



# Innovative Circuit Technology Ltd.



## Modular Power Series

INSTRUCTION MANUAL

855-340-000

### Models:

**Modular Power Shelf with Intelligent Controller**

**12V 50A Power Module ICT700-12PM**

**24V 25A Power Module ICT700-24PM**

**48V 12.5A Power Module ICT700-48PM**

**Battery Management Module**

**Load Distribution Module**

 **WARNING**

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**Risk of serious personal injury or damage to equipment and property! Always observe the following:**

- Install and operate unit in a Restricted Access location, such as an enclosed equipment rack
- Operate the supply from a grounded 3 wire 120Vac or 230/240Vac source (50 or 60Hz) with a branch circuit breaker rated 30A or less

**Always observe the following for applications requiring a backup battery:**

- Use only a Lead-Acid battery with rating and capacity appropriate for the model of supply in use
- Use an appropriate dc over-current protection device in line with the back-up battery connection
- Use a disconnect switch or circuit breaker in series with the battery connection, to ensure installation and service is done with the battery de-energised
- Use wire and connectors rated for the maximum load current and size of battery fuse or circuit breaker
- Ensure battery polarity is correct before connecting
- Do not attempt to charge a frozen battery
- Handle batteries with care, never short circuit battery terminals
- Always install batteries in a well ventilated area
- Always consult with battery manufacturer and observe all battery manufacturer recommendations.

 **CAUTION**

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**Risk of personal injury or damage to equipment! Always observe the following:**

- Install in a protected environment, keep sources of moisture away from unit
- Ensure the total power consumption of the load does not exceed the continuous rated capacity of the power supply output
- Do not block air inlet or outlet openings in the unit
- Do not place the power supply directly above or below an exposed battery, due to possible presence of corrosive and/or flammable gases

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# Contents

INTRODUCTION .....	4
INSTALLATION .....	5
Check Unit .....	5
Configure a System .....	5
Install Unit .....	8
Parallel Shelf Installation .....	14
OPERATION (Front Panel).....	15
System Status .....	17
Battery Management Module .....	18
Load Distribution Module.....	21
Alarm Inputs .....	22
Alarm History .....	22
Network Status and Advanced Options.....	23
Password Reset (Front panel).....	23
OPERATION (No ICM) .....	24
OPERATION (Network GUI).....	24
Log In to the Unit .....	24
System.....	25
Power Modules .....	26
Battery Backup (with optional BMM) .....	27
Load Distribution (with optional LDM) .....	31
Alarms.....	35
Communications .....	36
Router Configuration .....	45
Text Message Notifications .....	47
Troubleshooting Network Communications.....	47
STATUS INDICATORS AND ALARMS .....	48
PRODUCT SPECIFICATIONS .....	51
LIMITED WARRANTY .....	55

## INTRODUCTION

The Modular Power System is a complete flexible redundant power supply with intelligent networked control, advanced battery management, and load distribution options in a 1U high rack mounted chassis. The main rack shelf unit can accommodate an intelligent network controller module (ICM) with front graphic display and up to four parallel connected hot-swappable 12, 24 or 48V power modules with a combined 2,800W or 150A maximum output rating. Alternatively you may use the two right hand side flex module slots for a built in battery input module (BMM) with LVD contactor, 100A circuit breaker, current monitor, and advanced battery SOC estimation and test capability – and an intelligent four channel Load Distribution Module (LDM) to provide four 20A breaker protected outputs with advanced monitoring and remote on/off control.

For additional power connect a slave shelf with up to another 4 power modules to create a fully redundant 4,900W N+1 remote controlled power system.

Basic Power Module Ratings:

Module	12V 50A ICT700-12	24V 25A ICT700-24	48V 12A ICT700-48
Output Voltage adjustment range (V)	11.5 – 15.5	23.0 – 31.0	46.0 – 62.0
Default Output Voltage (V)	13.8	27.6	55.2
Output Current Limit adjustment range (A)	10 – 50	5 – 25	2.5 – 12.5
Default Current Limit (A) (+5%, -0%)	50.0	25.0	12.5

A typical configuration is illustrated below, consisting of a power shelf with an Intelligent networked Controller Module (ICM), two 700W Power Modules, a Battery Management Module (BMM) with two battery input breakers (Battery 1 lower, 2 upper), and a Load Distribution (LDM) module (with output breaker 1 to 4). This single 1U high shelf illustrated provides a remotely controlled 1400W hot-swap power supply with built in battery breakers, LVD contactor, advanced battery management capability, and four channels of intelligent remotely controlled power distribution.

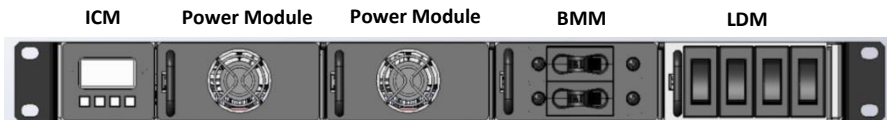


Figure 1: Typical Intelligent Power Shelf Configuration

# INSTALLATION

## Check Unit

Perform a quick physical check of the unit as it is being taken out of the box to ensure it has not been damaged during shipping. Check that the system configuration matches the version ordered, and that the following chassis accessories were shipped with your unit:

- Instruction Manual
- Removable 3 pin AC input wire clamp connector plug (in bag)
- Removable 7 pin alarm and temp sensor wire clamp connector (installed)
- Removable 3 pin Form-C alarm relay connector (installed)
- Plastic u-shaped cover with two 6-32x1/4" screws for output bus bars (in bag)
- Two rack mounting ears (installed)
- Two bolt/washer/nut sets for connections to the output bus bars (in bag)
- Plastic u-shaped connector cover with two 6-32x1/4" screws for optional BMM bus bar (in bag if ordered)
- Two bolt/washer/nut sets for connections to the BMML and BMMD bus bars and one set for the BMM (in bag)
- Remote battery temperature sensor (ICT-TMP) included when a BMM Battery Management Module is installed in the shelf

## Configure a System

A complete Modular Power System will consist of at least one power shelf with the Intelligent Control Module (ICM) installed, one to four matching 700W power modules, with up to two module slots used for an optional Battery Management Module (BMM), and/or a four channel Load Distribution Module (LDM). A second slave shelf without an ICM (ICT-SPS) may also be used to add up to an additional four modules to a system, two of which may be a BMM and/or a LDM. The ICM, BMM, and LDM are factory installed options, but the power modules are field installable and can be used in any of the remaining slot locations in a power shelf. Standard Power Shelf Versions:

Description	Model No. (-48V)	Model No. (+12, 24, 48V)
Intelligent Power Shelf with Control Module, up to 150A output max	ICT-IPS	ICT-IPS

Description	Model No. (-48V)	Model No. (+12, 24, 48V)
Intelligent Power Shelf with Control Module and a Single 100A input Battery Module (specify + or – bat V)	ICT-IPS-BMM	ICT-IPS-BMMP <sup>1</sup>
Intelligent Power Shelf with Control Module and a Single 100A input Battery Module, and Load Distribution Module (up to 4 x 20A at -48V, or 4 x 20A at +12/24V)	ICT-IPS-BMM-LDM	ICT-IPS-BMM-LDMP <sup>1</sup>
Intelligent Power Shelf with Control Module and Load Distribution Module (up to 4 x 20A at -48V, or 4 x 20A at +12/24V)	ICT-IPS-LDM	ICT-IPS-LDMP <sup>1</sup>
Intelligent Power Shelf with Control Module, and a Dual 100A input Battery Module (Dual matching battery strings combined through single LVD and current monitor)	ICT-IPS-BMMD	ICT-IPS-BMMDP <sup>1</sup>
Intelligent Power Shelf with Control Module, and a Single 100A input, 100A load output Battery Module (specify + or – bat V)	ICT-IPS-BMML	ICT-IPS-BMMLP <sup>1</sup>
Basic slave Power Shelf, no Control Module	ICT-SPS	ICT-SPS

*Contact ICT for other possible Power Shelf configurations*

**Power Module Versions:**

Description	Model No.
12V 700W Power Module (13.8V, 50A)	ICT700-12PM
24V 700W Power Module (27.6V, 25A)	ICT700-24PM
48V 700W Power Module (55.2V, 12.5A)	ICT700-48PM

**Accessories:**

Description	Model No.
5A Circuit Breaker for LDM	ICT-CB5
10A Circuit Breaker for LDM	ICT-CB10
15A Circuit Breaker for LDM	ICT-CB15
25A Circuit Breaker for LDM	ICT-CB25

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<sup>1</sup> Suffix “P” denotes shelf configured for Positive battery voltage. Blank denotes Negative battery Voltage ( i.e. for use with a -48V system)

Description	Model No.
Blanking Plate for unused power shelf positions (snap-in)	ICT-BPM
Blanking Plate for unused LDM breaker locations (snap-in)	ICT-BLP
Remote Battery Temperature Sensor (1pc included with Power Shelf/BMM)	ICT-TMP
Slave Power Shelf parallel output bus bar jumper strap (for two Power Shelves)	ICT-PAR
Slave Power Shelf parallel RJ-11 control cable jumper (4")	ICT-JMP

### Set Up the Power Shelf:

Ensure you have the correct Power Shelf, with the Battery (BMM) Module and/or the Load Distribution (LDM) module factory configured for Positive or Negative battery voltage. (See shelf model numbers, above) Check that you have the correct number of matching power modules for your application.

- Install the Distribution Module (LDM) breakers, if not already installed, in the four front locations of the optional LDM by snapping into the four breaker openings, (“On” or “I” facing up, “Off” or “0” down) ensuring the breaker connector tabs securely seat in the LDM breaker sockets. (NOTE: Ensure the correct breaker rating is installed in each location, as breakers can only be removed at a qualified service facility once snapped in place)
- Snap in a breaker blanking plate (ICT-BLP) in any unused breaker locations on the LDM
- Install one to four matching power modules with the same voltage rating in any remaining open shelf positions. The modules will share the total output load, automatically disconnecting from the internal power bus in the event of an internal failure, and may be “hot-swapped” (you can insert or remove a module while the shelf is powered). Ensure the combined power rating of all the installed power modules exceeds the total requirement of the planned load by at least 700W for true “N+1” redundant operation. (N+1 operation requires excess power module capacity to ensure that the load can be fully powered, even if one power module should fail or be removed)
- Carefully align each module with the internal shelf guides and firmly push into the shelf back plane until the module latch clicks into place, and the module is flush with the shelf front panel. Note that Power Modules can be easily removed by pressing the release latch located under the module handle to the right while firmly pulling the module from the Power Shelf. (the shelf may be powered while swapping modules)
- Snap in a shelf blanking plate (ICT-BPM) into any unused shelf positions to prevent accidental access to the internal circuitry of the shelf.

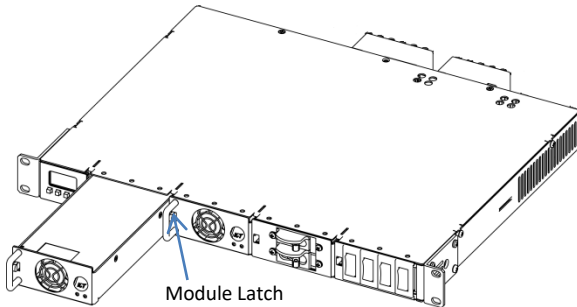


Figure 2: Installing Power Module in a Power Shelf  
(Module numbering is 1 to 4, L to R)

## Install Unit

### **WARNING**

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**Risk of serious personal injury or damage to equipment and property! Always observe the following!**

- When using a backup battery ensure the nominal battery voltage is correct for the model of Power Modules installed, and that the battery positive is connected to the positive (+) terminal and the battery negative is connected to the (-) terminal. **Note that the BAT terminal on the BMM may be internally tied to the (+) or (-) shelf output through the LVD contactor, depending on the polarity of the Power Shelf used**
  - Use an appropriate dc over-current protection device such as a fuse or circuit breaker in line with and near to the battery connection
  - Do not tie either Power Shelf main output to the BAT terminal on the BMM, as this may short circuit the battery or will bypass the internal LVD circuitry in the BMM
  - Make any earth Ground connection to only a single LOAD or BAT terminal if required. Do not ground both the load and battery as this may bypass the internal LVD circuitry
  - AC input wiring to the Modular Power Series unit must be protected using an outlet with a branch rated circuit breaker of 30A or lower value
- 

Check that the default system output voltage and current limit match the requirements of the battery and the loads to be connected.



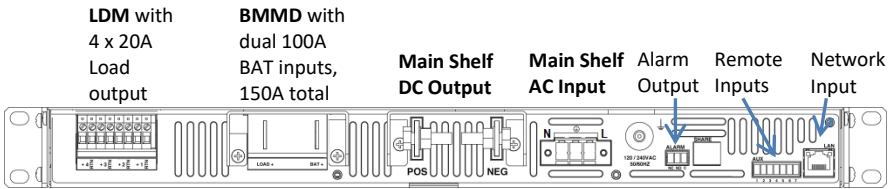


Figure 3: Typical Rear View (Showing optional BMM, LDM Connectors)

Mount the unit in an enclosed standard 19 inch equipment rack or other restricted access location, using rack mounting screws (not supplied). Support the rear of the unit with rack shelf supports or back rail if required.

Make connections to the load using wire and connectors appropriately rated for the maximum output current capability of the unit. The load may be powered three different ways:

Load Connection Point	Features
Directly from main Shelf DC Output Bus Bars	Full current rating of the shelf is available to operate the load, limited only by the maximum output capability of the combined Power Modules
One of four LDM Intelligent Output Channel Connector Ports (optional "LDM" installed)	Channel over current protection with LDM front circuit breaker (1 to 4), individual remote channel on/off control and current monitoring
High Current BMM Load Output Bus Bar (optional "BMML" installed)	Output Over current protection with BMM front 100A load breaker (breaker 2), load current monitoring

- The **LDM** outputs have **Output** and **Return** connection provided for each channel. Verify supply polarity before connecting loads
- The **BMM Load** Output provides the switched **Hot** lead connection only. Connect the load **Return** to either the **Pos** or **Neg** Shelf Output Bus bar, depending on the Shelf Polarity
- Connect a ground bonding wire from the chassis rear ground stud to the rack

See the following Modular Power System Block Diagram for internal details on connection options. Note that a **POS BATTERY** Voltage (typically +12V or +24V) system Shelf is shown. A **NEG BATTERY** Voltage (-48V) system Power Shelf will have the optional BMM and LDM internal back plane power connection made to the **DC-** bus.

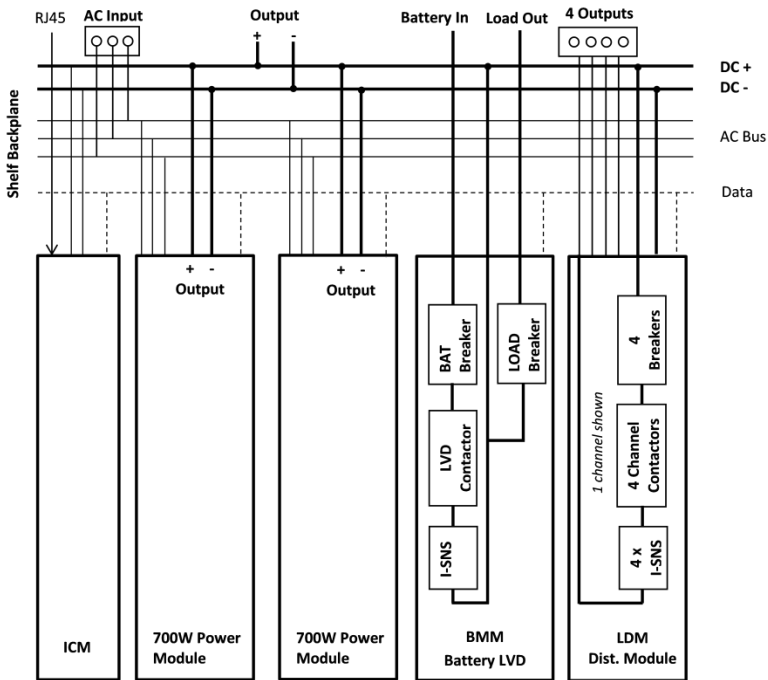


Figure 4: Battery Backed Power Shelf - Internal Block Diagram (Positive V Output)

### Make Sensor and Alarm Connections

- Connect the form-C alarm contact monitoring wiring to the ALARM Output connector if needed, as shown in the following table. The master shelf contacts are flagged for all system alarms while the slave shelf contacts indicate slave power module faults only, on dual shelf systems.

Pin Number	Name	Function
1	NC	Alarm NC (alarm state)
2	NO	Alarm NO (alarm state)
3	Common	Alarm output common

Alarm Output Connector: (use 22-26AWG wire)

- Connect the external Battery Temperature Sensor (ICT-TMP, included with a BMM equipped shelf) to the REMOTE input plug on the back panel (see Remote input table, below), to compensate the shelf output voltage according to the battery temperature. Mount the sensor to the mid-level side of the middle battery in a set using the adhesive backed clip, as shown below. The rate of voltage compensation (with optional BMM installed) can be adjusted via the ICM front panel interface, or the WEB GUI in the BMM

Settings section. The default compensation is 0mV/C per cell (no compensation), so this must be set according to the manufacturer’s recommendation for your battery to enable charge voltage temperature compensation. Battery temperature is assumed to be 25°C if no sensor is installed.

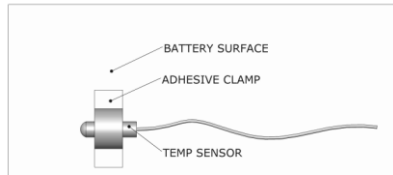


Figure 5: Battery Temperature Sensor Installation

- Install wiring to monitor up to four external voltage free alarm contacts, typically for external sensors such as a door or window switch, smoke detector output, or water detector etc. Enable the alarm inputs and set the contact logic (normally open or contact normally closed) via the WEB GUI, Alarm Settings section once the unit is powered up.

Pin Number	Name	Function
1	Alarm 1	Remote alarm 1 input
2	Alarm 2	Remote alarm 2 input
3	Alarm 3	Remote alarm 3 input
4	Alarm 4	Remote alarm 4 input
5	Alarm Return	Common remote alarm return point
6	Bat Temp	Remote Battery Temperature sensor
7	Bat Temp	Battery temp sensor return

Remote Input Connector: (use 22-26AWG wire)

### Make Battery Connections to Optional BMM

The optional Battery Management Module (BMM) provides a convenient and safe way to connect an external back-up battery to the modular power system. A high current Hydraulic-Magnetic circuit breaker (100A standard) provides over current protection, while an internal LVD contactor will disconnect the battery should it discharge below a safe level. Internal battery current monitoring provides a full suite of remote battery charge monitoring features.

### **WARNING**

**Risk of serious personal injury or damage to equipment and property! Always observe the following!**

- When connecting a battery ensure the nominal battery voltage is correct for the model of Power Modules installed, and that the battery positive is connected to the positive (+) terminal and the battery negative is

connected to the (-) terminal. Note that the BAT terminal on the BMM may be internally tied to the (+) or (-) shelf output through the LVD contactor, depending on the polarity of the Power Shelf used. **Check shelf model polarity before connecting a battery to the BMM!**

- Only use the Equalize Charge setting for flooded lead-acid batteries in a well ventilated location. **Do not use Equalize Charge on sealed batteries!** Always consult with battery manufacturer and observe all battery manufacturer recommendations.
  - Do not tie either of the Power Shelf main outputs to the BAT terminal on the BMM, as this may short circuit the battery or will bypass the internal LVD circuitry in the BMM
  - Make any earth Ground connection to only a single LOAD or BAT terminal if required. Do not ground both the load and battery as this may bypass the internal LVD circuitry
  - Use wire and connectors appropriately rated for the highest possible system current when making connections to the battery, BMM, and power shelf
- 

**Note:** Check that the default system output voltage and current limit match the requirements of the battery and the loads to be connected. Adjust the system output Voltage and Current Limit (see System Settings section) to match the combined battery and system load requirements before making final connections, if required. **Use only identically rated battery strings for the dual battery BMMD option** to ensure equal charging of each battery set.

Verify the polarity of BMM installed in your Power Shelf by noting the label under the rear BMM BAT bus bar input. (“**BAT +**” indicates a positive battery voltage system with the LVD contactor and battery breaker internally connecting this terminal to the shelf “**+**” output, while “**BAT -**” indicates a negative battery voltage system, with the LVD contactor and battery breaker internally connecting this terminal to the shelf “**-**” output )

Use wire and connectors appropriately rated for the highest possible system current when making connections to the battery, BMM, and power shelf. Connect the battery hot lead (see comment on polarity, above) to the BMM BAT bus bar, and the battery Return lead to the main shelf output bus bar of the corresponding polarity. (i.e.: a **Pos V** system will have the battery (+) tied to the BMM terminal, with the battery (-) tied to the main NEG output busbar, a **Neg V** system will have the battery (-) tied to the BMM terminal, with the battery (+) tied to the main POS output busbar.

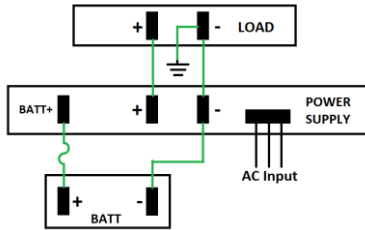


Figure 6: Negative Ground

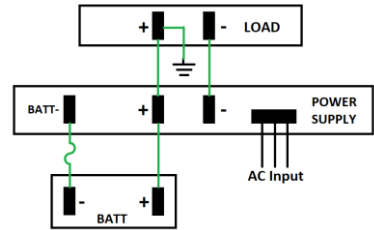


Figure 7: Positive Ground

Available BMM Variations:

-V BAT	+V BAT	Description	Connections
BMM	BMMP	Single 100A battery circuit breaker with LVD contactor with advanced battery management capability	Single BAT input bus bar (+ or – polarity, see note above)
BMMD	BMMDP	Dual 100A battery breakers to connect two identical battery strings through an LVD and current sensor with advanced battery management capability for the combined battery	BAT 1 and BAT 2 input bus bars (both either + or – polarity, see note above)
BMML	BMMLP	Single 100A battery breaker with LVD contactor with advanced battery management capability, and a 100A Load output breaker for high current dc output connections	Single BAT input, and load output bus bars (both either + or – polarity, see note above)

## Make Load Connections to Optional LDM

The Load Distribution Module (LDM) provides four remotely controlled and monitored outputs, with front panel over current protection provided by hydraulic-magnetic circuit breakers. (See page 7 for breaker installation instructions)

System Voltage	LDM Output Capacity
12, 24, or 48V	4 x 20A continuous output (25A pk)

Locate the four controlled outputs on the LDM back panel connector block. Note that the internal channel relay, current sensor and circuit breaker are in the Hot or output line, with Voltage polarity depending on the configuration of the Power Shelf. (Each output = NEG V, for -48V Power Shelf systems, each output = POS V, for +12, +24, or +48V configured systems)

Verify the polarity of your Modular Power System, and then connect up to four external loads using appropriately rated wire inserted and torqued in the four Cage-clamp output connector pairs on the LDM module back panel.

## Finalize all Shelf Wiring

**Make a Network Connection:** Connect a 10/100Base-T Ethernet cable to the RJ45 LAN port on the back panel to allow for remote monitoring and control of the Power Shelf.

(See the Network Monitoring and Control section for information on configuring and using the built in Web-GUI, e-mail, or SNMP functions)

**Check that all connections** to the power supply are correct and tight; re-install the plastic bus bar cover(s) using the original screws provided.

**Connect the AC power source:** De-energise the AC source by switching off its circuit breaker. Create a power cable using 3 conductor cord rated for the maximum input current of the unit (Up to 26A max for a 2800W configuration operating from a 120Vac line) by stripping and terminating the three wires in the Line, Neutral, and Ground terminals of the removable AC input connector provided with the unit (AC line labeled “L”, neutral labeled “N” and safety ground to the middle pin).

Plug the AC connector into the AC input on the power shelf back panel, and tighten the captive retaining screws.

Wire the source end of the cord to the de-energised AC supply (120V 30A, or 230V 16A, 50 or 60Hz) equipped with a branch rated circuit breaker of 30A or less.

## Parallel Shelf Installation

Use a slave Power Shelf for applications that require up to an additional 2800W of DC power. The ICT-SPS standard (Slave) Shelf has no internal ICM, as it is controlled and monitored by the ICM on the main unit, requiring only an additional AC line input connection, a control jumper cable (ICT-JMP) connection, and the installation of tie bars (ICT-PAR) to parallel the shelf outputs. **Do not attempt to connect shelves in series, they are meant for parallel operation only!**

The main and the slave power shelf must be installed as a set in adjacent rack locations to ensure the output power tie bars and control cable jumper will correctly fit.

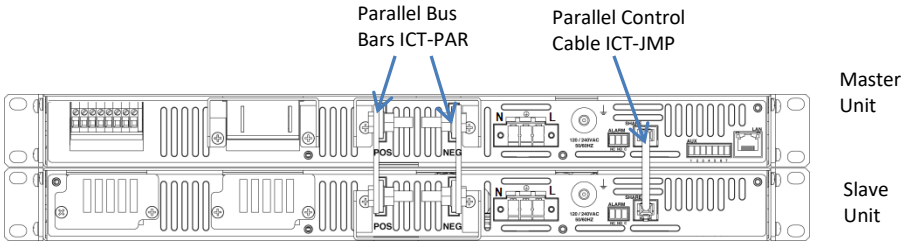


Figure 8: Master and Slave Shelf connected in Parallel

**! CAUTION**

**Risk of damage to equipment!**

- Do not use the internal BMM battery LVD contactor for parallel applications where load current can exceed the 150A maximum rating of the LVD contactor
- Do not parallel BMM modules. A battery connection may be made to a single BMM module, with maximum battery current not to exceed the rating of the individual BMM unit (150A)

Install the Shelf Paralleling Bus Bars (ICT-PAR) and plastic bus bar covers as shown in Figure 8, using the hardware included with the Modular Power System.

Install the Parallel Control Cable (ICT-JMP) connecting the two RJ-11 style SHARE ports as shown in Figure 8 to allow the Master ICM to control the slave shelf. (Shelf slots 1 to 4 (front, L to R) are on the main shelf, slots 5 to 8 (front, L to R) on the slave shelf)

Connect alarm monitoring wiring to the Form-C contacts on the slave shelf if desired, to remotely monitor for slave shelf module alarm conditions.

Connect a load to the parallel shelf outputs to utilize the combined power of all power modules installed in the two shelves, or connect the loads to the back panel output ports of any installed LDM modules for built in intelligent power distribution.

Connect a separate AC power cord to each shelf, using independent AC circuits rated for the full power operation of each shelf.

**OPERATION (Front Panel)**

Switch on the external AC power source circuit breaker, and check that the green POWER LED is lit on each Power Module, and that the ICM front graphic display is lit.

Your ICT Modular Power System will start up and operate at the factory default settings when AC power is connected, generally requiring no other set up or adjustment for basic operation.

Use the front graphic display and four interface buttons on the Intelligent Control Module (ICM) to monitor the supply operation and to make changes to settings such as output voltage, current limit, and battery Low Voltage disconnect points. (The display will go off after approximately 60 minutes of no use, and can be re-activated by momentarily pressing any of the front control buttons.)



Figure 9: ICM Front Control Interface – System Status Screen

The ICM Interface panel consists of the following elements:

**System Display screen:** Default System Status screen shown in Fig 9 displays the Shelf output voltage, the AC input voltage, and the total output current. (Numerically, and with a graphical indication of relative magnitude of system output current level) The screen will also show any active alarm conditions, and the current reading will flash to indicate when the unit is operating at its current limit.

**Up/Down ▲ ▼ Buttons:** Use to scroll through display screens, and to adjust selected settings

**Enter ◀ Button:** Press to select a screen for adjustment, or to enter a new value after adjustment

**Back X Button:** Press to return to the previous higher level menu item, or to exit from a setting without making any change

See the complete menu structure in the following diagram. Navigate through the various screens using the up and down arrows, the back button, and the Enter button.

Note that output voltage and current limit settings apply to the combined output of all installed power modules. The ICM treats the combined modules as a single high power supply. Adjust the system output Voltage and Current Limit



(see System Settings section) to match the battery type and system load requirements if required.

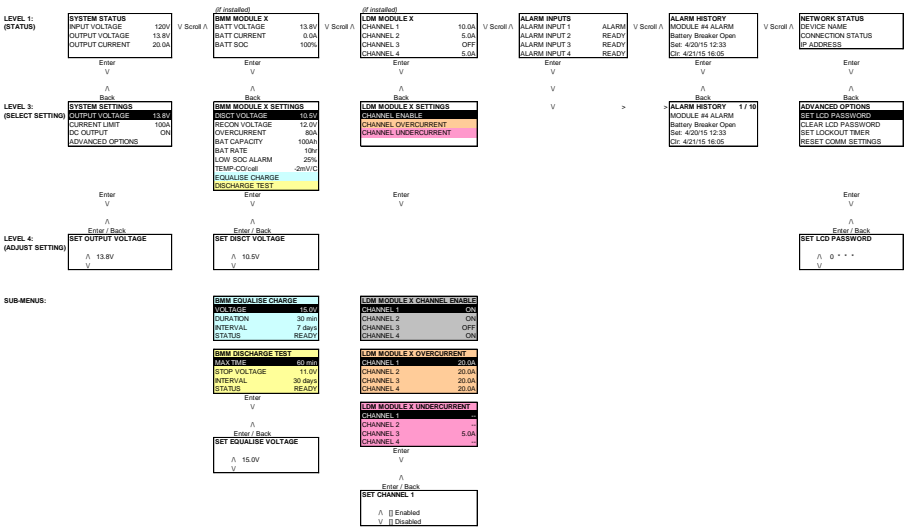


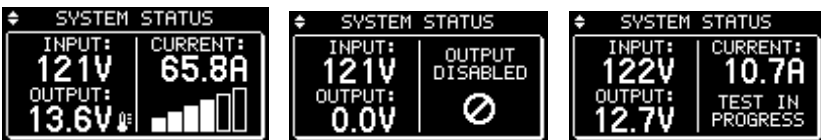
Figure 10: ICM Menu Structure

## System Status

The main system status screen will show the most current operating conditions for the unit, primarily the Input Voltage (Vac), the Output Voltage (Vdc), and the total Output Current (Ad)(Flashing when at the set current limit). Other information will be shown depending on the operating state of the unit:

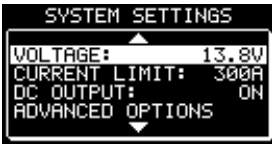
- A small thermometer symbol to indicate that the remote temperature sensor is installed and may be compensating the output voltage
- A bargraph indicating relative output current
- Indication that the output has been Disabled (off)
- Indication that a battery discharge test is in process

**System Settings:** The output voltage and output current limit settings come with factory default values that should be adjusted to match your actual system and battery float voltage requirements, as shown below:





Press Enter to move to the System Settings

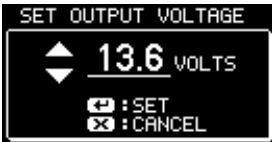


Scroll to highlight the parameter to change

- System Voltage
- Max total Output Current Limit
- Output Enable ON/OFF (default = ON)
- Advanced Options (Set screen Password, Clear Password, Set screen Lockout timer, Reset Comm settings to defaults)



Press Enter to select



Scroll to adjust parameter (Output V shown), press Enter to set value. Press Back **X** to return to System Settings Screen



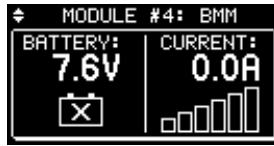
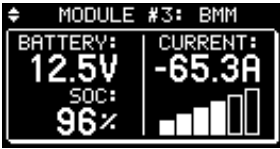
Alarms will be shown as they occur, press Back **X** button to return to the Status screen, press Enter for Alarm History info

Once the output voltage and current limit values are configured to suit the connected battery and loads, switch on the optional BMM battery breaker 1, and battery breaker 2 (if installed) to connect the backup battery string(s) to the system. Switch on the LDM output breakers 1 to 4 (if installed) to energise any loads connected to the Distribution Module outputs.

## Battery Management Module

The optional Battery Management Module (BMM) provides a convenient and safe way to connect an external back-up battery (2 matching battery strings with the BMMD) to the modular power system. A high current Hydraulic-Magnetic circuit breaker (single 100A standard, two on the BMMD) provides over current protection, while an internal LVD contactor will disconnect the battery should it discharge below a safe level. Internal battery current monitoring provides a full suite of remote battery charge monitoring features.

The BMM Status Screen indicates the Battery Voltage (Vdc), the combined Battery Current (+ Adc for charging, -Adc for discharging), the approximate battery State of Charge (SOC %), and a bar graph showing relative magnitude of the total battery current. A battery graphic marked with **X** indicates the battery is disconnected, replacing the SOC reading, as shown below.



BMM Status Screen with Battery-Disconnected icon

The SOC% is estimated by counting the Ah flowing into and out of the battery while knowing the nominal rated capacity of the battery (See **BMM Settings** Screen below to adjust the battery Ah capacity) The system resets the SOC to 100% whenever it detects that the battery is at the rated Float Voltage with minimal charge current for at least 24hr.

**BMM Settings:** The module comes with factory default settings loaded that should be configured to match the actual battery used in the system.

Adjust the **LVD** contactor **Disconnect** and **Reconnect Voltage** according to the battery manufacturer's recommendations.

Set the **Battery Overcurrent** Alarm level (Amps) to trigger an Alarm for excessive discharge current or charge current. (set to 0A to disable this alarm)

Configure the combined **Battery Capacity** (Ahr) so the system can estimate the total battery SOC%. Also set the **Battery Rate** (hrs) used in the battery specification to determine the battery capacity. (Usually will be 20hr or 10hr rate) Note that series connected batteries have the Ahr capacity of a single battery, while connecting batteries in parallel increases the total Ahr capacity.

Set the **Low SOC Alarm** (%) if desired, to raise an alarm when the battery is nearly discharged

Ensure the Battery temperature sensor (ICT-TMP) is installed and connected to the battery case (see **Make sensor and Alarm Connections** in the Installation section) for optimal Lead-Acid battery charging and best battery life. Set the **Temperature Compensation/°C** level per battery cell to match the recommendation of the battery manufacturer. (-4mV/°C per cell typical)

Configure the **Battery Equalize Charge** voltage, duration, and automatic repeat interval if desired when using flooded lead-acid type batteries only. The system will step up the output voltage to the Equalize Voltage for the Equalize Duration time whenever the Equalize Status is set to Enable, or automatically each interval time (days) when an Interval is set (default is 0, or off), once the battery is fully charged.

**⚠ WARNING**

Use the Equalize Charge setting for flooded lead-acid batteries in a well ventilated location only. **Do not use Equalize Charge on sealed batteries!**

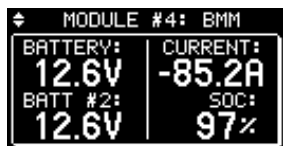
Configure the Battery **Discharge Test** to either manually or automatically check on the battery's ability to power the system for a set duration. Set Max Discharge Time, minimum Stop Voltage, and the automatic repeat Interval if desired. Each time the test is run the output voltage from the power modules will be reduced so that the external battery will power the system load until either the Max Discharge Time limit or the Stop Voltage is hit. A **Discharge Test Complete** notification (on the front display and with an e-mail if messaging is configured via the Network GUI) will indicate a **Test Failure** if the Stop Voltage is hit before the Max Time limit, as the battery was not able to power the load for the desired duration. Set the test **Interval** (days) to have the system initiate a discharge test every interval, once the battery reaches 100% SOC.

You may alternatively manually initiate a Battery Discharge Test of a fully charged battery by changing the discharge test Status parameter to **Enabled**.

Optional BMM versions are available which have the status screens shown below:

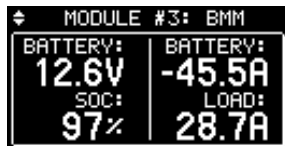
Dual Battery String BMMD  
Status Screen

- Battery 1 Voltage
- Battery 2 Voltage
- Combined Battery Current
- Combined SOC%

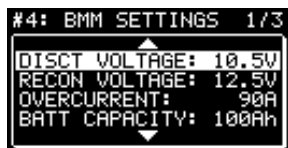


Battery with Load BMML  
Status Screen

- Battery Voltage
- Approximate SOC%
- Battery Current
- Load Current



Press Enter to move from the Status screen to the BMM Settings screen

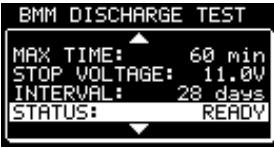



Scroll to highlight parameter to change

- LVD Disconnect V
- LVD Reconnect V
- Over Current Alarm level
- Battery Capacity (Ahr) rating
- Battery discharge rate (hrs) used for capacity spec. (typically either 10 or 20hrs)
- Low SOC Alarm (default 25% SOC)
- V Temp-co/cell (default = 0, typ = -4mV/°C)
- Equalize Charge settings
- Discharge Test settings



Press Enter to select parameter to adjust



Scroll to choose parameter in selected sub-menu. Press Enter  to select that item for adjustment



A notification will automatically appear indicating the results of a Discharge Test at completion of the test

## Load Distribution Module

The optional Load Distribution Module (LDM) provides a convenient way to include four channels of remotely managed DC power distribution within the Modular Power System shelf. Front panel mounted hydraulic-magnetic circuit breakers give over current protection for each channel, while independent current monitoring and on-off control allow for complete remote management of the connected loads. (Note that removal of the LDM circuit breakers must be done at the factory; ensure you are installing the correctly rated parts in the correct location prior to snapping in place)

The LDM Status screen shows the output current for each of the four outputs, plus indicates if a breaker is OPEN, and if an output has been switched OFF.

**LDM Settings:** Each output on the LDM may be forced ON or OFF by using the **OUTPUT CONTROL** function.

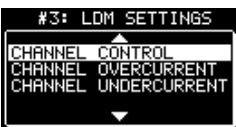
Set a load current level alarm by adjusting the output overcurrent, or output undercurrent threshold.




LDM Status Screen (OFF = channel set to off, OPEN = channel breaker tripped)



Press Enter to move from the Status screen to the LDM Settings screen



Scroll to choose parameter or sub-menu. Press Enter  to select that item for adjustment



Press Enter to select setting to be changed



Scroll to choose Output to be changed (On/Off control shown)



Scroll to change setting. Press Enter to set, press Back X button to exit without changing

## Alarm Inputs

The Alarm Inputs Status screen displays the current status of the four alarm inputs provided on a Power Shelf equipped with the Intelligent Control Module. Use these inputs to monitor voltage free external contact closures such as door sensors, smoke alarm outputs or a water sensor.

The alarm input Status screen shows the state of these contacts, changing from OK to ALARM when a contact activates. Configure the logic of the external contact type selecting Normally Open (NO) or Normally Closed (NC) to activate the alarm inputs using the Network GUI interface. The factory default setting has the alarm inputs disabled; you must select a contact type for each input to enable it.



Alarm Input Status screen



Press Enter or scroll to see the Alarm History log

## Alarm History

Scroll through the Alarm History screens to see the log of the 20 most recent alarm events. These alarms may have been raised by any module experiencing an alarm, or by one of the four external Alarm Inputs being triggered.



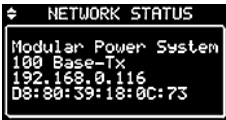
Scroll through the history screens to see the 20 most recent Alarm events. Shows the Module that raised the alarm, date, and time when set, and cleared

Note: The system date and time are normally set by the network. These may be manually set, see Network GUI Operation, Communication Basic Setup section.

## Network Status and Advanced Options

Scroll to the Network Status Screen to check the network connectivity, **IP address** of the system, and the assigned MAC address. Access the Advanced Options screen by pressing the Enter button when on the Network Status screen to set or clear a 4 digit **LCD Password** (to lock out the ICM Display adjustments after the LOCKOUT TIMER has expired), set the display **Lockout Timer** duration (0 to 60minutes), or **Reset Comm Settings** (sets GUI password, Communication settings, and IP address to the factory defaults).

Note: You will be prompted to enter the LCD PASSWORD once it is activated, when attempting to change any of the power system settings.



Network Status Screen




Press Enter to move to the Advanced Options screen




Scroll to setting to be changed



Scroll to adjust setting (Display Password setting shown) Press Enter  to save each setting, or Back **X** to exit with no change

## Password Reset (Front panel)

Always record the display password when set, as it must be entered to change any supply settings. To clear the display password in cases where it is lost, switch off the AC power to the unit, then simultaneously press the ENTER  and BACK **X** buttons for more than 15s while restoring the AC power. A new password will then have to be re-entered as shown above if password protection is required.

Reset the network GUI password back to the factory default (user: admin, no pw) by selecting **RESET COMM SETTINGS** in the Network Status front panel display menu shown above.

### OPERATION (No ICM)

Power modules installed in a basic shelf without an Intelligent Control Module (ICM) will behave as a fixed output power supply, with the output voltage and current limit set to the factory default levels. Modules may still be hot-swapped with identical replacement units, and the output load will share across all active power modules.

Check that each module’s green “POWER” LED is lit, indicating normal operation. A lit red “FAULT” LED indicates a faulted module. Momentarily withdraw the faulted module then re-insert once the LED is off to check if the fault can be re-set. If the fault persists while other modules are operating normally the faulted module must be replaced.

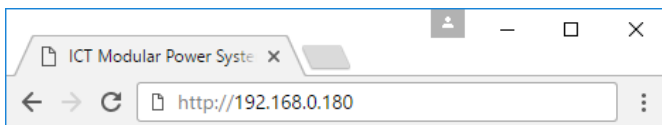
Alarm indications can be monitored remotely using the Form-C alarm relay contacts accessible via the back panel ALARM connector. (See the installation section for connection information)

### OPERATION (Network GUI)

Connect to your Intelligent Power System via the Ethernet for full access to all system settings, status, and alarm conditions. Units with the ICM installed are equipped with a built in Web server that can be accessed via any standard web browser on a network connected computer or phone. No additional software is required on your device.

### Log In to the Unit

1) Connect to the Modular Power System by entering the IP address of the unit in the location/address field of your browser as shown:



The default IP address of the unit is **192.168.0.180**, but any MPS connected to a network with a DHCP server will be assigned a different IP address automatically. To find the assigned address use the front graphic display interface on the power shelf, and navigate to the NETWORK STATUS screen.



Note the assigned IP address displayed, and use this in your browser address field to access the unit remotely.

You can also find the IP address of any ICT unit on a local network by running the **ICT IP Address Discovery tool**, after installing it on your Windows computer connected to the same network (tool available for download from <http://www.ict-power.com/tools-utilities/>)

2) You will be prompted for a user name and password to log into the Modular Power System's built in server. The default user name is **admin**, and no password is required as the factory default.

To log out of the ICT Modular Power System GUI close your browser session.

## System

Once successfully logged in the **System** page will be shown in your browser:

The screenshot shows the ICT Modular Power System GUI. At the top right, it displays 'Modular Power System', 'Module Power Series 48V', 'IP Address: 192.168.0.180', and 'Firmware: v1.00'. The main interface has two tabs: 'STATUS' (selected) and 'SETTINGS & CONTROL'. On the left is a navigation menu with 'System' selected. The 'System Status' section contains four panels: 'DC Output' (Output Status: Enabled, Output Voltage: 55.2 VDC, Total System Current: 0.0 A), 'AC Mains' (Input Voltage: 118 VAC), 'System Alarms' (Form C Alarm: OK, Power Module #1: OK, Power Module #2: OK, Alarm Input #1-4: OK), and 'Module #3: Battery Management' (Battery Voltage: 55.2 VDC, Battery Current: 0.0 A, Battery Temperature: 25 °C, Net Ah Count: 0 Ah, Run-time Remaining: -, Battery State of Charge: -, Alarm Status: OK). The footer contains 'Copyright © 2016 Innovative Circuit Technology Ltd.'

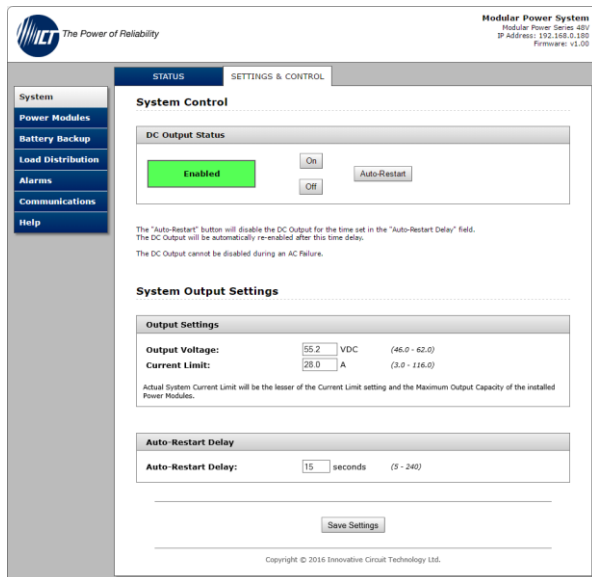
The **STATUS** tab provides a snap-shot of the operating status of the unit, showing the output voltage and current, the AC input voltage, the optional Battery Management Module parameters, the state and loading on the four optional Load Distribution module outputs, and the Alarm states of the internal alarm relay, and the four remote alarm inputs.

Click on the **SETTINGS & CONTROL** tab, to access the following functions:

- Use the **ON/OFF** buttons to remotely disable the system output by shutting off all power modules
- Use the **Auto Re-start** button to momentarily shut off the main output, and then restart automatically after a time delay (set in the **Auto-**

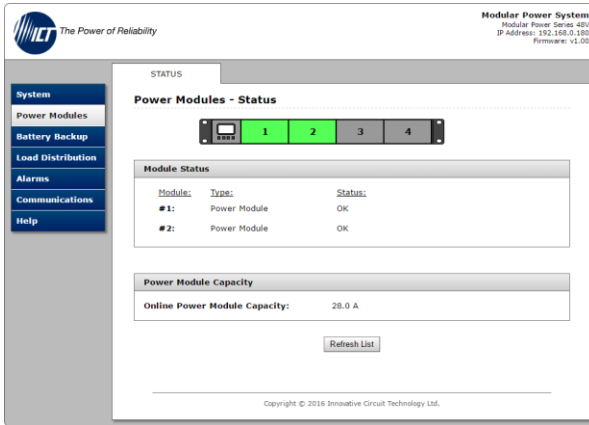
**Restart Delay** field). This feature can be used to remotely force connected equipment to re-boot.

- Set the system **Output Voltage** (to match the float voltage requirement for your external battery)
- Set the system output **Current Limit**, to limit the total current that can be drawn by all the external loads



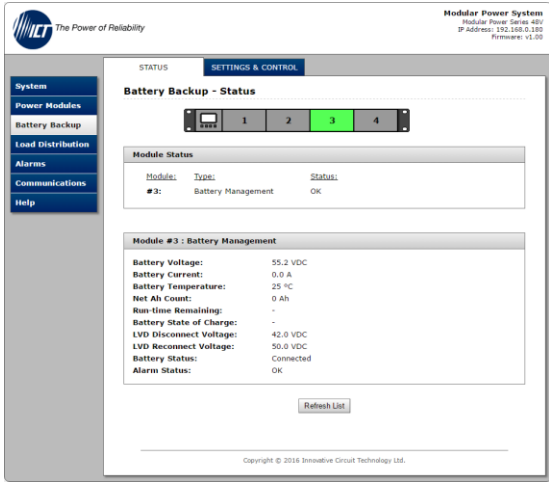
## Power Modules

Use this page to see the current status of all installed power modules in the system. Use the **System** page **SETTINGS & CONTROL** tab to make any changes to the output voltage and current limit of the combined modules. The combined maximum output capacity of all active power modules is shown here.



## Battery Backup (with optional BMM)

Select the **Battery Backup** page (**STATUS** tab) on units with the optional Battery Management Module installed to observe the status of the external battery (which may consist of 2 battery strings with the dual breaker BMMD versions). You may check battery string voltage, combined current (+ is charging, - is discharging), temperature (if ICT-TMP probe installed), Net Ah count (approximate Ah discharged from the battery, where 0Ah denotes full charge), the estimated run time remaining at the current load when in back-up mode, approximate battery state of charge in %, and the LVD threshold voltage settings.



Click on the **SETTINGS & CONTROL** tab to configure all battery related settings. Click on the **Save Settings** button at the bottom of the page to store your changes.

STATUS
SETTINGS & CONTROL

System

Power Modules

Battery Backup

Load Distribution

Alarms

Communications

Help

### Module #3 - Setup

---

#### Output Voltage Control

Temperature Coefficient / cell:  mV/°C

#### Equalise Charge

Equalise Voltage:  VDC (48.0 - 62.0)

Equalise Duration:  minutes (20 - 240)

Equalise Interval:  days (0 - 180)

Caution! For use with flooded batteries only (see Instruction Manual).  
Periodic Equalise Charge will be disabled if the Equalise Interval is set to 0 days.  
The Battery must be fully charged and the DC Output enabled before a Equalise Charge can be started.

Manual Equalise Charge is Not Ready.

Last Equalise Charge: 10/24/16 16:12:45  
Charge Time: 60 min  
Next Equalise Charge: Disabled

#### Configure Battery

Battery Capacity:  Ah (50 - 1000)

Rate:  Hour Rate

#### LVD Settings

Disconnect Voltage:  VDC (42.0 - 46.0)

Reconnect Voltage:  VDC (48.0 - 52.0)

#### Battery Over-Current Alarm

Over-Current Threshold:  A (0 - 150)

Over-Current Alarm will be disabled if the threshold is set to 0 Amps.

#### Battery Low SOC Alarm

SOC Threshold:  %

#### Alarm Reporting

When an alarm is triggered on this module,  
Activate Alarm Form C Contact:

Send E-mail:

#### Battery Discharge Test

Set Discharge Time:  minutes (20 - 240)

Set Discharge Voltage Limit:  VDC (44.0 - 52.0)

Discharge Test Interval:  days (0 - 180)

Periodic Battery Discharge Tests will be disabled if the Discharge Test Interval is set to 0 days.  
Discharge Voltage Limit must be set higher than the LVD Disconnect Voltage.  
The Battery must be fully charged and the DC Output enabled before a Battery Discharge Test can be started.

Manual Discharge Test is Not Ready.

Last Battery Discharge Test: 08/13/16 11:53:07  
Status: Complete  
Discharge Time: 60 min  
End Voltage: 46.10 VDC  
Amp-Hours Discharged: 19 Ah  
Next Periodic Discharge Test: Disabled

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## Output Voltage Control, Temperature Coefficient/Cell:

Make adjustments to the Battery voltage Temperature Coefficient/cell to optimize the automatic control of the battery charging voltage, to keep your battery in a good state of health.

Adjust this setting to match the battery manufacturers recommended compensation value in  $-mV/°C$  per cell. This value will typically be  $-4mV/°C$  for a flooded lead-acid battery (i.e. will compensate output voltage  $-24mV/°C$  for a 6 cell 12V battery) to help ensure the battery is fully charged in cold locations, and is not overcharged when warm. Note that the system must have the battery

temperature sensor (ICT-TMP) installed on the battery for this setting to have an effect. (default setting is 0mV, assumes 25°C operation)

### Equalize Charge Settings

Set up manual or automatic equalize charge cycles for flooded lead-acid batteries.



### **WARNING**

---

**Risk of serious personal injury or damage to equipment and property! Always observe the following:** Equalize charging is intended for Flooded Lead-Acid batteries only, and may produce higher than normal levels of hydrogen gas. Ensure the battery compartment is well ventilated to avoid any risk of explosion! Always consult with battery manufacturer and observe all battery manufacturer recommendations.

---

**Equalize Voltage:** Adjust this setting to the battery manufacturer's recommended value for an Equalize (or Boost) charge (for flooded lead-acid batteries only). A regular high voltage Equalize charge will help prevent stratification of the electrolyte in your battery, and can help extend its life.

**Equalize Duration:** Set the duration time (10-240 minutes) for the equalize charge voltage to be applied (as recommended for your battery).

**Equalize Interval:** Set the Equalize Charge Interval (0 – 180 days) so the system will perform an automatic Equalize charge once every interval time has elapsed. Set this time to 0 (default) to disable the automatic equalize charge.

Note that an Equalize Charge can only be initiated when the battery is fully charged. Press the Manual Equalize Charge button to manually initiate an equalize charge for the set Duration time once the battery is fully charged. (System will state that Manual Equalize Charge is Not Ready, if battery is not yet fully charged)

The days since the last equalize charge and the duration of that charge is noted here, along with the days remaining until the next automatic equalize charge. This information is to help track where the system is within the automatic charge cycle.

### Configure Battery

Set the rated **Battery Capacity** in Ah (50 to 1000Ah) of the total battery pack connected to the power system, and the discharge **RATE** (in hr) used by the battery manufacturer to determine the battery capacity. Normally the 10 or 20hr rate is used. The system will use this information to help determine the

battery state of charge, and remaining battery capacity when in use. Note that connecting two batteries in parallel will double the total Ah capacity, while connecting batteries in series will increase the voltage with no change to the Ah capacity.

### **LVD Settings**

Set the battery Low Voltage **Disconnect Voltage** threshold to a level that will protect the battery from excessive discharge. (default is 10.5/21/42V) The LVD contactor will open when the battery discharges to this level for at least 3s.

Set the **Reconnect Voltage** to a level at least 1.5V more than the disconnect voltage to prevent the LVD contactor repeatedly cycling on and off. This setting will be used when charging the battery from an external dc source (such as a solar system), otherwise once AC power returns the LVD contactor will automatically close so that the power modules can charge the battery directly.

### **Battery Over-Current Alarm**

Set the shelf output **Over-Current Threshold** to receive an alarm notification when the output current exceeds a set over-current level. Set the threshold to 0A to disable this alarm. (default setting)

### **Battery Low SOC Alarm**

Set the **SOC Threshold** to receive an alarm notification when the battery state of charge falls below the set level. Set the threshold to 0A to disable this alarm. (default setting)

### **Alarm Reporting**

Configure how you would like to be notified of the BMM alarms. Select the **Activate Form-C Contact** check box (default) to have the back panel alarm contacts change state for an alarm condition, and/or select the **Send E-mail** check box to have an alarm e-mail sent to the e-mail addresses set up on the communications page.

### **Battery Discharge Test**

Configure the Battery Discharge Test settings in this section, so that you may either manually or automatically perform a partial discharge test to gauge the relative capacity of the external battery. You should generally limit the depth of discharge to no more than 50% of the nominal battery capacity to avoid stressing the battery due to a deep discharge.

#### NOTE:

---

This test must only be done when AC power will be present during the test and for adequate time after the test to allow for a full re-charging of the battery.

Otherwise the battery may not have sufficient remaining capacity to power the load during an AC power outage.

---

Set **Max Discharge Time**, minimum **Discharge Voltage Limit**, and the automatic **Discharge Test Interval** if desired. Each time the test is run the output voltage from the power modules will be reduced so that the external battery will power the system load until either the **Max Discharge Time** limit or the **Discharge Voltage Limit** is hit. A **Discharge Test Complete** notification (on the front display and with an e-mail if messaging is configured via the Network GUI) indicates the battery is able to power the connected load for the set test duration while maintaining its voltage above the Discharge Voltage Limit. The system will indicate a **Discharge Test Failure** if the minimum Voltage Limit is hit before the Max Discharge Time limit, as the battery was not able to power the load for the desired duration.

Set the **Discharge Test Interval** (days) to have the system automatically initiate a discharge test every interval, once the battery reaches 100% SOC. Set this interval to 0 days to disable the automatic Discharge Test. (default setting)

You may alternatively manually initiate a Battery Discharge Test of a fully charged battery by changing the **Manual Discharge Test** parameter to **Enabled**. (This test parameter will show that the discharge test is **Not Ready** if the battery SOC is less than 100%)

Observe the saved information regarding the most recent discharge test shown here, with fields for days since the **Last Battery Discharge Test**, **Status** (Pass or Fail), **Discharge Time**, **End Voltage** at the completion of the test, and the **Amp Hours Discharged** during the test. The scheduled days until the next automatically repeating test will also be shown if this feature has been enabled.

### **Load Distribution (with optional LDM)**

Select the **Load Distribution** page (**STATUS** tab) on units with an optional Load Distribution Module installed to observe the status and load current of the four controlled outputs on the LDM module.

The screenshot displays the 'Modular Power System' web interface. At the top left is the logo 'ICT The Power of Reliability'. At the top right, it shows 'Modular Power System', 'Modular Power Series 402', 'IP Address: 192.168.0.180', and 'Firmware: v3.00'. Below the logo is a navigation menu with 'System', 'Power Modules', 'Battery Backup', 'Load Distribution', 'Alarms', 'Communications', and 'Help'. The main content area has two tabs: 'STATUS' and 'SETTINGS & CONTROL'. The 'Load Distribution - Status' page features a row of four module status indicators, with the fourth indicator (labeled '4') highlighted in green. Below this is a 'Module Status' table:

Module:	Type:	Status:
#4:	Load Distribution	OK

Below the table is a section titled 'Module #4 : Load Distribution' with the following data:

Output #1:	0.0 A
Output #2:	OFF
Output #3:	0.0 A
Output #4:	0.0 A
Alarm Status:	OK

A 'Refresh List' button is located below the data. At the bottom of the page, it says 'Copyright © 2016 Innovative Circuit Technology Ltd.'

Click on the **SETTINGS & CONTROL** tab to configure the settings for each output channel.



System

Power Modules

Battery Backup

Load Distribution

Alarms

Communications

Help

STATUS
SETTINGS & CONTROL

### Module #4 - Control

**Module Output Control**

<p><b>Output #1:</b>  <span style="background-color: green; color: white; padding: 2px 5px;">Enabled</span>   <input type="button" value="On"/>   <input type="button" value="Off"/></p>	<p><b>Output #3:</b>  <span style="background-color: green; color: white; padding: 2px 5px;">Enabled</span>   <input type="button" value="On"/>   <input type="button" value="Off"/></p>
<p><b>Output #2:</b>  <span style="background-color: red; color: white; padding: 2px 5px;">Disabled</span>   <input type="button" value="On"/>   <input type="button" value="Off"/></p>	<p><b>Output #4:</b>  <span style="background-color: green; color: white; padding: 2px 5px;">Enabled</span>   <input type="button" value="On"/>   <input type="button" value="Off"/></p>

If Power Cycling is enabled in Module Output Configuration settings, the "Off" button will be replaced with a "Cycle" button.

**Master Output Control**

**Module Setup**   (Click "Save Settings" when finished)

**Power-On Sequencing/Cycling**

Sequence/Cycle Delay:      second(s)   (0 - 60)

**Alarm Reporting**

When an alarm is triggered on this module,

Activate Alarm Form C Contact:  

Send E-mail:

**Module Output Configuration**   (Click "Save Settings" when finished)

**Select an Output to edit**

<input checked="" type="radio"/> #1: Radio 1	<input checked="" type="radio"/> #3: RF Amplifier
<input type="radio"/> #2: Radio 2	<input type="radio"/> #4: Repeater

**Output #1 Settings**

Output Label:  

Output State after Power Loss:  

Ignore Circuit Breaker status:  

Enable Power Cycling:  

If Power Cycling is enabled, "Sequence/Cycle Delay" must be set above.

**Output #1 Load-Shedding**

Enable Load-Shedding:  

Load-Shedding Threshold:      VDC   (0.0 - 58.5)

Recovery Threshold:      VDC   (10.5 - 60.0)

Load-Shedding Auto Recovery:  

If enabled, Load-Shedding will disable this Output if the system voltage drops below the threshold for at least 30 seconds.

**Output #1 Over-Current Alarm**

Over-Current Threshold:      A   (0 - 20)

This alarm will have no effect if the threshold is set to 0 Amps.

**Output #1 Under-Current Alarm**

Under-Current Threshold:      A   (0 - 20)

This alarm will have no effect if the threshold is set to 0 Amps.

### Module Output Control:

Click on the **Output #1 to #4 On or Off** button to close or open the relay on that output channel. Click on the Master Output Control **All Outputs On**, or **All Outputs Off** button to open or close the relays on all four output channels simultaneously. (All outputs are enabled as the factory default setting)

### Module Setup:

Use this section to set the **Power Cycle Delay** time, which will be used as the delay time (in seconds) before energising an output, for each output that has power cycling enabled. (See Output Configuration below)

Select the Alarm actions to be taken for the LDM **Alarm Reporting** - chose to activate the back panel Form-C alarm contact output and/or send an alarm e-mail to the address' chosen on the e-mail setup page by ticking the appropriate boxes.

### Module Output Configuration:

Select the output to be edited in the **Select an Output to Edit** box. Make any required changes, and then click on the **Save Settings** button at the bottom of the page to save any edits.

#### Output Settings

**Output Label:** Enter a descriptive label for the selected output channel if desired.

**Output State After Power Loss:** Sets the state for the output after the LDM loses all input power, then recovers. Select one of the following:

- **Restore last State:** Will return the output contactor to the state prior to the reset event (default)
- **Enable Output:** Will enable the output contactor, regardless of its previous state
- **Disable Output:** Will disable the output contactor, regardless of its previous state

**Ignore Circuit Breaker Status:** Will mask the circuit breaker open circuit detection, to prevent false alarms on an unused channel.

**Enable Power Cycling:** Check this box to enable output power cycling for the selected output, so that the output will automatically be re-enabled after the **Power Cycle Delay** time whenever the output is disabled using the **Output Off** button on the **Settings and Control** page, or when the **Network Watchdog** is triggered. This feature is useful for remotely resetting power to a router or other hardware required for the network connectivity of the panel.

**Note:** The **Power Cycle Delay** time must be set with duration long enough for the connected network hardware to fully reset for this function to be effective. Multiple outputs that are disabled using Power Cycling will be re-enabled in sequence from Output 1 to output 4.

#### Output Load Shedding

**Enable Load Shedding:** Check this box to disable this output when the bus voltage drops below the load-shedding threshold for at least 30s. This feature can be used to disconnect less critical loads to preserve back-up battery power as the battery voltage drops when the AC power has failed.

**Load-Shedding Threshold:** Enter the voltage level at which the selected output will be disconnected.

**Auto Recovery Threshold:** Enter the voltage level at which the selected output will automatically be reconnected. This value must be at least 0.5V above the **Load-Shedding Threshold** voltage.

**Load-Shedding Auto Recovery:** Check this box to allow the output to be automatically reconnected when the bus voltage is above the **Auto Recovery Threshold** for at least 60s. The output must be manually re-enabled using the **Output ON** button if the **Auto Recovery** function is not enabled.

### Output Over(Under)-Current Alarm

**Over-Current Threshold:** Enter the over-current level. Output current above this level for at least 5s will trigger the Over-Current Alarm. Disable this alarm by setting the threshold to 0A (default).

**Under-Current Threshold:** Enter the under-current level. Output current below this level for at least 5s will trigger the Under-Current Alarm. Disable this alarm by setting the threshold to 0A (default).

Click the Save Settings button to save the configuration for that channel, and then repeat the setup process for each of the 4 output channels to be used.

## Alarms

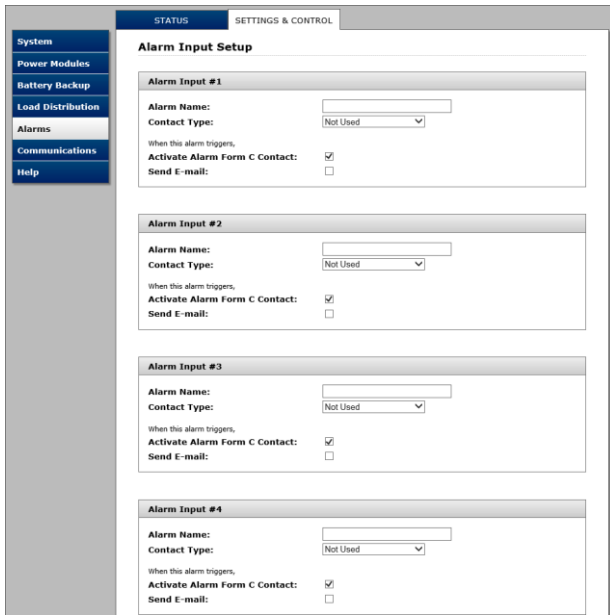
Click on the **Alarms** page to check the status and alarm history on the **STATUS** tab.

The screenshot shows the ICM web interface. The top left features the ICM logo and the tagline 'The Power of Reliability'. The top right displays 'Modular Power System' with details: 'Modular Power Series 48V', 'IP Address: 192.168.0.180', and 'Firmware: v1.00'. A navigation menu on the left includes 'System', 'Power Modules', 'Battery Backup', 'Load Distribution', 'Alarms', 'Communications', and 'Help'. The main content area is titled 'STATUS' and 'SETTINGS & CONTROL'. Under 'Alarm Status', there is a table for 'Active Alarms' with columns for 'Module', 'Alarm', 'Time Set', and 'Status'. One entry is shown: '#4 OUT #2 Breaker Open' with 'Time Set: 10/18/16 12:11:02' and 'Status: ACTIVE'. Below this is the 'Alarm History' section with columns for 'Module', 'Alarm', 'Time Set', and 'Time Cleared'. Three entries are listed: 'ICM Alarm Input 1' (11/09/16 08:01:20 to 11/09/16 09:15:03), '#3 Battery Low SOC' (09/26/16 12:42:56 to 09/26/16 14:17:24), and 'ICM AC Input Failure' (09/26/16 05:32:17 to 09/26/16 13:29:27). A 'Refresh List' button is located at the bottom of the history section. The footer contains 'Copyright © 2016 Innovative Circuit Technology Ltd.'

Click on the **SETTINGS & CONTROL** tab to set up the four remote alarm monitoring inputs. Give each input a meaningful name to suit the installation (these will be used for e-mailed alarm messages), and select a **Contact Type** of either Normally Open (NO) or Normally Closed (NC) for each device to be

monitored. Set alarm **Contact Type** to Not Used for all unused alarm input channels (default setting).

Select the action to be taken in the event of an alarm condition for each input, either activate the local Form-C contact alarm output relay on the MPS shelf, or send an alarm e-mail to the addresses set up in the Communications section.



## Communications

Select the **Communications** page tab to configure the Basic system parameters, Network settings, E-mail settings, User setup, and Maintenance functions. Click the Save Settings button at the bottom of each page to enable any changes you have made.

Select the **BASIC SETUP** tab to configure the device name, set the date and time and enable the watchdog timer and data logging features.

### Power System Device Info:

Enter a **Device Name** for the system (used in all email messages), and view the Model and hardware version.

### Date and Time Settings:

Check the system internal clock settings here, and select the tick box to **Synchronize with NTP Server** (default), then Enter an **NTP Server** address (i.e.

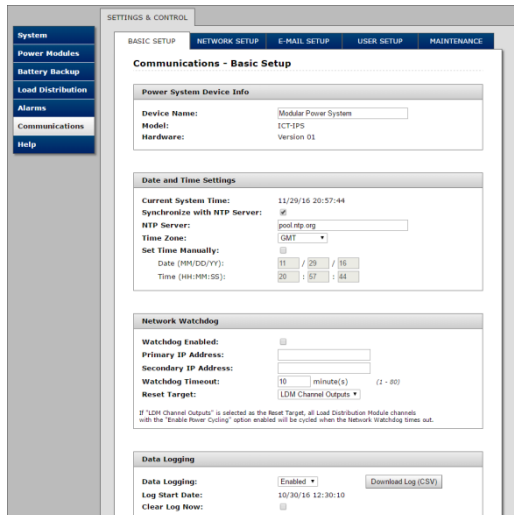
time.nist.gov) to automatically load network time. You may choose to **Set Time Manually** by selecting the tick box, and then enter the correct **Date** and **Time**.

**Network Watchdog:**

Enable the Network Watchdog to cycle power to an external device on loss of communications by selecting the **Watchdog Enabled** tick box. Set a **Primary** and **Secondary IP Address** for the unit to ping to determine the network is functioning, and then enter a **Watchdog Timeout** (1-60 minutes) to set how long the system will wait with no ping response from either IP address before initiating a reset. Choose a **Reset Target** (either **LDM Channel Outputs**, or the main **System Output**) which will then be reset for the power cycling delay time to re-boot any connected devices. Selecting "LDM Channel Outputs" as the Reset Target, will cause all Load Distribution Module channels with the "Enable Power Cycling" option selected to be cycled when the Network Watchdog times out. When selecting to reset the main "System Output", set the Auto Restart Delay time on the System page to define how long the system will be off when the Watchdog timeout is triggered.

**Data Logging:**

Enable **Data Logging** to keep a running record of the all the key system parameters and alarms, recorded once per minute for up to the last 30 days. Click on the **Download Log (CSV)** button to store the CSV format log file on your computer for further analysis. Click the **Clear Log Now** tick box to clear the system onboard data log and start a fresh log record.



Configure network settings on the **NETWORK SETUP** page.



---

## Saving any changes to the network settings will cause the ICM to re-start, causing momentary loss of communications

---

### Network:

**MAC Address:** Displays the MAC address assigned to the panel. It is also shown on line four of the LCD Network Status screen.

**Enable DHCP:** Turn on this setting if your network uses a DHCP server to automatically assign IP addresses. (Enabled as default setting). To manually assign a static IP address to the unit uncheck this box, then set the following parameters.

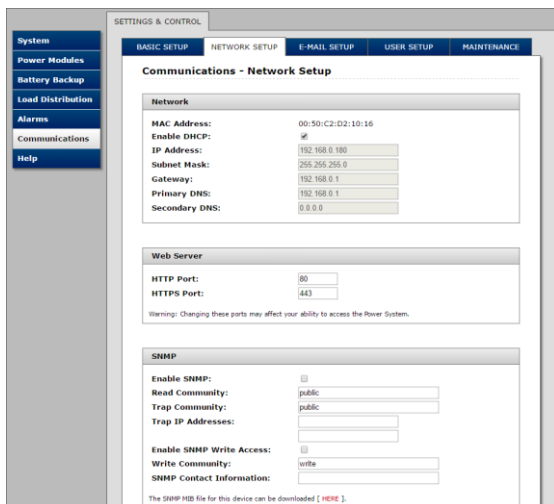
**IP Address:** Specify a unique IP address for the unit.

**Subnet Mask:** Specify the mask for the subnet the panel is located on

**Gateway:** Specify the IP address of the default router (Gateway) used for connecting attached devices to different networks.

**Primary DNS:** Specify the IP address of the Primary DNS Server for your network.

**Secondary DNS:** Specify the IP address of the Secondary DNS Server for your network.



### Web Server:



## CAUTION:

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### Changing the web server port numbers may cause loss of communication with the panel

---

The following ports may be changed within a range of 1 to 65565, if required.

**HTTP Port:** This port is used for HTTP traffic between the panel and your browser. The default HTTP port is **80**, and if you change this the new HTTP Port number must be appended to the URL used to access the panel. (e.g. use URL **http://192.168.0.180:8000** for IP address **192.168.0.180**, port **8000**)

**HTTPS Port:** The HTTPS (HTTP Secure) protocol uses encrypted data transfer between web browsers and servers for higher security. The default HTTPS port is **443**. Append any changed HTTPS port to the end of the URL for the panel.

To access the panel through a secure HTTPS connection, use **https://** at the start of the units URL. (e.g. **https://192.168.0.180:8888** for IP address **192.168.0.180**, HTTPS port **8888**)

## SNMP

Configure these settings if you would like to use SNMP based monitoring. SNMP (Simple Network Management Protocol) is an industry standard protocol for network management software. Enabling the SNMP function on the panel will allow standard SNMP management software to connect to the SNMP agent running on the panel and read real time system information such as bus voltage, and channel currents. The panel can send SNMP traps to the external management software when an alarm or fault occurs.

The information available from the SNMP agent is described in a MIB (Management Information Base) file, which can be downloaded from the link at the bottom of the SNMP box on this GUI page, or on the panels **Help** page. The unique panel MIB file must then be imported into your external SNMP management software.

**Enable SNMP:** Check this box to enable the SNMP agent.

**SNMP Version:** Sets the SNMP version (**v1/v2c**, **v3**, or **All**) supported by the SNMP agent. If **All** is selected, all SNMP versions will be supported

simultaneously. The appropriate settings for the selected SNMP version will need to be configured.

**Enable SNMP Write Access:** Check this box to allow remote SNMP control of the system output and individual LDM output channels. If this box is unchecked, all information available from the SNMP agent will be read-only.

**SNMP Contact Information:** Assign contact information, such as an operator name and phone number for the panel, which can be read via SNMP queries. (This information is optional)

### SNMPv1/v2c Settings:

**Read Community:** Enter the community string/password here for read-only SNMP access. The default read community string is “public”.

**Write Community:** Enter the community string/password here for read/write SNMP access. The default write community string is “write”.

NOTE:

The community strings should be changed to unique passwords before enabling SNMP, as the defaults are well known.

### SNMPv3 Settings:

**User Name:** Enter the user name for SNMPv3 access.

**Authentication Protocol:** Select the SNMPv3 authentication protocol (**None**, **MD5**, or **SHA**).

**Authentication Password:** If an authentication protocol is selected, enter the authentication password.

**Privacy Protocol:** Select the SNMPv3 privacy protocol (**None**, or **AES**).

**Privacy Password:** If a privacy protocol is selected, enter the privacy password.



## SNMP Trap Settings:

**Trap Community:** Enter the community string/password that is sent with all traps. Some trap receivers are able to filter on trap community.

**Trap IP Addresses:** Enter the IP addresses for up to two devices that will receive SNMP traps from the panel.

Select the **E-MAIL SETUP** page to configure all e-mail settings to enable automatic e-mail notifications directly from the unit. The information required for this is available from your Network Administrator, or Internet Service Provider. (ISP)

The screenshot shows the ICT web interface for a Modular Power System. The top left features the ICT logo and the tagline "The Power of Reliability". The top right displays the system name "Modular Power System", model "Modular Power Series 48V", IP address "192.168.0.180", and firmware version "Firmware: v1.00". The main navigation menu includes "System", "Power Modules", "Battery Backup", "Load Distribution", "Alarms", "Communications", and "Help". The "Settings & Control" section is active, with sub-tabs for "BASIC SETUP", "NETWORK SETUP", "E-MAIL SETUP", "USER SETUP", and "MAINTENANCE". The "E-MAIL SETUP" page is titled "Communications - E-mail Setup" and contains the following fields and options:

- E-mail**
- SMTP Server:
- SMTP Port:
- SMTP Server requires SSL:
- Sender E-mail Address:
- Recipient E-mail Addresses:
- SMTP User Name:
- SMTP Password:
- Minimum E-mail Interval:  minute(s)

Use commas to separate multiple Recipient E-mail Addresses.  
Leave the SMTP User Name & Password blank if the SMTP Server does not require authentication.

**General E-mail Notifications**

Send an E-mail Notification when:

- AC Input Power is lost:
- A Power Module failure occurs:
- A Module is offline:
- System Current Limit is triggered:
- Intelligent Controller Module reset:
- The Network Watchdog triggers:

### E-mail:

**SMTP Server:** Enter the name or the IP address of your SMTP server used for sending outgoing e-mail. (e.g. "smtp.gmail.com")

**SMTP Port:** Enter the port used by your SMTP server. (Normally 25)

**SMTP Server requires SSL:** Check this box if your SMTP server requires an encrypted SSL connection.

**Sender E-mail Address:** Enter an e-mail address that will appear as the sender for all e-mail notifications sent from the panel.

**Recipient E-mail Addresses:** Enter one or more e-mail addresses that are to receive all e-mail notifications from the panel. Use commas to separate multiple addresses. This field can also be used to send a text message

notification to a phone; see the **Text Message Notifications** section for further information.

**SMTP User Name:** Enter a SMTP user name here, if required by your SMTP server. Leave this field blank if the server does not require authentication.

**SMTP Password:** Enter a SMTP password here, if required by your SMTP server. Leave this field blank if the server does not require authentication.

**Minimum E-mail Interval:** Specify a minimum interval required between e-mail notifications. (Default 1 minute, range 0 to 60 minutes) This time interval is used to prevent an un-intended flood of e-mail alarm notifications that could occur when an alarm limit is incorrectly configured, for example.

### **General E-mail Notifications:**

Select these options to receive an e-mail when one or more of these events occurs:

**AC Input Power is lost:** Check this box to receive an e-mail notification when the ac input drops below a functional level.

**Power Module Failure occurs:** Check this box to receive an e-mail notification when any of the installed power modules stop functioning.

**A Module is Offline:** Check this box to be notified when a module loses communication with the ICM.

**System Current Limit is triggered:** Check this box to get a notification each time the system output current hits the maximum current limit value

**Intelligent Controller Module reset:** Check this box for notification of an ICM reset for any reason.

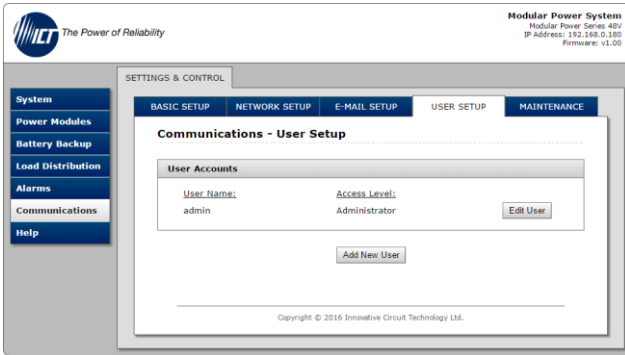
**The Network Watchdog triggers:** Check this box to receive an e-mail notification after the Network Watchdog triggers due to a loss of the network connection and the network has then come back online.

Select the **USER SETUP** tab to set up and configure the password for up to 10 users, with the ability to limit who has access to the panel settings. Click on the **Save Settings** button at the bottom of the page to save any password changes.

The unit has no password assigned by default, so an Administrator password should be assigned to your panel for improved security.

 **NOTE:**

Record your new password(s) for future access! If the Administrator password is lost the unit must be reset to return the password to the blank default setting, causing loss of all other user settings. See the **Password Reset** section for more details.



**Select a User to Edit:** Choose which of the user accounts to edit. Set the access level to be appropriate for the amount of control each user requires.

**Administrator:** This level has full access to the panel settings, and can set up users and change passwords (“admin” is the default user)

**Control:** User has read-only access to the panel, but can enable or disable the outputs, and change some of the basic settings.

**View-Only:** User can only view status, cannot change any settings

**New Password:** Use these fields to change the password of the selected user.

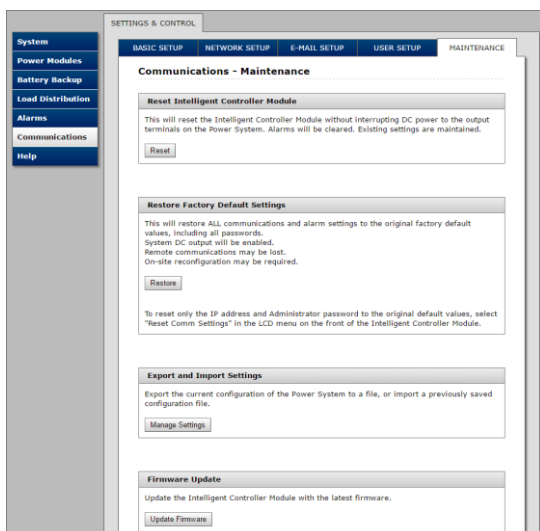
**New Password:** Enter the new password for the chosen user.

**Confirm New Password:** Re-enter the new password to confirm the entry.

**Confirm Changes:** Enter the current **Administrator Password** to confirm the new password changes, prior to saving the settings.

Use the **MAINTENANCE** tab to reset the panel (soft reset), restore the panel default settings, or send a test e-mail to verify e-mail functionality.

**Reset Intelligent Controller Module:** Clicking the **Reset** button will restart the controller. The LDM channel output states will be restored according to the **Output State after Panel Reset** setting for each output on the **Output Setup** page. All other settings are maintained during the reset.



**Restore Factory Default Settings:** Clicking the Restore button will restore **ALL** settings to the original factory default values, including the user passwords. To only restore the network settings and passwords see the **Password Reset** section. (This feature is only available to the system Administrator)

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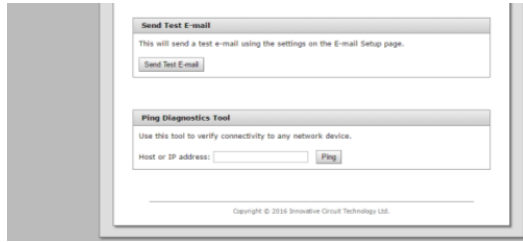
**Note:** Restoring the unit to Factory Default settings may cause loss of network communications due to loss of custom changes to any network settings

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To reset only the IP address and Administrator password to the original default values, select **Reset Comm Settings** in the graphic display menu on the front of the Intelligent Controller Module.

**Export and Import Settings:** The **Manage Settings** button will take you to the Export and Import Settings page, where you may export all the system settings (other than the Administrator password, Network and Web Server settings) to an encrypted **.cfg** file on the local computer. Use the **Import Settings** section on other systems to locate this file and then import it to any other MPS you are logged in to, greatly simplifying the configuration of multiple identical units.

**Firmware Update:** Download the latest Modular Power System firmware file from the ICT website (ict-power.com) to your local computer. De-compress this **.cry** file then press the **Update Firmware** button, and link to this file. Update the firmware on the power system control module by clicking the **Update Now** button. Note that the system settings will not be changed. Do not remove AC power during the update process!



**Send Test E-mail:** Click the **Send Test E-mail** button to send a test e-mail to the listed e-mail recipients using the e-mail settings on the **E-mail Setup** page.

**Ping Diagnostics Tool:** Use this feature to verify connectivity of any network connected device. Enter the hostname or IP address of the target device, and then click the **Ping** button to check if the device is active.

## Router Configuration

Use this section to help you set up your Modular Power System with remote Internet access when it is located behind a router.

A router allows multiple PC's to share a single Internet connection, and must be configured correctly to forward incoming remote data to the local IP address of your panel.

Example configuration using a Linksys WRT54G router: (others will be similar)

1. Log into your router and go to the port forwarding screen. In the example Linksys WRT54G router this is located in the Applications and Gaming tab. The location of the port forwarding fields may be different on your particular router. (consult the router manual for instructions)
2. Configure HTTP forwarding:
  - a. Enter a unique name in the **Application** field
  - b. Enter the HTTP port number that the panel is using in the **Start** and **End** fields. The default HTTP port for the panel is **80**.
  - c. Select **Both** under **Protocol** (TCP and UDP)
  - d. Enter the local IP address of the panel (e.g. 192.168.0.180) in the **IP address** field. (see step 2 of the **Operation (Network GUI)** section to verify the panel IP address)
  - e. Check the **Enable** box, and then click on **Save Settings**



### NOTE:

Many ISP's block access to port 80, so if your ISP does block this port you must change the HTTP port the panel uses from 80 to something else, such as 8000.

(Valid port numbers are in the range of 1 to 65535) See the **Network Setup** section for information on assigning new network ports.

You must also change the panel’s HTTP port from 80 if your local network has another device (such as a panel, or web server) already using port 80.

3. Configure HTTPS forwarding by repeating steps 2a to 2e with the HTTPS port number that the panel is using. The default HTTPS port number is **443**.

**Port Range Forwarding :** Certain applications may require to open specific ports in order for it to function correctly. Examples of these applications include servers and certain online games. When a request for a certain port comes in from the Internet, the router will route the data to the computer you specify. Due to security concerns, you may want to limit port forwarding to only those ports you are using, and uncheck the **Enable** checkbox after you are finished. **More...**

Application	Start	End	Protocol	IP Address	Enable
http	80	to 80	Both	192.168.0.180	<input checked="" type="checkbox"/>
https	443	to 443	Both	192.168.0.180	<input checked="" type="checkbox"/>
	0	to 0	Both	192.168.0.0	<input type="checkbox"/>
	0	to 0	Both	192.168.0.0	<input type="checkbox"/>
	0	to 0	Both	192.168.0.0	<input type="checkbox"/>
	0	to 0	Both	192.168.0.0	<input type="checkbox"/>
	0	to 0	Both	192.168.0.0	<input type="checkbox"/>
	0	to 0	Both	192.168.0.0	<input type="checkbox"/>
	0	to 0	Both	192.168.0.0	<input type="checkbox"/>
	0	to 0	Both	192.168.0.0	<input type="checkbox"/>

Router Port Forwarding Screen

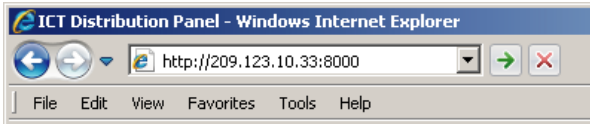
4. Determine the WAN IP address of your router assigned by the ISP. With the example router this information is on the **Status** tab, listed as **IP Address**.

**NOTE:**

When using a dynamic IP address the router’s WAN IP address may change from time to time without warning, depending on your ISP. In this case you should obtain a Static IP address from your ISP (it will not change) which will ensure more predictable access to the panel from a remote location. If a static IP address is not available you can use a Dynamic DNS service such as Dyn ([www.dyn.com](http://www.dyn.com)) to provide a stable address for the router.

5. To access the panel over the internet type the WAN IP address of the router in the location/address field of your browser, followed by a colon and the HTTP port number the panel is using. (e.g.

**http://209.123.10.33:8000** for a router address **209.123.10.33**, port **8000**)



Panel Access with Router Address

## Text Message Notifications

The panel can send alarm notifications as text messages to a cell phone by configuring the alarm e-mails to be sent to your mobile phone service provider. On the **E-mail Setup** page of the web based utility enter the address of your phone in the **Recipient E-mail Address** field.

Example with an AT&T phone: enter the recipient address **cellnumber@txt.att.net**, replacing **cellnumber** with your 10 digit cell phone number.

Cell address formats for some common North American mobile phone providers:

AT&T	<i>cellnumber@txt.att.net</i>
Verizon	<i>cellnumber@vtext.com</i>
Sprint	<i>cellnumber@messaging.sprintpcs.com</i>
T-Mobile	<i>cellnumber@tmomail.net</i>
Virgin Mobile	<i>cellnumber@vmobl.com</i>
Nextel	<i>cellnumber@messaging.nextel.com</i>
Bell Mobility	<i>cellnumber@txt.bell.ca</i>
Rogers	<i>cellnumber@pcs.rogers.com</i>
Telus	<i>cellnumber@msg.telus.com</i>
Virgin Mobile (Can)	<i>cellnumber@vmobile.ca</i>

## Troubleshooting Network Communications

*I am unable to access the web-based configuration utility:*

- Check that you are using the correct IP address for the system by downloading and running the **ICT IP Address Discovery tool** <http://www.ict-power.com/tools-utilities/>
- Check the network cable connections to the panel and the network

- Ensure the network card settings on your computer are configured for accessing the IP address of the MPS. To access a panel with the default IP address of 192.168.0.180 the typical network settings for your computer are:
  - IP Address: 192.168.0.180
  - Subnet Mask: 255.255.255.0
  - Gateway: 192.168.0.1
- If the HTTP port of the panel has been changed, you must append the new port number to the URL used to access the panel. (See the **Network Setup** section) See the **Password Reset** section for details on how to reset the port number to the factory default value.
- If your network switch allows you to manually configure port speed and duplex settings, turn-on “**Auto Negotiation**” for the switch port that the panel is connected to.

*I forgot my password:*

- See the Password Reset section of the manual

*I am not receiving e-mails from the panel:*

- Verify that the **Send-E-mail** checkboxes are ticked for any alarm conditions for which you wish to receive e-mail notifications.
- Verify your e-mail settings by going to the **Communications/Maintenance** page on the unit’s web GUI and clicking on the **Send Test E-mail** button, to send a test message to your designated recipient addresses. The **Send Test E-mail** box will show an error message if the system is unable to send the e-mail.
- Check on the **Communications/E-mail Setup** page and ensure the **SMTP Server** field is the correct address for your e-mail provider, and the **SMTP Port** is correct. (Port should be 25 for most servers)
- If your SMTP server requires SSL encryption, ensure the **SMTP Server requires SSL** checkbox is ticked. Otherwise leave blank.
- If your SMTP server requires authentication ensure that the **SMTP User Name** and **SMTP Password** fields are correctly entered.

## STATUS INDICATORS AND ALARMS

The status of the Modular Power System generally is indicated on the front graphic display module on units equipped with the ICM, or via the network GUI



on remotely monitored units. Green “POWER” and red “FAULT” LED’s on the power modules, along with the Form-C alarm contacts on the back panel indicate the core status of power shelf, even on non-ICM equipped units.

On Intelligent ICM equipped systems there is an option on the Setup page in the GUI for most alarms to make a selection to have the system send an Email to designated addresses for remote notification.

All alarms and warnings will be displayed on the ICM front graphic display on Intelligent Power Shelf systems, and entered in the Alarm History log. (Most recent 20 alarms listed)

Alarms generally reset automatically when the trigger condition is removed. Major alarms such as a Module DC Output Failure or Module Configuration Error require that the module be temporarily removed to cycle input power and clear the fault.

**Power Module Alarms:**

Alarm Condition	Trigger Condition	Module Output <sup>2</sup>	Red LED	Green LED	Alarm Relay	Send Email <sup>3</sup>
Power Failure	Loss of AC power to module	Disabled	Off	Off	Active	Yes
Module Operating	Normal operation	On	Off	On	No	-
Configuration Error	Different voltage modules in shelf	Off	On	Off	Active	Yes
Current Limit (Warning only, display will flash)	Output current approaches within 1A of the max current limit setting	On	Off	On	No	-
Fan Failure	Fan is not operating to spec	On	Off	On	No	Yes
Manual Disable	Output switched off by ICM or GUI	Disabled	Blink	Off	No	-
Module Removal	Module shelf connections open	Disabled	On	Off	No	-
PFC Shutdown	Internal bus voltage out of range	Disabled	On	Off	Active	Yes

<sup>2</sup> Other power modules are not affected when one module has its output disabled

<sup>3</sup> Email notifications only sent if enabled in the unit’s Network GUI Email Setup page, and either ac or dc power is available for the system to be operational

Alarm Condition	Trigger Condition	Module Output <sup>2</sup>	Red LED	Green LED	Alarm Relay	Send Email <sup>3</sup>
Module Fault	Internal aux voltages out of range	Disabled	On	Off	Active	Yes
Over Temp Shutdown	Internal temp too high	Disabled	On	Off	Active	Yes
DC Output Failure	Output above set point (Manually re-enable dc output to reset)	Disabled	On	Off	Active	Yes

### Battery Management Module (BMM) Alarms:

Alarm Condition	Trigger Condition	LVD Contactor	ICM Required	Alarm Relay	Send Email <sup>3</sup>
Module Power Failure	Loss of AC, and battery disconnected	Open	No	-	Yes
No Alarms	Normal Operation	Closed	No	No	-
Battery Low SOC	SOC drops below Low SOC setting	Closed	Yes	Active <sup>4</sup>	Yes
Battery Overcurrent	Battery I rises above OC setting for 10s	Closed	Yes	Active <sup>4</sup>	Yes
Circuit Breaker Open	Circuit breaker trips or manually opened	Open	Yes	Active <sup>4</sup>	Yes
Battery Over Temperature	Optional TMP probe temp >50C for 5s	Open	Yes	Active <sup>4</sup>	Yes
LVD	Battery V at LVD or Overvoltage setting	Open	No	Active	Yes
Configuration Error	Mixed polarity modules, or installed in slot 1, 2, 5, or 6	Open	No	Active	Yes

### Load Distribution Module (LDM) Alarms:

Alarm Condition	Trigger Condition	Output Relays	ICM Required	Alarm Relay	Send Email <sup>3</sup>
Module Power Failure	Loss of AC and DC bus connection	Open	No	-	Yes
No Alarms	Normal Operation, outputs enabled	Closed	No	No	-
Circuit Breaker Open	Circuit breaker opened or tripped	Closed	Yes	Active <sup>4</sup>	Yes
Output Undercurrent	Output current drops below setting for 5s	Closed	Yes	Active <sup>4</sup>	Yes

<sup>4</sup> Contact active only if alarm enabled in the Network GUI module Setup page

Alarm Condition	Trigger Condition	Output Relays	ICM Required	Alarm Relay	Send Email <sup>3</sup>
Output Overcurrent	Output current rises above setting for 5s	Closed	Yes	Active <sup>4</sup>	Yes
Configuration Error	Mixed polarity modules, or installed in slot 1, 2, 5, or 6	No change	Yes	Active <sup>4</sup>	Yes
Load Shedding	V drops below Load Shed setting for 30s	Open	Yes	Active <sup>4</sup>	Yes
Output Manually Disabled	Output manually disabled via ICM or GUI page	Open	Yes	-	-

### Intelligent Control Module (ICM) Alarms:

Alarm Condition	Trigger Condition	Alarm Relay	Send Email <sup>3</sup>
Alarm Input	Contact open or close on any Alarm input 1 to 4	Active (if set up on Alarm Input page)	Yes
AC Input Failure	AC input falls below 90Vac	Active	Yes
Shelf Overcurrent	Total output current on shelf is >150Adc for 20s	Active	Yes
System Current Limit	ALL power modules in system at their current or power limit for 15s	Active	Yes
Communication Bus Error	Internal communication bus error condition	Active	-

## PRODUCT SPECIFICATIONS

AC Input Nominal Rating: 120/240Vac 50/60Hz  
AC Input Operating Range: 108 to 264Vac  
AC Input Maximum Range: 100 to 280Vac

Input Power Factor: 0.99 typ (120Vac input)

Efficiency (typical): 90%

Output V Line Regulation: +/- 0.1%

<b>Model:</b>	<b>Power Shelf</b>	<b>12V Module</b>	<b>24V Module</b>	<b>48V Module</b>
Output Voltage <sup>5</sup> (Nominal Battery float Voltage) (+/- 0.5%)	Set by Power Modules installed	13.8V	27.6	55.2V
Max Current Limit (+5%, -0%)	150A <sub>dc</sub>	56A	28A	14A
Continuous Current Rating	150A <sub>dc</sub>	50A	25A	12.5A
Output Power (max)	2800W	700W	700W	700W
Output Noise (max mV <sub>rms</sub> )	-	30mV <sub>rms</sub>	30mV <sub>rms</sub>	60mV <sub>rms</sub>
Output V Load Regulation (over full load range at nominal output voltage)		1.7%	1.7%	1.2%
Input Current (max at 120Vac)	20A <sub>rms</sub> (with 2100W shelf output)	6.6A <sub>rms</sub>	6.6A <sub>rms</sub>	6.6A <sub>rms</sub>
BMM Max Battery Current (per input)	100A	-	-	-
BMM Max total Battery Current through LVD	150A	-	-	-
BMM LVD Threshold V (Default)	-	11.5V	23.0V	46.0V
BMM LVD Reconnect V (Default setting)	-	12.5V	25V	50V
BMM idle DC Power Draw <sup>6</sup>	<1W	-	-	-
LDM Max Load per Output (continuous)	-	20A	20A	20A

Output Grounding:

Power Modules are floating, may be connected with Positive or Negative ground<sup>7</sup>

<sup>5</sup> Actual Operating point may be lower due to battery charge requirement

<sup>6</sup> AC mains power off; backup battery connected; LVD open

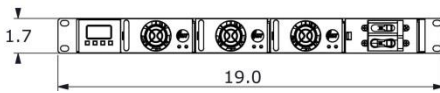
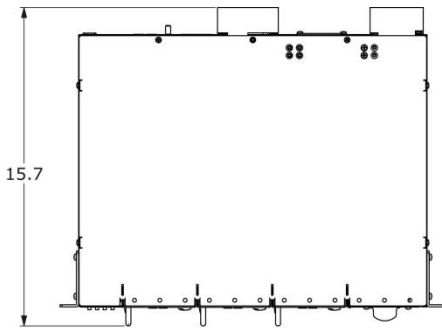
<sup>7</sup> Optional BMM and LDM modules are available in positive (-48V) or negative (+12/24V) ground configuration. Specify at time of ordering

Alarm Output:	Form-C contact, 0.5A 60Vdc max
DC Connectors: (Output, Battery)	Bus Bar, 5/16" bolt hole
Load Dist Module (LDM) Connectors:	8 terminal cage clamp style, 22-12AWG, 0.51Nm max torque
Alarm Output Connector:	3 pin removable plug, cage clamp type 16 –24 AWG
Alarm input, Bat temp sense Connector:	7 pin removable plug, cage clamp type 16 –24 AWG
Operating Temperature Range:	-30C to +60°C <sup>8</sup>
Storage Temperature Range:	-40 to +70°C
Humidity: (Operating) (Storage)	10 – 90% (non-condensing) 5 – 95% (non-condensing)
Cooling:	Load controlled fan on power modules
Regulatory Compliance:	UL/CSA60950-1, ICES-003, FCC Part 15/B , EN 61000-6-2 and EN 61000-6-3
Network Communication:	RJ45 10/100-T port (IPv4, HTTP, HTTPS, SMTP, DNS, TCP, UDP, ICMP, DHCP, ARP, SNMP, Sntp Protocols)
Network Security:	Password protection, SSL encryption for HTTPS and SMTP (TLS 1.0)

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<sup>8</sup> De-rate output 2% per °C above 50°C

Dimensions (inches):



Weight:

18lbs/8.2kg

**EMC Note:** This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules and ICES 003. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced RF technician for help.

Caution: Changes or modifications to this equipment not expressly approved by ICT Ltd. could void the user's authority to operate the equipment.

## **ICT LIMITED WARRANTY**

ICT Limited Warranty is only intended for the benefit of the original Purchaser of this product. This Warranty is not transferable or assignable without the prior written permission of ICT. ICT's sole obligation and liability under this warranty is limited to either repairing or replacing defective products at the sole discretion of ICT. When repairing or replacing the products, ICT may use products or parts that are new, equivalent to new or re-conditioned. Parts repaired or replaced during the warranty period will be under warranty for the remainder of the warranty period.

The warranty period on ICT products purchased new from ICT is two years. The warranty period for a repaired product or part thereof is ninety (90) days or the remainder of the unexpired term of the new product warranty period, whichever is greater. Repair or replacement of a defective product or part does not extend the original warranty coverage period.

No claim will be accepted unless written notice of the claim is received by ICT in accordance with ICT's Return Material Authorization (RMA) procedure, as soon as reasonably possible after the defect is discovered. A valid product serial number must be provided with the RMA claim to prove eligibility. The RMA form is available on the ICT website at [www.ict-power.com/support/warranty-repair/](http://www.ict-power.com/support/warranty-repair/).

The Purchaser shall at their own risk and cost return the defective product to ICT's factory or designated repair center once an RMA is issued by ICT. Return of the products to the customer after repair is completed shall be prepaid by ICT unless otherwise mutually agreed between the parties. Products shipped to ICT which have incurred freight damage will not be covered by this Warranty and any repairs or replacement parts, components or products needed will be invoiced in the full current price amount and returned freight collect to Purchaser. It is the Purchaser's responsibility to check the product upon receipt for any damage during shipping and to contact the carrier or shipper regarding such damage. Product that is returned as defective, which is determined to operate within published specifications will be returned to the Purchaser freight collect.

Warranty commences on the date the product is shipped from the ICT manufacturing facility, or in the case of purchase through an authorized ICT reseller, not more than ninety (90) days after original shipment of this product by ICT.

ICT assigns to Purchaser any warranties which are made by manufacturers and suppliers of components of, or accessories for, the ICT product and which are assignable. ICT makes no representations as to the effectiveness or extent of such warranties, assumes no responsibility for any matters which may be warranted by such manufacturers or suppliers and extends no additional coverage under this Warranty to such components or accessories.

In no event shall ICT be liable for any special, indirect or consequential damages such as, but not limited to, loss of use, business or goodwill, loss of revenue, or loss of profits, which may result, either directly or indirectly, from defects in products provided by ICT.

This Warranty will be void if the product has been subjected to misuse, neglect, accident, exposure to environmental conditions not conforming to the products' limits of operation, improper installation or maintenance, improper use of an electrical source, defects caused by sharp items or by impact pressure, a force majeure event, has been modified or repaired by anyone other than ICT or its authorized representative, has been subjected to unreasonable physical, thermal or electrical stress, improper maintenance, or causes external to the unit including but not limited to general environmental conditions such as rust, corrosive atmospheres, sustained temperatures outside the specified operating range of the equipment, exposure to power surges and/or electrical surges, improper grounding, mould or dust, animal or insect damage, water damage or immersion in liquid of any kind, or if the serial number has been altered, defaced, or removed.

ICT does not control the installation and use of any ICT product. Accordingly, it is understood this does not constitute a warranty of performance or a warranty of fitness for a particular purpose.

This Warranty represents the entire agreement between ICT and Purchaser with respect to the subject matter herein and supersedes all prior verbal or written communications, representations, understandings or agreements relating to this subject.

**INNOVATIVE CIRCUIT TECHNOLOGY LTD.**  
26921 Gloucester Way  
Langley, British Columbia, Canada V4W 3Y3  
T 604.856.6303 F 604.856.6365 [www.ict-power.com](http://www.ict-power.com)