balise does not receive any telegram from the Encoder, it will transmit an internally stored default value.
- F 128 Each block shall generate its independent part of the telegram, from sensing the input (from a lamp signal or similar).

4.2 Data Storage in the Encoder

- F 129 The data conversion shall be designed to handle telegram lengths up to 256 bits.
- F 130 Each unit in the encoder handling the telegram shall have its own external memory, in which configuration data, telegram headers, telegrams and checksums are stored.
- F 131 The encoder shall have a non-volatile, programmable read-only memory.

4.3 Change of telegram

- F132 Short transients, shorter than time T1, in the input signal aspect shall be filtered out.
- Note The standard value in Finland for T1 is 1720 ms.
- F 133 When the signal aspect gets unstable (i.e. changes repeatedly), the signal aspect shall be ignored by filtering.
- F 134 The times related to detecting valid signal aspects shall be programmable.

- F 135 A change in the input signal aspect shall be stable for T1. Otherwise it shall be rejected as a disturbance. T1 shall be 40 ms or more.
- F 136 If the inputs change repeatedly for a time T2, an error telegram, "Unstable input signal status", shall be selected. T2 shall be T1+20 ms or more.
- Note The standard value in Finland for T2 is 2520 ms.
- F 137 For safety reasons the time it takes to send a telegram shall be programmable to be shorter than T1.

5 ENCODER OUTPUT INTERFACE

5.1 General

- F 141 There shall be a wire terminal to provide easy connection of the outgoing conductors.
- F 142 The Encoder shall transform the data logic signals in the telegrams from the data conversion units into AMI code which is used as drive signals on the lines to the balises. There shall be at least four equal channels for this transformation.
- F 143 The drive signals shall be able to be transmitted for balise cable lengths of up to 3 km.
- F 144 The Alternate Mark Inversion (AMI) line code shall be chosen for serial transmission.

5.2 Telegram Transmission

- F 145 The encoder transmitter shall consist mainly of the AMI-encoder and an LP-filter. The data shall be prepared thus:
- logical "0" shall be "00"
 - logical "1" shall be "10"
- F 146 The output signal from the AMI encoder shall be lowpass filtered and then passed on to the line transformer.

6 ENCODER POWER SUPPLY

- F 151 The Encoder shall be fed by a separate power source.
- F 152 The feeding cable shall be fused with a fuse of minimum 2 A, the maximum value is depending of the feeding circuits.
- F 153 For supervision purposes the internal voltages shall be monitored.

7 TELEGRAM PROTOCOLS

- F 156 One telegram to be sent shall consist of a serial bit stream with a programmable protocol and a selectable bit rate. For the encoder the following ATP-VR/RHK (EBICAB 900) protocol is defined:
255 bit balise telegram with 50 kHz bit rate:
180 information bits,
72 bits for CRC and synchronisation,
2 bits for adjusting the zero/one ratio
1 bit for inversion check.
- F 157 One telegram shall be sent repeatedly as long as the input remains the same. Should the input change, the corresponding switching of telegrams shall be done in a controlled manner, i.e. after one telegram has reached the end.

8 ERROR MODES

F 161 For the data conversion five different error modes shall be defined. Each such error mode shall result in a specific output telegram according to following table

Error mode	Output state	Priority
Circuit error	Output disabled	5
Internal power distribution error	ERROR 4 telegram is sent	4
Flash error (wrong frequency)	ERROR 3 telegram is sent	3
Unstable input signal (see requirement F 114)	ERROR 2 telegram is sent	2
Undefined input signal combination	ERROR 1 telegram is sent	1

F 162 When two or more error modes appear simultaneously, the error with highest priority (i.e. the highest number in the table above) shall be chosen.

9 PROGRAMMING AND TESTING

- F 163 For the data conversion in the Encoder, a number of parameters shall be programmable:
- The telegrams (96 or more)
 - The required (valid) input combination for each telegram (the header)
 - Which inputs that are to be sent
 - The four ERROR telegrams
 - The block length of the safety telegrams.
- F 164 The programming and testing of the Encoder is done by connecting a cable between the Encoder and a specially built Programming and Testing Equipment, the PTE.

10 GENERATING OF TELEGRAM FILES

- F 165 A telegram file shall contain configuration data and all balise telegrams belonging to an information location.
- Note There are rules and guide lines about how to choose the correct parameters.

ATP-VR/RHK ENCODER GENERAL TECHNICAL REQUIREMENTS SPECIFICATION

GRS

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1 INTRODUCTION

Note This document specifies the general technical requirements for ATP-VR/RHK Encoders.

2 MECHANICAL DESIGN

- G 1 The Encoder frame shall consist of a box intended for wall mounting and is provided with modular structure and slots for Lamp Detection Interfaces and Balise Driver Interfaces.
- G 2 All the input and output cables, including the supply of power to the Encoder, shall be entered into the box via the bottom cable inlets of the box, and connected to the Interfaces.
- G 3 The connector front panels on the boards shall be keyed to prevent any mix-up (see Section 6, SFERS, R 5).
- G 4 For mounting the Encoder at least two brackets shall be used that are fixed to a wall.
- G 5 All external inputs/outputs shall be drawn via an external terminal block to the connectors for lamp detection interfaces, power input and balise driver interfaces.
- G 6 The connectors belonging to the wiring shall be mounted into the Encoder box. Connector positions shall be marked in the panel.

3 TECHNICAL DATA

G 7

Specification	Data
Power supply, Encoder: - limits - nominal - ripple - fuse	15-40 V DC including ripple 24 V DC Maximum 1 V peak to peak Minimum 2 A (slow blow)
Nominal voltage level for signalling lamps	- 6-36 V AC (25-400 Hz) or DC (low-voltage) - 24-115 V AC (25-400 Hz) or DC (high-voltage)
Nominal current range for signalling lamps	- 0-4.0 A (low-voltage) - 0-1.0 A (high-voltage)
Number of lamp detection inputs	1-12
Use of inputs number: 1-3	Optionally steady or flashing light
Use of inputs number: 4-12	Steady light
Insulation between lamp inputs: - voltage insulation - creeping distance	> 3 kV AC > 6 mm
Lamp state definitions: - ON - OFF - Nominal threshold - Nominal hysteresis	≥ 5 W ≤ 1 W 3 W 0.5 W
Maximum overload current in lamp sensing circuit	- 16 A for 60 s (low-voltage) - 4 A for 60 s (high-voltage)
Maximum external fuse in lamp sensing circuit	- 6 A (low-voltage) - 1.6 A (high-voltage)
Maximum transient voltages on lamp input pins	- $V_{cont} = 250 V_{RMS}$ - $V_{inst} = 1500 V_{RMS}$ for 300 ms pulses (shall resist 3 consecutive pulses with the space 5 s between the first and second pulse and 30 s between the second and third. - $V_{trans} = 10$ kV 1.2/50 μ s
Number of balise driver outputs	≥ 4
Insulation between balise driver outputs: - voltage insulation - creeping distance	> 3 kV AC or DC > 6 mm

4 INTERFACES

- G 8 The connector of the low-voltage lamp detection interface shall have the necessary amounts of pins, with 6-36 V AC or DC input.
- G 9 The connector of the high-voltage lamp detection interface shall have the necessary amounts of pins, with 24-115 V AC or DC input.
- G 10 The connectors of the balise driver interface shall have the necessary amounts of pins, two for each balise.

5 ENVIRONMENTAL AND EMC REQUIREMENTS

- G 11 The Encoder shall be dust and water protected, and shall comply with the encapsulation class IP 54 or better, including:
- Protection of persons from touching voltage-carrying parts
 - Prevention from the access of dust in a quantity that impairs functioning
 - Water splashing against the Encoder from all directions does not have any harmful effect.
- G 12 deleted
- G 13 The environmental requirements of standard EN 50125-3 shall be fulfilled, as far as the requirements are relevant for the Encoder. This requirement does not apply for encoders that have been accepted to service on or before 31st December 2013.
- G 14 The EMC requirements of standard EN 50121-4 shall be fulfilled. This requirement does not apply for encoders that have been accepted to service on or before 31st December 2013.
- G 15 The encoder shall be able to operate in a temperature range of -40°C to +70°C.

ATP-VR/RHK ENCODER SAFETY, FAILURE AND EMERGENCY PROTOCOL REQUIREMENTS
SPECIFICATION

SFERS

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1 INTRODUCTION

- Note The encoders are adapted to the existing national Finnish ATP system (ATP-VR/RHK).
- Note This document specifies the Reliability, Availability, Maintainability and Safety (RAMS) requirements for the encoders in use on the Finnish national railway network equipped with ATP-VR/RHK system.

2 APPLICABLE STANDARDS

R 1 In the design and constructions of the Encoder, the following standards shall be taken into consideration:

EN 50126 Railway applications - The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS).

EN 50129 Railway applications - Communications, signalling and processing systems - Safety related electronic systems for signalling.

This requirement does not apply for encoders that have been accepted to service on or before 31st December 2013.

Note 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 GENERAL SAFETY REQUIREMENTS

- R 2** In order to reach a high degree of safety at the design of the Encoder the following shall be taken into consideration:
- all risks of interchanging faults have been eliminated
 - programming and checking is done against the checksum
 - multi-block technique is used in the Logic Unit and Lamp Detector Interface.
- R 16** The Encoder shall be suitable for SIL 4 application.
- R 17** There shall be principal electrical circuit diagrams for the encoder inputs with following cases:
- One filament lamp signal circuitry
 - Double filament lamp signal circuitry
 - LED lamp unit signal circuitry
 - Control line circuitry
- R 21** The encoder shall have following overall safety requirements:
- The encoder shall not transmit a valid telegram that does not correspond to the signal aspect
 - The encoder shall not transmit a valid telegram that is less restrictive than the correct telegram
 - The encoder shall not affect the signal aspect causing a less restrictive aspect
 - The encoder shall not cause all the balises in a group to become silent
- R 22** There shall be instructions for safe installation, programming, use and maintenance of the encoder.
- R23** There shall be justified control principles for the encoder system which select the valid balise telegram. The system shall ensure that the encoder does not send less restrictive balise telegram to the balise in case of a failure.
- Note It should be taken into consideration that:
- The encoder cannot ensure validity of the control input signals
 - The encoder cannot interact with the signal system which controls the input signals
- Note This requirement can be fulfilled fully or partially by following national rules set by Finnish Transport Safety Agency or Finnish Transport Agency.
- Note The Encoder shall be identifiable and the telegram or program shall be identified according to the ID given to the encoder. This shall be verified manually or automatically when programming the encoder.
- Note There shall be a systematic checking procedure for programming the respective balise channel and the programmer shall check validity of the balise telegram file when programming the balise channel. The file names in programming shall refer to the hardware configuration ID's of the trackside equipment.
- Note When programming the encoder, only valid signal aspects for respective signal including fictive signal aspects shall have programmed telegrams. This shall be done in order to avoid excessive telegrams in encoder program which could permit less restrictive aspect if the signal lamps have failed. There shall be a procedure which prevents the programming of a balise channel with uncorresponding balise telegram.

4 INSULATION PROPERTIES

- R 3** All the printed circuit boards (PCBs) shall have sufficient insulation properties. All inputs shall be independent. The circuits that carry the lamp current shall be given a conducting area large enough to carry maximum currents.
- R 4** The insulation properties on the input and output boards, the Lamp Detector Boards and the Balise Driver Board, are as follows:
- the creeping distance is 6 mm
 - the insulation voltage is 3 kV

5 ELIMINATION OF INTERCHANGING RISKS

- R 5** The wiring to every individual lamp shall be keyed to its position on the connector front panel. The panels shall be mechanically keyed to a certain input to the Encoder. Therefore it shall be impossible to mix the inputs by replacing a faulty Lamp Detection Interface.

6 PROGRAMMING AND CHECKING AGAINST CHECKSUM

- R 6** The non-volatile memory of a Logic Unit in the Encoder shall be programmable with a data file.
- R 7** For the programming, appropriate programming and test equipment (PTE) or a handheld computer shall be used.
- R 8** deleted
- R 9** The Logic Unit number shall be defined by the program file. A set of valid telegrams shall be stored to the non-volatile memory. To select the only correct telegram a multi-block technique with different memories shall be used. The memories shall be programmed by a sequence different from the checking sequence.
- R 10** Furthermore a checksum shall be created for the content of all memories separately, and stored at normally unused positions in the memory blocks. When reading the content of the memories, it shall be possible to control, if the data system is corrupted or not.

7 THE DATA CONVERSION TECHNIQUE

- R 11** Several valid telegrams shall be stored in the Encoder. It is the key to safety that the Encoder shall select the only correct one in respect to the input from the colour lamp signal equipment or the interlocking system.
- R 12** The fail-safe design of the Encoder shall be able to tolerate at least 3 independent failures without any dangerous situation occurring.
- R 13** When a critical failure is diagnosed, the output to the balise shall be disabled.
- R 14** When the balise does not receive any telegram from the encoder, it shall transmit an internally stored default telegram.
- R 15** When a failure is detected in the Encoder, this shall be able to be interpreted by a passing train with operational ATP-VR/RHK onboard equipment.