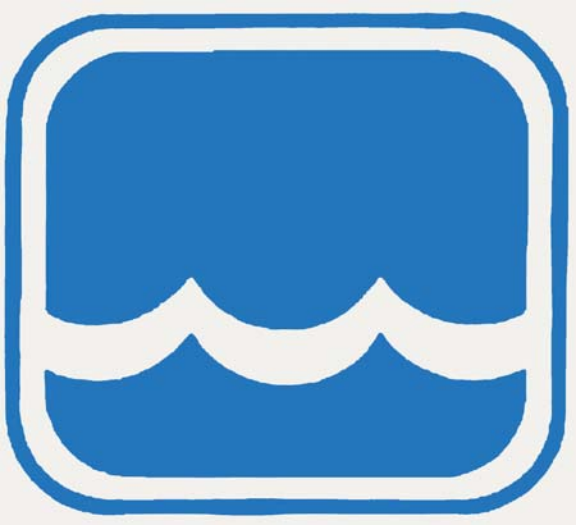
Global Water Instrumentation

SIT60 Hardware Manual



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Specifications

Operating Modes:		
	Timed Mode	Sensor values and/or output status are reported at user programmable time intervals (1 minute increments).
	Digital Event Mode	A report of any digital input is generated whenever it changes state. Digital event inputs can be programmed as pulse counters (accumulators).
	Analog Event Mode	A change in the reading of any analog input generates a report when it changes by more than a pre-programmed percentage for early detection of rapidly changing conditions.
	Interrogation	Sensor value or control status can be interrogated at any time by email (requires receive mode to be enabled).
	Control Output	Control by email 0.1A current sink per output 12Vdc supply available to drive load With external supply, maximum voltage is 24Vdc 2 Available as options (requires receive to be enabled).
Input Configurations:		
	Analog Inputs	10 bit resolution 0-20mA, 4-20mA, 0-5Vdc 4 inputs standard, 8 with DUAL-SIT60
	Digital Inputs	Contact Closure Internal Pull-up Resistor Pulse Counters 1 input standard, 3 optional, 8 total with DUAL-SIT60
	Options	Lightning and surge protection available on all inputs
RF		
	Frequency	Transmit-150MHz, Receive-138MHz
	Rate	2400 Baud
	Range	Anywhere with an unobstructed view of the sky
	Antenna Type	1 meter whip, 16 foot cable standard, longer as option
Power Supply		
	Voltage	12Vdc
	Supply Current	5mA Standby 50mA Receiving Mode Enabled 2A Transmitting
	Source	12Vdc Battery standard Optional battery charger Optional 120Vac or 220Vac adaptor Optional solar charger
Operating Conditions		
		-40° to +60° Celsius, -40° to 140° Fahrenheit 100% Humidity, Non-condensing

SIT60 Field Station

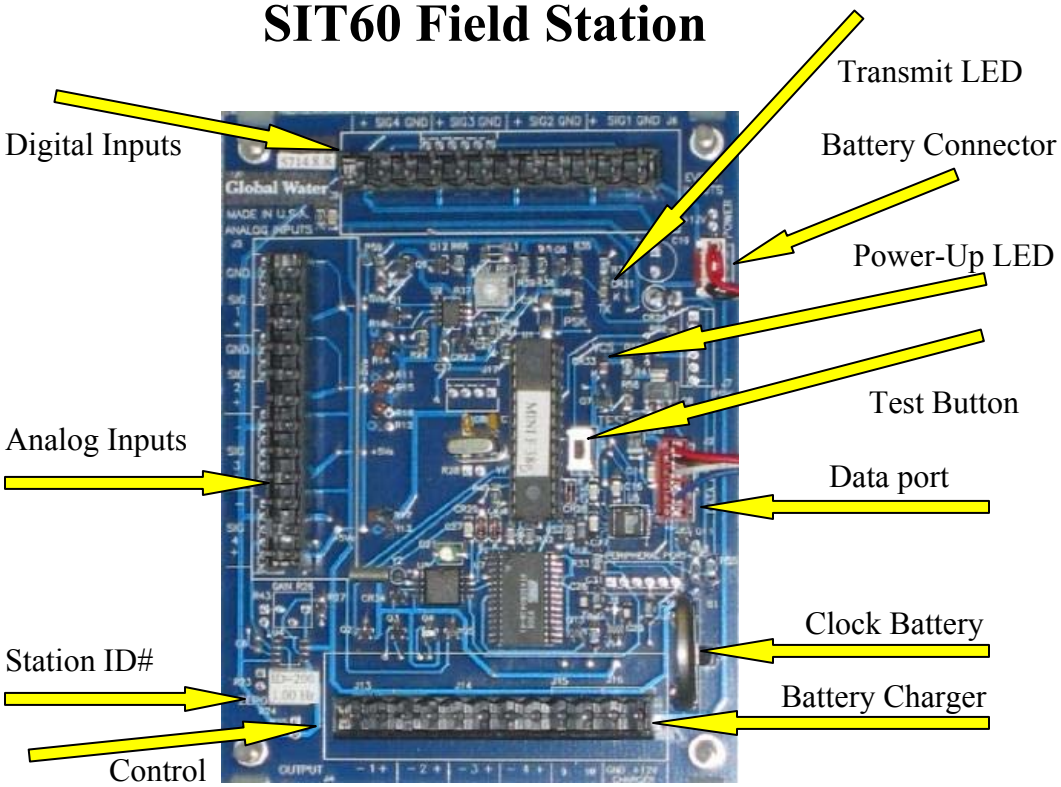

Figure 1. RTU Board

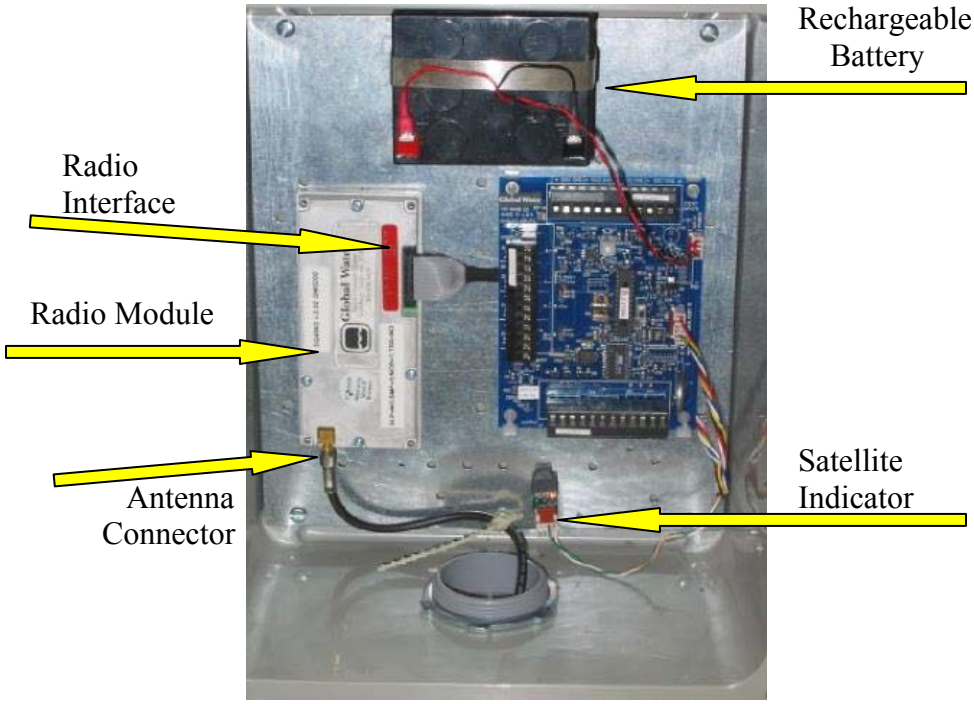

Figure 2. SIT60 Field Station

Description

The basic SIT60 Field Station consists of a weatherproof case, antenna with 16' cable, mounting brackets, radio module, RTU control board, satellite indicator, 12volt battery, I/O interface connectors, configuration report, hardware manual, and user's manual. Figure 1 and figure 2 show the location of the inputs, outputs, controls and indicators used to interface with the SIT60 Field Station.

Four **Analog Inputs** come standard and are capable of monitoring 0-20mA, 4-20mA, and 0-5volt sensors. Three terminals are provided for each sensor; Ground, Signal and +12volts switched. When the RTU begins to read the sensors, it will apply power to the switched supply for predetermined length of sensor warm-up time. When this time has elapsed, the reading will be taken and transmitted. The Signal Input sources current to ground for the case of 4-20mA and 0-20mA sensors. For 0-5volt sensors, the input voltage is referenced to ground.

The sensor loop current is converted to a voltage by passing it through a 250ohm resistor yielding a full-scale voltage of 5 volts at 20mA. The resulting 0-5 volt (0-20mA) signal is converted to 10bit digital data or a raw data value of 0-1023.

The **Digital Inputs** can be configured as status inputs or as accumulators. One input is standard and three additional inputs are available as options. Digital inputs are contact closure to ground and have internal 19.6K pull-up resistors to 12volts. A status input is read as a single bit in a 4bit word. Inputs 1-4 are associated with bits 1-4 respectively. All inputs high gives a raw data reading of 15, bit 1 low reads 14, bit 4 low is 7, etc. Individual bit status is checked by the database to assign digital labels. Accumulator data is sent as an 11bit number from 0-2047. The next increment after 2047 is zero. The accumulator cannot be reset to zero without a firmware change by Global Water. Accumulator totals such as rainfall can be kept track of using the totals table in FileAmigo.

Two **Control Outputs** are available as options, for controlling a wide variety of devices. The open drain output switches to ground when turned ON and can sink up to 100mA at 24 volts, and can drive a dc load directly or a relay for controlling heavier loads. The outputs are controlled by email commands as described in the User's Manual. Control commands should be sent one at a time. Sending a second command before the Field Station has received the first may result in one of them being lost.

The SIT60 Field Station is given a **Station ID#** and a Station Name by Global Water which are used as identifiers for remotely communicating with the station and accessing data at the website. Both are provided on a configuration report furnished with the unit.

Power to the Field Station is 12VDC and is supplied to the RTU board through the **Battery Connector** using the supplied cable. The unit is supplied with a 4A **Rechargeable Battery**. Optional power sources such as trickle chargers, solar cells and AC-DC converters (2A minimum) can be connected using the **Battery Charger** input.

The **DATA Port** connects the **RTU Board** to the **Radio Interface** on the **Radio Module.** The data port is also used to connect the RTU board to a computer for configuring the transmit interval, sensor warm-up time, analog and digital input modes, output controls and analog alarm levels. The interface uses a standard RS-232 format but requires a special cable and software not supplied with basic SIT60 system. Configuration is done by Global Water at the time of assembly. Contact Global Water if reconfiguration is required.

When data is transmitted, power is applied to the sensors for a warm-up period, the sensors are read, and then the data is sent. The red **Power-UP LED** is comes on during sensor warm-up or when the processor detects a change of state on a digital status input. The green **Transmit LED** is turned on as the control board communicates with the radio.

Data is transmitted when 1 of 4 conditions occur:

1) Interrogation by email as described in the User's Manual will cause the input and output status to be sent on demand.
2) Data is sent on a regular basis based on a preprogrammed time interval. This interval is programmed at the time of assembly based on the customer's requirements in increments of 1 minute from 1 to 9999.
3) Transmission can occur instantly when there is a change of state at one of the status event inputs, or when an analog input level deviates from the last value by more than a preset percentage. A digital input is programmed as an accumulator, status or status event at the time of assembly. Only a status event will cause an instantaneous transmission. The percentage of change in an analog input required to cause a transmission is also programmed at the time of configuration. Since voltage is required for sensors, they must be powered up. This will happen at the normal transmission interval or at a second preprogrammed interval, set in increments of minutes from 1 up to the normal transmission interval. For example: The system can transmit every hour but the sensors can be checked every 10 minutes to detect fast changing conditions.
4) Data is transmitted when the **Test Button** is pressed and held for about 1 second. This button, when pressed, will also reset the processor and turn the control outputs to OFF.

The **Satellite Indicator** has a red LED that comes on when a satellite is within receiving range. It is not necessary for it to be on to make a transmission. The radio module will hold the data and continue to poll the satellite until contact is made, then transmit.

The radio module is connected to the antenna through the **Antenna Connector** using a standard SMA connector. The SIT60 is supplied with 16 feet of cable but should more length be needed, an extender cable can be added. Extra cable can be ordered from Global Water or can be obtained from an outside vendor. Standard SMA connectors and RG-58 cable are used for lengths up to about 30 feet. Should longer cables be needed, it is suggested that a cable with lower loss is used. The VHF band is used for transmission and receiving so a one-meter whip antenna is suitable. An unobstructed view of the sky is required; the more unobstructed the view, the more likely it is that a satellite will be within receiving range and the shorter the latency time will be.

Latency Time

Latency time is the total time between the SIT60 sending data and the data appearing on the hosting web site. The data is held in the radio module until one of 30 satellites is within range, and then sent. The information is further held at the satellite until its data buffers are full before relaying it to one of several ground stations where it is transferred to the Internet. These two factors contribute most of the latency time but additional small time delays are added by data servers. Total delay time is not predictable but areas with good satellite coverage and an unobstructed view of the sky can expect a total delay of 1 to 5 minutes. Some international locations are not as well covered and may experience longer delays; as can locations such as canyons, mountainous areas and places surrounded by tall buildings.

Power Consumption

There are two power configurations modes for the SIT60. Receive Mode allows the ability to remotely interrogate the system, operate control outputs via email or receive real-time time stamps. The total supply current in this mode is about 70mA (50mA with Satellite Indicator unplugged). Standby Mode drops the system current to 5mA but the receiver is turned off in this mode so you will not be able to send control or interrogation commands to the Field Station or get real-time time stamps. In standby mode, the processor must power up the radio receiver for one minute to allow communication with the satellite before reading the sensors and sending data. The radio remains powered up (70mA/50mA) until contact is made with the satellite

A third option is available which is combination of both receive and standby modes. The unit can is shipped in receive mode allowing interrogation, controls and time stamp until a power down command is sent via email. This power down mode is permanent and can only be undone by returning the system to Global Water. The format for the command is as follows:

To: <***radioname***>@ORBCOMM.NET
Subject: SLP YES
Body: <empty> Don't type anything in the body of the message

Additional power is consumed by other factors. The transmitter draws 2A when transmitting and the amount of time it spends communicating with the satellite is unpredictable. More time is required when a satellite is temporarily out of range but in general you can assume it draws 2A for 15 seconds out of every transmission period. The sensors draw power during the sensor warm-up with a typical warm-up time of 1-3 seconds every transmission. Some sensors are on all the time, which can be a significant factor in a low power system and should be evaluated on a case-by-case basis. Lastly, the Satellite Indicator board has an LED that draws about 20mA when a satellite is within range, which can be more than 75% of the time with good sky. If power consumption is an issue, the connector to the indicator board should be unplugged and tied down.

In remote locations, a solar cell should be used unless the Field Station will be serviced often enough to keep a fully charged battery in place. As a general rule-of-thumb, the maximum capacity of the solar collector should exceed the average current drain of the system by 10 times. Dust will settle on the surface of the solar array over time, reducing its efficiency. It should be kept clear of snow and cleaned often enough to keep the battery charged.

Station ID# Offset

Channel #	Type	Example Station ID# 100	ID# Offset	Connector-Terminal
Analog Inputs				
1	Analog Input	101	1	J5-2
2	Analog Input	102	2	J5-5
3	Analog Input	103	3	J5-8
4	Analog Input	104	4	J5-11
Digital Inputs				
1	Digital Status or Status Event	94	-6	J6-2
2	Digital Status or Status Event	94	-6	J6-5
3	Digital Status or Status Event	94	-6	J6-8
4	Digital Status or Status Event	94	-6	J6-11
	OR			
1	Momentary Accumulator	99	-1	J6-2
2	Momentary Accumulator	97	-3	J6-5
3	Momentary Accumulator	96	-4	J6-8
4	Momentary Accumulator	95	-5	J6-11
Control Outputs				
1	Control Output	100	0	J4-1
2	Control Output	100	0	J4-3

Figure 3. Sensor Offset Table.

Each SIT60 Field Station is assigned a StationID at the time of configuration. Accessing the sensor information in the database requires knowing the SensorID, which is the StationID plus an offset value. The above example is for a SIT60 with StationID of 100. The data from all sensors is transmitted to the database as a block of raw data where the data for each individual sensor is manipulated by using the Adder and Multiplier values in the Sensor Configuration menu as described in the User's Manual. Determining which part of the data block to use for a given sensor is done using the offset number. There are 2 fields in the Sensor Configuration menu that accomplish this. The StationID is the fixed value assigned to the Field Station itself and the SensorID indicates which channel

is being used. If a water level sensor is connected to analog input channel 1, a value of 100 is entered in the StationID field and 101 in the SensorID field as shown in the above table. The corresponding raw data value for this sensor will then be used along with the Adder, Multiplier, Engineering Units, etc. to determine how the data is displayed and what alarm conditions, if any, exist.

Digital accumulators are each assigned a separate channel since the range of data is 0-2047. Digital status and status event are single bits so all 4 available inputs are grouped into one single channel where a single bit indicates the status of each input. The difference between status and status event is that a status event causes a transmission at the time the input changes state where as a status input has its state transmitted at the normal time interval between transmissions. The states of the control outputs are also single bits and so are grouped into a single channel.

In the case of status inputs, status event inputs and control outputs; the database uses the input channel number to determine the corresponding bit to be used for assigning digital labels in the Digital Labels menu. Bit 1 for input channel 1, etc.

Time Stamps

Two different time stamp modes are available to indicate when incoming data was taken, both of which are given in Greenwich Mean Time (GMT). Normally, when the data arrives at the web site it is given a time stamp, which is equal to the time the data was taken plus the latency time involved in getting it to the database.

A second real-time stamp is available which shows the actual time the data was taken. The time is added to the data packet by the satellite when the sensors data is sent and applied to the database when the data arrives at the website. Real-time stamp mode is initiated by sending an email message of the following format:

To: <***radioname***>@ORBCOMM.NET
Subject: TSS YES
Body: <empty> Don't type anything in the body of the message

Receive Mode must be enabled to implement this feature which increases the power consumption as previously discussed. The time stamp also counts as 12 bits of data, which can increase the data handling charge depending to configuration of the system.