

**BTL5-A/C/E/G\_ \_-M/U\_ \_ \_-P-S32/KA\_ \_ \_**  
**Technical Description**  
**User's Guide**



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**Safety Advisory**

These transducers together with processor card and/or programmable controller comprise a positioning system and may be used for this purpose only.

**Installation and Operation**

Installation and operation should be performed only by trained technical personnel. Unauthorized intervention and usage will result in loss of warranty and liability claim rights. When assembling the transducer, all specifications included in the section on Installation and Wiring must be observed. Special care with respect to selection and polarity of the connections should be taken when connecting the transducer to external controllers, including the power supply and form and duration of the control signals. Refer to the section on Technical Data for details. Only approved, regulated power supplies may be used for the positioning system.

**Usage and Checking**

All relevant safety regulations must be complied with when using the transducer system. In particular, precautions must be taken to ensure that any defect in the positioning system will not result in risk to persons or property. This may include the use of additional safety limit switches, E-STOP switches, and maintaining the permissible ambient conditions. The functionality of the positioning system and all associated components must be checked and documented regularly.

**Function Disturbances**

Whenever there are indications that the positioning system is not working properly, it should be taken out of service and guarded against unauthorized use.

**Scope**

This description is valid for the Micropulse™ linear displacement transducer series BTL5-A/C/E/G...P...

**Features and Advantages**

- Micropulse transducers feature:
- Very high resolution, repeatability and linearity.
  - Immunity to shock, vibration, contamination and electrical noise.
  - An absolute output signal.
  - IP 67 per IEC 529.

**Function and Design**

The transducer contains a tubular waveguide, protected by an aluminum extruded housing. A position magnet attached to the moving member of a machine or component to be positioned travels along the housing (Fig. 1).

Notch on housing to mark the beginning of the stroke range

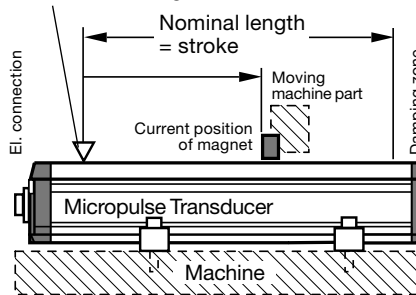


Fig. 1: Basic arrangement

The positioning magnet defines the position to be measured on the waveguide. An externally generated INIT pulse in conjunction with the magnetic field produces a torsional wave in the waveguide (magnetostriction), which propagates at ultrasonic velocity.

The wave component reaching the far end of the waveguide is absorbed by a damping technique. The component reaching the connection end passes through a coil, generating an

electrical signal. The wave propagation time is used to derive the position. Depending on the version the corresponding value is output as a voltage or a current either with rising or falling characteristic. This process takes place with extremely high precision and repeatability within the stroke range defined as nominal length.

On either side of the stroke range is a zone within which no reliable signal is available, but which may be entered by the magnet.

The electrical connection between the transducer and the processor or controller is made with a cable, which is either fixed to the transducer or detachable via a connector.

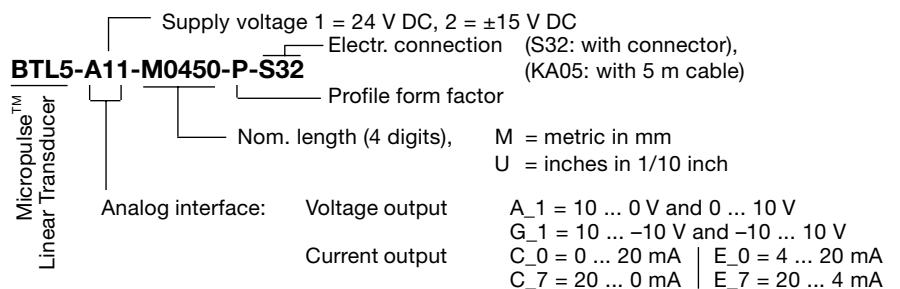
For optimal adaptability, a wide variety of nominal stroke lengths and magnet form factors are available. Magnets and control arms must therefore be ordered separately.

Dimensions for the Micropulse transducer are shown in Figs. 2 and 3. For magnet and control arm dimensions, see Figs. 6ff.

**Nominal Lengths**

The following nominal lengths are available in the increments given: from 50 to 1000 mm every 50 mm, from 1000 to 2000 mm every 100 mm, from 2000 to 3750 mm every 250 mm, other lengths upon request.

**Versions (indicated on product label)**



**Transducer, Installation**

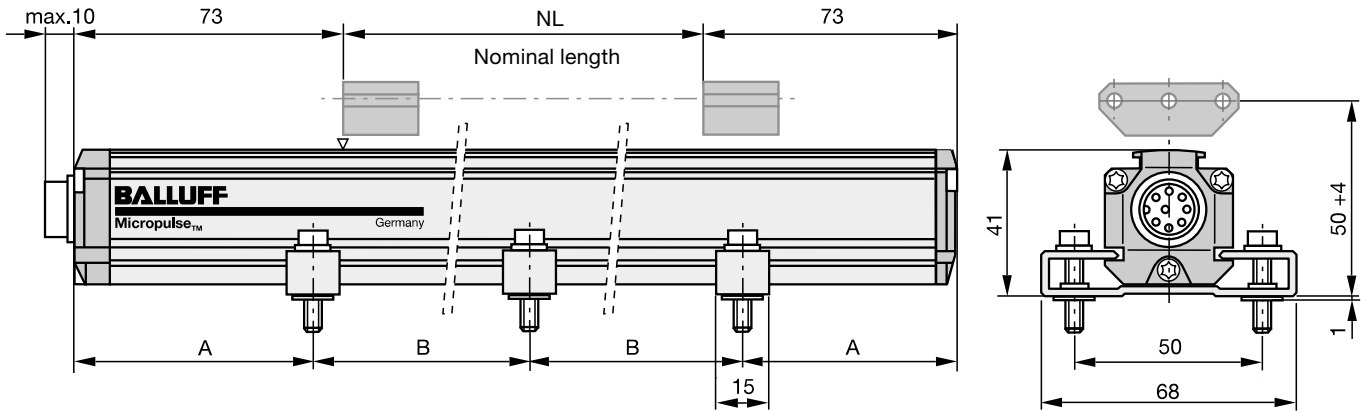


Fig. 2: Dimensional drawing for BTL5...P-S32 (with magnet BTL5-P-3800-2)

*Ensure that no strong electrical or magnetic fields are introduced in the immediately vicinity of the transducer.*

The installation orientation is not critical. Attach the transducer to a level surface on the machine using

the supplied mounting clamps and cylinder head screws. Sufficient quantity of mounting clamps will be supplied. These should be spaced evenly (Fig. 2).

Recommended spacing for long transducers and/or strong shock and vibration:

A = ca. 80 mm; spacing between the individual clamps  
 B = ca. 250 mm each.

The supplied isolation bushings serve to electrically isolate the transducer from the machine (see Fig. 3 and section "Start up/Noise Elimination").

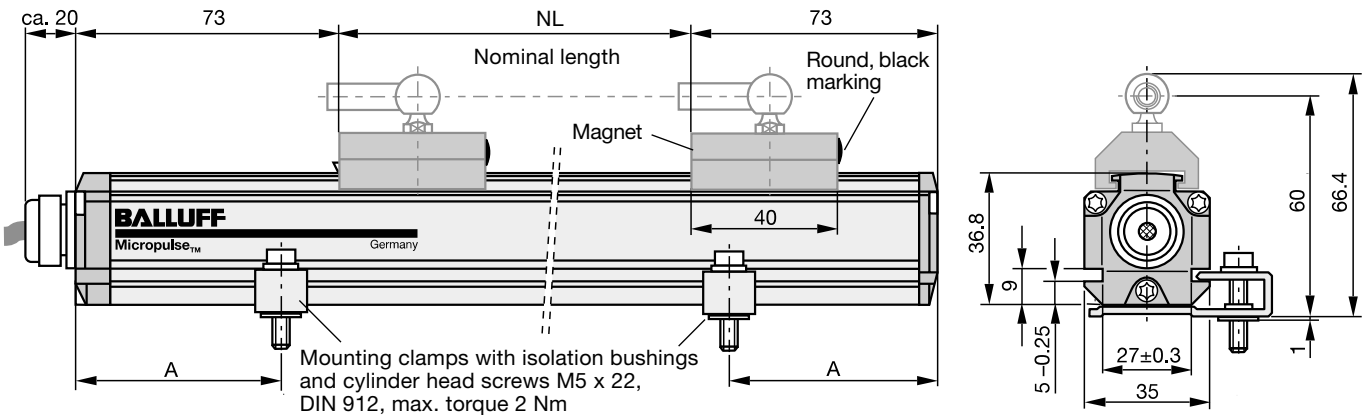


Fig. 3: Dimensional drawing with profile dimensions (transducer BTL5...P-KA.. with magnet BTL5-F-2814-1S)

**Wiring**

To avoid coupled noise, avoid proximity to high-current lines when routing cable between transducer, controller and power supply. Inductive coupled noise from AC harmonics (e.g., from phase controls) are especially critical, against which the cable shield offers no protection. Cable length max. 500 m; Ø 6 to 8 mm. Longer lengths may be used if construction, shielding and routing are such that external noise fields will have no effect on signal integrity.

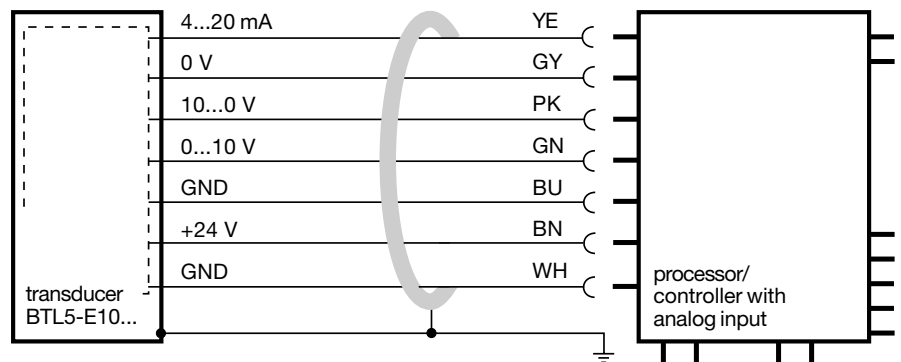


Fig. 4: BTL5-E10...KA \_- with processor card/controller, wiring example

**Wiring (cont.)**

**Output signals**

Pin	Cable	BTL5-A_1	-C_0	-C_7	-E_0	-E_7	-G_1	
1	YE yellow	not used	0...20 mA	20...0 mA	4...20 mA	20...4 mA	not used	
2	GY grey	0 V ①						
3	PK pink ②	10...0 V	10...0 V	10...0 V	10...0 V	10...0 V	10...-10 V	
4		not used						
5	GN green ②	0...10 V	0...10 V	0...10 V	0...10 V	0...10 V	-10...10 V	

**Supply voltage (external)**

Pin	Cable	BTL5-A/C/E/G1_	BTL5-A/C/E/G2_
6	BU blue	GND ① ③	GND ① ③
7	BN brown	+24 V DC	+15 V DC
8	WH white	GND	-15 V DC

**Note:**

① The analog transducer outputs are potential-free. When connecting to a module with non-potential-free inputs, ground loops may cause erroneous signals. Avoid this by defeating the potential-free function in the transducer: jumper Pin 2 and Pin 6 in the female connector (Fig. 5).

② A small voltage difference (< 10 mV) appears between pin 3 and 5 due to separate output drivers.

③ Reference GND for supply voltage and EMC!

**Important wiring note:**

To ensure electromagnetic compatibility (EMC), which Balluff verifies by the CE Marking, the following points must be strictly observed.

BTL transducer and processor / controller must be connected using shielded cable.

Shield: Copper-stranded mesh, 80 % coverage. The shield must be connected in the BKS connector (Fig. 12) to the body of the connector; see instructions packaged with the connector.

The shield must be grounded on the control side, i.e., connected to the protection ground.

Unused leads can be tied to GND on the control side, but they must never be connected to the shield.

Refer to the table for wiring assignments. Connections on the controller side may vary according to the controller and configuration used.

BKS connector, view towards solder side of female BKS-S 32M-00 or BKS-S 33M-00

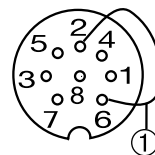


Fig. 5: Pin assignments BKS, connector type BTL

**Start-up**

**Check your connections**

Even though the connections are protected against polarity reversal, components may be damaged by incorrect wiring and overvoltage. Before you power up, check your connections carefully.

**Turning on the system**

Please note that when the system is turned on, uncontrolled movement can result, especially at first power-up and when the transducer is part of a closed-loop feedback system whose parameters are not yet set. Therefore ensure that start-up cannot lead to hazardous conditions.

If there is no magnet in the stroke range, the integrated function monitor provides the following defined output signals:

Voltage output 10 V  
 increasing decreasing  
 $U_A > 10 \text{ V}$  < 0 V

Current output 20 mA  
 increasing decreasing  
 $I_A \geq 20 \text{ mA}$  0 mA for BTL5-C...  
 $I_A \geq 20 \text{ mA}$  ≤ 4 mA for BTL5-E...

**Check signal values**

After installing a repaired or new transducer, we recommend you manually check the values given for the start and end position of the magnet. If you read different values\* than before the change or repair, be sure to compensate accordingly.

\* Slight variations due to manufacturing tolerances or product improvement are possible.

**Eliminating noise**

To avoid potential compensation - current flow - through the cable shield, we recommend use of the isolation bushings. Potential compensation occurs when the ground potential between control cabinet and machine is not the same.

**Magnets, Installation**

**Floating magnets**

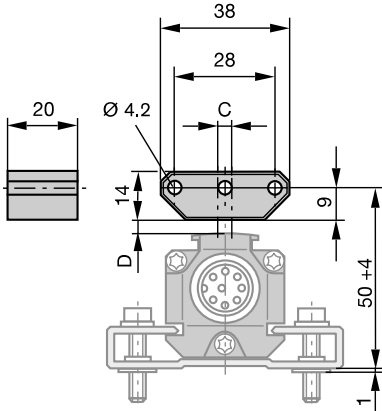


Fig. 6: Magnet BTL5-P-3800-2

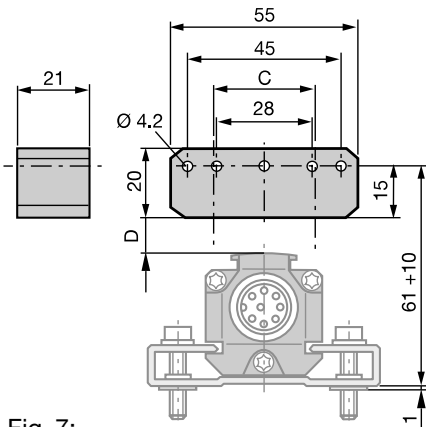


Fig. 7: Magnet BTL5-P-5500-2

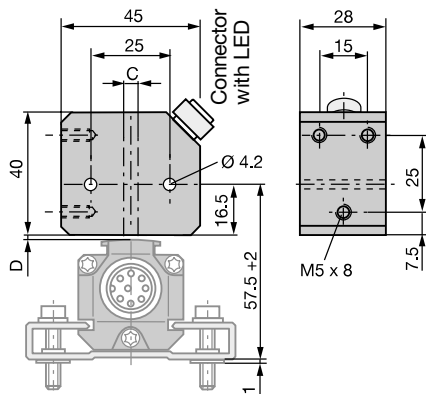


Fig. 8: BTL5-P-4500-1 Electromagnet (24 V/100 mA)

Advantages: Multiple magnets on a single transducer can be individually switched on and off (e.g., from a programmable controller digital output card).

The Micropulse transducer in profile housing can be used with either a floating (non-contact) magnet (see Figs. 2 and 6 to 8) or the captive (guided) magnet design (see Figs. 3, 9 and 11).

**Floating magnet**

The floating magnet (Figs. 6 to 8) is attached to the moving machine member using non-magnetizable screws (brass, aluminum). To assure accuracy of the transducer system, the moving member of the machine must carry the magnet along a parallel axis to the transducer. The following table show specifications in [mm] for distance between magnet and transducer as well as the permissible offset from center:

Magnet type	Distance " D "	Offset " C "
BTL5-P-3800-2	0.1 ... 4	± 2
BTL5-P-5500-2	5 ... 15	± 15
BTL5-P-4500-1	0.1 ... 2	± 2

**Captive magnets**

When using the guided magnets (Figs. 9 and 11), lateral forces should be avoided. This calls for connections which allow a corresponding freedom of motion along the magnet axis of travel. The warranty assumes that the BTL5-F-2814-1S magnet is connected with the machine member using a control arm. The BTL2-GS10...A control arm (Fig. 10) is available as an accessory (specify length LG when ordering).

**Captive magnets**

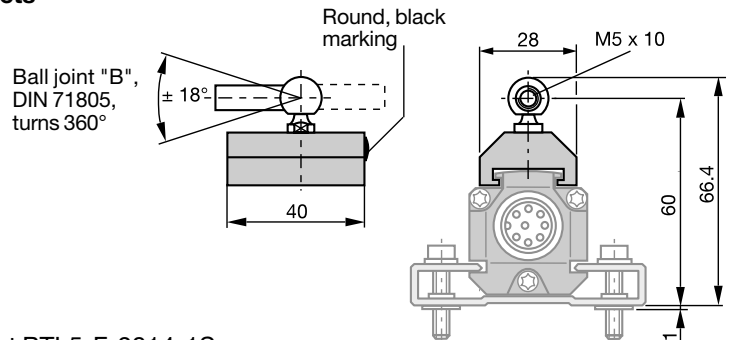


Fig. 9: Magnet BTL5-F-2814-1S

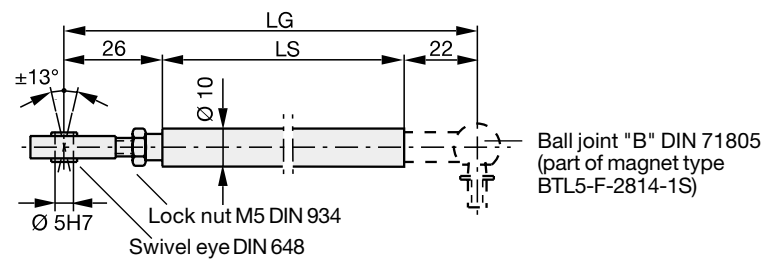


Fig. 10: Control arm BTL2-GS10...A

BTL5-M-2814-1S	
X = 48,5	Y = 57
BTL5-N-2814-1S	
X = 51	Y = 59,5

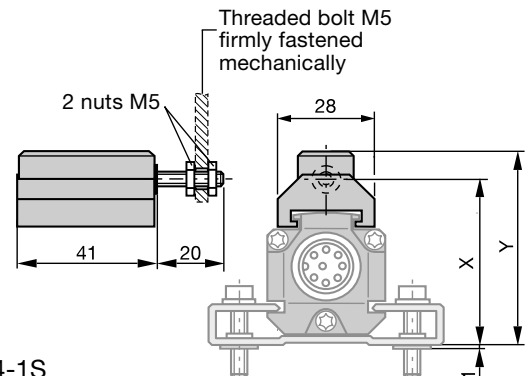


Fig. 11: Magnet BTL5-M/N-2814-1S

**Technical Data**

Typical values at 24 V DC and 25 °C. Ready for operation at once, full accuracy after warm-up (approx. 15 min after switching on). With a constant gap to transducer when using magnets BTL5-P-3800-2, BTL5-P-4500-1 or BTL5-P-550-2 or with guided magnets BTL5-F/M/N-2814-1S (exceptions see magnets):

Resolution	≤ ±2 μm	
+ Hysteresis	≤ ±4 μm	
= Repeatability	≤ ±6 μm	
△ Voltage	≤ ±0.1 mV	
△ Current	≤ ±0.16 μA	
Sampling rate $f_{\text{Standard}}$	= 1 kHz	
Non-linearity		
Nom. length ≤ 500 mm	> 500 mm	
in μm	±100	±0.02 % FS
in mV	≤ $\frac{1000}{\text{nom. length/mm}}$	≤ ±2 mV

Temperature coefficient  
 Voltage output:  
 $[150 \mu\text{V}/^\circ\text{C} + (5 \text{ ppm}/^\circ\text{C} \cdot P \cdot \text{V/NL})] \cdot \Delta T$   
 Current output:  
 $[0,6 \mu\text{A}/^\circ\text{C} + (10 \text{ ppm}/^\circ\text{C} \cdot P \cdot \text{I/NL})] \cdot \Delta T$   
 V = output voltage range in [V]  
 I = output current range in [mA]  
 NL = nominal length in [mm]  
 ΔT = temperature coefficient in [K]  
 P = magnet position in [mm]

Shock 100 g/6 ms  
 per IEC 68-2-27  
 Vibration 12 g, 10 to 2000 Hz  
 per IEC 68-2-6

**Dimensions, weight, ambient**

Nominal length ≤ 3750 mm  
 Dimensions see Figs. 2 and 3  
 Weight ca. 1.4 kg/m  
 depending on version and stroke  
 Housing anodized aluminum  
 Housing attachment  
 Mounting clamps with isolation  
 bushings and screws  
 Operating temp. -40 to +85 °C  
 Humidity < 90 %, non-dewing  
 Protection rating per IEC 529 IP 67  
 with connector attached

**Supply voltage (external)**

Regulated voltage  
 BTL5-1... 24 V DC ±20 %  
 Ripple ≤ 0.5 V<sub>pp</sub>  
 BTL5-2... ±15 V DC ±2 %  
 Current draw ≤ 150 mA (at 1 kHz)  
 Inrush ≤ 1 A  
 Time constant ca. 10 ms  
 Polarity reverse protection  
 built-in  
 Overvoltage protection  
 Transzorb protection diodes  
 Isolation voltage  
 GND to housing 500 V

**Outputs**

<b>BTL5-A...</b>		
Output voltage	0...10/10...0 V	
Load current	≤ 5 mA	
Ripple	≤ 5 mV	
<b>BTL5-G...</b>		
Output voltage	-10...10/10...-10V	
Load current	≤ 5 mA	
Ripple	≤ 5 mV	
<b>BTL5-C...</b>		
Output current	0...20/20...0 mA	
Load resistance	≤ 500 Ohm	
<b>BTL5-E...</b>		
Output current	4...20/20...4 mA	
Load resistance	≤ 500 Ohm	

**Connection to processor**

Analog interface:  
 With S32 connector for shielded  
 cable (max. length, see "Wiring"),  
 diameter 6 to 8 mm, or with integral  
 cable (5 m long)

**Magnets**

(please order separately)  
 Re: distance, offset and installation  
 dimensions, see pages 3 and 5  
 Operating temp. -40 to +85 °C

<b>BTL5-P-3800-2</b> (Fig. 6)	
Weight	ca. 12 g
Housing	plastic
<b>BTL5-P-5500-2</b> (Fig. 7)	
Weight	ca. 40 g
Housing	plastic
Non-linearity:	
Nom. length ≤ 500 mm	> 500 mm
	±150 μm   ±0,03 % FS

<b>BTL5-P-4500-1</b> (Fig. 8)	
Weight	ca. 90 g
Housing	plastic
<b>BTL5-F-2814-1S</b> (Fig. 9)	
Weight	ca. 28 g
Housing	plastic
<b>BTL5-M-2814-1S</b> (Fig. 11)	
Weight	ca. 32 g
Housing	anodized aluminum
Contact surface	plastic
<b>BTL5-N-2814-1S</b> (Fig. 11)	
Weight	ca. 35 g
Housing	anodized aluminum
Contact surface	plastic

**Control arm (optional)**

**BTL2-GS10- - - - -A**  
 Aluminum,  
 see Fig. 10 for dimensions  
 Various standard lengths LG  
 (specify when ordering)

**Accessories (optional)**

Connectors  
 Types, dimensions see Fig. 12  
 straight right-angle  
**BKS-S 32M-00** **BKS-S 33M-00**  
 No. 99-5672-19-08 No. 99-5672-78-08  
 (Binder part no.)

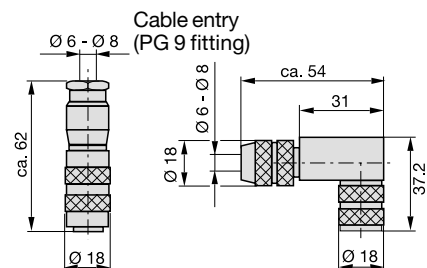


Fig. 12: Connector (optional)



The CE Marking  
 verifies that our  
 products comply with  
 the requirements of EC Directive

89/336/EWG (EMC Directive)

and the EMC Law. Testing in our  
 EMC Laboratory, which is accredi-  
 ted by the DATech for Testing Elec-  
 tromagnetic Compatibility, has  
 shown that Balluff products meet  
 the EMC requirements of the  
 Generic Standard

EN 50081-2 (Emission)  
 EN 50082-2 (Noise Immunity)

**Emissions tests:**

Radio frequency emission  
 EN 55011 Group 1, Class A

**Noise immunity tests:**

Static electricity (ESD)  
 IEC 1000-4-2 Severity Level 3

Electromagnetic fields (RFI)  
 IEC 1000-4-3 Severity Level 3

Fast transients  
 (BURST)  
 IEC 1000-4-4 Severity Level 4

Line transmitted noise disturbances,  
 induced by high-frequency fields  
 IEC 1000-4-6 Severity Level 3