7.3 Information on reliability

If the manufacturer provides values of the mean time between failures (MTBF) of any subassembly or module, and of the type-test configuration(s) (PLC-system(s)) under normal service conditions the manufacturer shall also explain the method used to determine it.

7.4 Information on other conditions

The user should reach agreement with the manufacturer for any mechanical conditions that are not specified in this standard.

7.5 Information on shipping and storage

The manufacturer shall provide shipping and storing instructions.

7.6 Information on a.c. and d.c. power supply

The manufacturer shall provide the following information.

– Data to allow selection of a suitable power distribution network to provide specified voltage at each power utilization point. This information includes peak inrush (at cold start and warm restart), repetitive peak and steady-state r.m.s. input currents under full-load conditions.
– External terminal identification for power supply interfaces.
– Typical example(s) for power supply system(s).
– Special supply installation requirements, if any, for PLC-systems energized through multiple power supplies or supply voltages and frequencies not included in 5.1.1.1.
– The effect of the following incorrect connections of power to the supply(ies):
  - reverse polarity;
  - improper voltage level and/or frequency;
  - improper lead connection.
– Complete information on PLC-system behaviour for typical power up/down sequences.
– Data to allow evaluation of the maximum values of interruption time which do not affect the normal operation of any PLC-system configuration; PS class (PS-1 or PS-2) of d.c. supplied devices.
– Memory back-up time with respect to temperature and maintenance requirements.
– Recommended time interval between replacement of energy sources, if applicable, and recommended procedure and subsequent effects on the PLC-system.
– Peak inrush current (at cold start and warm restart) or recommended fuse size and opening characteristics.

7.7 Information on digital inputs (current sinking)

The manufacturer shall provide the following information:

– volt-ampere curve over the full operating range, with tolerances or equivalent;
– digital input delay time for 0 to 1 and 1 to 0 transitions;
– existence of common points between channels;
– effect of incorrect input terminal connection;
– isolation potentials between channel and other circuits (including ground) and between channels under normal operation;
– type of input (Type 1, Type 2 or Type 3);

– monitoring point and binary state of visual indicator;
– effects when withdrawing/inserting input module under power;
– additional external load when interconnecting inputs and outputs, if needed;
– explanation of signal evaluation (for example, static/dynamic evaluation, interrupt release, etc.);
– recommended cable and cord lengths depending on cable type and electromagnetic compatibility;
– terminal arrangements;
– typical example(s) of external connections.

7.8 Information on digital outputs for alternating currents (current sourcing)

The manufacturer shall provide the following information with respect to digital outputs for a.c. operation:

– type of protection (i.e. protected, short-circuit-proof, non-protected output), and
  - for protected outputs: operating characteristics beyond 1,1 I_e including the current(s) level(s) at which the protecting device energizes, the current behaviour beyond, and the time(s) involved;
  - for short-circuit-proof outputs: information for replacement or resetting the protective device as required;
  - for non-protected outputs: specification for protective device to be provided by the user, as required;
– output delay time for state 0 to state 1 and state 1 to state 0 transitions;
– commutation characteristics and turn-on voltage with respect to zero-voltage crossing;
– existence of common points between channels;
– terminal arrangements;
– typical example(s) of external connections;
– number and type of outputs (for example, NO/NC contacts, solid state, individually isolated channels, etc.);
– for electromechanical relays, the rated current and voltage complying with 5.2.2.2.5;
– output ratings for the other loads such as incandescent lamps;
– total output current for multi-channel modules (see definition 3.40);
– characteristics of suppresser networks incorporated into the output circuit against voltage peaks due to inductive kickback;
– type of external protective networks, if required;
– effects of incorrect output terminal connection;
– isolation potentials between channel and other circuits (including ground) and between channels under normal operation;
– monitoring points of visual indicators in the channel (for example, MPU side/load side);
– recommended procedures for changing output modules;
– output behaviour during interruptions of MPU control, voltage dips and interruptions and power up/down sequences (see also 5.6);
– way of operation (i.e. latching/non-latching type);
– effects of multiple overloads on isolated multi-channel modules.

7.9 Information on digital outputs for direct current (current sourcing)

Information to be provided by the manufacturer for digital outputs for d.c. shall be the same as for digital outputs for a.c., as defined in 7.8. However, the specification of commutation for zero-voltage crossing does not apply, and with regard to electromechanical relay outputs, AC-15 is replaced by DC-13 in 5.2.2.2.5.

7.10 Information on analogue inputs

Besides the type and standard range, the manufacturer shall provide the following information.

7.10.1 Information on analogue input static characteristics

Static characteristics		Units and examples
1) Input impedance in signal range (manufacturer should specify if this is in the on or off state)		Ω
2) Analogue input error:	temperature coefficient	± % of full scale (which scale)
	maximum error at 25 °C	± % of full scale/K
3) Maximum error over full temperature range		± % of full scale (which scale)
4) Digital resolution		Number of bits
5) Data format returned of the application programme		Binary, BCD, etc
6) Value of a LSB (least significant bit)		mV, mA
7) Maximum permanent allowed overload (no damage)		V, mA
8) Digital output reading under overload condition		For example, flag
9) Type of input		For example, differential
10) Common-mode characteristics (d.c., a.c. 50 Hz, a.c. 60 Hz) if applicable		CMRR-dB, CMV-V
11) For other inputs (thermocouples, RTD, etc):	type(s) sensor(s)	J, K, T, etc.: Pt, 100, etc.
	measurement range(s)	Min. °C to max. °C
	linearization method	Internal or user-provided

7.10.2 Information on analogue input dynamic characteristics

Dynamic characteristics		Units and examples
1) Sample duration time (including setting time)		ms
2) Sample repetition time		ms
3) Input filter characteristics:	order	First, second, etc.
	transition frequency	Hz
4) Maximum temporary deviation during each specified electrical interference test		± % of full scale

7.10.3 Information on analogue input general characteristics

General characteristics	Units and examples
1) Conversion method	Dual slope, S.A, etc.
2) Operating modes	Trig, self-scan, etc.
3) Type of protection	RC, opto-isolator, MOVs, etc.
4) Isolation potentials under normal operation between channel and a) other circuits (including ground), b) between channels, c) power supply(ies) and d) interface(s)	V
5) External power supply data, if required	
6) Common points between channel if any	Technical data
7) Type, length of cable, installation rules recommended to provide interference immunity	Twisted pair, 50 m max
8) Calibration or verification to maintain rated accuracy	Month, years
9) Terminal arrangements	
10) Typical example(s) of external connections	
11) Effect of incorrect input terminal connection	

7.10.4 Information on analogue input miscellaneous characteristics

Miscellaneous characteristics	Units and examples
1) Monotonicity with no missing codes	Yes, no
2) Crosstalk between channels at d.c., a.c. 50 Hz and a.c. 60 Hz	dB
3) Non-linearity	% of full scale
4) Repeatability at fixed temperature after specified stabilization time	% of full scale
5) Lifetime of electromagnetic relay multiplexers, if applicable	Number of cycles, of hours

7.11 Information on analogue outputs

Besides the type and standard range, the manufacturer shall provide the following information.

7.11.1 Information on analogue output static characteristics

Static characteristics		Units and examples
1) Output impedance in signal range (manufacturer should specify if this is in the on or off state)		Ω
2) Analogue output error:	maximum error at 25 °C	± % of full scale (which scale)
	temperature coefficient	± % of full scale/K
3) Maximum error over full temperature range		± % of full scale (which scale)
4) Digital resolution		Number of bits
5) Data format returned of the application programme		Binary, BCD, etc
6) Value of a LSB (least significant bit)		mV, mA

7.11.2 Information on analogue output dynamic characteristics

Dynamic characteristics	Units and examples
1) Settling time for full-range change	ms
2) Overshoot	% of full scale
3) Maximum temporary deviation during each specified electrical interference test	± % of full scale

7.11.3 Information on analogue output general characteristics

General characteristics	Units and examples
1) Type of protection	Opto-isolator, etc.
2) Isolation potentials between channel and other circuits (including ground) and between channels under normal operation	V
3) External power supply data, if required	Technical data
4) For current outputs with external supply, the maximum and minimum voltage drop across the output terminals in the full output range	V
5) Type, length of cable, installation rules recommended to provide interference immunity	Twisted pair, 50 m max
6) Calibration or verification to maintain rated accuracy	Month, years
7) Terminal arrangements	
8) Common points between channels, if any	
9) Allowed type(s) of loads	Floating, grounded
10) Maximum capacitive load (for voltage outputs)	pF
11) Maximum inductive load (for current outputs)	mH
12) Typical example(s) of external connections	
13) Output response at power up and power down	
14) Effect of incorrect output terminal connection	

7.11.4 Information on analogue output miscellaneous characteristics

Miscellaneous characteristics	Units and examples
1) Monotonicity	Yes, no
2) Crosstalk between channels at d.c., a.c. 50 Hz and a.c. 60 Hz	dB
3) Non-linearity	% of full scale
4) Repeatability at fixed temperature after specified stabilization time	% of full scale
5) Output ripple	% of full scale

7.12 Information on communication interfaces

If the manufacturer provides communication interfaces to other than his own equipment, he shall provide the necessary information for correct operation. This may be achieved by referencing a specific standard or specification together with details of any options such as baud rate, type of cable to be used, etc.

7.13 Information on main processing unit(s) and memory(ies) of the PLC-system

Information to be provided by the manufacturer for main processing unit(s) and memory(ies) shall be

1) organization, capacity of programme memory;
2) organization, capacity of data memory and number of bits per word;
3) memory type(s) (i.e. CMOS-EPROM, etc.) available;
4) memory back-up functionality and service requirements if any;
5) data, constraints and procedures to determine a desired configuration (racks, cables, bus expanders, power supply unit, maximum number of I/Os per type, maximum number of I/O modules, etc.);
6) description of the programming languages supported by the PLC-system (combination of the PADT and the main processing unit(s);
7) to what extent the languages defined in IEC 61131-3 are supported, including the differences if any (objects, instructions, semantic and syntactic rules, etc.);

8) calculation methods to determine every memory utilization (user's application programme and data, firmware programme and data where applicable) and average values of every relevant time (scan time(s), system response time(s), transfer time(s), execution time(s));

9) mechanisms in which I/Os are processed (i.e. use of I/O image registers periodically refreshed by the system, immediate “get/put” type instructions, interrupt and event-driven programmes, etc.) and their effect on the following subjects:

   - system response time(s);
   - restart capabilities (i.e. cold, warm, hot restart);
   - detailed times for inputs, outputs, processing, etc.

10) effect of non-permanently installed peripherals on every relevant time (see item 8 of this subclause) when they are plugged/unplugged, connected/disconnected to their PLC-system interface;

11) PLC-system status information concerning cold, warm and hot restart if applicable. Description and usage of programmable timers usable to determine the process-dependent difference between warm and hot restart;

12) self-test and diagnostic functions implemented (see 5.8)

7.14 Information on remote input/output stations (RIOSs)

The manufacturer shall provide the following information:

– specifications for the selection of adequate cables and other devices needed for the communication link;

– specifications for proper installation of the whole system (including proper selection of energy source(s));

– type of I/O communication network (point-to-point, star, multi-drop, ring, etc.)

– principles, procedures and transmission speeds used on the communication link and their capability to transfer data from and to the RIOSs with respect to error coding/detection and to the delays of transmission in the best, most likely and worst cases;

– effect on transfer time(s) introduced to provide remote input information and RIOSs status to the user's application programme and to transmit its logical decisions to remote outputs;

– specified values and delays according to 5.6;

– configuration related data: maximum number of RIOSs in 1 single PLC-system configuration, min/max size of each;

– which I/O modules of the total I/O system may not be used in RIOSs and/or which of their functions are altered if any;

– type, architecture and characteristics of redundancy if provided;

– modems/repeaters if applicable. Maximum distance with or without repeaters;

– terminating devices if required;

– physical characteristics of the communication interface including isolation characteristics, maximum acceptable common mode voltage, built-in short-circuit protections, etc.;

– type of standard link interface (i.e. RS 232, RS 422, RS 485, RS 511, etc.);

– functional and safety earthing specifications;

– procedures for making/breaking logical and physical connection of a RIOS to a PLC-system (for example, “on line”).

7.15 Information on peripherals (PADTs, TEs, HMIs)

The manufacturer shall provide the following information through convenient documentation and marking:

– clear warnings and precautions to be observed when using functions enabling alteration of control conditions such as PLC-system status modification, changing of data or programmes in the memory, forcing input or output signal, etc.;
– usability of peripherals at RIOSs;
– service conditions for peripherals which are intended for use in an environment less severe than stated in Clause 4 (such peripherals may need to be remotely connected to the rest of the PLC-system through communication lines);
– specifications for the selection of adequate cables and other devices needed for the communication link;
– specifications for proper installation of the whole system (including proper selection of energy source(s));
– type of communication network (point-to-point, star, multi-drop, ring, etc.)
– principles, procedures and transmission speeds used on the communication link and their capability to transfer data from and to the RIOSs with respect to error coding/detection and to the delays of transmission in the best, most likely and worst cases;
– terminating devices if required;
– physical characteristics of the communication interface including isolation characteristics, maximum acceptable common mode voltage, built-in short-circuit protections, etc.;
– type of standard link interface (i.e. RS 232, RS 422, RS 485, etc.);
– functional and safety earthing specifications.

7.16 Information on self-tests and diagnostics

The manufacturer shall provide the following information through convenient documentation and marking:

– description of tests and diagnostics which are implemented and when they are executed (i.e. permanently, periodically, upon user's application programme request, during start-up procedure, etc.);
– correct functioning state and driving conditions of the alarm output(s) (see 5.8).

8 Electromagnetic compatibility (EMC) requirements

This Clause specifies electromagnetic compatibility (EMC) requirements for PLC-systems equipment (i.e. MPU, RIOSs, permanently/non-permanently installed peripherals).

NOTE Clauses 8, 9, and 10 of this standard contain the compliance requirements for the EU electromagnetic compatibility directive.

8.1 General

As potential radiating equipment, the installed PLC-system and other devices may emit conducted and radiated electromagnetic interference.

As potential receiving equipment the PLC-system may be affected by externally generated conducted interference, radiated electromagnetic fields and electrostatic discharges.

The requirements of 8.2 and 8.3 are intended to characterize the EMC performance of the PLC-system equipment and are the responsibility of the manufacturer. The user, advised by

the manufacturer, is responsible for the electromagnetic compatibility of the product as installed.

Since the PLC-system is only 1 component of the overall automated system, this standard does not deal with the EMC compatibility of the overall automated system.

If an optional EMC enclosure (for example, cabinet) or other protection device (for example, filter) is specified by the manufacturer it shall be included as part of the equipment under test (EUT).

The EMC enclosure port is the physical boundary of the PLC-system through which electromagnetic fields may radiate or impinge. See definition 3.51.

8.2 Emission requirements

PLCs are designed for the industrial environment, covered by IEC 61000-6-4, unless otherwise indicated by manufacturer's information.

8.2.1 General requirements for emission

For emissions, the objective of the requirements given in Table 29 is to ensure protection of the radio frequency spectrum.

8.2.2 Emission limits in the low-frequency range

Since the PLC-system is not connected to the public mains, there is no requirement up to 150 kHz.

8.2.3 Emission limits in the high-frequency range

Table 29 – Emission limits

Port	Frequency range	Severity level (normative)	Severity level (optional)	Reference standard
Enclosure port (radiated)		Measured at 10 m distance	Measured at 30 m distance	IEC 61000-6-4
	30-230 MHz	40 dB(μV/m) quasi-peak	30 dB(μV/m) quasi-peak	
	230-1 000 MHz	47 dB(μV/m) quasi-peak	37 dB(μV/m) quasi-peak	
a.c. power port (conducted)[1]	0,15-0,5 MHz	79 dB(μV) quasi-peak		IEC 61000-6-4
		66 dB(μV) average		
	0,5-30 MHz	73 dB(μV) quasi-peak		
		60 dB(μV) average		

[1] Impulse interference (click) which occurs less than 5 times per minute is not considered. For clicks appearing more often than 30 times per minute the limits apply. For clicks appearing between 5 and 30 times per minute a relaxation of the limits of 20 log 30/N (where N is the number of clicks per minute) is allowed. Criteria for separated clicks may be found in CISPR 14-1.

The requirements of this subclause are verified in accordance with 9.3 and 9.4.

8.3 EMC immunity requirements

PLCs are designed for the industrial environment, covered by IEC 61000-6-2, unless otherwise indicated by manufacturer's information.

8.3.1 General

The picture shown in Figure 11 is meant to describe the EMC and interference coupling mechanisms in a factory environment. Zone separation is determined by power distribution, installation practices and I/O wiring.

Zone C = Factory mains (isolated from public mains by dedicated transformer), primary surge protection and severe interference coupling. This zone can be described as a somewhat more severe environment then the general industrial environment covered by IEC 61000-6-2.

Zone B = Dedicated power distribution, secondary surge protection and moderate industrial interference coupling. This zone can be described as the general industrial environment covered by IEC 61000-6-2.

Zone A = Local power distribution, protected and low interference coupling. This zone is surrounded by the general industrial environment (Zone B). It is generally characterized by such practices as; shorter wiring, well protected power supplies (SELV/PELV), I/O impedance limiting, installation of protection networks, a.c./d.c. converters, isolation transformers, surge suppressers, etc. Zone A immunity environment is similar to the IEC 61000-6-1, light-industrial environment.

PLCs are designed for Zone B, covered by IEC 61000-6-2, unless otherwise indicated by manufacturer's information. Zone B encompasses Zone A.

If a product is to be used in multiple zones, then it shall be designed and tested to the most severe combination of requirements for its intended zones.

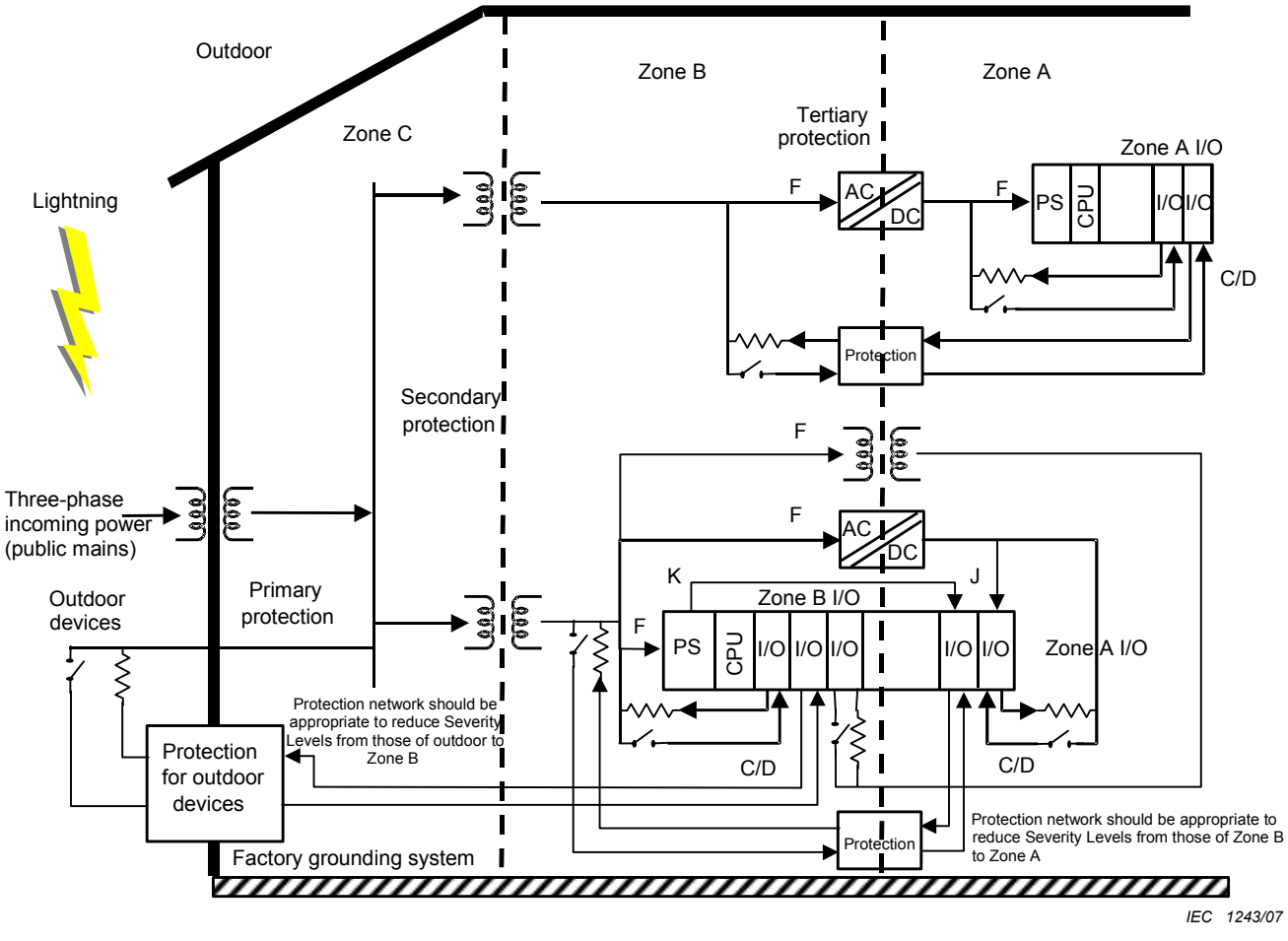

Figure 11 – EMC immunity zones

Dotted lines in Figure 11 are not meant to indicate physical separation or segregation. The letters referred to inFigure 11 (F, K, C, D, etc.) correspond to those referred to in Figure 2. They describe interface/ports.

Table 30 – EMC immunity zones, example regarding surge

EMC zones	EMC considerations		
Zone C	Factory mains distribution High rated voltage	Primary surge protection	Severe voltage surge coupling 4000 V
Zone B	Dedicated power distribution ≤300 V rated voltage	Secondary surge protection I/O impedance limiting	Moderate voltage surge coupling 2000 V
Zone A	Local power distribution ≤120 V rated voltage ≤100 V rated voltage ≤50 V rated voltage	I/O impedance limiting	Low-voltage surge coupling 1000 V 800 V 500 V

8.3.2 Performance criteria

Table 31 – Criteria to prove the performance of a PLC-system against EMC disturbances

Performance criterion		
Criterion	Operation	
	During test	After test
A	The PLC-system shall continue to operate as intended. No loss of function or performance, according to PFVPs (2.5)	The PLC-system shall continue to operate as intended
B	Degradation of performance accepted Examples: analogue values vary within manufacturer-specified limits, communication delay times vary within manufacturer-specified limits, flickering on HMI display, etc. No change of operating mode Examples: loss of data or uncorrected errors in communication, unintentional state changes of digital I/O which are seen by the system or test set-up, etc. No irreversible loss of stored data, according to PFVPs (2.5)	The PLC-system shall continue to operate as intended. Temporary degradation of performance must be self-recoverable
C	Loss of functions accepted, but no destruction of hardware or software (programme or data)	The PLC-system shall continue to operate as intended automatically, after manual restart or power off/power on

8.3.3 Immunity levels

Table 32 – Enclosure port tests, Zones A and B

Environmental phenomenon	Reference standard	Test		Test level	Test set-up	Normative items	Performance criteria
Electrostatic discharge	IEC 61000-6-2	Contact		±4kV	Table 38	[1]	B
		Air		±8kV			
Radio-frequency Electro-magnetic field Amplitude modulated	IEC 61000-6-2	80% AM, 1kHz Sinusoidal	2,0-2,7 GHz	1 V/m	Table 39	[4]	A
			1,4-2,0 GHz	3 V/m			
			80-1000 MHz	10 V/m			
Power frequency magnetic fields	IEC 61000-6-2	60 Hz		30 A/m	Table 40	[2, 3]	A
		50 Hz		30 A/m			

[1] The ESD test shall be applied to

a) operator accessible devices (for example, HMI, PADT and TE);

b) enclosure ports;

c) service accessible parts (for example, switches, keyboards, protective/functional earth, module housing, communications ports with connectors in place and metal connectors) which are not protected from casual access.

The ESD test shall not be applied to communications ports without connectors in place, I/O ports or power ports.

[2] This test is meant to test equipment sensitivity to magnetic fields normally occurring on the factory floor. The test is only applicable to equipment containing devices susceptible to magnetic fields, such as Hall effect devices, CRT displays, disk drives, magnetic memories and similar equipment. The basic PLC does not normally contain such devices; however, other devices, such as HMI, may. The test is not meant to simulate high-intensity magnetic fields such as those, for example, associated with welding and induction heating processes. This requirement may be satisfied by the test being applied to the sensitive device at the device manufacturer.

[3] There will be no deviation up to 3 A/m. Above 3 A/m the manufacturer will specify the allowed deviation for CRT display interfaces.

[4] This level does not represent the field emitted by a transceiver in close proximity to the PLC-system.

Zone B levels are the most typical industrial environmental levels.