

TRTC-2002-N1

Battery Backup System for Traffic Signals

TRTC-2002-N1 System

Installation, Operation and Maintenance Manual

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SAVE THESE INSTRUCTIONS

Before You Start: Safety

IMPORTANT SAFETY INSTRUCTIONS ARE CONTAINED IN THIS MANUAL

To reduce the risk of electrical shock and to ensure the safe operation of the TRTC-2002-N1, the important safety instructions are marked with the symbols as shown below. These symbols are used throughout this manual and wherever they appear, it indicates that the instructions should only be carried out by qualified personnel.

- ❖ Safety Symbols
 - ❖ Before Getting Started
 - ❖ System Safety Checklist
 - ❖ Battery Safety Checklist
 - ❖ Stand-By Generator
 - ❖ Servicing
-



❖ Safety Symbols



DANGER!

Indicates presence of **DANGEROUS VOLTAGE** in the area.
Extreme caution should be used.



ATTENTION!

Indicates **ATTENTION** to important operating instructions.
Follow them as indicated.



NOTE / TIP:

Indicates additional information to assist the completion of a procedure or tips for ease of operation.

❖ Before Getting Started



DANGER!

Do not expose the TRTC-2002-N1 to rain or moisture.



DANGER!

Total Earth ground leakage current of loads connected to the TRTC-2002-N1 should not exceed 2.4 mA.



DANGER!

The TRTC-2002-N1 generates, uses and can radiate radio frequencies if not installed and tested in accordance with the instructions contained in this manual. It has been tested and found to comply with the limits established for a Class A computing device pursuant to part 15 of FCC rules when it is operated alone. It also complies with the radio interference regulations of DOC, which are designed to provide a reasonable protection against such interference, when this type of equipment is used in a commercial environment. If there is interference to radio or TV reception, which is determined by switching it on and off. Relocate the equipment or use an electrical circuit other than the one used by the TRTC-2002-N1.

❖ System Safety Checklist



DANGER!

Sealed lead-acid batteries with high energy and chemical hazards are used. This manual contains important operation and safety instructions.

- Carefully unpack the TRTC-2002-N1. Report any shipping damage at once.
- *Read this manual.* If you have any questions about safe installation, operations or maintenance of the system, contact manufacturer service department.
- *Before installation,* confirm that the voltage and current requirements of the load(s) are compatible with the system's output. Confirm that the line voltage and current is compatible with the system's input requirements.
- The system should be installed on a dedicated power circuit.
- Use proper lifting techniques when moving system.
- The TRTC-2002-N1 has more than one live circuit. It is fed from AC as well as battery power. Power may be present at the output(s) even if the system is disconnected from line power.
- When installing a system in other than a Manufacturer cabinet, ensure that the environment meets the system specifications shown in the Appendix.

❖ Battery Safety Checklist



DANGER!

- High & **dangerous voltages** are present inside the system. Only qualified personnel should perform installation and maintenance.
- Live battery wires **must not** touch the TRTC-2002-N1 chassis or any other metal objects. **This can cause a fire or explosion.**
- **Inspect** the batteries once a year for signs of cracks, leaks, or swelling. Replace as needed.
- When batteries are in storage, **charge** them at least once every three months for optimum performance and to extend their lifetime.
- **Always** replace batteries with the ones of identical type and rating. **Never** install old or untested batteries. **Never** mix old with new batteries. **Never** mix the different amp hour rated batteries within one system.
- Use **insulated tools** during servicing.
- **Remove** all rings, watches, jewelry, or other conductive items before working inside the enclosure.
- **Follow** local regulations for the disposal of batteries. Recycling is the best method.
- **Never** burn batteries to dispose of them. **They may explode.**
- Do not open the batteries. **The contents are toxic.**

❖ Stand-By Generator



NOTE:

If the TRTC-2002-N1 constantly switches between Battery and Line modes because of line fluctuations, the input parameters should be broadened from Normal to Generator (See Section 8.2 “Sense Mode - Normal and Generator Waveforms”).

In generator mode, the acceptable range of input frequency and voltage is expanded to accommodate the voltage and frequency fluctuations created by a generator or a power source of such kind.

Use a generator with electronic speed and voltage controls which typically produces Total Harmonic Distortion in % (THD) of less than 10%. Generators with mechanical governors can force the system to run continuously in Battery mode.

Before installation, compare the generator's output voltage to the TRTC-2002-N1's input voltage requirements as listed on both nameplates. To insure the system's smooth operation, use a generator capable of supplying 2X or twice as much power as required by the total load.

SAVE THE ORIGINAL SHIPPING BOX

When returning the TRTC-2002-N1 for servicing, use the original shipping box with the supplied Styrofoam protectors. Manufacturer is not responsible for damage caused by improper packaging of returned systems.

READ THE OPERATOR'S MANUAL

Before installation, become familiar with the TRTC-2002-N1 by reviewing the procedures and drawings in this manual. If you have any questions about safe installation, operation, or maintenance, contact Manufacturer customer service department.

Complete the following for records & future servicing:

Model No.: TRTC-2002-N1

Serial No.: _____

(Above items can be found on the nameplate label attached to the side of the unit)

Products Sales Order No. _____

TRTC-2002-N1 P/N: _____

Purchase Order No.: _____

Purchased from: _____

(Following details are for installation location)

Installation date: _____

Installed by: _____

City: _____

State/Province: _____

Zip/Postal Code: _____

Country: _____

Telephone #: _____

Fax #: _____

E-Mail: _____

Street names of location: _____

Cabinet / controller type: _____

Section 1: Glossary

AC	Alternating Current
ANSI	American National Standards Institute
AWG	American Wire Gage
BBS	Battery Backup System
E-BBS	External Battery Backup System Cabinet
DC	Direct Current
IEEE	Institute of Electrical and Electronics Engineers
EIA	Electronic Industries Association
ITE	Institute of Transportation Engineers
KVA	Kilovolt-Ampere
LED	Light Emitting Diode
LCD	Liquid Chrystal Display
NEMA	National Electrical Manufacturers Association
NC	Normally Close
NO	Normally Open
OD	Outside Diameter
PTR	Power Transfer Relay
UL	Underwriters Laboratories
TB	Terminal Block
THD	Total Harmonic Distortion
UV	Ultraviolet Light
VDC	Volts DC
VA	Voltage Ampere
VAC	Voltage Alternating Current

Section 2: Theory of Operation

- ❖ Intro
 - ❖ 2.1 The Advantages
 - ❖ 2.2 System Description
-



The traffic signal cabinet is powered continuously when a TRTC-2002-N1 system is installed. The system allows connection for the normal utility power using standard terminal blocks or an optional generator power via standard 30 Amp (optional 50 Amp) generator receptacle. The optional bypass switch redirects utility power to the load and allows the TRTC-2002-N1 to be removed for service on a temporary or permanent basis without disrupting the operation of the traffic signal.

With a fully functioning UPS system, the PTS allows utility power to flow out to the traffic cabinet, when the utility line is qualified (within the acceptable range as programmed). If the UPS is not functioning, the PTS will bypass the UPS allowing the utility to flow out to the traffic cabinet. The UPS input is protected with one circuit breaker located on the PTS as well as another one located on the UPS module. When the UPS internal BOOST and BUCK is enabled, the PTS is activated allowing UPS to continuously boost the output when input is lower, buck or lower the output when input is higher or run from batteries when input power is outside the specified acceptable range. The PTS has dual NEMA power receptacles for optional battery heating pads, connecting a vacuum cleaner, or a PC for maintenance.

The smart, temperature compensated internal charger continuously monitors and maintains the batteries in a fully charged state. For the protection of the battery, the charging process is automatically discontinued when the battery temperature exceeds 50 degrees C. When the batteries are fully charged, the smart charger provides a continuously pulsating ON-OFF trickle charge to keep the batteries topped-off or fully charged. When input power is not qualified or is outside the acceptable range, the UPS derives the DC power from the storage tank of four batteries connected in series and maintains output power until the batteries are depleted down to a specified level or the utility power returns within its specified levels. The traffic intersection will continue to operate in full operation AND / OR in flash mode as programmed by the user. Programmable contacts allows the user to place the intersection in flash mode as soon as the input power is lost or after the batteries are depleted down to a certain capacity that is determined and programmed by the user. The amount of back-up time battery power can provide depends on the Amp-hour capacity of the batteries as well as the intersection watt load that requires support.

❖ 2.1 The Advantages

Advanced Power Protection Technology

TRTC-2002-N1 is an Uninterruptible Power Supply (UPS) also known as a Battery Backup System (BBS) designed for both indoor and outdoor applications. The TRTC-2002-N1 provides continuous power to traffic and signal equipment.

◆ Advanced Communications

The RS232 and/or USB ports allow for local or remote monitoring of the TRTC-2002-N1.

◆ **Smart Charging**

MP Series smart charge technology ensures the batteries are always at peak performance.

◆ **User Friendly Supervision**

The LCD panel provides “At a Glance” monitoring and control.

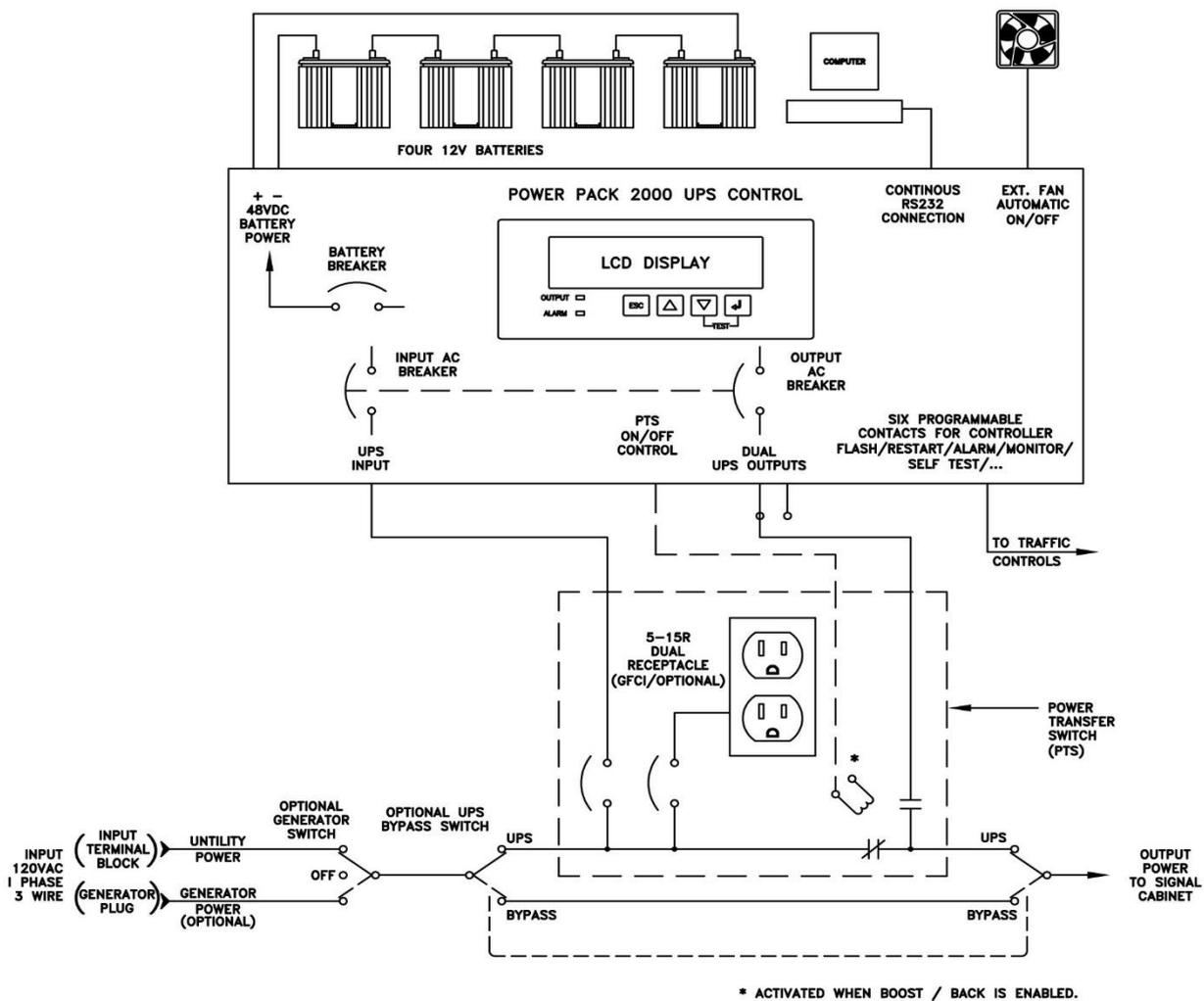
◆ **Service Friendly**

The batteries can be changed without shutting down the intersection loads or the TRTC-2002-N1.

❖ **2.2 System Description**

Purpose: Describes the operation of the TRTC-2002-N1 System.

The TRTC-2002-N1 System provides backup power to traffic control signal equipment. It consists of the PB2000 Uninterruptible Power Supply (UPS) System, the Power Transfer Switch (PTS), and batteries that provide back-up power when the line is unqualified. These three components can be mounted inside an enclosure to provide protection from most weather conditions.



Simplified TRTC-2002-N1 System Block Diagram

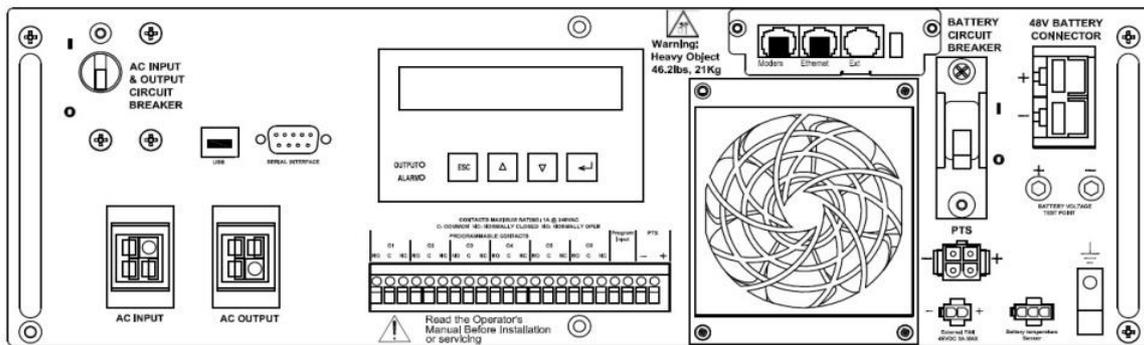
Section 3: A Tour of Your TRTC-2002-N1

- ❖ 3.1 Front Panel
- ❖ 3.2 Power Transfer Switch

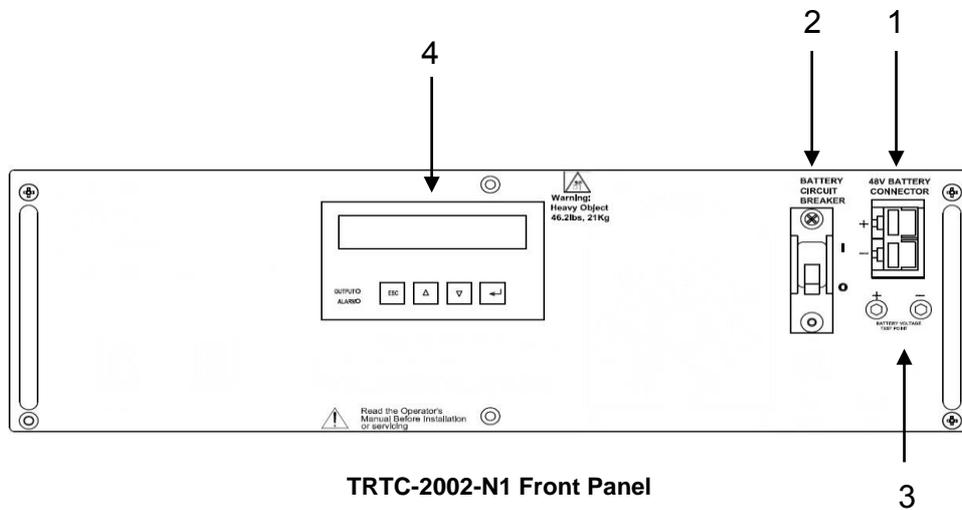


❖ 3.1 Front Panel

Purpose: Describes the display, connections and switches on the TRTC-2002-N1 front panel.



TRTC-2002-N1 : fcbPanel



TRTC-2002-N1 Front Panel

1. **48VDC Battery Connector**
Connects the battery to the unit. The battery string voltage is 48VDC.
2. **Battery Circuit Breaker**
Acts as an ON/OFF switch for battery power. Must be in the **ON** position for normal operation.
3. **Battery Voltage Test Points**
Battery voltage can be measured at these Test Jacks only when the battery circuit breaker is turned **ON**.

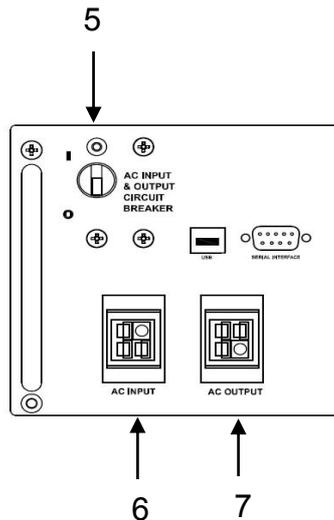


NOTE:

TEST JACKS ARE NOT DC POWER OUTLET TERMINALS.

4. Liquid Crystal Display (LCD) Control Panel

The UPS can be controlled and monitored via this LCD panel. See Section 5 for further information.



TRTC-2002-N1 Front Panel

5. AC Input & Output Circuit Breaker

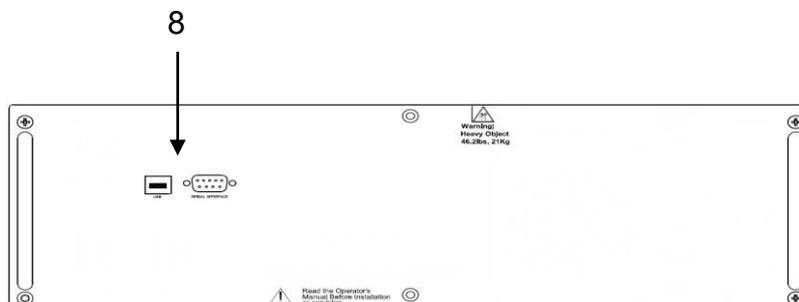
Acts as a line and output power ON/OFF switch to facilitate the unit's maintenance or replacement. Must be in the **ON** position for normal operation.

6. AC Input

Inlet Anderson PP45/4P provided for the input of line power.

7. AC Output

Outlet Anderson PP45/4P provides the connection for the output of line power.



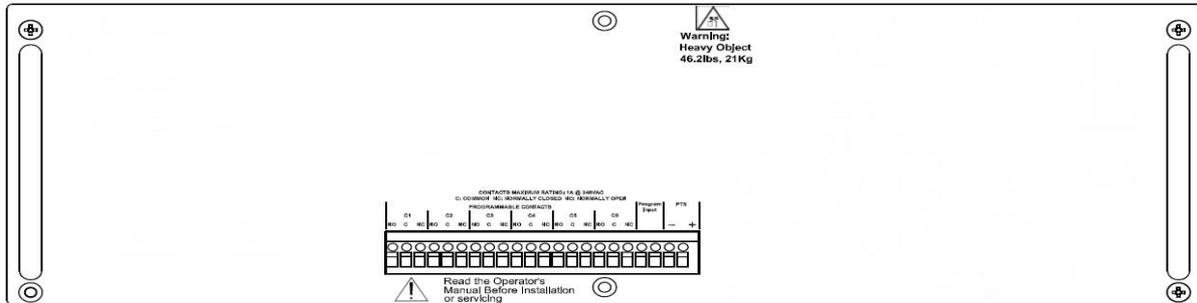
TRTC-2002-N1 Front Panel

8. USB / Serial Interface / RS232 Connector

The USB and /or DB-9 female connector is used to connect the TRTC-2002-N1 to the host computer for remote control, monitoring and calibration via RS232 commands.

For the USB or DB-9 female RS232 connections use computer industry standard computer cable between the computer's USB or RS232 port and the TRTC-2002-N1 unit's USB or RS232 ports.

See Section 4 for more details about connection and use.

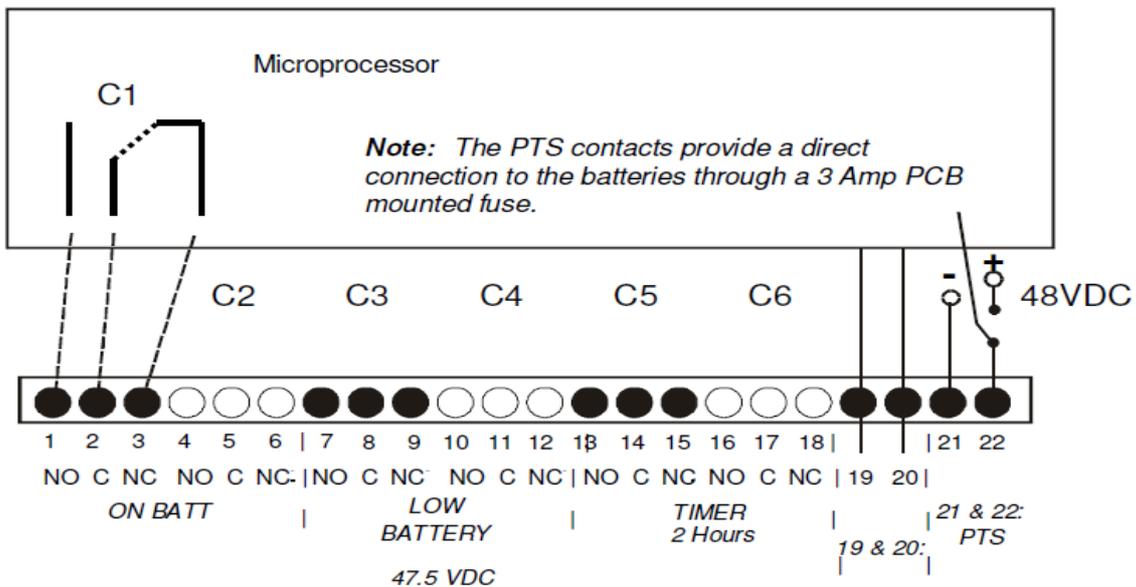


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TRTC-2002-N1 Front Panel

9. Green Control Terminal Block

This 22 position terminal block provides communication with the intersection controller, controls the Power Transfer Switch (PTS) and Programmable Input contact. Figure below shows its layout and operation.



Green Terminal Block



NOTE:

This terminal block is opto-isolated and shares a common ground with the serial interface. Each of the six programmable contacts can be programmed for one or more functions such as: *The Timer, Low Battery* and *On Batt*. The relay contacts are Form C type, i.e. each of the six programmable contacts has Common (C);

Normally Closed (NC) and Normally Open (NO) contact position.

- **On Batt:** This relay energizes when Utility Input line power is unqualified.
- **IMPORTANT:** When the AC input and output circuit breaker is turned OFF, an auxiliary switch of the circuit breaker opens which disables the On Batt. contact at the Green Control Terminal Block. This prevents the intersection lights from flashing.
- **Low Battery:** These relays energize when the battery drops below the programmed battery capacity. The default value is 47.5VDC or 40% battery capacity.



TIP:

You can change the preprogrammed value to match the batteries used and the actual operating conditions. See Section 9.7 Battery Maintenance.

- **Timer:** These relays energize after the unit has been in Battery mode for the programmed time period. The factory default value is 2 hours. The time can be programmed to be from 15 min. to 8 hours in 15 minute increments.
- **Program Input:** The programmable input contact can be programmed for one function such as: Self-test, EXT Alarm, EXT Battery Alarm, EXT Fan Failure, Door Interlock. Jumper the TB 19 & 20 on the Green Control Terminal Block and the program alarm will show on LCD display.
- **PTS:** TRTC-2002-N1 sends a 48VDC signal from the batteries to the PTS, which activates the PTS, resulting in transfer from Input power to BBS power. See Section 1.3, Wiring, of this manual for connection instructions.



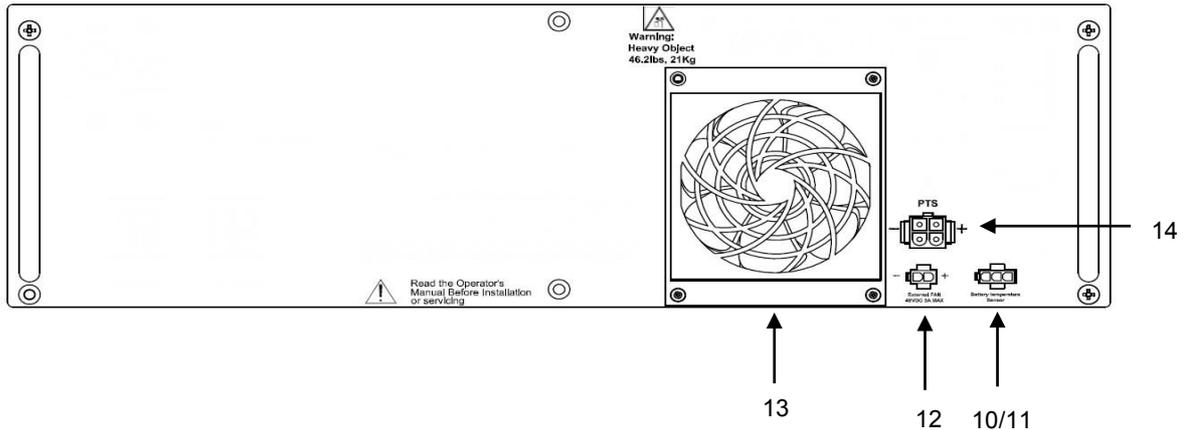
NOTE:

These contacts have a maximum rating of 1 Amp at 120V. Only the first On Batt contact is illustrated. The remaining 5 contacts for Low Battery, Timer, etc. are similar.



NOTE:

- 1) 6 sets of programmable contacts have the following factory default settings:
 - C1, C2 = "On Batt"
 - C3, C4 = "Low Batt @ 47.5VDC"
 - C5, C6 = "Timer @2.00 Hours"
- 2) User may program each of the six contacts for one or more functions.



TRTC-2002-N1 Front Panel

10. Battery Temperature Sensor Strain Relief

This secures the Battery Temperature Sensor cord to the panel and prevents connector disconnection during an earthquake or other severe vibrations.

First plug the sensor cable into the connector. Then use one of the ties provided in the mounting kit to attach the sensor cord to the strain relief loop. Ensure that the cable is secure.

11. Battery Temp Sensor

It attaches the battery temperature probe to the unit for monitoring battery temperature. The charging voltage is temperature dependent. The microprocessor of the smart charger adjusts the voltage for optimum charging.

The temperature probe connector **must** be plugged in for normal operation. The sensor end should be firmly attached to the terminal of the battery.



NOTE:

If the TRTC-2002-N1 is not charging the batteries check the temperature probe. To test the temperature probe unplug it from the face of the UPS. Check the resistance of the temperature probe by inserting the probes of an ohm meter into the top and bottom pins of the connector. The meter should read approximately 12,000 Ohms at 25°C (77 °F). If resistance is not in this range, replace temperature probe.

12. Ext Fan 48VDC

Provides DC Power (48VDC, 1 Amp (Max)), which could be used to power an optional 48VDC fan, mounted inside the enclosure for regulation of the interior temperature.

13. Internal Fan

This microprocessor-controlled fan regulates the unit's internal temperature. It must not be blocked. The filter in front of the fan is removable for cleaning.



NOTE:

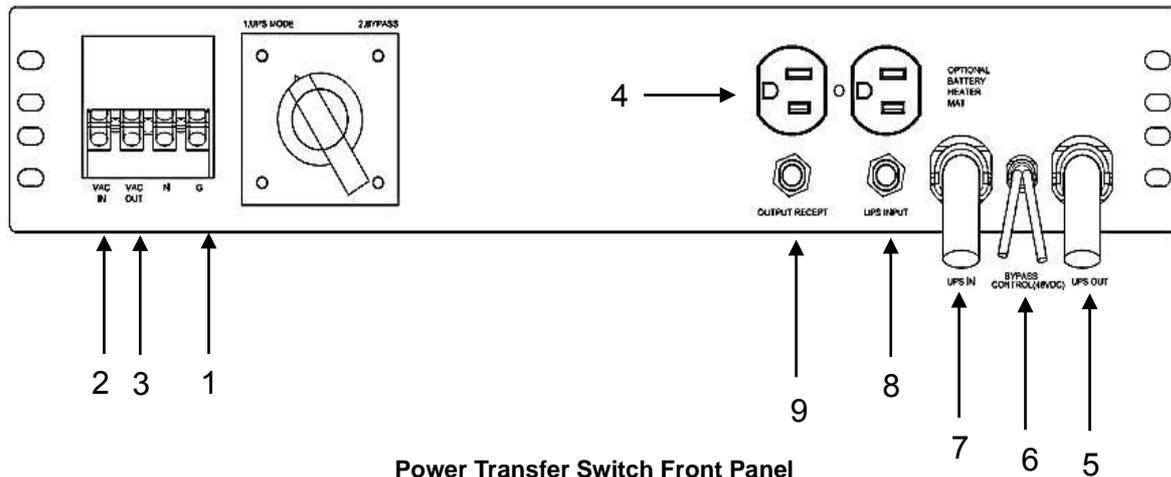
Inspect the filter every 6 months, or as often as required. Clean by removing it, running water through the filter and air-drying before reinstallation.

14. PTS Connector

The PTS Connector connects the TRTC-2002-N1 to the PTS via the Bypass control wires.

❖ 3.2 Power Transfer Switch

The Power Transfer Switch (PTS) shown below allows the UPS to be removed for service, replacement or maintenance without interrupting power to the traffic cabinet.



Power Transfer Switch Front Panel

1. The wires from the neutral and ground bus of the traffic cabinet are connected to this terminal block.
2. The Input line power is connected to the terminal block marked with “AC INPUT”.
3. The Output line power is connected to the terminal block marked with “AC OUTPUT”.
4. An optional surge suppressor, external PC, optional battery heater or a vacuum cleaner for maintenance may be plugged into these receptacles.
5. This “UPS OUT” cord is connected to the OUTPUT AC terminal block on the TRTC-2002-N1.
6. The Black and Red PTS control wires are connected to the PTS connector on the TRTC-2002-N1.
7. This “UPS IN” cord is connected to AC INPUT terminal blocks on the TRTC-2002-N1.
8. This circuit breaker provides input power protection for the TRTC-2002-N1.
9. The dual receptacles are protected by this circuit breaker.

Section 4: Installation

- ❖ Warnings & Tips
 - ❖ 4.1 Mounting
 - ❖ 4.2 Recommended Wiring
 - ❖ 4.3 Connecting the Output or Signal Cabinet
 - ❖ 4.4 Connecting the Utility Line Input Power
 - ❖ 4.5 Starting Up the UPS
 - ❖ 4.6 Testing the UPS
 - ❖ 4.7 Shutting Down the UPS
 - ❖ 4.8 Emergency Shutdown
 - ❖ 4.9 Removing the PTS
-



DANGER!

If this is a new traffic signal installation with Utility AC power going directly to UPS, make sure the upstream circuit breaker feeding the Utility Power is OFF before beginning this step. If this is addition of a UPS to an existing traffic signal cabinet, DO NOT terminate the power cable from the signal cabinet to the UPS at the signal cabinet end until the final step after all other connections have been completed. This will minimize the length of time the traffic signals must be off for final power connection.

There are many different ways that the Utility AC can be wired into the traffic signal cabinet. The intent of this manual is only to explain proper connection of utility AC at the UPS end of the cable. How the Utility AC is routed from the service entrance or through the traffic signal cabinet (hereafter referred to as the “power source”) to the UPS shall be determined by a licensed electrician in accordance with local electrical codes.



TIP:

The suggested method of wiring Utility AC to the UPS from the traffic signal cabinet is to connect the UPS at the traffic cabinet after the main cabinet breaker and surge suppressor so that the UPS is also protected by the cabinet surge suppressor.

❖ 4.1 Mounting

Purpose: Describes how to mount the TRTC-2002-N1 System into an enclosure.

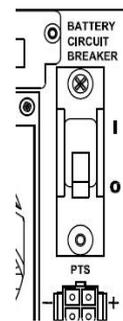
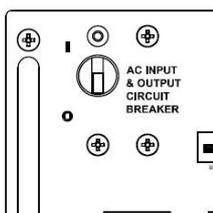
The TRTC-2002-N1 components can be mounted inside an existing NEMA or 332 or various other traffic cabinets. They can be shelf mounted in a NEMA or equivalent cabinet. The TRTC-2002-N1 can be bolted into an industry standard 19” rack using the optional ears or brackets, or it can be shelf mounted in a NEMA type enclosure.

❖ 4.2 Recommended Wiring

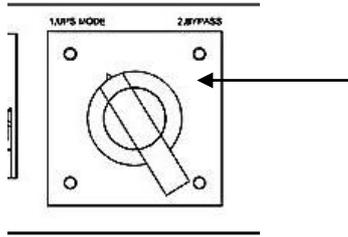
Consult a licensed electrician in accordance with local electrical codes.

1. AC Input Cords
 - a. UL Style 1015 CSA TEW 6 or 10 AWG
 - b. 105 stands of 30 AWG tinned copper
 - c. Rating 600V, 105°C, PVC Insulation
2. Power Interconnects between BBS components and 332A terminal blocks and busses.
 - a. UL Style 1015 CSA TEW 10 AWG
 - b. 105 stands of 30 AWG tinned copper
 - c. Rating 600V, 105°C, PVC Insulation
3. Relay connections
 - a. Insulated UL Style CSA TEW 18 AWG
 - b. 16 stands of 30 AWG tinned copper
 - c. Rating 600V, 105°C, PVC Insulation
4. DC Battery Connectors
 - a. Two-Part Modular Harness UL Style 1015 CSA TEW or Welding Style Cable or equivalent, 6 AWG Stranded and 10 AWG Stranded

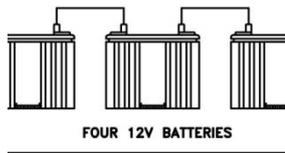
Verify the **UPSTREAM CIRCUIT BREAKER** is off.
Verify the **AC INOUT & OUTPUT CIRCUIT BREAKER** is off.
Verify the **BATTERY CIRCUIT BREAKER** is off.



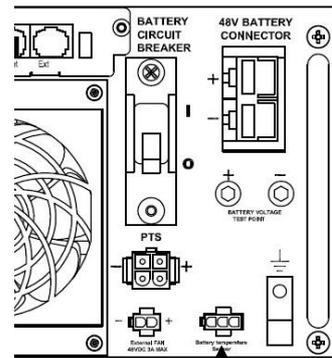
Verify the **UPS MODE / BYPASS** switch is in **BYPASS**.



Attach optional **Battery Temperature Sensor** to the middle battery. Plug the connector on the other end into the TRTC-2002-N1.



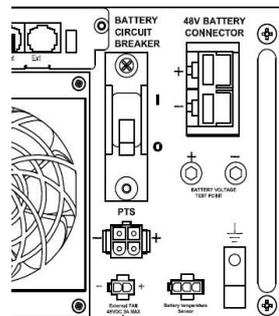
Wrap a tie around the strain relief loop and the battery temperature sensor to prevent the connector from disconnecting during an earthquake or other severe vibrations.



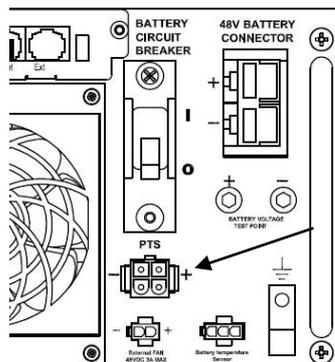
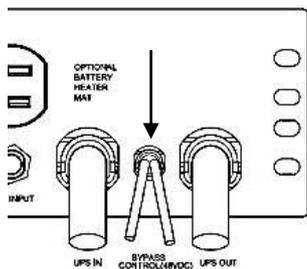
Attach **External Cabinet Fan** into the respective connector on the TRTC-2002-N1.



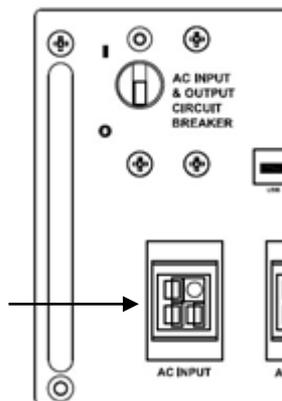
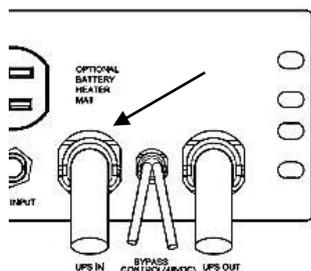
Wrap a tie around the strain relief loop and the fan to prevent the connector from disconnecting during an earthquake or other severe vibrations.



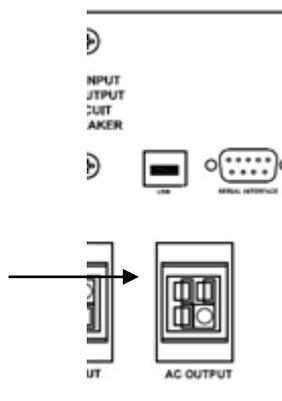
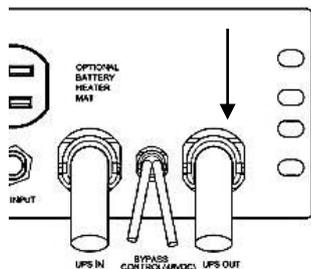
Connect the **BYPASS CONTROL** wires to the **PTS** connector into the TRTC-2002-N1.



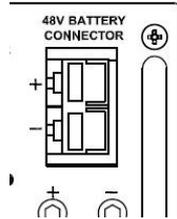
Connect the **PTS UPS IN** to the **UPS AC INPUT**.



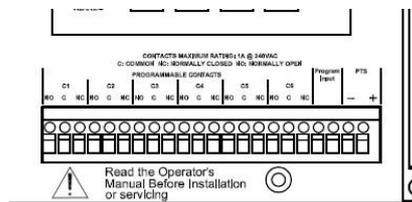
Attach **PTS UPS OUT** to the **UPS AC OUTPUT**.



Connect the cable from the batteries to the **48V BATTERY CONNECTOR** into the TRTC-2002-N1.

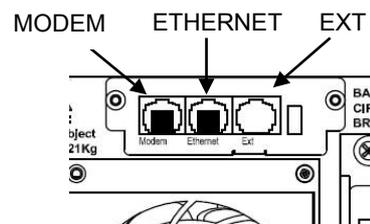
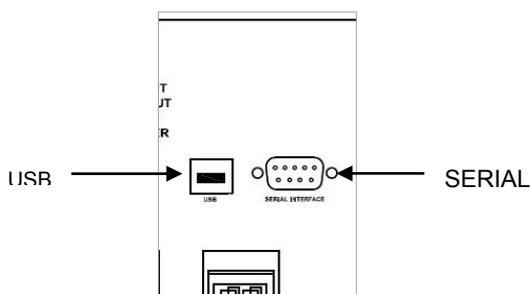


Each of the six contacts are of form C type, meaning Normally Open (NO), common (C) and Normally Closed (NC) dry contact rated for 1A @ 240VAC. Each of these contacts can be individually programmed to energize and stay latched for ON BATTERY, LOW BATTERY, TIMER, ALARM, FAULT and many other conditions as described in subsequent chapters. The ON BATTERY contact(s) are activated as soon as the unit is transferred to Battery mode. LOW BATTERY contact(s) are activated only in the Battery mode, as soon as the discharged battery reaches the lower value battery capacity as set by user and remains latched as long as the system remains in Battery mode. The TIMER contact(s) are activated only in the Battery mode after the user-programmed time is attained, that can be set in 15 minute intervals from 15 minutes to 8 hours.



Torque status/self-test terminal block to a maximum of 4.4 lb.-in (0.5Nm).
Maximum wire size 14 AWG.

Connect the **COMMUNICATION CABLES** where appropriate.



❖ 4.3 Connecting the Output or Signal Cabinet



DANGER!

If the installation is at an active intersection, have law enforcement begin directing traffic before the power to signals is turned off.

If this is a new traffic signal installation with Utility AC power going directly to UPS, make sure the upstream circuit breaker feeding the Utility Power is OFF before beginning this step. If this is addition of a UPS to an existing traffic signal cabinet, DO NOT terminate the power cable from the signal cabinet to the UPS at the signal cabinet end until the final step after all other connections have been completed. This will minimize the length of time the traffic signals must be off for final power connection.

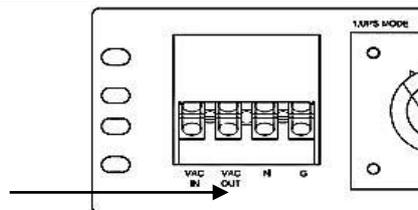
There are many different ways that the Utility AC can be wired into the traffic signal cabinet. The intent of this manual is only to explain proper connection of utility AC at the UPS end of the cable. How the Utility AC is routed from the service entrance or through the traffic signal cabinet (hereafter referred to as the “power source”) to the UPS shall be determined by a licensed electrician in accordance with local electrical codes.



TIP:

The suggested method of wiring Utility AC to the UPS from the traffic signal cabinet is to connect the UPS at the traffic cabinet after the main cabinet breaker and surge suppressor so that the UPS is also protected by the cabinet surge suppressor.

1. Connect a black wire from the VAC Out at the PTS to the Input Hot terminal in the signal cabinet.
2. The wires from Ground and Neutral Bus Bars from the traffic cabinet are extended to PTS Terminal Block.
3. OPEN the upstream breaker feeding utility power to the signal cabinet.
4. Disconnect the HOT wire (Black) connected between utility and traffic cabinet.
5. The cabinet side HOT wire is connected to “AC OUT” on the PTS.
6. The utility side HOT wire is connected to “VAC IN” on the PTS.
7. Torque the PTS terminal block to a maximum of 10.0 lb-in (1.1 Mm).



❖ 4.4 Connecting the Utility Line Input Power



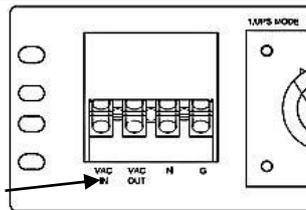
DANGER!

If the installation is at an active intersection, have law enforcement begin directing traffic before the power to signals is turned off.

Make sure the upstream circuit breaker for the power source is OFF before performing this step. Make sure both the BATTERY CIRCUIT BREAKER on the unit is also off.

Make sure the upstream circuit breaker feeding the utility power is OFF before beginning this step. Leave the NEUTRAL and GROUND wires connected from utility to signal cabinet. Extend the NEUTRAL and GROUND wires from their corresponding bus bars in the traffic cabinet to the terminal block on the PTS.

Connect the input HOT black wire from utility to “VAC IN” on PTS. Run wires from neutral and ground bus bars of traffic cabinet to PTS neutral & ground terminal blocks.



❖ 4.5 Starting Up the UPS

Purpose: Describes how to Start-up the system.



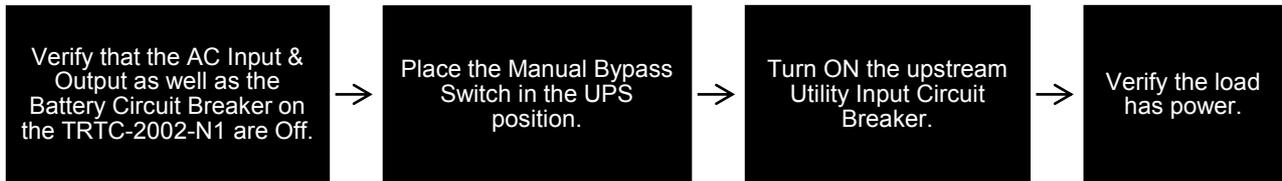
TIP:

If the system does not perform as described below, see TRTC-2002-N1 Troubleshooting Section 9.2.

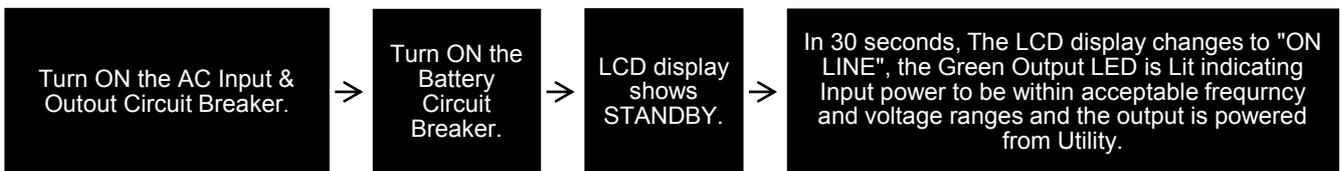
Step 1: Turn on the Utility Input Line Power

STARTUP PROCEDURE TIPS:

- The UPS automatically starts up in STANDBY mode.
- After the AC line is qualified (default 30 seconds) the UPS switches to ON LINE mode
- The PTS is fail safe in that the cabinet will always revert to utility power if there is ever a failure of the UPS or batteries.
- As an intersection safety measure, if there is no AC power and/or the AC breaker is not ON, the UPS will stay in STANDBY and can only be placed ON BATTERY manually to prevent accidentally leaving the intersection in operation on batter power without restoring AC power.



Step 2: Turn on the UPS



❖ 4.6 Testing the UPS



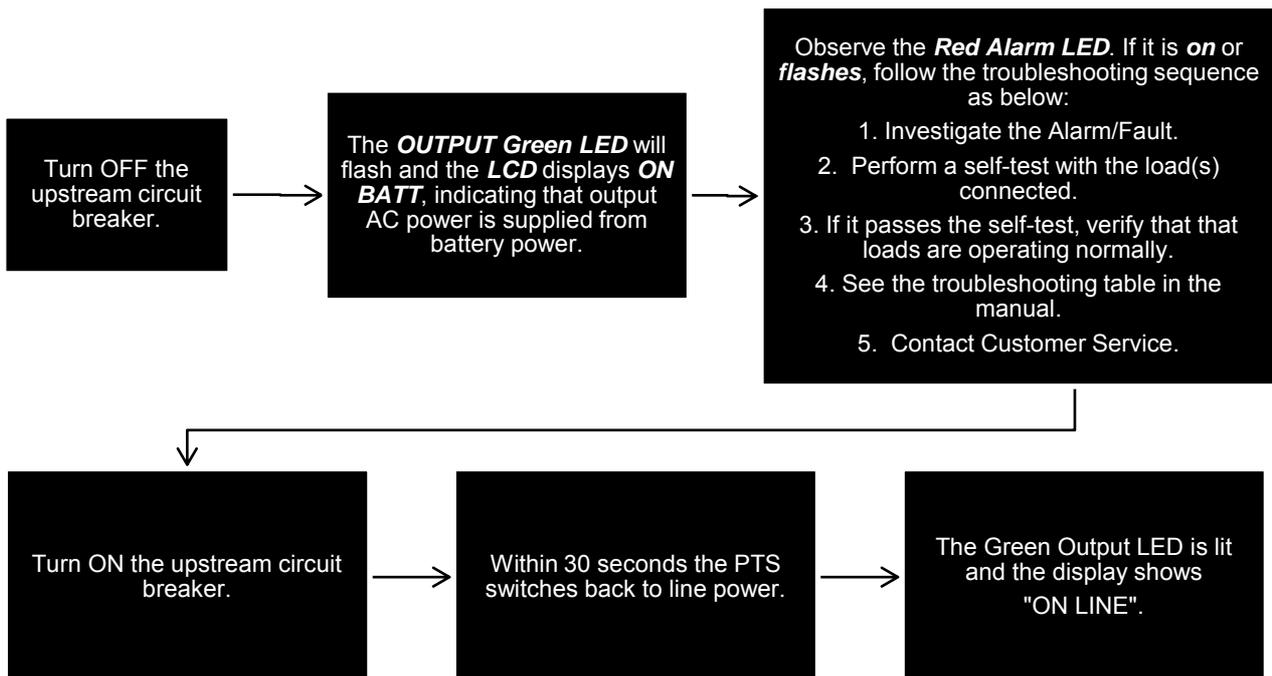
TIP:

Before turning off the AC power to the intersection as a final test, verify proper installation and ability to go ON BATTERY by placing the MANUAL BYPASS SWITCH to BYPASS. The unit should immediately go ON BATTERY. When the MANUAL BYPASS SWITCH is returned to UPS, the unit should go back On Line after AC Qualify time. Then to test the UPS further, perform the self-test feature via the CONTROL submenu (see Section 5.7 Control).



ATTENTION!

When performing the test below, if for any reason the unit fails to go ON BATTERY, immediately restore the AC power for the intersection at the upstream circuit breaker.



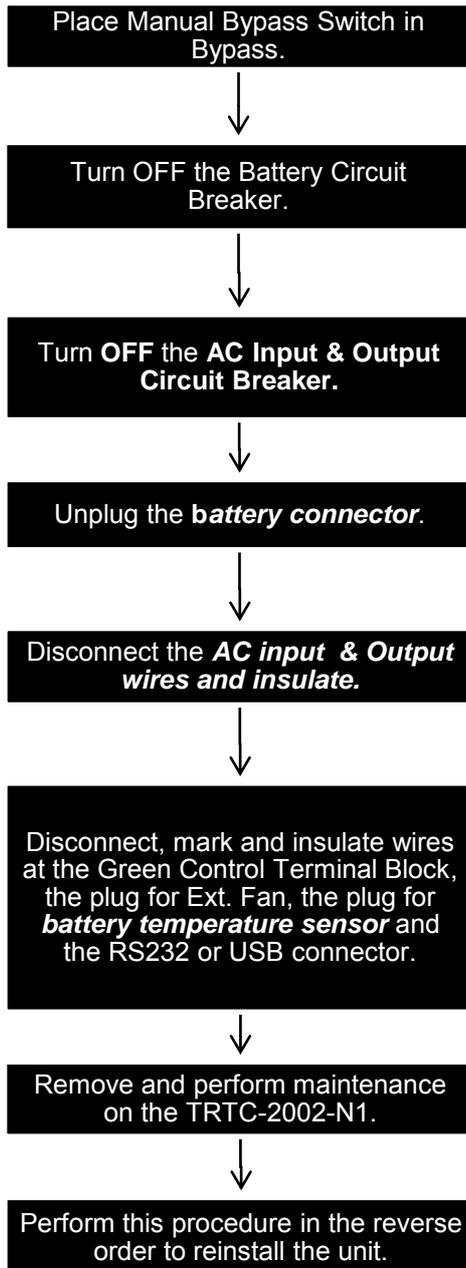
❖ 4.7 Shutting Down the UPS

Purpose: Describes how to shut down the system components for removal or maintenance.



ATTENTION!

Shutting down the TRTC-2002-N1 does not necessarily disconnect power to the loads.



TIP:

IMPORTANT: Place the Manual Bypass Switch in **BYPASS** before doing any maintenance on the unit or PTS to prevent accidentally losing power to the traffic signals.

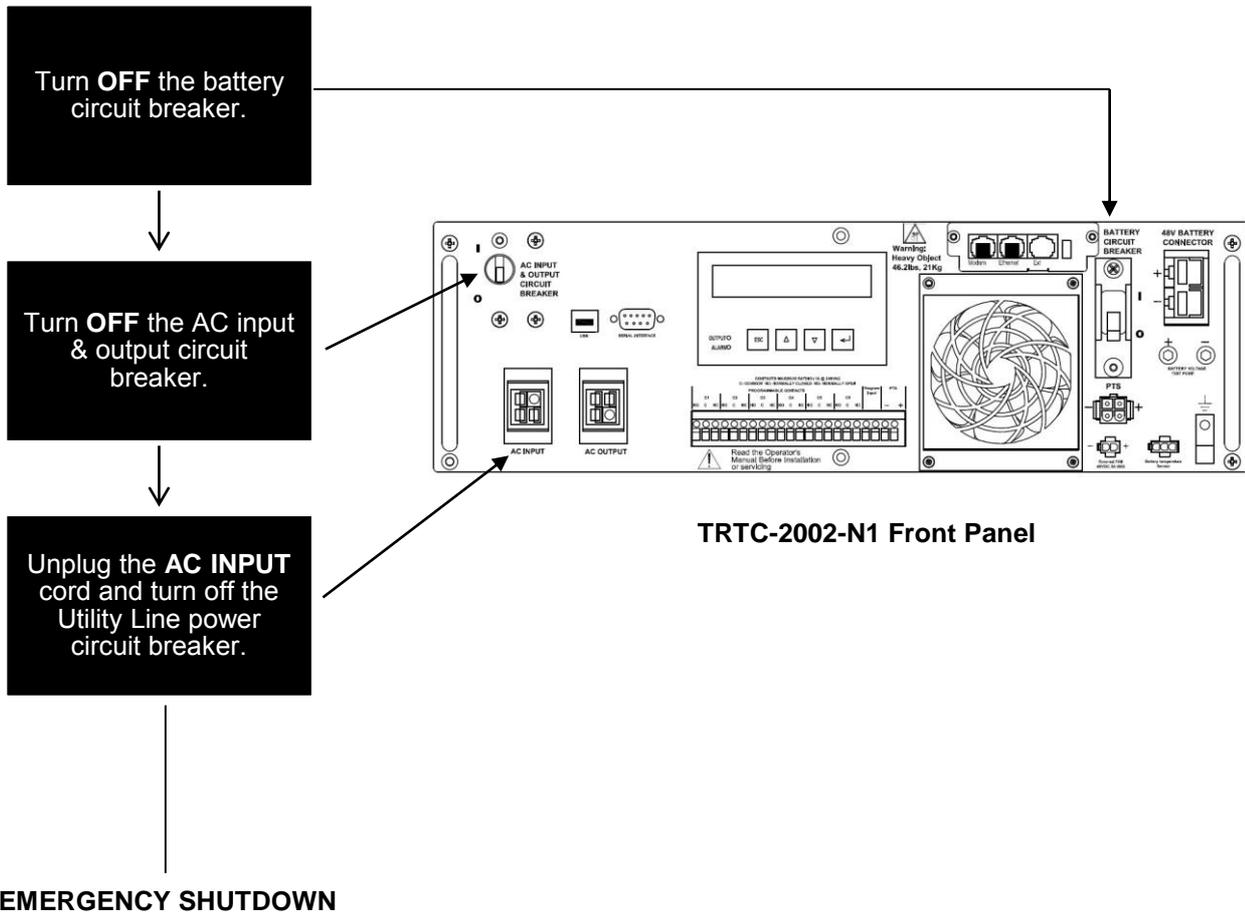


DANGER!

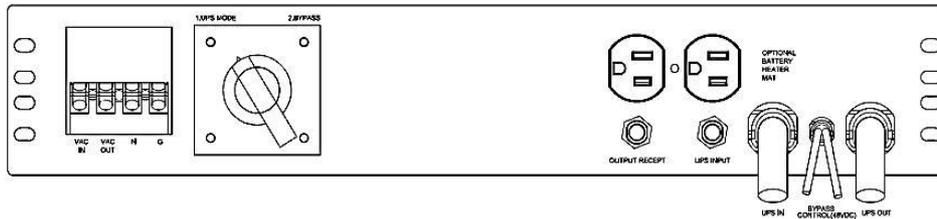
The AC input wires from PTS are still **HOT** or **Live**. Insulate the bare wires using wire nuts.

❖ 4.8 Emergency Shutdown

The TRTC-2002-N1 UPS is connected to more than one energy source. In an emergency, DISCONNECT utility input power, battery power, as well as an optional generator power, if utilized. Disconnecting all the AC and DC power sources will ensure that the output circuit is not live.



❖ 4.9 Removing the PTS



Turn OFF the Upstream Breaker.

Disconnect the UPS OUT Cord at the TRTC-2002-N1.

Disconnect the UPS IN Cord at the TRTC-2002-N1.

Disconnect the Red & Black PTS control wires at the TRTC-2002-N1.

Disconnect the wires from AC IN, NEUTRAL, GROUND and AC OUT from the PTS.

Remove and perform the maintenance on the PTS.

Perform this procedure in the reverse order to reinstall the PTS.



NOTE:

IMPORTANT: Verify that both the AC INPUT & OUTPUT and Battery Breaker are OFF at the TRTC-2002-N1.



Place the Manual Bypass Switch in BYPASS before doing any maintenance on the unit or PTS to prevent accidentally losing power to the traffic signals.

Section 5: Operation – LCD Interface

- ❖ 5.1 LED Interface Directory
 - ❖ 5.2 Menu Tree and Main Screen
 - ❖ 5.3 HyperTerminal at a Glance
 - ❖ 5.4 Using the LCD Interface
 - ❖ 5.5 Operating Modes
 - ❖ 5.6 Status
 - ❖ 5.7 Control
 - ❖ 5.8 Settings
 - ❖ 5.9 Maintenance
 - ❖ 5.10 Alarm Menu
 - ❖ 5.11 Fault Menu
 - ❖ 5.12 Events Log
-



❖ 5.1 LED Interface Directory

Description	Sub-Menu Location
AVR Feature	Settings
Battery Temp. Comp. (-2.5mV~-5mV/°C/Cell)	Settings
Battery Test Option	Maintenance
Change Password	Maintenance
Current UPS Status	Status
Daylight Saving	Settings
Enable Boost	Settings
Enable Buck	Settings
Event Log View	Maintenance
Events/Timer Reset	Control
Ext. Fan Control (Turn On at 20~50°C)	Settings
Ext. Fan Test	Control
Inverter On/Off	Maintenance
Line Conditioning	Maintenance
Line Qualify (3Sec,10Sec,30Sec)	Settings
Log Reset	Control
Manual On/Reset	Control
Password Protection	Control
Program Contacts	Settings
Program Contacts Test	Control
Program I/P Contacts	Settings
Self-Test	Control
Sense Type (Normal/Generator Mode)	Settings
Set Date/Time	Settings
UPS Status - Current	Status

❖ 5.2 Menu Tree and Main Screen

Purpose: Shows the Menu Tree.

- The Alarm and Fault submenus alert the operator of a problem with the TRTC-2002-N1. When the alarm LED is **ON** or **FLASHING**, press the **ENTER** button. One of the conditions described in Section 5.9 Maintenance and 5.10 Alarm Menu appears on the LCD screen.
- The status submenu provides measurements of important TRTC-2002-N1 inputs, output, and other parameters via the LCD screen (see Section 5.6 Status).
- The control submenu allows the operator to manage the TRTC-2002-N1 (see Section 5.7 Control).
- To learn the value of a specific measurement, when it appears on the LCD screen, press the **ENTER** button.
- To start a command, when it appears on the LCD screen, press the **ENTER** button.

STATUS MM/DD HH:MM
MAIN SCREEN

STATUS

01	V(in) = 120.0 VAC
02	V(out) = 120.0 VAC
03	P(out) = 1500 Watts
04	F(in) = 60.0 Hz
05	V(batt) = 55.2 VDC
06	Battery Temperature = +27 °C
07	Inv. Event = 65536
08	Inv. Timer = 0002.4H
09	Buck Event = 65536
10	Buck Timer = 0002.4H
11	Boost Event = 65536
12	Boost Timer = 0002.4H
13	C1=OFF C2=OFF C3=OFF
14	C4= C5= C6=OFF
15	Version = 4.2 / 3.2 (CPU/LCD)
16	Program I/P Contacts (See Table 5)
17	Program Contacts(See Table 6)
18	Line Conditioning (See Table 7)
19	Alarms (See Table 4)
20	Faults (See Table 3)

CONTROL

01	Self-Test
02	Program Contacts Test
03	Ext. Fan Test
04	Manual On/Reset
05	Events/Timer Reset
06	Log Reset
07	Password Protection

SETTINGS

01	Program Contacts (See Table 6)
02	AVR Feature (See Table 8)
03	Line Quality (3Sec, 10Sec, 30Sec)
04	Ext. Fan Control (Turn On @ 20 ~ 50°C)
05	Sense Type (Normal/Generator Mode)
06	Batt. Temp. Comp. (-2.5mV~5mV/°C/Cell)
07	Set Date/Time
08	Daylight Saving
09	Program I/P Contacts (See Table 5)

MAINTENANCE

01	Batt. Test. Option
02	Inverter On/Off
03	Event Log View
04	Line Conditioning (See Table 9)
05	Change Password

❖ 5.3 Using the LCD Interface

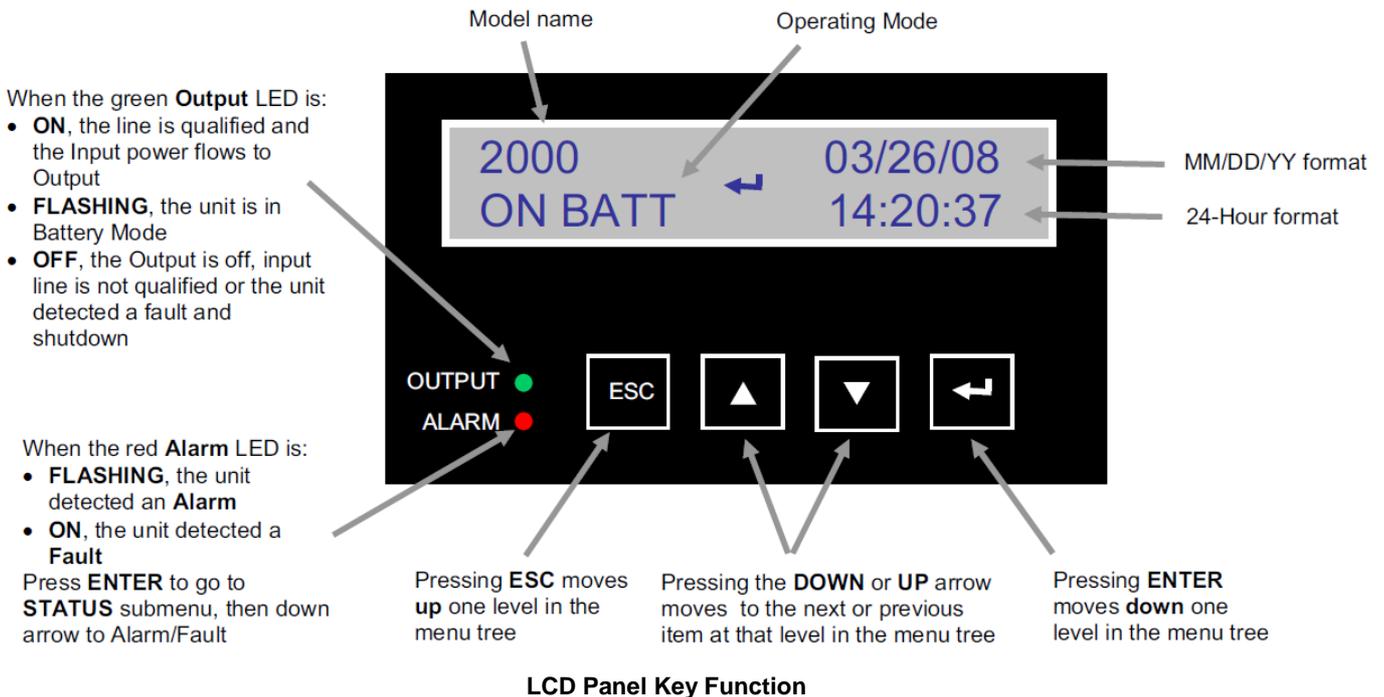
Purpose: Describes the LCD display menus.

.To Start the TRTC-2002-N1:



CONTRAST ADJUSTMENT FOR LCD DISPLAY

1. While pushing the ESC button on the front panel.
2. Press the ENTER button and adjust the contrast up or down.
3. Press ENTER when adjustment is complete.



TIP:

When the ambient air temperature drops below -20°C (-4°F), the LCD may turn DARK until the temperature rises above -20°C (-4°F). However the unit will operate normally.

❖ 5.4 Operating Modes

Purpose: Describes the operating modes.



TIP:

The LCD automatically displays the following modes when they change.

LCD Shows	Explanation
STANBY	This mode is displayed when the unit is first turned on. The inverter remains off and the TRTC-2002-N1 does not provide output power to the loads. If input line power is qualified, it automatically switches to line mode. To provide battery to the loads, use the manual on function (see Section 5.7 Control).
ON LINE	The normal operating mode. Input line power is provided to the loads the batteries are charging and the TRTC-2002-N1 is ready to provide backup power.
BOOST	The unit automatically transfers to BOOST mode to raise the lower input line voltage when output drops below the user programmable preset limit.
ON BATT	The unit automatically transfers to battery when input line power is unqualified or not present. The batteries provide power to the loads.
BUCK*	The unit automatically transfers to BUCK mode to reduce the higher input line voltage when output raises above the user programmable preset limit.
SELF TEST	When “Self-Test” mode is active, the unit will enter “Battery Mode” automatically to test or check if output voltage and waveform is correct. After the programmed duration, the unit returns back to “Line Mode”. Users may use “Maintenance Mode” to configure a longer time for self-test. Default time for self-test is 1 minute.
LOW BATT	When the unit is in “Battery Mode” the batteries begin to discharge. If the battery voltage falls below the user programmed (40% default setting) of its capacity. “Low Bat” warning appears.

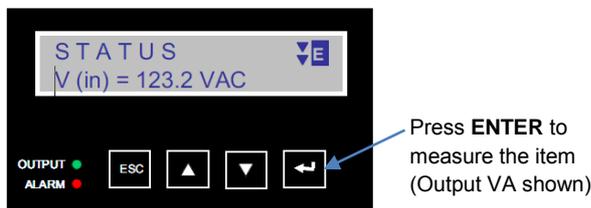
***When enabled.**

The following mode may be programmed by the User (see Section 5.8 Settings).

❖ 5.5 Status

Purpose: Describes how to use the Status Submenu to measure input/output parameters.

Procedure: When the desired item appears on the LCD screen, press **ENTER** to measure it. To see the updated reading, press **ENTER** again.



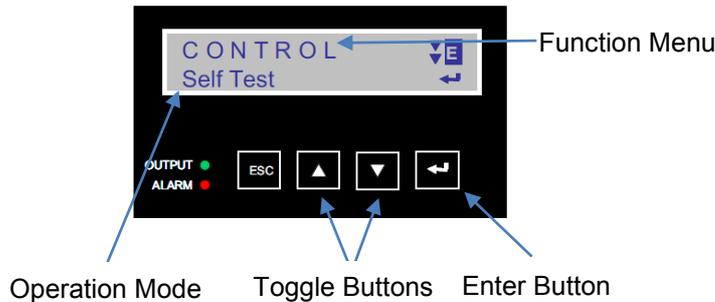
ITEM	LCD SHOWS	DESCRIPTION
Input Voltage	STATUS ▾ V (in) = 120.0 VAC	The Utility Input line voltage
Output Voltage	STATUS ◆ V (out) = 120.0 VAC	The output voltage (true RMS)
Output Power	STATUS ◆ P (out) = 1230 Watts	The output Power (watts)
Input Frequency	STATUS ◆ F (in) = 60.0 Hz	The Utility Input line frequency
Battery Voltage	STATUS ◆ V (batt) = 55.2 VDC	The average battery voltage
Battery Temperature	STATUS ◆ Batt. Temp. = +24 °C	The temperature of Battery case
Inv. Events	STATUS ◆ Inv. Events = 00016	The number of times the unit has been in Battery Mode
Inv. Timer	STATUS ◆ Inv. Timer = 0000.1h	The Total amount of time the unit has been in Battery Mode since the last reset. Each decimal indicates 6 minutes (0.1 x 6 minutes). The decimal increments by 2 or every 12 minutes.
Buck Events	STATUS ◆ BUCK Events = 00002	The number of times the unit has been in Buck Mode
Buck Timer	STATUS ◆ BUCK Timer = 0000.6h	The Total amount of time the unit has been in Buck Mode since the last reset.
Boost Events	STATUS ◆ BOOST Events= 00000	The number of times the unit has been in Boost Mode

Boost Timer	<div style="border: 1px solid black; padding: 2px;"> STATUS   BOOST Timer= 0000.6h </div>	The Total amount of time the unit has been in Boost Mode since the last reset.
Program Contact C1~C3 status	<div style="border: 1px solid black; padding: 2px;"> STATUS   C1=OFF C2=OFF C3=OFF </div>	The status of the program contact C1,C2,C3.
Program Contact C4~C6 status	<div style="border: 1px solid black; padding: 2px;"> STATUS   C4=OFF C5=OFF C6=OFF </div>	The status of the program contact C4,C5,C6.
Version No.	<div style="border: 1px solid black; padding: 2px;"> STATUS   Version = 2.2 / 2.2 </div>	The software version used in this unit. 2.2⇒Control board, 2.2⇒LCD Board
Program Input Contact	<div style="border: 1px solid black; padding: 2px;"> STATUS   Program I/P Contact ↓ </div>	It indicates Programmed values of Input Contact
Program Contact	<div style="border: 1px solid black; padding: 2px;"> STATUS   Program Contact ↓ </div>	It indicates Programmed values of all 6 Contacts
Line Conditioning	<div style="border: 1px solid black; padding: 2px;"> STATUS   Line Conditioning ↓ </div>	It indicates Programmed values of all input Line Detection parameter & warning levels
Alarms	<div style="border: 1px solid black; padding: 2px;"> STATUS   Alarms ↓ </div>	It indicates Alarms (see Section 5.7 Alarm Menu)
Faults	<div style="border: 1px solid black; padding: 2px;"> STATUS   Faults ↓ </div>	It indicates Faults (see Section 5.8 Fault Menu)

❖ 5.6 Control

Purpose: Describes how to use the control submenu to operate the unit.

Procedure: When the desired function appears on the LCD screen, pressing the ENTER button calls it up. Many functions have more than one option available. Scroll through them by pressing the toggle buttons. When the desired option appears, pressing the ENTER button switches the unit to the new option.



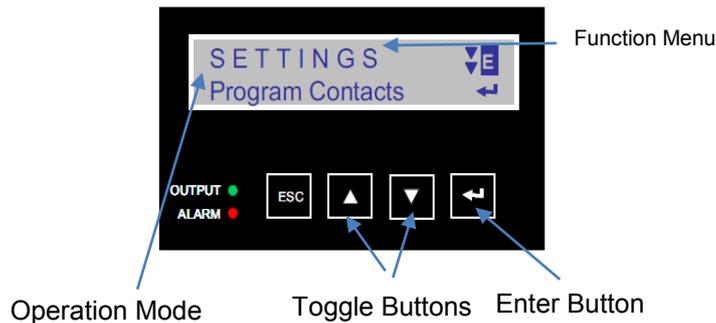
FUNCTION	LCD SHOWS	ACTION
SELF TEST		Pressing ENTER , starts the self test. CAUTION: The unit must be in Line Mode before starting the self-test.
PROGRAM CONTACTS TEST		Pressing ENTER starts the program contact switch test.
EXTERNAL FAN TEST		Pressing ENTER starts the external fan switch test.
MANUAL ON/RESET		This function is available only when the unit is first turned on the LCD shows Standby. Pressing ENTER manually starts the unit and the Battery supplies the output power.
EVENTS/TIMER RESET		Press ENTER when the LCD displays the message. This resets the event and timer counters to zero.
LOG RESET		Press ENTER when the LCD displays the message. This clears all the messages from the Event Log.
PASSWORD PROTECTION		This feature allows user to control the access of the Maintenance Menu with or without the password. When the Password access to the Maintenance Menu is Enabled here, the Maintenance Menu can ONLY be accessed when the correct Password is entered. When the Password access to the Maintenance Menu is DISABLED here, the Maintenance Menu can be accessed without the Password.

❖ 5.7 Settings

Purpose: Describes how to access and program critical parameters.

Procedure: When the desired function appears on the LCD screen, pressing the **ENTER** button calls it up.

Many functions have more than one option available. Scroll through them by pressing the toggle buttons. When the desired option appears, pressing the **ENTER** button switches the unit to the new option.



FUNCTION	LCD SHOWS	ACTION
PROGRAM CONTACTS	SETTINGS ▾ Program contacts ↓	Indicates programmed values of all 6 contacts and allows values to be changed.
AVR FEATURE	SETTINGS ◆ AVR Feature ↓	Enable and Disable Buck and Boost function.
LINE QUALITY	SETTINGS ◆ Line Quality ↓	Indicates the setting for AC recovery time. The selection options are: 3 sec, 10 sec, or 30 sec. Default recovery time is 30 sec.
EXTERNAL FAN CONTROL	SETTINGS ◆ Ext. Fan Control ↓	Indicates temperature setting for external fan.
SENSE TYPE	SETTINGS ◆ Sense Type ↓	Toggle between Generator [Generator parameter] and Normal [Normal parameters]. This broadens the unit's input parameters to accommodate the fluctuations created by a generator or noisy line
BATTERY TEMPERATUER COMPENSATED	SETTINGS ◆ Batt Temp. Comp. ↓	This adjusts the battery charging temperature compensated voltage to -3 / -4 / or -5 mV/°C/Cell. Consult the manufacture's specifications to find out which setting is best suited for your batteries. The factory default setting is -3 mV/°C /Cell.
SET DATE/TIME	SETTINGS ◆ Set Date/Time ↓	It indicates setting for date and time.
DAYLIGHT SAVING	SETTINGS ◆ Daylight Saving ↓	Enable and Disable daylight saving function.
PROGRAM INPUT CONTACT	SETTINGS ▲ Program I/P Contact ↓	Indicates programmed value of input contact and allow value to be changed.

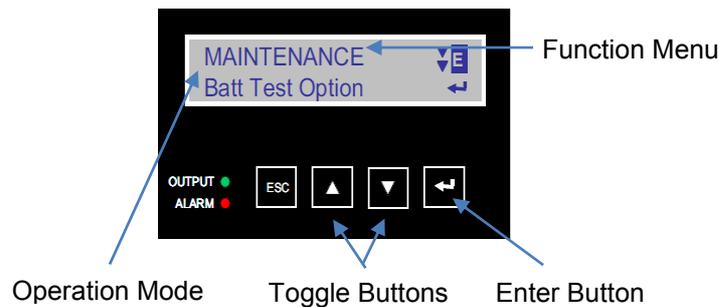
❖ 5.8 Maintenance

Purpose: Describes how to access, view and modify various parameters for maintenance.



NOTE:

ONLY trained and qualified personnel normally use this menu, consequently the password protection option is provided to access this Menu.

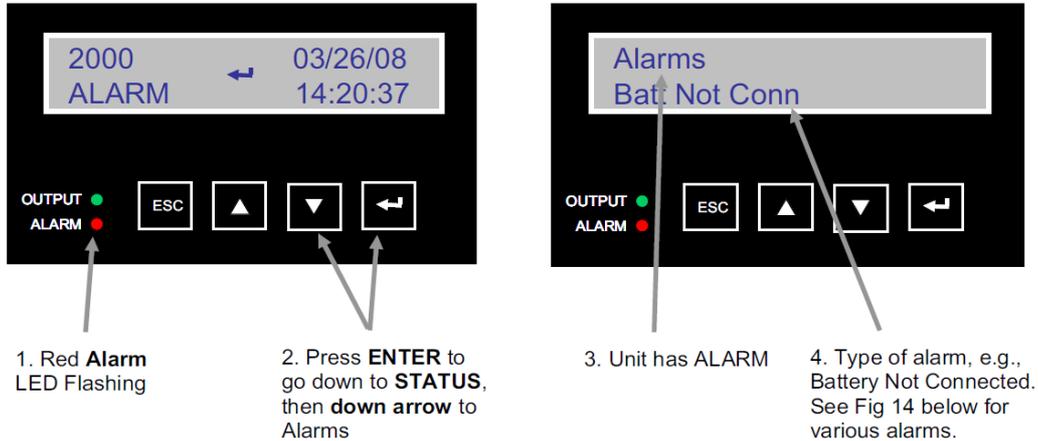


FUNCTION	LCD SHOWS	ACTION
PASSWORD ACCESS	<div style="border: 1px solid black; padding: 5px; width: fit-content;"> Enter Password Password : 0000 </div>	If a Password access is Enabled in CONTROL Menu, than it must be entered here before the Maintenance Menu can be accessed. Use the UP / DOWN arrow key with ENTER keys to enter a correct Password. Reentry is required if an error is made entering a Password.
BATTERY TEST OPTION	<div style="border: 1px solid black; padding: 5px; width: fit-content;"> MAINTENANCE Batt Test Option </div>	Battery Test Option can be verified here. Battery Test period of 1 to 255 minutes can be selected here in 1 minute increments. The TRTC-2002-N1 can be tested to run on Battery for Maintenance purposes here.
INVERTER ON/OFF	<div style="border: 1px solid black; padding: 5px; width: fit-content;"> MAINTENANCE Inverter On/Off </div>	Inverter can be turned ON or OFF. This option is available ONLY when the TRTC-2002-N1 is in Battery or Standby Mode.
EVENT LOG VIEW	<div style="border: 1px solid black; padding: 5px; width: fit-content;"> MAINTENANCE Event Log View </div>	The Event Log with Date & Time is viewed here in Binary digital format. (See Section 5.12 Event Log) for details.
LINE CONDITIONING	<div style="border: 1px solid black; padding: 5px; width: fit-content;"> MAINTENANCE Line Conditioning </div>	Indicates programmed values of all input Line Detection parameters & warning levels and allows values to be changed.
CHANGE PASSWORD	<div style="border: 1px solid black; padding: 5px; width: fit-content;"> MAINTENANCE Change Password </div>	The Password for the access of the Maintenance Menu is changed here. Use the UP / DOWN arrow key with ENTER keys to enter a correct Password. Reentry is required if an error is made entering a Password.

❖ 5.9 Alarm Menu

Purpose: Describes the Alarm Submenu and how to use the LCD for troubleshooting.

Procedure: When the **Red ALARM LED** is **FLASHING**, the unit has an alarm, indicating a condition not serious enough to stop it from providing output power. Press **ENTER** to see the alarm.



LED Shows an Alarm

LCD Displays the Alarm

LCD SHOWS	ALARM	DESCRIPTION
Line Freq	Line Frequency	The Input frequency is fluctuating & out of tolerance.
Low O/P Volt	Low Output Voltage	The output voltage is low, but still usable.
NO Temp. Probe	Temperature Probe Unplugged	The battery temperature probe is unplugged or damaged. When the unit detects the probe is unplugged, it will continue to operate but the charger voltage will automatically be set to the lowest value.
Over Load	Overload	The loads are drawing more power from the TRTC-2002-N1 than it can provide.
BATT not Conn	Battery Not Connect	The Battery is not connected.
High Temp	High Temperature	The Battery temperature is high.
Low Temp	Low Temperature	The Battery temperature is low.
Ext. Alarm	External Alarm	The external alarm of the program input contact.
Ext. Batt Alarm	External Battery Alarm	The external battery alarm of the program input contact.
Ext. Fan Fail	External Fan Fail	The external fan fail of the program input contact.
Door Interlock	Door Interlock	The door interlock of the program input contact.

Alarm Table



NOTE:

The alarms are self-resettable. After the alarm condition is removed, the unit automatically returns to Line mode if the line is qualified, or battery mode if the line is unqualified.

❖ 5.10 Fault Menu

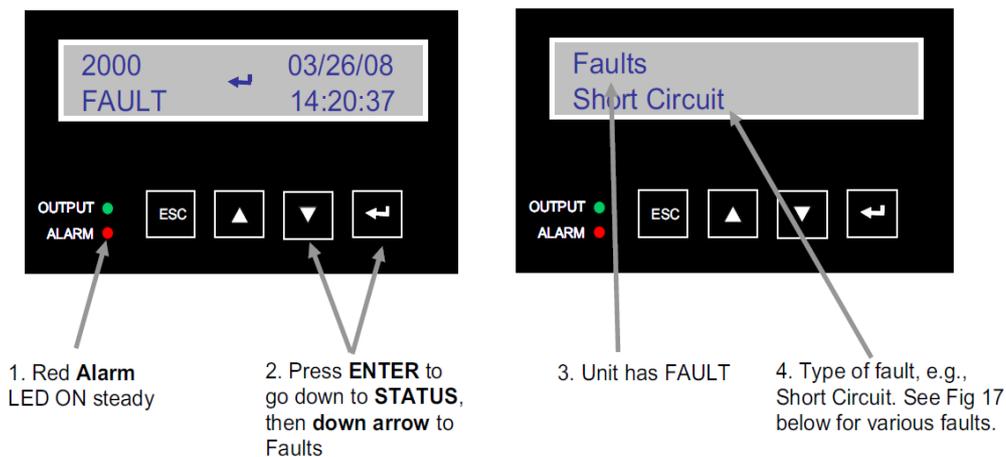
Purpose: Describes the Fault Submenu and how to use the LCD for troubleshooting.

Procedure: When the red **ALARM LED** is continuously ON, the unit has a fault, indicating a condition where backup power is unavailable. Press **ENTER** to display fault description.



TIP:

When the unit has a fault and line power is qualified and available, the output loads are directly connected to the Input line with no line conditioning or backup power provided.



LCD SHOWS	FAULT	DESCRIPTION
Short Circuit	Short Circuit	The load is short-circuited or the inverter did not start.
Batt. Low Volt	Low Battery Voltage *	The batteries output voltage is low.
Batt. High Volt	High Battery Voltage *	The batteries output voltage is high.
Temp High	High Temperature *	The battery temperature or the TRTC-2002-N1 internal temperature is high.
Over Load	Overload	The loads are drawing more power than the TRTC-2002-N1 can provide.

Fault Table

*These faults are self-resetting. After the fault condition is removed, the unit automatically returns to Line mode if the line is qualified or Battery mode if not. For all other faults, the unit is reset by shutting it down and restarting it using the AC and battery breakers. The faults can also be reset in the Control Menu of the LCD display.

❖ 5.11 Event Log

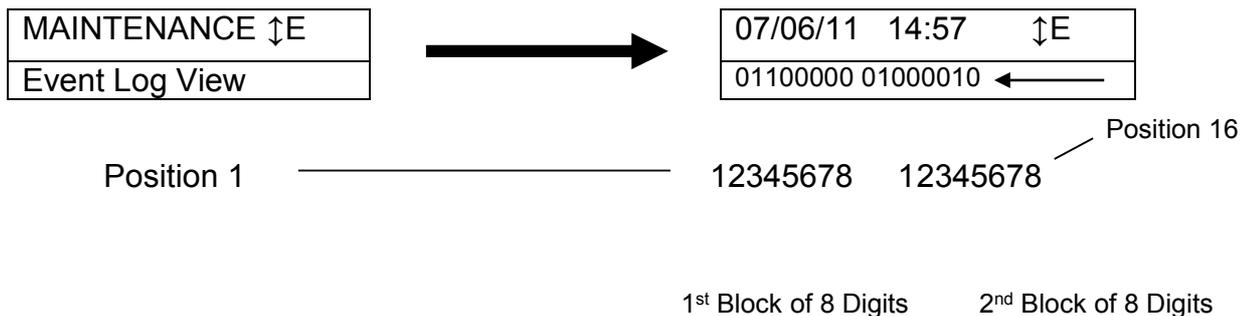
Purpose: Describes how to view and interpret the Event Log or Alarm Log.

Procedure: In the LCD panel, scroll down to the Maintenance Menu. Enter the password, using up / down arrows, to access the Maintenance Menu. The password is required only when the access to this menu is password protected in the control menu. The factory default password is 1111. Consult the factory if the programmed password is lost or forgotten. The last item in the Maintenance Menu is the EVENT LOG VIEW. The LCD screen displays the information in digital binary form. The full descriptive details can be seen using your PC in RS232 / USB mode.

ALARM IS DISPLAYED IN THE DIGITAL BINARY FORM

Two blocks of numbers appear on the second line of the LCD screen. Each block has 8 digits, for a total of 16 digits. The position of each one of the 16 digits indicates a unique event. A value of 1 indicates the presence of an event represented by the position of that digit, while a value of 0 indicates an absence of that event. The assignment of events for each of these 16 digits is identified below.

Example:



At the Event Log view menu press ENTER to access the Event Log View function. The first line indicates the date (MM/DD/YY) and time (HH:MM) of the event occurrence. The second line shows Events in UPS. Pressing UP allows to the next event, pressing DOWN allows to view the previous event.

1st Block of 8 Digits:

1	2	3	4	5	6	7	8
AC High	AC Low	Black-Out	Over Load	Hi Temp	Battery High Voltage	Battery Low Voltage	Short Circuit

2nd Block of 8 Digits:

9	10	11	12	13	14	15	16
Battery Low	Freq Low	Freq High	AC Fail	External Alarm	Battery Temp Over-Range	No Temp. Probe	Battery Not Connect

Section 6: Operation – RS-232 / USB Interface

- ❖ 6.1 RS-232 / USB Interface Directory
 - ❖ 6.7 Input / Output Values
 - ❖ 6.2 Menu Tree
 - ❖ 6.8 Maintenance
 - ❖ 6.3 RS-232 / USB Interface Info
 - ❖ 6.9 Line Slow Detection Parameters
 - ❖ 6.4 Main Menu
 - ❖ 6.10 Parameter Change Procedure
 - ❖ 6.5 Submenus
 - ❖ 6.11 Parameter Descriptions
 - ❖ 6.6 Unit Specifications
-



❖ 6.1 RS-232 / USB Interface Directory

Description	Location
Battery Charging Temperature Compensation	Maintenance
Resets The Event/Timer Counters (available in Line Mode)	Maintenance
Battery Test Options (available in Line Mode)	Maintenance
Battery Voltage Low Warning	Maintenance
Boost High *[107] V AC	Line Conditioning
Boost Low [102] V AC	Line Conditioning
Buck High [130] V AC	Line Conditioning
Buck Low *[125] V AC	Line Conditioning
Change Password (can only be changed in Line Mode)	Maintenance
Display Event Records	Event Log View
EEPROM Version	Unit Specifications
Ext. Fan On/Off By Temperature	Maintenance
High Gap [005] V AC	Line Conditioning
High Hyst *[145] V AC	Line Conditioning
High Limit [150] V AC	Line Conditioning
Input / Output Values	Input / Output Values
Inverter On/Off (available in Standby/Battery Mode)	Maintenance
Line Qualify Time	Maintenance
Load Shed Timer On/Off (available in Battery Mode only)	Maintenance
Low Gap [005] V AC	Line Conditioning
Low Hyst *[095] V AC	Line Conditioning
Low Limit [090] V AC	Line Conditioning
Model Name	Unit Specifications
Output Shutdown	Maintenance
Program I/O Contact Setup	Programmable Contacts Setup
Programmable Contacts Setup	Programmable Contacts Setup
Reset Event Log	Event Log View

❖ 6.2 Menu Tree

Hyper Terminal Menu Tree [0 – MAIN MENU]

```

[0- MAIN MENU]
  1 Unit Specification
  2 Input / Output Values
  3 Maintenance
  4 Line Conditioning Setup
  5 Programmable Contacts Setup
  6 Event Log View
  7 Load Setup Defaults

Date & Time      : 07/07/11, 15:28:00
Sense Type      : Normal
Line Status     : Normal
Output Status   : Line Mode
Contact Status  :
Contact C1 → [ON BATT/ Not Activated]
Contact C2 → [LOW BATT: 47.5 Volts] /Not Activated]
Contact C3 → [LOW BATT: 47.5 Volts] /Not activated]
Contact C4 → [TIMER: 2.00 Hours] / Not Activated]
Contact C5 → [TIMER: 2.00 Hours] / Not Activated]
Contact C6 → [ALARM: Any alarm] / Not Activated]
PROGRAM I/P CONTACT → [DOOR INTERLOOK]
/ [Not Activated]
Ext. Fan Status: [Not Activated]
Faults: NONE
Alarms: NONE
  
```

```

[0 – MAIN MENU]
[1-UNIT SPECIFICATION]
Unit Model MP2000
Unit Frequency      60 Hertz
Input Voltage      120 Volts
Output Voltage     120 Volts
Output VA 2000 VA
Battery Voltage     48 Volts
Max Chgr Current   10.0 amps
EEPROM Version     02.2
  
```

```

[0 – MAIN MENU]
[2- INPUT/OUTPUT VALUES]
Input: -
Voltage           121 Volts
Freq              60.2 Hertz
Output:-
Voltage           121 Volts
Freq              60.0 Hertz
Power             0000 Watts
Battery: -
Temperature       24 Deg C
Voltage           55.3 Volts
Evt/Timer
INV Event         00020
INV Timer         0000 Hours 07 Minutes
BUCK Event        00000
BUCK Timer        0000 Hours 00 Minutes
BOOST Event       00000
BOOST Timer       0000 Hours 00 Minutes
  
```

```

[0 – MAIN MENU]
[3 – MAINTENANCE]
30) Battery Test Options (available in Line Mode)
31) Output Shutdown
32) Inverter On/Off (available in Standby/ Battery Mode)
33) Change Password (can only be changed in Line Mode)
34) Line Qualify Time
35) Battery Voltage Low Warning
36) Load Shed Timer On/Off (available in Battery Mode only)
37) Resets the Event/Timer Counters (available in Line Mode)
38) Battery Charging Temperature Compensation
39) Ext. Fan On/Off By Temperature
  
```

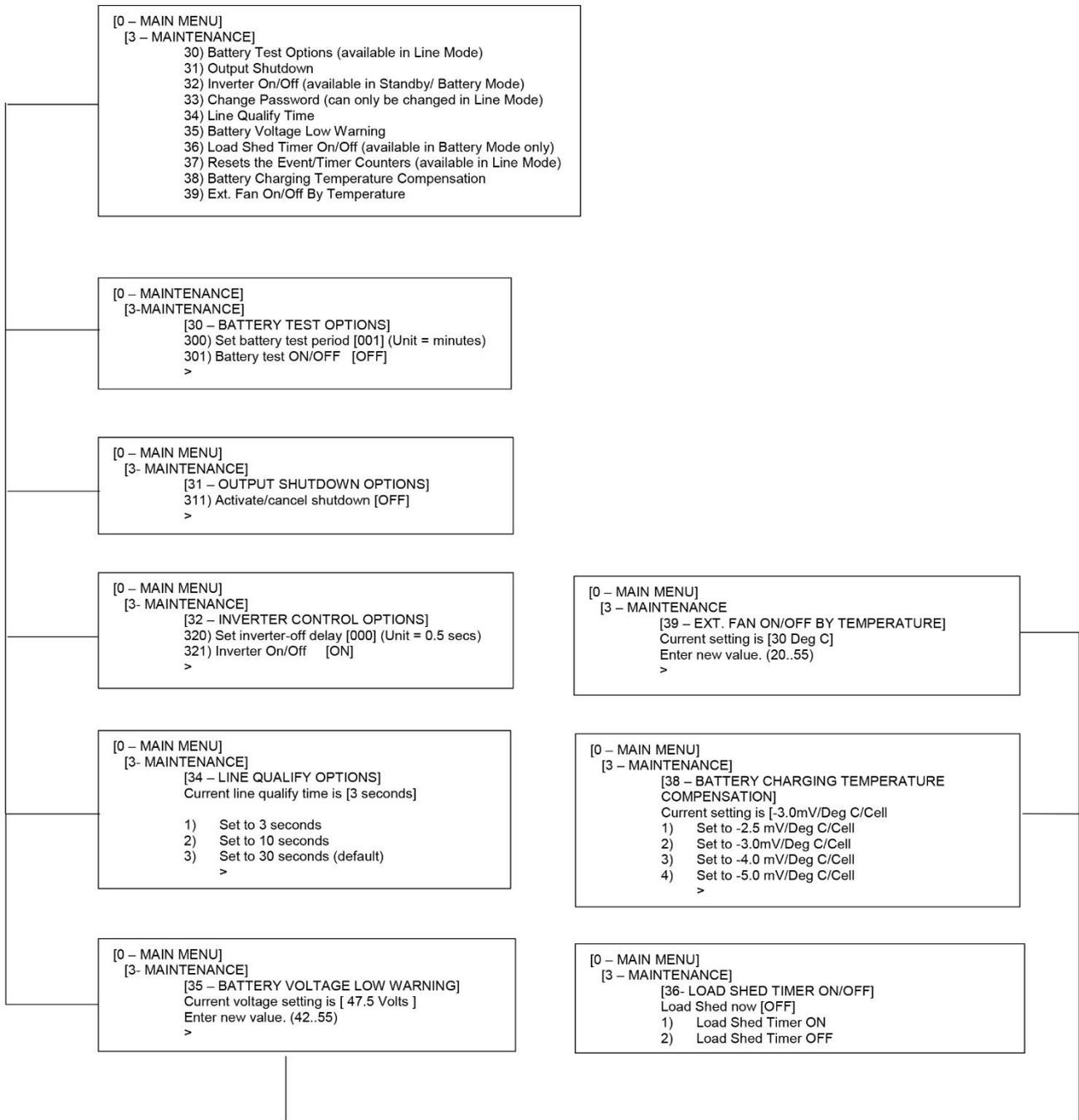
```

[0-MAIN MENU]
[4 – LINE CONDITIONING SETUP]
40) High Limit      [150] Vac
41) Low Lmt         [090] Vac
42) High Hyst      * [145] Vac
Low Hyst           * [095] Vac
44) Boost High     * [107] Vac
45) Boost Low      [102] Vac
46) Buck High      [130] Vac
47) Buck Low       * [125] Vac
High Gap           [005] Vac
                  [005] Vac
                  49) Low Gap
  
```

```

[0 – MAIN MENU]
[5 – PROGRAMMABLE CONTACTS SETUP]
50) Contact C1 = [ON BATT]
51) Contact C2 = [LOW BATT: 47.5 Volts]
52) Contact C3 = [LOW BATT: 47.5 Volts]
53) Contact C4 = [TIMER: 2.00 Hours]
Contact C5 = [TIMER: 2.00 Hours]
Any Alarm]
54) Contact C6 = [ALARM:
56) PROGRAM I/P CONTACT = [DOOR INTERLOCK]
  
```

Hyper Terminal Menu Tree [3 – MAINTENANCE]



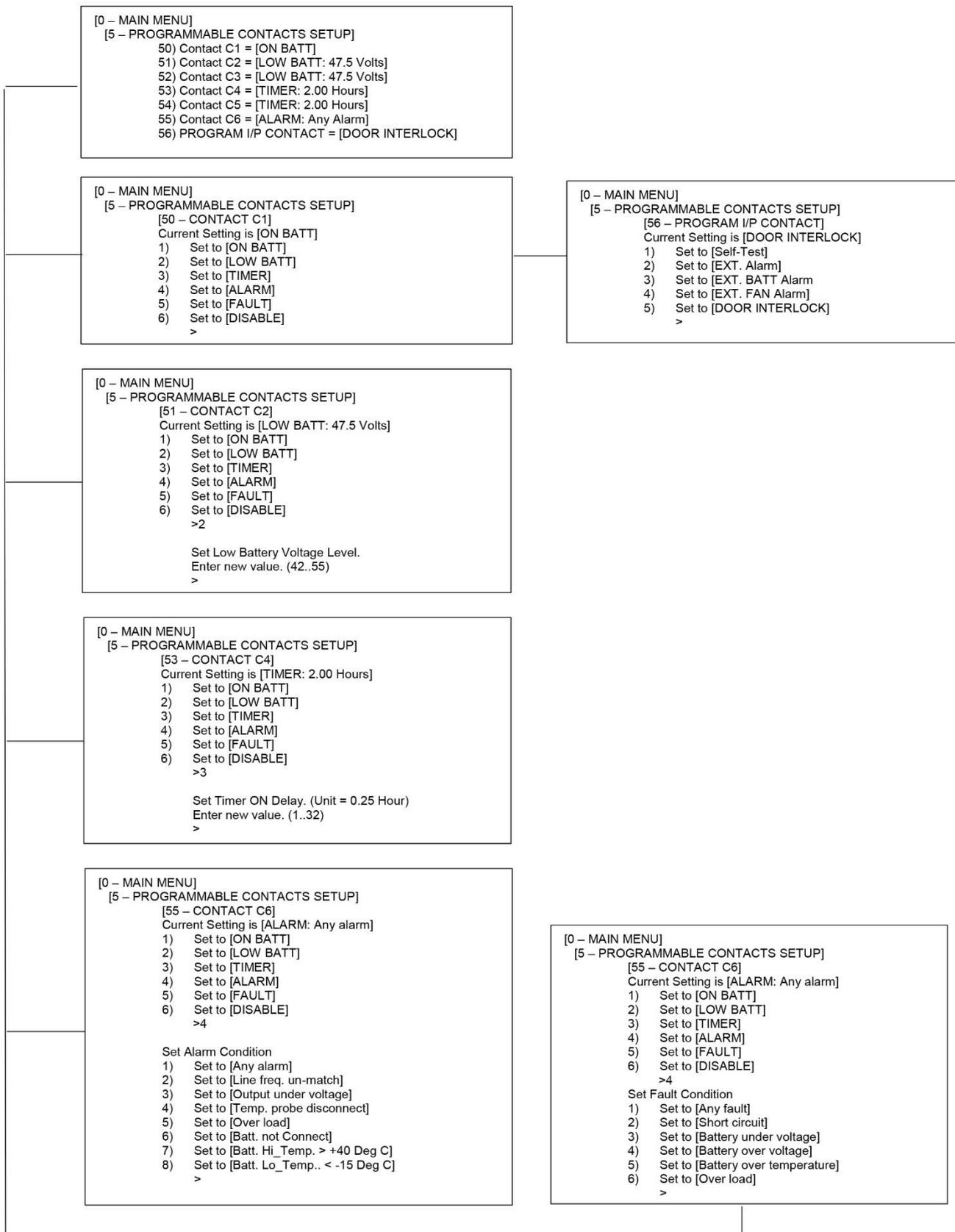
Hyper Terminal Menu Tree [4 – LINE CONDITIONING SETUP]

```
[0-MAIN MENU]
[4 – LINE CONDITIONING SETUP]
  40) High Limit      [150] Vac
  41) Low Lmt        [090] Vac
  42) High Hyst      * [145] Vac
  43) Low Hyst       * [095] Vac
  44) Boost High     * [107] Vac
  45) Boost Low      [102] Vac
  46) Buck High      [130] Vac
  47) Buck Low       * [125] Vac
  48) High Gap       [005] Vac
  49) Low Gap        [005] Vac
```

```
HIGH LIMIT [150}
Enter new value. (120..150)
>
```

Hyper Terminal Menu Tree

[5 – PROGRAMMABLE CONTACTS SETUP]



❖ 6.3 RS-232 / USB Interface Information



NOTE:

IMPORTANT NOTES:

1. For uses that are communicating via RS232 and have a network interface card installed, the Ethernet communication will be paused when connected over RS232. Ethernet communication will resume when the RS232 connection is disconnected.
2. The USB port is not a “true” USB port, the signal is converted to a serial RS232 signal. The USB port is installed as a convenience for users without a serial port on their computers. Please see note 1.

USB INFORMATION

The unit has both an RS-232 and USB port for communications, or an optional Ethernet port can be used. Only one of these ports can be used to communicate with the unit at any given time as they share the same internal circuit board connections.

When a Universal Serial Bus (USB) cable is used to connect to the unit, the drivers for the USB port must first be loaded on the PC. The drivers can be downloaded from the Prolific Technology Inc. web site:

http://www.prolific.com.tw/US/ShowProduct.aspx?p_id=225&pcid=41

Install the drivers on the laptop computer that will be used to interface.



NOTE:

Take notice of the installation order. First, run the InstallShield wizard, and then plug in the USB cable from the unit to the laptop.

The following steps will show how to install the USB drivers under Windows XP.

1. Run or double-click the InstallShield driver setup program “PL-2303 Driver Installer.exe”. The InstallShield Wizard will be displayed on your screen to inform you that the PL-2303 USB-to-Serial driver will be installed on your computer. Click Next to continue and start the installation.
2. Wait until the InstallShield Wizard informs you that driver installation is successfully installed. Click the Finish button to close the InstallShield program. If you have plugged the USB cable into the PC while running the setup installation, unplug and reconnect the cable for the system to detect the device.
3. Locate the USB port of your computer and plug in the USB cable. Windows should detect the driver as Prolific USB-to-Serial Com Port. Before Windows installs this, it may prompt you that this device driver has not yet passed Windows XP Logo compatibility. Click Continue Anyway. Windows will then start to install the driver for the USB-to-Serial Com Port.



NOTE:

In Windows path is: **Start/Programs/Accessories/Communication/HyperTerminal.**

HYPERTERMINAL INFORMATION

Starting with Windows Vista, Microsoft no longer bundled HyperTerminal, thus Windows 7 does not include it either. The commercial products HyperTerminal Private Edition and HyperACCESS support all versions of Windows up to and including Windows 7.

<http://en.wikipedia.org/wiki/HyperTerminal>

HyperTerminal is available at: <http://www.hilgraeve.com/hyperterminal/>

Another option is PuTTY: <http://en.wikipedia.org/wiki/PuTTY>

PuTTY is available at: <http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html>

❖ 6.4 Main Menu

Purpose: Describes the Main Menu.

The RS232 / USB menus are hierarchical. Press **ENTER** to access the top-level menu.

The main menu displays the sub menu numbers, the line status, the unit's output status and any faults or alarms that may be present.



TIP:

The factory set default password 1111 is required to access and set many functions.

Sub Menu Numbers	TRTC-2002-N1 [0-MAIN MENU] 1 Unit Specification 2 Input / Output Values 3 Maintenance 4 Line Conditioning Setup 5 Programmable Contacts Setup 6 Event Log View 7 Load Setup Defaults
Status, Faults, and Alarms Readouts	Date & Time : 07/06/11, 16:16:57 Sense Type : Normal Line Status : Normal Output Status: Line mode Contact Status: Contact C1 ==> [ON BATT]/[Not Activated] Contact C2 ==> [LOW BATT: 47.5 Volts]/[Not Activated] Contact C3 ==> [LOW BATT: 47.5 Volts]/[Not Activated] Contact C4 ==> [TIMER: 2.00 Hours]/[Not Activated] Contact C5 ==> [TIMER: 2.00 Hours]/[Not Activated] Contact C6 ==> [ALARM: Any alarm]/[Not Activated] PROGRAM I/P CONTACT ==> [Self-test]/[Not Activated] Ext. Fan Status: [Not Activated] Faults: NONE Alarms: NONE

Menu Tree



TIP:

The Status, Faults, and Alarms readouts are not automatically updated. Press **ENTER** to obtain the up to date status.

Tabulation of various items that appears under the Line Status, Output Status, Faults and Alarms are shown in the following tables.

Line Status: [Current Status]
 Output Status: [Current Status]
 Content Status: [Current Status]
 Ext. Fan Status: [Current Status]
 Faults: [If any, otherwise blank]
 Alarms: [If any, otherwise blank]
 >_

LINE STATUS	
Normal	Input power is normal.
Buck	Input power is out of tolerance. Buck mode is activated.
Blackout	Input voltage is not available.
Low	Input voltage is lower than programmed low limit.
High	Input voltage is higher than programmed Hi limit.
Freq low	Input frequency is too low (<55 Hz)
Freq high	Input frequency is too high (>65 Hz)

Line Status Displays

Line Status: [Current Status]
 Output Status: [Current Status]
 Content Status: [Current Status]
 Ext. Fan Status: [Current Status]
 Faults: [If any, otherwise blank]
 Alarms: [If any, otherwise blank]
 >_

OUTPUT STATUS
Line mode
Inverter mode
Inverter mode. Low bat. Warning
Boost mode
Buck mode
Hot swap mode
Shutdown due to fault
Shutdown due to low battery
Shutdown due to no line

Output Status Displays

Line Status: [Current Status]
 Output Status: [Current Status]
 Content Status: [Current Status]
 Ext. Fan Status: [Current Status]
 Faults: [If any, otherwise blank]
 Alarms: [If any, otherwise blank]
 >_

FAULT DISPLAYS	
Short-Circuit	Output Short Circuit
Vout_Hi	Output Voltage High
Vbat_Hi	Battery Voltage High
Vbat Lo	Battery Voltage Low
Temp Hi	Ambient Battery Temperature High or Internal Temperature High
Lout Hi	Output Current High
EEPROM_ERROR	Error Reading EEPROM
Wout Hi	Output Power High (Overload)
Bad Battery	Bad Battery
ALARM DISPLAYS	
Vout Lo	Output Voltage Low
Lout Hi	Output Current High
Overload	Output Overload
Temp Hi	Ambient Battery Temperature High
Pll	Ambient Battery Temperature Low
Line Freq	Phase Lock Loop Cannot Lock w/ Input
Temp_Probe_Disconnect	Temperature probe uninstalled or disconnected
Batt_Brk_Off	The battery breaker is off or the batteries are discharged
Program Input Alarm	The program input contact alarm detected.

Fault Alarm Displays

❖ 6.5 Sub Menus

Purpose: Describes the RS232 / USB Menu Tree that include: Unit Specifications, Input / Output Values, Maintenance and Line Slow Detection Setup Sub Menus.



TIP:

To access any item from the Main Menu. Type in the function number and press ENTER.

❖ 6.6 Unit Specifications

Menu 1 below lists the TRTC-2002-N1's specifications.

Procedure: At the main menu, type 1 and press Enter. The screen displays the Unit Specifications as shown below. To return to the main menu, press **Enter**.

[1 - Unit Specifications]		
Unit Model	TRTC-2002-N1	The model name
Unit Freq	60 hertz	Nominal operating frequency
Input Voltage	120 Volts	Nominal Input voltage
Output Voltage	120 Volts	Nominal output voltage
Output VA	2000 VA	The output VA capacity
Battery Voltage	48 Volts	Nominal battery capacity
Max Charge Current	10 amps	MAX charge capacity
EEPROM Version	02.2	EEPROM version of the TRTC-2002-N1

❖ 6.7 Input / Output Values

Menu 2 below lists the actual measurements of various input / output parameters.

Procedure: At the main menu, type 2 and press Enter. The screen displays the Unit Specifications as shown below. To return to the main menu, press **Enter**.

[2 – Input / Output Value]		
INPUT		
Voltage	120 Volts	The Input voltage
Freq	60.0 Hertz	The Input frequency
OUTPUT		
Voltage	120 Volts	The output voltage
Freq	60.0 Hertz	The output frequency
Power	0000 Watts	The output power in watts
BATTERY		
Temperature	25 Deg C	The ambient temperature of the battery case as read via attached temperature probe
Voltage	55.3 Volts	The battery DC voltage

EVT/TIMER		
INV Event	00019	The numbers of Input Power Failures
INV Timer	0000 Hours 07 Minutes	Total time that the battery was discharged since the last RESET
BUCK Event	00000	The numbers of BUCK function active
BUCK Timer	0000 Hours 00 Minutes	Total time that the BUCK function since the last RESET
BOOST Event	00000	The numbers of BOOST function active
BOOST Timer	0000 Hours 00 Minutes	Total time that the BOOST function since the last RESET

❖ 6.8 Maintenance

Menu 3 below lists the various maintenance options.

Procedure: At the main menu, type 3 and press ENTER. The Maintenance Menu shown below is displayed. To return to the main menu, press ENTER.

[3 - Maintenance]	
30 Battery Test Options	The start - stop for the Battery Test / Self-Test is initiated here. The test duration is user programmable in 1 minute intervals from 1 to 255 minutes. The factory default setting is 1 minute. Tip: The time duration can be changed only when TRTC-2002-N1 is in line mode.
31 Output Shutdown	This allows output to be switched OFF or Shutdown. TRTC-2002-N1 switches to STANDBY mode when this option is activated.
32 Inverter On/Off	During the BATTERY or STANDBY mode, this option allows the inverter to be switched OFF or turned ON after the user programmable delay time. The delay can be user programmable in 0.5 seconds steps from 0 to a maximum setting of 255 steps (128 seconds). The delay is only available in Standby or Battery modes. When the unit returns to Line Mode, the delay resets back to a default of 0 seconds. Thus during a battery discharge or ON BATTERY mode, operator can stop the inverter immediately after user.
33 Change Password *	This option allows for the change of password. The factory set default password is 1111. Tip: the password can only be changed in Line mode.
34 Line Qualify Time	When the input power returns and it is qualified, i.e. it is within acceptable range, the transfer from Battery mode to Line mode is delayed by user programmed 3 / 10 / 30 seconds herein that allows the returned utility power to settle down. The factory set default value is 30 seconds.
35 Battery Voltage Low Warning	The level for LOW BATTERY ALARM is set here. The Voltage level is user programmable in 0.5VDC increments from 42VDC to 55VDC. The factory default setting is 47.5VDC

	or 40%). The relationship between Remaining % capacity of battery and its DC Voltage depends on the characteristics of the batteries used.
36 Load Shed Timer On/Off	The programmable timer contacts are manually activated / deactivated ON DEMAND using this option. Certain Loads / Signals connected to this timer can be shed or dropped earlier to extend the back-up time. This function is available only in "Battery Mode".
37 Resets The Event/Timer Counters	Resets INV, BUBK, BOOST Event to 0 Resets INV, BUBK, BOOST Timer to 0
38 Battery Charging Temperature Compensation	Temperature compensated smart charger is utilized in TRTC-2002-N1. The rate of charging is adjusted here based on the battery case temperature. The factory default value is set at -3mv/deg°C /Cell. It can be configured to -3 / -4 / -5 mv/deg°C /Cell.
39 Ext. Fan On/Off By Temperature	Set the temperature in °C, above which the 48VDC power will be provided for external cooling fan. The temperature can be set in 1°C increment from 20 to 55°C. The factory default temperature is set at +25°C.

*Password Changing Procedure

1. Type the current password (the factory set password is 1111) and press **Enter**.
2. The words "Enter New Password" appears on the screen. Type the new password (any combination of 4 digits) and press **Enter**.



NOTE:

The password can only be four numeric digits – NO ALPHA CHARACTERS.

3. The words "Re-enter New Password" appear on the screen. Retype the new password and press **Enter**. If the wrong password is retyped, the screen displays "Error in entering data... please try again." Type the correct password and press **Enter**.

If the retyped password is correct, the screen returns to the main menu.

❖ 6.9 Line Slow Detection Parameters

This option allows user to change various detection and warning levels for input AC voltages, qualified and unqualified values, Transfer & Retransfer set points for going in & out of Battery mode / Boost / Buck modes. The factory set default values concur with those specified by major DOTs (Department of Transportations).

Electrical equipment is designed to operate at maximum efficiency at a specific standard supply voltage. Buck and boost is an ideal solution when the line voltage is consistently higher or lower than nominal. The transformer can buck (lower) or boost (raise) the supply voltage without having to go onto battery or involve any other active TRTC-2002-N1 board level components. The TRTC-2002-N1 input transformer has a second tap off the primary winding. When activated, the transformer will automatically switch to the secondary tap to buck or boost the voltage output 10%, thereby keeping the output within an acceptable range.



ATTENTION!

Improperly set parameter values can cause permanent damage to the unit. Changes should only be made by Manufacturer trained personnel. Contact Manufacturer before making any adjustment.



NOTE:

Parameter values are interdependent, changing one value can affect range and permissible value in another field. This feature is to protect the user from entering conflicting values.

❖ 6.10 Parameter Change Procedure

1. "Enter Password" appears (the factory set password is 1111), Type the password and press **Enter**.

If the wrong password is typed, the screen displays "Error in entering data... please try again." Type the correct password.

2. The Parameter Change Screen appears. Type the new value that is within the range of acceptable parameter limits and press **Enter**.
The screen returns to the Line Slow Detection Screen.

❖ 6.11 Parameter Descriptions



NOTE:

All levels are user programmable; some values are interdependent.

		AVR Feature Disable		AVR Feature Enable	
		Default Setting	RANGE	Default Setting	RANGE
40 Slow Detect High Lmt When input voltage exceeds this level, TRTC-2002-N1 transfers to Battery Mode from either Buck Mode (when enabled) or Line mode.	On Battery Mode Line / Buck to Battery	130VAC	120~150VAC	150VAC	120~150VAC
42 Slow Detect High Hyst When input voltage returns below this level, TRTC-2002-N1 transfers back to Line Mode from Battery Mode.	Battery to Line -----	*125VAC (High Lmt - High Gap)		*145VAC (High Lmt - High Gap)	
46 Slow Detect Buck High When input voltage exceeds this level, TRTC-2002-N1 transfers to Buck Mode (when enabled) reducing the output.	Line to Buck -----	[DISABLE]		130VAC	[DISABLE]
47 Slow Detect Buck Low When input voltage returns below this level, TRTC-2002-N1 releases the Buck Mode (when enabled) and transfers back to the Line Mode.	Buck to Line -----	[DISABLE]		*125VAC (Buck High - High Gap)	
	Normal -----				
44 Slow Detect Boost High When input voltage returns above this level, TRTC-2002-N1 releases the Boost Mode (when enabled) and transfers back to the Line Mode.	Boost to Line -----	[DISABLE]		*107VAC (Boost Low + Low Gap)	
45 Slow Detect Boost Low When input voltage reduces below this level, TRTC-2002-N1 transfers to Boost Mode (when enabled) increasing the output.	Line to Boost -----	[DISABLE]		102VAC	[DISABLE]
43 Slow Detect Low Hyst When input voltage returns above this level, TRTC-2002-N1 transfers back to the Line Mode from Battery Mode.	Battery to Line -----	*105VAC (Low Lmt + Low Gap)		*95VAC (Low Lmt + Low Gap)	
40 Slow Detect Low Lmt When input voltage reduces below this level, TRTC-2002-N1 transfers to Battery Mode from either Boost Mode (when enabled) or Line Mode.	Line / Boost to Battery On Battery Mode	100VAC	90~120VAC	90VAC	90~120VAC
48 High Gap		5VAC	3~7VAC	5VAC	3~7VAC
49 Low Gap		5VAC	3~7VAC	5VAC	3~7VAC

Section 7: Operation – Web Interface

- ❖ 7.1 Web Interface Directory
 - ❖ 7.2 Web Interface
-



❖ 7.1 Web Interface Directory

Description	Tab	Sub-menu
Attached Device Name	Home	Identification Information
Basic Information Setting	Home	Identification Information
Battery Charging Temp. Compensation	Configuration	Maintenance
Battery Temperature - Measured	Home	Measured Information
Battery Test Options	Configuration	Maintenance
Battery Voltage - Measured	Home	Measured Information
Battery Voltage Low Warning	Configuration	Maintenance
Boost Feature On/OFF	Configuration	Transfer Point
Boost Transfer Point Setting	Configuration	Transfer Point
Buck Feature ON/OFF	Configuration	Transfer Point
Buck Transfer Point Setting	Configuration	Transfer Point
Change Password	Configuration	Maintenance
Configuration Information	Home	Configuration Information
Contact Status	Home	Summary Information
Data Log	Log	Data Log
Data Log Length	Log	Log Settings
Date and Time Setting	System	Date and Time
Display Event Logs	Log	UPS Event Log
DNS Configuration	System	Network
Event Actions	Configuration	Event Actions
Event Log Length	Log	Log Settings
External Fan ON/OFF by Temperature	Configuration	Maintenance
Firmware Upgrading	System	Firmware Upgrade
High Transfer Point Setting	Configuration	Transfer Point
Identification Information	Home	Identification Information
Input Configuration	Configuration	UPS Parameters
Input Frequency - Measured	Home	Measured Information
Input Voltage - Measured	Home	Measured Information
Inverter ON/OFF	Configuration	Maintenance
Line Qualify Options	Configuration	Maintenance
Login User and Password Change	System	User
Low Transfer Point Setting	Configuration	Transfer Point
Network BBS Name	Home	Identification Information
Output Configuration	Configuration	UPS Parameters
Output Voltage - Measured	Home	Measured Information
Output Watts - Measured	Home	Measured Information

Relay Contact Settings	Control	Contacts
Reset the Event/Timer Counter	Configuration	Maintenance
Schedule a General System Test	Configuration	Schedule
Self-test	Control	Control UPS
SMTP Server Configuration	System	Network
TCP/IP Settings	System	Network
UPS Event Log	Log	UPS Event Log
UPS Summary	Home	Summary Information
User Links	System	User Links

❖ 7.2 Web Interface

Before connecting to your SNMP card be sure you have one of the following:

1. Ethernet crossover cable
2. **OR** Switch or hub and two Ethernet straight through Ethernet cables.
3. **OR** Computer that has an AutoLink networking port.
(An AutoLink port will determine if you are connecting to a device that requires a crossover cable or a straight through cable and automatically transmit and receive using the correct connection.)

Using one of the methods above connect the Ethernet port on your computer to the Ethernet center port on the NetPower card.

Then open a web browser and enter 192.168.1.51 into the address bar.

If you are prompted for a username and password enter.

Enter Username: **admin** Password: **user**

You are now connected to your new TRTC-2002-N1.

If you are not prompted for a username and password and your browser times out.

You will need to configure your computer's internet card with a different IP address and subnet mask. (See appendix for Step by Step Connecting With Windows XP and Step by Step Connecting With Windows 7.)



ATTENTION

Record the settings that are already displayed before you change anything. Failure to return these setting back to "normal" could result in you not being able to connect to your usual network.



NOTE:

The default settings can be reset by holding the green LED "light" on the network interface card in for until it stops flashing and changes to a solid green about 30 sec.

At this point, network interface card will need to be rebooted.

To reboot the network interface card either:

- 1. Completely power down the TRTC-20002-N1 or**
- 2. Remove the two screws securing the network interface card to the TRTC-2002-N1, and then remove the card about an inch, reinsert and reattach with the screws.**

Section 8: Adjustments

- ❖ 8.1 Back-Up Time Test
- ❖ 8.2 Sense Mode - Normal and Generator Waveforms



❖ 8.1 Back-Up Test

Purpose: Describes how to measure the back-up capacity of batteries.

This test provides the measurement of back-up time during power outage by actually discharging the batteries. The back-up time is load as well as battery dependent, thus more back-up time is available with a lower load (in Amps or Watts) and less time with more load.

EXAMPLE:

Start time is **1PM**.
ON BAT contact if selected, is activated.

Low Battery Alarm LED appears at **4PM**.
LOW BAT contact at selected value will be activated.

Low Battery capacity battery back-up time will be the time difference between 4PM and 1PM or **3 hours**.

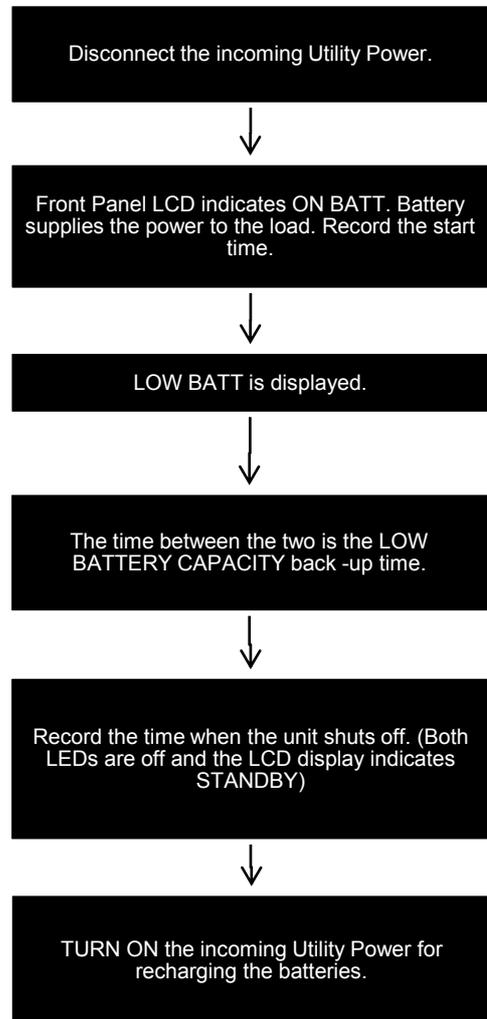
Shutdown time is **5PM**.
Battery reserve time will be the time difference between 4PM and 5PM or **1 hour**.

The **Total Battery Back-up** time is the sum of Low Battery capacity back-up time and Battery Reserve time or the time difference between 5PM and 1PM or 4 hours.



TIP:

It is recommended to perform this test every 6 months. Make sure the batteries are fully charged before starting this test.



❖ 8.2 Sense Mode - Normal and Generator Waveforms

This is used to broaden the input parameters to accommodate the voltage fluctuations created by a backup generator or a noisy line.

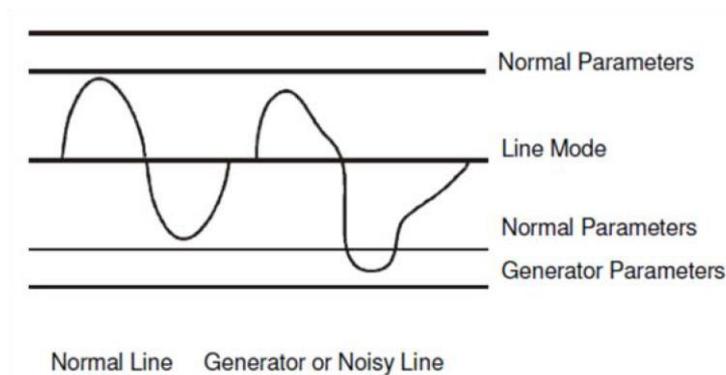
The factory default setting is normal, where the unit runs on normal parameters. Switching to Generator makes it run on noisy generator parameters.

If the unit constantly switches between line and battery modes due to a noisy line, select generator mode to prevent unnecessary transfers / returns.

In generator mode, the acceptable range of input frequency and voltage is expanded to accommodate the voltage and frequency fluctuations created by a generator or a power source of such kind.

Use a generator with electronic speed and voltage controls which typically produces Total Harmonic Distortion in % (THD) of less than 10%. Generators with mechanical governors can force the system to run continuously in Battery mode.

Before installation, compare the generator's output voltage to the TRTC-2002-N1's input voltage requirements as listed on both nameplates. To insure the system's smooth operation, use a generator capable of supplying 2X or twice as much power as required by the total load.



Section 9: Maintenance

- ❖ 9.1 Trouble Analysis
 - ❖ 9.2 TRTC-2002-N1 Troubleshooting
 - ❖ 9.3 PTS Troubleshooting
 - ❖ 9.4 Troubleshooting Sequence Chart
 - ❖ 9.5 Alignment Procedure – Battery Backup Test
 - ❖ 9.6 Preventative Maintenance
 - ❖ 9.7 Battery Maintenance
-



❖ 9.1 Trouble Analysis

Is there ~120V AC at the Input of the BBS or the optional Power Transfer Switch (PTS)?

Is the AC Input Output Circuit Breaker closed?

Are the batteries connected?

Is the Battery Circuit Breaker closed?

❖ 9.2 TRTC-2002-N1 Troubleshooting

Purpose: Describes the most common issues with the TRTC-2002-N1.

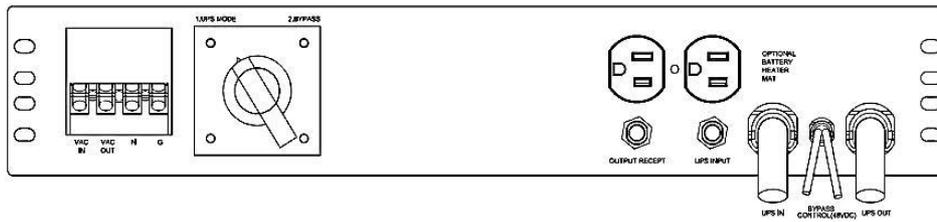
There are NO Maintenance items inside the TRTC-2002-N1 and it should be opened or serviced only by factory authorized service personnel, failure to do so will void the WARRANTY. If it fails to perform a specific function, the table below lists typical symptoms, causes and solutions. If you cannot resolve a problem, contact Manufacturer customer service department.

SYMPTOM	CAUSE	REMEDY
No Output	AC input & output circuit breaker is OFF.	Turn input & output circuit breaker on.
	No incoming utility line power.	Apply incoming utility power by closing upstream breaker.
	Red LED is lit solid on front indicating FAULT.	Read the FAULT under Status Menu of LCD display. Clear the fault. Shut off both the breakers on the front panel. Restart. Contact the factory, if fault persists.
Output LED OFF	Incoming utility power or battery power not available.	Apply qualified input power and verify battery breaker is closed.
	Faulty unit.	Contact factory.
Unit does not transfer to Battery mode during a power failure Or Backup time is less than rated	Battery not connected.	Connect batteries (48VDC nominal).
	Battery circuit breaker OFF.	Close battery breaker.
	Battery is not fully charged.	Fully recharge the battery then test the backup time.
	Dead battery.	Replace with a good battery.
	Battery failure.	Clean and tighten battery connections. Check batteries and replace if needed.
	Faulty unit.	Contact vendor.
Alarm LED is lit	Red LED steady ON indicates FAULT.	Correct the Fault (see 5.11).
	Red LED flashing indicates ALARM.	Correct the Alarm (see 5.10). Contact the factory if Alarm persists.
Batteries will NOT charge	Battery circuit OPEN.	Check that battery connections have proper torque. Check battery cable harness for connection error, loose / open connections. Check 46 to 53VDC present at the battery connector to TRTC-2002-N1. Check if battery breaker is closed. Replace the bad battery, if any.
	Wrong or bad temperature probe connected at front panel.	Use Factory supplied temperature probe reading approximately 12,000 OHMS @ 25°C (77°F).
LCD screen NOT readable	Adjust the contrast for LCD screen.	Press and hold ESC button. Press ENTER button. Adjust the contrast using UP or DOWN arrow Buttons. Press ENTER when completed.
	Faulty unit.	Contact factory.
Password Access NOT available	Entered Password is LOST or forgotten.	Call factory for resetting of the new password.

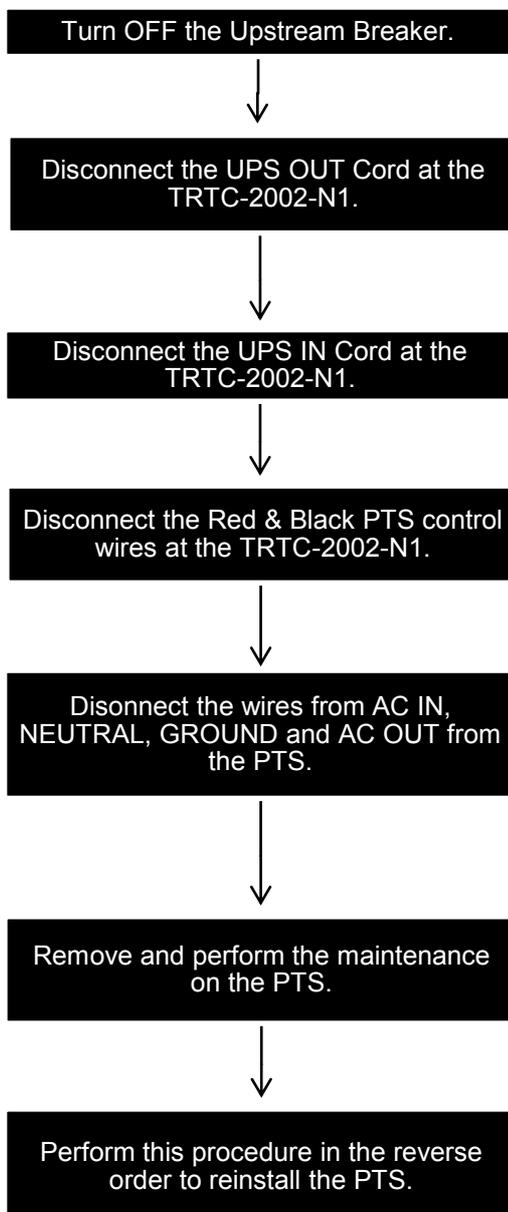
❖ 9.3 PTS Troubleshooting

SYMPTOM	CAUSE	REMEDY
No Output available From PTS	Upstream utility circuit breaker or fuse may be OPEN.	Close the upstream utility breaker or fuse.
	Utility AC Power not available.	Check with the AC voltmeter & contact the Utility Company.
	Wiring error PTS terminal block.	Correct wiring at PTS.
	Faulty PTS.	If 120 VAC is present at “AC IN” and NEUTRAL at the PTS terminal block, replace the PTS.
PTS won't allow transfer to Battery mode	TRTC-2002-N1 output power not connected to PTS.	Verify that “UPS OUT” cord from PTS is properly connected to the AC OUTPUT terminal block at the TRTC-2002-N1.
	“UPS INPUT” circuit breaker at PTS is open.	Reset the breaker & clear the fault.
	Black and red control wires from PTS are not connected at the PTS connector on the TRTC-2002-N1.	Check the connection at the TRTC-2002-N1.
	48VDC signal missing at TB 21 and 22 of Green Control terminal block at the TRTC-2002-N1.	Refer to Section 9.2 for further troubleshooting.
	Faulty PTS.	Replace PTS.
TRTC-2002-N1 does not return back to input Line mode	Utility input line power is missing.	Verify that “UPS IN” cord from PTS is properly connected to the AC INPUT Terminal Block at the TRTC-2002-N1.
		Verify that the “UPS INPUT” circuit breaker at PTS is closed.
		Ensure that utility input is present.

❖ 9.4 Troubleshooting Sequence Chart



Power Transfer Switch



NOTE:

IMPORTANT: Verify that both the AC INPUT & OUTPUT and Battery Breaker are OFF at the TRTC-2002-N1.



NOTE:

IMPORTANT: Place the Manual Bypass Switch in BYPASS before doing any maintenance on the unit or PTS to prevent accidentally losing power to the traffic signals.

❖ 9.5 Alignment Procedure – Battery Backup Test

Purpose: Describes how to measure the back-up capacity of batteries.

This test provides the measurement of back-up time during power outage by actually discharging the batteries. The back-up time is load as well as battery dependent, thus more back-up time is available with a lower load (in Amps or Watts) and less time with more load.



TIP:

It is recommended to perform this test every 6 months. Make sure the batteries are fully charged before starting this test.

EXAMPLE:

Start time is **1PM**.

ON BAT contact if selected, is activated.

Low Battery Alarm LED appears at **4PM**.

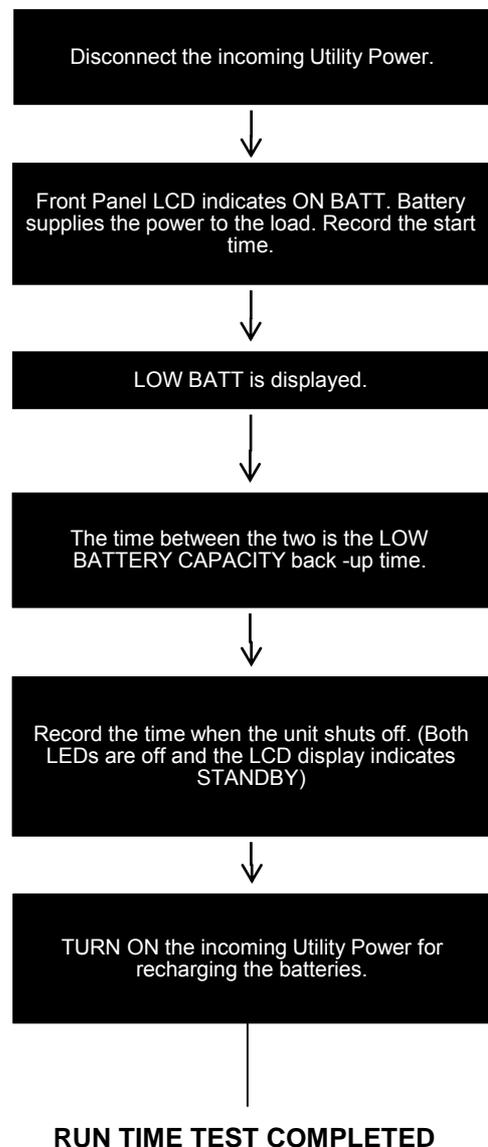
LOW BAT contact at selected value will be activated.

Low Battery capacity battery back-up time will be the time difference between 4PM and 1PM or **3 hours**.

Shutdown time is **5PM**.

Battery reserve time will be the time difference between 4PM and 5PM or **1 hour**.

The **Total Battery Back-up** time is the sum of Low Battery capacity back-up time and Battery Reserve time or the time difference between 5PM and 1PM or 4 hours.



❖ 9.6 Preventative Maintenance



TIP:

Recommended Time Frame: First 3 months – Monthly.

After 3 consecutive months of no issues, we recommend following this procedure at least every 3 months.

1. Inspect the TRTC-2002-N1 and wiring for any physical damage. Repair or replace as required.
2. Verify that all connections are securely fastened. Tighten if necessary.
3. Battery Checks.

NOTE: The Manufacturer of each battery along with the batteries Lot and Date Code.

Inspect the batteries for excessive temperature cracks or swelling. Replace all the batteries if any of the batteries are cracked or swollen.

Check the when the batteries were installed; consider replacing if they are more than 2-years old. Consult the Battery Manufacturer's recommendations regarding care and replacing.

4. Inspect the battery terminals for corrosions. Clean and apply a corrosion prevention compound such as NOCO Company NCP-2 or Sanchem Inc. NO-OX-ID if required.
5. Re-tighten the battery terminal bolts.
6. Verify that the battery temperature probe is securely attached to the battery, if applicable.

❖ 9.7 Battery Maintenance

This is intended only as general information for customers and end users of Marathon Power UPS product with lead-acid storage batteries.

Customers routinely have questions about the lifespan of batteries. There are several factors that all contribute to the useful life of the batteries used with the UPS:

1. The ambient temperature around the UPS.
2. How many times the batteries are discharged and recharged.
3. How well the batteries were stored and maintained, both prior to installation and during the life of the UPS.

The life span of the batteries is typically 3-5 years. Whether it's closer to 3 years or 5 years depends primarily on the factors above. For cooler operating environments, with fewer discharge/recharge cycles on well-maintained batteries, the life expectancy of a battery can approach up to 5 years. On the contrary, in the operating environments with extreme heat and moisture and numerous discharge/recharge cycles with poorly stored and maintained batteries the life of a battery can be reduced to two to three years.

If batteries are overly discharged or left standing in the discharged state for prolonged periods, hardened lead sulfate coats the electrodes and will not be removed during recharging. Such build up reduces the efficiency and life of the batteries and may permanently damage the battery. Also, over-charging can cause electrolyte to escape as corrosive gases. If a battery that has been damaged due to its internal chemistry as described above is used in a UPS, it can appear to the charging circuit as a "short circuit" causing excessive current to flow through the input and charger circuits and consequently destroying them.

Storage Notes

Please adhere to the following storage instructions if the UPS is not to be installed shortly after the delivery.

1. Store the unit as is in its original packing and shipping container.
2. The optimum storage temperature range is 5°F to 77° (-5°C to +25°).
3. Ensure that the equipment is fully protected from wet or damp areas and from moisture.
4. Ensure that the UPS is recharged every 6 months for at least 8 hours in order to maintain battery energy and maximize useable life.

APPENDICES

- ❖ TRTC-2002-N1 Specifications
- ❖ PTS Specifications
- ❖ Battery Care
- ❖ HyperTerminal Set-Up
- ❖ HyperTerminal at a Glance
- ❖ PuTTY at a Glance
- ❖ Step by Step Connecting to Windows XP
- ❖ Step by Step Connecting to Windows 7



❖ TRTC-2002-N1 Specifications

Functions	
Brownout Protection	This unit boosts the output voltage (or transfers to battery) during brownout or low input line conditions and returns to On Line when input power stabilizes and returns to normal. The values for Transfer / Retransfer, To / From Battery / Boost mode are user programmable.
Generator Compatibility	Generator mode allows for more variations in input voltage and frequency for use with an AC generator.
Battery Charger 10A	PFC switch-mode charger is temperature-compensated (-3 to -5 mV/°C /Cell) with automatic shut off above 50°C.
Inverter Mode	Capable of running continuously in inverter mode.
Inverter Mode Current Limit	Continuous electronic current limit is provided.
Measurements available for remote monitoring	- Input and output voltages - Input line frequency - Battery voltage and current - Battery and heat sink temp
Mechanical Specifications	
Dimensions (H x W x D), inch (mm)	5.25" x 17" x 10.5", 3U size (133 mm x 432 mm x 267 mm)
Weight, lb (kg)	46.2 (21)
Input Connection	Anderson PP45/4P Connect
Output Connection	Anderson PP45/4P Connect
Mounting	19" (483 mm) or 23" (584 mm) rack or shelf mount
Cooling	Microprocessor controlled, 12VDC, 3.62" (92 mm) fan
Audible Noise Level, dBA	<40
Operating Temperature, °C	-37° to +74°C (See Notes 1 and 2)
Storage Temperature °C	-50° to +75°C
Humidity	Less than or equal to 95%, Non-Condensing
Altitude, ft (m)	10,000 (3048) (See Note 2)

Electrical Specifications	
Output Apparent Power, VA	2000 (Inverter Mode) 2000 (Line Mode)
Output Active Power, W	1500 (Inverter Mode) 1500 (Line Mode)
Power Factor	0.75
Input Frequency, Hz +/- 3HZ	60
Input Voltage Range, VAC	90 to 150 VAC User programmable. Defaults set @ 100~ 130 VAC +/- 2 VAC.
Output Voltage Inverter Voltage	120 Nom (Tolerances are user programmable) 120 VAC +/-5%
Maximum Input Current, A	30
Transformer	Linear (Non-Isolated)
Transfer Time, msec	<65 msec. Buck & Boost enable <10 msec.
Inrush Current	Load dependent
Output Waveform THD, %	< 3 (Resistive Load)
Load Crest Ratio	3:1
Efficiency, Line Mode	> 95% (Resistive Load)
Efficiency, Inverter Mode	> 80% (Resistive Load)
Nominal Battery String 48VDC Voltage, VDC	48VDC
Step Load Response (50%)	1 Cycle full recovery
Over current Protection	Double Pole Single Throw Circuit Breaker Rated at 30 Amp for input and output DC Bus: 60 Amp circuit breaker
Transient Suppression	MOV transient suppression elements (>150V)
DC Power	Drawn from batteries



NOTE:

1. Between 55° and 74°C, the unit is de-rated to a maximum load of 1600VA/1200W.
2. De-rate operating temperature above 4900 ft. (1500m) by 5 deg. C per each additional 1000ft. (300m).

22 Position Terminal Block	
Functions	<p>A. Provides 6 sets of programmable contacts at pin 1 thru pin 18 for intersection flash control, Remote Alarms, Pagers or other user interface.</p> <ol style="list-style-type: none"> 1. "Low Batt": batteries have reached approximately 40% capacity remaining 2. "On Batt": unit is in inverter mode 3. "Timer": unit has been in inverter mode for 2 hours (programmable) 4. "Alarm": any of the following conditions occur: <ol style="list-style-type: none"> a. Line Frequency error b. Low Output voltage c. No Temperature Probe d. Overload e. No battery connected f. High temperature g. Low temperature 5. "Fault": any of the following conditions occur: <ol style="list-style-type: none"> a. Short circuit b. Batt low voltage c. Batt high voltage d. High temperature e. Overload <p>B. Provides 48 VDC signal to PTS on pins 21 & 22</p> <p>C. Provides programmable input contact on pins 19&20.</p> <ol style="list-style-type: none"> 1. Self-test 2. EXT Alarm 3. EXT Battery Alarm 4. EXT Fan Alarm 5. Door Interlock
Contact Type	Form C. Dry contacts rated 1 Amp at 120V
Wiring	Uses 14-26 AWG
Communication Specifications	
RS-232/USB/Ethernet ports	Monitors, controls and calibrates with terminal emulation software for service personnel to obtain unit diagnostics
RS-232	DB-9, Female, Opto-Isolated, straight-thru cable
USB	B-Type receptacle
Ethernet (optional)	10/100 Mbps Ethernet, auto-detected
Display Panel	2-line LCD



NOTE:

Specifications subject to change without notice. Certain functions require activation.

❖ PTS Specifications

INPUT	
Voltage Range, VAC	100~130VAC (120 VAC Nominal) Prog. 90–150VAC
Frequency	60 +/- 3 Hz
Current	30A (Resistive)
Step Load Response (50% Load Change)	½ Cycle Full Recovery (Full resistive load)
Short Circuit Protection	15A circuit breaker
Battery String Voltage	48VDC (Four 12VDC Battery)
OUTPUT	
Power, VA / W (Line or Inverter mode)	2000VA / 1500W
Power Factor	0.75
Output Voltage, VAC Line and Boost Mode	100~130 +/- 2 VAC (follows the input voltage)
Inverter Mode	120VAC +/- 5%
Output Waveform	Sine Wave
Output Waveform THD	< 3% (Resistive load)
Load Crest Factor	3:1 (Max)
Overload Capacity	110% for 3 minutes
PERFORMANCE	
PTS Transfer Time	< 65 ms Buck & Boost mode <10 ms

ENVIRONMENTAL	
Operating Temp (See Notes below)	
Storage Temp	-50 to +75 °C
Humidity (Non-Condensing)	<95%
Attitude (Note 2)	10,000ft /3000 m
PTS MECHANICAL	
Dimensions (WxDxH) inch/mm	4.75/120.6 (W) 6.5/165 (D) 4.6/116.8 (H)
Weight (lb/kg)	7.0/3.2
Mounting	Rack Mount EARS, 4 points Optional 19" rack mount
Input Connection	Terminal block
Output Connection to Loads	Terminal block
Output Connection to UPS	6 foot line cords ready for hard wiring to UPS terminal blocks
Cooling	Convection (Approx. 7 W contactor coil dissipation)
DESIGNED TO CONFORM TO	
Meets	TEES, July 2009, TEES, Errata 1, Jan 2010, TEES, Ch. 4 - BBS, July 2009
EMI	FCC Class A
Surge Immunity	IEC 1000-4-5, IEEE C62.41



NOTE:

- Between 55 ~ 74 °C, the system is de-rated to a maximum rectified-capacitive load of 1500 VA /1200 W.
- De-rate operating temperature above 4900 ft (1500m) by 2°C per 1000 ft. (300m).
- Refer to the Appendix TRTC-2002-N1 for additional specifications.
Due to ongoing improvements, specifications subject to change without notice.

❖ Battery Care

This is intended only as general information for customers and end users of Marathon Power UPS product with lead-acid storage batteries.

Customers routinely have questions about the lifespan of batteries. There are several factors that all contribute to the useful life of the batteries used with the UPS:

- ❖ The ambient temperature around the UPS.
- ❖ How many times the batteries are discharged and recharged.
- ❖ How well the batteries were stored and maintained, both prior to installation and during the life of the UPS.

The life span of the batteries is typically 3-5 years. Whether it's closer to 3 years or 5 years depends primarily on the factors above. For cooler operating environments, with fewer discharge/recharge cycles on well-maintained batteries, the life expectancy of a battery can approach up to 5 years. On the contrary, in the operating environments with extreme heat and moisture and numerous discharge/recharge cycles with poorly stored and maintained batteries the life of a battery can be reduced to two to three years.

If batteries are overly discharged or left standing in the discharged state for prolonged periods, hardened lead sulfate coats the electrodes and will not be removed during recharging. Such build up reduces the efficiency and life of the batteries and may permanently damage the battery. Also, over-charging can cause electrolyte to escape as corrosive gases. If a battery that has been damaged due to its internal chemistry as described above is used in a UPS, it can appear to the charging circuit as a "short circuit" causing excessive current to flow through the input and charger circuits and consequently destroying them.

Storage Notes

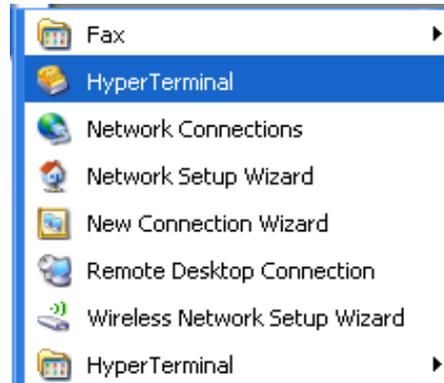
Please adhere to the following storage instructions if the UPS is not to be installed shortly after the delivery.

- ❖ Store the unit as is in its original packing and shipping container.
- ❖ The optimum storage temperature range is 5°F to 77° (-5°C to +25°).
- ❖ Ensure that the equipment is fully protected from wet or damp areas and from moisture.
- ❖ Ensure that the UPS is recharged every 6 months for at least 8 hours in order to maintain battery energy and maximize useable life.

❖ HyperTerminal Set-Up

The following HyperTerminal setting is recommended for local or remote communication between TRTC-2002-N1 & PC. For this tutorial, Com 1 is used. Verify the designation of COM port, where RS232/USB cable to PC is connected such as COM1, COM2, etc.

Step 1: The path is: Programs/Accessories/Communications/HyperTerminal as shown.



Hyper Terminal Selection Screen

Step 2: Click on the **HyperTerminal** icon. The **Connection Description** screen appears as shown. Enter a name and icon for your unit and click **OK**.



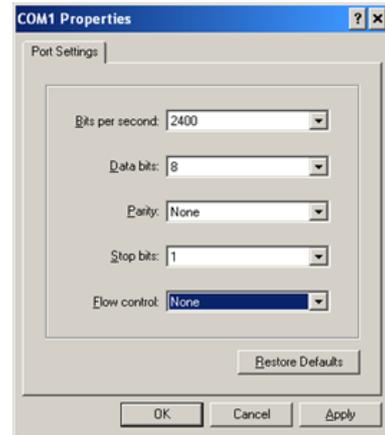
Connection Description Screen

Step 3: The **Connect To** screen appears. Select the COM port from the drop down menu as shown that will be used. Click **OK**.



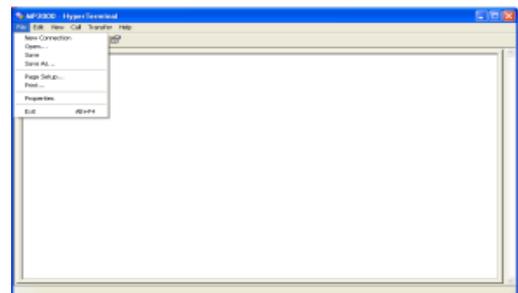
Connect To Screen

Step 4: The COM Properties screen appears. Select the port settings as shown.



COM Properties Screen

Step 5: A blank window with the entered file name appears. In the File menu, go to Properties and Click OK.



TRTC-2002-N1 Hyper Terminal Screen

Step 6: The [Name of Unit] Properties screen appears. Click on the Settings Tab. Select the fields as shown.

Step 7: Click the **ASCII Setup** button.

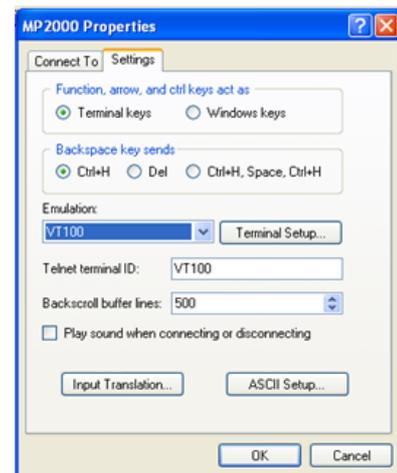
Step 8: Select the fields in the ASCII Setup screen as shown.

Step 9: Click OK. The properties window reappears.

Step 10: Click **OK**
HyperTerminal setup is completed.
Press **Enter** to go to TRTC-2002-N1 screen.

Press **Enter** to access the unit via RS232 / USB communications.

The Main Menu appears.

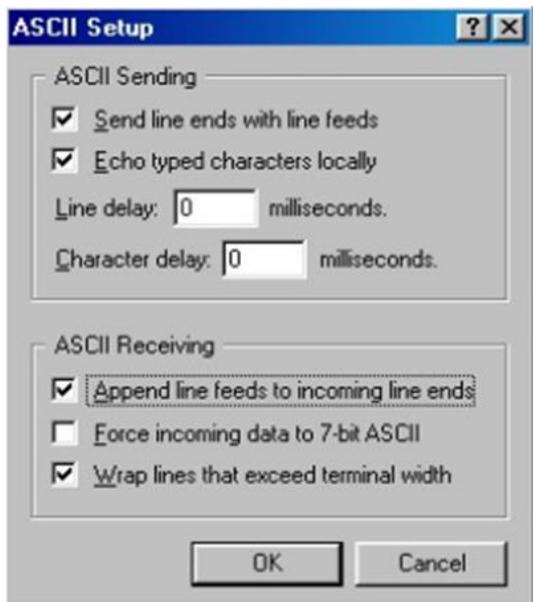
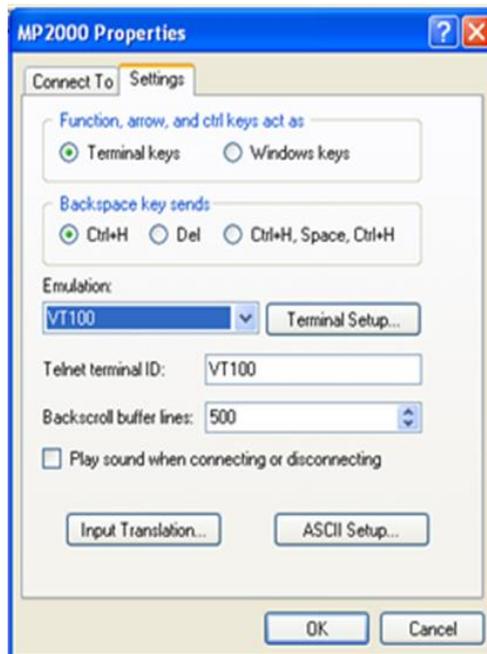
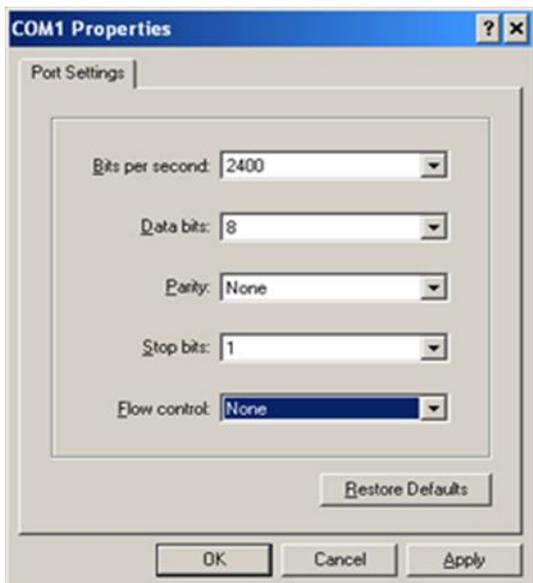


Properties Screen

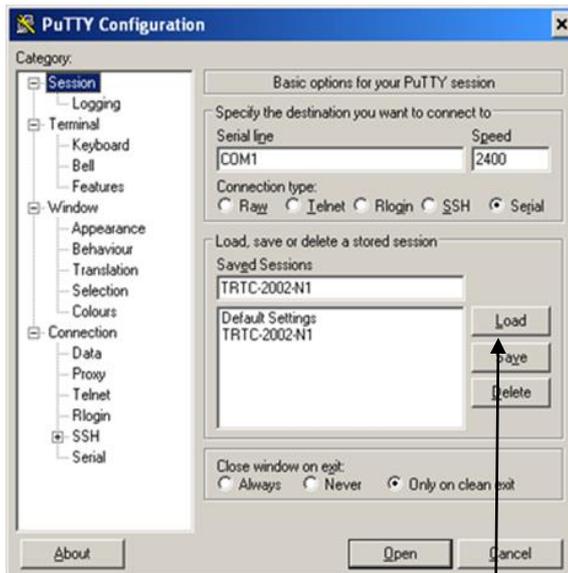
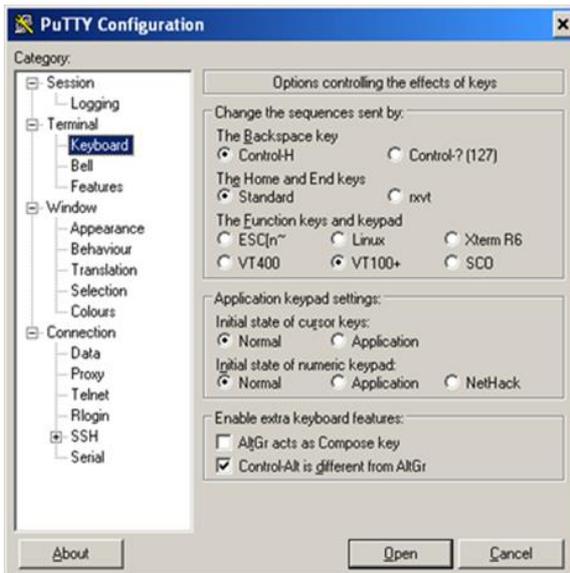
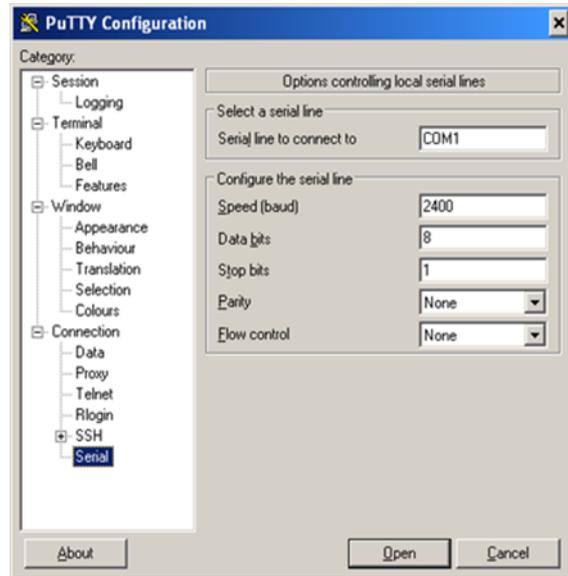
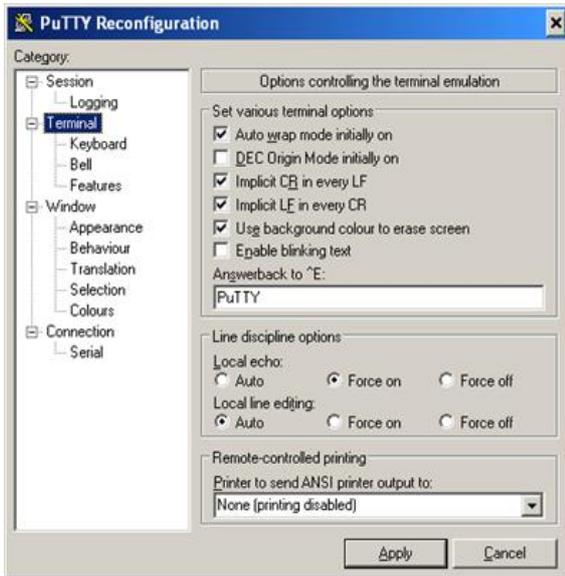


ASCII Setup Screen

❖ HyperTerminal at a Glance



❖ PuTTY at a Glance



Remember to return to the Session Panel and hit save, to save your settings.

❖ Step by Step Connecting With Windows XP

Before connecting to you SNMP card be sure you have one of the following.

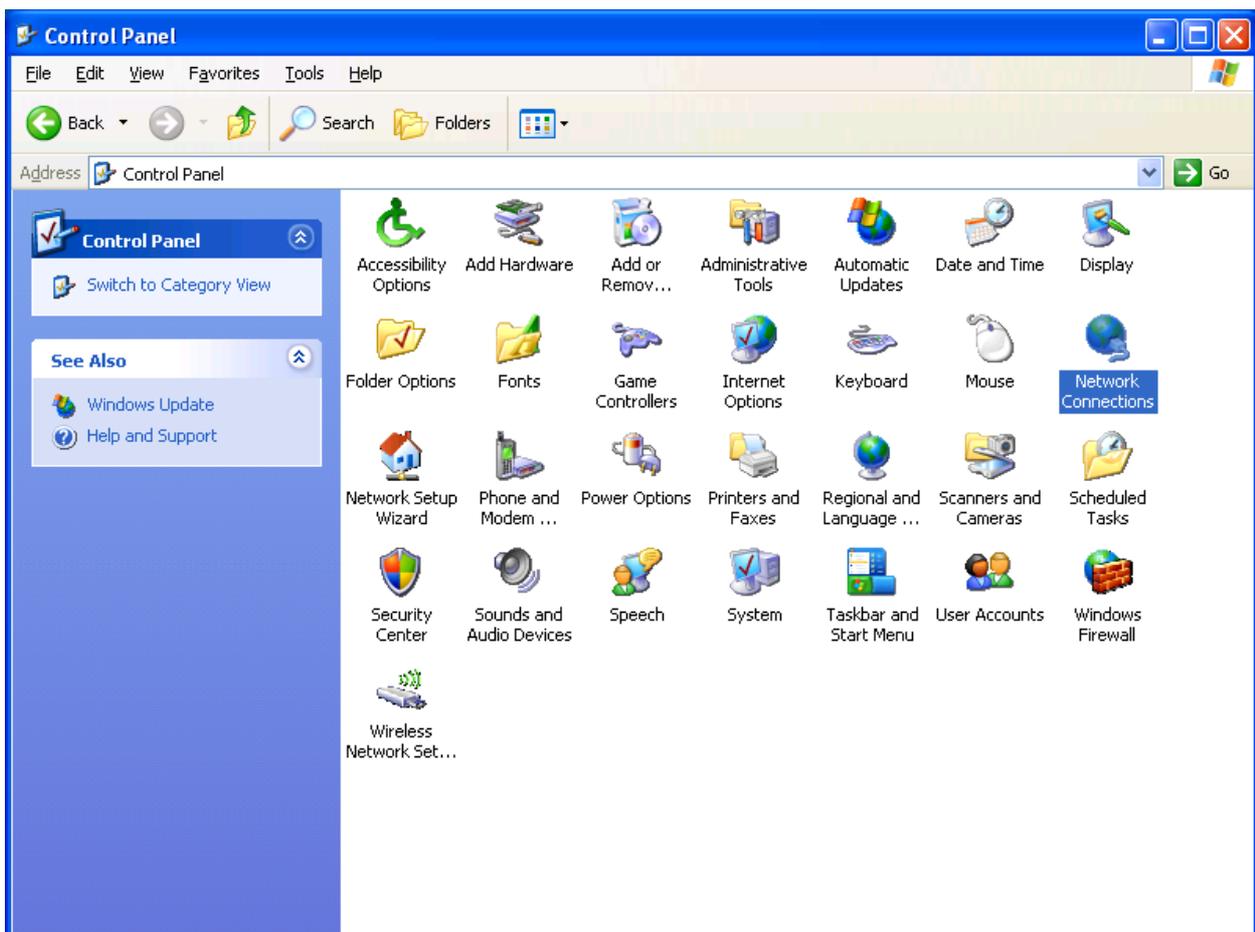
1. Ethernet crossover cable.
2. Or Switch or hub and two Ethernet straight through Ethernet cables.
3. Or Computer that has an AutoLink networking port.
(An AutoLink port will determine if you are connecting to a device that requires a crossover cable or a straight through cable and automatically transmit and receive using the correct connection.)



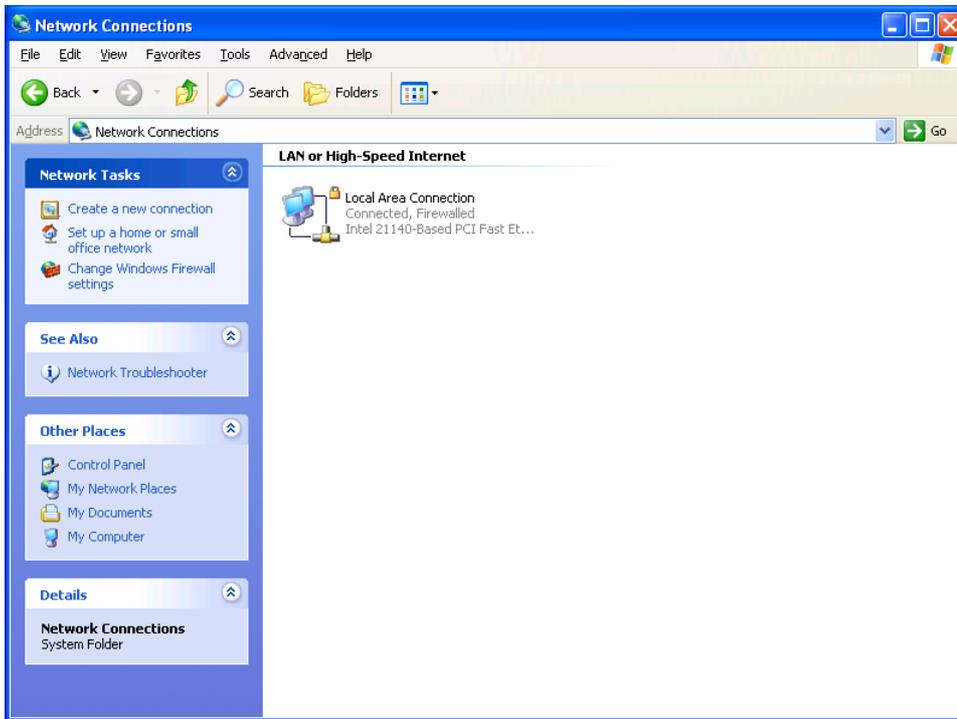
ATTENTION!

Record the settings that are already displayed before you change anything. Failure to return these setting back to “normal” could result in you not being able to connect to your usual network.

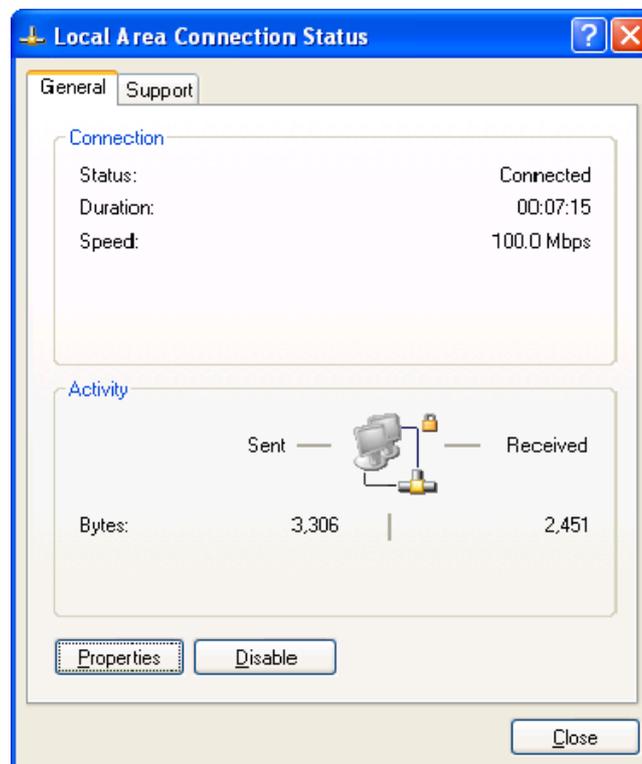
STEP 1: Go to the control Panel.



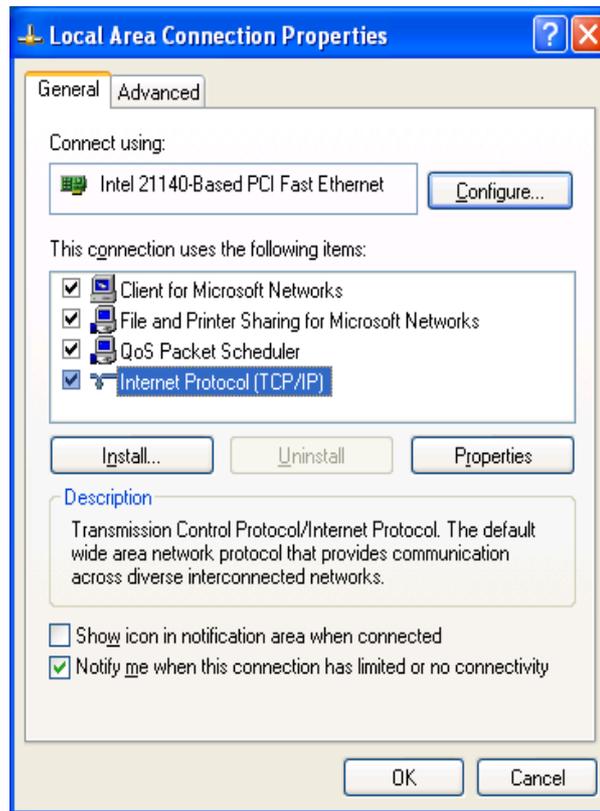
STEP 2: Double click on the Local Area Connection or Right click on the Local Area Connection that you are using to connect to the NetPower Card, click Properties.



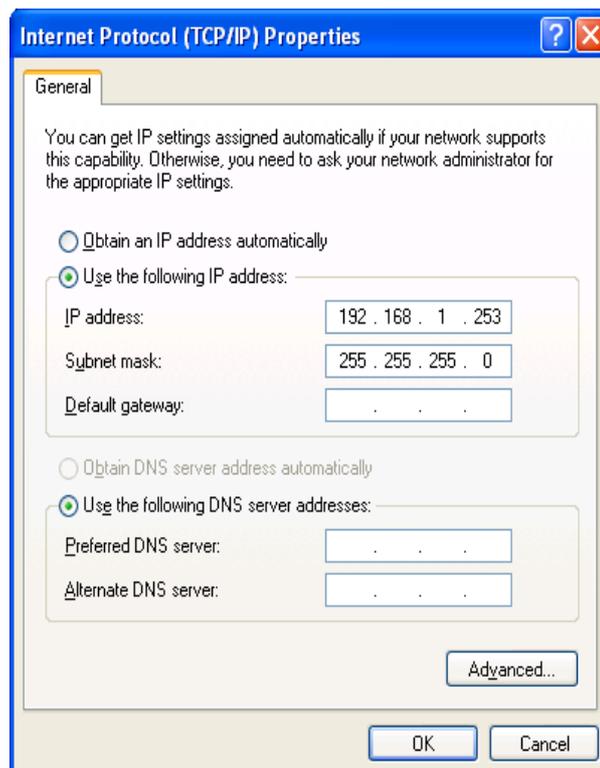
STEP 3: If you double clicked you will be presented with this screen, click on Properties.



STEP 4: After opening the properties dialog box, highlight Internet Protocol Version 4.



STEP 5: You will be presented with the dialog box below, enter the IP Address 192.168.1.253 with a subnet mask of 255.255.255.0, click Ok, Ok, then Close.



STEP 6: You should be back at Figure 1. Right click on Local Area Connection and click disable. Once it is disabled. Right click and enable this connection.

STEP 7: Now open a web browser and enter 192.168.1.51 into the address bar. If you are prompted for a username and password enter.

Enter Username: **admin** Password: **user**

STEP 8: Click on the Regular Interface link, then go to the System Tab / Network and enter the appropriate information in the fields provided.



ATTENTION!

Depending on the information changed on the System Tab / Network, you could lose your connection to the network interface card.

❖ Step by Step Connecting With Windows 7

Before connecting to you SNMP card be sure you have one of the following.

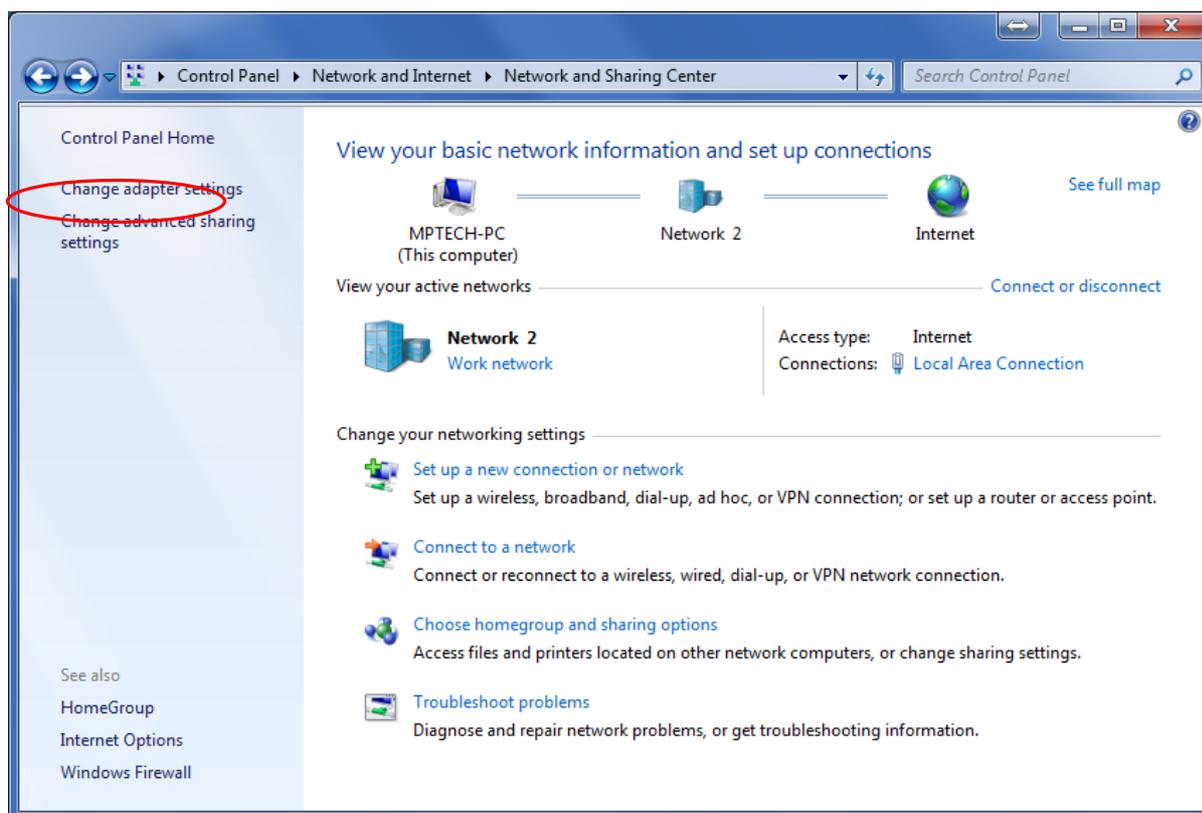
1. Ethernet crossover cable
2. or Switch or hub and two Ethernet straight through Ethernet cables.
3. or Computer that has an AutoLink networking port.
(An AutoLink port will determine if you are connecting to a device that requires a crossover cable or a straight through cable and automatically transmit and receive using the correct connection.)



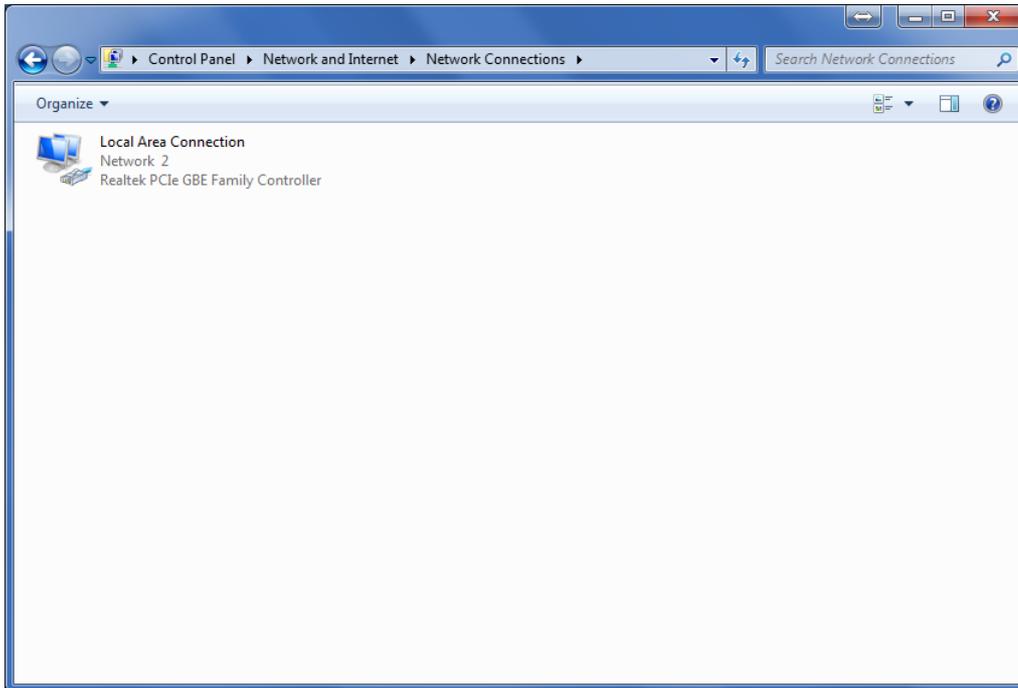
ATTENTION!

Record the settings that are already displayed before you change anything. Failure to return these setting back to “normal” could result in you not being able to connect to your usual network.

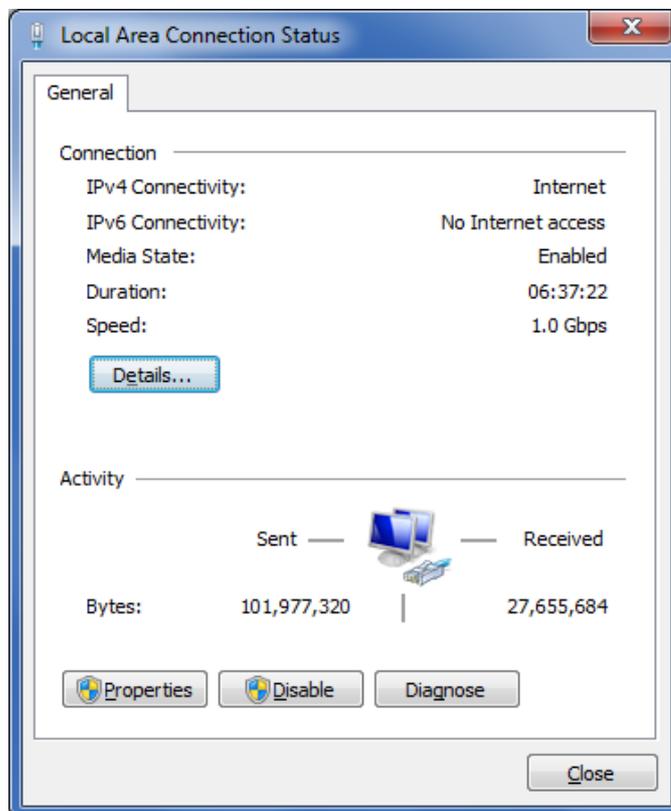
STEP 1: Go to the control Panel / Network and Internet / Network and Sharing Center. Click on Change Adapter Settings.



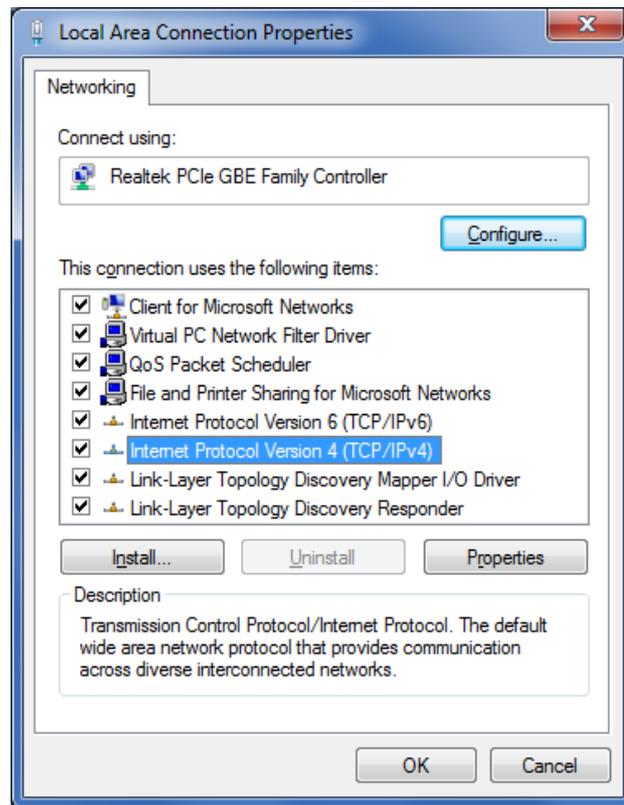
STEP 2: Double click on the Local Area Connection or Right click on the Local Area Connection that you are using to connect to the NetPower Card, click Properties.



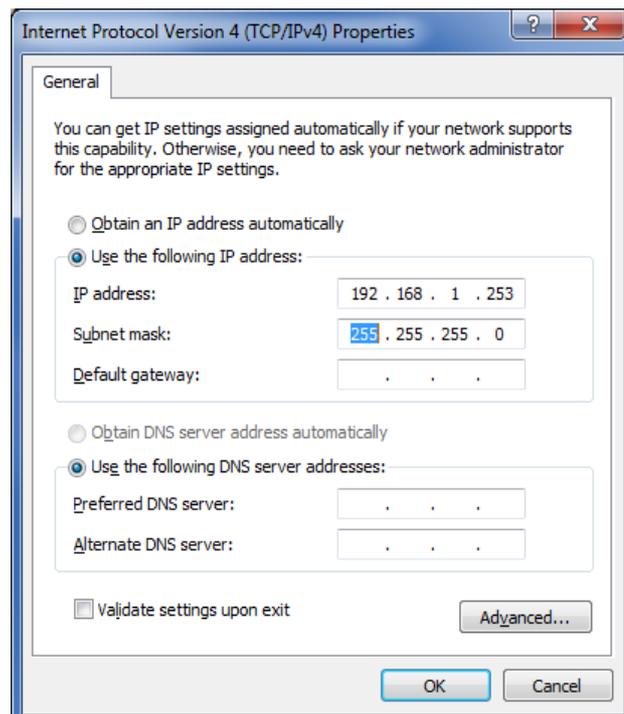
STEP 3: If you double clicked you will be presented with this screen, click on Properties.



STEP 4: After opening the properties dialog box, highlight Internet Protocol Version 4.



STEP 5: You will be presented with the dialog box below, enter the IP Address 192.168.1.253 with a subnet mask of 255.255.255.0, click Ok, Ok, Then Close.



STEP 6: You should be back at Figure 1. Right click on Local Area Connection and click disable. Once it is disabled. Right click and enable this connection.

STEP 7: Now open a web browser and enter 192.168.1.51 into the address bar.
If you are prompted for a username and password enter

Enter Username: **admin** Password: **user**

STEP 8: Using the Regular Interface and go to the System Tab / Network and enter the appropriate information in the fields provided.



ATTENTION!

Depending on the information changed on the System Tab / Network, you could lose your connection to the NetPower Card and may have to reconnect.

❖ TRTC-2002-N1 Return Instructions

Purpose: Describes how to return the TRTC-2002-N1 for repairs.



NOTE:

Manufacturer does not assume responsibility for damage caused by improper packaging of returned units. The TRTC-2002-N1 weighs approximately 46 lbs. and should only be shipped in a box or carton of sufficient thickness to withstand handling.

Before returning a UPS or any system component for repair or replacement, including batteries, a Return Material Authorization (RMA) number must be obtained from Customer service at the following Telephone / Address. Clearly write the RMA number on the original shipping container. If you do not have the original container, pack the unit with at least three inches of shock absorbing material, but do not use popcorn type material. Returns should be prepaid and insured (COD and freight collect cannot be accepted).

Contact Customer Service for ordering any parts or service.

For service, parts or technical information contact:

Marathon Power is available for customer service between 7:00am and 6:00pm PST, Monday-Friday and can be contacted as follows:

Phone: 310-689-2328

Fax: 310-689-2329

Email: support@marathon-power.com

Website: www.marathon-power.com

Address: 2538 E. 54th St., Huntington Park, CA 90255



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