

Specification for

ControlNet —

Part 9: Station management

ICS 25.040.40; 35.100.05

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Foreword

The DD 241 specification was developed by the Allen-Bradley Company, Inc. as “ControlNet”. Allen-Bradley has granted BSI a right to publish the specification as an open communications standard for digital communications networks in industrial control applications.

This part of DD 241 describes the General Description of the deterministic control network.

This publication consists of the following parts:

- *Part 1: General description;*
- *Part 2: Physical layer and media;*
- *Part 3: Data link layer;*
- *Part 4: Network and transport layer;*
- *Part 5: Data management;*
- *Part 6: Object model;*
- *Part 7: Device profiles;*
- *Part 8: Electronic data sheet;*
- *Part 9: Station management;*
- *Part 10: Object library.*

This Draft for Development is not to be regarded as a British Standard.

It is being issued in the Draft for Development series of publications and is of a provisional nature because the subject matter is still under development requiring wider exposure. It should be applied on this provisional basis so that information and experience of its practical application may be obtained.

A review of this Draft for Development will be carried out not later than 2 years after its Publication. Notification of the start of the review period, with a request for the submission of comments from users of this Draft for Development, will be made in an announcement in *Update Standards*.

According to the replies received the responsible BSI Committee will judge whether the Draft for Development can be converted into a British Standard or what other action should be taken.

Observations which it is felt should receive attention before the official call for comments will be welcomed.

These should be sent to the Secretary of BSI Technical Committee AMT/7 at BSI, 389 Chiswick High Road, London, W4 4AL, giving the document reference and clause number and proposing, where possible, an appropriate revision of the text.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 27 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

0 Introduction

The functions of Station Management allow

- access to variables and events within each of the Layers;
- a common user interface;
- co-ordinating the change of link parameters;
- non-disruptively adding nodes to the link;
- tuning of link parameters;
- clock synchronisation between nodes.

The access to variables and events within each of the Layers is accomplished by defining object interfaces for these parameters. The ControlNet Object (part 10, clause **240**) provides an interface to the Physical and Data Link Layers. The Message Router Object (part 10, clause **2**) and Connection Manager Object (part 10, clause **6**) provide an interface to the Network and Transport Layer. These objects are specified in detail in part 10, Object Library, but are mentioned here since they perform Station Management functions.

A common set of indicators are described to allow a consistent user interface to all devices on the control network. These indicators, typically LEDs, allow maintenance personnel to quickly diagnose problems with the Media, Physical and Data Link Layers.

The control network is quite flexible. It can be used to provide deterministic I/O at rates up to 2 ms and node separation distances up to 30 km. To a large degree, this flexibility can be traced to the ability to configure the link parameters. These parameters, which govern the access to the link, can be tuned for a number of different applications. The Station Management entity allows these parameters to be changed as the network is working — allowing the link to continue functioning as connections to new nodes are added and removed.

This part closes by describing the packet formats used to maintain clock synchronisation between nodes on a link. Because the control network has a deterministic multi-master time-based protocol, clock synchronisation to sub 10 μ s accuracy can be attained using these packet formats.

1 Scope

This part of the standard defines the requirements for the Station Management entity of a device on the deterministic control network.

The Station Management entity of the deterministic control network corresponds to the definition of Station Management of the seven layer OSI model in accordance with ISO 7498. Figure 9-1 shows the location of the Station Management entity within the OSI model.

2 Indicators

2.1 Required indicators

Two categories of status indicators shall be provided:

- One module status indicator;
- Two network status indicators.

Additional indicators may be present; however, the naming and symbol conventions of the standard indicators shall not be employed for other indicators.

NOTE Indicators, typically implemented as LEDs, help maintenance personnel to quickly identify a faulty unit or media.

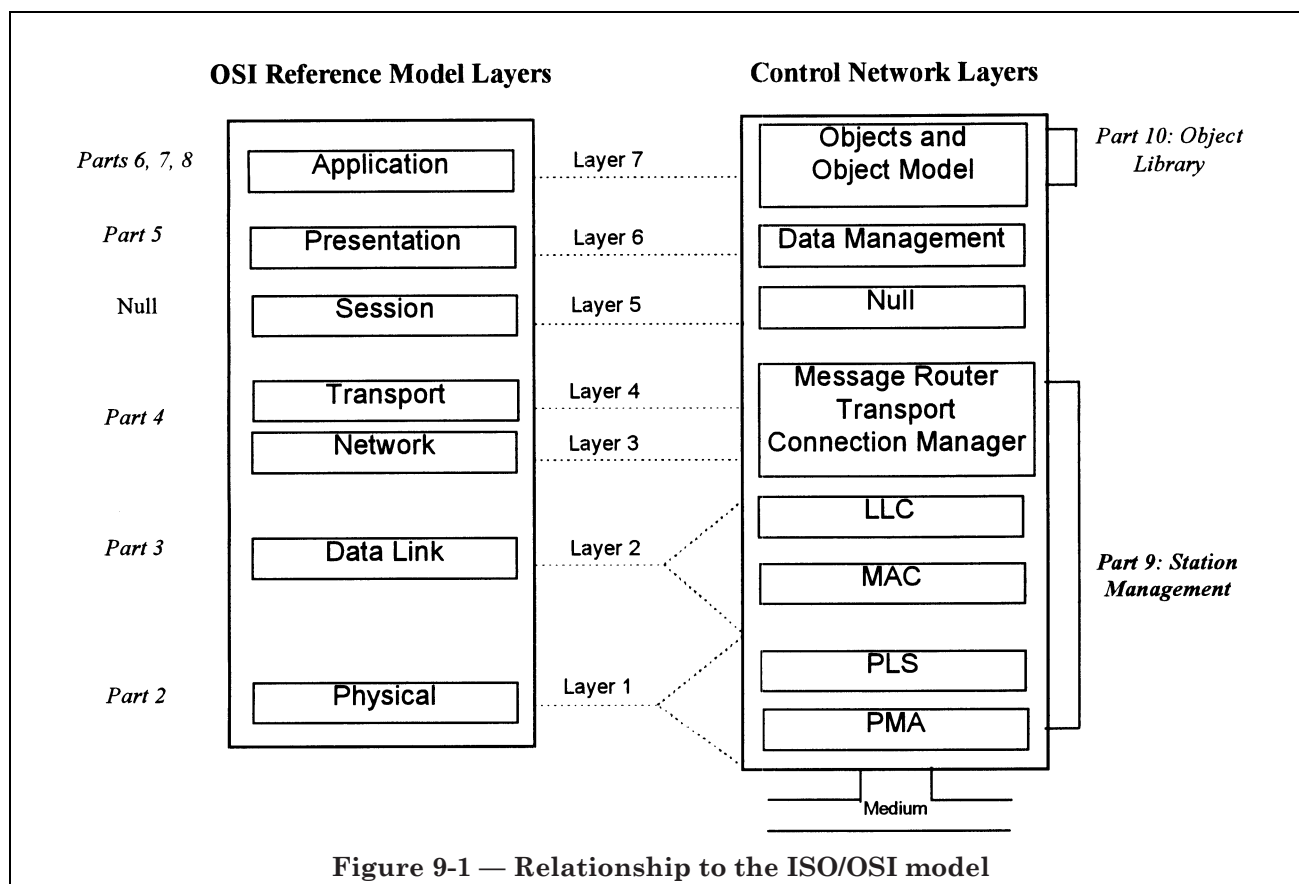
2.2 Common indicator requirements

2.2.1 Applicability of common requirements

The common indicator requirement shall only apply to indicators for which requirements are specified in this standard.

2.2.2 Visibility of indicators

Indicators shall be viewable without removing covers or parts from the equipment. Indicators shall be easily seen in normal lighting. Any labels and icons shall be visible whether or not the indicator is illuminated.



2.2.3 Indicator flash rate

A two state indicator shall have a flash rate of (1.0 ± 0.1) Hz. The indicator shall have a duty cycle of (50 ± 5) %.

NOTE The indicator is in the first state for approximately 0.5 seconds and in the second state for approximately 0.5 seconds.

2.2.4 Indicators at power up

During power up, the indicators shall turn on to a fault or reset state. All indicators shall remain on (illuminated) for at least 1 second. After completion of power up, the indicator shall return to a normal operational state.

2.3 Module status indicator

2.3.1 Behaviour

This bicolour (red/green) indicator shall provide device status. It shall indicate whether or not the device is powered, configured, and operating properly.

NOTE The state of this indicator is described in part 10, clause 1 which details the behaviour of the Identity object.

2.3.2 Labelling

The module status indicator shall be labelled with one of the following:

- “MS”;
- “status”;
- “mod status”;
- “module status”.

2.4 Network status indicators

2.4.1 Description

The indication of network status shall require two bicolour (red/green) indicators. If the device has redundant Physical Layers (channels), each of the indicators shall be associated with one of the channels. If the device does not support channel redundancy, one of the indicators shall be associated with the single channel, however, two indicators shall still be required.

NOTE These indicators signify a number of conditions within the Physical Layer; and when viewed together, they can reflect the state of the Data Link Layer.

2.4.2 Definitions

The following definitions shall be used to describe the indicator behaviour:

- **steady** — indicator shall be illuminated continuously;
- **alternating** — both indicators, viewed together, shall alternate between two defined states, and the two indicators shall always be in opposite states, out of phase;
- **flashing** — each indicator, viewed independently, shall alternate between two states, and if the indicators are flashing, they shall flash together, in phase.

2.4.3 Priority

The different states of the network status indicators shall follow a strict priority scheme. If more than one condition exists, the network status indicators shall display the state with the highest priority as specified in Table 9-1.

Table 9-1 — Network status indicators

priority	indicator state	how to view	cause
highest (1)	both steady off	viewed together	reset or no power
2	both steady red		failed link interface
3	alternating red/green		self test
4	alternating red/off		bad node configuration (such as duplicate MAC ID)
5	steady off	viewed independently	channel disabled or channel not supported
6	flashing red/green		invalid link configuration
7	flashing red/off		link fault or no MAC frames received
8	flashing green/off		temporary channel error, or listen-only
lowest (9)	steady green		normal operation

2.4.4 States

2.4.4.1 Steady green

During normal operation, when MAC frames are being received without detected errors, the network status indicator for any enabled channel shall be steady green.

2.4.4.2 Steady red

If the link interface has faulted, both indicators shall be steady red.

2.4.4.3 Steady off

If one of the Physical Layer entities is disabled, the indicator for the disabled channel shall be off. A channel can be disabled either because the device has only a single Physical Layer or because it has two Physical Layers but exists on a non-redundant network. Only deactivating the entire network interface shall cause both indicators to be extinguished (off).

2.4.4.4 Flashing green/off

A flashing green/off pattern shall signify a temporary channel error. The two channels shall be treated independently with respect to these errors. An error on channel A shall be indicated by any of three events:

- pls_status_indication from channel A does not equal Normal;
- DLL_badCRC_indication (CHA) is asserted;
- DLL_event_indication (DLL_EV_errA) is asserted.

Likewise, an error on channel B shall be indicated by any of three events:

- `pls_status_indication` from channel B does not equal Normal;
- `DLL_badCRC_indication` (CHB) is asserted;
- `DLL_event_indication` (`DLL_EV_errB`) is asserted.

If more than one error occurs in a single MAC frame, only one channel, error shall be declared. There shall be at most one error event per MAC frame per channel. Each Physical Layer shall have an independent `pls_status_indication`. The Data Link Layer shall report errors on at least the channel selected for presentation to higher levels. The DLL may also report errors on the other channel.

The flashing green state shall be entered whenever a channel error is detected. The flashing green state shall transition to the steady green state if no errors are detected for 4 ± 1 seconds on a given channel.

When the Data Link Layer is in a listen-only state, the indicator for any enabled channels shall flash green.

NOTE The listen-only state of the Data Link Layer is described in part 3. The ControlNet Object can be used to force the Data Link Layer to enter the listen-only state as described in part 10, clause 240.

2.4.4.5 *Flashing red/off*

A flashing red/off pattern shall signify a severe link error. If the `pls_frame_indication` from one of channels remains false for a 1.0 ± 0.1 second period, the respective indicator shall assume the flashing red state for the next 1.0 ± 0.1 second period.

For devices with redundant channels enabled, if the error rate for one of the channels exceeds that of the other channel by more than one error per N MAC frames received, then the channel with the higher rate shall flash red. N shall be in the range 10^6 through 2×10^6 . The interval used to measure channel error rate shall be 5×10^6 MAC frames.

2.4.4.6 *Flashing red/green*

A flashing red/green pattern shall signify a bad network configuration. The network status indicators shall enter the flashing red/green state if the network attachment monitor (NAM) indicates that the node has been asked to use invalid network parameters.

NOTE The network attachment monitor is described in clause 7 on page 8.

To optionally indicate a receive queue overflow or a transmit queue underflow, the network status indicators shall enter the flashing red/green state. The network status indicators shall remain in this state at least 3 seconds even if the overflow condition has cleared.

NOTE Transmit underflow for the DLL is defined in part 3.

2.4.4.7 *Alternating red/off*

An alternating red/off pattern shall signify a invalid node configuration. This state shall be entered if the `DLL_event_indication` has either of the following values:

- `DLL_EV_dupNode`;
- `DLL_EV_rogue`.

This state shall be left immediately when the error condition clears.

NOTE The `DLL_event_indication` is described in part 3.

2.4.4.8 *Alternating red/green*

An alternating red/green pattern shall signify that the Data Link Layer is in a self-test mode. The network status indicators shall remain in this state for at least 3 seconds even if the self-test has completed.

2.4.5 *NAP considerations*

The network status indicators do not usually reflect any errors received on the NAP; however, nodes which have only a NAP (no other Physical Layer variants) may optionally use the network status indicators to represent the status of the NAP. If this optional behaviour is implemented, the state of both the indicators shall reflect the state of NAP communication, instead of the A and B channels.

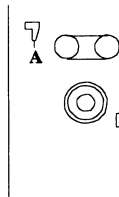
2.4.6 *Labelling*

The network status indicators shall be labelled using the symbols drawn in Figure 9-2 and Figure 9-3. The first channel shall be labelled with the outline of a channel icon. The second channel shall be labelled with a filled in channel icon. The first and second channels may optionally be labelled with an uppercase A and B, respectively.

Devices supporting non-redundant media

Both status indicators

- LED A is labelled with outline of icon and letter A.
- LED B is unlabelled.



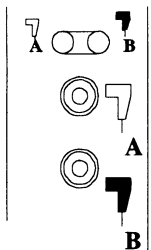
one media connector:
labelled with icon and letter A

Figure 9-2 — Non redundant network status indicator labelling

Devices supporting redundant media

Both status indicators

- LED A is labelled with outline of icon and letter A .
- LED B is labelled with a solid icon and letter B



two media
- one labelled with outline of icon and letter A
- one labelled with a solid icon and letter B

Figure 9-3 — Redundant network status indicator labelling

3 Switches

3.1 General

All switches shall behave in the same way for the same function. For example; all network address switches for devices shall behave in the same way.

3.2 Standardising switch behaviour

3.2.1 Software override of switches

If a user accessible switch can be overwritten by software, then an indicator shall be present that indicates whether or not it has been overwritten.

3.2.2 Software override of switches

If an attribute is configurable with a switch and it cannot be overwritten with software, then the device shall respond with an error to a service which attempts to set the attribute.

3.2.3 Times that switches are valid

Switches shall comply with either of the following rules:

- the switch shall be live at all times;