

AST50 & AST60 Smart Standard & High Range *HiQDT* Inline, Immersion & Submersible Conductivity Sensors



AST60 contacting conductivity sensor tips shown in K=0.1, 1.0 and 2.0 cell constants from left to right, respectively.

- Smart Digital Conductivity Sensors with Isolated RS-485 MODBUS RTU interfaces directly with any suitable PLC
- Windows software for configuration, calibration and testing of *HiQDT* smart digital sensors is provided free of charge
 - **Sensor stores temperature & cell constant calibrations including days in use since they were performed**
- Double 1"MNPT threaded body can be used for either immersion/submersion or inline style installation
- Redundant O-ring seals used on all versions for high on-stream reliability and long sensor service lifetime
- Suitable for a measurement ranging from 20 to 200,000 $\mu\text{S}/\text{cm}$ with outstanding chemical resistance for a wide variety of media. Open front-end geometry resists clogging and reduces maintenance. Ideal for remote installations.
- Wetted insulator materials of construction are CPVC for AST50 and TEFLON/KYNAR for AST60 with 316SS electrodes standard. Titanium, Monel & Hastelloy C-276 electrodes are optional with only minimal increase in cost.
- Max 100 psig @ 95°C for AST50 & Max 100 psig @ 125°C for AST60 (Max 500 psig with PEEK insulator)
- Dual EPDM O-ring seals ensure sensor reliability (Viton, AFLAS & KALREZ are optional). Front seal absorbs the brunt of chemical attack, allowing the rear O-ring to operate in a protected environment, and insure continued sealing.
- Available in cell constants of K=0.1/cm, K=1.0/cm & K=2.0/cm readily covering most common conductivity ranges
 - K=0.1/cm can be used from 20-2,000 $\mu\text{S}/\text{cm}$ in standard range & 200-10,000 $\mu\text{S}/\text{cm}$ in high range modes
 - K=0.2/cm can be used from 40-4,000 $\mu\text{S}/\text{cm}$ in standard range & 400-20,000 $\mu\text{S}/\text{cm}$ in high range modes
 - K=1.0/cm can be used from 200-20,000 $\mu\text{S}/\text{cm}$ in standard range & 2,000-100,000 $\mu\text{S}/\text{cm}$ in high range modes
 - K=2.0/cm can be used from 400-40,000 $\mu\text{S}/\text{cm}$ in standard range & 4,000-200,000 $\mu\text{S}/\text{cm}$ in high range modes
 - **Toggling between standard range and high range modes while sensor is in use is done by changing the range mode scaling factor register with handheld communicator, Windows software or customer PLC**
- Computed units available are salinity (PSU) and selectable total dissolved solids (TDS) units of NaCl, KCl or 442
- Cable length 20 feet standard terminated with quick-disconnect waterproof & corrosion-resistant NEMA 6P rated snap connector. Max 3,280 feet (1,000 meters) total cable length with 12VDC power supply employed.
- Waterproofing sealing option for completely submersible installation without the use of an immersion rod or standpipe.
 - Available in polypropylene (PP) and CPVC with integral vinyl or NORPRENE sealing hoses factory installed.



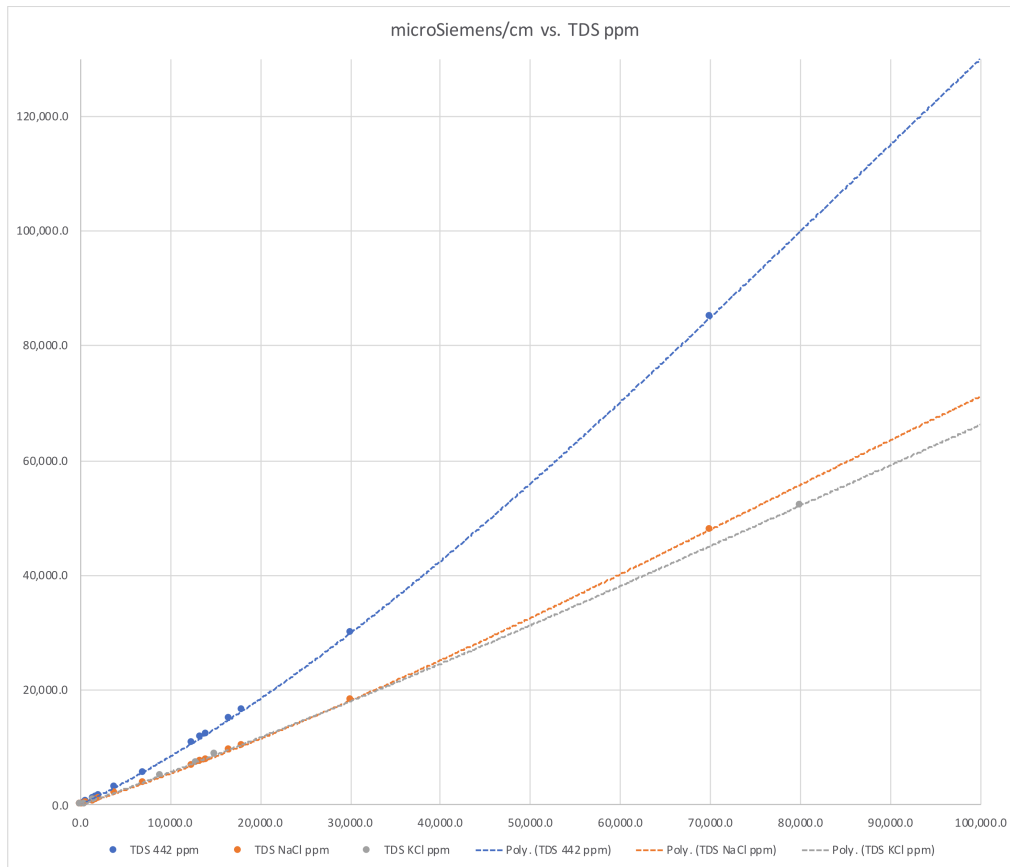
AST50 & AST60 Smart Digital *HiQDT* Conductivity Sensor Specs

Measurement Range:	See table below for <u>standard & high range configuration</u> of each cell constant
Operating Temperature Inline Use:	-35 to +95 °C (-31 to +203 °F) for AST50 <i>HiQDT</i> with CPVC insulator ** -35 to +120 °C (-31 to +248 °F) for AST60 <i>HiQDT</i> with TEFLON insulator **
Operating Temperature Submersible Use:	-35 to +85 °C (-31 to +185 °F) for both AST50 & AST60 <i>HiQDT</i> Sensors **
Operating Pressure:	Max 100 psig @ 95°C for AST50 Max 100 psig @ 120°C for AST60
Process Connections:	1" MNPT for both Front & Rear Threads
Wetted Materials of Construction:	
Insulator:	CPVC for AST50, TEFLON for AST60 (PEEK as a Special Order Option)
O-Rings:	EPDM (Standard); Viton, AFLAS or KALREZ (Optional); Redundant
Electrodes:	316SS Standard; Titanium, Monel, Hast C-276 and other upon request optional
Sensor Body:	CPVC for AST50, KYNAR for AST60 (316SS as a Special Order Option)
Temperature Element:	Pt1000 temperature sensor (included standard, required for all <i>HiQDT</i> sensors)
Temperature Input Range:	-40 to +210 °C (-31 to +410 °F) ±0.3°C <i>Limited by actual sensor specs</i> **
Cell Constants for AST50 & AST60:	K = 0.1, 0.2, 1.0 or 2.0 /cm
Cable Length Limits:	Standard 20 feet (6 meters), Max 3,280 feet (1,000 meters) with 12VDC supply
End of Cable Terminations:	4-pole waterproof & corrosion-resistant NEMA 6P rated HiQ4M snap connector
Storage and Shelf-Life:	One (1) year from date of dispatch from factory when stored at ambient.
Dimensional Details:	See following pages for drawing of each particular cell constant configuration.
Submersible Assemblies:	WPA, WPB, WPC Polypropylene Waterproofing Options for AST60 Sensors WPG & WPH CPVC Waterproofing Options for AST50 Sensors
Sealing Hose Options:	Braid reinforced vinyl tubing available for both WPB & WPH options High-Temperature Resistant NORPRENE tubing available only for WPB option

** Contact factory for applications where the measurement is below 0°C prior to purchase.

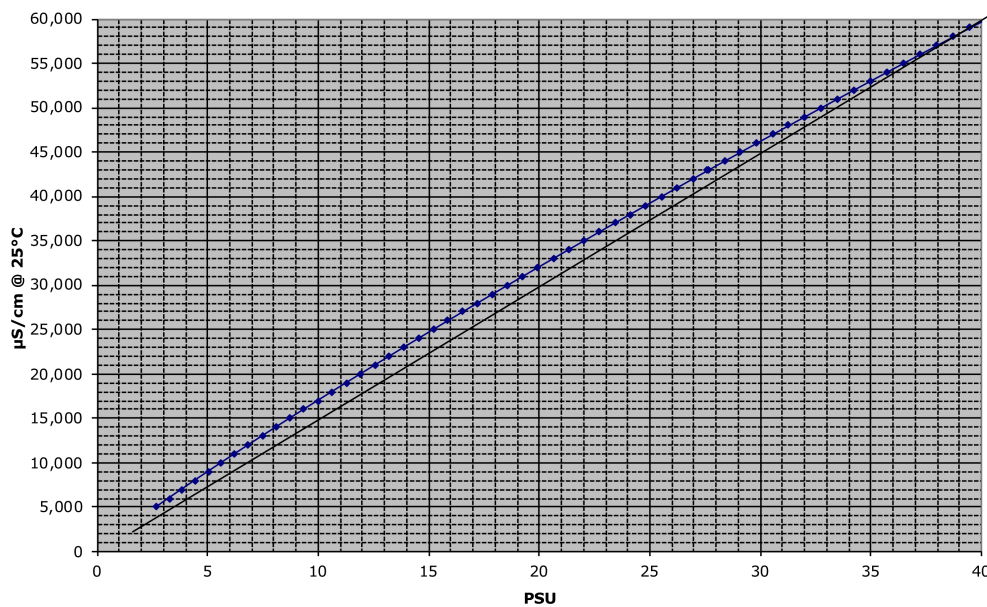
Temperature compensated conductivity ranges shown below at each temperature assumes the typical 2% per °C coefficient is used. If alternate temperature compensation coefficient is used recommended conductivity ranges will vary accordingly (inquire to factory).

Cell Constant of AST50 or AST60	Full Range of Raw Conductivity Input	Temperature Compensated Conductivity Range @ 25°C	Temperature Compensated Conductivity Range @ 75°C	Temperature Compensated Conductivity Range @ 125°C
K=0.1/cm Standard	20-2,000 µS/cm	20-2,000 µS/cm	10-1,000 µS/cm	7-667 µS/cm
K=0.1/cm High Range	200-20,000 µS/cm	200-10,000 µS/cm	100-10,000 µS/cm	66-6,667 µS/cm
K=0.2/cm Standard	40-4,000 µS/cm	40-4,000 µS/cm	20-2,000 µS/cm	13-1,333 µS/cm
K=0.2/cm Hi Range	400-40,000 µS/cm	400-20,000 µS/cm	200-20,000 µS/cm	133-13,333 µS/cm
K=1.0/cm Standard	200-20,000 µS/cm	200-20,000 µS/cm	100-10,000 µS/cm	67-6,667 µS/cm
K=1.0/cm High Range	2,000-200,000 µS/cm	2,000-100,000 µS/cm	1,000-100,000 µS/cm	667-66,667 µS/cm
K=2.0/cm Standard	400-40,000 µS/cm	400-40,000 µS/cm	200-20,000 µS/cm	133-13,333 µS/cm
K=2.0/cm High Range	4,000-400,000 µS/cm	4,000-200,000 µS/cm	2,000-200,000 µS/cm	1,333-133,333 µS/cm



Total dissolved solids are computed from the measured conductivity. Curves that define relationship between measured conductivity and user selectable total dissolved solid (TDS) of NaCl, KCl or 442 are preprogrammed into sensor. The supported min and max TDS may be limited by the choice of cell constant and range mode configuration used with full range of 0 to 100,000 ppm. Curves for other types of TDS units representing other salt mixtures available upon request as special orders (minimum order quantity may apply).

µS/cm @ 25°C vs PSU



The salinity units are computed from the measured conductivity. The curves that define the relationship between the measured conductivity and computed salinity in PSU are preprogrammed into the sensor. The supported min and max salinity values may be limited by the choice of cell constant and range mode configuration employed. Full range available is 0.000 to 50.000 PSU



Technical Specs for Smart Digital *HiQDT* AST50 & AST60 Contacting Conductivity Sensors available with Cell Constants 0.1, 0.2, 1.0 & 2.0

BENEFITS OF SMART DIGITAL HiQDT MODBUS CONTACTING CONDUCTIVITY 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.
- **Windows software for setup and calibration of HiQDT conductivity sensors is free allowing for easy and low-cost field commissioning for setup & pre-calibration of sensors** without the cost of a transmitter. Ideal for installation locations where a local display is not needed or possible due to site specific needs.
- **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' since 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. **Max of 1,000 meters (3,280 feet) with 12VDC power** supply to support for remote installation sites and consolidation of collected data.
- **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.
- **All Extension cables for HiQ & HiQDT sensors are interoperable**. Uniform extension cables minimize stocking. Separate field installation guide details available options to commission & exchange sensors.

Mechanical & Thermal

Electrical

Housing:	CPVC (AST50) or KYNAR (AST60)	Operating VDC:	8.0 to 13.0 VDC at sensor board
Mounting:	Inline, Immersion or Submersible as per sensor installation scheme	Power Supply:	Isolated & Regulated 9V or 12V DC
Rating:	Fully submersible and waterproof without the use of immersion tube (a.k.a. standpipe)	Current draw:	Max 35mA Absolute, Typical ~25mA
Connector:	NEMA 6P rated HiQ4M male snap connector for HiQDT snap extension cables; Extension cables for 3TX-HiQ platform can also be used for HiQDT type smart digital sensors as well	Conductivity Range:	See Conductivity Range Table on Page 2 for Each Cell Constant Type
Max Cable:	Up to 3,280 feet (1,000 meters) using 22 AWG leads when employing 12VDC power supply	Temp Sensor:	Integral Platinum 1000Ω TC Element
Temp.:	Inline max per sensor specs; Submersible Use limited to Max 85°C for all sensor models	Temp Range:	-40 to +210°C ±0.3°C (<i>limited by actual sensor specifications</i>) Max Temp is +85°C at sensor board (submersible)
Pressure:	Max 100 psig (<i>Max 500 psig for other sensors</i>)	Temp. Comp.:	Automatic for all measurements
Weight:	Per Sensor, Typically 0.5-2.0 kg (1.0-4.4 lbs)	Digital Output:	Isolated RS-485 MODBUS RTU
Dimensions:	Minimum size is 1" MNPT for inline installations; Minimum length is 9.0 to 9.3 inches without waterproofing seal with max of about 14 inches when the longest type WPB/WPH waterproofing seal is installed	Baud rate:	9600 or 19,200 kbps (selectable)
		Compatibility:	For use with ASTI HiQDT Handheld or ASTI HiQDT Windows software or any PLC with isolated RS-485 input that can serve as a MODBUS RTU master to HiQDT sensor slave
		CE mark:	EN61326A



HiQDT SMART DIGITAL CONDUCTIVITY SENSOR FEATURES & BASIC USAGE

The smart digital HiQDT conductivity sensor with integral RS-485 MODBUS RTU communications allows for a simple and fully portable installation. The sensor may be calibrated anywhere (lab, shop or field) and interfaced with any data acquisition or control system in the field via the RS-485 MODBUS RTU output. Temperature & cell constant calibrations can be done with sensor left in service if grab sample adjustments are desired to agree with reference values. Waterproof and corrosion-resistant NEMA 6P HiQ4M snap connectors come standard for easy seamless hot-swap of sensors from service for cleaning, recalibration and other maintenance requirements as well as eventual replacement in time.

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.

CALIBRATION OF HiQDT MODBUS RTU CONTACTING CONDUCTIVITY SENSORS

- Calibrate modes of the HiQDT Windows software & handheld communicator allows for the following adjustments:
 - Temperature offset adjustment (typically only required at initial time of commissioning)
 - Dry in air zero calibration in 'Offset' calibrate mode (typically only required at initial time of commissioning)
 - 'Slope' calibration adjusts conductivity to grab sample or standard to give the effective apparent cell constant
- Calibration values are stored inside the HiQDT smart digital conductivity sensor in EEPROM such that sensor can be powered down or moved without loss of calibration resulting in a true plug and play low maintenance installation.
- 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. The value of the sensor installed in service is adjusted in gain calibration mode to agree with the reference determined value.

COMPUTED UNITS BASED UPON MEASURED CONDUCTIVITY

Units of measure are native conductivity expressed as either $\mu\text{S}/\text{cm}$ or mS/cm for all cell constants depending upon particular range of interest. Computed units of salinity available from 0.000 to 50.000 PSU and user selectable computed units of total dissolved solids (TDS) of NaCl, KCl or 442 available from 0 to 100,000 ppm. The actual min and max for computed units may be limited by cell constant and range mode used for sensor configuration. Other computed units are on a special-order basis (minimum order quantities may apply for any special computed units).

IMPORTANT NOTE FOR POWERING HiQDT SMART DIGITAL SENSORS

- Although RS-485 MODBUS RTU communications from HiQDT conductivity sensors is isolated, the mating PLC serving as MODBUS Master should still have an isolated RS-485 input port for ensure best results in field use.
 - The power source that energizes sensor should be isolated (dedicated & separate from all other devices) or
 - DC/DC isolator can be added to the existing power supply employed to accomplish the same net result as having a dedicated and isolated 9V or 12V to DC power source.

NOTES ON ADJUSTABLE SMOOTHING DAMPENER & OUTPUT DELAY:

- Dampener LED when HiQDT conductivity sensor is connected allows for display & 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 operation, it is recommended to set this dampener & output delay variable to a low number in order to minimize power consumption while from battery power sources and maximize sampling time of process output



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 & Temperature Compensated Conductivity & Temperature for HiQDT AST50 & AST60 sensors See page 2 table for recommended low & high ranges for use at various temperatures for each cell constant Computed Values	<u>K=0.1/cm Standard & High Range</u> Range 0-2,000 μS/cm & 0-20,000 μS/cm <u>K=0.2/cm Standard & High Range</u> Range 0-4,000 μS/cm & 0-40,000 μS/cm <u>K=1.0/cm Standard & High Range</u> Range 0-20,000 μS/cm & 0-200,000 μS/cm <u>K=2.0/cm Standard & High Range</u> Range 0-40,000 μS/cm & 0-400,000 μS/cm All cell constants have max temperature range of -40.0 to +210.0 °C Salinity 0.000-50.000 PSU sent as 0 to 50,000 TDS 0-100,000 ppm sent as 0 to 50,000	Sensor Serial Number Sensor Diagnostics	Unique Serial Number Designation: YY.M-A.DD ** Sensor Item Number Software Revision Max Temp in Use Min Temp in Use Hours in Field Use
Raw Process Values	Same as the calibrated and temperature compensated conductivity and temperature for each cell constant configuration. Max recommended temperature compensated conductivity range depends upon cell constant, range mode and temperature.	Calibration Values	Temperature Offset Hours since Temp Offset Cal Zero Dry in Air Offset Hours since Dry in Air Zero Offset Cal Cell Constant Standard Range Cal Time since Standard Range Cal Cell Constant High Range Cal Time since High Range Cal

** Serial number format YY is the last digits of year M is month with A=Oct, B= Nov & C=Dec A is a letter from A to Z (as permissible) DD 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	Reset Calibrations	Will reset all user adjustable sensor calibrations back to factory default values
Zero Dry in Air Offset	Conductivity Reading Adjusted to Zero for dry in air condition	Dampener & Delay from Boot	Time averaging of process value 1, 2, 3, 4, 5, 8, 10, 15, 20 or 30 Seconds
Wet Gain Calibration to determine effective apparent cell constant	Calibrated Conductivity Value ±70% from nominal cell constant	Step Change	Increment value for stepwise calibration on the handheld communicator: 0.05, 0.10, 0.20, 0.5, 1.0 or 2.0 %
Range Mode	Standard Range or High Range Mode operation is selectable while sensor is in operation.	Special - Temp Compensation	0.00 to 9.99 % per degree Celsius (Default 2.10%)

NOTE 1: All MODBUS devices on network must use the same baudrate and have a unique node address. Handheld Communicator (HHC) is MODBUS master while all HiQDT sensors are MODBUS slaves. To interface HHC with HiQDT sensor, either removed it from the network, or else bypass with a bridge box with switch scheme. Access any given HiQDT sensor on the MODBUS network with HHC is possible if the existing MODBUS master is disconnected or powered down. If node of HiQDT sensor is not known, use Widows Software or HHC search feature to find it. Please see HiQDT installation guide and HiQDT controller manual for additional recommendations & details about commissioning, calibration and troubleshooting.

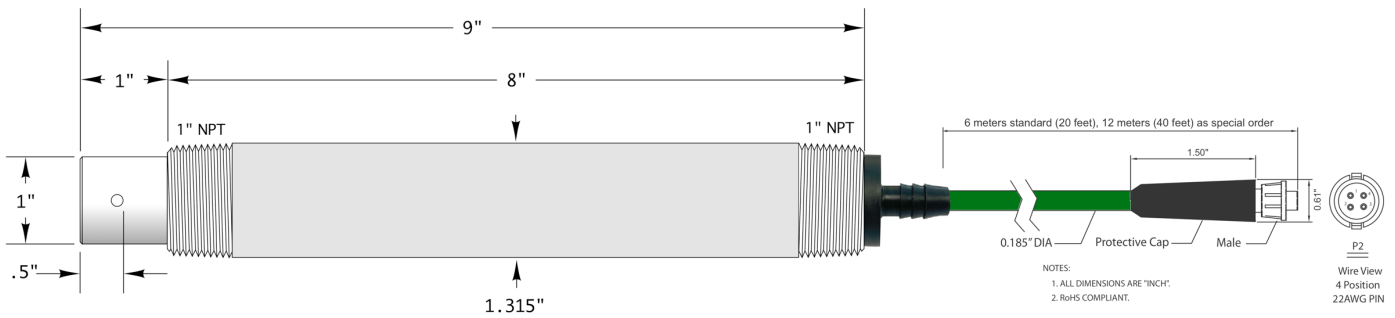
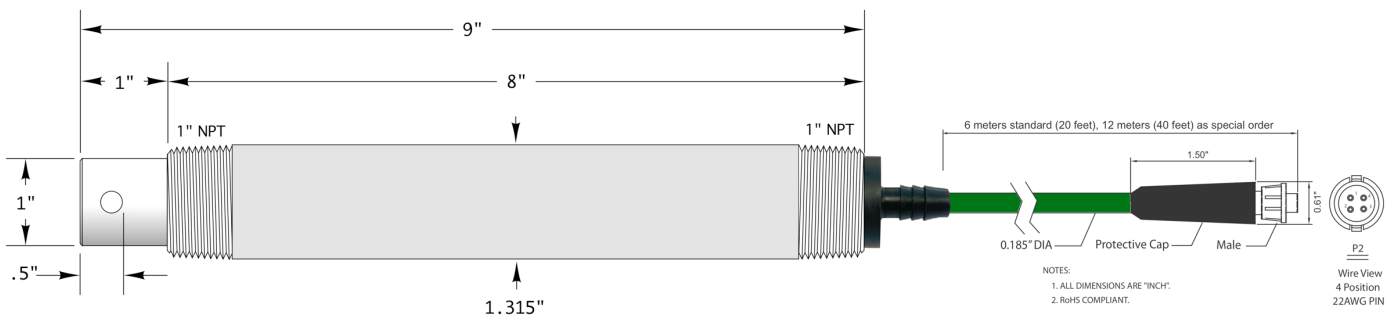
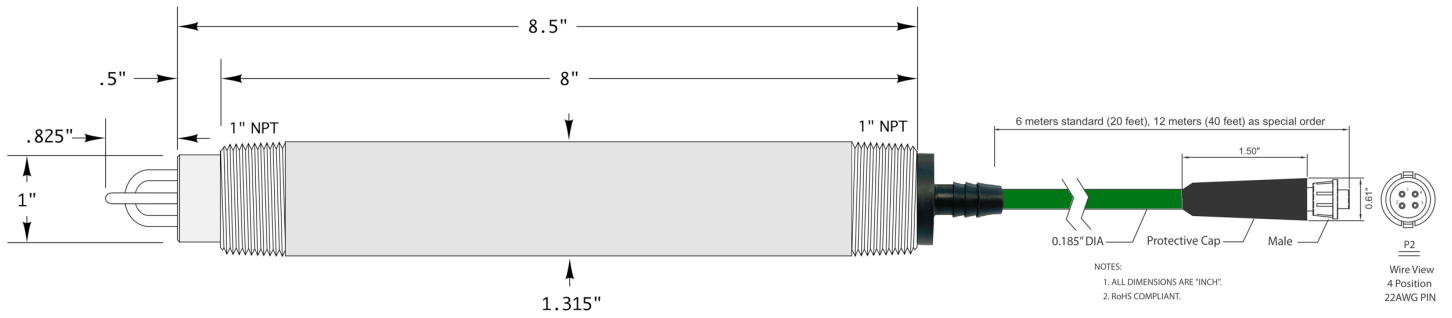
NOTE 2: Access to **READ** values in *Core Process Value Column* gained through MODBUS function code (04).

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).

Last Revised December 11, 2020

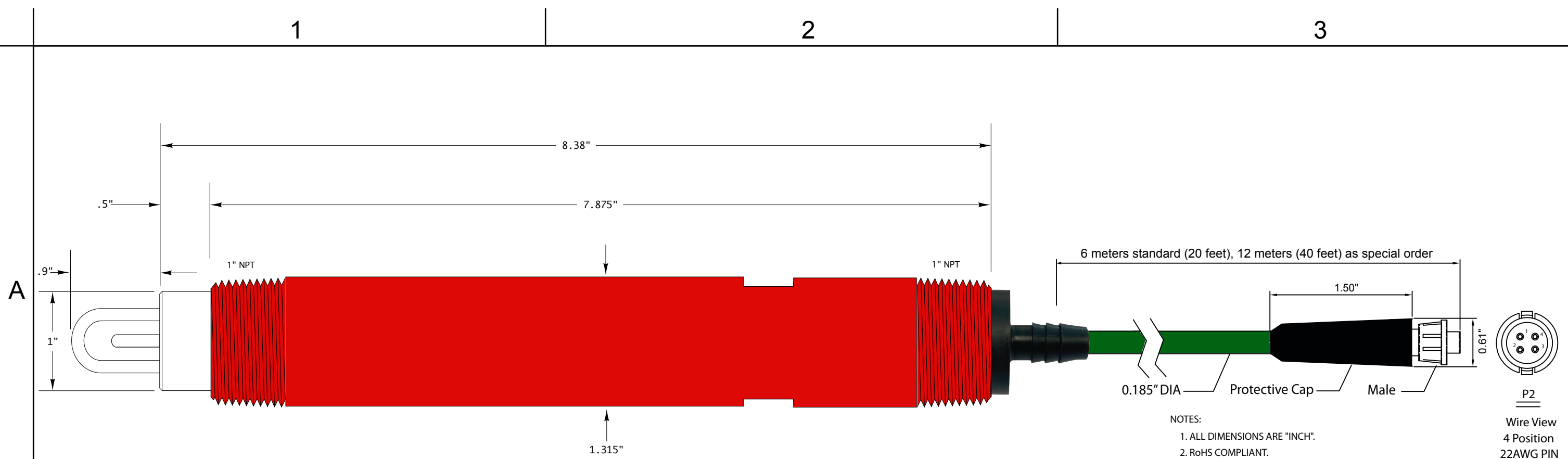
Dimensions for *HiQDT* AST50 & AST60 Cell Constants 0.1, 1.0 & 2.0



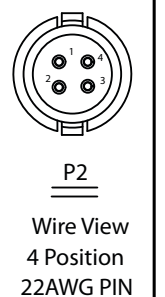
Drawings of AST50 & AST60 in the $K=0.1/cm$, $K=1.0/cm$ and $K=2.0/cm$ cell constant configurations are shown above without waterproofing option. Please inquire to factory for overall sensor length and dimensional details if a waterproofing option is to be added to sensor for submersible use.



AST50 contacting conductivity sensor tips shown in $K=0.1$, 1.0 and 2.0 cell constants from left to right, respectively.



NOTES:
 1. ALL DIMENSIONS ARE "INCH".
 2. RoHS COMPLIANT.



NOTES


1. All dimensions are in inches, unless otherwise indicated.
2. Please see specification sheet for recommended conductivity ranges for K=0.2/cm in standard, high & ultralow configurations
3. Material of construction for sensor body is KYNAR & Material of construction for insulator is TEFLON
4. Material of construction for electrodes is 316SS standard; Titanium, Monel or Hastelloy C-276 available as options
5. Material of construction for O-rings is EPDM standard; Viton, AFLAS or KALREZ available as options
6. Maximum temperature for fully submersible use in 85 degrees Celsius
7. Maximum inline temperature is 120 degrees Celsius at 100 psig
8. Smart HiQDT MODBUS RTU configuration uses waterproof HiQ4M quick disconnect snap connector. 20 feet (6 meters) integral cable standard; Extended integral cable lengths of 40 feet (12 meters) or 75 feet (23 meters) are available as options. Maximum total cable length 1,000 meters (3,200 feet).
9. Do not use any sensor beyond the factory defined maximum temperature, flow or pressure rating.

TOLERANCES	
1 Place: ± .1	3 Places: ± .005
2 Places: ± .01	4 Places: ± .0005
Angular: ± 0.25°	

DRAWN BY
RH

CHECKED BY
TADP

APPROVED BY
MJP

 Advanced Sensor Technologies U.S.A. Website: http://www.astisensor.com			
TITLE AST60-0.2-HiQDT Smart Conductivity Sensor			
SIZE B	PROJECT AST60-0.2-HiQDT	DRAWING NO. AST60-0.2-HiQDT	REV /
SCALE Not to Scale	MODEL AST60-0.2-HiQDT	SHEET 1	OF 1

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