



# Manual

## SDI-12 Tester

### Model 6412A



#### Revision History

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**Safety**

The SDI-12 tester instrument is intended to be used and operated by persons with adequate electrical training. It is intended for connection only to low voltage SDI-12 signal wiring. It shall not be connected to other electrical systems or higher voltage power supplies.

## 1.0 OVERVIEW

The SDI-12 Tester is a portable unit which simplifies the set up and fault finding of SDI-12 sensors in the field and on the laboratory bench. It allows sending a variety of commands enabling sensors to be configured and read. It also enables monitoring communications between a logger and sensors(s) on an SDI-12 bus.

The unit has the following functions.

Monitor bus	The instrument passively monitors any commands or data on the SDI-12 data bus and displays it to the LCD.
Query address	Interrogates a sensor to acquire its address.
Acknowledge active	Interrogates a sensor to ascertain its active status & address.
Change address	Assigns a new address to a sensor.
Send identification	Interrogates a sensor and reads its identification data.
Start measurement	Commands a sensor to commence a measurement cycle.
Send data	Commands a sensor to return measurement data.
Send Extended command	Sends extended and custom commands to a sensor.
Cyclical measure & send data	Repeatedly instructs a sensor to measure and return data. This is useful for checking and calibrating sensors.

To conserve the battery the unit will power off automatically 5 minutes after the last button press. A long beep will be heard prior to the unit turning off.

## 2.0 GENERAL OPERATION OF THE SDI-12 TESTER

The keypad buttons are used to turn the unit on and off as well as to navigate and configure the various functions.

**To turn the unit on** press and hold the PWR|OK button until a beep is heard.

**To navigate** between the different character parameters of the commands press the Left / Right buttons.

**To change a command parameter** or to change the viewed page when in the monitor mode use the Up / Down buttons.

**To turn the unit off**, press and hold the PWR|OK button until a long beep is heard

**Do not use anything other than a finger to press a button.** Membrane keypads will fail if you use a pen, screwdriver or other sharp object to depress the button.



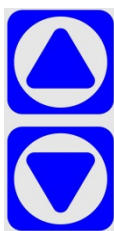
### PWR / OK button

**Press and hold** this button for 3 seconds to turn the unit on or off. Pressing this button will execute the current function.



### FUNC

Pressing the function button advances the unit through the different functions.



### Up | Down

The Up & Down buttons are used to scroll through command address(es) and command element options.



### Left | Right

The Left & Right buttons are used to select the address or command element being changed.

### Terminals

**SDI-12**

SDI-12 bus data line connection terminal.

**Ground**

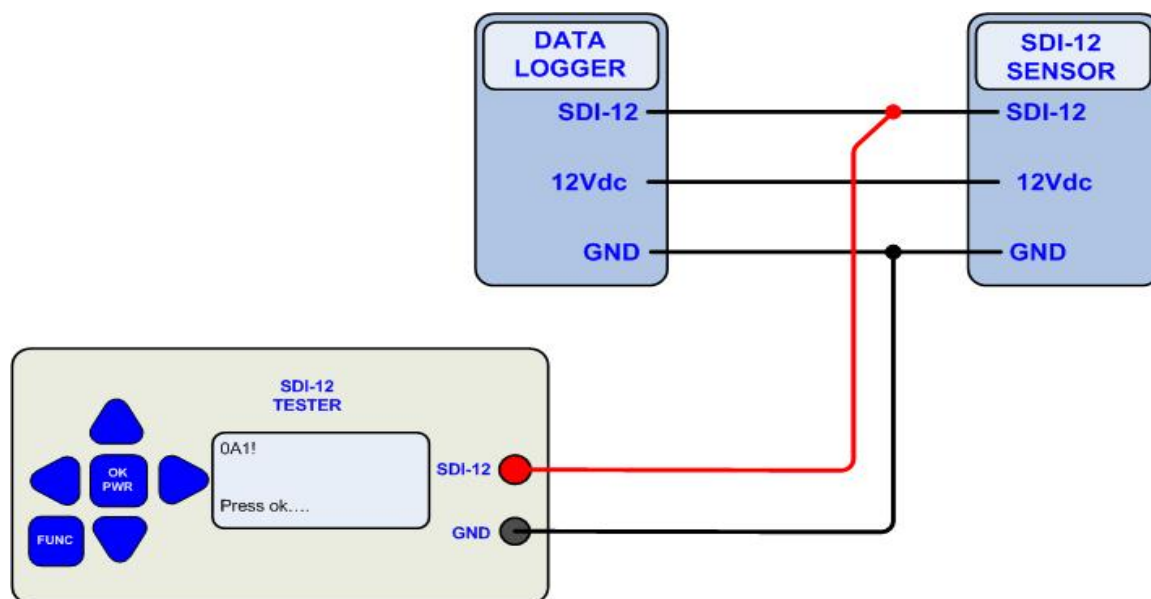
SDI-12 bus ground line connection terminal.

## 2.1 Connection for Operation

The unit needs to be connected to the SDI-12 bus. Two connections are required, the ground / earth and the SDI-12 data line.

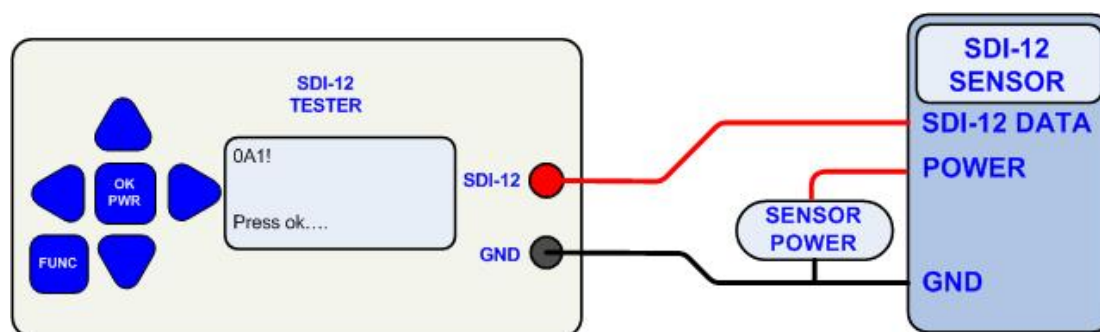
## 2.2 Monitoring SDI-12 Communications

As shown below, connect the SDI-12 Tester ground to the sensor ground. Then connect the SDI-12 Tester SDI-12 data line to the sensor data line.



## 2.3 Testing or Interrogating a SDI-12 Instrument

Ensure the sensor power supply is connected. Connect the SDI-12 Tester ground to the sensor ground. Then connect the SDI-12 Tester SDI-12 input to the sensor SDI-12 data line.



### 3.0 FUNCTIONS

The SDI-12 Tester has nine functions, these are detailed below.

#### 3.1 Power on Screen

When powered on the screen will display the firmware version and the battery charge status. A flat battery will show 0%, a new battery around 100%. It is recommended that a spare 9V alkaline battery be carried during field work.

<p><b>UNIDATA 6421A</b> <b>SDI-12 Tool</b> <b>Firmware V1.60</b> <b>Battery 85% left</b></p>
--

### 3.2 Monitoring the SDI-12 Bus

The Monitor Bus function allows the user to snoop on the SDI-12 bus to view commands sent by a logger and the responses returned by sensors.

**Monitor Bus. Pg1**  
**push OK to clear**  
**< = carriage return**  
**^ = line feed**

Up to 96 characters of data will be displayed after which the unit will halt to enable the user to read the captured data. The data is displayed as two pages of 3 lines each. The current page will be indicated in the top right hand corner of the LCD display as Pg1 or Pg2.

Carriage return or line feed characters will be displayed as "<" and "^" respectively. Press the Up and Down buttons to navigate between the two pages. Press the OK button to clear the display and capture more data.

**Monitor Bus. Pg1**  
**0D0!0+66523<^0D0**  
**!0+66523<^0M!**  
**00001<^0C!000001**

Press the Down button to go to Page 2. When on Page 2 pressing the Up button will return the display to Page 1.

**Monitor Bus. Pg2**  
**<^0D0!0+65534<^0**  
**D0!0+66523<^0D0!**  
**0+66523<^\_**



### 3.3 Acknowledge Sensor Active

- a!** The Acknowledge Active command a! is used to determine if a sensor is connected to the SDI-12 bus and is active.

Address characters in the ranges '0....9', 'a....z' and 'A....Z' are supported.

Send the Acknowledge Active a! command:

**Ack. Active. 0!**

**Push OK....**

Successful Acknowledge Active response - the sensor replies with its address:

**Ack. Active. 0!**

**Retries = 0**

**0<CR><LF>**

**Push OK....**

If there is no response from the sensor:

**Ack. Active. 0!**

**Retries = 3**

**No response!**

**Push OK....**

### 3.4 Query Sensor Address

- ?! The Query Sensor Address command ?! is used to determine the address of a sensor is connected to the SDI-12 bus.

Send the Query Address ?! command by pressing "OK"

**Query Addr. ?!**

**Push OK....**

Successful Query Address response - the sensor replies with its address:

**Query Addr. ?!**

**Retries = 0**

**Address = 0**

**Push OK....**

If there is no response from the sensor:

**Query Addr. ?!**

**Retries = 3**

**No response!**

**Push OK....**

### 3.5 Change Sensor Address

**aAb!** The Change Address command aAb! is used to assign a new address to a sensor.

The sensor changes its address from its current address 'a', to its new address 'b'. To confirm a successful address change the sensor will reply with its new address, for example:

Use the Left / Right buttons to select and the Up / Down buttons to change the new and old addresses on the LCD.

Command sent: 0A1!

Sensor response: 1<CR><LF>

Outcome: connected sensor address 0, address changed from 0 to 1.

Send the Change Address aAb! command by pressing "OK"

**Change Add 0A1!**

**Push OK....**

Successful address change response - the sensor replies with its newly assigned address

**Change Add 0A1!**

**Retries = 0**

**1<CR><LF>**

**Push OK....**

If there is no response from the sensor:

**Change Add 0A1!**

**Retries = 3**

**No response!**

**Push OK....**

### 3.6 Send Identification

**al!** The Send Identification command **al!** instructs the sensor to return it's ID string:

allccccccmmmmmmmvvxxx . . . xxx<CR><LF>

The ID string contains the following sensor information;

a	Sensor address
ll	SDI-12 version compatibility. eg. 13 $\equiv$ Version 1.3
ccccccc	Manufacturer code, 8 characters
mmmmmm	Model number, 6 characters
vvv	device firmware version eg. 150 $\equiv$ 1.50
xxx	device serial number, up to 13 characters

Maximum reply length is 33 characters + <CR><LF>

Send the Query ID **0l!** command by pressing "OK"

**Send ID. 0l!**

**Push OK....**

Successful ID query response - the sensor returns it's ID string:

**Send ID. 0l!**  
**013ccccccmmmmmm**  
**mvvvxxxxxxxxxxxx**  
**xx**

If there is no response from the sensor:

**Send ID. 0l!**  
**Retries = 3**  
**No response!**  
**Push OK....**

### 3.7 Start Measurement

**aM!** The Start Measurement command aM! instructs the sensor to take measurements. The sensor will reply with its address, the time until the data is ready to be read and the number of parameters that will be returned.

Command: aM!

Response: attn<CR><LF>

a: sensor address

ttt: time in seconds until data will be ready

n: number of values that will be returned in by a Send Data command.

A service request (a<CR><LF>) may be sent by the sensor when the parameters are ready.

Command sent: 0M!

Sensor response: 00012<CR><LF>

after 1 second.....

Sensor response: 0<CR><LF> (service request)

Command sent: 0D!

Sensor response: 0+95.2+2.54<CR><LF>

Outcome: connected sensor is address 0, in 1 second 2 parameters will be available to be read. After service request is sent the data is read via the aD! send data command.

Send the Start Measurement 0M! command by pressing "OK"

**Start Meas. 0M!**

**Push OK....**

Example response: The sensor will have 2 values ready for reading in 1 second:

**Start Meas. 0M!**

**Retries = 0**

**00012<CR><LF>**

**Push OK....**

If there is no response from the sensor:

**Start Meas. 0M!**

**Retries = 3**

**No response!**

**Push OK....**

Press OK to send the command again.

### 3.8 Send Data

**aD0!** The Send Data command aD0! is used to read the measured data values back from the sensor following a measurement command.

The number and type of parameters returned is dependent on the sensor under test.

The sensor response will be:

a<values><CR><LF> or

a<values><CRC><CR><LF>

Send the Return Data 0D! command by pressing "OK"

**Send Data. 0D!**

**Push OK....**

Example response: Sensor with address "0" has responded with four values.

**Send Data. 0D!  
0+24.4698+192.27  
14+192.3845+13.9  
990**

If there is no response from the sensor:

**Send Data. 0D!  
Retries = 3  
No response!  
Push OK....**

Press OK to send the command again.

### 3.9 Extended Commands

**aXCCCCCCC!** The Extended command function enables sending any combination of 8 ASCII characters as an SDI-12 command.

The full range of a...z, A...Z, 0...9 plus special characters can be sent.

As an Extended command the command length is limited to 7 characters plus the address, X and the terminating "!".

Any command character position set to the underscore "\_" will be ignored.

To create the required command use the Left and Right buttons shift the cursor to the required character position. Then using the Up and Down buttons select the desired character. Press the OK button to send the command.

The response ,up to 48 characters, will be displayed.  
Any underscores "\_" in the command will be ignored.

**Custom 0D0\_\_\_\_\_!**  
  
**Push OK....**

Press OK to send the command. The sensor response will be displayed.  
To repeat this process press the OK button again.

**Custom 0D0\_\_\_\_\_!**  
**0+24.4698+192.27**  
**14+192.3845+13.9**  
**990**

If there is no response from the sensor:

**Custom 0D0\_\_\_\_\_!**  
**Retries = 3**  
**No response!**  
**Push OK....**

Press OK to send the command again.

### 3.10 Cycle Command

**aX<sub>1</sub>Y<sub>1</sub>Z<sub>1</sub>!** The Cycle command is used to repeatedly send two commands to a sensor.

**aX<sub>2</sub>Y<sub>2</sub>Z<sub>2</sub>!** This is useful when checking the operation of a sensor or when performing calibration checks where you need to repeatedly initiate measurements and then read the resulting data.

Use the Left / Right buttons to navigate and the Up / Down buttons to change the characters to compose the required commands and the Delay time.

The delay time is the amount of time the tester will wait after sending the first command before sending the second command. The delay is adjustable between 1 and 9 seconds. Be aware that if you set the delay to less than the time required by a sensor to process a measurement command you may not get the expected response to the read data command.

Using the example below, after pressing OK the tester will send the command 0M! and will await a response and display it. The tester will then wait for 2 seconds (Delay=2S) and then send the 0D0! command. Returned data values will be shown on the display.

Set up the commands and dwell time:

**Cycle Delay=2S**  
**0M\_\_!**  
**0D0\_!**  
**Push OK....**

Press OK to send the command. The sensor response to command 1 will be displayed.

**Cycle Delay=2S**  
**0M\_\_! 00024**  
**0D0\_!**

After the selected dwell time (2S) the 2nd command will be sent & the response shown. Press OK to return to the initial command display.

**Cycle Delay=2S**  
**0+24.4698+192.27**  
**14+192.3845+13.9**  
**990**



If there is no response from the sensor:

**Cycle Delay=2S**  
**0M\_\_! No reply!**  
**0D\_\_! No reply!**  
**Push OK....**

Press OK to send the command sequence again.

## 4.0 COMMAND TRANSMISSIONS - RETRIES

Commands are sent with retries as per the SDI-12 standard.

If a response is not received the command is resent after a short delay (without a break being sent), this sequence is repeated twice.

If a response is still not received this sequence is repeated twice more.

As an example the command sequence for a completely unresponsive sensor would be:

*<break> <command> wait.....<command> wait.....<command> wait.....*

*<break> <command> wait.....<command> wait.....<command> wait..... [retry #1]*

*<break> <command> wait.....<command> wait.....<command> wait..... [retry #2]*

If a response is received the unit will cease re-sending the command and display the response to the LCD. The number of retries required to elicit a response will be displayed on the LCD.

## 5.0 SOME SDI-12 NETWORK DEBUGGING TIPS

### 5.1 Isolate sensors when checking

When testing sensors sometimes it is critical that only a single sensor data is connected.

If multiple sensors are connected and they have the same address they will respond simultaneously resulting in garbled responses. Likewise if multiple sensors are connected and a ?! command is sent they will respond simultaneously causing an invalid response.

## 5.2 Faulty or un-powered sensors

Un-powered or faulty sensors can connected to the SDI-12 bus can cause erroneous responses. If you are having problems getting sensible responses check that you do not have a faulty or un-powered sensor connected to the SDI-12 bus.

## 6.0 ELECTRICAL & MECHANICAL SPECIFICATIONS

Battery	Type: PP3 9V Alkaline recommended. Typical life: 120 hours continuous usage  Batteries should be removed prior to long periods of storage to prevent damage from leaking flat batteries.
SDI-12 line impedance	As per SDI-12 Standard V1.3
Storage Conditions & Operating Conditions	5°C to 55°C 90% humidity (non condensing).
Protection rating	IP61.
Materials	Case: Fire retardant ABS Keypad: Polyester