

IC48V Battery Charger/Analyser Operator Manual



IC48V BATTERY CHARGER AND CAPACITY TESTER OPERATORS MANUAL



IC48V Battery Charger/Analyser

Operator Manual



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1 Manual Revision History

Rev	Date	Description
1	17-09-2013	Written from an IC50A manual.
2	21-07-2015	Formatting changes..
3	21-04-2016	Corrected maximum charge current at 12V
4	18-11-2019	Updated menu system section and added new charge and capacity test modes.
5	22-06-2020	Added cell monitor connection details.
6	29/11/2020	Updated to reflect recent software changes.
7	22-02-2021	For clarity added calibration schematic using Rebling 7007 connector.
8	11-10-2021	Corrected technical specifications.
9	25-11-2021	Added information on new function to print cell voltages at start of run. Added details of default print modes. Added details of previous run history. Added information on thermal printer now fitted.
10	15-02-2022	Added information on the manual cell scan and balance functions.

2 Equipment Description

2.1 General

The Battery Charger Analyser is an electronically controlled combined universal battery charging unit with built in battery analysing (capacity testing) capabilities. It is housed in a metal enclosure designed for bench mounting. As it is supplied it is designed to work on a 230V supply. It can be operated on a 115V supply but it will exceed the fuse rating if used on high charge rates. The maximum charge power must be limited to 1800 Watts.

Equipment control is via an interactive 253 x 32 dot matrix display and data entry is via a 16-key keypad. Operating modes and functions are selected by the use of a simple menu system. Access to charging and testing operations is performed by either entry of eight digit battery library names, repeat of last charge or capacity test or new manual parameters. During operation the display will show the instantaneous values of battery voltage, current and time elapsed through the selected program.

Process modes can be created where complete unattended charging, capacity testing and final charging can be performed. Up to 6 different charge or capacity test steps can be created and up to 4 process programs can be stored in the unit. Each process step has an optional delayed start for resting the battery and also each step can sound the alarm with or without a pause in operation. The process is simply continued by pressing a key on the keypad.

Battery data is stored internally in the units non-volatile memory. The operator can add and modify this list by entering the details of the battery to be included on the display and keyboard. Alphanumeric digits, up to a maximum of 8 digits, identify Battery library entries

Batteries are connected to the front of the unit by means of two individual high current connectors. Connection to the battery has to be made via the appropriate connectors for that battery. The unit is supplied with M8 ring crimps that must have the appropriate connector for the battery type being tested fitted.

The IC48V can: -

- Charge 12V at 80.0A
- Charge 24V batteries at 80.0A
- Charge 48v batteries at 40.0A
- Capacity Test 12V Batteries at 100.0A
- Capacity test 24V batteries at 80.0A
- Capacity test 48v batteries at 40.0A

The unit contains a high flow rate fan to extract the heat energy generated internally when running in capacity test mode.

2.1.1 Charging Modes

CONSTANT VOLTAGE CHARGE

Where the battery is charged at a reducing current when the constant voltage threshold is met. Parameters for this mode are maximum charge time, optional minimum current to stop charge and a current threshold, which can detect a potentially faulty battery.

CONSTANT CURRENT CHARGE WITH TOP UP CHARGE

Where battery is charged at a constant current until a terminal voltage is met or a specified maximum time, at this point it can be charged for an additional time at a user set current. The overcharge voltage is set in this mode to prevent overcharging of the battery.

MULTIPLE STEP CONSTANT CURRENT CHARGE

Up to 4 constant current steps can be implemented for the charge cycle. this mode also has an overcharge voltage setting to prevent overcharging of the battery. Charge current can be set to zero for "rest" periods between charge steps.

CONSTANT CURRENT USING CELL MONITOR

In this mode the battery will be charged at constant current with the charge switching to the top up charge (if required) when all the cells reach the target voltage specified or a maximum time. A cell overcharge voltage can be set once the top up charge has been activated, and during the whole charge a fall in cell voltage can be detected an indication of cell breakdown.

2.1.2 Testing Modes

CAPACITY TEST TO TIME

This mode will discharge the battery connected at the current specified for the test duration specified thus reporting the battery capacity is 100% or more. The capacity test will be stopped if the target voltage is reached before the full test time has elapsed. During the capacity test and when it is terminated the display will show the amount the capacity test is complete as a percentage.

CAPACITY TEST TO TARGET VOLTAGE

This mode will discharge the battery down to the terminal voltage specified thus reporting the actual percentage capacity. The capacity test will be stopped if the target threshold voltage is reached before the full test time has elapsed. During the capacity test and when it is terminated the display will show the amount the capacity test is complete as a percentage.

CAPACITY TEST WITH CELL MONITOR

This mode will discharge the battery connected at the current specified for the test duration specified thus reporting the battery capacity is 100% or more. The capacity test will be stopped if any cell reached the cell target voltage before the full test time has elapsed. During the capacity test and when it is terminated the display will show the amount the capacity test is complete as a percentage.

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CAPACITY TEST TO FAILED CELLS

This mode performs a battery discharge as in the above mode but does not stop at the first cell to fall below the set threshold, but continues until the maximum time is met or the battery overall voltage. Each cell that falls below the cell target voltage before the end of test will be logged with the time in which it failed.

CAPACITY TEST USING A FIXED RESISTOR

This mode emulates the use of a fixed resistor for discharging, so that where CMM strictly specify that a fixed resistor must be used then this mode can be employed.

AUTOMATIC CELL BALANCE

This mode is designed to discharge the battery down to zero volts, where when any cell reached zero volts a balancing resistor will automatically be placed across it. When the battery total voltage reached near zero all the remaining balancing resistors will be applied.

FULL DISCHARGE

This mode will do a basic discharge of the battery at the current specified for the time specified.

The unit can be set so that a predefined charge or capacity test can be scheduled to start at up to 99h 99m in the future.

The unit contains the software that will allow it to be calibrated by the end user doing away with the need to send the unit to a service centre for periodic calibration. The re-calibration process only takes a few minutes and this is done without the need to access the internals of the unit.

The printer allows the operator to print hard copies of the charge and test results upon completion of the test. This report can be used to complement the service schedule by providing full traceability. The print can also include the printed serial number of the battery, and contains a signature strip so the results can be validated by the operator.

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2.2 Component Parts

Upon receipt of your new battery charger analyser unpack and check that all items are present in the containing box.

STANDARD ITEMS

- One IC48V Battery Charger Analyser
- One power cord
- One Set (+ve & -ve) standard battery leads.
- One paper Copy Operators Manual
- Certificate Of Conformity
- Calibration Certificate

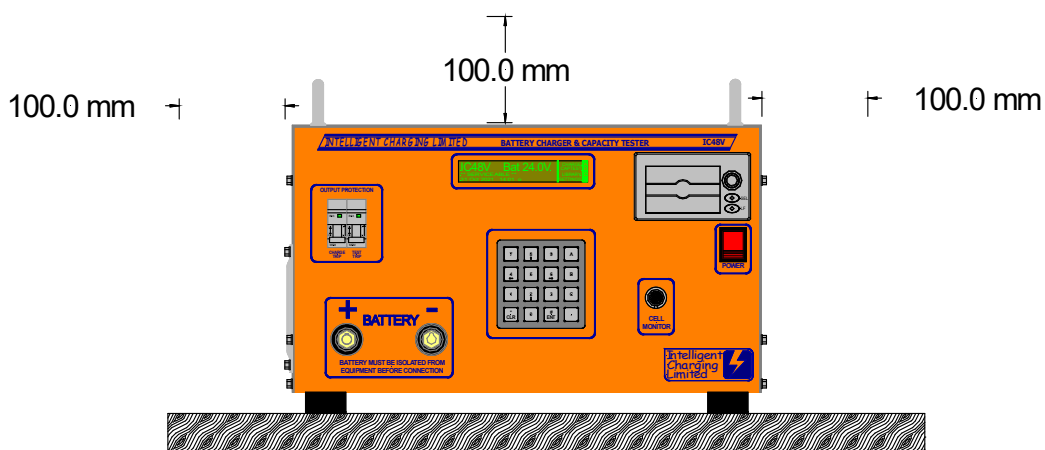
OPTIONAL ITEMS

- Cell Monitor Interface
- Cell Monitor Crown (to suit battery specified).
- Battery specific connectors.

2.3 Installation

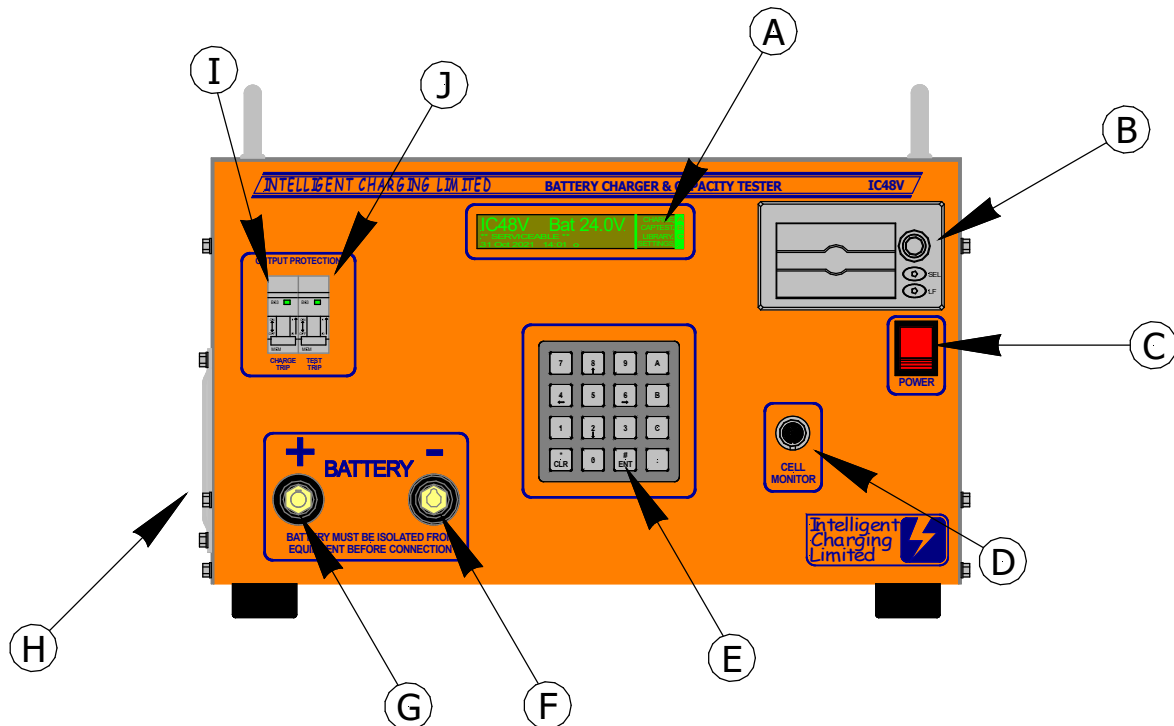
The Battery Charger Analyser should be mounted on a level surface such as a workbench or sturdy shelf above the batteries with a loading weight of at least 50Kg.

The unit should be sited so that at least 10cm of airspace is available all round the sides and top of the unit to allow free movement of air required for cooling.



2.4 Front Panel Controls And Indicators

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(A) – DISPLAY

All battery charger indications are made on this 256 x 32 dot matrix vacuum fluorescent display.

(B) - BUILT IN PRINTER

If fitted the optional 24 column printer. On the non printer models this will be a blanking plate.

(C) - MAINS POWER SWITCH

Pressing this switch activates mains power. It will illuminate to indicate power is being applied to the unit.

(D) - CELL MONITOR CONNECTOR

This 6 pin connector is the RS232 and power connector for the cell monitoring unit.

(E) – KEYPAD

All battery charge and capacity test functions are activated via this 16 key keypad.

(F) - NEGATIVE BATTERY TERMINAL

Connection of the negative battery lead is made to this terminal.

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(G) - POSITIVE BATTERY TERMINAL

Connection of the positive battery lead is made to this terminal.

(H) - HEAT EXCHANGER EXHAUST FAN

During use the unit absorbs electrical power, which it turns into heat, this fan exit is where the heat is extracted from the unit. It is important that it is not obstructed.

(I) & (J) - CHARGE & CAPACITY TEST CIRCUIT BREAKERS

The circuit breakers are fitted to prevent high currents from being driven into the battery or into the unit should a fault condition occur. Always ensure that the circuit breaker is in the ON position before starting a charge or capacity test.

WARNING

NEVER SWITCH THE CIRCUIT BREAK TO ON WHEN THE UNIT IS PERFORMING A CHARGE OR CAPACITY TEST AS SEVERE DAMAGE MAY OCCUR TO THE BATTERY OR THE EQUIPMENT

ALWAYS PRESS STOP FIRST

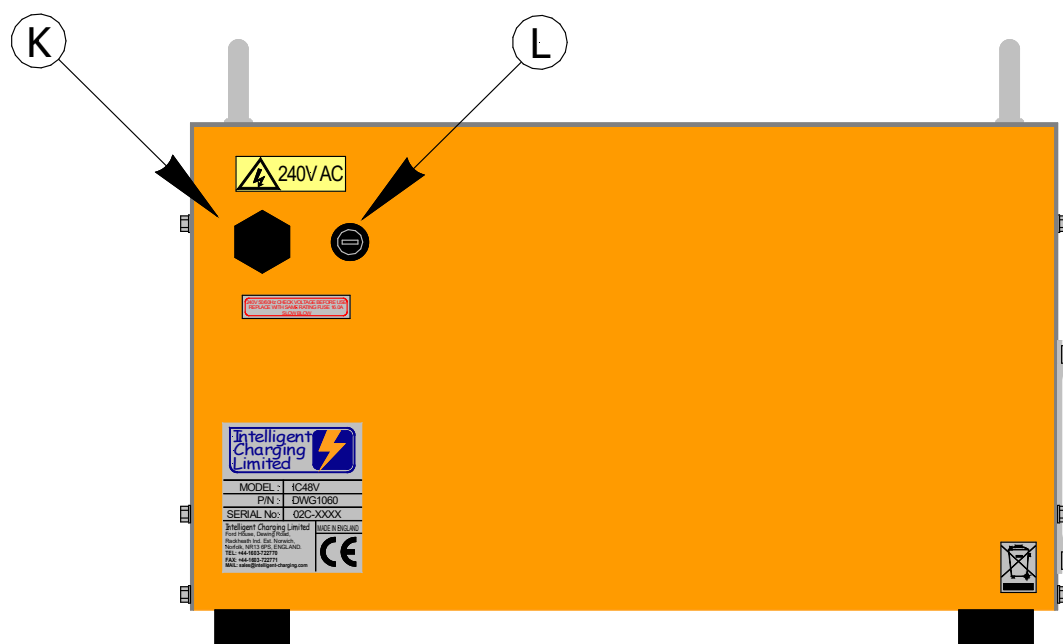
If the circuit breaker operates during a charge immediately press STOP and remove power from the unit and disconnect the battery.

Operation of the circuit breaker is an indication of a fault and the unit will need to be checked before using.

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2.5 Rear Panel Controls And Indicators



(K) - Mains Lead

This is the entry point for the power lead into the unit. Always check that the lead is not damaged before use.

(L) - Mains Fuse.

The mains fuse fitted to the IC48V is 16.0A Slow Blow 1¼"

3 Cell Monitor Interface

3.1 General

The MB73P+ battery charger analyser has built in support for the cell-monitoring interface (TH20).

This allows the monitoring of NiCd batteries of up to 20 cells and is only available for units that have firmware issue 3.0 or higher installed.

For upgrade details please contact Intelligent Charging Limited or your local reseller.

With the cell-monitoring interface connected two additional capacity test options become available and one additional charge option.

When the cell monitor is in use two additional displays can be selected by pressing '**B**' or '**C**' keys on the keypad while the unit is running. Pressing '**A**' key will return the display back to the default display.

'A' Default display.

This is the conventional display which all modes of operation use.

'B' A textual list of cell voltages.

This display will show all 20 cell voltages being measured as a simple list.

'C' A graphical bar graph.

This display will show all 20 cell voltages being measured a graphical bar graph, which will show the inter-relationship between each cell. Also displayed is a line representing the target voltage. The battery voltage and charge of capacity test current highest cell voltage, lowest cell voltage and the "cell focus" voltage are shown in text format. By using the left and right arrow keys on the keypad a highlight marker can be moved across each cell so that if one particular cell voltage needs to be monitored it will be displayed by the right of the bar graph. By pressing '**0**' and either '**↑**' or '**↓**' keys simultaneously will cause the 1.0V display window to be shifted up or down the 2.0V range.

The cell monitor is supplied as an interface unit with 21 patch lead connection for connecting to batteries via individual clamps. It has a connector fitted to it where "crown" assembly can be plugged in. The "crown" arrangement is placed onto the top of the battery with contact to the cells made via stainless test pins. The "crown" arrangement is manufactured to suit one style of battery. If many different styles of batteries are in use a "crown" will be required for each battery.

The cell monitor prior to firmware revision 5.08 notes cells by default in the order of cell 1 being the negative end of the battery, whereas 5.08 and higher firmware defaults to cell 1 being the cell at the positive end of the battery. The state of this condition can be swapped over by going to the cell monitor settings and changing the CELL DIRCT. There are two options "Cell #2 is negative " or "Cell #1 is positive" Confirmation of the current setting is also included on the cell printout and voltage monitor screens.

3.2 *Cell Monitor Connection*

It is very important that this section is adhered to when making electrical connections to the cell monitor as damage can be sustained if the connection order is not observed.

Connect the cell monitor 6 pin plug to the battery charger.

Switch on the battery charger.

Make sure that the letters "**CM**" appear on the bottom line of the display. This means that the charger has made a connection to the cell monitor.

Connect the battery main contacts "+" and "-".

3.2.1 **Connecting flying leads**

Supplied with the cell monitor are 20 red leads with crocodile clips and one black lead with crocodile clip.

Starting with the **BLACK** lead connect this to the cell monitor at one end and the other Clipped onto the battery **NEGATIVE** terminal.

Then one by one connect the **RED** leads starting at the terminal closest to the **BLACK** terminal on the cell monitor and to the first cell in the chain at the **NEGATIVE** end of the battery.

The leads are numbered "**01**" - "**20**".

If your battery cell "**01**" is **POSITIVE** then add the leads starting with "**20**" and counting down to "**01**".

If your battery is cell "**01**" is **NEGATIVE** then add the leads starting with "**01**" and counting up to "**20**".

Refer to section 3.10 Cell Number Reversal on how to change the cell counting mode for your battery notation.

3.2.2 **Connecting using the "CROWN"**

Connect the crown to the cell monitor via its 25 way connector. Ensure the plug is secured by the threaded ring.

Gentry apply the crown to the battery in accordance with the fitting instruction supplied with the crown.

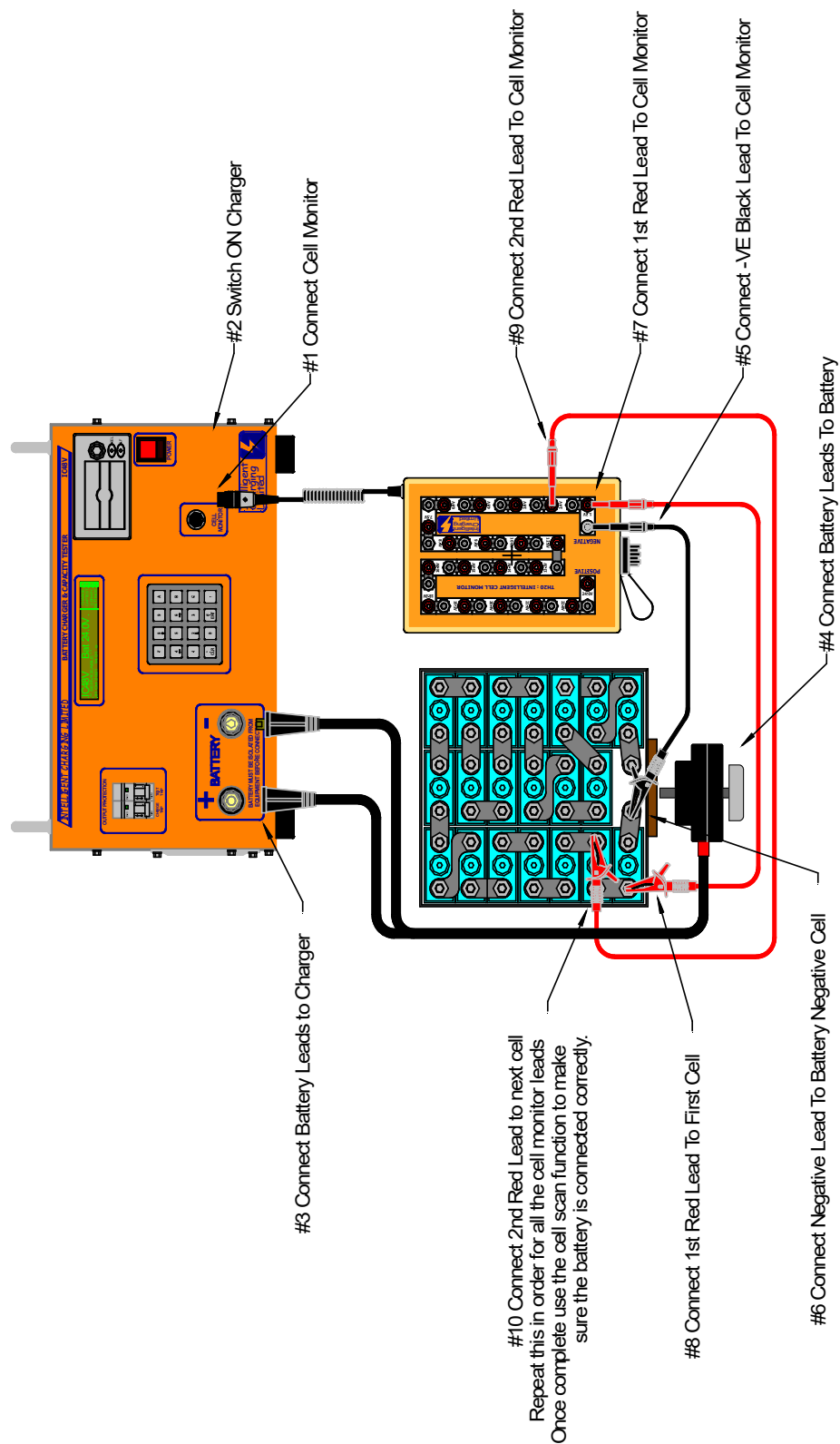
Using the charger menu operations it is most useful to follow the procedure to do a manual cell scan initially to make sure that the cell monitor and crown have successfully made all the connections. Refer to 3.7 Cell Scan Only Mode.

UNDER NO CIRCUMSTANCES CONNECT A BATTERY TO THE CELL MONITOR WITHOUT IT FIRST BEING CONNECTED TO THE BATTERY CHARGER AS DAMAGE MAY OCCUR TO THE INTERNAL SENSING CIRCUITRY.

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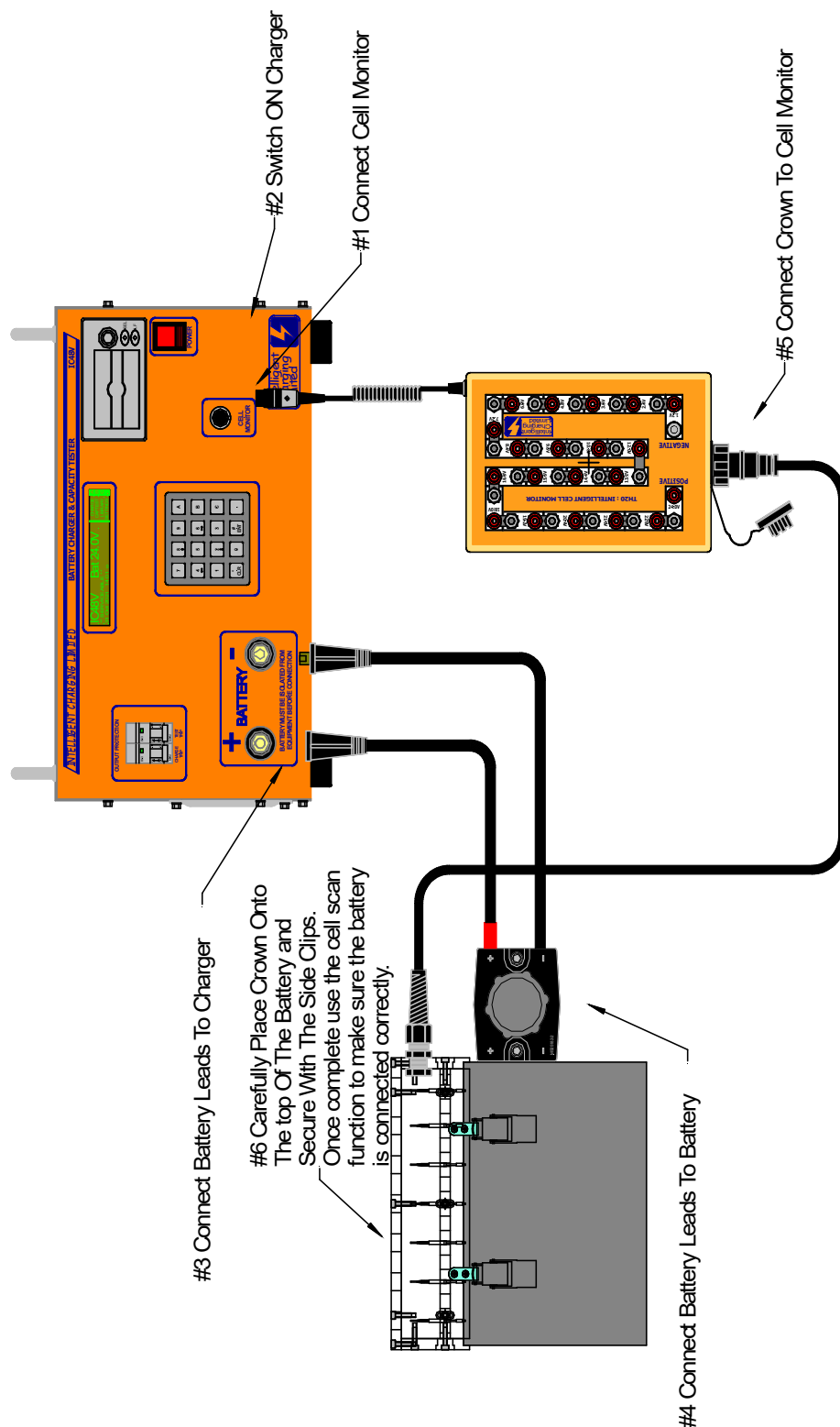
3.2.3 Flying Lead Connection Diagram



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3.2.4 Crown Connection Diagram



3.3 ***Charging With The Cell Monitor***

3.3.1 **Cell Monitor CC Charge**

In the constant current charge mode using the cell monitor interface the charge will take place at the predefined constant current until all the cells have reached the target set point typically 1.55V. At which time the charge rate will change to the additional time rate and the charge will continue until the additional time has elapsed. If at any time during the charge any cell voltage exceeds the cell overcharge voltage typically 1.65V the charge will stop. If a printer is connected to the unit the cell voltages can be printed at predefined timed intervals or can be printed by simply pressing the '.' key. If a printed report is required at the end of the charge, the final cell voltages will be included.

3.4 ***Discharging With The Cell Monitor***

3.4.1 **Cap Test Cell Monitor**

This capacity test mode allows you to discharge the battery at the required current for your pre-selected time until one cell goes below a predefined target voltage typically 1.00V at which point the discharge stops and the battery capacity can be seen. If a printer is connected to the unit the cell voltages can be printed at predefined timed intervals or can be printed by simply pressing the '.' key. If a printed report is required at the end of the capacity test the final cell voltages will be included.

3.4.2 **Automatic Cell Balance**

This mode allows you to set a predefined discharge current to flatten the battery and to perform an automatic cell balancing exercise. While during the discharge any cell approaches 0.00V its balancing resistor will be switched in to reduce the reverse charge effect. When the battery voltage falls below 3.0V and the discharge current falls below 2.0A the cell-monitoring interface will automatically switch in all the balancing resistors and will remain in that state until either the 'CLR' key is pressed or the **Discharge Time** elapses.

3.5 ***Cell Monitor Extended Display***

When performing a charge or capacity test the display will always default to showing the main process conditions, but when the cell monitor is in use there are two additional displays which give the operator a list of cell voltages at the instant in time or a graphical bar display of the cell voltages. The alternative displays are viewed by pressing either of the 'A', 'B' or 'C' keys on the keypad.

The 'A' key changes the display to the main process conditions:

The 'B' key changes the display to the full 20-cell voltage list:

The 'C' key changes the display to a bar graph of cell voltages:

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While the graphical display is viewed the range of the display can be dynamically changed from the default 0.8 to 1.8V to a bottom limit of 0.0V to 1.0V or an upper limit of 1.0 to 2.0V by pressing and holding the '0' and pressing either '↑' or '↓' keys respectively. Each step is an increment or decrement of 0.1V.

3.6 *Printing Data When Using The Cell Monitor*

If the printer is fitted to the charger analyser and the cell monitor is in use there are additional printing facilities available. When performing a charge or capacity test the cell voltages can be printed manually at a time to suit you by simply pressing the '.' key or a print interval can be specified in minutes. When the cell monitor is in use the full list of cell voltages will also be included in the final print at the end of the operation. The cell monitor printout is a similar format to the figure below:

```
Cell Volts At      0h14m39
      Cell 1 is POSITIVE
L=16 0.383V H=17 1.049V
01  1.041V Pass
02  1.047V Pass
03  1.033V Pass
04  1.039V Pass
05  1.029V Pass
06  1.045V Pass
07  1.041V Pass
08  1.037V Pass
09  1.037V Pass
10  1.041V Pass
11  1.019V Pass
12  1.031V Pass
13  1.029V Pass
14  1.035V Pass
15  1.031V Pass
16  0.383V Fail  0h12m36
17  1.049V Pass
18  1.007V Pass
19  1.025V Pass
20  0.997V Fail  0h14m29
```

3.7 *Cell Scan Only Mode*

A mode of operation is available where the cell monitor interface can be scanned while the unit is idle. This is obtained through the **SYSTEM** menu. While in this mode the 'B' & 'C' keys will display the textual cell voltages or the bar graph respectively.

In order to perform this operation follow this procedure.

From **MAIN** page select : -

SETTINGS -> SYSTEM -> MORE.... -> CELL MONIT -> CELL SCAN

The charger will then request the number of cells to be scanned and once entered the display will change to the bar graph display "C". The numeric display can be selected by

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pressing "B". Note for this feature to work the battery main connector needs to be connected to the battery. The charger performs no other checks and will keep the cell scan mode in operation indefinitely. To stop this operation press the "CLR" key. To take a snapshot of the cell voltages on the printer press the "." key.

3.8 *Cell Balance Only Mode*

If a battery has been previously drained and simply requires the balancing to be performed, then this feature can be used instead of the "CELL BALANCE" function from the "DISCHARGE" operation. It is important that the cell of the battery have been discharge to a safe level before performing this as overheating will occur.

From **MAIN** page select : -

SETTINGS -> SYSTEM -> MORE.... -> CELL MONIT -> BALANCE

The charger will then request the number of cells to be scanned and once entered the display will change to the bar graph display "C". The numeric display can be selected by pressing "B". Note for this feature to work the battery main connector needs to be connected to the battery. The charger performs no other checks and will keep the cell balance mode in operation indefinitely. To stop this operation press the "CLR" key.

3.9 *Initialise the cell monitor.*

If the cell monitor has been connected while power is on the battery charger, it will not be recognised until this operation is performed or the power is cycled.

From **MAIN** page select : -

SETTINGS -> SYSTEM -> MORE.... -> CELL MONIT -> INITIALISE

The charger will "beep" and display a message indicating the cell monitor has been initialised. Press "CLR" repeatedly to get back to the **MAIN** page and verify the symbol "TH" appears.

3.10 *Cell Number Reversal*

Older models of the TH20 are marked with cell numbers starting with #1 through to #20 (The maximum number of cells that can be monitored). Cell #1 is considered to be the cell which is connected to the negative (-ve) cell end of the battery whereas cell #20 (in a 20 cell battery) is considered to be the cell which is connected to the positive (+ve) end of the battery.

Many battery manufacturers use the reverse cell numbering where cell #1 is the positive (+ve) end of the battery and in the case of a 20 cell battery the #20 cell is the negative.

Because of this numbering technique the battery charger has an option in the cell monitor settings to "reverse" the cell numbering for display and printing purposes. The cell displays show which is +ve end of the battery and which is the negative so that if the cell numbering is reversed it is shown which way round the numbering takes.

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From **MAIN** page select : -

SETTINGS -> SYSTEM -> MORE.... -> CELL MONIT -> SETTINGS -> CELL DIRECT

Select **>> NEXT >>** or **<< PREV <<** to change to either : -

"CELL #1 IS NEGATIVE -VE" or

"CELL #1 IS POSITIVE +VE"

Then press **"ENT"**

This setting are remembered after power off.

3.11 Cell scan and print during standard charge modes

The charger has an option which allows the use of the cell monitor to monitor and print cell voltage during the standard charge modes where only the battery total voltage is being used as the reference, such as CONSTANT VOLTAGE CHARGE (Although the cell monitor will not work with Lead Acid batteries) CONSTANT CURRENT CHARGE and MULTI-STEP CHARGE or CAPACITY TEST TO 100%, CAPACITY TEST TO TARGET and FULL DISCHARGE.

When these modes of operation have the following properties.

"DON'T USE CELL MONITOR" The cell monitor is only used in the cell charge and capacity test modes.

"ALWAYS USE CELL MONITOR" The cell monitor is always used on the charge and capacity test modes above. The the charger does not act the on the cell voltage values, it only displays them.

"PROMPT TO USE CELL MONITOR" Use of the cell monitor will be confirmed when **START** is selected.

From **MAIN** page select : -

SETTINGS -> SYSTEM -> MORE.... -> CELL MONIT -> SETTINGS -> SCAN MODE

Select **>> NEXT >>** or **<< PREV <<** to change to either : -

"DON'T USE CELL MONITOR"

"ALWAYS USE CELL MONITOR"

"PROMPT TO USE CELL MONITOR"

Then press **"ENT"**

This setting is remembered after power off.

3.12 Automatically printing cell voltages at start

A feature has been incorporated which allows cell voltages to be printed a specified time into the beginning of a charge or capacity test. This value when set to non-zero will affect all cell monitoring charge and capacity testing modes. If set to zero cell

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voltages will not be printed at the start of a charge or capacity test. This value is unaffected by the regular cell voltage print interval. If print cells at start is set to 5 minutes and cell print interval is set to 15 minutes, the cell voltages will be printed at 5 minutes, 15 minutes, 30 minutes etc.

Note if this value has been set to a non zero value, when performing a cell monitor charge the cell voltages will also be printed at switch over from main charge to top up charge if one is set.

To set this value from **MAIN** page select : -

SETTINGS → SYSTEM → MORE.... → CELL MONIT → SETTINGS → START PRNT

Then enter minutes **ENT** then seconds **ENT**

This setting is remembered after power off.

3.13 *Cell Monitor Manual Scan*

There is a feature in the cell monitor settings which allows a manual scan of cell voltages without running a charge or capacity test. This is a useful tool for checking correct connection of the flying leads or crown connection before starting a charge or capacity test.

With the battery connected to the charger and the cell monitor connected to the battery perform the following menu steps.

SETTINGS → SYSTEM → MORE.... → CELL MONIT → CELL SCAN

Then enter the number of cells to be scanned from 1 to 22. Scanning will then begin.

The '**B**' key changes the display to the full 20-cell voltage list:

The '**C**' key changes the display to a bar graph of cell voltages:

To end the manual cell scan press the '**CLR**' key.

3.14 *Cell Monitor Manual Cell Balance*

There is a feature in the cell monitor setting which allows a manual cell balance to be performed on all cells connected to the battery. In order for this procedure to be executed no cells may have an open circuit voltage of more than 1.00V.

With the battery connected to the charger and the cell monitor connected to the battery perform the following menu steps.

SETTINGS → SYSTEM → MORE.... → CELL MONIT → BALANCE

Then enter the number of cells to be balanced from 1 to 22. The charger will then check the voltages of the cells and if any are above 1.0V will alert the operator and will not allow manual scanning to be performed.

If the cell voltages are satisfactory the cell balancing and scanning will begin.

The '**B**' key changes the display to the full 20-cell voltage list:

The '**C**' key changes the display to a bar graph of cell voltages:

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To end the manual cell balance press the 'CLR' key.

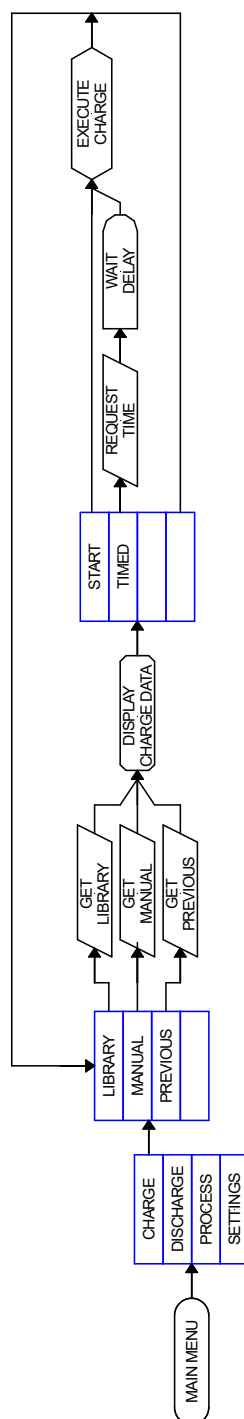
3.15 *Cell Monitor Specifications*

Power	+5.0V
Cell Voltage Range	-2.0V to +2.0V
Max No. Cells	20 Cell.
	Can be used with 22 cells. Available on request.
Scan Rate	1.4 seconds
Balance Switching current	2.0A
Balance continuous current	1.0A
Balance Resistance	$1.0\Omega \pm 1\%$ 2W
Voltage Accuracy	0.004V*
Note the voltage accuracy is not independent of the overall battery voltage accuracy.	

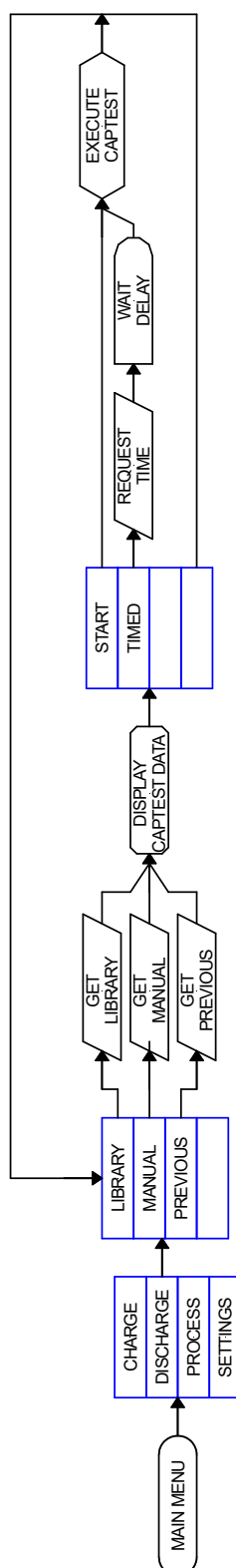
4 Equipment Menu Operation

The Battery Charger Analyser is operated by the use of a simple menu structure which is accessed by simply pressing the 'A', 'B', 'C' or '.' keys. To get back to the main menu the 'CLR' key is pressed repeatedly. The following flowchart illustrate the menu structure.

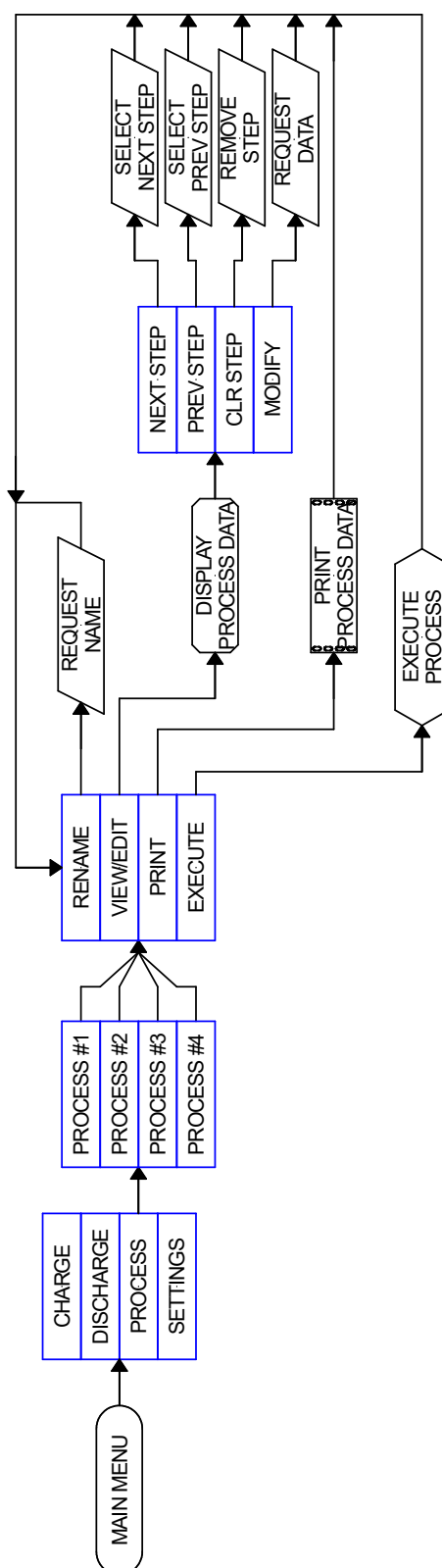
4.1 Charging Menu



**Intelligent
Charging
Limited**



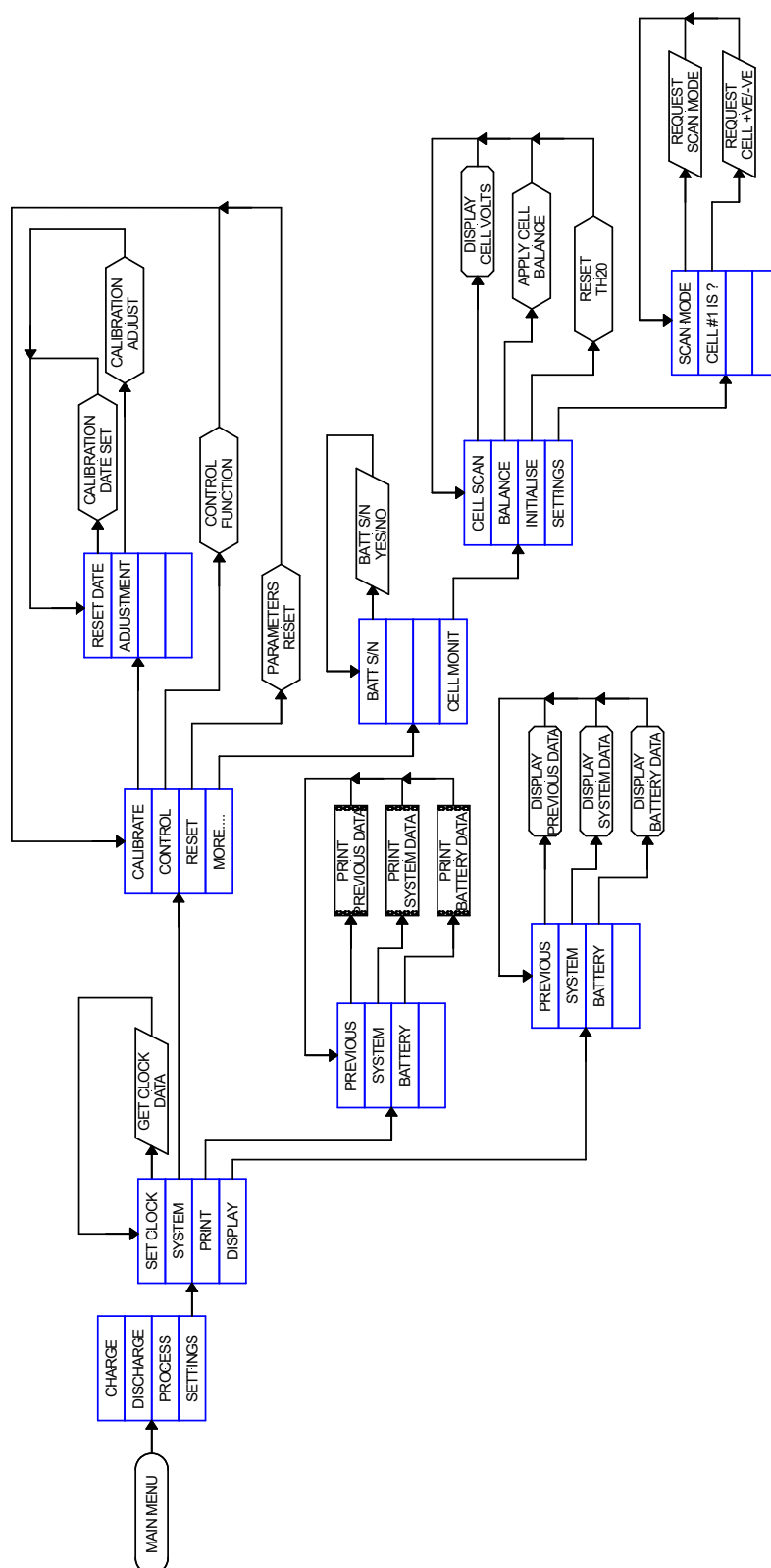
**Intelligent
Charging
Limited**



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4.4 Settings Menu



5 Connecting A Battery

For all methods of use of the battery charger the battery to be tested or charged must only be connected when the charger is either:

Not powered up,

or

Powered up and not executing a charge or capacity test function. Doing so would damage the equipment, and possibly draw an electrical arc that, may cause an explosion from the venting gases being emitted from the battery.

Care must also be executed in ensuring that the bared ends of the battery leads do not come in contact with the metalwork of the charger as this may also cause electrical arcing and or explosion risk.

THE BATTERY SHOULD NEVER BE CONNECTED OR DISCONNECTED FROM THE UNIT WHEN A CHARGE OR TEST IS IN PROGRESS AS ARCING CAN OCCUR CAUSING AN EXPLOSION FROM GASSES VENTING FROM BATTERIES BEING PROCESSED

THE BATTERY SHOULD ALWAYS BE ISOLATED FROM ANY EQUIPMENT BEFORE BEING CONNECTED

Stray ground loops between the attached equipment and the Battery Charger Analyser could cause catastrophic damage to the unit and the attached equipment.

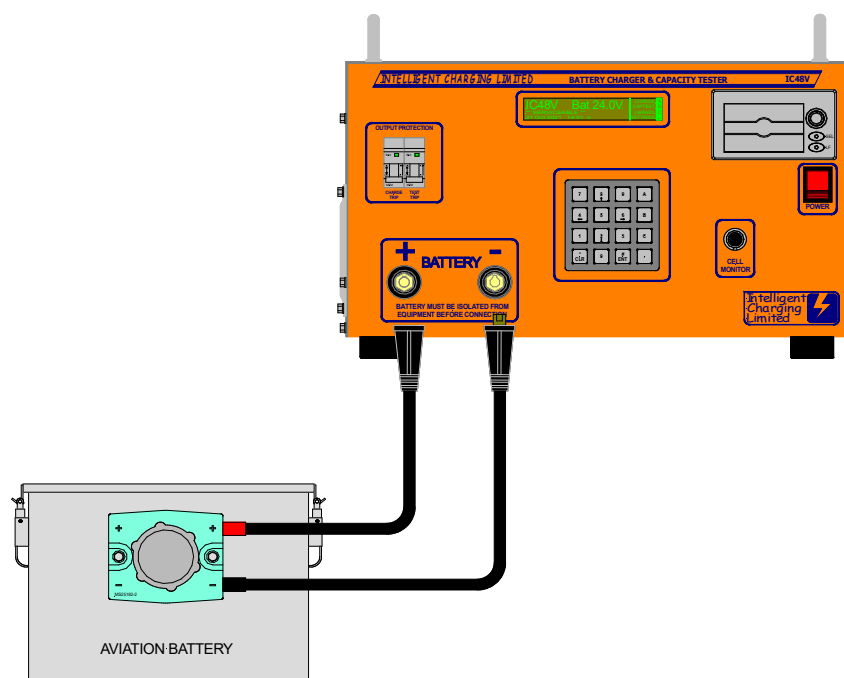
Provided with the unit is one set of leads terminated with 8mm Ring Crimp Connectors. The 8mm ring crimps should be fitted with suitable battery connectors to suit the battery being charged.

Always connect the battery leads as shown in the following figure to the unit before attempting to connect the battery to be charged/tested. Once the charger leads are connected to the unit then the battery can be connected.

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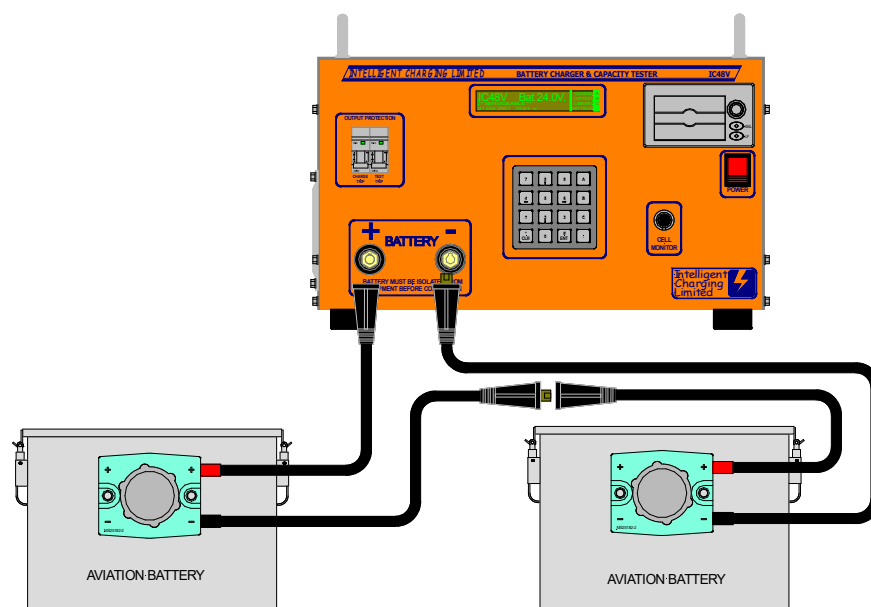


5.1 Battery Leads Connection Single Battery



5.2 Battery Lead Connection If Using With Two Batteries

As the IC48V has a 48V battery charging and capacity testing capability it is therefore possible to connect two 24V aviation batteries in series to perform a charge halving the time to back to service.



Note standard supply of the IC48V does not include the ELCON connector.

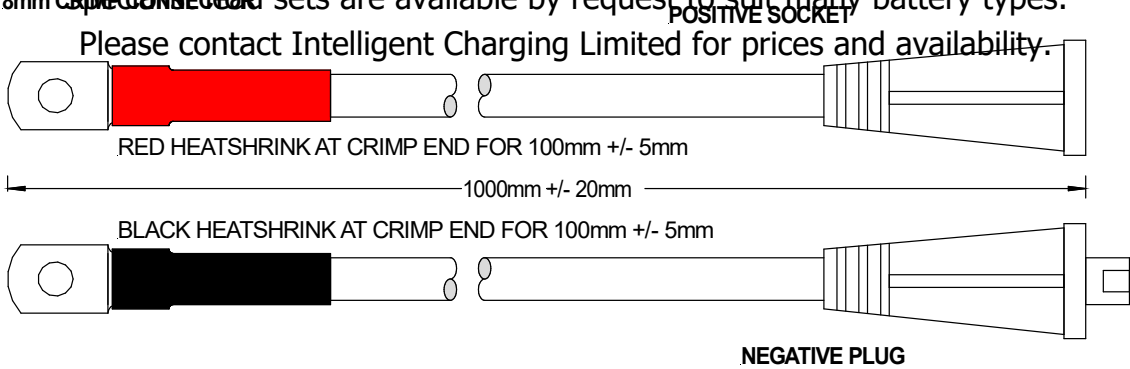
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5.3 Standard Lead Set

Specialised lead sets are available by request to suit many battery types.
Please contact Intelligent Charging Limited for prices and availability.



6 Battery Charge Operation

6.1 Constant Voltage Charge

This charge mode is designed primarily for Lead Acid batteries, but can be used for any type of battery, which requires top-up charging through a constant potential of the battery voltage. The battery will be charged at the amount of amps specified until the target voltage has been achieved. At this point the charging amps will gradually reduce to zero as the battery voltage is maintained. This will continue until the charge time has been completed. The parameters for the charge are as follows: -

Target Volts : This is the constant potential voltage of the battery.

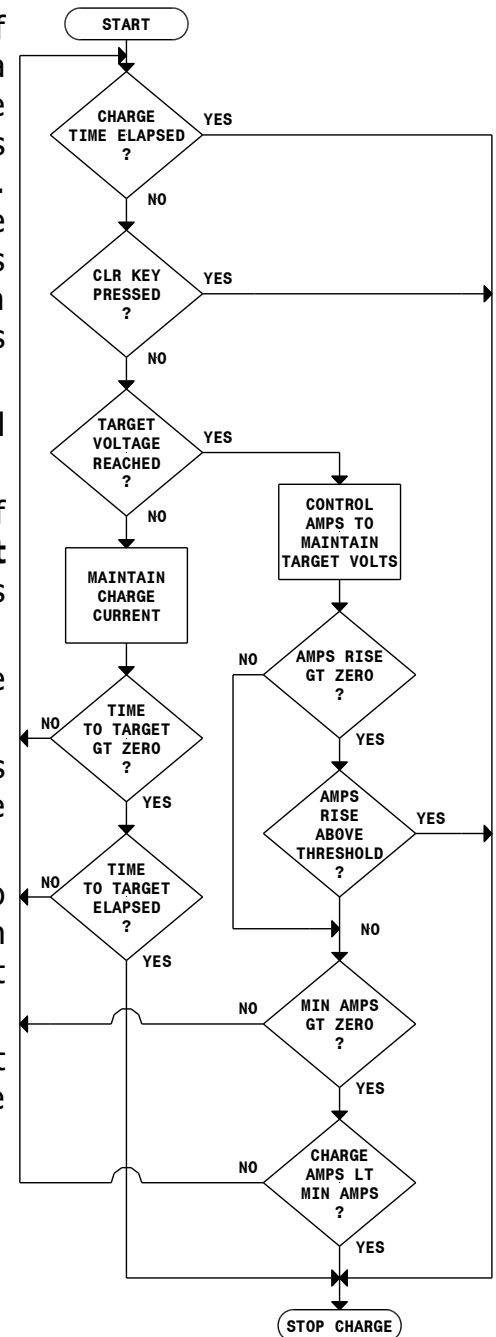
Charge Amps : This is the maximum amount of amps to deliver to the battery. Once the **Target Volts** has been reached the amount of amps delivered to the battery will decrease.

Charge Time : This is the maximum charge duration.

Minimum Amps : When the amount of amps delivered to the battery falls below this value the charge will stop. Set to zero if not required.

Amps Rise : If the current should increase to above this setting once the **Target Volts** has been reached the charge will stop. Set to zero if not required.

Target Fail Time : If the **Target Volts** has not been reached within this value of time then the charge will stop. Set to zero if not required.



6.2 Constant Current Charge

This charge mode is designed primarily for NiCd type batteries, but can be used for any battery type, which requires a constant current charge. The charge current is maintained at a constant current until the target voltage has been reached. The parameters for the charge are as follows: -

Target Volts : This is the voltage at which point the charge will stop, or switch to **Extra Time**.

Charge Amps : This is the constant current amps to deliver to the battery up until the **Target Volts** has been reached.

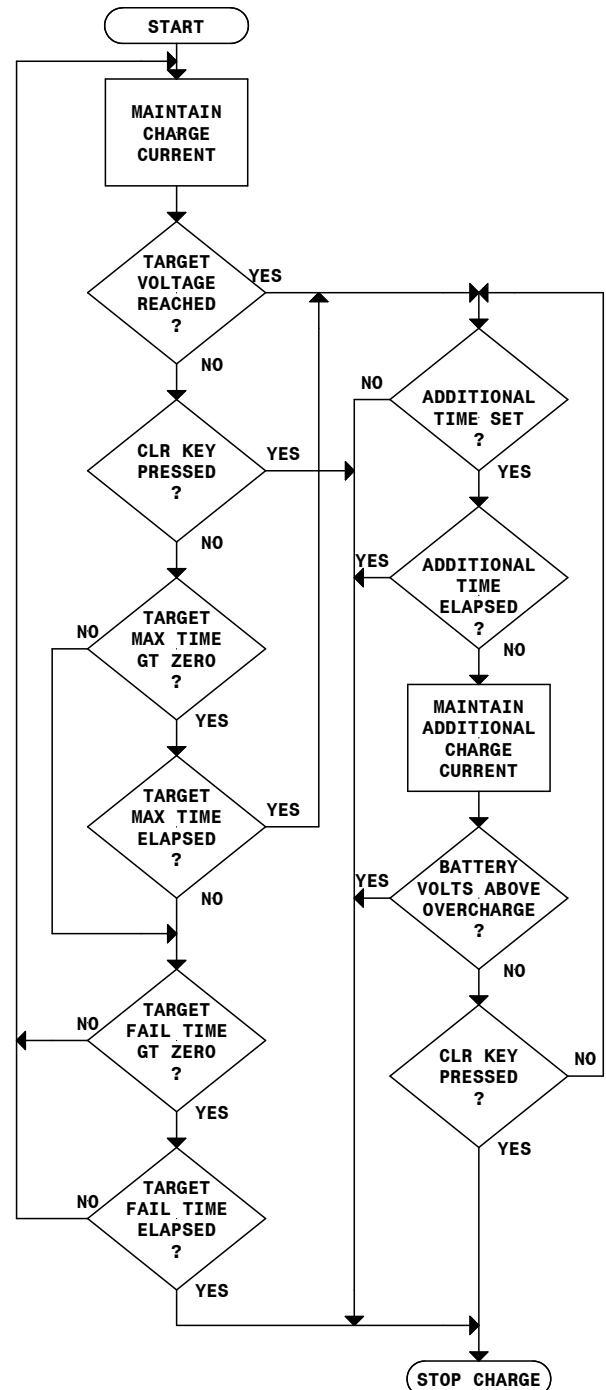
Maximum Time: This is the maximum time that the main charge can be applied, if zero is entered the extra target fail time will be requested.

Target Fail : If the **Target Volts** has not been reached within this value of time then the charge will stop. Set to zero if not required.

Extra Time : If set to a value greater than zero the charge will continue for this **Extra Time** once the **Target Voltage** has been achieved.

Extra Amps : If the **Extra Time** has been set to a value greater than zero this defines the constant current amps to deliver to the battery during the **Extra Time**.

Overcharge Volts : During the **Extra Time** the charge will stop if the battery voltage reaches this value.



6.3 Multi-Step Constant Current Charge

This charge mode is designed for NiCd batteries but can be used for any type of battery, which requires multi-step constant current charge. The unit will charge at the set amps for the time set for each step. During the charge the battery voltage will be monitored and the charge will stop if the overcharge voltage is exceeded. During the charge pressing the 'ENT' key can manually advance each step. The parameters for the charge are as follows: -

Step #1 Charge Amps : This is the constant current amps for step 1.

Step #1 Charge Time : This is the amount of time the charge is maintained for step 1.

Step #2 Charge Amps : This is the constant current amps for step 2.

Step #2 Charge Time : This is the amount of time the charge is maintained for step 2.

Step #3 Charge Amps : This is the constant current amps for step 3.

Step #3 Charge Time : This is the amount of time the charge is maintained for step 3.

Step #4 Charge Amps : This is the constant current amps for step 4.

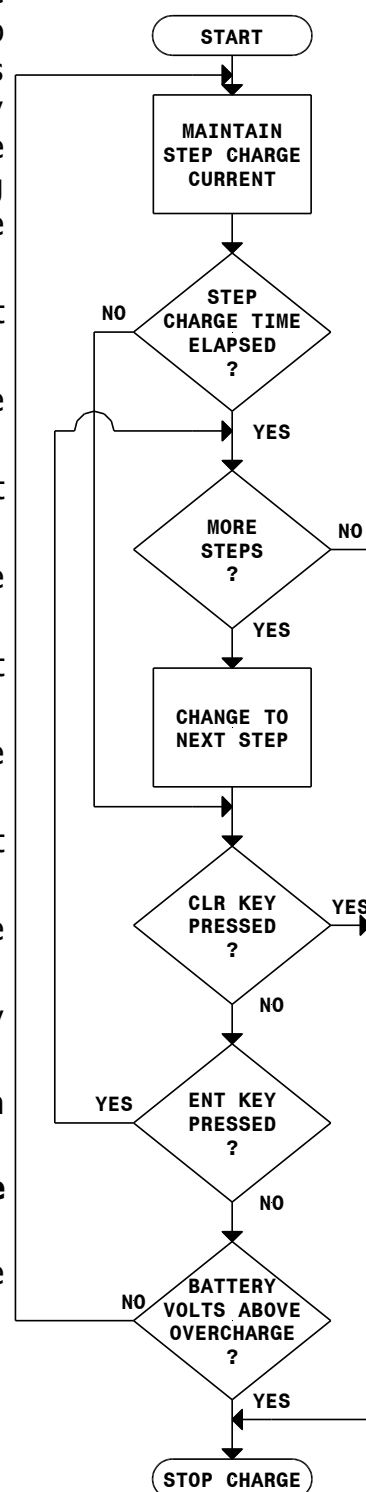
Step #4 Charge Time : This is the amount of time the charge is maintained for step 4.

Overcharge Volts : During the charge if the battery voltage exceeds this value then the charge will stop.

Note : Steps can have zero **Charge Amps** if a pause in charging is required between steps.

Steps that are not needed are simply set to zero **Charge Time** and zero **Charge Amps**.

At any time during the charge a step can be advanced before the time has elapsed by pressing the 'ENT' key.



6.4 Constant Current Charge Using Cell Monitor

This charge mode is designed for NiCd type batteries, but can be used for any battery type, which requires a constant current charge and has a cell voltage of 1.20V. The charge current is maintained at a constant current until all the cells have reached the cell target voltage. The parameters for the charge are as follows: -

Cell Target Volts : When all the cells have reached this voltage the charge will stop or switch to **Extra Time**.

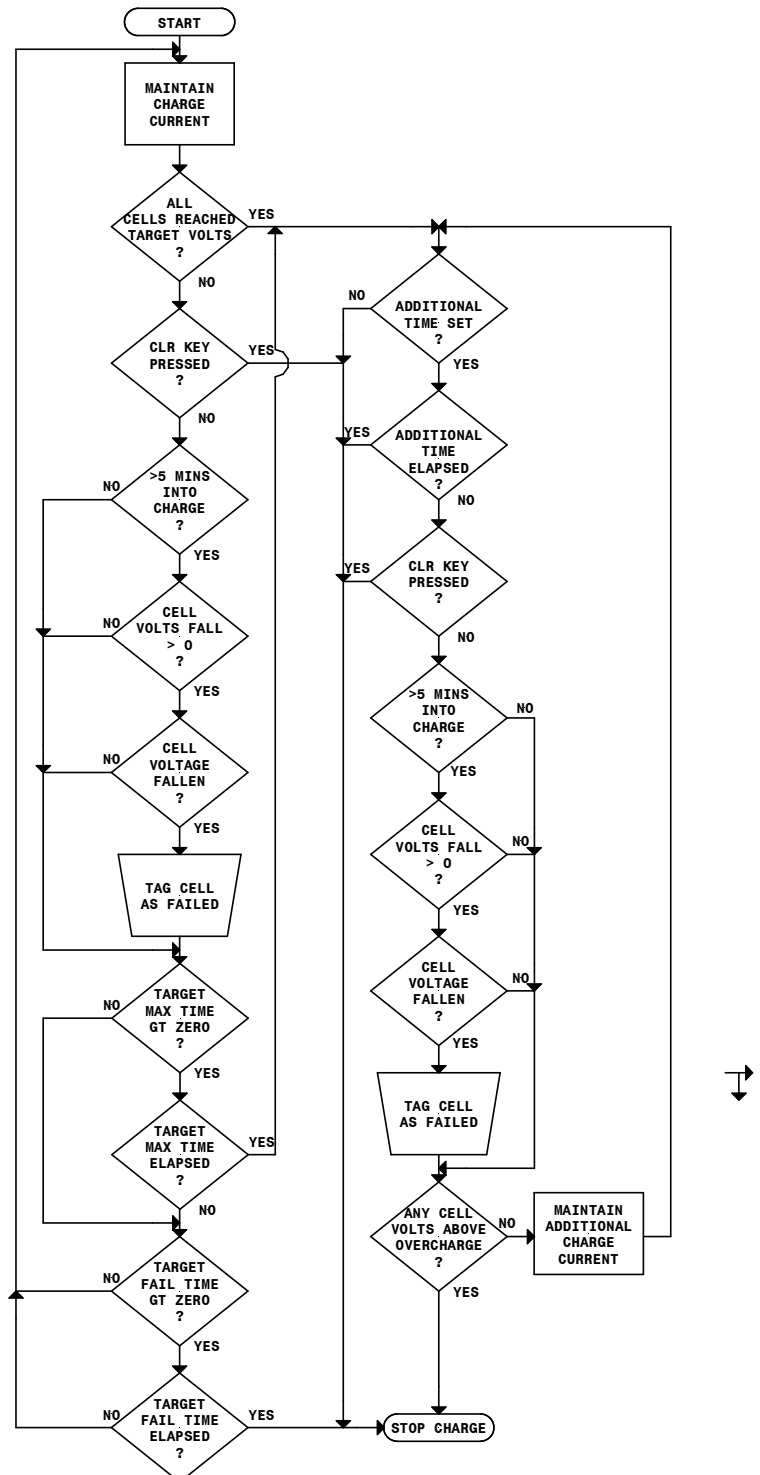
Charge Amps : This is the constant current amps to deliver to the battery until the **Cell Target Volts** has been reached.

Maximum Time: This is the maximum time that the main charge can be applied, if zero is entered the extra target fail time will be requested.

Target Fail : If the **Cell Target Volts** has not been reached within this time then the charge will stop. Set to zero if not required.

Extra Time : If set to a value greater than zero the charge will continue for this **Extra Time** time once the **Cell Target Volts** has been reached.

Extra Amps : If the **Extra Time** has been set to a value greater than zero this



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defines the amps to deliver to the battery during the **Extra Time**.

Cell Overcharge volts : During the whole charge process the charge will stop if any cell voltage reaches this value.

Cell voltage fall detection: This value is used to detect a fall in cell voltage, which usually does not happen once a charge has stabilised, this value is set to non zero if this feature is to be used.

Cell Print Interval : If a printer is available this value defines the period at which the cell voltages are printed.

6.5 *Performing A Charge*

6.5.1 Charge From A Library Entry

- Connect the battery to be charged and apply power to the unit.
- From the **MAIN** screen select **CHARGE** followed by **LIBRARY**.
- Using the **←→↑↓** arrows move the high light to point to the battery.
- Select **EXECUTE**.
- If a blank entry is selected the unit will warn that no data is exists.
- The unit will display the charge data for checking.
- To begin the charge select **START** or **TIMED**.
- If printer fitted and battery serial number set to on, the battery serial number will be requested at this point.

6.5.2 Charge From Manual Data

- Connect the battery to be charged and apply power to the unit.
- From the **MAIN** screen select **CHARGE** followed by **MANUAL**.
- Enter the charge data as requested.
- The unit will display the charge data for checking.
- To begin the charge select **START** or **TIMED**.
- If printer fitted and battery serial number set to on, the battery serial number will be requested at this point.

6.5.3 Charge From Previous Data

- Connect the battery to be charged and apply power to the unit.
- From the **MAIN** screen select **CHARGE** followed by **PREVIOUS**.
- The unit will display the charge data for checking.
- To begin the charge select **START** or **TIMED**.
- If printer fitted and battery serial number set to on, the battery serial number will be requested at this point.

7 Battery Capacity Test or Discharge Operation

7.1 Capacity Test To Time

This mode will discharge the battery at the predefined current until the set time has elapsed. If the battery target voltage has not been reached the unit will stop and report a capacity test of 100%. This reported capacity is the minimum capacity of the battery. If the battery target voltage is reached before the set time the unit will stop and report the capacity calculated as follows: -

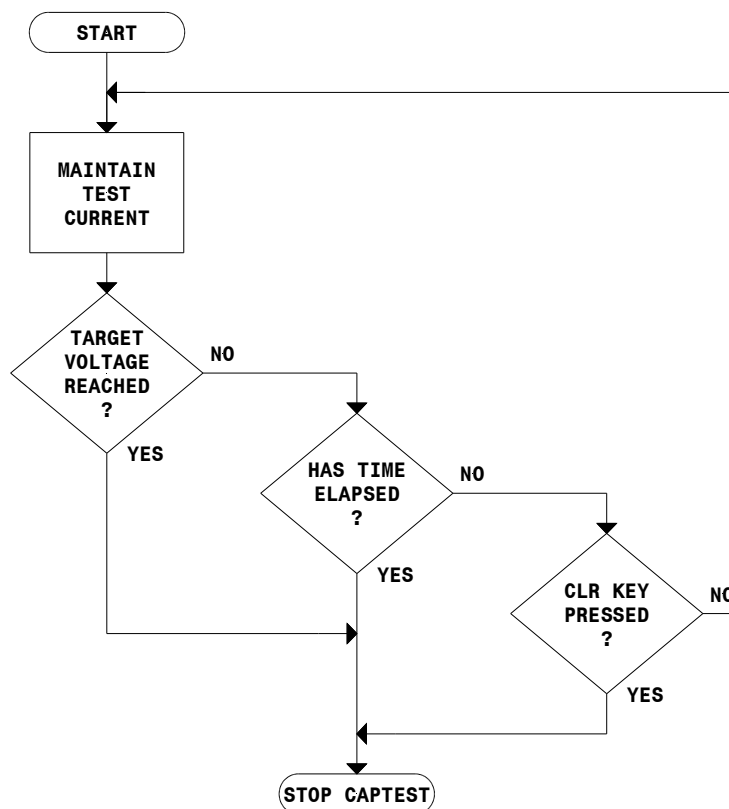
$$\% \text{BATTERY CAPACITY} = \frac{\text{ACTUAL CAPTEST TIME}}{\text{CAPTEST TIME}} \times 100$$

The parameters required for this mode are as follows: -

Target Volts : This is the point at which the discharge will stop.

Discharge Amps : This is the constant current amps to discharge the battery. This is usually the A/H rating of the battery.

Test Time : This is the maximum time at which the discharge test is to be performed. This is usually 1 Hour.



7.2 Capacity Test To Target Voltage

This mode will discharge the battery at the predefined current until the target voltage is reached. At this point the unit will stop and report the battery capacity as follows: -

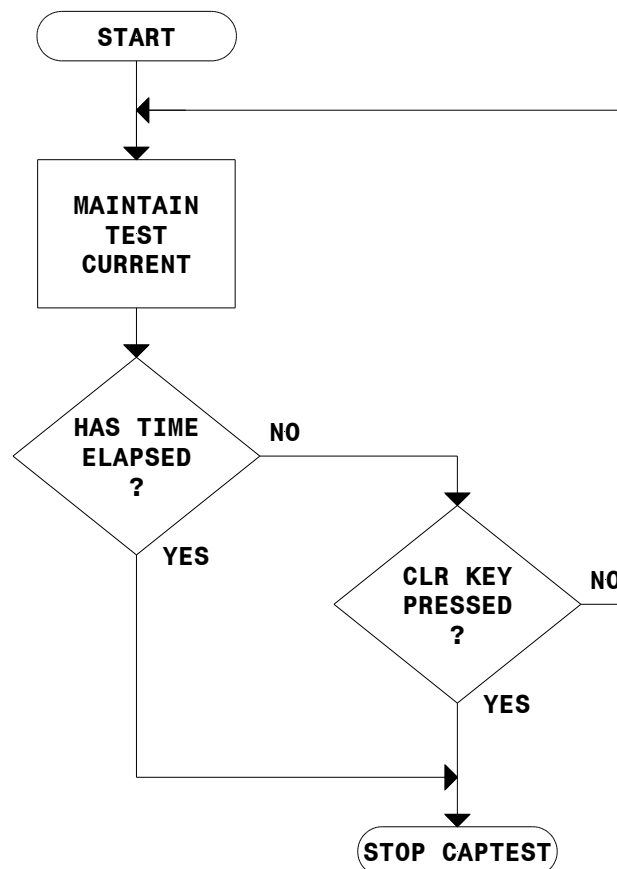
$$\% \text{BATTERY CAPACITY} = \frac{\text{ACTUAL CAPTEST TIME}}{\text{CAPTEST TIME}} \times 100$$

This mode can be used to discharge the battery and report the actual battery capacity. The parameters required for this mode are as follows: -

Target Volts : This is the point at which the discharge will stop.

Discharge Amps : This is the constant current amps to discharge the battery. This is usually the A/H rating of the battery.

Test Time : This is required to calculate the actual capacity of the battery at the end of the test. This is usually 1 Hour.



7.3 Capacity test Using Cell Monitor

This mode of operation requires the cell monitor to be connected to the battery before the capacity test can begin. In this mode the battery is discharged at the predefined current until the set time has elapsed. If the cell target voltage has not been reached the unit will stop and report a capacity test of 100%. This reported capacity is the minimum capacity of the battery. If any cell reaches the cell target voltage before the set time, the unit will stop and report the capacity calculated as follows: -

$$\% \text{BATTERY CAPACITY} = \frac{\text{ACTUAL CAPTEST TIME}}{\text{CAPTEST TIME}} \times 100$$

The parameters required for this mode are as follows: -

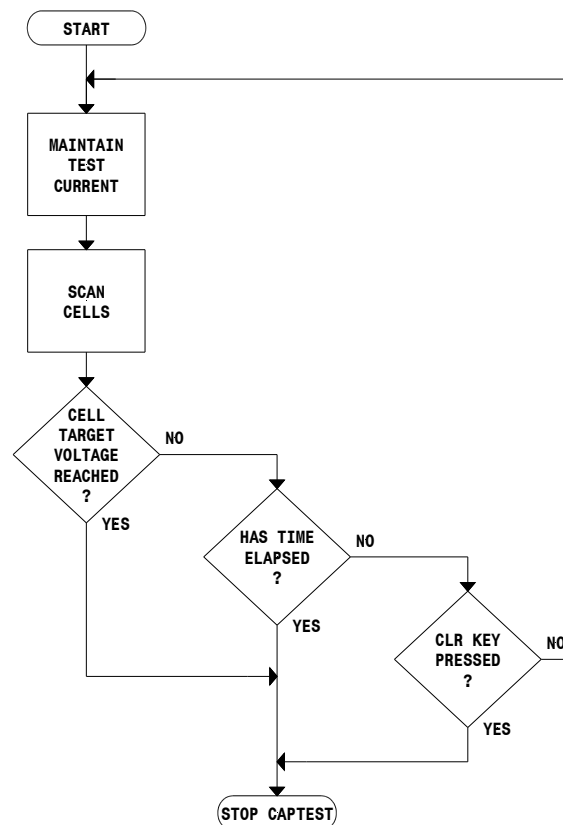
Number Of Cells : The number of cells in the battery pack.

Cell Target Volts : This is the point at which the discharge will stop.

Discharge Amps : This is the constant current amps to discharge the battery. This is usually the A/H rating of the battery.

Capacity Test Time : This is the maximum time at which the discharge test is to be performed. This is usually 1 Hour.

Cell Print Interval : If a printer is available this value defines the period at which the cell voltages are printed.



7.4 Capacity Test To Failed Cells

This mode of operation requires the cell monitor to be connected to the battery before the capacity test can begin. In this mode the battery is discharged at the predefined current until the set time has elapsed. If the battery voltage falls below the Target Volts before the capacity test time this reported capacity is the minimum capacity of the battery. If any cell reaches the cell target voltage before the set time or overall battery voltage set point the time that it fell below the set point will be logged and noted on the printed report. The reported capacity will be as follows: -

$$\% \text{BATTERY CAPACITY} = \frac{\text{ACTUAL CAPTEST TIME}}{\text{CAPTEST TIME}} \times 100$$

The parameters required for this mode are as follows: -

Number Of Cells : The number of cells in the battery pack.

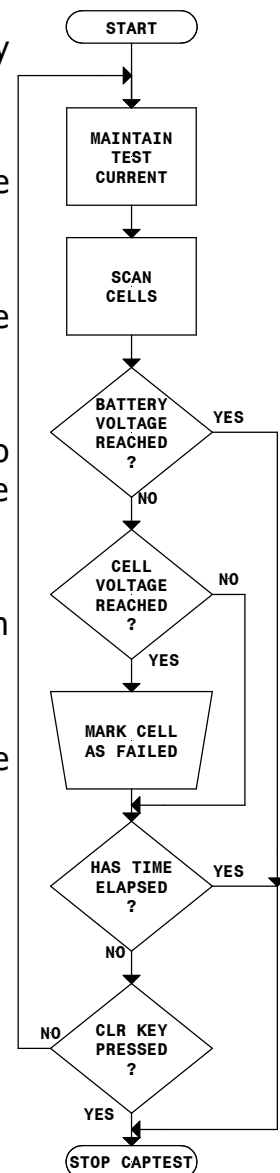
Target Volts : The battery voltage at which point the capacity test should stop if before the test time.

Cell Target Volts : This is the point at which the discharge will stop.

Discharge Amps : This is the constant current amps to discharge the battery. This is usually the A/H rating of the battery.

Capacity Test Time : This is the maximum time at which the discharge test is to be performed. This is usually 1 Hour.

Cell Print Interval : If a printer is available this value defines the period at which the cell voltages are printed.



7.5 Capacity Test Using A Fixed Resistor

In this mode the discharge current will fall as the battery voltage falls. It will discharge the battery at the current which is calculated continuously from the fixed resistor value entered and the battery voltage until the set time has elapsed. If the battery target voltage has not been reached the unit will stop and report a capacity test of 100%. This reported capacity is the minimum capacity of the battery. If the battery target voltage is reached before the set time the unit will stop and report the capacity calculated as follows: -

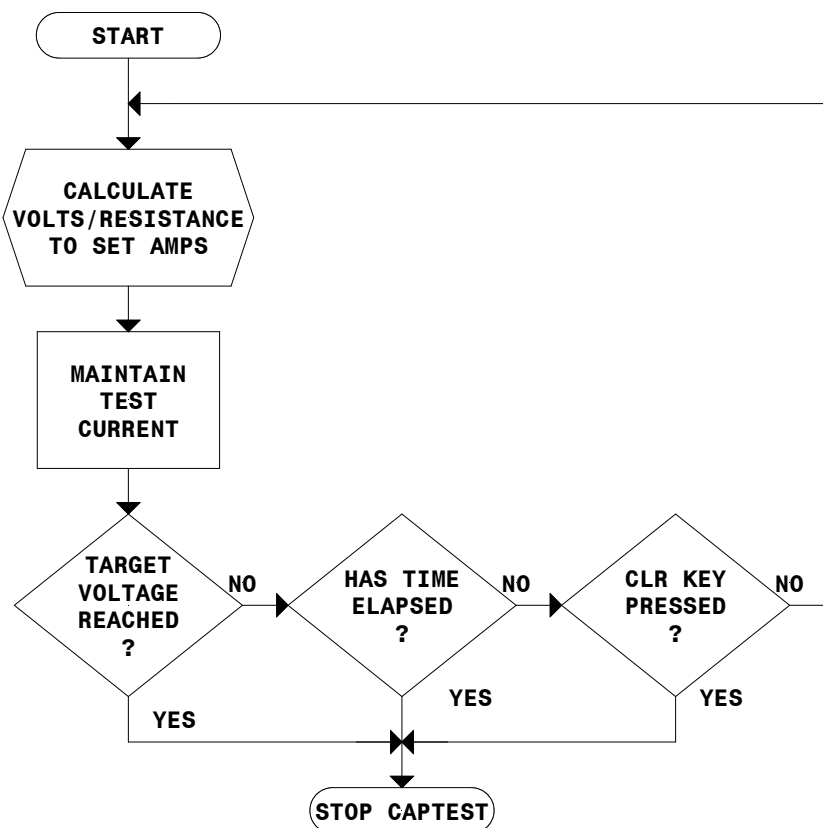
$$\% \text{BATTERY CAPACITY} = \frac{\text{ACTUAL CAPTEST TIME}}{\text{CAPTEST TIME}} \times 100$$

The parameters required for this mode are as follows: -

Target Volts : This is the point at which the discharge will stop.

Fixed Resistor Value : This is the resistance value of the emulated fixed resistor to be used.

Test Time : This is the maximum time at which the discharge test is to be performed. This is usually 1 Hour.



7.6 Automatic Cell Balancing

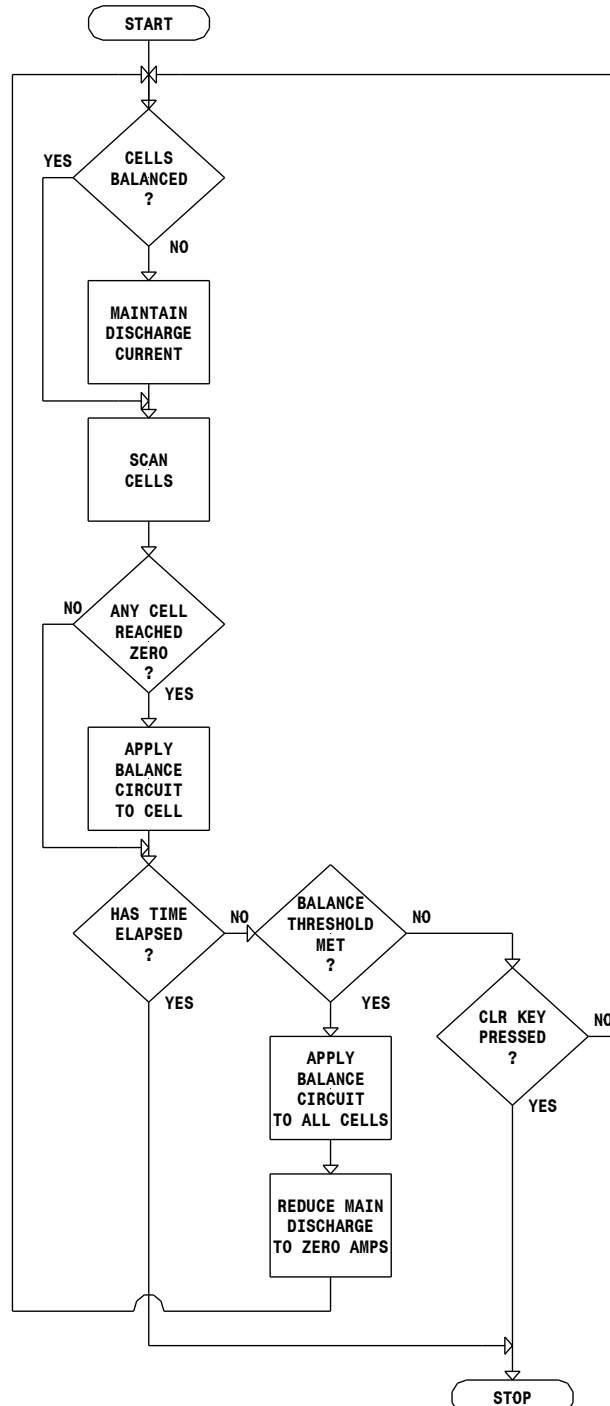
This mode of operation requires the cell monitor to be connected to the battery before the capacity test can begin. In this mode the battery will be discharged at the specified current until the battery voltage and the discharge current both fall below 2.0V and 3.0A respectively, at which point the unit will automatically switch in all balancing resistors and the unit will cease to discharge the battery relying on the balancing resistors to continue to discharge the battery. During the discharge if any cells falls to below zero volts the resistor will be switched in earlier to reduce the reverse charge condition. This mode will remain in operation until the discharge time has elapsed or the **CLR** key is pressed. During the total discharge process the cell voltages can be monitored and printed by pressing the **ENT** key.

The parameters required for this mode are as follows: -

Number Of Cells : The number of cells in the battery pack.

Discharge Amps : This is the constant current amps to discharge the battery.

Test Time : This is the maximum time at which the discharge test is to be performed.



7.7 Full Battery Discharge

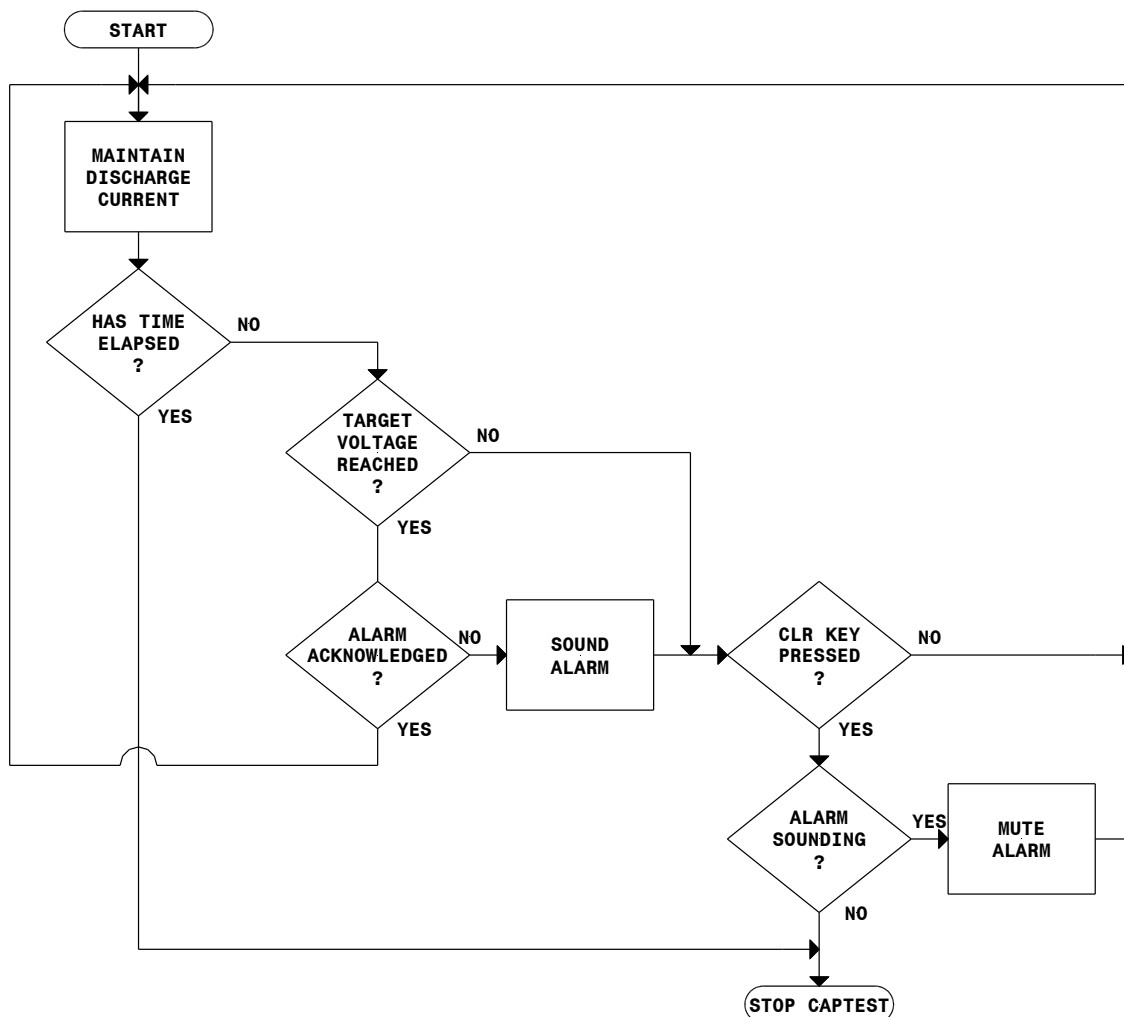
In this mode the battery is simply discharged at the **Discharge Amps** until the **Discharge Time** has been reached or stopped by pressing the **CLR** key. The **Alarm Volts** is used as an alert where manual application of balancing resistors is required where a cell monitor function has not been deployed. Once the alarm is sounding the unit will continue to discharge the battery and can be cleared by pressing the '**CLR**' key once.

The parameters required for this mode are as follows: -

Alarm Volts : This is the point at which the alarm will sound.

Discharge Amps : This is the constant current amps to discharge the battery.

Test Time : The length of time the discharge is to operate.



7.8 *Performing A Capacity Test*

7.8.1 Capacity Test or Discharge From A Library Entry

- Connect the battery to be discharged and apply power to the unit.
- From the **MAIN** screen select **DISCHARGE** followed by **LIBRARY**.
- Using the **←→↑↓** arrows move the high light to point to the battery.
- Select **EXECUTE**.
- If a blank entry is selected the unit will warn that no data is exists.
- The unit will display the charge data for checking.
- To begin the charge select **START** or **TIMED**.
- If printer fitted and battery serial number set to on, the battery serial number will be requested at this point.

7.8.2 Capacity Test or Discharge From Manual Data

- Connect the battery to be discharged and apply power to the unit.
- From the **MAIN** screen select **DISCHARGE** followed by **MANUAL**.
- Enter the discharge data as requested.
- The unit will display the charge data for checking.
- To begin the charge select **START** or **TIMED**.
- If printer fitted and battery serial number set to on, the battery serial number will be requested at this point.

7.8.3 Capacity Test or Discharge From Previous Data

- Connect the battery to be discharged and apply power to the unit.
- From the **MAIN** screen select **DISCHARGE** followed by **PREVIOUS**.
- The unit will display the charge data for checking.
- To begin the charge select **START** or **TIMED**.
- If printer fitted and battery serial number set to on, the battery serial number will be requested at this point.

8 Creating Or Modifying Library Entries

The Battery Charger Analyser has a set of built in user-defined battery charge and capacity test parameters. The following procedure has to be observed to either enter new items or modify existing entries or erase an entry completely.

- From the **MAIN** screen select **CHARGE** or **DISCHARGE**
- Select **LIBRARY**.
 - Using the **←→↑↓** arrows move the high light to point to the battery.
 - Select **DELETE** if you wish to remove this item from the library.
 - Select **PRINT** if you want to make a hard copy of the item selected.
 - Select **MODIFY** to make changes to the selected item.
 - If the selected item is marked as **NO DATA** the name for this item will be requested.

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- If the name entered is the same as an existing library entry the parameters for the existing entry will be used to be modified.
- The charge parameters will then be requested.
- Followed by the capacity test parameters.
- Once the parameters have been entered the library entry will be shown in the library list.
- Note the new entry will be inserted after the last valid library entry.
- Press '**CLR**' repeatedly to return to the main screen.

8.1 Data Entry Procedure

When creating or modifying a library entry, or entering manual battery data for a one off charge or discharge the unit will prompt for necessary values for each charge or discharge mode selected.

When entering data the '**CLR**' will backspace any wrongly entered values. If the data field is empty (i.e. cursor in first location) the whole data entry process will be aborted and the charger will take you back to the **MAIN** page.

8.2 Entering Charge Data

From the **MAIN** screen by selecting **CHARGE -> MANUAL**

From the **MAIN** screen by selecting **CHARGE -> LIBRARY -> ←→↑↓ -> MODIFY**

From the **MAIN** screen by selecting **PROCESS -> PROCESS # -> VIEW/EDIT -> MODIFY -> CHARGE BATTERY.**

The screen will request **CHARGE TYPE.**

Select >> **NEXT** >> or << **PREV** << to change to either : -

CONSTANT VOLTAGE CHARGE

CONSTANT CURRENT CHARGE

MULTI-STEP CHARGE

CELL MONITOR CC CHARGE

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The following tables explain what the values entered mean.

CONSTANT VOLTAGE CHARGE		
Value Required	Units	Description
Nominal Volts	Volts.	The battery nominal voltage is used to determine what power supply setting to use and also to help validate the data entered.
Target Voltage	Volts.	This is the constant voltage set point.
Charge Amps	Amps.	This is the maximum charge amps to put into the battery before the CV point is met at which point it will reduce.
Charge Time	Hours and Minutes.	The maximum charge time.
Min	Amps.	When the charge current falls below this value the charge will stop. If not used set to zero.
Rise	Amps	When the charge has reached the CV crossover point the current would normally continuously fall. If it was to rise again it is an indication of potential plate failure. This value can be set to stop the charge if the current should increase above the value entered. Set to zero if not required.
Target Fail	Hours and Minutes.	It can be determined by the battery A/H and the maximum charge amps that the battery would reach its CV point at a known time. If the battery takes significantly longer than calculated time then it can be an indication of internal plate failure and potential overheating. This value of time will stop the charge if the time elapses before the Target Voltage is achieved. If not required set to zero.

CONSTANT CURRENT CHARGE		
Value Required	Units	Description
Nominal Volts	Volts.	The battery nominal voltage is used to determine what power supply setting to use and also to help validate the data entered.
Target Volts	Volts.	This is the voltage at which point the charge will stop or switch to the TopUp charge if one has been set.
Charge Amps	Amps.	This is the constant current charge current.
Max Charge Time	Hours and Minutes	If this value is set to a non zero value the charge will stop or switch to the TopUp charge if one has been

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		set, at the preset time if the target voltage has not been met.
Target Fail Time	Hours and Minutes.	If a Max Charge Time has not been set the charge will stop if this time is met before the target voltage has been achieved. It will not switch to TopUp charge.
TopUp Amps	Amps.	If a TopUp charge is required this is the constant current TopUp current. If no TopUp is required set to zero.
TopUp Time	Time.	If a TopUp charge is required this is the length of the TopUp.
Overcharge Volts.	Volts.	During the TopUp charge the voltage can be detected and stopped if the Overcharge Voltage is exceeded.

MULTI-STEP CHARGE

Value Required	Units	Description
Nominal Volts	Volts.	The battery nominal voltage is used to determine what power supply setting to use and also the help validate the data entered.
Charge Amps #1	Amps.	Constant current step #1 current.
Charge Time #1	Hours and Minutes.	Constant current step #1 charge duration.
Charge Amps #2	Amps.	Constant current step #2 current.
Charge Time #2	Hours and Minutes.	Constant current step #2 charge duration.
Charge Amps #3	Amps.	Constant current step #3 current.
Charge Time #3	Hours and Minutes.	Constant current step #32 charge duration.
Charge Amps #4	Amps.	Constant current step #4 current.
Charge Time #4	Hours and Minutes.	Constant current step #4 charge duration.
Overcharge Volts	Volts.	Over charge voltage point to stop charge.

CELL MONITOR CC CHARGE

Value Required	Units	Description
Number of cells	1 to 20	The number of cells in the battery.
Target Volts	Volts.	This must be the cell target volts. When all cells are above this value, but under the overcharge voltage, the charge will move to the TopUp charge if one has

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		been set.
Charge Amps	Amps.	This is the constant current charge amps for main charge.
Max Charge Time	Hours and Minutes	If this value is set to a non zero value the charge will stop or switch to the TopUp charge if one has been set, at the preset time if the target voltage has not been met.
Target Fail Time	Hours and Minutes.	If a Max Charge Time has not been set the charge will stop if this time is met before the target voltage has been achieved. It will not switch to TopUp charge.
TopUp Amps.	Amps.	If a TopUp charge is required this is the constant current TopUp current. If no TopUp is required set to zero.
TopUp Time	Hours and Minutes	If a TopUp charge is required this is the length of the TopUp.
Cell Voltage Fall	Volts.	
Cell Overcharge	Volts.	During the charge the cell voltage is detected and stopped if the Overcharge Voltage is exceeded.
Cell Print Interval	Minutes.	During the whole charge the cell voltages can be printed at periodic intervals in minutes. If not required set to zero. Note during the charge the cell voltages can be manually printed at any time by pressing the '.' key.

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8.3 *Entering Discharge Data*

From the **MAIN** screen by selecting **CHARGE** -> **MANUAL**

From the **MAIN** screen by selecting **CHARGE** -> **LIBRARY** -> **↔↑↓** -> **MODIFY**

From the **MAIN** screen by selecting **PROCESS** -> **PROCESS #** -> **VIEW/EDIT** -> **MODIFY** -> **CHARGE BATTERY**.

The screen will request **CHARGE TYPE**.

Select >> **NEXT** >> or << **PREV** << to change to either : -

STANDARD CAPACITY TEST

CAP TEST CELL MONITOR

CAPTEST TO FAILED CELLS

CAPTEST FIXED RESISTOR

AUTOMATIC CELL BALANCE

FULL DISCHARGE

The following tables explain what the values entered mean.

STANDARD CAPACITY TEST		
Value Required	Units	Description
Selection	-	Select either : - TIME & TARGET = 100% OR LESS TARGET ONLY = ACTUAL CAPACITY
Nominal Volts	Volts.	The battery nominal voltage is used to determine what power rating is required for discharge and also the help validate the data entered.
Target Volts	Volts.	The target volts is the discharged voltage that the charge should stop the discharge and report the battery capacity.
Discharge Amps	Amps.	This is the constant current discharge amps that the battery has to be discharged at.
Discharge Time	Hours and Minutes.	This is the discharge time (usually 1 hour). If TIME & TARGET has been selected when this time is reached the charge will stop and report the battery capacity of 100%, otherwise the discharge will continue to report actual capacity.

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CAP TEST CELL MONITOR		
Value Required	Units	Description
Selection	-	Select either : - TIME & TARGET = 100% OR LESS TARGET ONLY = ACTUAL CAPACITY
Number of Cells	1 to 20	The number of cells in the battery.
Target Volts	Volts.	This is the minimum cell voltage that the discharge must go to. Once one cell meets this voltage the capacity test will stop, if before the discharge time. Once it stops it will report the battery capacity.
Discharge Amps	Amps	The discharge current to maintain.
Discharge Time	Hour and Minutes.	This is the discharge time (usually 1 hour). If TIME & TARGET has been selected when this time is reached the charge will stop and report the battery capacity of 100%, otherwise the discharge will continue to report actual capacity.
Cell Print Interval	Minutes.	During the whole charge the cell voltages can be printed at periodic intervals in minutes. If not required set to zero. Note during the charge the cell voltages can be manually printed at any time by pressing the '.' key.

CAPTEST TO FAILED CELLS		
Value Required	Units	Description
Selection	-	Select either : - TIME & TARGET = 100% OR LESS TARGET ONLY = ACTUAL CAPACITY
Number of Cells	1 to 22	The number of cells in the battery.
Target Volts	Volts.	The battery voltage at which point the discharge is to stop if the time up has not elapsed. At which point it will report the battery capacity as a function of time.
Discharge Amps	Amps	The discharge current to maintain.
Discharge Time	Hour and Minutes.	The maximum time for the capacity test usually 1 hour. When this time is elapsed the battery capacity will be reported as 100%.
Cell Fail Volts	Volts.	During the discharge the cell voltages are monitored and if any cell voltage falls below this figure the cell

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		will be tagged as failed and the time of failure recorded.
Cell Print Interval	Minutes.	During the whole charge the cell voltages can be printed at periodic intervals in minutes. If not required set to zero. Note during the charge the cell voltages can be manually printed at any time by pressing the '.' key.

CAPTEST FIXED RESISTOR

Value Required	Units	Description
Selection	-	Select either : - TIME & TARGET = 100% OR LESS TARGET ONLY = ACTUAL CAPACITY
Nominal Volts	Volts.	The battery nominal voltage is used to determine what power rating is required for discharge and also the help validate the data entered.
Target Volts	Volts.	The target volts is the discharged voltage that the charge should stop the discharge and report the battery capacity.
Discharge Resistance	Ohms.	This is the virtual resistance to be used to calculate discharge amps based on battery voltage.
Discharge Time	Hours and Minutes.	This is the discharge time (usually 1 hour). If TIME & TARGET has been selected when this time is reached the charge will stop and report the battery capacity of 100%, otherwise the discharge will continue to report actual capacity.

AUTOMATIC CELL BALANCE

Value Required	Units	Description
Number of Cells	1 to 20	The number of cells in the battery.
Discharge Amps	Amps.	The discharge current to maintain.
Discharge Time	Hours and Minutes.	The duration of the discharge, this will usually be a long time such as 17 hour so that full cell discharge has been achieved.
Cell Print Interval	Minutes.	During the whole charge the cell voltages can be printed at periodic intervals in minutes. If not required set to zero. Note during the charge the cell voltages can be manually printed at any time by pressing the '.' key.

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FULL DISCHARGE		
Value Required	Units	Description
Nominal Volts	Volts.	The battery nominal voltage is used to determine what power rating is required for discharge and also the help validate the data entered.
Alarm Volts.	Volts.	When the battery voltage falls below this set point the alarm will sound alerting the operator.
Discharge Amps	Amps	The discharge current to maintain. Note when the battery voltage falls to below one volt the discharge current will begin to fall due to the internal resistance and blocking diodes used in the discharge circuit.
Discharge Time	Hours and Minutes.	The discharge will continue for this set amount of time.

9 Process Mode

9.1 Overview Of Operation

Until now each charge or discharge action could only be done manually through a single set up and execution. The unit has now a process mode whereby multiple charge and discharge operations can be performed automatically.

The unit caters for up to four independent process trees containing up to six steps in each. Once a process tree is created it can be named and is stored in the units non-volatile memory so it can be recalled for subsequent re-use.

Each step in a process, apart from the usual charge and discharge parameters has three additional parameters.

At the beginning of each step a **Start Delay** can be specified to delay the process step, this may be after a high discharge or cell balance the battery can be "rested" before the charge can begin.

Also at the end of each step there are three options.

- **ALARM DISABLED**

At the end of the current step the next step will continue automatically.

- **ALARM & PAUSE**

At the end of the current step the alarm will sound and the next step will be paused until the '**ENT**' key is pressed. The alarm can be muted by pressing the '**CLR**' key once.

- **ALARM & CONTINUE**

At the end of the current step the alarm will sound and continue to sound until it is muted by pressing '**CLR**' once.

At the end of each step results will be printed if the **Prnt Yes** option is selected, this means that selective steps can be printed where the information is required, such as a Capacity Test where the capacity percentage needs to be known. Mundane steps such as cell balancing which may not need to be printed will not be if the print option is set to **Prnt Off**. Note if the print option is **Prnt Off**, the periodic cell value printing will also be disabled for this step.

9.2 Process Menu

To access the process menu select **PROCESS**. The four available processes will be displayed to the right and each one can be selected by pressing the appropriate key, '**A**', '**B**', '**C**' or '**.**'.

If a process has been named it's name will show, if it has not been named the display will simply show **PROCESS #1**, **PROCESS #2**, **PROCESS #3** & **PROCESS #4**.

Once the process has been selected the display will show the process name date last modified and the basic step information.

Select **RENAME** to set a recognisable name.

Select **VIEW/EDIT** to view and edit the process steps.

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Select **PRINT** to make a hard copy of all the process steps.
Select **EXECUTE** to start the process.

9.2.1 Renaming a process

A process name can consist of any types characters up to a maximum of ten.

To create letters above C the '**A**' key must be pressed repeatedly to go through all the letters in the alphabet, upper case only. To create punctuation mark and space the '.' must be pressed repeatedly. Once the desired character has been selected a pause of approx. 1 second must be observed to move the cursor to the next character position on the next keypress.

9.2.2 View or Edit A Process

When view or edit is pressed the details of the first process step will be displayed. If the process step has no data the display will show ""**PRESS MODIFY TO CREATE STEP**".

Selecting **NEXT STEP** will advance the process step to the next, until the last empty slot, or step 6, where it will then revert back to Step 1.

Selecting **PREV STEP** will cause the display to step back one step. Once step #1 is reached it will then revert back to the last empty step or step #6.

Selecting **CLR STEP** will cause the current process step to be cleared. If a step is cleared the steps that follow this step will be moved down one place, i.e. If step 3 is cleared step 4 will replace it, step 4 will be replaced by step 5, step 5 replaced by step 6 and step 6 will be cleared to a no action step.

Selecting **MODIFY** will start the data entry procedure. The display will show **SELECT MODE**.

Select **>> NEXT >>** or **<< PREV <<** to change to either : -

DISCHARGE BATTERY

CHARGE BATTERY

Press **ENT** to select either mode of operation.

The display will then ask for the charge or discharge data as per 8.2 Entering Charge Data or 8.3 Entering Discharge Data. Once the data entry is complete the display will show the data that has been selected.

9.3 Process Execution

To execute a process one must already be defined and properly configured. To start the process the following procedure must be applied.

- Check battery is correctly connected and a voltage is displayed in the main

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- menu.
- If using the cell monitor ensure that the cell monitor is connected correctly and check the cell readings using the **CELL MONIT** display window first.
- Select **PROCESS** menu.
- Select the process to be executed from the list shown.
- Select **EXECUTE** to start the process mode running.
- If printer fitted and battery serial number set to on, the battery serial number will be requested at this point.

At this point the unit will start execution of the process at step 1, continuing on through to the last step in the process tree.

9.4 **Process Termination**

Each process step will be executed normally, but under certain conditions the unit will stop the process if these conditions which are not a successful charge or capacity test. The following are termination conditions which will cause the next process to continue normally: -

BATTERY < TARGET VOLTS	Successful completion of capacity test before time up.
CHARGE COMPLETED	Successful completion of charge.
CAPACITY TEST COMPLETED	Successful completion of capacity test to time up.
DISCHARGE COMPLETE	Stopped as discharge is complete.

All other reasons are considered battery fault so therefore the process mode will stop for safety reasons.

At any point during the process the '**CLR**' key can be pressed to stop the process execution.

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10 Calibration

The Battery Charger Analyser has its own built in automatic calibration procedures which allow for quick adjustment of errors due to component ageing.

The calibration check is recommended done yearly and built into the Battery Charger Analyser is the ability to record the date of the last calibration and give indication on the printed report that the calibration has expired.

This is indicated by the line ***** **Serviceable** ***** when in date or *** **Calibration Due** *** when the calibration date has expired.

10.1 Equipment Required

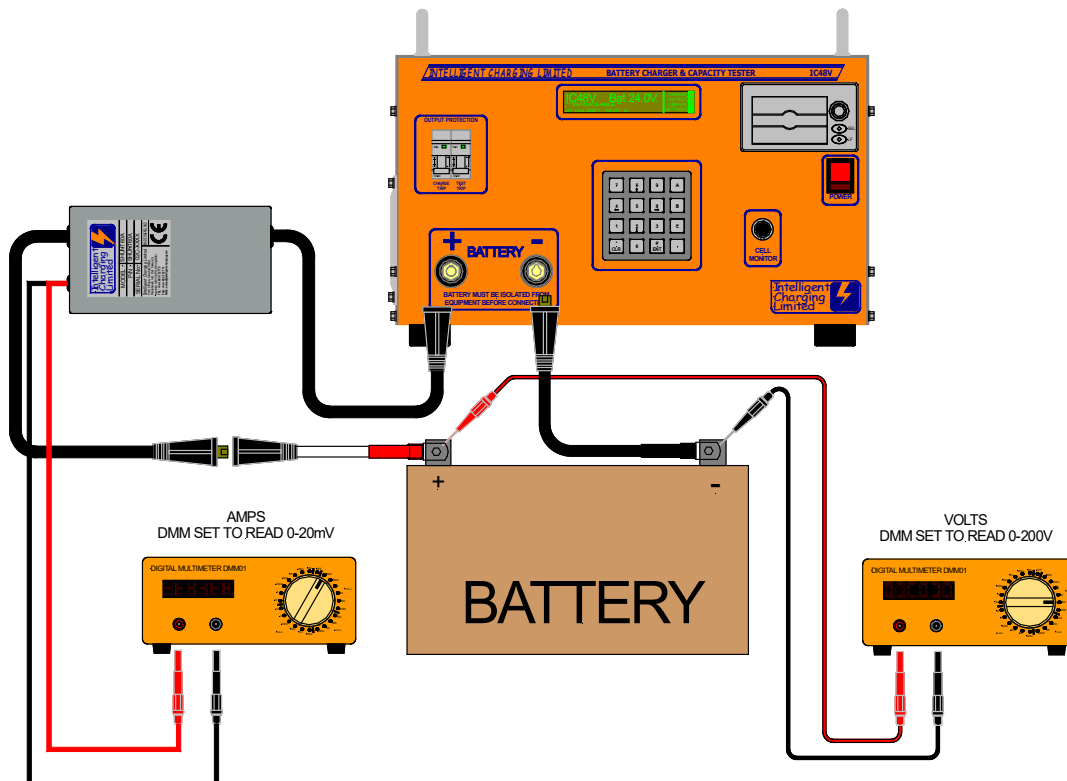
Calibrated Digital Multimeter capable of displaying 24V to two decimal places.

Calibrated Digital Ammeter capable of displaying 13A to two decimal places.

or

Calibrated Digital Multimeter capable of displaying 13mV to two decimal places and the SHUNT60A or equivalent 60A/60mV shunt.

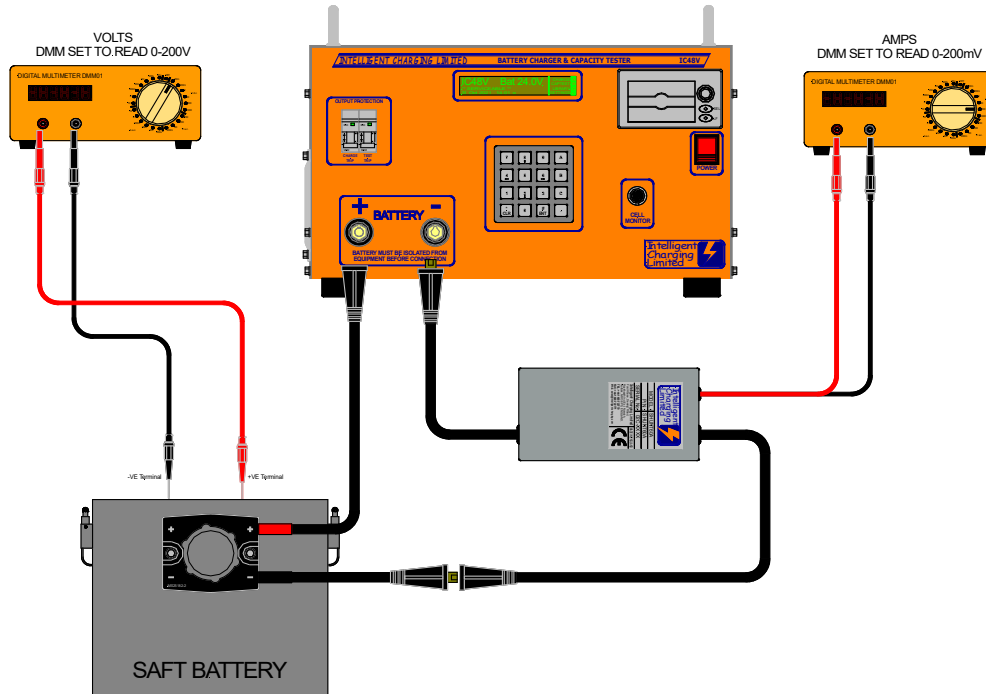
10.2 Calibration Equipment Connection



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10.3 Calibration Connection using Rebling 7007 (ELCON) connector



10.4 Check Procedure

Once per year the following calibration procedure should be applied.

- Connect a good quality 24V battery to the Battery Charger Analyser.
- Measure battery voltage and verify the Battery Charger Analyser display is within tolerance.
- Perform a capacity test at approx 13A.
- Measure the current passing out of the battery and verify that the Battery Charger Analyser display is within tolerance.
- Perform a charge at approx 13A.
- Measure the current being passed to the battery and verify that the Battery Charger Analyser display is within tolerance.

If these parameters are outside of specification then the **Calibration Adjustment** procedure should be followed.

If these check show that the Battery Charger Analyser is within tolerance and no adjustment is necessary then the following procedure need to be applied to the Battery Charger Analyser to reset the calibration date to the current date.

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Select **SETTINGS** -> **SYSTEM** -> **CALIBRATE** -> **RESET DATE**

- When requested enter the 4 digit serial number of the unit and press '**ENT**'.
- A confirmation screen will be displayed.

10.5 ***Making Calibration Adjustment***

If the calibration check has been performed and the unit is out of tolerance then a calibration adjustment will need to be performed. the following procedure needs to be observed in order to perform a calibration adjustment.

A good 24V battery and voltmeter and ammeter will need to be connected to the unit during this procedure.

SETTINGS -> **SYSTEM** -> **CALIBRATE** -> **ADJUSTMENT**

- When requested enter the 4 digit serial number of the unit and press '**ENT**'
- When requested enter the measured battery voltage and press '**ENT**'
- The charger will then set up a charge of approximately 14.0A
- Allow the charge current to stabilise.
- When requested enter the charge current and press '**ENT**'
- The charge will then set up a discharge of approximately 14.0A
- Allow the capacity test current to stabilise.
- When requested enter the capacity test current and press '**ENT**'
- The battery voltage is also measured again here to calculate the lead voltage drop to be used in voltage readings.
- When requested enter the Battery voltage and press '**ENT**'
- A confirmation screen will be displayed and the unit will go back to the Main Menu.

Note the unit has a build-in calibration checking and if any of the entered data does not correlate to valid calibration values stored internally it will sound the alarm and display a warning message and the calibration will be discarded. This protects the unit from incorrectly entered values.

The calibration procedure will have to be re-executed and if the error is repeated then the unit may have a fault and will need to be returned for service or repair.

10.6 ***Reviewing Calibration Date***

The calibration parameters can be displayed or printed out on the built in printer. To perform this operation the following procedure must be observed.

Select **SETTINGS** -> **PRINT** or **DISPLAY** -> **SYSTEM**

The unit will then print or display the calibration data.

11 Miscellaneous Unit Functions

11.1 *Description Of Stop Codes*

- **NO VALID DATA TO SHOW**

This will not usually appear. It is used when the battery charger has been reset and the previous end of charge or discharge results are requested.

- **BATTERY < TARGET VOLTS**

Applies to **CAPACITY TEST TO 100%** mode only. It indicates that the battery terminal voltage has reached the **Target Volts** setting this is a normal end of test condition and the capacity figure will be valid.

- **CHARGE COMPLETED**

Applies to all charge modes. It indicates that the **Charge Time** has been reached, or in **CONSTANT VOLTAGE CHARGE** an indication that the **Min Amps** point has been reached, in **CONSTANT CURRENT CHARGE** and **CELL MONITOR CC CHARGE** that the **Target Voltage** has been met where no **Extra Time** was specified.

- **CAPACITY TEST COMPLETED**

Applies to all capacity test modes. It indicates that the **Discharge Time** has been reached, or in **CAPACITY TEST TARGET** an indication that the **Target Voltage** has been met.

- **DISCHARGE COMPLETED**

Applies to all discharge modes. It indicates that the Discharge Time has been met.

- **OVERCHARGE VOLT REACHED**

Applies to **CONSTANT CURRENT CHARGE** and **MULTI-STEP CHARGE** modes. It is an indication that the **Overcharge Volts** set point has been reached.

- **BATTERY THRESHOLD AMPS**

Applies to **CONSTANT VOLTAGE CHARGE** only and indicates that the charge current has increased more than the **Amps Rise** threshold after the **Target Volts** had been achieved indicating a potentially faulty battery.

- **STOPPED BY OPERATOR**

Applies to all modes. Indicates that the charge or discharge operation was stopped by the operator pressing the '**CLR**' key.

- **BATTERY REV OR < 0.1V**

Applies to all modes. Indicates that a battery voltage less than 0.1V has been

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detected at start of operation indicating no battery connected or battery reverse connected.

- **FAILURE TO REACH TARGET**

Applies to **CONSTANT VOLTAGE CHARGE**, **CONSTANT CURRENT CHARGE** and **CELL MONITOR CC CHARGE**. Indicates that the battery voltage did not reach the set **Target Volts** within the **Target Fail** time.

- **EXCHANGER OVERHEAT**

Applies to all modes. Indicates that the heat exchanger has become too hot. This could be caused by obstructions to the airflow for cooling, or the unit is being operated at in high ambient temperature >30°C or in high altitudes where the air is thinner and its cooling effect is less efficient.

- **TRANSFORMER OVERHEAT**

Applies to all charge modes only. Indicates that the power transformers supplying the charge current are overheating. This could be caused by obstruction to the airflow within the unit or by operating the unit in temperatures > 30°C.

- **PARAMETER OUT OF RANGE**

Applies to all modes. Indicates that an operation is being requested that contains invalid data. This could be caused by failure of the backup battery. Replace battery as described in the SERVICE section found elsewhere in this manual. Note after battery replacement the unit will require recalibration.

- **CAPTEST AMPS EXCEEDED**

This is an indication that the capacity test amps is much greater than expected and cannot be reduced.

- **CHARGE AMPS EXCEEDED**

This is an indication that the charge amps is much greater than expected and cannot be reduced.

- **CANNOT GET ANY AMPS**

This is an indication that the charge or capacity test amps cannot be attained and is usually an indication that the circuit breakers have not been engaged.

- **CELL VOLTS FALL EXCEEDED**

This is an indication that during a cell monitor charge one or more cell voltages have fallen below the threshold if set.

- **CAPTEST POWER OVERLOAD**

Applies to discharge modes only. After 10 minutes into a capacity test the unit verifies it that the discharge amps and battery voltage combination does not exceed 10% above the watts rating for the unit. This error occurs because the unit is being operated outside of its limitations.

- **BATT VOLTS > TARG VOLTS**

Applies to **CONSTANT VOLTAGE CHARGE** mode only. This occurs when the

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battery voltage detected is 3.0V greater than the **Target Volts**. Note this can occur when a battery with a high impedance is connected to the unit. When current is applied to the battery its voltage rises dramatically high.

- **CELL MONITOR OFFLINE**

Applies to cell monitor charge and discharge modes only. It is an indication that the cell monitor is either not connected or has failed.

- **ERROR IN CELL VOLTAGES**

Applies to cell monitor charge and discharge modes only. This condition is reported if any cell voltage read goes below -2.0V or above +2.0V It can be caused by any of the cell input being disconnected. Use the cell monitor viewer to check connections.

- **MAINS POWER FAILURE**

This code will be displayed when a previous charge or discharge was stopped because of mains power failure. Note: If a timed start was active and the time had not elapsed the timed start will resume at the normal time.

- **CELL BELOW TARGET**

This code will be displayed when a cell monitor discharge which is used to obtain low cell values has been executed and has terminated with one or more cells below the target value.

11.2 ***Print Or Display Previous Operation Results***

The unit can store up to six previous charge and six previous capacity test operations.

Select **SETTINGS** -> **DISPLAY** or **PRINT** -> **PREVCHRG** or **PREVCAPT**

The display will then show the time started of each of the operations as shown below.

PRESS CHARGE NUMBER TO DISPLAY OR CLR			
1=24-11-2021	12:15	4=22-11-2021	13:45
2=23-11-2021	8:23	5=21-11-2021	8:42
3=23-11-2021	6:11	6=19-11-2021	17:29

Press the numeric key corresponding to the previous charge or capacity test you wish to display or print.

The last test results are stored in battery backed memory so the previous test results can be printed or displayed even if power had previously been removed from the unit.

11.3 ***Changing The Date Format And Date Time***

The unit has a battery backed built in clock and calendar which is used to time stamp test results and mark re-calibration events. It is important that the clock is set to the correct format, date and time for your region.

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Select **SETTINGS** -> **SET CLOCK**

Select >> **NEXT** >> or << **PREV** << to change to either : -

dd/mm/yyyy	18/11/2019
mm/dd/yyyy	11/18/2019
yyyy/mm/dd	2019/11/18
yyyy/dd/mm	2019/18/11
dd mmm yyyy	18 Nov 2019
mmm dd yyyy	Nov 18 2019

Press **ENT** to confirm.

Depending on the date format selected above the date and time will be requested one at a time.

The clock will be set to these settings. Note the clock does not automatically adjust to daylight saving time.

11.4 *Modifying Display Intensity*

The display on the unit has brightness control and this can be changed by pressing the **↑↓** arrow key repeatedly to get to the level you require.

The setting is maintained even after power has been removed from the unit.

Note in some operations like data entry the display brightness cannot be changed.

11.5 *Automatic screen dim*

When the charger is left idle for more than 15 minutes the screen will automatically dim to the lowest setting. Pressing any key will cause the display to revert back to the original screen setting. This is to extend the life of the VFD display.

11.6 *Printing battery serial number*

The battery serial number can be included in the printed report. This is requested from the operator when **START** or **DELAYED START** is selected.

By default the serial number on print option is turned off. To turn the request and print of the battery serial number the default setting has to be changed.

Select **SETTINGS** -> **SYSTEM** -> **MORE...** -> **BATT S/N**

Select >> **NEXT** >> or << **PREV** << to change to either : -

YES

NO

Press **ENT** to confirm.

If this is changed to "**yes**" then each time the **START** or **DELAYED START** is selected the serial number will be requested. The previous serial number is remembered so

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when working with the same battery in one session it does not need to be entered each time. If the printer is not fitted this setting has no effect.

11.7 *Printing operation data options.*

There are three printing options.

NEVER PRINT OPERATION DATA. When running a charge or capacity test the printer will not be used.

ALWAYS PRINT OPERATION DATA. When running a charge or capacity test the printer will always be used to record the operation.

PROMPT TO PRINT OPERATION DATA. Each time **START** or **TIMED START** is selected the charger will ask whether the operation data is to be printed.

11.8 *Cooling Fan*

The charger is fitted with a cooling fan which is used to extract the heat energy generated when charging and discharging. The fan in new units is automatically controlled by the microprocessor to only operate when the charge or capacity test has been started and switched it off after 10 minutes at end of charge or capacity test, or when the heat-sink temperature falls below 40°C, which ever is the greater.

12 Service And Maintenance

12.1 Calibration

The Battery Charger Analyser must at one yearly intervals, be calibrated to ensure that the measurement circuits are still within specifications. Where these are outside of acceptable tolerance then a full calibration must be performed. This procedure is described in the calibration section.

12.2 Cleaning

At yearly intervals it is advisable to ensure that the airflow for the heat exchanger is not obstructed by dust and dirt. To clear any dust and debris the unit must be disconnected from the mains and remove the battery leads from the unit. The cover must be removed and the heat exchanger blown clear by the use of a high pressure air gun. Where this is not available the use of pipe cleaners or similar must be employed to clear the dust built up.

Observe all safety precautions when using high pressure air. Wear ear defenders and safety goggles and do not point high pressure air at people or animals.

12.3 Battery Backup

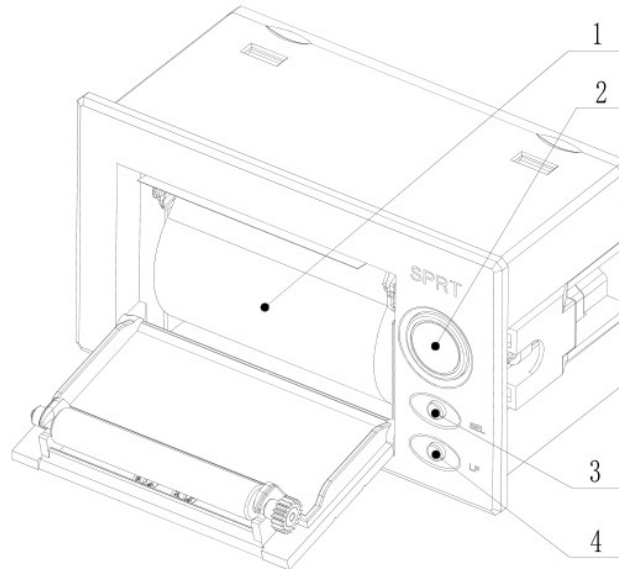
The internal parameters of the Battery Charger Analyser are maintained by a single coin cell mounted on the display PCB at the front of the unit. This should be changed every 4-5 years. If it should fail during use this will be indicated by the unit requesting the date and time when power is applied. Calibration data is unaffected as this is stored in FLASH memory.



The cell is a standard Lithium button cell number CR2032. When replacing the battery please observe the correct methods of disposal of the old battery in accordance with your local regulations.

12.4 *Printer Care (Light Grey Thermal)*

12.4.1 Controls And Indicators



1. Thermal Paper Roll (57.5mm x 40mm Max).
2. Door Release button
3. SEL Button RED Error Indicator
4. LF Button GREEN Power Indicator

12.4.2 Installing The Paper Roll

- Press (2) Door Release Button.
- Remove and discard old roll centre feed bobbin.
- Place new thermal paper roll with paper take off from the bottom into the tray.
- Close door with paper exiting at the top.
- After installing new roll perform a test print to ensure fitting is correct.

12.4.3 Online Button SEL

This button can switch online and offline status. Under online status, printer is usable, under offline status, [LF] button is usable, default status is online after powered on.

12.4.4 Paper Advance Button LF

With the printer offline (SEL) press LF once to automatic feed press again to stop.

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12.4.5 Power Indicator LED (GREEN)

To indicate power on or off status

12.4.6 Error And Busy Status Indicator LED (RED)

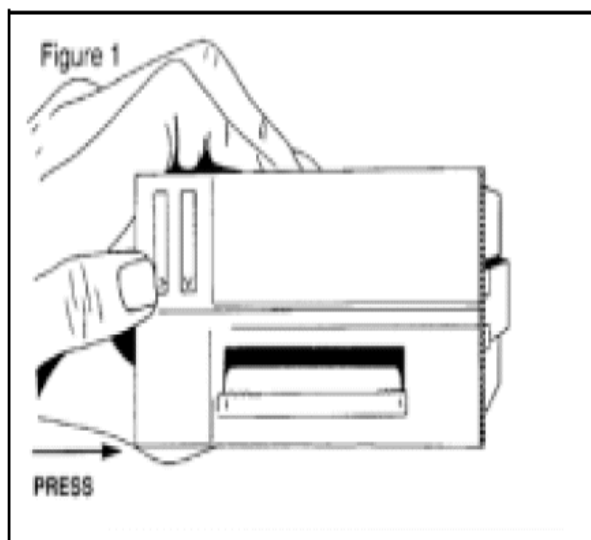
Indicator Status	Description
Off	Work normally
Flicker once every one second	Paper out, will recover after loading paper
Flicker twice every one second	Printer head is overheat, it will recover after cool down
Flicker three times every one second	Heating plate on printer head is broken, irrecoverable error, need to replace printer.

Note: When the printer is printing the red LED will occasionally blink.

12.5 Printer Care (Black Dot Matrix)

12.5.1 Door Latch

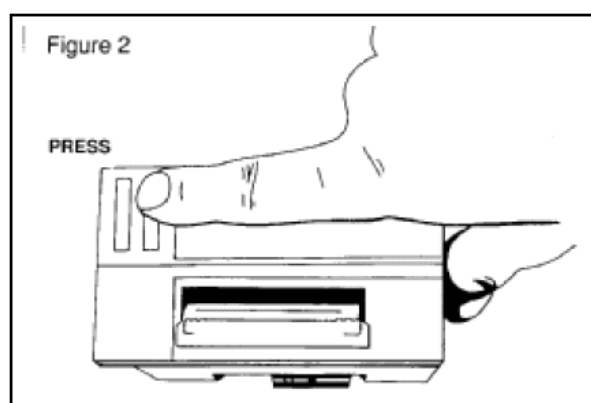
There are two buttons on the panel of the printer. One button the access door and the other the manual paper feed. With the mounted in its correct the two control buttons are of the front face. To open the door to the printer press the (the outer most of the two sideways toward the other using thumb or forefinger (see #1). This will release the latch door can be swung outwards to the paper roll.



front
operates
controls
printer
orientation
upper left
access
door latch
buttons)
button,
Figure
and the
expose

12.5.2 Paper Feed Button

With the printer in the correct orientation the paper feed the rightmost of the two To manually advance the paper this button as shown in figure 2. paper will continue to advance the button is pressed.



button is
buttons.
depress
The
while

12.5.3 Paper Roll Replacement

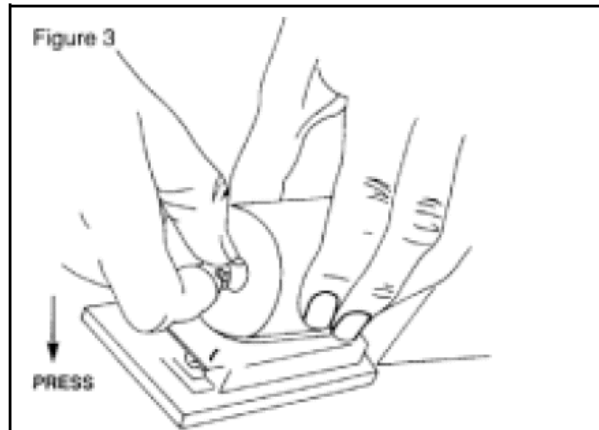
Open the printer door as described above and swing the door open to expose the paper roll. If any paper remains in the printer, tear the paper off against the paper tear bar and carefully pull the remaining paper backwards, from the rear of the mechanism mounting chassis, until the free end emerges.

Press the paper roll retaining inwards using thumb and forefinger (see Figure 3) and the empty roll.

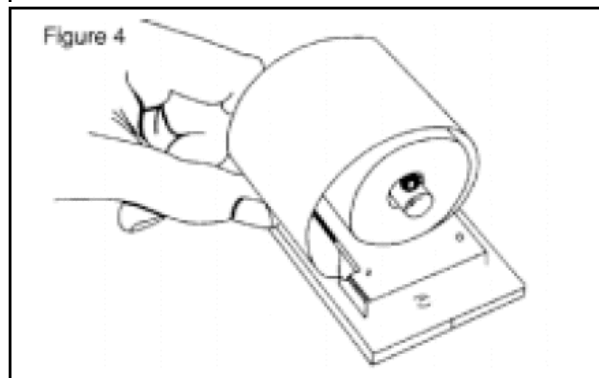
Take a new roll of paper, and the end from the rest of the roll. any damaged or gummed part of paper, and cut the free end with a pair of scissors or knife, a clean straight edge to present printer mechanism.

Thread the new roll past the retention button onto the spindle paper un-spooling in an anticlockwise direction when from the open end. (see Figure

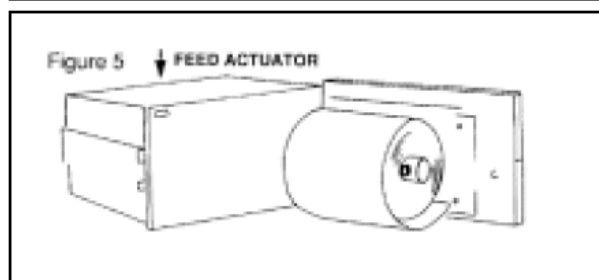
Press the paper feed actuator (button until the mechanism paper and pulls it through the the printer. (see Figure 5). Turn paper roll so that any loose turns wound snugly against the roll. the printer door. More paper now be fed through by pressing paper feed button on the front



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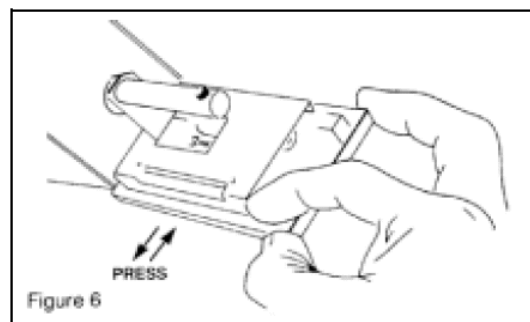


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12.5.4 Ribbon Cartridge Replacement

Tear off any paper emerging from the
Open the printer door by pressing the latch inwards.

Place forefinger against the lower the mechanism mounting chassis and against the chassis door. (see Figure Carefully press the door and chassis vertically opposite directions until the



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IC48V Battery Charger/Analyser

Operator Manual



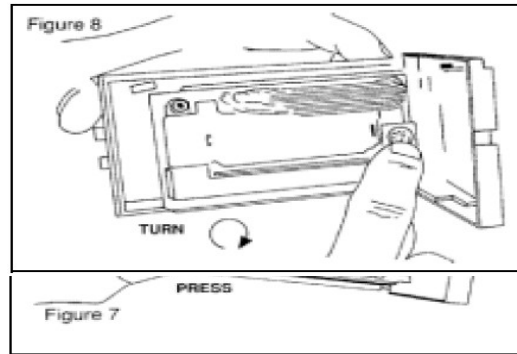
released. Do not pull the door and chassis apart without first releasing the catch. Swing the chassis back, leaving the door fully open. This will expose the printer mechanism and ink ribbon cartridge. Press down on the end of the ink ribbon cartridge marked "PUSH" (see Figure 7) and carefully remove the spent cartridge.

Fit a replacement cartridge, ensuring that the paper lies between the ribbon and the steel printer platen.

Check that the ribbon cartridge correctly seated over the printer drive shaft, and snap the cartridge place.

If necessary tighten the ribbon by the faceted disc clockwise by using (see Figure 8).

If there is some paper protruding front of the printer mechanism, that it will pass clearly through the guide channel and past the tear bar before snapping the chassis shut against the back of the door. Turn the paper roll by hand so that any loose turns are wound snugly against the roll. Close the door and check the paper flows freely, using the paper feed button.



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12.5.5 Consumables Available

A consumables pack is available containing five 19m rolls of paper and two Epson ribbon cartridges. Use of this paper is recommended, as most paper rolls from other sources are too large to fit within the printer housing, and may be of inferior quality causing dust and wear.

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13 Specifications

Input Voltage range 175-264VAC, 47-440Hz, 200-370VDC

Power Minimum 25W Maximum 2800W

Accuracy better than ± 1 LSD or 1.0% whichever is the greater

Minimum Operating Temperature -20°C^*

*Note the printer is only rated at 0°C

Maximum Operating Temperature 40°C^*

*High power discharging may need to be de-rated at high ambient temperatures.

Humidity 5% - 95% Non condensing

Altitude 0 to 3000 Metres.

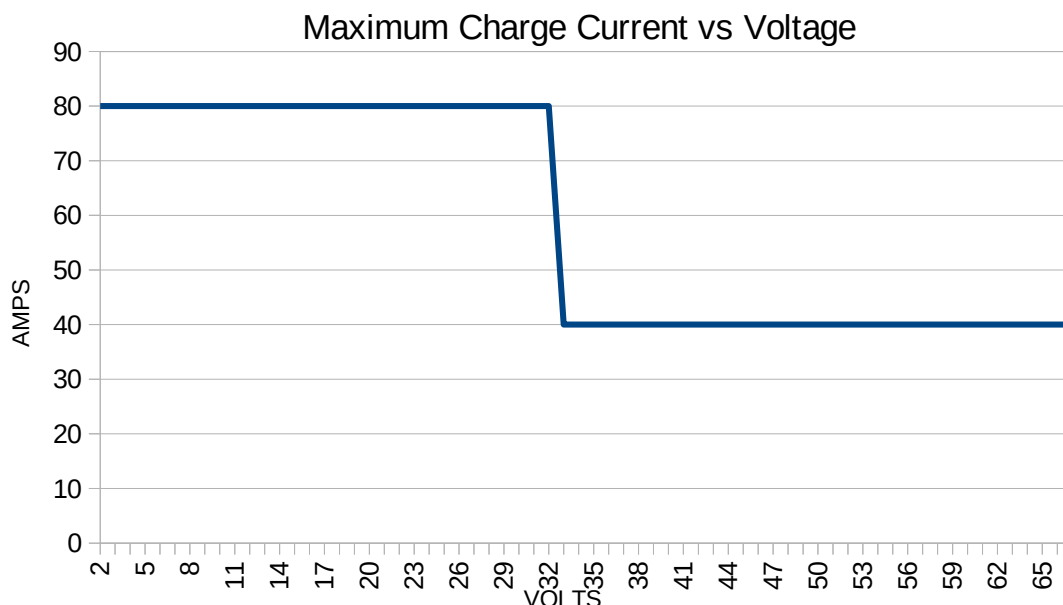
Charge Specifications:

Maximum battery output voltage 75.0V

For batteries nominally 12V maximum charge rate 80.0A

For batteries nominally 24V maximum charge rate 80.0A

For batteries nominally 48V maximum charge rate 40.0A



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Discharge Specifications

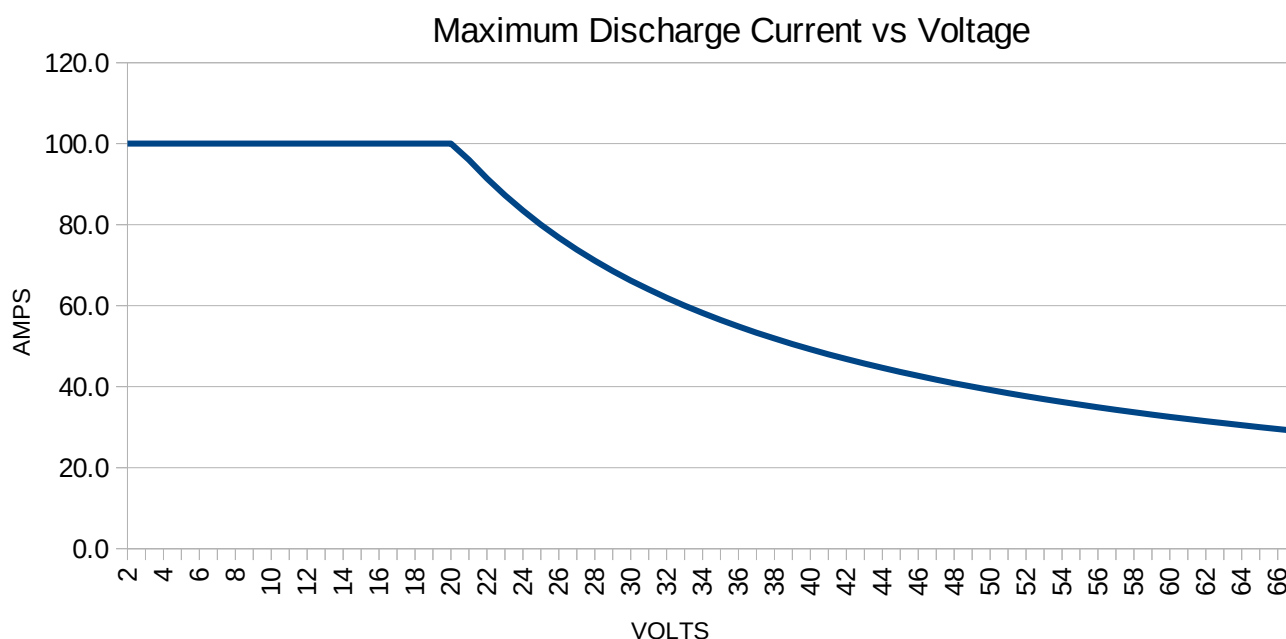
Maximum battery input voltage 75.0V

For batteries nominally 12V maximum discharge rate 100.0A

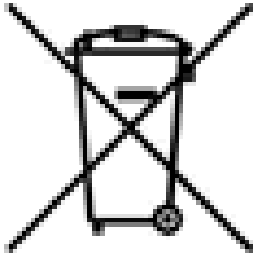
For batteries nominally 24V maximum discharge rate 80.0A

For batteries nominally 48V maximum discharge rate 40.0A

For batteries of non standard voltages a maximum voltage of 66V and a discharge rate of 100A or 1920W must be observed.



14 Product Disposal Instructions



The symbol shown here and on the product means that the product is classed as Electrical or Electronic Equipment and should not be disposed with other household or commercial waste at the end of its working life.

The Waste of Electrical and Electronic Equipment (WEEE) Directive (2002/96/EC) has been put in place to recycle products using best available recovery and recycling techniques to minimise the impact on the environment, treat any hazardous substances and avoid the increasing landfill.

Product disposal instructions for residential users.

When you have no further use for it, please remove any batteries and dispose of them and the product as per your local authority's recycling processes. For more information contact your local authority or the retailer where the product was purchased.

Product disposal instructions for business users.

Business users should contact their suppliers and check the terms and conditions of the purchase contract and ensure that this product is not mixed with other commercial waste for disposal.

15 Product Warranty

Your Intelligent Charging Limited product is guaranteed against faulty workmanship materials and malfunction for a period of 12 months from the date of purchase, unless agreed otherwise by Intelligent Charging Limited. Within this warranty period Intelligent Charging Limited will undertake to repair or replace the product proved to be faulty.

We recommend you keep all packaging for the duration of the 12 month warranty, after which you should dispose of all waste packaging in accordance with your local legislation

Products which have become faulty within the 12 month warranty period must be returned to Intelligent Charging Limited, where Intelligent Charging Limited will then investigate the warranty claim.

Intelligent Charging Limited products, when properly used, will render excellent service. Therefore, users must read the User Manual and any other literature supplied with the product carefully, and fully comply with all procedures shown in the literature and product training / familiarisation sessions, as misuse or failure to follow the instructions may render this warranty void.

This warranty is not transferable and excludes routine maintenance, consumables, parts subject to normal wear and tear, service maintenance kits and damage caused by misuse or negligence. Warranty claims attributable to improper, or careless, use or handling, and to normal wear, are excluded from this warranty.

Intelligent Charging Limited only obligation shall be to repair or replace such products that have proved to be faulty. Intelligent Charging Limited shall not be liable for any injury, loss or damage, direct or consequential, arising out of the use, or the inability to use the product. The customer shall determine the suitability of this product for its intended use, and the customer assumes all risks and liability whatsoever in connection herewith.

Intelligent Charging Limited reserves the right to improve or modify this product without prior notice.

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