Communicator for HiQDT Smart Digital pH & ORP Sensors

- Lightweight portable 9V battery powered handheld communicator (HHC) calibrates & configures **HiQDT smart digital RS485 MODBUS RTU sensors** at any location. All values stored in non-volatile sensor EEPROM for hot-swap portability when installed back into field service
- The following values are stored in non-volatile EEPROM memory inside the sensor board for complete installation portability & hot-swap use:
  - Offset calibration for temperature on pH or ORP sensors
  - Offset calibration for process value for pH or ORP sensors
  - Acidic slope for pH sensors used when reading < pH 7
  - Alkaline slope for pH sensors used when reading > pH 7
  - Factory set Sensor Serial & Item Number for traceability
  - The max & min °C in service & total time in use (energized)
- Node scanning feature for ease of finding address on connected sensor
- Node changing feature allows for any sensor to be used for any channel
- The calibration values themselves and time since that 'Cal' was last performed are displayed using 'View' key in the various Cal LED modes
- Intelligent software auto-detects sensor type on selected node meaning one HHC can interface all HiQDT smart digital MODBUS sensor types
- **MODBUS RTU** read/write for all information shown on handheld communicator for acquisition of measured process parameter (pH or ORP), temperature, calibrations & analytics for connected HiQDT smart digital sensor for intelligent remote management & troubleshooting
- Quick disconnect cables to 1,000 meters (3,280 feet); NEMA 6P & IP67 rated waterproof HiQ4M & HiQ4F snap connectors for rugged field use
- Input Data Ranges & Max Resolution for pH and ORP Measurements:
  - pH range of -2 to +16 with 0.001pH resolution
  - ORP range of ±1000 or ±2000mV; 0.1mV resolution
  - Temperature range of -40 to +210 °C; 0.1°C resolution
- Perform 1-point offset anywhere in the range. Slope calibrations are automatically assigned for acidic (-2 to +7) or alkaline (7 to 16) pH ranges yielding a 3-point point overall calibration scheme with a dual slope for optimal accuracy at any pH (can be very important for batch systems)
- Offset calibrations only for ORP measurement and temperature.
- Automatic Temperature Compensation (ATC) for pH measurement

Programming

Handheld communicator (HHC) has 3-digit display & 16 LEDs to show readings & analytic data as well as to calibrate and configure sensor. Programming is done by 4 key front panel. 'Mode' key used to toggle and navigate to each LED. 'Up' or 'Down' buttons scroll available options & adjust values. 'Mode' key is used to make selections and save entries. 'View' key provides additional information for the given LED mode (see table for details on use of 'View'). Once baudrate and node of connected sensor are entered all parameters are automatically loaded for zero configuration plug & play use in the field.

TECHNICAL SPECS FOR HiQDT HANDHELD COMMUNICATOR (HHC)

Mechanical

Housing:	ABS
Mounting:	Handheld
IP Class:	Housing IP40
Connector:	HiQ4M female for HiQ4M sensor male snap
Temp.:	Usage -15 to +50 °C (Storage -35 to +75 °C)
Weight:	130 grams with battery (4.6 ounces) 100 grams without battery (3.5 ounces)
Dimensions:	D 26 x W 60 x H 120 mm (1.0" X 2.4" X 4.7")

** Number of seconds until auto shutdown starts from when sensor is disconnected from HHC*

Electrical

Supply:	9V battery (Alkaline or Lithium)
Consumption:	~30 mA with HiQDT sensor "On"
Battery Life:	~15 hrs Alkaline or ~30 hrs Lithium Auto shutdown after 25 seconds * without communication
Input:	Smart Digital IOTRON™ & ZEUS™ HiQDT pH sensors & ORP sensors
Baud rate:	9600 or 19,200 kbps (selectable)
CE mark:	EN61326A

RoHS COMPLIANT

BENEFITS OF IOTRON™ & ZEUS™ SMART DIGITAL HiQDT MODBUS RTU SENSORS

- **Integral RS-485 MODBUS RTU interfaces all-modern PLC controllers & data acquisition systems.**
- **Communicator provides easy management of field installations** without the cost of a mating transmitter. This is ideal for locations where a local display is not necessary or possible due to installation limitations.
- **Intelligent management of sensor calibrations and service life-cycle** for efficient commissioning & maintenance. All aspects of installation are completely portable from the shop to the field site location.
- **The 'Days in Use' when calibration was performed is stored** allowing for optimal maintenance planning.
- **All digital sensors ensure** reliable operation even in noisy process environments.
- **No degradation in digital output** even with very long cable runs **up to max of 1,000 meters (3,280 feet)**
- Bridging connections & modifying installations easily without loss of signal quality with **NEMA 6P & IP67 rated quick disconnect waterproof and corrosion-resistant dual snap connector**. Simple plug and play operation for intelligent maintenance planning & smart management of sensor installations and stocking.
- **Low-cost snap digital extension cables** facilitate consolidation of very many HiQDT sensors outputs into one panel enclosure where very many remote field installations can all be conveniently all viewed at once.
- **Intelligent HiQDT handheld communicator software identifies type of sensor connected** & autoloads correct features. There exists no possibility of accidentally using the wrong set of options or settings.
- **All Extension cables for HiQDT sensors are inter-compatible**. Uniform extension cables minimize stocking. Separate field installation guide details available options to commission & exchange sensors.

SENSORS FOR USE WITH SMART DIGITAL HiQDT WITH RS-485 MODBUS RTU OUTPUT

- **!!NEW!! Ultra-Rugged Construction ZEUS™ pH Sensors** for Tough Inline, Immersion or Submersible Use
- **Entire line of proven Iotron™** inline, immersion, submersible, twist lock, sanitary, HOT-TAP retractable **pH & ORP sensors** made by ASTI are **ALL available** in the smart digital HiQDT type configuration
- The new rugged low-profile **impact & break resistant parabolic pH glass element** optimized for use in **slurries & high viscosity applications** (X3XX & X5XX series) is available in the HiQDT type configuration
- The novel **extreme dehydration resistant** style reference technology that allows for **prolonged exposure to dry conditions** and **intermittent wet & dry use** are also available in the HiQDT type configuration

TECHNICAL SPECIFICATIONS FOR HiQDT DIGITAL SENSORS WITH MODBUS

Mechanical & Thermal

Housing:	CPVC, RYTON, RADEL or PEEK
Mounting:	Inline, Immersion, Submersible, Sanitary & HOT-TAP as per sensor specifications
Rating:	Fully submersible and waterproof without the use of immersion tube (a.k.a. standpipe)
Connector:	NEMA 6P rated HiQ4M male snap connectors for HiQDT snap extension cables; Extension cables for 3TX-HiQ platform can be used for HiQDT type smart digital sensors as well
Max Cable:	Up to 3,280 feet (1,000 meters) using 22 AWG leads and 12VDC power supply
Temp.:	Inline max is per sensor specs; For Immersion & Submersible Use Max 125°C for all sensors
Pressure:	Up to 200 psig inline use for selected models
Weight:	Per Sensor, Typically 0.5 to 2 kilograms
Dimensions:	Per Sensor, Minimum size is ¾" MNPT for inline installations, Min length is 8.0 inches with max of about 12 inches with WPB/WPH

Electrical

Operating VDC:	7.0 to 13.0 VDC at sensor board
Power Supply:	Isolated & Regulated 9V to 12V DC
Current draw:	Max 20mA Absolute (Typical 15mA)
pH Range:	-2 to +16 *(limited by pH sensor specs)*
ORP Range:	±1000mV Std or ±2000mV Wide
Temp Sensor:	Integral Platinum 1000Ω TC Element
Temp Range:	-40 to +210°C ±0.3°C *(limited by actual sensor specs, Max 125°C Submersible)*
Temp. Comp.:	Automatic for all measurements
Digital Output:	Non-Isolated RS-485 MODBUS RTU
Compatibility:	For use with HiQDT Handheld Communicator or else any customer PLC with isolated RS-485 input that accepts MODBUS RTU slaves
CE mark:	EN61326A

RoHS COMPLIANT

INTELLIGENT HANDHELD COMMUNICATOR (HHC) FOR FIELD CALIBRATION, CONFIGURATION, SPOT MEASUREMENT & TROUBLESHOOTING OF HiQDT SMART DIGITAL RS485 MODBUS RTU SENSORS

LABEL ON LED	Parameter	Description & Method to Access	Range	Default
Sensor Type	Measurement type	Load options for connected sensor **'View' key shows software revision**	pH or ORP or DO or ISE or CON (autodetected)	Per Type
Reading *****	Process Parameter ****	Display current calibrated value **When pH > 9.99 the last digit of pH is shown by holding the 'View' key**	-2.00 to +16.00 for pH * -1,000 to +1,000 for Std ORP * -2,000 to +2,000 for Wide ORP *	Per Sensor & Media
Abs mV / mS	Process Parameter	Display the absolute mV value from connector pH or ORP sensor	-1,000 to +1,000 for pH * -1,000 to +1,000 for Std ORP * -2,000 to +2,000 for Wide ORP *	Per Sensor & Media
Cal Temp °C	**Offset calibration of temperature in °C** **	**Adjust temp reading up & down** **'View' key shows current temp cal.**	**±25.0 °C * from raw value**	**0.0**
Cal Offset	**mV Offset Calibration A.P. pH Calibration** **	**Defines the mV@pH7 for pH or mV Offset for ORP (relative mV)** **'View' shows current mV offset**	**±250 mV * from default**	**0.0**
Cal Slope	**Defines span for pH measurements** ** **Cal Slope mode used for pH sensors only**	**Defines mV per pH formeasurement in acidic and alkaline media from sensor response in this mode** **'View' shows acid slope if <pH7 or else alkaline slope if >pH7**	**30 to 90 mV per pH unit limits** ***Separate slope saved when slope cal is done acid solution (< pH7) or when slope calibration is done in alkaline solution (> pH7)***	**59.2 (Acidic)** **59.2 (Alkaline)**
Dampener	Smoothing dampener & output delay ***	Sets number of seconds to be used for dampener for process value(s)	1, 2, 3, 4, 5, 8, 10, 15, 20 or 30 Seconds	10 - Dampen 1 - Delay
Step Change	Sensitivity for 'Up' & 'Down' buttons	mV increment for each time the 'Up' or 'Down' button is depressed	Choices: 0.05, 0.10, 0.20, 0.5, 1.0 or 2.0	0.5
Special	Special Setup Features	Set temp compensation coefficient	Units are µV per °C (000-999)	198
Baudrate	Sets Baudrate for Com	Toggle between 9600 or 19,200 kbps	9600 or 19,200 kbps	Per Network
Node	Sets Address for Com	Chose a valid address on network	From 001 to 247	Per Sensor
Item/Serial #	Sensor Item Number & Sensor Serial Number	Item Number defines sensor model; 'View' shows Serial Number which is the unique traceable identifier	Item # from 1-9,999 with >999 shown in sequence; Serial # per HiQDT Serial Number Scheme	Per Sensor
Days in Use	Total time HiQDT sensor is energized	Increments time in use after dispatch from factory to track sensor lifetime & predictive maintenance purposes	0-65,535 in units of days (>999 displayed flashing) Within ±2% accuracy	Per Sensor Field Use
Max/Min °C	Displays max & Min Temp in field use	The max temp in field use is shown; Push 'View' button for min temp	-40 to +210 °C *	Per Sensor Field Use

**** Negative values are always shown as flashing.***

*COLOR NOTES: Parameters in light **light green** are defined by factory at dispatch time or determined from field use. Parameters in grey can be adjusted as desired. Parameters in **dark green** are obtained from wet calibrations done with HiQDT sensor in the field.*

**** Holding the 'View' key for 3 to 5 seconds in this LED mode shows the 'Days in Use' SINCE this calibration was performed**
**** When pH is greater than 9.99 the value will be shown flashing between XX. and .XX where the complete value is XX.XX**
**** Holding BOTH the 'View' AND 'Up' keys for 3 to 5 seconds in this LED mode will reset all calibration values back to default**
***** Holding the 'View' key for 3 to 5 seconds allows for the delay from boot value to be shown as well as adjusted**
****** Holding both 'Up' & 'Mode' keys shows software rev or both 'Down' & 'Mode' keys shows build date in Reading LED mode**
******* User Adjustable Timeout Feature: Press 'Down' + 'View' in 'Reading' mode to set minutes before automatic shutoff occurs**

NOTE ON WIDE ORP SENSORS WHEN VALUES ARE GREATER THAN 999:
Values shown as 1.00 to 1.99 corresponding to 1,00X to 1,99X. In 'Reading' mode press 'View' to display the last "X" digit of value.

NOTE ON HiQDT SMART DIGITAL pH SENSOR SLOPE CALIBRATION:

The HiQDT smart digital pH sensors will always have two slopes; one slope is for measurements performed in the acidic range (-2 to +7 pH) and the second slope is used for measurements in the alkaline range (+7 to +16 pH). Perform slope calibrations in BOTH the below and above pH7 condition to ensure the most reliable readings, especially for batch type applications crossing the pH7 threshold.

'Modbus Com' & 'Battery Low' LED

- The "Modbus Com" LED is illuminated briefly each time that a communication packet is sent or received.
- The "Battery Low" LED will at first flash as warning & then illuminate continuously when the 9V battery should be replaced.
  - **MUST Change 9V battery when LED is illuminated to ensure valid readings and calibrations.**

HiQDT SMART DIGITAL pH & ORP SENSOR FEATURES & BASIC USAGE

Smart digital HiQDT pH & ORP sensors with integral RS485 MODBUS RTU communications allow for a simple and fully portable installation scheme. Sensors can be calibrated anywhere (lab, shop or field) and then readily interfaced with any data acquisition or control system RS-485 MODBUS RTU master. Temperature & process offset calibrations can be done with sensor left in service if grab sample adjustments are desired to agree with laboratory reference values. Waterproof and corrosion-resistant NEMA 6P rated snap connector comes standard for easy and seamless hot-swap of sensors from service for cleaning, recalibration and other maintenance tasks as well as eventual replacement in the course of time.

SETUP OF HIQDT RS-485 MODBUS RTU SENSOR TO HANDHELD COMMUNICATOR (HHC)

1. **Instructions for scanning & changing nodes on page 8.**
2. Press the 'Mode' button to turn on HHC. The HHC will attempt to communicate with the last used baudrate and node address. If either no sensor is connected or available at the last used baudrate and node address then three dashes "---" are shown on display. If no buttons are pressed for 25 seconds form this state the HHC will automatically turn itself off to conserve battery life.
    a. If previous baudrate and node address are valid for connected sensor the HHC will automatically load all relevant LED options and addressable parameters for that sensor type.
3. Pressing 'Mode' button navigates to 'Node' LED mode. Use 'Up' & 'Down' keys to scroll to node of the connected sensor. Node information is typically found on label of sensor. If this information is not available the HiQDT Windows software can be used scan the sensor in question to determine the current node address. The baudrate and node address of the HiQDT sensors can only be changed by the Windows software. When the desired node address is reached press the 'Mode' key enter the value.
    a. Default node for pH sensors is 1, ORP sensors is 2 and Wide-Range ORP sensors is 3. If multiple sensors of the same type are used on same RS485 MODBUS RTU network the node address of same type of sensor must differ from default to ensure that each node as a unique valid address assigned.
4. If baudrate needs to be adjusted (9600 or 19,200 kbps) then the HHC automatically navigates to this LED mode next.
5. HHC will return back to the reading mode after selecting node & baudrate. If the selections are valid then process reading is shown otherwise three dashes "---" are shown.
6. Press 'Mode' button after reading LED to toggle to sensor type LED which shows type of sensor that is connected.

Handheld Communicator connected to PN 6353-HiQDT-STUB Immersion Slurry Resistant "STUBBY" Style RS-485 MODBUS RTU Smart Digital HiQDT pH Sensor. This configuration makes for a particularly compact arrangement ideal for portable field use.

SENSOR SERIAL NUMBER, ITEM NUMBER & TOTAL TIME IN FIELD SERVICE

Systematic tracking is achieved with factory digitally stamped serial number and item number as well as the build date of sensor. The internal clock on the HiQDT sensor board is incremented when sensor is continuous energized for one-hour period to monitor the total number of days in active field service. If the sensor is disconnected the incrementing of the time in service will stop. When the sensor is energized the incrementing of time in service will once again resume. The number of days in service is always the actual real-time total usage. The total days in use is shown in days and equally accurate for continuous or intermittent service such that the time in service is accurate even if the sensor is taken in & out of use for cleaning & re-calibration and/or swapped between different installations. The total time in service since each calibration was performed is shown when the 'View' key is pressed for 3 to 5 seconds in the given calibration LED mode.

IMPORTANT NOTE BEFORE PERFORMING CALIBRATIONS:

The time averaging dampener is always on even when performing calibrations. ***It can be desirable to adjust dampener to a short value when performing calibrations to make the calibration process quicker and then reset the dampener back to a higher value before reinstalling the sensor back into continuous use in field service (be sure to remember this last step!)***

TEMPERATURE CALIBRATION INSTRUCTIONS

The temperature is calibrated by pushing the 'Up' or 'Down' buttons when in the temperature display (°C) mode. *

CALIBRATION OF HiQDT SMART DIGITAL pH SENSORS WITH HANDHELD COMMUNICATOR

1. Use the 'Mode' button to toggle to 'Offset' LED and calibrate to first desired value using 'Up' and 'Down' keys. For this offset calibration the typical pH buffer employed are 6.86 or 7.00 although it is not necessary to use any specific pH buffer for the offset calibration. The offset calibration can be performed anywhere from -2 to +16 pH.
2. Use the 'Mode' button to toggle to the 'Slope' LED and use 'Up' and 'Down' keys until the display reads the desired value. This pH buffer 4.00 is typically used for applications that are acidic to neutral and pH buffer 9.18 or 10.00 are typically used for applications that are neutral to alkaline. Other pH buffers of potential interest include 1.68 for pH measurements that consistently are below 4.00 and the 12.45pH buffer for measurements consistently above pH 10.00.
3. Check exact value of the NIST traceable pH buffer used at the current ambient temperature (see bottle for details and following pages)
    a. The pH sensor is calibrated at three points to create the dual slope operating scheme:
        i. First calibration typically near pH 7 in 'Offset' LED mode becomes the mV offset
        ii. Second calibration in pH buffer below pH7 in 'Slope' LED mode becomes Acidic Slope
        iii. Third calibration in pH buffer above pH7 in 'Slope' LED mode becomes Alkaline Slope
    b. You must exit the 'Slope' mode after completing the acidic slope calibration (below pH7) pressing the 'Mode' button & toggling back around before performing second 'Slope' calibration for the alkaline (above pH7) case.
4. All calibration values are stored inside the HiQDT smart digital pH sensor in EEPROM such that sensor can be powered down or moved without loss of calibration values resulting in a true plug and play measurement system with seamless hot-swap of sensor in field.
5. Grab sample offset type calibration is done with sensor left in service after stabilized. A grab sample is analyzed offline by the preferred method. The inline field reading is made to agree with any grab sample analysis using ONLY 'Offset' calibration mode.
6. Results of the performed pH sensor calibrations can be viewed by pressing the 'View' key in each calibration LED mode which always returns the current calibration values used to compute the pH.

CALIBRATION OF HiQDT SMART DIGITAL ORP SENSORS WITH HANDHELD COMMUNICATOR

The ORP type sensors can only undergo an 'Offset' type calibration. Toggle to 'Offset' LED mode with 'Mode' and use the 'Up' and 'Down' buttons to adjust mV reading to match desired value* of ORP standard solutions or else to agree with an offline determined ORP reference value* of the inline process media. Not that while there exists no temperature compensation possible for the oxidation reduction potential (ORP) measurement, it is in fact very highly temperature dependent value. Care should be taken in using the ORP mV potential in cases of fluctuating temperatures in process.

** Negative values shown as flashing.*

Temperature Considerations for Calibrating pH Sensors with pH Buffers – Part 1 of 2

Exact pH Values of the NIST Traceable pH buffers at Various Temperatures
Nominal pH Buffer Designation @ 25°C Shown in Gray at Top of Column

Temp °C	**1.68**	**4.00**	**6.86**	**7.00**	**9.18**	**10.01**	**12.45**
0	1.67	4.01	6.98	7.11	9.46	10.32	13.42
5	1.67	4.00	6.95	7.08	9.39	10.25	13.21
10	1.67	4.00	6.92	7.06	9.33	10.18	13.00
15	1.67	4.00	6.90	7.03	9.28	10.12	12.81
20	1.68	4.00	6.88	7.01	9.23	10.06	12.63
25	1.68	4.00	6.86	7.00	9.18	10.01	12.45
30	1.68	4.01	6.85	6.98	9.14	9.97	12.29
35	1.69	4.02	6.84	6.98	9.10	9.93	12.13
40	1.69	4.03	6.84	6.97	9.07	9.89	11.98
45	1.70	4.04	6.83	6.97	9.04	9.86	11.84
50	1.71	4.06	6.83	6.97	9.02	9.83	11.71
55	1.72	4.07	6.83	6.97	8.99	9.80	11.57
60	1.72	4.09	6.84	6.98	8.97	9.78	11.45

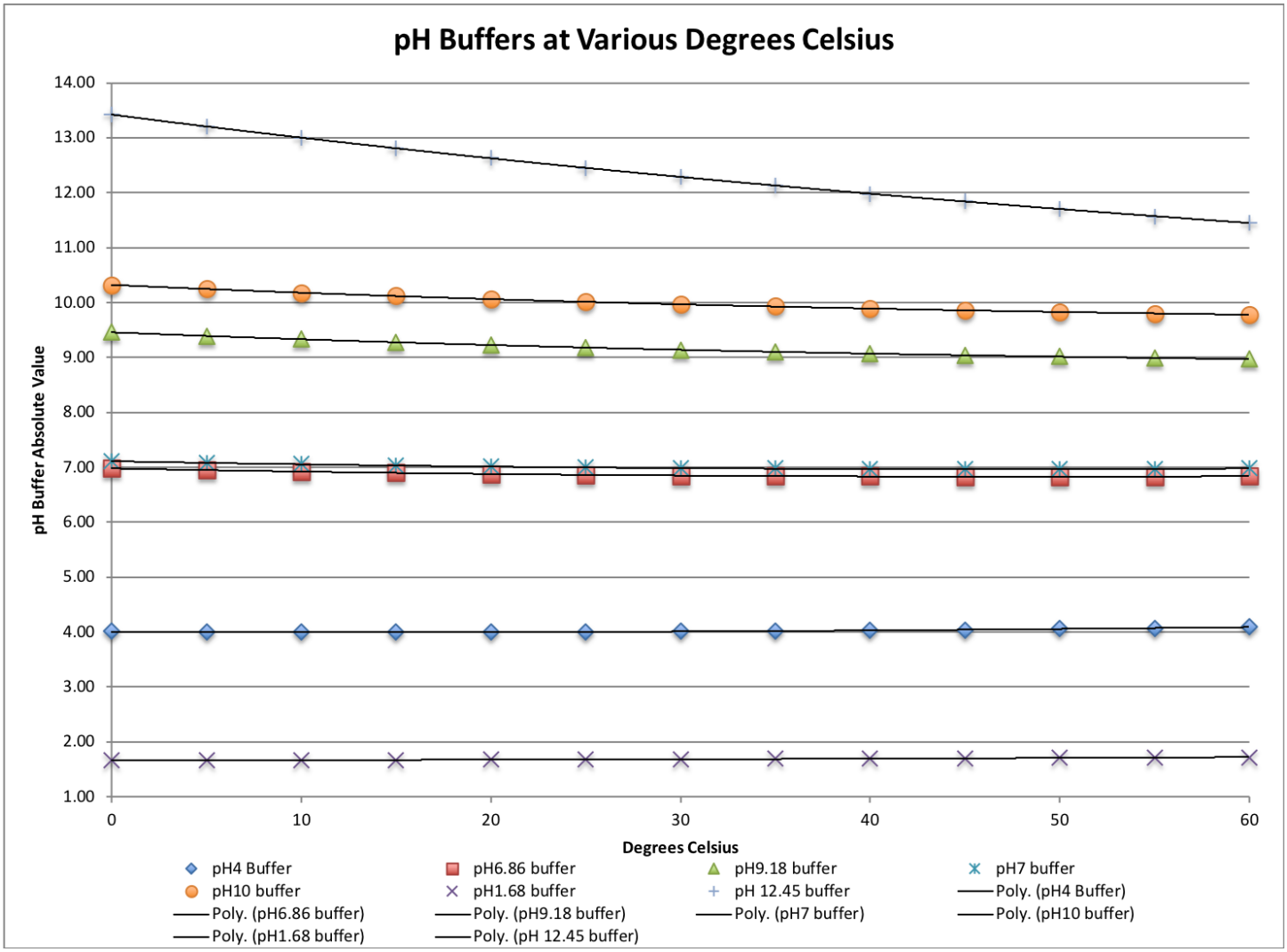
NIST traceable pH buffers are the most commonly used methods for calibration of industrial pH sensors. On each pH buffer bottle is written the exact pH value of the buffer at variety of temperature conditions. Listed above are the exact pH values for the most commonly used pH buffers between 0 and 60 °C. If using any pH buffer other than those shown above you will need to obtained the exact pH value for the current temperature condition. This information is typically provided on the label of the pH buffer.

To use any pH buffer besides 1.68, 4.00, 6.86, 7.00, 9.18, 10.01 or 12.45 you will need to account for the temperature induced shift of the pH value for the buffer in both the Windows software as well as any other devices used to perform calibrations of the HiQDT pH sensors. There are no reliable pH buffers below 1.69 and above 12.45 and so specialized and custom calibration schemes needed to be used for these situations. Contact factory for assistance in such cases.

Inquire to the factory if you plan to measure consistently below pH=1.0 or above pH=13.0 for special assistance. As can be seen from mere inspection the temperature dependence of high pH buffers is much more significant than for low pH buffers. Similarly for process solutions with high pH the temperature induced pH dependence may be quite significant and should be considered when trying to control such systems with fluctuating temperature. Process solutions with relatively weak ionic strength (low conductivity) are also rather prone to higher temperature induced pH shifts whereas process solution with relativley high ionic strength (high conductivity) are less prone to temperature induced pH shifts.

It is best practice to wait until the temperature reading on the sensor is no longer moving before selecting the setup temperature and starting calibration(s) with pH buffers. The temperature of the sensor may take some time to reach the ambient conditions of the pH buffer solution(s) if it was previously installed into field service at conditions that are significantly below or above the ambient temperature. Contact factory for assistance to establish best practice procedure for process lines where temperature consideration need to be considered seriously during the calibration process.

Temperature Considerations for Calibrating pH Sensors with pH Buffers – Part 2 of 2



Temperature compensation only accounts for the change in the mV response of the pH sensor itself with temperature. The type of temperature induced shifts such as those demonstrated in the table above for the pH buffers are NOT corrected in default Nernstian temperature compensation scheme. For process solutions the change in the pH value with temperature can be significantly more pronounced than for pH buffers which are inherently designed to shift in only the most minimal way due to changes in temperature, dilution, evaporation and other typical conditions in field use. Thankfully the HiQDT-pH sensors allow for a user defined temperature compensation coefficient to account for the NET temperature effects. The temperature impact on the pH sensor and the temperature impact on the measured solution cannot be cleanly separated (deconvoluted). It is, however, possible to determine the effective net mV per °C change and enter this as a custom temperature compensation coefficient. Contact the ASTI factory for assistance with such situations requiring special temperature compensation schemes. The default temperature compensation setting is the classical Nernstian 198µV (0.198mV) per °C with the allowable range of 000-999 µV to support most any custom value for your given process installation situation. The temperature compensation coefficient can be changed from the 'Special' LED.

Only the amount of buffer required for the given calibration should be dispensed. Buffers should not be reused to avoid dilution & cross-contamination. Buffers should not be left exposed to air or direct light for prolonged periods of time to avoid the impact of dissolved carbon dioxide from the atmosphere and other potential decomposition pathways. Special care should be taken the pH buffers above 7.00 are always fresh when used for calibrations as these tend to loose the integrity of their values much faster than pH buffers below 7.00. Buffers should be stored in a cool, dry location away from light and chemicals. The pH sensor should at a stable ambient temperature before performing any calibration.

!! IMPORTANT NOTE FOR POWERING HiQDT SMART DIGITAL SENSORS !!

- The RS-485 MODBUS RTU digital communications from the HiQDT smart digital sensors is non-isolated.
  - The power source that energizes sensor should be isolated (dedicated & separate from all other devices) or
  - DC/DC converter/isolator added to the existing power supply employed to accomplish the same net result

NOTES ON ADJUSTABLE SMOOTHING DAMPENER & OUTPUT DELAY:

- Dampener LED when pH & ORP HiQDT sensor is connected allows for display and modification of the variable that is used to set the number of seconds used for the smoothing dampener and delay from boot to send the output values
- For intermittent battery powered operation set dampener & output delay low to minimize power consumption

DISPLAY FEATURES AVAILABLE USING THE 'VIEW' KEY

- **In 'Node' mode press 'View' key to invoke the node scanning feature (see green instructions below for details). ***
- **In 'Baud Rate' mode press 'View' key for 3 to 5 seconds to invoke node changing mode. ** (see next page for notes)**
- In 'Sensor Type' LED mode, the software revision for the connected sensor is shown when the 'View' key is pressed.
- In 'Cal Temp.' LED mode, the offset in °C * for current temp calibration is shown when the 'View' key is pressed.
- In 'Cal Offset' LED mode, the offset in mV * is shown for both pH & ORP sensors when the 'View' key is pressed.
- In 'Cal Slope' LED mode, the current slope for the connected HiQDT pH sensors is shown in mV per pH units. Acidic slope is shown if the sensor is reading below pH7 and the alkaline slope is shown if the reading is above pH7.
  - Days since this calibration performed shown by holding 'View' in the 'Cal' mode for 3 to 5 seconds. **If BOTH 'View' & 'Up' pressed for 3 to 5 seconds in any 'Cal' mode will reset all calibrations back to factory default**

*** Initial node of '0' will be shown (press 'Mode' when node address is '0' to exit scan mode). Select starting address for scan with 'Up' or 'Down' keys. Node address scrolled in increments of 10. For example, pressing 'Up' key gives address of 1→10→20→30… and so forth while pressing 'Down' key gives addresses of →240→230→220… and so forth. Press 'Mode' to begin scan. Scanning is always performed in an ascending fashion. Scan will stop when sensor is found. Sensor type for node address found displayed flashing with node address. Press 'Mode' to select this node and you will enter 'Reading' mode. Press 'View' to continue scanning. If no sensors found when address 247 is reached then 'Err' is displayed. Press 'Mode' to resume scan and repeat these procedures.**

MODBUS RTU setup of HiQDT sensor is available to enable all functionality detailed below:

READ-ONLY Data	Core Process Value Description	READ-ONLY Data	Analytic Sensor Value Description
Calibrated Process Values for HiQDT-pH	Calibrated pH value with the range -2.000 to +16.000 sent as 0 to 18,000 Calibrated temp with the range -40.0 to +210.0 °C sent as 0 to 2,5000 ***pH values sent are always calibrated & are always temperature compensated.***	Connected Sensor Type	1 - HiQDT-pH 2 - HiQDT-ORP Standard Range 3 - HiQDT-ORP Wide Range 4 - HiQDT-DO (Dissolved Oxygen) 5 - HiQDT-ISE (Ion Selective) 6 - HiQDT-CON (EC Standard/High) 7 - HiQDT-CON-L (EC Ultralow)
Calibrated Process Values for HiQDT-ORP	Calibrated Standard ORP mV value -1,000.0 to +1,000.0 sent as 0 to 20,000 Calibrated Wide Range ORP mV value -2,000.0 to +,000.0 sent as 0 to 20,000 Calibrated temp with the range -40.0 to +210.0 °C sent as 0 to 2,5000	Sensor Serial Number Sensor Diagnostics	Unique Serial Number Designation: YY.M-AA.DDD ** Sensor Item Number Software Revision Max Temp in Use Min Temp in Use Days in Field Use
Raw Process Values	Raw mV sent as 25,000 ± 20,000 corresponds to range of -1,000.0 to +1,000.0 mV for the pH and standard range ORP modes. *Minimum 5,000 corresponds to -1,000mV and maximum 45,000 corresponds to +1,000mV.* Raw mV wide ORP sent as 25,000 ± 20,000 & corresponds to -2,000.0 to +2,000.0 mV. *Minimum 5,000 corresponds to -2,000mV & maximum 45,000 corresponds to +2,000mV.*	Calibration Values	Temperature Offset Days since Temp Offset Cal Process A.P. / mV Offset Days since mV Offset Cal pH Slope Acidic (pH Only) Days since Acidic Slope Cal (pH Only) pH Slope Alkaline (pH Only) Days since Base Slope Cal (pH Only)

** *Serial format YY is last digits of year; M is month with A=Oct, B= Nov & C=Dec; AA is letter(s) from A to nY (as permissible); DDD is value from 0 to 255*

READ/WRITE Type	Adjustable Calibration Description	READ/WRITE Type	Adjustable Parameter Description
Offset Adjust Temperature	**Calibrated Temperature Value Limit ±25.0 °C * from raw value** *The temperature to which reading is adjusted is sent as 0 to 2,500 corresponding to -40.0 to +210.0 °C*	Reset Calibrations	Will reset all user adjustable sensor calibrations back to factory default values
Offset Adjust mV Value *For HiQDT-ORP Only*	**Calibrated mV Value Std ORP Limit ±250 mV * from default** *The mV value to which reading is adjusted is sent as 0 to 2,000 corresponding -1,000 to +1,000 mV* **Calibrated mV Value Wide ORP Limit ±250 mV * from default** *The mV value to which reading is adjusted is sent as 0 to 4,000 corresponding -2,000 to +2,000 mV*	Dampener	Time averaging of process value 1, 2, 3, 4, 5, 8, 10, 15, 20 or 30 Seconds *NOTE: Dampener setting is the basis for the setting for the autocalibration in the factory supplied HiQDT controller. The minimum time to complete the autobuffer calibration is always at least the dampener settings plus two seconds. This should be considered if fast autobuffer calibration is important.*
Offset Adjust pH Value Asymmetric Potential *For HiQDT-pH Only*	**Calibrated pH Value for A.P. Limit ±250 mV * from default** *The pH value to which reading is adjusted is sent as 0 to 1,800 corresponding to -2.00 to +16.00 pH*	Delay from Boot	Time until process values are sent from boot 1, 2, 3, 4, 5, 8, 10, 15, 20 or 30 Seconds
Adjust Acidic Slope *For HiQDT-pH Only* *This slope used for pH<7*	**Calibrated pH Value - Acid Slope Limit 30 to 90 mV per pH unit** *The pH value to which reading is adjusted is sent as 0 to 1,800 corresponding to -2.00 to +16.00 pH*	Step Change	Increment value for stepwise calibration on the handheld communicator: 0.05, 0.10, 0.20, 0.5, 1.0 or 2.0 mV
Adjust Alkaline Slope *For HiQDT-pH Only* *This slope used for pH>7*	**Calibrated pH Value - Base Slope Limit 30 to 90 mV per pH unit** *The pH value to which reading is adjusted is sent as 0 to 1,800 corresponding to -2.00 to +16.00 pH*		

* ***Negative values shown as flashing.***

**** Select the current node for the attached sensor. If the current node is not known use the node scanning feature to determine it. When in the 'Baud Rate' LED mode, hold the 'View' key for at least 3 seconds to initiate the node changing mode. The current node of the sensor will be shown and the 'Sensor Type' and 'Node' LED will flash. If the 'Mode' key is pressed immediately after entering this node changing mode, then no change to the address will be made since the address displayed will equal the current node address. Use 'Up' and 'Down' keys to adjust the node to the modified address if desired. Press 'Mode' key to enter the new node address selected with 'Up' & 'Down keys.**

NOTE 1: For communication to be successful all MODBUS devices on the network must use the same baudrate and have a unique node address assigned. The handheld communicator is a MODBUS master whereas all HiQDT sensors are MODBUS slaves. In order for the handheld communicator to be interfaced with the HiQDT sensor, that sensor must either be removed from the network, or else bypassed by means of a suitable bridge box scheme. It is also possible to access any given HiQDT sensor on the MODBUS network if the existing MODBUS master is disconnected or powered down. If the node of the HiQDT sensor to be interfaced is not known, please use the Windows software to determine the current node address and modify if it should be necessary to ensure a valid & unique node address setting on the network. Please see HiQDT installation guide and HiQDT controller manual for additional recommendations & details about commissioning, calibration and troubleshooting.

NOTE 2: Access to **READ** values in *Core Process Value Column* gained through MODBUS function code (04).

NOTE 3: Access to **READ** parameters in the *Analytic Sensor Value Column, Adjustable Calibration Column & Adjustable Parameters Column* gained through MODBUS function code (03).

NOTE 4: Access to **WRITE** parameters in the *Analytic Sensor Value Column, Adjustable Calibration Column & Adjustable Parameters Column* gained through MODBUS function code (16).