Sentinel Series Safety Tester

Operating Instructions

SEAWARD GROUP

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Limited Warranty & Limitation of Liability

Seaward Electronic Ltd guarantees this product for a period of 1 year. The period of warranty will be effective at the day of delivery.

Disposal of Old Product

This product has been designed and manufactured with high quality materials and components that can be recycled and reused.

When this symbol is attached to a product it means the product is covered by the European Directive.

Please familiarise yourself with the appropriate local separate collection system for electrical and electronic products.

Please dispose of this product according to local regulations. Do not dispose of this product along with normal waste material. The correct disposal of this product will help prevent potential negative consequences for the environment and human health.

Contents

1.0 User Notes

These operating instructions are intended for the use of competent personnel.

The Sentinel Test Instrument has been designed to operate in a dry environment.

The following symbols are used in these operating instructions.

Warning of electrical danger! Indicates instructions must be followed to avoid danger to persons.

Important, follow the documentation! This symbol indicates that the operating instructions must be adhered to in order to avoid danger / ensure accuracy

2.0 Safety Notes

The Sentinel Test Instrument has been built and tested in accordance with:

BS EN 61010 part 1
BS EN 61557 part 1 and 2
BS EN 61326

The Sentinel Test Instrument has left the factory in a perfectly safe state. To maintain this state and ensure safe operation of the unit, all notes and warnings in these instructions must be observed at all times.

Always use the Sentinel Test Instrument with the supplied earth probe and earth return leads.

The Sentinel Test Instrument and all associated cables and leads must be checked for signs of damage before the equipment is operated.

Where safe operation of the Sentinel Test Instrument is no longer possible it should be immediately shutdown and secured to prevent accidental operation.

It must be assumed that safe operation is no longer possible:

- if the Sentinel Test Instrument or the cable assemblies show visible signs of damage, or
- the Sentinel Test Instrument does not function, or
- after long periods of storage under adverse environmental conditions.

If the Sentinel Test Instrument is used in a manner not specified by this document then the protection provided by the equipment may be impaired.

Workplace Precautions and Safety Checks

The Sentinel series instruments are capable of the output of dangerous voltages. This section describes precautions and procedures that should be followed in order to create a safe working environment

- Only competent personnel should be allowed to operate the Sentinel series of test instruments.
- Ensure the operating workplace is fully isolated, especially when the Sentinel is in operation. Creating an environment in accordance with EN50191 is strongly recommended.
- The test operative should avoid wearing any conductive materials, such as watches and rings whilst undertaking testing, or it is advised that suitably insulated gauntlets shall be worn.
- Always ensure the earth connection in the supply is properly connected.
- Ensure any devices that are adversely affected by magnetic fields are not placed near the Sentinel Test Instrument.
- Inspect all test leads prior to use to ensure there is no damage to the insulating material such as signs of overheating or splits.
- Before use it is recommended that the tester is checked for correct operation to ensure the current trip is working as required. The use of a Fault Simulator is recommended.

Operating Precautions

- Never touch the instrument, Test Leads or Probes, Terminals or any connected equipment under test whilst a Dielectric Withstand Test is being conducted
- Do not turn the Sentinel Off and On quickly or repeatedly. To allow protection circuits to properly initiate, please allow a few moments before turning the power back on.
- Only use the supplied leads when performing tests.
- Do not short the High Voltage Terminal with the Earth Connection. Doing so could charge the instrument chassis to a dangerously high level of voltage.
- Do not leave the Sentinel unattended whilst in operation, always turn the power off when leaving the test area
- If remotely controlling the Sentinel, adequate safety measures must be in place to prevent;
    - Inadvertent Output of the Test Voltage
    - Accidental contact with the instrument during testing
- Always ensure an adequate discharge time for the Equipment under Test.
- When DC Dielectric Withstand Testing is performed, the Equipment under Test (EUT), Test Leads and probes become highly charged. The Sentinel series of Test Instruments are equipped with circuitry to discharge the EUT after each test. The time required to discharge is dependant upon the EUT and the test voltage.
- Never disconnect the EUT from the Sentinel before discharging is complete

3.0 Accessories

Standard Accessories

The Sentinel instrument will be supplied from new with the following items.

1 off Dielectric Withstand Test Lead set (Comprises 2x Test Leads terminated in shrouded clips).

1 off Interlock Key.

1 off Remote Terminal Plug

1 off Power Lead

1 off operating instruction manual

1 off Earth Bond Test Lead set (Comprises 2x two wire shrouded clips, black & red) **Sentinel 501 Only.**

4.0 Description

The Sentinel Series Test Instruments are safety testers designed for testing of product in manufacturing, service and laboratory environments

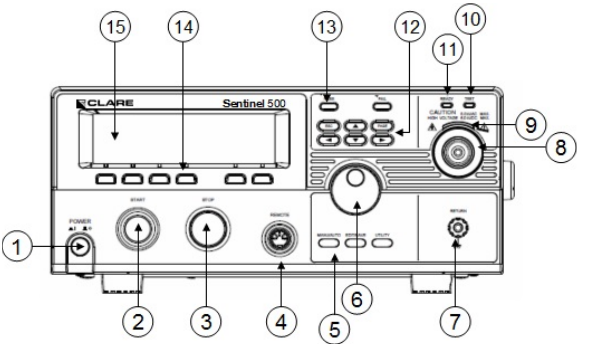
All models can operate at up to 5kVAC for AC Dielectric Withstand (Flash) Testing and at up to 6kVDC for DC Dielectric Withstand (Flash) Testing. The Sentinel 501 also includes Earth Bond and Insulation Resistance tests. Please refer to Electrical Specifications in section 6 for full test specifications

The Sentinel 500/ 501 has test terminals mirrored on both the front and rear for added safety and for more permanent safety testing environments. They also include an innovative sweep function to view test results as a graph, and a 500VA transformer.

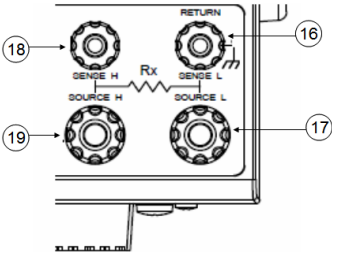
The Sentinel Series Test Instruments can store up to 100 manual tests, as well as run up to 16 manual tests sequentially as an automatic test, allowing the safety testers to accommodate any number of safety standards.

Front Panel

Sentinel 200/500



Sentinel 501



1. On/Off switch - Powers the internal electronics.

2. Start button - Used for starting tests whilst in READY status, and also to put the instrument into TEST status.

3. Stop button - Used to Stop or Cancel an active test. The Stop button is also used to enable the READY status to begin testing.

4. Remote Terminal – Used to connect a remote controller, for external Start / Stop conditions for example.

5. Configuration Keys – Comprising of

   Utility Key – Used to enter the Manual (MANU) utility or the Common Utility menus.

   Edit / Save Key – User to enter the edit function for Manual (MANU) and Automatic (AUTO) test parameters. Also used to save settings and test parameters.

   Manu / Auto Key – Used to switch between manual and automatic test mode.

6. Rotary Wheel – Used to increase / decrease test parameter values. Turn wheel clockwise to increase and anticlockwise to decrease values.

7. Return Terminal – Used for the voltage return when performing Dielectric Withstand Tests

8. High Voltage Terminal – Used for the output of test voltage. This terminal is recessed for safety purposes.

9. High voltage Indicator – Illuminates when the output terminal is active.

10. Test Indicator – Illuminates to indicate the Sentinel is performing a Test.

11. Ready Indicator – Illuminates to indicate that the Sentinel is ready to begin testing.

12. Control Buttons – Consisting of;

    Directional Keys – Used to navigate menu screens and parameter settings

    Escape Key – ESC used to exit from a menu or cancel a setting

    Page Key – PAGE, used to view automatic test information and test results

13. Pass / Fail Indicators – Used to advise the test status at the end of manual or automatic tests

14. Function Keys – The function keys offer different options dependant upon the currently active screen. Offer short cuts to various options.

15. Display – 240 x 64 Dot Matrix Display (LCD)

16. High Voltage Return and Earth Bond Voltage Sense return terminal, L (Sentinel 501 Only)

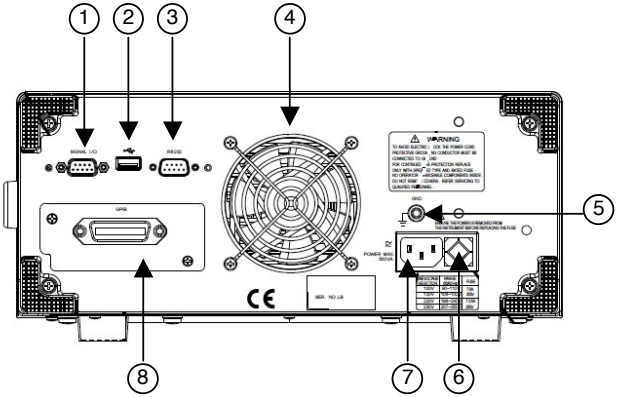
17. Earth Bond Current Source return, L (Sentinel 501 Only)

18. Earth Bond Voltage Sense Output terminal, H (Sentinel 501 Only)

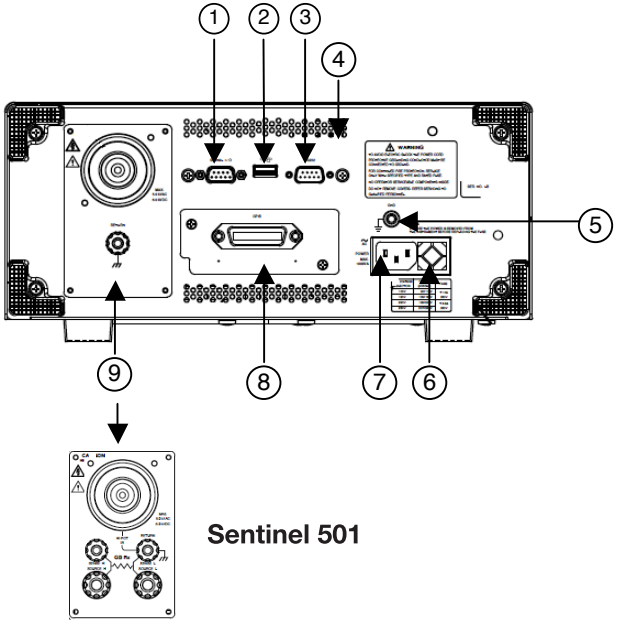
19. Earth Bond Current Source Output, H (Sentinel 501 Only)

Rear Panel

Sentinel 200



Sentinel 500



Sentinel 501

1. Signal I/O Port – Used to Monitor the Test Status (PASS, FAIL & TEST), and input signals (START and STOP). It is also used as part of the Interlock Key

2. USB A Socket – Used for Remote Control

3. RS232 Interface - Used for Remote Control and Firmware updates

4. Fan / Cooling Vents – Used for cooling of internal components.

⚠ **Please ensure that adequate room is left for the fan to vent. Do not cover the fan openings.**

5. Earth Connection – Used for connection of the (GND) Terminal to an Earth connection

6. Line Voltage Fuse – Line voltage Selector and fuse

Sentinel 200:	
100V/120V	T5A 250V
220V/230V	T2.5A 250V
Sentinel 500:	
100V/120V	T10A 250V
220V/230V	T6.3A 250V

7. Line Voltage Input – Incoming Mains supply
   100 /120/220/230V ±10%

8. GPIB Interface – Optional slot for GPIB interface card used for remote control

9. Rear Test Terminal Panel – Mirrored test terminals as per the front panel
   (Sentinel 500 & 501 Only)

⚠ **Do not Touch the High Voltage Terminals whilst testing is in process**

5.0 Environmental Conditions

The Sentinel Test Instrument has been designed to perform tests and measurements in a dry environment.

Maximum barometric elevation at which measurements can be recorded is 2000m.

Contamination degree 2 according to IEC 61010-1.

Electromagnetic compatibility (EMC). Interference immunity and emitted interference conforming to IEC 61326-1.

Operating temperature range of 0ºC to 40ºC without moisture condensation.

The Sentinel can be stored at any temperature in the range -10ºC to +70ºC (relative humidity up to 85%).

Supply rating is specified as 100/120/220/230V AC±10% at 50/60Hz

6.0 Electrical Specifications

Please Note – The specifications below apply when the Sentinel Test Instrument has been powered on for at least 30 minutes at temperature 15°C~35°C. Please see tables 1a and 1B for test output limitations at the end of this section

AC Dielectric Withstand Test

Output Voltage Range	0.100kV~ 5.000kV
Output Voltage Resolution	2V
Output Voltage Accuracy	±(1% of setting +5V) with no load
Maximum Rated Load	**Sentinel 200** 200 VA (5kV/40mA) **Sentinel 500 / 501** 500 VA (5kV/100mA)
Maximum Rated Current	**Sentinel 200** 40mA 0.001mA~10mA(0.1kV≤V≤0.5kV) 0.001mA ~ 40mA(0.5kV<V≤5kV) **Sentinel 500 / 501** 100mA 0.001mA~10mA(0.1kV≤V≤0.5kV) 0.001mA ~ 100mA(0.5kV<V≤5kV)
Frequency	50 Hz / 60 Hz
Voltage Regulation	±1% +5V [Maximum rated load → no load]
Voltmeter Accuracy	± (1% of reading+ 5V)
Current Measurement Range	**Sentinel 200** 0.001mA~040.0mA **Sentinel 500 / 501** 0.001mA~100.0mA
Current Best Resolution	**Sentinel 200** 1µA 0.001mA(0.001mA~0.999mA) 0.01mA(01.00mA~09.99mA) 0.1mA(010.0~040.0mA) **Sentinel 500/ 501** 1µA 0.001mA(0.001mA~1.100mA) 0.01mA(01.11mA~11.00mA) 0.1mA(011.1~100.0mA)
Current Measurement Accuracy	**Sentinel 200** ±(1.5% of reading +30 counts) when HI SET <1.00mA ± (1.5% of reading +3 counts) when HI SET ≥1.00mA

	Sentinel 500 / 501 ± (1.5% of reading +30 counts) when HI SET <1.11mA ± (1.5% of reading +3 counts) when HI SET ≥1.11mA
Window Comparator Method	Yes
ARC DETECT	Yes
Rise-time Control Function	Yes
RAMP (Ramp Time)	0.1~999.9S
TIMER (Test Time)	OFF*, 0.5S~999.9S
GND	RETURN/GUARD

* The timer can only be turned off under special MANU mode (MANU=***-000)

DC Dielectric Withstand Test

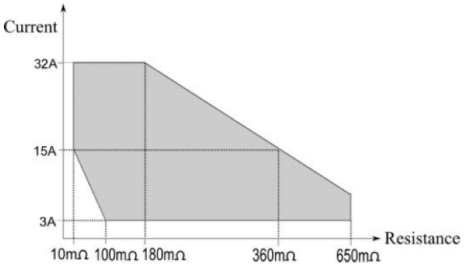
Output Voltage Range	0.100kV~ 6.000Kv
Output Voltage Resolution	2V
Output Voltage Accuracy	± (1% of setting +5V) with no load
Maximum Rated Load	**Sentinel 200** 50W (5kV/10mA) **Sentinel 500 / 501** 100W (5kV/20mA)
Maximum Rated Current	**Sentinel 200** 10mA 0.001mA ~ 2mA (0.1kV≤V≤0.5kV) 0.001mA ~ 10mA (0.5kV≤V≤6kV) **Sentinel 500 / 501** 20mA 0.001mA ~ 2mA (0.1kV≤V≤0.5kV) 0.001mA ~ 20mA (0.5kV<V≤6kV)
Voltmeter Accuracy	± (1% of reading+ 5V)
Voltage Regulation	± 1% +5V [Maximum rated load → no load]
Current Measurement Range	**Sentinel 200** 0.001mA~010.0mA **Sentinel 500 / 501** 0.001mA~20.0mA
Current Best Resolution	**Sentinel 200** 1μA 0.001mA(0.001mA~0.999mA) 0.01mA(01.00mA~09.99mA) 0.1mA(010.0mA) **Sentinel 500/ 501** 1μA 0.001mA(0.001mA~1.100mA) 0.01mA(01.11mA~11.00mA) 0.1mA(011.1~020.0mA)
Current Measurement Accuracy	**Sentinel 200** ± (1.5% of reading +30 counts) when HI SET <1.00mA

	± (1.5% of reading +3 counts) when HI SET ≥1.00mA
	Sentinel 500 / 501
	± (1.5% of reading +30 counts) when HI SET <1.11mA
	±(1.5% of reading +3 counts) when HI SET ≥1.11mA
Window Comparator Method	Yes
ARC DETECT	Yes
Rise-time Control Function	Yes
RAMP (Ramp Time)	0.1~999.9S
TIMER (Test Time)	OFF*, 0.5S~999.9S
GND	RETURN/GUARD

* The timer can only be turned off under special MANU mode (MANU=***-000)

Earth Bond Test (Sentinel 501)

Output Current Range	03.00A - 32.00A
Output Current Accuracy	± (1% of reading +0.2A) when 3A≤I≤8A
	± (1% of reading +0.05A) when 8A<I≤32A
Output Current Resolution	0.01A
Frequency	50Hz/60Hz selectable
Ohmmeter Measurement Accuracy	± (1% of reading +2mΩ)
Ohmmeter Measurement Range	10mΩ~650.0mΩ (depending on output current, see Graph below)



Test Voltage	(Max 6V (AC) Open circuit
Measurement Resolution	0.1mΩ
Window Comparator Method	Yes
TIMER (Test Time)	0.5S~999.9S
GND	OFF

Insulation Resistance Test (Sentinel 501)

Output Voltage	50 – 1000V
Output Voltage Resolution	50V
Output Voltage Accuracy	(1% of setting +5V) with no load
Measurement Range	1MΩ - 50GΩ

Test Voltage	Measurement Range	Accuracy
50V – 450V	0.001-0.050GΩ	±(5% of reading +1 count)
	0.051-2.000GΩ	±(10% of reading +1 count)
500V – 1000V	0.001 – 0.500GΩ	±(5% of reading +1 count)
	0.501 – 9.999GΩ	±(10% of reading +1 count)
	10.00 – 50.00GΩ	±(15% of reading +1 count)

Output Impedance	600kΩ
Window Comparator Method	Yes
Rise-time Control Function	Yes
RAMP (Ramp Time)	0.1 - 999.9S
TIMER (Test Time)	1S - 999.9S
GND	OFF

General

Display	240 x 64 Dot Matrix LED back light LCD
Memory	AUTO/MANU mode 100 memory blocks
Power Source	AC 100V/120V/220V/230V ±10% 50Hz/60Hz
Dimensions & Weight	**Sentinel 200** 330(W) x 148(H) x 452(D) mm, 19kg(Max) **Sentinel 500** 330(W) x 148(H) x 482(D) mm, 24kg(Max) **Sentinel 501** 330(W) x 148(H) x 587(D) mm, 27kg(Max)

Table 1a: Output Limitation when Testing (Sentinel 200)

	Upper Current	Pause	Output Time
AC	30mA≤I≤40mA	At least as long as the output time	Maximum 240 seconds
	0.001mA≤I<30mA	Not necessary	Continuous output possible
DC	0.001mA≤I≤10mA	Not necessary	Continuous output possible

NOTE: Output Time = Ramp Time + Test Time.

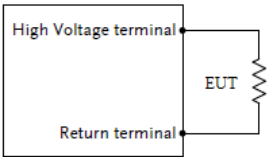
Table 1b: Output Limitation when Testing Sentinel 500 / 501			
	Upper Current	**Pause**	**Output Time**
AC	80mA≤I≤100mA	At least as long as the output time	Maximum 240 seconds
	0.001mA≤I<80mA	Not necessary	Continuous output possible
DC	0.001mA≤I≤20mA	Not necessary	Continuous output possible
	15A<I≤32A	At least as long as the output time	999.9
GB	3A≤I≤15A	Not necessary	999.9
NOTE: Output Time = Ramp Time + Test Time.			

7.0 Operation

Test Lead Connection

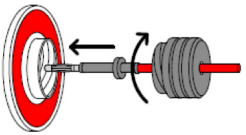
This section shows the correct method for connection of the Sentinel test instrument to the EUT.

For Dielectric Withstand and Insulation Resistance testing the test leads are connected as shown;

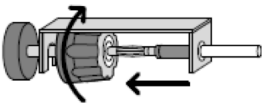


Ensure the Sentinel Test Instrument is switched off prior to connection of Test leads

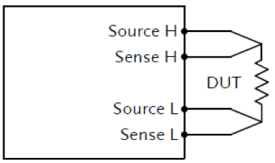
Connect the (Red) High Voltage test lead to the High Voltage Terminal and screw the connector into place. This ensures accidental disconnection by pulling on the Test Lead.



Connect the (White) Return Test Lead into the Return Terminal and screw the protective bar into place.

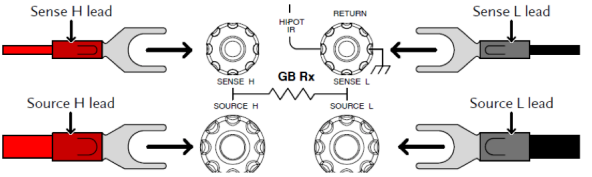


For Earth Bond Testing the test leads are connected as shown.



The thicker cables represent the current Source leads and should be connected to the lower terminals marked Source.

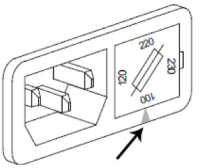
The voltage Sense leads should be connected to the upper terminals marked sense



Instrument Set Up

Before powering up your Sentinel test instrument, ensure the correct line voltage has been selected on the rear panel.

The desired line voltage should line up with the arrow on the fuse holder.



Connect the Power Cord to the AC Voltage Input.

If the Power Cord does not have an Earth Connection, ensure the ground terminal on the Sentinel is connected to an Earth Connection.

Always Ensure the Instrument is connected to an Earthed connection. Failure to do so could be harmful to the operator and instrument.

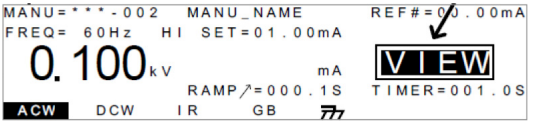
Press the Power Button.

Whilst powering up, all 5 LED indicators will light, check to ensure all are working.

The instrument will perform a System Self Test whilst initialising, check to ensure there are no errors. If errors are found, please contact our service department for help

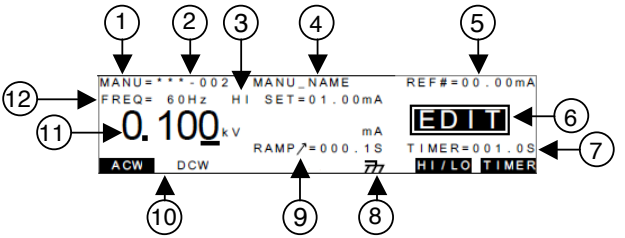
After Self Test, the unit will proceed into **VIEW** Status and is ready for use.

View Status



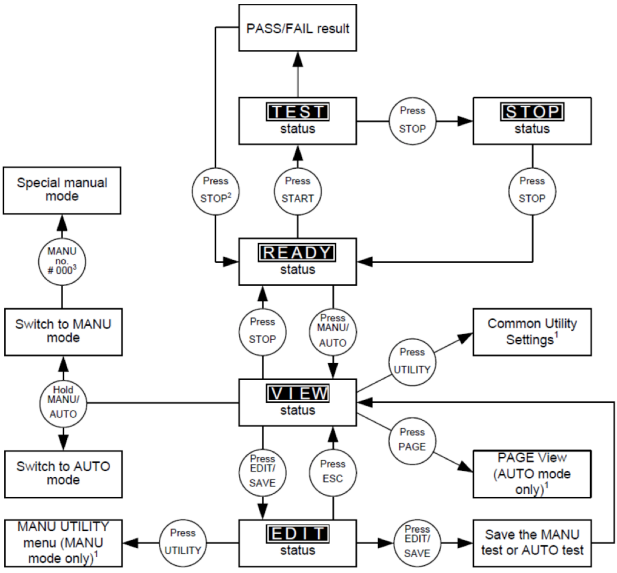
Test Screen and Menu Navigation

The screenshot below shows a typical test screen for the Sentinel



1. Manual / Automatic mode identification
2. Test / Sequence Number Identifier
3. Hi / Lo Trip Current
4. Manual / Automatic Custom Name
5. Offset Reference current
6. Status Mode
7. Test Time
8. Ground Mode
9. Ramp Up Time
10. Test Type Selections
11. Test Voltage
12. Test Frequency

The menu structure for the Sentinel is shown below. There are two main test modes, Manual (MANU) and Automatic (AUTO), along with 5 main operational statuses, VIEW, READY, EDIT, TEST and STOP



Notes

1 Press EDIT/SAVE to save settings or ESC to cancel and return to previous screen
2 Pressing the STOP key twice will indicate a FAIL result
3 When in MANU Mode, selecting MANU test number 000 will enter the special manual mode

VIEW Status – Used to view the parameters of the selected manual or automatic test. From this status the Sentinel can be placed into Manual or Automatic Mode

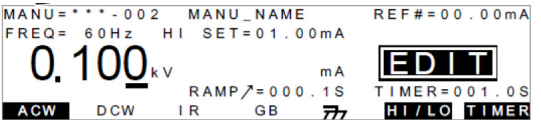
EDIT Status – Used to edit both the manual and automatic test parameters. Pressing the EDIT/SAVE Key will confirm and store any changes, or press the ESC key to cancel any changes

READY Status – When in this status the Sentinel is ready to begin testing, pressing the START button will place the Sentinel into TEST status and the test will begin. Press the MANU/AUTO key will return the Tester to VIEW status.

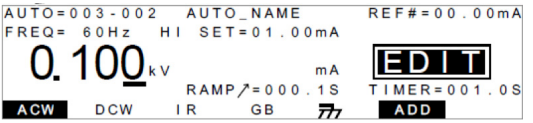
TEST Status – This status becomes active when either a manual or automatic test is running. Pressing Stop will cancel the test and will inhibit any further steps in an automatic test from being performed.

STOP Status - Will show when a test has been aborted by the operator by pressing the STOP button. A further press to the STOP button will return the Sentinel to the READY status.

MANU Mode – Used to create and / or execute a single test. The sentinel will display MANU in the top left hand corner to indicate it is in Manual Mode.



AUTO Mode – Used to create / run a sequence of up to 16 Manual Tests. 100 Automatic sequences can be created.



PAGE VIEW – Shows which manual tests are being used to create an automatic test sequence. The steps can be rearranged or deleted within this screen

COMMON UTILITY – Allows for changes to system wide settings including LCD, Buzzer, Interface and Control Settings

MANU UTILITY – This screen allows changes to each manual test separately. Options include ARC MODE, PASS HOLD, FAIL MODE, MAX HOLD and GROUND MODE.

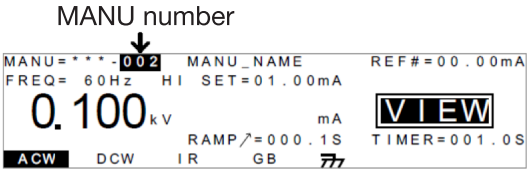
Manual Test Mode

The following section will describe how to create, edit and run a single test on the Sentinel. Each setting described in this section relates only to the selected manual test, no other manual tests are altered.

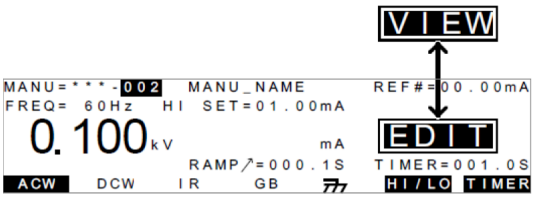
Manual Tests can be stored and recalled to any one of 100 dedicated memory locations. Once stored into a manual location it can be used as a step in an AUTO test sequence.

- From the VIEW status, ensure the Sentinel is in MANU mode. If in AUTO mode, press the MANU/AUTO key for three seconds to switch to MANU

- The scroll wheel can be used to choose the required MANU number



- To edit a manual test press the EDIT/SAVE key from the VIEW mode. This will place the Sentinel into EDIT mode for the chosen test number.



- Whilst in Edit mode, firstly choose the Test function to be performed using the test function soft keys beneath the LCD screen. The selected test function will become highlighted.

- Using the UP/Down keys, move the cursor to the voltage / current selection setting and use the scroll wheel to set the desired voltage / current level.

- Using the UP/DOWN keys, move the cursor to the frequency setting and use the scroll wheel to choose between a 50 or 60Hz test frequency for Earth Bond and AC Dielectric Withstand Only

- To set High and / or Low Limits use the UP/DOWN arrow to move the cursor or press the HI/LO button. Use the scroll wheel on the selected limit to choose the required test limit.

- The REF# feature acts as an offset in the measured value and is subtracted from the measured current. To set this use the vertical direction keys until the cursor is under REF#, use the scroll wheel to set the required current. For Earth Bond tests this value can be calculated by the Sentinel. For details please see page 38, Test Lead Null for Earth Bond Test.

- To set the Test time scroll to the TIMER function or press the TIMER button. Use the scroll wheel to set the time.

- To set the ramp time use the UP/DOWN keys until the cursor is below the Ramp time and use the wheel to set the desired ramp time.

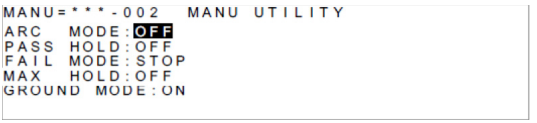
- A Test name can be set if desired with a maximum of 10 characters. In order to utilise this, use the UP/DOWN arrows to scroll to MANU_NAME and the first character will become active. Use the scroll wheel to select the required character then use the LEFT/ RIGHT arrows to move across to the next required character.

The available characters are shown below;

0	1	2	3	4	5	6	7	8	9																
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z
+	-	*	/	_	=	:	Ω	?	(	)	<	>	[	]											

Manual Test Utilities

The manual test utilities are configured for the current manual test. These utilities can be accessed from the EDIT status by pressing the UTILITY KEY



ARC Mode

When activated the Arc Detection system will detect fast voltage or current transients (Arcs) that are not usually detected. Arcing can be a sign of poor insulation, or other insulation problems that cause temporary spikes in current or voltage during the AC/DC Dielectric Withstand Test. There are three detection settings OFF, ON and CONTINUE and ON AND STOP.

From the MANU UTILITY menu use the UP/DOWN arrows to scroll to ARC MODE then use the scroll wheel to select the required option. If choosing either of the ON options the ARC current level can be set.

Note the ARC Setting range is directly related to the HI SET current limit

Sentinel 200 AC Dielectric Withstand

HI Set Limit	ARC Range
0.001mA - 0.999mA	1.00mA -2.000mA
0.100mA - 09.99mA	01.00mA - 20.00mA
010.0mA - 042.0mA	001.0mA - 080.0mA

Sentinel 500 / 501 AC Dielectric Withstand

HI Set Limit	ARC Range
0.001mA - 1.100mA	2.000mA
01.11mA - 11.00mA	02.00mA - 20.00mA
011.1mA - 110.0mA	002.0mA - 200.0mA

Sentinel 200 DC Dielectric Withstand

HI Set Limit	ARC Range
0.001mA - 0.999mA	1.00mA -2.000mA
0.100mA - 09.99mA	01.00mA - 20.00mA
010.0mA - 011.0mA	001.0mA - 020.0mA

Sentinel 500 / 501 DC Dielectric Withstand

HI Set Limit	ARC Range
0.001mA - 1.100mA	2.000mA
01.11mA - 11.00mA	02.00mA - 20.00mA
011.1mA - 021.0mA	002.0mA - 040.0mA

Pass Hold

The Pass hold settings only apply to the selected test when performed as part of an AUTO test. When activated this setting will hold a PASS judgement until the start button is pressed. This feature is ignored in MANU mode.

From the MANU UTILITY menu use the UP/DOWN arrows to scroll to PASS HOLD then use the scroll wheel to select ON or OFF.

Fail Hold

As above, except the Sentinel will hold a FAIL judgement until the Start button is pressed.

From the MANU UTILITY menu use the UP/DOWN arrows to scroll to FAIL HOLD then use the scroll wheel to select ON or OFF.

Max Hold

When activated the Max Hold setting will hold on the display the maximum current measured when performing either AC or DC Dielectric Withstand Tests.

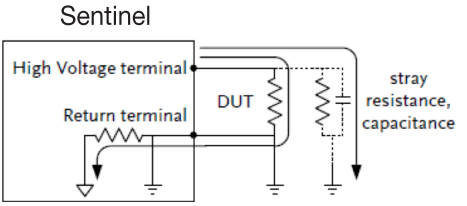
Ground Mode

When GROUND MODE is set to ON, the Sentinel grounds the return terminal to the ground. This mode is best for EUT that are grounded to an earth ground by their chassis, fixtures or operation environment. This mode measures the potential of the HIGH VOLTAGE terminal with respect to earth ground. This means that any stray capacitance/ resistance that leaks to earth ground will also be measured. This is the safest testing mode, though potentially not as accurate.

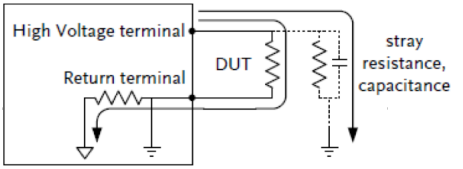
When GROUND MODE is set to OFF, the return terminal is floating with respect to the earth ground. This mode is for EUT that are floating and not directly connected to an earth ground. This is more accurate than when GROUND MODE is set to ON as any stray capacitance/resistance that leaks to the earth ground from the EUT side of the testing circuit will not be measured. For this reason, this testing mode is able to measure to a higher accuracy and resolution.

For Insulation Resistance and Ground Bond Tests the GROUND MODE is always set to OFF.

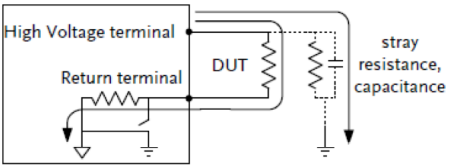
Ground Mode = ON, EUT Grounded



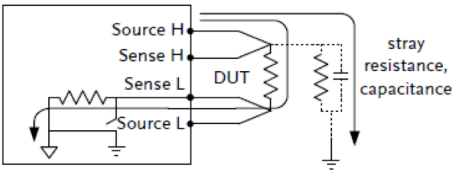
Ground Mode = ON, EUT Floating



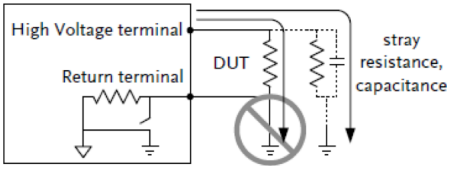
Ground Mode = OFF, EUT Floating



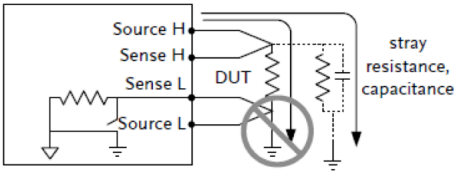
Earth Bond Testing



Ground Mode = OFF, EUT Grounded



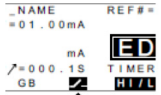
Earth Bond Testing



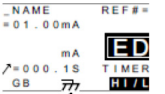
When Ground Mode is set to OFF, the EUT, fixtures or connected instrumentation cannot be earthed. This will short circuit the internal circuitry during a test. If it is not known whether the EUT test setup is earthed or not, always set the Ground Mode to ON.

To set the Ground Mode, from the MANU UTILITY screen use the UP/DOWN arrows to highlight Ground Mode setting and use the scroll wheel to alternate between ON and OFF.

The Ground Mode icon on the main screen will display accordingly whether the Mode is ON or OFF as below;



GROUND
MODE = OFF



GROUND
MODE = ON

Saving Manual Test Parameters

At any point where all required parameters have been set, the Manual test can be saved. Once created, this test can be incorporated into an Automatic Test Sequence.

Whilst in EDIT status, press the EDIT/SAVE button to save the current test. The Sentinel will return to the VIEW status for the chosen test number.

Pressing the ESC key at any point will cancel all changes.

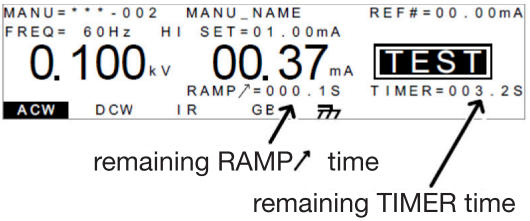
Performing a Manual Test

Manual Tests can be performed once the Sentinel is in READY status, if in VIEW status simply select the required manual test and press the STOP button to place the Sentinel to READY.

The LCD screen will display READY and the LED indicator will be illuminated blue

Press the START button to begin the test, the status will change to TEST and the TEST indicator will be illuminated orange.

The test time will be displayed as a countdown showing the time remaining. The test will begin with any ramp up time, followed by the test time. This will continue until the test is finished or stopped.



Dependant upon the test running the LCD screen will display the following information

AC / DC Dielectric Withstand – Achieved Test Voltage and Measured Current.

Insulation Resistance – Achieved Test Voltage and Measured Resistance (Sentinel 501).

Earth Bond – Achieved Test Current and Measured Resistance (Sentinel 501).

The test can be stopped manually at any time whilst running by simply pressing the STOP button. The test will be stopped immediately and a judgement on the result is not made.

Pressing the STOP button will place the Sentinel into STOP status. In this status all panel buttons except for the STOP button are active. Pressing STOP again will place the Sentinel back into READY status.

PASS / FAIL Condition in Manual Test

If the test is allowed to run until complete (the test is not stopped) then the Sentinel will judge the test as either a PASS or FAIL.

A PASS condition will be achieved if the HI or LO SET limits have not been tripped during the test time. Under this condition the STATUS section on the LCD will display PASS, the buzzer will sound (If configured) and the green PASS LED indicator will be lit.

The PASS judgement is held on the display until the START or STOP buttons are pressed. Pressing the START button will perform the test again, whereas pressing the STOP button will return the Sentinel to READY status.

The Pass judgement will be displayed upon completion of the Test and after any discharge time required.

A FAIL condition will be achieved if the HI or LO SET limits have been tripped, or a protection setting has been tripped during the test time. Under the FAIL condition the Status indicator will display FAIL, the buzzer will sound (if configured) and the red FAIL LED indicator will illuminate.

As soon as a test is judged to have failed, the Sentinel will cut off the test output to the terminals.

The FAIL judgement is held on the display until the STOP button is pressed. Pressing the STOP button will return the Sentinel to READY status.

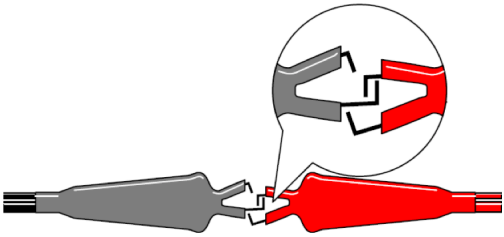
The Fail judgement will be displayed upon completion of the Test and after any discharge time required.

Test Lead Null for Earth Bond Test (Sentinel 501)

The null (ZERO) function is used to determine the resistance of the test leads and negate them when performing Earth Bond tests. When the test leads have been nulled, the reference is automatically set to the measured resistance of the test leads.

To perform this action, ensure the Sentinel is in the VIEW status for the required Earth Bond test.

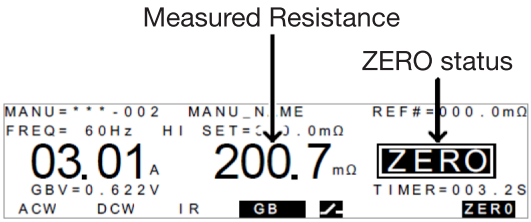
Short the positive and negative Earth Bond alligator clips as shown in the image below.



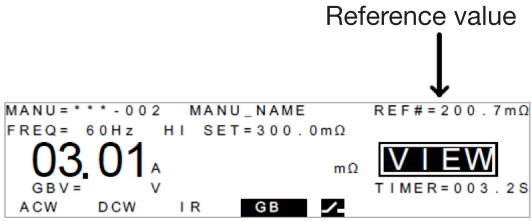
Press the STOP button to put the Sentinel into the READY status, then press the soft key displaying ZERO. This will highlight the ZERO option, press the START button to perform the zero check.

The Sentinel will change status to ZERO and the measured resistance will be displayed, once finished the Sentinel will revert to VIEW status and the resistance of the test leads will be automatically set into the reference (REF#) value.

During Zero Function



After Zero Function



Special MANU Mode 000 (Sentinel 500 & 501)

Special Manual Mode can be accessed by selecting MANU Test number 000. This specialist test feature allows additional features not available in other MANU test numbers as detailed below.

Within Manual Test Mode 000, all parameters and test functions are configured and saved as per previous instructions in this section. Manual Test 000 cannot be selected for AUTO test sequences.

Changing Dielectric Withstand Test Voltage During Test

Whilst performing a Dielectric Withstand test in this special mode the Scroll Wheel can be used to change the test voltage in real time. Simply scroll clockwise to increase and Anti-clockwise to decrease the test voltage. Please note, the test current cannot be altered therefore test judgements will be as per the set current.

Turning off Timer Setting

Whilst setting the test time in as described on page 30 the test time can be set to OFF when performing AC or DC Dielectric Withstand Tests.

To turn off the TIMER whilst in MANU 000, press and hold the TIMER soft key for 3 seconds.

If the test current is between 80mA and 100mA in AC DIELECTRIC WITHSTAND mode the timer cannot be turned off and is limited to 240s

Create Test Parameters

In MANU Test number 000 settings for each of the test functions can be saved and recalled. This means in one MANU setting, parameters for an AC Dielectric Withstand, DC Dielectric Withstand, Insulation Resistance and Earth Bond Test can all be saved then recalled by pressing the corresponding Function Key. For example if you are in the AC Dielectric Withstand mode, pressing the DCW key will load the settings for the last DC Dielectric Withstand Test used.

All Test parameters can be set using the prior MANU mode instructions earlier in this section.

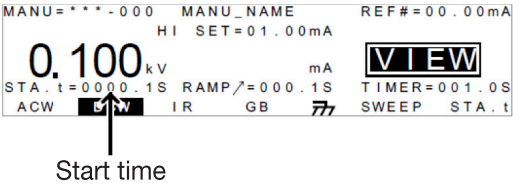
Sweep Function (Sentinel 500 Only)

For laboratory type testing the Sentinel 500 & 501 have a unique Sweep Mode. This function creates a graphical plot of the output Voltage, Current or Resistance versus time. Once the test has completed these parameters at any point in time can be viewed in the Graph.

The test items plotted on the graph are dependant upon the type of test performed.

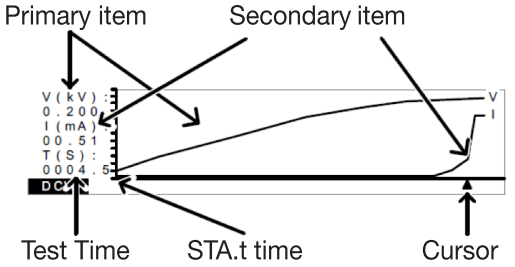
Test	Graph Items Vs Time
AC Dielectric Withstand	Test Voltage, Test Current (V,I)
DC Dielectric Withstand	Test Voltage, Test Current (V,I)
IR	Test Voltage, Test Resistance (V,R)
Earth Bond	Test Current, Test Resistance (I,R)

If required the start time of the Sweep function can be set. Whilst in the VIEW mode press the STA.t button, and use the scroll wheel to select a time. Make sure the sweep start time is significantly less than the test time in order to output meaningful data. Once the Start time has been set, use the EDIT/SAVE button to store the Start time.



In order to access the Sweep graph, firstly perform the required test and once finished press the SWEEP button to enter the graphical plot mode.

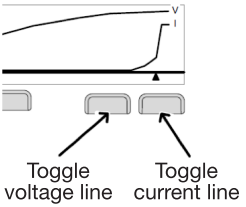
The LCD screen will then display a graph similar to the DC Dielectric Withstand example below;



The Sweep plot consists of the following items

1) Primary Item – Output Voltage (AC/ DC Dielectric Withstand, IR) or Output Current (Earth Bond Test). Displayed as Line Graph and Digital Display
2) Secondary Item – Test Current (AC / DC Dielectric Withstand) or Measured Resistance (IR and Earth Bond). Displayed as Line Graph and Digital Display.
3) Start Time – Shows where the Sweep Start function began.
4) Cursor – Use the scroll wheel to move the cursor alone the Time axis (X Axis). The measured values for both the Primary and Secondary Values will be displayed for that particular Test Time.

The Primary and Secondary Graph plots can be toggled on and off whilst in the Sweep Mode. Press the F5 Key to toggle the Primary Item and F6 to toggle the Secondary. As shown in the below DC Dielectric Withstand example



To exit the Graphical mode press the ESC key, the Sentinel will return to the MANU mode, VIEW Status.

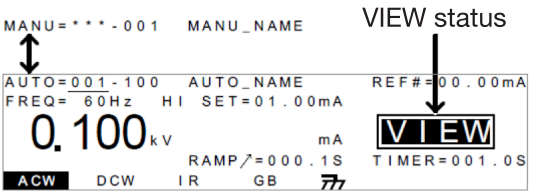
Automatic Test Mode

This section will explain how to create, edit and run automatic tests in the Sentinel. Automatic tests are created by linking together stored Manual tests.

A total of 100 Automatic test sequences can be created consisting of up to 16 Manual test steps.

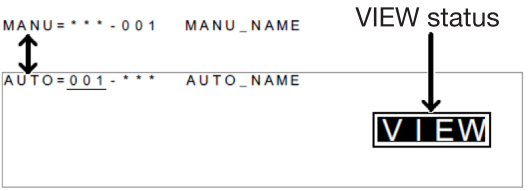
Choose / Recall an Automatic Test

Firstly the Sentinel must be placed into AUTO mode, if in MANU mode. From the VIEW status press and hold the MANU/AUTO key for three seconds.



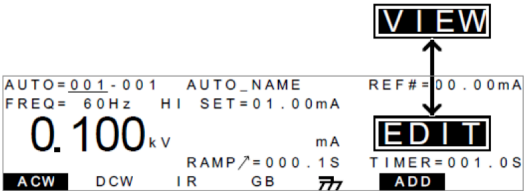
From the view mode use the scroll wheel to select the required automatic (AUTO) test sequence number, ranging from 001 to 100

If the automatic test has not yet been configured, the screen will be blank except for the Mode, Status and Test name.



Editing Automatic Test Sequences

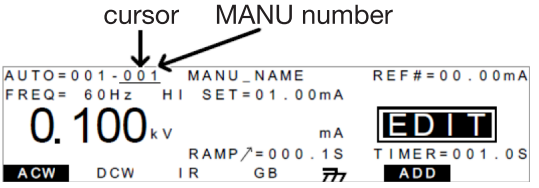
In order to edit an automatic test, the Sentinel must be placed into EDIT status. Whilst in VIEW status, press the EDIT/SAVE button. This will enter the EDIT status for the chosen AUTO sequence and will be indicated by the status change



Adding a Manual Test

Up to 16 Manual (MANU) tests can be added into an automatic sequence, with each step being added in sequential order.

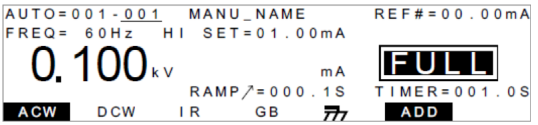
Press the DOWN arrow key to move the cursor to the MANU number on the display and use the scroll wheel to select the required manual test.



Press the ADD soft key option to add the selected manual test into the Automatic sequence.

Add further manual tests into the sequence by repeating the process of scrolling to the test required and pressing the ADD soft key until the test sequence is complete.

After 16 steps have been added to the test sequence the STATUS indicator will display FULL to warn no further steps can be added. It is possible to alter the order that tests are performed, please see page 47 for details.



Creating a Test Sequence Name

A custom name can be set if desired with a maximum of 10 characters. In order to utilise this, use the UP/ DOWN arrows to move the cursor to AUTO_NAME and the first character will become active. Use the scroll wheel to select the required character then use the LEFT/ RIGHT arrows to move across to the next required character.

Character List

0	1	2	3	4	5	6	7	8	9																
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z
+	-	*	/	_	=	:	Ω	?	(	)	<	>	[	]											

Saving the Automatic Test Sequence

Once all the required tests have been added and the Test Name completed the sequence can be stored to memory.

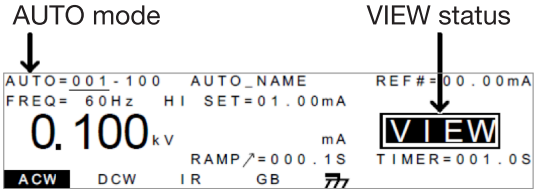
The Sentinel will be in the EDIT status, simply press the EDIT/ SAVE key to store the AUTO test, after which the Sentinel is returned to VIEW status.

Automatic Test Page View

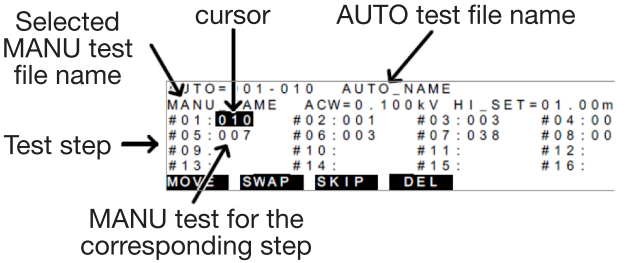
The page view function for Automatic tests displays all chosen Manual steps in list format. From this page view tests can be moved, swapped, skipped or deleted.

The Page view will also display information for the highlighted manual test, including MANU Test Name, Test Function, Test Voltage or Current and Test Limits.

To enable the page view function, ensure the Sentinel is in AUTO mode and VIEW status, select the Automatic test sequence you wish to view.



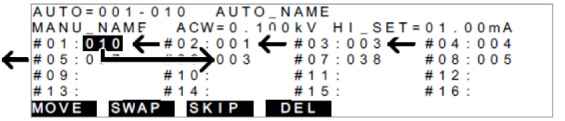
Press the PAGE button to enter the Page View function for the chosen AUTO test sequence.



Moving a Test from Page View

A test can be moved from its current position to another free slot. Using the directional keys move the cursor to the required test to be moved and press the MOVE soft key to select the test.

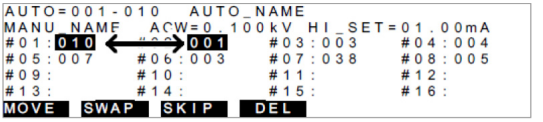
Use the directional keys again to select the desired step and press the MOVE soft key again to confirm the move. Any remaining MANU tests will move left to fill the vacated slot.



Swapping two tests from Page View

Any two manual tests can swap positions if needed. Using the directional keys move the cursor to the required first test to be swapped and press the SWAP soft key to select the test.

Use the directional keys again to select the desired test step to be swapped and press the SWAP soft key again to confirm the swap.

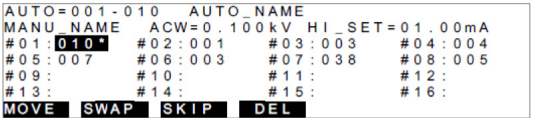


Skipping a Test step from Page View

If a Manual test step is not required it can be skipped so that it is not performed during the sequence but saved for future use if required.

Using the directional keys move the cursor to the required first test to be skipped and press the SKIP soft key to select the test.

The Test number will be appended with an asterisk (*) indicating it has been chosen for skipping. This test will now be omitted from any future performance of this test sequence.



Deleting a Test step from Page View

If a Manual test step is no longer required within the sequence it can be permanently deleted to free up a slot for further test steps.

Using the directional keys move the cursor to the required first test to be skipped and press the DEL soft key to remove the test from the sequence.

Saving changes made in Page View

Any changes made in Page View can simply be saved by pressing the EDIT/SAVE button. The Sentinel will return to VIEW status in AUTO Mode.

Alternatively to cancel any changes press the ESC key, to return to the status in AUTO Mode.

Performing an Automatic (AUTO) Test Sequence

During testing DO NOT touch the EUT, Test Leads or Terminals.

To perform an automatic test sequence the Sentinel must firstly be in VIEW mode. Use the scroll wheel to select the required AUTO test number.

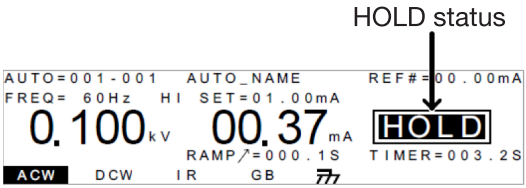
Press the STOP button to place the Sentinel into READY status. The display will indicate the Sentinel is ready to begin testing and the blue LED indicator will be illuminated.

Press the Start button to commence testing, the Sentinel will display TEST and the orange LED indicator will illuminate.

Each test will start by displaying any remaining ramp time, followed by the remaining test time. Tests will be performed in the sequence chosen until the last test has finished or the test is stopped.

If preferred the next test in the sequence can be halted until a start command is received. In order to activate this ensure the Pass Hold is set to ON, and / or the Fail Mode is set to HOLD when creating the manual MANU test. See page 33 for details.

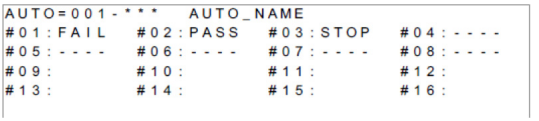
Once active and on completion of a test the Sentinel will enter HOLD status, the PASS or FAIL indicator will be lit for the completed test.



During testing all buttons except for the STOP and START Buttons are disabled.

In order to progress and perform the next test in the sequence, press the START button. Alternatively press the Stop button to cancel all remaining tests.

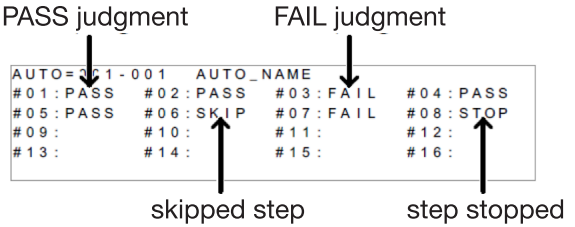
The STOP button can also be pressed at any time during the test process to halt testing. When pressed a judgement is not made on the current test and any remaining tests in the sequence are aborted. All the results for tests conducted up until the point the sequence was stopped are shown within the Page View screen.



To put the Sentinel back into READY mode and perform further tests, press the STOP key. To finish testing press the MANU / AUTO key to revert to view mode.

Automatic Test Results

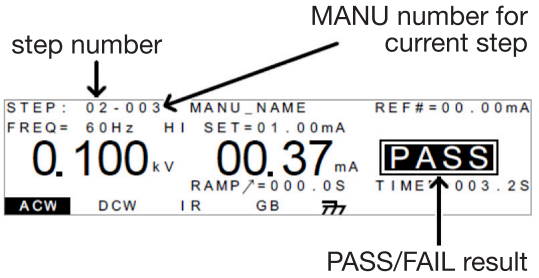
Once a test has been completed (the sequence is not stopped or protection setting tripped) then the Sentinel will judge each test step as a PASS or FAIL, and will be displayed in a table.



The judgement for the entire sequence will depend upon the individual results for each step in the sequence. A PASS judgement will only be issued if all steps have been deemed a PASS.

In this condition the PASS Indicator will be illuminated and if configured, the buzzer will sound. If any steps were failed the Red FAIL LED will illuminate, and if configured, a buzzer will sound, the entire test will be judged as a FAIL.

To view the individual results of each step turn the scroll wheel clockwise from the overview table to scroll through each test in the sequence. Turn the scroll wheel anti-clockwise to scroll back to the overview table.



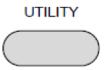
The results screen will be held until the STOP button is pressed, the Sentinel will return to the READY status and the blue READY indicator will be illuminated.

To exit testing mode, press the MANU/AUTO key to return to VIEW Status.

Common Utility Settings

The Common Utility settings relate to system wide configuration options that are active during both manual (MANU) and automatic (AUTO) test modes.

To access this menu ensure the Sentinel is in VIEW status and press the UTILITY key to enter the Common Utility Menu.



The soft keys will give four options, Display settings (LCD), Buzzer settings (BUZZ), Interface settings (INTER) and Remote Control settings (CTRL).

Common Utility – Display Options

Press the soft key labelled LCD to configure both the contrast and brightness of the LCD display.

Use the UP/DOWN arrow keys to select between LCD Contrast and LCD Brightness and use the scroll wheel to set the desired level

LCD Contrast	1(Low) – 8(High)
LCD Brightness	BRIGHT, DARK

Once set press the EDIT/ SAVE buttons to confirm the chosen settings and return to VIEW status.

Common Utility – Buzzer Settings

Press the soft key labelled BUZZ, this will allow the Sentinel to be configured to make an audible notification for both PASS and FAIL judgements. The length of time the buzzer is active for can also be configured

Use the UP/DOWN arrow keys to select between Pass Sound and Fail Sound then use the scroll wheel to turn the buzzer on and set the timer.

Pass Sound	ON (0.2s – 999.9s), OFF
Fail Sound	ON (0.2s – 999.9s), OFF

When testing in Automatic mode the sound will only apply to the overall PASS/ FAIL condition and not for each test step

Once set press the EDIT/ SAVE buttons to confirm the chosen settings and return to VIEW status.

Common Utility – Interface Settings

Press the soft key labelled INTER to configure any remote control settings for the Sentinel. USB, RS-232 or the optional GPIB settings can be configured from the menu option

Use the scroll wheel to select the required interface type, USB, RS232 or GPIB.
If RS232 or GPIB are chosen use the UP/DOWN arrow keys to select Baud Rate or Address respectively. Use the scroll wheel to select the required baud rate or GPIB Address, ensuring that they match the host machine.

Baud	9600,19200,38400,57600,115200
GPIB Address	0-30

Common Utility – Control Settings

Press the soft key labelled CTRL to configure Sentinel control settings menu. From here Start Controls, Double Action, Key Lock and Interlock settings can be adjusted.

Start Control is used to determine how a test is started, and can be configured to start from the front panel (START / STOP buttons), from a remote controller or via the SIGNAL I/O Port.

Double Action is a safety feature designed to prevent accidentally starting as test. When double action is enabled instead of pressing Start to begin the test, an operator must firstly press STOP followed by START within 500ms.

Key Lock disables the front panel keys from changing the test number, test mode or parameters. Only the Utility key and any keys required for testing purposes remain active.

The interlock function is a safety feature that prevents a test running unless the interlock pins on the signal I/O port connector are shorted. The supplied interlock key can be used for this purpose.

Once the CTRL soft key has been pressed, use the UP/DOWN arrow keys to select the required menu option; Start Ctrl, Double Action, Key Lock, or INTERLOCK.

Use the scroll wheel to select the required setting for the chosen menu item

Start Ctrl	FRONT PANEL, REMOTE CONNECT, SIGNAL IO
Double Action	ON, OFF
Key Lock	ON, OFF
INTERLOCK	ON, OFF

Press EDIT / SAVE to store the settings and return to VIEW status.

8.0 External Control Options

This section describes how to use the Remote Terminal Connection and the Signal I/O port.

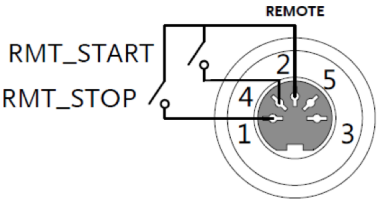
Remote Terminal

The remote terminal connector is a standard 5-Pin DIN terminal, suitable for a remote controller for remotely sending START and STOP conditions to the Sentinel.

If configured to use the remote terminal (Page 53) please note that the Sentinel can only be started using the remote terminal, however the Stop button on the main panel can still be used to stop tests.

Remote Terminal Pin Configuration

The following diagram and table indicates the Pin configuration for the Remote Terminal and



Pin No.	Pin Name	Description
1	RMT_STOP	Remote Stop Signal
2	COM	Common Line
3		Not Used
4	RMT_START	
5		Not Used

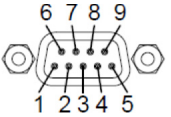
Signal Properties	
High Level Input Voltage	2.4-3.3V
Low Level Input Voltage	0 - 0.8V
Input Period	Minimum of 1ms

Signal I/O Port

The Signal I/O port has three main functions, the Interlock, Remotely Start and Stop for tests and test status monitoring.

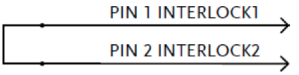
The supplied interlock key already has the required pins shorted together. Ensure the Interlock function is enabled to use this feature. Tests will only start when the interlock is in place and the pins shorted.

The Signal I/O port uses a DB-9 pin female connector. The pin configuration diagram is shown below.

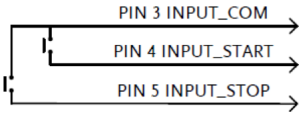


Pin No.	Pin Name	Description
1	INTERLOCK1	When the INTERLOCK is set to ON, a test will only begin when both pins are shorted
2	INTERLOCK2	
3	INPUT_COM	Common input line
4	INPUT_START	Start Signal Input
5	INPUT_STOP	Stop Signal Input
6	OUTPUT_TEST	Indicates a test is in progress
7	OUTPUT_FAIL	Indicates a test has failed
8	OUTPUT_PASS	Indicates a test has passed
9	OUTPUT_COM	Common Output line

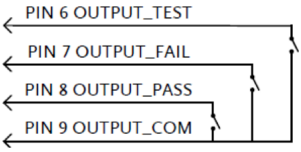
Interlock Connection



Input Connection



Output Connection



Input Signal Properties	
High Level Input Voltage	5V-32V
Low Level Input Voltage	0V-1V
Low Level Input Current	Maximum of -5mA
Input Period	Minimum of 1mS
Output Signal Properties	
Output Type	Relay form A
Output Rated Voltage	30VDC
Maximum Output Current	0.5A

If using the Signal I/O port to start and stop tests, firstly ensure the start control is set to SIGNAL I/O. See page 53 for details.

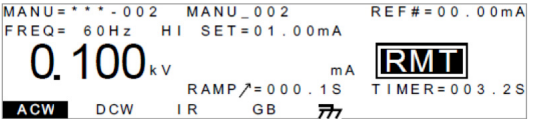
To start testing firstly ensure the control short INPUT_STOP and INPUT_COM for a minimum of 1ms to put the Sentinel into READY status. Followed by shorting INPUT_START and INPUT_COM for a minimum of 1ms, this will begin the test.

To stop testing at any point, the Front Panel STOP button can be used, alternatively short INPUT_STOP and INPUT_COM for a minimum of 1ms.

9.0 Remote Control

The following section describes the basic configuration of the Sentinel based on IEEE488.2 commands. The remote interface supports USB, RS232 and GPIB (Option). To enable any Remote Control method, use instructions provided on page 53.

When placed into Remote Control mode the Sentinel will change Status to display RMT as below;



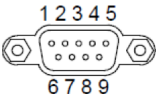
Whilst in remote control mode, all panel keys on the Sentinel are disabled, with the exception of the STOP button.

To exit Remote Control mode, simply press the stop button to return to READY status. From here, either Press MANU/AUTO button to return to VIEW status or press the START button to enter TEST Status.

Interface Configuration – RS232

Connection Type	Null Modem Cable
Baud Rate	9600, 19200, 38400, 57600, 115200
Parity	None
Data Bits	8
Stop Bit	1
Flow Control	None

PC Side		Sentinel Side	
DB9 Pin	Signal	Signal	DB9 Pin
2	RxD	TxD	2
3	TxD	RxD	3
5	GND	GND	5



Ensure the interface type is set to RS232 from the Common Utility Menu.

Interface Configuration - USB

When USB is selected for remote control, an RS232 port is simulated. Check the Device Manager within Windows for baud rate and RS232 settings, following the configuration for RS232 as above

PC Side Connector	TypeA, Host
Sentinel Side	Rear Panel Type A
USB Class	CDC (Communication Device Class)

Ensure the interface type is set to USB from the Common Utility Menu.

GPIB Configuration

The GPIB Connection is an optional accessory, please contact your Seaward representative for details.

GPIB Address	0-30

Ensure the interface type is set to GPIB from the Common Utility Menu.

USB / RS232 Remote Control Functionality Check

Invoke a terminal application such as Hyper Terminal. To check the COM port number and other settings, see the Device Manager in the PC.

Run this query command via the terminal after the Sentinel has been configured for USB or RS232 remote control;

*idn?

This should return the Model number, Serial number, and Firmware version in the following format:

Sentinel XXX, XXXXXXXXXXXX, V1.00

^j can be used as the terminal character when entering the queries/commands from a terminal application.

Command Syntax

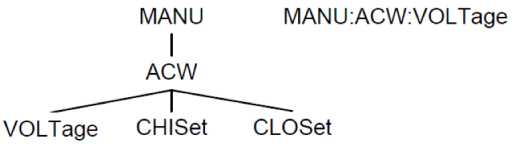
Compatible Standard

IEEE488.2 Partial compatibility
SCPI, 1999 Partial compatibility

Command Structure

SCPI commands follow a tree-like structure, organized into nodes. Each level of the command tree is a node. Each keyword in an SCPI command represents each node in the command tree. Each keyword (node) of an SCPI command is separated by a colon (:).

For example, the diagram below shows an SCPI sub-structure and a command example.



Command types

There are a number of different instrument commands and queries. A command sends instructions or data to the unit and a query receives data or status information from the unit.

Setting - A single or compound command with/ without a Parameter

Example MANU:STEP 1

Query - A query is a simple or compound command followed by a question mark (?). A parameter (data) is returned.

Example MANU:ACW:VOLTage?

Command Forms

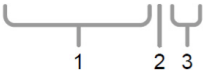
Commands and queries have two different forms, long and short. The command syntax is written with the short form of the command in capitals and the remainder (long form) in lower case.
The commands can be written in capitals or lower-case, just so long as the short or long forms are complete. An incomplete command will not be recognized.

Below are examples of correctly written commands.

Long form SYSTem:BUZZer:KEYSound
SYSTEM:BUZZER:KEYSOUND
system:buzzer:keysound

Short form SYST:BUZZ:KEYS
syst:buzz:keys

Command Format



1. Command Header
2. Space
3. Parameter

Parameters

Type	Description	Example
<Boolean>	Boolean Logic	0,1
<NR1>	Integers	0,1,2,3
<NR2>	Decimal Integers	0.1,3.14,8.5
<NR3>	Floating Point	4.5e-1, 8.25e+1
<NRf>	Any of NR1,2,3	1,1.5,4.5e-1
<string>	ASCII Text String	TEST_NAME

Message Terminator

CR,LF Carriage Return, Line feed Code

Commands

The following section describes and gives examples of the Commands that can be used with the Sentinel.

System Commands

The System Commands and associated page numbers for instructions are as follows;

SYSTem:LCD:CONTrast

This command sets the contrast of the LCD display from 1(Low) to 8 (Bright)

Syntax	SYSTem:LCD:CONTrast <NR1>	
Query syntax	SYSTem:LCD:CONTrast ?	
Parameter / Return Parameter	<NR1>	1 - 8
Example	SYSTem:LCD:CONTrast 5	
Sets the display Contrast to 5		

SYSTem:LCD:BRIGhtness

This command sets the brightness of the LDC display from 1(dark) to 2(bright).

Syntax	SYSTem:LCD:BRIGhtness <NR1>	
Query syntax	SYSTem:LCD:BRIGhtness ?	
Parameter / Return Parameter	<NR1>	1, 2
Example	SYSTem:LCD:BRIG 2	
Sets the display brightness to bright		

SYSTem:BUZZer:PSOUND

This command turns the buzzer sound on or off for a PASS judgement.

Syntax	SYSTem:BUZZer:PSOUND {ON/OFF}	
Query syntax	SYSTem:BUZZer:PSOUND ?	
Parameter / Return Parameter	<string>	ON or OFF
Example	SYST:BUZZ:PSOUND ON	
Turns the Buzzer on for PASS judgements		

SYSTem:BUZZer:FSOUND

This command turns the buzzer sound on or off for a FAIL judgement.

Syntax	SYSTem:BUZZer:FSOUND{ON/OFF}	
Query syntax	SYSTem:BUZZer:FSOUND ?	
Parameter / Return Parameter	<string>	ON or OFF
Example	SYST:BUZZ:FSOUND ON	
Turns the Buzzer on for FAIL judgements		

SYSTem:BUZZer:PTIMe

This command sets the time the buzzer is sounded for under a PASS judgement

Syntax	SYSTem:BUZZer:PTIMe <NR2>	
Query syntax	SYSTem:BUZZer:PTIMe ?	
Parameter / Return Parameter	<NR2>	0.2-999.9
Example	SYST:BUZZ:FTIM 1.5	
Turns the Buzzer on for 1.5 seconds if test is a FAIL		

SYSTem:BUZZer:FTIMe

This command sets the time the buzzer is sounded for under a FAIL judgement

Syntax	SYSTem:BUZZer:FTIMe <NR2>	
Query syntax	SYSTem:BUZZer:FTIMe ?	
Parameter / Return Parameter	<NR2>	0.2-999.9
Example	SYST:BUZZ:FTIM 1.5	
Turns the Buzzer on for 1.5 seconds if test is a FAIL		

SYSTem:ERRor

This query returns any errors in the output buffer. See the below table for error codes and descriptions.

Syntax	SYSTem:ERRor ?	
Parameter / Return Parameter	<string>	Error Code and Description
Example	SYST:ERR ?	
Returns “0,No Error” as the message if no error occurs		

Error Code	Description	Error Code	Description
0	No Error	30	Voltage Setting Error
20	Command Error	31	Current Setting Error
21	Volume Error	32	Current HI SET Error
22	String Error	33	Current LO SET Error
23	Query Error	34	Resistance HI SET Error
24	Mode Error	35	Resistance LO SET Error
25	Time Error	36	REF Setting Error
26	DC Over 50W Sentinel 200 or 100W Sentinel 500/501	37	Frequency Setting Error
		38	ARC Setting Error
		39	RAMP Time Setting Error
27	GBV > 5.4V	40	TEST Time Setting Error

SYSTem:GPIB:VERSion

This query questions the state of the GPIB connector

Syntax	SYSTem:GPIB:VERSion ?	
Return Parameter	<string>	Returns the GPIB version as a string “GPIB,V1.00” or “No GPIB Connected” if it does not detect a connected / configured device
Example	SYST:GPIB:VERS ?	
Returns the GPIB version if connected		

9.2 Function Commands

FUNCtion:TEST

This commands turns the currently selected test (output) on or off. When HOLD is displayed on the screen during AUTO tests, use the FUNCtion:TEST command to move on to the next step.

Setting the FUNCtion:TEST command to OFF at the end of a test will also temporarily turn the PASS/FAIL buzzer sound off.

Syntax	FUNCtion:TEST {ON/OFF}	
Query syntax	FUNCtion:TEST ?	
Parameter	ON	Turns the Test On
	OFF	Turns the Test Off
Return Parameter	TEST ON	Test is On
	TEST OFF	Test is Off
Example	FUNC:TEST ON	
Turns the test output On		

MEASure<x>

The Measure command Returns the test parameters & results of the tester in either MANU or AUTO mode. MANU mode: Returns the test parameters & results of a MANU test.AUTO mode: Returns the test parameters & results of the selected step (1-16) of the AUTO test. Return parameters: function, judgment/status, test voltage, test current/resistance, test time (time of completed test) or ramp time (elapsed time of test that has not been completed).

Query syntax	MEASure<x> ?	
Parameter (MANU mode)		No parameter required in MANU mode
Parameter (AUTO mode)	<x>	<NR1> 1-16. Step Number
Return Parameter	<string>	Returns the test status of the test in the following format: Function, Judgement or Status, Test Voltage, Test Current or Resistance, Test Time or Ramp time
	Function	ACW,DCW,IR,GB
	Judgement / Status	PASS, FAIL, VIEW
	Test Voltage	Voltage & Unit
	Test Current / Resistance	Current & Unit Resistance & Unit
Example (MANU)	MEAS ? >ACW, FAIL, 0.024kV, 0.023mA, R=0.002S	
Returns the test results of the current test		
Example (AUTO)	MEAS5 ? >DCW, FAIL, 0.124kV, 0.023mA, R=0.004S	
Returns the test results of Step 10 of the current AUTO test		

MAIN:FUNCtion

This command changes the Test mode between AUTO and MANU modes.

Syntax	MAIN:FUNCtion {MANU/AUTO}	
Query syntax	MAIN:FUNCtion ?	
Parameter / Return Parameter	MANU	Enter MANU Mode
	AUTO	Enter AUTO Mode
Example	MAIN:FUNC MANU	
Sets the tester to MANU mode		

Manual Test Commands

The following set of commands can be used when remotely configuring Manual (MANU) Tests.

MANU:STEP

Sets the MANU test number

Syntax	MANU:STEP <NR1>	
Query syntax	MANU:STEP ?	
Parameter / Return Parameter	<NR1>	0 - 100
Example	MANU:STEP 25	
Sets the MANU test number to 25		

MANU:NAME

Sets or returns the test name for the selected manual test. The Sentinel must be in MANU mode before this command can be used. Note only alphanumeric characters (A-Z, a-z, 0-9) and the "_" underscore character can be used to set the name

Syntax	MANU:NAME <string>	
Query syntax	MANU:NAME ?	
Parameter / Return Parameter	<string>	10 Character String. First character must be a letter.
Example	MANU:NAME Test1	
Sets the MANU test name to "Test1"		

MANU:RTIMe

Sets or returns the Ramp Time for the test in seconds.

Note: A “TIME ERR” will result if the Ramp Time + Test Time is ≥ 240 seconds when the HI SET limit is over 30mA (Sentinel 200) or over 80mA (Sentinel 500/ 501). This applies to the ACW function only.

Syntax	MANU:RTIMe <NR2>	
Query syntax	MANU:RTIMe ?	
Parameter / Return Parameter	<NR2>	0.1-999.9 Seconds
Example	MANU:RTIMe 1.5	
Sets the ramp time to 1.5 seconds		

MANU:EDIT:MODE

Sets or returns the mode (ACW, DCW, IR, GB) of the selected manual test.

Syntax	MANU:EDIT:MODE {ACW/DCW/IR/GB}	
Query syntax	MANU:EDIT:MODE ?	
Parameter / Return Parameter	ACW DCW IR GB	AC Hipot Mode DC Hipot Mode Insulation Resistance Earth Bond Mode
Example	MANU:EDIT:MODE ACW	
Sets the Test Mode to AC Dielectric Withstand		

MANU:ACW:VOLTage

Sets or returns the ACW voltage in kV. The test must first be in ACW mode before this command can be used.

Syntax	MANU:ACW:VOLTage <NR2>	
Query syntax	MANU:ACW:VOLTage ?	
Parameter / Return Parameter	<NR2>	0.100-5.000 (kV)
Example	MANU:ACW:VOLT 1.2	
Sets the AC Dielectric Withstand Voltage to 1.2kV		

MANU:ACW:CHISet

Sets or returns the ACW HI SET current value in milliamps. The test must first be in ACW mode before this command can be used.

Syntax	MANU:ACW:CHISet <NR2>	
Query syntax	MANU:ACW:CHISet ?	
Parameter / Return Parameter	<NR2>	0.001-042.0 (Sentinel 200) 0.001-110 (Sentinel 500/501)
Example	MANU:ACW:CHISet 10	
Sets the AC Dielectric Withstand Hi Trip level to 10mA		

MANU:ACW:CLOSet

Sets or returns the ACW LO SET current value in milliamps. The test must first be in ACW mode before this command can be used.

The LO SET range must use the HI SET range. If all the digits in the LO SET range are outside the HI SET range, an error will be produced. All digits outside the HI SET range are ignored and will not be used.

For example:

HI SET value – 12.34
LO SET value1 – 0.005 = Error
LO SET value2 – 0.053 = No Error

In the example above LO SET value1 will produce an error as all digits are outside the range of HI SET. LO SET value2 will not produce an error, but will return 0.05, not 0.053.

Syntax	MANU:ACW:CLOSet <NR2>	
Query syntax	MANU:ACW:CLOSet ?	
Parameter / Return Parameter	<NR2>	0.001-041.9 (Sentinel 200) 0.001-109.9 (Sentinel 500/501)
Example	MANU:ACW:CLOSet 0.5	
Sets the AC Dielectric Withstand Low Trip level to 0.5mA		

MANU:ACW:TTIMe

Sets or returns the ACW test time in seconds. The test must first be in ACW mode before this command can be used.

Note: A “TIME ERR” will result if the Ramp Time + Test Time is ≥ 240 seconds when the HI SET limit is over 30mA (Sentinel 200) or over 80mA (Sentinel 500/501). This applies to the ACW function only.

In special MANU mode, the TIMER can be turned off.

Syntax	MANU:ACW:TTIMe {<NR2>/OFF}	
Query syntax	MANU:ACW:TTIMe ?	
Parameter	<NR2> OFF	0.5 -999.9 seconds TIMER OFF (Special Manual mode 000 only)
Return Parameter	<NR2> OFF	0.5 -999.9 seconds TIMER is OFF (Special Manual mode 000 only)
Example	MANU:ACW:TTIM 20	
Sets the AC Dielectric Withstand test time to 20 seconds		

MANU:ACW:FREQuency

Sets or returns the ACW test frequency in Hz. The test must first be in ACW mode before this command can be used.

Syntax	MANU:ACW:FREQuency {50/60}	
Query syntax	MANU:ACW:FREQuency ?	
Parameter / Return Parameter	50 60	50 Hz 60 Hz
Example	MANU:ACW:FREQ 50	
Sets the AC Dielectric Withstand test frequency to 50Hz		

MANU:ACW:REF

Sets or returns the ACW reference value in mA. The test must first be in ACW mode before this command can be used.
The ACW reference value must be less than the HI SET value. The ACW reference value must use the same range as the HI SET value.

Syntax	MANU:ACW:REF <NR2>	
Query syntax	MANU:ACW:REF ?	
Parameter / Return Parameter	<NR2>	0.000-041.9 (Sentinel 200) 0.000-109.9 (Sentinel 500/501)
Example	MANU:ACW:REF 0.01	
Sets the AC Dielectric Withstand reference to 0.01mA		

MANU:ACW:ARCCurrent

Sets or returns the ACW ARC current value in mA. ARC must be enabled before the ARC current can be set. The test must first be in ACW mode before this command can be used.

ARC current uses the same range as the HI SET value. The ARC current is limited to 2X the HI SET value.

Syntax	MANU:ACW:ARCCurrent <NR2>	
Query syntax	MANU:ACW:ARCCurrent ?	
Parameter / Return Parameter	<NR2>	1.000-080.0 Sentinel 200 2.000-200.0 Sentinel 500/501
Example	MANU:ACW:ARCC 0.04	
Sets the AC Dielectric Withstand ARC value to 0.04mA		

MANU:DCW:VOLTage

Sets or returns the DCW voltage in kV. The test must first be in DCW mode before this command can be used.

Note: A “DC Over 50W” error will result if the DCW Voltage X HI SET value is > 50 watts (Sentinel 200).
Note: A “DC Over 100W” error will result if the DCW Voltage X HI SET value is > 100 watts (Sentinel 500/501).

Syntax	MANU:DCW:VOLTage <NR2>	
Query syntax	MANU:DCW:VOLTage ?	
Parameter / Return Parameter	<NR2>	0.100 – 6.100 (kV)
Example	MANU:DCW:VOLT 4	
Sets the DC Dielectric Withstand Voltage to 4kV		

MANU:DCW:CHISet

Sets or returns the DCW HI SET current value in milliamps. The test must first be in DCW mode before this command can be used.

Note: A “DC Over 50W” error will result if the DCW Voltage X HI SET value is > 50 watts. (Sentinel 200)
Note: A “DC Over 100W” error will result if the DCW Voltage X HI SET value is > 100 watts (Sentinel 500/501)

Syntax	MANU:DCW:CHISet <NR2>	
Query syntax	MANU:DCW:CHISet ?	
Parameter / Return Parameter	<NR2>	0.001-011.0 (Sentinel 200) 0.001-021.0 (Sentinel 500/501)
Example	MANU:DCW:CHISet 3	
Sets the DC Dielectric Withstand Hi Trip level to 3mA		

MANU:DCW:CLOSet

Sets or returns the DCW LO SET current value in milliamps. The test must first be in DCW mode before this command can be used.

The LO SET range must use the HI SET range. If all the digits in the LO SET range are outside the HI SET range, an error will be produced. All digits outside the HI SET range are ignored and will not be used.

For example:

HI SET value – 12.34
LO SET value1 – 0.005 = Error
LO SET value2 – 0.053 = No Error

In the example above LO SET value1 will produce an error as all digits are outside the range of HI SET. LO SET value2 will not produce an error, but will return 0.05, not 0.053.

Syntax	MANU:DCW:CLOSet <NR2>	
Query syntax	MANU:DCW:CLOSet ?	
Parameter / Return Parameter	<NR2>	0.001-010.9 (Sentinel 200) 0.001-020.9 (Sentinel 500/501)
Example	MANU:DCW:CLOSet 0.5	
Sets the DC Dielectric Withstand Low Trip level to 0.5mA		

MANU:DCW:TTIMe

Sets or returns the DCW test time in seconds. The test must first be in DCW mode before this command can be used.

In special MANU mode, the TIMER can be turned off.

Syntax	MANU:DCW:TTIMe {<NR2>/OFF}	
Query syntax	MANU:DCW:TTIMe ?	
Parameter	<NR2> OFF	0.5 -999.9 seconds TIMER OFF (Special Manual mode 000 only)
Return Parameter	<NR2> OFF	0.5 -999.9 seconds TIMER is OFF (Special Manual mode 000 only)
Example	MANU:DCW:TTIM 20	
Sets the DC Dielectric Withstand test time to 20 seconds		

MANU:DCW:REF

Sets or returns the DCW reference value in mA. The test must first be in DCW mode before this command can be used.
The DCW reference value must be less than the HI SET value. The DCW reference value must use the same range as the HI SET value.

Syntax	MANU:DCW:REF <NR2>	
Query syntax	MANU:DCW:REF ?	
Parameter / Return Parameter	<NR2>	0.000-010.9 Sentinel 200 0.000-020.9 Sentinel 500/501
Example	MANU:DCW:REF 0.01	
Sets the DC Dielectric Withstand reference to 0.01mA		

MANU:DCW:ARCCurrent

Sets or returns the DCW ARC current value in mA. ARC must be enabled before the ARC current can be set. The test must first be in DCW mode before this command can be used.

ARC current uses the same range as the HI SET value. The ARC current is limited to 2X the HI SET value.

Syntax	MANU:DCW:ARCCurrent <NR2>	
Query syntax	MANU:DCW:ARCCurrent ?	
Parameter / Return Parameter	<NR2>	1.000-20.00 Sentinel 200 2.000-040.0 Sentinel 500/501
Example	MANU:DCW:ARCC 0.04	
Sets the DC Dielectric Withstand ARC value to 0.04mA		

MANU:IR:VOLTage

Sets or returns the DCW voltage in kV. The test must first be in IR mode before this command can be used.

Syntax	MANU:IR:VOLTage <NR2>	
Query syntax	MANU:IR:VOLTage ?	
Parameter / Return Parameter	<NR2>	0.05 –1 (kV)
Example	MANU:IR:VOLT 0.5	
Sets the IR Voltage to 500V		

MANU:IR:RHISet

Sets or returns the IR HI SET current value in GΩ. The test must first be in IR mode before this command can be used.

Syntax	MANU:IR:RHISet <NR1>	
Query syntax	MANU:IR:RHISet ?	
Parameter / Return Parameter	<NR2> NULL	Format A: 0.002-50.00 (Unit GΩ) Format B: 0.002G-50.00G Format C: 2M-50000M Sets the HI Set value to ∞
Example	MANU:IR:RHIS 0.100	
Sets the IR Hi Trip to 0.1GΩ		

MANU:IR:RLOSet

Sets or returns the IR LO SET current value in GΩ. The test must first be in IR mode before this command can be used. The LO SET value must be less than the HI SET Value.

Syntax	MANU:IR:RLOSet <NR1>	
Query syntax	MANU:IR:RLOSet ?	
Parameter / Return Parameter	<NR2>	Format A: 0.001-50.00 (Unit GΩ) Format B: 0.001G-50.00G Format C: 1M-50000M
Example	MANU:IR:RLOS 0.010	
Sets the IR LO Trip to 10MΩ		

MANU:IR:TTIMe

Sets or returns the IR test time in seconds. The test must first be in IR mode before this command can be used.

Syntax	MANU:IR:TTIMe <NR2>	
Query syntax	MANU:IR:TTIMe ?	
Parameter / Return Parameter	<NR2>	1.0 -999.9 seconds
Example	MANU:IR:TTIM 5.0	
Sets the IR test time to 5 seconds		

MANU:IR:REF

Sets or returns the IR reference value in GΩ. The test must first be in IR mode before this command can be used.
The reference value must be less than the HI SET value.

Syntax	MANU:IR:REF <NR1>	
Query syntax	MANU:IR:REF ?	
Parameter / Return Parameter	<NR1>	Format A: 0-50.00 (unit =GΩ) Format B: 0G -50.00G Format C: 0M – 50000M
Example	MANU:IR:REF 0.900	
Sets the IR reference to 900MΩ		

MANU:GB:CURRent

Sets or returns the Earth Bond Current (GB) current in A. The test must first be in GB mode before this command can be used.

Syntax	MANU:GB:CURRent <NR2>	
Query syntax	MANU:GB:CURRent ?	
Parameter / Return Parameter	<NR2>	3.00 – 33.00
Example	MANU:GB:CURR 25.00	
Sets the GB Current to 25A		

MANU:GB:RHISet

Sets or returns the GB HI SET current value in mΩ. The test must first be in GB mode before this command can be used.

Syntax	MANU:GB:RHISet <NR2>	
Query syntax	MANU:GB:RHISet ?	
Parameter / Return Parameter	<NR2>	0.001-650.0
Example	MANU:GB:RHIS 100.0	
Sets the GB Hi Level to 100 mΩ		

Note: If the (GB current x HI SET resistance) > 5.4V, then an error will be generated (“GBV > 5.4V”).

MANU:GB:RLOSet

Sets or returns the GB HI SET current value in mΩ. The test must first be in GB mode before this command can be used. The LO SET value must be less than the HI SET Value.

Syntax	MANU:GB:RLOSet <NR2>	
Query syntax	MANU:GB:RLOSet ?	
Parameter / Return Parameter	<NR2>	0.000-649.9
Example	MANU:GB:RLOS 50	
Sets the GB LO Trip to 50mΩ		

MANU:GB:TTIMe

Sets or returns the GB test time in seconds. The test must first be in GB mode before this command can be used.

Syntax	MANU:GB:TTIMe <NR2>	
Query syntax	MANU:GB:TTIMe ?	
Parameter / Return Parameter	<NR2>	0.5-999.9 seconds
Example	MANU:GB:TTIM 1.0	
Sets the GB test time to 1.0 seconds		

MANU:GB:FREQuency

Sets or returns the GB test frequency in Hz. The test must first be in GB mode before this command can be used.

Syntax	MANU:GB:FREQuency {50/60}	
Query syntax	MANU:GB:FREQuency ?	
Parameter / Return Parameter	50 60	50 Hz 60 Hz
Example	MANU:GB:FREQ 50	
Sets the GB test frequency to 50Hz		

MANU:GB:REF

Sets or returns the GB reference value in mΩ. The test must first be in GB mode before this command can be used.
The reference value must be less than the HI SET value.

Syntax	MANU:GB:REF <NR2>	
Query syntax	MANU:GB:REF ?	
Parameter / Return Parameter	<NR2>	0.000-649.9
Example	MANU:GB:REF 090.0	
Sets the GB reference to 90mΩ		

MANU:GB:ZEROCHECK

Performs the zero check function. The test must first be in GB mode and in the READY status before this command can be used.

Syntax	MANU:GB:ZEROCHECK {ON/OFF}	
Query syntax	MANU:GB:ZEROCHECK ?	
Parameter / Return Parameter	ON OFF	Zero Function is active Zero Function is turned off
Example	MANU:GB:ZEROCHECK ON	
Activates the zero check function		

MANU:UTILity:ARCMode

Sets or returns the ARC mode status for the current test.

The ARC mode cannot be set for both IR and GB test functions.

Syntax	MANU:UTILity:ARCMODE {OFF/ ON_CONT / ON_STOP}	
Query syntax	MANU:UTILity:ARCMode ?	
Parameter / Return Parameter	OFF ON_CONT ON_STOP	ARC Mode is disabled ARC Mode is set to ON and Continue ARC Mode is set to ON and Stop
Example	MANU:UTILity:ARCM ON_STOP	
Turns the ARC Mode on and tests will stop if activated		

MANU:UTILity:PASShold

Sets or returns the PASS HOLD setting for the current test.

Syntax	MANU:UTILity:PASShold {OFF/ON}	
Query syntax	MANU:UTILity:Passhold ?	
Parameter / Return Parameter	OFF ON	Turns PASS HOLD Off Turns PASS HOLD On
Example	MANU:UTIL:PASS ON	
Turns the PASS MODE to ON		

MANU:UTILity:FAILmode

Sets or returns the Failure Mode setting for the current test.

Syntax	MANU:UTILity:FAILmode {CONT/HOLD/STOP}	
Query syntax	MANU:UTILity:Failmode ?	
Parameter / Return Parameter	CONT HOLD STOP	Sets/Returns the fail mode as continue Sets/Returns the fail mode as hold Sets/Returns the fail mode as stop
Example	MANU:UTIL:FAIL STOP	
Sets the fail mode to stop, Tests will be stopped after a fail		

MANU:UTILity:MAXHold

Sets or returns the Failure Mode setting for the current test.

Syntax	MANU:UTILity:MAXHold {ON/OFF}	
Query syntax	MANU:UTILity:MAXHold ?	
Parameter / Return Parameter	OFF ON	Turns MAX HOLD off Turns MAX HOLD on
Example	MANU:UTIL:MAXH ON	
Turns the MAX HOLD feature on		

MANU:UTILity:GROUNDMODE

Sets or returns the Grounding Mode for the current test.

The Ground Mode cannot be turned on for IR and GB Test functions.

Syntax	MANU:UTILity:GROUNDMODE {ON/OFF}	
Query syntax	MANU<x>:EDIT:SHOW ?	
Parameter / Return Parameter	OFF ON	Turns GROUND MODE off Turns GROUND MODE on
Example	MANU:UTIL:GROUNDMODE ON	
Turns the GROUNDMODE feature on		

MANU<x>:EDIT:SHOW

Return the test parameters for a saved manual test.

Query syntax	MANU<x>:EDIT:SHOW ?	
Return Parameter	<x>	<NR1> 000 -100 Manual Test Number
	<string>	Returns a string in the following format; Test Function, Test Voltage, HI SET value, LO SET value, Ramp Time, Test Time
Example	MANU1:EDIT:SHOW ?	
Returns the test parameters of manual test number 1 in the following format > ACW,0.100kV,H=01.00mA,L=00.00mA,R=000.1S, >T=001.0S.		

Sweep Commands

The following set of commands can be used in remote control mode for the Sweep Function. Please note this feature is not available on the Sentinel 200.

SWEEP:DATA:STATus

Returns the sweep mode, the voltage and current settings and the number data points that were used in the last sweep. There can be a maximum of 190 data points, depending on the testing time.

The data is returned as a string in the following format:

SWEEP MODE,VSET,ISET,Get Data[#data points].

Query syntax	SWEEP:DATA:STATus ?	
Return Parameter	<string>	Returns a string in the following format; SWEEP MODE, VSET+unit, ISET+units, Get Data =number of data points
Example	SWEEP:DATA:STATus ?	
Returns the sweep information >ACW,V=0.108kV,HI=10.96 mA ,Get Data=011		

SWEEP<X>:DATA:SHOW

Returns the data associated with a sweep graph. Data can be returned in one of two ways; either all the data can be returned or only the data at a particular point in time.
The test points are evenly distributed. There can be up to 190 data points.
If only the data from a single point is returned then the data is returned in the following format*:
DATA POINT, VSET, ISET, TIME, CR+LF

If all the data, for the all the points, is returned then the data is returned in the following format*:

ACW MODE,CR+LF
No.,V(kV),I(mA), T(S) ,CR+LF
001,0.071,0.032,0000.1,CR+LF
002,0.111,0.047,0000.2,CR+LF
……
013,0.601,0.215,0001.3,CR+LF
END

*Where CR+LF is a carriage return and line feed code. Time is in seconds.

Query syntax	SWEEP<x>:DATA:SHOW ?	
Return Parameter	<x>	<NR1> 1-190 (single data point) <NR1> 0 (all data points)
Example	SWEEP10:DATA:SHOW ?	
Returns the sweep information at point 10 >010,0.106,00.00,0001.0, CR+LF		

SWEEP:GRAPh:SHOW

Turns the Sweep graph on or off on the Sentinel 500 /501.

Syntax	SWEEP:GRAPh:SHOW {ON/OFF}	
Query syntax	SWEEP:GRAPh:SHOW ?	
Parameter / Return Parameter	OFF ON	Turns the Sweep Graph off Turns the Sweep Graph on
Example	SWEEP:GRAPh:SHOW ON	
Displays the sweep graph on the LCD display		

SWEEP :GRAPh:LINE

Sets or returns which lines are shown on the Sweep Graph.

Syntax	SWEEP:GRAPh:LINE {0/1/2/3}	
Query syntax	SWEEP:GRAPh:LINE ?	
Parameter / Return Parameter	0 1 2 3	Turns ALL lines off / all lines are off Displays the graph line for the primary item, e.g. V for ACW Displays the graph line for the secondary item, e.g. I for ACW Turn all Lines on / All lines are on
Example	SWEEP:GRAPh:SHOW ON	
Displays the sweep graph on the LCD display		

SWEEP:STARt:TIME

Sets or returns the start time (STA.t) of the sweep graph in milliseconds.
This setting will also set what the time will be for the first point for the sweep data that is returned in the SWEEP:DATA:SHOW query

Syntax	SWEEP:STARt:TIME <NR2>	
Query syntax	SWEEP:STARt:TIME ?	
Parameter / Return Parameter	<NR2>	0.1-1999.8 seconds
Example	SWEEP:STARt:TIME 500.0	
Sets the Sweep Start time to 500 seconds		

Auto Mode Commands

The following set of commands are used when remote controlling the Automatic Test mode.

AUTO:STEP

Sets or queries the AUTO number (Automatic Test Sequence Number)

Syntax	AUTO:STEP <NR1>	
Query syntax	AUTO:STEP ?	
Parameter / Return Parameter	<NR1>	1 - 100
Example	AUTO:STEP 11	
Sets the current AUTO number to 11		

AUTO<x>:PAGE:SHOW

Returns the Page View of the selected automatic test in the following format:

step1:MANU number, step2: MANU number, step3….etc.

Query syntax	AUTO<x>:PAGE:SHOW ?	
Return Parameter	<x>	1 - 100
Example	AUTO1:PAGE:SHOW ?	
Shows the Page View for AUTO Test 1 >01:011 ,02:004 ,03:003 ,04:014 , >05:015 ,06:020* ,07:012 ,08:018 , >09: ,10: ,11: ,12: , >13: ,14: ,15: ,16: ,		

AUTO:PAGE:MOVE

Moves the source step to a desired location

Syntax	AUTO:PAGE:MOVE <V1>,<V2>	
Parameter	<V1> <V2>	1-16 (Source Step) 1 -16 (Destination Step)
Example	AUTO1:PAGE:MOVE 2,5	
Moves the contents of Test Step 2 to Test Step 5		

AUTO:PAGE:SWAP

Swaps the source step with destination step.

Syntax	AUTO:PAGE:SWAP <V1>,<V2>	
Parameter	<V1> <V2>	1-16 (Source Step) 1 -16 (Destination Step)
Example	AUTO1:PAGE:MOVE 2,5	
Swaps the contents of Test Step 2 with Test Step 5		

AUTO:PAGE:SKIP

Skips the selected step when an AUTO test is performed. This is shown as an asterisk (*) when in the PAGE view.

Syntax	AUTO:PAGE:SKIP <NR1>,{ON/OFF}	
Parameter	<NR1> ON OFF	1-16 (Step Number) Skip the selected step Un-skip the selected step
Example	AUTO1:PAGE:SKIP 1,ON	
Skips step number one in the AUTO test		

AUTO:PAGE:DEL

Deletes the selected step from the AUTO test. The remaining steps move up to replace the deleted step.

Syntax	AUTO:PAGE:DEL <NR1>	
Parameter	<NR1>	1-16 (Step Number)
Example	AUTO1:PAGE:DEL 3	
Deletes the contents of step number 3		

AUTO:NAME

Sets or returns the AUTO name for the selected automatic test. The test must be in AUTO mode before this command can be used.

Note only alphanumeric characters (A-Z, a-z, 0-9) and the "_" underscore character can be used to set the AUTO test name.

Syntax	AUTO:NAME <string>	
Query syntax	AUTO:NAME ?	
Parameter / Return Parameter	<string>	10 Character String. First character must be a letter.
Example	AUTO:NAME Test1	
Sets the AUTO test name to "Test1"		

AUTO:EDIT:ADD

Add the selected MANU test to the current AUTO number.

Syntax	AUTO:EDIT:ADD <NR1>	
Parameter	<NR1>	1 -100
Example	AUTO:EDIT:ADD 7	
Adds MANU Test 7 to the current AUTO Test in the next available slot		

TESTok:RETurn

Allows “OK” to be displayed on the remote terminal when a test has stopped (PASS/FAIL or STOP). This applies for MANU and AUTO mode.

By default, TESTok:RETurn is set to OFF.

Syntax	TESTok:RETurn {ON/OFF}	
Query syntax	TESTok:RETurn ?	
Parameter / Return Parameter	ON OFF	Enables the OK message Disables the OK message
Example	TEST:RET:OFF	
Disables the message		

*SRE

AUTO MODE only. Use this command to get measurement step number at the current point in time during AUTO MODE testing.

Example: User can send command "*SRE" to GPT-9000 during AUTO mode.

Query syntax	*SRE ?	
Return Parameter	<NR1>	00 - 16
Example	*SRE	
>5 This indicates the current test step is number 5. Steps 1 – 4 have already been completed and the results for those steps can be retrieved.		

Common Commands

*CLS
*IDN
*RMTOFF

*CLS

The *CLS Command clears the internal registers
*IDN

This queries the model, serial number and firmware version of the Sentinel.

Query syntax	*IDN ?	
Return Parameter	<string>	Returns the instrument identification in the format shown in the example
Example	*IDN ?	
> Sentinel XXX, XXXXXXXXX, V1.00		

*RMTOFF

This command can be used to terminate a remote session. When this command is used “RMT” will no longer be displayed on the front panel, indicating that remote mode has been terminated.

Special Functions

Interlock Key Open

This special function is not a command. When in remote mode, the Sentinel will send the message, “Inter Lock Key Open” if a test is started with INTERLOCK set to ON, but the interlock signal I/O pins are not shorted (either with the included interlock key or manually).

This special function is analogous to the “INTERLOCK OPEN” message that is displayed on the front panel under the same conditions

Error messages

The below are the possible error messages returned from the SYST:ERR? Query are listed below;

Error Code	Description
0x14	Command Error
0x15	Value Setting Error
0x16	String Setting Error
0x17	Query Error
0x18	MODE Setting Error
0x19	Time Error
0x1A	DC Over 50W Sentinel 200 Only
0x1A	DC Over 100W Sentinel 500/501
0x1B	GBV > 5.4V

10.0 Frequently Asked Questions

Why doesn't the tester turn on?

Ensure the power cord is connected. Ensure the line input is set to the correct line voltage. Check to make sure the fuse is not blown.

The panel keys are not working?

Ensure the tester is not in remote mode.

Ensure the tester is not in SIGNAL I/O or Remote Connect mode.

When I press the START button the tester will not start testing?

The tester must first be in the READY status before a test can be started. Ensure the tester displays READY before pressing the START button.

If "Double Action" is enabled, the START button must be pressed 0.5 seconds after the STOP button is pressed, otherwise the tester will not start testing.

If "Interlock" is enabled, the interlock key must be inserted into the signal I/O port on the rear before a test can be started.

Lastly, ensure that the Start Ctrl setting is correctly configured in the Common Utility menu. For example, to enable the START button to start a test, ensure that the Start Ctrl setting is set to FRONT PANEL

Why does the accuracy not match the specification?

Make sure the tester is powered on for at least 30 minutes within +15°C~+35°C. This is necessary to stabilize the unit to match the specification.

11.0 Error Messages

System Self Test

The following error messages or messages may appear on the Sentinel screen during the Start-Up initialization. If any of these error messages appear on the please contact the Seaward service department.

Error Code	Description
0x11	EEPROM1 Error
0x12	EEPROM1 Error
0x21	W-V Offset Error (W-V: ACW/DCW voltage)
0x22	W-I Offset Error (W-I: ACW/DCW current)
0x23	IR-I Offset Error
0x24	GB-I Offset Error

Test Errors

The following error messages or messages may appear on the Sentinel screen when configuring or running tests.

Error Messages	Description
TIME ERR	TIME ERR is displayed when HI SET ≥30.00mA~40.00mA (Sentinel 200 or (80.00mA ~100mA (Sentinel 500/501), and if the RAMP time and TEST TIME setting is > 240S during AC Dielectric Withstand tests
OVER 50W Sentinel 200	For DC Dielectric Withstand Tests, OVER 50W is displayed if the HI SET setting multiplied by the voltage is greater than 50W
OVER 100W Sentinel 500/501	For DC Dielectric Withstand Tests, OVER 100W is displayed if the HI SET setting multiplied by the voltage is greater than 100W
I ERR	For AC / DC Dielectric Withstand Tests, this message is shown when the current set is too high

Error Messages	Description
SHORT	Voltage is too low or there is not High Voltage output. Could be an indicator that the EUT is shorted.
V ERR	Indicates that an abnormal voltage has been detected when performing AC or DC Dielectric Withstand tests
V = 0	When performing an Earth Bond (GB) test the voltage is equal to 0. Check that the Sense or Source leads are not open.
R ERR	When performing an IR test, this message will be displayed if the voltage is too high or the resistance = 0Ω. Check to see whether the DUT or test lead is shorting. For Earth Bond test, this message indicates the resistance is too high.
I<SET	When performing an Earth Bond test this message indicates that the test current is too low. This could be an indication that the Source leads are open or poorly connected.
I>SET	For Earth Bond Tests, indicates the test current is too high.
R=0	This error message indicates that there is an error with the measured resistance. Could be due to incorrectly performed zero function. Perform this function again.
GBV OVER	Indicates that the Earth Bond voltage is greater that 5.4V.

12.0 Cleaning and Maintenance

Cleaning

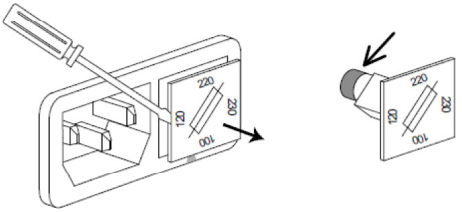
Use a soft cloth dampened in a solution of mild detergent and water. Do not use chemicals containing harsh material such as benzene, toluene, xylene and acetone.

Always disconnect the power cord before cleaning.

Replacing the Fuse

To replace the fuse, firstly ensure the Sentinel is powered off, then remove the power cord.

Using a flat screw driver, remove the fuse socket and replace the fuse in the fuse holder.



Ensure the correct line voltage is lined up with the arrow on the fuse holder, reinsert the fuse socket.

Input Voltage	Fuse Type
Sentinel 200	
100V/120V	T5A 250V
220V/230V	T2.5A 250V
Sentinel 200	
100V/120V	T10A 250V
220V/230V	T6.3A 250V

13.0 Service and Calibration

To maintain the specified accuracy of the measurement results, the instrument must be recalibrated at regular intervals by either the manufacturer or an authorised Seaward Service Agent. We recommend a recalibration period of one year.

For help or advice on Service and Calibration contact:

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