PRICE: $25.00

OPERATING MANUAL
TNF/TNQ SERIES
HOT-SWAP POWER SYSTEM

www.unipowercorp.com

Manual No. TN-702-2
9/10/02 TNFTNQ-Man

UNIPOWER Corporation

UNIPOWER NORTH AMERICA • 3900 Coral Ridge Drive, Coral Springs, Florida 33065, UNITED STATES • Tel: 954-346-2442 • Fax: 954-340-7901 • sales@unipower-corp.com
UNIPOWER EUROPE • Parkland Business Centre, Chartwell Road, Lancing, BN15 8UE, ENGLAND • Tel: +44(0)1903 768200 • Fax: +44(0)1903 764540 • info@unipower-europe.com

CONTENTS

ILLUSTRATIONS

OPERATING MANUAL

TNF/TNQ SERIES HOT-SWAP POWER SYSTEM

1.0 INTRODUCTION

1.1 This operating manual should be read through carefully before installing and operating the TNF and TNQ Series hot-swap power systems.

1.2 The TNF Series is a multi-output, switching, hot-swap power system with AC input and N+1 redundancy. The TNQ Series is an identical system except that it has DC input. The systems consist of 400-watt hot-swap modules and a separately available 2U, 19-inch rack mount. See Figure 1.

1.3 A typical system consists of up to three hot-swap modules in the 19-inch rack mount. The modules have up to four outputs, built-in ORing diodes and individual fan cooling. The module outputs are connected in parallel in the rack mount. V1 has active current sharing circuitry while the other outputs use controlled-slope type current sharing.

1.4 Unless it is stated otherwise, this manual will assume that two or three modules are employed in a rack to give N+1 redundant operation. This means that one or two modules can supply the total load, and the extra module is redundant. In normal operation the modules share the load approximately equally; if one module fails, the other module(s) automatically pickup the load.

1.5 The TNF Series is the AC input version with power factor correction, 85-264VAC input range and Level B EMI input filter. The TNQ Series is the DC input version with 40-75VDC input range. Both versions have 14 standard modules to choose from. The hot-swap modules and rack incorporate high-reliability hot-swap connectors. The rack has four standard output interface options.

1.6 The TNF/TNQ Series has a number of imortant operating features such as modules with dual main outputs of 3.3 and 5VDC, input power good and output power good signals with LED indicators, remote inhibit, remote sense on V1 and V2, thermal protection, overvoltage protection on all outputs and power factor correction on the TNF Series.

Figure 1. TNF/TNQ Series Three-Module Power System in Rack Mount

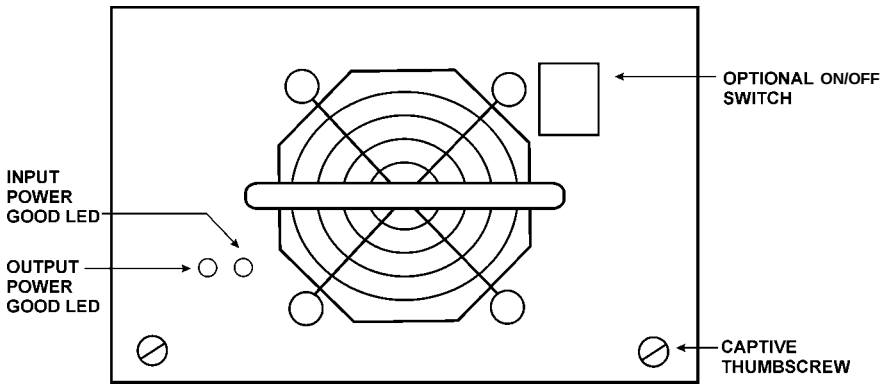


Figure 2. TNF/TNQ Series Hot-Swap Module Front Panel

2.0 FEATURES

The following is a summary of the important features of the TNF/TNQ Series modules:

- Tightly Regulated Output Voltage
- 400-Watt Modules
- Output Overload Protected
- Single- and Multi-Output Versions
- Low Profile: 2U(3.47 inches or 88.1mm) Height
- 0.99 Power Factor
- Class B EMI Input Filter
- Worldwide AC Input: 85-264 VAC at 47-63Hz
- Wide Range DC Input: 40-75VDC
- Remote Sensing on V1 & V2
- Active, Single-Wire Load Sharing
- Integral ORing Diodes
- Hot-Swappable Modules
- Front Panel Switch Option
- LED Operating Indicators
- Control and Monitoring Interface Signals
- 2U High, 19 -Inch Rack
- Rack Capacity Up to 3 Modules
- 1200W Redundant or 1800W Non-Redundant

3.0 PRODUCT LINE

3.1 Standard Hot-Swap Power Modules (Consult factory for non-standard configurations)

MAX. WATTS	V1 OUT	V2 OUT	V3 OUT	V4 OUT	MODEL NO. (AC)	MODEL NO. (DC)
SINGLE OUTPUT						
200	3.3V@60.0A				TNE9000	TNQE9000
300	5.0V@60.0A				TNE2000	TNQE2000
300	12.0V@25.0A				TNE3000	TNQF3000
350	24.0V@14.5A				TNE5000	TNQF5000
350	28.0V@12.5A				TNE6000	TNQF6000
400	48.0V@8.3A				TNE7000	TNQF7000
MULTI-OUTPUT						
400	3.3V@ 60.0A	5V @20A	12V @ 6A	12V @1.5A	TNF9233	TNQF9233
400	5V @ 60.0A	3.3V @20A	12V @ 6A	12V @1.5A	TNF2933	TNQF2933
400	5V @ 60.0A	12V @12.5A	12V @ 6A	-	TNF2330	TNQF2330
400	5V @ 60.0A	12V @12.5A	12V @ 6A	5V @1.5A	TNF2332	TNQF2332
400	5V @ 60.0A	12V @12.5A	12V @ 6A	24V @1.0A	TNF2335	TNQF2335
400	5V @ 60.0A	15V @10A	15V @ 6A	-	TNF2440	TNQF2440
400	5V @ 60.0A	15V @10A	15V @ 6A	5V @1.5A	TNF2442	TNQF2442
400	24V @ 12.5A	5V @20A	12V @ 6A	12V @1.5A	TNF5233	TNQF5233

Option S: Front-Panel On/Off Switch. Add "S" as suffix to the model number.

3.2 Racks

MODEL	INPUT	WIDTH	HEIGHT	NO. OF MODULES
TNR2U	AC	19”	2U, 3.47”	3
TNRQ2U	DC	19”	2U, 3.47”	3

3.3 System Rack Options

CODE	OUTPUT CONNECTIONS	
	V1 OUT	AUX. OUT (V2, V3, V4)
A	BUS BARS WITH 0.25” HOLES	J2, LMI 117108-1 0.25”TAB TERM. 8-POSITION
B	J1, POSITRONICS POWER-LOK, 24 PIN PLC24M3N0A1	J3, POSITRONICS POWER-LOK, 12 PIN PLC12M3N0A1

NOTE: Add Option Suffix Code to Rack Model No.

4.0 SAFETY WARNINGS

4.1 This switching power system has hazardous external and internal voltages. It should be handled, tested and installed only by qualified technical persons who are trained in the use of power systems and are well aware of the hazards involved.

4.2 The input terminals are at hazardous voltage potentials. Do not touch this area when power is applied.

4.3 When operating this power system, the input ground terminal must be connected to safety ground to minimize electrical shock hazard and to ensure low EMI (electromagnetic interference).

4.4 The internal voltages are at hazardous potentials. The module covers should not be removed. There are no user-serviceable components in these units. Removing the covers of the modules will void the warranty.

5.0 WARRANTY

All products of UNIPOWER Corporation are warranted for two (2) years from date of shipment against defects in material and workmanship. This warranty does not extend to products which have been opened, altered or repaired by persons other than persons authorized by the manufacturer or to products which become defective due to acts of God, negligence or the failure of customer to fully follow instructions with respect to installation, application or maintenance. This warranty is extended directly by the manufacturer to the buyer and is the sole warranty appli-

cable. EXCEPT FOR THE FOREGOING EXPRESS WARRANTY, THE MANUFACTURER MAKES NO WARRANTY, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. As the sole and exclusive remedy under this warranty, the manufacturer, at its option, may repair or replace the non-conforming product or issue credit, provided the manufacturer's inspection establishes the existence of a defect. To exercise this remedy, the buyer must contact the manufacturer's Customer Service Department to obtain a Return Material Authorization number and shipping instructions. Products returned without prior authorization will be returned to buyer. All products returned for repair must be shipped freight prepaid to UNIPOWER. If the buyer fails to fully comply with the foregoing, the buyer agrees that no other remedy (including, but not limited to, incidental or consequential damages for lost profits, lost sales, injury to person or property or any other incidental or consequential losses) shall be available to the buyer.

6.0 UNPACKING AND INSPECTION

6.1 This TNF or TNQ Series Power System was carefully tested, inspected and packaged for shipment from our factory. Upon receipt of the unit it should be carefully unpacked and inspected for any damage in shipment.

6.2 If there is evidence of damage, **do not** attempt to test the unit. The freight carrier should be notified immediately and a claim for the cost of the rectifier system should be filed with the carrier for direct reimbursement. Be sure to include the model and serial number of the damaged unit in all correspondence with the freight carrier. Also save the shipping carton and packing material as evidence of damage for the freight carrier's inspection.

6.3 UNIPOWER Corporation will cooperate fully in case of any shipping damage investigation.

6.4 Always save the packing materials for later use in shipping the unit. Never ship the rectifier system without proper packing.

7.0 DESCRIPTION OF OPERATION

7.1 **Outputs.** The TNF/TNQ Series hot-swap power modules use dual PWM converters, one for V1 and the other for V2, V3 and V4. Switching is done by MOSFET switches operating at 100kHz. All outputs are fully isolated, and each output has a series isolation diode.

7.2 **Parallel Operation.** In this mode the outputs of all modules are connected in parallel. The connection is done by the rack mount. A typical configuration is two or three modules in a rack mount to give either N+1 redundant operation or non-redundant operation.

7.3 Inputs. As described earlier, the input is either 85-264VAC for the TNF Series or 40-75VDC for the TNQ Series. Each module incorporates an input EMI filter to supress line noise and high-frequency transients from the input line to the module and from the module to the input line. For the TNF Series the input filter meets EN55022 Curve B and FCC20780 pt. 15J Curve B for conducted emissions. The input is also power factor corrected with harmonic input currents meeting EN61000-3-2. The inputs, both AC and DC, are also fuse protected. There is an optional front panel switch to control the input.

7.4 Control & Supervisory Signals. Each hot-swap power module incorporates a number of control and supervisory signals including inhibit, input power good, output power good, current share (V1) and remote sense (V1 & V2). These control signals are also brought out for each module at the rear of the 19-inch rack mount.

7.5 Module Keying. The AC (TNF Series) and DC (TNQ Series) input modules are each keyed for both the module and the rack mount so that the wrong module cannot be accidentally plugged in.

8.0 FRONT AND REAR PANEL DESCRIPTION

8.1 The front panel of a TNF/TNQ Series module is shown in Figure 2. The front, back and top views of the 400-Watt, hot-swap modules are shown in Figure 3. All input, output, and control and supervisory signals are brought out to a high-reliability, hot-swap connector which is shown in the back view. On the front panel are two green indicator LEDs, one for input power good and the other for output power good. Also shown on the front panel is the optional ON/OFF switch. Each module is individually fan cooled.

8.2 Figure 4 shows the mating 19-inch rack mount with three hot-swap modules. The rack is 2U (3.47 inches) high and 16.1 inches deep. The modules are secured in the rack by two captive thumbscrews on each module. All connections to the rack are made at the rear with connectors and bus bars on the back of the circuit board. The main output (V1) connection is made to bus bars with 0.25-inch holes or alternatively to a Positronics 24-pin connector.

8.3 Blank panels are available for slots not used by a module.

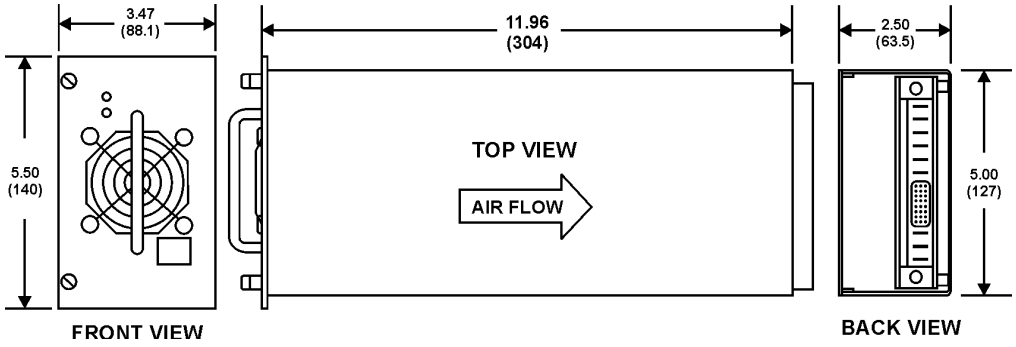


Figure 3. Views of Hot-Swap, 400-Watt Module

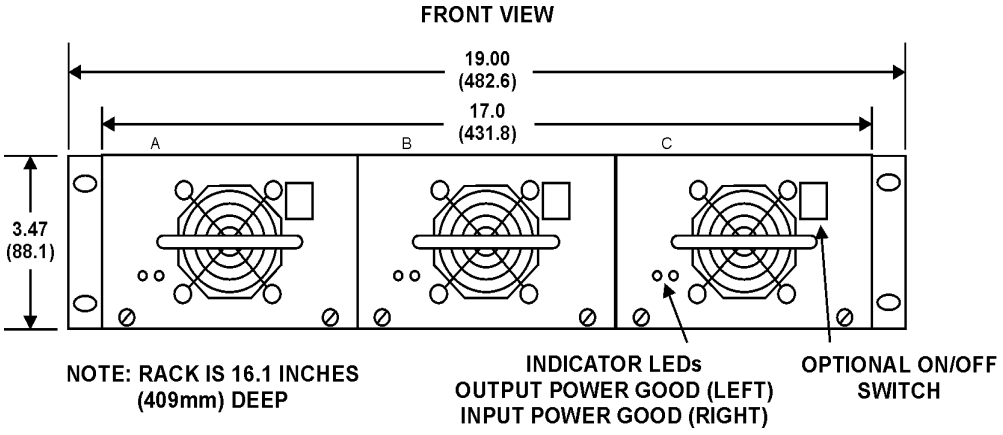


Figure 4. Front View of Mating 19-Inch Rack

9.0 HOT-SWAP MODULE SPECIFICATIONS

Typical at nominal 120/230VAC Line or 48VDC Full Load and 25°C Unless Otherwise Noted.

OUTPUT SPECIFICATIONS

Total Output Power, Max. ..... 400 watts
Voltage Adjust. Range, V1, V2 & V3 ..... ±10%
V4 ..... ±5%
Factory Set Tolerance ..... ±0.5%
Line Regulation[1] 0.2%
Load Regulation[1],V1 ..... 0.2%
V2 ..... 2.0%
V3 & V4 ..... 3.0%
Ripple & Noise[2], P-P. ..... 1% or 100mV
Hold-Up Time [3]. 20mS
Dynamic Response[4]. 300µS
Temperature Coefficient. ..... ±0.02%/°C
Minimum Load, All Outputs[5] 0A
Overload Protection. ..... Foldback Current Limiting
Overvoltage Protection ..... Power Shutdown
Remote Sense[6], V1 & V2 ..... Up to 0.25V Per Wire

INPUT SPECIFICATIONS

AC Input (TNF Series)

Input Voltage Range 85-264VAC
Power Factor 0.99
Harmonic Distortion ..... Meets EN61000-3-2
Inrush Limiting, Cold Start ..... 60A Peak
Input Frequency 47-63Hz
Input Current, Full Load 5.2A, 120VAC
..... 2.7A, 230VAC
EMI Input Filter, Conducted ..... EN55022 Curve B
FCC20780 pt. 15J Curve B
Input Immunity, Conducted
Fast Transients, Line-Line ..... ±2kV (EN61000-4-4 Level 3)
Surges, Line-Line ..... ±1kV (EN61000-4-5 Level 2)
Surges, Line-Ground ..... ±2kV (EN61000-4-5 Level 3)
Input Protection ..... Internal Fuse, 15A

DC Input (TNQ Series)

Input Voltage Range	40 to 75VDC
Input Current, Full Load, 48VDC	12.8A
EMI Input Filter	Standard
Inrush Limiting, Cold Start	60A Peak
Input Protection	Internal 20A Fuse
Immunity, Conducted	
Fast Transients, Line-Line	±2kV (EN61000-4-4 Level 3)
Surges, Line-Line	±1kV (EN61000-4-5 Level 2)
Surges, Line-Ground	±2kV (EN61000-4-5 Level 3)
Input Protection, TNQ Series	Internal Fuse, 20A

GENERAL SPECIFICATIONS

Efficiency	70% to 75%
Switching Frequency	100kHz Nominal
Isolation, class I [7], min.	>3000VAC Input - Output
	>1500VAC Input - Ground
	>50VDC Output - Ground
Safety Standards	EN60950, UL1950, CSA22.2-950

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature	0°C to 70°C Ambient
Derating	2.5% / °C, 50°C to 70°C
Storage Temperature	-40°C to +85°C
Cooling	Integral Ball Bearing Fan

PHYSICAL SPECIFICATIONS

Case Material	Aluminum
Dimensions, Inches (mm)	
Hot-Swap Module	3.47 H x 5.50 W x 11.96 D (88.1 x 140 x 304)
3-Module Rack	3.47 H x 17.00 W x 16.10D (88.1 x 432 x 409)

NOTES:

1. No Load to full load, including line regulation and load regulation.
2. Whichever is greater. 20MHz bandwidth. Measured with 0.1µF ceramic and 10µF tantalum capacitors in parallel across the output.
3. V1 on TNF Series only at 400W output power at nominal line.
4. <4% deviation recovering to within 1% for 25% load change.
5. For V2 on TNQ Series minimum load is 5%.
6. V1 only only on TNQ Series.
7. Input - output isolation figure is for isolation components only. 100% production Hipot tested.

10.0 DESCRIPTION OF FEATURES & OPTIONS

These descriptions refer to each hot-swap module.

FEATURE / OPTION	DESCRIPTION
Power Factor Correction	For AC input models (TNF Series) the input is power factor corrected to 0.99 typical. Input harmonic currents meet EN61000-3-2.
Universal Input	AC input for TNF Series is wide-range, 85-264VAC, 47-63Hz for worldwide operation.
Wide Range DC Input	The DC input for TNQ Series is wide-range 40-75VDC.
EMI Input Filter	For AC input TNF Series, the input filter suppresses conducted noise on the AC line. The filter meets EN55022 curve and FCC20780 pt. 15J Curve B.
Thermal Protection	Each hot-swap module latches off when the internal temperature reaches an excessive value. The module must be reset by cycling the input off and then on.
Isolated Outputs	All DC outputs are floating and isolated from all other outputs. They can be connected as + or - outputs with respect to common.
Inrush Current Limiting	The inrush current is limited to 60A maximum when the module is first turned on from a cold start.
Output Current Limiting	Foldback current limiting protects each output of a module from damage due to overload or short circuit conditions. This protection is continuous, without damage, and recovery is automatic when the overload is removed.
Current Sharing	The main output V1 has active current sharing which keeps the worst-case current sharing error between paralleled modules at 10% of a module's rated output current. The other outputs, V2, V3 & V4, use controlled-slope current sharing. When the modules are in a rack, all outputs are automatically connected in parallel.
Integral Isolation Diodes	All TNF and TNQ Series hot-swap modules have a built-in series isolation diode on each output to prevent a faulty output from affecting another paralleled output.
Overvoltage Protection	All outputs are protected from fault conditions in the module. OVP operates at 115% to 135% of the nominal output voltage. The module shuts down. The outputs are reset by cycling the AC input off and then on.

FEATURE / OPTION	DESCRIPTION
No Load Operation	All outputs can be operated down to zero load current except for the V2 output on DC input modules (TNQ Series) which requires a 5% minimum load.
High-Reliability Connectors	The TNF/TNQ Series uses connectors specifically designed for hot-swap applications. When a module is inserted into the rack, the ground pin makes first contact. This followed by all input and output power connections together with the control and supervisory signals. The last pin to make contact is the interlock pin, which then turns on the module.
LED Indicators	Each module has two green LED indicators. The left one is on when output power is OK; the right one is on when input power is OK.
Front Panel Switch (Option S)	This optional on/off switch lets the user control the turn-on of the inserted module.

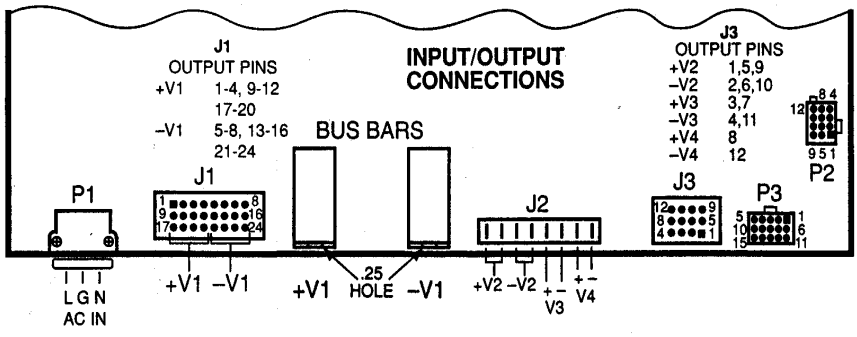
11.0 OPERATING INFORMATION

11.1 Input Voltage. The TNF/TNQ Series modules operate off worldwide AC input voltages in the range of 85 to 264 VAC at 47 to 63 Hz. Connections for line, neutral and ground are made to a standard IEC320 AC receptacle, P1. See Fig. 5a. The TNQ Series modules operate off a DC input voltage in the range 40 to 75VDC. Connections for +V, -V and ground are shown in Fig. 5b.

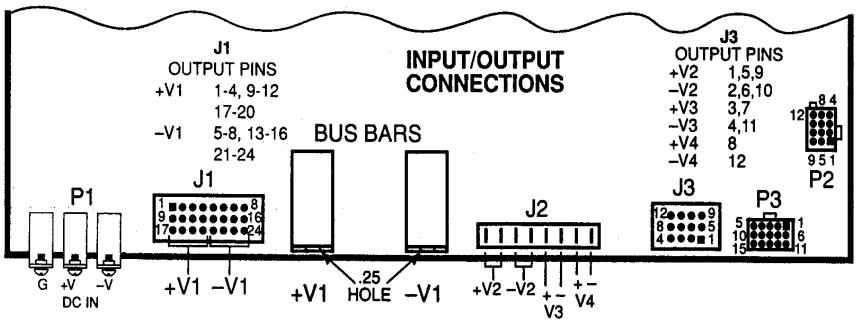
11.2 Outputs. The main output (V1) power connections are made to two bus bars which have 0.25 inch holes for bolting the connection on. See Fig. 5a or b. The left bus bar is positive and the right one negative. An alternative V1 output connection is to J1 where paralleled pins on the left side of the connector are for +V1 and on the right side for -V1. The desired V1 output connections are chosen at time of ordering.

The auxiliary outputs V2, V3 and V4 can be made available either at J2, an LMI connector, or J3, a Positronics connector. See Fig 5. Pins are paralleled according to the level of output current.

The connecting wires for all outputs should be sized to carry the rated output current plus 30%. Connecting lugs to the bus bar (V1) must be clean and securely connected to the terminals to reduce contact resistance. All outputs should have a 0.1uF ceramic capicitor and 10uF electrolytic capacitor in parallel across each output at the connection point or point of load to prevent noise pickup.



a) AC Input TNF Series



b) DC Input TNQ Series

Figure 5. Top, Rear View of Rack Showing Connections

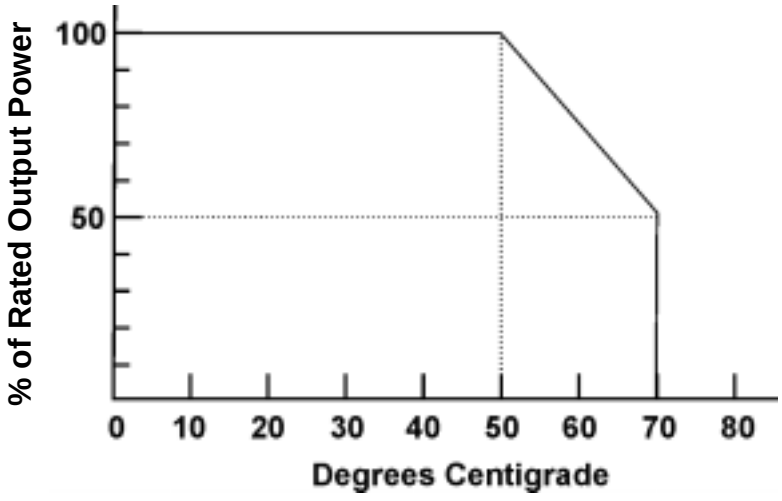


Figure 6. Rated Output Power vs. Ambient Temperature

11.3 Output Power. The TNF/TNQ Series hot-swap power modules have a maximum output power rating of 400 watts per module. Although the power ratings of all the outputs, when added up, may exceed this value, the maximum continuous total output power must not exceed 400 watts.

The maximum output power of a module may be drawn at up to 50^0C ambient temperature. Above 50^0C the output power must be derated by 2.5%/^{0}C. See Fig. 6. The maximum operating temperature is 70^0C, at which the output power must be derated to 50%.

11.4 Remote Sensing. Remote sensing connections for V1 and V2 are made to pins 14 & 22 and 13 & 21 respectively on J1, the module hot-swap connector. On the rack connector P3 they appear on pins 13 & 14 and 11 & 12 repectively. DC input versions (TNQ Series) do not have remote sensing on V2.

Remote sensing is used on high current outputs to regulate the output voltage at the point of load. The +Sense is connected to the +output at the load and the -Sense to the -output at the load. The sense leads should be a twisted pair to minimize noise pickup. The module outputs can compensate for a total voltage drop in the power leads up to 0.5V, or 0.25V in each lead. Sense leads can be no. 22 or 24 AWG wire but should not exceed 10 feet (3 meters) in length. If remote sensing is not required, the sense leads should be connected directly to the respective DC output terminals.

11.5 Control & Supervisory Signals. All control and supervisory signals are accessible at the signal part (pins 1-24) of the J1 hot-swap connector of the module. These signals also appear at P3 of the mating rack. Some signals are control inputs and others are monitoring outputs. The inputs and outputs that are used must have external 0.1uF ceramic capacitors across them to prevent noise pickup. For a description of each function see Section 13, “Description of Control and Supervisory Signals.” For pin connections see Section 12, “Input, Output and Control & Supervisory Signal Connections.”

11.6 Output Voltage Adjustments. The main output voltage (V1) and the auxiliary output voltages (V2, V3, V4) are independently adjustable by means of potentiometers accesible on the right side of each module. See Fig. 7. V1, V2 and V3 have an adjustment range of ±10% and V4 has an adjustment range of ±5%. When adjusting output voltages at the output terminals to values higher than nominal, it must be remembered that this

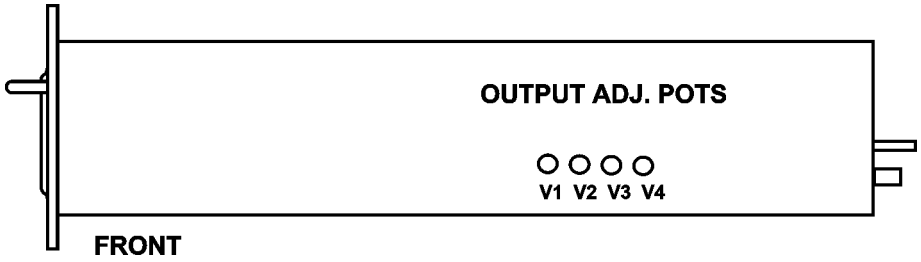


Figure 7. Output Voltage Adjustment Potentiometers

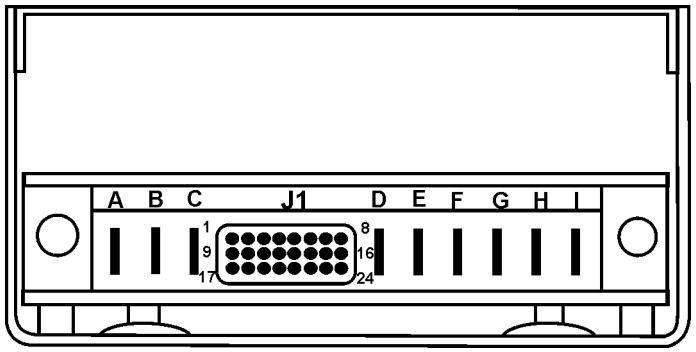


Figure 8. Module Rear View Showing Hot-Swap Connector

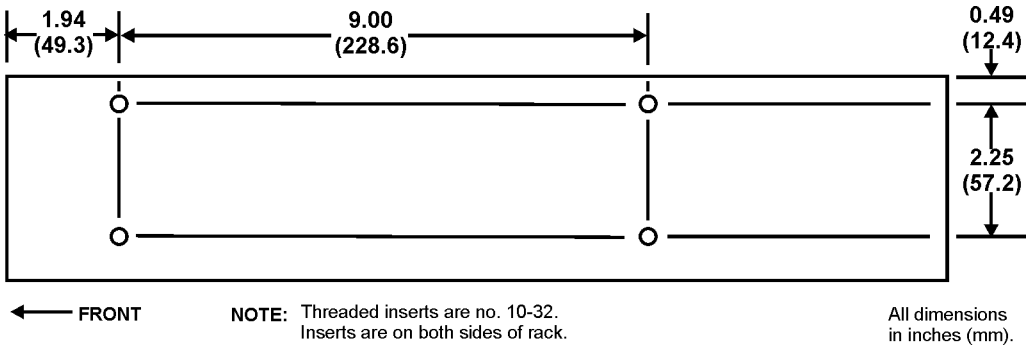


Figure 9. Rack Side View Showing Mounting Holes

increases the output power, and the total maximum output power of each output and of the total module must not be exceeded.

11.7 LED Indicators. Two green LED indicators are located on the front panel of each hot-swap module. See Fig. 2. When the left one is on, it indicates that all DC outputs are functioning. When the right one is on, it indicates that input power is within specified range.

12.0 INPUT, OUTPUT, CONTROL & SUPERVISORY SIGNAL CONNECTIONS

Pin connections for the input, outputs and control & supervisory signals are shown in the following tables.

12.1 Module Connections. Connections to a hot-swap module are made to J1, an ELCON FLATPAQ high-reliability connector. See Fig. 8.

MODULE J1 POWER CONNECTIONS

TERM.	FUNCTION	TERM.	FUNCTION
A	Frame Gnd	F	+V1 Out
B	AC Neut./+VDC	G	+V1 Out
C	AC Line / -VDC	H	-V1 Out
D	+V2 Out	I	-V1 Out
E	-V2 Out		

MODULE J1 CONTROL & SUPERVISORY SIGNAL CONNECTIONS

PIN	FUNCTION	PIN	FUNCTION	PIN	FUNCTION
1	Interlock	8	-V3 Out	16	-V3 Out
3	Inhibit	9	- Sense (V1)	20	Curent Share
4	Output Power Good	12	Input Power Good	21	+Sense (V2)
5	+V4 Out	13	- Sense (V2)	22	+ Sense (V1)
6	-V4 Out	14	- Sense (V1)	23	+V3 Out
7	+V3 Out	15	+V3 Out	24	-V3 Out

NOTE: All other pins are No Connection

J1 Connector: ELCON FLATPAQ No. 279-0320-0010
Mating Receptacle: No. 279-0320-00200
Module Evaluation Connector Kit: Kit No. 775-1419-0000
(Order from UNIPOWER Corporation, $95.00 each)

12.2 Rack Mount Connections. See Fig 5. The AC input connector, P1, is a standard IEC320 connector for the TNF Series. Line, ground and neutral connections are shown in Fig. 5a. For the TNQ Series, the DC input is made to three bus bars. Ground, +V and -V connections are shown in Fig. 5b.

For the V1 output there is a choice of two bus bars with 0.25-inch holes as shown in Fig 5., or J1, a Positronics POWER-LOK, 24-pin connector No. PLC24M3N0A1. (Mating connector is a PLC24F0000 housing with FC112N2 pins). The connection choice must be made when ordering. Connections to J1 are shown in Fig. 5. Multiple paralleled pins are used to carry the high output current.

RACK J1: V1 OUTPUT CONNECTIONS

PIN	OUTPUT	PIN	OUTPUT	PIN	OUTPUT
1	+V1	9	+V1	17	+V1
2	+V1	10	+V1	18	+V1
3	+V1	11	+V1	19	+V1
4	+V1	12	+V1	20	+V1
5	-V1	13	-V1	21	-V1
6	-V1	14	-V1	22	-V1
7	-V1	15	-V1	23	-V1
8	-V1	16	-V1	24	-V1

For V2, V3 and V4 outputs there is a choice of J2 connector, an LMI No. 117108-01 with eight 0.25-inch tab terminals (mates are fast-on connectors) or J3 connector, a Positronics POWER-LOK, 12-pin connector No. PLC12M3N0A1 (mate is PLC12F0000 housing with FC112N2 pins). The connections to J2 are shown in Fig. 5. Connections to J3 are shown in Fig. 5 and are as follows:

RACK J3: V2, V3 & V4 OUTPUT CONNECTIONS

PIN	OUTPUT	PIN	OUTPUT	PIN	OUTPUT
1	+V2	5	+V2	9	+V2
2	-V2	6	-V2	10	-V2
3	+V3	7	+V3	11	-V3
4	-V3	8	+V4	12	-V4

12.3 Control & Supervisory Signal Connections. These connections are made to P3. P3 is an AMP Mini MATE-N-LOK No. 770190-1 (mate is 172171-1 housing with 170366-1 pins). Pin connections are as follows:

RACK MOUNT P3: CONTROL & SUPERVISORY SIGNALS

PIN	FUNCTION	PIN	FUNCTION	PIN	FUNCTION
1	Input Power Good-C	6	Output Power Good-B	11	- Sense (V2)
2	Input Power Good-B	7	Output Power Good-A	12	+ Sense (V2)
3	Input Power Good-A	8	Inhibit-C	13	- Sense (V1)
4	V1 Current Share	9	Inhibit-B	14	+ Sense (V1)
5	Output Power Good-C	10	Inhibit-A	15	NC

NC = No Connection

NOTE: A, B and C refer to the module position from left to right, viewed from the front of the rack.

Rack System Interconnect Kit. This kit contains the mating connectors for J1, J2, J3 and P3 and is identical for either TNF or TNQ rack. Order Kit no. 775-1420-0000 from UNIPOWER Corporation

13.0 DESCRIPTION OF CONTROL AND SUPERVISORY SIGNALS

13.1 P3 Rack Connector Functions

SIGNAL	PINS	DESCRIPTION
Input Power Good - C	1	A TTL LO (sinks 8mA) occurs when the input voltage. (AC or DC) falls a preset amount below the low input voltage specification. A TTL HI is normal. For AC input the LO signal occurs at least 5msec. before the output voltages drop out of regulation. This signal is referenced to V1 -Sense. This signal is from Module C, the rightmost module of the three in the rack. See Fig. 4. This signal appears on Pin 12 of J1 on each module.
Input Power Good - B	2	Same description as Pin 1. This signal is from Module B, the center module in the rack.
Input Power Good - A	3	Same description as Pin 1. This signal is from Module A, the left-most module in the rack.
V1 Current Share	4	This connection, which goes to all three hot-swap modules on J1 Pin 20, control the active current sharing of the V1 output among the three modules. Current share error between any two modules is less than 10% of a module's rated output current. The external connection of this pin is for current sharing of additional modules with the three in the rack. Check with the factory for further information on this.

SIGNAL	PINS	DESCRIPTION
Output Power Good - C	5	A TTL LO (sinks 10mA) occurs when an output drops 10% to 20% from its nominal voltage. A TTL HI (sources 0.4mA) is normal. This output is for Module C, the rightmost module in the rack. See Fig. 4. This signal appears on Pin 4 of J1 on each module.
Output Power Good - B	6	Same description as Pin 5. This signal is from Module B, the center module in the rack.
Output Power Good - A	7	Same description as Pin 5. This signal is from Module A, the left most module in the rack.
Inhibit - C	8	A TTL LO (sinks 1mA) at this input inhibits (turns off) all outputs of the module. A TTL HI (sourcing 0mA), or open, turns on all module outputs. This control pin is to Module C, the rightmost module in the rack. See Fig. 4. This control appears on Pin 3 of J1 on each module.
Inhibit - B	9	Same description as Pin 8. This signal is from Module B, the center module in the rack.
Inhibit - A	10	Same description as Pin 8. This signal is from Module A, the left-most module in the rack.
- Sense (V2)	11	This remote sense lead should be connected to its corresponding -V2 output at the load point by means of a twisted pair with the V2 +Sense lead. For a full description of remote sensing, see Section 11.4. This connection appears on Pin 13 of J1 on each module. There is no V2 Sense on the TNQ Series.
+ Sense (V2)	12	This remote sense lead should be connected to its corresponding +V2 output at the load point by means of a twisted pair with the V2 -Sense lead. This connection appears on Pin 21 of J1 on each module. There is no V2 Sense on the TNQ Series.
- Sense (V1)	13	Same description as Pin 11 except that the connection is to -V1. The V1 - Sense lead is the reference connection for all the Control and Supervisory Signals. Pins 1 through 10 use this as the refer-ence connection. This connection appears on Pin 14 of J1 on each module.
+ Sense (V1)	14	Same description as Pin 12 except that the connection is to +V1. This connection appears on Pin 22 of J1 on each module.
N.C.	15	There is no connection to this pin.

14.0 PARALLEL AND REDUNDANT OPERATION

14.1 The TNF/TNQ Series is designed to operate in two basic configurations:

- N+1 redundant operation
- Non-redundant operation

These configurations are described below.

14.2 N+1 Redundant Operation. If three hot-swap modules are in the rack mount connected in parallel, N+1 redundant operation means a 2+1 configuration. Two power modules must be able to carry the full load within their maximum output capability. The third module is redundant. During normal operation the load currents are shared approximately equally among the three power modules by means of active current sharing circuitry for V1 and by means of controlled slope current sharing for V2, V3 and V4. If one of the hot-swap power modules fails, the load currents are automatically picked up by the other two. Since the system is hot-swap, the failed module can be pulled out of the rack and replaced by a good module without disturbing the loads. The TNF or TNQ Series can supply up to 800 watts output power in the 2+1 configuration.

N+1 redundant operation with quick replacement of a failed module gives virtually infinite MTBF for the power system. Such power systems are used in mission-critical electronic systems where system downtime cannot be tolerated.

14.3 Non-Redundant Operation. In non-redundant operation the modules operate with outputs in parallel, just as in the case of N+1 redundant operation. In this case, however, the full output power of the modules is used to power the load. If one of the modules fails, the outputs of the other(s) will go into current limit because they cannot carry the full load. The faulty module must be replaced to restore power to the loads. The TNF or TNQ Series can supply up to 1200 watts (with three modules) output power in non-redundant operation.

For electornic systems that can tolerate a short downtime, non-redundant operation is a useful way to go. The Output Power Good signal can be used to trigger an alarm which alerts an operator that a module needs to be replaced. By stocking replacement modules, system downtime can be kept very short.

14.4 Details of Parallel Operation. By using the mating rack mount, all three (or two) modules have their outputs automatically connected in parallel with current sharing, inside the rack.

14.5 Remote Sensing. For proper operation of the paralleled outputs, all remote sensing leads for each of the like-paralleled outputs must be connected together. This is done internally in the TNF/TNQ Series rack mount so that just one set of sense leads is available for each output. Each set of sense leads, +Sense and -Sense, should be twisted together to minimize noise pickup.

14.6 Control and Supervisory Signals. The following P3 connections are brought out separately for each module at the rack connector: Input Power Good, Output Power Good and Inhibit.

Input Power Good. (P3, Pins 1, 2 & 3). These pins can be connected together so that a single power fail warning occurs, since this will affect all three modules.

Output Power Good. (P3, Pins 5, 6 & 7). Although these pins may be connected to give a single warning signal, they are normally used separately to indicate which module has failed and must be replaced. The TTL LO signal indicates thermal shut-down of a module or an otherwise faulty output.

Inhibit (P3, Pins 8, 9 & 10). This function can be used to control the outputs of all three modules simultaneously (by connecting all three together) or each one separately. This and the above two controls are referenced to P3 Pin 13, V1 -Sense.

LED Indicators. Each module front panel has two LED indicators, the left one for Output Power Good and the right one for Input Power Good. The LEDs are green when both conditions are normal. If both LEDs are off, there is an input power failure; if only the left indicator is off, the module output has failed.

15.0 INSTALLATION

15.1 Mounting. See Figure 4. The TNF/TNQ Series rack mount may be mounted by means of the mounting brackets which each have two 0.406 x 0.278 inch mounting holes vertically spaced by 3.00 inches. The system

mounts in a standard 19-inch rack. One set of brackets (2) is supplied with each TNF or TNQ Series rack. Alternatively the system may be side-mounted using the four no. 10-32 PEM nuts on both sides of the rack. See Fig. 9.

15.2 Cooling. Each TNF/TNQ hot-swap module is cooled by its own internal DC ball-bearing fan. To insure proper cooling there must be a minimum clearance of one-inch (25mm) between the front of the fan and any other surfaces. Normal air flow is from the front of the module (fan-end) to the rear.

15.3 Input Connections. The AC input connection for the TNF Series is made to P1, a standard IEC320 connector. See Figure 5a. A three-wire line and plug must be used with proper connection made to line, neutral and safety ground. Proper line cord wire size must be used: No. 12 AWG is recommended.

DC input connections for the TNQ Series are made to three bus bars as shown in Fig 5b. The threaded bolts are no. 6-32. Proper connection should be made to +V, -V and ground. The proper wire size must be used: No. 12 AWG is recommended. Connections must be secure, and the wires or lugs must be clean to reduce contact resistance. Maximum torque on the bolts is 19 in-lbs.

15.4 Output Connections. The V1 output is taken at either the two bus bars or J1, based on the choice at time of ordering. See Section 11.2 for further details and mating connector numbers. Connection to the bus bar 0.25-inch holes should be made with bolts and nuts. The connection must be clean and secure to keep contact resistance low. For a multi-output system, outputs are taken at J2 or J3, based on the choice at time of ordering. See Section 12.2 for further details and mating connector numbers.

15.5 Control and Supervisory Signal Connections. These connections are made to P3. See Section 11.3 for further details on the connector and the function on each pin. Note that the Rack System Connector Kit contains mating connectors for all rack connections for both TNF and TNQ Series. Kit no. is 775-1420-0000 (order from UNIPOWER Corp., $150.00)

16.0 MAINTENANCE

No routine maintenance is required on the TNF/TNQ Series except for periodic cleaning of dust and dirt around the fan intakes. A small vacuum nozzle should be used for this. The hot-swap module covers should not be removed; there are no user-serviceable components in the unit.

17.0 POWER SYSTEM SETUP AND TESTING

17.1 These instructions assume a TNF/TNQ system with three modules in a rack mount used as a 2+1 redundant system. However, if the system uses three modules in non-redundant operation or only two in a 1+1 redundancy, the setup and testing is essentially the same.

17.2 The hot-swap modules should first be tested separately, outside the rack mount. This is done by using a mating connector to J1. The mate is ELCON FLATPAQ No. 279-0320-00200. Or use the Module Evaulation Connector Kit No. 775-1419-0000. Order from UNIPOWER Corp., for $95.00. Using either one, connect a three-wire AC power cord to the correct input terminals for line, neutral and ground for the TNF Series. For the TNQ Series connect wires for the DC input to the +V, -V and ground terminals. Do not connect to the AC or DC power source yet.

17.3 Connect the V1 and V2 sense leads to their respective V1 and V2 output voltages with correct polarity. Make sure that the Inhibit, Pin 3 of J1, is at TTL HI or open.

17.4 Plug the AC power cord into the wall socket (TNF) or connect the input wires to the DC power source (TNQ). Measure each output voltage of the module with a digital voltmeter. Each voltage should be approximately at its nominal output voltage specification. Disconnect the input power source from the unit.

17.5 Connect a load to each output. Each load should be 50% to 100% of the rated output load and the total load less than the module maximum output power rating. Reconnect the input power source. Adjust each output to within a few millivolts of its nominal or desired value. Accurate adjustment of each output will help the modules share currents more accurately. Disconnect the power source from the unit.

17.6 Repeat section 17.4 and 17.5 for the other two modules. After this is

done, each module's corresponding output voltages will have been adjusted to very nearly the same values. This will result in accurate current sharing.

17.7 Plug all modules into the rack mount. Secure each module with its two thumbscrews. Connect the full operating load to each rack output. Connect the remote sense leads with proper polarity for V1 and V2 from P3, Pins 13 & 14 and 11 & 12, respectively, to the loads. Connect the rack to the input power source.

17.8 Check the output voltage at each load with a digital voltmeter. Each voltage should be at the values adjusted to in Section 17.5. With a voltmeter check each output for 2+1 operation by unscrewing the thumbscrews on one of the modules and pulling it out far enough to disconnect it from the rack. The voltmeter should continue to read the correct values for each voltage with the remaining two modules in the rack. Replug the module in the rack mount and secure it with the thumb-screws. Repeat this test for each of the other two modules in the rack. In each case the output voltages at the loads should remain the same. This completes the check for 2+1 redundancy by simulating a failure in each of the modules.

17.9 If desired, the inhibit input of each module can be checked by turning off each module in turn and checking the output voltages with the other two operating similiar to the above. This also simulates the failure of a module.

18.0 TROUBLESHOOTING GUIDE

18.1 If you encounter difficulty and do not get the proper output voltages, go through the following troubleshooting guide.

18.2 Table 18-1. TNF/TNQ Module and Rack Troubleshooting

SYMPTOM	POSSIBLE CAUSE	ACTION TO TAKE
No output (all outputs).	No input power.	Check connection to AC or DC input source.
No output on one output.	Shorted output.	Remove short.
No output (all outputs).	Overvoltage protection (OVP) is engaged.	Check Output Power Good (Pin 4 of J1 on module, Pin 5, 6 or 7 of P3 on rack) for a logic LO. Cycle input power off and then on.
No output (all outputs).	Overtemperature protection is activated.	Check Output Power Good as above for logic LO. Cycle input power off then on.

18.2 Table 18-1. TNF/TNQ Module and Rack Troubleshooting (continued)

SYMPTOM	POSSIBLE CAUSE	ACTION TO TAKE
No output (all outputs).	Output is turned off by Inhibit control.	Check to see if Inhibit input (P3 of J1 on module or pins 8, 9 or 10 of P3 on rack) is a TTL LO. It should be a HI or open.
V1 or V2 Output higher than nominal value.	Remote sense leads not connected.	Connect sense leads as instructed in Sections 14.5 and 17.3. Also see section 11.4. Make sure the polarities are correct.
Noisy output voltages	External pickup in sense leads.	Twist or shield each pair of sense leads and re-route away from noise source. Connect capacitors as instructed in Section 11.2

18.4 Table 18-2. All Hot-Swap Modules Connected in Rack Mount

SYMPTOM	POSSIBLE CAUSE	ACTION TO TAKE
No output (all outputs).	No input power.	Check connection to AC or DC input source.
No output (one output).	Shorted output.	Remove short.
No output (all outputs).	Overvoltage protection is activated on one or more modules.	Cycle input power off and then on. Check to see that cooling fans are operating properly.
No output (all outputs).	Overtemperature protection (OVP) is engaged on one or more modules.	Cycle input power off and then on.
No output (all outputs).	Outputs are turned off by Inhibit control on one or more modules.	Make sure that Inhibit inputs on Pins 8, 9 and 10 of P3 are TTL HI or open.
Output V1 or V2 higher than nominal value.	Remote sense leads not connected.	Connect sense leads as instructed in Sections 14.5 and 17.3. Also see section 11.4. Make sure the polarities are correct.
No output (one or more outputs).	Loads are too high for the number of modules carrying them.	Reduce the loads to proper level.
Noisy output voltages (one or more outputs).	External pickup in sense leads.	Twist or shield each pair of sense leads and re-route away from noise source. Connect capacitors as instructed in Section 11.2

21.3 If none of the above actions solves the problem, call the UNIPOWER Corporation factory at 954-346-2442 Ext. 400 for help and try to resolve the problem over the telephone.