PRODUCT SHEET 2010

Data Sheet1001

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MEASURING SOLUTIONS

Solumetrix Toroidal Conductivity Sensors

This data sheet applies to:
INTEL ML50UK, (BKIN50)
EXTEL ML50UK, (BKEX50)
INTEL ML75UK, (BEIN75)
EXTEL ML75UK, (BEEX75) Note: BK=Black, BE=Beige,
'B' Series toroidal conductivity sensors

The 'B' series toroidal conductivity sensors overcome many of the difficulties associated with conventional toroidal sensors. The signal processing electronics have been incorporated in an ASIC which together with an in-built microcontroller, provide all the necessary electronics to measure, and digitise conductivity.
This allows the sensor to be pre-calibrated in the factory, the processing electronics being permanently paired with the sensor cell.
The sensors are calibrated on two ranges, 0-20mS (0.1uS resolution), and 200mS (1uS resolution).
The sensor has a single DC supply, 9-24Vdc, and 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
Calibration
Temperature compensation adjustment (0.00% > 3.00%, in 0.01% steps)
Data filtering parameter

The Sensor is compatible with the Solumetrix 4-20mWD2C, 4-20ND2C transmitters, and also, the SCR3 versatile 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.

Available in flange mount, with two thread sizes, the body material is in two temperature variants of polypropylene.
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.

The temperature compensation is carried out within the sensor electronics, and 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.

Conductivity: Dual BKIN50, BKEX50, BEIN75 BEEX75 range,
0-20.00 mS (Compensated), 0.1 uS resolution
0-200.0 mS (Compensated), 1 uS resolution
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
BKIN50	0-50.0°C	½" BSP Parallel	TTL	Internal
BKEX50	0-100.0°C	½" BSP Parallel	TTL	External
BKIN75	0-50.0°C	¾" BSP Parallel	TTL	Internal
BKEX75	0-50.0°C	¾" BSP Parallel	RS232	External

Probe connections:

Red: Power supply +10v to 24v DC @ 50 ma
Black: Power supply 0v
Brown: Serial RX (input, Optional, 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.

Probe 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 Probe type, always 01 hex
Byte 4 Probe Status data low byte
Byte 5 Probe 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, in uS (÷10 if on 200mS range), low byte

Byte 9 Uncompensated conductivity, in uS (÷10 if on 200mS range), high byte
Byte 10 Compensated conductivity, in uS (÷10 if on 200mS range), low byte
Byte 11 Compensated conductivity, in uS (÷10 if on 200mS range), 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

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		Check Sum	Tail 1	Tail2
	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	46	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	0	20mS	00 RS232 01 I2C 10 4-20ma 11 RS48		Polled	Normal
1	High Resolution	0	0	200mS			Continuous	Raw

Status byte description:

Bit 0	Probe data mode	0 = Normal mode, 1 = Raw mode
Bit 1	Probe poll mode	0 = Polled data mode, 1 = Continuous mode
Bits 2-3	Probe comms mode	0 = RS232, 1 = I2C, 2 = 4-20ma, 3 = RS485
Bit 4	Gain range	0 = 20mS, 1 = 200mS
Bit 5	Not used	0
Bit 6	Not used	0
Bit 7	High Res Temp mode	0 = Normal, 1 = High resolution temperature

Probe 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**		**Check sum**	**Tail1**	**Tail2**
	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+00 = AB Hex.
2's complement of AB = 55 Hex

Command details

Command	**Command data**	**Command Function**
01 hex	Temp comp value (1)	Set probe data into continuous data mode, Probe sends data every approx 300ms Temp comp value = %*100 e.g. 170 Dec = 1.7%
02 hex	Temp comp value (1)	Set probe into polled data mode; Probe only sends data when command 02 is received. Temp comp value = %*100 e.g.150dec=1.5%

03 to EF hex	Unused	
F0 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	Probe range (4)	Sets probe range, 0 = 20mS, 1 = 200ms If 0 conductivity = uS, if 1 conductivity = uS / 10
F8 hex	F8F8 hex	Sets probe into raw data mode, used for calibration, temperature, and conductivity values are raw ADC results.
F9 hex	F9F9 hex	Sets probe back into normal data mode.
FA hex	Cond offset value	Sets conductivity calibration offset value.
FB hex	Cond gain value	Sets conductivity calibration gain value.
FC hex	Unused	
FD hex	Averaging value	Sets probe averaging value, 0(off) to 32 Compensated conductivity value is averaged over this number of samples.
FE hex	0000 hex AF5A hex (6) F0A5 hex (6) 5F05 hex (6)	Sets probe interface to RS232 (default) Sets interface to I2C (needs specific hardware) Sets to 4-20ma (needs specific hardware) Sets interface to RS485 (needs specific hardware)
FF hex	FFFF hex (7)	Reset all EEPROM settings in probe 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. Reserved commands are used during manufacture and sending these commands will cause the probe 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.

8. Changing the probe comms mode only comes into effect at the next power cycle. Changing the comms mode on a probe that does not support it will result in a probe that will not communicate until the comms mode is reset by sending the Command FE with Data 0000 within 200mS of powering up the probe.

9. The reset command FF will clear the probe calibration and must only be used if you are able to recalibrate it using commands FA and FB

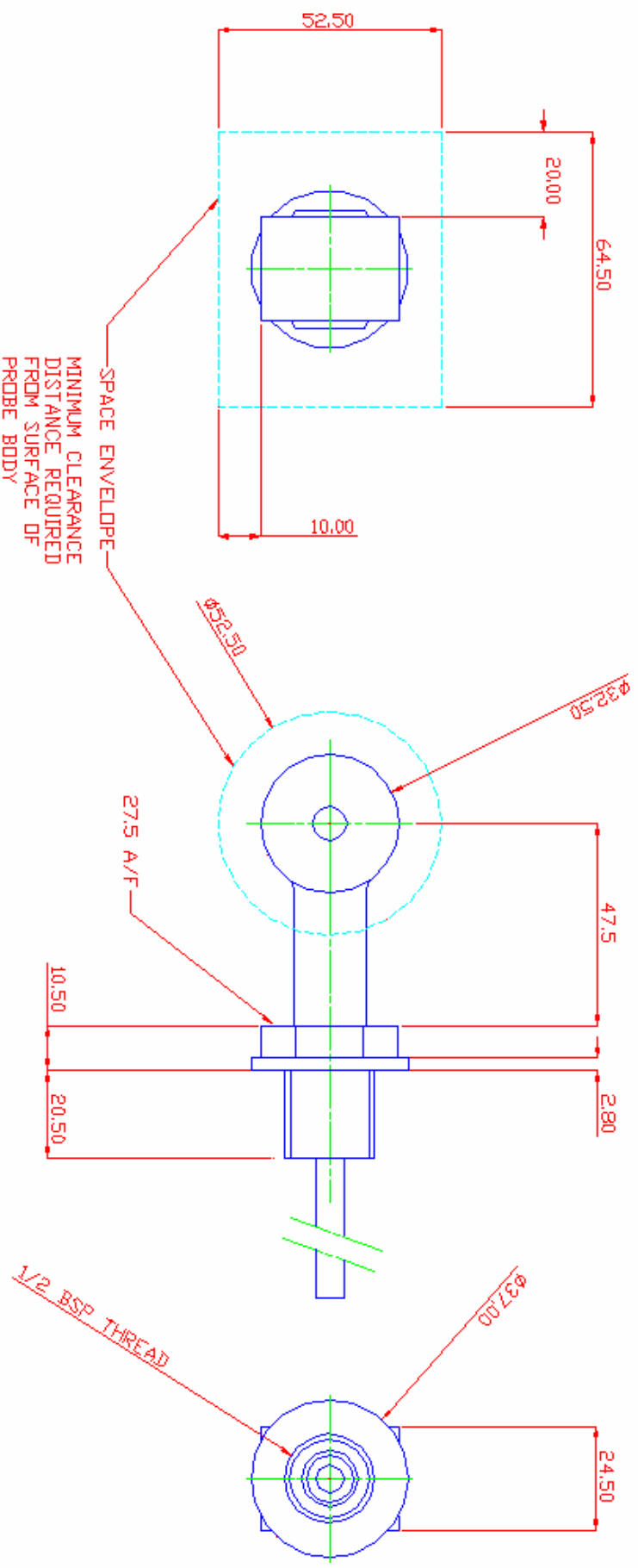
To recalibrate the probe:

- **a.** Select the desired gain range using command F7 hex.
- **b.** Set the probe into raw mode using command F8 hex.
- **c.** Have the probe in free air and note the value of uncompensated conductivity returned by the probe (OFFSET value).
- **d.** Send this value to the probe using command FA hex.
- **e.** Put the probe into a known conductivity solution that ideally is between ¼ and ¾ of the current range, or alternatively loop a 0.1% resistor through the hole in the probe.
  A 1k resistor will give 4.550mS; a 100r resistor will give 45.50mS
  Note down this is conductivity without any decimal points (TARGET value) e.g. 4550.
- **f.** Once the reading is stable note the new uncompensated conductivity reading returned from the probe (GAIN value).
- **g.** Send to the probe using command FB the 16 bit result from the following calculation. (TARGET*16384)/(GAIN-OFFSET)
- **h.** Return the probe to normal mode using command F9
- **i.** If desire turn on the averaging using command FD

Mechanical mounting:

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

BKIN50 & BKEX50
Dimensions



BEIN75 & BEEX75
Dimensions