SIMCO ION™
An ITW Company

IQ Power™ Control Station Modbus RTU

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. Both the Power Supplies and IQ Easy / IQ Easy LP Static Neutralizing Bars will report their 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 **#AB6203**, go to –

https://www.hms-networks.com/p/ab6203-b-anybus-compactcom-30-module-modbus-rtu

General and specific file documentation for this Modbus RTU 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.

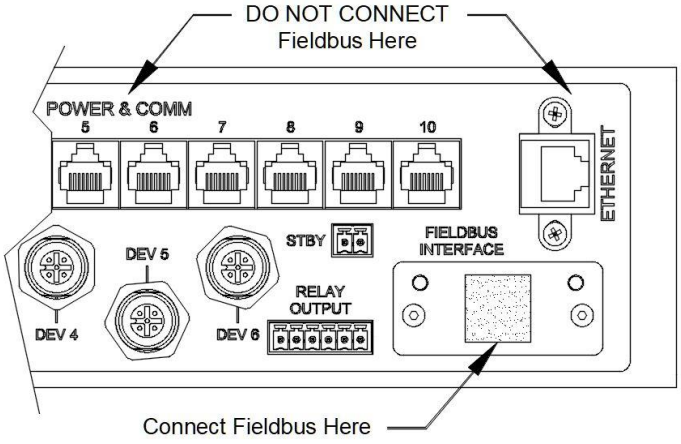
2. Modbus RTU

Modbus RTU Overview

The IQ Power Control Station will interface directly to a Modbus RTU 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 Modbus RTU read data is always 2 bytes for each holding register number. Process data for all (10) devices can be monitored through a single Modbus node.

Modbus RTU Interface: HMS Anybus Module #AB6203

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 #AB6203.



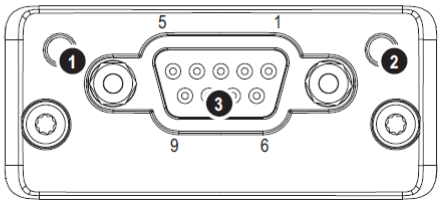
The Modbus interface is galvanically isolated, and provides both R5-232 and R5-485.

Pin	Direction	Signal	Comment
Housing	–	PE	Protective Earth
1	–	GND	Bus polarization, ground (isolated)
2	Output[a]	5V	Bus polarization, power +5V DC (isolated)
3	Input	PMC	Connect to pin #2 for R5-232 operation. Leave unconnected for R5-485 operation.
4	–	–	–
5	Bidirectional	B-Line	R5-485 B-Line
6	–	–	–
7	Input	Rx	R5-232 Data Receive
8	Output	Tx	R5-232 Data Transmit
9	Bidirectional	A-Line	R5-485 A-Line

a. Any current drawn from this pin will affect the total power consumption.

Modbus RTU Network Interface Connector

#	Item
1	Communication LED
2	Device Status LED
3	Modbus Interface



Communication LED

LED State	Description
Off	No power - *or* - no traffic
Yellow	This LED will flash during correct reception and transmission (20 ms on, 40 ms off)
Red	A fatal error has occurred

Device Status LED

LED State	Description
Off	Initializing - *or* - no power
Green	Module initialized, no error
Red	Internal error - *or* - major unrecoverable fault
Red, single flash	Communication fault or configuration error Case 1: Invalid settings in Network Configuration Object. Case 2: Settings in Network Configuration Object has been changed during runtime (i.e. the settings does not match the currently used configuration)
Red, double flash	Application diagnostics available

Programming Procedure

The user will be able to communicate with the Modbus RTU module to retrieve the process data from the system.

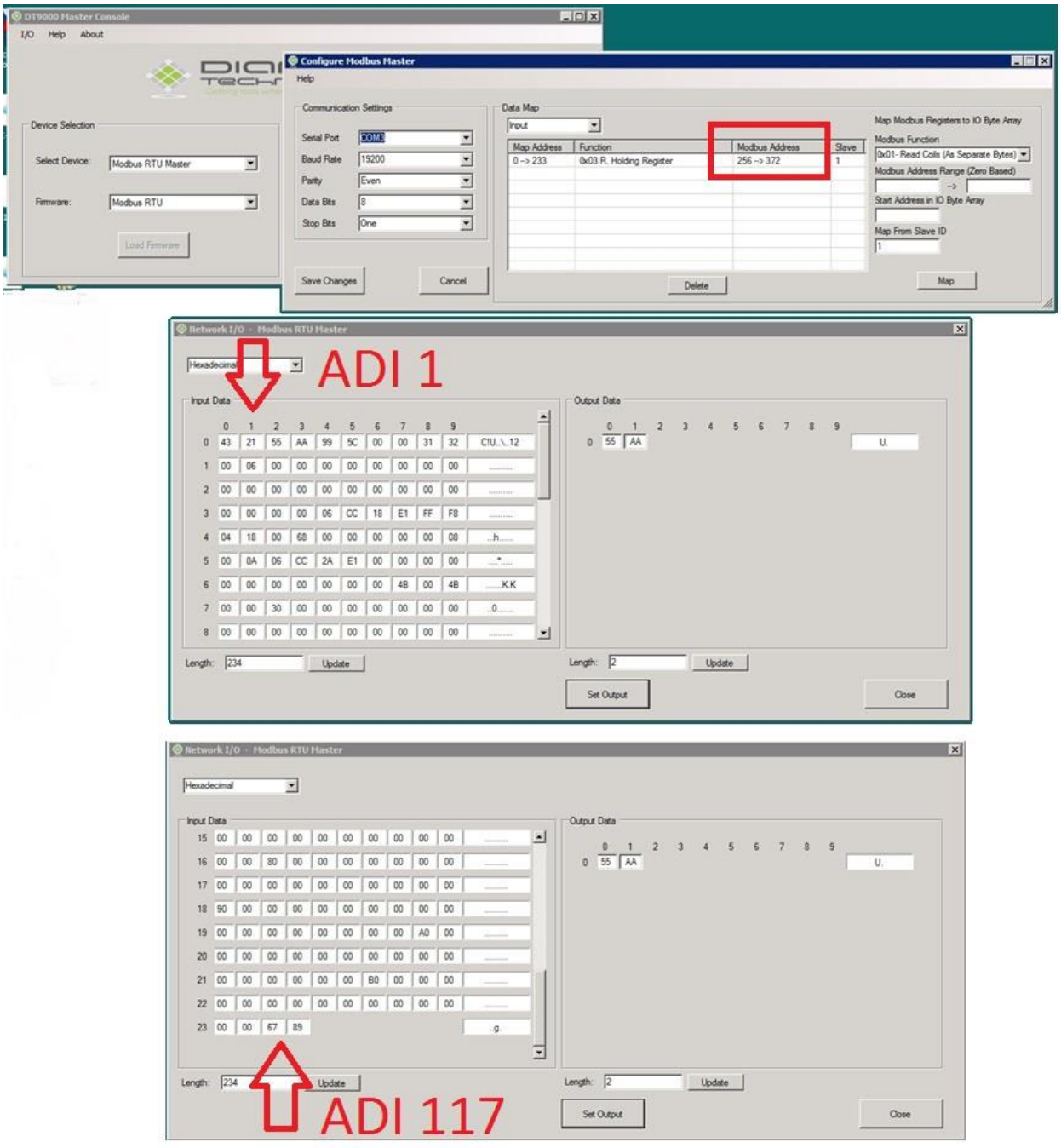
A typical procedure would be as follows:

1. Read **ADI#6** to determine which Devices are active in the system. An active Device will set the corresponding bit in ADI#6 if it powered "ON".
2. Read **ADI#7** to determine if any fault conditions exist in the system. Any non-zero value would indicate a fault exist in the system.
3. Read **ADI#8** to determine if any warning conditions exist in the system. A warning condition also includes service-type conditions such as "Clean Bar". Any non-zero value would indicate a warning condition exist in the system.

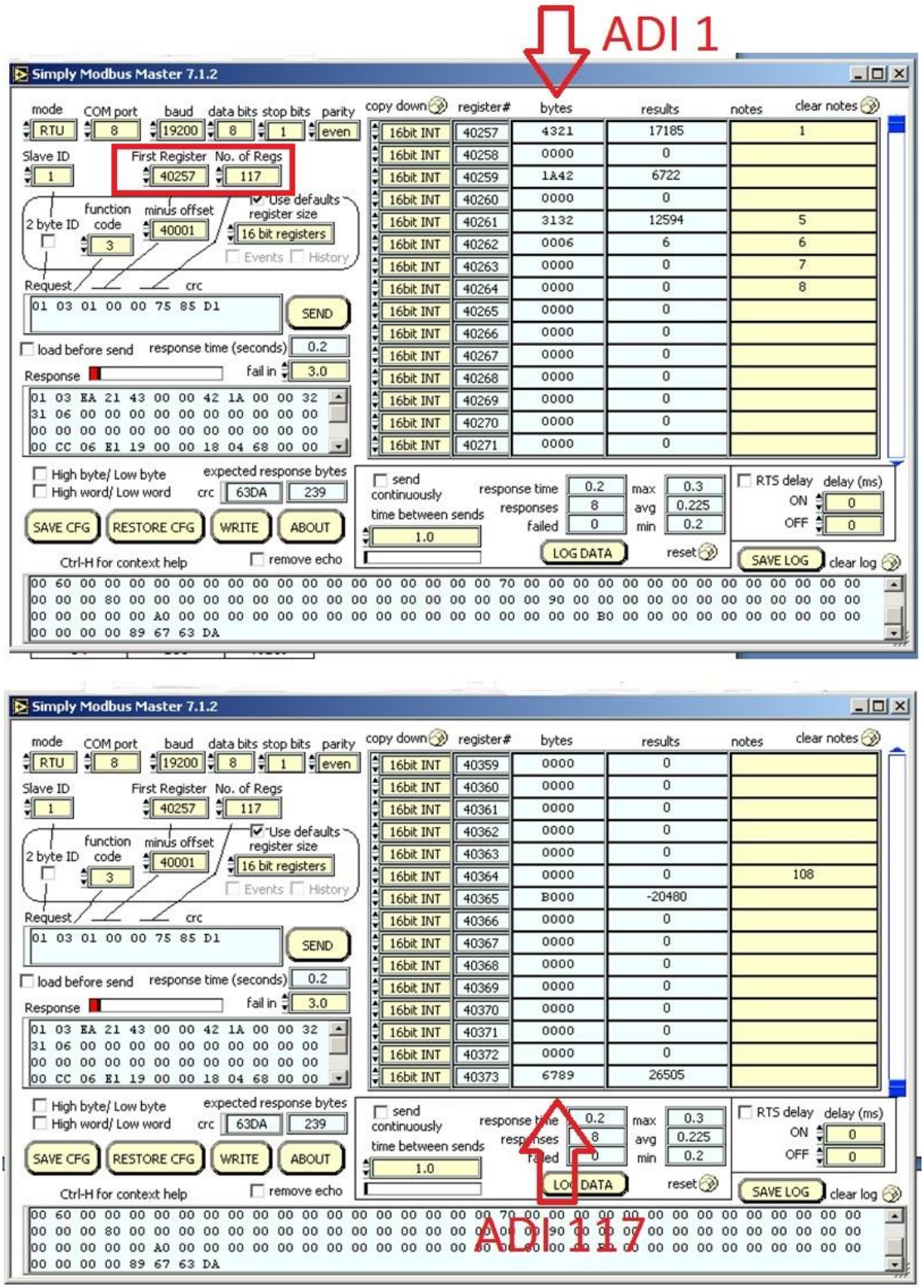
Process data for all ten (10) Devices can be monitored.

Process Data Buffer Examples

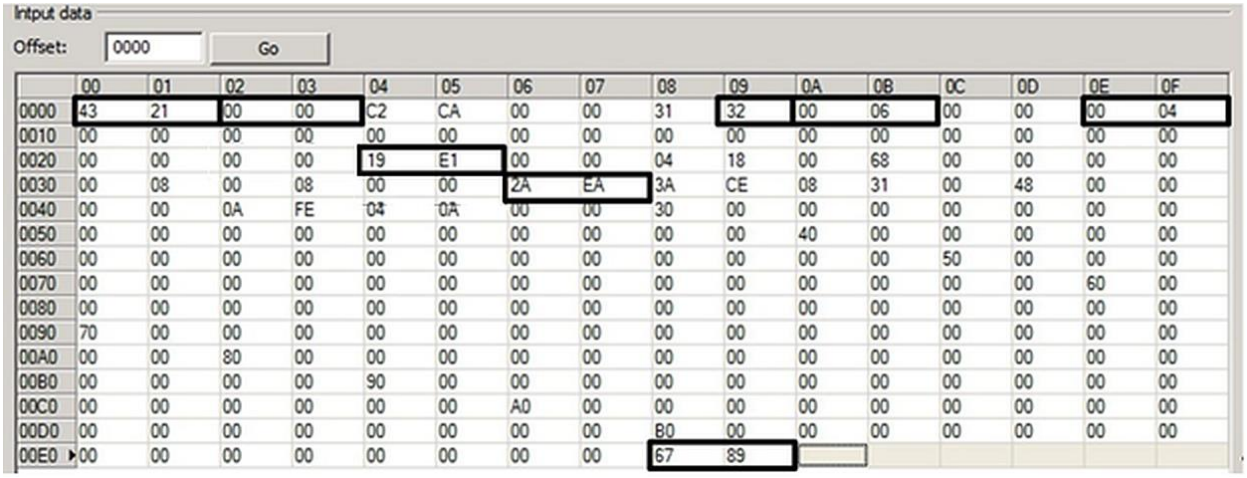
Example #1
Zero Based Address



Example #2
Modicon 5-Digit Address



Example #3
(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

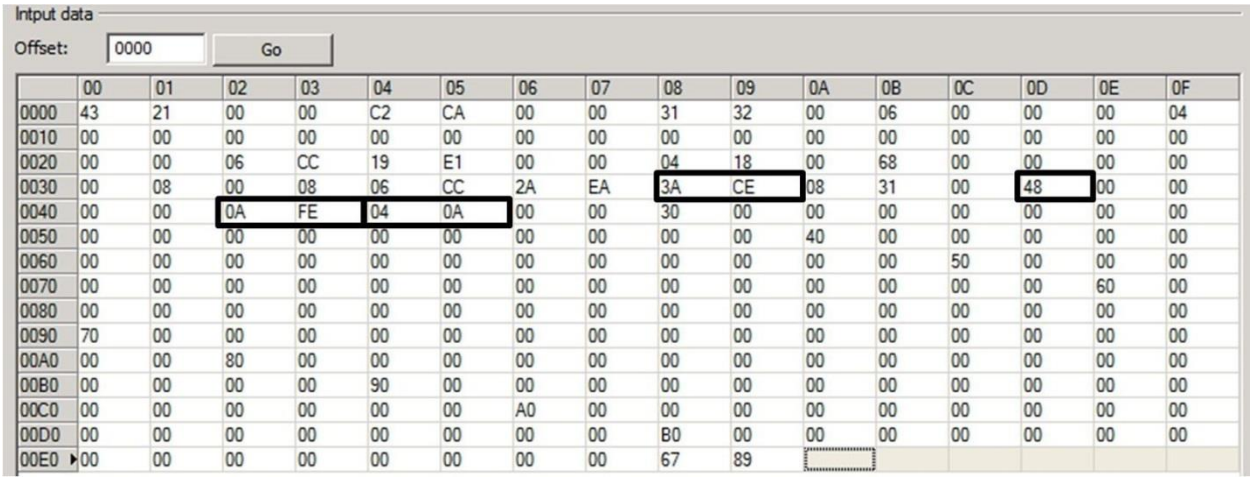
Web Voltages (WV#) data from each sensor module must be multiplied by a variable resolution to attain the actual web voltage. The value of the resolution depends on the maximum sensor voltage range, which in turn depends on the sensor mounting distance. The resolution is variable in order to gain the 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 max. operating range of +/- 20kV and the (decimal) resolution of the Web Voltage (WV#) data is **156.**

Example #4
(BPS, BPS-C, HL, HLC, IQ Easy, IQ Easy LP with Sensor)



	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.

Once connected, each ADI can be read as a holding register starting at address 256 (Zero Based addressing) or 40257 (Modicon 5-digit addressing).

ADI System

ADI# (decimal)	Zero Based Address (decimal)	Modicon 5-Digit Address (decimal)	Definition
1	256	40257	**Network Process Data Verification** Start-Of-Buffer marker used to verify network High/Low Byte alignment. [**HB**=0x43, **LB**=0x21]
2	257	40258	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	258	40259	Reserved
4	259	40260	Reserved
5	260	40261	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)	Zero Based Address (decimal)	Modicon 5-Digit Address (decimal)	Definition
6	261	40262	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	262	40263	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	263	40264	* 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)	Zero Based (decimal)	Modicon 5-Digit (decimal)	Definition
9	264	40265	Reserved [16-bit]
10	265	40266	Reserved [16-bit]
11	266	40267	Reserved [16-bit]
12	267	40268	Reserved [16-bit]
13	268	40269	Reserved [16-bit]
14	269	40270	Reserved [16-bit]
15	270	40271	Reserved [16-bit]
16	271	40272	Reserved [16-bit]
17	272	40273	Reserved [16-bit]

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

ADI# (decimal) / Zero Based Address (decimal)										Definition
Dev 1	**Dev 2**	**Dev 3**	**Dev 4**	**Dev 5**	**Dev 6**	**Dev 7**	**Dev 8**	**Dev 9**	**Dev 10**	
18 273	27 282	36 291	45 300	54 309	63 318	72 327	81 336	90 345	99 354	Reserved [16-bit]
19 274	28 283	37 292	46 301	55 310	64 319	73 328	82 337	91 346	100 355	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
20 275	29 284	38 293	47 302	56 311	65 320	74 329	83 338	92 347	101 356	[signed 16-bit] / 4 = I Neutralization (uA). **Note: 1, 4**
21 276	30 285	39 294	48 303	57 312	66 321	75 330	84 339	93 348	102 357	Reserved [16-bit]
22 277	31 286	40 295	49 304	58 313	67 322	76 331	85 340	94 349	103 358	Reserved [16-bit]
23 278	32 287	41 296	50 305	59 314	68 323	77 332	86 341	95 350	0x68 359	Reserved [16-bit]
24 279	33 288	42 297	51 306	60 315	69 324	78 333	87 342	96 351	105 360	Reserved [16-bit]
25 280	34 289	43 298	52 307	61 316	70 325	79 334	88 343	97 352	106 361	I pos (uA) [16-bit]
26 281	35 290	44 299	53 308	62 317	71 326	80 335	89 344	98 353	107 362	I neg (uA) [16-bit]

ADI Device 1 thru 10 BPS, BPS-C, HL, HLC, IQ Easy, IQ Easy LP (<u>without</u> Sensor) ADI# / Modicon 5-Digit Address

ADI# (decimal) / Modicon 5-Digit Address (decimal)										Definition
Dev 1	**Dev 2**	**Dev 3**	**Dev 4**	**Dev 5**	**Dev 6**	**Dev 7**	**Dev 8**	**Dev 9**	**Dev 10**	
18 40274	27 40283	36 40292	45 40301	54 40310	63 40319	72 40328	81 40337	90 40346	99 40355	Reserved [16-bit]
19 40275	28 40284	37 40293	46 40302	55 40311	64 40320	73 40329	82 40338	91 40347	100 40356	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 40276	29 40285	38 40294	47 40303	56 40312	65 40321	74 40330	83 40339	92 40348	101 40357	[signed 16-bit] / 4 = I Neutralization (uA). **Note: 1, 4**
21 40277	30 40286	39 40295	48 40304	57 40313	66 40322	75 40331	84 40340	93 40349	102 40358	Reserved [16-bit]
22 40278	31 40287	40 40296	49 40305	58 40314	67 40323	76 40332	85 40341	94 40350	103 40359	Reserved [16-bit]
23 40279	32 40288	41 40297	50 40306	59 40315	68 40324	77 40333	86 40342	95 40351	0x68 40360	Reserved [16-bit]
24 40280	33 40289	42 40298	51 40307	60 40316	69 40325	78 40334	87 40343	96 40352	105 40361	Reserved [16-bit]
25 40281	34 40290	43 40299	52 40308	61 40317	70 40326	79 40335	88 40344	97 40353	106 40362	I pos (uA) [16-bit]
26 40282	35 40291	44 40300	53 40309	62 40318	71 40327	80 40336	89 40345	98 40354	107 40363	I neg (uA) [16-bit]

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

ADI# (decimal) / Zero Based Address (decimal)										Definition
Dev 1	**Dev 2**	**Dev 3**	**Dev 4**	**Dev 5**	**Dev 6**	**Dev 7**	**Dev 8**	**Dev 9**	**Dev 10**	
18 273	27 282	36 291	45 300	54 309	63 318	72 327	81 336	90 345	99 354	I Positive (µA) [unsigned 16-bit]
19 274	28 283	37 292	46 301	55 310	64 319	73 328	82 337	91 346	100 355	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
20 275	29 284	38 293	47 302	56 311	65 320	74 329	83 338	92 347	101 356	**HB**: WV2 (V), **LB**: WV1 (V) 2 signed 8-bit bytes] **Note: 1,3,5**
21 276	30 285	39 294	48 303	57 312	66 321	75 330	84 339	93 348	102 357	I Negative (µA) [unsigned 16-bit]
22 277	31 286	40 295	49 304	58 313	67 322	76 331	85 340	94 349	103 358	**HB**: WV4 (V), **LB**: WV3 (V) [2 signed 8-bit bytes] **Note: 1,3,5**
23 278	32 287	41 296	50 305	59 314	68 323	77 332	86 341	95 350	0x68 359	**HB**: WV6 (V), **LB**: WV5 (V) * [2 signed 8-bit bytes] **Note: 1,3,5**
24 279	33 288	42 297	51 306	60 315	69 324	78 333	87 342	96 351	105 360	**HB**: WV8 (V), **LB**: WV7(V) * [2 signed 8-bit bytes] **Note: 1,3,5**
25 280	34 289	43 298	52 307	61 316	70 325	79 334	88 343	97 352	106 361	[signed16-bit] x 4 = Feedback Average (V) **Note: 1,2**
26 281	35 290	44 299	53 308	62 317	71 326	80 335	89 344	98 353	107 362	[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 BPS, BPS-C, HL, HLC, IQ Easy, IQ Easy LP with Sensor, ADI# / Modicon 5-Digit Address
(where device and sensor are paired AND use the same address)

ADI# (decimal) / Modicon 5-Digit Address (decimal)										Definition
Dev 1	**Dev 2**	**Dev 3**	**Dev 4**	**Dev 5**	**Dev 6**	**Dev 7**	**Dev 8**	**Dev 9**	**Dev 10**	
18 40274	27 40283	36 40292	45 40301	54 40310	63 40319	72 40328	81 40337	90 40346	99 40355	I Positive (µA) [unsigned 16-bit]
19 40275	28 40284	37 40293	46 40302	55 40311	64 40320	73 40329	82 40338	91 40347	100 40356	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 40276	29 40285	38 40294	47 40303	56 40312	65 40321	74 40330	83 40339	92 40348	101 40357	**HB**: WV2 (V), **LB**: WV1 (V) 2 signed 8-bit bytes] **Note: 1,3,5**
21 40277	30 40286	39 40295	48 40304	57 40313	66 40322	75 40331	84 40340	93 40349	102 40358	I Negative (µA) [unsigned 16-bit]
22 40278	31 40287	40 40296	49 40305	58 40314	67 40323	76 40332	85 40341	94 40350	103 40359	**HB**: WV4 (V), **LB**: WV3 (V) [2 signed 8-bit bytes] **Note: 1,3,5**
23 40279	32 40288	41 40297	50 40306	59 40315	68 40324	77 40333	86 40342	95 40351	0x68 40360	**HB**: WV6 (V), **LB**: WV5 (V) * [2 signed 8-bit bytes] **Note: 1,3,5**
24 40280	33 40289	42 40298	51 40307	60 40316	69 40325	78 40334	87 40343	96 40352	105 40361	**HB**: WV8 (V), **LB**: WV7(V) * [2 signed 8-bit bytes] **Note: 1,3,5**
25 40281	34 40290	43 40299	52 40308	61 40317	70 40326	79 40335	88 40344	97 40353	106 40362	[signed16-bit] x 4 = Feedback Average (V) **Note: 1,2**
26 40282	35 40291	44 40300	53 40309	62 40318	71 40327	80 40336	89 40345	98 40354	107 40363	[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# / Zero Based Address

ADI# (decimal) / Zero Based Address (decimal)										Definition
Dev 1	**Dev 2**	**Dev 3**	**Dev 4**	**Dev 5**	**Dev 6**	**Dev 7**	**Dev 8**	**Dev 9**	**Dev 10**	
18 273	27 282	36 291	45 300	54 309	63 318	72 327	81 336	90 345	99 354	**HB:** I Positive (µA) **LB:** I Negative (µA) [2-unsigned 8-bit bytes]
19 274	28 283	37 292	46 301	55 310	64 319	73 328	82 337	91 346	100 355	**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
20 275	29 284	38 293	47 302	56 311	65 320	74 329	83 338	92 347	101 356	Reserved [16-bit]
21 276	30 285	39 294	48 303	57 312	66 321	75 330	84 339	93 348	102 357	**HB:** Positive Drive (%) **LB:** Negative Drive (%) [2 unsigned 8-bit bytes]
22 277	31 286	40 295	49 304	58 313	67 322	76 331	85 340	94 349	103 358	Reserved [16-bit]
23 278	32 287	41 296	50 305	59 314	68 323	77 332	86 341	95 350	0x68 359	Reserved [16-bit]
24 279	33 288	42 297	51 306	60 315	69 324	78 333	87 342	96 351	105 360	Reserved [16-bit]
25 280	34 289	43 298	52 307	61 316	70 325	79 334	88 343	97 352	106 361	Reserved [16-bit]
26 281	35 290	44 299	53 308	62 317	71 326	80 335	89 344	98 353	107 362	Reserved [16-bit]

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

ADI Device 1 thru 10 Fantom (<u>without</u> Modular Sensor) ADI# / Modicon 5-Digit Address

ADI# (decimal) / Modicon 5-Digit Address (decimal)										Definition
Dev 1	**Dev 2**	**Dev 3**	**Dev 4**	**Dev 5**	**Dev 6**	**Dev 7**	**Dev 8**	**Dev 9**	**Dev 10**	
18 40274	27 40283	36 40292	45 40301	54 40310	63 40319	72 40328	81 40337	90 40346	99 40355	**HB:** I Positive (µA) **LB:** I Negative (µA) [2-unsigned 8-bit bytes]
19 40275	28 40284	37 40293	46 40302	55 40311	64 40320	73 40329	82 40338	91 40347	100 40356	**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 40276	29 40285	38 40294	47 40303	56 40312	65 40321	74 40330	83 40339	92 40348	101 40357	Reserved [16-bit]
21 40277	30 40286	39 40295	48 40304	57 40313	66 40322	75 40331	84 40340	93 40349	102 40358	**HB:** Positive Drive (%) **LB:** Negative Drive (%) [2 unsigned 8-bit bytes]
22 40278	31 40287	40 40296	49 40305	58 40314	67 40323	76 40332	85 40341	94 40350	103 40359	Reserved [16-bit]
23 40279	32 40288	41 40297	50 40306	59 40315	68 40324	77 40333	86 40342	95 40351	0x68 40360	Reserved [16-bit]
24 40280	33 40289	42 40298	51 40307	60 40316	69 40325	78 40334	87 40343	96 40352	105 40361	Reserved [16-bit]
25 40281	34 40290	43 40299	52 40308	61 40317	70 40326	79 40335	88 40344	97 40353	106 40362	Reserved [16-bit]
26 40282	35 40291	44 40300	53 40309	62 40318	71 40327	80 40336	89 40345	98 40354	107 40363	Reserved [16-bit]

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

ADI Device 1 thru 10 Fantom <u>with</u> Modular Sensor, ADI# / Zero Based Address (where Fantom and sensor are paired AND <u>use the same address</u>)

ADI# (decimal) / Zero Based Address (decimal)										Definition
Dev 1	**Dev 2**	**Dev 3**	**Dev 4**	**Dev 5**	**Dev 6**	**Dev 7**	**Dev 8**	**Dev 9**	**Dev 10**	
18 273	27 282	36 291	45 300	54 309	63 318	72 327	81 336	90 345	99 354	**HB:** I Positive (µA) **LB:** I Negative (µA) [2-unsigned 8-bit bytes]
19 274	28 283	37 292	46 301	55 310	64 319	73 328	82 337	91 346	100 355	**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
20 275	29 284	38 293	47 302	56 311	65 320	74 329	83 338	92 347	101 356	**HB**: WV2 (V), **LB**: WV1 (V) 2 signed 8-bit bytes] **Note: 1,3,5**
21 276	30 285	39 294	48 303	57 312	66 321	75 330	84 339	93 348	102 357	**HB:** Positive Drive (%) **LB:** Negative Drive (%) [2 unsigned 8-bit bytes]
22 277	31 286	40 295	49 304	58 313	67 322	76 331	85 340	94 349	103 358	**HB**: WV4 (V), **LB**: WV3 (V) [2 signed 8-bit bytes] **Note: 1,3,5**
23 278	32 287	41 296	50 305	59 314	68 323	77 332	86 341	95 350	0x68 359	Reserved [16-bit]
24 279	33 288	42 297	51 306	60 315	69 324	78 333	87 342	96 351	105 360	Reserved [16-bit]
25 280	34 289	43 298	52 307	61 316	70 325	79 334	88 343	97 352	106 361	[signed16-bit] x 4 = Feedback Average (V) **Note: 1,2**
26 281	35 290	44 299	53 308	62 317	71 326	80 335	89 344	98 353	107 362	[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 Fantom <u>with</u> Modular Sensor, ADI# / Modicon 5-Digit Address (where Fantom and sensor are paired AND <u>use the same address</u>)

ADI# (decimal) / Modicon 5-Digit Address (decimal)										Definition
Dev 1	**Dev 2**	**Dev 3**	**Dev 4**	**Dev 5**	**Dev 6**	**Dev 7**	**Dev 8**	**Dev 9**	**Dev 10**	
18 40274	27 40283	36 40292	45 40301	54 40310	63 40319	72 40328	81 40337	90 40346	99 40355	**HB:** I Positive (µA) **LB:** I Negative (µA) [2-unsigned 8-bit bytes]
19 40275	28 40284	37 40293	46 40302	55 40311	64 40320	73 40329	82 40338	91 40347	100 40356	**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 40276	29 40285	38 40294	47 40303	56 40312	65 40321	74 40330	83 40339	92 40348	101 40357	**HB**: WV2 (V), **LB**: WV1 (V) 2 signed 8-bit bytes] **Note: 1,3,5**
21 40277	30 40286	39 40295	48 40304	57 40313	66 40322	75 40331	84 40340	93 40349	102 40358	**HB:** Positive Drive (%) **LB:** Negative Drive (%) [2 unsigned 8-bit bytes]
22 40278	31 40287	40 40296	49 40305	58 40314	67 40323	76 40332	85 40341	94 40350	103 40359	**HB**: WV4 (V), **LB**: WV3 (V) [2 signed 8-bit bytes] **Note: 1,3,5**
23 40279	32 40288	41 40297	50 40306	59 40315	68 40324	77 40333	86 40342	95 40351	0x68 40360	Reserved [16-bit]
24 40280	33 40289	42 40298	51 40307	60 40316	69 40325	78 40334	87 40343	96 40352	105 40361	Reserved [16-bit]
25 40281	34 40290	43 40299	52 40308	61 40317	70 40326	79 40335	88 40344	97 40353	106 40362	[signed16-bit] x 4 = Feedback Average (V) **Note: 1,2**
26 40282	35 40291	44 40300	53 40309	62 40318	71 40327	80 40336	89 40345	98 40354	107 40363	[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 or HL Sensor Interface or Sensor Bar only, ADI# / Zero Based Address
(where sensor is the only device occupying a given address)

ADI# (decimal) / Zero Based Address (decimal)										Definition
Dev 1	**Dev 2**	**Dev 3**	**Dev 4**	**Dev 5**	**Dev 6**	**Dev 7**	**Dev 8**	**Dev 9**	**Dev 10**	
18 273	27 282	36 291	45 300	54 309	63 318	72 327	81 336	90 345	99 354	Reserved [16-bit]
19 274	28 283	37 292	46 301	55 310	64 319	73 328	82 337	91 346	100 355	**HB:** B[15] thru B[8]: Reserved **LB: Sensor Bar / 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
20 275	29 284	38 293	47 302	56 311	65 320	74 329	83 338	92 347	101 356	**HB**: WV2 (V), **LB**: WV1 (V) 2 signed 8-bit bytes] **Note: 1,3,5**
21 276	30 285	39 294	48 303	57 312	66 321	75 330	84 339	93 348	102 357	Reserved [16-bit]
22 277	31 286	40 295	49 304	58 313	67 322	76 331	85 340	94 349	103 358	**HB**: WV4 (V), **LB**: WV3 (V) [2 signed 8-bit bytes] **Note: 1,3,5**
23 278	32 287	41 296	50 305	59 314	68 323	77 332	86 341	95 350	0x68 359	**HB**: WV6 (V), **LB**: WV5 (V) * [2 signed 8-bit bytes] **Note: 1,3,5**
24 279	33 288	42 297	51 306	60 315	69 324	78 333	87 342	96 351	105 360	**HB**: WV8 (V), **LB**: WV7(V) * [2 signed 8-bit bytes] **Note: 1,3,5**
25 280	34 289	43 298	52 307	61 316	70 325	79 334	88 343	97 352	106 361	[signed 16-bit] x 4 = Feedback Average (V) **Note: 1, 2**
26 281	35 290	44 299	53 308	62 317	71 326	80 335	89 344	98 353	107 362	[signed 16-bit] x 4 = Overall Average (V) **Note: 1,2**

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

ADI Device 1 thru 10 Modular Sensor or HL Sensor Interface or Sensor Bar only, ADI# / Modicon 5-Digit Address
(where sensor is the only device occupying a given address)

ADI# (decimal) / Modicon 5-Digit Address (decimal)										Definition
Dev 1	**Dev 2**	**Dev 3**	**Dev 4**	**Dev 5**	**Dev 6**	**Dev 7**	**Dev 8**	**Dev 9**	**Dev 10**	
18 40274	27 40283	36 40292	45 40301	54 40310	63 40319	72 40328	81 40337	90 40346	99 40355	Reserved [16-bit]
19 40275	28 40284	37 40293	46 40302	55 40311	64 40320	73 40329	82 40338	91 40347	100 40356	**HB:** B[15] thru B[8]: Reserved **LB: Sensor Bar / 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 40276	29 40285	38 40294	47 40303	56 40312	65 40321	74 40330	83 40339	92 40348	101 40357	**HB**: WV2 (V), **LB**: WV1 (V) 2 signed 8-bit bytes] **Note: 1,3,5**
21 40277	30 40286	39 40295	48 40304	57 40313	66 40322	75 40331	84 40340	93 40349	102 40358	Reserved [16-bit]
22 40278	31 40287	40 40296	49 40305	58 40314	67 40323	76 40332	85 40341	94 40350	103 40359	**HB**: WV4 (V), **LB**: WV3 (V) [2 signed 8-bit bytes] **Note: 1,3,5**
23 40279	32 40288	41 40297	50 40306	59 40315	68 40324	77 40333	86 40342	95 40351	0x68 40360	**HB**: WV6 (V), **LB**: WV5 (V) * [2 signed 8-bit bytes] **Note: 1,3,5**
24 40280	33 40289	42 40298	51 40307	60 40316	69 40325	78 40334	87 40343	96 40352	105 40361	**HB**: WV8 (V), **LB**: WV7(V) * [2 signed 8-bit bytes] **Note: 1,3,5**
25 40281	34 40290	43 40299	52 40308	61 40317	70 40326	79 40335	88 40344	97 40353	106 40362	[signed 16-bit] x 4 = Feedback Average (V) **Note: 1, 2**
26 40282	35 40291	44 40300	53 40309	62 40318	71 40327	80 40336	89 40345	98 40354	107 40363	[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).

ADI Device 11 (Reserved / Not Applicable)

ADI# (decimal)	Zero Based Address (decimal)	Modicon 5-Digit Address (decimal)	Definition
108	363	40364	Reserved [16-bit]
109	364	40365	Reserved [16-bit]
110	365	40366	Reserved [16-bit]
111	366	40367	Reserved [16-bit]
112	367	40368	Reserved [16-bit]
113	368	40369	Reserved [16-bit]
114	369	40370	Reserved [16-bit]
115	370	40371	Reserved [16-bit]
116	371	40372	Reserved [16-bit]

ADI System

ADI# (decimal)	Zero Based Address (decimal)	Modicon 5-Digit Address (decimal)	Definition
117	372	40373	**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

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

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

Downstream

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

σ – average charge density on the web, *coulombs/m*^{2}. 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*

ε_o = 8.8542 x 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)

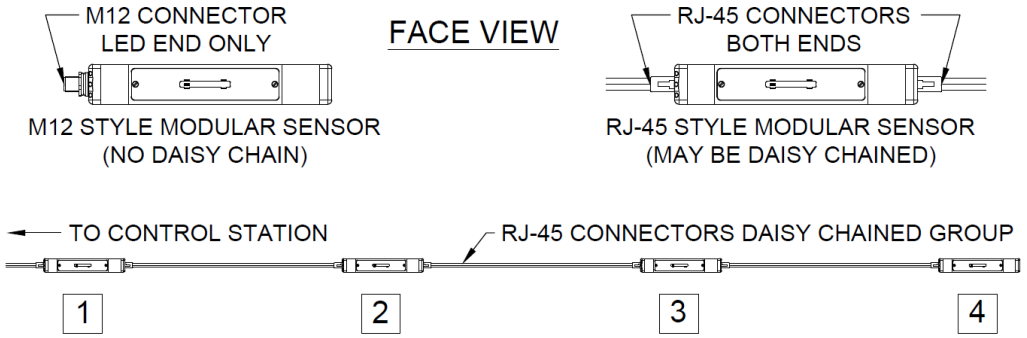
The description of the sensor values will vary based on the installation configuration, and the type of product connected to the IQ Power Control Station.

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 <u>selected</u> Modular Sensors at a given Control Station Address.
Overall Average is from <u>all</u> 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**

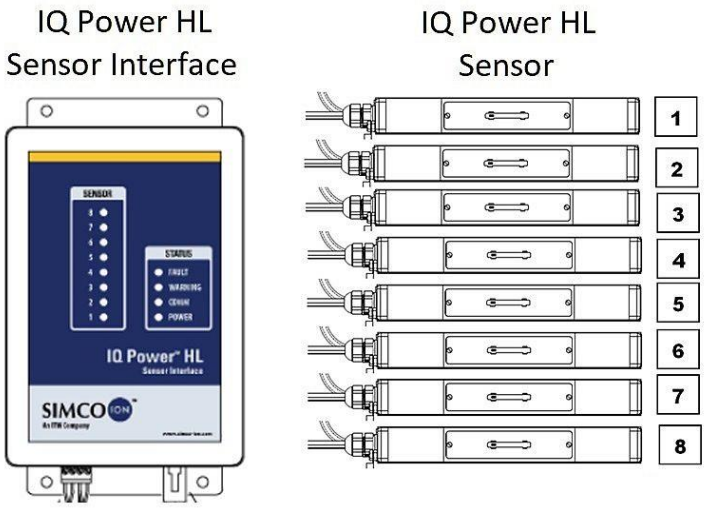
The PLC data buffer also includes a separate Overall and Feedback (CLFB) Average voltage value. The ADI mapping defines the location of these Average voltages in the PLC data buffer if applicable to the Fieldbus interface.

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	12/14/2018	Initial Release
B	1/4/2021	ECN 4152, Added IQ Easy LP
C	2/8/21	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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