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IF-006

Layer N Wireless Universal Smart Interface

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1 Layer N Smart Interface Introduction

The Layer N IF-006 Wireless Universal Smart Interface is designed to be used in conjunction with Layer N Smart Probes. The two elements snap together with a twist of an M12 connector to create a universal solution for any sensor application. Sensor installations can be further customized using M12 modular extension cables to quickly tailor solutions for any application. A wide variety of Layer N Smart Probes are available to create a customized wireless solution that fits your application. Including temperature, humidity, pressure, light, thermocouple, RTD, process, count, pulse, load cell, heat flux, and more.

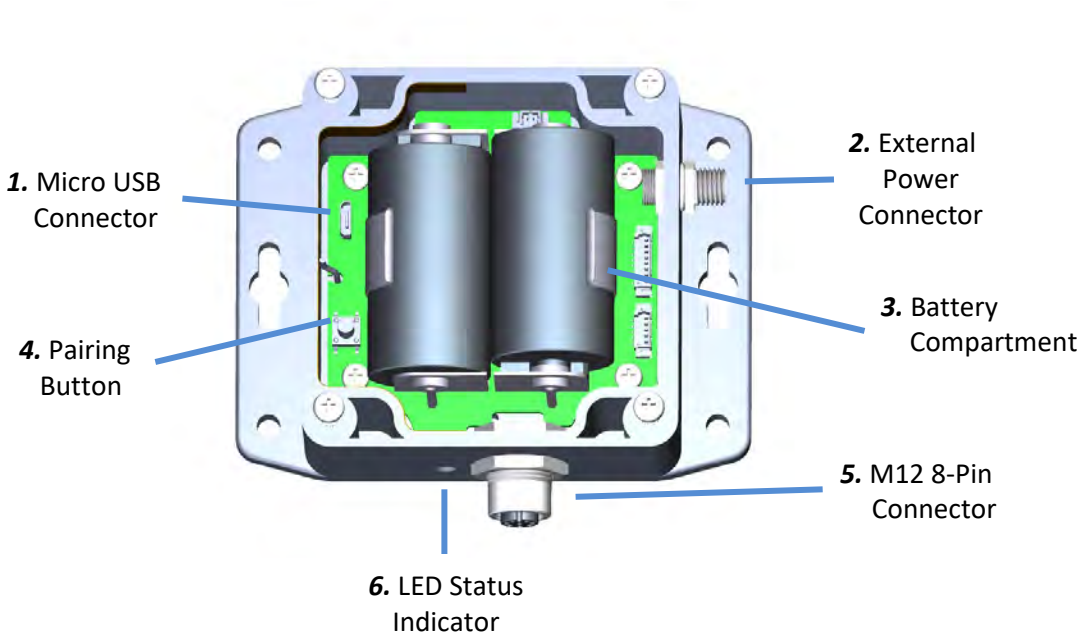
The IF-006 is easily paired to the Layer N Gateway with the press of a button and will automatically show up on your Layer N Cloud account. Local data logging keeps your data secure in the event of a power or network outage. Reports, History, and E-mail alerts from the Layer N Cloud keep you informed on the status of all your vital processes.

Layer N Smart Probes are fully configurable using your IF-006 unit and our free SYNC configuration software. An integrated Command Line Interface allows for quick serial configuration of your IF-006 using any standard terminal emulator.

Layer N wireless products are designed with robust AES256 encryption and advanced PKA-EC521bit (NIST) elliptic-curve cryptography to protect your data. Password protection ensures that access to device data is restricted and only accessible by authorized users. Device Authentication ensures that Layer N Smart Probes connect to validated Omega devices.

1.1 IF-006 Internal View

Refer to the following internal diagram of the IF-006 unit.



IF-006 Features	Description
1. Micro USB Connector	Used for SYNC configuration.
2. External Power Connector	M8 Connector 5V External Power. Keep covered if not in use.
3. Battery Compartment	Used for Battery Powered operation of device.
4. Pairing Button	Used to pair IF-006 device to Layer N Gateway. See Section **6 Pairing IF-006 to Layer N Gateway.**
5. M12 8-Pin Connector	M12 Connector Smart Probe Interface. See Section **3 *Layer N IF-006 Setup.***
6. LED Status Indicator	LED indicating the status of the IF-006 unit. See Section ***6 Pairing IF-006 to Layer N Gateway***.

2 Before You Begin

Before you begin setting up your IF-006, ensure you have created a Layer N Cloud account and registered your Gateway at cloud.omega.com. After registering your Gateway, it will automatically download the latest Gateway firmware revision and re-boot. Once the Gateway is registered and the pairing button LED is Green you may continue with the IF-006 installation.

Note **Important:** If you are adding and IF-006 to an existing Layer N Gateway it is required to update your Gateway to firmware version 1.0.9 or higher to ensure your Gateway and IF-006 communicate and operate correctly. Please follow the steps below to update your Gateway if needed.

Step 1: In the Layer N Cloud Interface, click the icon associated with the Gateway you will update.

Step 2: Click ***Update Firmware***.

Step 3: Click ***Confirm Update*** to finalize.

Note **Important:** During the update process, your Gateway will not be able to send or receive readings until the update process is complete.

3 Layer N IF-006 Setup

The setup your Layer N IF-006, follow these directions:

Step 1: Attach your preferred Layer N Smart Probe to the M12 8-pin female connector of the IF-006. (Some smart probes may require an M12 interconnect cable or additional accessories).

Step 2: If you are attaching an external probe or sensor to your Layer N Smart Probe, such as a thermocouple, attach it now.

Step 3: Use a Philips screwdriver to remove the 4 screws on the top cover of the IF-006 unit.

Step 4: Insert 2x C-Cell batteries into the battery compartment or plug in an external power source (external power only available on certain models).

The LED Status Indicator on the IF-006 unit will illuminate a *Solid Amber* light indicating that the device has been successfully powered on and is not yet connected to a Layer N Gateway.

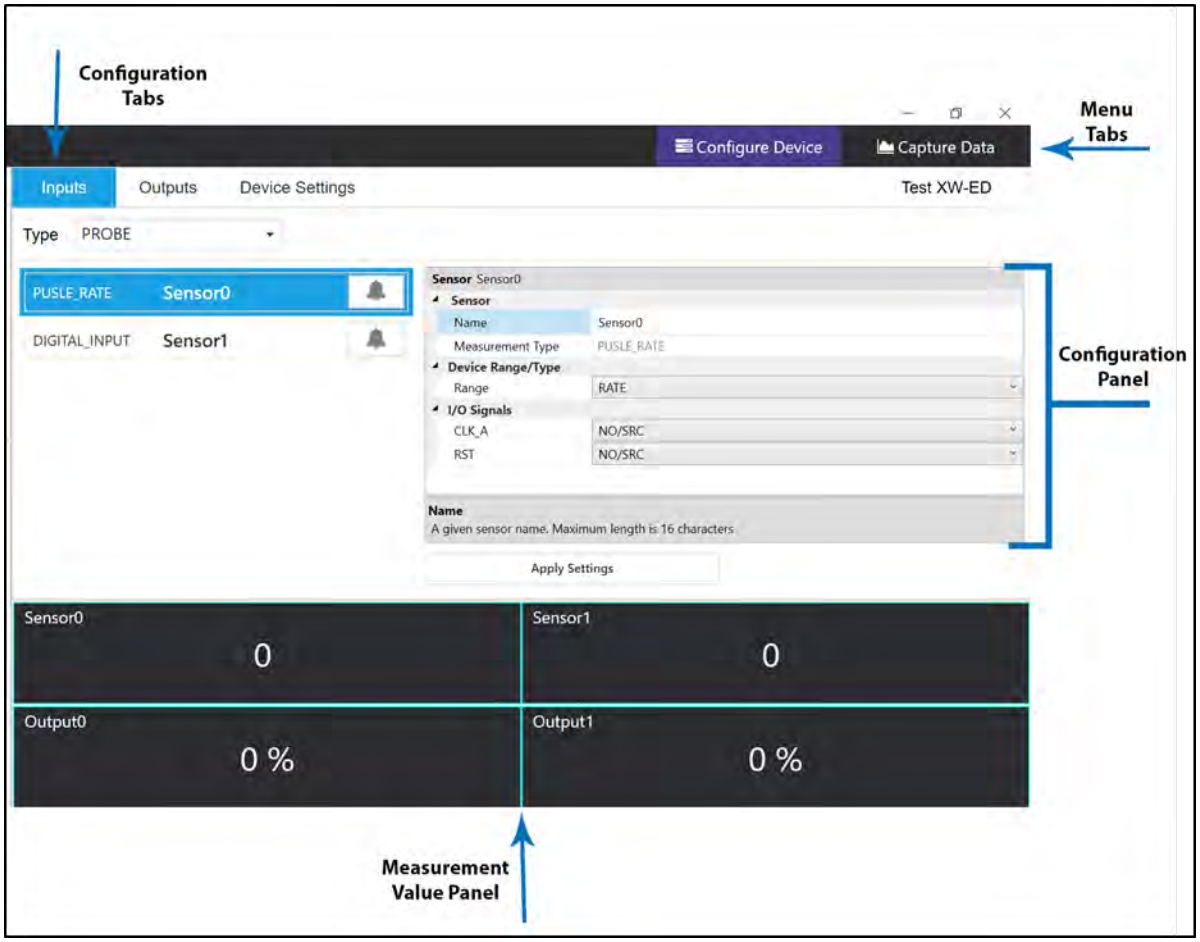
4 SYNC Configuration

The IF-006 and a connected Layer N Smart Probe can be configured using Omega's SYNC configuration software. To begin, launch the SYNC configuration software on your PC or laptop and connect your Layer N IF-006 using a micro USB 2.0 cable.

Once your Layer N IF-006 and Smart Probe are connected to SYNC, you will immediately see readings appear on the SYNC interface.

4.1 Configuring A Smart Probe

Certain Layer N Smart Probes may need to be configured to read an external sensor. Smart Probes can be configured while connected to an IF-006 unit. To configure a Layer N Smart probe that is connected to an IF-006 using SYNC, navigate to the ***Inputs*** configuration tab of the SYNC interface.



Depending on the type of Smart Probe connected, you will be presented a variety of configuration options. The **Type** dropdown allows the user to select which sensor to use if multiple sensors are available (such as Thermocouple or RTD on an SP-005) and should be the first thing to be configured. To ensure your Smart Probe is providing data in the correct units, click the **Device Range/Type** dropdown in the SYNC interface and choose your device type. The **Device Range/Type** is a secondary selection once the **Type** has been selected. For additional configuration options associated with your specific Smart Probe, refer to the Smart Probe User Documentation for your device.

Note: Some Layer N Smart Probes can provide data in different units, such as the SP-014 providing readings in *mA* or *mV*. Ensure your Smart Probe is set to the correct **Device Range/Type**.

4.2 High Power/Low Power Mode

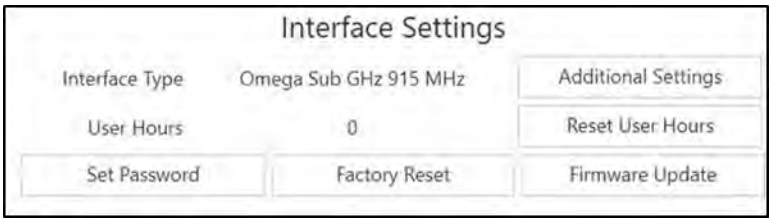
The default Low Power Mode range of the IF-006 transmits up to 1.2km with a clear line of sight. The North American variants of the Layer N IF-006 offer a ***High Power Mode*** feature that boosts the wireless transmit signal range of the device to 3.2km with a clear line of sight.

Note: Utilizing High Power Mode will lower the battery life of the IF-006. Refer to the table below for battery life estimations based on transmit power and update time.

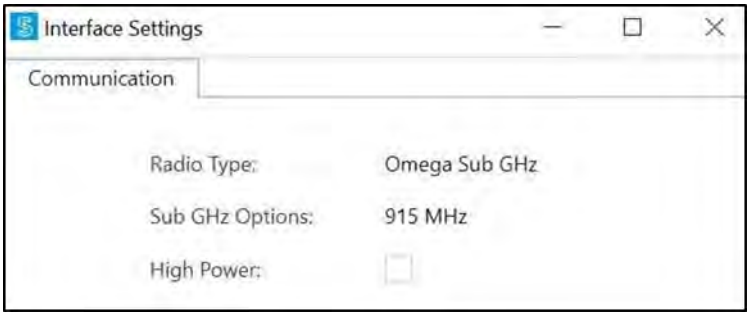
Transmit Power	Update Time	Battery Life*
Low	2 minutes	2 years
Low	90 minutes	5+ years
High	2 minutes	1 year
High	90 minutes	3 years

**Typical. Actual battery life may vary depending on the connected sensor, signal strength, and environmental conditions.*

To utilize High Power Mode, navigate to the ***Device Settings*** tab in the SYNC interface. Click ***Additional Settings*** under the ***Interface Settings*** section.

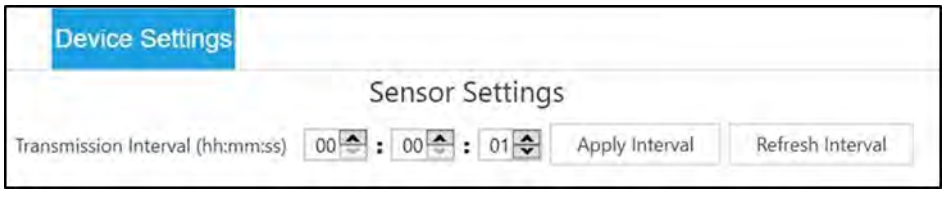


Check the ***High Power Mode*** box to enable it.



4.3 Transmit Interval

The Transmit Interval determines the time between readings for the Smart Probe. Probes connected to the IF-006 will have their transmit interval automatically set to 10 seconds if it is set to a number less than that to prevent wireless congestion. This transmit interval will also be reset to your minimum interval based on your Layer N Cloud account level once the IF-006 is paired. The Transmit Interval can be adjusted by navigating to the ***Device Settings*** tab in the SYNC interface and will appear beneath the ***Sensor Settings*** section.

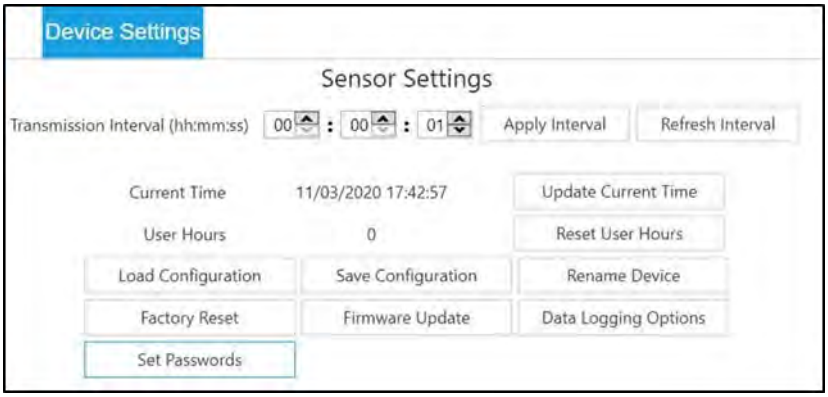


Note: SYNC can also be used to set passwords for your Layer N Smart Probes (refer to section ***5 Setting Passwords***). For more information on Omega's SYNC configuration software, refer to the SYNC User's Manual.

5 Setting / Changing Passwords

Layer N Smart Probe data can be password protected through SYNC. Password protecting your smart probe prevents data in the Smart Probe from being extracted without authorization. If your Smart Probe is password protected, the password must be stored in the IF-006 so it can transmit data to the Layer N Cloud. To assign a password to your Layer N Smart Probe, follow these instructions:

Step 1: Navigate to the ***Device Settings*** tab in the SYNC interface and click ***Set Passwords*** under the ***Sensor Settings*** section.



Step 2: Create a Configuration Password. Upon saving your password, you will be prompted to update the Interface Password as well to ensure your data is transmitted to the Layer N Cloud.

Note **Important:** If the interface password does not match the configuration password, data from your Smart Probe will not be sent to the Cloud and the LED Status Indicator on the IF-006 will flash Red and Green indicating there is an error.

5.1 Save Password

Password protects the SYNC configurable features of your Smart Probe and saves the newly entered password if it is successfully entered and confirmed in both text fields.

5.2 Clear Password

The Clear Password button removes the password protection from the probe.

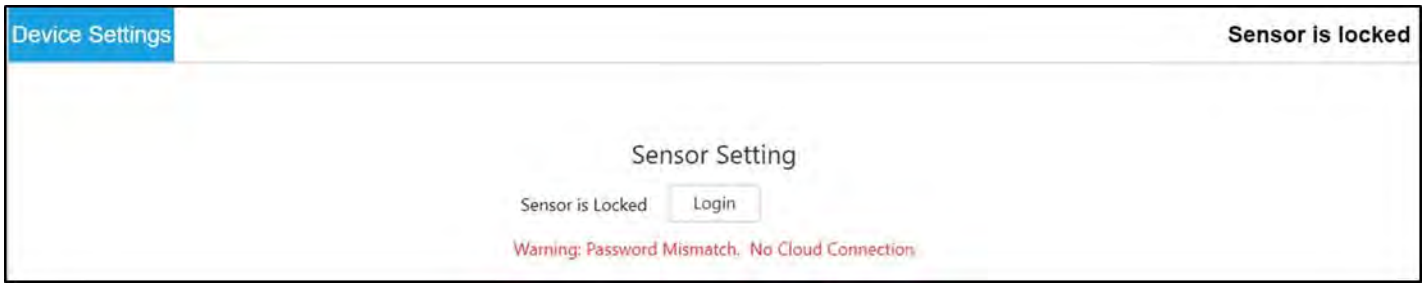
5.3 Login

Click the login button after entering your device password to access the configurable features.

5.4 Reset

The Reset Password button deletes the current password on the device. This will cause all logged data to be erased.

After 3 failed login attempts, it is required to power cycle the device before trying to login again.



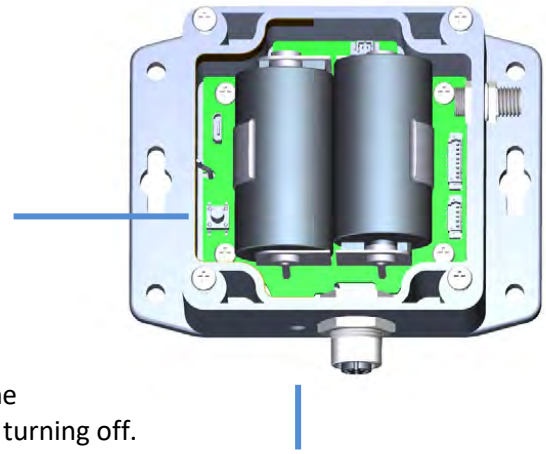
6 Pairing IF-006 to Layer N Gateway

Important: The IF-006 unit must be in close proximity to the Layer N Gateway during the pairing process. After pairing, the IF-006 can be moved to its final location.

The IF-006 wirelessly communicates to a Layer N Gateway to send your data to the Layer N Cloud. To pair your IF-006 to a Layer N Gateway, follow these instructions:

Step 1: Use a Philips screwdriver to remove the 4 screws on the top cover of your IF-006 unit if you have not already done so. Push the pairing button once on your IF-006. The LED Status Indicator will blink green indicating it is in *Pairing Mode*.

Step 2: Quickly push the pairing button once on your Layer N Gateway and the LED on the Gateway will blink green indicating the Gateway is in Pairing Mode.



When the IF-006 has been successfully paired to your Layer N Gateway the IF-006 LED will blink amber several times before blinking green once and turning off. The IF-006 LED will flash a green light each time data is sent to the gateway. Once you have completed the pairing process, you may use a Philips screwdriver to replace the cover on your IF-006. Your Smart Probe will appear as a listed device connected to your Gateway on the Layer N Cloud and can be identified by the MAC Address listed on the back of the IF-006 unit.

LED Status Indicator	
Color	**Status**
Amber (Solid)	IF-006 powered on; not connected to Gateway
Green (Blinking)	IF-006 in Pairing Mode
Amber (Blinking)	IF-006 searching for Gateway
Green (Flash)	IF-006 communicating to Gateway
Red and Green (Blinking)	Password Error

Note: The number of measurements displayed on the Layer N Cloud depends on the type of sensor purchased and the frequency of measurement updates depends on your Layer N Cloud subscription.

6.1 Reset Pairing

To reset the IF-006 and Gateway pairing, hold the pairing button down on the IF-006 until the LED Status Indicator is blinking Red. Release the button and the LED will return to Solid Amber indicating it is waiting to be paired.

7 IF-006 Interface

The IF-006 interface allows the radio or USB interface to directly access the externally attached smart sensor register space. If no smart sensor is attached attempts to access the smart sensor register space will return a or INVALID REGISTER (Modbus interface). Refer to the Smart Sensor Interface specification for a complete description of the smart sensor register space.

7.1 IF-006-1 USB (Serial) Packet Format

Communications to the IF-006 are based on Serial data frames. For serial terminal sessions and Modbus ASCII interaction the 'transaction' ends on the receipt of a CR (0x0d) character. For Modbus RTU transactions the entire transaction must adhere to the Modbus serial RTU time specifications.

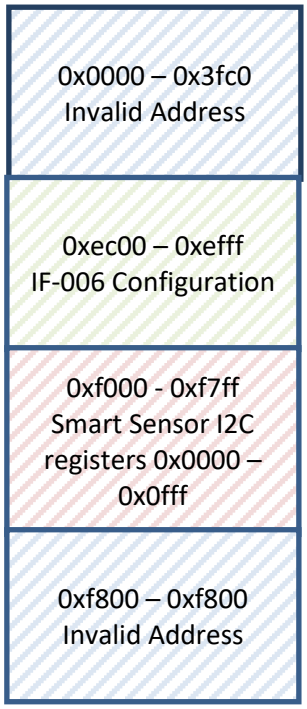
The IF-006 uses the ***first byte*** of the transaction (Start of Frame character) to determine the type of transaction. For the Modbus ASCII protocol the ascii '#' character denotes the start of the frame. For the CLI interface the first character denotes the operation to be performed as indicated in the table below. Any other byte value appearing in the start of the frame is interpreted as a Modbus RTU Modbus device address. Note that this requires excluding several Modbus addresses in the RTU mode, but in most cases, this will have no impact.

Refer to the Smart Sensor Command Line Interpreter documentation for further details on the interactive command line mode commands.

SoF Character	Hex	Interpretation
#	0x23	CLI Comment line (ignored)
:	0x3a	Start of Fame for Modbus ASCII frame
?	0x3f	CLI 'Help' command – display command / current state summary
C	0x49	CLI 'Configure' command – configure smart sensor device
I	0x4c	CLI 'Interface' command – configure interface device (IF-006)
O	0x4F	CLI 'Options' command – configuration options
R	0x52	CLI 'Read' command – Read any Smart Sensor register
T	0x54	CLI 'Trigger' command – trigger and event on smart sensor device
V	0x56	CLI 'View' command – view smart sensor data and status information
W	0x57	CLI 'Write' command – Write any Smart Sensor register
<any other>	<any other>	Indicates Register address for a Modbus RTU frame.

7.2 IF-006-1 Configuration Register Mapping

The IF-006 accepts USB (Serial) Modbus RTU packets and maps the Modbus register addresses to internal configuration registers and to external I2C registers.



Register addresses 0x0000 – 0x3fc0 and addresses 0xf800 – 0xffff are not recognized and will result in an INVALID ADDRESS response.

Registers 0xec00 – 0xefff are reserved for configuration of the IF006.

Registers 0xf000 – 0xf7fff are mapped to the external I2C device(s).

7.3 IF-006-1 Configuration Registers

The IF-006-1 Configuration registers are stored in non-volatile memory. Changes to the serial configuration and Modbus address take affect at the completion of the Modbus transaction.

	MB Register	Type	Access	Description Status
Reserved	0xec00	u16[16]	--	Reserved, return Invalid Address
I2C_Read Errors	0xefd0	u32	R	Number of Read errors
I2C_Write_Errors	0xefd2	u32	R	Number of Write errors
I2C_Read Retries	0xefd4	u32	R	Number of Read Retries
I2C_Write_Retries	0xefd6	u32	R	Number of Write Retries
I2C_Indirect_Retries	0xefd8	u32	R	Number of Read Retries
I2C_Read_Request	0xefda	u32	R	Number of read requests
I2C_Write_Request	0xefdc	u32	R	Number of write requests
Reserved	0xefda	--	--	Reserved, return Invalid Address
PROBE_PROCESS_STATE	0xefdf	u16	R	State variable- internal use only
INTERFACE_ PASSWORD	0xefe0	u8[16]	RW*	Read back as 0x01.. (blank) or 0x00 (non blank)
DEVICE_ID	0xefe8	u8[8]	RW*	Read only, but used as part of Boot load access mechanism
FW_VERSION	0xefec	u32	RW*	Read only but used as part of Boot load access mechanism. Formatted as MM.mm.bb.cc
HW_VERSION	0xefee	u32	R	Formatted as MM.mm.bb.cc
DEVICE_TYPE	0xeff0	u16	R	**0xff05 == IF-006**
SYSTEM CONTROL	0xeff1	u16	R/W	System Control (See below)
I2C_BASE_ADDRESS	0xeff2	u16	R/W	Defaults to 0x68. Sets base address of I2C device(s).
I2C_SPEED	0xeff3	u16	R/W	I2C bus speed in kHz, ie 40 == 40 kbit/second
SERIAL_CONFIG	0xeff4	u16	R/W	See Serial Configuration Word
MODBUS_ADDRESS	0xeff5	u16	R/W	Defaults to 1. Sets based address for Modbus transactions. Limited to 1 .. 247.
ADDRESS_RANGE	0xeff6	u16	R/W	Set to 0. No multi-device support
SYSTEM_STATUS	0xeff7	u16	R	System Status
MANUFACTURED_DATE	0xeff8	u16	R	Bit packed value with format YYYYYYY.MMMM.DDDDD
USER_HOURS	0xeff9	u16	R/W	User settable counter, increments every 3600 seconds
OPERATING_TIME	0xeffa	u32	R	Total number of seconds of operation
CORE_VERSION	0xeffc	U32	--	Formatted as MM.mm.bb.cc
INTERFACE_CONTROL	0xeffe	u16	R	See Below
GATEWAY_CONTROL	0xefff	u16	R	Reserved

7.3.1 I2C Stats

Modbus registers 0xefd0 to 0xefd9 provide access to statistics indicating the number of I2C errors and retries. The Retry counts indicate the number of transactions that resulted in a NAK.

When a NAK is detected the IF-006 will automatically generate up to 3 retries. If a NAK is detected on the 3rd attempt the transaction is dropped, an error is reported and the Read or Write Error count is incremented.

The Indirect Retry count is incremented if a NAK is generated when writing the Indirect register (0x0030).

7.3.2 Interface Password

The Interface password (IPW) is used when enumerating a device. If it matches the UPW of the attached device access will be allowed between the I2C (radio) channel and the attached device and the Password Error (PE) bit will be cleared.

If the IPW does not match the UPW the System Status PE bit will be set and no access to the radio channel will be allowed. If the Password Valid bit is set and the IPW being written matches the VPW the PE bit will be cleared.

Note: Writing to the IPW does not affect the UPW of the attached probe.

7.3.3 Device ID

A unique Device Identifier for the IF-006.

7.3.4 FW Version

Firmware version for the IF-006

7.3.5 HW Version

Hardware version for the IF-006

7.3.6 Device Type

A 16-bit value (0xff05) indicating the type of interface.

7.3.7 System Control

The System Control register determines how the IF-006 interacts with the attached probe.

Note: The System Control register shares the Authentication Required, Force Enumeration, Password Required and Password Auto Reset controls with the Extension Space control register.

System Control Register							
7	6	5	4	3	2	1	0
	CLI	HEX	VERBOSE			INTR MODE	
	0 ON 1 OFF	0 ON 1 OFF	0 ON 1 OFF	0 ON 1 OFF	0 ON 1 OFF	0 Ignore	
15	14	13	12	11	10	9	8
Auth Required	BOOT Mode		Reset Stats		Device Reset	Factory Reset	Force Enum.
0 ON 1 OFF							

7.3.7.1 INTR Mode

The INTR Mode determines how the Smart Probe INTR signal is handled. The IF-006 platform forces this to IGNORE.

7.3.7.2 Verbose

The Verbose mode causes expanded information when using the IF-006 in the CLI mode.

7.3.7.3 Hex

The Hex mode causes the data to be displayed as HEX values in the CLI mode.

7.3.7.4 CLI Enable

The CLI enable bit enables the CLI command interpreter.

7.3.7.5 Force Enumeration

If set, the enumeration process will be re-applied to the probe.

7.3.7.6 Device Reset

Setting the Device Reset bit will force the device to re-initialize using the current configuration information.

7.3.7.7 Factory Reset

Setting the Factory Reset bit will force a factory reset and all configuration parameters will be returned to the initial factory default values.

7.3.7.8 Shutdown

The MSP processor advises the radio subsystem when power is too low to continue operation thru the Reset Pending status bit. After appropriate processing by the radio subsystem it should set the Shutdown bit in the control register which will force the MSP processor to shut down the sensor interface.

Failure to generate the Shutdown command may lead to unstable operation as the measured battery voltage continues to degrade.

7.3.7.9 Reset Stats

The Reset Stats bit will force the I2C Statistic counters to be reset to 0.

7.3.7.10 Boot Mode

Setting the Boot Mode bit forces the devices into a boot strap mode. Once entered the device only accepts bootstrap records allowing firmware upgrades. The Boot Mode flag always reads back as 0.

7.3.7.11 Authentication Required

If set, Probe Authentication is applied when probes are enumerated.

7.3.8 Serial Configuration Word

All serial line configuration is done thru the serial channel using Modbus or CLI commands and the configuration information is retained in non-volatile memory. When altering the communications parameters any changes occur after the acknowledgement of the Modbus command.

The device serial configuration word is located at Modbus register address 0xeff4.

Serial Configuration							
7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Reserved		**Data Width**	**Stop Bits**	**Parity**		**Baud Rate**	
		0 7 Stop Bits **1 8 Data Bits**	**0 1 Stop** 1 2 Stop	0 No Parity 1 Mark Parity 2 Odd Parity **3 Even Parity**		0 9600 1 19,200 2 38,400 **3 115,200**	
15	**14**	**13**	**12**	**11**	**10**	**9**	**8**
Reserved							

7.3.9 Multi-Device Support

The IF-006 does not support multiple Smart Probes. The Modbus Range value is forced to 0.

7.3.10 Interface Control

The Interface Control register determines the characteristics of the IF-006 radio interface.

Note: The Interface Control register is directly mapped to the Extension Space control register on the IF-006. Access may be made thru either the IF-006 Interface Control register (0xeffe) or the IF-006 Extension space register (0xf700).

Interface Control Register							
7	6	5	4	3	2	1	0
Radio Type							
< see below >							
15	14	13	12	11	10	9	8
Radio Options							
< see below >							

7.3.10.1 Radio Type

The radio type field provides support for Sub GHz radio technology.

Radio Type			
None	0	0	0
Omega Sub Ghz	**0**	**0**	**1**
Reserved	.	.	.

7.3.10.2 Sub GHz Radio Options

The Radio Option byte provides additional configuration control and is radio specific.

Sub GHz Radio Configuration								
	15	14	13	12	11	10	9	8
		Reserved				Band		
Omega Sub Ghz (915 Mhz)						**0**	**0**	**1**
Omega Sub Ghz (816 Mhz)						0	1	0
Reserved								
Sub Ghz High Power Enable	X							

7.3.10.3 Sub Ghz Power

The Sub GHz Power level bit enables the Power Amplifier on the Sub Ghz radio assembly.

7.3.11 System Status

The System Status register provides information on the IF-006 connection to an attached probe. Some information is duplicated in the Extension Space status register. It is recommended that the IF-006 Configuration Status register is used for system configuration tools.

System Status Register							
7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Password Valid (PV)	**Enumerate Probe (EP)**	**Power Fault (PF)**	**Passwords Active (PA)**	**User PW Pending (UPP)**	**Password Error (PE)**	**Auth. Error (AE)**	**Probe Attached (PR)**
15	**14**	**13**	**12**	**11**	**10**	**9**	**8**
Device Ready	**Bootstrap Pending**						

7.3.11.1 Probe Attached

The Probe attached (PR) bit is set when a smart probe is detected by the IF-006. The IF-006 will periodically check the ability to access the probe and will clear this bit if the probe is detached. This status information is also available in the IF-006 configuration ***status*** register.

7.3.11.2 Authentication Error

If the Authentication Required control bit is set both the attached probe ***and*** the IF-006 execute a secure authentication sequence using a shared Private Key and 128-bit AES encrypted handshaking. If the authentication process fails, the Authentication Error (PE) bit is set and data cannot be accessed on the attached probe.

7.3.11.3 Password Error

If the internal IPW value does not match the non-blank UPW of the probe the Password Error (PE) bit is set and data will not be available to the radio interface..

7.3.11.4 User Password Pending

The User Password Pending bit is set during enumeration if the attached probe UPW is non-blank. It is cleared by writing the value UPW string thru the USB interface.

7.3.11.5 Power Fault

A power fault was detected on the external probe. The bit will be cleared when the overload condition has been removed.

7.3.11.6 Enumerating Probe

The Enumerating Probe (EP) bit is set while the interface is in the process of enumerating the attached probe.

7.3.11.7 Password Valid

The Password Valid bit is set if the IF-006 has determined the UPW of the attached probe is equal to the IPW or if the user enters the UPW over the USB channel.

7.3.11.8 Bootstrap Pending

The Bootstrap Pending flag is set following the Bootstrap control bit being set.

7.3.11.9 Device Ready

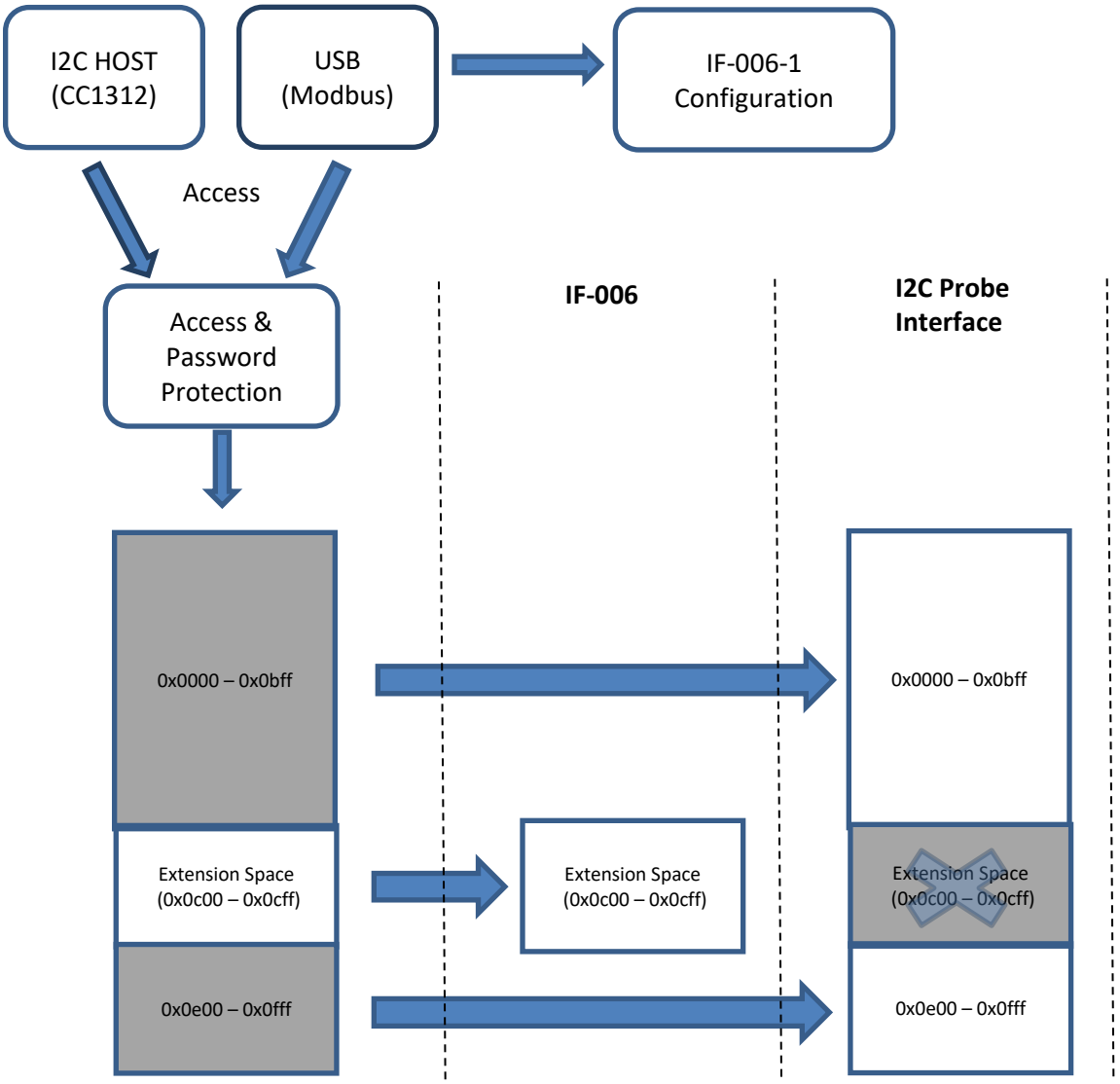
The Device Ready bit is set after all internal initialization is complete.

7.4 Attached Probe Data Access

Access to the attached Smart Sensor register space for the USB and I2C interfaces uses a common memory exchange mechanism that qualifies the access using the Omega Password and Omega Commissioning security interface.

The IF-006-1 Configuration registers are only accessible thru the USB Modbus interface and are not subject to security or password protection.

This architectural model allows the USB interface to directly configure the attached probe and prevents the access of the Extension Space registers for any attached probes.



7.5 Extension Data

The IF-006 platform includes the following Extension data I2C register address 0x0c00 – 0x0cff when accessed by the connected radio device or Modbus address 0xf600 – 0xf67f thru the USB connector.

The description strings are null terminated text strings describing the parameter values.

The Extension Data is available across the USB interface regardless of the Password status.

I2C Addr.	Modbus Addr.	Parameter Name	Parameter Description
0x0c00	0xf600	Structure Size	12 == 12 bytes of data, including this field
0x0c02	0xf601	VBat	Uint16_t - Battery voltage (mV)
0x0c04	0xf602	Vdc	External Power or USB voltage. (mV)
0x0c06	0xf603	Status	< see below>
0x0c08	0xf604	Switches	Unused, always read as 0
0x0c0a	0xf605	Capacity	Battery capacity as %. 0% indicates battery level below 1.8 Vdc. 100% indicates battery level above 3.0 Vdc
0x0c0c	0xf606	Control	< see below >
0x0c0e	0xf607	Probe Status	Not used
Extension Description Strings			
0x0c40	0xf620		'VBat'
0x0c46	0xf623		'Vdc'
0x0c4a	0xf625		'Status'
0x0c52	0xf629		'Unused'
0x0c5a	0xf62b		'Capacity'
0x0c5c	0xf62c		'Control'
Interface Password			
0x0cf0	0xf678	Interface Password	16 byte password used to match attached probe password

7.5.1 VBat

The VBat register contains the measured battery voltage in mV. For example, 2970 represents 2.970 volts. This value is periodically updated by the internal IF-006 firmware.

7.5.2 Vdc

The Vdc register contains the measured USB/External voltage in mV. For example, 4770 represents 4.770 volts. This value is periodically updated by the internal IF-006 firmware.

7.5.3 Status

The Status register provides an indication of the battery status and results of the most recent enumeration.

Note: The upper 8 bits of the Extension Space status bits are directly mapped to the lower 8 bits of the IF-006 Configuration System Status (0xeff7) register.

Status Register							
7	6	5	4	3	2	1	0
Battery Capacity (%)					**Reset Pending**	**Battery Low**	**Battery Powered**
100	>75	>50	>25	0	1 if Battery < 1.6 Vdc	1 if Battery < 1.9 Vdc	**1 == Battery Power**
15	14	13	12	11	10	9	**8**
Extended Valid	Enumerating Probe	Power Fault	Password Active	User Password Pending	Password Error	Authentication Error	**Probe Attached**

7.5.3.1 Battery Powered

Set to 1 if the device is operating under battery power, or 0 if the device is operating under USB power.

7.5.3.2 Battery Low

Set to 1 if the device is operating under battery power and the battery voltage is < 1.9 V_{DC}.

7.5.3.3 Reset Pending

Set to 1 if the device is operating under battery power and the battery voltage is < 1.6 V_{DC}.

7.5.3.4 Battery Capacity

The Battery Capacity bits provide an approximate indication of the remaining battery power. If no bits are set it indicates the battery is at 0% capacity

7.5.3.5 Probe Attached

The Probe Attached bit is set when a smart probe is detected by the IF-006. The IF-006 will periodically check the ability to access the probe and will clear this bit if the probe is detached.

7.5.3.6 Authentication Error

If the Authentication Required control bit is set both the attached probe ***and*** the IF-006 must execute a secure authentication using a shared Private Key and 128-bit AES encrypted handshaking. If the authentication process fails data cannot be accessed on the attached probe.

7.5.3.7 Password Error

The Password Error bit is set if the IPW password stored by the IF-006 does not match the attached probe UPW password. No network access will be allowed until the probe successfully enumerates with the attached device password matching the IF-006 password.

7.5.3.8 User Password Pending

The User Password Pending bit indicates that the user must enter a valid Password thru the USB interface channel.

7.5.3.9 Password Active

The Password Active bit indicates that the attached device requires a password to be entered.

7.5.3.10 Power Fault

A power fault was detected on the external probe.

7.5.3.11 Probe Enumerating

The interface is in the process of enumerating the attached probe.

7.5.3.12 Extended Valid

The Extended Valid bit is set if the Password Error, Authentication Error and Probe Attached status bits are valid.

7.5.4 Capacity

The Capacity provides a calculated 'battery capacity' remaining value, expressed as a percentage. For Alkaline based batteries this is a linear calculation over a range 1.9 V_{DC} and 3.0 V_{DC}.

7.5.5 Control

The Control register determines the processes required for probe enumeration, the configuration of the radio subsystem and allows the radio subsystem to acknowledge a shutdown request.

Control Register							
7	6	5	4	3	2	1	0
Connection Type					**Authentication Required**	**Force Enumeration**	**Shutdown**
15	14	13	12	11	10	9	8
Connection Options							
< see below >							

7.5.5.1 Shutdown

The MSP processor advises the radio subsystem when power is too low to continue operation thru the Reset Pending status bit. After appropriate processing by the radio subsystem it should set the Shutdown bit in the control register which will force the MSP processor to shut down the sensor interface.

7.5.5.2 Force Enumeration

If set, the enumeration process will be re-applied to the probe.

7.5.5.3 Authentication Required

If set, Probe Authentication is applied when probes are enumerated.

7.5.5.4 Connection Type

The connection type field provides support for Sub GHz radio technology.

Connection Type			
Wired	0	0	0
Omega Sub Ghz	**0**	**0**	**1**
Reserved	.	.	.

7.5.5.5 Sub GHz Radio Options

The Radio Option byte provides additional configuration control and is radio specific.

Sub GHz Radio Options								
	15	14	13	12	11	10	9	8
		Reserved				Band		
Omega Sub Ghz (915 Mhz)						**0**	**0**	**1**
Omega Sub Ghz (863 Mhz)						0	1	0
Reserved								
Sub Ghz High Power Enable	X							

7.5.5.6 Sub Ghz Power

The Sub GHz Power level bit enables the Power Amplifier on the Sub Ghz radio assembly.

8 IF-006 Command Line Interpreter (CLI)

The command line interpreter allows human readable commands to be sent to the smart sensor device thru a terminal emulator such as Tera Term or Putty which are widely available, typically at no cost, and may be easily installed on a PC or Linux systems such as Raspberry Pi.

Note: Changes made to the configuration registers thru the CLI are temporary and will reset to the power up configuration on the next power reset.

8.1 Help Command

The Help command uses the '?' character and will display a brief summary of the available commands and options. It is useful to determine if the IF-006 is correctly communicating to the USB channel and does not require a smart sensor device to be connected.

```
?
IF-006-1, Version 1.17.0.0

O(ptions)   <V/v(erbose)> <H/h(ex)/D(ecimal)>
R(ead)      <@><#n></d><{Add}> Reg [Len <format> ...]
W(rite)     <@><#n></d><{Add}> Reg [data <format>...]
V(iew)      <@><#n></d><{Add}> <I(nfo) | D(ata) | L(og) | N(ext)
T(rigger)   <{Add}> <R(eset) | F(actory reset) | P(ower reset) | W(passWord reset) | C(lear log) | S(ample) | L(og)
C(onfig)    <{Add}><R(ate) | I(nterrupt) | D(evice) | S(ensor nn) | O(utput nn)
I(nterface) <{Add}> <A/a(uthenticate) | U/u(pdate Interface Password) | E(numerate) | R(eset passwords)
                    P(assword) = ? | I(nterface Password) = ?>
S(erial)    <B(audrate) = 9600 | 19200 | 38400 | 115200> <P(arity) = E(ven) | O(dd) | M(ark) | N(one)>
              <S(top) = 1 | 2> <D(ata) = 7 | 8> <R(eset)>

@ - Continuous/no delay, #n - number cycles, /d - delay time, <..> - are optional formats: I/i(nteger), L/l(ong),
F/f(loat).precision, S/s(string)

Verbose, Hex,  I2C Addr: 0x68 @ 50 kbp,  Modbus Addr: 0x01, Modbus Range: 0x00
No Authentication Required
Passwords Active:

Probe Attached
```

8.1.1 Command Repetition @, #n, /d

The Read, Write, View, Configure and Trigger commands may be set up to repeat a specific number of times with an optional repetition rate. Repeated commands are terminated if an error occurs or any keyboard entry is made.

The '@' symbol causes the command to be repeated indefinitely, at the fastest possible rate. If the @ symbol is specified, the # and / may not be used.

The '#' symbol, followed by a numeric value, causes the command to be repeated the specified number of times.

The '/' symbol, followed by a numeric value, allows specifying a delay in seconds between each command repetition when using the '#' option.

If no repetition information is provided the command will be executed once.

8.1.2 Alternate Address {Add}

The I2C address used to access the Smart Sensor device defaults to 0x68, unless overwritten by the Options command. The address may be further overwritten in each command by enclosing the address in { } bracket.

8.1.3 Numeric formats

Data may be entered or displayed as hexadecimal, decimal or float values. The standard output shows data in decimal or hex format depending on the Verbose H/h/D mode setting, which may be overwritten using formatting characters. The following formatting characters are accepted.

Data Type	Suffix	Example (assume hex option selected)
Byte	<none, default>	R 0x68 -> display single byte value
16-bit integers	i	R 0x68 20 2 i -> result displayed as 0x1234
32-bit integers	l (lower case 'L')	R 0x68 20 2 l -> result displayed as 0x12345678
Floats	f.n (n == precision)	R 0x68 0x3c 4 f.3 → result displayed as 12.345, precision is optional and defaults to 1 digit.
Strings	S/s	R 0xe0 s → result displays the user defined device name located at 0xe0 W 0xe0 "My Name" → will write a new device name to the string. Be cautious not to exceed the maximum string lengths.

8.1.4 Invalid Commands

Since the first character of the serial record is used to determine the command and all other characters are treated as Modbus Start of Frame (':') or address values no interpretation is made of characters other than those shown in the Help summary and no error reporting will be generated. All commands must be entered as uppercase characters, and only the first character of commands or keywords are required.

8.1.5 Password Protection

If the Status information indicates that a password is required all accesses to the attached probed data will be blocked. Passwords may contain up to 16 characters. Use the ***Interface*** command to enter the correct UPW password:

I P = xxxx

8.2 Option Command

The Option command allows configuring the IF-006 device to use default values to simplify the user interface by providing extended formatting options. Changes to the Options settings are retained in internal Flash memory.

O(ptions) <V/v(erbose)> <H/h(ex)/D(ecimal)>

Characters shown in parenthesis (..) are optional. To Enable an option, specify the name with an upper-case character. Multiple options may be specified in the same command line in any order. To disable the option, specify the name with a lower-case character.

V(erbose) – turn on Verbose mode
v(erbose) – turn off Verbose mode

H(ex) – data values are output in hexadecimal Upper case ie: 0x1AC7
h(ex) – data values are output in hexadecimal Lower case ie: 0x1ac7
D(ecimal) – data values are output in decimal format ie: 6855

Multiple Options may be combined into a single command line.

Example:
Option V h - set to verbose mode, lower case hexadecimal output

Option
Verbose, Hex mode, Ignore INTR, I2C Addr: 0x68 @ 50 kbp, Modbus Addr: 0x01

The response from the Option command is a summary the current settings. Entering the O command with no parameters returns the current settings.

8.2.1 Verbose Mode

The Verbose mode adds formatting characters to command responses. Commas are inserted between each field and each record is enclosed in [ ] brackets.

8.2.2 Hex / hex / Decimal option

The Hex / hex and Decimal option determines how numeric data is displayed if not specifically designated as a *float, integer, long* or *string* value.
When entering data a '0x' indicates a hex value.

Option Verbose
Verbose, Hex mode, i(ignore INTR), I2C Address: 0x68 @ 50 kbp, Modbus Address: 0x01
// Read current sensor readings, display as 4 floats
R 0x3c 4f
[Dev: 104 Reg: 060 Cnt: 016 -> 23.1, 50.1, 984.0, 0.0]
// Force failure by disconnecting device
R 0x3c 4f
[Dev: 104 Reg: 060 E_NAK (009)
O v
verbose, Decimal mode, n(INTR ignored), I2C Address: 0x68 @ 50 kbp, Modbus Address: 0x01
R 0x3c 4f
23.1, 49.8, 983.9, 0.0
R 0x3c 4f
E_NAK (009)

8.2.3 I2C Address

The IF-006 defaults to using I2C address 0x68.

8.2.4 Bus Speed

The I2C bus speed defaults to 40 kb/second, suitable for up to 5-meter cable lengths.

8.3 Read Command

The Read command accepts the repetition information, the starting register number, the number of elements to be read and the format of the data. The starting register location ***must*** be provided while all other fields are optional. If the number of elements is omitted, it is assumed to be one. If the data format is omitted, it is assumed to be BYTES. There may be multiple number of elements and related format information contained within a read. Commas or spaces may be used to separate the individual values.

R(ead) <repetition options> register [<number> <format <.precision>> …]

The simplest form is R 0x????, where 0x???? represents a value between 0x0000 and 0x0fff. The command will return a single byte from the specified location.

A more complex example would be Read 0x38 1l 4f.2 to read the current time, and the 4 sensor readings. The Time information is stored in register 0x38 as a 32-bit long value and is then immediately followed by the four sensor results stored as floating point values at locations 0x003c to 0x004b.

```
// Location 0x3c represents the sensor readings, stored as floating point values.
// Read a single byte from the start of the sensor values (default count is 1, type byte)
R 0x3c
[Dev: 0x68 Reg: 0x3c Cnt: 0x01 ->  0x41 ]
// Read 2 bytes (the format defaults to BYTE)
R 0x3c 2
[Dev: 0x68 Reg: 0x3c Cnt: 0x02 ->  0x41,  0xb7 ]
// Read 3 'long ' (4 byte) values, representing 12 (0x0c) bytes
R 0x3c 3l
[Dev: 0x68 Reg: 0x3c Cnt: 0x0c ->  0x41b73333,  0x42483d71,  0x447605c3 ]
// Read 3 'float' ( 4 byte ) values, representing 12 ( 0x0c ) bytes, default precision is 2
R 0x3c 3f
[Dev: 0x68 Reg: 0x3c Cnt: 0x0c ->  22.8,  50.1,  984.0 ]
// Read 3 float values and display with 4 digit precision
R 0x3c 3f.4
[Dev: 0x68 Reg: 0x3c Cnt: 0x0c ->  22.8899,  50.1899,  984.1099 ]
O v d
verbose, Decimal mode, Ignore INTR,  I2C Addr: 0x68 @ 50 kbp,  Modbus Addr: 0x01
Read 0x38 1l 4f.2
 0000367195  23.22,  28.27,  1013.40,  0.00
```

8.4 Write Command

The Write command accepts the repetition information, the starting register address to receive the data and the data values. Multiple data elements may be written from a single command and the data values will be interpreted according to the formatting suffixes or minimum size required to represent the value. Floating point values are indicated by including a decimal point in the value. Strings are represented by using double quotes ("…"). Commas or spaces may be used to separate the individual values.

W(rite) <repetition options> register [<number> <format>> …]

W 0x80 123.4
[Dev: 0x68 Reg: 0x80 Cnt: 0x04]
R 0x80 1f
[Dev: 0x68 Reg: 0x80 Cnt: 0x04 -> 123.4]
W 0xe0 "Device Name"
[Dev: 0x68 Reg: 0xe0 Cnt: 0x0c]
R 0xe0 20s
[Dev: 0x68 Reg: 0xe0 Cnt: 0x14 -> "Device Name"]

8.5 View Command

The View command allows viewing common Smart Sensor attributes. The View command accepts an option that specifies what is to be displayed. If no option is provided the command assumes the **V**iew *I*nformation option.

V(iew) <repetition options> <I(nformation) | (D(ata) | L(og) | N(ext)>

Information Group	Attributes (registers)	Usage
I(nformation)	Device Name (0xe0), Device ID (0x00) Number of Sensors (0x00) Number of Outputs (0x00)	Provides summary of the device status and health used to take the measurements.
D(ata)	Current Time, Sensor Readings, Sensor Units	Provides summary of current time, reading values and units of measure.
L(og)	Extract Start, Extract End, Number Records	Provides information on information contained in Log file
N(ext)	Extract Time Extract Data	Extracts and displays the next log file record

View Information
Device: Device Name, ID: 00000001
Type: BTH-SP, Version: 1.25.4.0
Manufactured: 2017/08/25, Operating Hours: 11-13:33:48
Calibrated: 2017/08/25, Calibration Hours: 11-13:33:48
Oper Volt: 3.3 Vdc,Oper Temp: 21 oC, Fault Code: 0
Sensors: 3, Outputs: 2
View L
Start Time: 11-13:06:41, End Time: 11-13:33:59, Records Available: 820
V Data
11-13:34:03 21.0 .C 28.0 %RH 1017.0 mbar
V N
11-13:34:01 21.0 .C 28.0 %RH 1017.0 mbar

8.6 Trigger Command

The Trigger command allows initiating an action on the smart sensor making use of the options provided by the Trigger register at register location 0x26. If no option is provided a Trigger Log sequence will be performed, forcing a reading to be taken and saved to the event memory.

T(rigger) <{Add}> <R(eset) | F(actory reset) | P(ower reset) | W(passWord reset) | C(lear log) | S(ample) | L(og)

Action	Trigger Register, value	Usage
R(eset)	Trigger Register = Trigger Value 0x0004	Reset device forcing re-enumeration of sensor mix
F(actory reset)	Trigger Register = Trigger Value 0x0005	Forces a factory reset which clears all user set up and logged information
P(ower reset)	Trigger Register = Trigger Value 0x0006	Performs a user reset that is treated as a power on reset which includes logging the event in the event log.
W(password reset)	Trigger Register = Trigger Value 0x0007	Clears password and data log memory but does not clear configuration information.
C(lear log)	Trigger Register = Trigger Value 0x0003	Clears the event log
S(ample)	Trigger Register = Trigger Value 0x0100	Forces a sampling of the sensor data. The data ***is not*** written to the event log. The display will show the current values.
L(og)	Trigger Register (0x26), Trigger Value 0x0300	Forces a sampling of the sensor data and the information ***is*** saved to the event log. The display will show the current values.

8.7 Interface Command

The Interface command allows setting and clearing the Force Authentication control bit, changing the Interface Password, the attached Probe password, enumerating the attached probe and resetting of all passwords.

I ?
I(nterface) <{Add}> <A/a(uthenticate) | U/u(pdate Interface Password) | E(numerate) | R(eset passwords) P(assword) = ? | I(nterface Password) = ?>

Interface Option		Usage
A/a(uthenticate)	A – Force Authentication a - Clear Authentication mode	When Authentication is enforced probes will only operate on Omega Devices that enforce authentication. A factory Reset will clear the Authentication control bit on a probe.
U/u(pdate Interface Password)	U – force Interface Password to match User Password u – do not force Interface Password to track User Password	If the U option is selected than any changes entered for the User Password will be copied to the IPW Interface password allowing attached probes with matching passwords to transmit data to the cloud.
E(numerate)	Causes attached probe to be enumerated	Ensures that an attached probe is immediately enumerated
R(eset Passwords)	Similar to Password Reset trigger command	.
P(assword) = ?	Allows setting the User Password on the attached probe	The 16-character probe User password prevents unauthorized access to the probe data. If a probe is locked all accesses will return 0xff bytes.
I(nterface Passord) = ?	Allows setting the IF-006 interface password	When a probe is attached data will only be accessible to the cloud if the IF-006 interface password matches the attached probe User password.

The CLI will display the state of the Authentication control bit and status on the attached probe password when the ‘I’ or ‘?’ commands are entered.

Example: no authentication, no probe attached
I
No Authentication Required
Passwords Not Active

No Probe Attached

Example: no authentication, probe attached, a password is entered, the probe is detached and then re-attached and a data access is attempted.

```
I P = 1234
Password accepted
No Authentication Required
Passwords Active:

Probe Attached

// Probe is detached and then re-attached

I
No Authentication Required
Passwords Active: User Password Pending

// Attempt to access data
Probe Attached
V D

PASSWORD REQUIRED

// Enter the password
I P = 1234
Password accepted
No Authentication Required
Passwords Active:

Probe Attached
V D
7614-04:58:20  24.0 .C  24.0 .C  0.0 DIN
```

8.8 Config Command

The Config command allows setting specific operating characteristics of the device. If an option is not provided the current settings for the selected characteristic are provided. If no characteristic is provided a summary of the Config command is provided.

C(onfig) <repetition options> <R(ate) | D(evice) | S(ensors) | O(utputs)> < option >

Characteristic	Attributes (registers)	Usage
R(ate)	Event 1 Time Base	C R Displays current Rate C R = xx Sets the Event 1 sample time which is the default timer used to trigger reading and logging activity.
D(evice)	IO_DEVICE_NAME IO_LIST_SELECT	C D Displays the I/O mix available on the device with an indication of how to select difference configurations. C D = nn Allows selecting device configuration from available options shown in the C D command.
S(ensors)		C S Displays the list of all available sensors on the device and available configuration options. C S n Displays the configuration options available on sensor ‘n’. C S n = x Allows selecting a sensor configuration option from available options shown in the C S n command
O(utputs)	0x??	C O Displays the list of all available outputs on the device and available configuration options. C O n Displays the configuration options available on output ‘n’. C O n = x Allows selecting a output configuration option from available options shown in the C O n command

8.8.1 Configuring Devices

The Config Device command displays a list of different device configurations as shown below. In this example, there are 7 configurations available (0..6) and currently option #6 is selected as indicated by the '>>'.

To change the device configuration, enter C D = n, where n is one of the displayed options. The device will be reconfigured, a 'Reset' will be generated to force the new input selections to be enumerated and a revised list will be displayed.

```
C D
BTH-SP Options
     T / OUT (option: 0)
     H / OUT (option: 1)
     T,H / OUT (option: 2)
     B / OUT (option: 3)
     T,B / OUT (option: 4)
     H,B / OUT (option: 5)
 >> T,H,B / OUT (option: 6)

C D = 4
BTH-SP Options
     T / OUT (option: 0)
     H / OUT (option: 1)
     T,H / OUT (option: 2)
     B / OUT (option: 3)
 >> T,B / OUT (option: 4)
     H,B / OUT (option: 5)
     T,H,B / OUT (option: 6)
```

8.8.2 Configuring Sensors and Outputs

When configuring sensors and outputs multiple Sensor or Output Types may be presented. If any of the 'options' related to the Sensor or Output Type are selected the device will be reset to ensure re-enumeration of the selected type *and the remaining options (CLK A, RST etc.) may change.*

C S

Sensor Type (0) Options
- DIN (option: 0)
- >> RATE (option: 1)
- WIDTH (option: 2)
- DUTY (option: 3)
- DELAY (option: 4)
- CNT (option: 5)
- U/D_CNT (option: 6)
- QUAD_CNT (option: 7)

CLK_A
- NO/SNK (option: 8)
- >> NC/SNK (option: 9)
- NO/SRC (option: 10)
- NC/SRC (option: 11)

RST
- NO/SNK (option: 12)
- NC/SNK (option: 13)
- >> NO/SRC (option: 14)
- NC/SRC (option: 15)

C S 0 = 6

Sensor Type (0) Options
- DIN (option: 0)
- RATE (option: 1)
- WIDTH (option: 2)
- DUTY (option: 3)
- DELAY (option: 4)
- CNT (option: 5)
- >> U/D_CNT (option: 6)
- QUAD_CNT (option: 7)

CLK_A
- NO/SNK (option: 8)
- NC/SNK (option: 9)
- NO/SRC (option: 10)
- NC/SRC (option: 11)

DIR
- NO/SNK (option: 12)
- NC/SNK (option: 13)
- >> NO/SRC (option: 14)
- NC/SRC (option: 15)

RST
- NO/SNK (option: 16)
- NC/SNK (option: 17)
- >> NO/SRC (option: 18)
- NC/SRC (option: 19)

In addition to selectable options, Sensors may also contain Sensor Parameters, whose floating-point values are maintained in a fixed memory space allocated for each sensor. Sensor Parameters are displayed showing the corresponding allocated space. The corresponding Sensor Parameter may be read or written using the Read and Write commands.

```
V i
Device: Device_00000000, ID: 00000000
Type:   IR-T_O, Version: 1.3.0.1

Manufactured:  2017/09/01,  Operating Hours:     0-00:25:47
Calibrated:    2017/09/01,  Calibration Hours:   0-00:25:47
Oper Volt: 3.1 Vdc,Oper Temp: 25 oC, Fault Code: 0x0000
Sensors: 1, Outputs: 2, Sample Rate: 1
C D
IR-T_O Options
   T (option: 0)
 >> T / OUT (option: 1)

C S 0
MLX90614 (0) Options
 Emissivity (Parameter at: 0x08c0)
R 0x08c0 1 f
[Dev: 0x68 Reg: 0x8c0 Cnt: 0x04 ->  1.0 ]
C O 0
Output (0) Options
 >> PWM (option: 0)
 RATE
   OFF (option: 1)
 >> 10.0 Hz (option: 2)
   1.0 Hz (option: 3)
   0.1 Hz (option: 4)
 POL
 >> ACT.ON (option: 5)
   ACT.OFF (option: 6)
C O 0 = 6
Output (0) Options
 >> PWM (option: 0)
 RATE
   OFF (option: 1)
 >> 10.0 Hz (option: 2)
   1.0 Hz (option: 3)
   0.1 Hz (option: 4)
 POL
   ACT.ON (option: 5)
 >> ACT.OFF (option: 6)
```

8.9 Serial Command

The Serial command allows setting specific operating characteristics of the Serial (USB) interface. If no option is provided the current settings for the selected characteristic are provided.

S(erial) <**B**(audrate) = 9600 | 19200 | 38400 | 115200> <**P**(arity) = E(ven) | O(dd) | M(ark) | N(one)> <**S**(top) = 0 | 1> <**D**(ata) = 7 | 8> <**R**(eset)>
S
Baudrate = 115200, Parity = Even, Data = 8, Stop = 1

Multiple options may be set on the same command line in any order. The updated configuration will be shown using the current serial configuration and then all changes are applied at once.

Serial BR=38400, Stop = 1, Data=7 Parity = Odd
Baudrate = 38400, Parity = Odd, Data = 7, Stop = 1
<changes are applied, terminal configuration must be changed to match new configuration>

Characteristic	Options	Usage
Baudrate	9600, 19200, 38400, **115200**	Serial Baudrate = 38400
Parity	**Even**, Odd, Mark, None	S P=None
Stop	**1**, 2	S S=2
Data	7, **8**	Serial Databits = 8
Reset	--	Resets serial configuration to 115200, Even, 8, 1

9 Specifications

Wireless Communication

Frequency: 915 MHz

Range*: Up to 1.2 km in Low Power Mode
Up to 3.2 km in High Power Mode

**Clear line of sight. Actual range may vary depending on environment.*

Power

Alkaline Battery: 2x C-Cell batteries (included)

Transmit Power	Update Time	Battery Life*
Low	2 Mins	2 Years
Low	90 Mins	5+ Years
High	2 Mins	1 Year
High	90 Mins	3 Years

**Typical. Actual battery life may vary depending on the connected sensor, signal strength and environmental conditions.*

External Power*: 5 V_{DC} @ 1.75 W

**External power adapter optional. External power specification based on Omega specific power adapter*

Environmental

Operating Conditions for Base Unit: -20°C to 70°C (-4°F to 158°F), 90% RH non-condensing

Rating: IP65

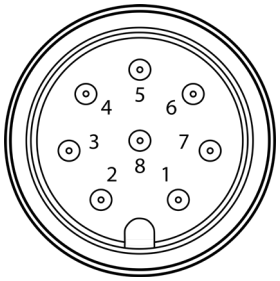
General

Software: Compatible with SYNC configuration software and Layer N Cloud

Certification

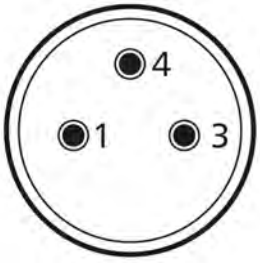
Contains FCC ID: WR3-MOD16370915

Contains IC ID: 8205A-MOD16370915



M12 8-Pin Connector

	Name	Function
Pin 1	N/A	No Connection
Pin 2	INTR	Interrupt Signal
Pin 3	SCL	SCL Signal
Pin 4	SDA	SDA Signal
Pin 5	Shield	Shield Ground
Pin 6	N/A	No Connection
Pin 7	GND	Power Return
Pin 8	VCC	Nominal 3.0 V_{DC} to Smart Probe



3-Pin External Power Connector

	Function
Pin 1	Neutral / DC-
Pin 3	Line / DC+
Pin 4	Not Connected

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components in which wear is not warranted, include but are not limited to contact points, fuses, and triacs.

OMEGA is pleased to offer suggestions on the use of its various products. However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by the company will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive, and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

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RETURN REQUESTS/INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

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- Industrial Water & Wastewater Treatment
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