Marine Sonic Technology, Ltd.

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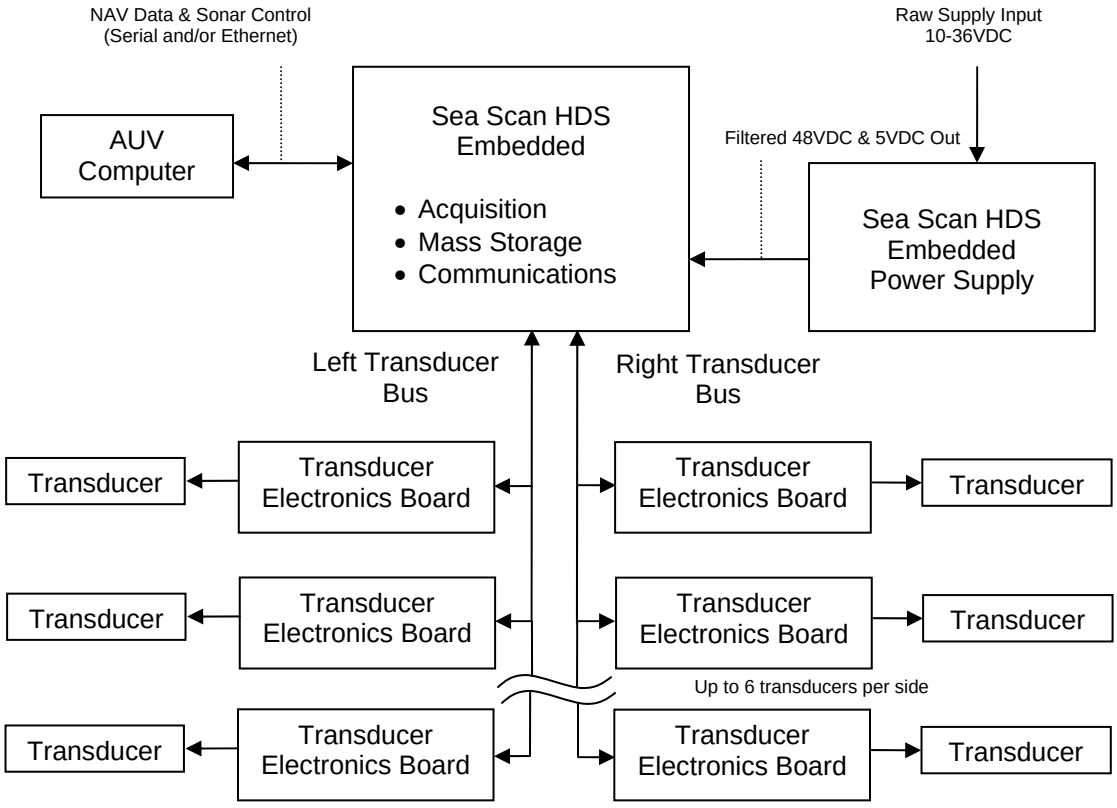
Sea Scan HDS in Embedded Applications

Purpose:

The intent of this document is to answer many of the common questions regarding the typical installation of Sea Scan® HDS Embedded in an un-manned configuration (e.g. AUV, UUV, etc). This document discusses the selection of support hardware/software and common installation problems.

This document is not intended to be an instruction manual for the installation of Sea Scan HDS Embedded. Most systems of this type are custom installations. As such, we can not provide a single exacting set of installation guidelines.

Hardware:



Typical System Level Block Diagram

Sea Scan HDS Embedded

Sea Scan HDS Embedded utilizes a FPGA processor that uses proprietary HDL components to achieve a system that operates as a standalone unit and does not rely on any operating system. It has features built in specifically designed to accommodate embedded operations such as those found on un-manned systems. These features include:

- Precise data acquisition timing
- 12 bit analog to digital signal conversion
- Compact flash based mass storage
- 10/100 Ethernet
- RS232 Console
- 4 configurable serial ports

All firmware is contained in a non-volatile memory onboard the processor daughter card. The system can be upgraded by Marine Sonic Technology, Ltd. as new firmware revisions become available.

A RS232 console serial port is available for both system setup and operation. This port is also useful for system debugging as it gives you simple control over the system via a serial console and basic ASCII commands.

Up to 4 other serial ports can be added to the system via drop-in daughter asynchronous card serial adapters. These adapters can give you different types of serial input standards. These may include isolated TTL, RS232, RS422 and/or RS485. These devices can be used as NMEA data inputs, command/control, or high speed data output. Any data coming into these ports must be in NMEA format and can be integrated into the Sonar Data Stream (See software section below). This daughter card can also supply an isolated synchronization port to allow you to synchronize another sonar to us. Custom solutions can be provided if required.

A 10/100 Ethernet port is provided for command/control, data streaming, configuration, and data transfer. Command/control utilizes a TCP/IP link for robust, reliable communications while high speed data is streamed via UDP packets to reduce processor load on both the embedded system and the receiving computer. A configuration web page is also included which provides a simple way of setting up the system and managing files.

Compact flash based mass storage is included on board to store collected data. This reduces the overall power and space footprint of the sonar system. All files are stored via a FAT32 filesystem which allows the use of PC-based compact flash readers for data retrieval. A type I/II compact flash card socket is provided so either a compact flash or Microdrive can be used. Sea Scan HDS Embedded ships with a Sandisk Extreme III 16GB Compact Flash card which provides more than 24hours worth of continuous data collection even at high ping rates.

The system can stream data out in real-time via Ethernet, serial and store the data on the compact flash disc simultaneously. This gives one the ability to have real-time viewing and data redundancy. If you intend to use real-time streaming, you will need to be sure the connection speed is sufficient. To achieve full speed operation, you must have more than 2Mbps for serial and 3Mbps for Ethernet. Slower speed connections can be accommodated but either the image quality will be degraded or the maximum ping rate will be lowered. More information on this is available upon request.

On-board LED indicators show the current status of several components. They are useful in determining the system status without the need of a test computer nearby. These lights show the current status of power, pinging, and left and right channel data density (rub check).

The embedded acquisition board dimensions are 2.5”W x 5”L x 0.75”H. The board weighs approximately 100g (connectors and configuration will affect overall weight).

Sea Scan HDS Power Supply

A Sea Scan HDS Power Supply is provided with the system. This supply was designed to address many of the problems that both our customers and Marine Sonic Technology, Ltd. have repeatedly faced. Here are a few features:

- Improved noise rejection
- Wide input voltage range eases system integration
- Power monitoring and protection (fuse-less)

This supply was specifically designed to be a low-noise supply that would compliment our ultra high gain sonar systems without producing electrical noise issues. The switching frequencies of the supplies were chosen to avoid our bandpass and the input and output power is both common-mode and differentially isolated. This results in a supply that produces clean power which should result in less system integration headaches.

The supply uses a very wide input range to accommodate most customers. The raw supply can range from 10- 36VDC. Higher supply inputs may be available upon request (up to 60VDC).

A power monitoring system has been integrated into the supply. The microcontroller based power monitor constantly measures the supply voltage and current draw. On-board FET switches can turn off power to the down-stream components in the case of a fault condition. This results in a system that can protect itself from damage without the need for a fuse which can be difficult to replace due to pressure vessels, etc. Hardware fuses are also integrated on the board as a redundant measure to protect against unforeseen circumstances.

High initial in-rush currents required that a startup delay be integrated into the power monitor. This delay can be configured via a jumper for fast battery supplies (10ms) or slow bench supplies (100ms). For best results, use the fast mode for mission-critical applications and the bench mode for testing simplicity.

An input/output port is available for external control. The input gives you the ability to toggle the power to the embedded system while the output lets you know the current state of the system. This port also acts as a serial port which provides system status information such as output voltages, current draws and any fault conditions. Power monitor settings can be modified using this serial interface so you can tailor it to your individual installation.

The complete system draws under 10 Watts at our maximum ping rate of 60Hz.

The power supply board dimensions are 2.5”W x 3.25”L x 0.75”H. The board weighs approximately 85g (connectors and configuration will affect overall weight).

Transducer Hardware

The transducer electronics board is responsible for creating an acoustic pulse and receiving the resulting echoes. It is connected to the embedded acquisition card. The embedded card provides the transducer electronics with power, trigger and frequency select commands and receives the resulting amplified sonar signal.

A logarithmic amplifier is used to remove the need for time varying gain controls. All data can be recorded raw and post processed to correct for absorption, dispersion, etc. This, combined with a 12 bit analog to digital converter, gives very high sonar image quality without compromises.

Sea Scan HDS supports a new feature that allows you to daisy-chain transducer electronics to simplify adding multiple sonar frequencies. The transducer electronics boards can addressed individually and enabled/disabled and/or powered on/off as required. There are two transducer busses in the system: the Left and Right. You can daisy-chain up to six transducer electronics boards to these busses, giving you up to eight individual transducers of any frequency combination you need to complete your mission. You will have the ability to name each transducer to simplify reviewing data.

Typical Noise Sources

Our system is designed to amplify very small electrical signals and display them. Unfortunately, other sources of electrical signals can be amplified and interfere with the image quality. These noise sources need to be handled properly to reduce their affect on the system.

Typical noise sources include (but are not limited to):

- Radiated (RF)
- Power supply ripple
- Common mode ripple

The transducer electronics are the most noise-sensitive part of our system. This is where most of the signal amplification occurs. In most systems, the transducer electronics are installed in the main dry-housing along with the sonar computer. To help prevent radiated electrical noise from affecting the sonar data, it is best to keep it as far away from other electronics as possible. Some of our customers put it on the back-side of their grounded chassis to help shield it from other active electronic noise sources.

Our newest transducers/electronics have a limit on the distance from the transducer electronics to the transducer of ~1 meter to maintain optimum conditions. If any longer distances are required, the system will still operate but noise pickup may become an issue.

Another method is to use separate external transducer modules which integrate the transducer electronics into the transducers themselves. External standalone transducer modules do help reduce noise transmitted by proximity but may not solve all noise problems. External modules are typically custom made to your specifications.

Here is a list of suggestions for helping reduce noise. Not all of these may be required and some are extremely difficult to accomplish but they are still listed for reference.

- Isolate (via distance and/or shielding) the transducer electronics from other electronics
- Carefully place and route any electronics, magnetic components, or cabling with any high frequency signals.

If you follow good EMI practices and the suggestions above, noise will probably not be an issue in the first place. If electrical noise still exists, we will work with you to find a solution.

External Sonar Interference

Some sonar systems can cause acoustic interference with our system. If other sonar systems are installed on board, care must be taken to ensure they do not affect our image collection. There are a number of ways to accomplish this. Here are a few:

- Use systems with frequencies very different from ours (i.e. if you have a 600kHz side scan, make the other system operate at 75kHz)
- Disable them during side scanning operations
- Synchronize their acoustic pulse with our own
- Physically separate all sonar systems to minimize acoustic cross-talk

We provide an external synchronization pulse that will allow other systems to know when we are collecting data. This sync pulse occurs every time our sonar system transmits a burst of sound.

Our ping rates can vary (depending on vehicle speed) from 1Hz up to 60Hz. This can far exceed the typical sonar ping rates. As such, it may be required to decimate our sync pulse (i.e. divide it down) so that the other sonar system only transmits after N number of our pings. This function can easily be accomplished using our built-in Synchro™ hardware. The Synchro™ hardware is easily configured to suit your needs.

Synchro™ features include:

- Decimation controls to enable/disable and specify decimation level
- Pulse controls adjust duration and phase of the sync pulse
- Adjustable fixed rate sync output regardless of current sonar settings (i.e. get a sync pulse even if we are not pinging)

Software:

NMEA Data Input

We recommend that other navigation information be provided in the form of NMEA sentences over a second serial port. These inputs are integrated into the data we collect and will enable extra features in the software that would previously be unavailable or inaccurate.

These features include:

- Aspect ratio correction
- Geo-referencing sonar data.
- Time Synchronization
- Accurate along-track measurements

We can take in Latitude, Longitude, course over ground (COG), speed over ground (SOG), depth, altitude, roll and pitch. We do not currently utilize roll/pitch inputs in our data review software.

The set of strings that would work best are:

- RMC Contains Latitude, Longitude, COG, and SOG
- DPT Provides water depth and transducer offset or altitude using a modified interpretation

- HDT Carries the current compass heading
- ZDA For time synchronization
- AUV Custom AUV data string that contains all of the above plus pitch and roll

For best results, the Latitude/Longitude should be accurate to at least to 4 to 5 decimal places.

Data Format

The data is stored in a SDS file format. We have this format described in detail here:

http://www.marinesonic.com/documents/seascanpcrealtimeoutputprotocol.pdf

You are welcome to write any code to read this format or you can use our review software. Examples for working with this data are provided to our customers with each system.

Other Resources:

Our website has miscellaneous documents that can assist in the selection and installation of Sea Scan Survey. These documents can be found in both the “Downloads” and the “Maintenance” pages.

http://www.marinesonic.com/

We are available to aide in the installation and/or troubleshooting of our systems. This type of support is a standard part of our product offering. We have worked with many companies to ensure their success in using our system.

Please feel free to contact us for more information.