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Solumetrix 'B' Series Toroidal Conductivity Sensors

Model: **BEIN75**

Conductivity: Three ranges,

0-2.0000 mS/cm (Compensated), 0-6.5500 mS (Uncompensated), 0.1 uS resolution
0-20.000 mS/cm (Compensated), 0-65.500 mS (Uncompensated), 1 uS resolution
0-200.00 mS/cm (Compensated), 0-655.00 mS (Uncompensated), 10 uS resolution

Temperature Range mechanical 0-50°C
Temperature Range measurable 0-100°C
Temperature resolution: 0.1 °C (default), 0.01 °C (Software selectable)
Temperature compensation: 0-2.55 % per °C (From 25°C), default 1.7 % per °C

Feature table:

Model	Temperature	Fixing Thread	Serial Interface	Electronics
BEIN75	0-50.0°C	¾" BSP Parallel	TTL	Internal

The 'B' series toroidal conductivity sensors overcome many of the difficulties associated with conventional toroidal sensors. The signal processing electronics is incorporated in the sensor's body and is permanently paired with the sensor cell.
This allows the sensor to be pre-calibrated at the factory.

The sensors are calibrated on 3 ranges, 0-2.0mS(0.1us resolution), 0-20mS (1uS resolution), and 0-200mS (10uS resolution).
The sensor requires a single 9-24V DC supply, and has two data lines, all in a single 4-wire unscreened cable.
The sensor communicates via a UART serial data port, allowing data to be read from the sensor, and also allowing various control functions to be carried out.

These functions are:

- Polling for data
- Range changing
- Temperature compensation adjustment (0.00% > 2.55%, in 0.01% steps)
- Data filtering parameter

The Sensors are compatible with the Solumetrix 4-20WD2C and 4-20ND2C transmitters, 0-10V, 4-20ma and RS485 modbus DIN module interfaces and also with the RM-33 rinse water controller.

OEM users can easily interface this device to their own input circuit requirements, needing only a 9600 baud UART, no level shifting, for lead lengths up to 300 metres.

The electronics package is incorporated in the body of the sensor for applications up to 50°C, and for higher temperatures the electronics are housed in an encapsulated module in the lead, situated close to the sensor body.
The sensor has an in-built temperature measurement circuit, and the conductivity signal is output as a digital data stream, comprising uncompensated, compensated conductivity values, together with temperature data. Temperature compensation is carried out within the sensor electronics, the default percentage value is 1.7%/°C.
The electronics package has been developed to be compliant with CE RF industrial fields and does not require any shielded cables for connection.

Sensor connections.

TTL comms

Red	Power supply +9V to 24V DC @ 50 mA
Black	Power supply 0V
Brown	Serial RX (optional input, not needed for default mode) Input Levels: 0 = <1.5V, 1 = +4.0V to +5.0V
Orange	Serial TX (output) Output Levels: 0 = <0.6V, 1 = >4.3V

Data format.

9600 baud, 8 data bits, no parity, 1 stop bit, no flow control.

Sensor data Output.
14 byte data packet consisting of:

Byte 1	Header check byte 1, always AA hex
Byte 2	Header check byte 2, always 55 hex
Byte 3	Sensor type, always 01 hex
Byte 4	Sensor Status data low byte
Byte 5	Sensor Status data high byte
Byte 6	Temperature in °C x 10, low byte
Byte 7	Temperature in °C x 10, high byte
Byte 8*	Uncompensated conductivity, low byte
Byte 9*	Uncompensated conductivity, high byte
Byte 10*	Compensated conductivity, low byte
Byte 11*	Compensated conductivity, high byte
Byte 12	Checksum byte, 2's complement of the sum of bytes 1 to 11 inclusive
Byte 13	Tail check byte 1, always 55 hex
Byte 14	Tail check byte 2, always AA hex

* Conductivity is in uS on 20mS range, ÷ 10 if on 200mS range, x 10 if on 2mS range.

Data transmitted every 300ms approx in default mode.

Byte	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Header 1	Header 2	Type	Status	S/W ver	Temperature		Uncompensated conductivity		Compensated conductivity		Checksum	Tail 1	Tail 2
	AA	55	01	↓	S/w Ver x 10	Low Byte	High Byte	Low byte	High byte	Low byte	High byte	↓	55	AA
Example hex data	AA	55	01	02	3E	CB	00	A0	04	06	05	48	55	AA
Decoded data			01	20mS	6.20	20.3°C		1.184mS		1.286mS				

Checksum = 2's complement of the 8 bit sum of bytes 1 to 11 inclusive.
e.g. From example above: AA+55+01+02+3E+CB+00+A0+04+06+05 = BA Hex
2's complement of BA = 46 Hex

Status byte details.

Bit	7	6	5	4	3	2	1	0
	Hi res temp	Not used	Gain range		Comms mode		Poll mode	Data mode
0	Normal	0	00 20mS 01 200mS 10 2mS 11 Not used		00 RS232		Polled	Normal
1	High Resolution	0					Continuous	Raw

Status byte description.

Bit 0	Sensor data mode	0 = Normal mode, 1 = Raw mode
Bit 1	Sensor poll mode	0 = Polled data mode, 1 = Continuous mode
Bits 2-3	Sensor comms mode	0 = RS232, No longer used.
Bits 4-5	Sensor Gain range	0 = 20mS, 1 = 200mS, 2 = 2mS
Bit 6	Not used	0
Bit 7	High Res Temp mode	0 = Normal, 1 = High resolution temperature

Sensor data input.

9600 baud, 8 data bits, no parity, 1 stop bit, no flow control.

10 byte data packet consisting of :

Byte 1	Header check byte 1, always AA hex
Byte 2	Header check byte 2, always 55 hex
Byte 3	Command
Byte 4	Command data, low byte
Byte 5	Command data, high byte
Byte 6	Reserved, low byte
Byte 7	Reserved, high byte
Byte 8	Checksum byte, 2's complement of the sum of bytes 1 to 7 inclusive
Byte 9	Tail check byte 1, always 55 hex
Byte 10	Tail check byte 2, always AA hex

Byte	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
	Header 1	**Header 2**	**Command**	**Command Data**		**Reserved**		**Checksum**	**Tail 1**	**Tail 2**
	AA	55	01	Low Byte	High Byte	Low Byte	High Byte	↓	55	AA
Example hex data 1	AA	55	FD	02	00	00	00	02	55	AA
Decoded data 1			Set Averaging	Set averaging to 2		0				
Example hex data 2	AA	55	02	AA	00	00	00	55	55	AA
Decoded data 2			Poll mode	Set Temp. comp. 1.7%						

Checksum = 2's complement of the 8 bit sum of bytes 1 to 7 inclusive.
e.g. From example 2 above: AA+55+02+AA+00+00+00 = AB Hex
2's complement of AB = 55 Hex

Command details

Command	Command data	Command Function
01 hex	Temp comp value(1)	Set sensor data into continuous data mode. Sensor sends data every approx. 300ms Temp comp value = %×100 e.g. 170 dec = 1.7%
02 hex	Temp comp value(1)	Set sensor into polled data mode. Sensor only sends data when command 02 is received. Temp comp value = %×100 e.g. 150 dec = 1.5%
03 to A2 hex	Reserved(3)	Reserved, do not use.
A3 hex	ASCII data mode(7)	0 = Solumetrix Data mode, 4 = ASCII data mode, Other values reserved.
A4 to F4 hex	Reserved(3)	Reserved, do not use.
F5 hex	High res temp(2)	1 = Temperature is returned to 0.01 °C 0 = Default 0.1 °C temperature resolution.
F6 hex	Reserved(3)	Reserved, do not use.
F7 hex	Sensor range(4)	Sets sensor range, 0 =20mS, 1 =200mS, 2 =2mS If 0 conductivity = mS, if 1 conductivity = mS / 10, If 2 conductivity = mS x 10
F8 to FC hex	Reserved(3)	
FD hex	Averaging value	Sets sensor averaging value, 0 (off) to 32. Compensated conductivity value is averaged over this number of samples.
FE hex		Reserved(3)
FF hex	FFFF hex(6)	Reset all EEPROM settings in sensor to defaults.

Command Notes:

1. The temperature compensation value can only be changed as part of commands 01 and 02 and must always be specified in these commands.
2. The internal calculations for the temperature compensated conductivity are always done using the high resolution (0.01°C) temperature.
3. These commands are unused or reserved, Reserved commands are used during manufacture and sending these commands will cause the sensor to malfunction.
4. Default range is 0-20mS unless requested at time of ordering.
5. Confirmation of most commands can be done only by reading the appropriate bits in the Status byte in the returned data.
6. The reset command FF will clear the sensor calibration and it will have to be returned to Solumetrix for Calibration.
7.

ASCII data format output.

This is a new optional ASCII data output mode from our sensors which can be viewed on a terminal program and easily logged to a file for direct import into Excel etc as a comma delimited file.

This can be specified at the time of ordering or can be set later using the command A3 as below.
The sensor part number will have a -AS on the part number if it is set to this mode when shipped.
This data is sent at the same 9600 baud rate as the normal sensor mode.

The data comprises of 4 comma delimited fields terminated by CR and LF

Example data packet:

28.190,0.0000,0.0000,242

As follows:

Temperature in degrees C, 6 characters, 5 digits & a DP, always xx.xxx, last digit is alway 0
,
Compensated conductivity in mS/cm, 6 characters, 5 digits & a DP, DP will change position according to sensor range.
,
Uncompensated conductivity in mS/cm, 6 characters, 5 digits & a DP, DP will change position according to sensor range.
,
Checksum, 3 characters, 8 bit (0-255) value.
CR and LF characters, terminates the data packet.

The Checksum is the 8 bit sum of the ASCII values of all the characters prior to the 3 checksum digits.

ASCII codes are:

. = 46
, = 44
0 = 48
1 = 49
2 = 50
3 = 51 etc

So, checksum of ascii data, characters in Bold: ***28.190,0.0000,0.0000,****242*

=50+56+46+49+57+48+44+48+46+48+48+48+48+44+48+46+48+48+48+48+44
=1010 (16bit)
Modulo 256 = 242

Another example:

Ascii data *28.160,3.6005,4.5494,023*

=50+56+46+49+54+48+44+51+46+54+48+48+53+44+52+46+53+52+57+52+44

Switching to/from ASCII mode.

There is a new command A3 hex for switching to and from ASCII mode.

To switch to Solumetrix normal data mode send: AA 55 A3 00 00 00 00 5E 55 AA
To switch to ASCII data mode send: AA 55 A3 04 00 00 00 5A 55 AA

All existing sensor commands will function as normal and can be used to change ranges etc.

E.G

Set range to 20mS AA 55 F7 00 00 00 00 0A 55 AA
Set range to 200mS AA 55 F7 01 00 00 00 09 55 AA
Set range to 2mS AA 55 F7 02 00 00 00 08 55 AA

Set TC to 1.7% AA 55 01 AA 00 00 00 56 55 AA
Set TC to 2.0% AA 55 01 C8 00 00 00 38 55 AA

Mechanical mounting.

The sensor can be fitted into tanks using a back nut and sealing washer or into the side of a ‘T’ piece inline with a pipe using an adaptor.
Note however that there needs to be a minimum clearance around the end of the sensor as specified in the drawings below.
The sensor should only be held during tightening using the hexagon on the body.
On no account should the sensor be tightened using a spanner on the head or a bar through the hole in the head, this will damage the sensor.