IEC 60728-7-3

Edition 2.0 2009-10

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Cable networks for television signals, sound signals and interactive services – Part 7-3: Hybrid fibre coax outside plant status monitoring – Power supply to transponder interface bus (PSTIB)

Réseaux de distribution par câbles pour signaux de télévision, signaux de radiodiffusion sonore et services interactifs – Partie 7-3: Surveillance de l'état des installations extérieures des réseaux hybrides à fibre optique et câble coaxial – Alimentation du bus d'interface du répéteur (PSTIB)

IEC 60728-7-3:2009-10(en-fr)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC
The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications
The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, …). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC online collection - oc.iec.ch
Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org
The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 18 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

A propos de l'IEC
La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC
Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC - webstore.iec.ch/advsearchform
La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études, …). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished
Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc
Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

IEC online collection - oc.iec.ch
Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

Electropedia - www.electropedia.org
Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 000 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

IEC 60728-7-3

Edition 2.0 2009-10

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Cable networks for television signals, sound signals and interactive services – Part 7-3: Hybrid fibre coax outside plant status monitoring – Power supply to transponder interface bus (PSTIB)

Réseaux de distribution par câbles pour signaux de télévision, signaux de radiodiffusion sonore et services interactifs – Partie 7-3: Surveillance de l'état des installations extérieures des réseaux hybrides à fibre optique et câble coaxial – Alimentation du bus d'interface du répéteur (PSTIB)

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

ICS 33.040.40; 33.160.01

ISBN 978-2-8322-9339-3

CONTENTS

FOREWORD 5
INTRODUCTION 7
1 Scope 8
2 Normative references 9
3 Terms, definitions and abbreviations 9
3.1 Terms and definitions 9
3.2 Abbreviations 10
4 Reference architecture forward and return channel specifications 10
5 Power supply to transponder interface bus specification overview 11
5.1 General 11
5.2 Interface compliance 11
5.3 Implementation compliance 11
5.4 Revision control 12
6 Power supply to transponder interface bus – Physical layer specification 12
6.1 Interface requirements 12
6.1.1 Connector type 12
6.1.2 Communications interface 12
6.1.3 Connector signals 12
6.1.4 Transponder power 12
6.1.5 Line balance 13
6.1.6 Cable length 13
6.1.7 Data encoding 13
6.1.8 Bit rate 13
6.1.9 Duplex 13
6.1.10 Method of communications 13
6.1.11 Indicators 13
6.2 Interface diagram 14
7 Alternative power supply to transponder interface bus – Physical layer specification 15
7.1 Introduction to alternative 15
7.2 Interface requirements 15
7.2.1 Connector type 15
7.2.2 Communications interface 15
7.2.3 Connector signals 15
7.2.4 Transponder power 15
7.2.5 Line balance 16
7.2.6 Cable length 16
7.2.7 Data encoding 16
7.2.8 Bit rate 16
7.2.9 Duplex 16
7.2.10 Method of communication 16
7.2.11 Indicators 17
7.3 Interface diagram 17
8 Power supply to transponder interface bus – Data link layer specification 18
8.1 DLL packet structure 18
8.1.1 General 18

8.1.2 Start 18
8.1.3 Destination Address 18
8.1.4 Source Address 19
8.1.5 Identification 19
8.1.6 Datagram 19
8.1.7 End 19
8.1.8 Checksum 19
8.2 DLE sequence 19
8.3 Interface timing 20
8.3.1 Message synchronization and interaction 20
8.3.2 Transmission timing requirements 21
8.4 DLL datagrams 22
8.4.1 Structure 22
8.4.2 Resolution versus accuracy 23
8.4.3 DLL datagram types 23
Annex A (informative) HMS specification documents 37
Bibliography 38

Figure 1 – Reference architecture diagram 11
Figure 2 – Sample PSTIB RS-485 interface 14
Figure 3 – Sample PSTIB RS-485 interface 17
Figure 4 – DLL packet structure 18
Figure 5 – PSTIB data and timing diagram 21
Figure 6 – DLL datagram structure 22
Figure 7 – Battery string naming conventions 33

Table 1 – Transponder type classifications 8
Table 2 – RJ-45 Connector pin assignment 12
Table 3 – Sample PSTIB RS-485 interface – Reference signals 14
Table 4 – RJ-45 Connector pin assignment 15
Table 5 – Sample PSTIB RS-485 interface – Reference signals 17
Table 6 – Generic DLL packet structure 18
Table 7 – Reserved destination address ranges 19
Table 8 – PSTIB timing specifications 21
Table 9 – Generic DLL datagram structure 22
Table 10 – DLL datagrams 24
Table 11 – Command: Get_Configuration datagram 24
Table 12 – Response: Get_Configuration datagram 25
Table 13 – Response: Get_Configuration datagram variable binding (general) 25
Table 14 – Response: Get_Configuration datagram variable binding (power supply) 26
Table 15 – Response: Get_Configuration datagram [a] variable binding (generator) 29
Table 16 – Command: Get_Power_Supply_Data datagram 30
Table 17 – Response: Get_Power_Supply_Data datagram 30
Table 18 – Response: Get_Power_Supply_Data datagram variable binding 30

Table 19 – Command: Power_Supply_Control datagram 33
Table 20 – Command: Get_Generator_Data datagram 33
Table 21 – Response: Get_Generator_Data datagram 34
Table 22 – Response: Get_Generator_Data Datagram variable binding 34
Table 23 – Command: Generator_Control datagram 35
Table 24 – Response: Invalid_Request datagram 35
Table 25 – Response: Request_Processed datagram 36
Table A.1 – HMS document family 37

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

CABLE NETWORKS FOR TELEVISION SIGNALS, SOUND SIGNALS AND INTERACTIVE SERVICES –

Part 7-3: Hybrid fibre coax outside plant status monitoring – Power supply to transponder interface bus (PSTIB)

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.

3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.

4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.

5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.

6) All users should ensure that they have the latest edition of this publication.

7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.

8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.

9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60728-7-3 has been prepared by technical area 5: Cable networks for television signals, sound signals and interactive services, of IEC technical committee 100: Audio, video and multimedia systems and equipment.

This second edition cancels and replaces the first edition published in 2003 of which it constitutes a technical revision. This edition includes the following significant technical changes with respect to the previous edition:

- All changes from standard ANSI/SCTE 25-3 v1.0 to standard ANSI/SCTE 25-3 v1.1 (2005) have been taken into account in this second edition.
- Clause 7 is based on standard ANSI/SCTE 110 (2005).
- Addition of informative Annex A concerning hybrid management sub-layer.

The text of this standard is based on the following documents:

CDV	Report on voting
100/1464/CDV	100/1599/RVC

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 60728 series, under the general title *Cable networks for television signals, sound signals and interactive services*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

Standards of the IEC 60728 series deal with cable networks including equipment and associated methods of measurement for headend reception, processing and distribution of television signals, sound signals and their associated data signals and for processing, interfacing and transmitting all kinds of signals for interactive services using all applicable transmission media.

This includes

- CATV[1]-networks;
- MATV-networks and SMATV-networks;
- individual receiving networks;

and all kinds of equipment, systems and installations installed in such networks.

The extent of this standardization work is from the antennas and/or special signal source inputs to the head-end or other interface points to the network up to the terminal input.

The standardization of any user terminals (i.e. tuners, receivers, decoders, multimedia terminals, etc.) as well as of any coaxial, balanced and optical cables and accessories thereof is excluded.

The following differences exist in some countries:

The Japanese *de facto* standard (NCTEA S-006) concerning requirements for the HFC outside plant management, which was published in 1995, has already been available in Japan. The purpose of this standard is to support the design and implementation of interoperable management systems for HFC cable networks used in Japan.

[1] This word encompasses the HFC networks used nowadays to provide telecommunications services, voice, data, audio and video both broadcast and narrowcast.

CABLE NETWORKS FOR TELEVISION SIGNALS, SOUND SIGNALS AND INTERACTIVE SERVICES –

Part 7-3: Hybrid fibre coax outside plant status monitoring – Power supply to transponder interface bus (PSTIB)

1 Scope

This part of IEC 60728 specifies requirements for the Hybrid Fibre Coax (HFC) Outside Plant (OSP) Power Supplies (PS). This standard is part of a series developed to support the design and implementation of interoperable management systems for evolving HFC cable networks. The purpose of the standards is to support the design and implementation of interoperable management systems for evolving HFC cable networks. The Power Supply to Transponder Interface Bus (PSTIB) specification describes the physical (PHY) interface and related messaging and protocols implemented at the Data Link Layer (DLL), layers 1 and 2 respectively in the 7-layer ISO-OSI reference model, that support communications between compliant transponders and the managed OSP power supplies and other related power equipment to which they interface.

This standard describes the PSTIB PHY and DLL layer requirements and protocols that shall be implemented to support reliable communications between all type 2 and type 3 compliant OSP transponders on the HFC plant and managed OSP power supplies and related hardware. Any exceptions to compliance with this standard will be specifically noted as necessary.

Transponder type classifications referenced within the HMS series of standards are defined in Table 1.

Table 1 – Transponder type classifications

Type	Description	Application
Type 0	Refers to legacy transponder equipment which is incapable of supporting the specifications	• This transponder interfaces with legacy network equipment through proprietary means. • This transponder could be managed through the same management applications as the other types through proxies or other means at the head-end.
Type 1	Refers to stand-alone transponder equipment (legacy or new), which can be upgraded to support the specifications	• This transponder interfaces with legacy network equipment through proprietary means. • Type 1 is a standards-compliant transponder (either manufactured to the standard or upgraded) that connects to legacy network equipment via a proprietary interface.
Type 2	Refers to a stand-alone, compliant transponder	• This transponder interfaces with network equipment designed to support the electrical and physical specifications defined in the standards. • It can be factory or field-installed. • Its RF connection is independent of the monitored NE.
Type 3	Refers to a stand-alone or embedded, compliant transponder	• This transponder interfaces with network equipment designed to support the electrical specifications defined in the standards. • It may or may not support the physical specifications defined in the standards. • It can be factory-installed. It may or may not be field-installed. • Its RF connection is through the monitored NE.

A list of documents in the HMS specifications family is provided in informative Annex A.

2 Normative references

The following referenced documents are indispensable for the application 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 60603-7, *Connectors for electronic equipment – Part 7: Detail specification for 8-way, unshielded, free and fixed connectors*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the following definitions apply.

3.1.1
data link layer
DLL
layer 2 in the Open System Interconnection (OSI) architecture; the layer that provides services to transfer data over the physical transmission link between open systems

3.1.2
network element
NE
an active element in the outside plant (OSP) that is capable of receiving commands from a head-end element (HE) in the head-end and, as necessary, providing status information and alarms back to the HE

3.1.3
open system interconnection
OSI
framework of International Organization for Standardization (ISO) standards for communication between multi-vendor systems that organizes the communication process into seven different categories that are placed in a layered sequence based on the relationship to the user. Each layer uses the layer immediately below it and provides services to the layer above. Layers 7 through 4 deal with end-to-end communication between the message source and destination, and layers 3 through 1 deal with network functions

3.1.4
physical layer
PHY
layer 1 in the Open System Interconnection (OSI) architecture; the layer that provides services to transmit bits or groups of bits over a transmission link between open systems and which entails electrical, mechanical and handshaking procedures

3.1.5
transponder
device that interfaces to outside plant (OSP) NEs and relays status and alarm information to the HE. It can interface with an active NE via an arrangement of parallel analogue, parallel digital and serial ports

3.2 Abbreviations

CATV	Community Antenna Television (network)
DLE	Data Link Escape
DLL	Data Link Layer
EIA	Electronic Industries Alliance
EMS	Element Management System
ETX	End of Text
Gnd	Ground
HE	Head-end Element
HFC	Hybrid Fibre Coax
HMS	Hybrid Management Sub-Layer
ISO	International Organization for Standardization
LED	Light Emitting Diode
MAC	Media Access Control
MATV	Master Antenna Television (network)
MIB	Management Information Base
NE	Network Element
OSI	Open System Interconnection
OSP	Outside Plant
PHY	Physical
PSTIB	Power Supply to Transponder Interface Bus
RF	Radio Frequency
Rx	Receive
SNMP	Simple Network Management Protocol
STX	Start of Text
Tx	Transmit
Tx En	Transmit Enable
xpndr	Transponder

4 Reference architecture forward and return channel specifications

The reference architecture for the series of specifications is illustrated in Figure 1.

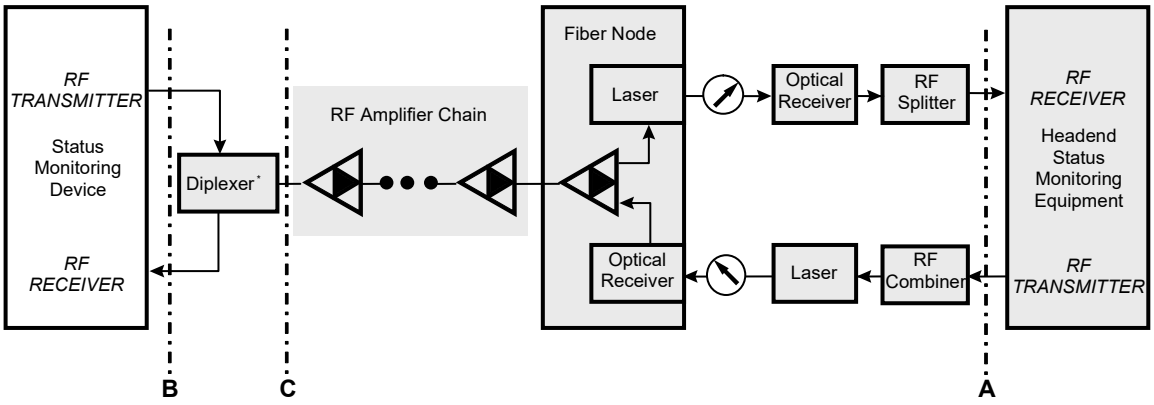

Figure 1 – Reference architecture diagram

All quantities relating to forward channel transmission or reverse channel reception are measured at point A in Figure 1. All quantities relating to forward channel reception or reverse channel transmission are measured at point B for two-port devices and point C for single-port devices as shown in Figure 1.

5 Power supply to transponder interface bus specification overview

5.1 General

PSTIB specification defines a status monitoring topology intended to replace existing analog, discrete status monitoring interfaces used today for monitoring power supplies and other power-related equipment deployed in HFC networks. In this topology, the transponder is simplified by moving all measurements and sensors to the monitored equipment, i.e. power supply or other power equipment. The transponder interfaces to the monitored equipment through a single multi-conductor cable. Transponder power is also provided through this interface. The power supply or other monitored power equipment assumes responsibility for measuring battery parameters, voltages, and other data associated with the equipment installation. Status and commands are passed between transponder and monitored equipment via a serial data interface bus.

The data protocol and command set are simple enough to be implemented in a simple microcontroller. The communication protocol is open and expandable so that as new requirements are defined they can be easily added to new revisions of this specification.

5.2 Interface compliance

Transponder and power supply vendors meeting the mechanical and electrical interface requirements at the PHY layer and the packet and protocol message formats at the DLL layer that are defined within this specification are said to be interface compliant. A Get_Configuration command (see 8.4.3) enables the transponder to determine compliance with a particular revision of this standard for power supplies or other power equipment. Support for this capability is critical as the PSTIB specification is updated over time and power supply equipment supporting different revisions of this specification co-exists within the same network.

5.3 Implementation compliance

Not all vendors will support the complete data set defined throughout this standard. The Get_Configuration response (see 8.4.3) provides the transponder or EMS with the specific status data that is and is not supported for each installation.

5.4 Revision control

The command and response data in this standard are synchronized with associated HMS SNMP MIBs (see Table A.1) that are used to represent this data in management systems. To maintain synchronization, a revision control mechanism shall exist. Therefore, any time this standard is revised so that new data items are added to any command or response, those data items shall be appended to the END of an existing command or response definition. New command and response sequences may also be created as needed. No revision shall change the location, definition or function of a previously defined datum.

6 Power supply to transponder interface bus – Physical layer specification

6.1 Interface requirements

6.1.1 Connector type

The physical connector to support serial communications over the PSTIB between compliant transponders and managed OSP power supply hardware shall implement the following:

a) RJ-45 connector, eight-wire conductor, according to IEC 60603-7;

b) appropriate metallic plating for outdoor usage;

c) operating temperature: –40 °C to +70 °C;

d) dual connectors wired in parallel shall be included on the monitored equipment to support daisy-chaining multiple monitored devices from a single compliant transponder.

6.1.2 Communications interface

The communications interface shall support the EIA RS-485 [1].

6.1.3 Connector signals

Connector pins shall support signalling as described in Table 2.

Table 2 – RJ-45 Connector pin assignment

Connector pin number	Signal
1, 8	Ground
2, 7	+24 V_{DC} ± 15 % at 200 mA
3, 6	RS-485 (+)
4, 5	RS-485 (–)

6.1.4 Transponder power

Powering of transponders from PSTIB interface compliant power supplies shall support the following attributes:

a) the transponder is powered only from the power supply. The transponder shall not connect directly to the system batteries;

b) the power supply shall implement appropriate isolation and system grounding so that the communication interface and transponder power remains functional under the operating conditions defined herein;

c) the transponder shall be bonded to chassis ground directly and/or through the system coaxial cable sheath;

d) optionally, transponder power may be bonded to chassis ground at the power supply interface. The power supply vendor shall determine this;

e) the power supply shall implement appropriate over-current and short-circuit protection of transponder power so that the communication interface and transponder power remain functional under the operating conditions defined herein;

f) up to eight (8) power supplies may be connected in parallel using the RS-485 interface.

6.1.5 Line balance

6.1.5.1 Monitored equipment

Line balance for monitored equipment shall be implemented as follows:

a) RS-485 (+) to a DC voltage of +5 V through a resistor (jumper/switch removable);

b) RS-485 (–) to ground through a resistor (jumper/switch removable);

c) RS-485 (+) tied to RS-485 (–) through a resistor (jumper/switch removable);

d) monitored equipment shall include jumpers to select or bypass resistors to an open state. Jumper or switch-selectable terminating resistors enable on-site configuration of individual installations. Transponders shall include line balance resistors only. Refer to Figure 2.

6.1.5.2 Transponder

Line balance for transponders shall be implemented as follows:

– RS-485 (+) tied to RS-485 (–) through a required resistor.

NOTE Values for each resistor and the decision to include or exclude specific bias resistors as a default should be determined by individual vendors.

6.1.6 Cable length

A maximum cable length of 1 219,2 m (4 000 ft) (for 100 kbit/s) properly terminated wire segment.

6.1.7 Data encoding

Non-return to zero (NRZ), asynchronous, 1 start bit, 8 data bits (ordering: bit 1,2 … 8), 1 stop bit. All integers are transmitted most significant byte first. Any exceptions to this rule will be specifically noted in this standard as necessary.

6.1.8 Bit rate

The bit rate supported shall be 9 600 Bd.

6.1.9 Duplex

This interface shall support half duplex operation. Multi-drop characteristics of RS-485 enable up to 32 drops per segment without signal repeaters.

6.1.10 Method of communications

All communication is transponder-initiated. One monitored device response per query.

6.1.11 Indicators

A LED or other visual device installed at the monitored equipment shall indicate communication has been established with a transponder over the PSTIB interface.