ELECTROMAGNETIC COMPATIBILITY (EMC) TEST PLAN

Complete name of Equipment Under Test (EUT)	*GapFiller Electrical Control Box*
Complete name and address of the manufacturer	*EC Engineering Sp. z o.o.* *ul. Armii Krajowej 28* *30-150 Kraków*
Serial number	*Prototype*

Standards used in the test plan	*Comments*
EMC Directive (2014/30/UE)	
PN-EN 50121-3-2:2017-04+A1:2019-07 (EN 50121-3-2:2016+A1:2019)	-
Other	
PN-EN 50155:2018-01 (EN 50155:2017)	*p.13.4.3.2,* *p.13.4.3.3,* *p.13.4.3.4 class S3* *p.13.4.3.5 class C2*

Complete name and address of the customer		
Place and Date (DD-MM-YYYY)		
Prepared by (Name and Surname)		

Table of Contents

Abbreviations used in the test plan:

AAN	*Asymmetric Artificial Network*
AE	*Associated Equipment (can be a local device - located in the test area, or a remote device)*
AMN	*Artificial Mains Network*
BCI	*Bulk Current Injector*
CAV	*CISPR Average value*
CCC	*Capacitive Coupling Clamp*
CDN	*Coupling Decoupling Network*
CMAD	*Common Mode Absorption Device*
CP	*Current probe*
EMC	*Electromagnetic Compatibility*
EM Clamp	*Electro-Magnetic Clamp*
EUT	*Equipment Under Test*
GRP	*Ground Reference Plane*
HCP	*Horizontal Coupling Plane*
LCL	*Longitudinal Conversion Loss*
LISN	*Line Impedance Stabilisation Network*
PK	*Peak Value*
QP	*Quasi-Peak value*
RBW	*Resolution Bandwidth*
RF	*Radio-frequency*
SAC	*Semi-anechoic Chamber*
VCP	*Vertical Coupling Plane*

1 *Description of EUT and AE*

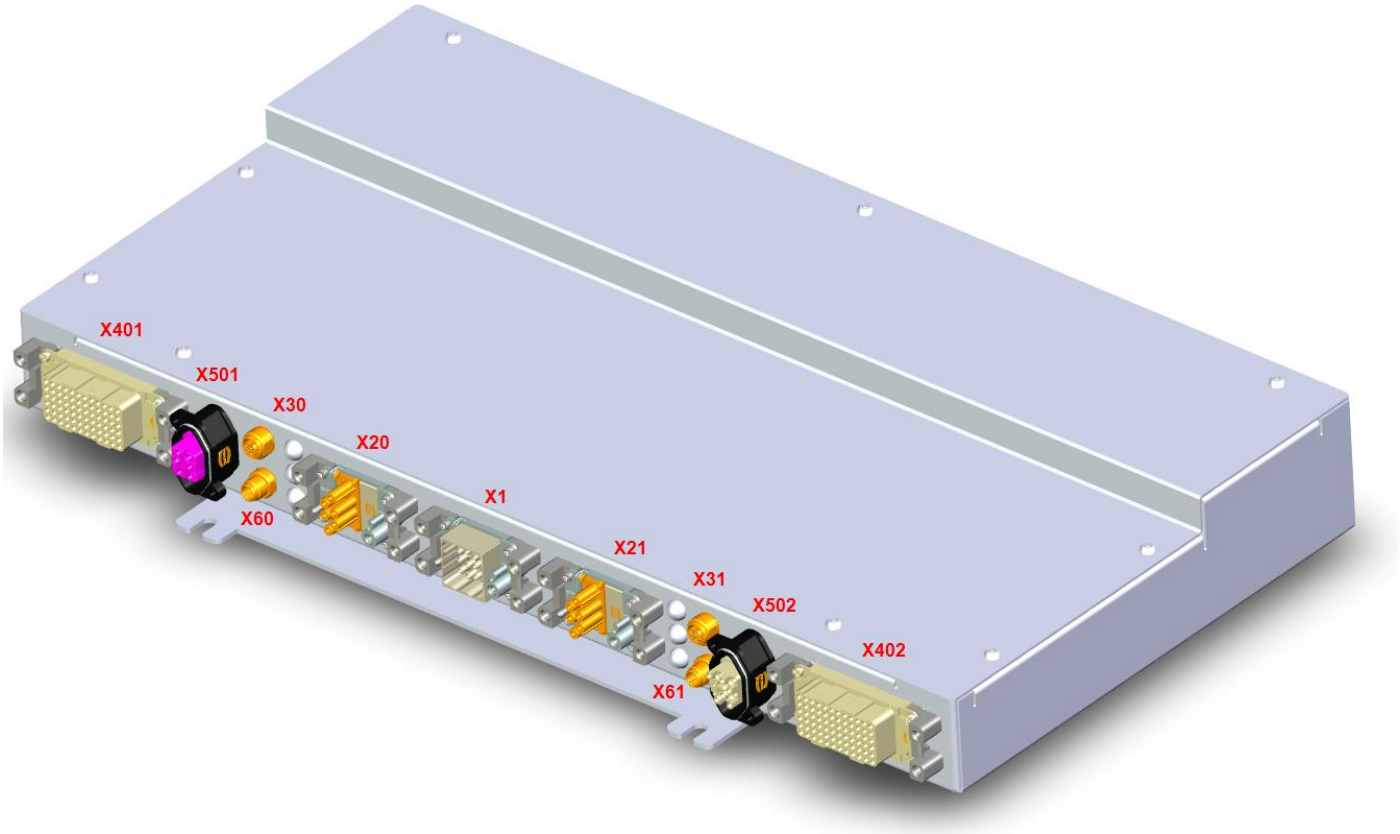
Table 1. General description of Equipment Under Test (EUT)

Intended use and short description	*Rail vehicle Gap Filler control.*	
Permissible ambient temperature and humidity for EUT operation	*Temperature*	*(-20 ÷ +85)°C*
	Humidity	*(0 ÷ 100)%* *without condensation of water vapor*
Power supply of EUT	*110 V DC*	
Frequency of internal frequency source in EUT	*≥ 108 MHz*	

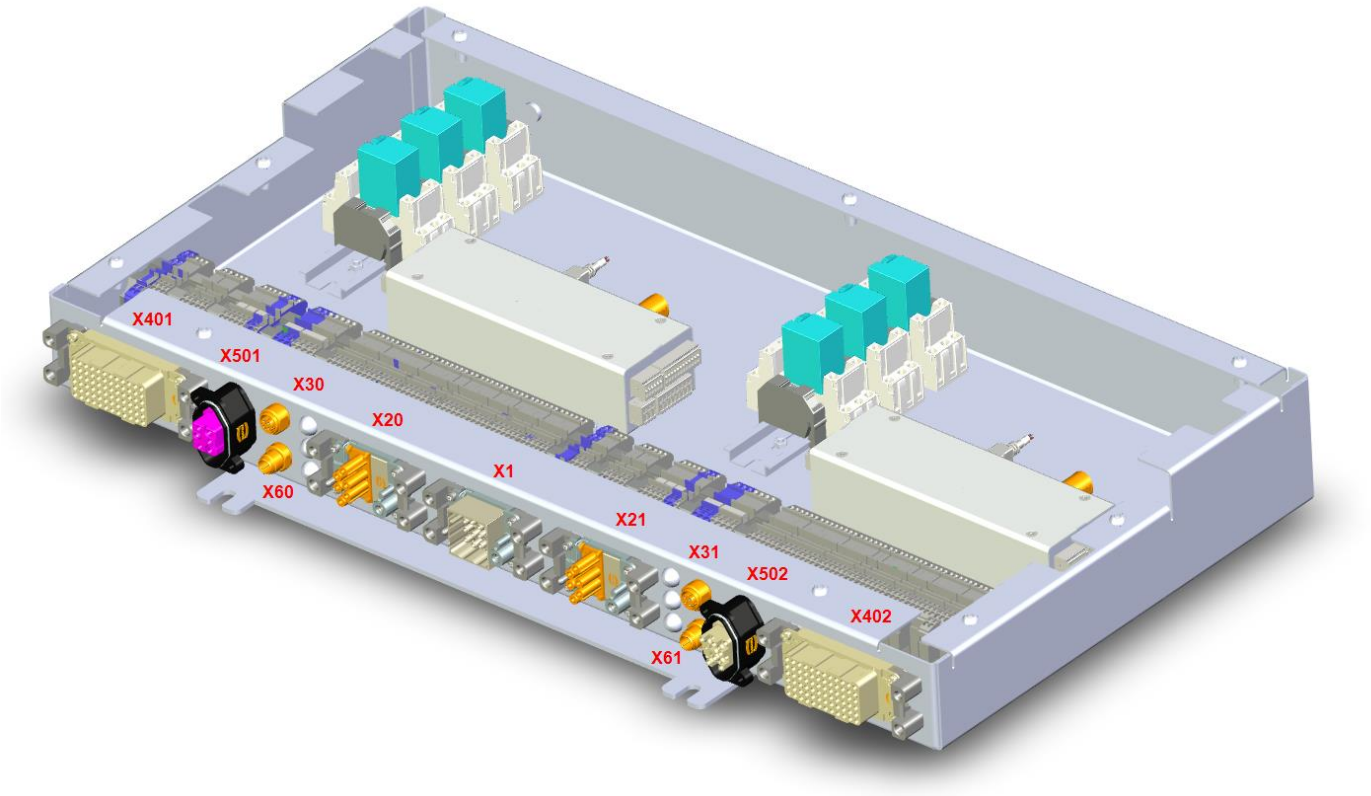
Table 2. Components of EUT (separate EUT housings)

Component of EUT (separate housing)	*Destination of installation*	*The typical position of the housing arrangement*	*Dimensions (W./D./H.)*	*Software / firmware*
GapFiller Electrical Control Box	*EUT installed inside Control Box*	*EUT surface with a signalling LED is the front surface. EUT surface with ETH sockets is the rear surface.*[1)]	(195 x 43 x 60) mm	special version only for EMC tests – prepared to allow continuous motor working

1) During the tests described in points 6.1 and 6.2 EUT should be set on the horizontal position (shown on the picture 1). During the test described in point 7.1 EUT should be set on the vertical position.



Pic. 1. General view of the EUT



Pic. 2. View inside of EUT

EUT connections diagram

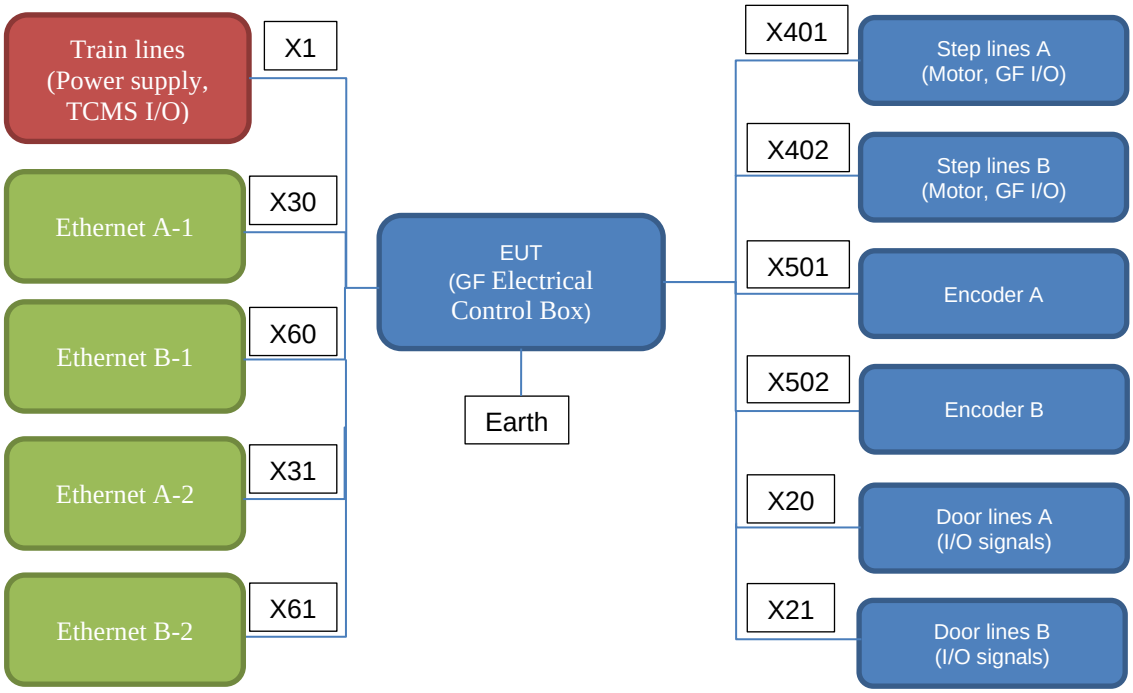


Table 3. ***EUT ports***

Port type and designator	***Port description and pinout***	***Maximum allowable wire length***	***Type of wire during tests***
X1-DC1 *DC Power Supply*	*1 - 110VDC* *15 - 0VDC*	*100 m*	*LIYCY 2x1,5mm^2* *(unshielded cable)*
X1-DC2 *DC Power Supply*	*2 - 110VDC* *16 - 0VDC*	*100 m*	*LIYCY 2x1,5mm^2* *(unshielded cable)*
X1-IOA *Train Inputs/Outputs*	*3 - Spare 1 (wire not connected)* *4 - Spare 2 (wire not connected)* *5 - Train line common 110V A -* *6 - Zero Velocity TL A* *7 - Door opening authorization A* *11 - Step safety loop IN A* *12 - Step safety loop OUT A* *19 - Gap Filler Locked Out (HW) A*	*100 m*	*LIYCY 6x1,5mm^2* *(unshielded cable)*
X1-IOB *Train Inputs/Outputs*	*8 - Train line common 110V B -* *9 - Zero Velocity TL B* *10 - Door opening authorization B* *13 - Step safety loop IN B* *14 - Step safety loop OUT B* *17 - Spare 3 (wire not connected)* *18 - Spare 4 (wire not connected)* *20 - Gap Filler Locked Out (HW) B*	*100 m*	*LIYCY 6x1,5mm^2* *(unshielded cable)*
X30 *Data Ethernet Transmission*	*Ethernet communication with a vehicle*	*100 m*	*cat 5e (shielded cable connected on both sides)*
X31 *Data Ethernet Transmission*	*Ethernet communication with a vehicle*	*100 m*	*cat 5e (shielded cable connected on both sides)*
X60 *Data Ethernet Transmission*	*Ethernet local maintenance port*	*100 m*	*cat 5e (shielded cable connected on both sides)*
X61 *Data Ethernet Transmission*	*Ethernet local maintenance port*	*100 m*	*cat 5e (shielded cable connected on both sides)*

Port type and designator	***Port description and pinout***		***Maximum allowable wire length***	***Type of wire during tests***
X401-IO *Step motor and Inputs/outputs*	*1 - CPS1-1-1* *2 - CPS1-1-2* *3 - CPS1-2-1* *4 - CPS1-2-2* *5 - CPS1-3-1* *6 - CPS1-3-2* *7 - Spare 1* *8 - Spare 2* *9 - CPS2-1-1* *10 - CPS2-1-2* *11 - CPS2-2-1* *12 - CPS2-2-2* *13 - CPS2-3-1* *14 - CPS2-3-2* *15 - CPS2-4-1* *16 - CPS2-4-2* *17 - CS1-1-1* *18 - CS1-1-2* *19 - CS1-2-1* *20 - CS1-2-2* *21 - CS1-3-1* *22 - CS1-3-2* *23 - Spare 3* *24 - Spare 4* *25 - CS2-1-1* *26 - CS2-1-2* *27 - CS2-2-1* *28 - CS2-2-2* *29 - CS2-3-1* *30 - CS2-3-2* *31 - Spare 5* *32 - Spare 6* *33 - LOS1-1-1* *34 - LOS1-1-2* *35 - LOS1-2-1*	*36 - LOS1-2-2* *37 - LOS1-3-1* *38 - LOS1-3-2* *39 - LOS1-4-1* *40 - LOS1-4-2* *41 - LOS2-1-1* *42 - LOS2-1-2* *43 - LOS-2-1* *44 - LOS2-2-2* *45 - LOS2-3-1* *46 - LOS2-3-2* *47 - Spare 7* *48 - Spare 8* *49 - PDS-1-1* *50 - PDS-1-2* *51 - Spare 9* *52 - Spare 10* *53 - PDS-3-1* *54 - PDS-3-2* *55 - Not used* *56 - Not used* *57 - CPS3-1-1* *58 - CPS3-1-2* *59 - CPS3-2-1* *60 - CPS3-2-2* *61 - CPS3-3-1* *62 - CPS3-3-2* *63 - Not used* *64 - Not used* *65 - Not used* *66 - Not used* *67 - Not used* *68 - Not used* *69 - Not used*	*20 m*	*LIYCY* *50x0,5mm^2* *(unshielded cable)*
X401-MOT *Step motor*	*70 - Earth* *71 - Motor+* *72 - Motor-*		*20 m*	*LIYCY; 3x0,5mm^2* *(unshielded cable)*
X501 *Step encoder*	*1 – Signal A* *2 – Signal B* *3 – VCC 12V* *4 – GND*		*20 m*	*LIYCY; 4x0,5mm^2; (shielded cable connected on both sides)*
X502 *Step encoder*	*1 – Signal A* *2 – Signal B* *3 – VCC 12V* *4 – GND*		*20 m*	*LIYCY; 4x0,5mm^2; (shielded cable connected on both sides)*
X20 *Door inputs/outputs*	*1 – Door closed and locked and not locked-out* *2 – Gap Filler Retracted State* *3 – Gap Filler Deployed State* *4 – Gap Filler retracted or locked-out*		*20 m*	*LIYCY; 4x0,5mm^2* *(unshielded cable)*
X21 *Door inputs/outputs*	*1 – Door closed and locked and not locked-out* *2 – Gap Filler Retracted State* *3 – Gap Filler Deployed State* *4 – Gap Filler retracted or locked-out*		*20 m*	*LIYCY; 4x0,5mm^2* *(unshielded cable)*

Port type and designator	***Port description and pinout***		***Maximum allowable wire length***	***Type of wire during tests***
X402-IO *Step motor and Inputs/outputs*	*1 - CPS1-1-1* *2 - CPS1-1-2* *3 - CPS1-2-1* *4 - CPS1-2-2* *5 - CPS1-3-1* *6 - CPS1-3-2* *7 - Spare 1* *8 - Spare 2* *9 - CPS2-1-1* *10 - CPS2-1-2* *11 - CPS2-2-1* *12 - CPS2-2-2* *13 - CPS2-3-1* *14 - CPS2-3-2* *15 - CPS2-4-1* *16 - CPS2-4-2* *17 - CS1-1-1* *18 - CS1-1-2* *19 - CS1-2-1* *20 - CS1-2-2* *21 - CS1-3-1* *22 - CS1-3-2* *23 - Spare 3* *24 - Spare 4* *25 - CS2-1-1* *26 - CS2-1-2* *27 - CS2-2-1* *28 - CS2-2-2* *29 - CS2-3-1* *30 - CS2-3-2* *31 - Spare 5* *32 - Spare 6* *33 - LOS1-1-1* *34 - LOS1-1-2* *35 - LOS1-2-1*	*36 - LOS1-2-2* *37 - LOS1-3-1* *38 - LOS1-3-2* *39 - LOS1-4-1* *40 - LOS1-4-2* *41 - LOS2-1-1* *42 - LOS2-1-2* *43 - LOS-2-1* *44 - LOS2-2-2* *45 - LOS2-3-1* *46 - LOS2-3-2* *47 - Spare 7* *48 - Spare 8* *49 - PDS-1-1* *50 - PDS-1-2* *51 - Spare 9* *52 - Spare 10* *53 - PDS-3-1* *54 - PDS-3-2* *55 - Not used* *56 - Not used* *57 - CPS3-1-1* *58 - CPS3-1-2* *59 - CPS3-2-1* *60 - CPS3-2-2* *61 - CPS3-3-1* *62 - CPS3-3-2* *63 - Not used* *64 - Not used* *65 - Not used* *66 - Not used* *67 - Not used* *68 - Not used* *69 - Not used*	*20 m*	*LIYCY* *50x0,5mm^2* *(unshielded cable)*
X402-MOT *Step motor*	*70 - Earth* *71 - Motor+* *72 - Motor-*		*20 m*	*LIYCY; 3x0,5mm^2* *(unshielded cable)*
EUT earth	*EUT housing screw*		*3 m*	*1x1,5mm^2*

1.1 Multiline ports definitions

1.1.1 X1-IOA - Train Inputs/Outputs

In this port there are only connections to the one side of Control Box (one control unit, one relays set). There are four groups on the port – one pin from one group was chosen:

a) Ground reference of signals for first internal controller and relays.
   Pins in the group: 5
   Chosen pin: 5
b) Electrically connected to the input of first internal controller and relays.
   Pins in the group: 6, 7
   Chosen pin: 6
c) Step safety loop IN A electrically connected to X401 connector.
   Pins in the group: 11, 12
   Chosen pin: 11
d) Electrically connected directly to the output of first internal controller.
   Pins in the group: 19
   Chosen pin: 19

1.1.2 X1-IOB - Train Inputs/Outputs

In this port there are only connections to the one side of Control Box (one control unit, one relays set). There are four groups on the port – one pin from one group was chosen:

a) Ground reference of signals for second internal controller and relays.
   Pins in the group: 8
   Chosen pin: 8
b) Electrically connected to the input of second internal controller and relays.
   Pins in the group: 9, 10
   Chosen pin: 9
c) Step safety loop IN A electrically connected to X402 connector.
   Pins in the group: 13, 14
   Chosen pin: 13
d) Electrically connected directly to the output of second internal controller.
   Pins in the group: 20.
   Chosen pin: 20

1.1.3 X401-IO / X402-IO Step motor and Inputs/outputs

In this port there are only connections between limit switches (all of them multi contacts) in mechanism and Control Box. There are 4 types of connections: connected to X1-IOA / X1-IOB port, connected to X20-IOA or X20-IOB port, connected to relays and connected to the input of internal control unit.

One limit switch has been chosen which has all types of connections:

a) Electrically connected to X1-IOA or X1-IOB port.
   Pins in the group: 1, 2, 7, 8, 9, 10, 17, 18, 25, 26, 33, 34, 41, 42, 57, 58
   Chosen pin: 34
b) Electrically connected to X20-IO or X21-IO port.
   Pins in the group: 3, 4, 11, 12, 15, 16, 19, 20, 23, 24, 27, 28, 35, 36, 43, 44, 49, 50, 59, 60
   Chosen pin: 36
c) Electrically connected directly to the input of internal control unit.
   Pins in the group: 5, 6, 13, 14, 21, 22, 29, 30, 31, 32, 37, 38, 45, 46, 53, 54, 61, 62.
   Chosen pin: 38
d) Electrically connected to relays.
   Pins in the group: 39, 40, 47, 48.
   Chosen pin: 39

Table 4. Associated Equipment (not a part of EUT) required to reproduce the representative operating conditions of EUT

AE name	*Manufacturer*	*Type / model*	*Serial number*	*Grounding connections*	*Software*
Motor with encoder	*Dunkenmotoren*	*GR63X55*		*Grounded*	*-*
Limit switches	*Pizzato*	*NA B222KF-DR2 R24*		*-*	*-*
Panel of trigger buttons for input ports	*RCC Nova*	*-*	*-*	*-*	*-*
Light bulbs panel for output ports status signalling	*RCC Nova*	*-*	*-*	*-*	*-*
PC laptop	*HP*	*Elitebook 820 G4*	*1157001426*	*-*	*MS Windows 7, Oracle VM, ping.exe*
DC Power Supply (LPS1)	*Elektro Automatik*	*EA-PS 5200-04 A*	*2935151072*	*-*	*n.a.*
DC Power Supply (LPS2) (only for PQT tests)	*Merawex*	*ZM110V5A-600R-10*	*19061482*	*-*	*-*
Ethernet switch	*Oring*	*IES-150B*	*020077A01361*	*Grounded*	*-*

2 *Representative operating conditions of EUT during tests*

Measurements of disturbances should be made only for Mode II. Immunity tests should be made only for Mode I, with exception of voltage dips, short interruptions and voltage variations on d.c. input power port immunity test, which should be made for both Mode I and Mode II independently.

Mode I
- *Frequency of subsequent queries (ping) on the ETH port – 2/s,*
- *Zero Velocity, Door Closed inputs activated,*
- *Door opening Authorization input not activated*
- *Motor is not working,*
- *Green indicator blinking,*
- *Yellow and Red indicator not illuminated.*

Mode II
- *Frequency of subsequent queries (ping) on the ETH port – 2/s,*
- *Zero Velocity, Door Closed inputs activated*
- *Door opening Authorization activated*
- *The motor is working and operating without load*
- *Green indicator blinking,*
- *Yellow and Red indicator not illuminated.*

Table 5. Basic functionality of EUT, determining its minimal operating level

Basic EUT functionality	*Chosen method of EUT observation during tests*
1. Idle mode – motor not working	*Observation of motor, observation of Green, Yellow and Red indicators and bulbs showing EUT outputs states – GF Locked Out, GF retracted State, GF open, GF retracted_or_locked-out*
2. Continuous operation mode – motor is working and simulates opening/closing Gap Filler	*Observation of motor, observation of Green, Yellow and Red indicators and bulbs showing EUT outputs states – GF Locked Out, GF retracted State, GF open, GF retracted_or_locked-out*
3. Ethernet communication	*Observation of communication using the computer program "ping.exe"*

3 *Confirmation procedure of executing the key functions of EUT and confirmation of correct functioning of AE before and after finishing the test*

Confirmation procedure of executing the key functions of EUT and confirmation of correct functioning of AE before and after finishing the test:

1. Activate Zero Velocity, Door Closed inputs. The motor shouldn't react
2. Additionaly activate Door opening Authorization input – motor should start.
3. Disactivation of Door opening Authorization input - should stopped the motor.
4. Activation of Door opening Authorization input again - should start the motor rotating in opposite direction.
5. GF open, GF retracted_or_locked-out outputs should be steady not present.
6. GF retracted State should be present only if GF is fully closed.
7. GF Locked Out should be present only if Lock-out is activated on mockup.

4 *Performance criteria in the immunity tests*

4.1 *Guidelines from the harmonized standard*

EN 50121-3-2:2016+A1:2019

"4 Performance criteria
The variety and the diversity of the apparatus within the scope of this standard make it difficult to define precise criteria for the evaluation of the immunity test results.

A functional description and a definition of performance criteria, during or as a consequence of the EMC testing, shall be provided by the manufacturer and noted in the test report, based on the criteria A, B, C defined in EN 50121-1:2017."

EN 50121-1:2017

"4 Performance criteria
NOTE This clause is based on EN 61000-6-2.

The variety and the diversity of the apparatus within the scope of this set of standards makes it difficult to define precise criteria for the evaluation of the immunity test results.

A functional description and a definition of performance criteria, during or as a consequence of the EMC testing, shall be provided by the manufacturer and noted in the test report, based on the following criteria:

- Performance criterion A: The apparatus shall continue to operate as intended during and after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. The performance level may be replaced by a permissible loss of performance. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation, and from what the user may reasonably expect from the apparatus if used as intended.

- Performance criterion B: The apparatus shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. The performance level may be replaced by a permissible loss of performance. During the test, degradation of performance is however allowed. No change of actual operating state or stored data are allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation, and from what the user may reasonably expect from the apparatus if used as intended.

- Performance criterion C: Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls."

PN-EN 50155:2018-01 (EN 50155:2017)

- General

The nominal performance level of the electronic equipment may be replaced by a permissible loss of performance. In the text below if performance criteria A, B or C are used in clause 4 to 12 the word "test" shall be replaced by "event". The minimum performance level shall be defined.

If the minimum performance level or the permissible loss of performance is not specified by the supplier, either of these may be derived from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.

No damage to any connected equipment is allowed when the electronic equipment does not operate as intendent during or after the test. Possible causes of failure are incorrect timing of output signals, overvoltage outside specifications, etc.

- Performance criterion A

The apparatus shall continue to operate as intended during and after the test/event. No degradation of performance or loss of function is allowed.

If agreed between the involved parties, the normal performance level (all functions are working as specified) can be replaced by a minimum performance level.

- Performance criterion B

The apparatus shall continue to operate as intended after the test/event.

During the test/event, degradation of performance is however allowed.

Changes of actual operating state or stored data are not allowed.

- Performance criterion C

During the test/event temporary loss of function is allowed. The equipment could:

- automatically restart. The normal performance shall be obtained within a maximum defined time. After this time the equipment shall retain the previous operating state and shall work as intended. The loss of significant data is not allowed; or

- manually restart or process controlled restart. In this case this shall be agreed between user and supplier and/or clearly defined in the user manual. In this case the user manual shall be available to the user at the tender stage.

Note: Significant stored data are application dependent and stated into the Performance specifications."

4.2 *Detailed performance criteria*

Performance criterion A

During the test there is not allowed:
- starting the motor when the EUT is in mode I and stopping the motor when the EUT is in mode II,
- stopping illumination of *Green indicator*
- starting illumination of *Yellow or Red indicator*
- *changing status of outputs: GF Locked Out,* GF retracted State, GF open, GF retracted_or_locked-out manifested by a change in the status of any of the light bulbs indicating the state of those outputs
- Ethernet communication interruption, taken as a loss of response to more than two ping requests in a row.

It is acceptable:
- changing the light intensity of the bulb reflecting the status of outputs,
- motor speed change but without changing the direction of rotation.

Performance criterion B

During the test there is not allowed:
- starting the motor when the EUT is in mode I and stopping the motor when the EUT is in mode II,
- *changing status of outputs: GF Locked Out,* GF retracted State, GF open, GF retracted_or_locked-out manifested by a change in the status of any of the light bulbs indicating the state of those outputs
- starting illumination of *Yellow or Red indicator*
- *missing more than 9 ethernet pings (sended 10times per second)*
- *information NOK received from stable test algorithm used only at EMC tests caused by: encoder speed not stable, unintended changing state of any inputs, unstable motor current*

It is permissible:
- changing the light intensity of the bulb reflecting the status of outputs,
- motor speed change but without changing the direction of rotation.
- stopping illumination of *Green indicator if it starts illumination automatically*

Performance criterion C

- not used

5 Decision rules regarding the statement of conformity

***For the results of conducted and radiated radio disturbances measurements and measurement of disturbance power**, the test report will contain information on measurement uncertainty U_{lab} estimated according to EN 55016-4-2. The test report will also contain the statement of conformity of the measurement result. Compliance or non-compliance with a disturbance limit given in the test plan will be determined in the following manner.*

If U_{lab} will be less than or equal to U_{cispr}, then:

- *the test report will contain the statement of conformity, if no measured disturbance level exceeds the disturbance limit,*
- *the test report will contain the statement of non-conformity, if any measured disturbance level exceeds the disturbance limit.*

If U_{lab} will be greater than U_{cispr}, then:

- *the test report will contain the statement of conformity, if no measured disturbance level, increased by (U_{lab} - U_{cispr}), exceeds the disturbance limit,*
- *the test report will contain the statement of non-conformity, if any measured disturbance level, increased by (U_{lab} - U_{cispr}), exceeds the disturbance limit.*

6 *Immunity tests*

6.1 Immunity to conducted disturbances, induced by radio-frequency fields

Test standard	*PN-EN 61000-4-6:2014-04 (EN 61000-4-6:2014)*
Frequency range	*(0,15÷80) MHz*
The step of frequency change	*1%*
Modulation parameters	*AM, 1 kHz, 80%*
The dwell time the exposure for each frequency step	*1 s*
Performance criterion	*A (acc. pt. 4.2 of the test plan)*

EUT ports subjected to exposure		
EUT port	*Test level*	*Coupling method*
X1-DC1, DC Power Supply	*20 V r.m.s.*	*CDN*
X1-DC2, DC Power Supply	*20 V r.m.s.*	*CDN*
X1-IOA, Train Inputs/Outputs, (pins 5, 6,11,19)	*20 V r.m.s.*	*CDN*
X1-IOB, Train Inputs/Outputs, (pins 8, 9, 13, 20)	*20 V r.m.s.*	*CDN*
X501, Step encoder, (pins 1, 2, 3, 4)	*20 V r.m.s.*	*CDN*
X502, Step encoder, (pins 1, 2, 3, 4)	*20 V r.m.s.*	*CDN*
X20, Door inputs/outputs, (pins 1,2,3,4)	*20 V r.m.s.*	*CDN*
X21, Door inputs/outputs, (pins 1,2,3,4)	*20 V r.m.s.*	*CDN*
Step motor and Inputs/outputs (X401)	*20 V r.m.s.*	*EM Clamp*
Step motor and Inputs/outputs (X402)	*20 V r.m.s.*	*EM Clamp*
ETH(X30)	*20 V r.m.s.*	*EM Clamp*
ETH(X31)	*20 V r.m.s.*	*EM Clamp*
ETH(X60)	*20 V r.m.s.*	*EM Clamp*
ETH(X61)	*20 V r.m.s.*	*EM Clamp*

6.2 Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests

Test standard	*PN-EN 61000-4-29:2004 (EN 61000-4-29:2000)*
EUT rated power supply voltage	*110 V DC*
Number of dips / interruptions for each test level	*10*

Note: During all tests, the generator should supply the EUT with attached associated equipment (AE).

Requirements p. 13.4.3.2 of PN-EN 50155:2018-01 (EN 50155:2017) standard

EUT port	*Test level*	*The time between dips / interruptions*	*Generator impedance*	*Performance criterion (acc. pt. 4.2 of the test plan)*
X1-DC1, X1-DC2	*Continuous EUT operation at voltage decreased to 70% U_T*	*not applicable*	*not applicable*	*A + confirm. procedure acc. p. 3*
X1-DC1, X1-DC2	*Continuous EUT operation at voltage increased to 125% U_T*	*not applicable*	*not applicable*	*A + confirm. procedure acc. p. 3*
X1-DC1, X1-DC2	*Voltage variations 140% U_T / 100 ms*	*30 s*	*not applicable *)*	*A*
X1-DC1, X1-DC2	*Voltage variations 140% U_T / 1 s*	*30 s*	*not applicable *)*	*B*

U_T – rated EUT supply voltage
*) the maximum EUT current with the engine running (no load) should not be greater than 70% of the current efficiency of the power supply used to power the EUT. It is not required to monitor the time of obtaining the increased voltage on the EUT terminals.

Requirements p. 13.4.3.3 of PN-EN 50155:2018-01 (EN 50155:2017) standard

EUT port	*Test level*	*The time between dips / interruptions*	*Generator impedance*	*Performance criterion (acc. pt. 4.2 of the test plan)*
X1-DC1, X1-DC2	*Voltage dips 60% U_T / 100 ms*	*10 s*	*high *)*	*A*

U_T – rated EUT supply voltage
*) typically this type of dip is carried out under conditions representing low mains impedance, however, the presence of a diode protection system in the EUT against voltage reverse polarity excludes reverse current flow. For this reason, it was considered sufficient for the purposes of this test to use a generator based on power supplies having a high impedance character (when switching the power supply to a circuit that initially had a higher voltage than that set in this power supply). It is not required to monitor the time of obtaining the reduced voltage on the EUT terminals.

Requirements p. 13.4.3.4 of PN-EN 50155:2018-01 (EN 50155:2017) standard for class S3

EUT port	*Test level*	*The time between dips / interruptions*	*Generator impedance*	*Performance criterion (acc. pt. 4.2 of the test plan)*
X1-DC1, X1-DC2	*Voltage interruptions 0% U_T / 20 ms*	*10 s*	*low *)*	*A*

U_T –rated EUT supply voltage
**) low impedance should be achieved by disconnecting the (+) EUT line from the power supply and connecting it to the (-) EUT line, causing the EUT DC port to short. It is not required to monitor the time of obtaining the reduced voltage on the EUT terminals.*

Requirements p. 13.4.3.5 of PN-EN 50155:2018-01 (EN 50155:2017) standard for class C2

EUT port	*Test level*	*The time between dips / interruptions*	*Generator impedance*	*Performance criterion (acc. pt. 4.2 of the test plan)*
X1-DC1, X1-DC2	*Voltage interruptions 0% U_T / 30 ms*	*10 s*	*high *)*	*B*

U_T – rated EUT supply voltage
**) high impedance should be achieved by opening the (+) EUT line from the power supply, causing the DC EUT port to open. It is not required to monitor the time of obtaining the reduced voltage on the EUT terminals.*

7 *Radio disturbance measurement*

7.1 Measurement of radiated radio disturbances

Test standard	*PN-EN 55016-2-3:2017-06+A1:2020-01 (EN 55016-2-3:2017+A1:2019)*

The height of the EUT insulating support above GRP	*80 cm*
Measuring distance	*3 m*
EUT ports subjected to test	*Enclosure*
EUT ports connected by CMAD clamps	*X30, X31, X60*

Frequency range	*Disturbance limit [dBµV/m]*			RBW [kHz]	*Comments*
	PK	QP	CAV		
(30÷230) MHz	*-*	*50*	*-*	*120 kHz*	*acc. to: PN-EN 61000-6-4:2008+A1:2012 (EN 61000-6-4:2007+A1:2011) table 1, SAC meas., limit levels (calculated) for measuring distance of 3 m*
(230÷1000) MHz	*-*	*57*	*-*		
(1000÷3000) MHz	*76*	*-*	*56*	*1 MHz*	*acc. to: PN-EN 61000-6-4:2008+A1:2012 (EN 61000-6-4:2007+A1:2011) table 1, SAC meas., SAC with absorbers acc. CISPR 16-1-4, limit levels for measuring distance of 3 m*
(3000÷6000) MHz	*80*	*-*	*60*		

THE END OF TEST PLAN