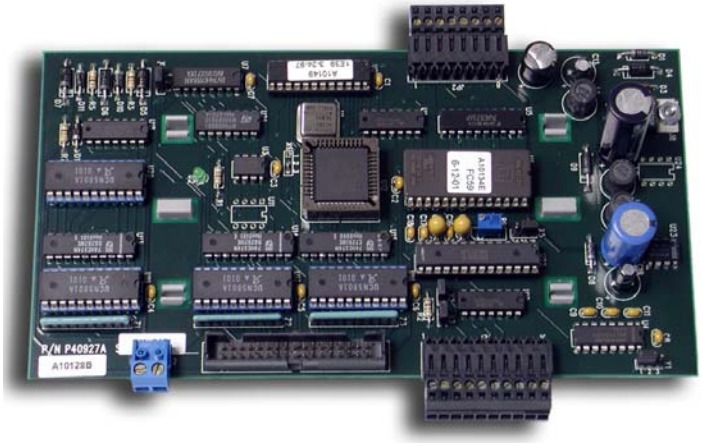
RAPID CONTROLS

Product Specification for SAB-P



The SAB-P Parallel Interface board measures Temposonics transducer position, scales and offsets this position and presents the value as a 24 bit Binary or BCD format parallel output. The 24 outputs are open collector sinking outputs (optionally source type). The board can function with start-stop or pulse width transducers or with SSI Tempo-III transducers. The board continually interrogates the transducer for position and updates the latched outputs. Transducer position information is also made available to the host via the RS232/RS422/RS485 interface. A setup mode allows setting of recirculations, transducer length, output format, etc via the RS232/RS422/RS485 port. An optional analog output provides position or velocity information in an analog form.

Features

- 24 bit Temposonics position, 0.0005 inch resolution with 4 recirculations.
- Fast operation, outputs can be updated as often as 5000 times per second.
- Use with Start/Stop or Pulse Width transducers, or SSI TEMPO III transducers.
- Natural binary or BCD output format.
- Analog Option provides 12 bit D/A converter for analog output function.
- Setup of scale, direction, offset, recirculations and output type is done via the serial link.
- Data ready output active during strobe of new data.
- Convenient removable screw terminals for all field side connections.
- RS232, RS422 or RS485 multi-drop communications for setup and readout of data.
- Single +18 to +25 VDC power input. +/-15 VDC generated on board to power TEMPO II transducer.
- Blinking green LED indicates good operation.
- Watch dog timer for reset upon software failure.
- EEPROM for nonvolatile storage of setup parameters.

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Specifications

- 24 bit magnetostrictive transducer measurement.
- 26 open collector outputs. Max 50V and 500 ma. Pull-ups installed.
- 34 Pin IDC header for status and 24 bit binary/BCD output.
- Data ready output goes low for 60 microseconds to indicate busy during update of the output. Data is actually latched 35 microseconds after Data Valid goes low and 25 microseconds before it returns high.
- Options allow use with the LP, TEMPO II RPM or DPM and TEMPO III SSI.
- 56 MHz Oscillator for 0.001 inch resolution with 2 recirculations on TEMPO II,
- 0.002 inch resolution for LP.
- Update rate: 100 to 5000 updates per second.
- Software selectable recirculations and transducer length for TEMPO II.
- 28 MHz 80C320 Processor with 64K EPROM and 1K local ram and Watchdog Timer.
- Power: +18V to +25 VDC at < 400 ma. Generates +/-15V @ 300 ma.
- DIN Rail Mount occupies 7.5 inches of rail space.
- TEMPO III SSI option available.
- Analog Output Option:
  - Position or Velocity Analog Output.
  - Output range (+/- 10V or 0 - 10V). 12 bit,
  - Polarity and Scale are setup options.

Mechanical Specifications

- 7.5 inch wide by 4.00 Inches long.

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Jumpers

X1: This jumper selects the serial communications receive interface.
- X1 1-2 RS232.
- X1 2-3 RS485/422.

X2,3: These jumpers connect RS485 line termination when installed.
- X2,3 Installed for last device on RS484, RS422.
- X2,3 Removed for all but the last device on RS485, RS422.

X4: Parallel Output Sink/Source (factory set)
- X4 1-2 for the sink output IC's.
- X4 2-3 for the source output IC's.

X5: Range select for the Analog Output option.
- X5 1-2 +/- 10V output.
- X5 2-3 0 - 10V output.

X6: Installed 2-3 for EPROM, 1-2 for Internal Program memory. (Factory Set)

R9: Analog Output Gain Trim.

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Connectors

Connector JP1 pinout

JP1-1	Logic Ground
JP1-2	RS232 Receive from to the Host.
JP1-3	RS232 Transmit to the Host.
JP1-4	RS422 Receive +, connect to JP1- 6 for RS485
JP1-5	RS422 Receive -, connect to JP1-7 for RS485
JP1-6	RS422 Transmit +, connect to JP1-4 for RS485 (RS485 +)
JP1-7	RS422 Transmit -, connect to JP1-5 for RS485 (RS485 -)
JP1-8	Analog Output
JP1-9	Logic Ground
JP1-10	Reserved for future use.

Connector JP2 pinout

JP2-1	Ch0 Interrogate + to the transducer	(Clk+ for SSI)	(YELLOW)
JP2-2	Ch0 Interrogate - to the transducer	(Clk- for SSI)	(GREEN)
JP2-3	Ch0 Gate + from the transducer	(Data+ for SSI)	(PINK)
JP2-4	Ch0 Gate - from the transducer	(Data- for SSI)	(GRAY)
JP2-5	+18 to +25V Power input	(+24V for SSI)	(SSI-RED)
	This is connected directly to JP3-1		
JP2-6	Logic Ground.		(WHITE)
JP2-7	-15 VDC to the transducer		(BLUE)
JP2-8	+15 VDC to the transducer		(TEMPO II-RED)

Connector JP3 pinout

JP3-1:	+18 to 25 VDC power input to the board.
	This pin is connected directly to JP2-5.
JP3-2:	Logic Ground

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Connector JP4 pinout

JP4 - 1: 2^0	BCD digit 1 (least significant)
JP4 - 2: 2^1	
JP4 - 3: 2^2	
JP4 - 4: 2^3	
JP4 - 5: 2^4	BCD digit 2
JP4 - 6: 2^5	
JP4 - 7: 2^6	
JP4 - 8: 2^7	
JP4 - 9: 2^8	BCD digit 3
JP4 - 10:2^9	
JP4 - 11:2^10	
JP4 - 12:2^11	
JP4 - 13:2^12	BCD digit 4
JP4 - 14:2^13	
JP4 - 15:2^14	
JP4 - 16:2^15	
JP4 - 17:2^16	BCD Digit 5
JP4 - 18:2^17	
JP4 - 19:2^18	
JP4 - 20:2^19	
JP4 - 21:2^20	BCD Digit 6
JP4 - 22:2^21	
JP4 - 23:2^22	
JP4 - 24:2^23	
JP4 - 25	Data Ready Output (Latch Pulse). When low outputs are changing. Low for approximately 60 usec. Data Changes after 30 usec. The rising edge can be used to strobe data to the host.
JP4 - 26	Error output. When low indicates loss of feedback or that the update time is too short for the number of recirculations. When high no errors are present.
JP4 - 27	Data hold input (Latch Inhibit). When High inhibits data from updating. **!!This output must be low or the outputs will not change.** Tie to Gnd (JP3-2) if unused.
JP4 - 28	Tri-State Input. When high the outputs are tri-stated. **!T!his output must be low or the outputs will not change.** Tie to Gnd (JP3-2) if unused.
JP4 - 29	N/C
JP4 - 30	Reserved for future use.
JP4 - 31	Kickback Protect Power supply. For inductive loads this point terminates the reverse voltage diodes present on the 5801 output drivers. For sinking applications connect to the positive load power supply. For sourcing applications connect to ground. This may be left unconnected for non-inductive.
JP4 - 32	Vin (5-24 VDC) System voltage used to pull up the outputs.
JP4 - 33	Kickback protect supply (see 31)
JP4 - 34	Vin (5-24 VDC) System voltage used to pull up the outputs.

Resistor Packs Z1, Z2, Z3

Resistor packs Z1, Z2 and Z3 are installed to pull the outputs up to the system voltage brought to the board on JP4. The default value of these pull-ups is 3.3K, which works well for most applications. If the outputs are going to be used with 5 Volt, TTL inputs, then these resistor packs can be changed to increase the speed. A value of 390 or 470 ohms will optimize the rise time of the outputs. When driving optically isolated inputs these resistor packs can usually be removed to decrease power consumption.

Operation

At power on, the board immediately retrieves the setup values from the EEPROM memory and begins normal operation. Normal operation consists of interrogating the transducer each update time and outputting the scaled and offset value to the parallel outputs along with status information. The board also allows host communications at 9600 baud at any time.

Host Communications

The board communicates to a host computer via RS232, RS422 or RS485 using a subset of the MODBUS protocol. See *Modbus Protocol Reference Guide*.

Read holding Registers: ":XX0300YY00ZZCS[CR]"
Where XX is the hexadecimal slave ID of the desired board.
YY is the hexadecimal starting address of the register.
ZZ is the hexadecimal number of registers to read.
CS is the hexadecimal twos complement checksum.
Register Numbers supported: 0 High word of unscaled position.
1 Low Word of unscaled position.
2 High word of scaled and offset position.
3 Low Word of scaled and offset position.

Read Status Coils: ":XX07CS[CR]"
Where XX is the hexadecimal slave ID of the desired board.
CS is the hexadecimal twos complement checksum.
The returned string is ":XX07YYCS[CR]"
Where XX is the hexadecimal slave ID of the desired board.
YY is the hexadecimal status value:
2^0 If set indicates no magnet or transducer.
2^1 If set indicates update time too short.
All zeros indicates no errors.
CS is the hexadecimal twos complement checksum.

Setup

The Parallel board ships from the factory with default values installed. The default setup is as follows:

Slave id = 0
Baud Rate = 9600 bps
Transducer Type = RPM
Units = inches
Gradient = 9.0 usec per inch
Resolution = .001 inch
Recirculations = 2
Measured Stroke Length = 100 inches
Update Time = 2000 usec.
Direction = Plus Extend
Offset Value = 0
Output Format = Binary
Output Type = True
Analog = Position, range of 100 inches and 0 offset. (Analog Output is an option.)

Setup can be accomplished with a terminal or computer connected to the JP1 Host connector. To enter the 'Setup Mode' the user should type 4 ESCAPE characters within 2 seconds at select baud rate(defaults to 9600 bps). The board will acknowledge with the setup menu. The board is then in the 'Setup Mode'. Setup values are stored in a nonvolatile EEPROM memory device on the board. Exiting the main setup menu returns the board to the operation mode.

The Main Setup Menu:

```
Rapid Controls Inc. Parallel [04-09-97|15:22]  -Data Changed-

T - Transducer Type: RPM
U - Units: English
G – Gradient (usec/inch): 8.982600
R - Recirculations: 2
E – Resolution (inches/count): 0.001000
M - Measured Stroke Range (inches): 100.000000
O – Offset (inches): 5.000000
Z – Zero at current position
D - Direction: Increases
F - Output Format: Binary
Y - Output Type: Complemented
I - Filter: Off
P - Update Time (usec): 2000
A - Analog Menu
B - Baud Rate: 9600
N - Turn Around Delay: 10000
V - Slave ID: 0
S - EEPROM Save
L - EEPROM Restore
C - Factory Defaults

Select [ABCDFGILMOPRSTUVYZ eXit] 00001272:
```

Select the desired item by pressing the appropriate key. You will be prompted for the input data. The input takes effect immediately but will not be saved to the EEPROM until the save key is pressed. The first line of the display tells you if the setup has been changed since it was last saved to the EEPROM.

Setup Items

Transducer Type
LP, RPM, DPM or SSI

This will cycle between types each time the key is pressed. Use LP and 1 recirculation for an LP transducer with Start/Stop. The SSI selection requires the SSI option and also affects the Gradient setting below. ***Note: Changing to the SSI type may change the update time. (See Update time Section)***

Units
English or Metric

This value cycles each time you press the key.

Gradient

Enter the gradient value from the transducer label. It is entered in microseconds per inch if English units are used or meters per second if Metric units are used. If an adjustment to the scale of the transducer is required, it must be done by scaling this number. If the transducer reads low then lower this value proportionally, if it reads high raise this value. If a SSI transducer is used with the board, the gradient is multiplied by the counts returned from the transducer, providing a scalar. This is the only multiplier affecting the position returned from a SSI transducer.

NOTE: When the SSI Type is selected, the gradient is used directly to scale the output. Enter a gradient value from 0 to 1.0 that provides the output resolution you desire. If you want the full resolution of the transducer enter 1.0. If you would like to have each of the output bits represent twice the transducer resolution enter 0.5, four times the resolution enter 0.25, etc.

Recirculations

If the RPM transducer type is selected this may be any value from 1 to 32. In all other modes this is forced to 1. Recirculations allow an averaging of multiple measurements to gain resolution. See Notes on setup below.

Resolution

The resolution is the value or weight of the least significant bit of the output binary word, when using a RPM or DPM transducer. It must be greater than or equal to the basic resolution. The basic resolution is a function of the measuring clock (always 56 MHz), the number of recirculations and the Gradient of the transducer (1 /(56 * recirculations * gradient)). See Notes on setup below.

The resolution is also used for part of the analog output calculation. For SSI transducers, the resolution must be set to the resolution marked on the side of the transducer.

Measured Stroke Range

Enter the maximum operational stroke length of the transducer measured from the large nut outward to the maximum extension of the magnet. This value is used, along with the recirculations, to calculate a minimum update time and for the output value when the transducer direction is reversed. It does not have to include any unused parts of the transducer beyond the further most possible position of the magnet.

Offset

Enter an offset value. This value is entered in units and is subtracted from the position value before it is output.

Zero at current position

This will set the offset so that the current position is 0.

Direction

This value toggles between Increases and Decreases each time the key is pressed. Increases means the value of the count will increase as the magnet moves away from the head of the transducer. Decreases means the value of the count will decrease as the magnet moves away from the head of the transducer. The output will be the Measured Stroke Range value when the magnet is fully retracted.

Output Format

This value toggles between Binary and BCD each time the key is pressed. In the BCD mode the maximum value is 999,999 * resolution. For example if 0.001 is the resolution then the maximum range is 999.999 inches. There is no sign bit for BCD. In binary format 2^23 is the sign bit. The range of values

possible is (-8,388,608 to 8,388,607) * resolution. For example: If the resolution is set to 0.001 inches the range is –8,388.608 inches to 8,388.607 inches.
Note: Changing to the BCD format while SSI transducer is selected may change the update time. (See update time section)

Output Type

This value toggles between True and Complemented each time the key is pressed. When in TRUE mode a 0 will be a low at the output and a 1 will be a high. Complemented is exactly opposite. This setting affects only the 24 data bit outputs and does not affect the control inputs or status outputs, which remain consistent as described in the JP4 connector description.

Update Time

Enter the update time in Microseconds. The transducer is interrogated each update time. The minimum value is calculated by the board based on the transducer type, the number of recirculations and the maximum stroke range. I.E. For an RPM transducer with 4 recirculations and a max stroke range of 32 inches the minimum allowable update time will be (9 * 4 * (32 +4)) or 1296 microseconds. The update time resolution is 200 microseconds so the set the update time to 1400 microseconds.

Note: When using SSI transducers and Analog Output or SSI transducers and BCD output the update time will be forced to a minimum of 400 microseconds.

Analog Menu

Press this key to enter the Analog Submenu.

Baud Rate

Select the desired baud rate from a menu. Baud rate will change immediately. Resetting the power to the Parallel module will return the baud rate to what was saved in the EEPROM.

Turn Around Delay

Enter the RS-485 turnaround delay. This is the amount of time in microseconds before the Parallel module will respond to a query over the RS-485 serial link.

Slave ID

Enter the Slave ID from 0 to 15 for the Modbus network.

EEPROM Save

Press this key to save the setup values, currently in effect, to the EEPROM memory.

EEPROM Restore

Press this key to restore the values from the EEPROM. They will take effect immediately.

Factory Defaults

Press this key to change the setup values, currently in effect, to the factory defaults.

The Analog Output Setup Menu

Analog Output

Toggle between the three possible Analog Output types, None, Position and Velocity. The menu will change based on the selection.

Note: When an Analog Output Type of Position or Velocity is selected and the Transducer Type is SSI the Update Time must will be forced to a minimum of 400 microseconds.

The Velocity Analog menu

Analog Velocity Full Scale

Enter the velocity represented by full-scale analog output.

Analog Velocity Time-base

Enter the time over which the velocity is measured. This must be set in increments of the update time and will always be forced to these increments. If you have set the update time to 1000 microseconds the choices will 10000,11000 etc. microseconds.

The Position Analog Menu

Analog Range

Enter the position to be represented by full-scale analog output.

Analog offset

Enter a value to offset the position information by, before applying it to the DAC. This value is subtracted from the scaled and offset position information before it is scaled for the D/A output. For example: If you would like the D/A output minimum value to start at 11.000 inches and increase from there, enter 11.000.

Setup Considerations

The number of recirculations and the gradient will determine both the resolution and the time required for the update of the transducer. A single recirculation is the time it takes for the propagation of the signal from the magnet to the receiver of the transducer. This is nominally 9 microseconds for each inch. Using more than one recirculation allows greater measurement resolution and provides averaging as well but also requires more time. To calculate the number of microseconds required add 4 inches to the useable length, multiply by 9 and multiply again by the number of recirculations, then add 50. The following table indicates the approximate resolution and time versus the number of re-circulations.

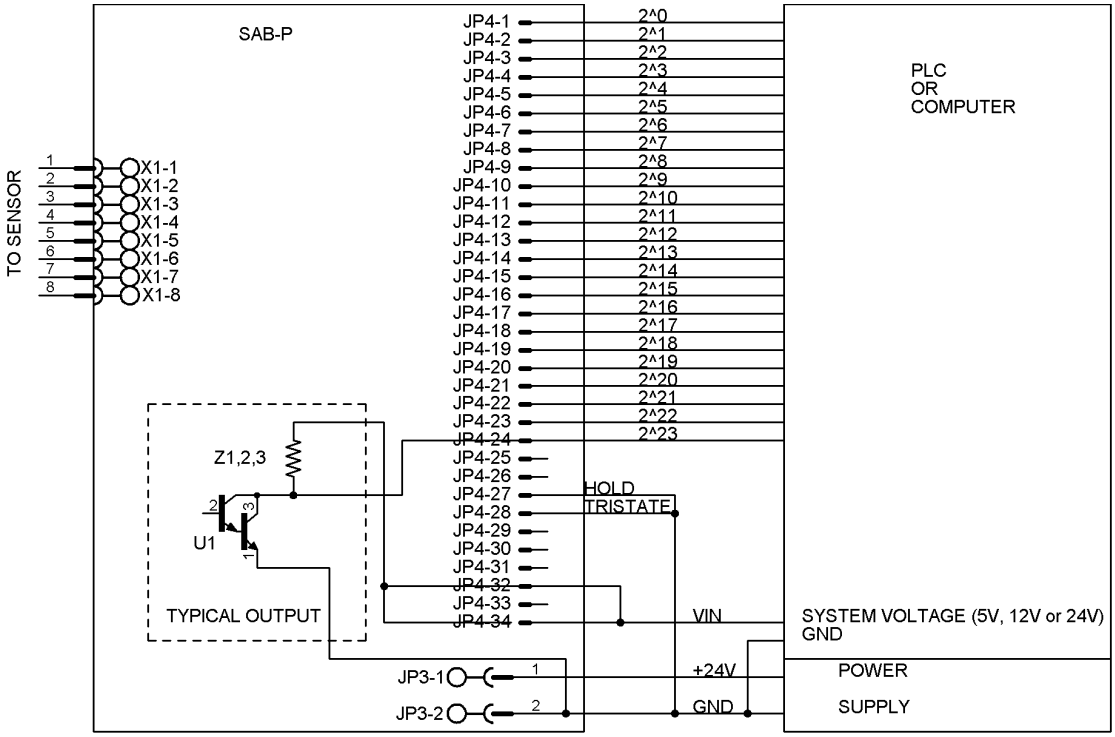
Re-circulations	32 inch transducer	100 inch transducer	Approximate Resolution
1	400 usec	1000 usec	0.002 inch
2	800 usec	1800 usec	0.001 inch
4	1400 usec	3800 usec	0.0005 inch
8	2800 usec	7600 usec	0.000025 inch
16	5400 usec	N/A	0.0000125 inch

SSI

The SSI transducer provides it's output information in a different fashion and accurately enough that it doesn't require the gradient etc. to be entered. The bare resolution of the transducer can be used directly for the output. It also can be updated at 200 microseconds regardless of length. In SSI mode the Gradient is used for a scalar to reduce resolution as required. See Gradient section above.

DPM

DPM transducers used with the standard tempo to parallel board must be externally interrogated. (except when the PFM option is specified). The resolution must be defined based on the recirculations set in the DPM module of the transducer.



Minimum connections

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Custom implementations PF1 (Free running PWM)

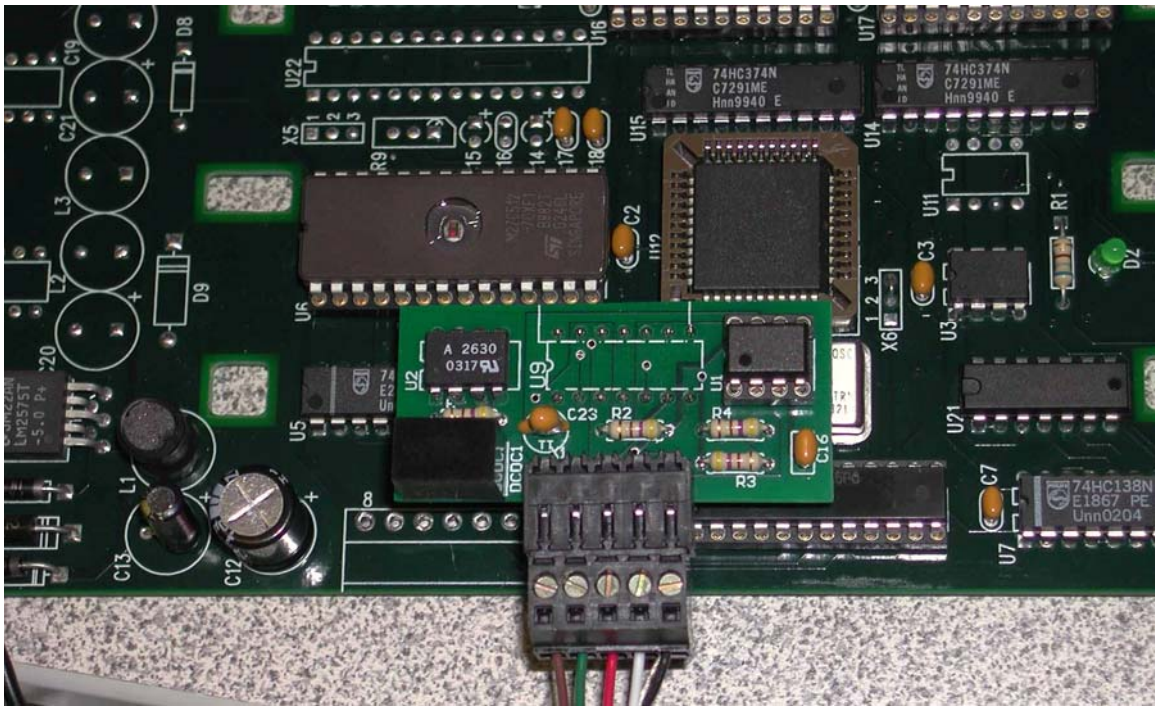
The PF1 model is designed to eavesdrop on a PWM sensor that is being interrogated by some other device. All menu items are the same except the Sensor type selection item is fixed as the DPM type. The re-circulations setup item in the menu should be set to the number of re-circulations used in the sensor monitored. The board is electrically isolated from the Gate lines of the sensor. Connections are made through a 5 pin Weidmueller connector, X1, on a small daughter board. Pin 1 is located nearest the black Dc/Dc converter.

X1 Pin 1	N/C
X1 Pin 2	N/C
X1 Pin 3	Gate +
X1 Pin 4	Gate –
X1 Pin 5	Sensor DC common

Custom implementations RF1 (Free running Start/Stop)

The RF1 model is designed to eavesdrop on a Start/Stop sensor that is being interrogated by some other device. The sensor must be used with a single re-circulation. The Sensor type selection item is fixed as the DPM type. The re-circulations setup item in the menu should be set to 1. The board is electrically isolated from the Interrogate and Gate lines from the sensor. Connections are made through a 5 pin Weidmueller connector, X1, on a small daughter board. Pin 1 is located nearest the black Dc/Dc converter.

X1 Pin 1	Interrogate + from the sensor
X1 Pin 2	Interrogate – from the sensor
X1 Pin 3	Gate + from the sensor
X1 Pin 4	Gate – from the sensor
X1 Pin 5	Sensor DC common



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