



FSK Isolation Transceiver

Operating Manual

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1 Introduction

The FSK isolation transceiver manages top-side telemetry for the SeaSPY, SeaQuest, and Synapse magnetometers. It serves as the interface between the magnetometer and the data logging software, and enables the use of long tow cables.

Key functions of the FSK isolation Transceiver:

- provide a stable and electrically isolated power supply to the magnetometer
- convert the RS-232 data logger interface to FSK for communication with magnetometer over the long tow cable
- keep the magnetometer synchronized to the transceiver's battery-powered clock
- provide LED indicators for the power status, towfish connection status and data exchange

The terms Transceiver, isolation transceiver and FSK transceiver are considered equivalent for the purpose of this document.

Recent developments:

2023: 2nd generation transceivers feature 4 connectors instead of the original 3 and include an integrated GNSS receiver that automatically synchronizes the transceiver and magnetometer time to UTC satellite time. The 4th connector is for the optional external GNSS input (RS-232), for installations where the transceiver is not exposed to open sky.

Additionally, transceiver firmware updates can now be made by the customer using the Marine Magnetics Firmware Installer tool.

2026: 3rd generation transceivers add support for the newest Synapse gen.2 magnetometers and the new advanced command protocol, while still maintaining compatibility with the older generation products such as SeaSPY, SeaQuest and Synapse gen.1.

Note that SeaSPY2 gradiometer is not supported by 3rd gen. transceivers. Synapse network which allows up to 30 magnetometers to be connected together replaces the old gradiometer mode which had a limit of 2 magnetometers.

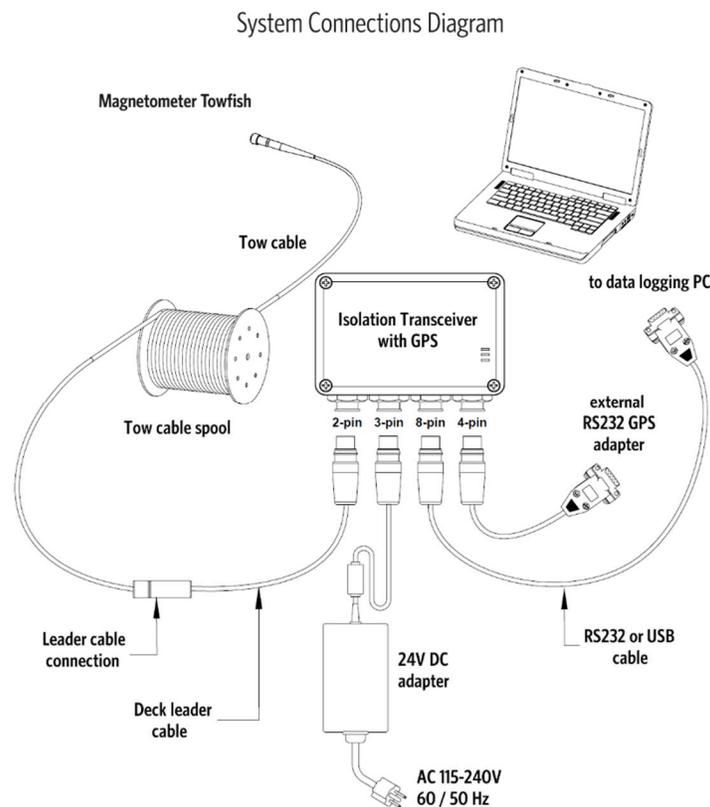


Figure 1 – Magnetometer system connection diagram for the FSK transceiver

Note that a separate GNSS is required for recording positions during a survey, and is not part of the magnetometer interface system.

2 Transceiver RS-232 serial interface

The connection between the data logging computer and the transceiver is via RS-232 (or USB/Virtual COM port), using:

RS-232 Baud Rate: 115200 baud **Data bits:** 8, **Stop bits:** 1, **Parity:** None

Transceiver RS-232 baud rate can be configured through the transceiver settings menu in the RS-232 terminal:

- **Gen.3 transceivers:** use the command **\$menu,0** to access the transceiver settings menu
- **Gen.2 and Gen.1 transceivers:** use **Ctrl+B** command for RS-232 baud rate settings.

Refer to Section 5 for details on transceiver configuration.

The transceiver utilizes full duplex communication: commands that are sent to the transceiver or magnetometer while it is transmitting data will not disrupt the transmission.

When using the supplied USB cable, the transceiver's integrated RS232-USB converter is used, which emulates a virtual COM port with the same baud rate settings.

The transceiver will respond to some commands even if no magnetometer is connected. For example, you can query and set the transceiver's internal time and date without the magnetometer connected. As soon as you connect the magnetometer, the transceiver will recognize the towfish and, if necessary, will set its internal clock.

Refer to your magnetometer's user manual for further details:

<https://marinemagnetics.com/products/>

Note: Synapse gen.2 magnetometers add support for direct RS-232 connections, making the isolation transceiver optional.

RS-232 settings for Synapse gen.2 are the same as those for the isolation transceiver. To change the Synapse RS-232 settings, use the **\$menu,SN** command, where SN is the Serial Number of your magnetometer. Refer to Section 5.1.1 for details.

2.1 GNSS based time synchronization

Beginning with gen.2, isolation transceivers support automatic time synchronization based on GNSS signal or NMEA input from an external GNSS. This ensures that the connected magnetometer or array are precisely synchronized to UTC time at all times, and magnetometer data will be in sync with survey positions. The transceiver contains a rechargeable battery that will maintain its clock after a sync, even when the satellite signal becomes unavailable.

Desktop transceiver models with GPS synch support contain an integrated GNSS receiver that automatically maintains accurate date and time whenever the transceiver is positioned such that it can receive satellite signals. The GPS Sync LED indicates whenever the satellite signal lock is established.

External GNSS interface is supported through the 4th connector on the desktop transceiver, and can be used in installations where the transceiver is not exposed to open sky and the integrated GNSS is unable to obtain satellite signal.

External GNSS interface is RS-232, with a default baud rate of 9600. The GNSS baud rate can be changed if necessary in the transceiver configuration settings. Refer to Sections 5 and 7.1 for configuration and electrical wiring details.

Supported NMEA data: GxZDA, GxRMC and GxGGA.

Side Scan Sonar Interface transceivers do not contain integrated GNSS receivers, but support external GNSS input via dedicated pins on the interface connector. Refer to Section 7.2 for wiring details.

NOTE: the integrated GNSS in the transceiver is only used for time synchronization, and cannot be used for navigation or as a source of magnetometer positions during the survey. A dedicated survey GPS with appropriate antenna placement is required for positioning.

3 Top-side (desktop) transceiver

Desktop transceivers feature a robust water resistant housing but are not submersible, and need to be protected from immersion and excessive sea spray. These transceivers feature three status LEDs to indicate power, communication with towfish, and satellite (GPS) time sync.



Table 1 - LED indicator states for the desktop transceiver

Power LED	Orange	Towfish not connected / not detected. <i>Check tow cable.</i>
	Green	Towfish is detected and powered.
	Red	Fault condition, or the transceiver output power is disabled. <i>Enable towfish power.</i>
Data LED	Blue (flashing)	Data is being received from magnetometer.
	Blank	Data is not being received. <i>Check towfish/FSK baud rate setting.</i>
Satellite Sync LED	Blue (flashing)	No satellite lock. Searching for satellite signal.
	Blue (solid)	GPS satellite signal is acquired, and the transceiver will keep itself and the connected towfish synchronized to GPS time.

When the transceiver is first powered up, the *Power* LED will glow orange and the transceiver will transmit a brief identification message to the PC's serial port terminal program. If the PC RS-232 terminal shows no power-up message, check the PC/Host baud rate.

If a magnetometer is detected, the *Power* LED will turn green, and the magnetometer's own identification header will also be displayed in the terminal.

The *Data* LED will flicker blue whenever data is received from the magnetometer. If the Data LED is blank, it could indicate that the sampling is disabled or that the magnetometer towfish baud rate is set incorrectly.

Upon detection of the magnetometer towfish, the transceiver will automatically set the magnetometer's internal time and date.

4 Side Scan Sonar interface transceiver

Side Scan Sonar (SSS) interface for magnetometers operated through FSK consists of a short 5 or 10m tow cable and a submersible SSS interface module that contains an isolation transceiver core. The SSS interface transceiver features the same functionality as the top-side desktop transceiver with the addition of a pressure-rated housing.

SSS interface transceiver features a single status LED: Power LED.

The SSS interface module is coupled mechanically to the SSS tow point and connected to the magnetometer interface port on the SSS unit. Two types of mechanical couplings are offered: slot and tab, for fitting to a variety of sonar models.

Note that the sonar data interface cable is supplied by the sonar manufacturer, while the magnetometer interface cable is supplied by Marine Magnetics.

Test Cable: The SSS interface module is supplied with a lab test cable for checking the operation and configuring the settings using a laptop or PC without the SSS connection. The test cable provides connections for a DC power input (24V DC recommended) and RS-232 interface to the host PC.

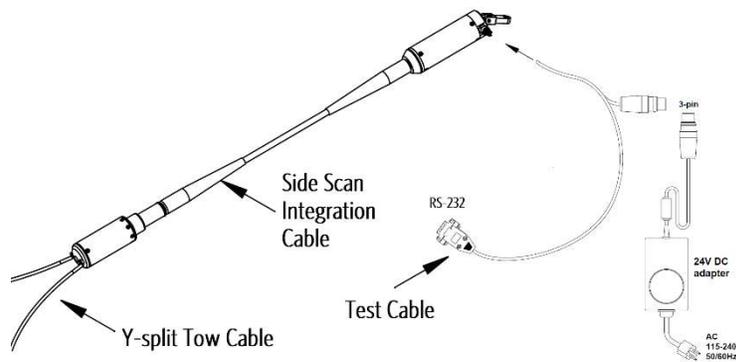


Figure 2 - Side Scan Sonar (SSS) FSK transceiver interface and test cable for Synapse, Synapse gradiometer and SeaSPY

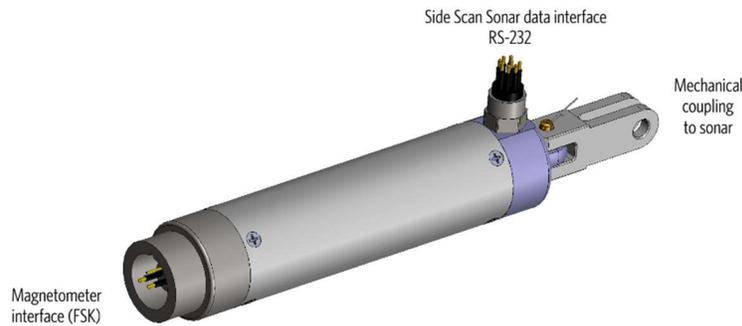


Figure 3 - Side Scan Sonar interface transceiver (submersible) shown with a slot coupling

5 Transceiver configuration

Your isolation transceiver will come pre-configured for your system. However you may need to change the configuration if you wish to use a different magnetometer model, or change the RS-232 settings in the transceiver to match your data logging system.

5.1 Configuring the gen.3 isolation transceiver and Synapse gen.2 towfish

Gen.3 isolation transceiver supports Synapse gen.2 magnetometers and the newest command protocol, as well as earlier products such as Synapse gen.1, SeaQuest and SeaSPY2 (except SeaSPY gradiometers).

The latest command protocol consists of commands that begin with \$, and responses that begin with #. The parameter following the command or response represents the network node address. (e.g. ,0, represents the transceiver while ,16036, represents the connected unit SN 16036). Omitting the node address will address the command to the master node in the Synapse network (e.g. \$fver,16043)

Refer to Synapse Operating Manual for details on the Synapse command protocol.

Command	Description
\$time	Get date and time from the isolation transceiver (IT). If a towfish is connected it will also check the towfish time and synchronize it to the IT time if there is a discrepancy. e.g. response: #time,0,250922/10:11:22.5 (,0, after the command or response represents the IT; date format: YYMMDD)
\$time,,250922152239	Set transceiver date and time. (Formerly T command) date format: YYMMDD response: #time,0,250922/15:22:39.2 As soon as the time is set, the IT will attempt to set the time of the towfish, provided one is connected. The IT will keep the time after it is powered off for as long as the internal battery remains charged (several days). Note that if the integrated GPS has a satellite lock, the satellite time will always override any user-configured time.
\$fver,0	Get firmware version from the transceiver e.g. response: #fver,<sn>,3.5.0,C4A8DDFB,02.0.0 Firmware Version (3.5.0), checksum (C4A8DDFB), protocol revision (2.0.0)
\$menu,0	Transceiver configuration menu
\$stat,0	Scan sensors in the transceiver. (Formerly D command) e.g. response: #stat,0,45.9,123,05.6 Output voltage (45.9V), output current (123mA), and supplied power (05.6W). In addition to querying the towfish this command also displays the voltage being supplied by the IT, and the current and power consumption of the magnetometer, as well as the depth sensor reading.

Table 2 – Commands supported by the gen.3 isolation transceiver

Command	Description
\$clst	Get list of all connected Synapse towfish , and their internal sensor configurations
\$fver,16043	Get firmware version from the Synapse towfish SN 16043
\$sync,,1	Resync Synapse network
\$smpl,,0	Stop sampling (this command propagates to all connected towfish)
\$smpl,,10	Begin sampling at 10 Hz (this command propagates to all connected Synapse towfish)
\$data	Get data format setting from current master towfish e.g. response: #data,16043,0 Supported formats: 0: normal, 1: compact, 2: base64 compressed
\$data,,1	Set data format to Compact (1) in the current master towfish (,,)

Table 3 – Common Synapse commands when used with gen.3 isolation transceiver

5.1.1 Baud rate configuration for gen.3 transceiver

Gen.3 isolation transceiver features a configuration menu that can be accessed by sending the **\$menu,0** command to it. The menu presents a selection of options and parameters, including the baud rates and FSK Version that may need to be changed when switching between different magnetometer models.

\$menu,0 open the transceiver (node zero) configuration menu
(Opening the menu stops all other processes temporarily, but will time-out after 4 seconds)

Response:

Choose:

```
1 - Serial number 12347
2 - bps rate ch0 (host): 115200bps <- RS-232 PC-to-Transceiver baud rate
3 - bps rate ch1 (gps): 9600bps <- external GPS baud rate
4 - bps rate fsk : 31250bps <- Transceiver-to-Towfish baud rate (FSK baud rate)
5 - Det Threshold (0.1mA) 00050 <- Towfish detection threshold current (5 mA)
6 - Current Limit (0.1mA) 15000 <- Output current limit (1.5 A)
7 - FSK Interface (on/off) 1
8 - FSK Version (gen) 1 <- Choose FSK Version: 0:gen0 (SeaSPY/Synapse gen.1), 1:gen1 (Synapse gen.2)
```

Use the following FSK settings for connecting to specific magnetometer models:

Synapse gen.2:

```
4 - bps rate fsk : 31250bps
7 - FSK Interface (on/off) 1
8 - FSK Version (gen) 1
```

Synapse gen.1:

```
4 - bps rate fsk : 31250bps
7 - FSK Interface (on/off) 1
8 - FSK Version (gen) 0
```

SeaQuest2:

```
4 - bps rate fsk : 31250bps
7 - FSK Interface (on/off) 1
8 - FSK Version (gen) 0
```

SeaSPY and SeaSPY2:

```
4 - bps rate fsk : 9600bps
7 - FSK Interface (on/off) 1
8 - FSK Version (gen) 0
```

5.2 Configuring the gen.1 and gen.2 transceivers

Gen.1 isolation transceivers are compatible with products such as SeaSPY, SeaQuest and SeaSPY Gradiometer.

Gen.2 transceiver adds integrated GPS, firmware updates, and support for Synapse gen.1, but is not compatible with Synapse gen.2.

Gen.1 and gen.2 transceiver commands are single-byte commands.

Command	Description
<space> or t	Get time: Requests current transceiver date and time. If a towfish is connected it will also check the towfish time and synchronize it to the transceiver time if there is a discrepancy.
T	Set transceiver date and time. As soon as the time is set, the IT will attempt to set the time of the towfish, provided one is connected. The IT will remember the time after it is powered off for as long as the internal battery remains charged.
d or D	Scan sensors. In addition to querying the towfish this command also displays the voltage being supplied by the IT, and the current and power consumption of the magnetometer, as well as the depth sensor reading.
?	Display command menu
!	Get transceiver and towfish serial numbers.
Ctrl+O	Power On/Off. Toggles output power to the towfish.
Ctrl+B	Change transceiver RS-232 baud rate for the top-side telemetry link (PC-Transceiver) use 9600 for SeaSPY, 25000 for SeaQuest1, 31250 for Synapse and SeaQuest2
Ctrl+T	Resync towfish to the transceiver clock
Ctrl+X	Abort/Cancel current command
*	Enter transceiver diagnostic mode. A security code is required.

Table 4 – Commands supported by gen.1 and gen.2 isolation transceivers

5.2.1 Baud rate configuration for gen.1 and gen.2 transceiver:

Use <Ctrl+B> to configure the transceiver's communication settings:

```

^B
Change comm settings
PC-115200bps GPS-9600bps FISH-31200bps
1- xcvr<->PC
2- xcvr<->GPS
3- xcvr<->towfish
4- xcvr<->towfish comm channel

```

Select option 1 to change the Transceiver-PC baud rate:

```

1
>1-Set xcvr<->PC baud rate
1:2400 2:4800 3:9600 4:38400 5:115200

```

Select option 3 to change the Transceiver-Towfish (FSK) baud rate:

```

3
3-Set xcvr<->towfish baud rate
1:1200 2:2400 3:4800 4:9600 (SeaSPY) 5:25000 (SeaQuest1) 6:31250 (Synapse, SeaQuest2)
>
4
Baud set to 9600bps

```

Use <Ctrl+X> to if you need to cancel any command

```

^X
>
Aborted -Baud rate not changed

```

5.3 Transceiver gradiometer mode (gen.1 and gen.2)

To operate a SeaSPY gradiometer, the isolation transceiver must be configured to work in gradiometer mode, which is supported only by gen.1 and gen.2 transceivers.

Gradiometer mode enables the transceiver to communicate with up to 2 connected SeaSPY magnetometers via a single shared FSK connection.

When in gradiometer mode, the transceiver refers to the two connected magnetometers as Forward/FT and Rear/RT, based on the unit serial numbers configured during gradiometer mode setup.

Note that the transceiver does not distinguish between the longitudinal and horizontal transverse arrangements for the purpose of communication, but always refers to the connected units as forward and rear. When working with a horizontal transverse gradiometer, the recommended approach is to treat the front unit as port side, and rear unit as starboard side. This is the approach used in BOB software when capturing SeaSPY gradiometer data.

The gradiometer data string always includes the front/port side data first, followed by the rear/starboard side unit data:

Example:

```
*24.232/19:39:00.0 F[049446.120 165 0382 -0000.1 015.47 G__] R[048787.477 133 0277 -0000.2 599.99 G__] +00658.643
*DATE/TIME      F[front/port SeaSPY data]      R[rear/starboard SeaSPY data]      difference (nT)
```

5.3.1 Configuring gradiometer mode:

To enter / exit gradiometer mode, send the **c** command to the transceiver.

The same command can also be used to check the list and arrangement of connected units.

Important: Correct unit SN's must be configured in the gradiometer mode for the transceiver to be able to communicate with the connected SeaSPY magnetometers.

Example:

```
<| c
>|
>| Current mode: GRAD - 2 Towfish
>| F Towfish: 14997
>| R Towfish: 14998
>| Switch to MAG mode (Y/N)?
<| n
>| Still in GRAD mode
```

Sending the **c** command to the transceiver shows that it is currently in gradiometer mode, and that

SN 14997 is configured as the Front/Port side unit, while

SN 14998 is configured as Rear/Starboard side unit.

Switching to (single) mag mode while having two SeaSPYs connected to the transceiver will result in communication errors.

Entering incorrect serial number(s) into the configuration for either of the two SeaSPYs will result in Towfish Not Responding error:

```
FT:Not Responding
```

or

```
RT:Not Responding
```

6 Transceiver firmware updates

Beginning with version 2.21, the isolation transceiver firmware can be updated using the Firmware Installer tool found on the Marine Magnetics web site: <https://marinemagnetics.com/install/syfi/public/default.htm>

NOTE: Older firmware versions (older than v 2.34) require that the gradiometer mode be disabled and the GPS signal to be blocked before updating the firmware to prevent satellite sync from interrupting the update process. Use the `c` command to switch from gradiometer mode to single mag mode, cover the transceiver with a metal box or aluminum foil to block the satellite signal, and wait 5 min before updating the firmware.

7 Electrical specifications

An isolation transceiver is required when operating a Synapse magnetometer or Synapse array system via a 2-conductor tow cable. The transceiver provides a clean regulated power supply to the towfish or array and converts the RS-232 data interface to FSK, enabling telemetry over long tow cables. The isolation transceiver also features a battery-powered clock for synchronizing the towfish or array, and an integrated GPS to ensure precise synchronization to UTC time.

A standard desktop isolation transceiver is used when powering up to three Synapse magnetometers. Systems containing more than 3 magnetometers require the use of a high-output isolation transceiver.

The recommended input voltage for the isolation transceiver is 24V.

Table 5 – Desktop and Side Scan Interface isolation transceiver electrical specifications

Parameter	Units	Min	Typ.	Max
Input voltage (transceiver)	VDC	9 V	24 V	28 V
Output voltage (transceiver)	VDC	45 V	45 V	45 V
Output power (Max)	W	-	-	25 W
Output power – single Synapse	W	3.5 W	5 W	7 W
Output power – 2-mag gradiometer	W	7 W	10 W	14 W
RS-232 baud rate	baud	9600*	115200	115200

Output overload protection:

If the transceiver output current exceeds 3.4 A, an internal fuse will trip and stay tripped until the output load returns to acceptable level. It will then automatically reset itself. A short circuit in the tow cable or at the tow connector will not cause damage to either the interface electronics or the towing system.

7.1 Connector wiring for desktop isolation transceiver (Gen.1-Gen.3)



Table 6 – Towfish electrical connector wiring (2-pin connector)

Pin	Function	Notes
1	V+ / FSK +	45 VDC + FSK telemetry
2	GND	45 VDC + FSK telemetry

Table 7 - Power input connector wiring (3-pin connector)

Pin	Function	Notes
1	VDC	External power (9-28 VDC)
2	GND	External power (9-28 VDC)
3	GND	External power (9-28 VDC)

Table 8 – RS-232/USB COMMS connector wiring (8-pin connector)

Pin	Function	Notes
1	USB VDC	Integrated USB – RS232 adapter
2	USB DATA+	Integrated USB – RS232 adapter
3	USB DATA-	Integrated USB – RS232 adapter
4	USB GND	Integrated USB – RS232 adapter
5	RS-232 Tx (PC > MAG)	RS-232
6	RS-232 Rx (MAG > PC)	RS-232
7	RS-232 GND	RS-232
8	n/c	

Table 9 – External GPS NMEA input connector wiring (4-pin connector)

Pin	Function	Notes
1	n/c	
2	NMEA RS-232 Rx (GNSS > MAG)	External GNSS NMEA for time synchronization
3	n/c	
4	NMEA RS-232 GND	External GNSS NMEA for time synchronization

Table 10 - External GPS input connector wiring for desktop isolation transceiver (4-pin connector)

7.2 Connector wiring for side scan interface transceiver (Gen.1-Gen.3)

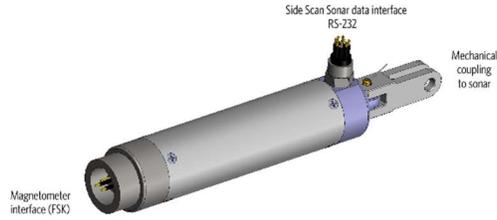


Table 11 – Side Scan Sonar (SSS) Interface connector wiring (8-pin connector)

Pin	Function	Notes
1	V+	VDC input from SSS (9-28 VDC)
2	GND	VDC input from SSS (9-28 VDC)
3	RS-232 Tx (SSS > MAG)	RS-232
4	RS-232 Rx (MAG > SSS)	RS-232
5	RS-232 GND	RS-232
6	n/c	
7	NMEA RS-232 Rx	External GNSS NMEA for time synchronization (Gen.2,3)
8	NMEA RS-232 GND	External GNSS NMEA for time synchronization (Gen.2,3)

Table 12 – Magnetometer Interface connector wiring (2-pin connector)

Pin	Function	Notes
1	V+ / FSK +	45 VDC + FSK telemetry
2	GND	45 VDC + FSK telemetry

Table 13 - External GPS input connector wiring for desktop isolation transceiver (4-pin connector)