



DPC: 23 / 30461648 DC

BSI Group Headquarters

389 Chiswick High Road London W4 4AL

Tel: +44 (0)20 8996 9000

Fax: +44 (0)20 8996 7400

www.bsigroup.com

Date: 15 August 2023

Origin: International

Latest date for receipt of comments: 4 October 2023

Project No. 2022/01970

Responsible committee: GEL/65 Measurement and control

Interested committees:

Title: BS EN IEC 61326-2-7 Electrical equipment for measurement, control and laboratory use – EMC requirements

Part 2-7: Particular requirements – Test configurations, operational conditions, test levels and performance criteria for field devices with Ethernet-APL interfaces

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Responsible Committee Secretary: Ms Charmaine Mukherjee (BSI)

Direct tel:

E-mail: charmaine.mukherjee@bsigroup.com

Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

PROJECT NUMBER: IEC 61326-2-7 ED1	
DATE OF CIRCULATION: 2023-08-11	CLOSING DATE FOR COMMENTS: 2023-11-03
SUPERSEDES DOCUMENTS: 65A/1069/CD, 65A/1096/CC	

IEC SC 65A : SYSTEM ASPECTS	
SECRETARIAT: United Kingdom	SECRETARY: Ms Stephanie Lavy
OF INTEREST TO THE FOLLOWING COMMITTEES: SC 65C	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.
FUNCTIONS CONCERNED: ☒ EMC ☐ ENVIRONMENT ☐ QUALITY ASSURANCE ☐ SAFETY	

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TITLE:

Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 2-7: Particular requirements – Test configurations, operational conditions, test levels and performance criteria for field devices with Ethernet-APL interfaces

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ELECTRICAL EQUIPMENT FOR MEASUREMENT, CONTROL AND LABORATORY USE – EMC REQUIREMENTS –

Part 2-7: Particular requirements – Test configurations, operational conditions, test levels and performance criteria for devices with Ethernet-APL interfaces

1 Scope

In addition to the requirements of IEC 61326-1, this part of IEC 61326 specifies the EMC test requirements for process automation equipment using at least one Ethernet-APL (Ethernet Advanced Physical Layer) compliant port. The type of equipment covered by this part includes infrastructure devices such as switches as well as measurement and control devices. This part of IEC 61326 provides requirements for the EMC test setups of the APL interface for devices intended for use in process control and process measurement.

The other functions of the equipment remain covered by other parts of the IEC 61326 series.

Note Ethernet-APL uses IEEE Std. 802.3-2022 Ethernet Physical Layer 10BASE-T1L, suitable to be used for full-duplex communication over a single balanced pair of conductors.

The test levels are based on the intended environment as stated in the product's specification or user documentation and selected appropriately from IEC 61326-1.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61158-2:2019, Industrial communication networks – Fieldbus specifications – Part 2: Physical layer specification and service definition

IEC TS 63444:202x, Industrial Networks – Ethernet-APL Port Profile Specification

IEC 61326-1:2020, Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements

IEC 61326-2-3:2020, Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 2-3: Particular requirements – Test configuration, operational conditions and performance criteria for transducers with integrated or remote signal conditioning

IEC 61000-4-2:2008, Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test

IEC 61000-4-3:2006, Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test Amendment 1:2007 Amendment 2:2010

IEC 61000-4-4:2012, Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test

IEC 61000-4-5:2014, Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test Amendment 1:2017

IEC 61000-4-6:2013, Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields

IEC 61000-4-8:2009, Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test

IEC 61000-4-11:2004+AMD1:2017, Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests

IEC 61000-4-16:2015, Electromagnetic compatibility (EMC) – Part 4-16: Testing and measurement techniques - Test for immunity to conducted, common mode disturbances in the frequency range 0 Hz to 150 kHz

IEC 61000-4-29:2000, Electromagnetic compatibility (EMC) – Part 4-29: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests

CISPR 11:2015+AMD1:2016+AMD2:2019, Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-161 and the following apply. ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1.1 Advanced Physical Layer (APL)

physical layer, specified in IEEE 802.3-2022

Note to entry: Additional requirements for use in process industries are specified in the APL documentation as provided within IEC TS 63444.

3.1.2 APL segment

segment of two APL ports, each containing a 10BASE-T1L compatible PHY, connected at each end of a two-wire, shielded cable

Note 1 to entry: An APL segment can optionally be equipped with a maximum of two auxiliary devices and containing up to 10 inline terminal connections.

Note 2 to entry: An APL segment is either a trunk or a spur.

3.1.3 APL switch

ethernet switch including at least one APL compliant port

3.1.4 APL port

electrical and mechanical interface of a device to an APL SEGMENT

3.1.5 auxiliary device

device that is connected within an APL SEGMENT and does not include a 10BASE-T1L PHY, e.g. it could comprise a power load or introduce communication signal insertion losses

Note to entry: A surge protector is an example of an auxiliary device.

3.1.6 cascade port

APL PORT used in powered daisy-chain networks

3.1.7 connection, inline connection

mated device or combination of devices used to connect cables or cable elements to other cables or application specific equipment

3.1.8 field switch

APL SWITCH having at least one port to which a SPUR can be connected

3.1.9 power switch

switch including at least one port feeding power into a TRUNK

3.1.10 PHY

physical layer circuitry required to implement physical layer functions

3.1.11 spur

APL segment which connects a field device to a field switch

Note 1 to entry: An APL spur segment may have a maximum cable length of 200 m.

Note 2 to entry: An APL spur segment may optionally be equipped with a maximum of two auxiliary devices and up to four inline terminal connections.

3.1.12 trunk

APL SEGMENT which connects two field switches or a field switch with a power switch

Note 1 to entry: An APL trunk segment may have a maximum cable length of 1 000 m.

Note 2 to entry: An APL trunk segment may optionally be equipped with a maximum of two auxiliary devices and up to 10 inline terminal connections.

3.1.13 industrial electromagnetic environment

environment existing at locations characterized by a separate power network, in most cases supplied from a high- or medium-voltage transformer, dedicated for the supply of installations feeding manufacturing or similar plants with one or more of the following conditions:

- frequent switching of heavy inductive or capacitive loads,
- high currents and associated magnetic fields,
- presence of Industrial, Scientific and Medical (ISM) equipment (for example, welding machines)

3.1.14 specified electromagnetic process control environment

environments encompassed are industrial, both indoor and outdoor, and based on the requirements of the process industry, specifically chemical/petrochemical/pharmaceutical manufacturing plants. The difference between this electromagnetic environment compared to the general industrial environment (see 3.1.13) is due to the mitigation measures employed against electromagnetic phenomena leading to a specified electromagnetic environment with test values that have been proven in practice to gain high availability

The environment of industrial application with a specified electromagnetic environment typically includes the following characteristics:

- industrial area with limited access,
- limited use of mobile transmitters,
- dedicated cables for power supply and control, signal or communication lines,
- separation between power supply and control, signal or communication cables,

- factory building mostly consisting of metal construction,
- overvoltage/lightning protection by appropriate measures (for example, metal construction of the building or use of protection devices),
- pipe heating systems driven by AC main power,
- no high-voltage substation close to sensitive areas,
- presence of CISPR 11 Group 2 ISM equipment using ISM frequencies only with low power,
- competent staff,
- periodical maintenance of equipment and systems,
- mounting and installation guidelines for equipment and systems

3.1.15 laboratory

test and measurement area that is specifically used for analysis, testing and servicing and where equipment is operated by trained personnel

3.1.16 field device (APL)

device with one SPUR load port which sends or receives process values

Note to entry: In addition, it may have an optional power supply port.

3.1.17 uplink port

ethernet port of an APL infrastructure device used for connection to the Ethernet network

3.1.18 performance level

specified operation of equipment under conditions of intended use

3.1.19 degradation (in performance)

undesired departure in the operational performance of any device, equipment or system from its intended performance

Note to entry: The term "degradation" can apply to temporary or permanent failure.

[SOURCE: IEC 60050-161:1990, 161-01-19]

3.1.20 loss of performance

operation of equipment outside a specified PERFORMANCE LEVEL

3.1.21 loss of function

operation of equipment with one (or more) of the equipment's functions unusable

3.1.22 long-distance line

line within a building which are longer than 30 m, or which leave the building (including lines of outdoor installations)

3.2 Abbreviations

AE	auxiliary equipment
CCC	capacitive coupling clamp
CDN	coupling/decoupling network
CN	coupling network
EMC	electromagnetic compatibility
ESD	electrostatic discharge

272	EUT	equipment under test
273	FD	FIELD DEVICE
274	ICMP	internet control message protocol
275	IP	internet protocol
276	RF	radio frequency

277

278 **4 General**

279 This document specifies the requirements and test setups for testing APL infrastructure and
280 FIELD DEVICES.

281 **4.1 General considerations on EMC testing of devices with APL interface**

282 The following general rules apply when testing APL devices:

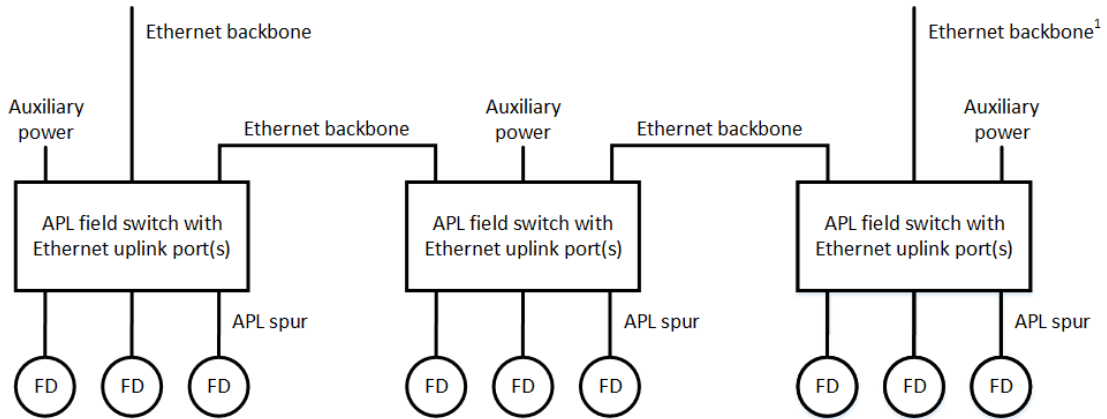
- 283 • Base for the EMC testing of infrastructure and FIELD DEVICES with APL interface is the
284 IEC 61326 series.
- 285 • Test levels and test requirements for industrial environments are provided in Table 3 of
286 this document. These levels are the minimum requirements for EMC testing for an APL
287 device.
- 288 • For core process industry environments, specifically
289 chemical/petrochemical/pharmaceutical manufacturing plants, additional tests may be
290 required. The higher test levels required for these environments are provided in Table
291 4 of this document.

292 The manufacturer may choose to perform all tests on either a single EUT or divide the tests
293 among multiple EUTs. If the latter, each test result shall be traceable to the EUT tested. The
294 testing sequence with multiple EUTs is optional.

295 **4.2 Structure of an APL system**

296 APL allows different system configurations, using 10/100/1 000 Mbit/s Ethernet network
297 connections with powered APL TRUNKS.

298 Figure 1 illustrates an example of an APL network connected to a control network using an
299 Ethernet network. In such a case, the 10/100/1 000 MBit/s Ethernet BACKBONE is directly
300 connected to the APL FIELD SWITCHES. For an Ethernet network, an APL system also supports
301 redundant ring topologies.

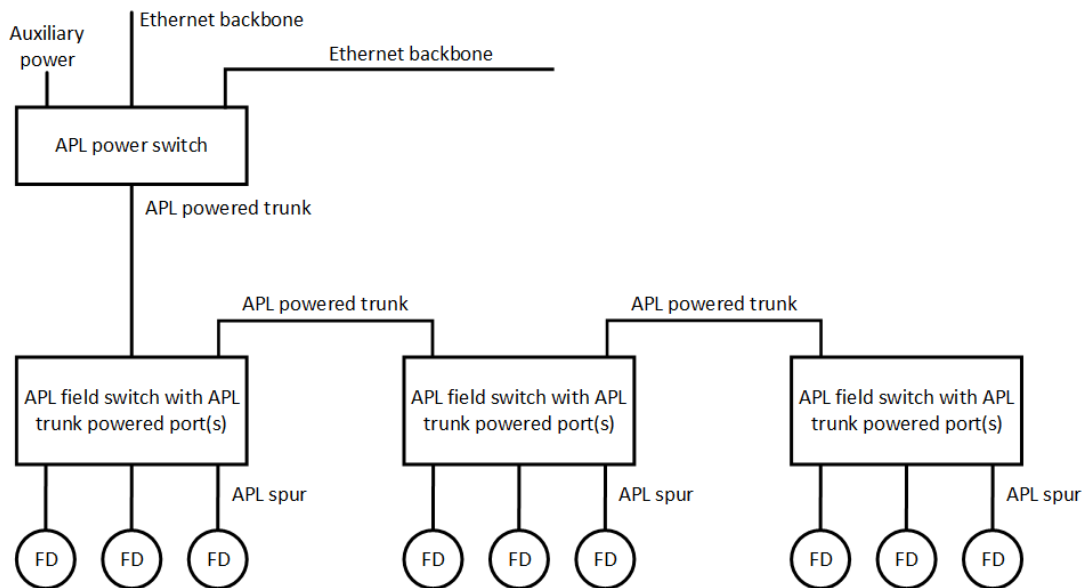


FD: APL field device

¹ In case of a ring topology.

Figure 1 – APL system structure for APL FIELD SWITCHES with Ethernet UPLINK PORT(S)

Figure 2 illustrates an example of an APL network connected to a control network using a powered APL TRUNK. The communication link between the control network and the APL SEGMENT is performed through a POWER SWITCH, which additionally feeds power onto the APL TRUNK. For a powered APL TRUNK an APL system currently does not support redundant ring topologies.



FD: APL field device

Figure 2 – APL system structure for APL FIELD SWITCHES with APL TRUNK powered port(s)

Each APL SPUR finally terminates at a FIELD DEVICE, which may also be powered in accordance with the applicable hazardous area classification, so that FIELD DEVICES, which will typically be intrinsically safe certified, can be located in an appropriately assessed hazardous area.

Each TRUNK cable length may be up to 1 000 m long, depending on the type of the cable used, the power loss through the cable and the power consumption of the components connected to the TRUNK. The SPUR cable length may be up to 200 m, depending on the type of the cable used.