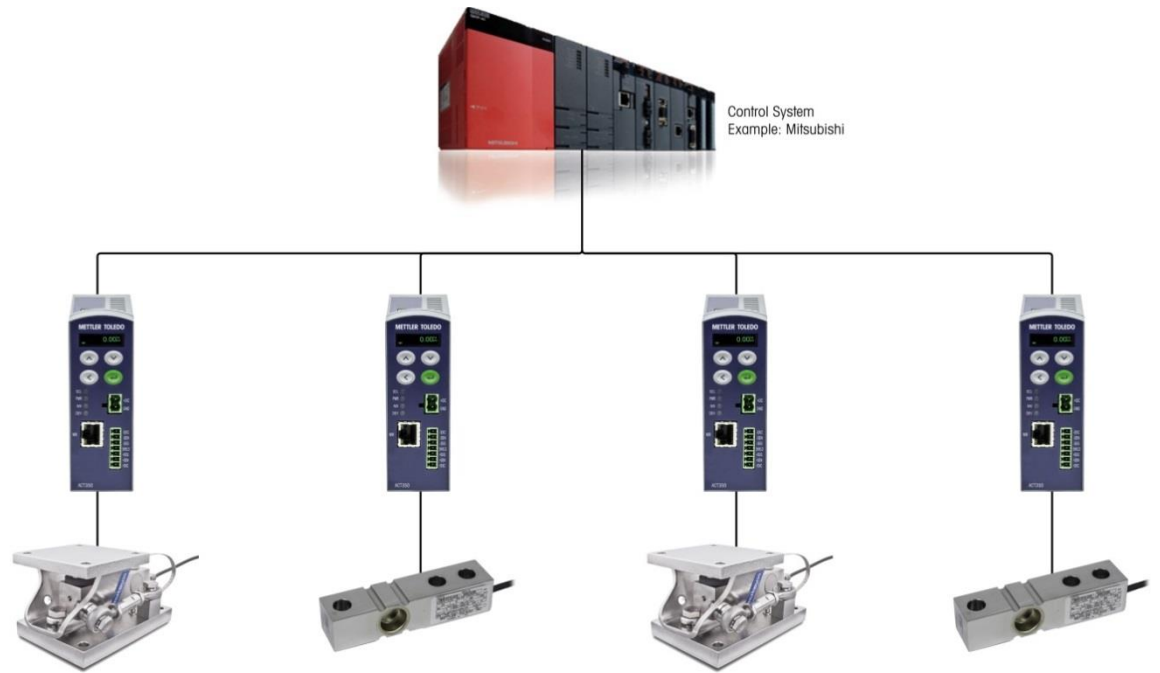


ACT350

Fieldbus Communication - SAI



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A Standard Automation Interface

A.1. Overview

This appendix covers

- Overview
- General Structure
- Data Format
- Byte and Word Order of Data
- Floating Point Numbers
- Test Mode
- Asynchronous Format

The Standard Automation Interface (SAI) is a protocol designed to exchange data between METTLER TOLEDO devices and automation systems. The goals of this interface are to provide: 1) a common data layout for load cells, terminals, and other devices regardless of the physical interface or automation network used, 2) a single protocol for the convenience of automation integrators, control system programmers, and our automation customers, and 3) a tiered approach to create a flexible protocol for diverse devices.



Figure A-1: Overview of a Control System

A.2. General Structure

The protocol has two primary data types – cyclic data and asynchronous data (also known as acyclic or explicit messaging).

A.2.1. Cyclic Data

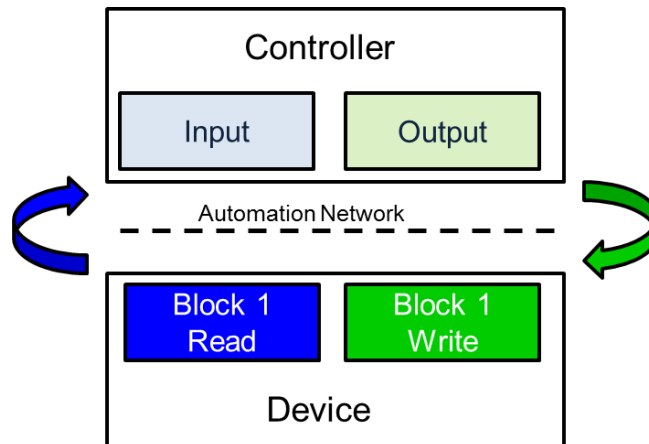


Figure A-2: Controller/Device Read-Write Overview

The cyclic data is broken in sections of data called blocks. Each block of data is 4 words (16 bits each) in length. The data within these blocks can express numeric values, string values, or individual bits that represent state/command depending on the type of block specified. Two fixed formats (1 Block and 2 Block) are provided for ACT350. The ACT350 supports 4 words in and 4 words out in the 1 Block format and 8 words in and 8 words out in the 2 Block format. The number of input words (data sent from the device to the process controller) and output words (data sent from the process controller to the device) always match. This limits the number of configurations to a reasonable amount.

- 1 Block format - 1 Block In & 1 Block Out
- 2 Block format - 2 Blocks In & 2 Blocks Out

The two types of cyclic blocks supported on the ACT350 are floating point and status/command. Numeric values will be sent via floating point blocks as opposed to integer or other types because the decimal point and sign are included and do not require special data handling. Status/command data is grouped together in 16 bit words to conserve space.

A.2.2. Two Types of Cyclical Blocks

- Floating Point
- Status / Command

MT "Device" to "Control" Words (Read)		"Control" to MT "Device" Words (Write)	
1 Block Format (single floating point block in / single floating point block out)			
FPB	Empty (unassigned)	FPB	Empty (unassigned)
MT 'Device' to 'Control' Words (Read)		'Control' to MT 'Device' Words (Write)	
2 Block format (2 blocks in / 2 blocks out: 1 floating point block and 1 status/command block in each)			
FPB	SCB	Empty (unassigned)	FPB SCB Empty (unassigned)

Figure A-3: Combinations of possible cyclical data types by block data format

A.2.2.1. Floating Point Block

The floating point blocks are used to exchange numeric data such as weight and its associated scale status. The floating point block consists of a 32 bit floating point value and two 16 bit words. The use of this block is slightly different depending on the source of the data (the device or the control system).

A single block of data sent by the device to the control system is mapped as follows:

Floating Point Data Block (Read)	
Word 0	32 bit (requested) Floating point value
Word 1	
Word 2	16 bit Device status
Word 3	16 bit Response value

Figure A-4: Minimum Floating Point Data Block (Read)

The device's Read Floating Point Data Block contains the floating point value requested by the control system from its Write Floating Point Data Block. It uses 16 bits in the third word to provide status bit information based on the command (for example, scale status such as motion or center of zero). The last the 16 bit Response value is used to inform the control system what the contents of the floating point value are (example: gross weight of scale 1).

A single block of data sent by the control system to the device is mapped in a similar manner:

Floating Point Data Block (Write)	
Word 0	32 bit Floating point value - optionally used with Command & Channel Indicator
Word 1	
Word 2	16 bit Channel Mask
Word 3	16 bit Command value

Figure A-5: Minimum Floating Point Data Block (Write)

The control system's Write Floating Point Data Block is used to issue commands to the device. These commands can be as simple as the request for specific data to be reported in the Read

Floating Point Data Block - for example, report net weight. It can also contain commands to write a value into the device's data – for example, set Comparator Limit 1 = 100. In this case, the optional floating point value is used to send the value with the command. The Channel Mask provides a method to issue the same command to multiple channels in the device. The ACT350 is a single channel device. The last word contains the 16 bit Command value to instruct the device what command is issued.

Both the Read Floating Point Block and the Write Floating Point Block have a similar structure for their Response Value and Command Value words. The Write block sends its commands and the device responds with the same value when the command is successful. Details about the use of these words is described in section A.3, **Data Format**.

A.2.2.2. Status Block

The status blocks are used to provide state (on/off) data. The status blocks are structured to support three sets of status words. Examples of data provided through status blocks include alarms, physical I/O, target control, comparator state, or application specific states.

The status data sent by the device to the control system is similar to the layout used to provide the status information in the floating point block. Because there is available space, three sets of status data and 1 word to indicate what data is provided are included in this type of block:

Status Block - Read	
Word 0	Status Group 1
Word 1	Status Group 2
Word 2	Status Group 3
Word 3	Response value

Figure A-6: Status Block (Read)

The command data sent by the control system to the device requires less space. In order to maintain a consistent layout (input vs. output block size), words 1 - 3 are currently reserved until/unless these words are needed to provide information from the control system in the future:

Status Block - Write	
Word 0	Reserved
Word 1	Reserved
Word 2	Reserved
Word 3	Command value

Figure A-7: Status Block (Write)

A.2.3. Asynchronous Data (Explicit or Acyclic Messaging)

The asynchronous data does not have the same size/layout restrictions as cyclic data due to its negative impact on network performance (bandwidth and speed). This format uses special message instructions in the control system to immediately execute the command specified within its

configuration. These messages and their instructions are control system dependent. Within the configuration of the instruction, a variable or memory space is defined for the data exchanged through the execution of the message. The ACT350 supports the Direct access data format for Asynchronous data.

The Direct access data does not require the variable name within the data. The layout for direct access data is shown Figure A-8

Word 0	Byte 2	Byte 1
Word 1	Byte 4	Byte 3
Word 2	Byte 6	Byte 5
Word 3	Byte 8	Byte 7
...		
Word n	Byte $(2n + 2)$	Byte $(2n + 1)$

Figure A-8: Explicit Messaging Direct data format

A.3. Data Format

The formats of the data available in the protocol have been designed to provide sets of data based on ACT350 functionality. Data type and space required is dependent on the selected format. The Act350 can use either the 1 block format or the 2 block format.

A.3.1. 1 Block Format

The SAI 1 Block Format is the basic format in the SAI protocol. The user selection of this format supports three typical use cases

- Some control network interfaces have limited space
- Some devices have limited data
- Some customers want limited data

In order to insure that less complex applications are capable of using/providing this data, advanced features like user-defined data mapping are not included in this format.

The objective is to provide basic data with little to no special coding. In addition, data size is limited to insure good communication performance and to comply with as many automation networks as possible.

A.3.1.1. Cyclic Data Operation

The cyclic data of the 1 Block Format should be sent with minimal device configuration and minimal control system integration. Once the device is successfully added to the control system network, it should immediately begin sending its default cyclic data (typically gross weight

information). The 1 Block Format always consists of a single Read Floating Point Data Block and a single Write Floating Point Data Block.

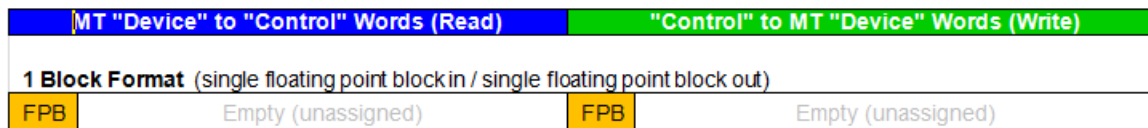


Figure A-9: The 1 Block Format data layout

A.3.1.1.1. Device to Control System Operations (Read Data)

The 1 Block Format requires the device to repeatedly send a 4 word block of input data to the control system. This data is sent automatically as part of the automation network's update of cyclic data (scan). The structure of the data provided is based on the Floating Point Block:

Word 0	Requested floating point value
Word 1	
Word 2	Scale status group
Word 3	Response Word

Figure A-10: Floating Point Read Block

This block contains three parts: 2 words for the floating point value (word 0-1), 1 word to provide device status bits (word 2), and 1 word for the individual status bits that are used to identify the source and type of data being sent in the floating point value (word 3).

By default, if the control system sends no data in its Write Floating Point Data Block (the output data is all zeroes), the device will send its gross weight data for channel 1, the scale status word for this channel, and a response value word with all bits set to 0.

A.3.1.1.2. Floating Point Value (Word 0 & 1)

The floating point value is single precision. The order of the data in the floating point value will generally be determined by configuration of the byte swap and word swap parameters. The default setting of these parameters is typically based on the type of automation interface used. Refer to section A.3, **Data Format**, for additional details.

A.3.1.1.3. Scale Status Group (Word 2)

The device status is a composite status word that contains individual bits to indicate the state of various scale or device specific binary (on/off) values. These include error and data validation bits to make it possible to determine when the data received is good and can be safely used. It also contains command status bits to provide some information on the state of a command issued in the floating point write block.

Bit #	Scale Status Group
0	Sequence bit 0
1	Sequence bit 1
2	Heart Beat
3	Data Okay
4	Alarm Condition
5	Center of Zero
6	Motion
7	Net Mode
8	Alternate weight unit
9	Device specific bit 1
10	Device specific bit 2
11	Device specific bit 3
12	Device specific bit 4
13	Device specific bit 5
14	Device specific bit 6
15	Device specific bit 7

- Bit 0, 1 **Sequence bits:** These are used as sequence toggle bits. As commands are sent by the control system (and seen by the device), the device increments their value as an indication that a command has been seen and acted on
- These bits can be used during a sequence of commands to insure that there have been no sequencing errors in the request and the response of data. They are updated on every NEW command
- Bit 2 **Heart Beat:** To insure that the device is working as expected and updating data in Words 0, 1 and 2, this heart beat bit is toggled between off and on states. The frequency is dependent on the specific device's ability to cycle this bit. For example, a 1 second heart beat would be sufficient for most applications
- Bit 3 **Data Okay:** This bit is used to indicate that the data being reported is OK. This bit gets set to 0 when the device is still operational but the scale has a critical error (for example over capacity) and the value being reported cannot be guaranteed to be valid.
- Bit 4 **Alarm Condition:** This bit is true when there is an application fault, predictive diagnostics alarm, or command received cannot be executed as requested. If this bit is true the control system should use a Field Value command to determine the nature of the failure.
- Bit 5 **Center of Zero:** This bit is true when the gross weight value is at a value of zero +/- one quarter of a weights and measures verification interval denoted as "e"
- Bit 7 **Net Mode:** This bit is true when the weight reported by the device has had a tare taken and the net weight is different than the gross.
- Bit 8 **Alternate weight unit:** This bit indicates when a weight unit other than the primary weight unit is being used by the device ... if this bit is set to a "1" an alternate weight unit is in use
- Bit 9 -15 **Device Specific bits:** These bits are used to provide device specific status information (such I/O or application status)

A.3.1.1.4. Response Word (Word 3)

The Response Word is used to provide feedback on the state of the command issued in the Write Floating Point Data Block. Depending on what type of command has been sent, this response may be used to indicate that the command failed, it succeeded, or it was seen and the data requested is being sent in the floating point value.

The structure of the Response Word is identical to the structure of the Command Word. It consists of two sets of bits: bits 11-14 which are used to indicate the channel value and bits 0-10 which are used to indicate the response value. Bit 15 is used to indicate an error condition. It is set to "0" if the device can provide the desired data or comply with the requested command. If it cannot, then this bit is set to a "1" to indicate an error. A full description of the possible error codes are described in Commands section.

The channel indicator bits are intended for devices which support multiple sensors or scales, allowing an individual device to support up to a maximum of 16 channels. Single channel (scale or load cell) devices such as the ACT350 will always use 0000 as their default channel value.

Bit #	Data		
15	MSB always 0	0000	Channel 1
14	MSB of channel	0001	n/a
13		0010	n/a
12		0011	n/a
11	LSB of channel	0100	n/a
10	MSB of response value	0101	n/a
9		0110	n/a
8		0111	n/a
7		1000	n/a
6		1001	n/a
5		1010	n/a
4		1011	n/a
3		1100	n/a
2		1101	n/a
1		1110	n/a
0	LSB of response value	1111	n/a

Figure A-11: Response Word Layout

The Response bits have values to indicate the current state of the command sent by the control system in its request for data or in its attempt to trigger a particular device function. The structures of the Command Word and Response Word match so that any command issued in the Write will have the same exact value in the Read response when the device successfully recognizes and completes the command.

For example, if the control system requests that gross weight of scale 1 be sent in its command data, the device places this weight information in its floating point and places a response value equal to the command value into its response word.

Additional details of possible responses are provided in Appendix C, **Cyclic Commands**, and Appendix D, **Acyclic Commands**.

A.3.1.1.5. Control System to Device Operations (Write Data)

The 1 Block Format provides a single 4 word block of output data from the control system. The structure of the data provided is based on the Floating Point Write Block.

Word 0	Floating point value – optionally used with command
Word 1	
Word 2	Channel Mask
Word 3	Command Word

Figure A-12: Floating Point Write Block

This block contains three parts: 2 words for an optional floating point value (word 0-1), 1 word to provide the ability to send a single command to multiple channels scale via the Channel mask (word 2), and 1 command word for the command & channel indicator bits used to identify the data desired by the control system (word 3).

A.3.1.1.6. Floating Point Value (Word 0 & 1)

The floating point value is single precision. Layout of FP value bits are described in the **Byte Order** section of this document.

A.3.1.1.7. Channel Mask (Word 2)

The Channel Mask only applies to devices that support multiple channels and is not typically available for all commands. The command's channel is identified by bits 11-14 in the Command Word. If a device only has a single channel, such as the ACT350, the channel mask should not be used since the default device channel will be used in all cases and would be selected from the command word. The Channel Mask should be set to all zeroes when not in use.

Bit#	Data
0	1 = Apply command to channel 1
1	n/a
2	n/a
3	n/a
4	n/a
5	n/a
6	n/a
7	n/a

Bit#	Data
8	n/a
9	n/a
10	n/a
11	n/a
12	n/a
13	n/a
14	n/a
15	n/a

A.3.1.1.8. Command Word (Word 3)

The Command Word consists of two sets of bits: bits 11-14 which are used to indicate which channel value and bits 0-10 which are used to indicate the command value. Bit 15 is always set to 0 to keep the overall value of the word positive when evaluated as an integer.

The channel indicator bits are intended for devices which support multiple sensors or scales, allowing an individual device to support up to a maximum of 16 channels. Single channel (scale or load cell) devices will always use 0000 as their default channel value. These bits indicate which channel the command should be applied to.

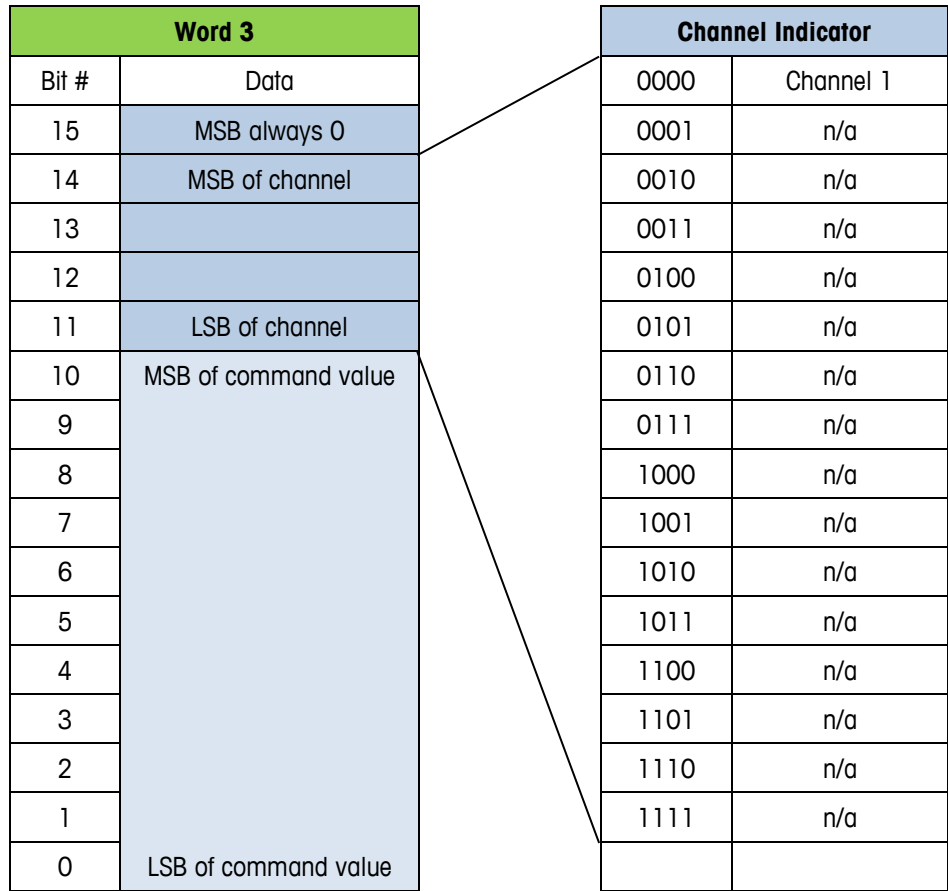


Figure A-13: Command Word Layout

The Command bits 0-10 are used by the control system to select the reported data from the device data in the Floating Point Read Block, change device data values, or issue operational commands such as tare, zero, etc. Details of available commands are provided in Appendix B, **Cyclic Commands**, and Appendix C, **Acyclic Commands**.

The value used in the Command Word is a combination of the command value and the channel value. This combination creates a specific command to a targeted channel, for example report gross weight of channel 2.

To calculate the word's complete integer value, the command value should be added to the channel value:

$$\text{Command Word} = \text{Channel Value} + \text{Command Value}$$

Channel #	Bit value	Integer value
1	0 0 0 0	0

Figure A-14: Channel Value

Command	Bit value	Integer value
Report Default Data (gross wt)	000 0000 0000	0

Command	Bit value	Integer value
Report Rounded Gross Weight	000 0000 0001	1
Report Rounded Tare Weight	000 0000 0010	2
Report Rounded Net Weight	000 0000 0011	3
Report raw counts	000 0000 1010	10

Figure A-15: Command Value

Command	Command value	Channel value	Word value
Report Gross Weight, Channel 1	0	0	0
Report Net Weight, Channel 1	3	0	3
Report raw counts, Channel 1	10	0	10

Figure A-16: Command Word Values

By default, if the control system has no data (all "0") in its write block, the device will see this as a command to report its default data (typically gross weight) for the first channel.

A.3.2. 2 Block Format

The SAI 2 Block Format builds on the format structure used by the 1 Block Format; however it provides support for two blocks of input data and two blocks of output data. This fixed format requires no configuration. This format was designed for applications where the device supports additional status information. Status groups provide the means for the PLC to monitor status of RedAlert Alarms and comparators.

A.3.2.1. Cyclic Data Operation

The cyclic data of the 2 Block Format supports two read blocks and two write blocks - a single Floating Point Data Block and a single Status Block for each. Like the 1 Block Format, the 2 Block Format should provide a default configuration that immediately begins to send default cyclic data (with little to no coding).

MT 'Device' to 'Control' Words (Read)			'Control' to MT 'Device' Words (Write)		
2 Block format (2 blocks in / 2 blocks out: 1 floating point block and 1 status/command block in each)					
FPB	SCB	Empty (unassigned)	FPB	SCB	Empty (unassigned)

Figure A-17: 2 Block Data Format Layout

A.3.2.1.1. Device to Control System Operations (Read Data)

The 2 Block Format requires the device to repeatedly send two (4 word) blocks of input data to the control system. This data is sent automatically as part of the automation network's update of cyclic data (scan). The structure of the data provided consists of one Floating Point Read Block and one Status Read Block:

Floating Point Data (Block 1)	
Word 0	Requested floating point value (32 Bit)
Word 1	
Word 2	Scale Status Group
Word 3	Response Word
Status (Block 2)	
Word 4	Status Group 1
Word 5	Status Group 2
Word 6	Status Group 3
Word 7	Response Word

Figure A-18: 2 Block Format Read

Block 1 contains three parts: 2 words for the floating point value (word 0-1), 1 word for the scale status bits (word 2), and 1 response word for the individual status bits that are used to identify the source and type of data being sent in the floating point value (word 3).

By default, if the control system sends no data in its Write Floating Point Data Block (the output data is all zeroes), the device will typically send its gross weight data for channel 1, the scale status word for this channel, and a response word that indicates that the floating point value in words 0 & 1 is the gross weight for channel 1 (all bits set to 0).

Block 2 contains four parts: 3 separate status group words (words 4-6) and a response word (word 7) for the individual status bits that are used to identify the source and type of data being sent in the status words.

A.3.2.1.2. Floating Point Value (Word 0 & 1), Scale Status Group (Word 2) and Response Word (Word 3)

Words 0, 1, 2 and 3 are identical to what has been described under the 1 block section above.

A.3.2.1.3. Status Group 1, Status Group 2 or Status Group 3 (Word 4 – Word 6)

The Status Group 1, Status Group 2, and Status Group 3 words can contain specially group bits of status information. The Command Word in the Write Status Block is used by the control system to tell the device what data is desired in these words. Each command used to request status data in these words represents a particular combination (refer to the status block commands in the **Commands** section) of the following status words:

A.3.2.1.4. Status Group 1 Alarms (Default, word 4)

The critical alarm status bits are sent as part of the default status block when a status block command "0" is sent. If the control system does not place any data in the Write Command word, the device will send this data in word 4.

Bit #	RedAlert Alarms
0	n/a
1	Out of A/D range over/under

Bit #	RedAlert Alarms
2	Checksum failure
3	Weight blocked
4	n/a
5	Customer-defined overload
6	Customer-defined underload
7	n/a
8	Zero out of range
9	n/a
10	n/a
11	Weights and measures failure
12	n/a
13	Test mode
14	Open (always 0)
15	Open (always 0)

Bit 0 n/a

Bit 1 **Out of A/D range over/or under:** A "1" state occurs when all bits in the A/D buffer equal "1" or when all the bits in the A/D buffer equal "0". In the product a timer will be necessary to prevent against (meaningless) instantaneous alarm indications

Bit 2 **Checksum Failure:** A checksum analysis of memory does not yield the expected result.

Bit 3 **Weight Blocked:** The weight data does not change appreciably over a defined period of time. The assumption is that all scales have drift and noise from the environment, a non-changing condition would indicate that the scale is not moving as expected because it is either blocked or is not responding to the MCU (under conditions when there are no proactive diagnostics available to discover the root cause).

Bit 4 n/a

Bit 5 **Overload:** The weight is equal to or greater than a "customer-programmed" limit either on the scale or individual sensor's capacity (in a multi-sensor system). Overload is a conditional limit but in many cases can lead to catastrophic errors such as mechanical breakage or personal injury

Bit 6 **Under load:** The weight is under the "customer-programmed" limit on the scale / sensor (under zero but still within A/D range)

Bit 7 n/a

Bit 8 **Zero Out of Range** – A control system, or an operator attempts a zero command and the device does not accept the command because the weight is outside of the specified (setup) limits or the weights and measures limits. This typically occurs when the customer inadvertently attempts to zero the scale when the object being measured has not been removed.

Bit 9 n/a

- Bit 10 **n/a**
- Bit 11 **Weights and Measures failure** – An algorithm in the sensor or scale detects that the product is no longer in compliance with weights and measures regulations
- Bit 12 **n/a**
- Bit 13 **Test Mode** – This bit is set to 1 when the device is in a mode in which live data is replaced with special test data.
- Bits 14-15 Unused at this time (always 0)

A.3.2.1.5. Status Group 2 Alarms (Default, word 5)

These status bits are sent as part of the default status block when a status block command "0" is sent. If the control system does not place any data in the Write Command word, the device will send this data in word 5.

Bit #	Scale Group 2 Status
0	Unit bit 1
1	Unit bit 2
2	Unit bit 3
3	Unit bit 4
4	MinWeigh Error
5	Range bit 1 (always 0)
6	Range bit 2 (always 0)
7	In Set Up
8	Power Up Zero Failure
9	n/a
10	Always 1
11	Open (always 0)
12	Open (always 0)
13	Open (always 0)
14	Open (always 0)
15	Open (always 0)

Bits 0-3 **Unit bits 1-4** are used to indicate the weight unit based on the values shown

Bit 3	Bit 2	Bit 1	Bit 0	Value
0	0	0	0	g
0	0	0	1	kg
0	0	1	0	lb
0	1	1	1	Special/custom

- Bit 4 **MinWeigh Error** is used to indicate when scale is below acceptable minimum weighing range
- Bit 5 & 6 **Range bits 1 & 2** are always 0, because the ACT350 is single range device
- Bit 7 **In Setup:** Used to indicate when scale is in setup mode
- Bit 8 **Power up zero failure:** Used to indicate when scale has not been able to complete its power-up restore/reset of zero
- Bit 9 **n/a**
- Bit 10 **Always 1**
- Bit 11-15 **Unused (always 0)**

A.3.2.1.6. Comparator Status Group 2

The comparator application status bits are sent when a status block command that contains this status word in its combination is sent in the Write Command word. There are two groups of these comparator bits. A total of 5 comparators are supported on the ACT350 and bits 0-4 are assigned within the first group. Bits 5-15 are not supported on the ACT350 within the first group. Bits 0-4 in the second group are not supported on the ACT350.

Bit #	Data
0	Comparator 1
1	Comparator 2
2	Comparator 3
3	Comparator 4
4	Comparator 5
5	n/a
6	n/a
7	n/a
8	n/a
9	n/a
10	n/a
11	n/a
12	n/a
13	n/a
14	n/a
15	n/a

Figure A-19: Comparator Group 1 Status Bits

Bit #	Data
0	n/a
1	n/a
2	n/a
3	n/a
4	Open

Figure A-20: Comparator Group 2 Status Bits

The comparator status bits turn ON for the listed comparator when the assigned comparison logic is true. For example, if a comparator is configured for coincidence with 100 kg, when the weight value is 100 kg the bit would be ON.

A.3.2.1.7. I/O Status Groups (Default, word 6)

There are multiple commands for input and output status words. On ACT350 versions where physical I/O are supported the I/O status groups are used to contain a combination of input and output status bits for I/O. Devices which have no physical I/O can still have variables and logic to virtually represent inputs and outputs within the device. The ACT350 will provide an invalid command response to a command for any unsupported I/O groups. The status bits for group 1 are sent as part of the default status block (in word 6).

Bit #	Data
0	In 1
1	In 2
2	In 3
3	n/a
4	n/a
5	n/a
6	n/a
7	n/a
8	Out 1
9	Out 2
10	Out 3
11	Out 4
12	Out 5
13	n/a
14	n/a
15	n/a

Figure A-21: I/O Group 1 Status Bits

The Input status bits reflect the state of the associated input (ON when ON, OFF when OFF). The output status bits reflect the state of the associated output (ON when ON, OFF when OFF).

A.3.2.1.7.1. Response Word (Word 7)

The Response Word is used to provide feedback on the state of the command issued in the Write Status Block. Like the Floating Point Response Word, this response may be used to indicate that the command failed, it succeeded, or it was seen and the data requested is being sent in the status words of this block.

The structure of this Response Word is identical to the Floating Point Response Word and the Command Word structures. It consists of two sets of bits: bits 11-14 which are used to indicate the channel value and bits 0-10 which are used to indicate the response value. Bit 15 is used to indicate an error condition. It is set to "0" if the device can provide the desired data or comply with the requested command. If it cannot, then this bit is set to a "1" to indicate an error. A full description of the possible error codes are described in **Commands** section.

The channel indicator bits are intended for devices which support multiple sensors or scales, allowing an individual device to support up to a maximum of 16 channels. Single channel (scale or load cell) devices will always use 0000 as their default channel value.

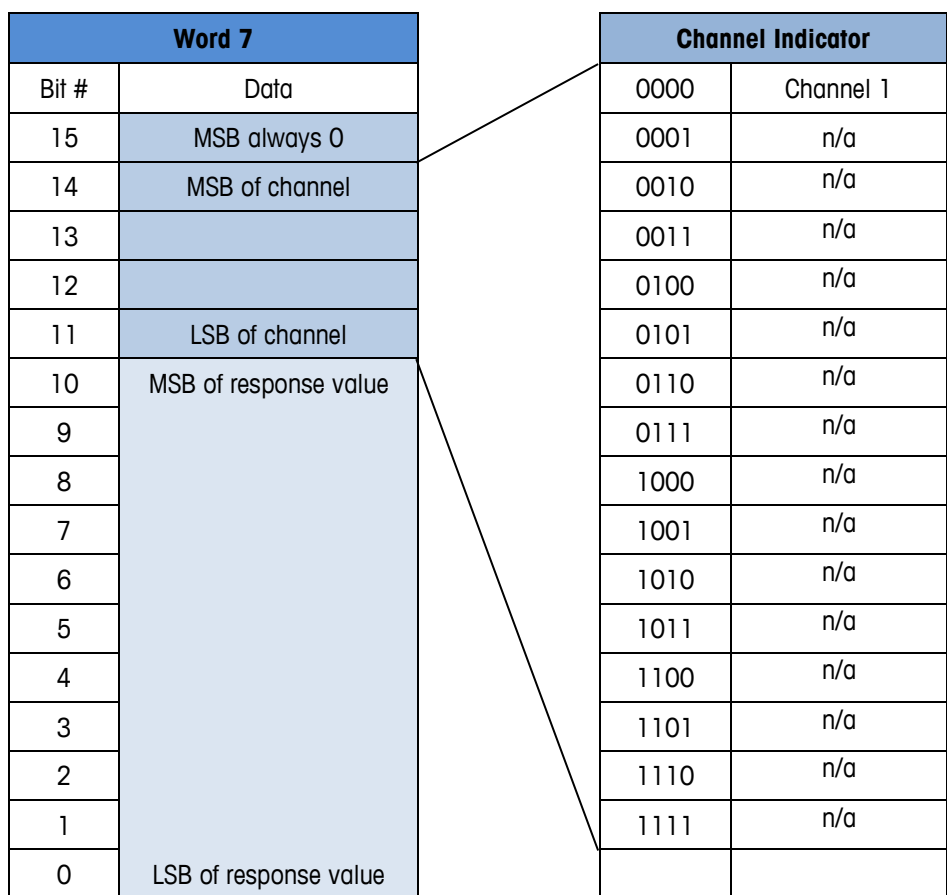


Figure A-22: Status Response Word Layout

The Response bits have values to indicate the current state of the command sent by the control system in its request for data. The structures of the Command Word and Response Word match so

that any command issued in the Write will have the same exact value in the Read response when the device successfully recognizes and completes the command.

Additional details of possible responses are provided in the **Commands** section of this document.

A.3.2.1.8. Control System to Device Operations (Write Data)

The 2 Block Format requires the control system to send two blocks of output data (one floating point and one status) to the device automatically as part of the automation network's update of cyclic data (scan). The structure of the data provided is fixed as shown in Figure A-23.

Floating Point Data (Block 1)	
Word 0	Floating point value – optionally used with command
Word 1	
Word 2	Channel Mask
Word 3	Command Word
Status (Block 2)	
Word 4	Reserved
Word 5	Reserved
Word 6	Reserved
Word 7	Command Word

Figure A-23: 2 Block Format Write

Block 1 contains three parts: 2 words for an optional floating point value (word 0-1), 1 word to provide the ability to send a single command to multiple channels scale via the Channel mask (word 2, always 0000 for ACT350), and 1 command word for the command & channel indicator bits used to identify the data desired by the control system (word 3).

Block 2 contains two parts: 3 reserved words (in order to maintain a 4 word layout similar to all other blocks), and 1 command word for the command & channel indicator bits used to identify the data desired by the control system (word 7). The Status Block Command Word is similar to Floating Point Block Command Word, however one command is used to request the combination of three different status words in the read block.

A.3.2.1.9. Floating Point Value (Block 1, Word 0 & 1), Channel Mask (Block 1, Word 2) and Command Word (Block 1, Word 3)

Words 0, 1, 2 and 3 are identical to what has been described under the 1 Block section earlier.

A.3.2.1.10. Status reserved (Block 2, Word 4-6)

The Write Status Block only needs the Command Word (word 7) to request the data for the Read Status Block. These words have been reserved and should be set to "0".

A.3.2.2. Command Word (Block 2, Word 7)

This Command Word is used to request data for the corresponding Read Status Block. It consists of two sets of bits: bits 11-14 which are used to indicate which channel value and bits 0-10 which

are used to indicate the command value. Bit 15 is always set to 0 to keep the overall value of the word positive when evaluated as an integer.

The channel indicator bits are intended for devices which support multiple sensors or scales, allowing an individual device to support up to a maximum of 16 channels. Single channel (scale or load cell) devices will always use 0000 as their default channel value. These bits indicate which channel the command should be applied to.

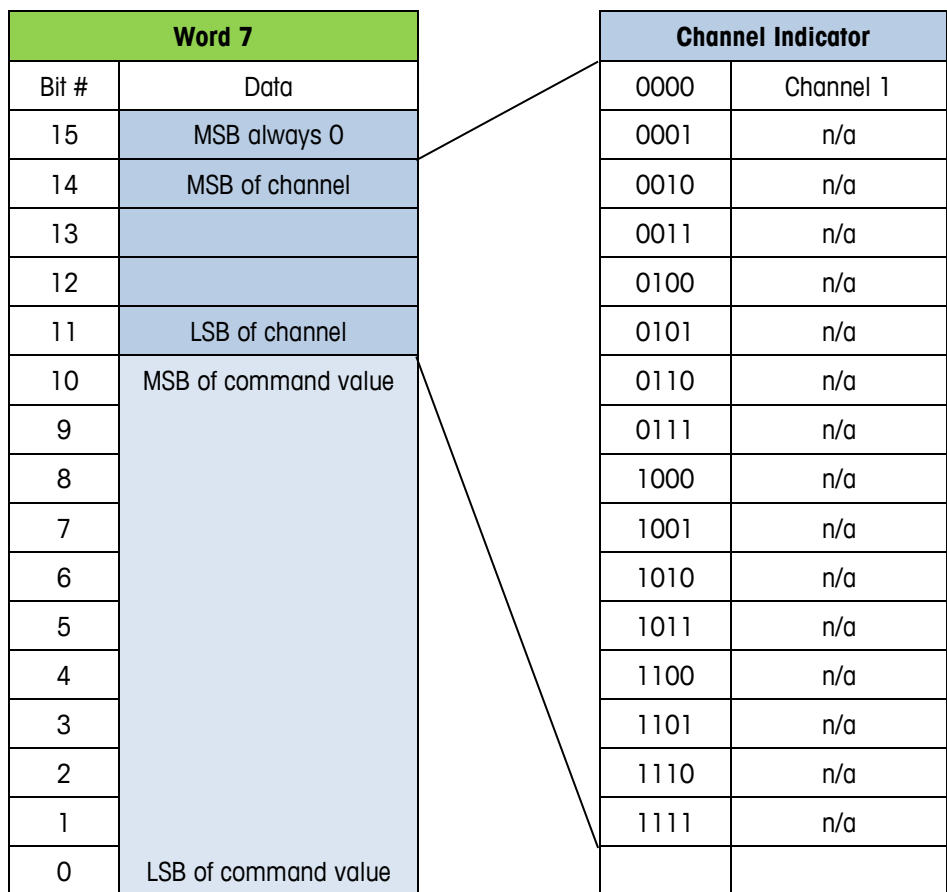


Figure A-24: Command Word Layout

The Command bits 0-10 are used by the control system to select the reported data from the device data in the Status Read Block. Details of available status block commands are provided in the **Commands** section of this document.

Like the Command Word for the Floating Point Block, the value used in the Status Block Command Word is a combination of the command value and the channel value. To calculate the word's complete integer value, the command value should be added to the channel value:

$$\text{Command Word} = \text{Channel Value} + \text{Command Value}$$

By default, if the control system has no data (all "0") in its write block, the device will see this as a command to report its default data for the status block. This is typically RedAlert, Scale Group 2, and I/O Group 1 status data.

A.4. Byte and Word Order of Data

Device data order is configurable as part of the PLC interface setup parameters provided in data format type selection. The default data format selection is "Automatic". With the selection as Automatic, the byte and word order defaults to a known default based on fieldbus type. The data format selection allows selection of Little Endian and Big Endian data format selections. These selections must be made prior to communication operation between the control system and the device. The Byte Swap and Word Swap selections determine the data order expected during the communication exchange.

For example, the device may be sending a 4 byte (2 Word) hex data message to the control system, represented numerically as OA0B0C0D.

A.4.1. Little Endian (Byte Swap = No / Word Swap = No)

4 byte hex value ...	Memory/ register order	Data
OA OB OC OD	n	OD
MSD LSD	n+1	OC
	n+2	OB
	n+3	OA

Word 0	Byte 2 = OC	Byte 1 = OD
Word 1	Byte 4 = OA	Byte 3 = OB

Word 0	Byte 2 = OA	Byte 1 = OB
Word 1	Byte 4 = OC	Byte 3 = OD

A.4.2. Big Endian (Byte Swap = Yes / Word Swap = Yes)

4 byte hex value ...	Memory/ register order	Data
OA OB OC OD	n	OA
MSD LSD	n+1	OB
	n+2	OC
	n+3	OD

Word 0	Byte 2 = OB	Byte 1 = OA
Word 1	Byte 4 = OD	Byte 3 = OC

The default setting for the Byte Swap and Word Swap parameters is automation interface type specific.

SAI Name	Memory Address (A = MSB)				Native Control System	Fieldbus
	M+3	M+2	M+1	M+0		
Little Endian	A	B	C	D	Rockwell	Ethernet/IP
Big Endian	D	C	B	A	Siemens	PROFINET, PROFIBUS

PLC DATA FORMAT

Operating Mode Standard Automation Interface ▼

Format 1 Block ▼

Byte / Word Swap Automatic ▼

Figure A-25: PLC Data Format Options

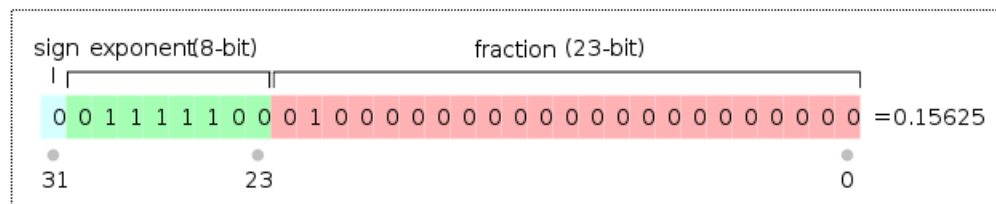
The Byte / Word Swap configuration step is used to support differences in control system hardware. This selection allows the device to switch the order of words and bytes within each word so that it can match the order expected by the control system. There are three possible choices:

- Automatic
- No swap
- Byte & Word swap

The Automatic selection is the default. When Automatic is selected, the byte and word order is determined by two possible methods – first, each fieldbus type has a known default that is used until the test command is sent from the control system and second, a test command can be sent from the control system to put the device into a test state which checks for a specific floating point value and determines the order based on the way the data is received. The current state of the byte order is shown as the Current Order.

A.5. Floating Point Numbers

The floating point numbers exchanged by the Floating Point Blocks follow the IEEE 754 -1985 convention for single precision (32 bit) floating point values.



Word 0	00000000	00000000
Word 1	00111110	00100000

The order of the bytes / words may be affected by the setting of the Byte Swap / Word Swap parameters. Integers (whole numbers) sent through the floating point blocks should always have zeroes to the right of the decimal point location (5.00000, for example).

A.6. Test Mode

If the ACT350 transmitter is put in the automatic byte/word swap mode, a special floating point command can be sent from the control system to test the communications and make sure the byte and word order are set to match what it expects. This special command contains data that is byte and word order independent (the same in every byte).

The control system must place the value 2.76 (0x4030a3d7) in the floating point write value and send 80h in all four bytes of word 2 and word 3:

Word 0	FP value = 2.76	
Word 1		
Word 2	Byte 2 = 80	Byte 1 = 80
Word 3	Byte 4 = 80	Byte 3 = 80

The ACT350 will see the special command and then read the data in the floating point bytes to determine which order the control system is using. Once it determines the order, it changes its configuration to match and should then respond to the command in same order as the command data. The response will include the sent value (2.76) so that the control system can verify that the device is sending data in the expected order.

This test mode can also be used to confirm that the ACT350 is communicating with the control system even when other parts of the ACT350 may not be configured or operational (for example, the scale not yet calibrated). If the ACT350 is not in the automatic mode when the test command is sent, it will use the order specified in its configuration.

The Test Mode bit (13) of the RedAlert status bits will turn on when the ACT350 is in the test mode. In this state, the ACT350 will also accept the other test commands and respond with pre-defined test data instead of normal operational data. For example, when in test mode, the ACT350 will respond with an expected fixed weight value instead of the actual weight so that test scripts can be written against these known values. This also provides methods for the control system to force status bits to a specific state for the same reason.

Until the ACT350 is told to exit test mode or power is cycled on the ACT350, it will remain in test mode (Test Mode = 1) and indicate that data is invalid (Data OK = 0). Once the command to exit test mode is received or the ACT350's power is cycled, it will revert to sending operational data instead of test data. To exit test mode, the control system must send the Exit Test Mode command by sending 88h in both bytes of Word 3. If the Custom Format is used and there is no Floating Point Block, the Test Command can be sent through the Write Status Block. If both block types are present, only one command in one of the blocks is required to place the device in or out of test mode.

Word 3	Byte 2 = 88	Byte 1 = 88
---------------	-------------	-------------

A.6.1. Floating Point Test Commands for "Report" values

If the control system sends a floating point command to report a value when in test mode, the ACT350 will respond with fixed data instead of valid data (it may be unable to provide valid data during the test). A simple formula will be used to calculate what this fixed value should be:

$$5000.11 + \text{Command Value} = \text{Reported data value for command}$$

For example, if the command to report gross weight is sent after the ACT350 is placed in test mode, the ACT350 should provide the proper response value and its floating point value for gross weight should be 5000.11 ($5000.11 + 0 = 5000.11$). If Net weight is requested, the ACT350 should send 5003.11 ($5000.11 + 3 = 5003.11$).

A.6.2. Floating Point Test Commands for Scale Status bits

Special test commands are available to turn on and off the scale status bits provided in the floating point blocks when the ACT350 has been placed in test mode. Refer to the list provided in this document. The responses for these commands will also follow the formula above – if a trigger command of "1" is sent, the response value in the floating point will be "5001.11". If the command value "0" is sent the response value will be "5000.11".

A.6.3. Status Block Test Commands

Special test commands are available to turn on and off the status bits provided in the status blocks when the device has been placed in test mode. A special error response is provided when a test command is sent for status bits that have not been requested. Refer to the list provided in **Commands** section.

A.6.4. Test Variables for Acyclic and Variable Block Test Commands

Acyclic and variable block test commands do not require the ACT350 to be in test mode. To test the acyclic Direct Access Level 1 variables, a reserved index or class/instance/attribute is used for each type of variable (See **Commands** section). Each read variable always returns the same value and does not permit a new value to be written to it. Each write variable expects a specific value to be sent and will return an error state if any other value is sent. No special test command is assigned for Direct Access Level 2 variables.

For Indirect Access and Variable Block tests, two reserved variable names are assigned (refer to the **Commands** section). These variables have no other functional purpose except to respond to test read and test write commands. Each read variable always returns the same value and does not permit a new value to be written to it. Each write variable expects a specific value to be sent and will return an error state if any other value is sent.

A.6.5. Performance Test Commands

The floating point data block provides a special command to permit performance testing of ACT350's data update through the fieldbus interface. This command (1912) switches the device into a special mode to send a timer count at the rate specified by the value in the floating point write (0 = at A/D rate, 1 = at 1 msec rate, n = n msec rate). If the device is generally not capable of providing this data, or of providing data at a particular speed, it will return a response of 'invalid

command.' It is also possible that the device will be unable to reach the desired speed due to other system activity.

Once in this mode, the device will report the updated count value in the floating point read block at the specified rate.

A.7. Asynchronous Format

SAI Asynchronous Format is for one-time read or write data that occurs outside of the normal scan cycle. This is typically used for setup data before the operation "starts" or other special information that is not needed as frequently. Acyclic messaging is typically not used for "real-time" activities and is generally used for non-repetitive or low repetition requests, from a control system; simply stated, the control system sends a request and the device responds to the request.

Asynchronous Format provides **no** cyclic data. However, a device can support this format along with one or more of the cyclic data formats in this specification.

This format uses special message instructions in the control system to immediately execute the command specified within its configuration. These messages and their instructions are control system dependent. Within the configuration of the instruction, several parameters are used to define: 1) the command type, 2) the device variable that the command applies to, and 3) the control system memory space or variable used with the instruction (for write value or read response).

There are two methods of sending/receiving data through acyclic messages: 1) direct access to the variable through a unique name or number defined by the control system's acyclic message block and 2) indirect access through a variable name provided in the data structure of two generic message blocks reserved for this purpose (one for read, one for write). Within the Asynchronous Format, the specification covers two levels of direct access and one level of indirect access. When the Asynchronous Format is supported by a device, it must support Direct Access Level 1. All other methods are optional and not interdependent so a device can choose to provide Direct Level 1 only; Direct Level 1 and Indirect Access, but not Direct Level 2; Direct Level 1 and Level 2 but not Indirect; or all three. Variable names are exclusive within the Direct Access Levels – meaning that a variable in Level 1 will not be renamed in Level 2. However variables available in the Direct Access Levels may also be found in Indirect Access method.

A.7.1.1. Direct Access Level 1

The ACT350 supports the Asynchronous Format via Direct Access Level 1.

This group uses the acyclic parameter access method provided through the automation interface to read and write specific internal variables. Each variable is assigned its own unique parameter; either an index number, or class/instance/attribute which will differ depending on the automation bus type. This group would likely include weight data but not application-specific data; for example, it would not include counting variables like average piece weight or count.

In the Direct Levels, the control system variable's memory space shares a similar structure with the variable block data only since it does not require the words reserved for the command and variable name. Its space is reserved based on the type of data requested and the type of command used:

Word 0	Byte 2	Byte 1
Word 1	Byte 4	Byte 3
Word 2	Byte 6	Byte 5
Word 3	Byte 8	Byte 7
...		
Word n	Byte (2n + 2)	Byte (2n + 1)

Figure A-26: Asynchronous Direct Command / Response

Word 0	Read Length	
Word 1	Variable Group	
Word 2	Variable Subgroup	
Word 3	Variable Item	
Word 4	Byte 2	Byte 1
Word 5	Byte 4	Byte 3
Word 6	Byte 6	Byte 5
Word 7	Byte 8	Byte 7
...		
Word n	Byte (2n + 2)	Byte (2n + 1)

Figure A-27: Asynchronous Direct Command / Response

A.7.2. Control System Parameters for Direct Access

Because control systems use different methods for providing acyclic messages, the parameter used in the message block may also differ and is based on their requirements.

A.7.2.1. Profibus/ProfiNet Acyclic Messages

For most control systems using Profibus or ProfiNet networks, there are two types of commands that can be used to execute acyclic messages: RDREC (SFB52) and WRREC (SFB53). The index and length parameters within these blocks are used to specify what variable (for Direct Access) or what command (for Indirect Access) is required. To read a variable, a combination of RDREC and WRREC commands are used. To write a value to a variable, the WRREC command is used. Index numbers used are interface dependent due to the restrictions of the particular network type.

A.7.2.2. EIP/ControlNet/DeviceNet Acyclic Messages

For control systems using EthernetIP, ControlNet or DeviceNet networks, there are two types of commands that can be used to execute asynchronous messages: CIP Generic Message Instruction for Get Attribute Single ("e") or CIP Generic Message Instruction for Set Attribute Single ("10"). These commands use parameters called class code, instance number, attribute number and length to be configured in the message block in order to specify what variable (for Direct Access) or what command (for Indirect Access) is required.

B Cyclic Commands

This appendix covers

- Floating Point Block Commands
- Status Block Commands
- Other Responses
- Commands

The commands available for the control system to use in Write blocks are grouped according to block type and command type. All commands are considered "one-shot" – meaning that the command is only triggered once even if it remains in the command word for multiple scans until another command is sent. In order to permit a command to be issued a second time, a no-op command is provided.

No more than one command per block is permitted (the only exception is a cancel operation command to abort the previously sent command). All other commands to this block will be ignored until its active command is completed (either successfully or not). Specifically additional commands sent before completion are not "stored" to be acted upon completion of the prior command. When multiple block commands are sent, the order of completion should be lowest word block to highest and it will be the control system's responsibility to make sure command conflicts do not exist when multiple blocks are assigned to the same channel.

All responses to commands for the cyclic data blocks are provided in the same manner – through the response word value. During the process of receiving and executing the operation required for a command, the device will follow a defined sequence, as shown in Figure B-1.

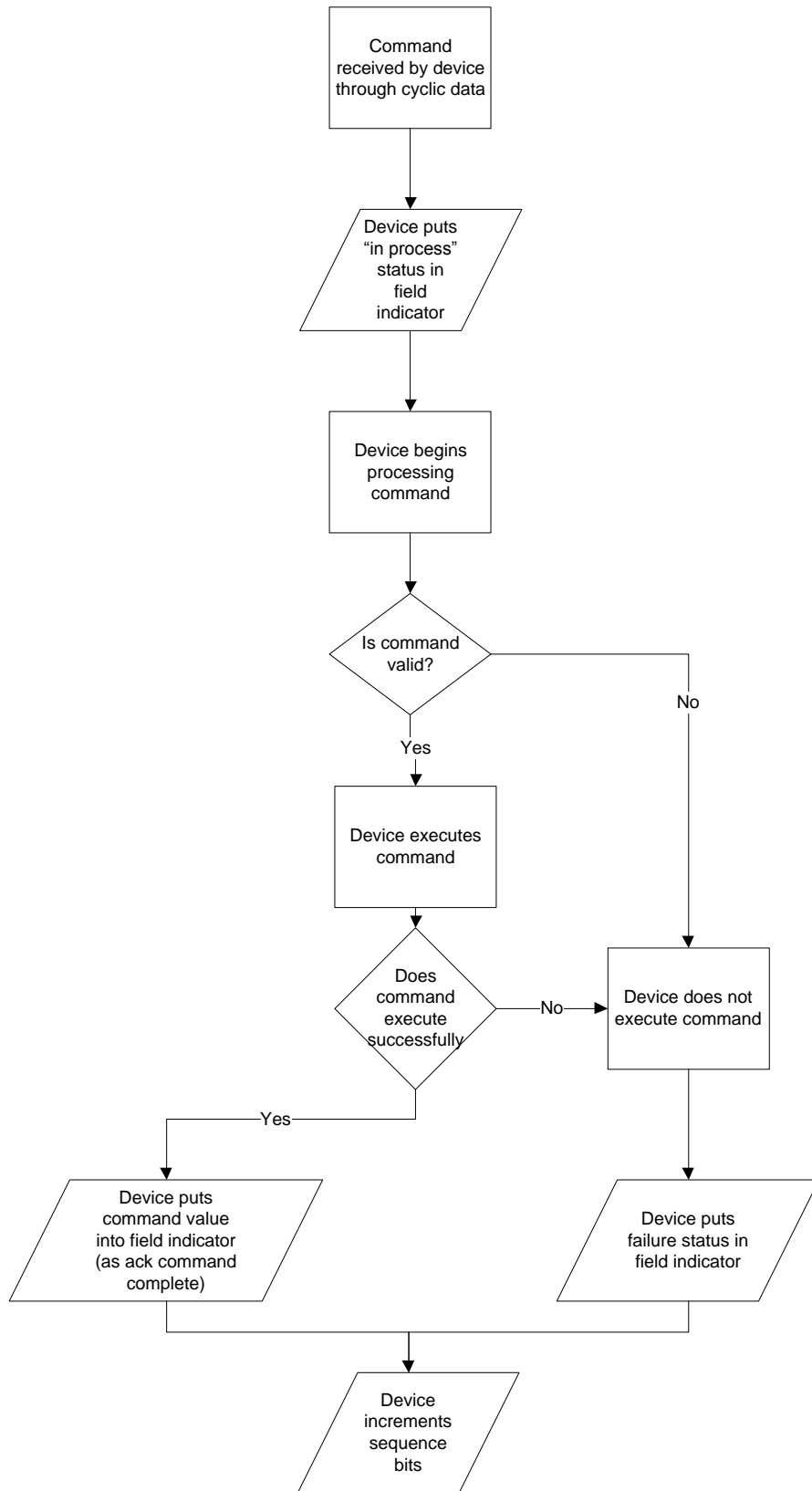


Figure B-1: Receiving and Executing a Command

If a command is aborted, it will follow the sequence shown in Figure B-2.

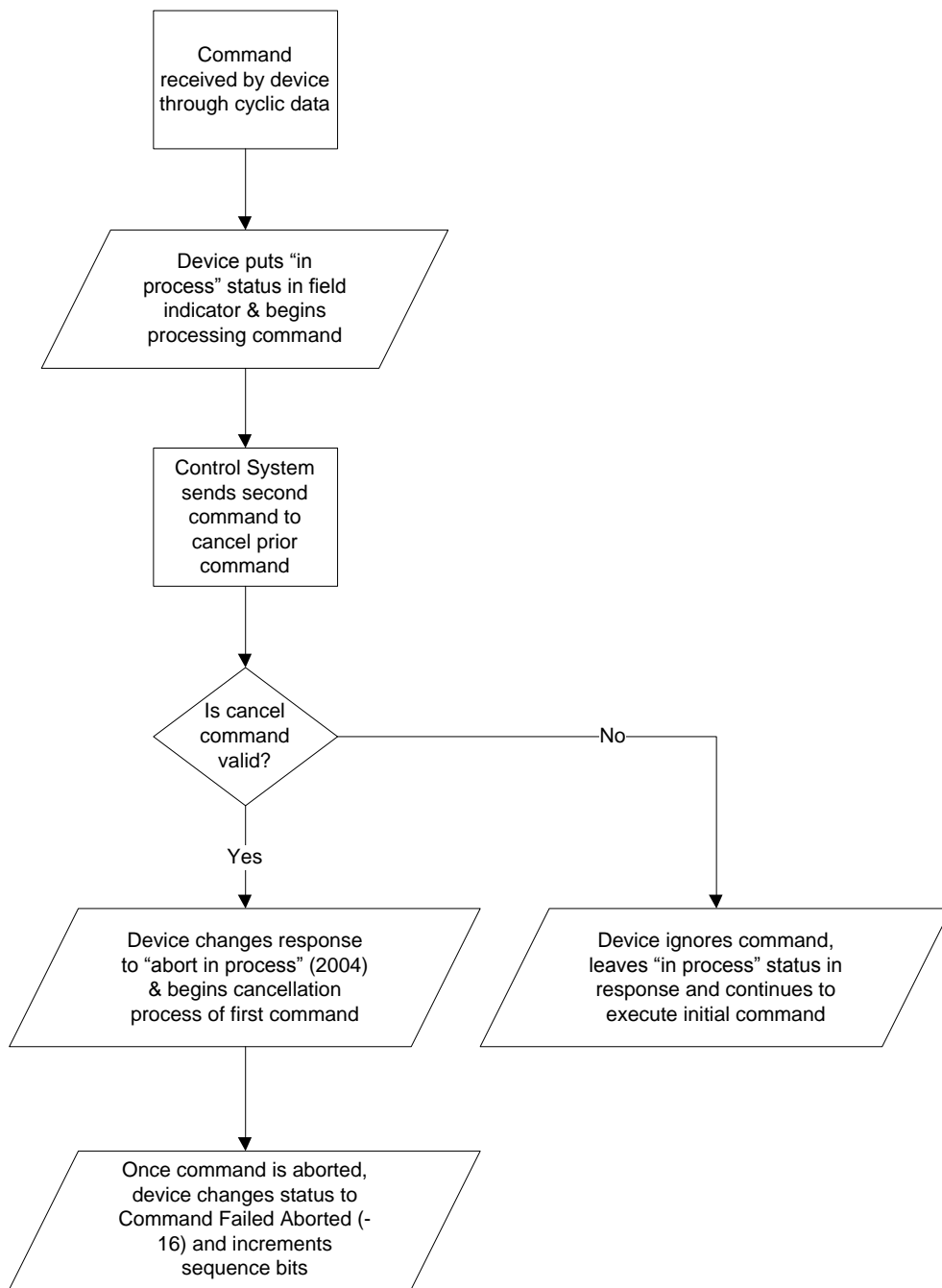


Figure B-2: Aborted Command Sequence

For multi-step commands, special commands are used to advance to the next step, to retry a failed step, or to abort the entire process. There are also corresponding status values to indicate when the device is ready to execute the next step or when the step has failed.

During a stepped procedure, the commands follow the procedure shown in Figure B-3.

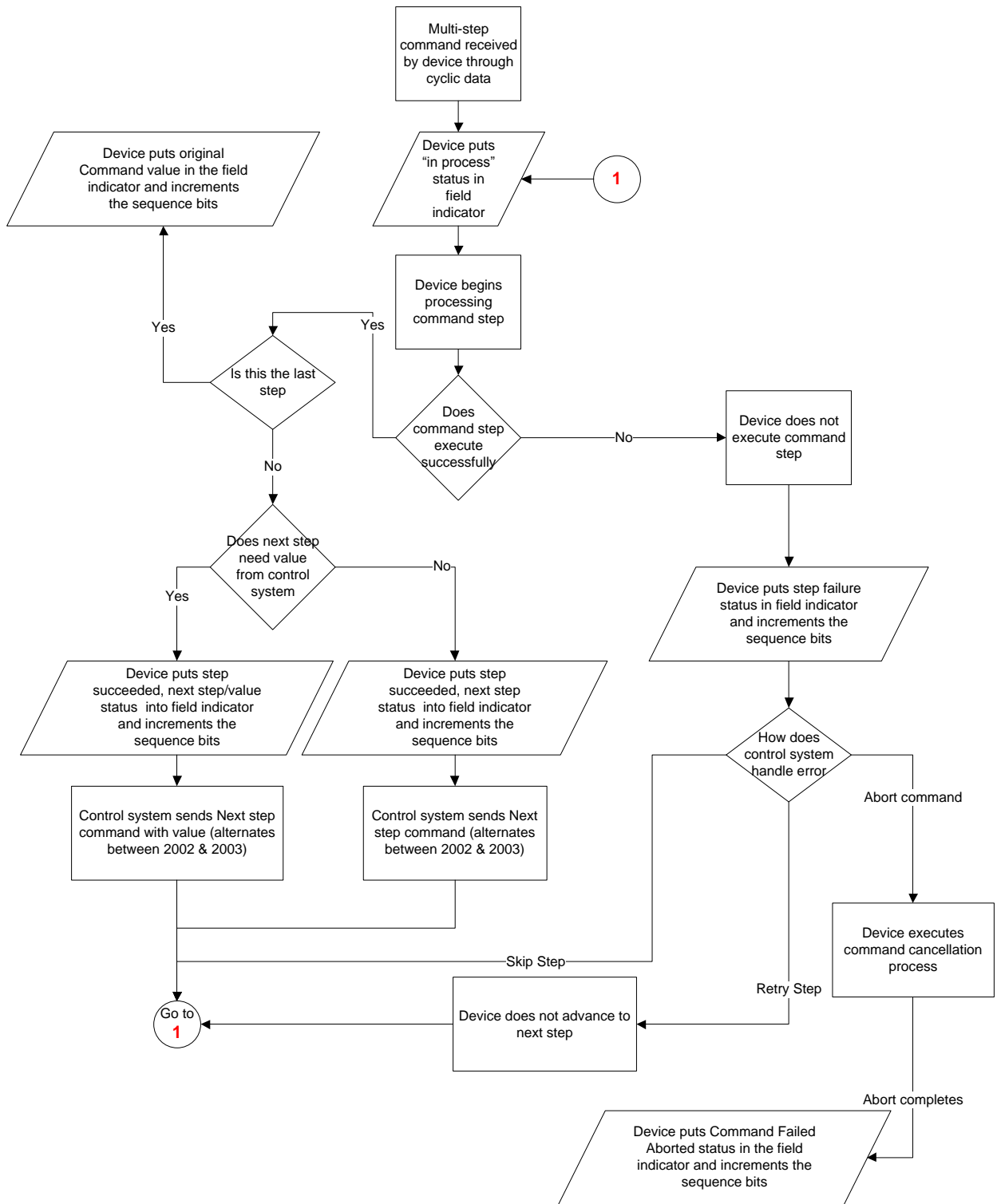


Figure B-3: Stepped Command Procedure

B.1. Floating Point Block Commands

There are five types of floating point commands: report, write (immediate), write (sequence), operation (immediate), or operation (sequence). Each type is based on the command use and the expected response from the device. Refer to the **Commands** section for the full list of possible commands.

B.1.1. Floating Point Report Commands

Floating Point Report Commands are used to request the data that is sent by the device in its read floating point block. These commands are used to get continuously updated data for information such as gross weight, net weight, raw weight, rate, or other application numeric data values that are time critical.

Command	Description	Value
Report Default value	Reports Gross weight data in displayed resolution	0
Report Rounded Tare Weight	Tare weight data in displayed resolution	2
Report Rounded Net Weight	Net weight data in displayed resolution	3

B.1.1.1. Valid Command Response

When a valid floating point report command is received, the ACT350 does the following:

1. Places the "in process" response in the field indicator value and begins processing the command...
2. Reports the requested data in the floating point words of the floating block
3. Updates the Response word to indicate what data is present in the floating point value. This should match what the command & channel value were in the command request of the write block.
4. Increments and updates the sequence bits in the status word.
5. Continues to update the floating point value and status bits until another command is received.

The Timeout and Invalid command data responses should not occur in report commands (no data should be sent with command and any provided should be ignored).

B.1.2. Floating Point Write Commands

Floating Point Write Commands are used to write a value provided by the floating point write block to some device function. These commands are used to set common process values such as tare, target, tolerance, or other application numeric data values that can be user-specified during operation. These commands may or may not execute immediately so the in process response may be seen by the control system in the cyclic data before the command completes.

Command	Description	Value
Write Preset Tare Weight	Sets Preset Tare to Value provided	201
Write Comparator 1 Limit	Sets comparator 1 limit to value provided	240

Command	Description	Value
Write Filter Mode	Sets filter to value provided	290

B.1.2.1. Valid Command Response

When a valid floating point write command is received, the ACT350 does the following:

1. Places the "in process" response in the field indicator value and begins processing the command...
2. Loads the supplied value into the ACT350's internal variable. Reports the value stored in the floating point words of the floating block.
3. Updates the Response word to indicate what command was received. This should match what the command & channel value were in the command request of the write block.
4. Increment and update the sequence bits in the status word.

The Timeout command data response should not occur in write commands.

B.1.3. Floating Point Operation Commands

Floating Point Operation Commands are used to trigger an operation. These commands may or may not require a sequence of responses. Simple operations may execute immediately and require no additional sequence steps. More complex operations may take multiple steps to execute and require additional commands from the control system to continue through the entire process.

Command	Description	Value
Tare	Tare when stable	400
Zero	Zero when stable	401
Clear Tare	Clear tare	402

B.1.3.1. Valid Command Response

When a valid floating point operation command is received, the ACT350 does the following:

1. Places the "in process" response in the field indicator value and begins processing the command...
2. Triggers the operational function requested by the command.
3. Wait for the response from the ACT350, if the process takes multiple steps, report "step complete" when current step is finished successfully. Report "step failed" when current step is unsuccessful. Wait for Continue or Abort command from control system to start next step. Repeat as many times as required. If the process is complete, continue to step 4.
4. Updates the Response word to indicate what command was received. This should match what the command & channel value were in the command request of the write block.
5. Increments and updates the sequence bits in the status word.

B.2.

B.3. Status Block Commands

Status block commands are only report type. They are used to request the data that is sent by the ACT350 in its Status blocks. These commands are used to get continuously updated status data for scale, target, or physical discrete input/output information. See **Commands** section for the full list of possible commands.

Command	Description	Value
Report Default Status	RedAlert Alarm, I/O Group 1, and Scale Group 2 status bits	0
Report I/O mix 1	I/O group 2, I/O group 3, I/O group 4	9

B.3.1. Valid Command Response

When a valid Status report command is received, the ACT350 does the following:

1. Places the "in process" response in the field indicator value and begins processing the command...
2. Reports the requested data in the status group word of the Status block
3. Updates the Response word to indicate what data is present in the status group word. This should match what the command & channel value were in the command request of the write block.
4. Continues to update the status bits until another command is received.

The Timeout and Invalid command data responses should not occur in report commands.

B.4. Other Responses

In addition to the valid response, there may be other possible responses:

B.4.1. Invalid Command Response

An invalid command response is sent when the ACT350 determines that the command is known but cannot be executed. This might occur due state restrictions – for example attempting to zero when the scale is outside of acceptable zero range. When an invalid command is received, the ACT350 does the following:

1. Places the "in process" response in the field indicator value and begins processing the command...
1. Updates the Response word to indicate invalid command (Bit 15 = 1, error value = 1)
2. Increments and updates the sequence bits in the status word.

B.4.2. Unknown Command Response

An unknown command response is sent when the ACT350 does not support this information (for example requesting rate values from ACT350). When an unsupported command is received, the ACT350 does the following:

1. Places the "in process" response in the field indicator value and begins processing the command...
2. Updates the Response word to indicate unsupported command (Bit 15 = 1, error value = 4)
3. Increments and updates the sequence bits in the status word.

B.4.3. Invalid Command data Response

An invalid command data response is sent when a valid write command is received with an invalid value (for example one that is smaller or larger than the allowed value). When invalid command data is received, the ACT350 does the following:

1. Places the "in process" response in the field indicator value and begins processing the command...
2. Updates the Response word to indicate invalid command value (Bit 15 = 1, error value = 8)
3. Increments and updates the sequence bits in the status word.

B.4.4. Timeout Command Response

A timeout command response is sent when the valid command that is received by the ACT350 is unable to execute within a pre-determined time. This might occur for commands that require no motion or stable weight before execution, for example. When the command timeout occurs, the ACT350 does the following:

1. Places the "in process" response in the field indicator value and begin processing the command...
2. Updates the Response word to indicate command timeout failure value (Bit 15 = 1, error value = 2)
3. Increments and updates the sequence bits in the status word.

If the control system chooses to abort the previous command, it can issue a special command to cancel operation of this previous command as long as its status is in process or during any step of a multiple step sequence. After the cancel command is acknowledged through the use of its value as an abort in process response, ACT350 will provide a response to indicate the initial command has been aborted.

B.4.5. Aborted Command Response

A command failed - aborted response is sent once a second command to cancel the prior command has been received and processed. This can only occur if the original command 1) permits cancellation, 2) has not already completed successfully, and 3) has already failed. When the command abort occurs, the ACT350 does the following:

1. Places the "abort in process" response (2004) in the field indicator value and begin processing the command...
2. Updates the Response word to indicate command abort failure value (Bit 15 = 1, error value = 16)
3. Increments and updates the sequence bits in the status word.

Refer to **Commands** section for a flow chart of the abort process.

B.4.6. Step Successful Command Response

A step successful command response is sent when ACT350 determines that the command's current step has been successfully executed and requires acknowledgement to start the next step in the process. When a previous step completes and the next step in the sequence must be "started", the ACT350 does the following:

1. Places the "in process" response in the field indicator value and begins processing the command...
2. Updates the Response word to indicate step successful when ready to execute next step (value = 2046)
3. Increments and updates the sequence bits in the status word.

The control system should send one of the next step commands to continue with the next step in the process.

B.4.7. Step Successful / Next Value Command Response

A step successful / next value command response is sent when ACT350 determines that the command's current step has been successfully executed and requires the next value and acknowledgement to start the next step in the process. When a previous step completes and the next step in the sequence requires another value to execute the next step in the process, the ACT350 does the following:

1. Places the "in process" response in the field indicator value and begin processing the command...
2. Updates the Response word to indicate step successful and next value is needed when ready to execute next step (value = 2045)
3. Increments and updates the sequence bits in the status word.

The control system should send one of the next step commands with the required value in the floating point words to continue with the next step in the process.

B.4.8. Step Failed Command Response

A step failed command response is sent when ACT350 determines that the command's current step has failed. Once the current step executes and fails, the ACT350 does the following:

1. Places the "in process" response in the field indicator value and begin processing the command...
2. Updates the Response word to indicate step failed (Bit 15 = 1, error value = 32)

3. Increments and updates the sequence bits in the status word.

At this point the control system will need to decide whether to abort the sequence (command = 2004), to retry the step (command = 2005), or to skip this step (command = 2006) and try to perform the next step. Not all processes will allow all three of these options – those not permitted will have an invalid command response when the next step command is sent.

B.5. Commands

B.5.1. Special Commands

For all block types, there are some reserved commands used for unique status or command sequencing.

Command	Description	Value
Test Command	Used to determine communication works and byte/word order & enter test mode	FP = 2.76 Mask = 80h, 80h Cmd = 80h, 80h Bit 15 = 1 + ... 2185 for both words
Exit Test Mode	Used to return to normal operation	FP & Mask = 0 Cmd = 88h, 88h Bit 15 = 1 + ... 6553
Response only	These are used to indicate failed command status through the floating point field ... each of these responses turns on bit 15 and the bit value shown in ()	Bit 15 = 1 + ...
Response only	Command Failed Invalid	(1)
Response only	Command Failed Timeout	(2)
Response only	Command Failed Unknown	(4)
Response only	Command Failed Value Invalid	(8)
Response only	Command Failed Aborted	(16)
Response only	Command Step Failed	(32)
Response only	Test Command Failed	(64)

B.5.2. General System Commands

Command	Description	Value
Response only	Command has been received and is being evaluated (in process)	2047
Response only	Step Successful	2046
Response only	Step Successful, Next Value	2045

Command	Description	Value
NOOP 1	No operation command – used to test command response, clear prior command, etc.	2000
Next step 1	Continue to next step in sequence	2002
Next step 2	Continue to next step in sequence	2003
Cancel operation	Abort sequence ... response value means abort in process	2004
Retry Step	After step failure, retries previous step in sequence	2005
Skip Step	After step failure, skips step and advances to next in sequence	2006

B.5.3. Floating Point block Commands

B.5.3.1. Weight Report Commands

Command	Description	Value
Report Default Data	For ACT350 this is the Gross weight data in displayed resolution	0
Report Rounded Gross Weight	Gross Weight data in displayed resolution	1
Report Rounded Tare Weight	Tare weight data in displayed resolution	2
Report Rounded Net Weight	Net weight data in displayed resolution	3
Report Rounded Rate	Rate (change in gross weight over time) in displayed resolution	4
Report Gross Weight	Gross weight data in internal resolution	5
Report Tare Weight	Tare weight data in internal resolution	6
Report Net Weight	Net weight data in internal resolution	7

B.5.3.2. Comparator Report Commands

Command	Description	Value
Report Comparator 1 Limit		40
Report Comparator 2 Limit		42
Report Comparator 3 Limit		44
Report Comparator 4 Limit		46
Report Comparator 5 Limit		48

B.5.3.3. Miscellaneous Report Command

Command	Description	Value
Report Last Error Code		100

B.5.3.4. Weight Write Immediate Commands

Command	Description	Value
Write Preset Tare Weight	Sets Preset Tare to Value provided	201

B.5.3.5. Comparator Write Immediate Commands

Command	Description	Value
Write Comparator 1 Limit		240
Write Comparator 2 Limit		242
Write Comparator 3 Limit		244
Write Comparator 4 Limit		246
Write Comparator 5 Limit		248

B.5.3.6. Weight Operation Immediate Commands

Command	Description	Value
Tare	Tare when stable	400
Zero	Zero when stable	401
Clear Tare	Clear tare	402

B.5.3.7. Floating Point Status Bit Test Commands

Command	Description	Value
Alarm Bit	Turn on or off bit in scale status word when in test mode	1900
Motion Bit	...	1901
Net Mode bit	FP = 1 to set ON or FP = 0 to set OFF	1902
Center of zero bit		1903
Alt weight bit		1904
Device bit 1		1905
Device bit 2		1906
Device bit 3		1907
Device bit 4		1908
Device bit 5		1909
Device bit 6		1910
Device bit 7		1911

B.5.4. Status/Command block Commands

Status/Command block commands are unique to this block type and not ALL block types. So for example, a command value of 0 in the status/command block will report the default status words (RedAlert, I/O Group 1, Scale Group 2 Status bits).

B.5.4.1.**Status Commands**

Command	Description	Value
Report Default Status words	Default status words (see below)	0
Report RedAlert Alarm, Scale Group 2, I/O group 1	RedAlert Alarm, Scale group 2, I/O group 1	1
Report Target / Comparator Status	Target 1, Comparator group 1, Comparator group 2	2
Report Comparator mix 1	Comparator group 1, comparator group 2, I/O group 1	16
Report Alarms & Scale Group 2	RedAlert Alarm, Alarm, Scale Group2	21

The default for ACT350 is the same as command 1.

C Acyclic Commands

C.1. ACT350 Level 1 Variable List

This appendix covers

- ACT350 Level 1 Variable List
- ACT350 Level 2 Variable List

C.1.1. PROFIBUS

Command	Description	Read/Write	Data Type	PROFIBUS Slot (hex)	PROFIBUS Index (hex)
Default	Gross weight data in defined resolution	Read	Float, 4	1	14
Report Rounded Gross Weight	Gross weight data in defined resolution	Read	Float, 4	1	15
Report Rounded Tare Weight	Tare weight data in defined resolution	Read	Float, 4	1	16
Report Rounded Net Weight	Net weight data in defined resolution	Read	Float, 4	1	17
Report Unrounded Gross Weight	Gross weight data in internal resolution	Read	Float, 4	1	18
Report Unrounded Tare Weight	Tare weight data in internal resolution	Read	Float, 4	1	19
Report Unrounded Net Weight	Net weight data in internal resolution	Read	Float, 4	1	1A
Write Tare Register (Preset Tare)	Example after power fail restart (read is handled through tare weight variable above)	Write	Float, 4	1	1B
Tare Command	T command of CPTZ	Write	Byte, 1	1	1C
Clear Tare Command	C command of CPTZ	Write	Byte, 1	1	1D
Zero Command	Z command of CPTZ (executed with motion check)	Write	Byte, 1	1	22
Report Zero Operation Status	Example after power fail restart	Read	Short, 2	1	24
Turn All Outputs OFF	Forces all outputs OFF	Write	Float, 4	1	26
Alarm Status Group	Report alarm status group	Read	Short, 2	1	28

Command	Description	Read/Write	Data Type	PROFIBUS Slot (hex)	PROFIBUS Index (hex)
ReadAlert Status Group	Report RedAlert status	Read	Short, 2	1	29
Scale Status Group 2	Scale status group	Read	Short, 2	1	2A
Report Scale Status Group 1	Reports scale status bits (group 1)	Read	Short, 2	1	27
Report Tare Operation Status	Report Tare operation status	Read	Short, 2	1	1F
Report ID1	Device identification information #1	Read	Byte, 21	1	2B
Report ID2	Device identification information #2	Read	Byte, 21	1	2C
Report ID3	Device identification information #3	Read	Byte, 21	1	2D
Report Software version	Device software OS version	Read	Byte, 21	1	2E
Report Fieldbus version	Device fieldbus stack version	Read	Byte, 21	1	2F
Report SAI version	Device supported SAI version	Read	Byte, 21	1	31
Read Floating Point	Test floating point variable – always reads 123.45 – no write permitted	Read	Float, 4	1	A
Write Floating Point	Test floating point variable – no usage in device except for test	Write	Float, 4	1	B
Read Integer	Test integer variable – always reads 9876	Read	Short, 2	1	C
Write Integer	Test integer variable – no usage in device except for test	Write	Short, 2	1	D
Read String	Test string variable – always read "ABCD"	Read	Byte, 21	1	E
Write String	Test string variable – no usage in device except for test	Write	Byte, 21	1	F
Read Long	Test long integer variable – always reads 98765	Read	Int, 4	1	10
Write Long	Test long integer variable – no usage in device except for test	Write	Int, 4	1	11
Read Byte	Test byte variable – always reads 56h	Read	Byte, 1	1	12
Write Byte	Test byte variable – no usage in device except for test	Write	Byte, 1	1	13

C.1.2. Ethernet/IP

Command	Description	Read/Write	Data Type	EIP Class Code	EIP Instance Values	EIP Attribute #
Default	Gross weight data in defined resolution	Read	Float, 4	300	01	01
Report Rounded Gross Weight	Gross weight data in defined resolution	Read	Float, 4	300	01	02
Report Rounded Tare Weight	Tare weight data in defined resolution	Read	Float, 4	300	01	03
Report Rounded Net Weight	Net weight data in defined resolution	Read	Float, 4	300	01	04
Report Unrounded Gross Weight	Gross weight data in internal resolution	Read	Float, 4	300	01	05
Report Unrounded Tare Weight	Tare weight data in internal resolution	Read	Float, 4	300	01	06
Report Unrounded Net Weight	Net weight data in internal resolution	Read	Float, 4	300	01	07
Write Tare Register (Preset Tare)	Example after power fail restart (read is handled through tare weight variable above)	Write	Float, 4	300	01	08
Tare Command	T command of CPTZ	Write	Byte, 1	300	01	09
Clear Tare Command	C command of CPTZ	Write	Byte, 1	300	01	11
Zero Command	Z command of CPTZ (executed with motion check)	Write	Byte, 1	300	01	14
Report Zero Operation Status	Example after power fail restart	Read	Short, 2	300	01	17
Turn All Outputs OFF	Forces all outputs OFF	Write	Float, 4	301	01	02
Alarm Status Group	Report alarm status group	Read	Short, 2	302	01	02
RedAlert Status Group	Report RedAlert status	Read	Short, 2	302	01	03
Scale Status Group 2	Scale status group	Read	Short, 2	302	01	04
Report Scale Status Group 1	Reports scale status bits (group 1)	Read	Short, 2	302	01	1
Report Tare Operation Status	Report Tare operation status	Read	Short, 2	300	01	16
Report ID1	Device identification information #1	Read	Byte, 21	303	1	1
Report ID2	Device identification information #2	Read	Byte, 21	303	1	2
Report ID3	Device identification information #3	Read	Byte, 21	303	1	3

Command	Description	Read/Write	Data Type	EIP Class Code	EIP Instance Values	EIP Attribute #
Report Software version	Device software OS version	Read	Byte, 21	303	1	4
Report Fieldbus version	Device fieldbus stack version	Read	Byte, 21	303	1	5
Report SAI version	Device supported SAI version	Read	Byte, 21	303	1	7
Read Floating Point	Test floating point variable – always reads 123.45 – no write permitted	Read	Float, 4	30F	01	01
Write Floating Point	Test floating point variable – no usage in device except for test	Write	Float, 4	30F	01	02
Read Integer	Test integer variable – always reads 9876	Read	Short, 2	30F	01	03
Write Integer	Test integer variable – no usage in device except for test	Write	Short, 2	30F	01	04
Read String	Test string variable – always read "ABCD"	Read	Byte, 21	30F	01	05
Write String	Test string variable – no usage in device except for test	Write	Byte, 21	30F	01	06
Read Long	Test long integer variable – always reads 98765	Read	Int, 4	30F	01	07
Write Long	Test long integer variable – no usage in device except for test	Write	Int, 4	30F	01	08
Read Byte	Test byte variable – always reads 56h	Read	Byte, 1	30F	01	09
Write Byte	Test byte variable – no usage in device except for test	Write	Byte, 1	30F	01	10

C.1.3. PROFINET

Command	Description	Read/Write	Data Type	PROFINET Slot + Sub Slot	PROFINET Index Value
Default	Gross weight data in defined resolution	Read	Float, 4	1, 1	2000
Report Rounded Gross Weight	Gross weight data in defined resolution	Read	Float, 4	1, 1	2001
Report Rounded Tare Weight	Tare weight data in defined resolution	Read	Float, 4	1, 1	2002
Report Rounded Net Weight	Net weight data in defined resolution	Read	Float, 4	1, 1	2003
Report Unrounded Gross Weight	Gross weight data in internal resolution	Read	Float, 4	1, 1	2004

Command	Description	Read/Write	Data Type	PROFINET Slot + Sub Slot	PROFINET Index Value
Report Unrounded Tare Weight	Tare weight data in internal resolution	Read	Float, 4	1, 1	2005
Report Unrounded Net Weight	Net weight data in internal resolution	Read	Float, 4	1, 1	2006
Write Tare Register (Preset Tare)	Example after power fail restart (read is handled through tare weight variable above)	Write	Float, 4	1, 1	2020
Tare Command	T command of CPTZ	Write	Byte, 1	1, 1	2010
Clear Tare Command	C command of CPTZ	Write	Byte, 1	1, 1	2012
Zero Command	Z command of CPTZ (executed with motion check)	Write	Byte, 1	1, 1	2013
Report Zero Operation Status	Example after power fail restart	Read	Short, 2	1, 1	2009
Turn All Outputs OFF	Forces all outputs OFF	Write	Float, 4	1, 1	2031
Alarm Status Group	Report alarm status group	Read	Short, 2	1, 1	2041
RedAlert Status Group	Report RedAlert status	Read	Short, 2	1, 1	2042
Scale Status Group 2	Scale status group	Read	Short, 2	1, 1	2043
Report Scale Status Group 1	Reports scale status bits (group 1)	Read	Short, 2	1, 1	2040
Report Tare Operation Status	Report Tare operation status	Read	Short, 2	1, 1	2008
Report ID1	Device identification information #1	Read	Byte, 21	1	2050
Report ID2	Device identification information #2	Read	Byte, 21	1	2051
Report ID3	Device identification information #3	Read	Byte, 21	1	2052
Report Software version	Device software OS version	Read	Byte, 21	1	2053
Report Fieldbus version	Device fieldbus stack version	Read	Byte, 21	1	2054
Report SAI version	Device supported SAI version	Read	Byte, 21	1	2056
Read Floating Point	Test floating point variable – always reads 123.45 – no write permitted	Read	Float, 4	1, 1	5000
Write Floating Point	Test floating point variable – no usage in device except for test	Write	Float, 4	1, 1	5001
Read Integer	Test integer variable – always reads 9876	Read	Short, 2	1, 1	5002
Write Integer	Test integer variable – no usage in device except for test	Write	Short, 2	1, 1	5003
Read String	Test string variable – always read "ABCD"	Read	Byte, 21	1, 1	5004
Write String	Test string variable – no usage in device except for test	Write	Byte, 21	1, 1	5005

Command	Description	Read/Write	Data Type	PROFINET Slot + Sub Slot	PROFINET Index Value
Read Long	Test long integer variable – always reads 98765	Read	Int, 4	1, 1	5006
Write Long	Test long integer variable – no usage in device except for test	Write	Int, 4	1, 1	5007
Read Byte	Test byte variable – always reads 56h	Read	Byte, 1	1, 1	5008
Write Byte	Test byte variable – no usage in device except for test	Write	Byte, 1	1, 1	5009

C.2. ACT350 Level 2 Variable List

C.2.1. PROFIBUS

Command	Description	Read/Write	Data type	PROFIBUS Slot	PROFIBUS Index
Report Comparator 1 limit	Read value for comparator #1	Read	Float, 4	2	0x04
Write Comparator 1 limit	Write value for comparator #1	Write	Float, 4		
Report Comparator 2 limit	Read value for comparator #2	Read	Float, 4	2	0x05
Write Comparator 2 limit	Write value for comparator #2	Write	Float, 4		
Report Comparator 3 limit	Read value for comparator #3	Read	Float, 4	2	0x06
Write Comparator 3 limit	Write value for comparator #3	Write	Float, 4		
Report Comparator 4 limit	Read value for comparator #4	Read	Float, 4	2	0x07
Write Comparator 4 limit	Write value for comparator #4	Write	Float, 4		
Report Comparator 5 limit	Read value for comparator #5	Read	Float, 4	2	0x08
Write Comparator 5 limit	Write value for comparator #5	Write	Float, 4		
Report # of Comparators used	Read how many comparators used	Read	Byte, 1	2	0x03
Write # of Comparators used	Write how many comparators used	Write	Byte, 1		
Apply Parameters	Apply parameters, reinitialize	Write	Byte, 1	2	0x1E
Comparator Status Group 1	Comparator Status Group 1	Read	Short, 2	1	D0
Display – Energy Saving Mode	Time value for the display to turn off	Read/Write	Float, 4	1	78

C.2.2. Ethernet/IP

Command	Description	Read/Write	Data type	EIP Class Code	EIP Instance Values	EIP Attribute #
Report Comparator 1 limit	Read value for comparator #1	Read	Float, 4	0x411	1	0x05
Write Comparator 1 limit	Write value for comparator #1	Write	Float, 4			
Report Comparator 2 limit	Read value for comparator #2	Read	Float, 4	0x411	1	0x06
Write Comparator 2 limit	Write value for comparator #2	Write	Float, 4			
Report Comparator 3 limit	Read value for comparator #3	Read	Float, 4	0x411	1	0x07
Write Comparator 3 limit	Write value for comparator #3	Write	Float, 4			
Report Comparator 4 limit	Read value for comparator #4	Read	Float, 4	0x411	1	0x08
Write Comparator 4 limit	Write value for comparator #4	Write	Float, 4			
Report Comparator 5 limit	Read value for comparator #5	Read	Float, 4	0x411	1	0x09
Write Comparator 5 limit	Write value for comparator #5	Write	Float, 4			
Report # of Comparators used	Read how many comparators used	Read	Byte, 1	0x411	1	0x04
Write # of Comparators used	Write how many comparators used	Write	Byte, 1			
Apply Parameters	Apply parameters, reinitialize	Write	Byte, 1	0x411	1	0x1F
Comparator Status Group 1	Comparator Status Group 1	Read	Short, 2	0x411	1	0x01
Display Energy Saving Mode	Time value for the display to turn off	Read/Write	Float, 4	0x416	1	0x09

C.2.3. PROFINET

Command	Description	Read/Write	Data type	PROFINET Slot + Sub Slot	PROFINET Index Value
Report Comparator 1 limit	Read value for comparator #1	Read	Float, 4	1, 1	0x4055
Write Comparator 1 limit	Write value for comparator #1	Write	Float, 4		
Report Comparator 2 limit	Read value for comparator #2	Read	Float, 4	1, 1	0x4056
Write Comparator 2 limit	Write value for comparator #2	Write	Float, 4		
Report Comparator 3 limit	Read value for comparator #3	Read	Float, 4	1, 1	0x4057
Write Comparator 3 limit	Write value for comparator #3	Write	Float, 4		
Report Comparator 4 limit	Read value for comparator #4	Read	Float, 4	1, 1	0x4058
Write Comparator 4 limit	Write value for comparator #4	Write	Float, 4		
Report Comparator 5 limit	Read value for comparator #5	Read	Float, 4	1, 1	0x4059
Write Comparator 5 limit	Write value for comparator #5	Write	Float, 4		

Command	Description	Read/Write	Data type	PROFINET Slot + Sub Slot	PROFINET Index Value
Report # of Comparators used	Read how many comparators used	Read	Byte, 1	1, 1	0x4054
Write # of Comparators used	Write how many comparators used	Write	Byte, 1		
Apply Parameters	Apply parameters, reinitialize	Write	Byte, 1	1, 1	0x406F
Comparator Status Group 1	Comparator Status Group 1	Read	Short, 2	1, 1	0x4051
Display – Energy Saving Mode	Time value for the display to turn off	Read/Write	Float, 4	1, 1	0x4309