TECHNICAL SPECIFICATION

# ISO/TS 20684-2

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# Intelligent transport systems — Roadside modules SNMP data interface —

## Part 2: Generalized field device basic management

*Systèmes de transport intelligents — Interface de données SNMP pour les modules en bord de route —*

*Partie 2: Gestion de base d'appareil de terrain généralisé*



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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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# Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems.*

A list of all parts in the ISO 20684 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

# Introduction

## 0.1 Background

The need for standardized communication with ITS field devices is growing around the world. Several countries have adopted SNMP-based field device communication standards.

There is a growing view and empirical evidence that standardizing this activity will result in improved ITS performance, reduced cost, reduced deployment time, and improved maintainability. The ISO 20684 series extends ISO 15784-2 by defining the management information necessary to monitor, configure and control features of field devices. The data elements in all parts of the ISO 20684 series may be used with any relevant protocol, but were designed with an expectation that they would be used with one of the ISO 15784-2 protocols.

By using this approach, agencies can specify open procurements and systems can be expanded geographically in an open and non-proprietary manner which reduces costs, speeds up deployment and simplifies integration.

## 0.2 Overview

SNMP is a collection of well thought-out and well-proven concepts and principles. SNMP employs the sound principles of abstraction and standardization. This has led to SNMP being widely accepted as the prime choice for communication between management systems and devices on the Internet and other communications networks.

The original implementation of SNMP was used to manage network devices such as routers and switches. Since then, the use of SNMP has grown into many areas of application on the Internet and has also been used successfully over various serial communications networks.

This document defines management information for ITS field devices following the SNMP conventions.

## 0.3 Document approach and layout

This document defines:

a) Conformance tables for this document (Clause 5);

b) Architectural assumptions made by this document (Clause 6);

c) User needs that are deemed to be common to many types of field devices (Clause 7);

d) Requirements for implementing the identified user needs, organized by major feature (Clause 8);

e) Security vulnerabilities that should be considered by implementers of this document (Clause 9);

f) The management information base (MIB) for the features defined by this document (Annex A);

g) A requirements traceability table that traces requirements to the design elements (Annex B);

h) A series of standardized codes that can be used to identify types of sensors and actuators (Annex C);

i) The user needs, features and requirements that were considered for but not included in this document (Annex D).

In addition, a simplified version of the conformance table and the MIBs are available electronically at https://standards.iso.org/iso/ts/20684/-2/ed-1/en/.

# Intelligent transport systems — Roadside modules SNMP data interface —

# Part 2: Generalized field device basic management

## 1 Scope

Field devices are a key component in intelligent transport systems (ITS). Field devices include traffic signals, message signs, weather stations, traffic sensors, roadside equipment for connected ITS (C-ITS) environments, etc.

Field devices often need to exchange information with other external entities (managers). Field devices can be quite complex necessitating the standardization of many data concepts for exchange. As such, the ISO 20684 series is divided into several individual parts.

This part of the ISO 20684 series identifies basic user needs for the management of virtually any field device and traces these needs to interoperable designs. This includes the ability to identify the device, its capabilities, and its status.

NOTE This document is similar to portions of NTCIP 1103 v03 and NTCIP 1201 v03.

ISO 20684-1 provides additional details about how the ISO 20684 series relates to the overall ITS architecture.

## 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.

ISO 20684-1, *Intelligent transport systems — Roadside modules SNMP data interface — Part 1: Overview*

IETF RFC 2578, *Structure of Management Information Version 2 (SMIv2), April 1999*

IETF RFC 2579, *Textual Conventions for SMIv2, April 1999*.

IETF RFC 2580, *Conformance Statements for SMIv2, April 1999*.

IETF RFC 3411, *An Architecture for Describing Simple Network Management Protocol (SNMP) Management Frameworks, December 2002*

IETF RFC 3418, *Management Information Base (MIB) for the Simple Network Management Protocol (SNMP), December 2002*

IETF RFC 6933, *Entity MIB (Version 4), May 2013*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 20684-1 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

## 4 Symbols and abbreviated terms

| | |
|---|---|
| AC | alternating current |
| C-ITS | connected intelligent transport systems |
| I/O | input/output |
| IEC | International Electrotechnical Commission |
| IETF | Internet Engineering Task Force |
| ISO | International Organization for Standardization |
| ITS | intelligent transport systems |
| MIB | management information base |
| NTCIP | national transportation communications for ITS protocol |
| RFC | request for comments |
| RTM | requirements traceability matrix |
| SNMP | simple network management protocol |

## 5 Conformance

This conformance section follows the rules defined in ISO 20684-1. Table 1 traces each user need to a set of software features. Table 2 traces each feature to a set of requirements. Table 3 defines terms that are used as predicates in the conformance codes listed in Tables 1 and 2. The ISO 20684-2 PICS file is available electronically at https://standards.iso.org/iso/ts/20684/-2/ed-1/en/. For a full understanding of these tables and codes, see ISO 20684-1.

**Table 1 — User need and feature conformance**

| Need | Requirement | Conformance |
|---|---|---|
| 7.1: Monitor the field device | | M |
| | 8.1: Field device requirements | M |
| | 8.3: Cabinet | M |
| 7.2: Monitor and control single-value inputs and outputs | | O |
| | 8.2: General-purpose I/O | M |
| 7.3.1: Monitor cabinet doors | | O |
| | 8.2: General-purpose I/O | M |
| | 8.4: Cabinet doors | M |
| 7.3.2: Monitor and control cabinet fans | | O |
| | 8.2: General-purpose I/O | M |
| | 8.5: Cabinet fans | M |
| 7.3.3: Monitor and control cabinet heaters | | O |
| | 8.2: General-purpose I/O | M |
| | 8.6: Cabinet heaters | M |

**Table 1** *(continued)*

| Need | Requirement | Conformance |
|---|---|---|
| 7.3.4: Monitor cabinet humidity | | O |
| | 8.2: General-purpose I/O | M |
| | 8.7: Cabinet humidity | M |
| 7.3.5: Monitor cabinet temperature | | O |
| | 8.2: General-purpose I/O | M |
| | 8.8: Cabinet temperature | M |
| 7.3.6: Monitor cabinet mains power | | O.1 (1..*) |
| | 8.2: General-purpose I/O | M |
| | 8.9: Cabinet mains power | M |
| 7.3.7: Monitor cabinet battery power | | O.1 (1..*) |
| | 8.2: General-purpose I/O | M |
| | 8.10: Cabinet battery | M |
| 7.3.8: Monitor cabinet generator power | | O.1 (1..*) |
| | 8.2: General-purpose I/O | M |
| | 8.11: Cabinet generator | M |
| 7.3.9: Monitor cabinet solar power | | O.1 (1..*) |
| | 8.2: General-purpose I/O | M |
| | 8.12: Cabinet solar power | M |
| 7.3.10: Monitor cabinet wind power | | O.1 (1..*) |
| | 8.2: General-purpose I/O | M |
| | 8.13: Cabinet wind power | M |

Annex D provides additional user needs that were considered but not included in this document.

Table 2 traces each feature to a set of requirements and defines under what conditions those requirements could be mandatory in order to claim conformance to this document.

**Table 2 — Requirement conformance**

| Feature | Requirement | Conformance |
|---|---|---|
| 8.1: Field device requirements | | |
| | 8.1.2.1: Discover basic capabilities of the field device | M |
| | 8.1.2.2: Discover SNMP capabilities of the field device | M |
| | 8.1.2.3: Configure the field device's identity | M |
| | 8.1.2.4: Identify the field device | M |
| | 8.1.2.5: Identify the SNMP engine | M |
| | 8.1.2.6: Monitor the field device configuration identifier | M |
| | 8.1.2.7: Monitor controller operation | M |
| | 8.1.2.8: Monitor controller up time | M |
| | 8.1.2.9: Monitor watchdog failure count | M |
| | 8.1.2.10: Reset the controller | M |
| | 8.1.3.1: Field device performance requirements | M |
| | 8.1.3.2: Support maximum message size | M |
| | 8.1.3.3: Support changeable memory | O.2 (1..*) |
| | 8.1.3.4: Support volatile memory | O.2 (1..*) |
| | 8.1.4.1: Control access | M |

**Table 2** *(continued)*

| | |
|---|---|
| 8.1.4.2: Coordinate multiple managers | M |
| 8.2: General-purpose I/O | |
| 8.2.2.1: Discover general-purpose I/O capabilities | M |
| 8.2.2.2: Configure general-purpose I/O | M |
| 8.2.2.3: Retrieve configuration of general-purpose I/O | M |
| 8.2.2.4: Monitor value from general-purpose I/O port | input: M; bidirectional: M |
| 8.2.2.5: Monitor status of general-purpose I/O port | M |
| 8.2.2.6: Monitor status of general-purpose I/O type | M |
| 8.2.2.7: Control output value of general-purpose I/O port | output: M; bidirectional: M |
| 8.2.2.8: Confirm output setting for general-purpose I/O port | output: M; bidirectional: M |
| 8.2.3.1: General-purpose I/O port capabilities | M |
| 8.3: Cabinet | |
| 8.3.2.1: Configure the cabinet's physical components | M |
| 8.3.2.2: Identify the cabinet's physical components | M |
| 8.3.2.3: Determine power source | O |
| 8.3.3.1.a) Mainline (alternating current) power | ac:M |
| 8.3.3.1.b) Battery power | battery:M |
| 8.3.3.1.c) Generator power | generator:M |
| 8.3.3.1.d) Solar power | solar:M |
| 8.3.3.1.e) Wind power | wind:M |
| 8.3.3.2: Support UPS power | O |
| 8.4: Cabinet doors | |
| 8.4.3.1: Cabinet doors monitored | M |
| 8.4.4.1: Cabinet doors monitored through general-purpose I/O | M |
| 8.5: Cabinet fans | |
| 8.5.3.1: Cabinet fans actively monitored | 0.3 (1..*) |
| 8.5.3.2: Cabinet fan control | 0.3 (1..*) |
| 8.5.4.1: Cabinet fans managed through general-purpose I/O | M |
| 8.6: Cabinet heaters | |
| 8.6.3.1: Cabinet heaters actively monitored | 0.4 (1..*) |
| 8.6.3.2: Cabinet heater control | 0.4 (1..*) |
| 8.6.4.1: Cabinet heaters managed through general-purpose I/O | M |
| 8.7: Cabinet humidity | |
| 8.7.3.1: Cabinet humidity monitored | M |
| 8.7.4.1: Cabinet humidity monitored through general-purpose I/O | M |
| 8.8: Cabinet temperature | |
| 8.8.3.1: Cabinet temperature monitored | M |
| 8.8.4.1: Cabinet temperature monitored through general-purpose I/O | M |
| 8.9: Cabinet mains power | |
| 8.9.3.1: Cabinet mains power voltage | M |
| 8.9.3.2: Cabinet mains power current | O |

**Table 2** *(continued)*

| | |
|---|---|
| 8.9.4.1: Cabinet mains power voltage monitored through general-purpose I/O | M |
| 8.9.4.2: Cabinet mains power current monitored through general-purpose I/O | M |
| 8.10: Cabinet battery | |
| 8.10.3.1: Cabinet battery voltage | M |
| 8.10.3.2: Cabinet battery current | M |
| 8.10.3.3: Cabinet battery charge | M |
| 8.10.4.1: Cabinet battery voltage monitored through general-purpose I/O | M |
| 8.10.4.2: Cabinet battery current monitored through general-purpose I/O | M |
| 8.10.4.3: Cabinet battery charge monitored through general-purpose I/O | M |
| 8.11: Cabinet generator | |
| 8.11.3.1: Cabinet generator voltage | M |
| 8.11.3.2: Cabinet generator current | M |
| 8.11.3.3: Cabinet generator engine speed | M |
| 8.11.3.4: Cabinet generator fuel level | M |
| 8.11.4.1: Cabinet generator voltage monitored through general-purpose I/O | M |
| 8.11.4.2: Cabinet generator current monitored through general-purpose I/O | M |
| 8.11.4.3: Cabinet generator engine speed monitored through general-purpose I/O | M |
| 8.11.4.4: Cabinet generator fuel level monitored through general-purpose I/O | M |
| 8.12: Cabinet solar power | |
| 8.12.3.1: Cabinet solar power voltage | M |
| 8.12.3.2: Cabinet solar power current | M |
| 8.12.4.1: Cabinet solar power voltage monitored through general-purpose I/O | M |
| 8.12.4.2: Cabinet solar power current monitored through general-purpose I/O | M |
| 8.13: Cabinet wind power | |
| 8.13.3.1: Cabinet wind power voltage | M |
| 8.13.3.2: Cabinet wind power current | M |
| 8.13.4.1: Cabinet wind power voltage monitored through general-purpose I/O | M |
| 8.13.4.2: Cabinet wind power current monitored through general-purpose I/O | M |

Table 3 provides the formal reference to clauses where the predicates used in Tables 1 and 2 are defined.

**Table 3 — External standard reference**

| Predicate | Clause |
|---|---|
| ac | 7.3.6 |
| battery | 7.3.7 |
| bidirectional | 8.2.3.1.c |
| generator | 7.3.8 |
| input | 8.2.3.1.a |
| output | 8.2.3.1.b |
| solar | 7.3.9 |
| wind | 7.3.10 |

Each requirement specifying a need for a data exchange traces to one dialogue and one or more data elements that an implementation claiming conformance to the requirement shall support. The traceability from requirements to dialogues and data elements is defined in the Requirements Traceability Matrix (RTM) as contained in Annex B. Annex B may include references to dialogues and data elements defined in other documents; any locally defined dialogues shall be defined in the body of the standard while all data elements shall be defined in accordance with Annex A of this document using a Management Information Base (MIB) conforming to the format defined in IETF RFC 2578.

If the implementation supports SNMP, all supported data element instances (i.e., SNMP objects) shall be accessible via any dialogue that meets the requirements of SNMP and the data element definition.

NOTE The dialogues defined in this document are specified to promote a common interface for testing purposes and are not intended to restrict otherwise allowable requests or notifications.



# 6 Architecture

## 6.1 General

This document defines data for management and control of roadside field devices. Figure 1 depicts the physical view of this interface using the graphical conventions defined by the architecture reference for cooperative and intelligent transportation (ARC-IT, http://arc-it.net) and also documented in ISO 14813-5:2020, Annex B.

The manager of the field device is shown in grey indicating that it can be any type of physical object, such as a central system, another field device, a maintenance laptop or any other device that supports the defined interface.

The field device is shown in orange, indicating that it is located in the field (e.g. along the roadside). It shall have a connection to the manager and may have any number of connections to other ITS-S or external systems.

The figure indicates two information transfers between these physical objects. The first is the “configuration and commands” information flow from the manager to the field device. The second is “status and notifications” information flow from the field device to the manager. Both flows are shown in green indicating that authentication is required and both are shown with a single arrowhead indicating a unicast transfer.

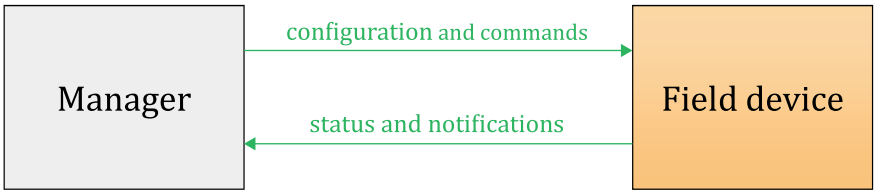


**Figure 1 — Physical view of interface**

## 6.2 Architecture reference

This document addresses technical details identified within the Harmonised Architecture Reference for Technical Standards (HARTS). The scope of this architecture is described at http://htg7.org/html/analysis/servicepackages.html.

## 6.3 Functional view of interface

This document is concerned with defining the data concepts used to manage a field device. The scope of this document does not define the logic used to manage the field device or the protocols used to exchange the defined data elements. However, the data concepts defined in this document have been defined with the assumption that they would be exchanged using an SNMP-like interface.

## 6.4 Physical view of interface

This document addresses interfaces between a "field device" and the physical objects that can potentially manage it, typically "centres" and other "field device" objects. Specific information flows considered within the scope of this document include:

— device identification: information used to initialize, configure, and control the field device.

This document also defines other flows as deemed necessary during the development of detailed designs.

## 6.5 Communications view of interface

### 6.5.1 Overview

This document addresses the data within the application and management entities of the ITS-S architecture reference model as depicted in Figure 2.

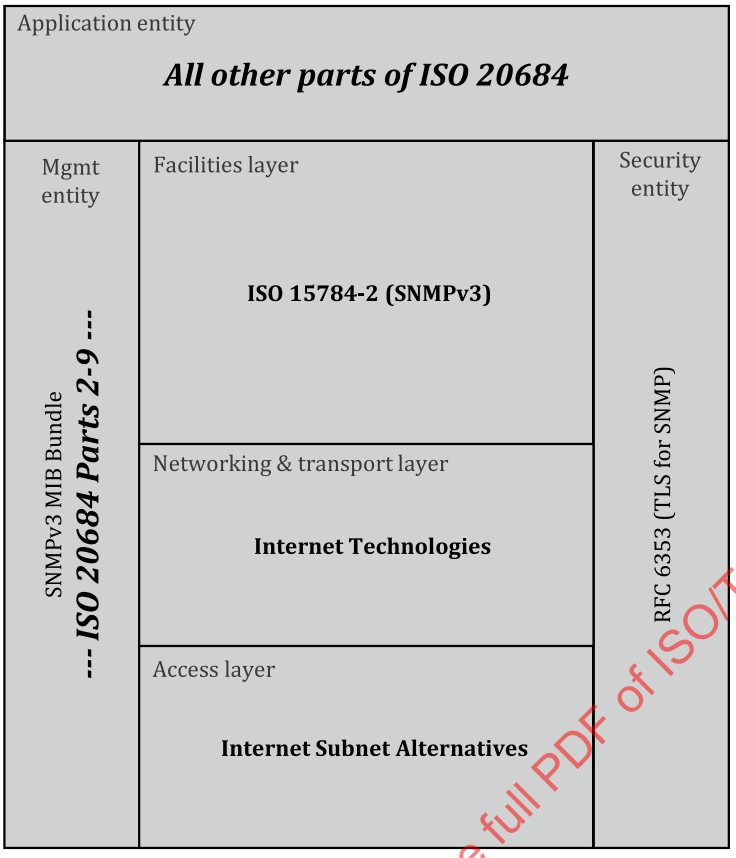


**Figure 2 — Communications view of interface**



### 6.5.2 Security and data protection

Authentication and authorization are dependent on Datagram Transport Layer Security (DTLS)/ Transport Layer Security (TLS) coupled with either X.509 or IEEE 1609.2 certificates. Encryption can be provided as needed using any encryption method with a registered OBJECT IDENTIFIER.

## 7 User needs

### 7.1 Monitor the field device

A manager needs to be able to identify and monitor the overall capabilities and health of each field device controller and its cabinet to discover anomalous conditions that can affect its operation or security. This will assist the manager in confirming which controller(s) may be in a cabinet, as well as the type and specific instance of each controller and the high-level capabilities offered by the device as well as performing proper maintenance actions.

EXAMPLE A manager that is receiving unexpected errors can verify which device it is communicating with as a part of a debugging process and can determine if the device configuration has been changed since its last known state so that the appropriate action can be taken if access has not been authorized.

### 7.2 Monitor and control single-value inputs and outputs

Field devices may be equipped with auxiliary input and/or output ports that can be connected to simple external devices. A manager can need to be able to monitor input ports to enable remote monitoring of simple external devices and/or control output ports to enable remote control of simple external devices.

EXAMPLE 1 A field device can use an auxiliary output to remotely open or close a gate.

 

EXAMPLE 2 A field device can use an auxiliary input to report current gate position in percentage open.

## 7.3 Monitor cabinet

### 7.3.1 Monitor cabinet doors

A manager can need to be able to monitor the open/close status of each cabinet door to determine when equipment is being physically accessed.

### 7.3.2 Monitor and control cabinet fans

A manager can need to be able to monitor and control the on/off status of each cabinet fan to manage the cabinet temperature.

### 7.3.3 Monitor and control cabinet heaters

A manager can need to be able to monitor and control the on/off status of each cabinet heater to manage the cabinet temperature.

### 7.3.4 Monitor cabinet humidity

A manager can need to be able to monitor the relative humidity within the cabinet to disable the controller or subsystems in extreme conditions.

### 7.3.5 Monitor cabinet temperature

A manager can need to be able to monitor the air temperature inside the cabinet to determine when climate control equipment should be activated and/or to disable equipment to prevent overheating.

### 7.3.6 Monitor cabinet mains power

A manager can need to be able to monitor the status of the incoming mains power line, which is typically provided by the power grid to detect when this power is lost or becomes unstable.

### 7.3.7 Monitor cabinet battery power

A manager can need to be able to monitor the status of the battery power system to determine the quality of power and amount of charge available.

### 7.3.8 Monitor cabinet generator power

A manager can need to be able to monitor the status of the cabinet generator power to determine the quality of power being produced and the fuel reserve.

### 7.3.9 Monitor cabinet solar power

A manager can need to be able to monitor the status of the solar power system to determine the amount of power being generated.

### 7.3.10 Monitor cabinet wind power

A manager can need to be able to monitor the status of the wind power system to determine the amount of power being generated.

# 8 Requirements

## 8.1 Field device requirements

### 8.1.1 Field device definition

The field device represents the whole deployed unit including the controller and any attached equipment (e.g. sensors or displays that can be alongside or embedded in the roadway).

### 8.1.2 Field device data exchange requirements

#### 8.1.2.1 Discover basic capabilities of the field device

The field device shall allow a manager to discover the basic capabilities of the field device including:

a) the maximum message size supported by the field device;

b) the amount of memory supported and available within the field device; and

c) the communication services provided by the field device.

#### 8.1.2.2 Discover SNMP capabilities of the field device

The field device shall allow a manager to discover the MIB module capabilities to which the field device conforms.

#### 8.1.2.3 Configure the field device's identity

The field device shall allow a manager to configure the field device's identity, including its:

a) contact,

b) name, and

c) location.

#### 8.1.2.4 Identify the field device

The field device shall allow a manager to identify the field device by retrieving the identity information that was configured for the device along with:

a) a description of the field device implementation, and

b) the unique identifier of the field device implementation.

#### 8.1.2.5 Identify the SNMP engine

The field device shall allow a manager to identify the identifier of the SNMP engine and entity.

#### 8.1.2.6 Monitor the field device configuration identifier

The field device shall allow a manager to quickly identify any change to the field device's configuration by monitoring a single parameter.

#### 8.1.2.7 Monitor controller operation

The field device shall allow a manager to determine if any of the following errors are detected:

a) PROM integrity error;



 

b) RAM integrity error;

c) programme/process error;

d) display interface error;

e) general-purpose input/output error; or

f) other detected error (specific to make, model, and version of device).

#### 8.1.2.8 Monitor controller up time

The field device shall allow a manager to monitor the amount of time the controller has been operating since the last reboot and the number of reboots.

#### 8.1.2.9 Monitor watchdog failure count

The field device shall allow a manager to determine the number of watchdog failures that have occurred.

#### 8.1.2.10 Reset the controller

The field device shall allow a manager to remotely reset the controller.

### 8.1.3 Field device capabilities

#### 8.1.3.1 Field device performance requirements

In the absence of any other specification, the maximum allowed response time for any standardized request shall be 100 ms.

The maximum response time for any non-standard request shall be calculated as follows:

a) Identify the minimum number of standardized request messages that contain all of the objects included in the request for which the calculation is being made.

b) The maximum response time for the non-standard request shall be the sum of the maximum response times for all of the standardized requests identified in Step a).

#### 8.1.3.2 Support maximum message size

The field device shall support a maximum SNMP message size of at least 484 bytes. A specification may require support for larger SNMP message sizes.

#### 8.1.3.3 Support changeable memory

The field device shall support an amount of changeable memory as specified by the specification.

#### 8.1.3.4 Support volatile memory

The field device shall support an amount of volatile memory as specified by the specification.

### 8.1.4 Field device design constraints

#### 8.1.4.1 Control access

Under all circumstances, the field device shall only allow each manager to access data to which it is explicitly authorized.

NOTE This includes data that is recorded in logs, sent in notifications and other indirect access mechanisms.

#### 8.1.4.2 Coordinate multiple managers

Tables that are likely to contain different definitions for different managers shall be designed to easily restrict access to authorized managers and avoid inadvertent conflicts.

EXAMPLE A log can be designed to support a scheme where an administrative manager that has universal rights does not inadvertently change the definition of a log for another manager.

## 8.2 General-purpose I/O

### 8.2.1 General-purpose I/O definition

The general-purpose I/O feature indicates whether the device supports any general-purpose I/O functionality (such as external ports, internal sensors, etc.) that allow for the input and/or output of single-value data. Each port may be input-only, output-only or bidirectional.

A specification should define the types and quantities of general-purpose I/O ports that the field device should support.

### 8.2.2 General-purpose I/O data exchange requirements

#### 8.2.2.1 Discover general-purpose I/O capabilities

The field device shall allow a manager to discover the capabilities of the general-purpose I/O feature.

#### 8.2.2.2 Configure general-purpose I/O

The field device shall allow a manager to configure each general-purpose I/O port by defining its:

a) description,

b) minimum threshold (before it reports an error), and

c) maximum threshold (before it reports an error).

#### 8.2.2.3 Retrieve configuration of general-purpose I/O

The field device shall allow a manager to retrieve the current configuration of each general-purpose I/O port.

#### 8.2.2.4 Monitor value from general-purpose I/O port

The field device shall allow a manager to retrieve the current value being reported from the general-purpose I/O port.

#### 8.2.2.5 Monitor status of general-purpose I/O port

The field device shall allow a manager to retrieve the current status of the indicated general-purpose I/O port.

#### 8.2.2.6 Monitor status of general-purpose I/O type

For each type of general-purpose I/O port supported by the field device, the field device shall allow a manager to determine if any of the entries of that general-purpose I/O type are reporting errors or outside-of-threshold conditions.

#### 8.2.2.7 Control output value of general-purpose I/O port

The field device shall allow a manager to control the output value of the general-purpose I/O port.

#### 8.2.2.8 Confirm output setting for general-purpose I/O port

The field device shall allow a manager to verify the last output value sent to the general-purpose I/O port.

### 8.2.3 General-purpose I/O capabilities

#### 8.2.3.1 General-purpose I/O port capabilities

Each general-purpose I/O port shall be defined as one of:

a) Input,

b) Output, or

c) Bidirectional.

## 8.3 Cabinet

### 8.3.1 Cabinet definition

The cabinet represents the enclosure of the field device controller that hosts the agent that responds to the requests defined by this document.

### 8.3.2 Cabinet data exchange requirements

#### 8.3.2.1 Configure the cabinet's physical components

The field device shall allow a manager to configure information about the cabinet and each of its major components. The information for each item shall include an alias and asset identifier.

#### 8.3.2.2 Identify the cabinet's physical components

The field device shall allow a manager to identify information about the cabinet and each of its components. The information for each item shall include an alias, an asset identifier, make, model, version and related information. The information shall also indicate the arrangement of equipment, such as the field device controller being contained within the cabinet.

#### 8.3.2.3 Determine power source

The field device shall allow a manager to determine the current power source for the cabinet.

### 8.3.3 Cabinet power capability requirements

#### 8.3.3.1 Support power sources

The cabinet shall be supported by at least one of the following power sources:

a) mainline (alternating current) power,

b) battery power,

c) generator power,

d) solar power, or

e) wind power.

#### 8.3.3.2 Support UPS power

The field device shall support an uninterrupted power supply for the cabinet.

## 8.4 Cabinet doors

### 8.4.1 Cabinet door definition

The cabinet door feature indicates the open/close status of each cabinet door monitored by a sensor.

### 8.4.2 Cabinet door data exchange requirements

There are no cabinet door data exchange requirements beyond those defined for the general-purpose I/O feature.

### 8.4.3 Cabinet door capability requirements

#### 8.4.3.1 Cabinet doors monitored

The field device shall monitor the main cabinet door. The project specification may specify additional cabinet doors that shall be monitored.

### 8.4.4 Cabinet door design constraints

#### 8.4.4.1 Cabinet doors monitored through general-purpose I/O

For each cabinet door monitored, the field device shall provide an entry in the general-purpose I/O table where fdGPIOType equals "BDO", in accordance with Annex C.

## 8.5 Cabinet fans

### 8.5.1 Cabinet fan definition

The cabinet fan feature indicates the on/off status of each cabinet fan.

### 8.5.2 Cabinet fan data exchange requirements

There are no cabinet fan data exchange requirements beyond those defined for the general-purpose I/O feature.

### 8.5.3 Cabinet fan capability requirements

#### 8.5.3.1 Cabinet fans actively monitored

The field device shall monitor each cabinet fan to determine if the fan blades are turning at a significant rate. If this requirement is selected, the fdGPIOPortDirection for each cabinet fan shall be either input or bidirectional.

#### 8.5.3.2 Cabinet fan control

The field device shall allow remote on/off control of each cabinet fan. If this requirement is selected, the fdGPIOPortDirection for each cabinet fan shall be either output or bidirectional.



 

#### 8.5.4 Cabinet fan design constraints

##### 8.5.4.1 Cabinet fans managed through general-purpose I/O

For each cabinet fan, the field device shall provide an entry in the general-purpose I/O table where fdGPIOType equals "BFO", in accordance with Annex C.

### 8.6 Cabinet heaters

#### 8.6.1 Cabinet heater definition

The cabinet heater feature indicates the on/off status of each cabinet heater.

#### 8.6.2 Cabinet heater data exchange requirements

There are no cabinet heater data exchange requirements beyond those defined for the general-purpose I/O feature.

#### 8.6.3 Cabinet heater capability requirements

##### 8.6.3.1 Cabinet heaters actively monitored

The field device shall monitor each cabinet heater to determine if the heater is generating significant heat. If this requirement is selected, the fdGPIOPortDirection for each cabinet heater shall be either input or bidirectional.

##### 8.6.3.2 Cabinet heater control

The field device shall allow remote on/off control of each cabinet heater. If this requirement is selected, the fdGPIOPortDirection for each cabinet heater shall be either output or bidirectional.

#### 8.6.4 Cabinet heater design constraints

##### 8.6.4.1 Cabinet heaters managed through general-purpose I/O

For each cabinet heater, the field device shall provide an entry in the general-purpose I/O table where fdGPIOType equals "BHO", in accordance with Annex C.

### 8.7 Cabinet humidity

#### 8.7.1 Cabinet humidity definition

The cabinet humidity feature indicates the current relative humidity of the air within the cabinet.

#### 8.7.2 Cabinet humidity data exchange requirements

There are no cabinet humidity data exchange requirements beyond those defined for the general-purpose I/O feature.

#### 8.7.3 Cabinet humidity capability requirements

##### 8.7.3.1 Cabinet humidity monitored

The field device shall support at least one cabinet humidity sensor. The project specification may specify support for additional cabinet humidity sensors.

#### 8.7.4 Cabinet humidity design constraints

##### 8.7.4.1 Cabinet humidity monitored through general-purpose I/O

For each cabinet humidity sensor, the field device shall provide an entry in the general-purpose I/O table where fdGPIOType equals "BCH", in accordance with Annex C.

### 8.8 Cabinet temperature

#### 8.8.1 Cabinet temperature definition

The cabinet temperature feature indicates the current temperature of the air within the cabinet.

#### 8.8.2 Cabinet temperature data exchange requirements

There are no cabinet temperature data exchange requirements beyond those defined for the general-purpose I/O feature.

#### 8.8.3 Cabinet temperature capability requirements

##### 8.8.3.1 Cabinet temperature monitored

The field device shall support at least one cabinet temperature sensor. The project specification may specify support for additional cabinet temperature sensors.

#### 8.8.4 Cabinet temperature design constraints

##### 8.8.4.1 Cabinet temperature monitored through general-purpose I/O

For each cabinet temperature sensor, the field device shall provide an entry in the general-purpose I/O table where fdGPIOType equals "BCT", in accordance with Annex C.

### 8.9 Cabinet mains power

#### 8.9.1 Cabinet mains power definition

The cabinet mains power feature indicates the status of the mains power line into the cabinet, which is generally provided from the power grid.

#### 8.9.2 Cabinet mains power data exchange requirements

There are no cabinet mains power data exchange requirements beyond those defined for the general-purpose I/O feature.

#### 8.9.3 Cabinet mains power capability requirements

##### 8.9.3.1 Cabinet mains power voltage

The field device shall support at least one voltage sensor for the cabinet mains power. The project specification may specify support for additional voltage sensors for the cabinet mains power.

##### 8.9.3.2 Cabinet mains power current

The field device shall support at least one electrical current sensor for the cabinet mains power. The project specification may specify support for additional electrical current sensors for the cabinet mains power.



 

#### 8.9.4 Cabinet mains power design constraints

##### 8.9.4.1 Cabinet mains power voltage monitored through general-purpose I/O

For each cabinet mains power voltage sensor, the field device shall provide an entry in the general-purpose I/O table where fdGPIOType equals "BLV", in accordance with Annex C.

##### 8.9.4.2 Cabinet mains power current monitored through general-purpose I/O

For each cabinet mains power electrical current sensor, the field device shall provide an entry in the general-purpose I/O table where fdGPIOType equals "BLA", in accordance with Annex C.

### 8.10 Cabinet battery

#### 8.10.1 Cabinet battery definition

The cabinet battery feature indicates the status of the main cabinet battery, which is generally charged by an external source such as a solar array.

#### 8.10.2 Cabinet battery data exchange requirements

There are no cabinet battery data exchange requirements beyond those defined for the general-purpose I/O feature.

#### 8.10.3 Cabinet battery capability requirements

##### 8.10.3.1 Cabinet battery voltage

The field device shall support at least one voltage sensor for the cabinet battery. The project specification may specify support for additional voltage sensors for the cabinet battery.

##### 8.10.3.2 Cabinet battery current

The field device shall support at least one electrical current sensor for the cabinet battery. The project specification may specify support for additional electrical current sensors for the cabinet battery.

##### 8.10.3.3 Cabinet battery charge

The field device shall support at least one charge sensor for the cabinet battery. The project specification may specify support for additional charge sensors for the cabinet battery.

#### 8.10.4 Cabinet battery design constraints

##### 8.10.4.1 Cabinet battery voltage monitored through general-purpose I/O

For each cabinet battery voltage sensor, the field device shall provide an entry in the general-purpose I/O table where fdGPIOType equals "BBV", in accordance with Annex C.

##### 8.10.4.2 Cabinet battery current monitored through general-purpose I/O

For each cabinet battery electrical current sensor, the field device shall provide an entry in the general-purpose I/O table where fdGPIOType equals "BA", in accordance with Annex C.

#### 8.10.4.3 Cabinet battery charge monitored through general-purpose I/O

For each cabinet battery charge sensor, the field device shall provide an entry in the general-purpose I/O table where fdGPIOType equals "BBC", in accordance with Annex C.

## 8.11 Cabinet generator

### 8.11.1 Cabinet generator definition

The cabinet generator feature indicates the status of the main cabinet generator.

### 8.11.2 Cabinet generator data exchange requirements

There are no cabinet generator data exchange requirements beyond those defined for the general-purpose I/O feature.

### 8.11.3 Cabinet generator capability requirements

#### 8.11.3.1 Cabinet generator voltage

The field device shall support at least one voltage sensor for the cabinet generator. The project specification may specify support for additional voltage sensors for the cabinet generator.

#### 8.11.3.2 Cabinet generator current

The field device shall support at least one electrical current sensor for the cabinet generator. The project specification may specify support for additional electrical current sensors for the cabinet generator.

#### 8.11.3.3 Cabinet generator engine speed

The field device shall support at least one engine speed sensor for the cabinet generator. The project specification may specify support for additional engine speed sensors for the cabinet generator.

#### 8.11.3.4 Cabinet generator fuel level

The field device shall support at least one fuel level sensor for the cabinet generator. The project specification may specify support for additional fuel level sensors for the cabinet generator.

### 8.11.4 Cabinet generator design constraints

#### 8.11.4.1 Cabinet generator voltage monitored through general-purpose I/O

For each cabinet generator voltage sensor, the field device shall provide an entry in the general-purpose I/O table where fdGPIOType equals "BGV", in accordance with Annex C.

#### 8.11.4.2 Cabinet generator current monitored through general-purpose I/O

For each cabinet generator electrical current sensor, the field device shall provide an entry in the general-purpose I/O table where fdGPIOType equals "BGA", in accordance with Annex C.

#### 8.11.4.3 Cabinet generator engine speed monitored through general-purpose I/O

For each cabinet generator engine speed sensor, the field device shall provide an entry in the general-purpose I/O table where fdGPIOType equals "BGS", in accordance with Annex C.

#### 8.11.4.4 Cabinet generator fuel level monitored through general-purpose I/O

For each cabinet generator fuel level sensor, the field device shall provide an entry in the general-purpose I/O table where fdGPIOType equals "BGF", in accordance with Annex C.

## 8.12 Cabinet solar power

### 8.12.1 Cabinet solar power definition

The cabinet solar power feature indicates the status of the solar power system.

### 8.12.2 Cabinet solar power data exchange requirements

There are no cabinet solar power data exchange requirements beyond those defined for the general-purpose I/O feature.

### 8.12.3 Cabinet solar power capability requirements

#### 8.12.3.1 Cabinet solar power voltage

The field device shall support at least one voltage sensor for the cabinet solar power system. The project specification may specify support for additional voltage sensors for the cabinet solar power system.

#### 8.12.3.2 Cabinet solar power current

The field device shall support at least one electrical current sensor for the cabinet solar power system. The project specification may specify support for additional electrical current sensors for the cabinet solar power system.

### 8.12.4 Cabinet solar power design constraints

#### 8.12.4.1 Cabinet solar power voltage monitored through general-purpose I/O

For each cabinet solar power voltage sensor, the field device shall provide an entry in the general-purpose I/O table where fdGPIOType equals "BSV", in accordance with Annex C.

#### 8.12.4.2 Cabinet solar power current monitored through general-purpose I/O

For each cabinet solar power electrical current sensor, the field device shall provide an entry in the general-purpose I/O table where fdGPIOType equals "BSA", in accordance with Annex C.

## 8.13 Cabinet wind power

### 8.13.1 Cabinet wind power feature

The cabinet wind power feature indicates the status of the wind power system.

### 8.13.2 Cabinet wind power data exchange requirements

There are no cabinet wind power data exchange requirements beyond those defined for the general-purpose I/O feature.

#### 8.13.3 Cabinet wind power capability requirements

##### 8.13.3.1 Cabinet wind power voltage

The field device shall support at least one voltage sensor for the cabinet wind power system. The project specification may specify support for additional voltage sensors for the cabinet wind power system.

##### 8.13.3.2 Cabinet wind power current

The field device shall support at least one electrical current sensor for the cabinet wind power system. The project specification may specify support for additional electrical current sensors for the cabinet wind power system.

#### 8.13.4 Cabinet wind power design constraints

##### 8.13.4.1 Cabinet wind power voltage monitored through general-purpose I/O

For each cabinet wind power voltage sensor, the field device shall provide an entry in the general-purpose I/O table where fdGPIOType equals "BWV", in accordance with Annex C.

##### 8.13.4.2 Cabinet wind power current monitored through general-purpose I/O

For each cabinet wind power electrical current sensor, the field device shall provide an entry in the general-purpose I/O table where fdGPIOType equals "BWA", in accordance with Annex C.

## 9 Security vulnerabilities

There are data elements defined in this document with a MAX-ACCESS clause of read-write and/or read-create. These and other data elements are sensitive and need to be protected from malicious and inadvertent manipulation and/or disclosure. The support for requests in a non-secure environment without proper protection can have a negative effect on network operations. A sampling of the vulnerabilities includes:

a) the ability to change a device's identity;

b) the ability to change sensor thresholds when errors are reported;

c) the ability to change the output value on an output port; and

d) the ability to monitor current values such as sensor inputs.

To overcome these vulnerabilities, it is highly recommended that SNMPv3 with TLS support, as defined in RFC 6353, is used to exchange the data.

# Annex A
(normative)

# Management information base (MIB)

## A.1 Field device main MIB

This annex provides the formal definition of the field device objects related to the controller and controller cabinet. The definitions are contained within MIBs, which conform to the format defined in IETF RFC 2578. Near the start of each MIB module, an imports clause is used to identify any elements defined in other MIB modules that are normatively required for the complete definition of the current MIB module. As per the rules of IETF RFC 2578, the source for each group of imported elements is identified by the respective module name (e.g. "SNMPv2-SMI"). This document supplements the module name with the document identifier (e.g., "RFC 2578") that contains the formal definition of the imported MIB module. The formal references to each of these normatively referenced documents are provided in Clause 2 of this document.

```
-- ****************************************************************************
-- A.1.1 Header
-- ****************************************************************************
-- ASN1START
FIELD-DEVICE-MAIN-MIB { iso(1) standard(0) 20684 part2(2) version1(1) annexA1(1) }
DEFINITIONS ::= BEGIN
IMPORTS
MODULE-IDENTITY, OBJECT-TYPE, OBJECT-IDENTITY, Counter32, Integer32, Unsigned32
                                                        FROM SNMPv2-SMI
                                                          -- RFC 2578

TruthValue
                                                        FROM SNMPv2-TC
                                                          -- RFC 2579

MODULE-COMPLIANCE, OBJECT-GROUP
                                                        FROM SNMPv2-CONF
                                                          -- RFC 2580

snmpEngineGroup
                                                        FROM SNMP-FRAMEWORK-MIB
                                                          -- RFC 3411

systemGroup
                                                        FROM SNMPv2-MIB
                                                          -- RFC 3418

entityPhysicalGroup, entityPhysical2Group
                                                        FROM ENTITY-MIB
                                                          -- RFC 6933

fieldDevice, iso20684p2
                                                        FROM FIELD-DEVICE-TC-MIB
                                                          -- ISO 20684-1 Annex A
;
fdMainMIB MODULE-IDENTITY
  LAST-UPDATED "201801051922Z"
  ORGANIZATION "ISO TC 204 WG 9"
  CONTACT-INFO
   "name: Kenneth Vaughn
    phone: +1-571-331-5670
    email: kvaughn@trevilon.com
    postal: 6606 FM 1488 RD STE 148-503
            Magnolia, TX 77354
            USA"
  DESCRIPTION
    "The MIB that defines basic information that is generic to most field devices.
    Copyright (C) International Organization for Standardization (ISO) (2017).
    This version of this MIB module is part of ISO/TS 20684-2; see ISO/TS 20684-2
    itself for full legal notices."
  REVISION "201909090414Z"
```

```
  DESCRIPTION
    "Revisions based on comments from CD and other inputs prior to DIS ballot."
  REVISION "201801051922Z"
  DESCRIPTION
    "Revisions to produce CD ballot version."
  REVISION "201711220332Z"
  DESCRIPTION
    "Initial version of the MIB module as distributed for NP Ballot."
  ::= {iso20684p2 1}

-- ****************************************************************************
-- A.1.2 Node Definitions
-- ****************************************************************************
fdMainMIBConformance OBJECT-IDENTITY
  STATUS     current
  DESCRIPTION
    "A node containing conformance statements related to the fdMainMIB, as
    defined in ISO/TS 20684-2."
  ::= {fdMainMIB 2}

fdMainMIBCompliances OBJECT-IDENTITY
  STATUS     current
  DESCRIPTION
    "A node for compliance statements for the fdMainMIB."
  ::= {fdMainMIBConformance 1}

fdMainMIBGroups OBJECT-IDENTITY
  STATUS     current
  DESCRIPTION
    "A node for group definitions related to fdMainMIB."
  ::= {fdMainMIBConformance 2}

fdController OBJECT-IDENTITY
  STATUS     current
  DESCRIPTION
    "A node defining management information related to the field device
    controller."
  ::= {fieldDevice 1}

fdCabinet OBJECT-IDENTITY
  STATUS     current
  DESCRIPTION
    "A node defining management information related to the field device cabinet."
  ::= {fieldDevice 2}


-- ****************************************************************************
-- A.1.3 Field Device
-- ****************************************************************************
fdConfigurationID OBJECT-TYPE
  SYNTAX     Unsigned32
  MAX-ACCESS read-only
  STATUS     current
  DESCRIPTION
    "A relatively unique identifier that shall change when and only when there is
    a change to one or more of the configuration parameters stored within the
    device. A SET to a configuration parameter to its current value shall not
    result in a change in this value. The identifier may be sequentially
    assigned, may reflect a checksum or other relatively unique integer for
    each configuration, or a combination of values (e.g., a sequence combined
    with a checksum)."
  REFERENCE  "NTCIP 1201 v03 Clause 2.2.1"
  ::= {fdController 1}

fdControllerStatus OBJECT-TYPE
  SYNTAX     BITS {
               other (0),
               prom (1),
               ram (2),
               program (3),
               display (4),
```

```
              gpio (5)
            }
  MAX-ACCESS read-only
  STATUS     current
  DESCRIPTION
    "A bitmap that indicates if there are any errors currently detected in the
    field device.
    other - an error not defined by the other values of this object; the error
      may be related to objects defined by other standards, other parts of
      the ISO 20684 series, or proprietary conditions.
    prom - an error with the programable read-only memory
    ram - an error with the random access memory
    program - an error detected in the program or processor
    display - an error associated with the display on the controller
    gpio - a bit is set on one or more of the fdGPIOTypeStatus objects"
  REFERENCE  "NTCIP 1203 v03 Clause 5.11.2.1.2"
  ::= {fdController 2}

fdWatchdogFailureCount OBJECT-TYPE
  SYNTAX     Counter32
  MAX-ACCESS read-only
  STATUS     current
  DESCRIPTION
    "Indicates the number of times the watchdog timer elapsed (i.e., reported a
    suspected error condition in the device)."
  REFERENCE  "NTCIP 1203 v03 Clause 5.11.1.5"
  ::= {fdController 3}

fdControllerReset OBJECT-TYPE
  SYNTAX     TruthValue
  MAX-ACCESS read-write
  STATUS     current
  DESCRIPTION
    "A mechanism allowing the manager to reset/reboot the field device. SETting
    this value to 'true' shall cause the field device to reset (but will not
    modify values stored in changeable memory). Once the controller resets,
    the value of this object shall return to 'false'. SETting this value to
    'false' shall result in a 'wrongValue' error."
  REFERENCE  "NTCIP 1203 v03 Clause 5.7.2"
  ::= {fdController 4}

fdTotalChangeableMemory OBJECT-TYPE
  SYNTAX     Unsigned32
  UNITS      "bytes"
  MAX-ACCESS read-only
  STATUS     current
  DESCRIPTION
    "The total amount of 'non-volatile' memory supported by the device whose
    values are able to survive a power loss."
  REFERENCE  "NTCIP 1203 v03 Clause 5.6.3"
  ::= {fdController 5}

fdFreeChangeableMemory OBJECT-TYPE
  SYNTAX     Unsigned32
  UNITS      "bytes"
  MAX-ACCESS read-only
  STATUS     current
  DESCRIPTION
    "The amount of free 'non-volatile' memory available whose values is able to
    survive a power loss."
  REFERENCE  "NTCIP 1203 v03 Clause 5.6.4"
  ::= {fdController 6}

fdTotalVolatileMemory OBJECT-TYPE
  SYNTAX     Unsigned32
  UNITS      "bytes"
  MAX-ACCESS read-only
  STATUS     current
  DESCRIPTION
    "The total amount of memory supported by the device whose values will not
    survive a power loss."
```

```
  REFERENCE  "NTCIP 1203 v03 Clause 5.6.6"
  ::= {fdController 7}

fdFreeVolatileMemory OBJECT-TYPE
  SYNTAX     Unsigned32
  UNITS      "bytes"
  MAX-ACCESS read-only
  STATUS     current
  DESCRIPTION
    "The amount of free memory available whose values will not survive a power
    loss."
  REFERENCE  "NTCIP 1203 v03 Clause 5.6.7"
  ::= {fdController 8}

-- ****************************************************************************
-- A.1.4 Cabinet
-- ****************************************************************************
fdCabinetLatitude OBJECT-TYPE
  SYNTAX     Integer32 (-900000000..900000001)
  UNITS      " tenths of microdegrees"
  MAX-ACCESS read-only
  STATUS     current
  DESCRIPTION
    "The latitude of the cabinet in which the field device controller resides,
    per WGS-84 datum."
  REFERENCE  "NTCIP 1204 v03 Clause 5.4.1"
  ::= {fdCabinet 1}

fdCabinetLongitude OBJECT-TYPE
  SYNTAX     Integer32 (-1800000000..1800000001)
  UNITS      "tenths of microdegrees"
  MAX-ACCESS read-only
  STATUS     current
  DESCRIPTION
    "The longitude of the cabinet in which the field device controller resides,
    per WGS-84 datum."
  REFERENCE  "NTCIP 1204 v03 Clause 5.4.2"
  ::= {fdCabinet 2}

fdCabinetElevation OBJECT-TYPE
  SYNTAX     Integer32 (-500..9001)
  UNITS      "metres"
  MAX-ACCESS read-only
  STATUS     current
  DESCRIPTION
    "The elevation of the base of the cabinet in which the field device resides."
  REFERENCE  "NTCIP 1204 v03 Clause 5.5.1"
  ::= {fdCabinet 3}

fdCabinetPowerSource OBJECT-TYPE
  SYNTAX     INTEGER {
               unknown (0),
               other (1),
               mainLine (2),
               battery (3),
               generator (4),
               solar (5),
               wind (6),
               ups (7)
             }
  MAX-ACCESS read-only
  STATUS     current
  DESCRIPTION
    "The most significant source of power currently being used within the
    cabinet.
    unknown - The system is unable to determine the power source at present
      (this is considered an error state)
    other - A source other than the standardized sources
    mainLine - mains power from the main power lines
    battery - Battery designed for primary use
    generator - Power from a fuelled generator
```

```
    solar - Power from solar energy conversion
    wind - Power from wind energy conversion
    ups - Power from a battery designed for backup use only

    If the power is provided by a hybrid source (e.g., batteries connected to
    solar panels) the value of this object will report the source providing
    the greatest net power. Thus, if solar panels are currently generating 30
    watts and the cabinet is consuming 50 watts, this object shall report
    'solar'."
  REFERENCE  "NTCIP 1202 v03 Clause 5.13.7; NTCIP 1203 v03 Clause 5.11.3.6"
  ::= {fdCabinet 4}

-- ****************************************************************************
-- A.1.5 Conformance Information
-- ****************************************************************************
fdMainMIBCompliance MODULE-COMPLIANCE
  STATUS     current
  DESCRIPTION
    "The conformance statement for an ITS Field Device."
  MODULE     -- this module
    MANDATORY-GROUPS {
                fdBasicCapabilitiesGroup,
                fdConfigurableIdentityGroup,
                fdConfigurationIDGroup,
                fdMonitorControllerGroup,
                fdWatchdogGroup,
                fdResetGroup
              }
    GROUP      fdPowerSourceGroup
    DESCRIPTION
      "Unconditionally optional group for monitoring power source"
  MODULE     -- this module
    MANDATORY-GROUPS {
                snmpEngineGroup
              }
  MODULE     -- this module
    MANDATORY-GROUPS {
                systemGroup
              }
  MODULE     ENTITY-MIB
    MANDATORY-GROUPS {
                entityPhysicalGroup,
                entityPhysical2Group
              }
  ::= {fdMainMIBCompliances 1}

fdBasicCapabilitiesGroup OBJECT-GROUP
  OBJECTS    {
                fdTotalChangeableMemory,
                fdFreeChangeableMemory,
                fdTotalVolatileMemory,
                fdFreeVolatileMemory
              }
  STATUS     current
  DESCRIPTION
    "The objects necessary for discovering the basic capabilities of the field
    device."
  REFERENCE "Clause 6.1.2.1"
  ::= {fdMainMIBGroups 1}

fdConfigurableIdentityGroup OBJECT-GROUP
  OBJECTS    {
                fdCabinetLatitude,
                fdCabinetLongitude,
                fdCabinetElevation
              }
  STATUS     current
  DESCRIPTION
    "The configurable objects necessary for identifying the field device."
  REFERENCE "Clause 6.1.2.3, Clause 6.1.2.4"
  ::= {fdMainMIBGroups 2}
```

```
fdConfigurationIDGroup OBJECT-GROUP
  OBJECTS     {
                fdConfigurationID
              }
  STATUS      current
  DESCRIPTION
    "The objects necessary for quickly monitoring the field device's
    configuration."
  REFERENCE "Clause 6.1.2.6"
  ::= {fdMainMIBGroups 3}

fdMonitorControllerGroup OBJECT-GROUP
  OBJECTS     {
                fdControllerStatus
              }
  STATUS      current
  DESCRIPTION
    "The objects necessary for monitoring the field device's controller."
  REFERENCE "Clause 6.1.2.7"
  ::= {fdMainMIBGroups 4}

fdWatchdogGroup OBJECT-GROUP
  OBJECTS     {
                fdWatchdogFailureCount
              }
  STATUS      current
  DESCRIPTION
    "The object necessary for monitoring the field device's watchdog."
  REFERENCE "Clause 6.1.2.9"
  ::= {fdMainMIBGroups 5}

fdResetGroup OBJECT-GROUP
  OBJECTS     {
                fdControllerReset
              }
  STATUS      current
  DESCRIPTION
    "The object necessary for remotely resetting the field device's controller."
  REFERENCE "Clause 6.1.2.10"
  ::= {fdMainMIBGroups 6}

fdPowerSourceGroup OBJECT-GROUP
  OBJECTS     {
                fdCabinetPowerSource
              }
  STATUS      current
  DESCRIPTION
    "The objects necessary for determining the power source for the field device."
  REFERENCE "Clause 6.3.2.3"
  ::= {fdMainMIBGroups 7}

END
-- ASN1END
```

## A.2 General-purpose I/O MIB

```
-- ****************************************************************************
-- A.2.1 Header
-- ****************************************************************************
-- ASN1START
FIELD-DEVICE-GPIO-MIB { iso(1) standard(0) 20684 part2(2) version1(1) annexA2(2) }
DEFINITIONS ::= BEGIN
IMPORTS
MODULE-IDENTITY, OBJECT-IDENTITY, OBJECT-TYPE, Integer32
                                                    FROM SNMPv2-SMI
                                                      -- RFC 2578
MODULE-COMPLIANCE, OBJECT-GROUP
                                                    FROM SNMPv2-CONF
                                                      -- RFC 2580
SnmpAdminString
```

```
                                                        FROM SNMP-FRAMEWORK-MIB
                                                          -- RFC 3411
fieldDevice, iso20684p2, ITSBitmap, ITSInteger8, ITSUnits, ITSUnsigned8
                                                        FROM FIELD-DEVICE-TC-MIB
                                                          -- ISO 20684-10 Annex A
;
fdGPIOMIB MODULE-IDENTITY
  LAST-UPDATED "201801060302Z"
  ORGANIZATION "ISO TC 204 WG 9"
  CONTACT-INFO
   "name: Kenneth Vaughn
    phone: +1-571-331-5670
    email: kvaughn@trevilon.com
    postal: 6606 FM 1488 RD STE 148-503
            Magnolia, TX 77354
            USA"
  DESCRIPTION
    "The MIB that defines objects to manage logical general-purpose input/output
    devices. Copyright (C) International Organization for Standardization (ISO)
    (2017). This version of this MIB module is part of ISO/TS 20684-2; see ISO/TS
    20684-2 itself for full legal notices."
  REVISION "201909090414Z"
  DESCRIPTION
    "Revisions based on comments from CD and other inputs prior to DIS ballot."
  REVISION "201801060302Z"
  DESCRIPTION
    "Updated version for CD ballot."
  REVISION "201711220332Z"
  DESCRIPTION
    "Initial version of the MIB module as distributed for NP Ballot."
  ::= {iso20684p2 2}

-- ****************************************************************************
-- A.2.2 Node Definitions
-- ****************************************************************************
fdGPIOMIBConformance OBJECT-IDENTITY
  STATUS     current
  DESCRIPTION
    "A node containing conformance statements related to the fdGPIOMIB, as
    defined in ISO/TS 20684-2."
  ::= {fdGPIOMIB 2}

fdGPIOMIBCompliances OBJECT-IDENTITY
  STATUS     current
  DESCRIPTION
    "A node for compliance statements for the fdGPIOMIB."
  ::= {fdGPIOMIBConformance 1}

fdGPIOMIBGroups OBJECT-IDENTITY
  STATUS     current
  DESCRIPTION
    "A node for group definitions related to fdGPIOMIB."
  ::= {fdGPIOMIBConformance 2}

fdGPIO OBJECT-IDENTITY
  STATUS     current
  DESCRIPTION
    "A node defining management information related to the field device's
    general-purpose input and output ports."
  ::= {fieldDevice 3}


-- ****************************************************************************
-- A.2.3 Object Definitions for General Purpose I/O Ports
-- ****************************************************************************
fdGPIOTable OBJECT-TYPE
  SYNTAX     SEQUENCE OF FdGPIOEntry
  MAX-ACCESS not-accessible
  STATUS     current
  DESCRIPTION
    "A static table that provides summary information about all of the logical
```

```
    GPIO ports of the indicated fdGPIOType. GPIO ports are general-purpose in
    the sense that they shall not be used as a part of mission-critical or
    safety-related functions; the fdGPIOType field usually assigns a specific
    function to the port. The table is static from the SNMP perspective but may
    be configurable by other means."
  REFERENCE  "NTCIP 1201 v03 Clause 2.9.3; RFC 3433"
  ::= {fdGPIO 1}

fdGPIOEntry OBJECT-TYPE
  SYNTAX     FdGPIOEntry
  MAX-ACCESS not-accessible
  STATUS     current
  DESCRIPTION
    "An entry that provides summary information about all of the logical GPIO
    ports of the indicated fdGPIOType."
  INDEX      {fdGPIOType}
  ::= {fdGPIOTable 1}

FdGPIOEntry ::= SEQUENCE {
               fdGPIOType       SnmpAdminString,
               fdGPIOTypeCount  ITSUnsigned8,
               fdGPIOTypeStatus ITSBitmap
             }

fdGPIOType OBJECT-TYPE
  SYNTAX     SnmpAdminString (SIZE(3))
  MAX-ACCESS not-accessible
  STATUS     current
  DESCRIPTION
    "An index that identifies the logical type of GPIO. Values that start with
    an ASCII hyphen (0x2D) shall be available for implementation-specific purposes.  All
other values are reserved for parts of ISO 20684. Each standardized value shall be
associated with a
    precise meaning, units, and scale. Each standardized value shall also define
    a maximum value for precision and allowed values for direction. Non-
    standardized entries shall not use any uppercase ASCII characters in the
    value of this object. Implementations reading non-standardized values should
    take care to verify that the meaning, units and scale are as expected. All
    implementations should take care to ensure precision and direction are as
    expected for intended use."
  REFERENCE  "RFC 6933 entPhysicalIndex"
  ::= {fdGPIOEntry 1}

fdGPIOTypeCount OBJECT-TYPE
  SYNTAX     ITSUnsigned8
  MAX-ACCESS read-only
  STATUS     current
  DESCRIPTION
    "The number of rows in the table for the indicated GPIO port type."
  REFERENCE  "NTCIP 1201 v03 Clause 2.9.3.1"
  ::= {fdGPIOEntry 2}

fdGPIOTypeStatus OBJECT-TYPE
  SYNTAX     ITSBitmap
  MAX-ACCESS read-only
  STATUS     current
  DESCRIPTION
    "A bitmapped value indicating the status of each logical GPIO port of the
    type specified for this row of the table. If the current value of
    fdGPIOPortStatus for the port is 'unavailable' or 'nonoperational', or if
    the auxiliary port's value is greater than the maximum value or less than
    the minimum value, the bit shall be set to one (1); if the current value of
    fdGPIOPortStatus for the port is 'other', the value of this bit is governed
    by rules not defined by the ISO 20684 series; otherwise, the bit shall be set to
    zero (0)."
  REFERENCE  "NTCIP 1203 v03 Clause 5.11.2.9.1 etc"
  ::= {fdGPIOEntry 3}

fdGPIOPortTable OBJECT-TYPE
  SYNTAX     SEQUENCE OF FdGPIOPortEntry
  MAX-ACCESS not-accessible
```

```
  STATUS      current
  DESCRIPTION
    "A static table that provides access to control and status objects for each
    logical general-purpose input and/or output (GPIO) port supported by the
    device. GPIO ports are general-purpose in the sense that they shall not be
    used as a part of mission-critical or safety-related functions. The
    fdGPIOType field usually assigns a specific function to the port. The
    mechanism by which a logical port is associated with a physical port is not
    defined by this document. The physical ports may be analogue or digital. The
    electrical levels used by the ports are outside the scope of this document.
    Rows cannot be added or deleted via the standard SNMP interface defined by
    this table, but implementations may provide other mechanisms to allow for
    end-user configure the table."
  REFERENCE  "NTCIP 1201 v03 Clause 2.9.3"
  ::= {fdGPIO 2}

fdGPIOPortEntry OBJECT-TYPE
  SYNTAX      FdGPIOPortEntry
  MAX-ACCESS not-accessible
  STATUS      current
  DESCRIPTION
    "An entry that provides detailed information about a specific logical GPIO
    port."
  INDEX       {fdGPIOType, fdGPIOPortNumber}
  ::= {fdGPIOPortTable 1}

FdGPIOPortEntry ::= SEQUENCE {
                fdGPIOPortNumber          ITSUnsigned8,
                fdGPIOPortDescription     SnmpAdminString,
                fdGPIOPortDirection       INTEGER,
                fdGPIOPortUnits           ITSUnits,
                fdGPIOPortExponent        ITSInteger8,
                fdGPIOPortPrecision       INTEGER,
                fdGPIOPortMinValue        Integer32,
                fdGPIOPortMaxValue        Integer32,
                fdGPIOPortRequestedValue  Integer32,
                fdGPIOPortValue           Integer32,
                fdGPIOPortMinThreshold    Integer32,
                fdGPIOPortMaxThreshold    Integer32,
                fdGPIOPortStatus          INTEGER
              }

fdGPIOPortNumber OBJECT-TYPE
  SYNTAX      ITSUnsigned8
  MAX-ACCESS not-accessible
  STATUS      current
  DESCRIPTION
    "An index to uniquely identify the row of the table within the fdGPIOType.
    Digital port numbers shall be assigned sequentially within each fdGPIOType
    starting at one up to a maximum of 127. Analogue port numbers shall be
    assigned sequentially within each fdGPIOType starting at 128 up to a maximum
    of 255. The location of the physical ports associated with each logical
    fdGPIOPort is implementation specific and may be configurable by means not
    defined within this document."
  REFERENCE  "NTCIP 1201 v03 Clause 2.9.3.2"
  ::= {fdGPIOPortEntry 1}

fdGPIOPortDescription OBJECT-TYPE
  SYNTAX      SnmpAdminString
  MAX-ACCESS read-write
  STATUS      current
  DESCRIPTION
    "A textual description of the logical GPIO port and/or the device connected
    to the port. The description should describe the location of any physical
    port and the sensor or controlled device."
  REFERENCE  "NTCIP 1201 v03 Clause 2.9.3.3"
  ::= {fdGPIOPortEntry 2}

fdGPIOPortDirection OBJECT-TYPE
  SYNTAX      INTEGER {
                output (1),
```

```
              input (2),
              bidirectional (3)
            }
  MAX-ACCESS read-only
  STATUS     current
  DESCRIPTION
    "An indication of whether the logical GPIO port supports input and/or output
    capabilities. For example, an input-only cabinetTemperature port would imply
    a temperature sensor; an output-only cabinetTemperature port would imply a
    thermostat; an input/output cabinetTemperature port would imply a thermostat
    with the ability to report the current temperature reading. The direction
    for entries where fdGPIOType contains an uppercase letter shall be one of
    the values allowed for the defined type in Annex C of ISO/TS 20684-2."
  REFERENCE  "NTCIP 1201 v03 Clause 2.9.3.6"
  ::= {fdGPIOPortEntry 3}

fdGPIOPortUnits OBJECT-TYPE
  SYNTAX     ITSUnits
  MAX-ACCESS read-only
  STATUS     current
  DESCRIPTION
    "Indicates the units in which the value is reported/provided. The units for
    entries where fdGPIOType contains an uppercase letter shall be as defined by
    the defined type in Annex C of ISO/TS 20684-2."
  REFERENCE  "RFC 3433 entPhySensorType"
  ::= {fdGPIOPortEntry 4}

fdGPIOPortExponent OBJECT-TYPE
  SYNTAX     ITSInteger8
  MAX-ACCESS read-only
  STATUS     current
  DESCRIPTION
    "Indicates the resolution used by all value related objects for this logical
    GPIO port, expressed as a base 10 exponent. For example, if fdGPIOPortUnits
    is metres and fdGPIOPortExponent is -3, the value objects are represented in
    millimetres; if fdGPIOPortUnits is metres and fdGPIOPortExponent is 3, the
    value objects are represented in kilometres. The exponent for entries where
    fdGPIOType contains an uppercase letter shall be as defined by the defined
    type in Annex C of ISO/TS 20684-2."
  REFERENCE  "RFC 3433 entPhySensorScale"
  ::= {fdGPIOPortEntry 5}

fdGPIOPortPrecision OBJECT-TYPE
  SYNTAX     Integer32 (0..2147483647)
  MAX-ACCESS read-only
  STATUS     current
  DESCRIPTION
    "The precision of the reported values. A sensor may measure the same
    condition multiple times and report slightly different values; the value of
    this object would report the maximum variation that may occur in the sensor
    value object (at a 99% confidence level) when reading a particular condition
    within the sensor's defined operating range. The precision for entries where
    fdGPIOType contains an uppercase letter shall be less than or equal to the
    maximum precision defined by the defined type in Annex C of ISO/TS 20684-2."
  REFERENCE  "RFC 3433 entPhySensorPrecision"
  ::= {fdGPIOPortEntry 6}

fdGPIOPortMinValue OBJECT-TYPE
  SYNTAX     Integer32
  MAX-ACCESS read-only
  STATUS     current
  DESCRIPTION
    "The minimum value supported for the logical GPIO port. Input values below
    this reading should be considered unreliable."
  REFERENCE  "NTCIP 1201 v03 Clause 2.9.3.4"
  ::= {fdGPIOPortEntry 7}

fdGPIOPortMaxValue OBJECT-TYPE
  SYNTAX     Integer32
  MAX-ACCESS read-only
  STATUS     current
```

```
  DESCRIPTION
    "The maximum value supported for the logical GPIO port. Input values above
    this reading should be considered unreliable."
  REFERENCE  "NTCIP 1201 v03 Clause 2.9.3.4"
  ::= {fdGPIOPortEntry 8}

fdGPIOPortRequestedValue OBJECT-TYPE
  SYNTAX     Integer32
  MAX-ACCESS read-write
  STATUS     current
  DESCRIPTION
    "The output value set for the logical GPIO port. The value of this object
    should be between fdGPIOPortMinValue and fdGPIOPortMaxValue, inclusive. A
    SET request for a value outside of this range on an output or bidirectional
    port shall result in an 'inconsistentValue' error. For output ports, this
    should be the same value as the value object. For bidirectional ports, this
    value will represent the last commanded state. For an input port, the value
    shall always be zero (0). An attempt to set this value on an input port
    shall result in a 'notWritable' error."
  REFERENCE  "NTCIP 1201 v03 Clause 2.9.3.7"
  ::= {fdGPIOPortEntry 9}

fdGPIOPortValue OBJECT-TYPE
  SYNTAX     Integer32
  MAX-ACCESS read-only
  STATUS     current
  DESCRIPTION
    "The current value on the logical GPIO port. For an output port this value
    should be the same as the requestedValue. For input and bidirectional ports,
    this is the current value being received."
  REFERENCE  "NTCIP 1201 v03 Clause 2.9.3.5"
  ::= {fdGPIOPortEntry 10}

fdGPIOPortMinThreshold OBJECT-TYPE
  SYNTAX     Integer32
  MAX-ACCESS read-write
  STATUS     current
  DESCRIPTION
    "The lower warning threshold defined for the logical GPIO port. Whenever the
    fdGPIOValue is less than the value of this object, the bit in
    fdGPIOTypeStatus that corresponds with this sensor shall have the value of
    one."
  REFERENCE  "NTCIP 1203 v03 Clause 5.11.2.9.3.4"
  DEFVAL     {-2147483648}
  ::= {fdGPIOPortEntry 11}

fdGPIOPortMaxThreshold OBJECT-TYPE
  SYNTAX     Integer32
  MAX-ACCESS read-write
  STATUS     current
  DESCRIPTION
    "The upper warning threshold defined for the logical GPIO port. Whenever the
    fdGPIOValue is greater than the value of this object, the bit in
    fdGPIOTypeStatus that corresponds with this sensor shall have the value of
    one."
  REFERENCE  "NTCIP 1203 v03 Clause 5.11.2.9.3.5"
  DEFVAL     {2147483647}
  ::= {fdGPIOPortEntry 12}

fdGPIOPortStatus OBJECT-TYPE
  SYNTAX     INTEGER {
               other (1),
               active (2),
               unavailable (3),
               nonoperational (4),
               notInService (5)
             }
  MAX-ACCESS read-only
  STATUS     current
  DESCRIPTION
    "The operational status of the GPIO port. Valid values are:
```

```
    other - a state not defined by this document
    active - The GPIO port appears to be operating normally and is in service.
    unavailable - The logical GPIO port is determined to be unassociated with
      any attached equipment. This may be due to the logical port not being
      associated with a physical port or may be due to the device definitively
      determining that the physical port is not attached to any device.
    nonoperational- The data received from the logical GPIO port appears to be
      suspect, which may be due to a disconnected wire or out-of-range, jittery,
      or wildly fluctuating readings.
    notInService - The logical GPIO port has been taken out of service. A
      manager may set the object to 'active' or 'notInService'; an attempt to
      set the value to any other value will result in a 'wrongValue' error. The
      port will remain in the 'notInService' state until it is set to the active
      state. Once commanded to the active state, the status may change among any
      state other than notInService until manually set to the notInService
      state."
  REFERENCE  "RFC 3433 EntitySensorStatus"
  ::= {fdGPIOPortEntry 13}

-- ****************************************************************************
-- A.2.4 Conformance Information
-- ****************************************************************************
fdGPIOMIBCompliance MODULE-COMPLIANCE
  STATUS     current
  DESCRIPTION
    "The conformance statement for logical general-purpose input/output port
    support for an ITS field device."
  MODULE     -- this module
    MANDATORY-GROUPS {
                fdGPIOCapabilitiesGroup,
                fdGPIOEditableConfigurationGroup,
                fdGPIOReadableConfigurationGroup,
                fdGPIOMonitorPortStatusGroup,
                fdGPIOMonitorPortTypeStatusGroup
              }
    GROUP      fdGPIOInputGroup
    DESCRIPTION
      "Management information that is required if the field device supports one
      or more input or bidirectional general-purpose I/O ports."
    GROUP      fdGPIOOutputGroup
    DESCRIPTION
      "Management information that is required if the field device supports one
      or more output or bidirectional general-purpose I/O ports."
  ::= {fdGPIOMIBCompliances 1}

fdGPIOCapabilitiesGroup OBJECT-GROUP
  OBJECTS    {
                fdGPIOTypeCount
              }
  STATUS     current
  DESCRIPTION
    "The objects necessary for determining the capabilities of the general-purpose
    I/O ports."
  REFERENCE "Clause 6.2.2.1"
  ::= {fdGPIOMIBGroups 1}

fdGPIOEditableConfigurationGroup OBJECT-GROUP
  OBJECTS    {
                fdGPIOPortDescription,
                fdGPIOPortMinThreshold,
                fdGPIOPortMaxThreshold
              }
  STATUS     current
  DESCRIPTION
    "The objects necessary for refining the configuration of a general-purpose I/O
    port at run-time."
  REFERENCE "Clause 6.2.2.2, Clause 6.2.2.3"
  ::= {fdGPIOMIBGroups 2}

fdGPIOReadableConfigurationGroup OBJECT-GROUP
  OBJECTS    {
```