DOCUMENTACIÓN TÉCNICA SISTEMAS DE DETECCIÓN DE TREN CONFORMES ETI

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TABLA DE CONTENIDOS **PÁGINA**

1.-INTRODUCCIÓN

El 28 de septiembre de 2023 entraron en vigor importantes cambios normativos en relación con la Especificación Técnica de Interoperabilidad (ETI) de los Subsistemas de Control-Mando y Señalización del sistema ferroviario de la Unión Europea. Estas amplias revisiones de las distintas ETI tienen por objeto seguir avanzando en la interoperabilidad del sistema ferroviario europeo, mejorar la digitalización del sector y promover el transporte ferroviario de mercancías.

El pasado 10 de noviembre de 2023 se recibió comunicación de la Agencia Española de Seguridad Ferroviaria (AESF), entidad responsable de las funciones relacionadas con la interoperabilidad del sistema ferroviario español, en la que se informaba a las distintas entidades del sector ferroviario de las actuaciones que debían adoptarse para cumplir con las nuevas obligaciones y el plazo para hacerlo. En particular, se destacan las medidas más importantes que deben adoptarse tras la entrada en vigor de los textos modificados antes mencionados. Entre ellas se encuentran:

- **Compatibilidad de los sistemas de detección de trenes no conformes con la ETI de CAC.**

De conformidad con el artículo 13.1 del Reglamento de Ejecución (UE) 2023/1695 de la Comisión (nueva ETI de CAC), los Estados miembros cuyos administradores de infraestructuras exploten sistemas de detección de tren que no cumplan con el Reglamento deben solicitar un caso específico y notificar a la Agencia Ferroviaria de la UE (EUAR) lo siguiente:

a. Los límites de corriente de interferencia para los circuitos de vía, en particular los métodos de evaluación y la impedancia del vehículo, de conformidad con la cláusula 3.2.2 del documento ERA/ERTMS/033281 v5.

b. Los límites de campo de frecuencias para los contadores de ejes en los ejes X, Y y Z, en particular los métodos de evaluación de acuerdo con la cláusula 3.2.1 del documento ERA/ERTMS/033281 v5.

c. Casos específicos de sistemas de detección de tren no conformes que utilicen la plantilla mencionada en el anexo B.1 del documento ERA/ERTMS 033281 v5.

ADIF cumple con este requisito con el documento ERA-TDC-MS-ES.

- **Compatibilidad de los sistemas de detección de trenes conformes con la ETI de CAC.**

De conformidad con el artículo 13, apartado 2, del Reglamento de Ejecución (UE) 2023/1695 de la Comisión (nueva ETI), los administradores de infraestructuras informarán a la EUAR de los límites de corriente de interferencia necesarios o de la gestión de frecuencias para los sistemas de detección de tren conformes con la ETI, tal como se especifica en las secciones 3.2.2.1 a 3.2.2.6 del documento ERA/ERTMS/033281 v5 para sus redes pertinentes.

Con anterioridad a la recepción de esta comunicación, la Subdirección de Instalaciones de ADIF, siguiendo las mismas premisas recogidas en el artículo 13 de la citada ETI de CAC, inició una serie de contactos con todas las empresas tecnológicas proveedoras de Sistemas de Detección de Tren, solicitando los datos requeridos y acordando una hoja de ruta que marcará los hitos a cumplir para la correcta recogida de la información.

Por lo tanto, el primer paso es el análisis, clasificación y ubicación de todos los contadores de ejes y circuitos de vía presentes en la RFIG, indicando el cumplimiento de la ETI CCS 2023, la previsión de certificación frente a dicha norma, la solicitud de una excepción para aquellos casos en los que no se prevea dicho cumplimiento, y la delimitación de los límites de frecuencia y corriente inducida para el correcto funcionamiento de los sistemas compatibles con la ETI.

ADIF cumple con este punto en el presente documento donde, en su Anexo 1, incluye todos los certificados de interoperabilidad para los sistemas de contadores de ejes descritos en este documento, a excepción de los que a fecha en la fecha de redacción del presente documento aún no han sido expedidos, pero cuyo informe intermedio ha resultado favirable.

Igualmente, en el Anexo 2 se detalla la comparativa de los límites de compatibilidad electromagnética, los parámetros de evaluación y sus criterios de aceptación.

2.-ALCANCE

El presente documento tiene por objeto enumerar la gestión de frecuencias y los límites de corriente de todos los sistemas de detección de tren (circuitos de vía y contadores de ejes) presentes en las líneas sujetas a interoperabilidad instaladas en el Estado miembro **España (ES),** excluida la red de ancho métrico y las líneas gestionadas por las autoridades portuarias.

Los requisitos de este documento garantizan la compatibilidad con los parámetros descritos en ERA/ERTMS/033281 v5 de los siguientes sistemas de detección de tren:

Tabla 01

TECNOLOGÍA	Sistema	*SDT*	*Distancias entre ejes*					*Geometría de la rueda*						*Otros parámetros*						*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	FTG 46	CdV	✓		✓	✓	✓							✓	✓	✓	✓	✓	✓		✓
	FTG 917	CdV	✓		✓	✓	✓							✓	✓	✓	✓	✓	✓		✓
	TCM100	CdV	✓		✓	✓	✓							✓	✓	✓	✓	✓	✓		✓
	ACM 250	CdE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓							✓	
THALES	TTC	CdV	✓		✓	✓	✓							✓	✓	✓	✓	✓	✓		✓
	AZLM	CdE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓							✓	
ALSTOM	ITE JS (HVI)	CdV	✓		✓	✓	✓							✓	✓	✓	✓	✓	✓		✓
	DIGICODE	CdV	✓		✓	✓	✓							✓	✓	✓	✓	✓	✓		✓
	STDS	CdV	✓		✓	✓	✓							✓	✓	✓	✓	✓	✓		✓
FRAUSCHER	RSR 123	CdE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓							✓	
	RSR 180	CdE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓							✓	
ELECTRANS	EAC-214-PLUS	CdE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓							✓	
	ME 3091/ME 5091	CdV	✓		✓	✓	✓							✓	✓	✓	✓	✓	✓		✓
ICF	AC900	CdE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓							✓	

✓	Cumple con v5
✓	Informe intermedio favorable. En espera de certificación
✗	No cumple o cumple parcialmente con V5
	No es relevante para este sistema

3.-REFERENCIAS NORMATIVAS

- Reglamento de Ejecución (UE) 2023/1693 de la Comisión, de 10 de agosto de 2023, por el que se modifica el Reglamento de Ejecución (UE) 2019/773, relativo a la especificación técnica de interoperabilidad relativa al subsistema «explotación y gestión del tráfico» del sistema ferroviario de la Unión Europea.

- Reglamento de Ejecución (UE) 2023/1694 de la Comisión, de 10 de agosto de 2023, por el que se modifican los Reglamentos (UE) Nº 321/2013, (UE) Nº 1299/2014, (UE) Nº 1300/2014, (UE) Nº 1301/2014, (UE) Nº 1302/2014 y (UE) Nº 1304/2014, y el Reglamento de Ejecución (UE) 2019/777.

- Reglamento de Ejecución (UE) 2023/1695 de la Comisión, de 10 de agosto de 2023, sobre la especificación técnica de interoperabilidad relativa a los subsistemas de control-mando y señalización del sistema ferroviario de la Unión Europea, y por el que se deroga el Reglamento (UE) 2016/919.

- Decisión de Ejecución (UE) 2023/1696 de la Comisión, de 10 de agosto de 2023, por la que se modifica la Decisión de Ejecución 2011/665/UE relativa al pliego de condiciones del registro europeo de tipos de vehículos autorizados a que se refiere el artículo 48 de la Directiva (UE) 2016/797 del Parlamento Europeo y del Consejo.

- UNE-CLC/TS 50238-1:2020. Aplicaciones ferroviarias. Compatibilidad entre material rodante y sistemas de detección de trenes. Parte 1: Generalidades.

- UNE-CLC/TS 50238-2:2020. Aplicaciones ferroviarias. Compatibilidad entre material rodante y sistemas de detección de trenes. Parte 2: Compatibilidad con circuitos de vía.

- UNE-CLC/TS 50238-3:2022. Aplicaciones ferroviarias. Compatibilidad entre material rodante y sistemas de detección de trenes. Parte 3: Compatibilidad con contadores de ejes (Ratificado por la Asociación Española de Normalización en febrero de 2022).

- Orden TMA/576/2020, de 22 de junio, por la que se aprueba la "Instrucción Ferroviaria: Especificaciones técnicas del material rodante ferroviario para la puesta en servicio de unidades autopropulsadas, locomotoras y coches (IF MR ALC-20)".

- PNE-prEN 50728:2022. Aplicaciones ferroviarias. Material rodante. Ensayos de compatibilidad electromagnética con circuitos de vía.

- UNE-EN 50592:2017. Aplicaciones ferroviarias. Ensayos de compatibilidad electromagnética del material rodante con los contadores de ejes.

4.-COMPATIBILIDAD ELECTROMAGNÉTICA

4.1.-CAMPOS ELECTROMAGNÉTICOS

4.1.1.-Gestión de frecuencias

Se da cumplimiento con la norma ERA/ERTMS/033281 versión 5 (ancho de vía de 1668 mm y 1435 mm), válido para todos los sistemas de detección de tren descritos en este documento.

Los contadores de ejes que se relacionan a continuación, se encuentran actualmente en operación en la red de infraestructuras ferroviarias españolas, siendo sus límites de gestión de frecuencias descritos en los apartados siguientes:

4.1.1.1.-ACM250

Este sistema está en proceso de certificación contra ERA/ERTMS/033281 v5 (ancho de vía de 1668 mm y 1435 mm). Los límites de gestión de frecuencias considerados para el presente sistema de detección de trenes han sido especificados y documentados por la empresa que presta soporte técnico al sistema (SIEMENS).

Está equipado con sensores contadores de ejes modelo **ZPD43/ZPD43I** con límites de gestión de frecuencia descritos en la Tabla 01:

Tabla 01

Banda	Gama de frecuencias definida por la frecuencia central [kHz]	Límite de emisión Eje X [dBµA/m] (RMS)	Límite de emisión Eje Y [dBµA/m] (RMS)	Límite de emisión Eje Z [dBµA/m] (RMS)	Método de evaluación	Orden de filtrado (Butterworth) y ancho de banda de 3 dB [Hz]	Parámetros de evaluación [ms]
Banda 1	42.98	109	94	107	BP	2º ± 160 Hz	Tiempo de integración: 1.8

4.1.1.2.-AZLM

El sistema cumple con los límites establecidos por ERA/ERTMS 033281 v.5. Los límites de gestión de frecuencias considerados para el presente sistema de detección de trenes han sido especificados por la empresa que presta soporte técnico al sistema (THALES-HITACHI).

Equipado con sensores de contador de ejes modelo **Zp30H/Zp30K** con límites de gestión de frecuencia descritos en la Tabla 02:

Tabla 02

Banda	Gama de frecuencias definida por la frecuencia central [kHz]	Límite de emisión Eje X [dBµA/m] (RMS)	Límite de emisión Eje Y [dBµA/m] (RMS)	Límite de emisión Eje Z [dBµA/m] (RMS)	Método de evaluación	Orden de filtrado (Butterworth) y ancho de banda de 3 dB [Hz]	Parámetros de evaluación [ms]
Banda 1	27.0 bis 32.0	114	94	101	BP	4º ± 120 / ±450	Tiempo de integración: 4

4.1.1.3.-RSR123

El sistema cumple con los límites establecidos por ERA/ERTMS 033281 v5. Los límites de gestión de frecuencias considerados para el presente sistema de detección de trenes serán los especificados en los datos facilitados por la empresa que da soporte técnico al sistema (PASCH Y CIA., S.A.U.).

Este sensor forma parte de sistemas de contador de ejes como los modelos **FAdC** o **ACS2000. Sus límites de gestión de frecuencias se describen en el Cuadro** 03:

Tabla 03

Tipo	Banda	Gama de frecuencias definida por la frecuencia central [kHz]	Límite de emisión Eje X [dBµA/m] (RMS)	Límite de emisión Eje Y [dBµA/m] (RMS)	Límite de emisión Eje Z [dBµA/m] (RMS)	Método de evaluación	Orden de filtrado (Butterworth) y ancho de banda de 3 dB	Parámetros de evaluación [ms]
SYS1	Banda 3	1000.0 - ± 1.0	120.5	114.5	114.5	BP	4 ±3.0	Tiempo de integración: 2
SYS2	Banda 3	1228.8 - ± 1.0	119.5	113.6	113.6	BP	4 ±3.0	Tiempo de integración: 2

4.1.1.4.-RSR180

El sistema cumple con los límites establecidos por ERA/ERTMS 033281 v5. Los límites de gestión de frecuencias considerados para el presente sistema de detección de trenes serán los especificados en los datos facilitados por la empresa que da soporte técnico al sistema (PASCH Y CIA., S.A.U.).

Este sensor forma parte de sistemas de contador de ejes como los modelos **FAdC** o **ACS2000**. Sus límites de gestión de frecuencias se describen en el Cuadro 04:

Tabla 04

Banda	Gama de frecuencias definida por la frecuencia central [kHz]	Límite de emisión Eje X [dBµA/m] (RMS)	Límite de emisión Eje Y [dBµA/m] (RMS)	Límite de emisión Eje Z [dBµA/m] (RMS)	Método de evaluación	Orden de filtrado (Butterworth) y ancho de banda de 3 dB	Parámetros de evaluación [ms]
Banda 2	250.0 - ± 1.0	121	113.8	101.0	BP	4 ±5.0	Tiempo de integración: 1.5214 s.

Rango de frecuencia	Dirección de campo	Aumento de los límites del campo magnético para un tiempo de integración reducido de 0,5 x Tint [dB]	Aumento de los límites de campo magnético para un tiempo de integración reducido de 0,25 x Tint [dB]
De 234 a 287 kHz	X, Y, Z	6	12

4.1.1.5.-AC900

El sistema contador de ejes cumple con los límites establecidos por ERA/ERTMS 033281 v5. Los límites de gestión de frecuencias considerados para el presente sistema de detección de trenes serán los especificados en los datos facilitados por la empresa que presta soporte técnico al sistema (INGENIERIA Y CONTROL FERROVIARIO S.A.).

Tabla 05

Banda	Gama de frecuencias definida por la frecuencia central [kHz]	Límite de emisión Eje X [dBµA/m] (RMS)	Límite de emisión Eje Y [dBµA/m] (RMS)	Límite de emisión Eje Z [dBµA/m] (RMS)	Método de evaluación	Orden de filtrado (Butterworth) y ancho de banda de 3 dB	Parámetros de evaluación [ms]
Fuera de banda	De 10 a 27 años	línea recta de 135 a 130 dB/log(f)	línea recta de 135 a 130 dB/log(f)	línea recta de 135 a 130 dB/log(f)	FFT		Tiempo de grabación 1 ms, ventana de Hanning, 50% de superposición, retención máxima
Banda 1	27 a 41,2 y 44,8 a 52	93	93	98	BP	4º orden 300 Hz	Tiempo de integración de superposición del 20% (puntos de 3 dB): 1 ms
Banda 1	De 41,2 a 44,8	93	93	98	BP	4º orden 320 Hz	Tiempo de integración de superposición del 20% (puntos 3dB):
Fuera de banda	De 52 a 234	130	130	130	FFT		Tiempo de grabación 1 ms, ventana de Hanning, 50% de superposición, retención máxima
Banda 2	De 234 a 287	120	99	100	BP	4º orden; 7500 Hz	20% de solapamiento (3 dB-puntos), tiempo de integración: 1,5 ms
Banda 2	De 287 a 363	109	99	91	BP	4º orden; 7500 Hz	20% de solapamiento (3 dB-puntos), tiempo de integración 1,5 ms
Fuera de banda	De 363 a 740	125	125	125	FFT		Tiempo de grabación 1 ms, ventana de Hanning, 50% de superposición, retención máxima
Banda 3	De 740 a 1026	106	85	101	BP	4º orden; 10 kHz	20% de solapamiento (3 dB-puntos), tiempo de integración: 1,5 ms
Banda 3	De 1026 a 1250	119	113	113	BP	4º orden; 10 kHz	20% de superposición (puntos de 3 dB), integración

4.1.1.6.-EAC-214-PLUS

Los estudios intermedios presentados por el fabricante (ELECTRANS) garantizan el cumplimiento de los límites establecidos por ERA/ERTMS 033281. Pendiente de la emisión de un informe por parte del organismo certificador.

4.1.2.-Especificación de medición, prueba y evaluación

Las mediciones han sido proporcionadas por los respectivos proveedores de sistemas de detección de trenes, teniendo en cuenta las especificaciones de la norma EN50592:2016 y los datos proporcionados por normas anteriores como la EN 50238-3:2020, Anexo A.

4.2.-INTERFERENCIA CONDUCIDA

4.2.1.-Impedancia del vehículo

En cuanto a la impedancia de los vehículos, en el marco legal español, la orden TMA 576/2020 ordena con carácter general que "cada unidad de influencia (unidad autopropulsada, locomotora de composición simple o coche con pantógrafo) debe tener una impedancia de entrada mínima de 2 Ω a 50 Hz".

NOTA: En la misma orden, más concretamente en el apartado 4.2.3.3.1.1, se especifica que para garantizar la compatibilidad con los sistemas de detección de trenes basados en circuitos de vía, "todo el material rodante de tracción eléctrica que circule por líneas de corriente continua dotadas de circuitos de vía de 50 Hz deberá estar equipado con un detector de 50 Hz que actuará sobre el sistema de tracción y el convertidor de servicios auxiliares cuando detecte, durante más de 2 segundos, un nivel de intensidad superior a 1,5 A RMS. El filtro equipado por el detector tendrá un ancho de banda máximo de ±2 Hz".

4.2.2.-Corriente de tracción: 25 kV AC, 50 Hz Límites de corriente de inducción electromagnética.

4.2.2.1.-FTGS

El circuito de vía, tanto en su modelo FTGS46 como en el FTGS917, cumple con los límites establecidos por ERA/ERTMS 033281 v5. Los límites de corriente de interferencia considerados para el actual sistema de detección de trenes serán los especificados en la norma EN 50238-2:2020, Anexo A.

Tabla 06: FTGS 46

Rango de frecuencia	Límite de corriente de interferencia [valor rms]	Método de evaluación	Parámetros de evaluación
4686–4814 Hz	1 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 4750 Hz Ancho de banda 3dB: 200 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg
5186-5314 Hz	1 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 5250 Hz Ancho de banda 3dB: 206 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg

Rango de frecuencia	Límite de corriente de interferencia [valor rms]	Método de evaluación	Parámetros de evaluación
5686-5814 Hz	1 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 5750 Hz Ancho de banda 3dB: 214 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg
6186-6314 Hz	1 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 6250 Hz Ancho de banda 3dB: 220 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg

** Cuando no se indique el tiempo de integración para calcular el valor RMS, se utilizará la duración de un ciclo a la frecuencia del circuito considerado.

Tabla 07: FTGS 917

Rango de frecuencia	Límite de corriente de interferencia [valor rms]	Método de evaluación	Parámetros de evaluación
9436-9564 Hz	0,33 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 9500 Hz Ancho de banda 3dB: 360 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg

Rango de frecuencia	Límite de corriente de interferencia [valor rms]	Método de evaluación	Parámetros de evaluación
10436-10564 Hz	0,33 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 10500 Hz Ancho de banda 3dB: 380 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg
11436-11564 Hz	0,33 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 11500 Hz Ancho de banda 3dB: 400 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg
12436-12564 Hz	0,33 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 12500 Hz Ancho de banda 3dB: 425 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg
13436-13564 Hz	0,33 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 13500 Hz Ancho de banda 3dB: 445 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg

Rango de frecuencia	Límite de corriente de interferencia [valor rms]	Método de evaluación	Parámetros de evaluación
14436-14564 Hz	0,33 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 14500 Hz Ancho de banda 3dB: 470 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg
15436-15564 Hz	0,33 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 15500 Hz Ancho de banda 3dB: 490 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg
16436-16564 Hz	0,33 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 16500 Hz Ancho de banda 3dB: 510 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg

** Cuando no se indique el tiempo de integración para calcular el valor RMS, se utilizará la duración de un ciclo a la frecuencia del circuito considerado.

4.2.2.2.-TTC

El circuito de vía cumple con los límites establecidos por ERA/ERTMS 033281 según certificado aportado por la empresa responsable de su tecnología (ALSTOM). Los límites de corriente de interferencia considerados para el actual sistema de detección de tren serán los especificados en la norma EN 50238-2:2020, Anexo A.

Tabla 08

EN 50238-2:2020			
Rango de frecuencias	**Límite de corriente de interferencia [valor rms]**	**Método de evaluación**	**Parámetros de evaluación**
4000 Hz	1 A	Filtro paso banda	• Características del filtro PB: Rango de frecuencias centrales: 4000 Hz Ancho de banda 3dB: 158 Hz Butterworth, orden 2· N= 6 • Cálculo RMS: Tiempo de integración: 0.02 sec Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0.02 sec Tiempo mínimo entre dos superaciones: 0.35 sec
4500 Hz	1 A	Filtro paso banda	• Características del filtro PB: Rango de frecuencias centrales: 4500 Hz Ancho de banda 3dB: 158 Hz Butterworth, orden 2· N= 6 • Cálculo RMS: Tiempo de integración: 0.02 sec Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0.02 sec Tiempo mínimo entre dos superaciones: 0.35 sec
5000 Hz	1 A	Filtro paso banda	• Características del filtro PB: Rango de frecuencias centrales: 5000 Hz Ancho de banda 3dB: 158 Hz Butterworth, orden 2· N= 6 • Cálculo RMS: Tiempo de integración: 0.02 sec Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0.02 sec Tiempo mínimo entre dos superaciones: 0.35 sec

EN 50238-2:2020			
Rango de frecuencias	**Límite de corriente de interferencia [valor rms]**	**Método de evaluación**	**Parámetros de evaluación**
5500 Hz	1 A	Filtro paso banda	• Características del filtro PB: Rango de frecuencias centrales: 5500 Hz Ancho de banda 3dB: 158 Hz Butterworth, orden 2· N= 6 • Cálculo RMS: Tiempo de integración: 0.02 sec Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0.02 sec Tiempo mínimo entre dos superaciones: 0.35 sec
6000 Hz	1 A	Filtro paso banda	• Características del filtro PB: Rango de frecuencias centrales: 6000 Hz Ancho de banda 3dB: 158 Hz Butterworth, orden 2· N= 6 • Cálculo RMS: Tiempo de integración: 0.02 sec Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0.02 sec Tiempo mínimo entre dos superaciones: 0.35 sec
6500 Hz	1 A	Filtro paso banda	• Características del filtro PB: Rango de frecuencias centrales: 6500 Hz Ancho de banda 3dB: 158 Hz Butterworth, orden 2· N= 6 • Cálculo RMS: Tiempo de integración: 0.02 sec Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0.02 sec Tiempo mínimo entre dos superaciones: 0.35 sec
9000 Hz	0.33 A	Filtro paso banda	• Características del filtro PB: Rango de frecuencias centrales: 9000 Hz Ancho de banda 3dB: 158 Hz Butterworth, orden 2· N= 6 • Cálculo RMS: Tiempo de integración: 0.02 sec Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0.02 sec Tiempo mínimo entre dos superaciones: 0.35 sec

EN 50238-2:2020			
Rango de frecuencias	**Límite de corriente de interferencia [valor rms]**	**Método de evaluación**	**Parámetros de evaluación**
10000 Hz	0.33 A	Filtro paso banda	• Características del filtro PB: Rango de frecuencias centrales: 10000 Hz Ancho de banda 3dB: 158 Hz Butterworth, orden 2· N= 6 • Cálculo RMS: Tiempo de integración: 0.02 sec Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0.02 sec Tiempo mínimo entre dos superaciones: 0.35 sec
11000 Hz	0.33 A	Filtro paso banda	• Características del filtro PB: Rango de frecuencias centrales: 11000 Hz Ancho de banda 3dB: 158 Hz Butterworth, orden 2· N= 6 • Cálculo RMS: Tiempo de integración: 0.02 sec Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0.02 sec Tiempo mínimo entre dos superaciones: 0.35 sec
12000 Hz	0.33 A	Filtro paso banda	• Características del filtro PB: Rango de frecuencias centrales: 12000 Hz Ancho de banda 3dB: 158 Hz Butterworth, orden 2· N= 6 • Cálculo RMS: Tiempo de integración: 0.02 sec Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0.02 sec Tiempo mínimo entre dos superaciones: 0.35 sec
13000 Hz	0.33 A	Filtro paso banda	• Características del filtro PB: Rango de frecuencias centrales: 13000 Hz Ancho de banda 3dB: 158 Hz Butterworth, orden 2· N= 6 • Cálculo RMS: Tiempo de integración: 0.02 sec Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0.02 sec Tiempo mínimo entre dos superaciones: 0.35 sec

EN 50238-2:2020			
Rango de frecuencias	**Límite de corriente de interferencia [valor rms]**	**Método de evaluación**	**Parámetros de evaluación**
14000 Hz	0.33 A	Filtro paso banda	• Características del filtro PB: Rango de frecuencias centrales: 14000 Hz Ancho de banda 3dB: 158 Hz Butterworth, orden 2· N= 6 • Cálculo RMS: Tiempo de integración: 0.02 sec Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0.02 sec Tiempo mínimo entre dos superaciones: 0.35 sec
15000 Hz	0.33 A	Filtro paso banda	• Características del filtro PB: Rango de frecuencias centrales: 15000 Hz Ancho de banda 3dB: 158 Hz Butterworth, orden 2· N= 6 • Cálculo RMS: Tiempo de integración: 0.02 sec Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0.02 sec Tiempo mínimo entre dos superaciones: 0.35 sec
16000 Hz	0.33 A	Filtro paso banda	• Características del filtro PB: Rango de frecuencias centrales: 16000 Hz Ancho de banda 3dB: 158 Hz Butterworth, orden 2· N= 6 • Cálculo RMS: Tiempo de integración: 0.02 sec Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0.02 sec Tiempo mínimo entre dos superaciones: 0.35 sec
17000 Hz	0.33 A	Filtro paso banda	• Características del filtro PB: Rango de frecuencias centrales: 17000 Hz Ancho de banda 3dB: 158 Hz Butterworth, orden 2· N= 6 • Cálculo RMS: Tiempo de integración: 0.02 sec Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0.02 sec Tiempo mínimo entre dos superaciones: 0.35sec

4.2.2.3.-STDS

Estudios intermedios remitidos por el fabricante (ALSTOM) aseguran el cumplimiento de los límites establecidos por ERA/ERTMS 033281. En espera de emisión de informe por órgano certificador.

4.2.2.4.-ME 3091/ME 5091

El circuito de vía cumple con los límites establecidos por ERA/ERTMS 033281. Los límites de corriente considerados para el presente sistema de detección de tren serán los especificados en la norma nacional Orden TMA 576/2020.

Tabla 09

Rango de frecuencia	Límite de corriente de interferencia [valor rms]	Método de evaluación	Parámetros de evaluación
11.000 Hz	1,5 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 11.000 Hz Ancho de banda 3dB: 1200 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,5 seg
12.000 Hz	1,5 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 12.000 Hz Ancho de banda 3dB: 1400 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,5 seg
13.000 Hz	1,5 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 13.000 Hz Ancho de banda 3dB: 1600 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,5 seg

Rango de frecuencia	Límite de corriente de interferencia [valor rms]	Método de evaluación	Parámetros de evaluación
14.000 Hz	1.2 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 14.000 Hz Ancho de banda 3dB: 1600 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,5 seg
15.000 Hz	1.2 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 15.000 Hz Ancho de banda 3dB: 1800 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,5 seg
16.000 Hz	1.2 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 16.000 Hz Ancho de banda 3dB: 2000 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,5 seg
17.000 Hz	1 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 17.000 Hz Ancho de banda 3dB: 2600 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,5 seg

Rango de frecuencia	Límite de corriente de interferencia [valor rms]	Método de evaluación	Parámetros de evaluación
18.000 Hz	1 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 18.000 Hz Ancho de banda 3dB: 2800 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,5 seg
19.000 Hz	1 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 19.000 Hz Ancho de banda 3dB: 3000 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,5 seg

** Cuando no se indique el tiempo de integración para calcular el valor RMS, se utilizará la duración de un ciclo a la frecuencia del circuito considerado.

4.2.3.-Corriente de tracción CC (1,5 kV y 3 kV): Límites de corriente de inducción electromagnética.

4.2.3.1.-FTGS

El circuito de vía cumple con los límites establecidos por ERA/ERTMS 033281. Los límites de corriente de interferencia considerados para el presente sistema de detección de trenes serán los especificados en la norma EN 50238-2:2020.

Tabla 10: FTGS 46

Rango de frecuencia	Límite de corriente de interferencia [valor eficaz]	Método de evaluación	Parámetros de evaluación
4686-4814 Hz	1 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 4750 Hz Ancho de banda 3dB: 200 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg
5186-5314 Hz	1 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 5250 Hz Ancho de banda 3dB: 206 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg
5686-5814 Hz	1 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 5750 Hz Ancho de banda 3dB: 214 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg

Rango de frecuencia	Límite de corriente de interferencia [valor eficaz]	Método de evaluación	Parámetros de evaluación
6186-6314 Hz	1 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 6250 Hz Ancho de banda 3dB: 220 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg

** Cuando no se indique el tiempo de integración para calcular el valor RMS, se utilizará la duración de un ciclo a la frecuencia del circuito considerado.

Tabla 11: FTGS 917

Rango de frecuencia	Límite de corriente de interferencia [valor eficaz]	Método de evaluación	Parámetros de evaluación
9436-9564 Hz	0,33 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 9500 Hz Ancho de banda 3dB: 360 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg
10436-10564 Hz	0,33 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 10500 Hz Ancho de banda 3dB: 380 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg

Rango de frecuencia	Límite de corriente de interferencia [valor eficaz]	Método de evaluación	Parámetros de evaluación
11436-11564 Hz	0,33 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 11500 Hz Ancho de banda 3dB: 400 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg
12436-12564 Hz	0,33 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 12500 Hz Ancho de banda 3dB: 425 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg
13436-13564 Hz	0,33 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 13500 Hz Ancho de banda 3dB: 445 Hz Butterworth, orden 2 * N = 6 • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg
14436-14564 Hz	0,33 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 14500 Hz Ancho de banda 3dB: 470 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg

Rango de frecuencia	Límite de corriente de interferencia [valor eficaz]	Método de evaluación	Parámetros de evaluación
15436-15564 Hz	0,33 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 15500 Hz Ancho de banda 3dB: 490 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg
16436-16564 Hz	0,33 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 16500 Hz Ancho de banda 3dB: 510 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg

** Cuando no se indique el tiempo de integración para calcular el valor RMS, se utilizará la duración de un ciclo a la frecuencia del circuito considerado.

4.2.3.2.-TCM100

El circuito de vía cumple con los límites establecidos por ERA/ERTMS 033281 v5. Los límites de corriente de interferencia considerados para el presente sistema de detección de trenes serán los especificados en la norma nacional Orden TMA 576:2020 y la norma UNE 50238-2:2020.

Tabla 12

Rango de frecuencia	Límite de corriente de interferencia [valor eficaz]	Método de evaluación	Parámetros de evaluación
4686–4814 Hz	1 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 4750 Hz Ancho de banda 3dB: 300 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: 0,04 segundos Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg
5186-5314 Hz	1 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 5250 Hz Ancho de banda 3dB: 300 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: 0,04 segundos Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg
5686-5814 Hz	1 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 5750 Hz Ancho de banda 3dB: 300 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: 0,04 segundos Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg

Rango de frecuencia	Límite de corriente de interferencia [valor eficaz]	Método de evaluación	Parámetros de evaluación
6186-6314 Hz	1 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 6250 Hz Ancho de banda 3dB: 300 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: 0,04 segundos Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg
9436-9564Hz	1 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 9500 Hz Ancho de banda 3dB: 300 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: 0,04 segundos Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg
10436-10564 Hz	1 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 10500 Hz Ancho de banda 3dB: 300 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: 0,04 segundos Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg
11436-11564 Hz	1 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 11500 Hz Ancho de banda 3dB: 300 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: 0,04 segundos Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg

Rango de frecuencia	Límite de corriente de interferencia [valor eficaz]	Método de evaluación	Parámetros de evaluación
12436-12564 Hz	1 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 12500 Hz Ancho de banda 3dB: 300 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: 0,04 segundos Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg
13436-13564 Hz	1 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 13500 Hz Ancho de banda 3dB: 300 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: 0,04 segundos Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg
14436-14564 Hz	1 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 14500 Hz Ancho de banda 3dB: 300 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: 0,04 segundos Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg
15436-15564 Hz	1 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 15500 Hz Ancho de banda 3dB: 300 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: 0,04 segundos Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg

Rango de frecuencia	Límite de corriente de interferencia [valor eficaz]	Método de evaluación	Parámetros de evaluación
16436-16564 Hz	1 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 16500 Hz Ancho de banda 3dB: 300 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: 0,04 segundos Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg
17436-17564 Hz	1 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 17500 Hz Ancho de banda 3dB: 300 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: 0,04 segundos Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg
18436-18564 Hz	1 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 18500 Hz Ancho de banda 3dB: 300 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: 0,04 segundos Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg
19436-19564 Hz	1 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 19500 Hz Ancho de banda 3dB: 300 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: 0,04 segundos Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,04 seg Tiempo mínimo entre dos superaciones: 0,08 seg

4.2.3.3.-TTC

El circuito de vía cumple con los límites establecidos por ERA/ERTMS 033281 según certificado aportado por la empresa responsable de su tecnología (ALSTOM). Los límites de corriente de interferencia considerados para el actual sistema de detección de tren serán los especificados en la norma EN 50238-2:2020, Anexo A.

Tabla 13

Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
4000 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec
4500 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec
5000 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec

Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
5500 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec
6000 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec
6500 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec
9000 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec

Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
10000 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec
11000 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec
12000 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec
13000 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec

Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
14000 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec
15000 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec
16000 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec
17000 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35sec

4.2.3.4.-DIGICODE

El circuito de pista cumple con los límites establecidos por ERA/ERTMS 033281 v5. Los límites de corriente de interferencia considerados para el presente sistema de detección de trenes serán los especificados en la norma nacional Orden TMA 576:2020 y la norma UNE 50238-2:2020.

Tabla 14

Rango de frecuencia	Límite de corriente de interferencia [valor eficaz]	Método de evaluación	Parámetros de evaluación
2100 Hz	2.2 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 2100 Hz Ancho de banda 3dB: 400 Hz Chebyshev orden 2 * N = 10, ondulación = 0.01 dB • Cálculo RMS: Tiempo de integración: 1 seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 1 seg
2500 Hz	2.2 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 2100 Hz Ancho de banda 3dB: 400 Hz Chebyshev orden 2 * N = 10, ondulación = 0.01 dB • Cálculo RMS: Tiempo de integración: 1 seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 1 seg
2900 Hz	1,5 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 2100 Hz Ancho de banda 3dB: 400 Hz Chebyshev orden 2 * N = 10, ondulación = 0.01 dB • Cálculo RMS: Tiempo de integración: 1 seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 1 seg
3300 Hz	1,5 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 2100 Hz Ancho de banda 3dB: 400 Hz Chebyshev orden 2 * N = 10, ondulación = 0.01 dB • Cálculo RMS: Tiempo de integración: 1 seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 1 seg

Rango de frecuencia	Límite de corriente de interferencia [valor eficaz]	Método de evaluación	Parámetros de evaluación
3700 Hz	1,5 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 2100 Hz Ancho de banda 3dB: 400 Hz Chebyshev orden 2 * N = 10, ondulación = 0.01 dB • Cálculo RMS: Tiempo de integración: 1 seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 1 seg
4100 Hz	1,5 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 2100 Hz Ancho de banda 3dB: 400 Hz Chebyshev orden 2 * N = 10, ondulación = 0.01 dB • Cálculo RMS: Tiempo de integración: 1 seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 1 seg
4500 Hz	1,5 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 2100 Hz Ancho de banda 3dB: 400 Hz Chebyshev orden 2 * N = 10, ondulación = 0.01 dB • Cálculo RMS: Tiempo de integración: 1 seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 1 seg
4900 Hz	1,5 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 2100 Hz Ancho de banda 3dB: 400 Hz Chebyshev orden 2 * N = 10, ondulación = 0.01 dB • Cálculo RMS: Tiempo de integración: 1 seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 1 seg

4.2.3.5.-ITE JS (HVI)

Considerado por la normativa nacional española (Orden TMA 576-2020) dentro de los Circuitos de vía *"inmunes a las interferencias generadas por el material rodante debido a la forma de onda de la señal del circuito de vía."*

4.2.3.6.-STDS

Certificado para el cumplimiento de los límites establecidos por ERA/ERTMS 033281.

4.2.3.7.-M3091/M5091

El circuito de pista cumple con los límites establecidos por ERA/ERTMS 033281. Los límites de corriente de interferencia considerados para el presente sistema de detección de trenes serán los especificados en la norma nacional Orden TMA 576/2020.

Tabla 16

Rango de frecuencia	Límite de corriente de interferencia [valor rms]	Método de evaluación	Parámetros de evaluación
11.000 Hz	1,5 A	Filtro paso banda	• Características del filtro BP: Rango de frecuencias centrales: 11.000 Hz Ancho de banda 3dB: 1200 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,5 seg
12.000 Hz	1,5 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 12.000 Hz Ancho de banda 3dB: 1400 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,5 seg
13.000 Hz	1,5 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 13.000 Hz Ancho de banda 3dB: 1600 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,5 seg

Rango de frecuencia	Límite de corriente de interferencia [valor rms]	Método de evaluación	Parámetros de evaluación
14.000 Hz	1.2 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 14.000 Hz Ancho de banda 3dB: 1600 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,5 seg
15.000 Hz	1.2 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 15.000 Hz Ancho de banda 3dB: 1800 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,5 seg
16.000 Hz	1.2 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 16.000 Hz Ancho de banda 3dB: 2000 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,5 seg
17.000 Hz	1 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 17.000 Hz Ancho de banda 3dB: 2600 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,5 seg

Rango de frecuencia	Límite de corriente de interferencia [valor rms]	Método de evaluación	Parámetros de evaluación
18.000 Hz	1 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 18.000 Hz Ancho de banda 3dB: 2800 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,5 seg
19.000 Hz	1 A	Filtro de paso de banda	• Características del filtro BP: Rango de frecuencias centrales: 19.000 Hz Ancho de banda 3dB: 3000 Hz Butterworth, orden 2 * N = 6 • Cálculo RMS: Tiempo de integración: ** seg Superposición de tiempo: min 50 % • Criterios de evaluación: Tiempo máximo de superación: 0,5 seg

** Cuando no se indique el tiempo de integración para calcular el valor RMS, se utilizará la duración de un ciclo a la frecuencia del circuito considerado.

4.2.4.-Especificación de medición, prueba y evaluación

Las mediciones han sido proporcionadas por los respectivos proveedores de sistemas de detección de trenes, teniendo en cuenta las especificaciones de la norma prEN50728:2022 y los datos proporcionados por normas anteriores como la EN 50238-2:2020, Anexo A, y la norma nacional Orden 576/2022.

5.-ANEXO 2: COMPARATIVA PARÁMETROS EMC

En el presente Anexo se hace la comparativa detallada de los valores de compatibilidad electromagnética de cada Sistema de detección de tren frente a los valores límites aportados en la normativa de referencia EN 033281 v5. Todos los resultados se valoran indicando si **CUMPLE (✓),NO CUMPLE (✗)** o **diferencias significativas en los parámetros de medición (✗).**

5.1.1.-CUMPLIMIENTO POR BANDAS DE FRECUENCIA

TECNOLOGÍA	Sistema	25 KV AC 50 Hz										
		A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11
SIEMENS	FS2000/5000											
	FS3000						✗	✗	✗			
	DSA 50 Hz											
THALES	CV 50 Hz ALCATEL											
ALSTOM	TI21 I-M				✗	✗						
	EBITRACK 400				✗	✓		✗	✗			
	50 Hz (ERICSSON)											
	GRS											
ENYSE	50 Hz ENYSE											
HITACHI	UM71-2000				✗	✗						

3 KV CC										
A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11
			✓	✓	✓	✗	✗			
					✗	✗	✗			
			✗	✗						
			✓			✗				
✗	✗									

TECNOLOGÍA	Sistema	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11
SIEMENS	FTG 46						✓	✓	✓			
	FTG 917									✓	✓	✓
	TCM100											
THALES	TTC						✓	✓	✓		✓	✓
ALSTOM	ITE JS (HVI)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	DIGICODE											
ELECTRANS	ME 3091/ME 5091											✓

A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11
					✓	✓	✓			
								✓	✓	✓
					✓	✓	✓	✓	✓	✓
					✓	✓	✓		✓	✓
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
			✓	✓	✓	✓	✓			
										✓

5.1.2.-FTGS 46

5.1.2.1.-25 kV CA, 50 Hz LÍMITES DE INTERFERENCIA ELECTROMAGNÉTICA

Tabla A2.1

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**		**Frequency range**	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**
4686–4814 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4750 Hz 3dB-Bandwidth: 200 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4750 Hz 3dB-Bandwidth: 200 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
5186-5314 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5250 Hz 3dB-Bandwidth: 206 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5250 Hz 3dB-Bandwidth: 206 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**		**Frequency range**	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**
5686-5814 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5750 Hz 3dB-Bandwidth: 214 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5750 Hz 3dB-Bandwidth: 214 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
6186-6314 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 6250 Hz 3dB-Bandwidth: 220 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 6250 Hz 3dB-Bandwidth: 220 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

** Cuando no se indique el tiempo de integración para calcular el valor RMS, se utilizará la duración de un ciclo a la frecuencia del circuito considerado

5.1.2.2.-CC (3 kV, 1,5 kV) LÍMITES DE INTERFERENCIA ELECTROMAGNÉTICA

Tabla A2.2

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**		**Frequency range**	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**
4686–4814 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4750 Hz 3dB-Bandwidth: 200 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4750 Hz 3dB-Bandwidth: 200 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
5186–5314 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5250 Hz 3dB-Bandwidth: 206 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4750 Hz 3dB-Bandwidth: 200 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
5686–5814 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5750 Hz 3dB-Bandwidth: 214 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4750 Hz 3dB-Bandwidth: 200 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**		**Frequency range**	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**
6186-6314 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 6250 Hz 3dB-Bandwidth: 220 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4750 Hz 3dB-Bandwidth: 200 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

** Cuando no se indique el tiempo de integración para calcular el valor RMS, se utilizará la duración de un ciclo a la frecuencia del circuito considerado

5.1.3.-FTGS 917

5.1.3.1.-25 kV CA, 50 Hz Límites de interferencia electromagnética

Tabla A2.3

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
9436-9564 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 9500 Hz 3dB-Bandwidth: 360 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	9320-16755	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 9500 Hz 3dB-Bandwidth: 360 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
10436-10564 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 10500 Hz 3dB-Bandwidth: 380 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	9320-16755	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 10500 Hz 3dB-Bandwidth: 380 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
11436-11564 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 11500 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	9320-16755	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 11500 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
12436-12564 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 12500 Hz 3dB-Bandwidth: 425 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	9320-16755	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 12500 Hz 3dB-Bandwidth: 425 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
13436-13564 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 13500 Hz 3dB-Bandwidth: 445 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	9320-16755	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 13500 Hz 3dB-Bandwidth: 445 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
14436-14564 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 14500 Hz 3dB-Bandwidth: 470 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	9320-16755	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 14500 Hz 3dB-Bandwidth: 470 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
15436-15564 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 15500 Hz 3dB-Bandwidth: 490 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	9320-16755	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 15500 Hz 3dB-Bandwidth: 490 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
16436-16564 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 16500 Hz 3dB-Bandwidth: 510 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	9320-16755	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 16500 Hz 3dB-Bandwidth: 510 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

5.1.3.2.-CC (3 kV, 1,5 kV) LÍMITES DE INTERFERENCIA ELECTROMAGNÉTICA

Tabla A2.4

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**		**Frequency range**	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**
9436-9564 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 9500 Hz 3dB-Bandwidth: 360 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	9436-19755 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 9500 Hz 3dB-Bandwidth: 360 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
10436-10564 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 10500 Hz 3dB-Bandwidth: 380 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	9436-19755 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 10500 Hz 3dB-Bandwidth: 380 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
11436-11564 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 11500 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	9436-19755 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 11500 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
12436-12564 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 12500 Hz 3dB-Bandwidth: 425 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	9436-19755 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 12500 Hz 3dB-Bandwidth: 425 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
13436-13564 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 13500 Hz 3dB-Bandwidth: 445 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	9436-19755 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 13500 Hz 3dB-Bandwidth: 445 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
14436-14564 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 14500 Hz 3dB-Bandwidth: 470 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	9436-19755 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 14500 Hz 3dB-Bandwidth: 470 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
15436-15564 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 15500 Hz 3dB-Bandwidth: 490 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	9436-19755 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 15500 Hz 3dB-Bandwidth: 490 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
16436-16564 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 16500 Hz 3dB-Bandwidth: 510 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	9436-19755 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 16500 Hz 3dB-Bandwidth: 510 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

** Cuando no se indique el tiempo de integración para calcular el valor RMS, se utilizará la duración de un ciclo a la frecuencia del circuito considerado

5.1.4.-TCM 100

5.1.4.1.-CC (3 kV, 1,5 kV) LÍMITES DE INTERFERENCIA ELECTROMAGNÉTICA

Tabla A2.5

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**		**Frequency range**	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**
4686–4814 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4750 Hz 3dB-Bandwidth: 300 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4750 Hz 3dB-Bandwidth: 200 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
5186-5314 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5250 Hz 3dB-Bandwidth: 300 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4750 Hz 3dB-Bandwidth: 206 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
5686-5814 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5750 Hz 3dB-Bandwidth: 300 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4750 Hz 3dB-Bandwidth: 214 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
6186-6314 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 6250 Hz 3dB-Bandwidth: 300 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4750 Hz 3dB-Bandwidth: 220 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
9436-9564Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 9500 Hz 3dB-Bandwidth: 300 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	9320-19755Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 9500 Hz 3dB-Bandwidth: 360 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
10436-10564 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 10500 Hz 3dB-Bandwidth: 300 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	9320-19755Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 10500 Hz 3dB-Bandwidth: 380 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
11436-11564 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 11500 Hz 3dB-Bandwidth: 300 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	9320-19755Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 11500 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
12436-12564 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 12500 Hz 3dB-Bandwidth: 300 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	9320-19755Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 12500 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
13436-13564 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 13500 Hz 3dB-Bandwidth: 300 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	9320-19755Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 13500 Hz 3dB-Bandwidth: 425 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
14436-14564 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 14500 Hz 3dB-Bandwidth: 300 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	9320-19755Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 14500 Hz 3dB-Bandwidth: 445 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
15436-15564 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 15500 Hz 3dB-Bandwidth: 300 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	9320-19755Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 15500 Hz 3dB-Bandwidth: 470 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
16436-16564 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 16500 Hz 3dB-Bandwidth: 300 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	9320-19755Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 16500 Hz 3dB-Bandwidth: 490 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
17436-17564 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 17500 Hz 3dB-Bandwidth: 300 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	9320-19755Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 17500 Hz 3dB-Bandwidth: 510 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
18436-18564 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 18500 Hz 3dB-Bandwidth: 300 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	9320-19755Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 18500 Hz 3dB-Bandwidth: 510 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
19436-19564 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 19500 Hz 3dB-Bandwidth: 300 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec	✓	9320-19755Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 19500 Hz 3dB-Bandwidth: 510 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

5.1.5.-ACM 250

Tabla A2.6

THALES-HITACHI								EV	ERA ERTMS 033281 v.5							
Band	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	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 1	42,98	109	94	107	BP	2 ± 160Hz	Integration time: 1,8 ms	✓	Band 1	41.2-44.8	93	83*/90*	98	BP	4th order 320 Hz	20% overlap (3dB points) Integration time: 1ms

5.1.6.-FS2000/5000

5.1.6.1.-CC (3 kV, 1,5 kV) LÍMITES DE INTERFERENCIA ELECTROMAGNÉTICA

Tabla A2.7

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**		**Frequency range**	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**
1682-1716 Hz	3.7 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 1699 Hz 3dB-Bandwidth: 50 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: 0.21 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.016 sec	×	1500-2700 Hz	0,3 A	FFT	• Time window 1s, Hanning window, • min. 80% overlap Maximum time of exceedance: 0.3s
1984-2018- Hz	3.2 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2001 Hz 3dB-Bandwidth: 50 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: 0.21 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.016 sec	×	1500-2700 Hz	0,3 A	FFT	• Time window 1s, Hanning window, • min. 80% overlap • Maximum time of exceedance: 0.3s

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
2282-2316 Hz	3.3 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2299 Hz 3dB-Bandwidth: 50 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: 0.21 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.016 sec	✕	1500-2700 Hz	0,3 A	FFT	• Time window 1s, Hanning window, • min. 80% overlap • Maximum time of exceedance: 0.3s
2584-2618Hz	2.8 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2601 Hz 3dB-Bandwidth: 50 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: 0.21 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.016 sec Min. time between two exceedances: 0.88 sec	✕	1500-2700 Hz	0,3 A	FFT	• Time window 1s, Hanning window, • min. 80% overlap • Maximum time of exceedance: 0.3s
4040-4120 Hz	0.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4080 Hz 3dB-Bandwidth: 160 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: 0.4 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.88 sec	✕ ✕	2700-5100 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4100 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2·N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances: 1.5 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
4280-4360 Hz	0.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4320 Hz 3dB-Bandwidth: 160 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: 0.4 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.88 sec •	✗ ✗	2700-5100 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4500 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2·N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec • Min. time between two exceedances: 1.5 sec
4520-4600 Hz	0.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4560 Hz 3dB-Bandwidth: 160 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: 0.4 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.88 sec •	✗ ✗	2700-5100 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4500 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2·N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec • Min. time between two exceedances: 1.5 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
5000-5080 Hz	0.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5040 Hz 3dB-Bandwidth: 160 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: 0.4 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.88 sec •	✗	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4750 Hz 3dB-Bandwidth: 200 Hz Butterworth, order 2·N= 6 • RMS calculation: Integration time: 0.4 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.80 sec •
5240-5320 Hz	0.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5280 Hz 3dB-Bandwidth: 160 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: 0.4 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.88 sec •	✗	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4750 Hz 3dB-Bandwidth: 200 Hz Butterworth, order 2·N= 6 • RMS calculation: Integration time: 0.4 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.80 sec •

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
5480-5560 Hz	0.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5520 Hz 3dB-Bandwidth: 160 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: 0.4 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.88 sec •	✗	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4750 Hz 3dB-Bandwidth: 200 Hz Butterworth, order 2·N= 6 • RMS calculation: Integration time: 0.4 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.80 sec •
5960-6040 Hz	0.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 6000 Hz 3dB-Bandwidth: 160 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: 0.4 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.88 sec •	✗	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4750 Hz 3dB-Bandwidth: 200 Hz Butterworth, order 2·N= 6 • RMS calculation: Integration time: 0.4 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.80 sec •

5.1.7.-FS 3000

5.1.7.1.-25 kV CA, 50 Hz LÍMITES DE INTERFERENCIA ELECTROMAGNÉTICA

Tabla A2.8

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
4080 Hz	0.52 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4080 Hz 3dB-Bandwidth: 124 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.016 sec Min. time between two exceedances: 0.514 sec	☒ ☒	2700-5100 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4100 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2·N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances:1.5 sec
4320 Hz	0.45 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4320 Hz 3dB-Bandwidth: 124 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.016 sec Min. time between two exceedances: 0.514 sec	☒ ☒	3450-7550 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4250 Hz 3dB-Bandwidth: 600 Hz Butterworth, order 2·N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances:1.5 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
4560 Hz	0.39 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4560 Hz 3dB-Bandwidth: 124 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.016 sec Min. time between two exceedances: 0.514 sec	☒ ☓	2700-5100 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4500 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2·N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances:1.5 sec
5040 Hz	0.66 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5040 Hz 3dB-Bandwidth: 124 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.016 sec Min. time between two exceedances: 0.514 sec	☒ ☓	2700-5100 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4900 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2·N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances:1.5 sec
5280 Hz	0.27 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5280 Hz 3dB-Bandwidth: 124 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.016 sec Min. time between two exceedances: 0.514 sec	☒ ☓	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5250 Hz 3dB-Bandwidth: 206 Hz Butterworth, order 2·N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
5520 Hz	0.27 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5520 Hz 3dB-Bandwidth: 124 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.016 sec Min. time between two exceedances: 0.514 sec	☒ ☒	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5250 Hz 3dB-Bandwidth: 206 Hz Butterworth, order 2·N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
6000 Hz	0.26 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 6000 Hz 3dB-Bandwidth: 124 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.016 sec Min. time between two exceedances: 0.514 sec	☒ ☒	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 6250 Hz 3dB-Bandwidth: 220 Hz Butterworth, order 2·N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
6480 Hz	0.25 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 6480 Hz 3dB-Bandwidth: 124 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.016 sec Min. time between two exceedances: 0.514 sec	☒ ☒	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5250 Hz 3dB-Bandwidth: 206 Hz Butterworth, order 2·N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
6720 Hz	0.24 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 6720 Hz 3dB-Bandwidth: 124 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.016 sec Min. time between two exceedances: 0.514 sec	☒ ☒	3450-7550 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 6750 Hz 3dB-Bandwidth: 600 Hz Butterworth, order 2·N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances:1.5 sec
7200 Hz	0.24 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 7200 Hz 3dB-Bandwidth: 124 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.016 sec Min. time between two exceedances: 0.514 sec	☒ ☒	3450-7550 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 7250 Hz 3dB-Bandwidth: 600 Hz Butterworth, order 2·N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances:1.5 sec

5.1.7.2.-CC (3 kV, 1,5 kV) LÍMITES DE INTERFERENCIA ELECTROMAGNÉTICA

Tabla A2.9

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**		**Frequency range**	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**
4080 Hz	0.52 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4080 Hz 3dB-Bandwidth: 124 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.016 sec Min. time between two exceedances: 0.514 sec	☒ ✕	2700-5100 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4100 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2·N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances: 1.5 sec
4320 Hz	0.45 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4320 Hz 3dB-Bandwidth: 124 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.016 sec Min. time between two exceedances: 0.514 sec	☒ ✕	3450-7550 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4250 Hz 3dB-Bandwidth: 600 Hz Butterworth, order 2·N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances: 1.5 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
4560 Hz	0.39 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4560 Hz 3dB-Bandwidth: 124 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.016 sec Min. time between two exceedances: 0.514 sec	☒ ☒	2700-5100 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4500 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2·N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances: 1.5 sec
5040 Hz	0.66 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5040 Hz 3dB-Bandwidth: 124 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.016 sec Min. time between two exceedances: 0.514 sec	☒ ☒	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4750 Hz 3dB-Bandwidth: 200 Hz Butterworth, order 2·N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
5280 Hz	0.27 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5280 Hz 3dB-Bandwidth: 124 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.016 sec Min. time between two exceedances: 0.514 sec	☒ ☒	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5250 Hz 3dB-Bandwidth: 206 Hz Butterworth, order 2·N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
5520 Hz	0.27 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5520 Hz 3dB-Bandwidth: 124 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.016 sec Min. time between two exceedances: 0.514 sec	☒ ☒	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5750 Hz 3dB-Bandwidth: 214 Hz Butterworth, order 2·N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
6000 Hz	0.26 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 6000 Hz 3dB-Bandwidth: 124 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.016 sec Min. time between two exceedances: 0.514 sec	☒ ☒	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 6250 Hz 3dB-Bandwidth: 220 Hz Butterworth, order 2·N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
6480 Hz	0.25 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 6480 Hz 3dB-Bandwidth: 124 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.016 sec Min. time between two exceedances: 0.514 sec	☒ ☒	3450-7550 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 6250 Hz 3dB-Bandwidth: 600 Hz Butterworth, order 2·N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances: 1.5 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
6720 Hz	0.24 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 6720 Hz 3dB-Bandwidth: 124 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.016 sec Min. time between two exceedances: 0.514 sec	☒ ☒	3450-7550 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 6750 Hz 3dB-Bandwidth: 600 Hz Butterworth, order 2·N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances: 1.5 sec
7200 Hz	0.24 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 7200 Hz 3dB-Bandwidth: 124 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.016 sec Min. time between two exceedances: 0.514 sec	☒ ☒	3450-7550 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 7250 Hz 3dB-Bandwidth: 600 Hz Butterworth, order 2·N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances: 1.5 sec

5.1.8.-DSA 50 Hz

5.1.8.1.-CC (3 kV, 1,5 kV) Límites de interferencia electromagnética

Tabla A2.10

ORDEN TMA 576-2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
50 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 50 Hz 3dB-Bandwidth: 2 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.2sec	×	SIN DATOS			

5.1.9.-TTC

5.1.9.1.-25 kV CA, 50 Hz LÍMITES DE INTERFERENCIA ELECTROMAGNÉTICA

Tabla A2.11

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
4000 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec	×	2700-5100 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4100 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2·N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances:1.5 sec
4500 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4500 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec	×	2700-5100 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4500 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2·N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances:1.5 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
5000 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec	✓	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5250 Hz 3dB-Bandwidth: 206 Hz Butterworth, order 2·N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
5500 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5500 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec	✓	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5250 Hz 3dB-Bandwidth: 206 Hz Butterworth, order 2·N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
6000 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 6000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec	✓	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 6250 Hz 3dB-Bandwidth: 220 Hz Butterworth, order 2·N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
6500 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 6500 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec	✓	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 6250 Hz 3dB-Bandwidth: 220 Hz Butterworth, order 2·N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
9000 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 9000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec	✗	SIN DATOS			

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
10000 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 10000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec	✓	9320-16755 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 9500 Hz 3dB-Bandwidth: 360 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
11000 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 11000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec	✓	9320-16755 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 10500 Hz 3dB-Bandwidth: 380 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
12000 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 12000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec	✓	9320-16755 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 11500 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
13000 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 13000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec	✓	9320-16755 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 12500 Hz 3dB-Bandwidth: 425 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
14000 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 14000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec	✓	9320-16755 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 13500 Hz 3dB-Bandwidth: 445 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
15000 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 15000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec	✓	9320-16755 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 14500 Hz 3dB-Bandwidth: 470 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
16000 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 16000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec	✓	9320-16755 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 15500 Hz 3dB-Bandwidth: 490 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
17000 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 17000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35sec	✓	9320-16755 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 16500 Hz 3dB-Bandwidth: 510 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

5.1.9.2.-CC (3 kV, 1,5 kV) LÍMITES DE INTERFERENCIA ELECTROMAGNÉTICA

Tabla A2.12

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**		**Frequency range**	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**
4000 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec	✓	2700-5100 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4100 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2*N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances: 1.5 sec
4500 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4500 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec	✓	2700-5100 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4500 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2*N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances: 1.5 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
5000 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec	✓	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4750 Hz 3dB-Bandwidth: 200 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
5500 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5500 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec	✓	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5250 Hz 3dB-Bandwidth: 206 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
6000 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 6000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec	✓	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5750 Hz 3dB-Bandwidth: 214 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
6500 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 6500 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec	✓	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 6250 Hz 3dB-Bandwidth: 220 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
9000 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 9000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec	✗	SIN DATOS			
10000 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 10000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec	✓	9320-19755 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 9500 Hz 3dB-Bandwidth: 360 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
11000 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 11000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec	✓	9320-19755 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 10500 Hz 3dB-Bandwidth: 380 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
12000 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 12000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec	✓	9320-19755 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 11500 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
13000 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 13000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec	✓	9320-19755 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 12500 Hz 3dB-Bandwidth: 425 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
14000 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 14000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec	✓	9320-19755 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 13500 Hz 3dB-Bandwidth: 445 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
15000 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 15000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec	✓	9320-19755 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 14500 Hz 3dB-Bandwidth: 470 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
16000 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 16000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35 sec	✓	9320-19755 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 15500 Hz 3dB-Bandwidth: 490 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
17000 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 17000 Hz 3dB-Bandwidth: 158 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.02 sec Min. time between two exceedances: 0.35sec	✓	9320-19755 Hz	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 16500 Hz 3dB-Bandwidth: 510 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

5.1.10.-AZLM: Pedal Zp30H, Zp30K

Tabla A2.13

THALES-HITACHI								EV	ERA ERTMS 033281 v.5							
Band	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	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 1	27-32	114	94	101	BP	4th order +-12 Hz	Integration time: 4 ms	✓	Band 1	27-41.2	93	93	98	BP	4th order 300 Hz	20% overlap (3dB points) Integration time: 1 ms

5.1.11.-SIG L90: Pedal Zp30C

Tabla A2.14

THALES-HITACHI								EV	ERA ERTMS 033281 v.5							
Band	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	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 1	27-32	114	94	101	BP	4th order +-12 Hz	Integration time: 4 ms	✓	Band 1	27-41.2	93	93	98	BP	4th order 300 Hz	20% overlap (3dB points) Integration time: 1 ms

5.1.12.-RSL: Pedal Zp30C

Tabla A2.15

THALES-HITACHI								EV	ERA ERTMS 033281 v.5							
Band	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	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 1	27-32	114	94	101	BP	4th order +-12 Hz	Integration time: 4 ms	✓	Band 1	27-41.2	93	93	98	BP	4th order 300 Hz	20% overlap (3dB points) Integration time: 1 ms

5.1.13.-CV 50 Hz ALCATEL

5.1.13.1.-CC (3 kV, 1,5 kV) LÍMITES DE INTERFERENCIA ELECTROMAGNÉTICA

Tabla A2.16

ORDEN TMA 576-2020				EV	ERA ERTMS 033281 v.5			
Frequency range	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**		**Frequency range**	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**
50 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 50 Hz 3dB-Bandwidth: 2 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.2sec	✕	SIN DATOS			

5.1.14.-ITE JS (HVI)

5.1.14.1.-CC (3 kV, 1,5 kV) LÍMITES DE INTERFERENCIA ELECTROMAGNÉTICA

Considerado por la normativa nacional española (Orden TMA 576-2020) dentro de los Circuitos de vía *"inmunes a las interferencias generadas por el material rodante debido a la forma de onda de la señal del circuito de vía."*

5.1.15.-DIGICODE

5.1.15.1.-CC (3 kV, 1,5 kV) LÍMITES DE INTERFERENCIA ELECTROMAGNÉTICA

Tabla A2.17

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
2100 Hz	2.2 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2100 Hz 3dB-Bandwidth: 400 Hz Tchebyshev order 2*N= 10, Ripple = 0.01 dB • RMS calculation: Integration time: 1 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 1 sec	✓	1900-2700 Hz	2.2 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2100 Hz 3dB-Bandwidth: 400 Hz Tchebyshev order 2*N= 10, Ripple = 0.01 dB • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances: 1.5 sec
2500 Hz	2.2 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2500 Hz 3dB-Bandwidth: 400 Hz Tchebyshev order 2*N= 10, Ripple = 0.01 dB • RMS calculation: Integration time: 1 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 1 sec	✓	1900-2700 Hz	2.2 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2500 Hz 3dB-Bandwidth: 400 Hz Tchebyshev order 2*N= 10, Ripple = 0.01 dB • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances: 1.5 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
2900 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2900 Hz 3dB-Bandwidth: 400 Hz Tchebyshev order 2*N= 10, Ripple = 0.01 dB • RMS calculation: Integration time: 1 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 1 sec	✓	2700-5100 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2900 Hz 3dB-Bandwidth: 400 Hz Tchebyshev order 2*N= 10, Ripple = 0.01 dB • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances: 1.5 sec
3300 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 3300 Hz 3dB-Bandwidth: 400 Hz Tchebyshev order 2*N= 10, Ripple = 0.01 dB • RMS calculation: Integration time: 1 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 1 sec	✓	2700-5100 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 3300 Hz 3dB-Bandwidth: 400 Hz Tchebyshev order 2*N= 10, Ripple = 0.01 dB • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances: 1.5 sec
3700 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 3700 Hz 3dB-Bandwidth: 400 Hz Tchebyshev order 2*N= 10, Ripple = 0.01 dB • RMS calculation: Integration time: 1 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 1 sec	✓	2700-5100 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 3700 Hz 3dB-Bandwidth: 400 Hz Tchebyshev order 2*N= 10, Ripple = 0.01 dB • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances: 1.5 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
4100 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2100 Hz 3dB-Bandwidth: 400 Hz Tchebyshev order 2*N= 10, Ripple = 0.01 dB • RMS calculation: Integration time: 1 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 1 sec	✓	2700-5100 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4100 Hz 3dB-Bandwidth: 400 Hz Tchebyshev order 2*N= 10, Ripple = 0.01 dB • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances: 1.5 sec
4500 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2100 Hz 3dB-Bandwidth: 400 Hz Tchebyshev order 2*N= 10, Ripple = 0.01 dB • RMS calculation: Integration time: 1 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 1 sec	✓	2700-5100 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4500 Hz 3dB-Bandwidth: 400 Hz Tchebyshev order 2*N= 10, Ripple = 0.01 dB • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances: 1.5 sec
4900 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2100 Hz 3dB-Bandwidth: 400 Hz Tchebyshev order 2*N= 10, Ripple = 0.01 dB • RMS calculation: Integration time: 1 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 1 sec	✓	2700-5100 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 4900 Hz 3dB-Bandwidth: 400 Hz Tchebyshev order 2*N= 10, Ripple = 0.01 dB • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances: 1.5 sec

5.1.16.-TI21 I-M

5.1.16.1.-25 kV CA, 50 Hz LÍMITES DE INTERFERENCIA ELECTROMAGNÉTICA

Tabla A2.18

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**		**Frequency range**	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**
1533-1566 Hz	0.806 A	Band-Pass Filter	• BP filter characteristics: 1550 Centre frequencies range: 1549 Hz 3dB-Bandwidth: 12 Hz Butterworth, order 2*N= * • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec	☒ ☒	1500-3200 Hz	3 A	FFT	• Time window 1s, Hanning window, • Min. 80% overlap • Maximum time of exceedance: 0.3s
1682-1716 Hz	0.731 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 1699 Hz 3dB-Bandwidth: 12 Hz Butterworth, order 2*N= * • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec	☒ ☒	1500-3200 Hz	3 A	FFT	• Time window 1s, Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
1831-1865 Hz	0.753 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 1848 Hz 3dB-Bandwidth: 12 Hz Butterworth, order 2*N= * • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec	☒ ☒	1500-3200 Hz	3 A	FFT	• Time window 1s, Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s
1979-2013 Hz	0.696 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 1996 Hz 3dB-Bandwidth: 12 Hz Butterworth, order 2*N= * • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec	☒ ☒	1900-2700 Hz	2.2 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2100 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2*N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances: 1.5 sec
2129-2163 Hz	0.498 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2146 Hz 3dB-Bandwidth: 12 Hz Butterworth, order 2*N= * • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec	☒ ☒	1900-2700 Hz	2.2 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2100 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2*N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances: 1.5 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
2279-2313 Hz	0.492 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2296 Hz 3dB-Bandwidth: 12 Hz Butterworth, order 2*N= * • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec	☒ ☒	1900-2700 Hz	2.2 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2100 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2*N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances: 1.5 sec
2428-2462 Hz	0.44 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2445 Hz 3dB-Bandwidth: 12 Hz Butterworth, order 2*N= * • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec	☒ ☒	1900-2700 Hz	2.2 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2100 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2*N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances: 1.5 sec
2576-2610 Hz	0.416 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2593 Hz 3dB-Bandwidth: 12 Hz Butterworth, order 2*N= * • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec	☒ ☒	1900-2700 Hz	2.2 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2100 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2*N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances: 1.5 sec

5.1.16.2.-CC (3 kV, 1,5 kV) LÍMITES DE INTERFERENCIA ELECTROMAGNÉTICA

Tabla A2.19

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**		**Frequency range**	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**
1533-1566 Hz	0.134 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 1549 Hz 3dB-Bandwidth: 12 Hz Butterworth, order 2*N= * • RMS calculation: Integration time: 2 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec	☒ ☒	1500-2700 Hz	3 A	FFT	• Time window 1s, Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s
1682-1716 Hz	0.101 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 1699 Hz 3dB-Bandwidth: 12 Hz Butterworth, order 2*N= * • RMS calculation: Integration time: 2 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec	☒ ☒	1500-2700 Hz	0.3 A	FFT	• Time window 1s, Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s
1831-1865 Hz	0.142 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 1848 Hz 3dB-Bandwidth: 12 Hz Butterworth, order 2*N= * • RMS calculation: Integration time: 2 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec	☒ ☒	1500-2700 Hz	3 A	FFT	• Time window 1s, Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
1979-2013 Hz	0.091 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 1996 Hz 3dB-Bandwidth: 12 Hz Butterworth, order 2*N= * • RMS calculation: Integration time: 2 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec	☒ ☒	1900-2700 Hz	2.2 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2100 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2*N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances: 1.5 sec
2129-2163 Hz	0.148 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2146 Hz 3dB-Bandwidth: 12 Hz Butterworth, order 2*N= * • RMS calculation: Integration time: 2 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec	☒ ☒	1900-2700 Hz	2.2 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2100 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2*N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances: 1.5 sec
2279-2313 Hz	0.132 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2296 Hz 3dB-Bandwidth: 12 Hz Butterworth, order 2*N= * • RMS calculation: Integration time: 2 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec	☒ ☒	1900-2700 Hz	2.2 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2100 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2*N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances: 1.5 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
2428-2462 Hz	0.143 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2445 Hz 3dB-Bandwidth: 12 Hz Butterworth, order 2*N= * • RMS calculation: Integration time: 2 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec	☒ ☒	1900-2700 Hz	2.2 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2500 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2*N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances: 1.5 sec
2576-2610 Hz	0.167 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2593 Hz 3dB-Bandwidth: 12 Hz Butterworth, order 2*N= * • RMS calculation: Integration time: 2 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec	☒ ☒	1900-2700 Hz	2.2 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2500 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2*N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances: 1.5 sec

5.1.17.-EBITRACK 400

5.1.17.1.-25 kV CA, 50 Hz LÍMITES DE INTERFERENCIA ELECTROMAGNÉTICA

Tabla A2.20: EBITRACK 400:25kv 50Hz Límites de Frecuencia en Circuitos de Vía de Doble Carril en plena vía para Frecuencias dentro de Banda

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**		**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	✗	1500-3200 Hz	3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap • Maximum time of exceedance: 0.3s
1694-1704 Hz	0.936 [A]	FFT	• Time window 1s • Hanning window • 50% overlap	✗	1500-3200 Hz	3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s
1843-1853Hz	0.810 [A]	FFT	• Time window 1s • Hanning window • 50% overlap	✗	1500-3200 Hz	3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s
1991-2001 Hz	0.778 [A]	FFT	• Time window 1s • Hanning window • 50% overlap	✗	1500-3200 Hz	3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s
2141-2151 Hz	0.663 [A]	FFT	• Time window 1s • Hanning window • 50% overlap	✗	1500-3200 Hz	3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s
2291-2301 Hz	0.628 [A]	FFT	• Time window 1s • Hanning window • 50% overlap	✗	1500-3200 Hz	3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s
2440-2450 Hz	0.545 [A]	FFT	• Time window 1s • Hanning window • 50% overlap	✗	1500-3200 Hz	3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**		**Frequency range**	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**
2588-2598 Hz	0.547 [A]	FFT	• Time window 1s • Hanning window • 50% overlap	✓	1500-3200 Hz	0.3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s

Tabla A2.21: EBITRACK 400 25kv 50Hz: Límite de Frecuencia Fuera de Banda en Circuitos de Vía de Doble Carril en plena vía

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**		**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	✓	1500-3200 Hz	0.3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s
1705-1744 Hz	2.340 A	FFT	• Time window 1s • Hanning window • 50% overlap	✓	1500-3200 Hz	0.3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s
1854-1894 Hz	2.025 A	FFT	• Time window 1s • Hanning window • 50% overlap	✓	1500-3200 Hz	0.3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s
2002-204 Hz	1.945 A	FFT	• Time window 1s • Hanning window • 50% overlap	✓	1500-3200 Hz	0.3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s
2152-2194 Hz	1.658 A	FFT	• Time window 1s • Hanning window • 50% overlap	✓	1500-3200 Hz	0.3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s
2302-2344 Hz	1.570 A	FFT	• Time window 1s • Hanning window • 50% overlap	✓	1500-3200 Hz	0.3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s
2451-2494 Hz	1.363 A	FFT	• Time window 1s • Hanning window • 50% overlap	✓	1500-3200 Hz	0.3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s
2599-2644 Hz	1.368 A	FFT	• Time window 1s • Hanning window • 50% overlap	✗	1500-3200 Hz	3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s

Tabla A2.22: EBITRACK 400 25kv 50Hz: Límite de Frecuencia en Circuitos de Vía de Doble Carril en Áreas de Estaciones

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**		**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	☒ ✕	3450-7550 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5750 Hz 3dB-Bandwidth: 600 Hz Butterworth, order 2·N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances:1.5 sec
6065-6135 Hz	1.073 A	FFT	• Time window 1s • Hanning window • 50% overlap	☒ ✕	3450-7550 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 6250 Hz 3dB-Bandwidth: 600 Hz Butterworth, order 2·N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances:1.5 sec
6465-6535 Hz	1.052 A	FFT	• Time window 1s • Hanning window • 50% overlap	☒ ✕	3450-7550 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 6250 Hz 3dB-Bandwidth: 600 Hz Butterworth, order 2·N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances:1.5 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**		**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	✗ ✗	3450-7550 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range:6750 Hz 3dB-Bandwidth: 600 Hz Butterworth, order 2·N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances:1.5 sec
7265-7335 Hz	1.046 A	FFT	• Time window 1s • Hanning window • 50% overlap	✗ ✗	3450-7550 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 7250 Hz 3dB-Bandwidth: 600 Hz Butterworth, order 2·N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances:1.5 sec
7665-7735 Hz	1.058 A	FFT	• Time window 1s • Hanning window • 50% overlap	✗	SIN DATOS			
8065-8135 Hz	1.053 A	FFT	• Time window 1s • Hanning window • 50% overlap	✗	SIN DATOS			
8465-8535 Hz	1.149 A	FFT	• Time window 1s • Hanning window • 50% overlap	✗	SIN DATOS			

5.1.17.2.-CC (3 kV, 1,5 kV) LÍMITES DE INTERFERENCIA ELECTROMAGNÉTICA

Tabla A2.23: EBITRACK 400:3kv CC Límites de Frecuencia en Circuitos de Vía de Doble Carril en plena vía para Frecuencias dentro de Banda

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**		**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	✗	1500-2700 Hz	3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s
1694-1704 Hz	0.936 [A]	FFT	• Time window 1s • Hanning window • 50% overlap	✓	1500-2700 Hz	0.3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s
1843-1853Hz	0.810 [A]	FFT	• Time window 1s • Hanning window • 50% overlap	✗	1500-2700 Hz	3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s
1991-2001 Hz	0.778 [A]	FFT	• Time window 1s • Hanning window • 50% overlap	✓	1500-2700 Hz	0.3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s
2141-2151 Hz	0.663 [A]	FFT	• Time window 1s • Hanning window • 50% overlap	✗	1500-2700 Hz	3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s
2291-2301 Hz	0.628 [A]	FFT	• Time window 1s • Hanning window • 50% overlap	✓	1500-2700 Hz	0.3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s
2440-2450 Hz	0.545 [A]	FFT	• Time window 1s • Hanning window • 50% overlap	✗	1500-2700 Hz	3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s
2588-2598 Hz	0.547 [A]	FFT	• Time window 1s • Hanning window • 50% overlap	✓	1500-2700 Hz	0.3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s

Tabla A2.24: EBITRACK 400 3kv CC: Límites de Frecuencia en Circuitos de Vía de Doble Carril en plena vía para Frecuencias dentro de Banda

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**		**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	✗	1500-2700 Hz	3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s
1705-1744 Hz	2.340 A	FFT	• Time window 1s • Hanning window • 50% overlap	✓	1500-2700 Hz	0.3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s
1854-1894 Hz	2.025 A	FFT	• Time window 1s • Hanning window • 50% overlap	✓	1500-2700 Hz	0.3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s
2002-2044 Hz	1.945 A	FFT	• Time window 1s • Hanning window • 50% overlap	✗	1500-2700 Hz	3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s
2152-2194 Hz	1.658 A	FFT	• Time window 1s • Hanning window • 50% overlap	✗	1500-2700 Hz	3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s
2302-2344 Hz	1.570 A	FFT	• Time window 1s • Hanning window • 50% overlap	✗	1500-2700 Hz	3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s
2451-2494 Hz	1.363 A	FFT	• Time window 1s • Hanning window • 50% overlap	✗	1500-2700 Hz	3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s
2599-2644 Hz	1.368 A	FFT	• Time window 1s • Hanning window • 50% overlap	✓	1500-2700 Hz	0.3 A	FFT	• Time window 1s, • Hanning window, • Min. 80% overlap Maximum time of exceedance: 0.3s

Tabla A2.25: EBITRACK 400 3kv CC: Límites de Frecuencia en Circuitos de Vía de Doble Carril en plena vía para Frecuencias dentro de Banda

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**		**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	×	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5250 Hz 3dB-Bandwidth: 206 Hz Butterworth, order 2·N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
6065-6135 Hz	1.073 A	FFT	• Time window 1s • Hanning window • 50% overlap	×	4650-6360 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 5250 Hz 3dB-Bandwidth: 206 Hz Butterworth, order 2·N= 6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
6465-6535 Hz	1.052 A	FFT	• Time window 1s • Hanning window • 50% overlap	☒ ☒	3450-7550 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 6750 Hz 3dB-Bandwidth: 600 Hz Butterworth, order 2·N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances:1.5 sec
6865-6935 Hz	1.062 A	FFT	• Time window 1s • Hanning window • 50% overlap	☒ ☒	3450-7550 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 6750 Hz 3dB-Bandwidth: 600 Hz Butterworth, order 2·N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances:1.5 sec
7265-7335 Hz	1.046 A	FFT	• Time window 1s • Hanning window • 50% overlap	☒ ☒	3450-7550 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 6750 Hz 3dB-Bandwidth: 600 Hz Butterworth, order 2·N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances:1.5 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
7665-7735 Hz	1.058 A	FFT	• Time window 1s • Hanning window • 50% overlap	×	SIN DATOS			
8065-8135 Hz	1.053 A	FFT	• Time window 1s • Hanning window • 50% overlap	×	SIN DATOS			
8465-8535 Hz	1.149 A	FFT	• Time window 1s • Hanning window • 50% overlap	×	SIN DATOS			

5.1.18.-50 Hz (ERICSSON)

5.1.18.1.-CC (3 kV, 1,5 kV) Límites de interferencia electromagnética

Tabla A2.26

ORDEN TMA 576-2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
50 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 50 Hz 3dB-Bandwidth: 2 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.2sec	×	SIN DATOS			

5.1.19.-GRS

5.1.19.1.-CC (3 kV, 1,5 kV) LÍMITES DE INTERFERENCIA ELECTROMAGNÉTICA

Tabla A2.27

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**		**Frequency range**	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**
75 Hz	0.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 57 Hz 3dB-Bandwidth: 20 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.2 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.2 sec Min. time between two exceedances: 1.7 sec	✗ ✗	70.5-79.5 Hz	1.9 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 75 Hz 3dB-Bandwidth: 5 Hz Butterworth, order 2*N= 8 • RMS calculation: Integration time: 0.5 sec Time overlap: min 75 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances: 2 sec
225 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 225 Hz 3dB-Bandwidth: 20 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.2 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.2 sec Min. time between two exceedances: 1.7 sec	✗	205.5-245.4 Hz	4 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 225.45 Hz 3dB-Bandwidth: 6.5 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.5 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.2 sec Min. time between two exceedances: 2 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
375 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 375 Hz 3dB-Bandwidth: 20 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.2 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.2 sec Min. time between two exceedances: 1.7 sec	×	SIN DATOS			
525 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 525 Hz 3dB-Bandwidth: 20 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.2 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.2 sec Min. time between two exceedances: 1.7 sec	×	SIN DATOS			
675 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 675 Hz 3dB-Bandwidth: 20 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: 0.2 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.2 sec Min. time between two exceedances: 1.7 sec	×	SIN DATOS			

5.1.20.-50 Hz ENYSE

5.1.20.1.-CC (3 kV, 1,5 kV) Límites de interferencia electromagnética

Tabla A2.28

ORDEN TMA 576-2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
50 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 50 Hz 3dB-Bandwidth: 2 Hz Butterworth, order 2·N= * • RMS calculation: Integration time: 0.02 sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.2sec	×	SIN DATOS			

5.1.21.-UM71-2000

5.1.21.1.-25 kV CA, 50 Hz LÍMITES DE INTERFERENCIA ELECTROMAGNÉTICA

Tabla A2.29

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**		**Frequency range**	**Interference current limit [rms value]**	**Evaluation method**	**Evaluation parameters**
1700 Hz	0.3 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 1700 Hz 3dB-Bandwidth: 90 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.3 sec	☒ ✕	1500-3200 Hz	3 A	FFT	• Time window 1s • Hanning window, • Min. 80% overlap • Maximum time of exceedance: 0.3s
2000 Hz	0.3 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2000 Hz 3dB-Bandwidth: 90 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.3 sec	☒ ✕	1900-2700 Hz	2.2 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2100 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2*N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances: 1.5 sec

EN 50238-2:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
2300 Hz	0.3 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2300 Hz 3dB-Bandwidth: 90 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.3 sec	☒ ☒	1900-2700 Hz	2.2 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2100 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2*N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances: 1.5 sec
2600 Hz	0.3 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2600 Hz 3dB-Bandwidth: 90 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.3 sec	☒ ☒	1900-2700 Hz	2.2 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 2100 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2*N= 10 • RMS calculation: Integration time: 1 sec Time overlap: min 90 % • Evaluation criterio: Maximum time of exceedance: 1 sec Min. time between two exceedances: 1.5 sec

5.1.22.-RSR122

Tabla A2.30

FRAUSCHER								EV	ERA ERTMS 033281 v.5							
Band	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	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 (3dB points) Integration time: 2 ms	✗	Band 3	1026-1250	119	113	113	BP	4th order; 10 kHz	20% overlap (3dB-points), Integration time 1.5 ms
Band 3 (RSR122 SYS2)	1020 to 1050	99,8	78,3	61,8	BP	4th order 6,0 kHz	20% overlap (3dB points) Integration time: 2 ms	✗	Band 3	1026-1250	119	113	113	BP	4th order; 10 kHz	20% overlap (3dB-points), Integration time 1.5 ms

Tabla A2.31

Rango de frecuencia	Dirección del campo	Aumento de los límites del campo magnético para un tiempo de integración reducido de 0,5 x T_{int} [dB]	Aumento de los límites de campo magnético para un tiempo de integración reducido de 0,25 x T_{int} [dB]
De 27 a 52 kHz	X	2	6
De 27 a 52 kHz	Y, Z	6	12
De 234 a 287 kHz	X, Y, Z	6	12
De 287 a 363 kHz	X, Y, Z	3	6
De 740 a 1026 kHz	X, Y, Z	6	12
De 1020 a 1050 kHz	X, Y, Z	6	12
De 1115 a 1145 kHz	X, Y, Z	6	12

5.1.23.-RSR123

Tabla A2.32

FRAUSCHER								EV	ERA ERTMS 033281 v.5							
Band	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	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
SYS1	1000.0 - ± 1.0	120.5	114.5	114.5	BP	4 ±3.0	Integration time: 2 ms	✓	Band 3	740-1026	106	85	101	BP	4th order; 10 kHz	20% overlap (3dB-points), Integration time: 1.5 ms
SYS2	1228.8 - ± 1.0	119.5	113.6	113.6	BP	4 ±3.0	Integration time: 2 ms	✓	Band 3	1026-1250	119	113	113	BP	4th order; 10 kHz	20% overlap (3dB-points), Integration time 1.5 ms

5.1.24.-RSR180

Tabla A2.33

FRAUSCHER								EV	ERA ERTMS 033281 v.5							
Band	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	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 2	250.0 - ± 1.0	121	113.8	101.0	BP	4 ±5.0	Integration time: 1.5 ms	✓	Band 2	234-287	120	99	100	BP	4th order; 7500 Hz	20% overlap (3dB-points), Integration time: 1.5 ms

5.1.1.-DEF 87-CE (E-CE-95)

Tabla A2.34

EN 50238-3:2020								EV	ERA ERTMS 033281 v.5							
Band	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	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 1	34.1- ± 7.1	93	93	98	BP	4th order 300 Hz	20% overlap (3dB points) Integration time: 1 ms	✓	Band 1	27-41.2	93	93	98	BP	4th order 300 Hz	20% overlap (3dB points) Integration time: 1 ms
Band 1	43- ± 1.8	93	83 / 90	98	BP	4th order 300 Hz	20% overlap (3dB points) Integration time: 1 ms	✓	Band 1	44.8-52	93	93	98	BP	4th order 300 Hz	20% overlap (3dB points) Integration time: 1 ms
Band 1	48.4- ± 3.6	93	93	98	BP	4th order 300 Hz	20% overlap (3dB points) Integration time: 1 ms	✓	Band 1	44.8-52	93	93	98	BP	4th order 300 Hz	20% overlap (3dB points) Integration time: 1 ms

5.1.3.-ME3091 /ME 5091

5.1.3.1.-25 kV CA, 50 Hz LÍMITES DE INTERFERENCIA ELECTROMAGNÉTICA

Tabla A2.35

Orden TMA 576:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
11.000 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 11.000 Hz 3dB-Bandwidth: 1200 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.5 sec	✓	9320-16755	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 11500 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
12.000 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 12.000 Hz 3dB-Bandwidth: 1400 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.5 sec	✓	9320-16755	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 12500 Hz 3dB-Bandwidth: 425 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

Orden TMA 576:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
13.000 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 13.000 Hz 3dB-Bandwidth: 1600 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.5 sec	✓	9320-16755	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 13500 Hz 3dB-Bandwidth: 445 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
14.000 Hz	1.2 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 14.000 Hz 3dB-Bandwidth: 1600 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.5 sec	✓	9320-16755	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 14500 Hz 3dB-Bandwidth: 470 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

Orden TMA 576:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
15.000 Hz	1.2 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 15.000 Hz 3dB-Bandwidth: 1800 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.5 sec	✓	9320-16755	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 15500 Hz 3dB-Bandwidth: 490 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
16.000 Hz	1.2 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 16.000 Hz 3dB-Bandwidth: 2000 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.5 sec	✓	9320-16755	0.33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 16500 Hz 3dB-Bandwidth: 510 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
17.000 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 17.000 Hz 3dB-Bandwidth: 2600 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.5 sec	✗	SIN DATOS			

Orden TMA 576:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
18.000 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 18.000 Hz 3dB-Bandwidth: 2800 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.5 sec	×	SIN DATOS			
19.000 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 19.000 Hz 3dB-Bandwidth: 3000 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.5 sec	×	SIN DATOS			

5.1.3.2.-CC (3 kV, 1,5 kV) LÍMITES DE INTERFERENCIA ELECTROMAGNÉTICA

Tabla A2.36

Orden TMA 576:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
11.000 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 11.000 Hz 3dB-Bandwidth: 1200 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.5 sec	✓	9436-19755 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 11500 Hz 3dB-Bandwidth: 400 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
12.000 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 12.000 Hz 3dB-Bandwidth: 1400 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.5 sec	✓	9436-19755 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 12500 Hz 3dB-Bandwidth: 425 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
13.000 Hz	1.5 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 13.000 Hz 3dB-Bandwidth: 1600 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.5 sec	✓	9436-19755 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 13500 Hz 3dB-Bandwidth: 445 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

Orden TMA 576:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
14.000 Hz	1.2 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 14.000 Hz 3dB-Bandwidth: 1600 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.5 sec	✓	9436-19755 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 14500 Hz 3dB-Bandwidth: 470 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
15.000 Hz	1.2 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 15.000 Hz 3dB-Bandwidth: 1800 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.5 sec	✓	9436-19755 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 15500 Hz 3dB-Bandwidth: 490 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
16.000 Hz	1.2 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 16.000 Hz 3dB-Bandwidth: 2000 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.5 sec	✓	9436-19755 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 16500 Hz 3dB-Bandwidth: 510 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

Orden TMA 576:2020				EV	ERA ERTMS 033281 v.5			
Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters		Frequency range	Interference current limit [rms value]	Evaluation method	Evaluation parameters
17.000 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 17.000 Hz 3dB-Bandwidth: 2600 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.5 sec	✓	9436-19755 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 17500 Hz 3dB-Bandwidth: 510 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
18.000 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 18.000 Hz 3dB-Bandwidth: 2800 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.5 sec	✓	9436-19755 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 18500 Hz 3dB-Bandwidth: 510 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec
19.000 Hz	1 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 19.000 Hz 3dB-Bandwidth: 3000 Hz Butterworth, order 2*N= 6 • RMS calculation: Integration time: ** sec Time overlap: min 50 % • Evaluation criterio: Maximum time of exceedance: 0.5 sec	✓	9436-19755 Hz	0,33 A	Band-Pass Filter	• BP filter characteristics: Centre frequencies range: 19500 Hz 3dB-Bandwidth: 510 Hz Butterworth, order 2*N=6 • RMS calculation: Integration time: 0.04 sec Time overlap: min 50 % • Evaluation criteria: Maximum time of exceedance: 0.04 sec Min. time between two exceedances: 0.08 sec

5.1.4.-AC900

Tabla A2.38

ICF								EV	ERA ERTMS 033281 v.5							
Band	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	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
Out of band	10-27	straight line from 135-130 dB/log(f)	straight line from 135-130 dB/log(f)	straight line from 135-130 dB/log(f)	FFT		Record time 1 ms, Hanning window, 50% overlap, max hold	✓	Out of band	10-27	straight line from 135-130 dB/log(f)	straight line from 135-130 dB/log(f)	straight line from 135-130 dB/log(f)	FFT		Record time 1 ms, Hanning window, 50% overlap, max hold
Band 1	27-41.2 44.8-52	93	93	98	BP	4th order 300 Hz	20% overlap (3dB points) Integration time: 1 ms	✓	Band 1	27-41.2 44.8-52	93	93	98	BP	4th order 300 Hz	20% overlap (3dB points) Integration time: 1 ms
Band 1	41.2-44.8	93	93	98	BP	4th order 320 Hz	20% overlap (3dB points) Integration time: 1ms	✓	Band 1	41.2-44.8	93	83*/90*	98	BP	4th order 320 Hz	20% overlap (3dB points) Integration time: 1ms
Out of band	52-234	130	130	130	FFT		Record time 1 ms, Hanning window, 50% overlap, max hold	✓	Out of band	52-234	130	130	130	FFT		Record time 1 ms, Hanning window, 50% overlap, max hold
Band 2	234-287	120	99	100	BP	4th order; 7500 Hz	20% overlap (3dB-points), Integration time: 1.5 ms	✓	Band 2	234-287	120	99	100	BP	4th order; 7500 Hz	20% overlap (3dB-points), Integration time: 1.5 ms
Band 2	287-363	109	99	91	BP	4th order; 7500 Hz	20% overlap (3dB-points), Integration time 1.5 ms	✓	Band 2	287-363	109	99	91	BP	4th order; 7500 Hz	20% overlap (3dB-points), Integration time 1.5 ms
Out of band	363-740	125	125	125	FFT		Record time 1 ms, Hanning window, 50% overlap, max hold	✓	Out of band	363-740	125	125	125	FFT		Record time 1 ms, Hanning window, 50% overlap, max hold
Band 3	740-1026	106	85	101	BP	4th order; 10 kHz	20% overlap (3dB-points), Integration time: 1.5 ms	✓	Band 3	740-1026	106	85	101	BP	4th order; 10 kHz	20% overlap (3dB-points), Integration time: 1.5 ms
Band 3	1026-1250	119	113	113	BP	4th order; 10 kHz	20% overlap (3dB-points), Integration time 1.5 ms	✓	Band 3	1026-1250	119	113	113	BP	4th order; 10 kHz	20% overlap (3dB-points), Integration time 1.5 ms