

# Product overview

## Connectors for applications in bus and rail vehicles



# M12/RJ45 cable assemblies and connectors from METZ CONNECT for applications in bus and rail vehicles

The latest generation of modern passenger transport vehicles (buses and rail vehicles) now have Ethernet networks that connect active network devices (ETBN, repeaters, switches) and end devices such as cameras, digital entertainment systems, WiFi access points, and displays for status information and supply them with power and data.

Passive components such as cables and connectors that meet the unique needs of the respective place of application are used to make the physical connection. For this purpose, cables with increased protection requirements against fires and their effects in bus and rail vehicles, as well as connectors with increased mechanical load and protection class, which still function perfectly even under strong vibrations and mechanical vibrations, are used.

The product range for bus and rail vehicle applications includes M12 plugs and jacks (D and X coded) for field assembly, as well as cable assemblies with different transmission properties (Cat.5, Cat.7) and lengths. These can be combined with a variety of connectors, including RJ45 and M12 connectors. Choosing the right Ethernet connector for bus and rail vehicles depends on the specific requirements of the application.

METZ CONNECT provides you with the appropriate cable assemblies and connectors to the highest quality standards, which are manufactured and tested in accordance with current standards and regulations. Connectors from the product range establish a secure connection to Ethernet networks.



## Relevant standards for bus applications

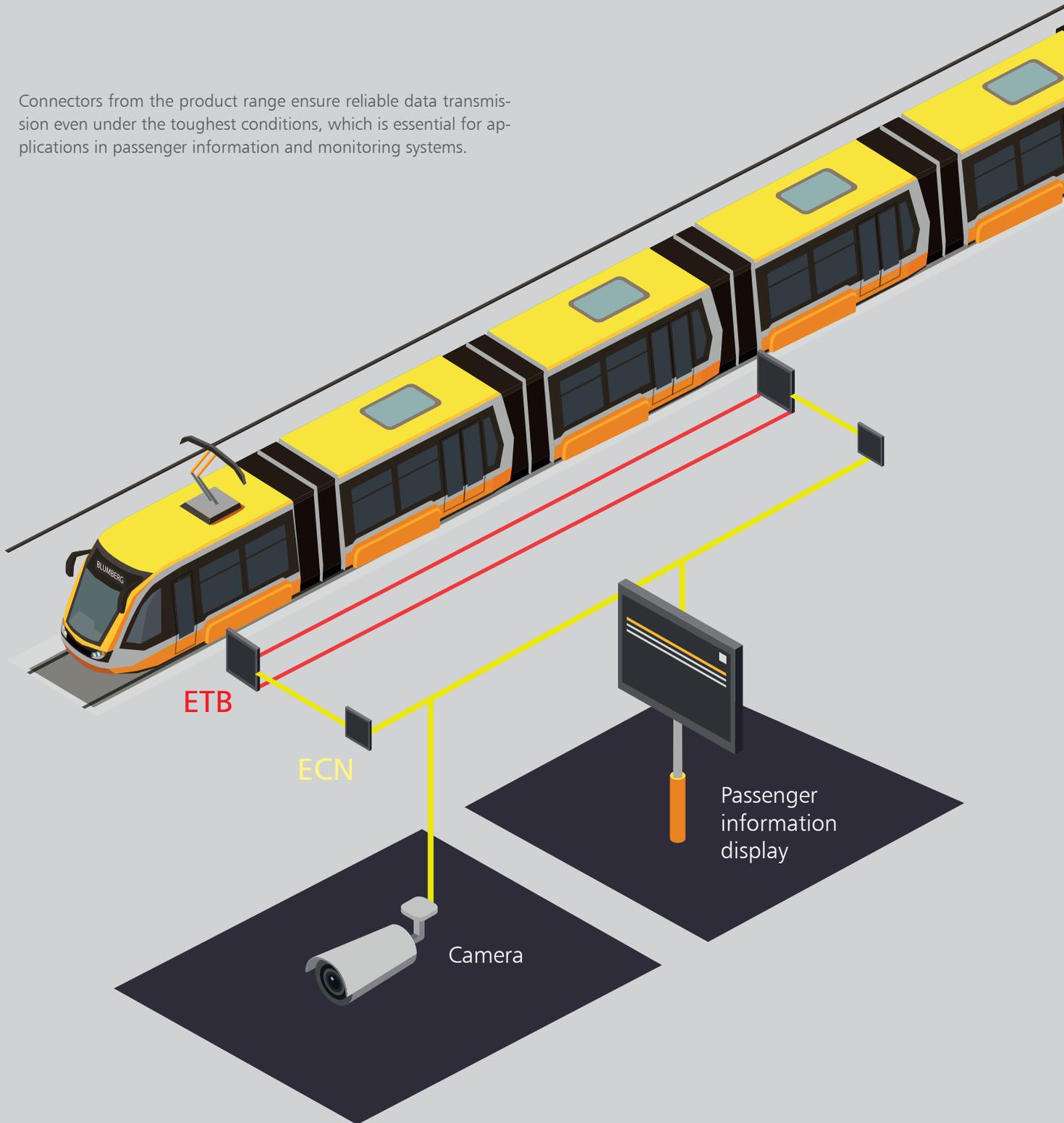
- > ECE R118 (fire behavior of wire)
- > IEC 60529; 2009-09 | Protection classes due to housing (IP code)
- > IEC 61076-2-109 or IEC 61076-2-101 (connector type testing)



## Relevant standards for rail vehicle applications

- > DIN EN 45545-1 and DIN EN 45545-2 | Fire behavior
- > DIN EN 50155 | Mechanical load
- > IEC 60529; 2009-09 | Protection classes due to housing (IP code)
- > IEC 61076-2-109 or IEC 61076-2-101 (connector type testing)

Connectors from the product range ensure reliable data transmission even under the toughest conditions, which is essential for applications in passenger information and monitoring systems.





## Cable assembly for bus vehicles

### Cable type: AWG 22/19 PUR Cat.5e

Shielded PUR wire for secure data transmission in buses. The wire is UL-verified and fulfills the requirements of Cat.5e (electrical properties based on EN50288-2-1). The materials and design of the wire allow for increased mechanical stress (abrasion, bending, vibrations, etc.). The requirements of UN/ECE-R 118 Fire safety in buses and coaches are met. The wire with high fire protection is particularly suitable for use in buses, e.g., for passenger entertainment and information systems and ticket or stop signaling systems.

#### WIRE PROPERTIES:

- > Outer coat diameter:  $\varnothing$  (6.5 ± 0.2) mm
- > Material: PUR
- > Buffer diameter/strand structure: AWG22/19
- > Buffer insulation material: PE
- > Buffer colors: 1 YE, 2 WH, 3 OG, 4 BU
- > Temperature range: permanently installed -40 to +80°C, moving -20 to +80°C
- > Torsion: +/-180°/m, ≥ 5 million cycles
- > Drag-chain compatible: max. 20m/s<sup>2</sup> 5 million cycles
- > Category: Cat.5e
- > Shielding: yes

#### SPECIFIC PROPERTIES:

Flame-retardant, seawater-resistant, recyclable, PWIS-free, RoHs-compliant, acid- and alkali-resistant, ozone-resistant, UV-resistant, hydrolysis-resistant, drag chain-compatible, torsion-capable, halogen-free, oil-resistant, high flexibility, microbe-resistant, PROFINET Type R, UN ECER118

#### FIRE PROTECTION:

- > Fire safety in buses and coaches according to UN/ECE R118
- > Flame-retarding according to IEC 60332-1-2

#### POSSIBLE CONNECTOR HEADS:

- > M12 connector, D coded
- > M12 connector, D coded angled
- > M12 connector, D coded with flange
- > M12 connector, D coded with flange angled
- > RJ45 connector, molded



Standard versions available in the following lengths: 1.0 m, 2.0 m, 5.0 m, 10.0 m. Further lengths can be found on our website or in the configurator: [www.metz-connect.com/configurator](http://www.metz-connect.com/configurator)





### Cable type: AWG 22/7 PUR Cat.5e

Shielded PUR wire for secure data transmission in buses. The wire is CMX-verified and fulfills the requirements of Cat.5e (electrical properties based on EN50288-2-1). The materials and design of the wire allow for increased mechanical stress (abrasion, bending, vibrations, etc.). Use in drag chains with up to 3 million bending cycles is possible without risk. The requirements of UN/ECE-R 118 Fire safety in buses and coaches are met. The wire with high fire protection is particularly suitable for use in buses, e.g., for passenger entertainment and information systems and ticket or stop signaling systems.

#### WIRE PROPERTIES:

- > Outer coat diameter:  $\varnothing$  (6.5 ± 0.2) mm
- > Material: PUR
- > Buffer diameter/strand structure: AWG22/7
- > Buffer insulation material: FRNC
- > Temperature range: permanently installed -40 to +70°C, moving -20 to +60°C
- > Drag-chain compatible: max. 4m/s<sup>2</sup> 3 million cycles
- > Category: Cat.5e
- > Shielding: yes

#### SPECIFIC PROPERTIES:

Flame-retardant, seawater-resistant, recyclable, PWIS-free, RoHs-compliant, acid- and alkali-resistant, ozone-resistant, UV-resistant, hydrolysis-resistant, drag chain-compatible, halogen-free, oil-resistant, high flexibility, microbe-resistant, UN/ECE-R 118, PROFINET Type C

#### FIRE PROTECTION:

- > Fire safety in buses and coaches according to UN/ECE R118
- > Flame-retarding according to IEC 60332-1-2

#### POSSIBLE CONNECTOR HEADS:

- > M12 connector, D coded
- > M12 connector, D coded angled
- > M12 connector, D coded with flange
- > M12 connector, D coded with flange angled
- > RJ45 connector, molded



Standard versions available in the following lengths: 1.0 m, 2.0 m, 5.0 m, 10.0 m. Further lengths can be found on our website or in the configurator: [www.metz-connect.com/configurator](http://www.metz-connect.com/configurator)



## Cable assembly for bus and rail vehicles



### Cable type: AWG 22 EM 104 Cat.5

Halogen-free, electron-beam cross-linked Cat.5 wire with improved fire resistance. Very good properties in terms of NEXT, damping and shield design. This wire is used in fixed and protected installations in rail vehicles and buses and fulfills the fire protection requirements in accordance with EN 45545-2 (HL1 - HL3). It is ideally suited to Ethernet applications of class D (ECN) according to IEEE 802.3. For installation, the instructions according to EN 50355 and EN 50343 must be observed. Due to the thin diameter, this wire is particularly suitable for connecting the molded RJ45 connectors. RADOX® is a registered trademark of HUBER+SUHNER AG, Switzerland

#### WIRE PROPERTIES:

- > Outer coat diameter:  $\varnothing$  (6.6 ± 0.2) mm
- > Material: RADOX® EM 104
- > Coat color: blue
- > Buffer diameter/strand structure: AWG22 1x4 star quad
- > Buffer insulation material: RADOX® FOAM
- > Buffer colors: 1 WH,2 BU,3 OG,4 YE
- > Bending radius: permanent: 6 x  $\varnothing$  wire
- > Temperature range: permanently installed -50 to 90°C
- > Halogen-free: yes
- > Category: Cat.5
- > Shielding: yes

#### SPECIFIC PROPERTIES:

Flame-retardant, RoHS-compliant, halogen-free, increased thermal resistance, low smoke emission, oil- and fuel-resistant, UN/ECE R118

#### FIRE PROTECTION:

- > Fire protection DIN EN 45545-2 HL1-3
- > DIN 5510 fire protection levels 1-4
- > NF F16-101 category A1, A2, B, UNI CEI 11170
- > Risk level LR1-LR4
- > Fire protection in coaches UN/ECE R118

#### POSSIBLE CONNECTOR HEADS:

- > M12 connector, D coded
- > M12 connector, D coded angled
- > M12 connector, D coded with and without flange
- > M12 connector, D coded with and without flange angled
- > RJ45 connector, molded



Standard versions available in the following lengths: 1.0 m, 2.0 m, 5.0 m, 10.0 m. Further lengths can be found on our website or in the configurator: [www.metz-connect.com/configurator](http://www.metz-connect.com/configurator)





### Cable type: AWG22 Polyolefin copolymer Cat.5

Halogen-free, electron-beam cross-linked Cat.5 data wire with improved behavior in the event of fire and increased temperature resistance. This wire is used in fixed and protected installations in rail vehicles and buses and fulfills the fire protection requirements in accordance with EN 45545-2 (HL1 - HL3). It is ideally suited to applications of class D (ECN) according to IEEE 802.3. For installation, the instructions according to EN 50355 and EN 50343 must be observed. Due to the thin wall thicknesses, this wire is particularly suitable for connecting the molded RJ45 connectors. BETAtrans® is a registered trademark of LEONI Studer AG, Switzerland.

#### WIRE PROPERTIES:

- > Outer coat diameter:  $\varnothing$  (6.6 ± 0.2) mm
- > Material: BETAtrans® Polyolefin copolymer
- > Coat color: blue
- > Buffer diameter/strand structure: AWG22/7 1x4 star quad
- > Buffer insulation material: BETAtrans® cell PE
- > Buffer colors: 1 YE, 2 WH, 3 OG, 4 BU
- > Bending radius: permanent: 5 x  $\varnothing$  wire, moving: 6 x  $\varnothing$  wire
- > Temperature range: permanently installed -40 to +85°C
- > Halogen-free: yes
- > Category: Cat.5
- > Shielding: yes

#### SPECIFIC PROPERTIES:

Flame-retardant, PWIS-free, RoHS-compliant, halogen-free, increased thermal resistance, low smoke emission, oil- and fuel-resistant, UN/ECE R118

#### FIRE PROTECTION:

- > Fire protection DIN EN 45545-2 HL1-3
- > DIN 5510 fire protection levels 1-4
- > NF F16-101 category A1, A2, B, UNI CEI 11170
- > Risk level LR1-LR4
- > Fire protection in coaches UN/ECE R118

#### POSSIBLE CONNECTOR HEADS:

- > M12 connector, D coded
- > M12 connector, D coded angled
- > M12 connector, D coded with and without flange
- > M12 connector, D coded with and without flange angled
- > RJ45 connector, molded



Standard versions available in the following lengths: 1.0 m, 2.0 m, 5.0 m, 10.0 m. Further lengths can be found on our website or in the configurator: [www.metz-connect.com/configurator](http://www.metz-connect.com/configurator)





### Cable type: AWG24 EM 104 Cat.7

Halogen-free, electron-beam cross-linked 1200 MHz data bus wire with improved behavior in the event of fire. It is better than category 7 according to EN 50288 and IEC 61156 and has an outstanding NEXT, low damping and excellent shielding properties (pair and overall shielding) as well as a low skew. This wire fulfills the fire protection requirements according to EN 45545-2 (HL1 - HL3). The coat corresponds to the requirements of EM 104 according to EN 50264-1, EN 50306-1 and class M according to EN 50306-4. In the harsh environment of railway vehicles, this wire proves itself with its excellent resistance to oils and fuels.

#### WIRE PROPERTIES:

- > Outer coat diameter:  $\varnothing$  (8.1  $\pm$  0.2) mm
- > Material: RADOX<sup>®</sup> EM 104
- > Coat color: blue
- > Buffer diameter/strand structure: AWG24 4x2
- > Buffer insulation material: RADOX<sup>®</sup> FOAM
- > Buffer colors: 1 WHOG, 2 OG; 3 WHGN, 4 GN; 5 WHBN, 6 BN; 7 WHBU, 8 BU
- > Bending radius: permanent: 4 x  $\varnothing$  wire
- > Temperature range: permanently installed -50 to +70°C
- > Halogen-free: yes
- > Category: Cat.7
- > Shielding: yes

#### SPECIFIC PROPERTIES:

Flame-retardant, RoHs-compliant, halogen-free, increased thermal resistance, low smoke emission, oil- and fuel-resistant, uv-resistant

#### FIRE PROTECTION:

- > Fire protection in rail vehicles EN 45545-2
- > Fire protection in rail vehicles 50264-1, EN 50306-1
- > Fire safety in buses and coaches UN/ECE R118
- > Material properties of the coat EN 50264-1 EM 104 EN 50306-1

#### POSSIBLE CONNECTOR HEADS:

- > M12 connector, X coded
- > M12 jack, X coded with flange



Standard versions available in the following lengths: 1.0 m, 2.0 m, 5.0 m, 10.0 m. Further lengths can be found on our website or in the configurator: [www.metz-connect.com/configurator](http://www.metz-connect.com/configurator)





[www.metz-connect.com/configurator](http://www.metz-connect.com/configurator)

## M12 connectors and jacks for field assembly D and X coded

M12 connectors for field assembly with EMC protection are suitable for assembling connectors of connection wires with different lengths or for repairing defective connectors on site. Our M12 connectors for field assembly with screw cap and insulation displacement connection are suitable for the bus and railway industry and are available in different versions.

### Product properties

- > X coded based on IEC PAS 61076-2-109
- > D coded based on DIN EN 61076-2-101
- > Connection of AWG 26/1 - 22/1, AWG 26/7 - 22/7
- > Conductor diameter CU full core 0.4 to 0.64 mm
- > Conductor diameter CU strand 0.48 to 0.76 mm
- > Core diameter up to 1.6 mm
- > Robust die-cast zinc housing
- > IP67 when plugged
- > Simple assembly - connect without special tools
- > Suitable for applications in the railway industry according to the data sheet

### M12 jacks for field assembly

	PRODUCT NAME	FEATURE 1	FEATURE 2	P/N
	M12 jack	4-pole, D coded, without flange	cable sheath from 6.0 to 9.7 mm	MMF881A115
	M12 jack	4-pole, D coded, with flange	cable sheath from 6.0 to 9.7 mm	MMF881A115-0001
	M12 jack	4-pole, D coded, without flange	cable sheath from 4.0 to 6 mm	MMF891A115
	M12 jack	4-pole, D coded, with flange	cable sheath from 4.0 to 6 mm	MMF891A115-0001
	M12 jack	8-pole, X coded, without flange	cable sheath from 6.0 to 9.7 mm	MMF881A315
	M12 jack	8-pole, X coded, with flange	cable sheath from 6.0 to 9.7 mm	MMF881A315-0001

### M12 connector for field assembly

	PRODUCT NAME	FEATURE 1	FEATURE 2	P/N
	M12 connector	4-pole, D coded on RJ45	cable sheath from 6.0 to 9.7 mm	MNF881A115
	M12 connector	4-pole, D coded on RJ45	cable sheath from 4.0 to 6.0 mm	MNF891A115
	M12 connector	8-pole, X coded on RJ45	cable sheath from 6.0 to 9.7 mm	MNF881A315-0001

### M12 switch cabinet bushing

	PRODUCT NAME	FEATURE 1	FEATURE 2	P/N
	M12 switch cabinet bushing	4-pole, D coded on RJ45	straight angled	MWN811A115 MWN911A115
	M12 switch cabinet bushing	8-pole, X coded on RJ45	straight angled	MWN811A415 MWN911A415

### M12 accessories

	PRODUCT NAME	FEATURES	P/N
	M12 connector protective cap IP54	protective cap M12x1 for connector, screw-on, black, similar to RAL9005	700669
	M12 jack screw-on plugs IP54	protective plugs M12x1 for adapter, screw-on, black, similar to RAL9005	700701



# D coded

## M12 round connector

### printed circuit board jacks – 4-pole, D coded

	PRODUCT NAME	CONNECTION TYPE	MOUNTING / COLOUR	P/N
	M12 printed circuit board jack	solderable, 90° angled	<2.5 mm wall thickness <4.0 mm wall thickness <5.0 mm wall thickness	MMT471A115 MMT471A115-0001 MMT471A115-0002
	M12 printed circuit board jack	solderable	front mounting	MMW360A1A1
	M12 printed circuit board jack	solderable solderable, in individual parts cast, IP67 when unplugged	front mounting	MMT361A115 MMT361A115-0001 MMT361A115-0009
	M12 printed circuit board jack	solderable	back wall mounting	MMW370A1A1
	M12 printed circuit board jack	solderable solderable, in individual parts cast, IP67 when unplugged	back wall mounting	MMT371A115 MMT371A115-0001 MMT371A115-0009
	Printed circuit board insert M12	solderable	green	MMT060A115

# X coded

### Printed circuit board jacks – 8-pole, X coded

	PRODUCT NAME	CONNECTION TYPE	MOUNTING / COLOUR	P/N
	M12 printed circuit board jack	solderable, angled 90°, back wall mounting	<2.5 mm wall thickness <4.0 mm wall thickness <5.0 mm wall thickness	MMT471A315 MMT471A315-0001 MMT471A315-0002
	M12 printed circuit board jack	in individual parts, solderable, 90° angled	<2.5 mm wall thickness <4.0 mm wall thickness <5.0 mm wall thickness	MMT471A315-0003 MMT471A315-0004 MMT471A315-0005
	M12 printed circuit board jack	solderable solderable, in individual parts cast, IP67 when unplugged	front mounting	MMT361A315 MMT361A315-0001 MMT361A315-0009
	M12 printed circuit board jack	solderable solderable, in individual parts cast, IP67 when unplugged	back wall mounting	MMT371A3B5 MMT371A3B5-0001 MMT371A3B5-0009
	Printed circuit board insert M12	solderable	green black	MMT060A315 MMT060A315-0001
	Printed circuit board insert M12	solderable, 90° angled	back wall mounting	MMTA70A315

# A coded

## M12 round connector

### printed circuit board jacks – 2-pole, A coded

PRODUCT NAME		CONNECTION TYPE	MOUNTING / COLOUR	P/N
M12 printed circuit board jack		solderable solderable, in individual parts cast, IP67 when unplugged	front mounting	MMT361A915 MMT361A915-0001 MMT361A915-0009
		solderable solderable, in individual parts cast, IP67 when unplugged	back wall mounting	MMT371A915 MMT371A915-0001 MMT371A915-0009
Printed circuit board insert M12		solderable	black	MMT060A915-0001

### Printed circuit board jacks – 3-pole, A coded

PRODUCT NAME		CONNECTION TYPE	MOUNTING / COLOUR	P/N
M12 printed circuit board jack		solderable solderable, in individual parts cast, IP67 when unplugged	front mounting	MMT361A615 MMT361A615-0001 MMT361A615-0009
		solderable solderable, in individual parts cast, IP67 when unplugged	back wall mounting	MMT371A615 MMT371A615-0001 MMT371A615-0009
Printed circuit board insert M12		solderable	black	MMT060A615-0001

### Printed circuit board jacks – 4-pole, A coded

PRODUCT NAME		CONNECTION TYPE	MOUNTING / COLOUR	P/N
M12 printed circuit board jack		solderable solderable, in individual parts cast, IP67 when unplugged	front mounting	MMT361A715 MMT361A715-0001 MMT361A715-0009
		solderable solderable, in individual parts cast, IP67 when unplugged	back wall mounting	MMT371A715 MMT371A715-0001 MMT371A715-0009
Printed circuit board insert M12		solderable	black	MMT060A715-0001

### Printed circuit board jacks – 5-pole, A coded

PRODUCT NAME		CONNECTION TYPE	MOUNTING / COLOUR	P/N
M12 printed circuit board jack		solderable solderable, in individual parts cast, IP67 when unplugged	front mounting	MMT361A815 MMT361A815-0001 MMT361A815-0009
		solderable solderable, in individual parts cast, IP67 when unplugged	back wall mounting	MMT371A815 MMT371A815-0001 MMT371A815-0009
Printed circuit board insert M12		solderable	black	MMT060A815-0001

# METZ CONNECT Test laboratory

Some of the tests required for the safe and reliable use of our products in bus and rail vehicles are carried out and documented in our in-house test laboratory. These include customer-specific shock and vibration tests as well as application-relevant climate tests and temperature shocks. We also have an in-house high-frequency laboratory where all tests are carried out to ensure stable and durable data transmission with METZ CONNECT connection technology.

METZ CONNECT connectors are tested as standard and correspond to the Cat.6<sub>A</sub> and Cat.5e categories in terms of their transmission properties.

## Standards and regulations

### DIN EN 45545-1 and -2 | Fire behavior

This standard defines the protection requirements against fires and their effects in bus and rail vehicles. It aims to minimize the probability of a fire starting, to contain the development of the fire, and thereby reduce the harmful effects on passengers as much as possible. The aim is to ensure that passengers can leave the vehicle without outside help and can escape to safety independently, particularly from heat, smoke

and toxic gases. Part 2 of the standard regulates the ensuing requirements for cables and other electronic equipment and the necessary test methods. To cover as many design classes and operating classes of vehicles as possible, our connectors' materials have been selected in accordance with the R24 set of requirements.

### DIN EN 50155 | Mechanical load

The requirements the DIN EN 50155 standard places on electrical equipment simulate all conceivable operating conditions in which rail vehicles may find themselves. The tests to be carried out check whether the products still function perfectly

under extreme temperatures, temperature shocks, high humidity and heat, strong vibrations, and mechanical shocks. The IP protection class test to IP67 is also carried out as part of the overall test procedure.

### IEC 60529 | Degrees of protection by enclosure (IP code)

This international standard corresponds to the European standard DIN EN60529 and complies with the German standard DIN VDE 0470-1, November92 edition. It specifies the designations, requirements, and tests for the classification of types of protection by enclosures for electrical equipment

(e.g. connectors). Protection against access to hazardous parts, protection against solid foreign bodies, and protection against water are assessed. The degree of protection is designated by an IP code.

### ECE R118 | Fire behavior

This regulation specifies the fire behavior of interior materials and cables in buses.

Operating classes (Operational Category)

OPERATING CLASSES	OPERATION IN TUNNELS, ON UNDERGROUND AND / OR ELEVATED TRACK SECTIONS	STATIONS / RESCUE STATIONS. SAFE AREA VISIBLE	LATERAL EVACUATION
OC 1 	no	immediate	possible
OC 2 	tunnels up to 5 km long	within a short driving time	possible
OC 3 	tunnel > 5 km length	within a longer travel time	possible
OC 4 	tunnels up to 5 km long	within a short driving time	not possible

Risk levels (Hazard Level)

OPERATING CLASSES		TYPE CLASS			
		N STANDARD	A AUTOMATIC TRAINS WITHOUT STAFF	D DOUBLE-DECKER VEHICLES	S SLEEPING AND COUCHETTE CARRIAGES
OC 1 	no tunnel operation	HL1	HL1	HL1	HL2
OC 2 	tunnel max. 5 km	HL2	HL2	HL2	HL2
OC 3 	tunnel > 5 km	HL2	HL2	HL2	HL3
OC 4 	none lateral evacuation	HL3	HL3	HL3	HL3



We realize ideas

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