SIMCO ION™
An ITW Company

IQ Power™ Control Station EtherNet/IP (EIP)

INTERFACE SPECIFICATION
(IQCS V7.0 and higher)

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1. OVERVIEW

IQ Power Control Station (CS)

The Simco-Ion IQ Power Control Station (CS) provides a power, communication and control hub for IQ Power and IQ Easy static neutralizing and sensing devices. The system control offered by the Control Station allows for integration of IQ Easy Static Sensors and IQ Easy Static Neutralizing Bars with the IQ Power system.

The Control Station will also provide network connectivity for a variety of fieldbus communication protocols such as EtherNet/IP, PROFIBUS DP-V1, PROFINET IO, Modbus RTU, Modbus TCP, DeviceNet and ControlNet by use of an HMS Industrial Network Anybus Module.

This document will outline the real-time status that is available from the IQ Power system for users that may want to monitor and/or record process data via their network.

IQ Power - Power Supply (BPS /BPS-C / HL / HLC)

A Simco-Ion IQ Power - Power Supply (BPS /BPS-C / HL / HLC) will provide the output power for a static neutralizer and process all of the system intelligence to maintain complete static control. The power supply will report its data as a “device”.

IQ Easy / IQ Easy LP Neutralizer Bar

The Control Station may also integrate IQ Easy and IQ Easy LP Neutralizing Bars with the IQ Power system.   The IQ Easy / IQ Easy LP Static Neutralizing Bar will report its data as a “device”.

IQ Power Fantom Blower

An IQ Power Fantom ionized air blower provides ionized air for static neutralization. The blower will report its data as a “device”. A Fantom blower connected to a Control Station will still need to be connected to line voltage due to power requirements of the air blower.

IQ Easy Modular Sensor / IQ Power HL Sensor

When an IQ Easy Modular Sensor or IQ Power HL Sensor is paired with a neutralizer, the data will report as “device (neutralizer) with static sensor”. If a Sensor is not paired with a neutralizer, the data report as “device sensor only”.

IQ Power Network Verification

The Control Station is designed to allow users to verify network connectivity to the process data buffer.

The Application Data Instance (ADI) map includes several known process data bytes that can be used to verify High Byte (HB) & Low Byte (LB) data alignment on the bus and the start/end of buffer markers. Refer to ADI map for details on the location of the Start-Of-Buffer ‘NPDV4321’ and End-Of-Buffer ‘NPDV6789’ markers.

Technical Information

Technical information for the specific Anybus® CompactCom module is available from the Anybus HMS Industrial Networks web site.   For the **M30** series module **#AB6214**, go to –

https://www.hms-networks.com/p/ab6214-b-anybus-compactcom-30-module-ethernet-ip

General and specific file documentation for this EtherNet/IP (EIP) Anybus® module should be available. This includes software design guides, driver packages, help documents, configuration utilities, network interface specific information (appendix documents) and other technical support information. If the above link does not provide the required information, contact customer support at Anybus. Assistance is also available through Simco-Ion customer support.

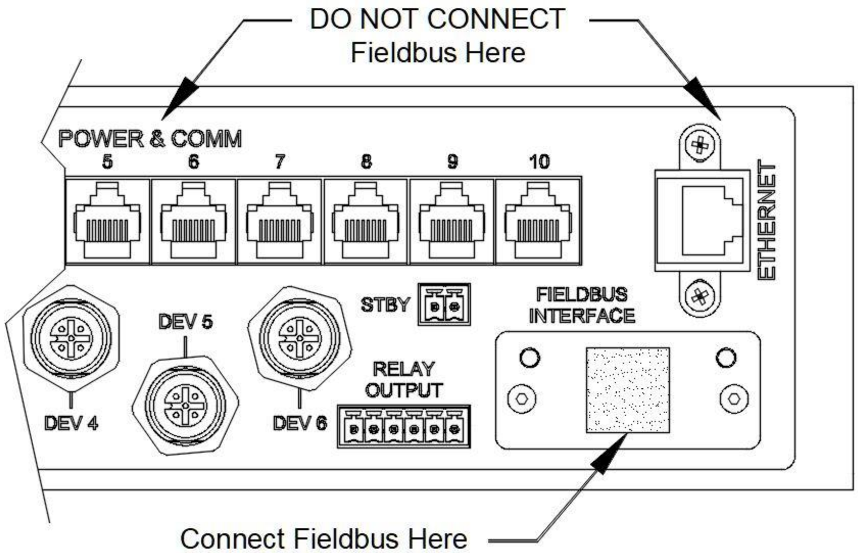
2. EtherNet/IP (EIP)

EtherNet/IP Overview

The IQ Power Control Station will interface directly to an EtherNet/IP (EIP) network. All process data values read are 16-Bit hex values composed of a High Byte (HB) and a Low Byte (LB). The length of each explicit CIP Message of process data is always 2 bytes for each instance. The Ethernet interface supports 10/100Mbit, full or half duplex operation.

EtherNet/IP Network Connectivity Cabling

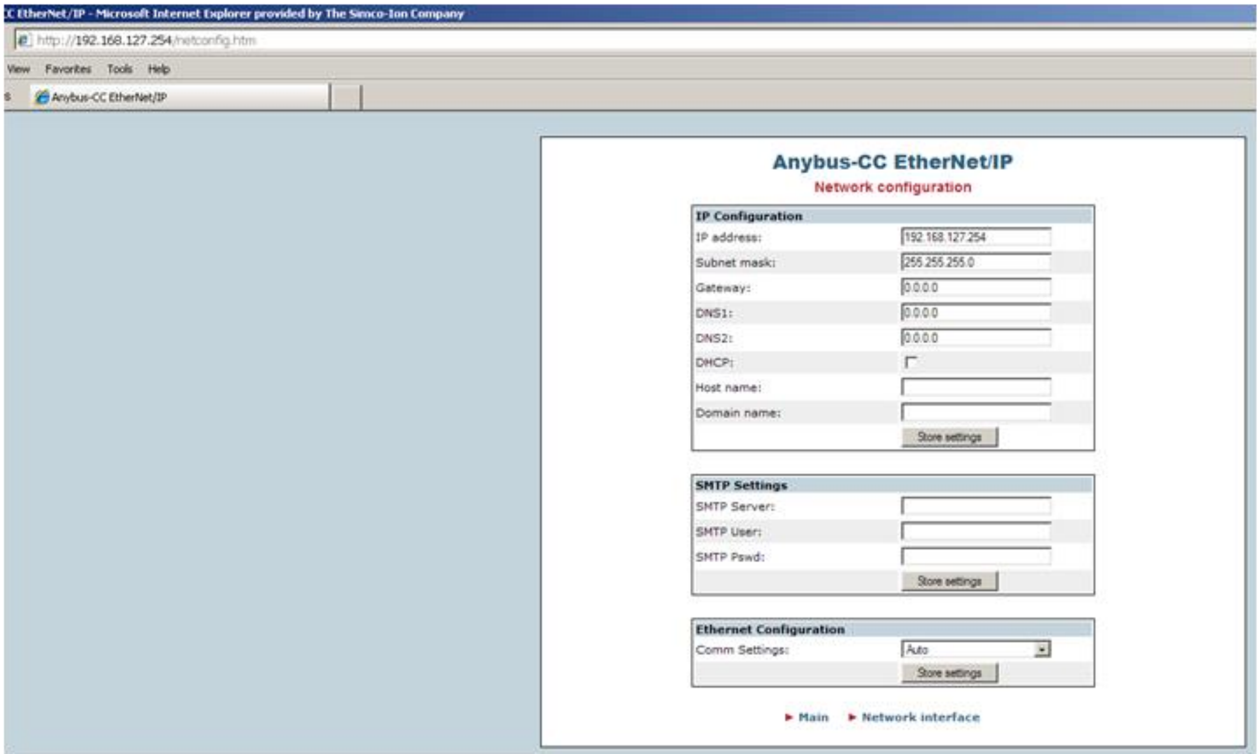
An Ethernet "crossover cable" is required if the communication link to the EIP module is directly from a laptop/PC. A standard Ethernet patch cable is used if the communication link to the EIP module is through a hub or switch.



EtherNet/IP Interface: HMS Anybus Module #AB6214 (AB6224)

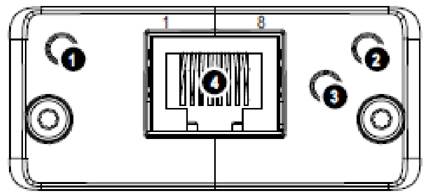
The fieldbus module integrated into the IQ Power Control Station is supplied by HMS Anybus. Additional technical information for the hardware and supplemental software is available at the website: www.AnyBus.com. The fieldbus interface is the Anybus CompactCom (ABCC) module #AB6214. The user should also download "Anybus IP Config Utility Program" from the website to change the IP address of their Ethernet module if necessary. Default web pages are also available for Network Information, Configuration, and Statistics.

Sample snapshot of a browser to view the EtherNet/IP module web page:



EIP Network Interface Connector

#	Item
1	Network Status LED
2	Module Status LED
3	Link/Activity
4	Ethernet Interface



Network Status LED

Note: A test sequence is performed on this LED during startup.

LED State	Description
Off	No power or no IP address
Green	On-line, one or more connections established (CIP Class 1 or 3)
Green, flashing	On-line, no connections established
Red	Duplicate IP address, FATAL error
Red, flashing	One or more connections timed out (CIP Class 1 or 3)

Module Status LED

Note: A test sequence is performed on this LED during startup.

LED State	Description
Off	No power
Green	Controlled by a Scanner in Run state
Green, flashing	Not configured, or Scanner in Idle state
Red	Major fault (EXCEPTION-state, FATAL error etc.)
Red, flashing	Recoverable fault(s)

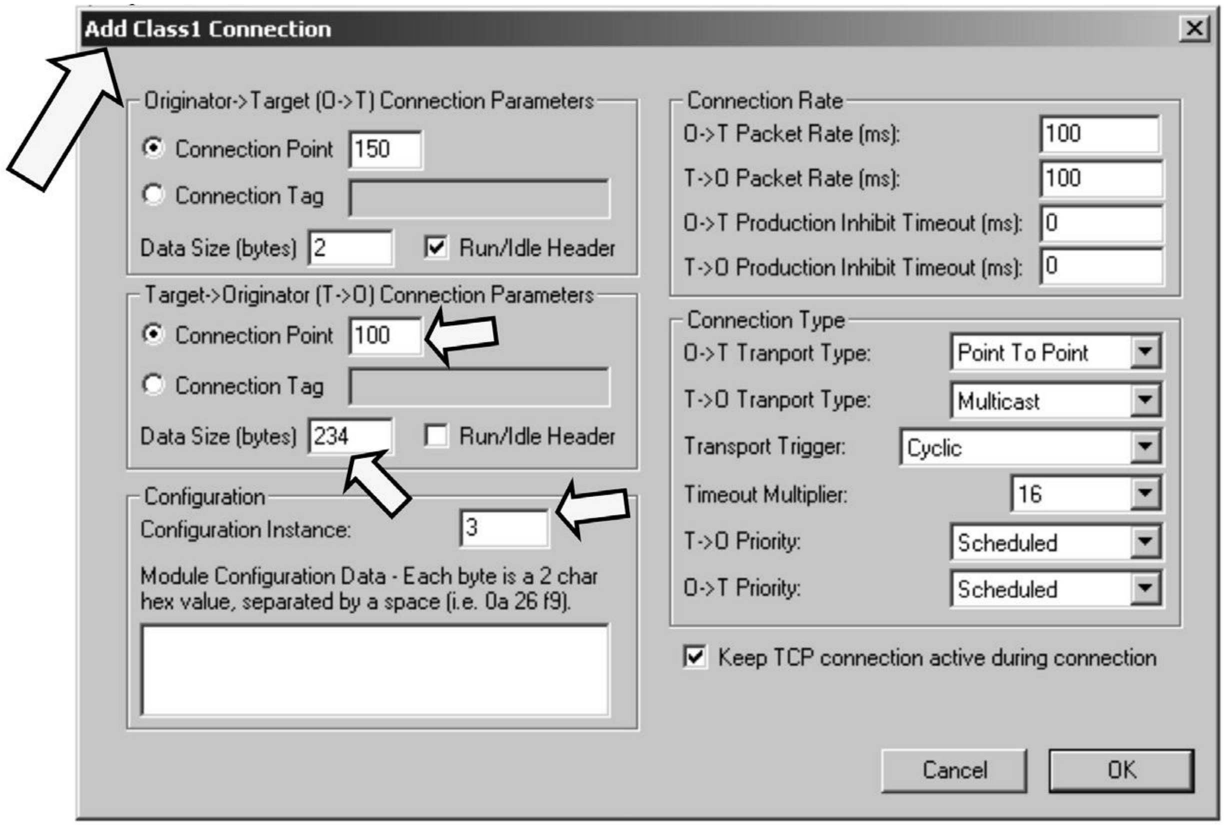
LINK/Activity LED

LED State	Description
Off	No link, no activity
Green	Link established
Green, flickering	Activity

Ethernet Interface

The Ethernet interface supports 10/100Mbit, full or half duplex operation.

EtherNet/IP Class1 Connection Setup



Programming Procedure

The user will be able to communicate with the EIP module to retrieve the process data from the system. Process data for all the devices connected to the IQ Power Control Station can be monitored through a single IP Address.
The factory default IP Address for the EIP module is "**192.168.127.254**"

All of the process data is mapped to an Application Data Instance (ADI).
The definition for each ADI is outlined in this document.

The following methods are ways to monitor Process Data:

1. Establish Class1 connection with target EtherNet/IP module.
   Make a Class 1 connection to the EIP Module and monitor all process data bytes.
2. Send an Explicit CIP message to the specific ADI to receive the 16-bit Process Data value.

A typical procedure would be as follows:

A. Read **ADI#6** to determine which devices are active (Global Status 'ON' bit) in the system.
An active device will set the corresponding bit in ADI#6 if it is powered "ON".

B. Read **ADI#7** to determine if any fault conditions (Global Status Fault bits) exist in the system.
Any non-zero value would indicate a fault exist in the system.

C. Read **ADI#8** to determine if any warning conditions (Global Status Warning bits) exist in the system. Any non-zero value would indicate a warning condition exist in the system.
A warning condition also includes service-type conditions such as "Clean Bar".

Process Data Buffer Examples

Example #1
(BPS, BPS-C, HL, HLC, IQ Easy, IQ Easy LP)

Intput data

Offset: 0000 Go

	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
0000	43	21	00	00	C2	CA	00	00	31	32	00	06	00	00	00	04
0010	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0020	00	00	00	00	19	E1	00	00	04	18	00	68	00	00	00	00
0030	00	08	00	08	00	00	2A	EA	3A	CE	08	31	00	48	00	00
0040	00	00	0A	FE	04	0A	00	00	30	00	00	00	00	00	00	00
0050	00	00	00	00	00	00	00	00	00	00	40	00	00	00	00	00
0060	00	00	00	00	00	00	00	00	00	00	00	00	50	00	00	00
0070	00	00	00	00	00	00	00	00	00	00	00	00	00	00	60	00
0080	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0090	70	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00A0	00	00	80	00	00	00	00	00	00	00	00	00	00	00	00	00
00B0	00	00	00	00	90	00	00	00	00	00	00	00	00	00	00	00
00C0	00	00	00	00	00	00	A0	00	00	00	00	00	00	00	00	00
00D0	00	00	00	00	00	00	00	00	B0	00	00	00	00	00	00	00
00E0	00	00	00	00	00	00	00	00	67	89						

ADI#1 HB: 43 hex (Network Process Data Verification **High Byte**).
ADI#1 LB: 21 hex (Network Process Data Verification **Low Byte**).

ADI#2: 0000 hex (set Standby Mode / Run Mode, all devices set for Run Mode).
(ADI#2 is a unique register in that it is input only; all other registers are output only).

ADI#5 LB: 32 hex (Firmware Version **3.2**).

ADI#6: 0006 hex (Device "On/Off" Status indicates **Device#1** and **#2** are "ON", all others "OFF" or not connected).

ADI#8: 0004 hex (Device Warning Status indicates **Device#2** has a warning condition asserted).

ADI#19 HB: Device#1 Output Code = x9 hex (x = reserved bits, Output 90%)
ADI#19 LB: Device#1 Status Code = E1hex
(Power On, Comm On, Bar HV On, Speed Y).

ADI#28 HB: Device#2 Output Code = xA hex (x = reserved bits, Output "High", e.g. 10).
ADI#28 LB: Device#2 Status Code = EA hex
(Power On, Comm On, Bar HV On, Clean Bar On, Hybrid Y).

ADI#117 HB: 67 hex (Network Process Data Verification **High Byte**).
ADI#117 LB: 89 hex (Network Process Data Verification **Low Byte**).

Standby Mode

The high voltage for any neutralizing device may be turned off by placing the device in Standby Mode. Because there may be more than one input on a system that can place a device in Standby Mode, setting a device into standby or run mode is as follows: **ADI#2** is an input register that controls the setting of standby / run mode. A transition of the appropriate bit in this register from 0 to 1 will place that device into Standby Mode. Transitioning the bit from 1 to 0 will place the device in Run Mode. Based on the number of devices, it typically takes 2 to 10 seconds for the change of mode to take effect. The startup / default setting for this register is 0000 hex which is Run Mode. If the device is a Modular Sensor or HL Sensor Interface, changing the related bit will have no effect.

After a command is issued, the status of connected devices can be confirmed by checking the status of each individual device thru the corresponding device **Status Code B[5] Standby/Run status**, however it may take up to 30 seconds for the status to be changed and updated.

Sensor Module Web Voltage Calculation

Web Voltage (WV#) data from each sensor module must be multiplied by a variable resolution to attain the actual web voltage. The value of the resolution depends on the maximum sensor voltage range, which in turn depends on the sensor mounting distance. The resolution is variable in order to gain the greatest precision possible given the 8-bit transmission of the web voltage data.

Sensor Module Web Voltage Resolution

Mounting Distance (in.)	Operating Range (kV)	WV Resolution (V)
2	+/-20	156
3	+/-25	195
4	+/-30	234
6	+/-40	312
8	+/-50	390
10	+/-60	468

In this example, **Device#2** Neutralizer bar is paired with a Sensor mounted at 2 inches has a maximum operating range of +/- 20kV and the (decimal) resolution of the Web Voltage (WV#) data is **156.**

Example #2
(BPS, BPS-C, HL, HLC, IQ Easy, IQ Easy LP, with Sensor)

Intput data

Offset: 0000 Go

	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
0000	43	21	00	00	C2	CA	00	00	31	32	00	06	00	00	00	04
0010	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0020	00	00	06	CC	19	E1	00	00	04	18	00	68	00	00	00	00
0030	00	08	00	08	06	CC	2A	EA	3A	CE	08	31	00	48	00	00
0040	00	00	0A	FE	04	0A	00	00	30	00	00	00	00	00	00	00
0050	00	00	00	00	00	00	00	00	00	00	40	00	00	00	00	00
0060	00	00	00	00	00	00	00	00	00	00	00	00	50	00	00	00
0070	00	00	00	00	00	00	00	00	00	00	00	00	00	00	60	00
0080	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0090	70	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00A0	00	00	80	00	00	00	00	00	00	00	00	00	00	00	00	00
00B0	00	00	00	00	90	00	00	00	00	00	00	00	00	00	00	00
00C0	00	00	00	00	00	00	A0	00	00	00	00	00	00	00	00	00
00D0	00	00	00	00	00	00	00	00	B0	00	00	00	00	00	00	00
00E0	00	00	00	00	00	00	00	00	67	89						

Web Voltage (WV#) data must be multiplied by WV Resolution, **156** in this case, to attain the actual web voltage:

ADI#29 HB: WV2 = 3A hex (58 decimal): **Actual** Web Voltage at sensor is 58 * **156**v = +9048 volts.
ADI#29 LB: WV1 = CE hex (-50 decimal): **Actual** Web Voltage at sensor is -50 * **156**v = -7800 volts.
ADI#31 LB: WV3 = 48 hex (72 decimal): **Actual** Web Voltage at sensor is 72 * **156**v = +11232 volts.

In this example, only **Sensor Module #3 [WV3]** has been enabled for Closed-Loop-Feedback (CLFB).
ADI#34: 0AFE hex (2814 decimal): Device#2 Feedback Average 2814 * 4 volts = +11256 volts.
ADI#35: 040A hex (1034 decimal): Device#2 Overall Average 1034 * 4 volts = +4136 volts.

Note that status data from your device will be different than that shown in this example.

Sensor module data is reported in a signed value which use a two's compliment representation.
For example, in signed 8-bit:
-2 decimal = FE hex = 1111 1110 binary
-1 decimal = FF hex = 1111 1111 binary
0 decimal = 00 hex = 0000 0000 binary
+1 decimal = 01 hex = 0000 0001 binary
+2 decimal = 02 hex = 0000 0010 binary
…
+126 decimal = 7E hex = 0111 1110 binary
+127 decimal = 7F hex = 0111 1111 binary
-128 decimal = 80 hex = 1000 0000 binary
-127 decimal = 81 hex = 1000 0001 binary

IQ Easy Modular Sensors may use WV1 thru WV4 when grouped in a single Control Station Address.
IQ Power HL Sensor may use WV1 thru WV8 when reporting thru a given HL Sensor Interface.
IQ Easy Sensor Bars (legacy installation) may use WV1 thru WV8.

Appendix A (Application Data Instance Map)

The Application Data Instance (ADI) Reference Table is a common reference for all interfaces.

ADI System

ADI# (decimal)	Instance (hex)	Definition
1	0x01	**Network Process Data Verification** Start-Of-Buffer marker used to verify network High/Low Byte alignment. [**HB**=0x43, **LB**=0x21]
2	0x02	Device **Standby Mode / Run Mode** Command [16-bit word] A transition state change for each bit will place the corresponding device into **Standby Mode or Run Mode**. B[15] thru B[11]: Reserved B[10]: Transition from 0 to 1 = Standby Mode [Device #10] B[10]: Transition from 1 to 0 = Run Mode [Device #10] B[9]: Transition from 0 to 1 = Standby Mode [Device #9] B[9]: Transition from 1 to 0 = Run Mode [Device #9] B[8]: Transition from 0 to 1 = Standby Mode [Device #8] B[8]: Transition from 1 to 0 = Run Mode [Device #8] B[7]: Transition from 0 to 1 = Standby Mode [Device #7] B[7]: Transition from 1 to 0 = Run Mode [Device #7] B[6]: Transition from 0 to 1 = Standby Mode [Device #6] B[6]: Transition from 1 to 0 = Run Mode [Device #6] B[5]: Transition from 0 to 1 = Standby Mode [Device #5] B[5]: Transition from 1 to 0 = Run Mode [Device #5] B[4]: Transition from 0 to 1 = Standby Mode [Device #4] B[4]: Transition from 1 to 0 = Run Mode [Device #4] B[3]: Transition from 0 to 1 = Standby Mode [Device #3] B[3]: Transition from 1 to 0 = Run Mode [Device #3] B[2]: Transition from 0 to 1 = Standby Mode [Device #2] B[2]: Transition from 1 to 0 = Run Mode [Device #2] B[1]: Transition from 0 to 1 = Standby Mode [Device #1] B[1]: Transition from 1 to 0 = Run Mode [Device #1] B[0]: Reserved Note: The bit state in **ADI#2** does NOT reflect the actual Standby/Run status of the device (e.g. IQ BPS, Easy Bar, etc)
3	0x03	Reserved
4	0x04	Reserved
5	0x05	Simco-Ion Product Identification & Firmware Version HB = Product ID (e.g. 0x31 = Communication Module) LB = Firmware Version (e.g. 0x75 = Version #7.5)

ADI Device Global

ADI# (decimal)	Instance (hex)	Definition
6	0x06	Device "On/Off" Status [16-bit word] B[15] thru B[11]: Reserved B[10]: 1 = "On", 0 = "Off" or not connected (Device #10] B[9]: 1 = "On", 0 = "Off" or not connected (Device #9) B[8]: 1 = "On", 0 = "Off" or not connected (Device #8) B[7]: 1 = "On", 0 = "Off" or not connected (Device #7) B[6]: 1 = "On", 0 = "Off" or not connected (Device #6) B[5]: 1 = "On", 0 = "Off" or not connected (Device #5) B[4]: 1 = "On", 0 = "Off" or not connected (Device #4) B[3]: 1 = "On", 0 = "Off" or not connected (Device #3) B[2]: 1 = "On", 0 = "Off" or not connected (Device #2) B[1]: 1 = "On", 0 = "Off" or not connected (Device #1) B[0]: Reserved
7	0x07	Device "Fault"(red) Status [16-bit word] B[15] thru B[11]: Reserved B[10]: 1 = "Fault Active", 0 = "no Fault"" (Device #10) B[9]: 1 = "Fault Active", 0 = "no Fault" (Device #9) B[8]: 1 = "Fault Active", 0 = "no Fault" (Device #8) B[7]: 1 = "Fault Active", 0 = "no Fault" (Device #7) B[6]: 1 = "Fault Active", 0 = "no Fault" (Device #6) B[5]: 1 = "Fault Active", 0 = "no Fault" (Device #5) B[4]: 1 = "Fault Active", 0 = "no Fault" (Device #4) B[3]: 1 = "Fault Active", 0 = "no Fault" (Device #3) B[2]: 1 = "Fault Active", 0 = "no Fault" (Device #2) B[1]: 1 = "Fault Active", 0 = "no Fault" (Device #1) B[0]: Reserved
8	0x08	* Device "Warning"(yellow) Status [16-bit word] B[15] thru B[11]: Reserved B[10]: 1 = "Warning Active", 0 = "no Warning"" (Device #10) B[9]: 1 = "Warning Active", 0 = "no Warning" (Device #9) B[8]: 1 = "Warning Active", 0 = "no Warning" (Device #8) B[7]: 1 = "Warning Active", 0 = "no Warning" (Device #7) B[6]: 1 = "Warning Active", 0 = "no Warning" (Device #6) B[5]: 1 = "Warning Active", 0 = "no Warning" (Device #5) B[4]: 1 = "Warning Active", 0 = "no Warning" (Device #4) B[3]: 1 = "Warning Active", 0 = "no Warning" (Device #3) B[2]: 1 = "Warning Active", 0 = "no Warning" (Device #2) B[1]: 1 = "Warning Active", 0 = "no Warning" (Device #1) B[0]: Reserved

* If a device (neutralizer) has a "clean bar" alarm, it will assert a "warning".

ADI Device 0 (Reserved / Not Applicable)

ADI# (decimal)	Instance (hex)	Definition
9	0x09	Reserved [16-bit]
10	0x0A	Reserved [16-bit]
11	0x0B	Reserved [16-bit]
12	0x0C	Reserved [16-bit]
13	0x0D	Reserved [16-bit]
14	0x0E	Reserved [16-bit]
15	0x0F	Reserved [16-bit]
16	0x10	Reserved [16-bit]
17	0x11	Reserved [16-bit]

ADI Device 1 thru 10 BPS, BPS-C, HL, HLC, IQ Easy, IQ Easy LP, (<u>without</u> Sensor)

ADI# (decimal) / Instance (hex)										Definition
Dev 1	**Dev 2**	**Dev 3**	**Dev 4**	**Dev 5**	**Dev 6**	**Dev 7**	**Dev 8**	**Dev 9**	**Dev 10**	
18 0x12	27 0x1B	36 0x24	45 0x2D	54 0x36	63 0x3F	72 0x48	81 0x51	90 0x5A	99 0x63	Reserved [16-bit]
19 0x13	28 0x1C	37 0x25	46 0x2E	55 0x37	64 0x40	73 0x49	82 0x52	91 0x5B	100 0x64	B[15] thru B[12]: Reserved **Output Code** B[11,10,9,8]: A = Output “High” B[11,10,9,8]: 9 = Output 90% B[11,10,9,8]: 8 = Output 80% B[11,10,9,8]: 7 = Output 70% B[11,10,9,8]: 6 = Output 60% B[11,10,9,8]: 5 = Output 50% B[11,10,9,8]: 4 = Output 40% B[11,10,9,8]: 3 = Output 30% B[11,10,9,8]: 2 = Output 20% B[11,10,9,8]: 1= Output “Low” B[11,10,9,8]: 0=No output **Status Code** B[7]: 1 = Power ON, 0 = OFF B[6]: 1 = Comm ON, 0 = OFF B[5]: 1 = Bar HV ON (**Run Mode**), 0 = Bar HV OFF (**Standby Mode**) B[4]: 1 = Fault ON, 0 = OFF B[3]: 1 = Clean Bar ON, 0 = OFF B[2]: 1 = Distance Y, 0 = N B[1]: 1 = Hybrid Y, 0 = N B[0]: 1 = Speed Y, 0 = N
20 0x14	29 0x1D	38 0x26	47 0x2F	56 0x38	65 0x41	74 0x4A	83 0x53	92 0x5C	101 0x65	[signed 16-bit] / 4 = I Neutralization (uA). **Note: 1, 4**
21 0x15	30 0x1E	39 0x27	48 0x30	57 0x39	66 0x42	75 0x4B	84 0x54	93 0x5D	102 0x66	Reserved [16-bit]
22 0x16	31 0x1F	40 0x28	49 0x31	58 0x3A	67 0x43	76 0x4C	85 0x55	94 0x5E	103 0x67	Reserved [16-bit]
23 0x17	32 0x20	41 0x29	50 0x32	59 0x3B	68 0x44	77 0x4D	86 0x56	95 0x5F	0x68 104	Reserved [16-bit]
24 0x18	33 0x21	42 0x2A	51 0x33	60 0x3C	69 0x45	78 0x4E	87 0x57	96 0x60	105 0x69	Reserved [16-bit]
25 0x19	34 0x22	43 0x2B	52 0x34	61 0x3D	70 0x46	79 0x4F	88 0x58	97 0x61	106 0x6A	I Positive (µA) [16-bit]
26 0x1A	35 0x23	44 0x2C	53 0x35	62 0x3E	71 0x47	80 0x50	89 0x59	98 0x62	107 0x6B	I Negative (µA) [16-bit]

ADI Device 1 thru 10 BPS, BPS-C, HL, HLC, IQ Easy, IQ Easy LP, with Sensor (where device and sensor are paired AND use the same address)

ADI# (decimal) / Instance (hex)										Definition
Dev 1	**Dev 2**	**Dev 3**	**Dev 4**	**Dev 5**	**Dev 6**	**Dev 7**	**Dev 8**	**Dev 9**	**Dev 10**	
18 0x12	27 0x1B	36 0x24	45 0x2D	54 0x36	63 0x3F	72 0x48	81 0x51	90 0x5A	99 0x63	I Positive (µA) [unsigned16-bit]
19 0x13	28 0x1C	37 0x25	46 0x2E	55 0x37	64 0x40	73 0x49	82 0x52	91 0x5B	100 0x64	B[15] thru B[12]: Reserved **Output Code** B[11,10,9,8]: A = Output “High” B[11,10,9,8]: 9 = Output 90% B[11,10,9,8]: 8 = Output 80% B[11,10,9,8]: 7 = Output 70% B[11,10,9,8]: 6 = Output 60% B[11,10,9,8]: 5 = Output 50% B[11,10,9,8]: 4 = Output 40% B[11,10,9,8]: 3 = Output 30% B[11,10,9,8]: 2 = Output 20% B[11,10,9,8]: 1= Output “Low” B[11,10,9,8]: 0=No output **Status Code** B[7]: 1 = Power ON, 0 = OFF B[6]: 1 = Comm ON, 0 = OFF B[5]: 1 = Bar HV ON (**Run Mode**), 0 = Bar HV OFF (**Standby Mode**) B[4]: 1 = Fault ON, 0 = OFF B[3]: 1 = Clean Bar / Warning ON, 0 = OFF B[2]: 1 = Distance Y, 0 = N B[1]: 1 = Hybrid Y, 0 = N B[0]: 1 = Speed Y, 0 = N
20 0x14	29 0x1D	38 0x26	47 0x2F	56 0x38	65 0x41	74 0x4A	83 0x53	92 0x5C	101 0x65	**HB**: WV2 (V), **LB**: WV1 (V) [2 signed 8-bit bytes] **Note: 1,3,5**
21 0x15	30 0x1E	39 0x27	48 0x30	57 0x39	66 0x42	75 0x4B	84 0x54	93 0x5D	102 0x66	I Negative (µA) [unsigned16-bit]
22 0x16	31 0x1F	40 0x28	49 0x31	58 0x3A	67 0x43	76 0x4C	85 0x55	94 0x5E	103 0x67	**HB**: WV4 (V), **LB**: WV3 (V) [2 signed 8-bit bytes] **Note: 1,3,5**
23 0x17	32 0x20	41 0x29	50 0x32	59 0x3B	68 0x44	77 0x4D	86 0x56	95 0x5F	0x68 104	**HB**: WV6 (V), **LB**: WV5 (V) * [2 signed 8-bit bytes] **Note: 1,3,5**
24 0x18	33 0x21	42 0x2A	51 0x33	60 0x3C	69 0x45	78 0x4E	87 0x57	96 0x60	105 0x69	**HB**: WV8 (V), **LB**: WV7(V) * [2 signed 8-bit bytes] **Note: 1,3,5**
25 0x19	34 0x22	43 0x2B	52 0x34	61 0x3D	70 0x46	79 0x4F	88 0x58	97 0x61	106 0x6A	[signed16-bit] x 4 = Feedback Average (V) **Note: 1,2**
26 0x1A	35 0x23	44 0x2C	53 0x35	62 0x3E	71 0x47	80 0x50	89 0x59	98 0x62	107 0x6B	[signed 16-bit] x 4 = Overall Average (V) **Note: 1,2**

* WV5 thru WV8 not used with IQ Easy Modular Sensor.

ADI Device 1 thru 10 Fantom (<u>without</u> Modular Sensor)

ADI# (decimal) / Instance (hex)										Definition
Dev 1	**Dev 2**	**Dev 3**	**Dev 4**	**Dev 5**	**Dev 6**	**Dev 7**	**Dev 8**	**Dev 9**	**Dev 10**	
18 0x12	27 0x1B	36 0x24	45 0x2D	54 0x36	63 0x3F	72 0x48	81 0x51	90 0x5A	99 0x63	**HB:** I Positive (µA) **LB:** I Negative (µA) [2-unsigned 8-bit bytes]
19 0x13	28 0x1C	37 0x25	46 0x2E	55 0x37	64 0x40	73 0x49	82 0x52	91 0x5B	100 0x64	**HB:** Balance * (1 to 99) [unsigned 8-bit] **LB: Status Code** B[7]: 1 = Fixed Y, 0 = NO B[6]: 1 = Manual Narrow Y, 0 = NO B[5]: 1 = CLFB y, 0 = NO B[4]: 1 = Manual Wide Y, 0 = NO B[3]: 1 = HV & Fan ON (**Run Mode**) 0 = HV & Fan OFF (**Standby Mode**) B[2]: 1 = Fault (red LED) ON, 0 = OFF B[1]: 1 = Warning (yellow LED) ON, 0 = OFF B[0]: 1 = Power (green LED) ON, 0 = OFF
20 0x14	29 0x1D	38 0x26	47 0x2F	56 0x38	65 0x41	74 0x4A	83 0x53	92 0x5C	101 0x65	Reserved [16-bit]
21 0x15	30 0x1E	39 0x27	48 0x30	57 0x39	66 0x42	75 0x4B	84 0x54	93 0x5D	102 0x66	**HB:** Positive Drive (%) **LB:** Negative Drive (%) [2 unsigned 8-bit bytes]
22 0x16	31 0x1F	40 0x28	49 0x31	58 0x3A	67 0x43	76 0x4C	85 0x55	94 0x5E	103 0x67	Reserved [16-bit]
23 0x17	32 0x20	41 0x29	50 0x32	59 0x3B	68 0x44	77 0x4D	86 0x56	95 0x5F	0x68 104	Reserved [16-bit]
24 0x18	33 0x21	42 0x2A	51 0x33	60 0x3C	69 0x45	78 0x4E	87 0x57	96 0x60	105 0x69	Reserved [16-bit]
25 0x19	34 0x22	43 0x2B	52 0x34	61 0x3D	70 0x46	79 0x4F	88 0x58	97 0x61	106 0x6A	Reserved [16-bit]
26 0x1A	35 0x23	44 0x2C	53 0x35	62 0x3E	71 0x47	80 0x50	89 0x59	98 0x62	107 0x6B	Reserved [16-bit]

* Balance: 50 ~ nominally balanced output, <50 ~ negative biased output, >50 ~ positive biased output.

ADI Device 1 thru 10 Fantom with Modular Sensor (where Fantom and sensor are paired AND use the same address)

ADI# (decimal) / Instance (hex)										Definition
Dev 1	**Dev 2**	**Dev 3**	**Dev 4**	**Dev 5**	**Dev 6**	**Dev 7**	**Dev 8**	**Dev 9**	**Dev 10**	
18 0x12	27 0x1B	36 0x24	45 0x2D	54 0x36	63 0x3F	72 0x48	81 0x51	90 0x5A	99 0x63	**HB:** I Positive (µA) **LB:** I Negative (µA) [2-unsigned 8-bit bytes]
19 0x13	28 0x1C	37 0x25	46 0x2E	55 0x37	64 0x40	73 0x49	82 0x52	91 0x5B	100 0x64	**HB:** Balance * (1 to 99) [unsigned 8-bit] **LB: Status Code** B[7]: 1 = Fixed Y, 0 = NO B[6]: 1 = Manual Narrow Y, 0 = NO B[5]: 1 = CLFB y, 0 = NO B[4]: 1 = Manual Wide Y, 0 = NO B[3]: 1 = HV & Fan ON (**Run Mode**) 0 = HV & Fan OFF (**Standby Mode**) B[2]: 1 = Fault (red LED) ON, 0 = OFF B[1]: 1 = Warning (yellow LED) ON, 0 = OFF B[0]: 1 = Power (green LED) ON, 0 = OFF
20 0x14	29 0x1D	38 0x26	47 0x2F	56 0x38	65 0x41	74 0x4A	83 0x53	92 0x5C	101 0x65	**HB:** WV2 (V), **LB:** WV1 (V) [2 signed 8-bit bytes] **Note: 1,3,5**
21 0x15	30 0x1E	39 0x27	48 0x30	57 0x39	66 0x42	75 0x4B	84 0x54	93 0x5D	102 0x66	**HB:** Positive Drive (%) **LB:** Negative Drive (%) [2 unsigned 8-bit bytes]
22 0x16	31 0x1F	40 0x28	49 0x31	58 0x3A	67 0x43	76 0x4C	85 0x55	94 0x5E	103 0x67	**HB:** WV4 (V), **LB:** WV3 (V) [2 signed 8-bit bytes] **Note: 1,3,5**
23 0x17	32 0x20	41 0x29	50 0x32	59 0x3B	68 0x44	77 0x4D	86 0x56	95 0x5F	0x68 104	Reserved [16-bit]
24 0x18	33 0x21	42 0x2A	51 0x33	60 0x3C	69 0x45	78 0x4E	87 0x57	96 0x60	105 0x69	Reserved [16-bit]
25 0x19	34 0x22	43 0x2B	52 0x34	61 0x3D	70 0x46	79 0x4F	88 0x58	97 0x61	106 0x6A	[signed 16-bit] x 4 = Feedback Average (V) **Note: 1, 2**
26 0x1A	35 0x23	44 0x2C	53 0x35	62 0x3E	71 0x47	80 0x50	89 0x59	98 0x62	107 0x6B	[signed 16-bit] x 4 = Overall Average (V) **Note: 1, 2**

* Balance: 50 ~ nominally balanced output, <50 ~ negative biased output, >50 ~ positive biased output.

ADI Device 1 thru 10 Modular Sensor <u>or</u> HL Sensor Interface <u>or</u> Sensor Bar <u>only</u> (where sensor is the only device occupying a given address)

ADI# (decimal) / Instance (hex)										Definition
Dev 1	Dev 2	Dev 3	Dev 4	Dev 5	Dev 6	Dev 7	Dev 8	Dev 9	Dev 10	
18 0x12	27 0x1B	36 0x24	45 0x2D	54 0x36	63 0x3F	72 0x48	81 0x51	90 0x5A	99 0x63	Reserved [16-bit]
19 0x13	28 0x1C	37 0x25	46 0x2E	55 0x37	64 0x40	73 0x49	82 0x52	91 0x5B	100 0x64	**HB:** B[15] thru B[8]: Reserved **LB: Sensor / HL Sensor Interface Status Code** B[7]: 1 = Power ON, 0 = OFF B[6]: 1 = Comm ON, 0 = OFF B[5]: Reserved B[4]: 1 = Fault ON, 0 = OFF B[3]: 1 = Warning ON, 0 = OFF B[2]: Reserved B[1]: Reserved B[0]: Reserved
20 0x14	29 0x1D	38 0x26	47 0x2F	56 0x38	65 0x41	74 0x4A	83 0x53	92 0x5C	101 0x65	**HB**: WV2 (V), **LB**: WV1 (V) [2 signed 8-bit bytes] **Note: 1,3,5**
21 0x15	30 0x1E	39 0x27	48 0x30	57 0x39	66 0x42	75 0x4B	84 0x54	93 0x5D	102 0x66	Reserved [16-bit]
22 0x16	31 0x1F	40 0x28	49 0x31	58 0x3A	67 0x43	76 0x4C	85 0x55	94 0x5E	103 0x67	**HB**: WV4 (V), **LB**: WV3 (V) [2 signed 8-bit bytes] **Note: 1,3,5**
23 0x17	32 0x20	41 0x29	50 0x32	59 0x3B	68 0x44	77 0x4D	86 0x56	95 0x5F	0x68 104	**HB**: WV6 (V), **LB**: WV5 (V) * [2 signed 8-bit bytes] **Note: 1,3,5**
24 0x18	33 0x21	42 0x2A	51 0x33	60 0x3C	69 0x45	78 0x4E	87 0x57	96 0x60	105 0x69	**HB**: WV8 (V), **LB**: WV7(V) * [2 signed 8-bit bytes] **Note: 1,3,5**
25 0x19	34 0x22	43 0x2B	52 0x34	61 0x3D	70 0x46	79 0x4F	88 0x58	97 0x61	106 0x6A	[signed 16-bit] x 4 = Feedback Average (V) **Note: 1,2**
26 0x1A	35 0x23	44 0x2C	53 0x35	62 0x3E	71 0x47	80 0x50	89 0x59	98 0x62	107 0x6B	[signed 16-bit] x 4 = Overall Average (V) **Note: 1,2**

* WV5 thru WV8 not used with IQ Easy Modular Sensor.

Notes:

1. Signed values use a two's compliment representation.
2. ADI data value not valid if device is in 'Standby' mode **[Status Code B[5]: Standby/Run Mode]**.
3. Sensor Web Voltage (WV#) requires calculation, see Sensor Web Voltage Calculations.
4. This value is not supported in Pulse Mode.
5. Refer to Appendix C for additional Sensor information (WVx).

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ADI Device 11 (Reserved / Not Applicable)

ADI# (decimal)	Instance (hex)	Definition
108	0x6C	Reserved [16-bit]
109	0x6D	Reserved [16-bit]
110	0x6E	Reserved [16-bit]
111	0x6F	Reserved [16-bit]
112	0x70	Reserved [16-bit]
113	0x71	Reserved [16-bit]
114	0x72	Reserved [16-bit]
115	0x73	Reserved [16-bit]
116	0x74	Reserved [16-bit]

ADI System

ADI# (decimal)	Instance (hex)	Definition
117	0x75	**Network Process Data Verification** End-Of-Buffer marker used to verify network High/Low Byte alignment. [**HB**=0x67, **LB**=0x89]

Appendix B (Surface Charge Density Calculations)

IQ Power Control Station Calculations

The IQ Power neutralizer system continuously measures the neutralizing current I_n *($I_{Neutralization}$)*, alternately: $I_n = I_{Positive} - I_{Negative}$, and continuously calculates value of the initial web surface charge density and field intensity as:

Upstream

$$\sigma_{initial} = -\frac{K_{up} \cdot I_n}{\nu \cdot W} \text{ , or } \quad E_{initial} = V_{up} = \frac{\sigma_{initial}}{\varepsilon_o} = -\frac{K_{up} \cdot I_n}{\varepsilon_o \cdot \nu \cdot W}$$

The residual web surface charge density and the residual field intensity are estimated as:

Downstream

$$\sigma_{residual} = \sigma_{initial} \cdot (1 - K_{dn}) \text{ , or } \quad E_{residual} = V_{dn} = \frac{\sigma_{residual}}{\varepsilon_o}$$

σ – average charge density on the web, *coulombs/m²*. For $\mu C/m^2$ multiply the number in coulombs/m^2 by 1,000,000.

E – electrical field intensity at surface of web, *V/m*. For *kV/cm* divide number *V/m* by 100,000.

I_n – absolute value of the neutralizing current from IQ Power neutralizer, *A*

Note: the absolute value is used for calculations; the sign is used for indicating the polarity of the initial charge on the web

K_{up} is determined by field meter (adjust K_{up} so V_{up} =field meter reading).

W - web width covered by the neutralizer (the shorter of the length of the first bar or the web width), *meters*

V_{dn} is measured by field meter to determine K_{dn}.

ν - web velocity, *meters per second*

$\varepsilon_o = 8.8542 \times 10^{-12}$ F/m (permittivity of free space)

$$K_{eff} = 1 - \frac{\text{residual charge}}{\text{initial charge}}$$

K_{eff} is the neutralizing efficiency whose value can range from 0.1 to 1.1. The actual value depends on the type of the neutralizer, its condition, its installation, distance to the web, and other variables.

- Complete neutralization: residual charge =0 and $K = 1$
- Incomplete neutralization: residual charge >0 and the original polarity, K<1
- Overcompensation: residual charge >0 and the opposite polarity, K>1

The K_{eff} could be set based on prior knowledge and some experimentation. with IQ Power neutralizers, when installed according to the instructions, and within the optimal range, have K_{eff}>0.9.

The K_{eff} should be a programmable value, initially set for IQ Power neutralizers at 0.9.

The K_{eff} can be determined using an electrostatic fieldmeter [very carefully, as fieldmeters are notoriously inaccurate and error-prone]. Consult with Simco-Ion for instructions for determining the constant K_{eff}.

Method application notes:

1. The method provides useful information when the material carries electrostatic charge of one polarity.
2. The surface charge density or field intensity values are displayed only when the HVPS is enabled and the Bar is on. Otherwise, "NA" should be displayed for all material charge values.
3. When there is any alarm condition, i.e. Short Circuit, Hardware, Clean Bar, or Communication Loss, "NA" should be displayed for all material charge values.
4. Use $\mu C/m^2$ as a unit of measurements for surface charge density. Multiply the readings in C/m^2 by 1,000,000 to get $\mu C/m^2$.
5. Use kV/cm as a unit of measurements for field intensity. Divide the readings in V/m by 100,000 to get kV/cm.
6. The method applies when the bar-to-material distance is generally constant, i.e. does not vary more than 2-3 inches (50-75 mm) during the measurements. In other words, the formulas would not apply when a bar is installed at a winder and if the distance to the roll changes, for example from 20 inches (500 mm) at the start of the roll to 3 inches (75 mm) at the finish.
7. The bar must be installed sufficiently away from any metal parts, rollers or machine frame cross members, so that the neutralizing current from the bar is less than 0.5 uA when the machine is not running and no material is present. However, if there are machine frame components or rollers, or other metal objects too close to the neutralizing bar, the neutralizing current values will be higher. The "background" neutralizing current could introduce unacceptable errors in the surface charge density calculations.
8. The bar must be installed within optimal operating range from the web.
9. The length of the bar cannot be shorter than the width of the web by more than two inches.
10. I_n = absolute value of the neutralizing current; the absolute value is used for calculations; the sign is used for indicating the polarity of the initial charge on the web.

Appendix C (Additional Sensor Information)

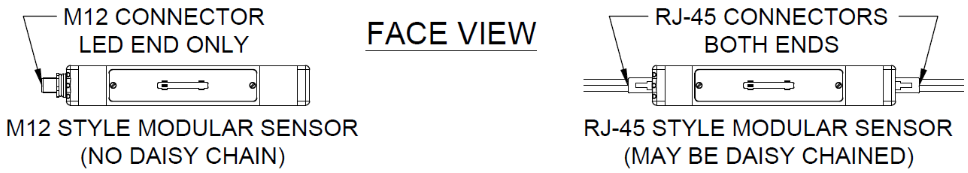
The description of the sensor values will vary based on the installation configuration, and the type of product connected to the IQ Power Control Station.

There are two (2) different sensor products offered by Simco-Ion:

1. IQ Easy Modular Sensor
2. IQ Power HL Sensor

Depending on installed equipment, the sensor values defined as Web Voltage (WV1 to WV4 or WV1 to WV8) in the ADI data mapping reflect voltage levels at a sensor module.

IQ Easy Modular Sensor



If the installation is a group of IQ Easy Modular Sensors under a single Control Station Address, WV1 up to WV4 may be available at that address. WV1 reflects the voltage level at SENSOR NUMBER 1. WV2 reflects the voltage level at SENSOR NUMBER 2. The sequential pattern continues for up to four (4) MODULAR SENSORS (WV1 to WV4).

Feedback Average is from selected Modular Sensors at a given Control Station Address. Overall Average is from all Modular Sensors at a given Control Station Address.

[signed16-bit] x 4 = Feedback Average (V) **Note: 1,2**
[signed 16-bit] x 4 = Overall Average (V) **Note: 1,2**

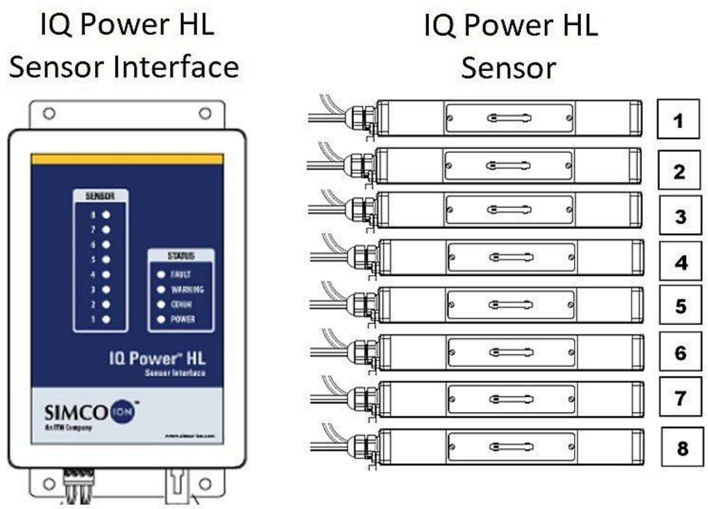
The PLC data buffer also includes a separate Overall and Feedback (CLFB) Average voltage value. The ADI mapping defines the location of these Average voltages in the PLC data buffer if applicable to the Fieldbus interface.

The IQ Power Control Station (CS) can connect up to ten (10) IQ Easy Modular Sensor Groups at device address 1 to 10. Four (4) IQ Easy Modular Sensors can be installed at each CS device address. ADI data mapping defines the PLC buffer location of each CS device address (1 to 10).

Refer to the Control Station or IQ Easy Modular Sensor manuals for additional information.

NOTE: IQ Easy Sensor Bar (legacy installation) up to WV8 may be available for the bar.

IQ Power HL Sensor



If the installation is an IQ Power HL Sensor Interface, each IQ Power HL Sensor is assigned a Sensor Number. The sensor number may be 1 through 8.
The IQ Power HL Sensor comes from the factory with a label on its cable identifying its assigned Sensor Number.

WV1 reflects the voltage level at HL Sensor labeled number 1.
WV2 reflects the voltage level at HL Sensor labeled number 2.
:
WV8 reflects the voltage level at HL Sensor labeled number 8.

A single IQ Power HL Sensor Interface can report the status data for up to eight (8) HL Sensors (if the HL Sensor is connected to the Sensor Interface).

[signed16-bit] x 4 = Feedback Average (V) **Note: 1,2**
[signed 16-bit] x 4 = Overall Average (V) **Note: 1,2**

The PLC data buffer also includes a separate Overall and Feedback (CLFB) Average voltage value. The ADI mapping defines the location of these Average voltages in the PLC data buffer if applicable to the Fieldbus interface.

The IQ Power Control Station (CS) can connect up to ten (10) IQ HL Sensor Interfaces at device address 1 to 10. One (1) IQ HL Sensor Interface can be installed at each CS device address. The ADI data mapping defines the PLC buffer location of each CS device address (1 to 10).

Refer to the Control Station or IQ Power HL Sensor manuals for additional information.

Revision History

Version	Date	Description
A	12/10/2018	Initial Release
B	1/4/2021	ECN 4152, Added IQ Easy LP
C	2/8/2021	ECN 4162, Added Fieldbus Connection Illustration & Appendix C
D	12/15/2021	ECN 4228, Updated Anybus Technical Information
E	11/27/2023	ECN 4388, Updated for IQ Easy Modular Sensor
F	7/15/2024	ECN 4429, Updated Anybus link, p.2

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