RAPID CONTROLS

Product Specification for synchronized quadrature converter model SAB-QS

The SAB-QS is a two-channel module that converts change in magnetostrictive transducer position to the AB quadrature format and is synchronized to the host controller via strobe inputs. The conversion is implemented with a micro-controller and EPLD allowing a wide range of flexibility and high-speed output. When commanded by the host controller, the module interrogates the magnetostrictive transducers and outputs any change as the correct number of state changes on the AB quadrature lines. Quadrature changes are output in a burst fashion upon receipt of the strobe input. The strobe input used by the host controller to synchronize the updates of the transducer can also be used to signal that the absolute position of the transducer is to be output via the quadrature lines. Each channel has a *transducer OK* relay output to signal the proper functioning of the transducer. A setup mode allows easy setup of transducer type and recirculations via the RS232/RS485 port.

Features

- Two channels of 24-bit position from Start/Stop, PWM, or SSI magnetostrictive transducers
- Fast quadrature output of up to 1,500,000 counts per second on two channels
- Transducer updates are synchronous with a host controller using the strobe inputs
- Strobe inputs can cause absolute position of each channel to be output
- Transducer OK relay output and LED signals valid transducer operation
- Software selectable recirculations and transducer type. EPLD change required for SSI
- Setup mode uses RS232 or RS485 at 9600 baud or dip switches
- Blinking LED indicates micro-controller operation and synchronization
- Watchdog timer for reset upon software failure
- EEPROM for non-volatile storage of setup parameters
- Convenient screw terminal connections
- As many as four channels of differential quadrature outputs in a small DIN rail enclosure

Specifications

- Two channels of 24 bit magnetostrictive transducer measurement
- 28 MHz oscillator for 0.001 inch resolution with 4 recirculations, optional 56 MHz oscillator
- Two channels of 5-volt differential A and B outputs
- Quadrature output rate is 437.5 kHz per channel (1,750,000 counts/sec Quadrature)
- Update rate is synchronized to host controller based on strobe input pulse
- Minimum strobe length of 1µs, maximum of 100µs for incremental operation
- Minimum strobe length of 100ms, maximum of 1s for send-all absolute operation
- 5V DC inputs for strobe synchronization and send-all are optimized for use with open collector outputs.
- Two relay contacts for transducer OK can switch up to 500mA at 200VDC
- 87C520 processor at 28 MHz with 1KB local RAM and 64 words of non-volatile EEPROM storage
- Power requirements: 7.5 – 26 VDC at <300 mA (optional features may consume more current)
- DIN rail module is 4.65 in (118 mm) x 5.41 in (137.5 mm) and occupies 1.8 in (45 mm) of rail space

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Ordering information

Specify model: **SAB-QS-*A*-*B*-*C***

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

B Transducer Interface
- **RPM** Start Stop or PWM
- **SSI** SSI

C Special Options
- **56** 56 MHz Oscillator
- Omit for no special options

Contents

General Operation

At power-on the board will begin normal operation which consists of waiting for strobe pulses and responding with either incremental or absolute position information. The SAB-QS can operate in either synchronized or free-running mode. Synchronized mode requires a strobe pulse each time the transducer is interrogated, while free-running mode interrogates at a set interval. During normal synchronized operation, the board can be in one of two states: synchronized or unsynchronized. The board is in the synchronized mode when it receives strobe inputs at least once per second. The strobe pulse can be incremental or absolute depending on the length of the pulse.

Synchronized mode

An incremental strobe, defined as between 1 and 100 microseconds in length, will cause the output of the position difference that has occurred between the current strobe and the previous strobe. The transducer is interrogated after every incremental strobe. An absolute strobe, defined as between 100 and 1000 milliseconds in duration, will cause the output of the absolute position of the transducer. While synchronized, the board status LED will blink once for every 256 strobe pulses received. Both channels add to this count.

Unsynchronized mode

If a valid strobe synchronization pulse is not received for 1 second, the board will begin operating in unsynchronized mode. In this mode, the board will interrogate the transducer once a second and blink the LED on for one tenth of a second each second. No quadrature output is performed in this mode.

In either mode (synchronized or unsynchronized), the transducer status lights will light to indicate whether valid position information has been received from the transducer.

Free-running mode

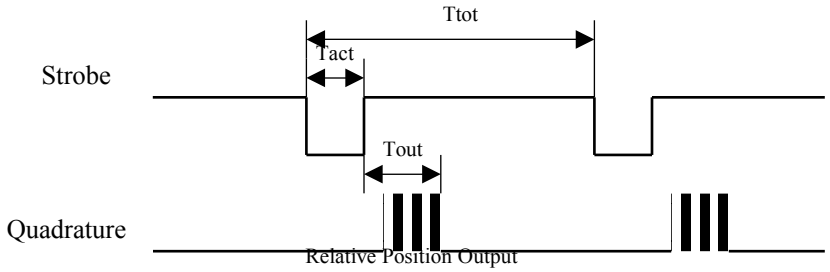
Free-running mode will cause the board to act as if an incremental strobe is received every user-defined update period, causing the SAB-QS to act as if it is continually synchronized.

In any of the modes (synchronized, unsynchronized, or free-running), the transducer status lights will light to indicate whether valid position information has been received from the transducer.

Incremental Timing

An incremental strobe is defined as a strobe input that is active for one to one hundred microseconds. An incremental strobe commands the board to send any position change since the last strobe (incremental or absolute). When synchronized, the board interrogates the transducer every time the channel strobe input goes low and updated incremental position information is sent over the quadrature lines at this time.

Incremental Timing Diagram

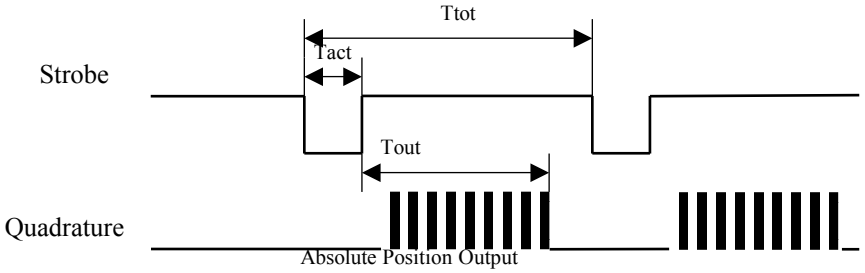


Parameter	Minimum	Maximum
Ttot (Total time between updates)	Tact + Tout + 100us	1 s
Tact (Strobe active width)	1 us	100 us
Tout (Quadrature output time)	100 us	800 us

Absolute Timing

If the channel strobe input goes low for longer than 100 milliseconds and less than 1 second, the board will output the current transducer position absolutely (send-all). Further strobe synchronization pulses are ignored until the send-all has completed.

Absolute Timing Diagram



Parameter	Minimum	Maximum
Ttot (Total time between updates)	Tact + Tout	
Tact (Strobe active width)	100 ms	1 s
Tout (Quadrature output time)	100 us	Varies with transducer length and recirculations

Status

The red LED on the board will blink on for one tenth of a second each second in unsynchronized mode. The red LED will blink evenly (on time equals off time) based on the speed of *Strobe* input pulses while in synchronized mode.

Two green LEDs indicate the status of the transducers. A lit LED indicates a good transducer and a dim or dark LED indicates a missing transducer or magnet.

Setup

Setup can be accomplished with a terminal or computer connected to the JP1 (host) connector. If the host desires to enter the 'Setup Mode' the host should send three escape (ASCII 27) characters rapidly at 9600 baud; the board will acknowledge with a setup menu. During setup, the board will continue to perform transducer updates as if it was in normal mode, but it is not recommended that the SAB-QS be used in production equipment while in setup mode. Setup values can be stored in non-volatile EEPROM memory. If items are not stored in the EEPROM, they will be reverted to the saved values following a power-cycle.

Setup Considerations, Start/Stop PWM

The number of recirculations will determine both the resolution and the time required for the update of the Start/Stop transducer. A larger number of recirculations will increase the time needed for an update of the transducer. If this time is greater than the time between synchronization pulses, position information may not be output during every synchronization period.

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 exact value is printed on the transducer label as the transducer gradient). Using more than one recirculation allows greater measurement resolution but requires more time per update. The following table indicates the resolution and time versus the number of recirculations. It includes 4 inches of overhead time beyond the 32 inches of useful stroke length.

Recirculations	Update time for 32 inch transducer	Approximate Resolution
1	324 µs	0.004 in per count
2	648 µs	0.002 in per count
4	1296 µs	0.001 in per count
8	2592 µs	0.0005 in per count

Default Setup

The default setup is programmed at the factory and is available via the 'Factory Defaults' setup command.

Setup item	Default Value
Recirculations	2
Transducer type	Start/Stop
Free running	No
Update Time	1000us

Setup Operation

Note: Setup is meant to be performed off line.

To start the setup process, connect a 9600-bps terminal to the serial port and press escape three times quickly. A menu will appear offering various setup possibilities. To exit the setup mode, choose 'Quit' from the setup menu or cycle the power to the board.

Setup Menu Items

Recirculations

The number of recirculations directly affects the precision of the positions measured by the transducer. Valid values are from 1 to 8. This change goes into effect as soon as it is entered. Recirculations are not used if the transducer type is set to PWM.

Transducer Type

Select Start/Stop or PWM depending on the transducer type connected.

Free Running

Select if you wish to operate in free-running mode.

Update Time

The time between updates when the channel is operating in free-running mode.

Save to EEPROM

Select this item to save the values to the EEPROM. The values will not be saved until this is selected.

Load from EEPROM

Select his item to load the values from the EEPROM to memory.

Factory Defaults

Select this item to change all of the setup values to the factory defaults. Note that this does not save the factory default settings in the EEPROM.

Quit

Select this item to exit setup and begin operation. The values you have chosen will now be in effect. However any values not saved to the EEPROM will be lost when power is removed.

Dip Switch S1

Dip switch S1 controls the setup information for the SAB-QS. If all of the dip switches are OFF then the setup information is read from the EEPROM. If any switch is ON the setup is read from the switch.

Note: models with software revisions prior to November 9, 2000 do not support setup via dip-switches.

Switches 2-4 and 6-8 control the setup for channel 0 and 1, respectively. The SAB-QS will behave as described in the following table. Switches 1 and 5 enable free-running mode for each channel when on.

Switch 1(5)	Switch 2(6)	Switch 3(7)	Switch 4(8)	Channel Setup
OFF	OFF	OFF	OFF	Setup data is read from EEPROM
OFF	ON	OFF	OFF	1 Recirculation RPM (Synchronous)
OFF	OFF	ON	OFF	2 Recirculations RPM (Synchronous)
OFF	ON	ON	OFF	4 Recirculations RPM (Synchronous)
OFF	OFF	OFF	ON	8 Recirculations RPM (Synchronous)
OFF	ON	OFF	ON	PWM (Synchronous)
OFF	OFF	ON	ON	24-bit binary SSI (Synchronous)
OFF	ON	ON	ON	25-bit binary SSI (Synchronous)
ON	OFF	OFF	OFF	Setup data is read from EEPROM
ON	ON	OFF	OFF	1 Recirculation RPM (Free-running)
ON	OFF	ON	OFF	2 Recirculations RPM (Free-running)
ON	ON	ON	OFF	4 Recirculations RPM (Free-running)
ON	OFF	OFF	ON	8 Recirculations RPM (Free-running)
ON	ON	OFF	ON	PWM (Free-running)
ON	OFF	ON	ON	24-bit binary SSI (Free-running)
ON	ON	ON	ON	25-bit binary SSI (Free-running)

Configuration Jumpers

Jumper X2

This jumper selects the serial communications receive 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 120 Ohm line termination and 1k Ohm biasing resistors.

Jumper X4QS

This jumper selects the sense of the DC input 1. Install 1-2 for active low input, 2-3 for active high input.

Jumper X5QS

This jumper selects the sense of the DC input 2. Install 1-2 for active low input, 2-3 for active high input.

Jumper X6 and X7

This jumper is factory set. Models supporting Start/Stop and PWM sensors have X11 set 1-2. Models supporting SSI sensors have X11 set 2-3.

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	Channel A strobe input. This input is used for synchronization and send-all for channel A. An open-collector output or 5 volt logic can be used to pull this line low.
JP1 – 7	Channel B strobe input. This input is used for synchronization and send-all for channel B. An open-collector output or 5 volt logic can be used to pull this line low.
JP1 – 8	Status common for channel A and channel B relay outputs.
JP1 – 9	Channel A transducer status normally open relay contact. Closed and connected to JP1-8 when a good transducer is connected.
JP1 – 10	Channel B transducer status normally open relay contact. Closed and connected to JP1-8 when a good transducer is connected.

Connector JP2

Quadrature output connector

JP2 – 1	Ch0 A
JP2 – 2	Ch0 A\
JP2 – 3	Ch0 B
JP2 – 4	Ch0 B\
JP2 – 5	N/C
JP2 – 6	N/C
JP2 – 7	Logic ground
JP2 – 8	Ch1 A
JP2 – 9	Ch1 A\
JP2 – 10	Ch1 B
JP2 – 11	Ch1 B\
JP2 – 12	N/C
JP2 – 13	N/C
JP2 – 14	Logic ground

Connector JP3

Transducer connector

JP3 – 1	Ch0 Interrogate + to the transducer	(YELLOW)
JP3 – 2	Ch0 Interrogate - to the transducer	(GREEN)
JP3 – 3	Ch0 Gate + from the transducer	(PINK)
JP3 – 4	Ch0 Gate - from the transducer	(GRAY)
JP3 – 5	+ Power to the transducer	(RED)
JP3 – 6	Ground	(WHITE & SHIELD)
JP3 – 7	- Power to the transducer	(BLUE)
JP3 – 8	Ch1 Interrogate + to the transducer	(YELLOW)
JP3 – 9	Ch1 Interrogate - to the transducer	(GREEN)
JP3 – 10	Ch1 Gate + from the transducer	(PINK)
JP3 – 11	Ch1 Gate - from the transducer	(GRAY)
JP3 – 12	+ Power to the transducer	(RED)
JP3 – 13	Ground	(WHITE & SHIELD)
JP3 – 14	- Power to the transducer	(BLUE)

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 (for transducer requiring -15V)

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.

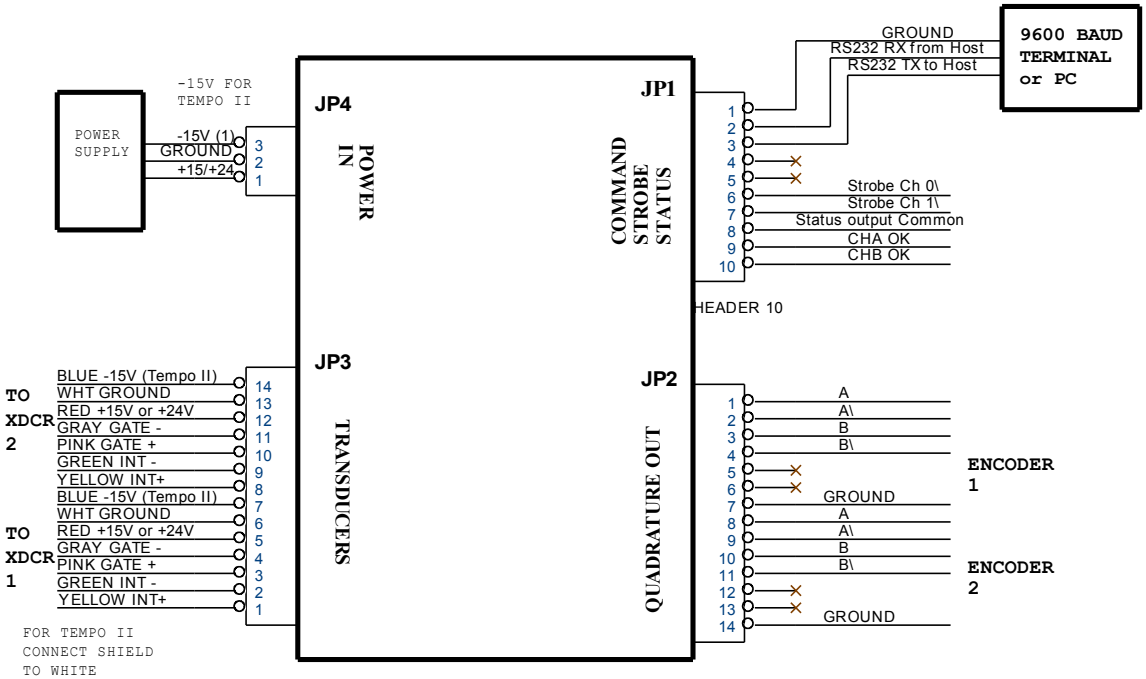
Enclosure

The SAB-Q2 is available in a DIN rail mounted enclosure, containing one or two SAB-Q2 boards. The enclosure is 4.64 inches deep x 5.31 deep x 51.77 wide, and uses 1.8 inches or DIN rail space.

This configuration can provide up to four channels of differential ABZ quadrature output based on magnetostrictive transducer input per enclosure.

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.



Note (1): -15V is required only if TEMPO II transducer