TECHNICAL DOCUMENTATION FOR NON TSI COMPLIANT TRAIN DETECTION

ERA-TDC-MS-ES

Reference: ERA-TDC-MS-ES	Document type:
Version : 1.0	T
Date : 22/11/2024	

	Edited by	Quality review	Approved by
Name	CGF	FJAM	JADL
Position	Signaling Technician	Area Manager of Engineering and Facility Maintenance	Deputy Director of Facilities

Amendment record

Version	Date	Section number	Modification/description	Author
1.0	22/11/2024	All		

INDEX **PAGE**

1.-INTRODUCTION

This document specifies the requirements for non TSI compliant train detection systems in a harmonised format. The following table presents a summary of the parameters in which each train detection system

is non-compliant:

Table 01

TECHNOLOGY	System	SDT	Axle distances					Wheel geometry						Other parameters						EMC	
			3.1.2.1	3.1.2.2	3.1.2.3	3.1.2.4	3.1.2.5	3.1.3.1	3.1.3.2	3.1.3.3	3.1.3.4	3.1.3.5	3.1.3.6	3.1.4	3.1.5	3.1.6	3.1.7	3.1.8	3.1.9	3.2.1	3.2.2
SIEMENS	FS2000/5000	TC	✓		✗	✓	✓							✓	✓	✓	✓	✓	✓		✗
	FS3000	TC	✓		✗	✓	✓							✓	✓	✓	✓	✓	✓		✗
	DSA 50 Hz	TC	✓		✓	✓	✓							✓	✓	✓	✓	✓	✓		✗
THALES	CV 50 Hz ALCATEL	TC	✓		✓	✓	✓							✓	✓	✓	✓	✓	✓		✗
ALSTOM	TI21 I-M	TC	✓		✓	✓	✓							✓	✓	✓	✓	✓	✓		✗
	EBITRACK 400	TC	✓		✓	✓	✓							✓	✓	✓	✓	✓	✓		✗
	50 Hz (ERICSSON)	TC	✓		✓	✓	✓							✓	✓	✓	✓	✓	✓		✗
	GRS	TC	✓		✓	✓	✓							✓	✓	✓	✓	✓	✓		✗
ENYSE	50 Hz ENYSE	TC	✓		✓	✓	✓							✓	✓	✓	✓	✓	✓		✗
HITACHI	UM71-2000	TC	✓		✗	✓	✓							✓	✓	✓	✓	✓	✓		✗
THALES	SIG L90	AC	✓	✗	✓	✓	✓	✓	✓	✗	✗	✓	✓							✓	
	RSL	AC	✓	✗	✓	✓	✓	✓	✓	✗	✗	✓	✓							✓	
FRAUSCHER	RSR 122	AC	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓							✗	
ELECTRANS	DEF-87-CE (E-CE-95)	AC	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓							✗	

TC	Track Circuit
AC	Axle Counter
✓	V5 compliant
✗	Not or partially compliant with V5
	Not relevant to this system

2.-SCOPE

This report applies to train detection systems that do not comply with the TSI, which are installed in the Member State **Spain (ES).**

The requirements of this document ensure compatibility with the following non-TSI-compliant train detection systems:

Table 02

Track circuits	Axle counters
• FS 2000/5000 • FS 3000 • DSA 50 Hz • CV 50Hz ALCATEL • TI21 I-M • EBITRACK 400 • 50 Hz (ERICSSON-ADTRANZ) • GRS • 50 Hz ENYSE • UM71-2000	• SIG L90 • RSL • RSR 122 • DEF-87-CE (E-CE-95)

This inform does not cover metric gauge lines (1000 mm) and those intended for the classification and management of goods within port facilities.

Note: The parameters faced by Train Detection Systems are described in ERA/ERTMS/033281 v.5.

3.-PARAMETERS

3.1.-VEHICLE DESIGN AND OPERATION

3.1.1.-Definitions

For the definition of the longitudinal dimensions of the vehicle Figure, (which shows an example for a three-axle twin-bogie vehicle), applies, where:

ai = distance between following axles, where i = 1, 2, 3, ..., n-1, where n is the total number of axles of the vehicle

bx = distance from the first axle (b_1) or the last axle (b_2) to the nearest end of the vehicle, i.e. nearest buffer/nose

L = total length of the vehicle

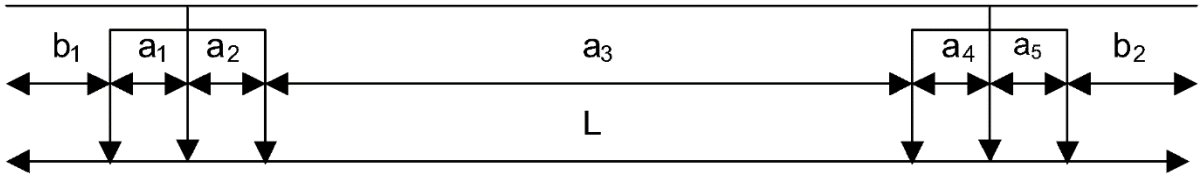

Figure 1: Longitudinal vehicle dimensions

If more vehicles are connected in a consist, the characteristics stated in the remainder of this section 3.1 and related to ai apply to the relevant distance of the axles belonging to each vehicle individually, while the characteristics related to bi only apply to the two ends of the complete consist.

For definition of wheel dimensions Figure 2 applies, where:

D = wheel diameter

B_R = width of the rim

S_d = thickness of the flange measured at the line 10mm above the running tread as given in Figure 2

S_h = height of the flange

Other dimensions in Figure 2 are not relevant in this document.

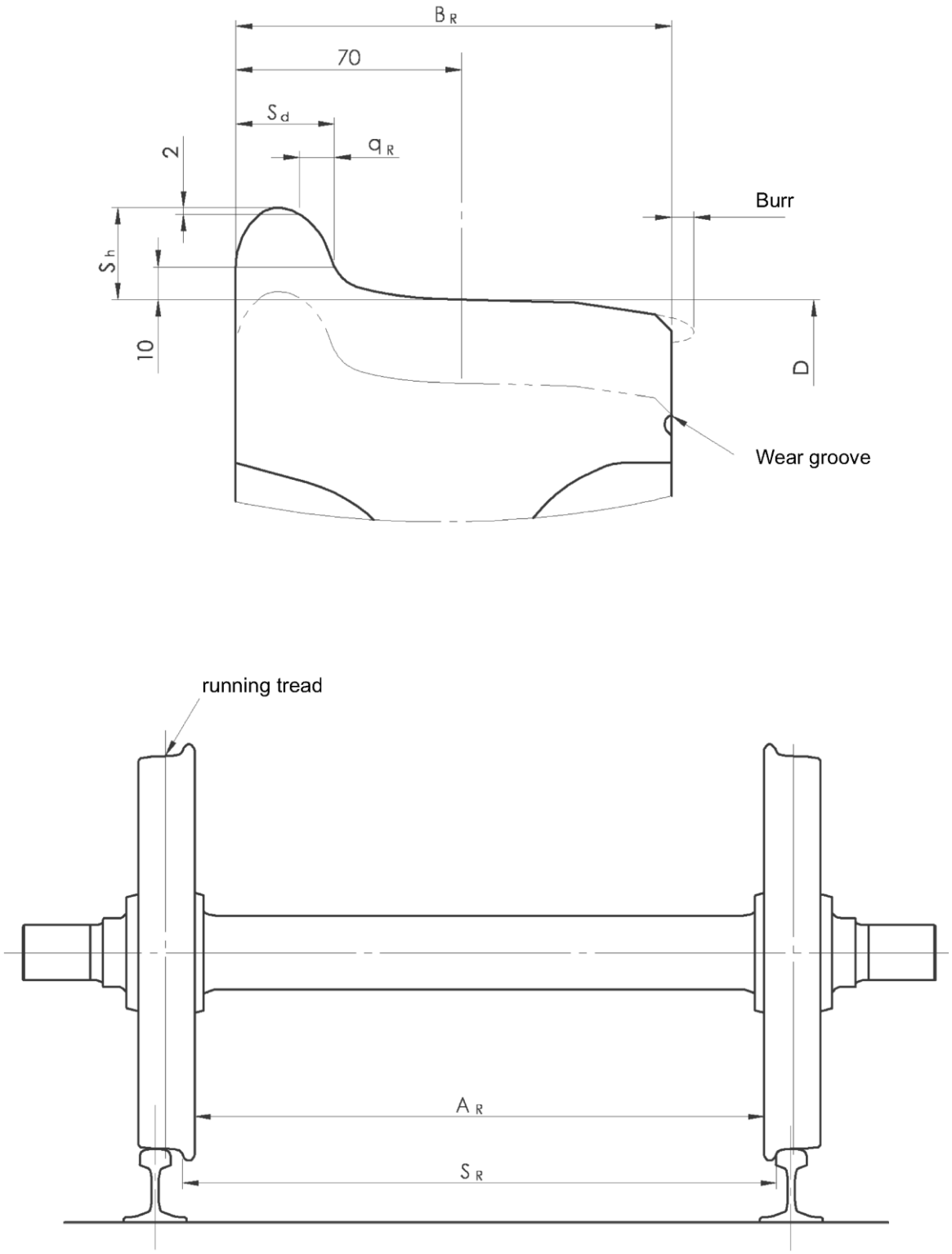

Figure 2: Wheel and wheelset dimensions

The values quoted in the following paragraphs are absolute limit values including any measurement tolerances.

The term wheelset applies to any pair of opposite wheels, even those not connected by a common axle. Except where stated, wheelset assemblies are assumed to have continuous wheel centres and not have spoke wheels. Any references to wheel sets concern centre of wheels.

3.1.2.-Axle distances

3.1.2.1.-MAXIMUM AXLE DISTANCE

Compliant with ERA/ERTMS/033281 version 5.0 (1668mm and 1435 mm track gauge).

3.1.2.2.-MINIMUM AXLE DISTANCE

Compliance with ERA/ERTMS/033281 version 5.0 (for 1668mm and 1435mm track gauges) is achieved except for **SIG L90 and RSL axle counters**, both equipped with **Zp30C wheel sensors**, where the minimum wheelbase is adjusted according to the following table:

Table 04

Speed	Wheel Diameter	Axle distance
v ≤ 300 km/h	D ≥ 900 mm	≥ 1.5 m

In the case of the **DEF-87-CE** sensors (also used in **E-CE-95** track circuits), partial compliance with the ERA/ERTMS/033281 limits is observed, specifically those defined for speeds of up to 300 km/h. For speeds above 300 km/h, the minimum wheelbase will be the product of the speed and 7.2, which is greater than the value set in version 5 (2160 mm).

3.1.2.3.-MINIMUM DISTANCE BETWEEN THE FIRST AND LAST AXLES

Compliance with ERA/ERTMS/033281 version 5.0 (for 1668mm and 1435mm track gauge), **except for** the following exceptions:

Table 05

FS2000/5000 and FS3000	The maximum distance for the neutral zone is 4000 mm.
UM71-2000	The maximum distance for the neutral zone can reach up to 10000 mm.

Note 1: In the reference standard, the parameters are specified by focusing on rolling stock, which means that the parameter corresponding to the track circuit is the inverse. Specifically, when referring to the "minimum distance between the first and last axles", this minimum value must coincide with the maximum configuration value of the track circuit, which in this case refers to the maximum length of the antenna or neutral zone.

Note 2: The worst-case scenario that technology allows is considered, even though the parameter for the neutral zone between two track circuits directly depends on the design and configuration of the facilities.

3.1.2.4.-DISTANCES BETWEEN THE END OF THE TRAIN AND THE FIRST AXLE OF THE NEW HIGH-SPEED LINES

Compliance with ERA/ERTMS/033281 version 5.0 (1668mm and 1435 mm track gauge).

Note: This parameter is not considered a feature of the train sensing system itself, but rather a variable of the design phase of the line.

3.1.2.5.-DISTANCES BETWEEN THE END OF THE TRAIN AND THE FIRST AXLE ON OTHER LINES

Compliance with ERA/ERTMS/033281 version 5.0 (1668mm and 1435 mm track gauge).

Note: This parameter is not considered a feature of the train sensing system itself, but rather a variable of the design phase of the line.

3.1.3.-Wheel geometry

3.1.3.1.-MINIMUM RIM WIDTH

Compliance with ERA/ERTMS/033281 version 5.0 (1668mm and 1435 mm track gauge).

3.1.3.2.-MINIMUM WHEEL DIAMETER

Compliance with the ERA/ERTMS/033281 version 5.0 (1668mm and 1435 mm track gauge), except for **DEF-87-CE** (also used in **E-CE-95** track circuits) for which compliance is partial, as its value is valid for speeds up to 350 km/h (criteria evaluated by its certification in ERA/ERTMS 033281 V.3), but not calculated for higher speeds, as it is an open point in the repealed regulation. However, since the maximum speed of Spanish railway lines is less than 350 km/h, these systems will be considered compliant with interoperability regulations.

3.1.3.3.-MINIMUM FLANGE THICKNESS

Compliance with ERA/ERTMS/033281 version 5.0 (1668mm and 1435 mm track gauge), except for **SIG L90** and **RSL** axle counters, both with **Zp30C** wheel sensors, where the wheel flange thickness range adjusts to the following table:

Table 06

Track gauge [mm]	Wheel diameter D [mm]	Flange thickness S_d [mm]
1435 1668	$330 \leq D \leq 840$	From 27.5 to 33
	$D \geq 840$	From 22 to 33

3.1.3.4.-Flange Height

Compliance with ERA/ERTMS/033281 version 5.0 (1668mm and 1435 mm track gauge), with the exception of the **SIG L90** and **RSL** axle counters, both with **Zp30C** wheel sensors, where the wheel flange height range adjusts to the following table:

Table 07

Track gauge [mm]	Wheel diameter D [mm]	Flange height S_h [mm]
1435 1668	330 ≤ D ≤ 760	From 32 to 38
	D ≥ 760	26 to 36 (compliance with ERA/ERTMS/033281 v.5.0)

For **RSR122** it partially complies with the minimum wheel flange thickness requirement in accordance with version 5 of the aforementioned standard.

Table 08

Track gauge [mm]	Wheel diameter D [mm]	Flange height S_h [mm]
1435 1668	330 ≤ D ≤ 760	From 32 to 38
	D ≥ 760	26 to 38 (compliance with ERA/ERTMS/033281 v.5.0)

3.1.3.5.-Metal and inductive components between wheels

Compliance with ERA/ERTMS/033281 version 5.0 (1668mm and 1435 mm track gauge).

3.1.3.6.-Wheel Material

Compliance with ERA/ERTMS/033281 version 5.0 (1668mm and 1435 mm track gauge).

3.1.4.-Using Sandblasting Equipment

Compliance with ERA/ERTMS/033281 version 5.0 (1668mm and 1435 mm track gauge).

3.1.5.-On board flange lubrication

Compliance with ERA/ERTMS/033281 version 5.0 (1668mm and 1435 mm track gauge).

3.1.6.-Use of composite brake shoes

Compliance with ERA/ERTMS/033281 version 5.0 (1668mm and 1435 mm track gauge).

3.1.7.-Vehicle axle load and metal construction

3.1.7.1.-VEHICLE AXLE LOAD

Compliance with ERA/ERTMS/033281 version 5.0 (1668mm and 1435 mm track gauge).

3.1.7.2.-VEHICLE METAL CONSTRUCTION

Compliance with ERA/ERTMS/033281 version 5.0 (1668mm and 1435 mm track gauge).

3.1.8.-Use of shunt assisting devices

Compliance with ERA/ERTMS/033281 version 5.0 (1668mm and 1435 mm track gauge).

NOTE: The use of shunting assisting device is not required on the Spanish Rail Network if the vehicles are compliant with the requirements defined in this document.

3.1.9.-Impedance between wheels

Compliance with ERA/ERTMS/033281 version 5.0 (1668mm and 1435 mm track gauge).

3.2.-ELECTROMAGNETIC COMPATIBILITY

3.2.1.-ELECTROMAGNETIC FIELDS

3.2.1.1.-FREQUENCY MANAGEMENT

Compliance with ERA/ERTMS/033281 version 5.0 (1668mm and 1435 mm track gauge), **except for RSR 122** axle counter detectors.

3.2.1.2.-VEHICLE EMISSION LIMITS AND EVALUATION PARAMETERS

Compliance with ERA/ERTMS/033281 version 5.0, **except for the DEF-87-CE (E-CE-95)** axle counter detectors, as we can only ensure compliance with the limit values of ERA/ERTMS/033281 version 3.0, failing to meet the uncertainty range of version 5.0. And the **RSR122** sensors, where the narrowband emission limits and evaluation parameters are defined in Table 09.

Table 09

Type	Frequency range defined by the centre frequency [kHz]	Emission limit X Axis [dBµA/m] (RMS)	Emission limit Y Axis [dBµA/m] (RMS)	Emission limit Z Axis [dBµA/m] (RMS)	Evaluation method	Filter order (Butterworth) and 3 dB-bandwidth	Evaluation parameters
Band 3 (RSR122 SYS1)	1115 to 1145	99.7	78.6	61.7	BP	4th order 6.0 kHz	20% overlap (3 dB dots) Integration Time: 2 ms
Band 3 (RSR122 SYS1)	From 1020 to 1050	99.8	78.3	61.8	BP	4th order 6.0 kHz	20% overlap (3 dB dots) Integration Time: 2 ms

3.2.1.3.-ASSESSING LIMIT EXCEEDANCES

Compliance with ERA/ERTMS/033281 version 5.0, **except for RSR122** axle counter detectors where the narrow band emission limits and evaluation parameters are defined in Table 10

Table 10

Frequency range	Field direction	Increasing of magnetic field limits for a reduced integration time of 0,5 x T_{int} [dB]	Increasing of magnetic field limits for a reduced integration time of 0,25 x T_{int} [dB]
27 to 52 kHz	X	2	6
27 to 52 kHz	Y, Z	6	12
234 to 287 kHz	X, Y, Z	6	12
287 to 363 kHz	X, Y, Z	3	6
740 to 1026 kHz	X, Y, Z	6	12
1020 to 1050 kHz	X, Y, Z	6	12
1115 to 1145 kHz	X, Y, Z	6	12

3.2.1.4.-MEASUREMENT, TEST AND EVALUATION SPECIFICATION

The tests for the acquisition of the indicated values have been designed and executed by the company supporting the system following the specifications and parameters set forth in the standard EN 50592:2016.

3.2.2.-CONDUCTED INTERFERENCE

3.2.2.1.-VEHICLE IMPEDANCE

Regarding vehicle impedance, in the Spanish legal framework, order TMA 576/2020 generally mandates that "each influencing unit (self-propelled unit, locomotive in simple composition, or car with a pantograph) must have a minimum input impedance of 2 Ω at 50 Hz."

NOTE: The same order, more specifically in section 4.2.3.3.1.1, specifies that to ensure compatibility with train detection systems based on track circuits, "all electric traction rolling stock operating on direct current lines equipped with 50 Hz track circuits must be equipped with a 50 Hz detector that will act on the traction system and the auxiliary services converter when it detects, for more than 2 seconds, an intensity level greater than 1.5A RMS. The filter equipped by the detector will have a maximum bandwidth of ±2 Hz."

3.2.2.2.-TRACTION CURRENT

Compliance with ERA/ERTMS/033281 version 5.0 track circuits, **except** for **FS2000/5000, FS3000, GRS, TI 21 I-M, EBITRACK 400, UM71-2000 track circuits** and, in general, all track circuits based on 50 Hz electrical circuits (**DSA 50 Hz, ERICSSON** and **ENYSE)** will be considered exceptions.

3.2.2.2.1.-25 kV AC, 50 Hz Electromagnetic Interference Limits

FS 3000

The track circuit does not comply with the limits established by ERA/ERTMS 033281. The interference current limits considered for the current train detection system shall be those specified in EN 50238-2:2020, Annex A.

Table 11

Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
4080 Hz	0.52 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 4080 Hz 3dB bandwidth: 124 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: **s. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.016 seconds. Minimum time between two exceedances: 0.514 s.
4320 Hz	0.45 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 4320 Hz 3dB bandwidth: 124 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: **s. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.016 seconds. Minimum time between two exceedances: 0.514 s.
4560 Hz	0.39 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 4560 Hz 3dB bandwidth: 124 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: **s. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.016 seconds. Minimum time between two exceedances: 0.514 s.

Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
5040 Hz	0.66 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 5040 Hz 3dB bandwidth: 124 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: **s. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.016 seconds. Minimum time between two exceedances: 0.514 s.
5280 Hz	0.27 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 5280 Hz 3dB bandwidth: 124 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: **s. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.016 seconds. Minimum time between two exceedances: 0.514 s.
5520 Hz	0.27 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 5520 Hz 3dB bandwidth: 124 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: **s. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.016 seconds. Minimum time between two exceedances: 0.514 s.
6000 Hz	0.26 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 6000 Hz 3dB bandwidth: 124 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: **s. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.016 seconds. Minimum time between two exceedances: 0.514 s.

Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
6480 Hz	0.25 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 6480 Hz 3dB bandwidth: 124 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: **s. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.016 seconds. Minimum time between two exceedances: 0.514 s.
6720 Hz	0.24 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 6720 Hz 3dB bandwidth: 124 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: **s. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.016 seconds. Minimum time between two exceedances: 0.514 s.
7200 Hz	0.24 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 7200 Hz 3dB bandwidth: 124 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: **s. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.016 seconds. Minimum time between two exceedances: 0.514 s.

*The nearest standard order in the evaluation method will be chosen to match the 3 dB deployment points.

** Where the integration time to calculate the RMS value is not indicated, the duration of one cycle at the frequency of the considered circuit will be used.

The track circuit does not comply with the limits established by ERA/ERTMS 033281. The interference current limits considered for the current train detection system shall be those specified in EN 50238-2:2020, Annex A.

Table 13

EN 50238-2:2020			
Frequency range	**Interference Current Limit [rms value]**	**Evaluation method**	**Evaluation parameters**
1533-1566 Hz	0.806 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 1549 Hz 3dB bandwidth: 12 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: 0.04 sec Time overlap: min 50% • Evaluation criteria: Maximum Time to Overcome: 0.04 sec
1682-1716 Hz	0.731 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 1699 Hz 3dB bandwidth: 12 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: 0.04 sec Time overlap: min 50% • Evaluation criteria: Maximum Time to Overcome: 0.04 sec
1831-1865 Hz	0.753 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 1848 Hz 3dB bandwidth: 12 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: 0.04 sec Time overlap: min 50% • Evaluation criteria: Maximum Time to Overcome: 0.04 sec
1979-2013 Hz	0.696 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 1996 Hz 3dB bandwidth: 12 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: 0.04 sec Time overlap: min 50% • Evaluation criteria: Maximum Time to Overcome: 0.04 sec

EN 50238-2:2020			
Frequency range	**Interference Current Limit [rms value]**	**Evaluation method**	**Evaluation parameters**
2129-2163 Hz	0.498 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 2146 Hz 3dB bandwidth: 12 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: 0.04 sec Time overlap: min 50% • Evaluation criteria: Maximum Time to Overcome: 0.04 sec
2279-2313 Hz	0.492 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 2296 Hz 3dB bandwidth: 12 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: 0.04 sec Time overlap: min 50% • Evaluation criteria: Maximum Time to Overcome: 0.04 sec
2428-2462 Hz	0.44 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 2445 Hz 3dB bandwidth: 12 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: 0.04 sec Time overlap: min 50% • Evaluation criteria: Maximum Time to Overcome: 0.04 sec
2576-2610 Hz	0.416 A	Band-Pass Filter	• BP filter characteristics: Centre Frequency Range: 2593 Hz 3dB bandwidth: 12 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: 0.04 sec Time overlap: min 50% • Evaluation criteria: Maximum Time to Overcome: 0.04 sec

*The nearest standard order in the evaluation method will be chosen to match the 3 dB deployment points.

The track circuit does not comply with the limits established by ERA/ERTMS 033281. The interference current limits considered for the current train detection system shall be those specified in EN 50238-2:2020, Annex A.

Table 14: Open Line Frequency Double Rail Track Circuit Limit for of in-band frequencies

Frequency range	Interference current limit [RMS Value]	Evaluation method	Evaluation parameters
1544-1554 Hz	0.953 [A]	FFT	Time window 1 sec, Hanning window, 50% overlap
1694-1704 Hz	0.936 [A]	FFT	Time window 1 sec, Hanning window, 50% overlap
1843-1853Hz	0.810 [A]	FFT	Time window 1 sec, Hanning window, 50% overlap
1991-2001 Hz	0.778 [A]	FFT	Time window 1 sec, Hanning window, 50% overlap
2141-2151 Hz	0.663 [A]	FFT	Time window 1 sec, Hanning window, 50% overlap
2291-2301 Hz	0.628 [A]	FFT	Time window 1 sec, Hanning window, 50% overlap
2440-2450 Hz	0.545 [A]	FFT	Time window 1 sec, Hanning window, 50% overlap
2588-2598 Hz	0.547 [A]	FFT	Time window 1 sec, Hanning window, 50% overlap

Table 15: Open Line Frequency Double Rail Track Circuit Limit for out of band frequencies

Frequency Range 1	Frequency Range 2	Interference current limit [RMS Value]	Evaluation method	Evaluation parameters
1506-1543 Hz	1554-1594 Hz	2,383 A	FFT	Time window 1 sec, Hanning window, 50% overlap
1656-1693 Hz	1705-1744 Hz	2,340 A	FFT	Time window 1 sec, Hanning window, 50% overlap
1806-1842 Hz	1854-1894 Hz	2,025 A	FFT	Time window 1 sec, Hanning window, 50% overlap
1956-1990 Hz	2002-204 Hz	1.945 A	FFT	Time window 1 sec, Hanning window, 50% overlap
2106-2140 Hz	2152-2194 Hz	1,658 A	FFT	Time window 1 sec, Hanning window, 50% overlap
2246-2290 Hz	2302-2344 Hz	1,570 A	FFT	Time window 1 sec, Hanning window, 50% overlap
2406-2439 Hz	2451-2494 Hz	1,363 A	FFT	Time window 1 sec, Hanning window, 50% overlap
2546-2587 Hz	2599-264 Hz	1,368 A	FFT	Time window 1 sec, Hanning window, 50% overlap

Table 16: Station Area Frequency Double Rail Track Circuit Limit

Frequency Channel	In-band 50Hz harmonic ± range	Interference current limit [RMS Value]	Evaluation method	Evaluation parameters
F5	5700 ± 35	1,081 A	FFT	Time window 1 sec, Hanning window, 50% overlap
F1	6100 ± 35	1,073 A	FFT	Time window 1 sec, Hanning window, 50% overlap
F7	6500 ± 35	1.052 A	FFT	Time window 1 sec, Hanning window, 50% overlap
F3	6900 ± 35	1.062 A	FFT	Time window 1 sec, Hanning window, 50% overlap
F6	7300 ± 35	1,046 A	FFT	Time window 1 sec, Hanning window, 50% overlap
F2	7700 ± 35	1.058 A	FFT	Time window 1 sec, Hanning window, 50% overlap
F8	8100 ± 35	1,053 A	FFT	Time window 1 sec, Hanning window, 50% overlap
F4	8500 ± 35	1,149 A	FFT	Time window 1 sec, Hanning window, 50% overlap

The track circuit does not comply with the limits established by ERA/ERTMS 033281. The interference current limits considered for the current train detection system shall be those specified in EN 50238-2:2020, Annex A.

Table 17

EN 50238-2:2020			
Frequency range	**Interference Current Limit [rms value]**	**Evaluation method**	**Evaluation parameters**
1700 Hz	0.3 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 1700 Hz 3dB bandwidth: 90 Hz Butterworth, order 2· N= 6 • RMS Calculation: Integration Time: **sec Time overlap: min 50% • Evaluation criteria: Maximum Time to Overcome: 0.3 sec
2000 Hz	0.3 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 2000 Hz 3dB bandwidth: 90 Hz Butterworth, order 2· N= 6 • RMS Calculation: Integration Time: **sec Time overlap: min 50% • Evaluation criteria: Maximum Time to Overcome: 0.3 sec
2300 Hz	0.3 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 2300 Hz 3dB bandwidth: 90 Hz Butterworth, order 2· N= 6 • RMS Calculation: Integration Time: **sec Time overlap: min 50% • Evaluation criteria: Maximum Time to Overcome: 0.3 sec
2600 Hz	0.3 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 2600 Hz 3dB bandwidth: 90 Hz Butterworth, order 2· N= 6 • RMS Calculation: Integration Time: **sec Time overlap: min 50% • Evaluation criteria: Maximum Time to Overcome: 0.3 sec

** Where the integration time to calculate the RMS value is not indicated, the duration of one cycle at the frequency of the considered circuit will be used.

3.2.2.2.2.-DC (3 kV, 1.5 kV) Electromagnetic interference limits

FS 2000/5000

The track circuit does not comply with the limits established by ERA/ERTMS 033281. The interference current limits considered for the current train detection system shall be those specified in EN 50238-2:2020, Annex A.

Table 18

Frequency range	Interference Current Limit [rms value]	Evaluation method	Evaluation parameters
1682-1716 Hz	3.7 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 1699 Hz 3dB bandwidth: 50 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: 0.21 sec. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.016 seconds.
1984-2018-Hz	3.2 A	Band-Pass Filter	• BP filter characteristics: Centre Frequency Range: 2001 Hz 3dB bandwidth: 50 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: 0.21 sec. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.016 seconds.
2282-2316 Hz	3.3 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 2299 Hz 3dB bandwidth: 50 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: 0.21 sec. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.016 seconds.
2584-2618Hz	2.8 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 2601 Hz 3dB bandwidth: 50 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: 0.21 sec. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.016 seconds. Minimum time between two exceedances: 0.88 s.

Frequency range	Interference Current Limit [rms value]	Evaluation method	Evaluation parameters
4040-4120 Hz	0.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 4080 Hz 3dB bandwidth: 160 Hz Butterworth, order 2· N= * • RMS Calculation: Integration time: 0.4 sec. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.04 s. Minimum time between two exceedances: 0.88 s.
4280-4360 Hz	0.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 4320 Hz 3dB bandwidth: 160 Hz Butterworth, order 2· N= * • RMS Calculation: Integration time: 0.4 sec. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.04 s. Minimum time between two exceedances: 0.88 s.
4520-4600 Hz	0.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 4560 Hz 3dB bandwidth: 160 Hz Butterworth, order 2· N= * • RMS Calculation: Integration time: 0.4 sec. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.04 s. Minimum time between two exceedances: 0.88 s.
5000-5080 Hz	0.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 5040 Hz 3dB bandwidth: 160 Hz Butterworth, order 2· N= * • RMS Calculation: Integration time: 0.4 sec. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.04 s. Minimum time between two exceedances: 0.88 s.

Frequency range	Interference Current Limit [rms value]	Evaluation method	Evaluation parameters
5240-5320 Hz	0.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 5280 Hz 3dB bandwidth: 160 Hz Butterworth, order 2· N= * • RMS Calculation: Integration time: 0.4 sec. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.04 s. Minimum time between two exceedances: 0.88 s.
5480-5560 Hz	0.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 5520 Hz 3dB bandwidth: 160 Hz Butterworth, order 2· N= * • RMS Calculation: Integration time: 0.4 sec. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.04 s. Minimum time between two exceedances: 0.88 s.
5960-6040 Hz	0.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 6000 Hz 3dB bandwidth: 160 Hz Butterworth, order 2· N= * • RMS Calculation: Integration time: 0.4 sec. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.04 s. Minimum time between two exceedances: 0.88 s.

*The nearest standard order in the evaluation method will be chosen to match the 3 dB deployment points.

The track circuit does not comply with the limits set by ERA/ERTMS 033281. The interference current limits considered for the current train detection system shall be those specified in EN 50238-2:2020, Annex A

Table 19

Frequency range	Interference Current Limit [rms value]	Evaluation method	Evaluation parameters
4080 Hz	0.66 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 4080 Hz 3dB bandwidth: 124 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: **s. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.016 seconds. Minimum time between two exceedances: 0.514 s.
4320 Hz	0.59 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 4320 Hz 3dB bandwidth: 124 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: **s. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.016 seconds. Minimum time between two exceedances: 0.514 s.
4560 Hz	0.52 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 4560 Hz 3dB bandwidth: 124 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: **s. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.016 seconds. Minimum time between two exceedances: 0.514 s.
5040 Hz	0.66 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 5040 Hz 3dB bandwidth: 124 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: **s. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.016 seconds. Minimum time between two exceedances: 0.514 s.

Frequency range	Interference Current Limit [rms value]	Evaluation method	Evaluation parameters
5280 Hz	0.34 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 5280 Hz 3dB bandwidth: 124 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: **s. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.016 seconds. Minimum time between two exceedances: 0.514 s.
5520 Hz	0.32 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 5520 Hz 3dB bandwidth: 124 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: **s. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.016 seconds. Minimum time between two exceedances: 0.514 s.
6000 Hz	0.31 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 6000 Hz 3dB bandwidth: 124 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: **s. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.016 seconds. Minimum time between two exceedances: 0.514 s.
6480 Hz	0.28 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 6480 Hz 3dB bandwidth: 124 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: **s. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.016 seconds. Minimum time between two exceedances: 0.514 s.

Frequency range	Interference Current Limit [rms value]	Evaluation method	Evaluation parameters
6720 Hz	0.27 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 6720 Hz 3dB bandwidth: 124 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: **s. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.016 seconds. Minimum time between two exceedances: 0.514 s.
7200 Hz	0.26 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 7200 Hz 3dB bandwidth: 124 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: **s. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.016 seconds. Minimum time between two exceedances: 0.514 s.

*The nearest standard order in the evaluation method will be chosen to match the 3 dB deployment points.

** Where the integration time to calculate the RMS value is not indicated, the duration of one cycle at the frequency of the considered circuit will be used.

DSA 50 HZ

The track circuit does not comply with the limits established by ERA/ERTMS 033281. The interference current limits considered for this train detection system will be those specified in the national standard Order TMA 576:2020.

Table 20

Frequency Range	Interference Current Limit [rms value]	Evaluation method	Evaluation parameters
50 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 50 Hz 3dB bandwidth: 2 Hz Butterworth, order 2· N= * • RMS Calculation: Integration time: 0.02 sec. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.2 seconds.

*The nearest standard order in the evaluation method will be chosen to match the 3 dB deployment points.

50 HZ ALCATEL-MARCONI

The track circuit does not comply with the limits set by ERA/ERTMS 033281. The interference current limits considered for this train detection system will be those specified in the national standard Order TMA 576:2020.

Table 22

Frequency Range	Interference Current Limit [rms value]	Evaluation method	Evaluation parameters
50 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 50 Hz 3dB bandwidth: 2 Hz Butterworth, order 2· N= * • RMS Calculation: Integration time: 0.02 sec. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.2 seconds.

*The nearest standard order in the evaluation method will be chosen to match the 3 dB deployment points.

This track circuit does not comply with the limits set by ERA/ERTMS 033281. The interference current limits considered for the current train detection system shall be those specified in EN 50238-2:2020, Annex A.

Table 23

EN 50238-2:2020			
Frequency range	**Interference Current Limit [rms value]**	**Evaluation method**	**Evaluation parameters**
1533-1566 Hz	0.134 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 1549 Hz 3dB bandwidth: 12 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: 2 sec Time overlap: min 50% • Evaluation criteria: Maximum Time to Overcome: 0.04 sec
1682-1716 Hz	0.101 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 1699 Hz 3dB bandwidth: 12 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: 2 sec Time overlap: min 50% • Evaluation criteria: Maximum Time to Overcome: 0.04 sec
1831-1865 Hz	0.142 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 1848 Hz 3dB bandwidth: 12 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: 2 sec Time overlap: min 50% • Evaluation criteria: Maximum Time to Overcome: 0.04 sec
1979-2013 Hz	0.091 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 1996 Hz 3dB bandwidth: 12 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: 2 sec Time overlap: min 50% • Evaluation criteria: Maximum Time to Overcome: 0.04 sec

EN 50238-2:2020			
Frequency range	**Interference Current Limit [rms value]**	**Evaluation method**	**Evaluation parameters**
2129-2163 Hz	0.148 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 2146 Hz 3dB bandwidth: 12 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: 2 sec Time overlap: min 50% • Evaluation criteria: Maximum Time to Overcome: 0.04 sec
2279-2313 Hz	0.132 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 2296 Hz 3dB bandwidth: 12 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: 2 sec Time overlap: min 50% • Evaluation criteria: Maximum Time to Overcome: 0.04 sec
2428-2462 Hz	0.143 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 2445 Hz 3dB bandwidth: 12 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: 2 sec Time overlap: min 50% • Evaluation criteria: Maximum Time to Overcome: 0.04 sec
2576-2610 Hz	0.167 A	Band-Pass Filter	• BP filter characteristics: Centre Frequency Range: 2593 Hz 3dB bandwidth: 12 Hz Butterworth, order 2· N= * • RMS Calculation: Integration Time: 2 sec Time overlap: min 50% • Evaluation criteria: Maximum Time to Overcome: 0.04 sec

*The nearest standard order in the evaluation method will be chosen to match the 3 dB deployment points.

The track circuit complies with the limits established by ERA/ERTMS 033281. The interference current limits considered for the present train detection system will be those specified in the standard EN 50238-2:2020, Annex A.

Table 24: EBITRACK 400:3kv CC. Open Line Frequency Double Rail Track Circuit Limit for of in-band frequencies

EN 50238-2:2020			
Frequency range	**Interference Current Limit [rms value]**	**Evaluation method**	**Evaluation parameters**
1544-1554 Hz	**0.953 [A]**	**FFT**	• **Time window 1s** • **Hanning window** • 50% overlap
1694-1704 Hz	**0.936 [A]**	**FFT**	• **Time window 1s** • **Hanning window** • 50% overlap
1843-1853Hz	**0.810 [A]**	**FFT**	• **Time window 1s** • **Hanning window** • 50% overlap
1991-2001 Hz	**0.778 [A]**	**FFT**	• **Time window 1s** • **Hanning window** • 50% overlap
2141-2151 Hz	**0.663 [A]**	**FFT**	• **Time window 1s** • **Hanning window** • 50% overlap
2291-2301 Hz	**0.628 [A]**	**FFT**	• **Time window 1s** • **Hanning window** • 50% overlap
2440-2450 Hz	**0.545 [A]**	**FFT**	• **Time window 1s** • **Hanning window** • 50% overlap
2588-2598 Hz	**0.547 [A]**	**FFT**	• **Time window 1s** • **Hanning window** • 50% overlap

Table 25: EBITRACK 400 3kv DC: Open Line Frequency Double Rail Track Circuit Limit for out of band frequencies

EN 50238-2:2020			
Frequency range	**Interference Current Limit [rms value]**	**Evaluation method**	**Evaluation parameters**
1554-1594 Hz	**2,383 A**	**FFT**	• **Time window 1s** • **Hanning window** • 50% overlap
1705-1744 Hz	**2,340 A**	**FFT**	• **Time window 1s** • **Hanning window** • 50% overlap
1854-1894 Hz	**2,025 A**	**FFT**	• **Time window 1s** • **Hanning window** • 50% overlap
2002-2044 Hz	**1.945 A**	**FFT**	• **Time window 1s** • **Hanning window** • 50% overlap
2152-2194 Hz	**1,658 A**	**FFT**	• **Time window 1s** • **Hanning window** • 50% overlap
2302-2344 Hz	**1,570 A**	**FFT**	• **Time window 1s** • **Hanning window** • 50% overlap
2451-2494 Hz	**1,363 A**	**FFT**	• **Time window 1s** • **Hanning window** • 50% overlap
2599-2644 Hz	**1,368 A**	**FFT**	• **Time window 1s** • **Hanning window** • 50% overlap

Table 26: EBITRACK 400 3kv DC. Station Area Frequency Double Rail Track Circuit Limit

EN 50238-2:2020			
Frequency range	**Interference Current Limit [rms value]**	**Evaluation method**	**Evaluation parameters**
5665-5735 Hz	**1,081 A**	**FFT**	• **Time window 1s** • **Hanning window** • 50% overlap
6065-6135 Hz	**1,073 A**	**FFT**	• **Time window 1s** • **Hanning window** • 50% overlap
6465-6535 Hz	**1.052 A**	**FFT**	• **Time window 1s** • **Hanning window** • 50% overlap

EN 50238-2:2020			
Frequency range	**Interference Current Limit [rms value]**	**Evaluation method**	**Evaluation parameters**
6865-6935 Hz	1.062 A	FFT	• Time window 1s • Hanning window • 50% overlap
7265-7335 Hz	1,046 A	FFT	• Time window 1s • Hanning window • 50% overlap
7665-7735 Hz	1.058 A	FFT	• Time window 1s • Hanning window • 50% overlap
8065-8135 Hz	1,053 A	FFT	• Time window 1s • Hanning window • 50% overlap
8465-8535 Hz	1,149 A	FFT	• Time window 1s • Hanning window • 50% overlap

50 HZ ERICSSON-ADTRANZ

The track circuit does not comply with the limits established by ERA/ERTMS 033281. The interference current limits considered for this train detection system will be those specified in the national standard Order TMA 576:2020.

Table 27

Frequency Range	**Interference Current Limit [rms value]**	**Evaluation method**	**Evaluation parameters**
50 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 50 Hz 3dB bandwidth: 2 Hz Butterworth, order 2· N= * • RMS Calculation: Integration time: 0.02 sec. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.2 seconds.

*The nearest standard order in the evaluation method will be chosen to match the 3 dB deployment points.

GRS

GRS is an ATP-coded track circuit. This track circuit does not comply with the limits set by ERA/ERTMS 033281. The interference current limits considered for the current train detection system shall be those specified in EN 50238-2:2020, Annex A.

Table 28

Frequency Range	Interference Current Limit [rms value]	Evaluation method	Evaluation parameters
75 Hz	0.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 57 Hz 3dB bandwidth: 20 Hz Butterworth, order 2 * N = 6 • RMS Calculation: Integration time: 0.2 sec. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.2 seconds. Minimum time between two exceedances: 1.7 s.
225 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 225 Hz 3dB bandwidth: 20 Hz Butterworth, order 2 * N = 6 • RMS Calculation: Integration time: 0.2 sec. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.2 seconds. Minimum time between two exceedances: 1.7 s.
375 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 375 Hz 3dB bandwidth: 20 Hz Butterworth, order 2 * N = 6 • RMS Calculation: Integration time: 0.2 sec. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.2 seconds. Minimum time between two exceedances: 1.7 s.
525 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 525 Hz 3dB bandwidth: 20 Hz Butterworth, order 2 * N = 6 • RMS Calculation: Integration time: 0.2 sec. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.2 seconds. Minimum time between two exceedances: 1.7 s.

Frequency Range	Interference Current Limit [rms value]	Evaluation method	Evaluation parameters
675 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 675 Hz 3dB bandwidth: 20 Hz Butterworth, order 2 * N = 6 • RMS Calculation: Integration time: 0.2 sec. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.2 seconds. Minimum time between two exceedances: 1.7 s.

50 HZ ENYSE

The track circuit does not comply with the limits established by ERA/ERTMS 033281. The interference current limits considered for this train detection system will be those specified in the national standard Order TMA 576:2020.

Table 29

Frequency Range	Interference Current Limit [rms value]	Evaluation method	Evaluation parameters
50 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequency range: 50 Hz 3dB bandwidth: 2 Hz Butterworth, order 2· N= * • RMS Calculation: Integration time: 0.02 sec. Time overlap: min 50% • Evaluation criteria: Maximum time to exceedance: 0.2 seconds.

*The nearest standard order in the evaluation method will be chosen to match the 3 dB deployment points.

3.2.2.3.-Measurement, Test, and Evaluation Specification

The measurements have been provided by the respective suppliers of train detection systems, taking into account the specifications of the prEN50728:2022 standard and the data provided by currently in force standards such as EN 50238-2:2020, Annex A, and the national standard Order 576/2022. Any significant discrepancy in the measurement parameters has been considered a reason for non-compliance, as it makes it impossible to correctly assess compatibility with the limits imposed by the ERA/ERTMS standard 033281 v.5.

The same applies to train detection systems that lack information on limits, such as those based on 50 Hz track circuits, for which a special warning is made about non-compliance due to the absence of interference current limit values. In these cases, we will consider that they do not admit any induced current to ensure their correct operation.

ANNEX 1: NUMBER OF NON-COMPLIANT TRAIN DETECTION SYSTEMS PRESENT IN THE SPANISH RAILWAY NETWORK

SUPPLIER	*SDT*	*PRODUCT NAME*	*SECTIONS*			
			0	*1.5 Kv DC*	*3 Kv DC*	*25 kV 50 Hz*
SIEMENS	TC	FS 2000/5000	*169*	*0*	*1682*	*2*
	TC	FS3000	*149*	*0*	*2291*	*1207*
	TC	DSA 50 Hz (DIMETRONIC)	*21*	*0*	*1297*	0
THALES	TC	50 Hz (ALCATEL-MARCONI)	*18*	*0*	*614*	*0*
	AC	SIG. L90	*813*			
	AC	RSL	*242*			
HITACHI	TC	UM71-2000	*11*	*0*	*0*	*1505*
FRAUSCHER	*AC*	RSR122	*201*			
ALSTOM	TC	TI21 I-M	*20*	*0*	*1657*	*124*
	TC	EBITRACK 400	*0*	*0*	*160*	*133*
	TC	50 Hz (ERICSSON-ADTRANZ)	*43*	*0*	*1257*	*0*
	TC	GRS	*34*	*0*	*391*	*57*
ELECTRANS	*AC*	DEF-87-CE (E-CE-95)	*1244*			
ENYSE	TC	50 Hz	*35*	*0*	*535*	*0*

TOTAL: 15,912 Train Detection Systems

ANNEX 2: DETECTION SYSTEMS NOT APPLICABLE TO THE STUDY

JUSTIFICATION

The train detection systems used in the Spanish railway network are characterised by their variety, versatility and functionality. Therefore, the diversity of products active today covers a wide range of technologies, applications, and suppliers. Within this variety, the presence of detection systems with a discrete and localized presence is noteworthy, in most cases far from the main international railway connection lines and which, in some way, have served as precursors to the systems currently deployed.

Carrying out a compatibility study of these systems, considered "singular", could be considered an unnecessary deployment of resources, since their consistency will not be certified in the future due to the null replicability declared by the supplier companies.

For this reason, these systems are listed and located in this Annex, with the aim of considering them from an anecdotal point of view and highlighting their unjustified incompatibility given the remote possibilities of interoperability of the secondary lines where they are present.

SYSTEMS

SUPPLIER	*TDS*	*PRODUCT NAME*	*SECTIONS*			
			0	*1.5 kV DC*	*3 kV DC*	*25 kV 50 Hz*
SIEMENS	TC	*SSA 50 Hz*	*34*	*0*	*0*	3
HITACHI	*AC*	CLX	*3*			
REVENGE	*AC*	CV AXLE COUNTER ISLAND	*1*			
	TC	ISLAND AUDIO FREQUENCY CV	*1*	*0*	*0*	*0*
ALSTOM	TC	SJ-24S	1	*0*	*0*	*0*
ELECTRANS	TC	ME 3015/ME 3047	0	*0*	1	*0*

LOCATION

SIEMENS – SSA 50 Hz

Main Line	Line	Line Code	Route	Sections
A.V. MADRID CHAMARTÍN – VALLADOLID – PALENCIA – LEÓN	BIF. VENTA DE BAÑOS – LEON	084	BIF. LAS ARENAS-BIF. VILECHA	1
			BIF. CAMB. VILECHA-BIF. MUNICIPAL STADIUM	1
			BIF. ESTADIO MUNICIPAL-LEÓN	1
MADRID ATOCHA -CÁCERES-VALENCIA DE ALCÁNTARA	BIF. PLANETARIUM – BIF. CASA DE LA TORRE	500	ILLESCAS-VILLALUENGA-YUNCLER	5
			TORRIJOS-TALAVERA DE LA REINA	15
			VILLALUENGA-YUNCLER-TORRIJAS	14

HITACHI – CLX

Main Line	Line	Line Code	Route	Sections
VENTA DE BAÑOS-LEON-ORENSE-VIGO	LEÓN – A CORUÑA	800	Baamonde and Guitiriz Level Crossings	2
ALCAZAR DE SAN JUAN-CORDOBA-SEVILLE-CADIZ	MÉRIDA – LOS ROSALES	516	Calamonte Level Crossing	1

REVENGA INGENIEROS Track Circuit

Main Line	Line	Line Code	Route	Sections
01 – MADRID-CHAMARTÍN-CLARA CAMPOAMOR – IRUN /HENDAYE	Intermodal Abando Ind. Prieto – Casetas (Ribera Alta)	700	Level crossing PK 156/197	1

REVENGA INGENIEROS Axle Counter

Main Line	Line	Line Code	Route	Sections
MADRID CHAMARTIN – VALENCIA-SAN VICENTE DE CALDERS	ALICANTE – EL REGUERÓN	336	Level crossing PK 5/868	1

SJ24S

Main Line	Line	Line Code	Route	Sections
ALCAZAR DE SAN JUAN-CORDOBA-SEVILLE-CADIZ	BIF. LAS MARAVILLAS-BIF. RIO FRIO	460	Level Crossing 35/657	1

ME 3015/ME 3047

Main Line	Line	Line Code	Route	Sections
MADRID - BARCELONA	JADRAQUE – CARRASCOSA DE HENARES	200	Level crossing 104/045	1