







Sentinel 150 series

Automatic switch mode battery chargers

Installation, Operation and Maintenance

This Manual Refers to the Following Models

	Standard models	UL recognised/listed models
Open frame models	SNTL1501205CDxx  SNTL1502405CDxx SNTL1501210CDxx	SNTLUL1501205CDxx  SNTLUL1502405CDxx  SNTLUL1501210CDxx
Enclosed models	ESNTL1501205CDxx  ESNTL1502405CDxx ESNTL1501210CDxx	ESNTLUL1501205CDxx  ESNTLUL1502405CDxx  ESNTLUL1501210CDxx ESNTLUL1501210CDxxNFPA

Note: "xx" above refers to battery type options specified on order: see pages 3 and 6 (DC Output calibration) for battery types/voltages.



For safe and correct use of these chargers, read and save the safety information that precedes the installation and operation instructions. This guide contains 8 pages (including this one). If any pages are missing, contact the battery charger supplier or manufacturer for replacement documentation.



Sentinel 150 (open-frame, with protective cover)
SNTL150 model shown



Enclosed Sentinel 150
ESNTLUL150 (left) and ESNTLUL150xxNFPA (right) models shown

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FM 28221 (Tulsa, OK - USA)
FM 29422 (UK)

Important Safety Information – Read and Save These Instructions

This manual contains important safety and operating instructions for all SNTL150, SNTLUL150, ESNTL150 & ESNTLUL150 models.

- Do not expose the battery charger to rain, snow or wet environments.
- The use of any attachment not recommended or sold by the battery charger manufacturer may result in risk of fire, electric shock or injury to persons.
- Do not operate the charger if it has received a sharp blow, been dropped, or otherwise damaged in any way: return to supplier.
- Do not disassemble the charger: return to supplier when service or repair is required. Incorrect re-assembly may result in a risk of electric shock, fire or faulty operation.

WARNING – RISK OF EXPLOSIVE GASES

WORKING IN THE VICINITY OF A LEAD ACID BATTERY IS DANGEROUS. BATTERIES GENERATE EXPLOSIVE GASES DURING NORMAL BATTERY OPERATION.

To reduce the risk of battery explosion, follow these instructions and those published by battery manufacturers and the manufacturer of any equipment you intend to use in the vicinity of the battery. Review cautionary marking on these products and any attached equipment.

PERSONAL PRECAUTIONS.

- (i) Someone should be within range of your voice or close enough to come to your aid when you work near a lead-acid battery.
- (ii) Have plenty of fresh water and soap nearby in case battery acid contacts skin, eyes or clothing.
- (iii) Wear complete eye protection and clothing protection. Avoid touching eyes whilst working near batteries.
- (iv) If battery acid contacts skin or clothing, wash immediately with soap and water. If acid enters eyes, immediately flood eyes with running cold water for at least 10 minutes and get immediate medical attention.
- (v) NEVER smoke or allow a spark or flame in vicinity of battery.
- (vi) Be extra cautious to reduce risk of dropping a metal tool on to the battery. It may spark or short-circuit the battery or other electrical part that may cause explosion.
- (vii) Remove personal metal items such as rings, bracelets, necklaces and watches when working with batteries. High power batteries can produce a short-circuit current high enough to weld a ring or the like to metal, causing a severe burns.
- (viii) Use the charger only for charging battery types as stated on the charger. Do not use the charger for charging dry-cell batteries that are commonly used with home appliances. These batteries may burst and cause injury to persons and damage to property.
- (ix) NEVER CHARGE A FROZEN BATTERY

PRIOR TO INSTALLATION /COMMISSIONING

- Clean battery terminals. Be careful to keep corrosion from coming into contact with eyes.
- Add distilled water in each cell until the battery acid reaches a level specified by battery manufacturer. This helps purge excessive gas from the cell. Do not overfill. For a battery without cell caps, carefully follow manufacturer's recharging instructions.
- Study all battery manufacturer's specific precautions, such as removing or not removing cell caps while charging and recommended rates of charge.
- Determine the voltage of battery by referring to engine manual and ensure this matches the charger's output voltage.

CHARGER LOCATION AND CONNECTION

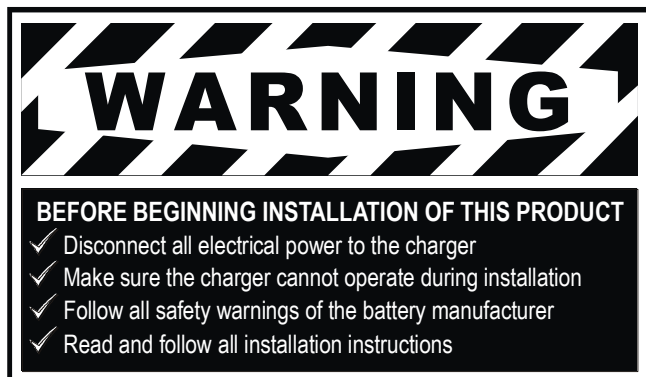
- Never place the charger directly above battery being charged: gases from the battery will corrode and damage the charger.
- Never allow battery acid to drip on to the charger when reading specific gravity or filling battery.
- Do not operate the charger in a closed-in area or restrict ventilation in any way.
- The battery charger should be connected to a grounded, metal, permanent wiring system; or an equipment-grounding conductor should be run with circuit conductors not connected to equipment-grounding terminal on the battery charger.
- Connections to the battery charger should comply with all local codes and ordinances.
- Open frame SNTL models – these chargers should be installed so that they are not likely to be contacted by people.
- Wiring for the AC supply input, DC charge output and DC control (e.g. alarm output) circuits must be physically separate, e.g. using separate wire harnesses and cable gland access. For AC input and ground leads, use 1mm²/17 AWG or larger wire conductors rated to 90°C/194°F. For DC (charger to battery) leads, use 2.5mm²/13 AWG or larger wire on standard charger models, and 4mm²/11 AWG or larger wire on NFPA models.

For safe and correct use of the charger, follow the following steps. Should you have any problems or the unit does not function as expected, consult our troubleshooting guide at the end of these instructions.

- Visually inspect unit for any signs of damage, caused by transport or storage.
- Mount the charger as outlined above, paying attention to ambient temperature.
- Ensure the mains AC supply is isolated, and ensure the correct rated input voltage before connection.
- Ensure the charger is earthed at the marked earth terminal/stud.
- Check batteries in accordance with the manufacturer's guidelines.
- Check that the charger is correct for battery type and voltage.
- Connect the charger to the batteries, observing correct polarity and ensuring a secure and tight connection.
- Switch on the charger at the mains AC power supply.

General Information

Please read the following before installing. A visual inspection of this product for damage during shipping is recommended before installation. It is your responsibility to ensure that qualified mechanical and electrical technicians install this product. If in doubt, please contact your local Murphy or Enovation Controls representative.



The Sentinel 150 range provides automatic, current limited and voltage controlled charging of wet lead acid, VRLA or NiCd batteries. The units may be used in a wide range of industrial charging applications, including standby engines, pumps and generators.

Sentinel uses switch mode power supply technology to give a compact and lightweight construction, improved efficiency and low heat dissipation, wide supply voltage tolerance and low output ripple.

Sentinel chargers are available as an open-frame module (with protective cover) for surface or DIN rail mounting in an enclosed panel, or as a stainless steel, wall-mounted enclosure with DC charge ammeter (and voltmeter on NFPA models). Electrical connection of the AC supply, battery and control circuits is via screw terminal blocks.

Float charge operation

Sentinel operates an intelligent, multi-stage battery charge regime. In normal charging mode, the charger maintains the battery at a pre-calibrated float voltage (see table right), while supplying any additional DC load up to the specified current limit (see Specifications right).

When fully charged, a battery will only accept the charge required to replace internal losses (approx. 1mA per AH of battery). E.g. for a system with a 1 Amp standing load and a fully charged 50 AH lead acid battery, Sentinel will typically supply 1.05 Amps.

AutoBoost operation

All Sentinel 150 models include an AutoBoost feature. AutoBoost provides a temporary increase in output voltage, equalising the charge between cells and maximising battery life and capacity.

AutoBoost is triggered automatically when the battery falls below a preset voltage, or can be initiated manually (whatever the battery voltage) via a momentary switch input. Once the batteries have reached the boost voltage level, Sentinel reverts to normal float charge mode, preventing battery over-charge and gassing.

Temperature compensation

The optimum charge voltage for lead acid and NiCd batteries varies with ambient temperature. Sentinel can be configured to sense ambient temperature and automatically compensate the output charge voltage.

Configuration is by links on the circuit board: temperature compensation can be disabled, or enabled for use with a remote 'RTC' sensor (available separately as a standard 3 metre / 9.8 feet lead assembly, or other lengths to special order).

Alarm outputs

UL models include a self-diagnostic circuit charge fail / main AC fail relay output (switched positive contact), for driving a remote alarm or annunciator circuit.

Specifications

	(E)SNTL(UL) 1501205	(E)SNTL(UL) 1502405	ESNTLUL 1501210 xxNFPA
power supply:			
operating voltage range:			
standard (non-UL) models			95 – 265 V AC
UL approved models			95 – 250 V AC
operating frequency			47 – 63 Hz

DC charge output:

	12	24	12
nominal voltage	see DC output calibration table		
float / boost voltages	5	5	10
current limit			
line regulation		< 2%	
load regulation		< 2%	
output ripple		< 1%	

alarm outputs:

charge fail / mains AC failure (UL models only)	solid state relay (switched +DC), energised (+DC) during normal charge, de-energised (open circuit) during fault
low battery volts (NFPA models only):	solid state relay (volt free/dry SPNC contacts), energised (open) during normal charge, de-energised (closed) during fault
high battery volts (NFPA models only)	solid state relay (volt free/dry SPNO contacts), de-energised (open) during normal charge, energised (closed) during fault
current rating (all relays)	250mA max. @ 30 V DC (resistive load), UL class 2

general:

operating temperature	-20 to +60 °C / -4 to +140 °F
humidity	20% to 90% RH
dimensions	see Dimensions & Assembly
weights	see Dimensions & Assembly
electrical safety	2006/95/EC (EN 60065)
electromagnetic compatibility	2004/108/EC (EN 61000-6-2, EN 61000-6-4)

UL approval:

All UL models:	BBGQ: UL1236, CSA 22.2 no 107.2
ESNTLUL1501210xxNFPA models only	BBHH: UL1236 SE

DC output calibration

Battery type:		model option code	float volts (V DC)	boost volts (V DC)
12V	Vented lead acid (6 cells)	LA	13.5	14.1
	Calcium-Calcium (6 cells)	CA	13.8	15.6
	VRLA, AGM (6 cells)	AGM	13.5	14.4
	VRLA, Gel (6 cells)	GEL	13.5	13.8
	NiCd (10 cells)	10NC	14.1	14.5
24V	Vented Lead acid (12 cells)	LA	27.0	28.2
	Calcium-Calcium (12 cells)	CA	27.6	31.2
	VRLA, AGM (12 cells)	AGM	27.0	28.8
	VRLA, Gel (12 cells)	GEL	27.0	27.6
	NiCd (18 cells)	18NC	25.6	26.1
	NiCd (20 cells)	20NC	28.2	29.0

Note: Calibration figures at 20 deg C. Output voltage will vary if temperature compensation is enabled – see Electrical Connection & Configuration section.

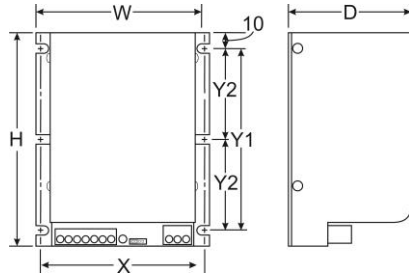
Enclosed NFPA models include two additional relay outputs (volt-free/dry contacts) for independent signalling of high and low battery voltage faults, and compliance with the NFPA 110 standard.

Dimensions and Assembly



CAUTION: Sentinel 150 chargers should be handled by the circuit board cover (SNTL models) or steel enclosure (ESNTL models). Care should be taken not to handle static sensitive components through exposed circuit boards and terminals.

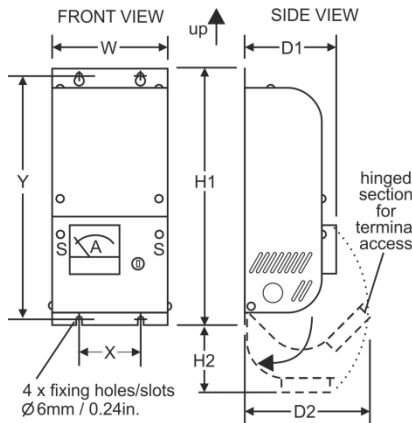
SNTL(UL)150xx models



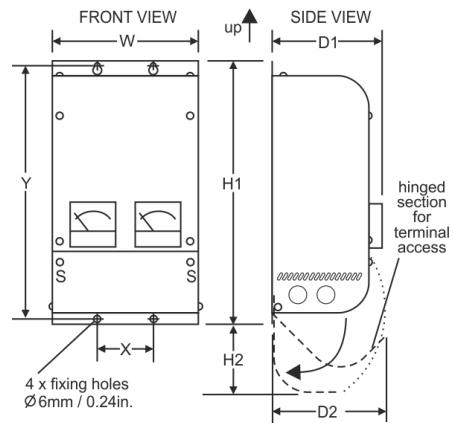
Overall:	
W	110 mm / 4.33 in.
H	135 mm / 5.31 in.
D	78 mm / 3.07 in.
Fixing holes:	
X	100 mm / 3.94 in.
Y1	115 mm / 4.53 in.
Y2	57.5 mm / 2.26 in.
Weight:	
	0.55 kg / 1.2 lb.

- These chargers are designed for mounting in a vertical plane inside an enclosed control panel or housing. Mounting orientation should be as shown above, with protective cover ventilation slots at the top & bottom, electrical connection terminals lowermost.
- For safe heat dissipation, mount Sentinel in the orientation shown, with a minimum air-gap clearance of 40mm/1.5 in. above/below and 25mm/1 in. at the sides. Consideration must be given to ventilation for proper heat dissipation.
- For surface mounting, use the 2 centre slots (Ø 6mm/0.24 in.) or 4 corner slots (Ø 6mm/0.24 in.). Ensure that the mounting studs/bolts/nuts/screws adequately support the charger, and are tightened sufficiently to not to become loose during normal use, e.g. due to engine/equipment vibration.
- Optional clip for DIN rail mounting (2 required for each charger), part number 045-0001.

ESNTL(UL)150xx models



ESNTLUL150xxNFPA models



	ESNTL(UL)150xx models	ESNTLUL150xxNFPA models
Overall:		
W	120 mm / 4.72 in.	165 mm / 6.50 in.
H1	267 mm / 10.51 in.	300 mm / 11.81 in.
H2	70 mm / 2.76 in.	80 mm / 3.15 in.
D1	95 mm / 3.74 in.	125 mm / 4.92 in.
D2	130 mm / 5.12 in.	
Fixing holes:		
X	63.5 mm / 2.50 in.	
Y	255 mm / 10.04 in.	285.5 mm / 11.25 in.
Weight:		
	1.25 kg / 2.8 lb.	2.0 kg / 4.4 lb.

- These chargers are designed for wall or frame mounting in the orientation shown above, with enclosure air vents uppermost. For safe heat dissipation, allow a minimum air-gap clearance of 40mm/1.5 in. above/below and 25mm/1 in. at the sides. Consideration must be given to ventilation for proper heat dissipation.
- Mounting is via the enclosure back-plate, using 4 holes/slots (Ø 6mm/0.24in.) on the upper and lower edges. Ensure that the mounting studs/bolts/nuts/ screws adequately support the charger weight, and are tightened sufficiently to not to become loose during normal use, e.g. due to engine/equipment vibration.
- Access to the electrical connection terminals is via hinged lower sections on the front facia. Remove the 2 x securing screws (marked S above), and then rotate the hinged sections through 90 degrees.
- Electrical cable entry is via knock-outs on either side of the enclosure, which must be carefully removed from the enclosure sides. A suitable cable-gland (20mm/0.8in. diam.) must be used to prevent damage to cables and stop unwanted entry into the inner part of charger. Cable harnesses for DC charge output, DC control and AC supply input must be physically separated, e.g. using separate harnesses and case access ports: see 'wire harness separation' section on page 5.
- Connect the charger wiring as detailed in the following **Electrical Connection** section. When wiring is complete, and before using the charger, re-secure the hinged front section using the 2 fixing screws.

Electrical Connection & Configuration



WARNING: DANGER OF INJURY OR DEATH. During normal operation, Sentinel is connected to high voltage AC circuits. Before connection, disconnection or handling of these chargers, ensure isolation of all AC power supplies. Connection or disconnection with live wiring can also cause hazardous sparking and component damage.

Connection terminals (general)

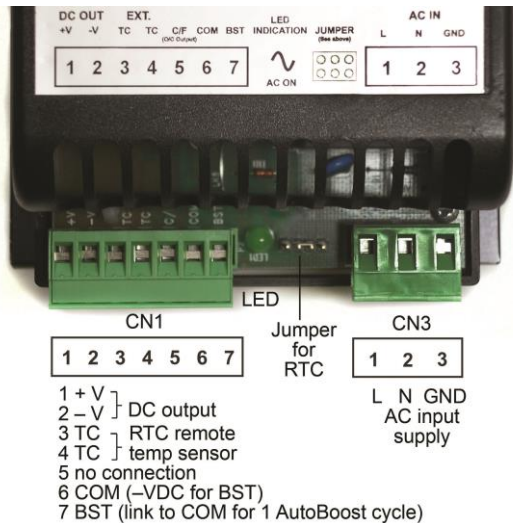
Open frame SNTL(UL)150 models:

Open frame Sentinels use a pair of two-part connectors with removable screw terminal blocks:

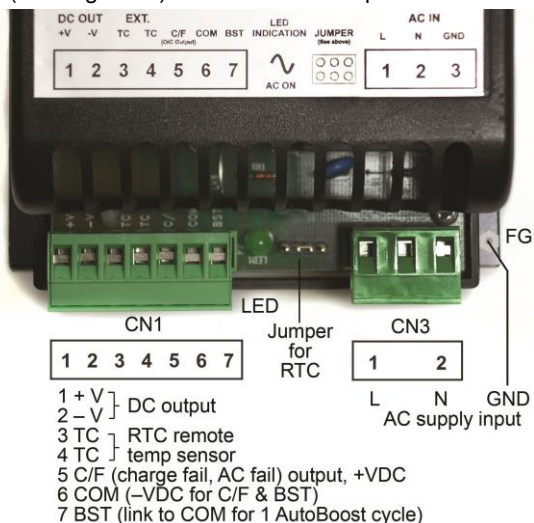
- **CN1:** one 7-way block for connection of the DC Charge Output, RTC remote temperature sensor, AutoBoost manual initiate and (UL models only) charge fail output. Use a 3 mm/0.1 in. flat-head screwdriver to tighten/ loosen the terminals.
- **CN3:** one 3-way block for connection of the mains AC power supply. Use a 5mm/0.2in flat-head screwdriver to tighten/loosen the terminals. For details of wire ratings and fusing, see the **AC Input (power supply)** section following.

CN3 AC input terminal numbering varies with model. Check the product label for connection details:

SNTL150 (standard, non-UL) models: AC supply live, neutral and ground wires are all connected to CN3:



SNTLUL150 (UL approved) models: AC supply live and neutral wires are connected to CN3; the AC supply ground wire must be connected to a separate M4 stud labelled FG (frame ground) on the metal baseplate:



Enclosed ESNTL150 and ESNTUL150 models (except ESNTLUL150xxNFPA)

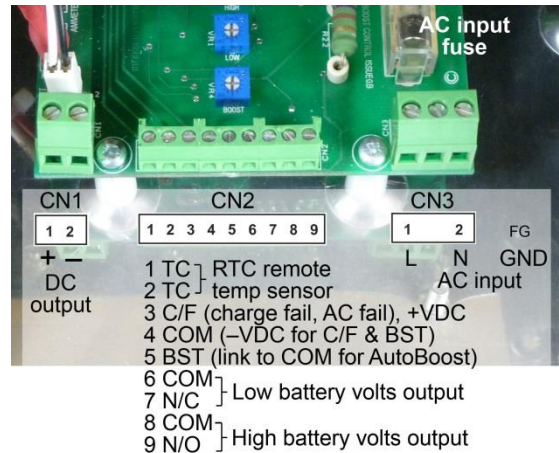
Enclosed ESNTL(UL)150 models have the same circuit board, terminal numbering and connection requirements as open-frame SNTL(UL)150 models, but are fitted with standard (non-removable) screw terminals blocks. Access to the screw terminals, and access for the wiring harness (via cable glands), is detailed in the **Dimensions and Assembly** section.

Enclosed ESNTLUL150xxNFPA models

Connection on these models through three terminal blocks on an additional circuit board, which also includes two additional NFPA 110 compliant alarm outputs.

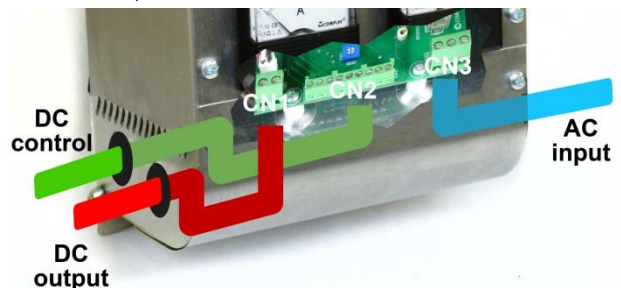
- **CN1:** a 2-way block for the DC Charge Output. Use a 5mm/0.2in flat-head screwdriver to tighten/loosen the terminals. See **DC Charge Output** section following for details of wire ratings and fusing.
- **CN2:** a 9-way block for connection of RTC remote temperature sensor, AutoBoost manual initiate and three NFPA 110 compliant alarm relay outputs.
- **CN3:** a 3-way block for the AC power supply. Use a 5mm/0.2in flat-head screwdriver to tighten/loosen the terminals. See **AC Input (power supply)** section following for details of wire ratings and fusing.

Terminal arrangement:



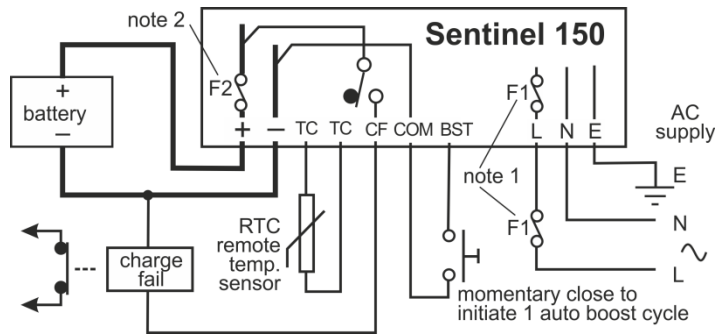
All models – wire harness separation

For all models, wire connections for the DC charge output, DC control signals and AC input supply must be physically separated, e.g. separate wire harnesses, separately routed through the case/panel. For enclosed ESNTL models, use separate cable access ports (ESNTLUL150xxNFPA model shown below):



Electrical Connection & Configuration (cont.)

Typical Connection



Notes:

- 1) AC fusing (F1): see AC Input (power supply) section
- 2) DC fusing (F2): see DC Output section
- 3) Battery output is isolated from chassis.
- 4) Solid state charge fail output relay (UL models only) shown in de-energised (fault) state.
- 5) High and low battery volts outputs (UL...NFPA version) are not shown.
- 6) AC supply input ground/earth connection:
 - CN3 pin 3 on standard (non-UL) models
 - M4 chassis stud (marked FG) on UL models

DC Charge Output



Before DC connection or disconnection:-

- Ensure AC supply input is isolated. **Disconnecting the batteries while the AC supply is live can result in sparking at the battery terminals, ignition of battery gasses and serious personal injury.**
- Check that the charger model and output ratings are compatible with battery type & voltage (see table below). **Incompatibility may result in damage to the charger, batteries and serious personal injury.**

Connect the Sentinel DC charge output to the battery terminals, observing the warnings above and the correct DC polarity. Use 4mm²/11 AWG or larger wire for ESNTLUL150xxNFPA models (10A DC output). For all other models (5A DC output), use 2.5mm²/13 AWG or larger wire.

All Sentinel 150 models include an electronic, self-resetting DC output fuse for protection of reverse polarity and short-circuit faults. In the event of such faults, isolate the AC supply, disconnect the output terminals and allow the fuse to self-reset; replacement of the fuse should not be necessary. The charger can then be re-connected and switched back on. If the fuse fails to reset, contact your supplier for further advice.

Float & AutoBoost output voltages

The DC output float and AutoBoost voltages are factory calibrated for the battery type specified at order. The battery type is identified on the charger rating label, and forms part of the model code. Standard calibrations are:

Battery type	model option code	float volts (V DC)	boost volts (V DC)	
12V	Vented lead acid (6 cells)	LA	13.5	14.1
	Calcium-Calcium (6 cells)	CA	13.8	15.6
	VRLA, AGM (6 cells)	AGM	13.5	14.4
	VRLA, Gel (6 cells)	GEL	13.5	13.8
	NiCd (10 cells)	10NC	14.1	14.5
24V	Vented Lead acid (12 cells)	LA	27.0	28.2
	Calcium-Calcium (12 cells)	CA	27.6	31.2
	VRLA, AGM (12 cells)	AGM	27.0	28.8
	VRLA, Gel (12 cells)	GEL	27.0	27.6
	NiCd (18 cells)	18NC	25.6	26.1
NiCd (20 cells)	20NC	28.2	29.0	

Note: Calibration figures at 20 deg C. Output voltage will vary if temperature compensation is enabled – see section following.

TC: Temperature Compensation

Automatic temperature compensation (of the DC output) is configured using a row of four circuit board pins, located between the two terminal blocks on the main circuit board.

Pin header configuration is:

Link position / mode	Description
Disabled	(Factory default setting). Temperature compensation disabled. Ambient temperature does not affect DC float and boost voltages. Use this setting if battery temperature does not deviate significantly from 20°C.
External	Temperature compensation enabled, with measurement by external, battery-mounted RTC sensor (see below). DC output varies by 3mV per cell per °C of temperature deviation from 20°C, within the range -10 to +50°C. Increasing temperatures result in decreasing output voltage; decreasing temperatures result in increasing output voltage. Use this setting for optimal temperature measurement and compensated DC charge output.
Internal	Not for customer use. Temperature measurement by internal sensor, for factory calibration only.

The two TC terminals are designed for connection to a Murphy RTC sensor, and **ONLY** when the Sentinel is configured for external temperature sensing. **DO NOT** connect other types of temperature sensor.

When an RTC sensor is connected, the sensor head must be mounted in a position that gives the most accurate/representative measurement of battery temperature.

The standard RTC sensor (part code 42.70.3900) includes a 3 metre lead assembly. Non-standard lead lengths are available to special order.

Alarm outputs (UL models only):

All UL models

UL approved Sentinels include a self-diagnostic 'charge fail' (C/F) circuit and relay output for driving a remote relay, alarm or fault annunciator. The solid state relay energises (positive DC output, 250mA max. Current @ 30VDC) during normal charging, and de-energises (open circuit) immediately following a DC charge fail or mains AC failure condition, e.g. loss of AC supply, AC fuse failure, DC fuse failure or low/no charge current.

Electrical Connection & Configuration (cont.)

Alarm outputs (cont.)

ESNTLUL150xxNFPA models

These models have two additional alarm outputs for compliance with the NFPA 110 standard. Each solid-state output has volt-free/dry contacts rated 250mA max @ 30 VDC:

- **Low battery voltage.** This relay is energised during normal charging, and de-energises (NC contacts closing) if a low battery voltage is maintained for 120 seconds. This delay allows for normal battery voltage variations, e.g. during engine cranking.)
- **High battery voltage.** This relay is de-energised in normal operation, and energises (NO contacts closing) if a high battery voltage is maintained for 120 seconds.

COM: common


This terminal is internally connected to battery negative DC. It may be used as a convenient negative DC feed for the BST (AutoBoost initiate) input, or as a return connection for a remote relay or device driven by the (positive DC) charge fail output. (See Typical Connection diagram.)

BST: AutoBoost Initiate

In normal operation, Sentinel automatically initiates AutoBoost mode if battery voltage falls below a preset level, then returns to float charge mode when the AutoBoost cycle is complete.


AutoBoost may also be manually initiated (at any time, whatever the battery voltage) by momentarily linking the BST and COM terminals, typically using a push-to-make, front-of-panel push button. Sentinel automatically returns to float mode at the end of a single AutoBoost cycle, even if the BST and COM terminals remain linked.

AC Input (power supply)



Before AC connection, disconnection or fuse replacement:

- Isolate the AC supply
- Ensure a good ground/earth connection to the charger, to CN3 screw terminal on standard (non-UL) models, or M4 chassis stud marked FG on UL models.
- Ensure the AC supply voltage is compatible with the charger's supply rating. **Exceeding the rated voltage may result in damage to the charger and connected equipment, and cause serious personal injury.**
- Fit only the fuse types/ratings shown on each product's label.



DANGER ! HIGH VOLTS

Standard (non-UL) SNTL150 and ESNTL150 models

Connect the AC input supply (live, neutral and ground) wires to Sentinel connector CN3:

CN3 pin	Function
1	AC supply live, 95 to 265 VAC, 47 to 63 Hz
2	AC supply neutral
3	AC supply ground/earth

AC input and ground connections require 1mm²/17 AWG or larger wire conductors.

AC fuse ratings are specified on the charger label. Open frame SNTL150 models require connection of an external fuse in the live AC supply wiring. Enclosed ESNTL150 models have a replaceable TR5 package fuse, located on the circuit board near connector CN3.

UL approved SNTLUL150 and ESNTLUL150 models

Connect the AC supply live and neutral wires to Sentinel connector CN3:

CN3 pin	Function
1	AC supply live, 95 to 250 VAC, 47 to 63 Hz
-	(Centre terminal, no connection)
2	AC supply neutral

The AC supply ground/earth wire must be connected to the separate M4 stud marked FG (frame ground), located near CN3 on the charger's metal base plate (open frame models) or case chassis (enclosed models).

AC supply and ground connections require 1mm²/17 AWG or larger wire conductors, rated for temperature 90°C/194°F.

AC fuse ratings are specified on the charger label. All UL models have a replaceable TR5 package fuse, located on the circuit board near connector CN3.

Fault Finding, Warranty and Maintenance

Warranty and servicing

Sentinel chargers are supplied with a 2 year warranty on parts and workmanship.

Maintenance is limited to keeping the charger free from ingress of dust, dirt or moisture, and ensuring clear air-flow for ventilation.

In the event of an operating query or suspected fault, please consult the sections in this manual, including the troubleshooting flowchart on page 8, or contact your supplier for further advice before returning the charger.



WARNING: Except for fuse replacement on some models, Sentinel battery chargers are not user-serviceable, and should be returned to the supplier in the event of failure.

No attempt should be made to repair the charger. Any attempt to do so may invalidate warranties, cause damage to the charger and connected equipment, and result in serious personal injury.

Fault Finding, Warranty and Maintenance

Troubleshooting Flowchart:

