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SUBJECT:

BusRide Multiport Firmware Specification

Smart Distributed System

BusRide Multiport Firmware Specification

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DATE	EVENT
06/05/1998	Original issue.
11/04/1998	Removed from Table 1 column titled Catalog
1/18/1999	Table 5 and 6 added: **0X8717 for catalog listings that have a total of 4 Input/Output ports. 0X870B for catalog listings that have a total of 8 Input/Output ports. Section 3.18.1 added: Catalog listings that have a total of 4 Input/Output ports, have storage space for 24 characters. Catalog listings that have 8 ports, have storage space for 12 characters.

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1. INTRODUCTION

1.1 Scope

This document is a specification for the behavior and operation of the BusRide Multiport Firmware component. This firmware consists of a Microcontroller chip with embedded software. The reader should refer to individual product literature for additional product specifications and application information.

1.2 References

This document is a supplement to the following Honeywell MICRO SWITCH documents:

GS 052 103	Application Layer Protocol
GS 052 104	Physical Layer Specification
GS 052 105	Device Design Guidelines
GS 052 106	Interface Guidelines Specification
GS 052 107	Component Model Specification
GS 052 108	Verification Test Procedure Specification

Additionally, the reader should be familiar with Bosch V2.0A CAN Specification.

1.3 Definition of Terms

Acknowledge A message or signal that is used to reply to a message or signal Sender that its message or signal was received.

Action ID Actions, together with events, comprise the SDS behavior of the embedded object. Specific actions are referenced by ID and are used to direct the object to initiate actions.

ASCII American Standard Code for Information Interchange. An eight bit (seven data plus one parity) standard code representing characters used in American data processing.

Attribute ID An attribute ID is the location of the data in an Embedded objects. A group of attribute ID's defines the data structure of the embedded object. A Read primitive is used by a SDS application service element to read an attribute value and a Write primitive is used to modify an attribute value.

Bit Number The numerical position of a bit within binary notation of a number. It is equal to the exponent of the coefficient at that position. Numbering always begins with 0 at the least significant (far right hand) bit.

Byte A group of eight bits.

CAN Controller Area Network.

Component See Physical Device.

COS	Change Of State as related to binary devices. A binary sensor changes states when actuated, while a binary actuator changes states upon a command.
Data Descriptor	A 16 bit value that defines the data type associated with an attribute. See the Data Descriptor section of Specification GS 052 107 for more information.
Default State	A pre-defined Logical State which is applied to the output pins at power-up, and after watchdog time-out.
Device Model	A description of input or output device behavior that is completely defined by a set of properties (attributes), a set of actions, and a set of events.
Diagnostics	Status data or flags which identify device malfunctions or data corruption.
EEPROM	An Electrically Erasable Programmable Read Only Memory
Embedded Object	A network addressable entity within a logical device. The address of the embedded object is a combination of the address of the Logical Device plus the embedded object ID. Embedded objects have defined attributes (0-255), actions (0-255), and events (0-255) that are specific to the embedded object.
Event ID	Event, together with actions, comprise the SDS behavior of the embedded object. A Event primitive is used by objects to report the occurrence of events.
Flag	A single Boolean bit having only two possible logical states: On = 1; Off = 0.
IC	Integrated Circuit
Input	Describes the reference of a SDS device object's network variable. The reference is with respect to an SDS Host interface. Input is defined as providing information to an SDS Host interface.
Least Significant Bit	The bit in the binary notation of a number that is the coefficient with the exponent of Zero.
Logical Address	The numeric value of the upper eight bits of the eleven bit Standard CAN Identifier, excluding the SDS Direction Bit. This includes Identifier bits ID_9 through ID_3 defined in Bosch V2.0A CAN Specification. The value range is from 0 to 125. Addresses 126 and 127 are illegal on CAN networks, and should not be used. (See also User Address.)
Logical Device	A single input or output control element, along with its embedded device(s). Each Logical Device has a single Logical Address.
Logical State	The on/off state of an electrical signal or flag.
LSB	Least Significant Bit

Microcontroller	A single integrated circuit microprocessor that incorporates ROM and/or RAM and/or one or more I/O functions. Usually used for control applications rather that data processing because the limited amount of memory that can be placed on one IC with the microprocessor.
Most Significant Bit	The bit in the binary notation of a number that is the coefficient of the highest exponent possible.
MSB	Most Significant Bit
Network	All the media, connectors, and associated communication elements by which a given set of communicating devices are interconnected.
Network Data	Data which is communicated to and from other devices on the bus which relate to the status and condition of the object. This data typically is the data required in the execution of a PLC program.
Network Variable	An attribute ID which contains network data.
Node	A Physical Device connected to the bus via a single CAN interface (i.e. one or more Logical Devices including the CAN interface).
Object Model	A description of behavior or structure that is completely defined by a set of properties (attributes), a set of actions, and a set of events.
Output	Describes the reference of the SDS device object's network variable. The reference is with respect to an SDS host interface. Output is defined as receiving an output response from an SDS host interface.
Packed Data	Multiple bit Boolean data that is accessed as a single byte. Each byte may contain up to eight Boolean bits.
Physical Device	All of the addressable Logical Device(s) and non-addressable other device(s) connected to the bus via a single CAN interface.
Power Cycle	The act of removing and re-applying electrical power.
Power-Up	The time period beginning with the application of electrical power.
RAM	A Random Access (read/write) Memory. The data stored here is not retained through a memory power cycle.
Register	A RAM memory location used for the storage of numeric information or Flags.
ROM	A Read Only Memory.
SDS	Smart Distributed System

SDS Direction Bit The most-significant bit of the CAN Identifier (ID_{10}) field defined in Bosch V2.0A CAN Specification.

SDS Host A device which consumes Input Network Data and/or produces Output Network Data. It may also perform the functions of message acknowledgment and startup for other devices on the network.

Sender By SDS Application Layer Protocol Standards, Logical Devices that initiate an application Layer Service Request are Senders.

User Address The Logical Address incremented by 1. The range is from 1 to 126.

2. OVERVIEW

BusRide ports allow non-smart sensor and actuator devices to be connected to a single branch on the Smart Distributed System Bus. Each port is configured in hardware as input or output. This configuration is not changeable by the end user. Several BusRide catalog listings are available with different I/O configurations.

Table 1: BusRide I/O Configurations

Description	Port 1	Port 2	Port 3	Port 4	Port 5	Port 6	Port 7	Port 8
8 DC-In	DC-In	DC-In	DC-In	DC-In	DC-In	DC-In	DC-In	DC-In
8 DC-Out	DC-Out	DC-Out	DC-Out	DC-Out	DC-Out	DC-Out	DC-Out	DC-Out
4 DC-In & 4 AC-Out	DC-In	DC-In	DC-In	DC-In	AC-Out	AC-Out	AC-Out	AC-Out
4 DC-In & 4 DC-Out	DC-In	DC-In	DC-In	DC-In	DC-Out	DC-Out	DC-Out	DC-Out
4 DC-In	DC-In	DC-In	DC-In	DC-In				
4 DC-Out	DC-Out	DC-Out	DC-Out	DC-Out				
4 AC-Out	AC-Out	AC-Out	AC-Out	AC-Out				
2 DC-In & 2 DC-Out	DC-In	DC-In	DC-Out	DC-Out				

2.1 SDS Device Models

Three Smart Distributed System device models are supported, as shown in Table 5, Table 6, Table 7 and Table 16. Attribute 57, Model Type, controls which Smart Distributed System model is emulated by the BusRide Multiport

2.1.1 Model Type 0

Model Type 0 is a *single address* model containing 4 or 8 *embedded objects*. This model type conserves logical address space (more than 126 I/O points on a single bus) while still allowing single point access to each device. This is because it makes use of the *Embedded Object ID* field and the logical address to select the target device. This model type is recommended for applications with large I/O counts, where slower actuation rates are expected.

2.1.2 Model Type 1

Model Type 1 is a *multi-address* model that assigns an independent logical address to each BusRide I/O port. This model type is recommended for applications with smaller I/O counts (less than 126) per bus. It allows for faster response times by utilizing Short-Form messages. It is the only model type that is compatible with the Intelligent Terminal Strip (ITS) controller.

2.1.3 Model Type 2

Model Type 2 is a *single address, single embedded object* model with all the active input bits *packed* together in attribute 18 and all active output bits *packed* together in attribute 19. This model type conserves logical address space and bus bandwidth because multiple data bits are transferred in a single message. This is the preferred model type in most new applications.

2.2 I/O Truth Tables

The BusRide Multiport allows multiple non-Smart Distributed System devices to be connected to a single branch on the Smart Distributed System Bus. The sensors can be any combination of mechanical switches, photo-electric, three wire proximity sensors, or other devices that have open collector dc logic signals. Logic inputs are *false* (0) when open circuited, and *true* (1) when forced high or low. Table 2 shows the relationship between the Network Input Data and the sensor input pins.

Table 2: Input Data Truth Table

Sensor NO/NC	**Sensor Input Pin**	Network **Input Data**
0	False	0
0	True	1
1	False	1
1	True	0

The logic level of each output pin is controlled by a Network Output Data attribute bit, in accordance with the truth table in Table 3. The output pin state is equal to the Network Output Data bit state unless the output state is forced with Action 51. The output pin OFF state is defined as the open-circuit or unpowered state

Table 3: Output Pin Truth Table

	Network Output Data	
	0	**1**
Not Forced	OFF	ON
Forced to 0	OFF	OFF
Forced to 1	ON	ON

2.3 LED Indicators

Several LED indicators are provided for the convenience of the user. These indicate various status and diagnostic conditions. Please note that the Input LED shows the status of the input logic signal, which does not necessarily reflect the status of the Input Network Data. This is because the latter is influenced by the configuration of other attributes.

Table 4: LED Indicators

Power LED	**Color**
No power present	Off
Power present	Green
Communication LED	
No bus power	Flashing red
Bus power present, no communication	Constant red
Bus power present, communication passive	Constant green
Bus power present, communication active	Flashing green
Input LED	
Input (sensor) off, no fault	Off
Input (sensor) on, no fault	Amber
Input fault, short circuit	Red
Input fault (sensor missing/open)	Flashing red
Output LED	
Output off, no fault	Off
Output on, no fault	Amber
Output on, fault (short circuit)	Red
Output on, fault (actuator missing/open)	Flashing red

2.4 Recommended Configuration Sequence

All of the following steps are recommended for configuring new devices.

1. Set the logical address to the desired base value, and verify setting.

2. Set Attribute 57, Model Type, if necessary. Re-verify addresses if Attribute 57 was changed.

3. Set Attributes 6, 10, 59, 60 and 61 as desired for each input embedded object. If Model Type 2 is selected, set Attribute 62 as desired.

4. Set Attribute 58 as desired for each output embedded object.

3. READ/WRITE ATTRIBUTES

All Attributes are readable at any time. Attributes designated by a letter **R** in the ***Access*** column in Table 5, Table 6 and Table 7 are read-only. Attributes designated by a letter **W** in the ***Access*** column may be written by the end user. Attributes designated by a letter **P** in the ***Access*** column may be written only under password control. Attributes 1, 3, 4, 7, Attributes 11 through 15 and Attribute 57 are associated with the Multiport node. (These have a **BLACK BACKGROUND** in Table 5, Table 6 and Table 7.) These attributes exhibit an identical response from **all** addressable objects in the node. All other attributes (WHITE BACKGROUND) are associated with each individual addressable object. The Model 2 column is all WHITE because model 2 has only a single addressable object.

Table 5: Input Object Model type 1.1.2.1 and 1.5.4.3

Attribute ID	Description	Type	Size	Access	Model 0 Descriptor	Model 1 Descriptor	Model 2 Descriptor
0	Network Data Descriptor	Unsigned	Byte	R	0x0025	0x0025	0x0025
1	Baud Rate	Unsigned	Byte	R	0x0020	0x0020	0x0020
2	Object Model	Unsigned	Byte	R	0x0023	0x0023	0x0023
3	Partner ID number	Unsigned	Word	R	0x0040	0x0040	0x0040
4	Logical Address List	Unsigned	Byte	R	0x0020	0x0027*	0x0020
6	Un/Solicited	Boolean	Undefined	W	0x8100	0x8100	0x8100
7	Software Version	ASCII	Undefined	R	0x070B	0x070B	0x070B
8	Diagnostic Error Counter	Unsigned	Byte	R	0x0020	0x0020	0x0020
9	Diagnostic Register	Unsigned	Byte	W	0x8023	0x8023	0x8023
10	Cyclical Timer	Unsigned	Byte	W	0x8020	0x8020	0x8020
11	Serial Number	Unsigned	Long	P	0x0060	0x0060	0x0060
12	Date Code	ASCII	Undefined	P	0x0703	0x0703	0x0703
13	Catalog Listing	ASCII	Undefined	P	0x0717	0x0717	0x0717
14	Partner Name	ASCII	Undefined	R	0x070E	0x070E	0x070E
15	Component Tag Name	ASCII	Undefined	W	0x8717	0x8717	0x8717
18	Network Input Data	Boolean	Undefined	R	0x0100	0x0100	0x0107*
56	Tag Name	ASCII	Undefined	W	0x870B**	0x870B**	0x8717
57	Model Type	Unsigned	Byte	W	0x8020	0x8020	0x8020
59	Mechanical Switch Mode	Boolean	Undefined	W	0x8100	0x8100	0x8107*
60	NO/NC	Boolean	Undefined	W	0x8100	0x8100	0x8107*
61	Enable Re-transmission	Boolean	Undefined	W	0x8100	0x8100	0x8100
62	Change of Value Mask	Boolean	Undefined	W	(n/a)	(n/a)	0x8107*
63	Enable Device I/O Cable Open Diagnostic	Boolean	Undefined	W	0x8100	0x8100	0x8107*
65	Batch Counter	Unsigned	Byte	W	0x8020	0x8020	(n/a)
66	ON-Delay Timer	Unsigned	Word	W	0x8040	0x8040	(n/a)
67	OFF-Delay Timer	Unsigned	Word	W	0x8040	0x8040	(n/a)

* The length value is dependent on the number of ports. (see Table 8)

(n/a) Indicates that the attribute is not-available in this model type.

** 0X8717 for catalog listings that have a total of 4 Input/Output ports. 0X870B for catalog listings that have a total of 8 Input/Output ports.

Table 6: Output Object Model type 1.3.7.1 and 1.6.4.4

Attribute ID	Description	Type	Size	Access	Model 0 Descriptor	Model 1 Descriptor	Model 2 Descriptor
0	Network Data Descriptor	Unsigned	Byte	R	0x0025	0x0025	0x0025
1	Baud Rate	Unsigned	Byte	R	0x0020	0x0020	0x0020
2	Object Model	Unsigned	Byte	R	0x0023	0x0023	0x0023
3	Partner ID Number	Unsigned	Word	R	0x0040	0x0040	0x0040
4	Logical Address List	Unsigned	Byte	R	0x0020	0x0027*	0x0020
7	Software Version Number	ASCII	Undefined	R	0x070B	0x070B	0x070B
8	Diagnostics Error Counter	Unsigned	Byte	R	0x0020	0x0020	0x0020
9	Diagnostic Register	Unsigned	Byte	W	0x8023	0x8023	0x8023
11	Serial Number	Unsigned	Long	P	0x0060	0x0060	0x0060
12	Date Code	ASCII	Undefined	P	0x0703	0x0703	0x0703
13	Catalog Listing	ASCII	Undefined	P	0x0717	0x0717	0x0717
14	Partner Name	ASCII	Undefined	R	0x070E	0x070E	0x070E
15	Component Tag Name	ASCII	Undefined	W	0x8717	0x8717	0x8717
19	Network Output Data	Boolean	Undefined	W	0x8100	0x8100	0x8107*
56	Tag Name	ASCII	Undefined	W	0x870B**	0x870B**	0x8717
57	Model Type	Unsigned	Byte	W	0x8020	0x8020	0x8020
58	Watchdog Timer	Unsigned	Byte	W	0x8020	0x8020	0x8020
63	Enable Device I/O Cable Open Diagnostic	Boolean	Undefined	W	0x8100	0x8100	0x8107*

* The length value is dependent on the number of ports. (see Table 8)

** 0X8717 for catalog listings that have a total of 4 Input/Output ports. 0X870B for catalog listings that have a total of 8 Input/Output ports.

NOTE: The *Descriptor* columns in Table 5, Table 6 and Table 7 contain the hexadecimal code values that indicate the data type associated with each attribute. The *length* value of these descriptors indicates the maximum possible length for the attribute data. Actual data lengths are product dependent and may be less than specified in these tables. (See the Data Type section of Specification GS 052 103 and the NDD section of Specification GS 052 107 for more information.)

Table 7: Combination Input/Output Object Model type 1.11.4.2

Attribute ID	Description	Type	Size	Access	Model 2 Descriptor
0	Network Data Descriptor	Unsigned	Byte	R	0x0025
1	Baud Rate	Unsigned	Byte	R	0x0020
2	Object Model	Unsigned	Byte	R	0x0023
3	Partner ID Number	Unsigned	Word	R	0x0040
4	Logical Address List	Unsigned	Byte	R	0x0020
6	Un/Solicited	Boolean	Undefined	W	0x8100
7	Software Version Number	ASCII	Undefined	R	0x070B
8	Diagnostics Error Counter	Unsigned	Byte	R	0x0020
9	Diagnostic Register	Unsigned	Byte	W	0x8023
10	Cyclical Timer	Unsigned	Byte	W	0x8020
11	Serial Number	Unsigned	Long	P	0x0060
12	Date Code	ASCII	Undefined	P	0x0703
13	Catalog Listing	ASCII	Undefined	P	0x0717
14	Partner Name	ASCII	Undefined	R	0x070E
15	Component Tag Name	ASCII	Undefined	W	0x8717
18	Network Input Data	Boolean	Undefined	R	0x0103*
19	Network Output Data	Boolean	Undefined	W	0x8103*
56	Tag Name	ASCII	Undefined	W	0x8717
57	Model Type	Unsigned	Byte	W	0x8020
58	Watchdog Timer	Unsigned	Byte	W	0x8020
59	Mechanical Switch Mode	Boolean	Undefined	W	0x8103*
60	NO/NC	Boolean	Undefined	W	0x8103*
61	Enable Re-transmission	Boolean	Undefined	W	0x8100
62	Change of Value Mask	Boolean	Undefined	W	0x8103*
63	Enable Device I/O Cable Open Diagnostic	Boolean	Undefined	W	0x8107*

* The length value is dependent on the number of ports. (see Table 8)

NOTE: The Combination I/O model is valid only for Model Type 2, and only if the *physical device* has both inputs and outputs. If this device is set for Model Type 0 or 1, then each port behaves as a single point input or output model shown in Table 5 or Table 6. (See also Table 9: Object Models.)

3.1 Attribute 0: Network Data Descriptor

This attribute always returns six data bytes; the first three bytes contain the descriptor for the Network Input Data. If the object does not have inputs, the first three bytes are zeros. The last three bytes contain the descriptor for the Network Output Data. If the object does not have outputs, the last three bytes are zeros. The descriptor has a different value for each of the three Smart Distributed System device models (see Table 8). See the Network Data Descriptor section of Specification GS 052 107 for more information.

Table 8: Network Data Descriptor Values

Model Type	Input Descriptor	Output Descriptor
Model Type 0, All except last embedded object	0x12, 0x4100	0x13, 0xC100
Model Type 0, Last embedded object	0x12, 0x0100	0x13, 0x8100
Model Type 1	0x12, 0x0100	0x13, 0x8100
Model Type 2, 2 port	0x12, 0x0101	0x13, 0x8101
Model Type 2, 4 port	0x12, 0x0103	0x13, 0x8103
Model Type 2, 8 port	0x12, 0x0107	0x13, 0x8107

3.2 Attribute 1: Baud Rate Mode

Attribute 1 always returns a single byte **zero** value to indicate Autobaud Mode.

3.3 Attribute 2: Object Model

The Object Model value indicates the location of this object in the hierarchy structure of Smart Distributed System. Each level of the hierarchy specifically defines SDS attributes, actions, and events. See the SDS Hierarchy section of Specification GS 052 107 for more information.

Table 9: Object Models

	Model Type 0	Model Type 1	Model Type 2
Input Object	1.1.2.1	1.1.2.1	1.5.4.3
Output Object	1.3.7.1	1.3.7.1	1.6.4.4
Combination Object	n/a	n/a	1.11.4.2

3.4 Attribute 3: Partner Identification Number

This attribute is an unsigned single word value: **0x0001** that identifies Honeywell Micro Switch as the manufacturer of the device. It is permanently fixed in ROM.

3.5 Attribute 4: Logical Address List

Attribute 4 returns unsigned single byte(s) that indicates the actual *Logical Address*(s) the BusRide Multiport is using. This is the *User* address decremented by 1. Note: *Logical Address*es range from 0 to 125; *User* addresses range from 1 to 126.

3.5.1 Model Types 0 and 2

Attribute 4 in Model Type 0 and Model Type 2 returns one data byte indicating the current Logical Address.

3.5.2 Model Type 1

Attribute 4 in Model Type 1, provides a linkage between the Logical Address assignments and the I/O port locations in the device. It returns multiple data bytes that indicate all the addresses the BusRide Multiport is currently occupying on the bus. These address values are transmitted in order by port number. NOTE: Any port whose logical address is identical to that of a lower numbered port within the same component, is *hidden* from bus communication. Port number 1 cannot be hidden.

3.6 Attribute 6: Un/Solicited Mode

This attribute is a single bit Boolean value that is formatted as shown in Table 12, with data bit 0 controlling the unsolicited Change of Value (COV) or Change of State (COS) message transmission for the device. COV Event messages are transmitted by Model Type 0, and Model Type 2; Short-form COS messages are transmitted by Model Type 1. In Model Type 2 only, it is necessary to also have the Change of Value Mask bit set (Attribute 62) to get COV messages from a port.

3.7 Attribute 7: Software Version Number

This attribute is an ASCII string, permanently fixed in ROM memory to identify the software version.

3.8 Attribute 8: Diagnostics Error Counter

This attribute is an unsigned single byte value that indicates the number of diagnostic errors that are currently in the TRUE state in Attribute 9.

3.9 Attribute 9: Diagnostic Register

NOTE: Diagnostic flags are latched; that is, once a flag is true, it will stay in that state until a Reset Errors event message is received, or the device is power-cycled. This attribute can also be written; this feature allows the user to create diagnostic error conditions to test his control system's response.

The Cable Open diagnostics are enabled independently for each port with Attributes 63. The Cable Short diagnostics are always enabled.

3.9.1 Model Types 0 and 1

Data for this attribute is shown in Table 10. It consists of three data bytes. The first byte contains ROM Error, Bus Error, and EEPROM Error flags at data bits 0, 2, and 7 respectively. The second byte contains the Device I/O Cable Open error flag at bit 0. The third byte contains the Device I/O Cable Short error flag at bit 0. Byte 1 is common to all ports and bytes 2 and 3 are unique for each port. A Clear Errors Action sent to any port will clear byte 1 flags for all ports. Byte 2 and 3 flags shall be cleared individually at each port. The forth byte is not used and will always show a value of zero.

Table 10: Diagnostic Data for Model Types 0 and 1

Data bit		Description
First Byte	7	**EEPROM Read Error**
	6	Reserved
	5	Reserved
	4	Reserved
	3	Reserved
	2	Off bus communication Error
	1	Reserved
	0	ROM Checksum Error
Second Byte	1 to 7	not used
	0	Device I/O Cable Open
Third Byte	1 to 7	not used
	0	Device I/O Cable Short
Forth Byte	0 to 7	not used

3.9.2 Model Type 2

Data for this attribute is shown in Table 11. It consists of two data bytes. The first byte contains ROM Error, Bus Error, and EEPROM Error flags at data bits 0, 2, and 7 respectively. The second byte contains the Device I/O Cable Open error flags for each active port. The third byte contains the Device I/O Cable Short error flags for each active port. Byte 1 is common to all ports and bytes 2 and 3 are unique for each port. The forth byte is not used and will always show a value of zero.

Table 11: Diagnostic Data for Model Type 2

Data bit		Description
First Byte	7	EEPROM Read Error
	6	Reserved
	5	Reserved
	4	Reserved
	3	Reserved
	2	Off bus communication Error
	1	Reserved
	0	ROM Checksum Error
Second Byte	7	Device I/O Cable Open at Port 8
	6	Device I/O Cable Open at Port 7
	5	Device I/O Cable Open at Port 6
	4	Device I/O Cable Open at Port 5
	3	Device I/O Cable Open at Port 4
	2	Device I/O Cable Open at Port 3
	1	Device I/O Cable Open at Port 2
	0	Device I/O Cable Open at Port 1
Third Byte	7	Device I/O Cable Short at Port 8
	6	Device I/O Cable Short at Port 7
	5	Device I/O Cable Short at Port 6
	4	Device I/O Cable Short at Port 5
	3	Device I/O Cable Short at Port 4
	2	Device I/O Cable Short at Port 3
	1	Device I/O Cable Short at Port 2
	0	Device I/O Cable Short at Port 1
Forth Byte	0 to 7	not used

3.10 Attribute 10: Cyclical Timer

This attribute is an unsigned single byte value. Setting Attribute 10 to a non-zero value will enable unsolicited status messages to be transmitted with a time interval equal to 10.24 milliseconds times the set value. These messages will reflect the current state of the Network Input Data.

3.11 Attribute 11: Serial Number

This attribute is a 32 bit unsigned long integer value used to differentiate products prior to address assignment. (Note: All multi-byte integer values are transmitted on SDS with MSB first, LSB last.) The Serial Number is set during manufacturing under password control.

3.12 Attribute 12: Date Code

This attribute is a four byte ASCII string that identifies the date of manufacture of the product. The digits are transmitted year first, then week. It is normally read-only, but can be written under password control.

3.13 Attribute 13: Catalog Listing

This attribute is a 24 byte ASCII string that identifies the Partner's product. It is normally read-only, but can be written under password control.

3.14 Attribute 14: Partner Name

This attribute is a 15 byte ASCII string: **Honeywell, Inc.** It is permanently fixed in ROM.

3.15 Attribute 15: Component Tag Name

This attribute is a 24 byte ASCII string that describes and/or categorizes the component product. It is normally set during manufacturing but can be changed by the end user. This tag name is shared by all embedded objects within the component.

3.16 Attribute 18: Network Input Data

This is the primary input data required in the execution of the external control program.

3.16.1 Model Types 0 and 1

The single bit Boolean data for this attribute is formatted as shown in Table 12. Data bit 0 contains the Boolean data for the corresponding port. Data bits 1 through 7 are not used and will always indicate a value of zero.

Table 12: Network Input Data for Model Types 0 and 1

Data bit	Description
1 through 7	not used
0	Network Input Data

3.16.2 Model Type 2

The Boolean data for this attribute is formatted as shown in Table 13. Data bits 0 through 7 contain the Boolean data for active input ports 1 through 8 respectively. Data bits corresponding to inactive ports will always indicate a value of zero.

Table 13: Network Input Data for Model Type 2

Data bit	Description
7	Network Input Data: Port 8
6	Network Input Data: Port 7
5	Network Input Data: Port 6
4	Network Input Data: Port 5
3	Network Input Data: Port 4
2	Network Input Data: Port 3
1	Network Input Data: Port 2
0	Network Input Data: Port 1

3.17 Attribute 19: Network Output Data

This is the primary output data required in the execution of the external control program. This attribute data is cleared at bus power-up and after Watchdog Time-out.

3.17.1 Model Types 0 and 1

Data for this attribute is formatted as shown in Table 14. Data bit 0 contains the Boolean data for the corresponding port. Data bits 1 through 7 are not used and will always indicate a value of zero.

Table 14: Network Output Data for Model Types 0 and 1

Data bit	Description
1 through 7	not used
0	Network Output Data

3.17.2 Model Type 2

Data for this attribute is formatted as shown in Table 15. Data bits 0 through 7 contain the Boolean data for active output ports 1 through 8 respectively. Data bits corresponding to inactive ports will always indicate a value of zero.

Table 15: Network Output Data for Model Type 2

Data bit	Description
7	Network Output Data: Port 8
6	Network Output Data: Port 7
5	Network Output Data: Port 6
4	Network Output Data: Port 5
3	Network Output Data: Port 4
2	Network Output Data: Port 3
1	Network Output Data: Port 2
0	Network Output Data: Port 1

3.18 Attribute 56: Tag Name

3.18.1 Model Types 0 and 1

This attribute is a read/write space for each port, in which the user may store any ASCII coded information. The amount of storage space varies with the different I/O configurations. Catalog listings that have a total of 4 Input/Output ports, have storage space for 24 characters. Catalog listings that have 8 ports, have storage space for 12 characters.

3.18.2 Model Type 2

This attribute is a 24 byte read/write space in which the user may store any ASCII coded information.

3.19 Attribute 57: Model Type

This numeric attribute controls which Smart Distributed System device model type the BusRide Multiport will emulate. Three Smart Distributed System models are supported, as shown in Table 16. Model Type 0 is a single address model containing 4 or 8 *embedded objects*. Model Type 1 is a *multi-address* model that utilizes up to 8 SDS bus addresses. Model Type 2 is a single address, single embedded object model with all inputs *packed* together in an attribute and all outputs *packed* together in another attribute. See section 2.1, SDS Device Models for additional application information. The only acceptable values that can be written to Attribute 57 are 0, 1, and 2. Any other value will result in a data error response.

Table 16: Model Type

Model Type value	Model Type Name	Description
0	Embedded Object Model	1 logical address containing 4 or 8 single-point embedded devices.
1	Multi-address Model	4 or 8 logical addresses, each address has 1 single-point devices.
2	Single Address, Packed Data Model	1 logical address containing 1 input and/or 1 output attribute, containing multi-bit data.

3.20 Attribute 58: Watchdog Timer

The Watchdog Timer attribute is an unsigned, single byte integer value. It is an internal countdown timer that is restarted each time a bus communication messages is received by the **logical device**. A single Watchdog Timer is employed in Model Types 0 and 2 because these models have a single logical device. Multiple timers are employed in Model Type 1, one for each logical device. The timing range is 30 milliseconds (data = 3) to 2.6 seconds (data = 255) and the resolution approximately 10ms. Data values 1 and 2 return Illegal Data responses.

If the Watchdog Timer value is set to Zero, the watchdog function is off, and the outputs will remain in their last commanded state indefinitely.

If the Watchdog Timer value is non-zero, the timer is initially started by the first Write message to the Network Output Data. Once started, the Watchdog Timer is restarted by ANY message to the **logical device**. The device will transmit an **Event 7, No-op** message 10 to 20 milliseconds before watchdog time-out. If time-out occurs, bus communication is assumed to be lost and three things happen:

1. The Network Output Data is set to the OFF state This also sets the output pins to the OFF, unless the outputs are forced.

2. Bit 1 of Attribute 9 is set to True.

3. The previous transmission of Event 7 is aborted if it did not complete. An attempt is made to transmit an **Event 0, Error** message by embedded object 0. This transmission of Event 0 is also aborted if it does not complete within 20 milliseconds. The purpose of aborting is to prevent tying up the bus with re-transmissions, due to a local node malfunction.

3.21 Attribute 59: Mechanical Switch Mode

This mode provides a 50 millisecond time-delay to de-bounce mechanical switch contacts. This helps to prevent multiple COV messages caused by mechanical switch contact bounce.

3.21.1 Model Types 0 and 1

Data for this attribute is a single bit Boolean value and is formatted as shown in Table 17, with data bit 0 controlling the input mode for the corresponding port. If data bit 0 is false (0) the port is in the solid-state sensor mode; if the bit is true (1) the port is in the Mechanical Switch mode. NOTE: ON-Delay and OFF-Delay timers override the Mechanical Switch mode timer for Model Types 0 and 1.

Table 17: Mechanical Switch Mode Data for Model Types 0 and 1

Data bit	Description
1 through 7	not used
0	Mechanical Switch Mode

3.21.2 Model Type 2

Data for this attribute is a Boolean value and is formatted as shown in Table 18, with data bits 0 through 7 controlling the input mode for active input ports 1 through 8 respectively. If a data bit is false (0) the corresponding port is in the solid-state sensor mode; if the bit is true (1) the port is in the Mechanical Switch mechanical switch mode.

Table 18: Mechanical Switch Mode Data for Model Type 2

Data bit	Description
7	Mechanical Switch Mode: Port 8
6	Mechanical Switch Mode: Port 7
5	Mechanical Switch Mode: Port 6
4	Mechanical Switch Mode: Port 5
3	Mechanical Switch Mode: Port 4
2	Mechanical Switch Mode: Port 3
1	Mechanical Switch Mode: Port 2
0	Mechanical Switch Mode: Port 1

3.22 Attribute 60: NO/NC

3.22.1 Model Types 0 and 1

Data for this attribute is a single bit Boolean value and is formatted as shown in Table 19 with data bit 0 controlling the logic inversion of the sensor input signal. The logic inverts if the bit value is 1. See also Table 2: Input Data Truth Table.

Table 19: NO/NC for Model Types 0 and 1

Data bit	Description
1 through 7	not used
0	Invert Network Input Data Port

3.22.2 Model Type 2

Data for this attribute is a eight bit Boolean value and is formatted as shown in Table 20 with data bits 0 through 7 controlling the logic inversion of the sensor input signal of active input ports 1 through 8 respectively. The logic inverts if the bit value is 1. See also Table 2: Input Data Truth Table.

Table 20: NO/NC for Model Type 2

Data bit	Description
7	Invert Input Port 8
6	Invert Input Port 7
5	Invert Input Port 6
4	Invert Input Port 5
3	Invert Input Port 4
2	Invert Input Port 3
1	Invert Input Port 2
0	Invert Input Port 1

3.23 Attribute 61: Enable Re-transmission

This single bit Boolean value determines whether the device re-transmits COS or COV messages automatically in the event that no acknowledgment is received from the host. Data for this attribute is formatted as shown in Table 21, with data bit 0 controlling the data re-transmission for the device. Most applications will require re-transmissions enabled; this is the factory default setting. Future applications requiring peer to peer or broadcast communications may need to use this attribute to disable re-transmissions. NOTE: This attribute is single bit Boolean data type, in all 3 model types.

Table 21: Enable Re-transmission Data

Data bit	Description
1 through 7	not used
0	Enable Re-transmission

- If set to 1, COS or COV messages will be automatically re-transmitted at 10 ms. intervals, until an acknowledgment is received from the host.

- If set to 0, only the initial COS or COV message will be transmitted. No re-transmissions will be made.

3.24 Attribute 62: Change of Value Mask

This attribute is only available if Attribute 57: Model Type, has a value of **2** and the device has active inputs. Data for this attribute is a Boolean value and is formatted as shown in Table 22, with data bits 0 through 7 controlling the unsolicited Change of Value (COV) message transmission for active input ports 1 through 8 respectively. If the bits in Table 22 are true (1) and the corresponding port changes state, an unsolicited Change of Value (COV) message will be transmitted. It is necessary to also have the Un/Solicited Mode bit set (Attribute 6) to get COV messages from any port. If two or more ports change state simultaneously, only a single COV message will be transmitted.

Table 22: Change of Value Mask for Model Type 2

Data bit	Description
7	COV Mask Bit: Port 8
6	COV Mask Bit: Port 7
5	COV Mask Bit: Port 6
4	COV Mask Bit: Port 5
3	COV Mask Bit: Port 4
2	COV Mask Bit: Port 3
1	COV Mask Bit: Port 2
0	COV Mask Bit: Port 1

3.25 Attribute 63: Enable Device I/O Cable Open Diagnostic

3.25.1 Model Types 0 and 1

Data for this attribute is a single bit Boolean value and is formatted as shown in Table 23 with data bit 0 enabling the Cable Open Diagnostic. The diagnostic is enabled if the bit value is 1.

Table 23: Enable Cable Open Diagnostic for Model Types 0 and 1

Data bit	Description
1 through 7	not used
0	Enable Cable Open Diagnostic

3.25.2 Model Type 2

Data for this attribute is a eight bit Boolean value and is formatted as shown in Table 24 with data bits 0 through 7 enabling the Cable Open Diagnostic for ports 1 through 8 respectively. The diagnostic is enabled if the bit value is 1.

Table 24: Enable Cable Open Diagnostic for Model Type 2

Data bit	Description
7	Enable Port 8 Cable Open Diagnostic
6	Enable Port 7 Cable Open Diagnostic
5	Enable Port 6 Cable Open Diagnostic
4	Enable Port 5 Cable Open Diagnostic
3	Enable Port 4 Cable Open Diagnostic
2	Enable Port 3 Cable Open Diagnostic
1	Enable Port 2 Cable Open Diagnostic
0	Enable Port 1 Cable Open Diagnostic

3.26 Attribute 65: Batch Counter

This attribute is available only for input devices and Attribute 57: Model Type, has a value of **0 or 1**. Attribute 65 is a single unsigned byte. Programming it to a non-zero value enables the Batch Counting mode. This mode counts both ON and OFF sensor input transitions and reports one network data ON/OFF cycle per batch. The batch size is programmable from 2 to 255 and Attribute 60: NO/NC controls the initial Network Data Bit state. **NOTE: A network data transition will occur at the end of each batch of sensor input transitions. This means that the Network Data Bit has equal on and off times.** The first batch after power-up will count correctly. Reading Attribute 65 will restart the current batch count. Setting Attribute 65 to zero disables the Batch Count mode.

3.27 Attribute 66: ON-Delay Timer

This attribute is available only for input devices and Attribute 57: Model Type, has a value of **0 or 1**. Attribute 66 is a single unsigned word value. Setting a non-zero value will enable the ON-Delay function which delays the network data transition from **0 to 1**. This also delays the transmission of the COS or COV ON message. The timing range is from zero to 65,535 milliseconds in 1 millisecond intervals, and with an accuracy of about 1 millisecond.

3.28 Attribute 67: OFF-Delay Timer

This attribute is available only for input devices and Attribute 57: Model Type, has a value of **0 or 1**. Attribute 67 is a single unsigned word value. Setting a non-zero value will enable the OFF-Delay function which delays the network data transition from **1 to 0**. This also delays the transmission of the COS or COV OFF message.. The timing range is from zero to 65,535 milliseconds in 1 millisecond intervals, and with an accuracy of about 1 millisecond.

4. ACTIONS

Table 25: Actions

Action ID	Description	Request Data	Request Data Type	Response Data	Response Data Type
0	NO-OP	None		None	
1	Change Address	New Address 0 Partner ID Serial Number	Unsigned Byte Unsigned Byte Unsigned Word Unsigned Long	None	
2	Initiate Self Test	None		None	
6	Reset Errors	None		None	
8	Enroll	None		Partner ID Serial Number	Unsigned Word Unsigned Long
51	Force Network Variable	Network Variable ID (Optional) State Value	Unsigned Byte Boolean Byte	None	
52	Remove Force Network Variable	Network Variable ID (Optional)	Unsigned Byte	None	
53	Read Variable Descriptor Word	Attribute ID	Unsigned Byte	Attribute ID Attribute Tag	Unsigned Byte Unsigned Word
57	Password	Password Data	Unsigned Word	None	

4.1 Action 0: NO-OP

This action is used primarily during Autobaud and to solicit a response from another device to verify bus communication integrity. No action is performed by the requested device except to Acknowledge the message.

4.2 Action 1: Change Address

Invoking this action will change the *Logical Address* of the BusRide Multiport Three optional methods are provided. These method options are indicated by the number of data bytes contained in the message.

1. If the message contains <u>one</u> data byte, the Action will change the *Logical Address* of the Device to the address specified in the data byte.

2. If the message contains <u>two</u> data bytes, the Action will change the *Logical Address* of the Port Number defined in the second data byte, to the address specified in the first data byte. NOTE: This method is applicable only for Model Type 1. This feature allows the user to change the address of a hidden port. If the second byte contains a value of zero (0), the target port is assumed to be the port that received the command, and the *Logical Address* will be changed as described in method 1.

3. If the message contains eight data bytes, then byte numbers 3 and 4 are assumed to be the Partner ID Number (Attribute 3), bytes 5 through 8 are assumed to be the device Serial Number (Attribute 11). If these identification numbers are correct for this device, the *Logical Address* will be changed as described in option 1; else, the message will be ignored. NOTE: Data byte 2 must have a value of 0 for Model Types 0 and 2. For Model Type 1, data byte 2 identifies the target port number if the value is non-zero.

The address value has a valid range of 0 to 125. The new *User* address will be the value of the data incremented by 1. (See Attribute 4.)

4.3 Action 2: Initiate Self Test

Invoking this action initiates a self-test sequence internal to the BusRide Multiport. This action is acknowledged prior to starting the self-test. An Event 0 is transmitted only if internal errors are found.

4.4 Action 6: Reset Errors

Invoking this action clears Attribute 8 and the error flags in both bytes of Attribute 9.

4.5 Action 8: Enroll

Invoking this action returns a six data byte message. The first two data bytes are the Partner Identification Number and the remaining four bytes are the device Serial Number. The firmware waits for a random time delay, up to 10 milliseconds maximum, prior to responding to this Action. The purpose of the delay is to make it possible to detect multiple devices with the same Logical Address.

4.6 Action 51: Force Input/Output Variable State

The Force Input/Output Variable Action is valid for either input or output ports. Attribute ID number, State Value, and Mask are transmitted sequentially in a single Action 51 message. **Action 51 may be applied only to the Network Data attributes 18 and 19.** The first data byte shall contain the Network Variable ID. The second data byte/word is the State value; and the third data byte/word is an optional mask. If the mask is not present, ALL outputs will be forced. Forced I/O states are retained until an Action 52: Remove Force State message is received for the attribute.

Table 26: Force Action Truth Table

Force Mask Bit	State Value Bit	Input Data	Physical Output Pin
0	(don't care)	no change	no change
1	0	0	OFF
1	1	1	ON

4.6.1 Force Input Ports

Invoking this action on an **INPUT** port, forces the logical state of the unmasked **Input Data** attribute bits, to the state of the bits in the State Value byte/word. (However, forcing inputs has no effect on the input port indicator LEDs.) COV Events are produced (if enabled) as a result of this action, emulating the normal function of the inputs. The Input Data will remain in this state until another Action 51 or Action 52 message is received.

4.6.2 Force Output Ports

For OUTPUTS, Forcing has no effect on Output Data. Invoking this action on an **OUTPUT** port, forces the **physical output state** of the unmasked output pins, and the port indicator LEDs, to the state of the bits in the State Value byte/word. The output pins will remain in this state until another Action 51 or Action 52 message is received.

NOTE: While an output is forced, a Watchdog time-out has no effect on the output pin state, but it may change the Output Data.

4.7 Action 52: Remove Force Input/Output Variable State

Invoking this action removes the forced state imposed by Action 51, and restores normal operation to the Network Input Data.

4.8 Action 53: Read Variable Descriptor Word

Invoking this action with a valid attribute ID number in the first data byte, will return the data descriptor for the selected attribute variable. This information allows a host device to determine the type of data any attribute requires or produces. All valid descriptor values are shown in the *Descriptor* columns in Table 5, Table 6 and Table 7. Invoking Action 53 with an invalid attribute ID, returns a 0,0 value. See the Primitive Tags section of Specification GS 052 103 for more information on data descriptors.

4.9 Action 57: Password

The Password function is used to protect configuration information, located in EEPROM, from tampering or accidental destruction. **This Action will always yield a positive acknowledge, even if the password data is incorrect.**

1. Invoking this Action, with the **correct password** in the data field, will set a flag that enables the write mode of the attributes that may be written only under password control. These attributes are indicated by the letter P in the *Access* column in Table 5, Table 6 and Table 7.

2. Invoking this Action with a message that contains **no data**, will reset the password mode flag.

3. Invoking this Action with an **incorrect password**, sets a password lockout flag. This prevents any further use of the Password Action until after the next power-up.

5. EVENTS

Table 27: Events

Event ID	Description	Request Data	Request Data Type
0	Diagnostic Error	Diagnostic Error Count	Unsigned Byte
3	End Of Timer	Attribute ID Network Input Data	Unsigned Byte Boolean Byte
6	Change Of Value	Attribute ID Network Input Data	Unsigned Byte Boolean Byte

5.1 Event 0: Diagnostic Error

If any of the error flags in Attribute 9 changes from 0 to 1, the BusRide Multiport will transmit a Diagnostic Error Event. The monitoring device shall then read Attribute 9 to determine which error(s) has occurred. If any of the error flags, in any byte of Attribute 9, is a 1 when an Initiate Self-Test (Action 2) is executed, the BusRide Multiport will transmit a Diagnostic Error Event.

5.2 Event 3: End Of Timer

End Of Timer (EOT) Event messages are associated only with all 3 model types. This event occurs at the time interval set by the Cyclical Timer. The EOT message includes the Attribute ID and the Network Input Data value.

5.3 Event 6: Change Of Value

Change Of Value (COV) Event messages are transmitted by Model Type 0, and Model Type 2. (Model Type 1 uses Short-Form COS messages for this event.) This event occurs each time one or more unmasked inputs change logic state. The input shall have a **1** in the corresponding location in Attribute 62, Change of Value Mask; and, Attribute 6, Un/Solicited Mode, shall be set to **1**. The COV message includes the Attribute ID and the Network Input Data value.

5.4 Event 7: No-op

This Event applies only to output object models that include Attribute 58: Watchdog Timer. At least10 milliseconds, and no more than 20 milliseconds before watchdog time-out, the logical device will transmit an Event 7, No-op message. This event is used to indicate the time-out error is about to occur. No action is performed by the receiving device except to Acknowledge the message. Any response to this message restarts the watchdog timer, thus preventing the output change and the error.

6. SHORT-FORM MESSAGES

Short-Form Change Of State Messages are associated only with Model Type 1 inputs. Short-form Write messages are accepted only by Model Type 1 outputs as ON/OFF commands for the Network Output Data attribute.

6.1 Short-Form Change Of State-ON

The short-form COS-ON message is produced (in Model Type 1 only) when the Network Input Data attribute changes from **0 to 1**. If Attribute 61 is TRUE, the short-form COS-ON message will be re-transmitted at 10ms intervals, until an application layer Acknowledge message is received.

6.2 Short-Form Change Of State-OFF

The short-form COS-OFF message is produced (in Model Type 1 only) when the Network Input Data attribute changes from **1 to 0**. If Attribute 61 is TRUE, the short-form COS-OFF message will be re-transmitted at 10ms intervals, until an application layer Acknowledge message is received.

6.3 Short-Form Write ON

The Short-Form Write-ON message sets the Network Output Data attribute to ONE.

6.4 Short-Form Write OFF

The Short-Form Write-OFF message sets the Network Output Data attribute to ZERO.