RAPID CONTROLS

# Product Specification for SAB-S-TMX


The SAB-S-TMX board is a two-channel module that acquires magnet position information from one or two magnetostrictive transducers and returns this information to a host computer via a RS232 or RS485 serial interface. The board can operate in a single magnet multiple recirculation mode or in the multiple magnet mode. With SSI transducers the board can be switched between 24 or 25 bit mode. The board uses an expanded version of the TMX communication protocol. Multiple boards can be connected in the multi-drop mode to access up to 32 transducers via a single RS485 connection. Each channel has a transducer OK output and LED to signal the proper functioning of the transducer. A blinking LED indicates operation of the processor.

## Features

- Two channels of 24-bit position from Start/Stop, PWM or SSI magnetostrictive transducers
- 56 MHz oscillator for 0.001 inch resolution with 2 recirculations.
- Software selectable gradients, recirculations and offset
- Blinking red LED indicates good operation
- Transducer OK output and LED signals valid transducer operation for each channel
- Watchdog timer for reset upon software failure
- EEPROM for non-volatile storage of setup parameters
- Convenient screw terminal connections
- As many as four channels in a small DIN rail enclosure
- DIN rail mount occupies 1.8 inches of rail space

## Specifications

- Two channels of 24 bit magnetostrictive transducer measurement
- Interfaces with Start/Stop, PWM, or SSI transducers
- The most significant bit of 25 bit SSI transducers is not used
- 56 MHz oscillator for 0.001 inch resolution with 2 recirculations
- Update rate of 5 milliseconds per magnet on each channel
- 28 MHz 87C520 processor with 1KB local RAM
- Sixty-four words of non-volatile EEPROM storage
- Software selectable recirculations (1 to 31)
- Software selectable scale and offset
- Two electrically isolated DC inputs (12-24 VDC)
- Six TTL level outputs (20mA source/sink)
- Two electrically isolated DC outputs for Transducer OK (0-24 VDC at 50 ma)

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- Switch selectable baud rate from 1200 to 38400 baud, 8 bits no parity and 1 stop bit
- Power requirements: 7.5 – 26 VDC at <300 mA (optional features may consume more current)
- Enclosure is 4.64 inches deep x 5.31 high x 1.77 wide (118 x 135 x 46 mm)
- Enclosure occupies 1.77 inches (45 mm) of DIN rail space
- Enclosure can hold two boards with two channels per board

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## Ordering information

Specify model: **SAB-S-*A-B-C-D-E***

**A. Protocol Options**
- **TMX** Supports the TMX protocol

**B. Number of Channels**
- **2** One 2-channel board in DIN enclosure
- **4** Two 2-channel boards in DIN enclosure

**C. Transducer Interface**
- **RPM** Start/Stop or PWM
- **SSI** SSI

**D. Other Options**
- **ANA** Analog output
- omit No options

**E. Oscillator Options**
- **LAM** 28 MHz Oscillator
- omit 56 MHz Oscillator

Model notes:

- All models except -ANA models support multi-magnet and single-magnet (recirculating) modes. When the multi-magnet mode dipswitch is selected, both channels are multi-magnet but a single magnet can be used without recirculating.
- When the SSI transducer type is specified both channels will be SSI format. 24 or 25 bit transducers are supported. And Dip Sw 4 selects 24 or 25 bit for both channels.
- SSI models do not support any of the multi-magnet functions
- Only the lower 24 bits of a 25 bit SSI transducers are used
- Gray code SSI transducers are not supported by the SAB-S-TMX.
- The SAB-S-TMX-?-RPM model supports start/stop and PWM transducers simultaneously.
- Multi-magnet mode is not possible with SSI or PWM transducers.
- Resolution in multi-magnet or single recirculation Start/Stop mode is 0.002 inches or 0.001 inches if using a -LAM model.
- When recirculating or when PWM mode is selected the resolution will be 0.002 inches over the number of recirculations of the transducer (or 0.001 / recirculations for -LAM models).

# Contents



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## General Operation

At power-on the board retrieves setup information from the EEPROM and immediately begins measuring the magnet positions. A 56-MHz counter determines the position count over the programmed number of recirculations or magnets. A scale is applied to normalize the transducer to the desired resolution. The unit provides position information via the RS2332/485 serial interface at a user selected baud rate.

## Status

A red LED on the board blinks during operation to indicate processor operation. Two green LEDs indicate the status of the transducers. When lit the LED indicates a good transducer with the correct number of magnets, and a dark LED indicates a missing or bad transducer or missing magnets. An erratic or blinking LED can indicate noise or the loss of a magnet in the multi-magnet mode.

## Setup

Dip switch S1 selects the channel address, baud rate and mode of operation. Any other setup values are controlled via the serial interface using the TMX communications protocol. Setup values downloaded via the serial interface are stored in non-volatile EEPROM memory for retrieval at each power up.

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## Setup Considerations

### Single Magnet Mode

For Start/Stop transducers the number of recirculations will determine both the resolution and the time required for the update of the transducer. For PWM transducers the recirculations is determined in the transducer, but **recirculations must be set to zero for the channel to use a PWM transducer**. For a Start/Stop transducer, the board controls recirculations. A single recirculation is the time it takes for the propagation of the signal from the magnet to the receiver of the transducer. The signal travels at approximately 9 microseconds per inch (the transducer gradient). Using more than one recirculation allows for greater measurement resolution. The following table indicates the approximate resolution and time versus the number of recirculations. Actual resolution can be calculated by using the following formula: X = 1 / (56*R*G); where X is the resolution in inches, R is the number of recirculations, and G is the transducer gradient. If using a –LAM model, the formula must be changed to X = 1 / (28*R*G).

| Recirculations | Resolution |
|---|---|
| 1 | 0.002 in |
| 2 | 0.001 in |
| 4 | 0.0005 in |
| 8 | 0.00025 in |

### Setting the Scale

The “RD” command allows the position to be read out in engineering units. The scale value entered into the board with the “TS” command is used to accommodate engineering units. The resolution in inches is calculated as described above. To read out in inches simply enter the resolution as the scale. To use other units modify the scale accordingly. To read out in counts, set the scale to 1.0. When you are using PWM transducer and the recirculations are set to 0 on our board, use the transducers internal recirculation value in the above calculations.

Example: Transducer with a 9.123 microseconds per inch gradient and 2 recirculations.
Resolution = 1/(9.123 * 2 * 56 ) = 0.00097868809 inches
Resolution = 1/(9.123 * 2 * 56 * 25.4) = 0.02485867744 mm

To read out in inches “$1TS0.00097868809↵”
To read out in mm “$1TS0.024858567744↵”

### Multiple Magnet Mode

*Note: Multiple magnet mode is not available on -ANA models.*

The number of recirculations determines the number of magnets that position data will be collected for. Position data in multiple magnet mode always has a resolution of approximately 0.002 in. (0.004 in. when using a -LAM model).

## Default Setup

The default setup is programmed at the factory and after EEPROM failure.

| Setup item | Default Value |
|---|---|
| Recirculations | 2 |
| Offset | 0 counts |
| Scale | 1.0 |
| Print Setup | 053 (16-bit binary precision, 5.3 floating point precision) |
| Offset mapping | 0 (No map) |

# COMMUNICATIONS

Up to sixteen SAB-S-TMX modules can be connected for two-way communication with a host computer, a programmable logic controller, or any other device capable of two-way serial communications (RS-232 or RS-485). Each module communicates with the host only, not with other SAB-S-TMX modules. The host must initiate all interactions, a module will never communicate without being commanded to do so. The SAB-S-TMX module is capable of two forms of serial communication: RS-232 and RS-485. RS-232 is suitable for connecting a single SAB-S-TMX to a host over distances of 50 feet or less. RS-485 is suitable for connecting up to 16 SAB-S-TMX modules to a host at distances of up to 4000 feet.

## Communications Protocol Overview

The SAB-S-TMX module uses a subset of the TMX protocol, which is channel oriented. Each address refers to one of the two channels on a module. The S1 dipswitch on the module selects the base address. Some commands affect both channels on the module. A command that references both channels can be sent to either of the two channel addresses on the board.

### Command Structure

The command message begins with a dollar sign (‘$’), followed by the channel address, followed by a two-character command, command parameters, if any, and a carriage return (ASCII 13). An example of a legal command is “$ARD”, which requests the position of a SAB-S-TMX module in single magnet mode whose address is ‘A’. The command “$ARD1” would request the position of the first magnet of a SAB-S-TMX module in multiple magnet mode.

### Response Structure

The SAB-S-TMX responds to command messages in several ways. A response beginning with an asterisk (‘*’), indicates acknowledgement of a valid command. A response beginning with a question mark (‘?’) indicates an error message.

Responses beginning with an asterisk may be followed by data if necessary, and are always terminated by a carriage return. Responses beginning with a question mark are followed by the channel the command requested action from, and an error message. The following error messages may be returned:

| | |
|---|---|
| COMMAND ERROR | Two character command not recognized |
| SYNTAX ERROR | Too few or too many characters in command |
| VALUE ERROR | Incorrect character used as numeric value<br>or illegal numeric value |
| WRITE PROTECTED | Command must be preceded by write enable (WE). |

**Protocol Notes**

The length of command messages is limited to 20 characters. The SAB-S-TMX does not allow spaces between the prompt character (‘$’), the channel, or the command. The channel address can be calculated through the following formula:

Channel address = ASCII value: 48 + [(dip_switch_base_address * 2) + channel]

## The SAB-S-TMX Command Set

### Setup Commands

| **CZ** | Clear Zero(write protected) |
|---|---|
| Forces the offset of a channel to zero(0). This action is independent of any previously set offset. | |
| Example: $1CZ↵ | |
| **Response** | **Meaning** |
| *↵ | Offset set to zero. |

| **MOxx** | Map Offset(write protected) |
|---|---|
| Maps the offset of a channel to a magnet. ‘xx’ can be 0-32, and is the number of the magnet to map the offset to. If xx is zero(0), the offset map is disabled and positions are offset to the value stored with the SO command. If xx is 1-32, positions returned are returned relative to that magnet. Magnet xx is always returned as 0. The mapping is only active when in multiple magnet mode. | |
| Example: $3MO2↵ | |
| **Response** | **Meaning** |
| *↵ | Offset mapped to specified magnet. |

| **Rm** | Read Map |
|---|---|
| Returns the offset map as specified by the MO command. Mapping is only active in multiple magnet mode. | |
| Example: $1Rm↵ | |
| **Response** | **Meaning** |
| *3↵ | Offset mapped to magnet 3. |
| *0↵ | Offset is not mapped to a magnet. |

| **Rr** | Read Recirculations |
|---|---|
| If the SAB-S-TMX is in single magnet mode, the number of recirculations for the channel is returned. If the SAB-S-TMX is in multiple magnet mode, the number of magnets expected is returned. | |
| Example: $ARr↵ | |
| **Response** | **Meaning** |
| *4↵ | 4 recirculations or 4 magnets expected. |
| *1↵ | 1 recirculation or 1 magnet expected. |

| **RR** | Remote Reset(write protected) |
|---|---|
| Resets the SAB-S-TMX, just as if power had been cycled. | |
| Example: $1RR↵ | |
| **Response** | **Meaning** |
| *↵ | Reset commencing. |

| **RS** | Read Format |
| --- | --- |
| Returns the format configuration, as set by the SU command. Note that there is only one format configuration per card, not one per channel. | |
| Example: $3RS↵ | |
| **Response** | **Meaning** |
| *100H↵ | 24-bit precision, with floating output. |
| *053H↵ | 16-bit precision, with 5.3 floating point output. |
| *1F5H↵ | 24-bit precision, with 5-digit exponential output. |

| **RT** | Read Scale |
| --- | --- |
| Returns the scale, as set by the TS command. This number is multiplied by the offset position to present floating-point output in engineering units. | |
| Example: $1RT↵ | |
| **Response** | **Meaning** |
| *1.000↵ | The scale is 1.000. |
| *5E-2↵ | The scale is 0.05. |
| *-3.2243↵ | The scale is –3.2243. |

| **RV** | Read Version |
| --- | --- |
| Returns the version of the SAB-S-TMX board. This string includes the date of code compilation, and copyright information. | |
| Example: $1RV↵ | |
| **Response** | **Meaning** |
| *…↵ | The SAB-S-TMX is of a certain version. |

| **RZ** | Read Zero |
| --- | --- |
| Returns the offset in engineering units. | |
| Example: $1RZ↵ | |
| **Response** | **Meaning** |
| *4.55↵ | The offset is 4.55 units. |
| *0.0000↵ | The offset is 0.0000 units. |

| **Srxx** | Set Recirculations(write protected) |
| --- | --- |
| Sets the number of recirculations or magnets expected. ‘xx’ can be 0-32, and is the number of recirculations or magnets expected. If the SAB-S-TMX is in single magnet mode, the number of recirculations is set to xx. If the SAB-S-TMX is in multiple magnet mode, the number of magnets expected is set to xx. If the number of magnets expected is set to 0, the SAB-S-TMX will treat this as if it had been set to 1. The value is saved but is unused for SSI modules. | |
| Example: $1Sr5↵ | |
| **Response** | **Meaning** |
| *↵ | Recirculations set. |

| **SOxxxx** | Set Offset in Counts(write protected) |
|---|---|
| Sets the offset to 'xxxx' counts. This number must be a decimal number from –8388608 to 8388607. | |
| Example: $3SO12701↵ | |
| **Response** | **Meaning** |
| *↵ | Offset set to requested number of counts. |

| **SUpff** | Set Format(write protected) |
|---|---|
| Sets the SAB-S-TMX format configuration. The 'p' can be either zero(0), or one(1). A zero indicates that binary output has 16-bit precision, and a one indicates that binary output has 24-bit precision. The 'ff' is a hexadecimal number indicating the floating point output configuration. 'ff' must be 2 digits; if the first digit is F, output is exponential with the second digit indicating the number of significant figures in the output. If both digits are zero(0), output has floating precision. Otherwise, the first digit indicates the number of digits present before the decimal point, and the second indicates the number of digits present after the decimal point. Note that there is only one format configuration per card, not one per channel. | |
| Example: $1SU153H↵ | |
| **Response** | **Meaning** |
| *↵ | The format configuration has been set. |

f

| **TSxx** | Set Scale(write protected) |
|---|---|
| Sets the scale of the channel to xx. 'xx' is a floating point number that can be any value other than zero. The scale value is used to provide output in engineering units, and/or to correct for the gradient of the transducer or any other scaling error. | |
| Example: $1TS0.0005↵ | |
| **Response** | **Meaning** |
| *↵ | The scale has been set to the requested value. |

| **TZ** | Set Offset in Engineering Units(write protected) |
|---|---|
| Sets the offset to another offset relative to the current offset. This means that if an offset is already set, the new offset will be added to the old offset. For example, if the old offset is 5.00 units, and the command "$TZ5.00" is sent, the new offset will be 10.00 units. | |
| Example: $1TZ4.00↵ | |
| **Response** | **Meaning** |
| *↵ | The offset has been changed as requested. |

| **WE** | Write Enable |
|---|---|
| Enables commands that are "write protected". This mechanism against protects accidental use of commands that could affect proper SAB-S-TMX operation. | |
| Example: $1WE↵ | |
| **Response** | **Meaning** |
| *↵ | Write protect is disabled. |

| **WP** | Write Protect |
|---|---|
| Disables commands that are "write protected". This mechanism protects against accidental use of commands that could affect proper SAB-S-TMX operation. Write protection is defaulted to at power-on. | |
| Example: $1WP↵ | |
| **Response** | **Meaning** |
| *↵ | Write protect is enabled. |

**Position Commands**

| **AD** | Read All Positions in decimal |
|---|---|
| If the SAB-S-TMX is in single magnet mode, positions for both channels are returned in decimal. If the SAB-S-TMX is in multiple-magnet mode, positions for all magnets of the channel are returned in decimal. Regardless of the set binary precision all positions are returned as 6 digit decimal numbers. The following error responses are possible: "????20", missing magnet; "????40", missing or bad transducer. Note: If any of the values reported with this command exceed 999999 counts the string length returned will be extended. | |
| Example: $1AD↵ | |
| **Response** | **Meaning** |
| *001234005678012345↵ | Positions: 1234, 5678, and 12345. |
| *????40004456↵ | Missing transducer, position of 4456. |

| **AH** | Read All Positions in Hexadecimal |
|---|---|
| If the SAB-S-TMX is in single magnet mode, positions for both channels are returned in hexadecimal. If the SAB-S-TMX is in multiple magnet mode, positions for all magnets of the channel are returned in hexadecimal. If binary precision is set to 16-bit, all positions are returned as 4-digit hexadecimal numbers; if binary precision is set to 24-bit, all positions are returned as 6-digit hexadecimal numbers. The following error responses are possible: "??20", missing magnet; "??40", missing or bad transducer. If binary precision is set to 24-bit, these responses are prefixed with two more question marks('?'). | |
| Example: $1AH↵ | |
| **Response** | **Meaning** |
| *120A12BC341248AF↵ | Positions: 120Ah, 12BCh, and 3412h, 48AFh. |
| *????4000445AH↵ | Missing transducer, position of 00445Ah. |

| **RCxx** | Read Position in Counts |
|---|---|
| Returns a position in counts. If the SAB-S-TMX is in single magnet mode, the xx parameter is not used, and the position is returned for the selected channel. If the SAB-S-TMX is in multiple magnet mode, the xx parameter can be from 1-32 and indicates the magnet to return. See command AH for an explanation of position error responses. | |
| Example: $1RC↵ (single magnet mode)<br>$1RC3↵ (multiple magnet mode) | |
| **Response** | **Meaning** |
| *004AAFH↵ | The position is 004AAFh. |
| *????20H↵ | The selected magnet is missing. |

| **RDxx** | Read Position in Engineering Units |
|---|---|
| Returns a position in engineering units. If the SAB-S-TMX is in single magnet mode, the xx parameter is not used, and the position is returned for the selected channel. If the SAB-S-TMX is in multiple magnet mode, the xx parameter can be from 1-32 and indicates the magnet to return. The following error responses are possible: "??20", missing magnet; "??40", missing or bad transducer. If binary precision is set to 24-bit, these responses are prefixed with two more question marks('?'). | |
| Example: $1RD↵ (single magnet mode)<br>$1RD5↵ (multiple magnet mode) | |
| **Response** | **Meaning** |
| *0.4441↵ | The position is 0.4441 |
| *??40H↵ | The selected channel's transducer is missing. |

**IO Commands**

| **DI** | Read Digital Inputs |
|---|---|
| Returns the digital inputs as a 8-bit hexadecimal number. The SAB-S-TMX only has two inputs, and the upper 6 bits of the number will always be zero. | |
| Example: $1DI↵ | |
| **Response** | **Meaning** |
| *01H↵ | Current is flowing through input 0. |
| *00H↵ | No inputs have current flowing. |

| **DOxx** | Set Digital Outputs |
|---|---|
| Sets the digital outputs to xx. 'xx' is an 8-bit hexadecimal number. Note that the SAB-S-TMX has only 6 digital outputs; the 2 high bits of the requested output setting will not be used. | |
| Example: $1DO00H↵ | |
| **Response** | **Meaning** |
| *↵ | The outputs have been set as requested. |

| **RO** | Read Digital Outputs |
|---|---|
| Returns the digital outputs as an 8-bit hexadecimal number. | |
| Example: $1RO↵ | |
| **Response** | **Meaning** |
| *04H↵ | The outputs are set to 04h |

**Limit Switch Commands**

Each of the six outputs can be defined as an output or as a limit switch value. Any command to set an output switches the entire board to the output mode. Likewise any command to set a limit switch switches the entire board to the limit mode. Commands to read limit switch values do not change the mode. The default setting for each of the high and low limit switch values is 0.000 from the factory. The default channel assignment assigns all limits to channel 1, magnet 1. Each output is assigned to a channel as part of the limit set command. All settings are maintained in EEPROM even though the board is changed to the output mode. Limit position settings must be made after the scale is selected. If the scale is changed, limits must be set again.

| **RL*xy*** | Read Limit |
|---|---|
| Returns the value of a limit switch or its bounds. ***x*** is the limit switch number, 1-6. ***y*** is either 'L', 'U', or 'V'. 'L' refers to the lower bound of the limit switch; 'U' to the upper bound. If *y* is 'V', a '1' is returned if the limit switch is on, a '0' if it is off. The limit can still be read if it is assigned to a different channel on the same board. The channel setting will not be changed by this command. | |
| Example: $1RL4L↵ | |
| **Response** | **Meaning** |
| *12.345↵ | The bound of the limit is 12.345 units |
| *1↵ | The limit is currently on. |
| *0↵ | The limit is currently off. |

| **RM*x*** | Read Limit Magnet |
|---|---|
| Returns the number of the magnet to which limit *x* is assigned. ***x*** is the limit switch number, 1-6. This is the magnet that position is taken from for comparison with limit switch bounds. | |
| Example: $1RM2↵ | |
| **Response** | **Meaning** |
| *1↵ | The limit is assigned to magnet 1 |
| *4↵ | The limit is assigned to magnet 4 |

| **SL*xyzz.zzz*** | Set Limit |
|---|---|
| Sets a limit bound. ***x*** is the number of the limit to affect (1-6), and ***y*** is either 'L' if the lower bound will be affected, or 'U' if the upper bound will be affected. ***zz.zzz*** is the new value of the limit bound. | |
| Example: $2SL3U5.000↵ | |
| **Response** | **Meaning** |
| *↵ | The command was successful. |

| **SM*xy*** | Set Limit Magnet |
|---|---|
| Sets the number of the magnet to which limit *x* is assigned. 'y' is the magnet to which limit 'x' will be assigned to. This command does not affect the channel the limit is assigned to. This command is only needed while in multi-magnet mode. | |
| Example: $1SM13↵ | |
| **Response** | **Meaning** |
| *↵ | The command was successful. |

**Analog Commands**

The SAB-S-TMX-ANA features two analog outputs, one corresponding to each transducer channel. The analog output range can be unipolar (0 to Full Scale) or bipolar (- Full Scale to + Full scale) depending on jumper settings, and is based on the position of the magnet. The actual full scale voltage is adjustable and is factory set for 10 Volts. See the analog output section for details.

The analog output is the minimum (0 or –Full Scale) when the position is at or below the low position for the channel. The output is the maximum (full scale) when the position is at or above the high position for the channel. The single ended analog output for positions between the low and high positions can be determined from the following formula:

Unipolar operation:

output = ((posn – low) / (high – low)) * full_scale

Bipolar operation:

output = ((posn – low) / (high – low)) * (full_scale * 2)

Where:

output is the analog output voltage,
posn is the offset and scaled position for the channel,
low is the low position for the channel,
high is the high position for the channel,
and full_scale is the maximum analog output voltage (10V).

The factory default low position is 0.00 and the default high position is 10.00.

| **LOxx.xxx** | Set Low Analog Output Position |
|---|---|
| Sets the low analog output position to *xx.xxx*. The value is given as a scaled, offset value. | |
| Example: $1LO1.25↵ | |
| **Response** | **Meaning** |
| *↵ | The command was successful. |

| **HIxx.xxx** | Set High Analog Output Position |
|---|---|
| Sets the high analog output position to *xx.xxx*. The value is given as a scaled, offset value. | |
| Example: $2HI75.00↵ | |
| **Response** | **Meaning** |
| *↵ | The command was successful. |

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## Dip Switch Settings

All communication methods use 8 bits no parity and one stop bit. Dip switch S1 is used to select the serial communications baud rate, board base address, and single or multiple magnet mode. The switch is read at power on so power must be cycled after changes are made.

| Switch | Meaning |
|---|---|
| SW 1 | Baud Rate Select 0 |
| SW 2 | Baud Rate Select 1 |
| SW 3 | Baud Rate Select 2 |
| SW 4 | Single Magnet Operation = Off<br>Multiple Magnet Operation = On<br>For SSI selects 24 bit (Off) or 25 bit (On)<br>Note that this switch is ignored on -LAM models. |
| SW 5 | Address Select 0 |
| SW 6 | Address Select 1 |
| SW 7 | Address Select 2 |
| SW 8 | Address Select 3 |

| Baud Rates | SW 1 | SW 2 | SW 3 |
|---|---|---|---|
| 38400 bps | ON | ON | ON |
| 19200 bps | OFF | OFF | OFF |
| 9600 bps | ON | OFF | OFF |
| 4800 bps | OFF | ON | OFF |
| 2400 bps | OFF | OFF | ON |
| 1200 bps | ON | ON | OFF |

| Address Select | SW 5 | SW 6 | SW 7 | SW 8 |
|---|---|---|---|---|
| Base Address = '1' | OFF | OFF | OFF | OFF |
| Base Address = '3' | ON | OFF | OFF | OFF |
| Base Address = '5' | OFF | ON | OFF | OFF |
| Base Address = '7' | ON | ON | OFF | OFF |
| Base Address = '9' | OFF | OFF | ON | OFF |
| Base Address = ';' | ON | OFF | ON | OFF |
| Base Address = '=' | OFF | ON | ON | OFF |
| Base Address = '?' | ON | ON | ON | OFF |
| Base Address = 'A' | OFF | OFF | OFF | ON |
| Base Address = 'C' | ON | OFF | OFF | ON |
| Base Address = 'E' | OFF | ON | OFF | ON |
| Base Address = 'G' | ON | ON | OFF | ON |
| Base Address = 'I' | OFF | OFF | ON | ON |
| Base Address = 'K' | ON | OFF | ON | ON |
| Base Address = 'M' | OFF | ON | ON | ON |
| Base Address = 'O’ | ON | ON | ON | ON |

## Scale Factor Calculation

The SAB-S-TMX can be configured to read in any desired unit by setting the correct value for the scale function (see command "TS" for command structure). The following formula can be used to calculate the scale factor:

Scale Value: [1 ÷ (56,000,000 • g • R)] • S

*Where:*
g = transducer gradient expressed in usec per inch
R = number of recirculations. Note that when dip switch 4 is ON, "R" in the above formula is always = 1
S = scale factor

*Note that this alternate equation is used on -LAM models:*
Scale Value: [1 ÷ (56,000,000 • g • R)] • S

**Example 1:**
*Find:* Scale Value, in inches, if the sensor gradient = 8.9876 µs/in. and 2 recirculations

Scale Value: [1 ÷ (56,000,000 * 8.9826 * $10^{-6}$ * 2)] * 1 = <u>0.00099399</u>

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# Jumpers

## Jumper X1

This jumper selects the source of the program to execute.
X1 1-2 Runs the internal program. (Soldered in this position)
X1 2-3 Runs an external program.

## Jumper X2

This jumper selects the serial communications format.
X2 1-2 RS485
X2 2-3 RS232

## Jumper X3

This jumper connects RS485 line termination resistors Install 1-2 and 3-4 for the last board in a series of RS485 configured boards to provide line termination.
X3 1-2 Connects RS485 – to +5V pull up terminator
X3 3-4 Connects RS485 + to ground pull down terminator

## Jumper X4

This jumper selects the type of inputs and status outputs , Source or Sink. To use the inputs and outputs as sinking install 1-3, 5-7, 2-4 and 6-8 then connect JP1,8 to ground. To use the inputs and outputs in source mode install 1-2, 3-4, 5-6 and 7-8 then connect JP1,8 to the positive voltage.

# Connectors

## Connector JP1

| | | |
|---|---|---|
| JP1 – 1 | Logic Ground | |
| JP1 – 2 | RS232 Receive from host | |
| JP1 – 3 | RS232 Transmit to host | |
| JP1 – 4 | RS485 TxD/RxD- | (RS485 A) |
| JP1 – 5 | RS485 TxD/RxD+ | (RS485-B) |
| JP1 – 6 | Input 1. Cause current to flow between this input and JP1-8 to turn the input on. Current flow can be in either direction. A 1.2K current limiting resistor on the board allows use with 12 to 24 VDC. | |
| JP1 – 7 | Input 2. The operation of this input is the same as JP1-6. | |
| JP1 – 8 | Input common for Ch0 and Ch1 'Send All' inputs. | |
| JP1 – 9 | Ch0 Transducer status output | |
| JP1 – 10 | Ch1 Transducer status output | |

## Connector JP2

Digital Output connector

| | |
|---|---|
| JP2 – 1 | Output 1 |
| JP2 – 2 | Output 1\ |
| JP2 – 3 | Output 2 |
| JP2 – 4 | Output 2\ |
| JP2 – 5 | Output 3 |
| JP2 – 6 | Output 3\ |
| JP2 – 7 | Logic ground |
| JP2 – 8 | Output 4 |
| JP2 – 9 | Output 4\ |
| JP2 – 10 | Output 5 |
| JP2 – 11 | Output 5\ |
| JP2 – 12 | Output 6 |
| JP2 – 13 | Output 6\ |
| JP2 – 14 | Logic ground |

## Connector JP3

Transducer connector

| | | |
|---|---|---|
| JP3 – 1 | Ch0 Interrogate + to the transducer | (CLK+ for SSI) |
| JP3 – 2 | Ch0 Interrogate - to the transducer | (CLK- for SSI) |
| JP3 – 3 | Ch0 Gate + from the transducer | (DATA+ for SSI) |
| JP3 – 4 | Ch0 Gate - from the transducer | (DATA- FOR SSI) |
| JP3 – 5 | + Power to the transducer | |
| JP3 – 6 | Ground | Ground and shield |
| JP3 – 7 | - Power to the transducer | For TII only else unused See JP4 |
| JP3 – 8 | Ch1 Interrogate + to the transducer | (CLK+ for SSI) |
| JP3 – 9 | Ch1 Interrogate - to the transducer | (CLK- for SSI) |
| JP3 – 10 | Ch1 Gate + from the transducer | (DATA+ for SSI) |
| JP3 – 11 | Ch1 Gate - from the transducer | (DATA- for SSI) |
| JP3 – 12 | + Power to the transducer | |
| JP3 – 13 | Ground | Ground and Shield |
| JP3 – 14 | - Power to the transducer | For TII only else unused See JP4 |

## Connector JP4

The board is powered via JP4; the board can operate on any DC voltage from 7.5V to 26VDC. However, the voltage input on JP4-1 is also passed along to the transducers via JP3-5 and JP-3-12. When using transducers requiring +24V apply +24V to JP4-1, ground to JP4-2 and do not apply any voltage at JP4-3. For transducers requiring +/- 15V apply +15V to JP4-1, ground JP4-2 and apply –15V to JP4-3.

| | |
|---|---|
| JP4 – 1 | +7.5 to +26 VDC input the board and the transducers. |
| JP4 – 2 | Power supply and signal ground |
| JP4 – 3 | -15 VDC input to the board (only for transducers requiring -15V) |

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### Analog Board Connector J1

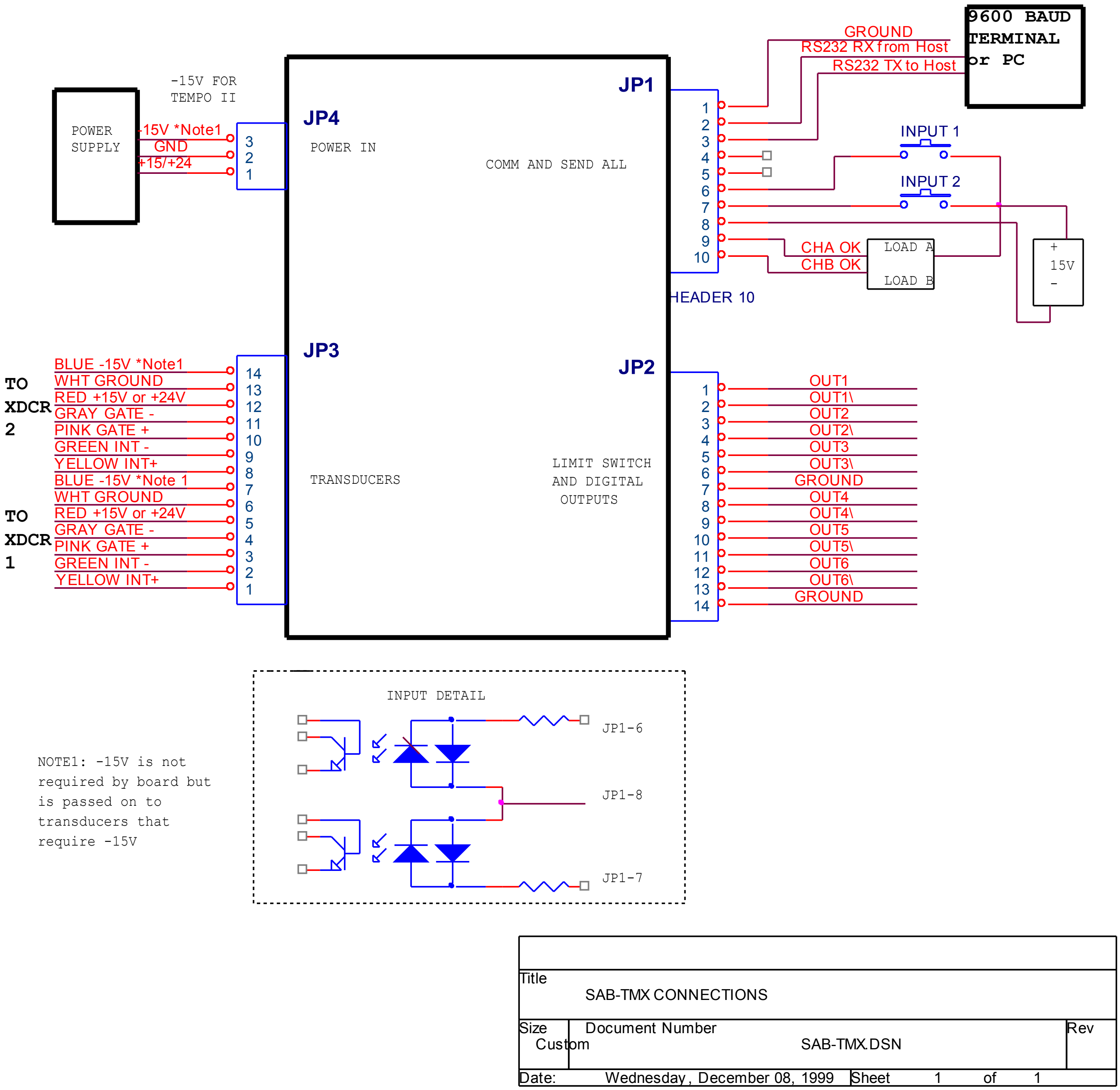
| | |
|---|---|
| J1 – 1 | Ch0 analog out |
| J1 – 2 | Analog Ground |
| J1 – 3 | Ch0 analog out – (Complement of pin 1) |
| J1 – 4 | Ch1 analog out |
| J1 – 5 | Analog Ground |
| J1 – 6 | Ch1 analog out – (Complement of pin 4) |
| J1 – 7 | No Connect |
| J1 – 8 | No Connect |

## Power Consumption

The board consumes approximately 100 milliamps of the + input voltage supplied to JP4-1 for it's own operation. Each transducer attached requires approximately 100 milliamps of the + input voltage for a total of 300 milliamps. The board does not require the – input voltage at JP4-3 but passes it along to the transducer.

## Connections

The board and the connectors are oriented as shown here. There is a direct connection form JP4-1 to JP3-5 and 12. There is also a direct connection from JP4-3 to JP3-7 and 14. Ground is common to JP4-2, JP3-6, JP3-13, JP2-7, JP2-14 and JP1-1.



## Enclosure

The SAB-S-TMX comes mounted in a DIN rail enclosure, containing one or two SAB-S-TMX boards. The enclosure is 4.64 inches deep x 5.31 deep x 1.77 wide, and uses 1.8 inches or DIN rail space.

This configuration can provide up to four channels of magnetostrictive transducer input per enclosure.

## Optional analog output

The SAB-S-TMX-ANA features two analog outputs, one corresponding to each transducer channel. The analog output range can be unipolar (0 to Full Scale) or bipolar (- Full Scale to + Full scale) depending on jumper settings, and is based on the position of the magnet when in single magnet mode, or the position of the first magnet when in multiple magnet mode. The actual Full scale voltage is adjustable and is factory set for 10 Volts.

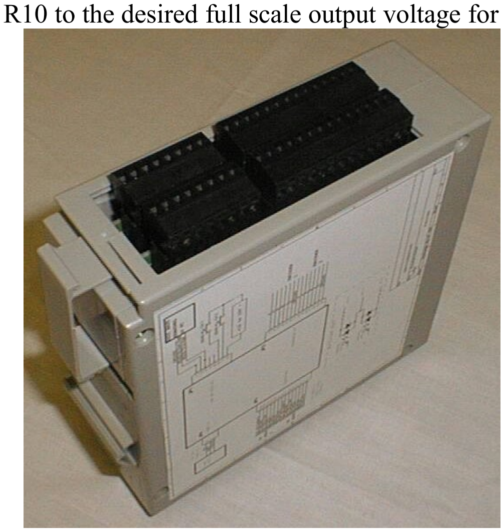
The SAB-S-TMX-ANA features a differential analog output for each channel. The complement of the output is available on the output connector allowing a voltage swing of 2 * Full Scale when measured relative to the complementary output or Full scale when measured relative to the analog ground.

### Analog board jumper settings

| | |
|---|---|
| X1 | Remove jumpers for channel 0 unipolar operation<br>Install jumpers 1 –2 and 3 – 4 for channel 0 bipolar operation |
| X2 | Remove jumpers for channel 1 unipolar operation<br>Install jumpers 1 –2 and 3 – 4 for channel 1 bipolar operation |

### Analog board adjustments

| | |
|---|---|
| R3 | Adjust R3 to the desired full scale output voltage for channel 0 |
| R10 | Adjust R10 to the desired full scale output voltage for channel 1 |



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