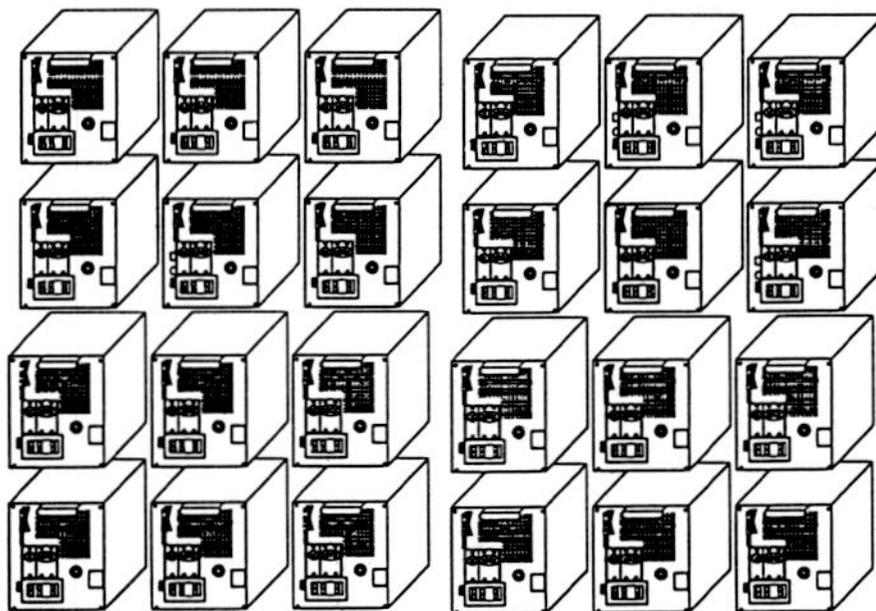


# MPR25 / MPR15 SERIES, SINGLE PHASE -48V, 25A SWITCH MODE RECTIFIER NT5C06

Equipment Installation, Operation and Maintenance Manual  
P0711722 - Standard Release 6.0 - November 1994

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**NORTEL**

**POWER**



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Power Systems

# **MPR25 / MPR15 SERIES, SINGLE PHASE -48V, 25A SWITCH MODE RECTIFIER NT5C06**

Equipment Installation, Operation and Maintenance Manual

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*This issue is to add enhanced extended temperature feature to MPR15 rectifier, and to revise the signal availability on the power shelves.*

### SAFETY PRECAUTIONS

This equipment meets CSA 22.0 - 0M1982, CSA C22.2 - 107-1957 and UL1950. High voltages are present inside the unit. Consequently, insulated tools, eye protection and adequate lighting are essential when working on the unit. In addition, up-to-date drawings must be used.

This equipment contains a number of discrete and micro-electronic solid state devices subject to permanent damage due to electrostatic potentials in handling and installation unless appropriate precautions are observed.

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## General

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This document provides information to install, operate and maintain the MPR15 (-48 V/15A) and MPR25 (-48 V, 25 A) series (NT5C06) Switch Mode Rectifier, the Power Shelf NT5C10, 19 in. and 23 in. for embedded and system applications, as well as the NT5C13F( ) Low Voltage Disconnect series.

### Applications

The MPR15/MPR25 rectifiers are designed to operate continuously in a battery or batteryless -48V power system, either embedded as part of a small system or as part of a power plant in a system application.

Several models are available to operate in a controlled environment. An extended temperature version is capable of withstanding a temperature range from -40°C to +65°C while standard models operate from 0° to +65°C ambient. The MPR15EX model operates from -40°C to +50° C ambient and the standard MPR15E operate from 0°C to +50°C.

The MPR25E and MPR25EX are suitable for various embedded and system applications. These models offer additional features often requested by customers to aid installation, operating and maintenance requirements.

The MPR15EX is intended for low power application when only 110/120 VAC power is available.

The rectifier will operate with existing NT rectifiers and other compatible manufacturers' products. It is compatible with NT conventional and microprocessor-based controllers designed to interface with the basic standard signals.

10 General Information

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**Rectifier Models**

Three models are listed in Table 1.

**Table 1 NT5C06 Models**

MODEL	TYPE	NT(CODE)
MPR25E	25 AMP - ENHANCED BASIC	NT5C06CA (BROWN) NT5C06CC (GREY)
MPR15E	15 AMP - ENHANCED BASIC 110 VAC	NT5C06CB (BROWN) NT5C06CD (GREY)
MPR25EX	ENHANCED EXTENDED TEMPERATURE	NT5C06BB (BROWN) NT5C06BC (GREY)
MPR15EX	15 AMP - ENHANCED EXTENDED TEMPERATURE, 110 VAC	NT5C06CE

Table 2 Rectifier Feature Summary

UNIT FEATURE	MPR15E & MPR25E ENH.	MPR15EX & MPR25EX ENH. EXT. TEMP
DC BREAKERS	X	X
REMOTE ON/OFF	X	X
REMOTE HVSD RESET	X	X
FLOAT/EQL CONTROL	X	X
REMOTE EQUALIZE	X	X
FAN ALARM INDICATOR	X	X
RFA INDICATOR	X	X
LOCAL/REMOTE SENSING	X	X
CURRENT LIMIT	X	X
CURRENT WALK-IN	X	X
THERMAL SHUTDOWN	X	X
EXT. TEMP. RANGE		X
CURRENT METER	X	X
AC BREAKER	X	X
BROWN/GREY OPTION	X	X
FILTER (A0370200)	OPT	OPT

- NOTES:
1. For Ordering Details, consult Ordering Guide.
  2. All units may be ordered in brown or grey.
  3. The air filter option is restricted to applications under 50°C (122°F) and is recommended for Central Office application.

# Summary of Specifications

## Mechanical

The rectifier MPR25 or MPR15 has the following dimensions:

### RECTIFIER

Height:	168 mm (6.60 in.)
Depth:	260 mm (10.25 in.)
Width:	149 mm (5.85 in.)

## Electrical

### Rectifier Voltage and Current

The input current requirements of the MPR15/MPR25 rectifier and the NT5C10 power shelves are as follows:

CONDITION: Typical input current value for 54Vdc, full load output.  
 ( ) = maximum input current at  
 Output 54Vdc, current limit  
 Minimum line

	120 Vac	208 Vac	240 Vac
Frequency	47-63 Hz	47-63 Hz	47-63 Hz
Range	96-132 VAC	176-264 VAC	176-264 VAC
1. MPR15	10.5A (16.5A)	n/a	n/a
2. MPR25	n/a	11.7A (15.5A)	10.2A (15.5A)
3. NT5C10 Shelf:			
(a) 2 rectifiers	21.0A (33.0A)	23.4A (31.1A)	20.4A (31.1A)
(b) 3 rectifiers	31.5A (49.5A)	35.1A (46.6A)	30.6A (46.6A)

Input protection:	20 A AC breaker
Output voltage:	Floating: -46 VDC to -57 VDC Equalizing: 0 to -2.5 VDC above float
Output regulation	At the point of regulation: within $\pm 0.5\%$ of the selected value for all specified input and output variations and within $\pm 1\%$ for any combination of specified input, output and environment conditions.
Output protection:	30 A DC breaker
Output current:	at 96-132 V input * - 15A for MPR15E/EX at 176-264 V input - 25A for MPR25E/EX
Current limit:	17.5 to 20 A minimum for 96-132 V input and 25.5 to 30A for 176-264 V input. From -46 VDC to -57 VDC. Constant power for output from -57 VDC to -59.5 VDC

**NOTE:** The AC inrush current during the turn-on sequence of the rectifier under all input and output conditions specified in this document will not exceed its full load steady-state value.

### Output Noise and Ripple

- less than 22 dBmC at voice frequency, with batteries measured at the point of regulation and over the entire range of the rectifier, inducing operation in the current limit mode, and low nominal and high input conditions.
- less than 10 mVrms in any 3 kHz band between 10 kHz and 20 MHz. Measurements made with or without batteries at the output terminal of the rectifier and with the rectifier in the local sensing mode.
- peak-to-peak switching voltage spikes less than 250 mV (600 mV from  $-40^{\circ}\text{C}$  to  $0^{\circ}\text{C}$ ), measured differentially by an oscilloscope with 2 MHz bandwidth.

## 14 Summary of Specifications

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### **Acoustical Noise**

The rectifier does not produce sound levels above 60 dB with "A" weighting and measured 1.5 m (5 ft.) above the floor and 0.5 m (2 ft.) from the rectifier, while operating at no load, partial load or full load.

### **Efficiency and Power Factor**

Efficiency is 88% at nominal input voltage of 208 V and maximum output load of 25 A at 54Vdc.

Power factor is .60 at a nominal voltage of 208 VAC and a maximum load of 25 A with 0.5 ohm line impedance.

### **Reliability**

The rectifier has an MTBF greater than 120,000 hours (Bellcore spec.) under normal operating conditions, at 30° C.

### **Heat Dissipation**

The maximum heat dissipation is 150 W at -56 V and 25A load (1 x MPR25).

### **Electromagnetic Interference (EMI)**

The rectifier meets FCC part 15, sub-part B for Class A digital devices.

## **Environmental**

### **Operating**

A two inch airflow clearance is required at the front and rear of the rectifier. Consult NT Power Products Division for applications requiring less than two inch clearance.

The rectifier will operate satisfactorily under the following environmental conditions:

Temperature:

MPR15E:	0° to 50° C	(32° to 122° F)
MPR15EX:	-40° TO 50° C	(-40° TO 122°F) See Note
MPR25E:	0° TO 65° C	(32° TO 149°F)
MPR25EX:	-40° TO 65°C	(-40° TO 149°F)

Humidity: 0 to 95% (non-condensing)

Altitude: Sea level to 2100 m (7000 ft.)

**Transportation**

The following environmental limits must be observed during transportation:

Temperature:	-50° C to 75° C (-58° F to 167° F)
Humidity:	Up to 95% Relative Humidity at 25 mm (1 in.) of water vapor pressure.
Vibration:	5.5 to 500 Hz. 3.5 g maximum (sinusoidal) 762 mm (30 in.) maximum drop (packaged)
Pressure:	87.5 mm Hg at 15,200 m (50,000 ft.)
Temperature Shock:	-50°C to 27° C (-58° F to 80° F) in 5 min.

## 16 Summary of Specifications

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### **Storage**

The following environmental limits must be observed during storage:

Temperature: -50° C to 75° C (-58° F to 167° F).

Humidity: Up to 95% Relative Humidity at 25 mm  
(1 in.) of water vapor pressure.

The rectifier contains aluminum electrolytic capacitors. For this reason, either the rectifier shall be in operation or once a year the equipment shall be energized for at least two hours in order to maintain the electrolytic capacitors in good condition.

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# Operation

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## Rectifier Operation

The main AC line voltage is rectified and filtered to an unregulated high DC voltage. The input circuit provides EMI filtering, inrush current limiting, low and high AC inhibit, lightning and surge voltage protection and input fault protection in the form of an AC breaker.

The high frequency isolating power section consists of a full bridge converter using power MOSFETs and a high frequency power transformer.

The high frequency AC voltage generated at the secondary of the power transformer is rectified and filtered. The output section provides EMI filtering, a shunt for output DC current sense and output protection in the form of a DC breaker. A current mode pulse width regulator varies the pulse width of the signal driving the power MOSFETs. This allows regulation to the output DC voltage.

The monitoring circuitry includes soft start, rectifier fail alarm (RFA), "rectifier OK" LED, local and remote equalize, temporary release, thermal shutdown, AC valid, local and remote high voltage shut down (HVSD), local and remote HVSD reset, logic valid, fan failure detect and LED.

A three digit output current meter reads the output shunt and displays the value using an integrated logic circuit.

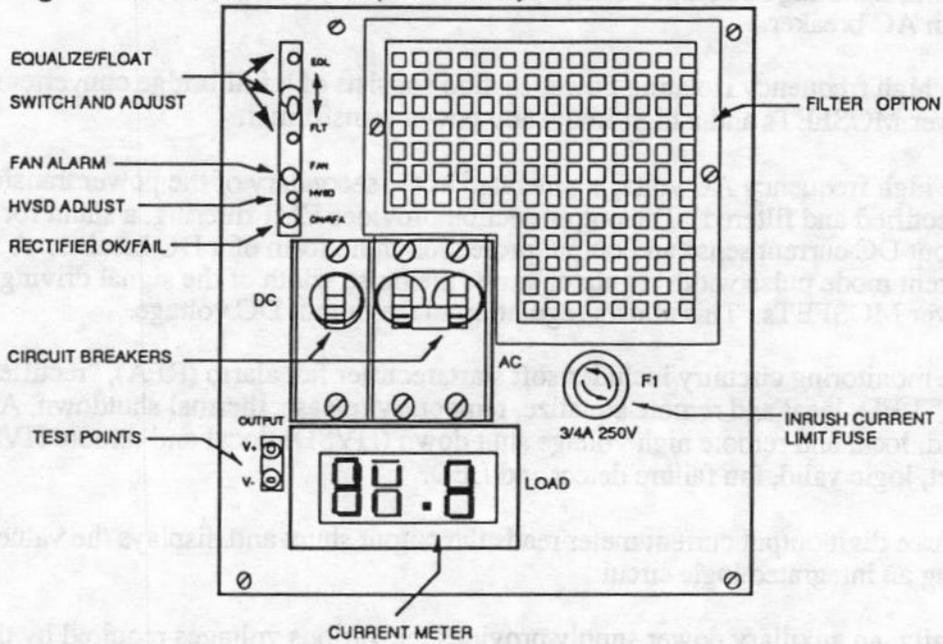
Finally, an auxiliary power supply provides the various voltages required by the internal circuitry and cooling fan.

## Display and Rear Interface

### Display

Figures 1 and 2 show the front and rear views of the rectifier when all options are included.

**Fig. 1 - NT5C06 Rectifier (front view)**



### Local Float/Equalize Control

The rectifier is equipped with a momentary Float/Equalize switch. When the switch is held up to EQL, the rectifier changes to equalize mode and boosts the output voltage to the value set by the EQL potentiometer located above. Otherwise, the rectifier delivers a float voltage set by the FLT potentiometer.

### Indicators

Lamp Designation	Color	Description
RFA/ON	Red/Green	Rect. failed or no load current/ Rectifier operational
Fan	Red	Fan Failed

### Rectifier Failure Alarm (RFA)

The rectifier incorporates facilities for monitoring its operational state and extends a global alarm upon detection of an internal failure or a no load condition. When the rectifier operates in parallel with other rectifiers and its output voltage is adjusted lower, the RFA LED will change to RED and an RFA alarm will be sent.

### Fan Failure Alarm

A fan failure will activate the fan alarm and inhibit the operation of the rectifier. An RFA will also be issued upon rectifier inhibit.

### Internal High Voltage Shut Down (HVSD)

The rectifier includes a high voltage monitor. Whenever the rectifier output voltage exceeds a value adjustable from -52 to -59.5 V the rectifier shuts down immediately, locks out and transmits an RFA. This function does not depend on the output load condition.

### Local ON/OFF Control (DC and optional AC breakers)

Circuit breakers are used to turn the rectifier ON/OFF locally and disengage it from the DC circuit. The local OFF control overrides the remote control signals.

### **Inrush Current Limiting Fuse (f1)**

A 3/4 A, 250V fuse is connected in line with the soft start circuitry to protect the input circuitry against high inrush currents in case of an internal failure. On the MPR15E model NT5C06CB/CD/CE, failure of this fuse during operation will disable the unit. See Recommended Replaceable Parts section to order a replacement fuse.

### **Test Points (V+, V-)**

Test points allow the user to measure the voltage at the point of regulation, whether the DC breaker is ON or OFF. A 10 K resistor is placed in series with the -48V lead to prevent damage due to a short circuit at the jack terminals.

### **Current Meter**

A three digit output current meter, available on the enhanced model, reads the output shunt and displays the value using an integrated logic circuit.

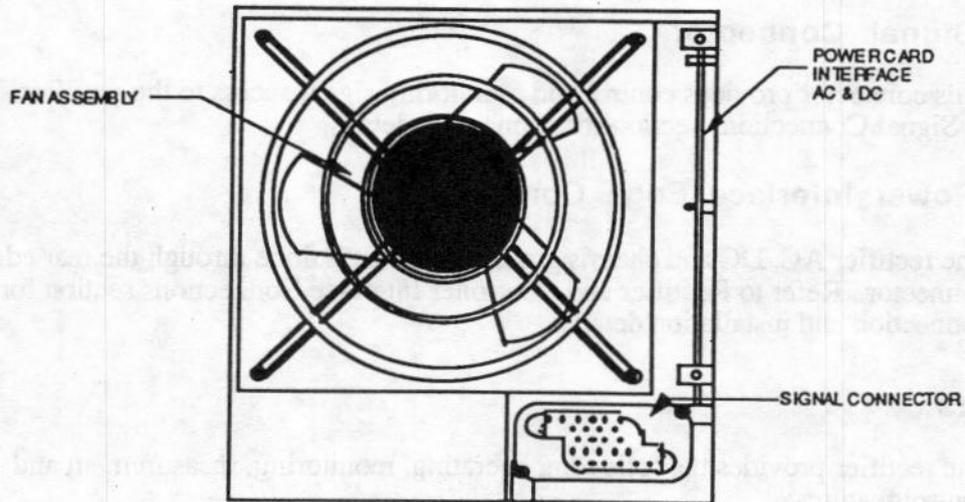
### **Fan Filter Option**

For dusty environments a fan filter option may be used to prevent the dust particles from deteriorating the cooling efficiency of the rectifier. (See Recommended Replaceable Parts section to order an air filter kit.)

**The maximum operating ambient temperature should be limited to 50° C (122° F) for environments requiring the rectifier air filter.**

Rear Interface

Fig. 2 Rear Interface



### **Fan Cooling Assembly**

The fan cooling assembly ensures adequate cooling of the internal components. This assembly is replaceable in the field. Consult Fan Replacement Procedure section for details.

### **Signal Connector**

This connector provides control and monitoring signal access to the rectifier. Refer to Signal Connections section for connection details.

### **Power Interface Edge Connector**

The rectifier AC, DC and chassis ground interface is done through the rear edge connector. Refer to Rectifier and Controller Interface Connections section for connection and installation details.

## **Features**

The rectifier provides the following operating, monitoring, measurement and control features:

### **Operating Features**

#### **Remote Voltage Sensing**

Provision is made to extend the sensing leads to the battery or to the charge/discharge bus (batteryless operation) of the plant. Opening of either sensing leads will not result in a voltage increase at the rectifier output terminals.

#### **Current Limiting**

The rectifier will automatically limit the output current to 17.5 to 20 A (MPR15) and 25.5 to 30 A (MPR25). Extended periods of operation in the current limiting mode, and repeated transitions between constant-voltage operation and constant-current operation have no detrimental effect on rectifier performance or service life.

The rectifier is capable of starting when connected across a completely discharged battery without requiring human intervention or operating protecting devices.

Transitions from constant-voltage operation to constant-current operation and vice versa will occur automatically as determined by the output current. The current limit circuit will remain working in both the float and equalize modes.

#### **Soft Start and Walk-In**

The output current rises from 10% to 90% in 2 seconds (typically).

#### **AC Inrush Current**

The AC current during the turn on sequence of the rectifier under all input and output conditions specified in this document will not exceed its full load steady-state value.

#### **Sequential Start**

The rectifier Temporary Release (TR) leads are available for use with an external sequential start circuit.

#### **Parallel Operation**

The rectifier is capable of operating in parallel with other rectifiers having similar output slope characteristics.

#### **Discharge of Output Capacitors**

The output capacitors will automatically discharge when the rectifier is disconnected and the AC power removed.

#### **Load Sharing**

Rectifiers connected in parallel and sensing at the same point will share the load with other rectifiers having similar negative output slope characteristics (300 mV drop from zero to full load).

The rectifier will share the load proportionally to its output rating to within  $\pm 10\%$  precision.

## **Monitoring Features**

### **Input AC Voltage Monitor**

The rectifier monitors the input voltage and inhibits its operation when the voltage exceeds the specified limits refer to Summary of Specifications section, sub section Electric. An RFA is initiated.

The rectifier recovers its normal operation automatically when the specified input voltage is re-established.

### **Thermal Shutdown**

The rectifier protects itself against thermal overstress by inhibiting its operation for the duration of the high temperature condition. The RFA alarm is triggered. The rectifier will restart after the temperature has reduced to a safe level.

### **Output Current Monitor**

The rectifier monitors the output current. The unit will initiate an RFA alarm when no output current is detected during parallel operation.

## **Measurement Features**

### **Remote Rectifier Current Measurement**

The rectifier is equipped with a 50 mV/25 A shunt connected on the positive lead near the output terminals. The shunt signal is available on the signal connector. See Fig. 3.

### **Test Points (V+, V-)**

Voltage jacks are provided for measuring the voltage at the point of regulation.

## Control Features

### Remote ON/OFF Control

When a ground signal is applied to the 'Temporary Release' (TR) input, the rectifier inhibits its operation and activates the rectifier's RFA. Upon removal of the remote ground signal the rectifier returns to normal operation.

### Remote High Voltage Shutdown

In addition to the local high voltage shutdown feature, the power plant controller can shut down any rectifier by sending a high voltage shutdown signal, ground (BAT.RTN) pulse. The rectifier will shut down if it is supplying more than 10% of its full load rating.

### Local/Remote High Voltage Shutdown Reset

The rectifier may be reset from an HVSD condition either locally by resetting the AC circuit breaker, (if so equipped) or the associated AC breaker on the distribution panel or remotely by applying a ground signal at the HVSDR input of the rectifier provided:

- the 'TR' lead is not activated;
- the 'AC' (optional) and 'DC' breakers are closed

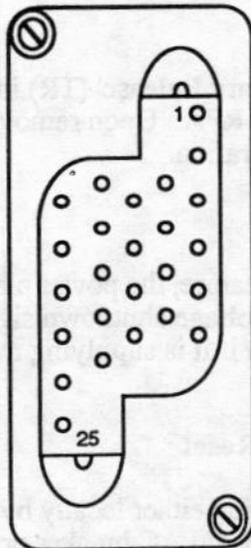
### Remote Equalize Control

The rectifier is equipped with remote Equalize control. This function is operated by applying a remote ground signal (BAT POS) and returns to normal (Float) operation upon removal of the signal.

## Signal Connections

The interface connector located at the rear of the rectifier provides control, alarm and monitoring signals. The control inputs are activated by a ground (BAT. RTN) signal. The alarm contacts are extended by relays and are isolated from each other and from the rectifier chassis. All contacts are rated 60 VDC and 0.5A.

FIG. 3



- 1 - REMOTE EQL
- 2 - SENSING RG +
- 3 - SENSING RC -
- 4 - TEMPORARY RELEASE
- 5 - REMOTE HVSD RESET
- 6 - REMOTE HVSD
- 7 - RFA NC
- 8 - Not Connected
- 9 - FAN ALARM NC
- 10 - RFA COMMON
- 11 - FAN ALARM COMMON
- 12 - SHUNT +
- 13 - SHUNT -
- 14 - FAN ALARM NO
- 15 - RFA NO
- 16 - GROUND
- 17 - SENSE COMMON
- 18 - SENSE NC
- 19 - SENSE NO
- 20 - Not Connected
- 21 - Not Connected
- 22 - Not Connected
- 23 - Not Connected
- 24 - Not Connected
- 25 - Not Connected

Connector housing: AMP 211149-1  
 Crimp type pins (24-20 AWG): AMP 66103-1  
 PCB solder/wire wrap pins: AMP 66460-7

The 'SENSE' alarm contact closes to indicate that the remote sense leads are open.

The signals normally connected to NT controllers are indicated below.

---

**Rectifier and Controller Interface Connections**

DESIGN.	DESCRIPTION	SIGNAL
RG+/RC-	Sensing Leads	battery or charge/discharge bus
HVSD	Remote High Voltage	Bat RTN Shutdown
HVSDR	Remote High Voltage	Bat RTN Shutdown Reset
TR	Remote Inhibit	Bat RTN
EQ	Remote Equalize	Bat RTN
RFA	Rectifier Failure Alarm	Form C contacts
F.AL M	Fan Failure Alarm	Form C contacts
Shunt (+) and Shunt (-)	Rectifier Current	50 mV at 25A

## Power Shelf

---

### Mechanical

The power shelf provides housing for plug-in rectifiers and for an optional LVD. The power shelf provides power connections and signal access to the rectifiers.

As listed in Table 3, there are two shelf sizes with capacities as follows:

- a)            19" mounting
  - 2 x MPR25 or MPR15 (Fig. 4)
  - 2 x MPR25 or MPR15 + LVD
  - 3 x MPR25 or MPR15
  
- b)            23" mounting
  - 3 x MPR25 or MPR15 (Fig. 5)
  - 2 x MPR25 or MPR15 + LVD (Fig. 7)
  - 2 x MPR25 or MPR15 + LVD + RPM1000C (Fig. 6)
  - 3 x MPR25 or MPR15 + EQL SW Assembly (Fig. 8)

There are two main versions of application:

- SYSTEM (Table 4A)
  - in the system version, the rectifier signals are brought out from the shelf via connectorized cables for direct plug-in to the Power Plant's Controller.
  - the AC input is either common bussed or individually fed, equipped or not for EMI filtering, to the rectifiers.
  
- EMBEDDED (Table 4B)
  - these shelves are designed to fit specific applications. The rectifier signals are brought out from the shelf through an open ended cable or as suited by the particular application requirements.

- the AC input is either common bussed or individually fed, equipped or not for EMI filtering, to the rectifiers.

In all of the above versions the DC output is common bussed within the shelf with separate BAT RTN (+VDC), BAT (-VDC) and LOAD (-VDC) where an LVD is installed.

**Table 3 Power Shelf Feature Summary**

FEATURES	MPS75S	MPS75E	MPS50S	MPS50E
MOUNTING	23"	23"	19"	19"
RECTIFIER POSITIONS	3	2 / 3	2	2
LVD POSITION	0	1 / 0	0	1
CONTROL SIGNAL ACCESS	CONNECTOR- IZED	OPEN CABLE	CONNECTOR- IZED	OPEN CABLE
INDIVIDUAL AC	AVAILABLE	AVAILABLE	AVAILABLE	AVAILABLE
COMMON AC	AVAILABLE	AVAILABLE	AVAILABLE	AVAILABLE
BROWN	YES	YES	YES	YES
DOLPHIN GREY CHASSIS	YES	YES	NO	NO
OXFORD GREY CHASSIS	YES	YES	NO	YES
EMI FILTERING OPTION	AVAILABLE	AVAILABLE	NOT AVAILABLE	NOT AVAILABLE
LOCAL EQUALIZE OPTION	NO	AVAILABLE	NO	NO
AC FAIL ALARM OPTION	AVAILABLE	AVAILABLE	NO	NO

NOTES: For exact option configurations and ordering, refer to References Section.

The description for the above power shelf codes is as follows:

- "S" at the end of the code signifies system application.
- "E" at the end of the code signifies embedded application.

**TABLE 4A - Modular Power Shelf Embedded Application Signal Availability**

PEC Code	Color	AC Com/ Indiv	HSB FLS	DC EMI FLT	WIDTH (in)	SPECIAL FEATURES	LVD PEC	NOTES
NT5C10BA-1	Brown	Common	HSB		19		NT6C13FM NT6C13FE	1
NT5C10BA-3	Brown	Individual	FLS		19	AC delay signal	N/A	
NT5C10BA-5	Brown	Common	FLS		19		NT6C13FM NT6C13FE	1
NT5C10BB-1	Oxford Gray	Individual	HSB		19		NT6C13FG	
NT5C10BB-3	Oxford Gray	Common	FLS		19		NT6C13FG	
NT5C10BF-1	Brown	Common	FLS		19		NT6C13FA	
NT5C10BC-1	Brown	Individual	FLS	X	23		NT6C13FA	5
NT5C10BC-3	Brown	Common	FLS	X	23		NT6C13FA	5
NT5C10BD-3	Oxford Gray	Common	FLS	X	23		NT6C13FC	5
NT5C10BE	Brown	N/A	N/A	N/A	8.2	Rectifier adapter	NT6C13FF	
NT5C10BM	Dolphin Gray	Common	FLS	X	23	EQL Switch	N/A	2
NT5C10BJ	Brown	Common	FLS	X	23	LVD+I/F PCB LVD+RPM1000C	NT6C13FA NT6C13FJ	3, 5 4, 5
NT5C10BK	Dolphin Gray	Common	FLS	X	23	LVD+I/F PCB LVD+RPM1000C	NT6C13FC NT6C13FK	3, 5 4, 5
NT5C10BL	Oxford Gray	Individual	FLS	X	23		NT6C13FC	5
NT5C10BP	Dolphin Gray	Common	FLS		19		NT6C13FC	
NT5C10BQ-46	Brown	Individual	FLS	X	23	AC delay signal	N/A	

**NOTES:**

1. Required when hooked up to an external RPM1000.
2. Also order equalize switch assembly A0401062 NT5C10KB
3. Required when used with I/F PCB option. Also order kit P0736446.
4. Required when used with RPM1000C. Also order P0736447.
5. Optional AC Fail Alarm available. Order NT5C10KC A0627271.
6. Delayed Start feature.

**LEGEND:**

HSB: Hot Stand-by\*  
FLS: Free Load Sharing

TABLE 4A - Modular Power Shelf Embedded Application Signal Availability

AVAILABLE SIGNALS																	
PEC CODE	EQL	RG+	RC-	HVSDR	HVSD	RFA			RFA MAJ	FAN		NC	C	SEN		TR	NSR
						NC	NO	C	NC	NC	C			ALM	LVA		
NT5C10BA-1	O	BK	R			W		BR	BL	R				O	Y		
NT5C10BA-3		BL/W	W/BL			S/W		W/S		O/R	R/O	W/O	O/W				
NT5C10BA-5	O	BK	R			W		BR							Y		
NT5C10BB-1	O	BK	R			W		BR							Y		
NT5C10BB-3	O	BK	R			W		BR							Y		
NT5C10BF-1		TB1-2	TB1-1			TB1-5	TB1-4	TB1-3									TB1-6
NT5C10BC-1						BL		BR									
NT5C10BC-3						BL		BR									
NT5C10BD-3		PI-2	PI-1			PI-3											
NT5C10BE		J2-1	J2-4			J2-3,5		J2-2							J2-6		
NT5C10BM						BL		BR									
NT5C10BJ (4)	PE1-1	PE1-2	PE1-3	PE1-5	PE1-6	PE1-7				PE1-4					P3-1	PE1-8	
NT5C10BJ (3)	PI-1	PI-2	PI-3	PI-5	PI-6	PI-7				PI-4					P3-8	PI-8	
NT5C10BK (4)	PE1-1	PE1-2	PE1-3	PE1-5	PE1-6	PE1-7				PE1-4					P3-1	PE1-8	
NT5C10BK (3)	PI-1	PI-2	PI-3	PI-5	PI-6	PI-7				PI-4					P3-8	PI-8	
NT5C10BL		BK	R			W											
NT5C10BP		TB1-2	TB1-1			TB1-5	TB1-4	TB1-3									TB1-6
NT5C10BQ		BL/W	W/BL			S/W		W/S		O/R	R/O	W/BR	BR/W				

NOTE: For shelves equipped with an optional NT5C10KC AC Fail Alarm Circuit, the Alarm Signal is available on TB1-1 (NC) and TB1-2 (C).

TABLE 4B - Modular Power Shelf System Application Signal Availability

NT CODE	COLOR	AC COM/INDIV	DC OTP EMI	19/23 IN	EQL	RG+	RC-	HVS DR	HV SD	RFA		RFA MAJ	REG ALM	LV ALM	TR	AC FAIL		NOTES
										NC	NC					NC	C	
NT5C10CA-1/2	BROWN	COM		19	P1-1	P1-2	P1-3	P1-5	P1-6	P1-7	P1-4				P1-8			
NT5C10CB-1/2	BROWN	COM	X	23	P1-1	P1-2	P1-3	P1-5	P1-6	P1-7	P1-4				P1-8			5
NT5C10CB-3/4	BROWN	INDIV	X	23	P1-1	P1-2	P1-3	P1-5	P1-6	P1-7	P1-4				P1-8			5
NT5C10CB-5/6	BROWN	COM		23	P1-1	P1-2	P1-3	P1-5	P1-6	P1-7	P1-4				P1-8			5
NT5C10CC-1/2	DOL. GREY	COM	X	23	P1-1	P1-2	P1-3	P1-5	P1-6	P1-7	P1-4				P1-8			5
NT5C10CD-1/2	OX. GREY	COM	X	23	P1-1	P1-2	P1-3	P1-5	P1-6	P1-7	P1-4				P1-8			5
NT5C10CE	DOL. GREY	INDIV	X	23	P1-1	P1-2	P1-3	P1-5	P1-6	P1-7	P1-4				P1-8			5
NT5C10CF	BROWN	INDIV		23	P1-1	P1-2	P1-3	P1-5	P1-6	P1-7	P1-4				P1-8			5
NT5C10CG	DOL. GREY	COM		23	P1-1	P1-2	P1-3	P1-5	P1-6	P1-7	P1-4				P1-8			5
NT5C10CH	DOL. GREY	INDIV		23	P1-1	P1-2	P1-3	P1-5	P1-6	P1-7	P1-4				P1-8			5
NT5C10CO-61	DOL. GREY	COM	X	23	P1-1	P1-2	P1-3	P1-5	P1-6	P1-7	P1-4				P1-8	TB 1-6	TB 1-7	5,6

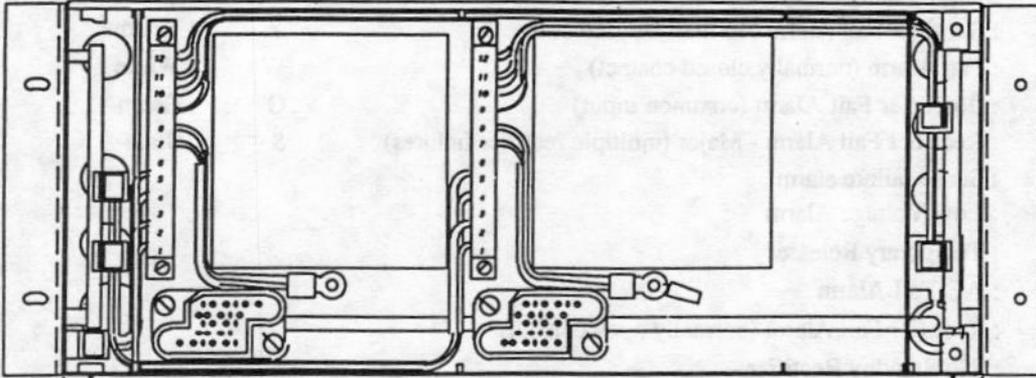
NOTE: For shelves equipped with an optional NT5C10KC AC Fail Alarm Circuit, the Alarm Signal is available on TB1-1 (NC) and TB1-2 (C).

**LEGEND:**

EQL	: Equalize	R	: Red
RG	: Rectifier sense (+vc lead)	O	: Orange
RC	: Rectifier sense (-vc lead)	BL	: Blue
HVSDR	: High Voltage Shutdown Restart	BK	: Black
HVSD	: High Voltage Shutdown	BR	: Brown
RFA NC	: Rectifier Fail Alarm (normally closed contact)	Y	: Yellow
FAN NC	: Fan Alarm (normally closed contact)	W	: White
RFA C	: Rectifier Fail Alarm (common input)	G	: Green
RFA MAJ	: Rectifier Fail Alarm - Major (multiple rectifier failures)	S	: Slate
SEN ALM	: Sense failure alarm		
LVA	: Low Voltage Alarm		
TR	: Temporary Release		
AC/FAIL	: AC Fail Alarm		
RFA/NO	: Rectifier Fail Alarm (normally open contact)		
NSR	: No Standby Rectifier		
NC	: Normally Close		
NO	: Normally Open		
C	: Common		
OTP EMI	: Output EMI Filter		

Here are some views of the power shelves available.

**Fig. 4 - 19 Inch Power Shelf (Front View)**



**Fig. 5 - 23 Inch Power Shelf (front view)**

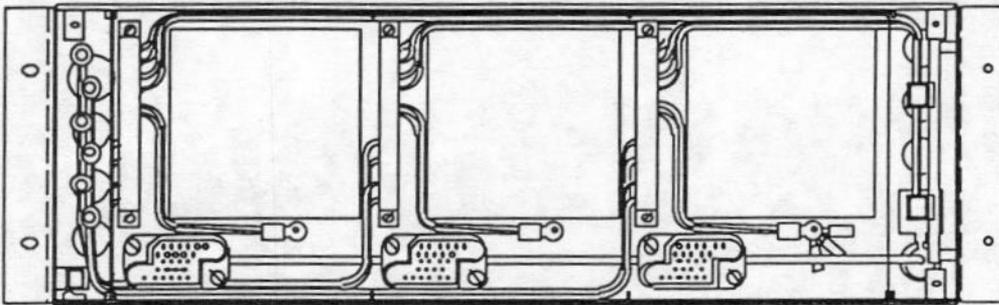


Fig. 6 - Power Shelf NT5C10BJ or NT5C10BK (exterior view)

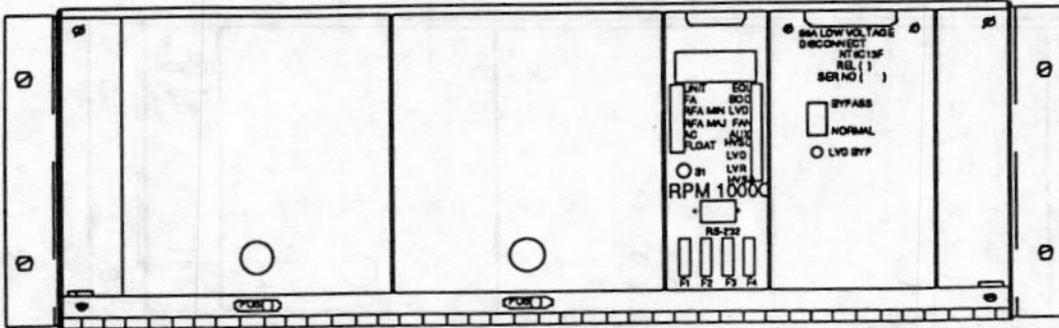


Fig. 7 - Power Shelf NT5C10BJ or NT5C10BK (interior view)

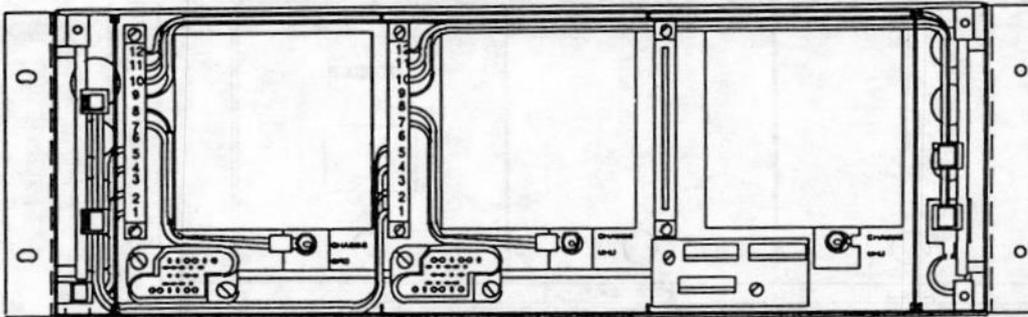


Fig. 8 - Power Shelf NT5C10BM e/w EQL Switch Assembly

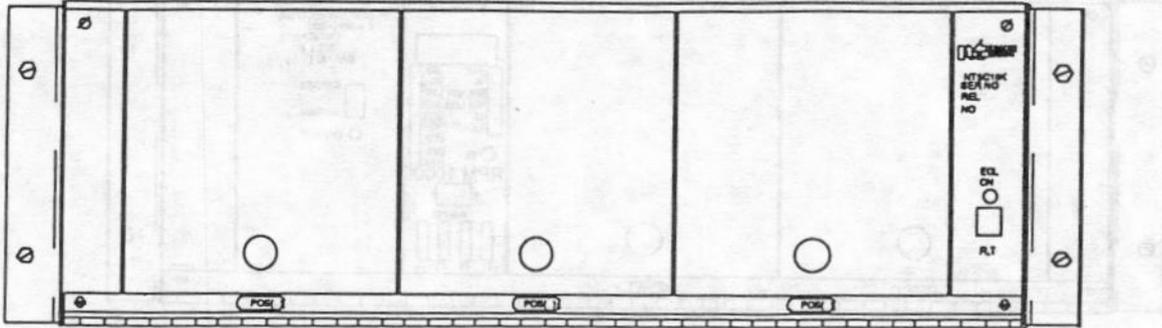
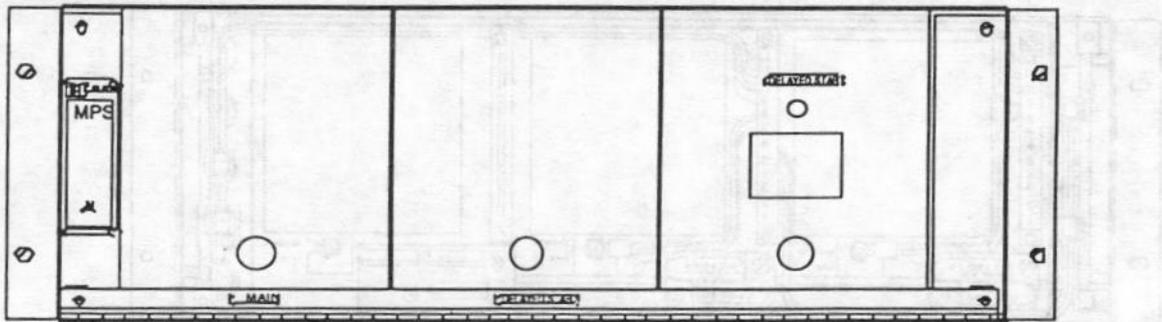


FIG. 9 - Power Shelf NT5C10CO e/w Start Delay LED



**Electrical**

When using the MPR25 rectifier, powered from 208/240 VAC 50/60 Hz single phase, the power shelf equipped with one, two or three rectifiers has the following specifications:

CONDITION: Typical input current value for 54Vdc, full load output.  
 ( ) = maximum input current at  
 Output 54Vdc, current limit  
 Minimum line

Input Voltage: 208 VAC  
 Frequency: 47-63 Hz  
 Range: 176-264 VAC

Input Current:	one rectifier	11.7 (15.5)
	two rectifiers	23.4 (31.0)
	three rectifiers	35.1 (46.5)

Output Voltage -46Vdc TO -57Vdc

Output current: one rectifier 25A  
 two rectifiers 50A  
 three rectifiers 75A

Please note that when three phase 208/240 VAC lines are used to power more than one shelf, it is preferable to distribute the shelves equally among the phases.

Use a 20A breaker or FRN type fuse for individual AC.  
 Use a 40A breaker or FRN type fuse for 2 rectifiers, common AC.  
 Use a 60A breaker or FRN type fuse for 3 rectifiers, common AC.

When using the MPR15 rectifier powered from 120 VAC, the power shelf equipped with one, two or three rectifiers has the following specifications:

CONDITION: Typical input current value for 54Vdc, full load output.  
 ( ) = maximum input current at  
 Output 54Vdc, current limit  
 Minimum line

Input Voltage: 120 VAC  
 Frequency: 47-63 Hz  
 Range: 96-132 VAC

Input Current:	one rectifier	10.5 (16.5)
	two rectifiers	21.0 (33.0)
	three rectifiers	31.5 (49.5)

Use a 20A breaker or FRN type fuse for individual AC.  
 Use a 40A breaker or FRN type fuse for 2 rectifiers, common AC.  
 Use a 60A breaker or FRN type fuse for 3 rectifiers, common AC.

Output Voltage: -46 VDC to -57 VDC

Output current: one rectifier 15A  
 two rectifiers 30A  
 three rectifiers 45A

**Environmental**

The power shelf is suitable for use with rectifiers equipped with the extended temperature option as well as with the standard temperature range. It is designed for use under the following environmental conditions:

Temperature: -40° C to 65° C (-40° F to 149° F)  
 Humidity: 0 - 95% (non-condensing)  
 Altitude: Sea level to 2100 m (7000 ft.)

---

**Storage**

During shipping and storage the acceptable environmental range is:

- high temperature: +75° C dry heat (167° F)
- low temperature: -50° C (-58° F)
- humidity: 0 to 95% (non-condensing)

## Installation and Start-up Procedure

---

### Tools and Test Equipment

The following tools and test equipment are required:

- Potentiometer screwdriver Bourns Inc. No. 32
- Potentiometer screwdriver Bourns Inc. No. 60
- Screwdriver 3 inch
- Digital voltmeter - Fluke 8000 A or equivalent
- Dummy load

### Installation Procedure

#### Power Shelf Installation Procedure

Position the Power Shelf against the rack.

Fasten the shelf in the position indicated by the drawings (normally directly below the controller or below another Power Shelf).

Release the clamping bar from the front of the Power Shelf (Refer to Figures 10A, 10B and 11).

Remove the AC junction box cover (left side) and store for re-installation.

Remove the DC and control wiring area cover (right side) and store for re-installation.

Fig. 10A - 19 Inch Power Shelf

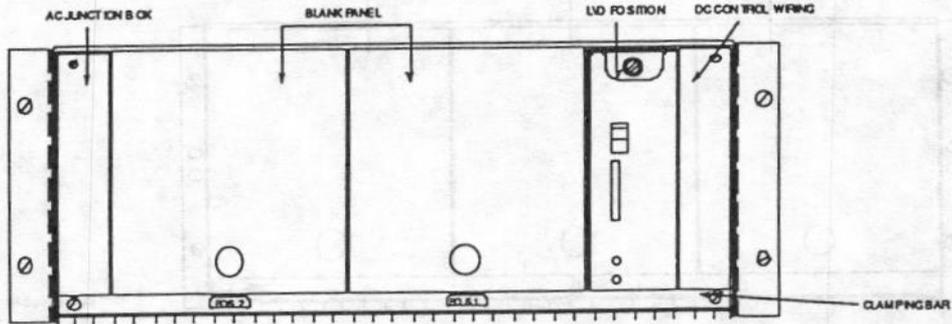
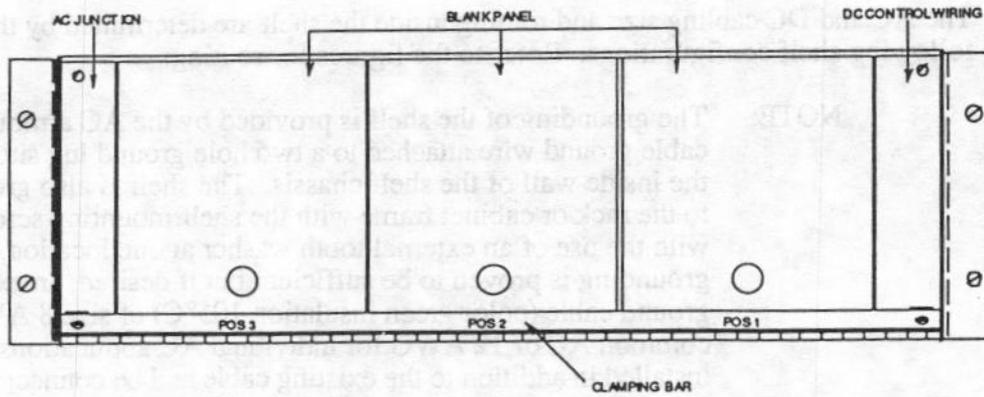
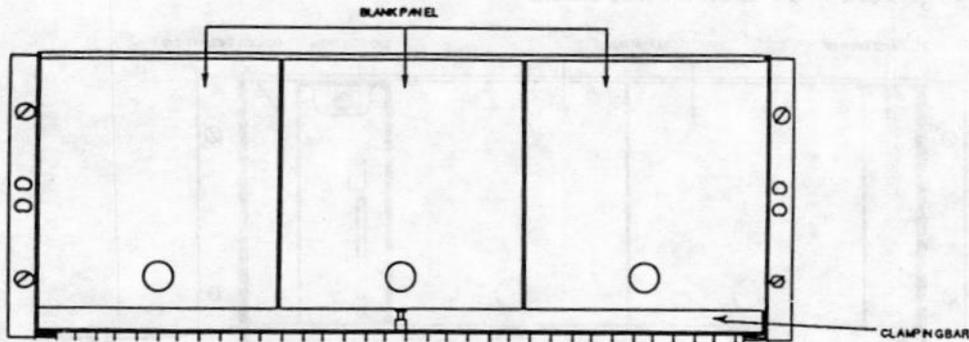


Fig. 10B - 23 Inch Power Shelf



**Fig. 11 - 19 Inch Power Shelf (NT5C10BF and NT5C10BP only)**



### **Cabling the Power Shelf**

The AC and DC cabling size and routing inside the shelf are determined by the following shelf configurations. Refer to the figures for routing:

**NOTE:** The grounding of the shelf is provided by the AC armoured cable ground wire attached to a two hole ground lug sitting on the inside wall of the shelf chassis. The shelf is also grounded to the rack or cabinet frame with the shelf mounting screws with the use of an external tooth washer at one location. This grounding is proven to be sufficient but if desired, an extra ground cable (color green insulation 105°C) of size 8 AWG for common AC or 12 AWG for individual AC applications can be installed in addition to the existing cable and be connected to an external system ground. Using a 0.25 inch ring lug termination, the new ground wire can be installed on one of the existing ground lug screws inside the shelf. The wire routing shall follow the inside top back of the shelf and shall come out on the right DC cabling side opening. Make sure that the wire does not interfere with the rectifier connections. See Fig. 12A for the extra ground connection mounting location.

Shelf configurations are as follows:

**19 in. System Shelf (NT5C10CA-1/2)**

capacity:	-	2 x MPR25
AC common cable	-	2/8 AWG ARMORED CABLE Ref. Fig. 12 (side) Fig. 16 (rear)
DC cables	-	6 AWG (BAT and BAT RTN) Ref. Fig. 17 (side) Fig. 18 (rear)
Signals	-	2 x 8 conductor connectorized cables

**19 in. Embedded Shelf (NT5C10BF-1 and NT5C10BP)**

capacity:	-	3 x MPR25
AC common cable	-	2/6 AWG ARMORED CABLE
DC cables	-	6 AWG (BAT AND BAT RTN)
Signals:	-	1 cable (for remote sensing and alarm)

Note: See Appendix A for additional information.

**19 in. Embedded Shelf (NT5C10BA-1/2)**

capacity:	-	1 x MPR25 + LVD 1 x MPR25 + 1 x MPR25 standby + LVD
AC common cable	-	2/8 AWG ARMORED CABLE REF. FIG. 12 (SIDE) FIG. 16 (REAR)
DC cables	-	6 AWG (BAT AND BAT RTN) REF. FIG. 17 (SIDE) FIG. 18 (REAR)
Signals:	-	1 cable (for remote sensing and alarm)

**19 in. Embedded Shelf (NT5C10BA-3/4)**

capacity:	-	2 x MPR25
AC indiv. cable	-	2/12 AWG ARMORED CABLE REF. FIG. 14
DC cables	-	6 AWG (BAT AND BAT RTN) REF. FIG. 17 (SIDE) FIG. 18 (REAR)
Signals:	-	1 cable (for remote sensing and alarm)

**19 in. Embedded Shelf (NT5C10BA-5/6, NT5C10BB-3/4)**

- capacity: - 2 x MPR25 + LVD
- AC common cable - 2/8AWG ARMORED CABLE  
REF. FIG. 12
- DC cables - 6 AWG (BAT AND BAT RTN)  
REF. FIG. 17 (SIDE) FIG. 18(REAR)
- Signals: - 1 cable (for remote sensing and alarm)

**19 in. Embedded Shelf (NT5C10BB-1/2)**

- capacity: - 2 x MPR25 + LVD
- AC common cable - 2/12 AWG ARMORED CABLE  
REF. FIG. 12
- DC cables - 6 AWG (BAT AND BAT RTN)  
REF. FIG. 17 (SIDE) FIG. 18 (REAR)
- Signals: - 1 cable (for remote sensing and alarm)

**23 in. System Shelf (NT5C10CB-1/2, NT5C10CB-5/6,  
NT5C10CC-1/2, NT5C10CD-1/2)  
NT5C10CG**

- capacity: - 3 x MPR25
- AC common cable - 2/6 AWG ARMORED CABLE  
REF. FIG. 12 (side) FIG. 16 (rear)
- DC cables - 4 AWG (BAT AND BAT RTN)  
REF. FIG. 17 (SIDE) FIG. 18 (REAR)
- Signals: - 2 X 8 conductors connectorized cables

**23 in. System Shelf (NT5C10CB-3/4, NT5C10CE,  
NT5C10CF, NT5C10CH)**

- capacity: - 3 x MPR25
- AC indiv. cable - 2/12 AWG ARMORED CABLE  
REF. FIG. 15
- DC cables - 4 AWG (BAT AND BAT RTN)  
REF. FIG. 17 (SIDE) FIG. 18 (REAR)
- Signals: - 2 x 8 conductors connectorized cables

**23 in. Embedded Shelf (NT5C10BC-1/2)**

- capacity: - 3 x MPR25
- AC indiv. cable - 2/12 AWG ARMORED CABLE  
REF. FIG. 15
- DC cables - 4 AWG (BAT AND BAT RTN)  
REF. FIG. 17 (SIDE) FIG. 18 (REAR)
- Signals: - 1 cable (for remote sensing and alarm)

**23 in. Embedded Shelf (NT5C10BC-3, NT5C10BD-3))**

- capacity: - 3 x MPR25
- AC common cable - 2/6 AWG ARMORED CABLE  
REF. FIG. 12 (side) FIG. 16 (rear)
- DC cables - 4 AWG (BAT AND BAT RTN)  
REF. FIG. 16 (SIDE) FIG. 17 (REAR)
- Signals: - 1 cable (for remote sensing and alarm)

**23 in. Embedded Shelf (NT5C10BM)**

- capacity: - 3 x MPR25
- AC common cable - 2/6 AWG ARMORED CABLE  
REF. FIG. 12 (side) FIG. 16 (rear)
- DC cables - 4 AWG (BAT AND BAT RTN)  
REF. FIG. 17 (SIDE) FIG. 18 (REAR)
- Signals: - 1 cable (for remote sensing and alarm)

**23 in. Embedded Shelf (NT5C10BL)**

- capacity: - 3 x MPR25
- AC indiv. cable - 2/12 AWG ARMORED CABLE  
REF. FIG. 15
- DC cables - 4 AWG (BAT AND BAT RTN)  
REF. FIG. 17 (SIDE) FIG. 18 (REAR)
- Signals: - 1 cable (for remote sensing and alarm)

**23 in. Embedded Shelf (NT5C10BJ, NT5C10BK)**

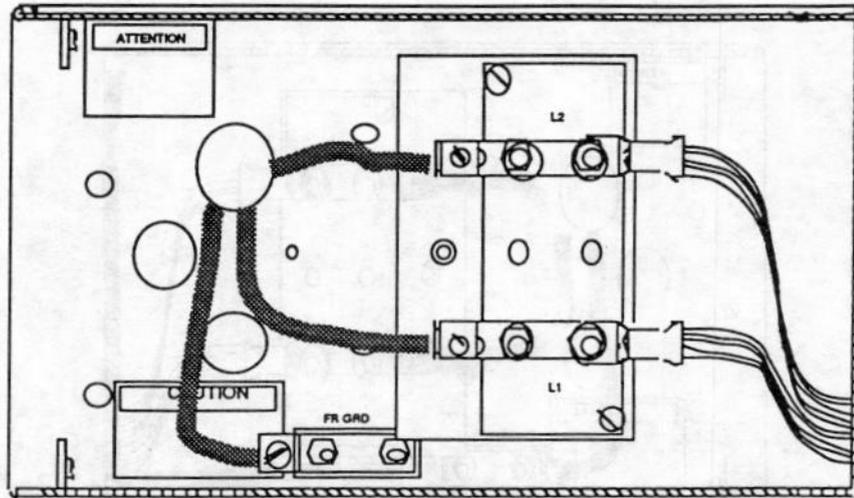
- capacity: - 2x MPR25
- AC common cable - 2/8 AWG ARMORED CABLE  
REF. FIG. 12 (side) FIG. 16 (rear)
- DC cables - 6 AWG (BAT AND BAT RTN)  
REF. FIG. 17 (SIDE) FIG. 18 (REAR)
- Signals: - 2 cables (for remote sensing and alarm)

**23 in. System Shelf (NT5C10CO)**

- capacity: - 1 x MPR15 + 1 X MPR15 "Delay Start"
- AC common cable - 2/12 AWG ARMORED CABLE  
REF. FIG. 12 (side) FIG. 16 (rear)
- DC cables - 6 AWG (BAT AND BAT RTN)  
REF. FIG. 17(SIDE) FIG. 18 (REAR)
- Signals: - 2 cables (for remote sensing and alarm)

**NOTE: SEE APPENDIX B FOR ADDITIONAL INFORMATION**

Fig. 12 - System Shelf or Embedded (left view) - Common Bussed AC - Side Access



- punch out 1.125 in.dia. knockout left side of shelf
- mount conduit connector with lock nut
- run and connect wires as illustrated
- re-install the blank panel to prevent access to the connections inside.

Fig. 12A - (Optional) Extra Ground Connection Mounting Location  
(Typical Installation View for all shelf models)

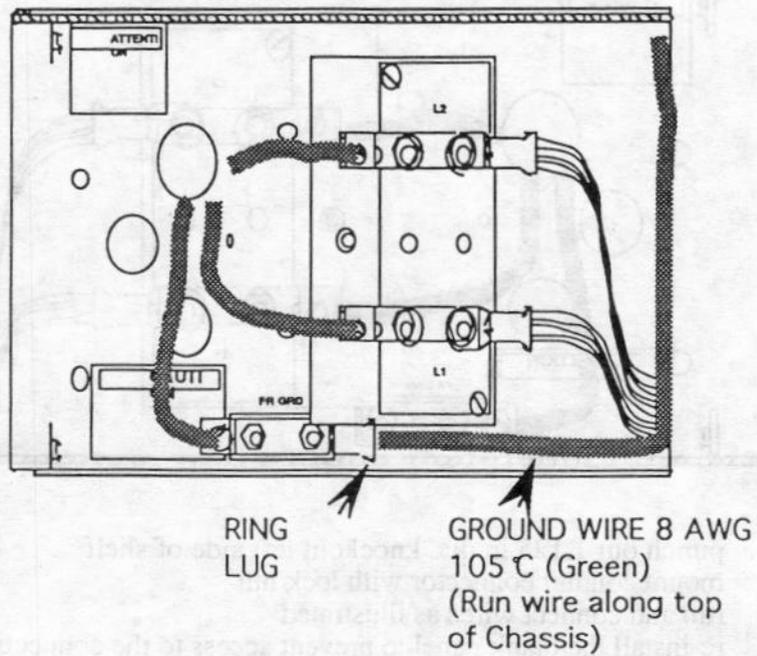
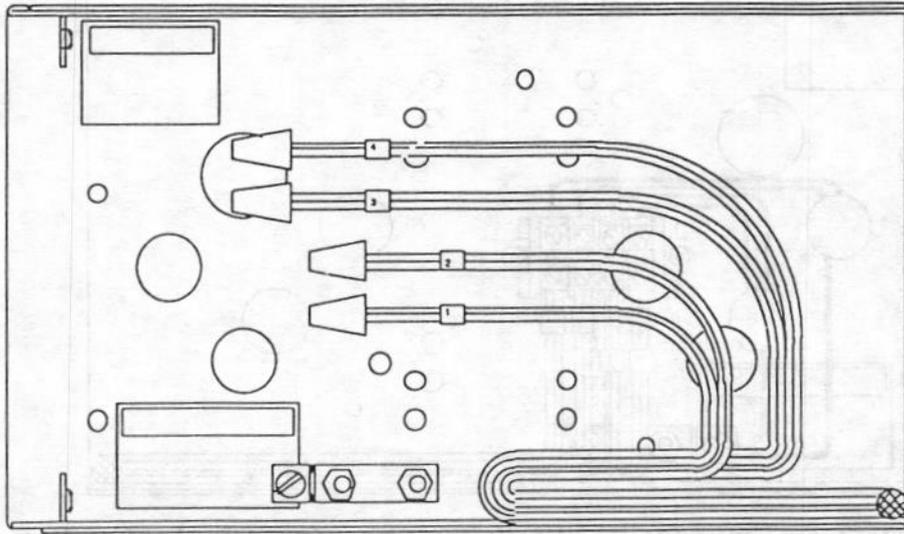


Fig. 13 - Embedded Shelf (left view) - Individual AC - Side Access Old Vintage



- punch out 0.875 in. dia. knockout left side of shelf
- mount conduit connector with lock nut
- run and connect wires as illustrated
- re-install the blank panel to prevent access to the connections inside.

Fig. 14 - Embedded Shelf (left view) - Individual AC - Side Access

NT5C108A-3/4

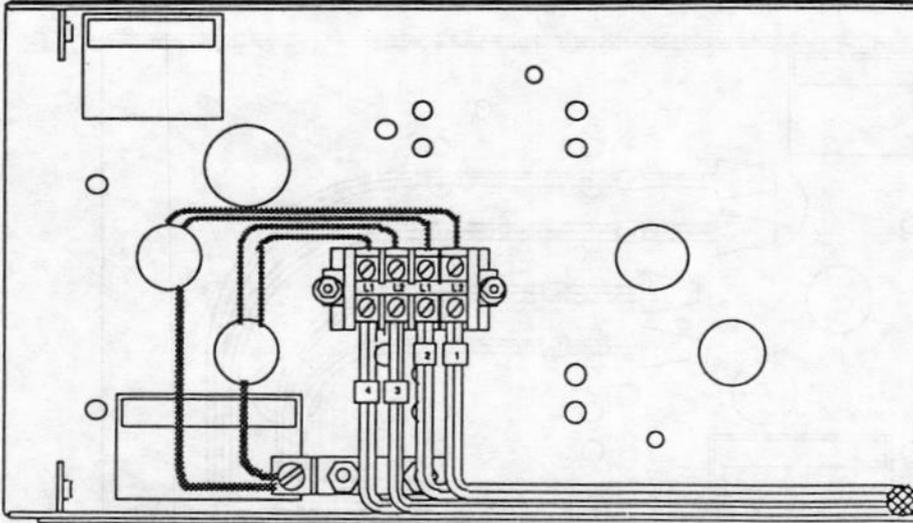
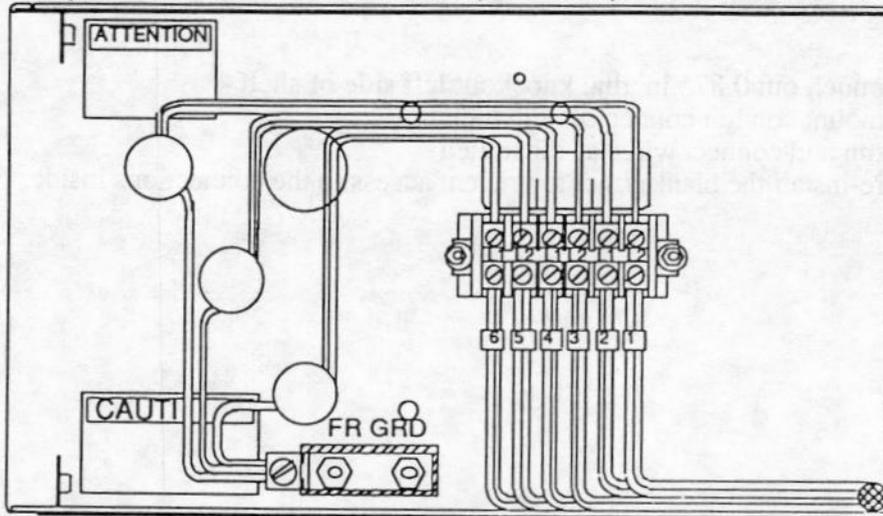


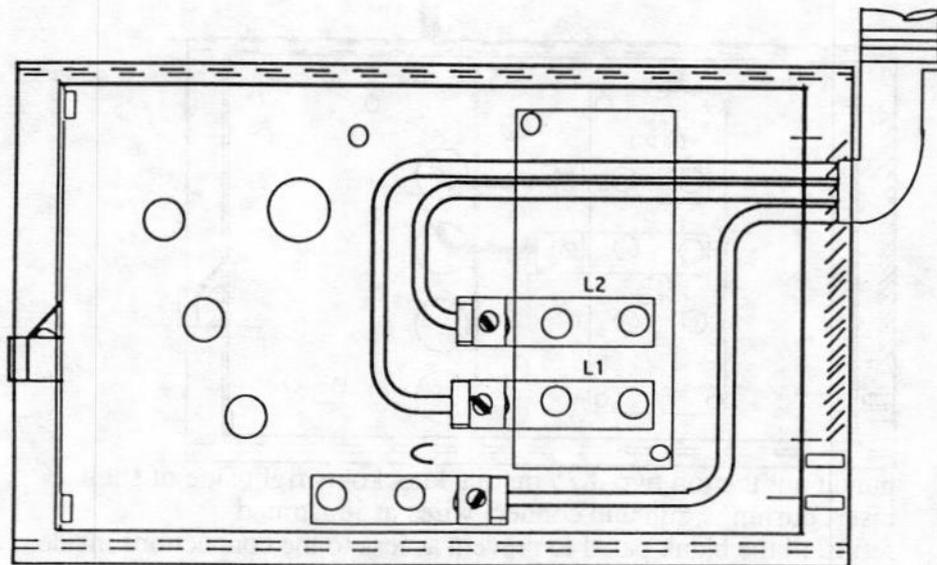
Fig 15 - System or Embedded Shelf (left view) - Individual AC - Side Access



For Fig. 14 and 15,

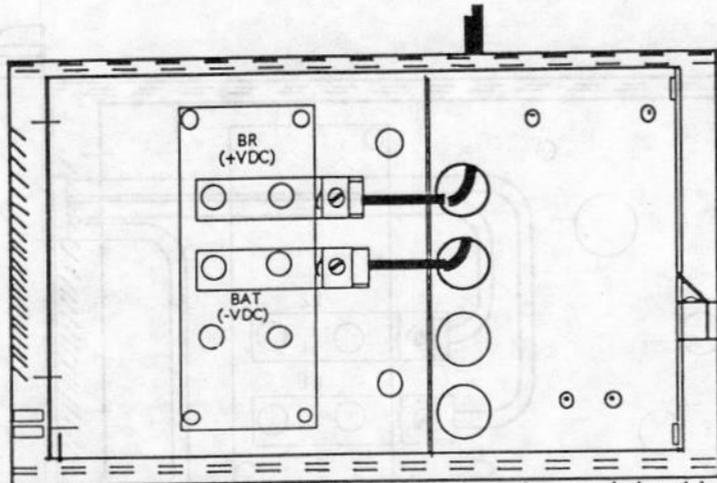
- punch out 0.875 in. dia. knockout left side of shelf
- mount conduit connector with lock nut
- run and connect wires as illustrated
- re-install the blank panel to prevent access to the connections inside.

Fig. 16 System Shelf (left view) - Common Bussed AC - Rear Access



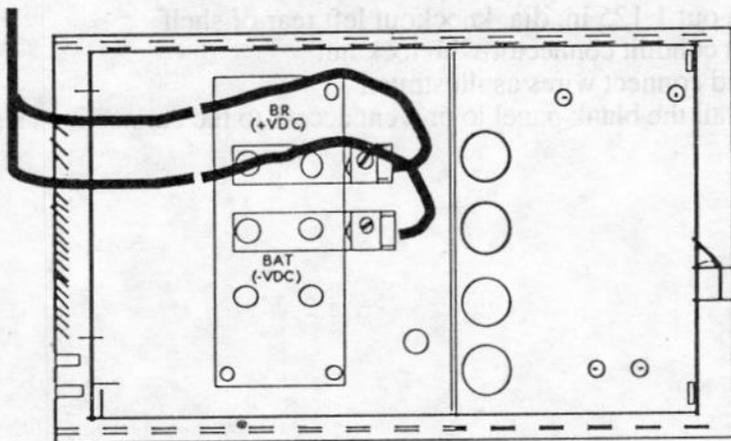
- punch out 1.125 in. dia. knockout left rear of shelf
- mount conduit connector with lock nut
- run and connect wires as illustrated
- re-install the blank panel to prevent access to the connections inside.

Fig. 17 - System or Embedded Shelf (right view) - DC Connecting - Side Access



- punch out the top two .875 in. dia. knockouts right side of shelf
- insert bushings, run and connect wires as illustrated
- re-install the blank panel to prevent access to the connections inside.

Fig. 18 - System or Embedded Shelf (right view) - DC Cabling - Rear Access



- punch out the top two .875 in. dia. knockouts right rear of shelf
- insert bushings, run and connect wires as illustrated
- re-install the blank panel to prevent access to the connections inside.

**Power Plant Interface - Signals Cabling**

Rectifier and Controller Interface Connections

Standard System Application Signal Cable Connections:

DESIGNATION	DESCRIPTION	SIGNAL TO ACTIVATE
RG (+) and RC (-)	Sensing Leads	BATR TN
HVSD	High Voltage Shutdown	BAT RTN
HVSDR	High Voltage Shutdown Reset	BAT RTN
TR	Remote Inhibit	BAT RTN
EQ	Remote Equalize	Form C contacts
RFA	Rectifier Failure Alarm	Form C contacts
FAN ALM	Fan Failure Alarm	Form C contacts

When the rectifier is installed in an embedded shelf, the RC+, RG-, EQL (if equipped) and RFA monitoring signals are extended by the cable assembly which is fed through the rear of the shelf.

The connections available from the rectifier interface connector located at the rear of the unit are described in the Rectifier and Controller Interface Connections section of this practice.

Refer to the reference section for all the interface signal wiring information for each shelf model number.

Following is a brief description of special interface or alarms signals from specific applications.

Power Shelf control signals for:

### **NT5C10BA-1/2, NT5C10BF-1 and NT5C10BP Hot Standby Power Shelf**

The NT5C10BA-1/2, NT5C10BF-1 and NT5C10BP wiring is such that when the power shelf is equipped with two or more rectifiers, one rectifier is inhibited (Standby) and will be activated when one rectifier (Main or Regular) fails.

These power shelves are equipped with a relay which provides an alarm signal "NSR" (No Standby Rectifier) when the standby rectifier is missing from its position. Also two RFA signals are available for transmitting the alarm signal to the monitoring unit.

**NOTE:** The earlier vintage "Main" rectifier has been referred to as the "Regular" rectifier.

Ref: See Appendix A for additional Information on the NT5C10BF and NT5C10BP Shelves

### **NT5C10BA-3/4 Special operating signal - AC fail NC**

Originating from a time delay relay, this signal indicates the line input voltage state of the left rectifier in the shelf. This relay which is normally closed, will become open after a delay of 8 to 10 seconds following the AC line input removal. The know indicator should be set to #6.

**NOTE:** The standby rectifier HVSD should be adjusted 0.5 V higher than the main rectifier and its float voltage 0.1 V lower than the main rectifier.

### **NT5C10BJ & NT5C10BK**

The NT5C10BJ and NT5C10BK power shelves (23 inch mounting) are designed for embedded applications. The difference between the NT5C10BJ and NT5C10BK is that the first is painted brown and the second is painted Dolphin grey. Both power shelves can be equipped with two MPR15 and MPR25 rectifiers and a low voltage disconnect unit (NT6C13FC), or with two rectifiers, one

RPM1000C and one low voltage disconnect unit without control circuit pack (NT6C13FJ).

When the NT6C13FJ unit is used, the RPM1000C is performing the control and monitoring function. The NT6C13FJ is equipped with an interface circuit pack that receives the LVD signal from the RPM1000C (battery return) to open the LVD contactor and is equipped with a bypass switch. The function of the BYPASS switch is to prevent accidental release of the LVD contactor during maintenance or when the RPM1000C must be replaced.

The power shelves offered in two configurations as described above. When the RPM1000C is not provided, the power shelf is equipped with the NT5C10PC interface circuit pack. The function of this circuit pack. The function of this circuit pack is to connect the rectifier control cables (J1 & J2) and alarm cable (J3). Following is the connector pin assignments:

Connector J1 & J2		Connector J3	
Pin	Assignment	Pin	Assignment
1	EQL	1	EQL
2	RG+	2	HVSDR
3	RC-	3	HVSD
4	N/C	4	RFA1
5	HVSDR	5	LOGIC RETURN
6	HVSD	6	RFA2
7	RFA	7	N/C
8	N/C	8	LVA

To connect the alarm signals (J3) to alarm monitoring unit it requires to order cable assembly P0739814.

### NT5C10BM

The NT5C10BM power shelf (23 inch mounting) is wired to accept the NT5C10KB local equalize feature. It houses up to three MPR15 or MPR25 rectifiers and is wired for common AC input, 120/208/240 Vac.

When the equalize switch is set to EQL position, a battery return signal is send to remote equalize input port of each rectifier in the power shelf. The rectifier output

voltage will increase by the amount set with the EQL adjustment potentiometer of the rectifier. Each rectifier must be adjusted individual to the same equalize voltage level. The yellow colour LED indicates that the rectifiers are in equalize mode.

### **NT5C10KA & KB**

This is an option offered with the embedded power shelves to provide local equalize. The power shelf must be pre-wired in order to install this feature. The NT5C10KA is brown and the Nt5C10KB is oxford grey colour.

**NOTE:** It is recommended that the rectifiers be inserted in the shelf from right to left, starting in position 1. When a Low Voltage Disconnect unit is available, the LVD shall be mounted to the right of position 1.

### **NT5C10KC**

This is an option offered to provide an AC Fail Alarm upon loss of the input line power. Selectable for 120 or 208/280 VAC operation, the circuit provides a dry C form contact relay TB1-1 (NC) & TB1-2 (C), to send an alarm. See NTP Supplement P0803489 for more information.

### **NT5C10CO**

This power shelf houses two rectifiers. One rectifier operates in the standard mode (no delay) and the other is inhibited for a fixed time after an AC power failure. The delayed start is required to allow time for the batteries to be sufficiently charged, in order for the required total AC input current for the two rectifiers be reduced to less than 20 amperes.

The rectifier that is delayed will be activated immediately if the main rectifier fails, or is pulled out or missing, or produces an RFA. The delayed start rectifier will not transmit an RFA signal to the controller during the time that it is inhibited, but it will transmit an RFA signal to the controller after the delayed start period, if the DC or AC circuit breaker is open.

When the rectifier is on the delayed start mode, the RFA LED on the rectifier will be lit (red), but at the same time the "DELAYED START", yellow LED of the timer will be ON to signify that the rectifier with the RFA red LED is on delayed start mode.

REF: See Appendix B for additional information on the NT5C10CO shelf.

### Rectifier Installation Procedure

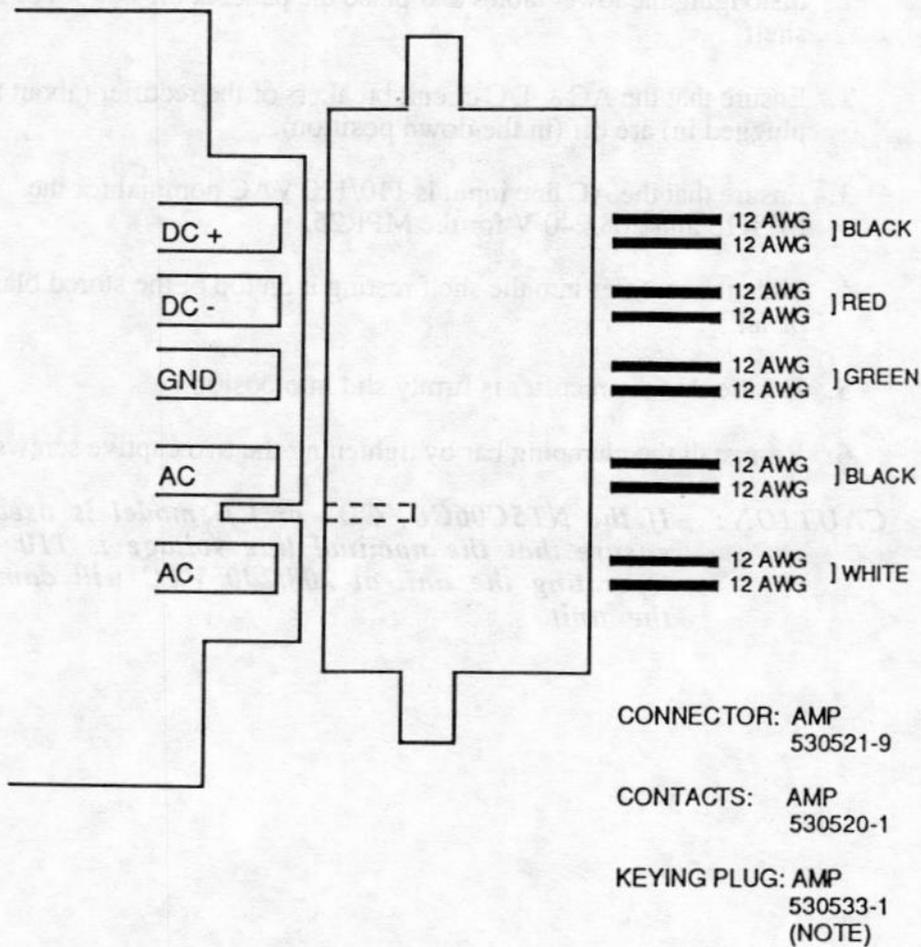
1. Release the clamping bar and remove the blank panel by a lift motion, dislodging the lower tables and place the panel at the bottom of the shelf.
2. Ensure that the AC & DC circuit breakers of the rectifier (about to be plugged in) are off (in the down position).
3. Ensure that the AC line input is 110/120 VAC nominal for the MPR15 and 208/240 V for the MPR25.
4. Slide the rectifier into the shelf resting it on top of the stored blank panel.
5. Ensure that the rectifier is firmly slid into position.
6. Re-install the clamping bar by tightening the two captive screws.

**CAUTION:** *If the NT5C06CB, CD or CE model is used, ensure that the nominal line voltage is 110 VAC. Operating the unit at 208/240 VAC will damage the unit.*

### Cabling the Rectifier

The AC and DC cabling to the rectifier is provided directly by an internal wire harness in the power shelf.

Fig. 19



**NOTE:** When required, keying plugs can be ordered under CPC A0377927. Inset one in the third plug location from the bottom.

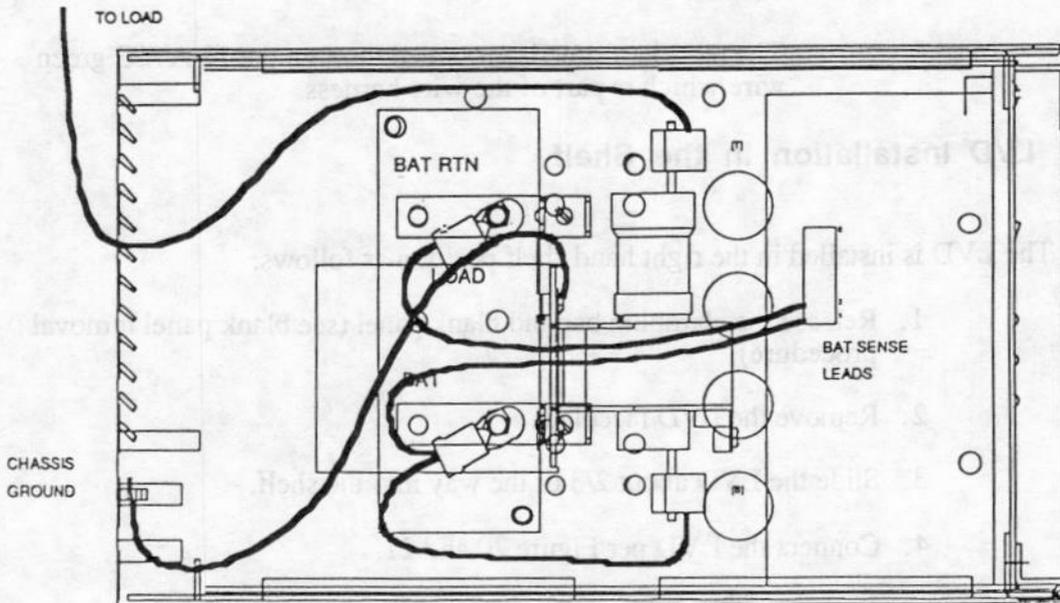
The rectifier frame is grounded through the 12 AWG green wire which is part of the wire harness.

### **LVD Installation in the Shelf**

The LVD is installed in the right hand shelf position as follows:

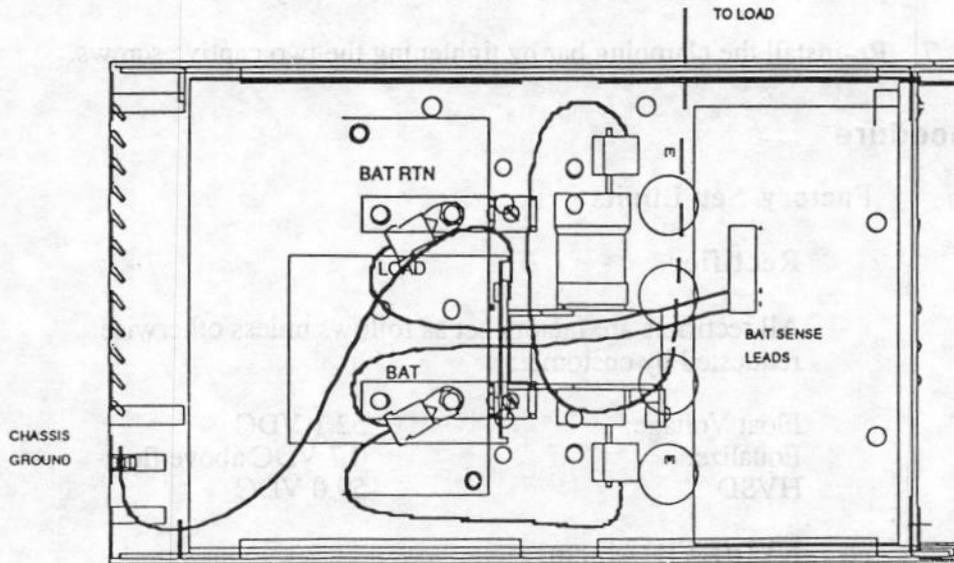
1. Release the clamping bar and blank panel (see blank panel removal procedure).
2. Remove the LVD faceplate.
3. Slide the LVD about 2/3 of the way into the shelf.
4. Connect the LVD per Figure 20 and 21.

Fig. 20 - Embedded Shelf - LVD Connections - Rear Access



- remove LVD face plate and place LVD part way into the shelf
- connect wires as illustrated (use 2 X 10 AWG wires for contactor).
- push LVD into shelf and place clamping bar

Fig. 21 - Embedded Shelf - LVD Connections - Side Access



- remove LVD face plate and place LVD part way into the shelf
- connect wires as illustrated (use 2 X 10 AWG wires for contactor)
- push LVD into shelf and place clamping bar

5. Re-install the small LVD faceplate.
6. Push the LVD the remaining distance into the shelf and slide the blank panel into the shelf between the LVD and the adjacent rectifier.
7. Re-install the clamping bar by tightening the two captive screws.

## Start-up Procedure

**NOTE: Factory Set Limits**

### Rectifier

All rectifiers are factory set as follows unless otherwise requested by customer:

Float Voltage:	52.1 VDC
Equalize:	0.7 VDC above float
HVSD	59.0 VDC

### LVD/LVD Alarms

Low Voltage Alarm (LVA):	-47 VDC
Low Voltage Disconnect (LVD):	-43.5 VDC

## Rectifier

### Power Up

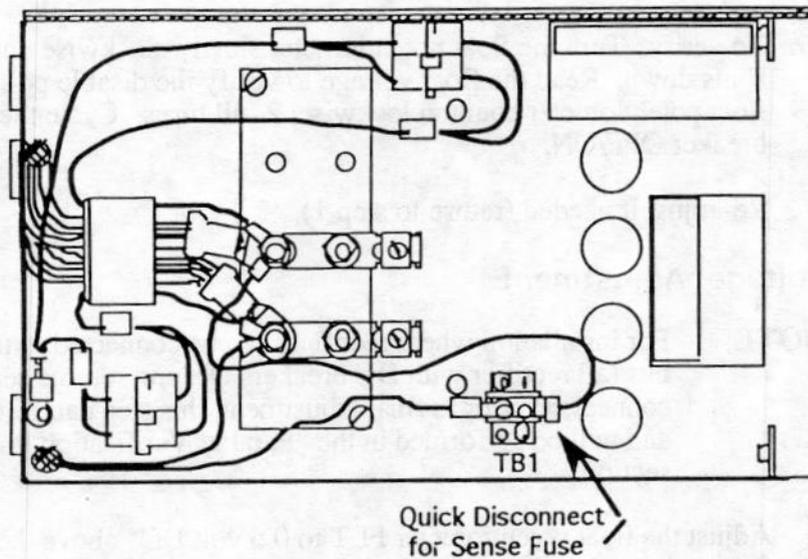
1. Verify that the rectifiers DC and AC circuit breakers are in the OFF position.
2. Open the sense leads by disconnecting a quick disconnect tab of TB-1 on the power shelf or removing the controller sense fuse (system application) or setting dip switches to the OFF position (system application) for all the shelf rectifiers.

**NOTE:** The quick disconnect tab TB1 is situated on the right end side of the shelf and is accessible by removing the front cover (see fig. 22). For system applications, refer to the appropriate system procedure guide for the fuse or dip switch location.

3. Turn ON the main AC feed.
4. Turn ON the AC circuit breaker of one rectifier; the rectifier shall provide voltage on the front panel test point terminals.

**NOTE:** If the rectifier does not provide voltage, check the inrush fuse F1. If the no voltage status remains, refer to the appropriate troubleshooting section.

FIG. 22 - Embedded Shelf Quick Disconnect for Sense (section view)



### HVSD Adjustment

1. Turn the HVSD potentiometer fully clockwise.
2. Monitoring the test points (V+, V-), adjust the float potentiometer FLT to the desired HVSD level.

**NOTE:** If the desired HVSD level is greater than the float limit of -57V, hold the FLT/EQL switch to EQL and use the EQL potentiometer to bring the float voltage to the desired HVSD level. Hold the switch through the following steps.

3. Turn the HVSD potentiometer slowly counterclockwise until the rectifier shuts down. The test points voltage shall start to decay to 0 volt.
4. Turn float potentiometer counterclockwise, 2 full turns.
5. Cycle the AC breaker OFF/ON. The unit shall power up with the return of the float voltage on the test points.
6. To verify. Turn the float potentiometer slowly clockwise until unit shuts down. Read the float voltage to verify the disable point. Turn float potentiometer counterclockwise, 2 full turns. Cycle the AC breaker OFF/ON.
7. Re-adjust if needed (return to step 1).

### Float Voltage Adjustment

**NOTE:** For installation where rectifiers can be connected to the charge bus (all rectifier with DC breakers ON and remote sense leads connected) prior to final adjustment, this step can be omitted and will be performed in the "Parallel Verification Procedure" section.

1. Adjust the float potentiometer FLT to 0.5 volt DC\* above the desired float voltage determined by the battery vendor or power engineer, using the voltmeter attached to the test point (V+ V-).

2. Final system's float voltage adjustment will be performed as per the "Parallel Verification Procedure" step no. 6.

\* The 0.5 volt DC extra does not apply to MPR25 rectifiers of release above Rel: 30.

### **Equalize Voltage Adjustment**

1. Hold the equalize switch to the EQL position.
2. While the switch is up, set the equalize potentiometer to 0.5 volts DC \* above the desired level determined by the battery vendor or power engineer, using the voltmeter attached to the test point (V+ V-).

### **Parallel Verification Procedure**

**NOTE:** The following does not apply to rectifier shelf applications with hot stand-by. For delayed start shelf applications, wait after the delay before performing the next step.

1. All the rectifiers in the shelf or system must have been individually adjusted per the above POWER UP, HVSD ADJUST, FLT ADJUST AND EQUALIZE ADJUST procedures before going to the following steps.
2. Verify that the rectifier DC and AC circuit breakers are in the OFF position.
3. Reconnect the sense leads by connecting the quick tab of TB-1 on the shelf or re-installing the sense fuse (system application) or setting dip switches to the ON position (system application) for all the shelf rectifiers..
4. Turn all the DC breaker to the ON position.
5. Turn all the AC breaker to the ON position.

**NOTE:** Some rectifiers may still indicate an RFA (RFA led with color red). An RFA may be indicated when a rectifier delivers less than 0.1A. Turning the float potentiometer FLT slightly clockwise shall make them go green.

6. The rectifiers float potentiometer FLT may need to be re-adjusted to the desired system float voltage determined by the battery vendor or power engineer. This procedure can be executed by increasing the FLT potentiometer of the units giving the lowest current, if the system float voltage is too low or reducing the FLT potentiometer of the rectifiers carrying the highest current, if the system float voltage is too high. The system float voltage shall be read from the system's meter voltage reading. Verify that the system's voltage level is maintained while proceeding through step no. 7.
- \* The 0.5 volt DC extra does not apply to MPR25 rectifiers of release above Rel: 30.
7. The load share amperage per rectifier must be equal. Adjust the individual float potentiometer as needed to balance the current delivered by each rectifier. It is recommended that the current from each rectifier be at least 3 ampere per rectifier (i.e. 9A for three rectifiers) for best adjustment results. It is also recommended to leave the units functioning for at least 30 minutes to reach full stability prior to final adjustment.

### Low Voltage Disconnect

Test and Adjustment of LVD Units (NT6C13FA...FH) (Circuit Pack NT6C13PB Rel 03)

To verify the LVA and LVD/LVDR operating levels in operation without disconnecting the load proceed as follows:

1. Set the NORMAL/BYPASS switch to the BYPASS position. The TEST LED should illuminate.
2. Connect a digital voltmeter at the test jacks located at the front/bottom of the LVD unit.
3. Turn the Test potentiometer slowly counterclockwise and check when the LVA LED illuminates. It should illuminate at  $-47 \pm 0.5$  V.

4. Continue to turn the Test potentiometer counterclockwise until the LVD LED illuminates. It should illuminate at  $-43.5 \pm 0.5$  V.
5. Turn the Test potentiometer clockwise. At  $-47 \pm 0.5$  V the LVA LED should extinguish.
6. Continue to turn the Test potentiometer clockwise. Between  $-50$  and  $-50.5$  V the LVD LED should extinguish.
7. If no adjustment is required, set the NORMAL/BYPASS switch to the NORMAL position. The TEST LED should extinguish. If there is need to readjust any alarm level, follow the steps described below:

#### **Adjustment procedures for the 50A LVD unit Rel. 02, 02A, 3 & 3A**

8. Set the NORMAL/BYPASS switch to the BYPASS position (if not already in the BYPASS position).
9. Remove the LVD unit's faceplate by turning the fastener located at the front/top of the unit one quarter turn counterclockwise.
10. Connect the digital voltmeter to the test jacks located at the front/bottom of the unit's PCB.

#### **LVA Adjustment**

11. Turn the Test potentiometer counterclockwise until the voltage reading on the meter is  $-47$  V. Turn the LVA adjust potentiometer R20 (located below the LVA LED) clockwise until the LVA LED illuminates or counterclockwise it extinguishes.
12. Reinstall the faceplate removed in step 9.

#### **LVD/LVDR adjustment procedures**

**WARNING:** Do not switch the NORMAL/BYPASS switch back to the NORMAL position if the LVD/LVDR potentiometers are readjusted and their adjustments are not completely verified. Doing so can cause loss of power to the load.

13. Turn the LVD and the LVDR potentiometers fully counterclockwise.

**NOTE:** To ensure that the potentiometer is turned fully counterclockwise, the pot must be turned 20 full turns or until the click sound produced by the pot's clutch is heard, when it has reached the end of its adjustments.

14. Turn the LVDR potentiometer four turns clockwise for Rel. 2 and 2A or 9 turns for Rel. 3 and 3A.

**NOTE:** The effect of the LVDR potentiometer in setting the reconnect voltage level is approximately 1.6 V per turn for Rel. 2 and 2A, or approximately 0.75 V for Rel. 3 and 3A. The Connect/disconnect voltage difference is smaller when the LVDR potentiometer is turned counterclockwise and is larger when it is turned clockwise.

15. Adjust the voltage measure at the test jacks to -43.5 V by the Test potentiometer.

16. Turn the LVD potentiometer clockwise until the LVD LED illuminates.

17. The LVD LED should extinguish between -50 and -50.5V. Adjust the voltage with the Test potentiometer until the LVD LED extinguishes. If the LVD LED does not extinguish, turn the LVDR potentiometer slightly counterclockwise or clockwise if the LED extinguishes before -50V.

18. To verify the adjustment, set the Test voltage to -43.5V. Readjust the LVD potentiometer until the LVD LED illuminates.

19. Readjust the Test voltage to -51V. The LVD LED should extinguish between -50 and -50.5V. If it does not, repeat step 17.

20. Set the NORMAL/BYPASS switch to the NORMAL position. The TEST LED should extinguish.

## Rectifier Replacement/Add-On Procedure

1. Verify that the new rectifier DC and AC circuit breakers are in the OFF position.
2. Install the new rectifier in the shelf per the Rectifier Installation Procedure in the Installation and Start-up Procedure section.
3. Open the sense leads by disconnecting a quick disconnect tab of TB-1 on the power shelf or removing the controller sense fuse (system application) or setting a dip switch to the OFF position (system application) for the selected rectifier.

**NOTE:** The quick tab TB1 is situated on the right end side of the shelf and is accessible by removing the front cover (see fig. 22). For system applications, refer to the appropriate system procedure guide for the fuse or dip switch location.

4. Verify that the shelf main AC feed is ON.
5. Turn ON the AC circuit breaker of the rectifier. The rectifier shall provide voltage on the front panel test point terminals.

**NOTE:** If the rectifier does not provide voltage, check the inrush fuse F1. If the no voltage status remains, refer to the appropriate troubleshooting section.

6. The rectifier factory settings are set as follow, unless otherwise requested by customer:

Float voltage:	52.1 Vdc
Equalize:	0.7 Vdc above float
High voltage shut down:	59.0 Vdc

If any of these settings need to be modified, refer to the appropriate section of Float Voltage, HVSD and Equalize adjustment in the Rectifier Start-Up Procedure section.

7. Reconnect the sense leads.

**NOTE:** Some rectifiers may indicate an RFA (RFA LED with color red). an RFA is indicated when a rectifier delivers less than 0.1A. Turning the float potentiometer FLT slightly clockwise shall make them go green.

8. The rectifiers float potentiometer FLT may need to be re-adjusted to the desired system float voltage determined by the battery vendor or power engineer. This procedure can be executed by increasing the FLT potentiometer of the units giving the lowest current, if the system float voltage is too low or reducing the FLT potentiometer of the rectifiers carrying the highest current, if the system float voltage is too high. The system float voltage shall be read from the system's meter voltage reading. Verify that the system's voltage level is maintained while proceeding through step no. 9.
9. The load share amperage per rectifier must be equal. Adjust the individual float potentiometer as needed to balance the current delivered by each rectifier. It is recommended that the current from each rectifiers be at least 3 ampere per rectifier (i.e. 9A for three rectifiers) for best adjustment results. It is also recommended to leave the units functioning for at least 30 minutes to reach full stability prior to final adjustment.

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## Low Voltage Disconnect

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The LVD provides protection for the batteries. The LVD disconnects the load from the batteries when a preset low voltage, which can cause permanent battery damage is reached.

The LVD is available in brown or grey colour (faceplate only). The nominal dimensions are 6.60 in. high, 10.25 in. long and 2.2 in. or 5.85 in. wide (faceplate only). The LVD is designed to be housed in the power shelf and is used primarily in embedded applications.

The Low Voltage and Low Voltage Disconnect alarms are visually displayed at the LVD unit and can also be cabled out for monitoring purposes.

### Electrical

- Input voltage:	-42 to -60 VDC
- Input current:	0.400A
- LVD current capacity	50A
- LVD adjustability	-42 to -53 VDC
- Auto reconnect:	8V above the release level
- Low Voltage Alarm	-47 +/- 0.5V

### Environmental

The LVD will operate satisfactorily under the following conditions:

- Temperature:	-40°C to 65°C (-40°F to 149°F)
- Humidity:	0% to 95% (non condensing)
- Altitude:	Sea level to 2100m (7000 ft.)

### Storage

The unit is capable of withstanding temperature and humidity as specified below, during shipping and storage:

## 72 Low Voltage Disconnect

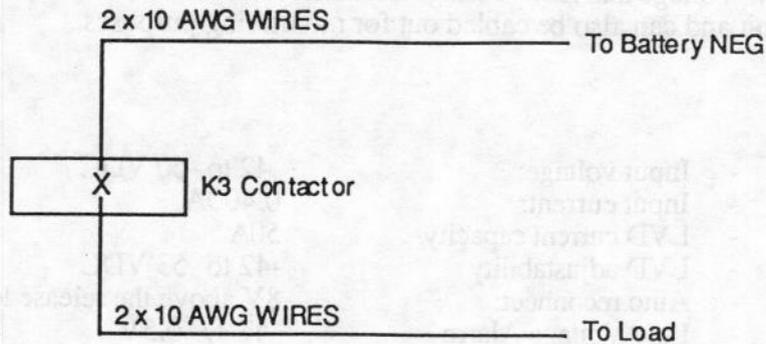
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- High Temperature: +75°C Dry heat (167°F)
- Low Temperature: -50°C (-58°F)
- Humidity: 0 to 95% (non condensing)

### DC Cabling

The DC cabling from the batteries or shelf to the Low Voltage Disconnect unit must be connected manually. Fig. 23 illustrates the connections to be made. Section Installation and Start up Procedure indicates the sequence to be followed when the unit is installed in the power shelf.

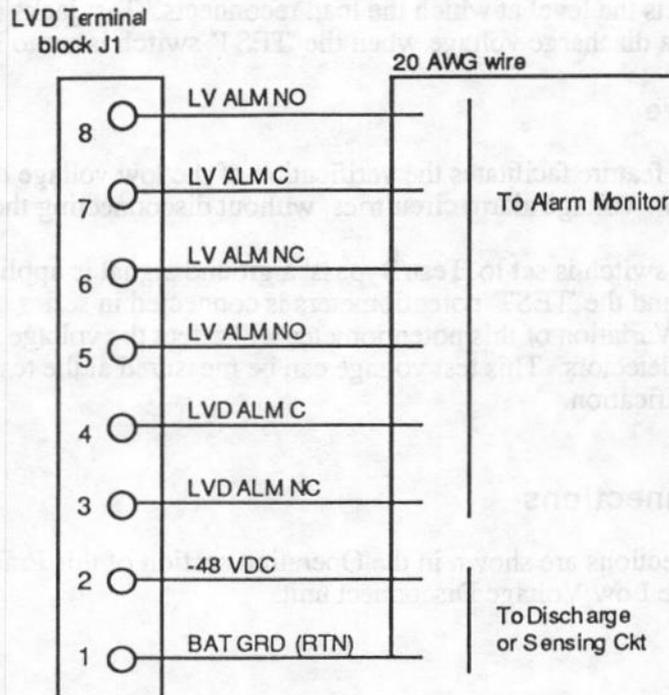
Fig. 23 - Low Voltage Disconnect Connections



### Control and Monitoring Signals

The control and monitoring signals for the Low Voltage Disconnect unit are shown below. Those signals are accessible directly on the terminal block in the unit. Section Installation and Start up Procedure describes the detailed procedure for interconnecting the LVD in an embedded shelf application.

**Fig. 24 - Low Voltage Control and Monitoring Signals**



**Operation**

The battery voltage is monitored by the low voltage disconnect and low voltage alarm circuit (LVA). When the voltage drops to approximately -47 VDC, the LVA LED lights and the alarm is extended on the terminal block.

When the battery voltage drops to the low voltage disconnect level, the contactor opens, disconnecting the load from the battery. This turns the LVD LED ON and activates the low voltage disconnect alarm. When the battery voltage rises by approximately 8 V (adjustable) above the release level, the load is reconnected to the batteries and the alarm is cleared.

The LVD potentiometer sets the level at which the load disconnects and the LVDR potentiometer sets the level at which the load reconnects. Test jacks (TP1 and TP2) provide the plant discharge voltage when the 'TEST' switch is set to NORMAL.

### **Test Feature**

The internal test feature facilitates the verification of the low voltage disconnect, reconnect and low voltage alarm circuitries, without disconnecting the load.

When the panel switch is set to 'Test/Bypass' a ground signal is applied to lock the LVD contactor and the 'TEST' potentiometer is connected in series with the control circuit. Variation of this potentiometer will affect the voltage senses by the LVD and LVA detectors. This test voltage can be measured at the test jacks TP1 and TP2 for verification.

### **Signal Connections**

The signal connections are shown in the Operation section of this Practice for the installation of the Low Voltage Disconnect unit.

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# Maintenance and Troubleshooting

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## Maintenance

### Rectifier

#### Float/Equalize and Remote Equalize

- a) Disconnect the sense leads locally from the rectifier, by either disconnecting a quick disconnect tab TB1 on the shelf or removing the appropriate system fuse. (See Rectifier Interface section for System Applications.) Open the output DC breaker. The unit is ready for local adjustment. The unit shall provide voltage on the front panel test point terminals. If it is not, cycle the AC breaker to reset the unit.
- b) Hold the FLT/EQL momentary switch to EQL for local equalize.
- c) Using a voltmeter, verify and adjust the EQL potentiometer so that the output voltage reads 0.5 volts\* above the system equalize requirement.
- d) Release the FLT/EQL switch. Check that the output voltage drops to the float value plus 0.5V\*.
- e) Verify the HVSD level. It is recommended that it be set approximately 3 V above the power system shutdown limit. Refer to the Start-up Procedure section, subsection Rectifier, for the verification procedure.
- f) Reconnect the sense leads locally to the rectifier. Close the output DC breaker. Cycle the AC breaker to reset the unit. The ON led should be green.

### Filter

If the unit operates in a dusty environment the optional fan filter is recommended. It must be inspected and changed or thoroughly cleaned at least every 12 months. **Do not install a wet filter on the unit.**

To remove the filter, simply unscrew it. Re-install it by reversing the operation.

- \* The 0.5 volt DC extra does not apply to MPR25 rectifiers of release above Rel: 30.

### Fan Cooling

Visually inspect the intake of the airflow for any obstruction by foreign objects or excessive dust and dirt build-up. Open both the DC and AC breakers and remove the unit from the power shelf. Inspect the air outlet for obstruction by foreign objects. Visually inspect the air outlet of the enclosure or cabinet. If a problem is detected in the rectifier, contact your local NT service facility. The unit cannot be opened for on-site servicing.

**CAUTION:** *Do not attempt to access the inside of the unit with any tool or finger. Severe electrical shocks could result.*

### Storage

The rectifier contains aluminum electrolytic capacitors. For this reason, either the rectifier shall be in operation or once a year the equipment shall be energized for at least two hours in order to maintain the electrolytic capacitors in good condition.

### Power Shelf

The rectifier shelf is free of maintenance requirements.

### Low Voltage Disconnect

The LVD voltage adjustment levels should be verified periodically (preferably at intervals no greater than 1 year apart). Refer to Troubleshooting section, subsection Low Voltage Disconnect for the verification procedure. When the verification has been completed, set the Test/bypass switch to the Normal position.

The DC connections on the main contactor should be torqued (70 in.-lb.) periodically (at 1 year intervals) to avoid build up of hot spot and voltage drop.

## Troubleshooting

### Rectifier Fail Alarm

- Verify that the input AC voltage is within the specified limits.
- Cycle the AC breaker off/on to reset the unit from a possible HVSD shutdown.
- Make sure the HVSD potentiometer is adjusted properly. Refer to Start up Procedure section, subsection Rectifier for adjustment procedure.
- If the unit is used in parallel with other units the rectifier will indicate an RFA alarm when the unit gives no current. This could mean that the float voltage is too low. Increase the float voltage by turning the FLT potentiometer clockwise until the ON/RFA led turns green.
- Verify the front panel inrush current fuse (F1, 3/4 A, 250 V). A blown fuse on the MPR15E (NT5C06CB/CD/CE) may indicate that the input line voltage is too high. Refer to the Recommended Replacement Part section to order a replacement fuse.
- The unit should not be opened for on-site servicing. If the problem persists contact your local NT service facility.

### Load Sharing

Verify that the sense leads of all rectifiers are connected to a common point (across the battery, or output power terminals of the power shelf or at the discharge busbar).

Readjust the rectifier's float voltage until all rectifiers share the load. It is recommended that the current from each rectifier be 3 Amp minimum for best results.

It is also recommended to leave the units functioning for at least 30 minutes to reach full stability prior to final system adjustment.

## Fan Failure

Fan failure is detected by the absence of fan rotation. The rectifier will be inhibited and an RFA and Fan alarm will be activated. The Fan Fail LED will turn RED.

## Fan Replacement Procedure

**CAUTION:** *Before replacing the fan, turn the rectifier off. Remove the rectifier from the shelf. Wait five (5) minutes to allow all internal capacitors to fully discharge.*

- With the unit sitting solidly on a clean work bend, carefully remove the five (5) mounting screws which hold the fan assembly (See Fig. 25).
- Slowly and carefully remove the fan assembly by pulling it from the chassis.

**CAUTION:** *Do not allow any dirt, dust, moisture or metallic particles to fall inside the unit.*

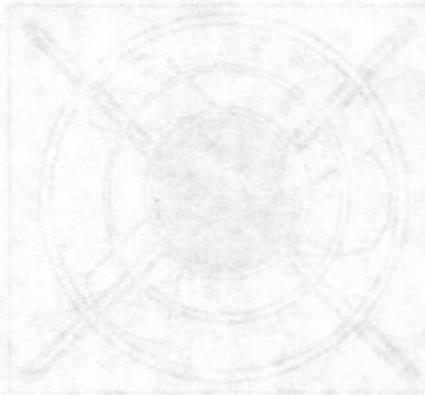
- Take note of which side the wire is connected to the fan.
- Disconnect the fan connector (three pins)
- Remove the four (4) retaining screws which hold the chassis plate, fan and fan grille together (See Fig. 25).
- Place the mounting clips on the replacement fan (if it is not so equipped).
- Mount the replacement fan in the same orientation as the old ensuring the wire is connected to the fan in the same manner. Ensure the orientation of the fins is such that the air is blown outwards when the fan is operated.

- Mount the fan, fan grille and chassis plate with the four (4) retaining screws.
- Reconnect the fan connector and mount the fan assembly in the unit with the five (5) mounting screws.

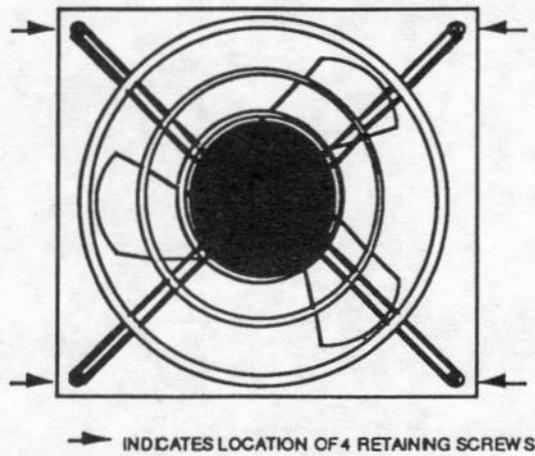
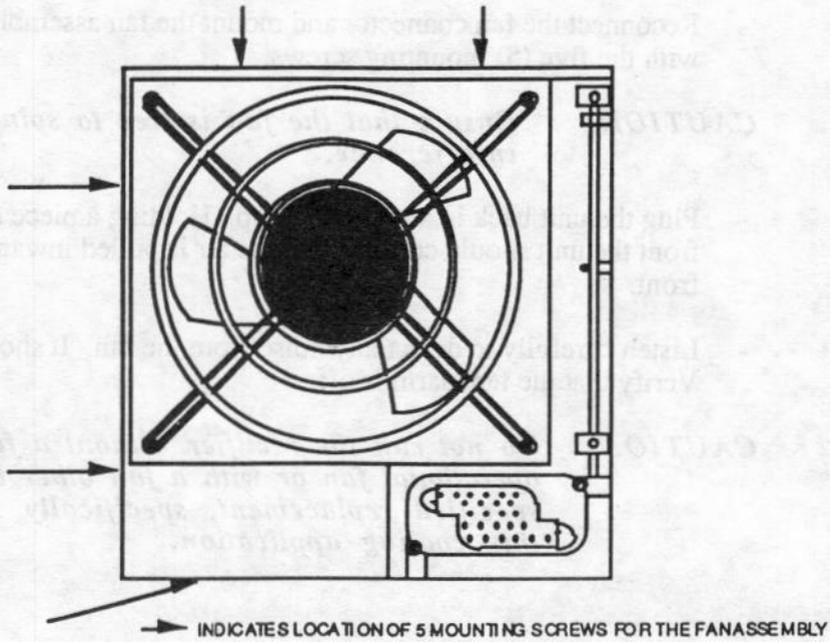
**CAUTION:** *Ensure that the fan is free to spin without interference.*

- Plug the unit back in and power it up. Holding a piece of paper at the front the unit should confirm that the air is pulled inwards from the front.
- Listen carefully to detect any noise from the fan. It should run free. Verify that the fan alarm is off.

**CAUTION:** *Do not run the rectifier without a fully operational fan or with a fan other than the specified replacement, specifically selected for this cooling application.*



**Fig. 25 - Fan Assembly**



## Low Voltage Disconnect

In case of difficulty, follow the steps indicated below:

**NOTE:** When the LVD is defective and has to be removed from the system, bypass the LVD externally (use #6 AWG cable) in order to maintain power to the load.

**WARNING:** Before readjusting the potentiometers set the test switch to the Test/Bypass position.

<b><u>SYMPTOM:</u></b>	<b><u>Possible cause</u></b>
Low Voltage Test/Bypass LED lit	The switch is on the Test/Bypass position
LVA and LVD LED lit	Check the voltage level at the test jacks and the position of the Test switch. Verify the LVA and LVD adjustment. Set the test switch to the Test/Bypass position to verify their operation. Replace the circuit pack if they are still not operational.
The LVD disconnects the load	Verify the voltage at the test jacks. Remove the faceplate and check the fuse located on the control PCB

## Abbreviations

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ALM	Alarm
C	Common
EMI	Electromagnetic Interference
EQL	Equalize
HVSD	High Voltage Shutdown
LED	Light Emitting Diode
LVA	Low Voltage Alarm
LVD	Low Voltage Disconnect
LVDR	Low Voltage Disconnect/Reconnect
MPR	Modular Power Rectifier
MPS	Modular Power Shelf
NC	Normally Closed
NO	Normally Open
NSR	No Standby Rectifier
NT	Northern Telecom
NSR	No Standby Rectifier
PCB	Printed Circuit Board
RFA	Rectifier Fail Alarm
TR	Temporary Release
FAN ALM	Fan Alarm

# References

FIG. 26 - System Application Power Shelf MPS50S and MPS75S

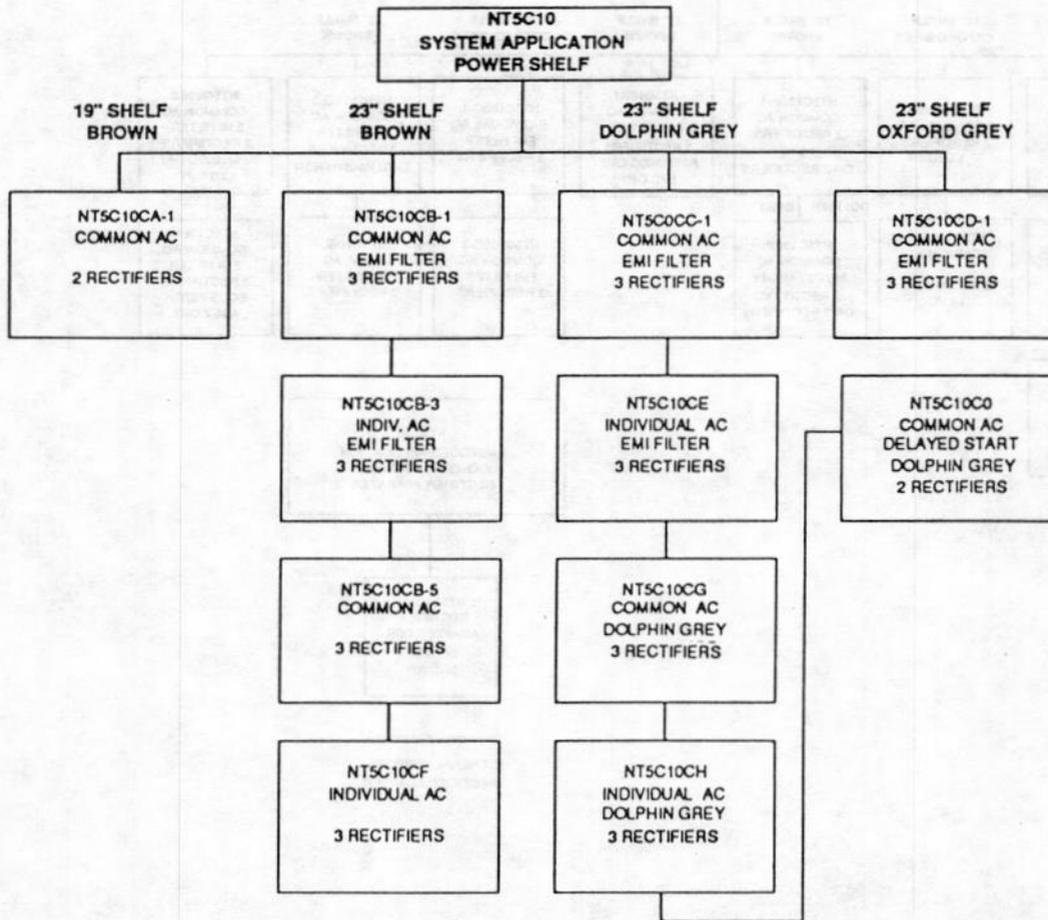


FIG. 27 - Embedded Application Power Shelf MPS50E and MPS75E

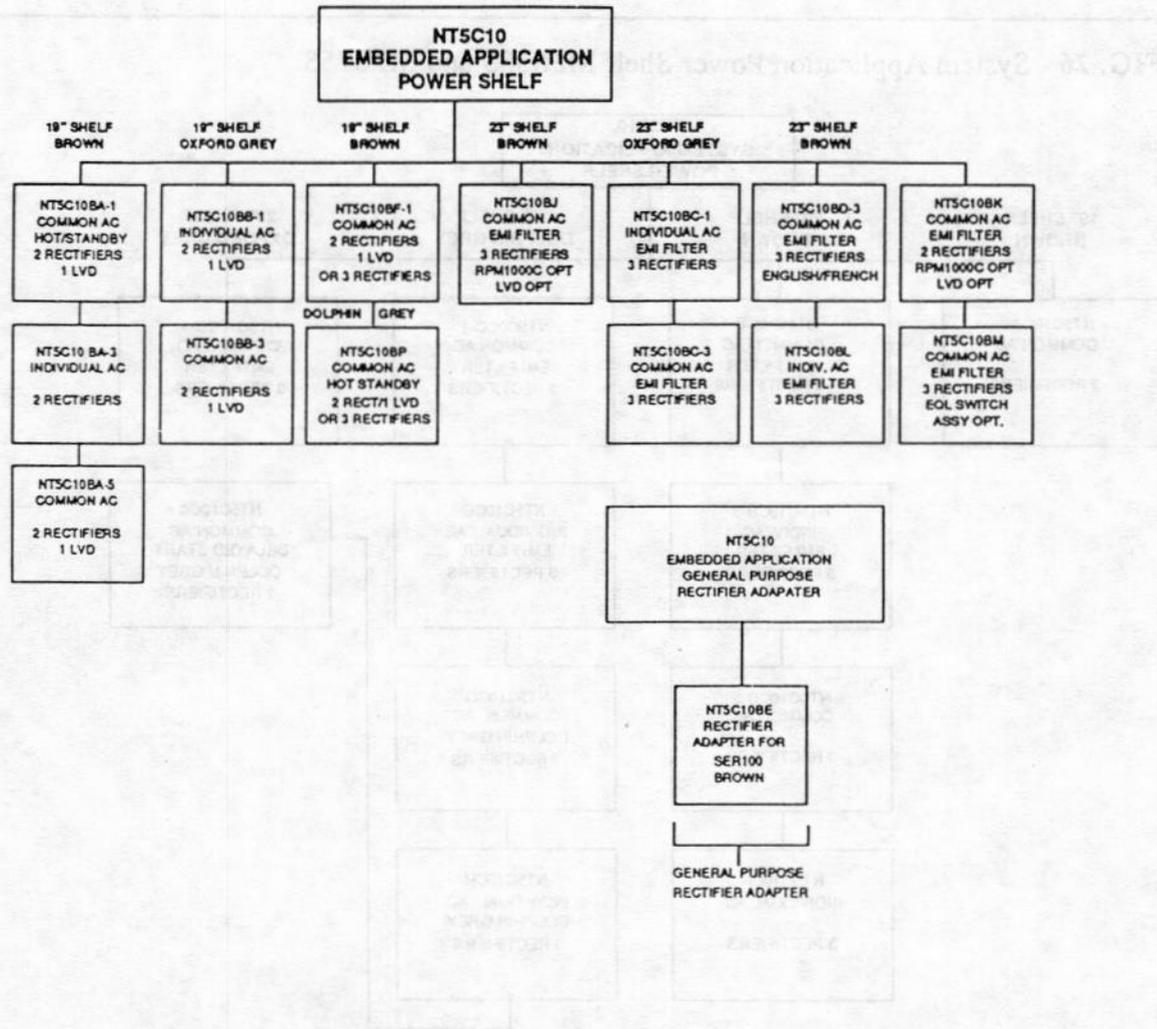
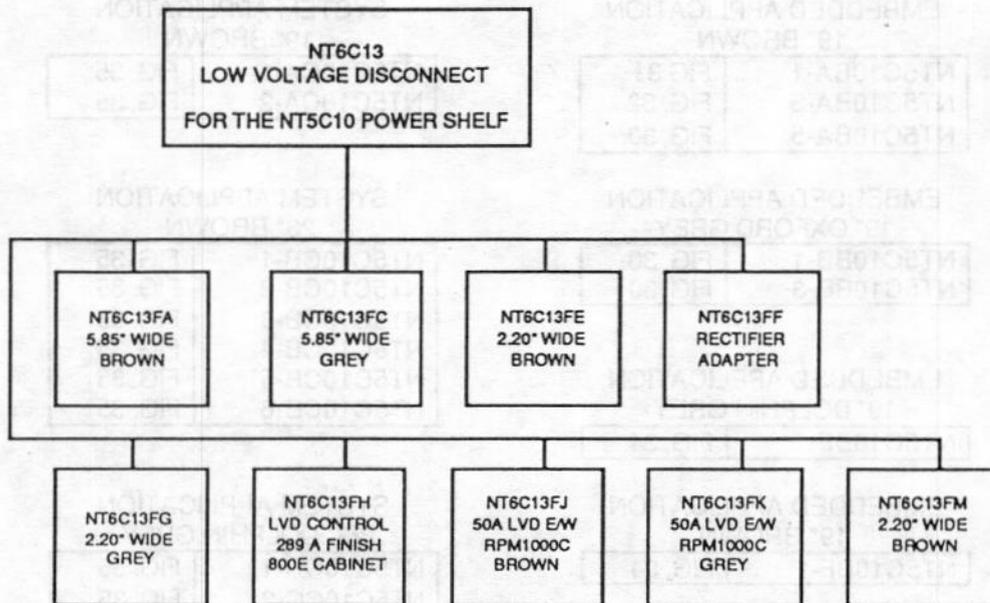


FIG. 28 - Low Voltage Disconnect



**FIG. 29 - POWER SHELF WIRING FIGURE INDEX**

EMBEDDED APPLICATION  
19" BROWN

NT5C10BA-1	FIG.31
NT5C10BA-3	FIG. 32
NT5C10BA-5	FIG. 30

SYSTEM APPLICATION  
19" BROWN

NT5C10CA-1	FIG. 35
NT5C10CA-2	FIG. 35

EMBEDDED APPLICATION  
19" OXFORD GREY

NT5C10BB-1	FIG. 30
NT5C10BB-3	FIG. 30

SYSTEM APPLICATION  
23" BROWN

NT5C10CB-1	FIG. 35
NT5C10CB-2	FIG. 35
NT5C10CB-3	FIG. 35
NT5C10CB-4	FIG. 35
NT5C10CB-5	FIG. 35
NT5C10CB-6	FIG. 35

EMBEDDED APPLICATION  
19" DOLPHIN GREY

NT5C10BP	FIG. 34
----------	---------

EMBEDDED APPLICATION  
19" BROWN

NT5C10BF-1	FIG. 34
------------	---------

SYSTEM APPLICATION  
23" DOLPHIN GREY

NT5C10CC-1	FIG. 35
NT5C10CC-2	FIG. 35
NT5C10CG	FIG. 35
NT5C10CH	FIG. 35
NT5C10CO	FIG. 41

EMBEDDED APPLICATION  
23" BROWN

NT5C10BC-1	FIG. 36
NT5C10BC-2	FIG. 36
NT5C10BC-3	FIG. 36
NT5C10BJ	FIG. 37

SYSTEM APPLICATION  
23" OXFORD GREY

NT5C10CD-1	FIG. 35
NT5C10CD-2	FIG. 35
NT5C10CE-1	FIG. 35
NT5C10CE-2	FIG. 35
NT5C10CF-1	FIG. 35
NT5C10CF-2	FIG. 35

EMBEDDED APPLICATION  
23" OXFORD GREY

NT5C10BD-3	FIG. 33
NT5C10BK	FIG. 37

EMBEDDED APPLICATION  
23" DOLPHIN GREY

NT5C10BL	FIG. 39
NT5C10BM	FIG. 40,36

Fig. 30 - NT5C10BA-5/6 & NT5C10BB-1/2/3/4 EMBEDDED APPLICATION

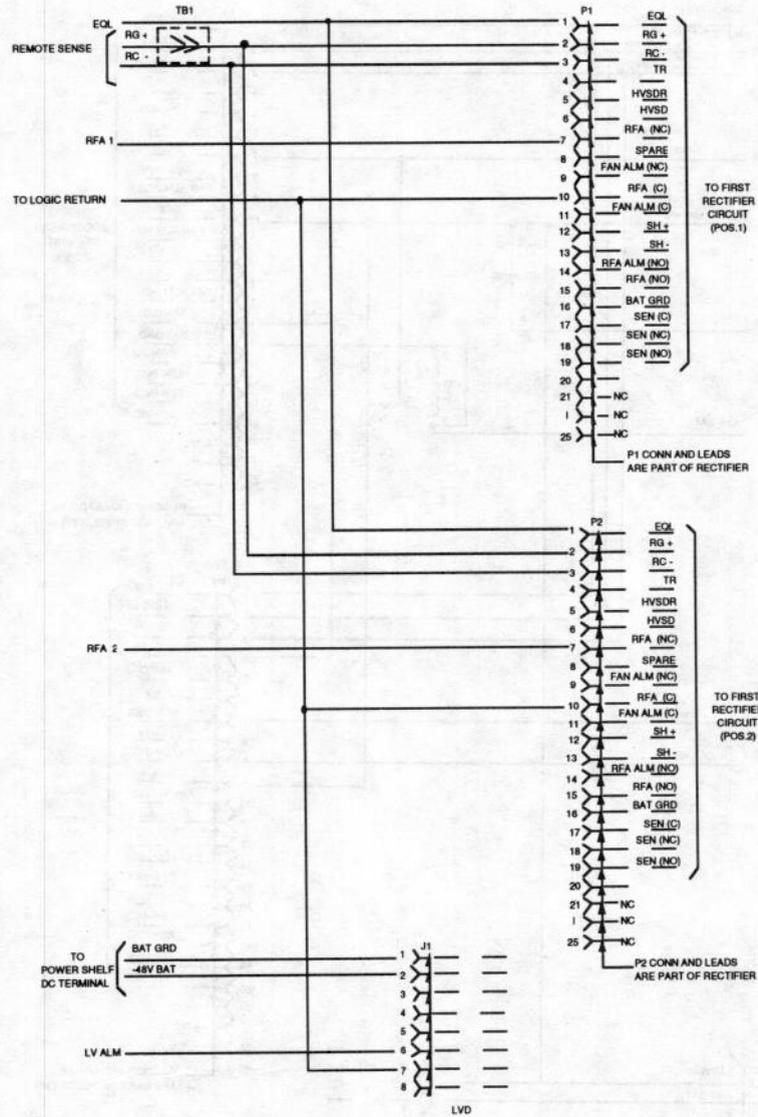


Fig. 31 - NT5C10BA-1/2 EMBEDDED APPLICATION

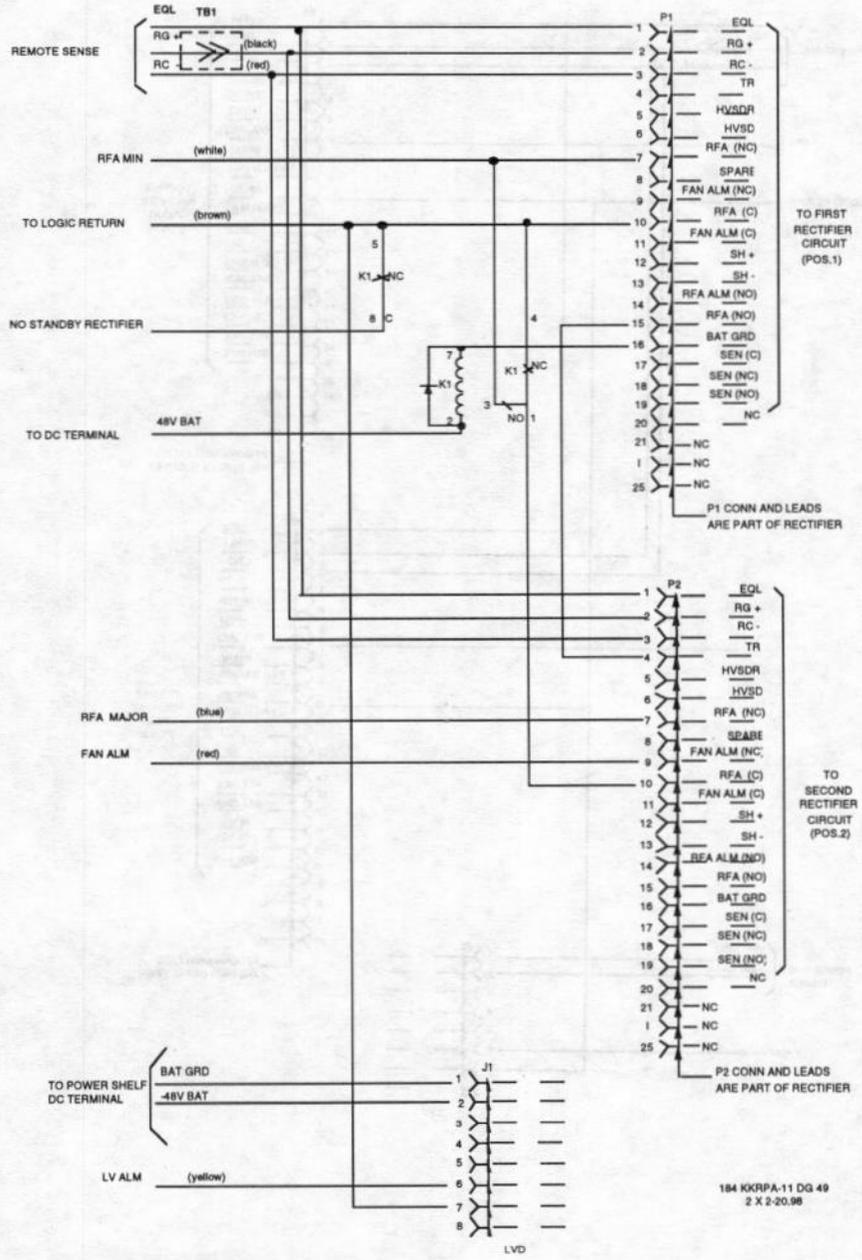


Fig. 32 - NT5C10BA-3/4 EMBEDDED APPLICATION

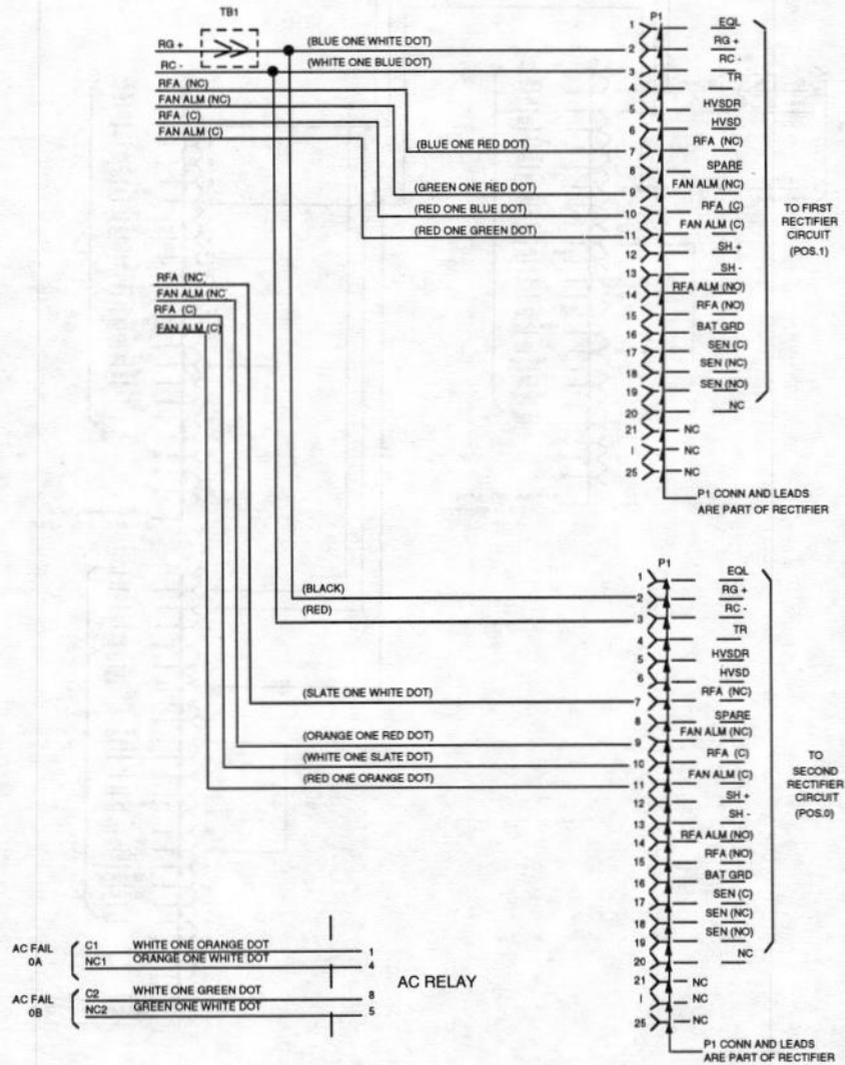


Fig. 33 - NT5C10BD EMBEDDED APPLICATION

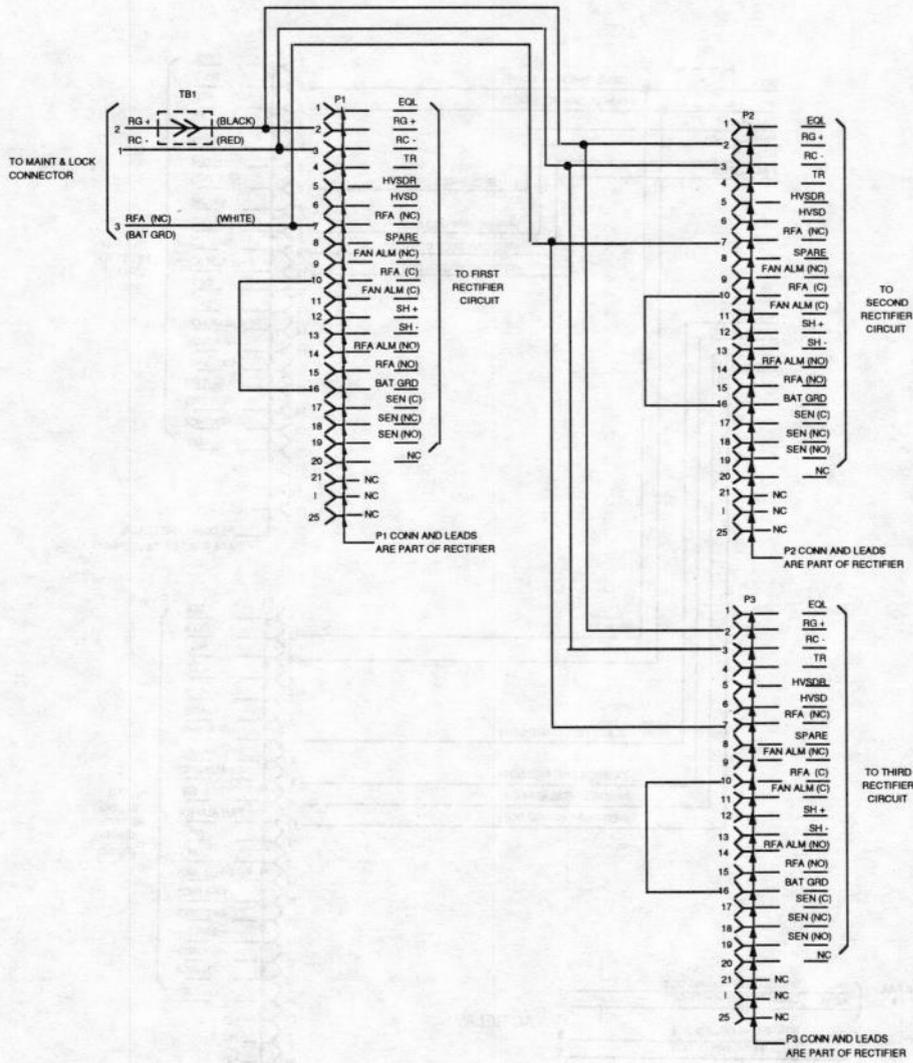
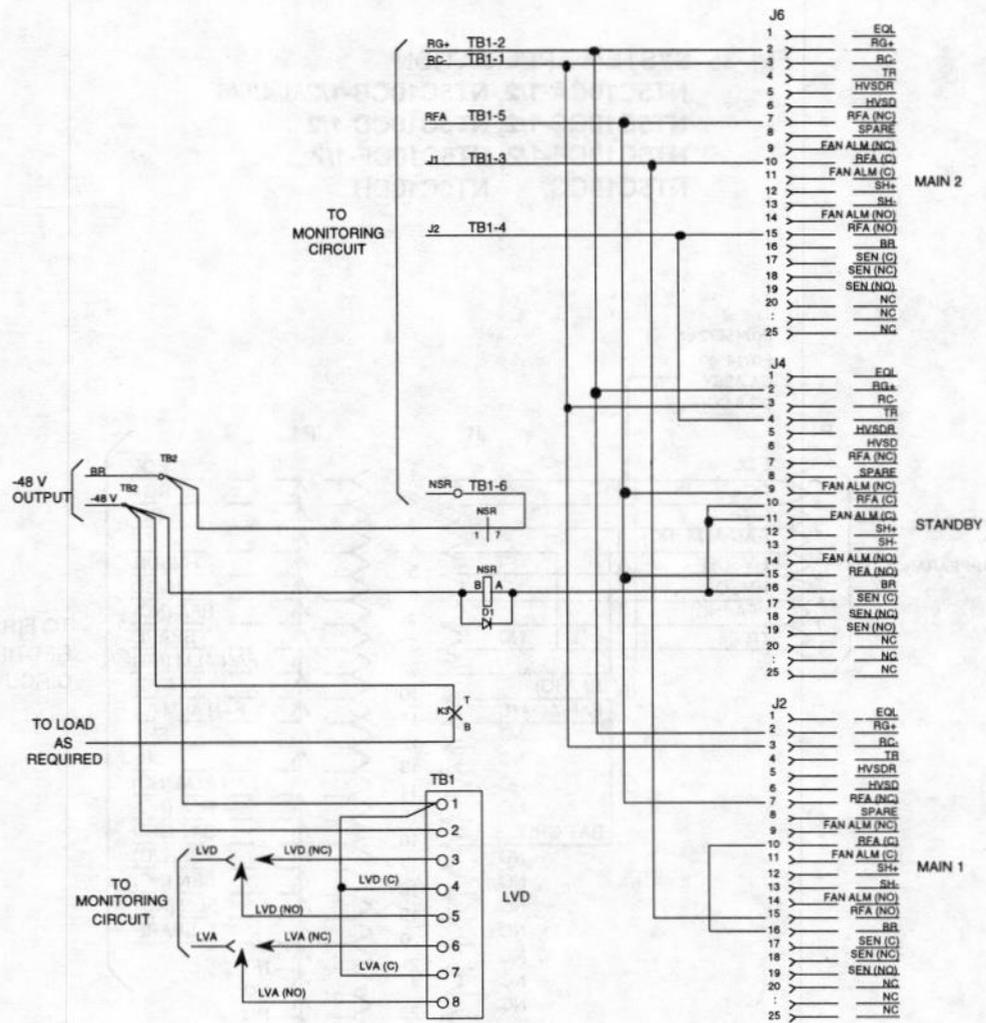


Fig. 34 - NT5C10BF and NT5C10BP EMBEDDED APPLICATION



**Fig. 35 SYSTEM APPLICATION**  
 NT5C10CA-1/2, NT5C10CB-1/2/3/4/5/6  
 NT5C10CC-1/2, NT5C10CD-1/2  
 NT5C10CE-1/2, NT5C10CF-1/2  
 NT5C10CG, NT5C10CH

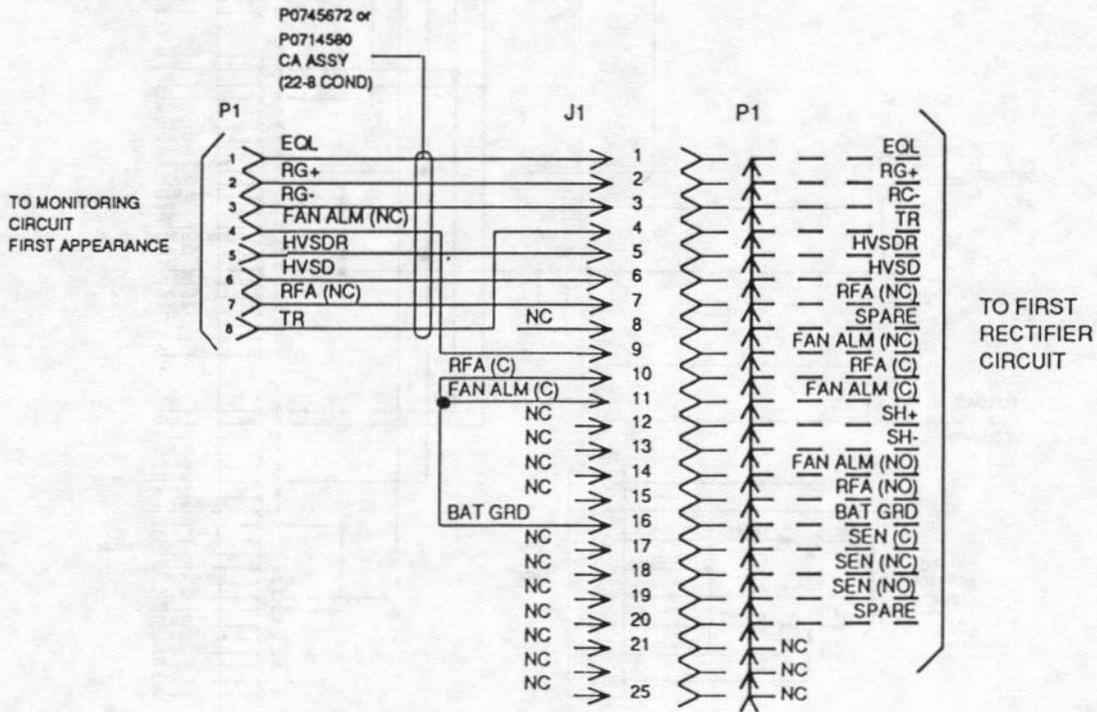


FIG. 36 - EMBEDDED APPLICATION NT5C10BC-1, NT5C10BC-2, NT5C10BC-3, NT5C10BM

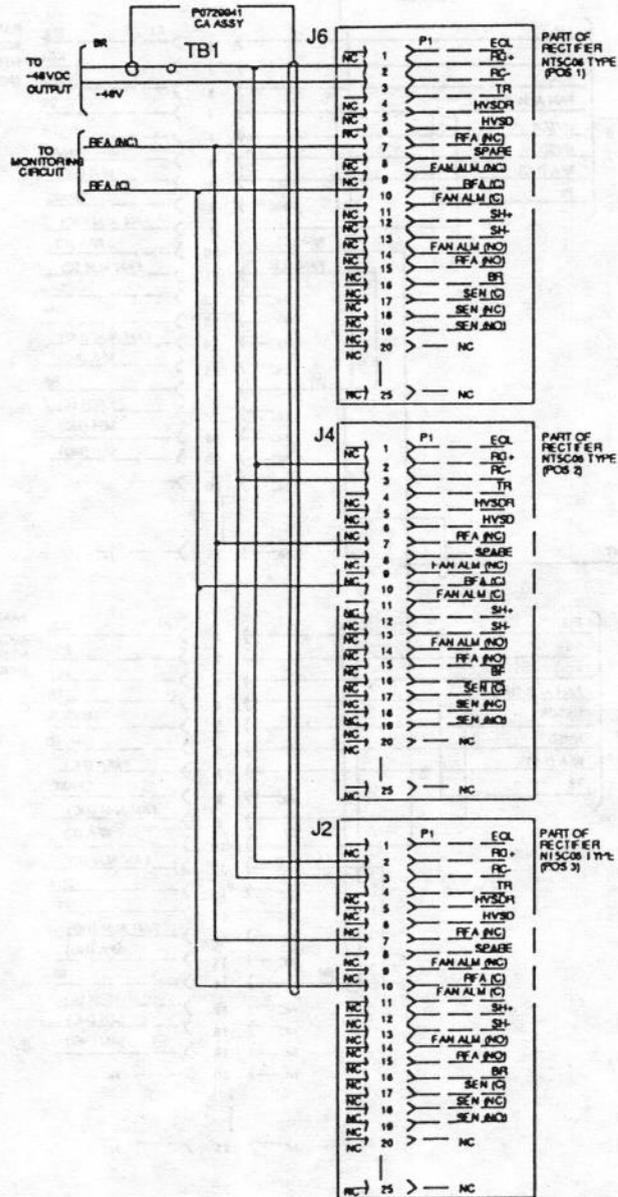


FIG. 37 - EMBEDDED APPLICATION NT5C10BJ, NT5C10BK e/w RPM1000C and LVD KIT

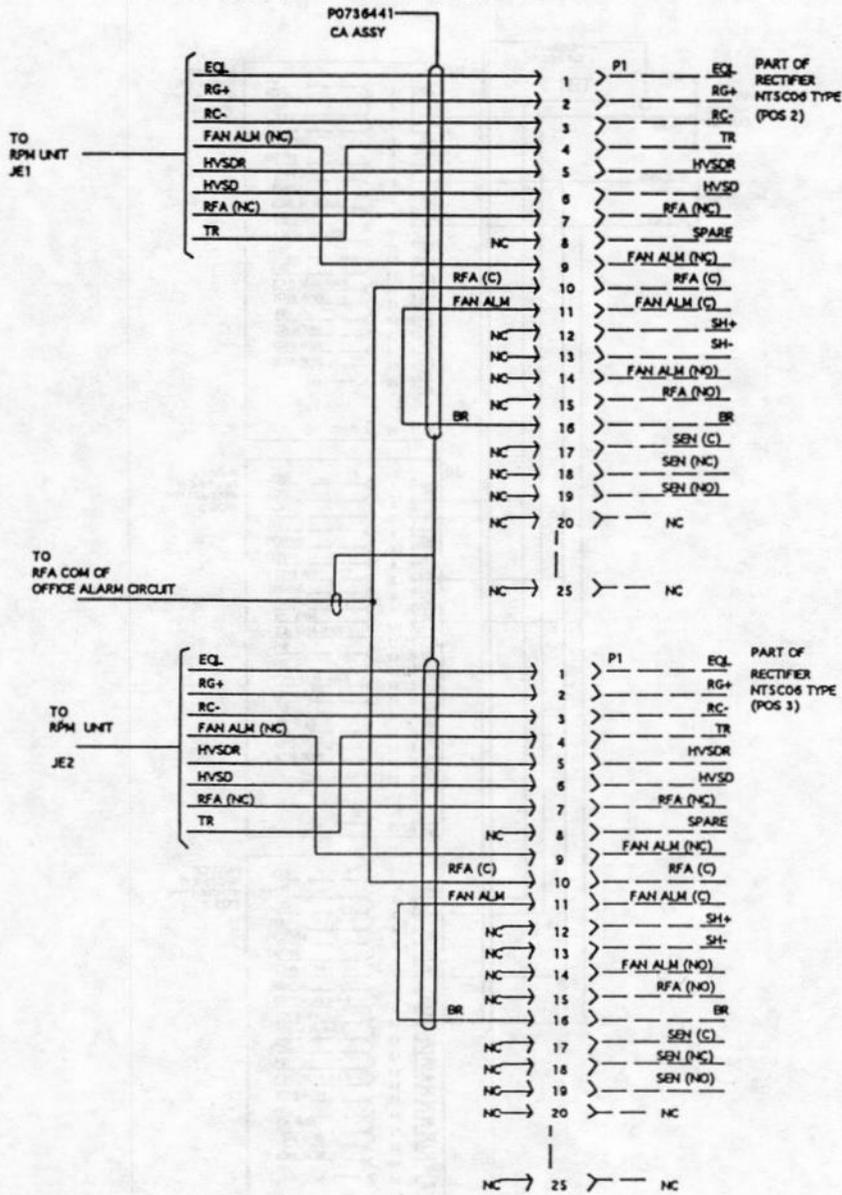
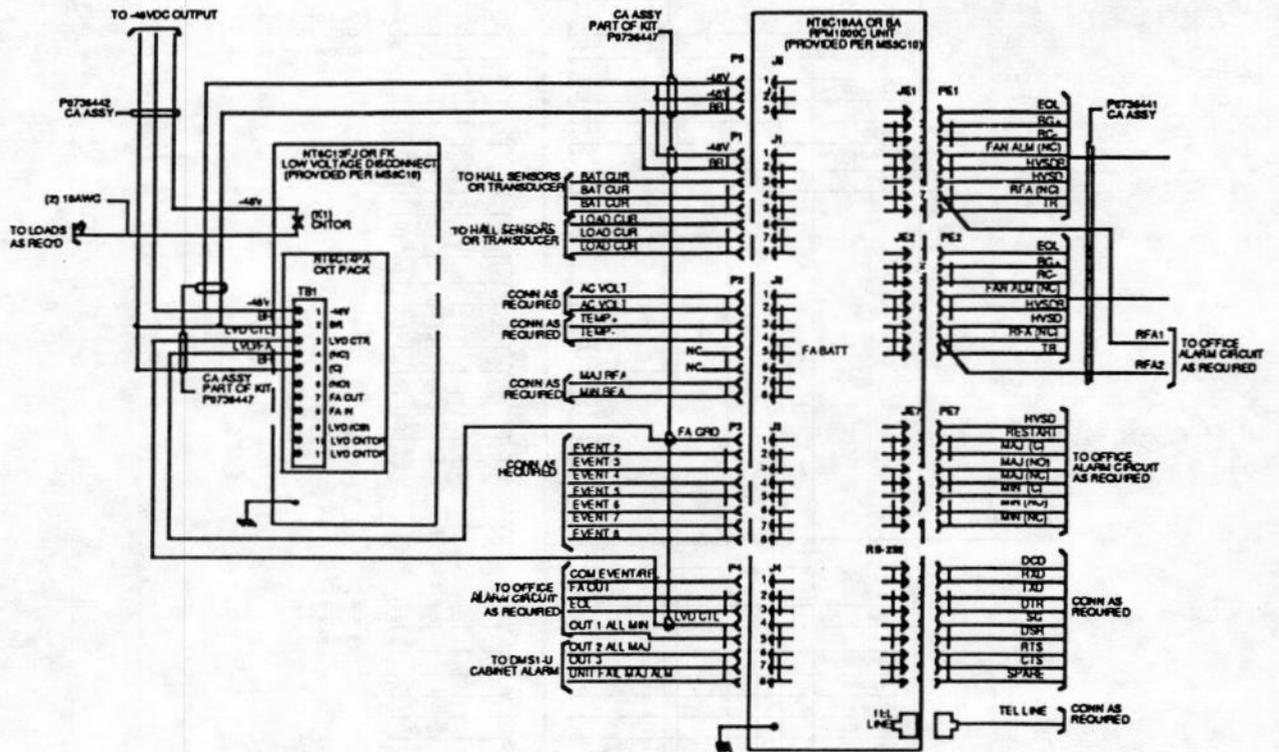


FIG. 37A - EMBEDDED APPLICATION NT5C10BJ, NT5C10BK e/w RPM1000C and LVD KIT



**FIG. 38 - EMBEDDED APPLICATION NT5C10BJ, NT5C10BK e/w LVD and I/F CIRCUIT PACK KIT**

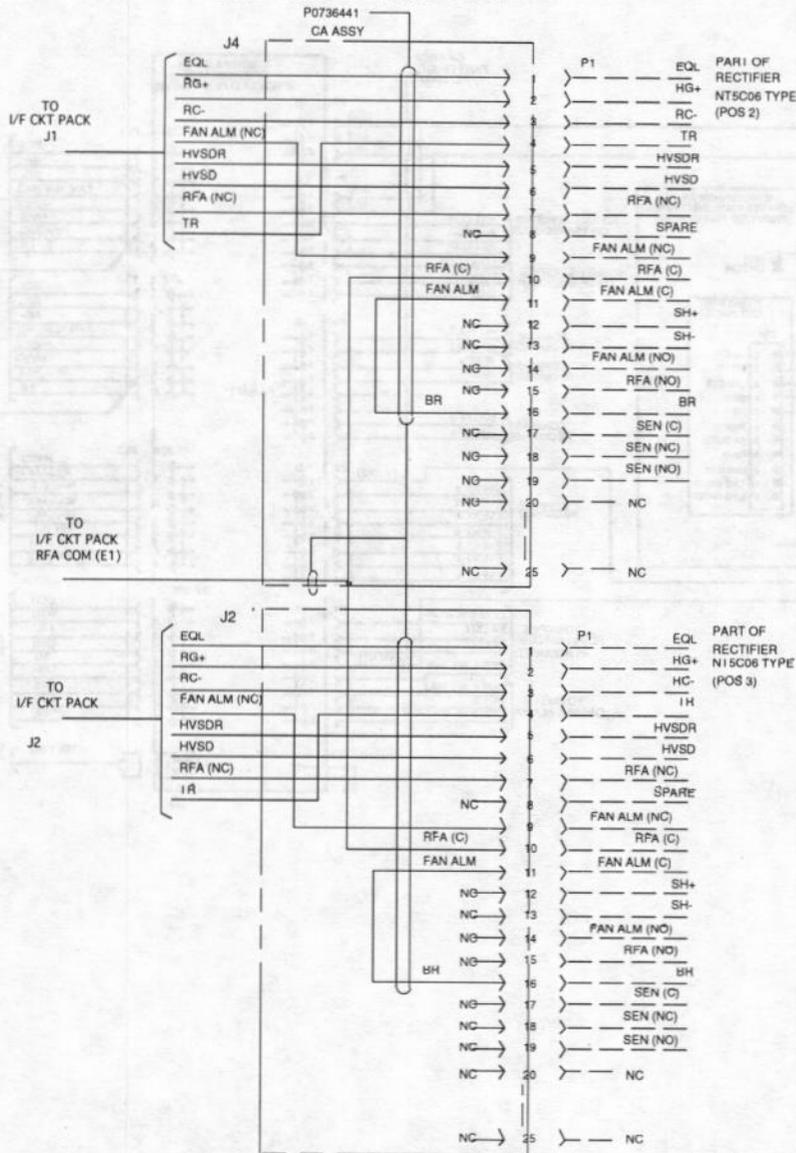


FIG. 38A - EMBEDDED APPLICATION NT5C10BJ, NT5C10BK e/w LVD and I/F CIRCUIT PACK KIT

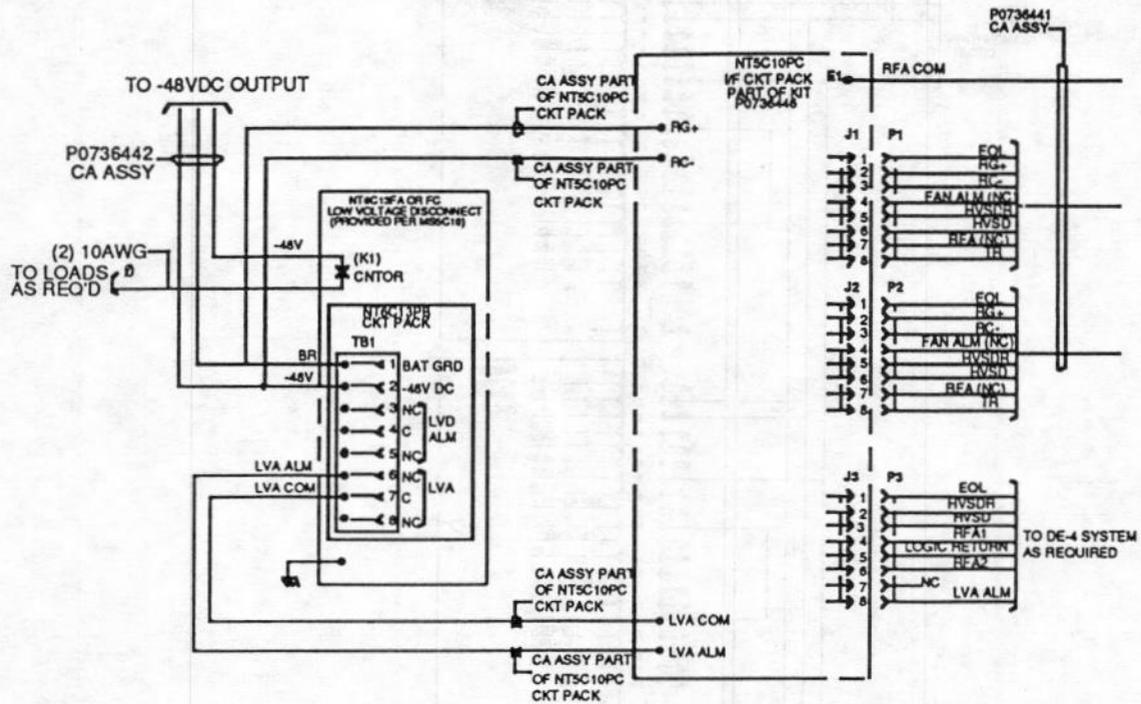


FIG. 39 - EMBEDDED APPLICATION NT5C10BL

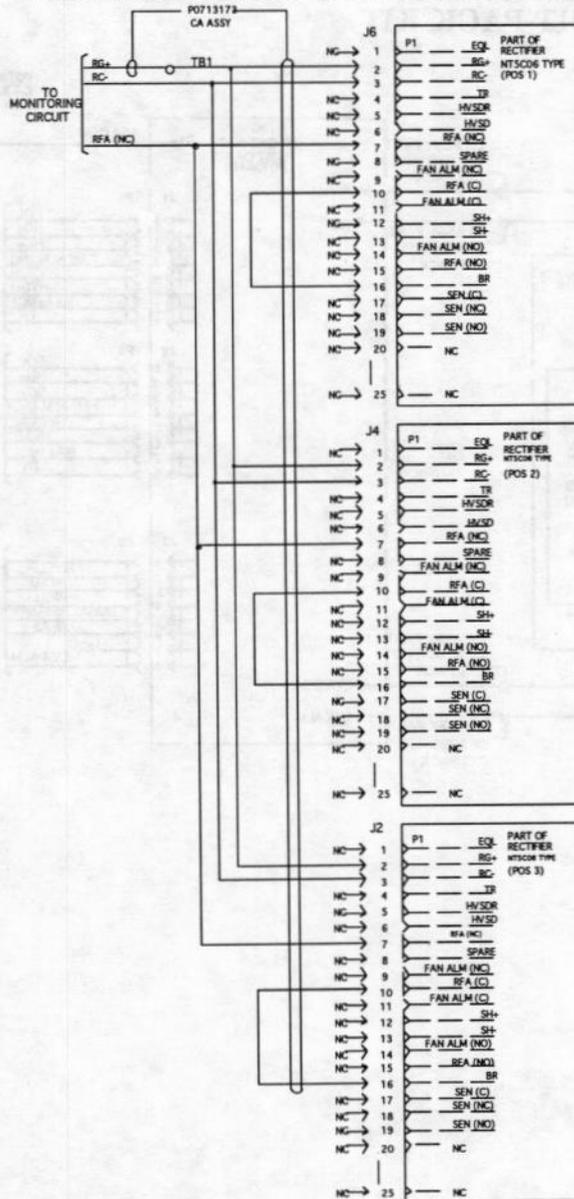


FIG. 40 - EMBEDDED APPLICATION NT5C10BM e/w NT5C10KB

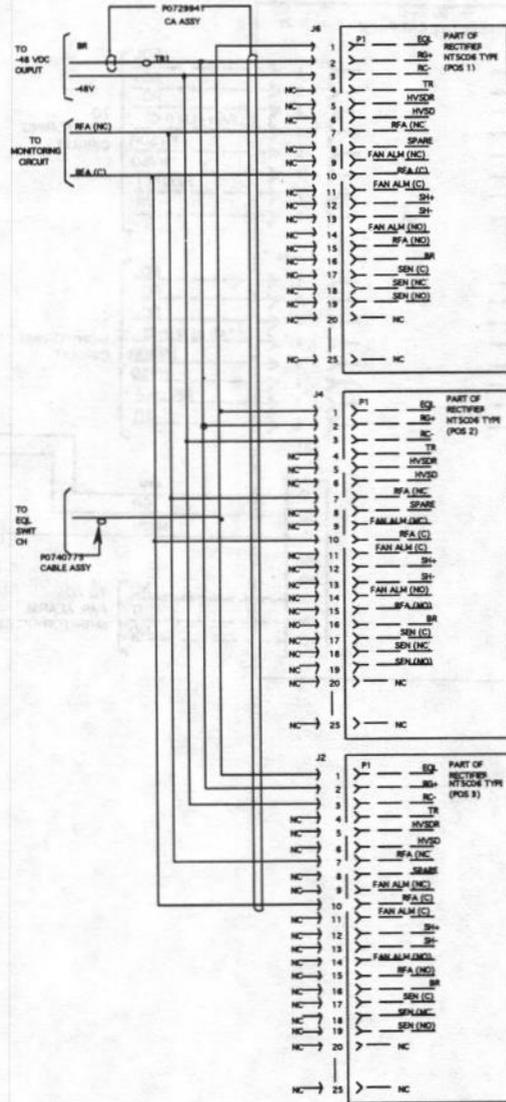


FIG. 41 - SYSTEM APPLICATION NT5C10CO

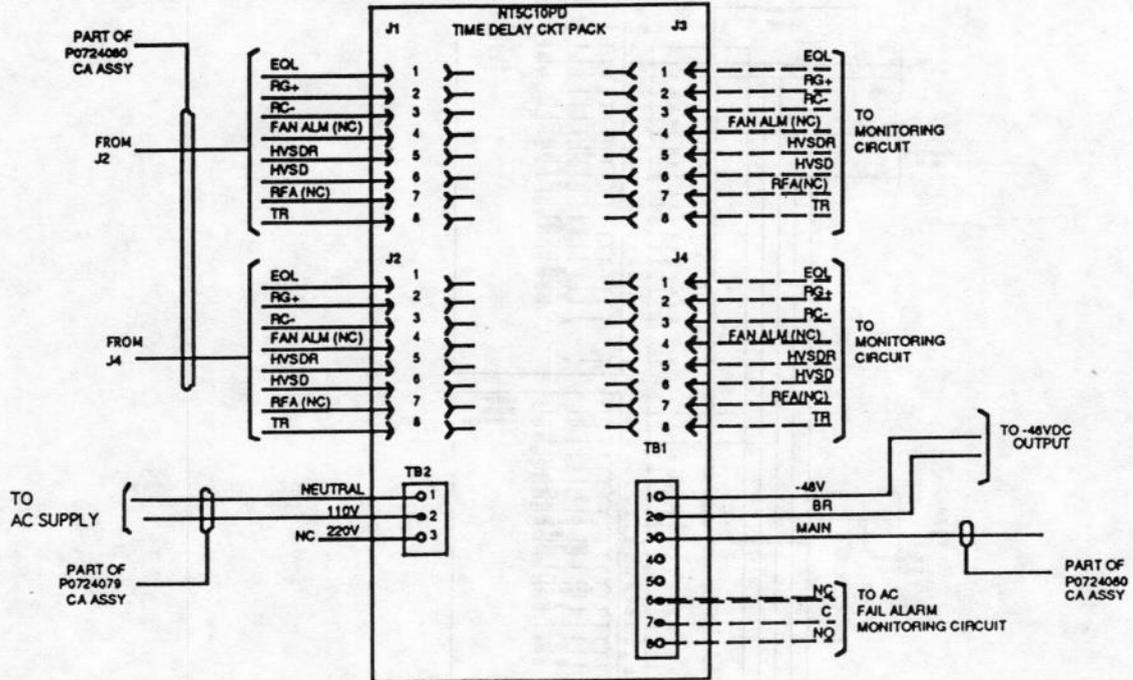
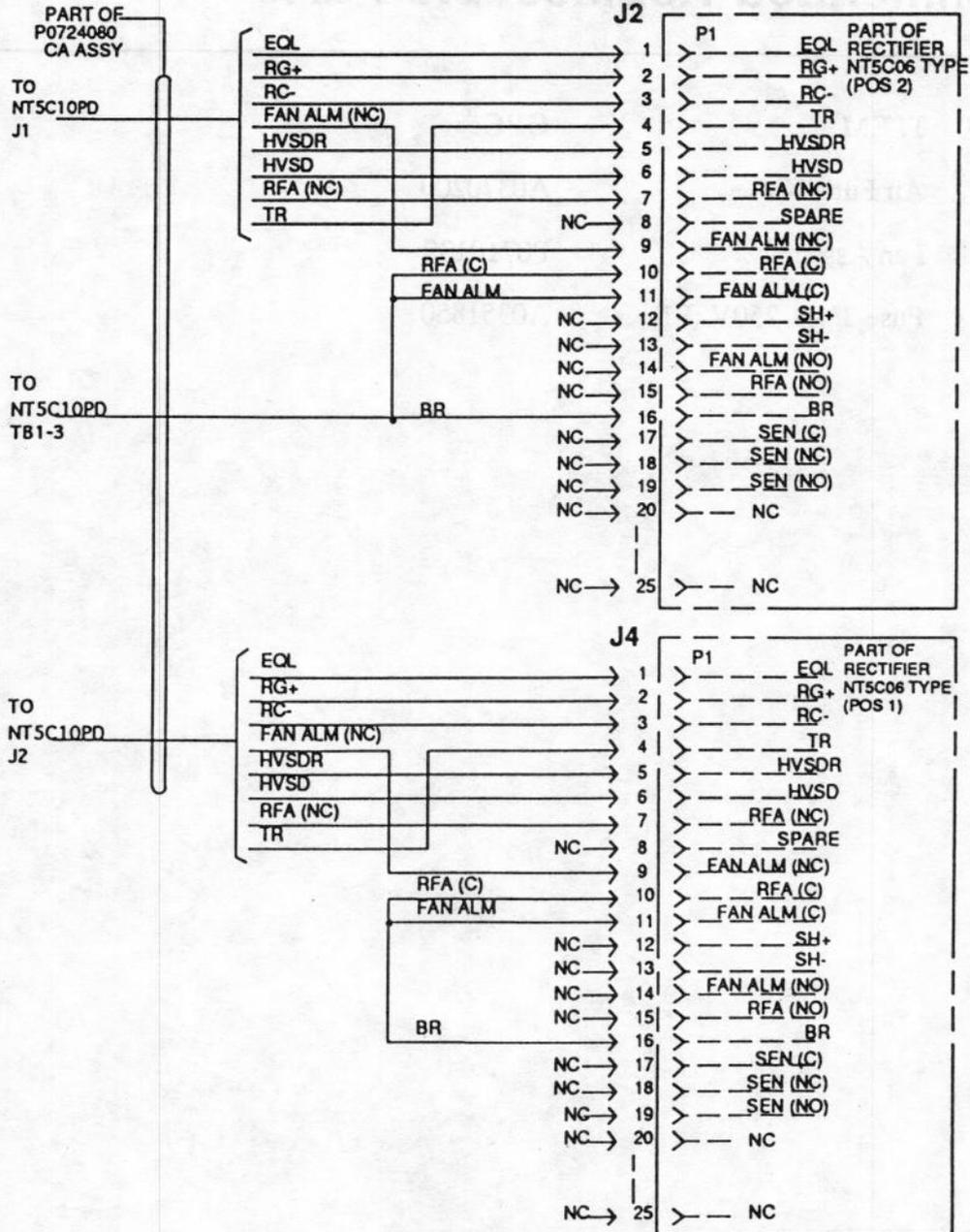


FIG. 41A



# Recommended Replaceable Parts

ITEM	CPC
Air Filter Kit	A0370200
Fan Assembly	P0710139
Fuse 3/4A, 250V (F1)	A0351850

---

## Customer Service

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For parts or service contact the nearest Northern Telecom Sales Office, or direct all orders to:

NORTHERN TELECOM CANADA LTD  
POWER PRODUCTS DIVISION  
150 Montreal-Toronto Blvd.  
Lachine, Que.  
H8S 1B6  
Attention Dept. 5560  
Tel. (514) 639-2828 or 1-800-363-2288

U.S.A. customers direct inquiries to:

NORTHERN TELECOM INC.  
4001 East Chapel Hill - Nelson Hwy.  
P.O. Box 13010  
Research Triangle Park, N.C. 27709  
Attn. Power Products Division - Marketing Dept.  
Tel. (919) 992-4435 or 1-800-992-8417 (for ordering information)  
1-800-347-4580 (for 8:00 a.m. to 6:00 p.m. repair service)  
1-800-627-8318 (for 24 hours emergency repair service)

International customers direct inquiries to your nearest NORTHERN TELECOM Sales Office.

## Appendix A - NT5C10BF-1 and NT5C10BP

---

### Purpose

The Supplement is issued to provide additional information about the NT5C10BF-1 (brown) and NT5C10BP (grey).

### Application

The NT5C10BF-1 and NT5C10BP power shelf, is used in the FTIP & FTOP application. This power shelf provides housing for two MPR15E rectifiers plus on 50A LVD, FTIP application, or three MPR25EX rectifiers, FTOP application. In both applications the rectifier in the center will be wired for standby operation (standby means that his rectifier will be inhibited under normal operation and will become active when another rectifier in the same power shelf issues an RFA).

### FTIP Application

The MPR15E (NT5C06CB/CD) rectifier is used in this application. Two rectifiers maximum can be used per system plus on 50A LVD. The main rectifier is active and carries the load and the standby is inhibited. It will be activated upon removal or failure of the main rectifier (Hot Standby model).

During transfer from a failed "MAIN" unit to a "STANDBY" unit the load current will be supplied by the backup batteries. The standby unit will provide the required current within 10 seconds.

### Application Configuration Table

RECT QTY	FUNCTION MAIN/STANDBY	LVD	ALARMS	CURRENT CAPACITY
1	MAIN/NONE/LVD	YES	RFA/LVA/LVDA	17.5A
2	MAIN1/STANDBY/LVD	YES	RFA/LVA/LVDA/NSR	17.5A

## Alarms

Available alarms for monitoring the status of the FTIP power system are as follows:

- LVA Battery Return (RTN)
- LVDA Battery Return (RTN)
- RFA Battery Return (RTN)
- NSR (No Standby Rectifier) Battery Return (RTN)

## Power and Signal Lead Termination

The power and signal cables are terminated as follows:

- |    |                               |                               |
|----|-------------------------------|-------------------------------|
| a) | Power Cables:                 |                               |
|    | Battery Return (RTN A)        | TB1-1 (White with Red tracer) |
|    | Battery (-48 A)               | TB1-2 (Red)                   |
| b) | Signal Cables:                |                               |
|    | Negative Sense (RC-)          | TB1-1 -48V                    |
|    | Positive Sense (RG+)          | TB1-2 RTN                     |
|    | Jumper *                      | TB1-3                         |
|    | Jumper *                      | TB1-4                         |
|    | Rectifier Fail (RFA)          | TB1-5                         |
|    | No Standby Rectifier (NSR)    | TB1-6                         |
|    | Low Voltage Disconnect (LVDA) | TB1-3 part of LVD unit        |
|    | Low Voltage Alarm (LVA)       | TB1-6 part of LVD unit        |

\* When the Main 2 rectifier is missing TB1-3 & TB1-4 must be strapped together.

### Factory Set Voltage Limits

- Float Voltage -52.1 VDC
- Equalize 0.7 VDC above Float
- LVA -47 Vdc
- LVDA -43.5 Vdc

The above limits are factory set and can be changed by the user.

### FTOP Application

The MPR25EX rectifier will be used in FTOP application. Three rectifiers maximum can be used per system. One or two of the rectifiers (Main) are active and carry the load and the other (Standby rectifier) is inhibited. It will be activated upon failure of one of the main rectifiers. The rectifier at the center will be wired as standby and the other rectifiers will be active. The maximum power capacity of the system will be 50A.

During transfer from a failed "MAIN" unit to a "STANDBY" unit the load current will be supplied by the backup batteries. The standby unit will provide the required current within 10 seconds.

### Application Configuration Table

RECT QTY	FUNCTION MAIN/STANDBY	LVD	ALARMS	CURRENT CAPACITY
1	MAIN1/NONE/NONE	NO	RFA	25 A
2	MAIN1/STANDBY/NONE	NO	RFA/NSR	25 A
2	MAIN1/NONE/MAIN2	NO	RFA	50 A
3	MAIN1/STANDBY/MAIN2	NO	RFA/NSR	50 A

### Alarms

Available alarms for monitoring the status of the FTOP power system are as follows:

- RFA Battery Return (RTN)
- NSR (No Standby Rectifier) Battery Return (RTN)

### Power and Signal Lead Termination

The power and signal cables are terminated as follows:

a) **Power Cables:**

Battery Return (RTN A)	TB1-1 (White with Red tracer)
Battery (-48 V A)	TB1-2 (Red)

b) **Signal Cables:**

Negative Sense (RC-)	TB1-1 -48V
Positive Sense (RG+)	TB1-2 RTN
Jumper1 *	TB1-3
Jumper2*	TB1-4
Rectifier Fail (RFA)	TB1-5
No Standby Rectifier (NSR)	TB1-6

- \* When the Main 2 rectifier is missing TB1-3 & TB1-4 must be strapped together.

### Factory Set Voltage Limits

- Float Voltage -52.1 VDC
- Equalize 0.7 above Float
- HVSD -59 VDC

The above limits are factory set and can be changed by the user.

## General Requirements

### Power Shelf Size

The power shelf NT5C10BF-1 and NT5C10BP is designed specifically for the FTIP/FTOP application. Its dimensions are 17.0 in W x 7.0 in H x 12.0 in D. It provides housing for up to three MPR25EX (NT5C06BB) SMRs, FTOP application, or two MPR15E (NT5C06CB/CD) SMRs plus one 50A LVD module (NT6C13FA), FTIP application. The middle rectifier is wired as Standby.

### Shelf Labelling

The power shelf is labeled indicating the following component and connection positions;

a) Front (left to right):

- MAIN1
- STANDBY
- MAIN2/LVD

b) Rear (right to left):

Signal Connections:

- RC- TB1-1
- RG+ TB1-2
- J1 TB1-3
- J2 TB1-4
- RFA TB1-5
- NSR TB1-6

Power Connections:

- RTNA TB2-1
- -48V A TB2-2

**NOTE 1: The Standby rectifier HVSD should be adjusted 0.5 higher than the main rectifier(s) and its float voltage should be adjusted 0.1 volts lower than the main rectifier(s).**

## Appendix B - NT5C10CO SHELF

---

### General

This Appendix contains supplemental information for the NT5C10CO "DELAYED START" power shelf.

### NT5C10CO Power Shelf

#### Description:

The power shelf houses two rectifiers. One rectifier operates in the standard mode (no delay) and the other is inhibited for a fixed time after an AC power failure. The delayed start is required to allow time for the batteries to be sufficiently charged, in order for the required total AC input current for the two rectifiers be reduced to less than 20 amperes.

The rectifier that is delayed will be activated immediately if the main rectifier fails, or is pulled out or missing, or produces an RFA. The delayed start rectifier will not transmit an RFA signal to the controller during the time that it is inhibited, but it will permit transmission of an RFA signal to the controller after the delayed start period.

When the rectifier is on the delayed start mode, the RFA LED on the rectifier will be lit (red), but at the same time the "DELAYED START" yellow LED of the timer will be ON to signify that the rectifier with the RFA red LED is on delayed start mode.

#### Technical Specifications:

Input AC: 120 VAC/18 A

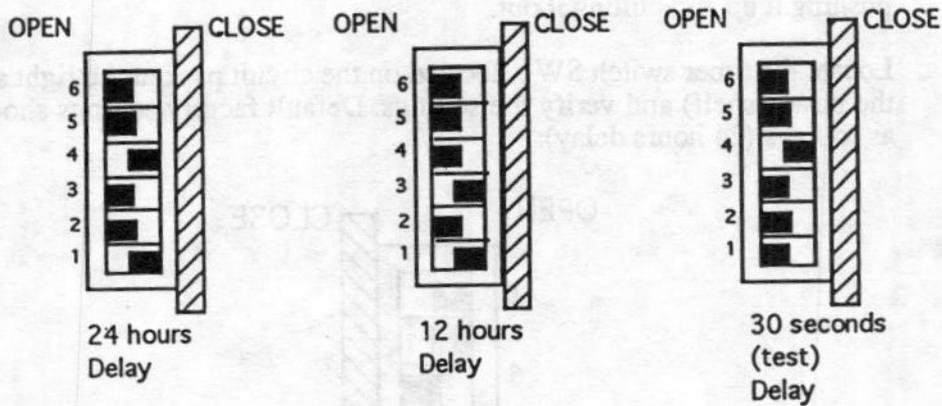
**WARNING:** The power shelf must be connected to 120 VAC and 20 Amperes circuit. The AC receptacle must be rated 20 amperes and wired with #12 AWG. Failed to do so, the AC breaker/fuse at the AC distribution cabinet could open under some operational conditions resulting in loss of power for both rectifiers.

Power system maximum Load: 6 A typical to 10 A maximum.

Battery charging current: 7 to 11 A, depending on power system load.

Maximum battery reserve: 120 AH (based on 8 hours).

Delayed Start delay: Two positions; 12 & 24 hours (12 hours for 6A load application and 24 hours for 10 A load applications).  
Factory delayed start setting: 24 hours



Other functions:  
Test Mode:

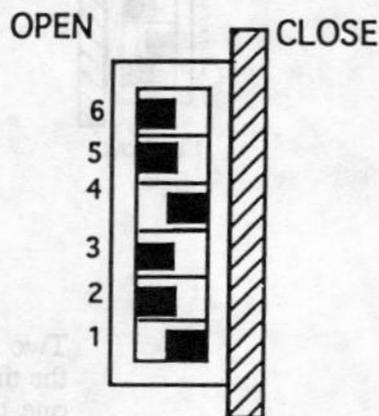
Two switches are provided. One to reset the timer without interrupting the AC and one to reduce the starting delay to less than one minute.

## Power-up and Verification

### Verification

For systems equipped with the NT5C10CO power shelf, proceed as follows:

1. Verify that the rectifiers AC circuit breakers are in the "OFF" position.
2. Release the clamping bar of the power shelf, by loosening the 2 screws.
3. Remove the right blank panel from the power shelf by removing the screw, pushing it up and pulling it out.
4. Locate the timer switch SW1 (located on the circuit pack at the right side of the power shelf) and verify the settings. Default factory settings should be as follows (24 hours delay):



The above settings will provide approximately twenty four (24) hours delay, which is sufficient to charge the batteries with a reserve on 80 to 120AH and at the same time supply power to a 10A load. When the load is 6A or less on a battery reserve of less than 80AH, then open the SW1-4 and close the SW1-3 for a delay of 12 hours.

5. Plug - in the AC power plug to the wall receptacle.

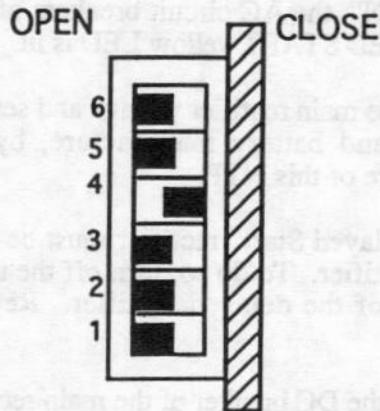
6. Turn "ON" the AC circuit breakers of the main rectifier. Observe that the DELAYED START yellow LED is lit.
7. Verify the main rectifier voltage and set the voltage limits as specified by the system and battery manufacture, by following the Rectifier Start-Up Procedure of this NTP.
8. The "Delayed Start" rectifier must be adjusted to the same voltages as the main rectifier. To do so, turn off the main rectifier and turn "ON" the AC breaker of the delayed rectifier. Repeat Step 6 & 7 on the unadjusted rectifier.
9. Turn on the DC breaker of the main rectifier.
10. Wait until the delayed start yellow LED is extinguished (12h or 24h) OR until the system batteries are fully charged to their nominal voltage before proceeding to the next procedure of Adjustment & Verification.

### Adjustment and Verification

The following steps required when there is need to verify the systems operation.

**CAUTION:** The power system batteries must be fully charged to their nominal voltage before proceeding to the following steps.

1. Release the clamping bar of the power shelf by loosening the 2 screws.
2. Remove the right blank panel by removing the screw, pushing it up and pulling it out.
3. Locate the timer SW1 switch on the circuit pack, then set the switches as follows:



4. Turn "ON" the DC and AC breakers of both rectifiers.

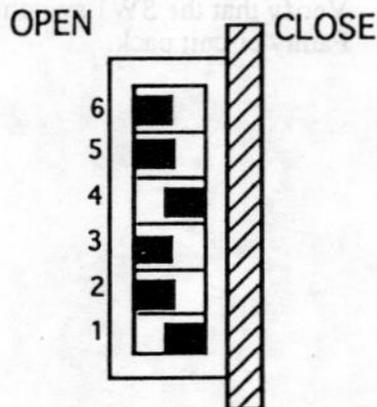
**NOTE:** At this point, one rectifier may indicate an RFA. An RFA may be indicated when a rectifier delivers less than 0.1A. Turning the FLT potentiometer slightly clockwise shall return it to normal operation with no RFA.

5. Verify that the rectifiers, float and equalize voltage levels are correct. If needed, adjust them to battery manufacture specifications.
6. CLOSE and OPEN the SW1-6 switch (timer reset).
7. Observe the following:
  - The "DELAYED START" yellow LED at the circuit pack will be lit.
  - The RFA red LED of the rectifier at the "DELAYED START" position will be lit.
  - The operation of the rectifier at position "MAIN" is normal.
  - No RFA alarm signal shall be sent to the system monitoring circuit.
  - After approximately 30 seconds the yellow LED and the red (RFA) LED will extinguished. The DELAYED START rectifier will resume its normal operation.

8. Connect an external six amperes load (or use telecommunication system load) and readjust the float and equalize voltage of the rectifiers in order to share the load.
9. Reset the timer by closing and opening the SW1-6 switch and observe the operation of the power system:
  - The DELAYED START yellow LED lit.
  - Output current of main rectifier approximately 6 A.
  - Delayed Start rectifier is inhibited. Zero output current. RFA LED lit.
  - No alarm indication on the system monitoring unit.

After approximately 30 seconds:

  - Delayed Start LED off.
  - The Delayed start rectifier resumes normal operation and shares the total load of the system with the other rectifier.
10. Set the timer switch as follows:



The above settings will provide approximately twenty four (24) hours delay, which is sufficient to charge the batteries with a reserve on 80 to 120AH and at the same time supply power to a 10A load. When the load is 6A or less on a battery reserve of less than 80AH, then open the SW1-4 and close the SW1-3 for a delay of 12 hours.

## Troubleshooting

Following are recommended steps of analyzing possible reasons of malfunctions of the system equipped with NT5C10CO power shelf. This is in addition to Troubleshooting guide of the NTP 167-9021-107.

---

### Fault Diagnosis

---

#### FAULT SYMPTOM

#### POSSIBLE CAUSES

---

Delayed Start did not activated (delayed start LED is not lit):

No ACV at the power shelf input terminals.  
Main rectifier removed or generates an RFA.  
Faulty circuit pack.

Incorrect time delay:

Verify that the SW1 switch is set properly.  
Faulty circuit pack.



## Appendix C - Schematics

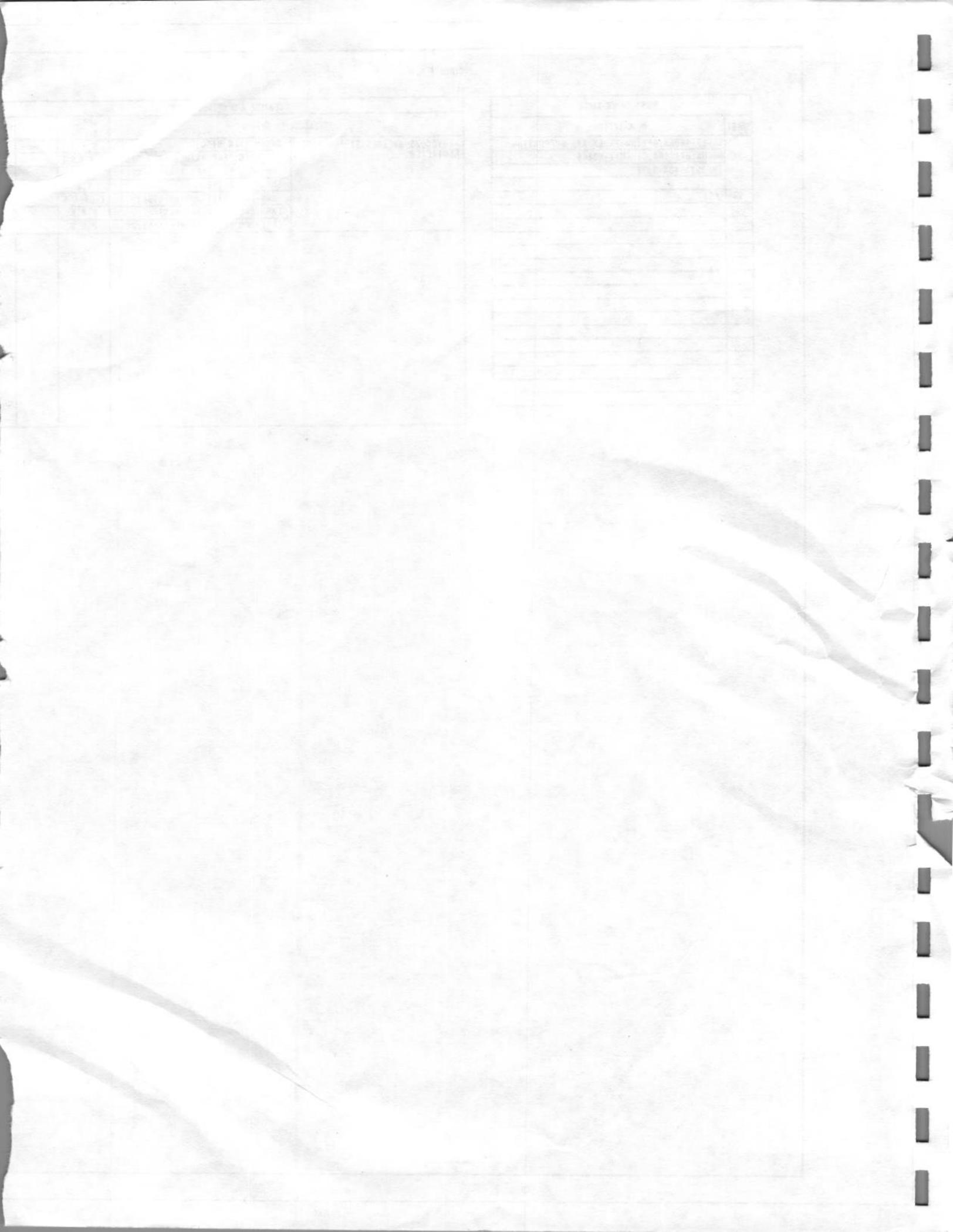
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FS5C06

# Appendix C - Schematics

FIGURE

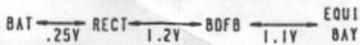




SUPPORTING DOCUMENTATION	
ASSEMBLY DRAWING	AD5C06
WIRING DRAWING	W05C06
TEST SPEC	X55C06
STOCKLIST	SL5C06BB
STOCKLIST	SL5C06BC
STOCKLIST	SL5C06CA
STOCKLIST	SL5C06CB
STOCKLIST	SL5C06CC
STOCKLIST	SL5C06CD
STOCKLIST	SL5C06CE

**CIRCUIT NOTES:**

104. THE RECOMMENDED MAXIMUM LOOP DROP FOR CHARGE AND DISCHARGE LEADS SHALL BE AS FOLLOWS:



105. FOR CHARGE AND DISCHARGE LEAD CALCULATION USE THE FOLLOWING FORMULA FOR COPPER ONLY:

$$\text{CIRC WIL} = \frac{11.1 \times \text{MAX CURRENT} \times \text{LOOP LENGTH}}{\text{ALLOWABLE VOLT DROP}}$$

106. OUTPUT POSITIVE LEAD SHALL BE CONNECTED TO CD GROUND.

107. AC INPUT FUSING SHALL BE:

a) 20A FRN TYPE FUSE FOR 110V-240V OR CIRCUIT BREAKER WITH EQUIVALENT CURVE.

108. THESE CONNECTORS AND ASSOCIATED WIRING ARE SHOWN FOR INFORMATION ONLY, AND ARE NOT PART OF THE RECTIFIER. THEY MUST HOWEVER, MATE WITH ASSOCIATED PART ON RECTIFIER.

109. AT 110V OPERATION, OUTPUT CURRENT IS INTERNALLY LIMITED TO 15A.

110. CONNECTION OF E19 TO E20 ON FILTER PCB, IS REQUIRED TO BE OPENED DURING INSULATION BREAKDOWN TESTS. THIS CONNECTION MUST REMAIN OPEN PER WOP P0745103 FOR STNA (FRANCE) POWER PLANT APPLICATIONS ONLY.

111. CONNECTION USED ONLY ON SELECTED CUSTOMER ASSEMBLIES DEFINED BY DCM P30313-AC.

**INFORMATION NOTES:**

301. UNLESS OTHERWISE SPECIFIED RESISTANCE VALUES ARE IN OHMS. CAPACITANCE VALUES ARE IN MICRO-FARADS. VALUES PRECEDED BY THE SYMBOL + (PLUS) OR - (MINUS) ARE IN VOLTS.

DRAWING NUMBER			
FS5C06			
90-06-21		DCAEPBA0	
RDC	W.B.	STREAM	ISSUE
		01	01
ON PAGE 2, AT FILTER CKT PACK, TERM E19 & E20, REF TO "J3 & P3" ADDED. WOD EXISTING STOCK.			
DCA EP400		CL:E	
90-10-05			
RP	RL	STREAM	ISSUE
		01	02
*P,R* OPTIONS ADDED. *S,T,V* OPTIONS WERE NOT SO DESIGNATED. MODIFY EXISTING STOCK.			
DCN P10306		CL:E	
DCN P20101			
92/01/07			
RDC	RL	STREAM	ISSUE
		01	03
ADDED JUMPER BETWEEN R111 (PB/08) & Q2 (PC/0C). NOTE 111 ADDED.			
DCN P30313		CL:AC	
93-04-19			
PB	RL	STREAM	ISSUE
		01	04
NOTE 110 MODIFIED.			
DCN P30115		CL:D	
94-05-17			
JD	RL	STREAM	ISSUE
		01	05
SH 1 SUPP DOC TOL REF TO STOCKLIST ADDED. NOTE 101 EXTENDED TEMPERATURE (110VAC) ADDED. NOTE 102 103,201 & APP FIG 1 RWY. SH 2 CONVERTER CKT PACK OPT N ADDED ON NT5C06RA. FILTER CKT PACK OPT N ADDED ON NT5C0600. LOGIC CKT PACK OPT N ADDED ON NT5C060C.			
DCN E40301		CL:WP	
94-12-05			
JD	RL	STREAM	ISSUE
		01	06
INITIAL APPLICATION			
25 AMP SWR NT5C06			
POWER SYSTEMS			
TITLE			
-48VDC, 25AMP SWITCHING MODE RECTIFIER			
SCALE	DRAWING NUMBER		
	FS5C06		
NORTHERN TELECOM	SIZE	MTL	PAGE
	6S		1 OF 2

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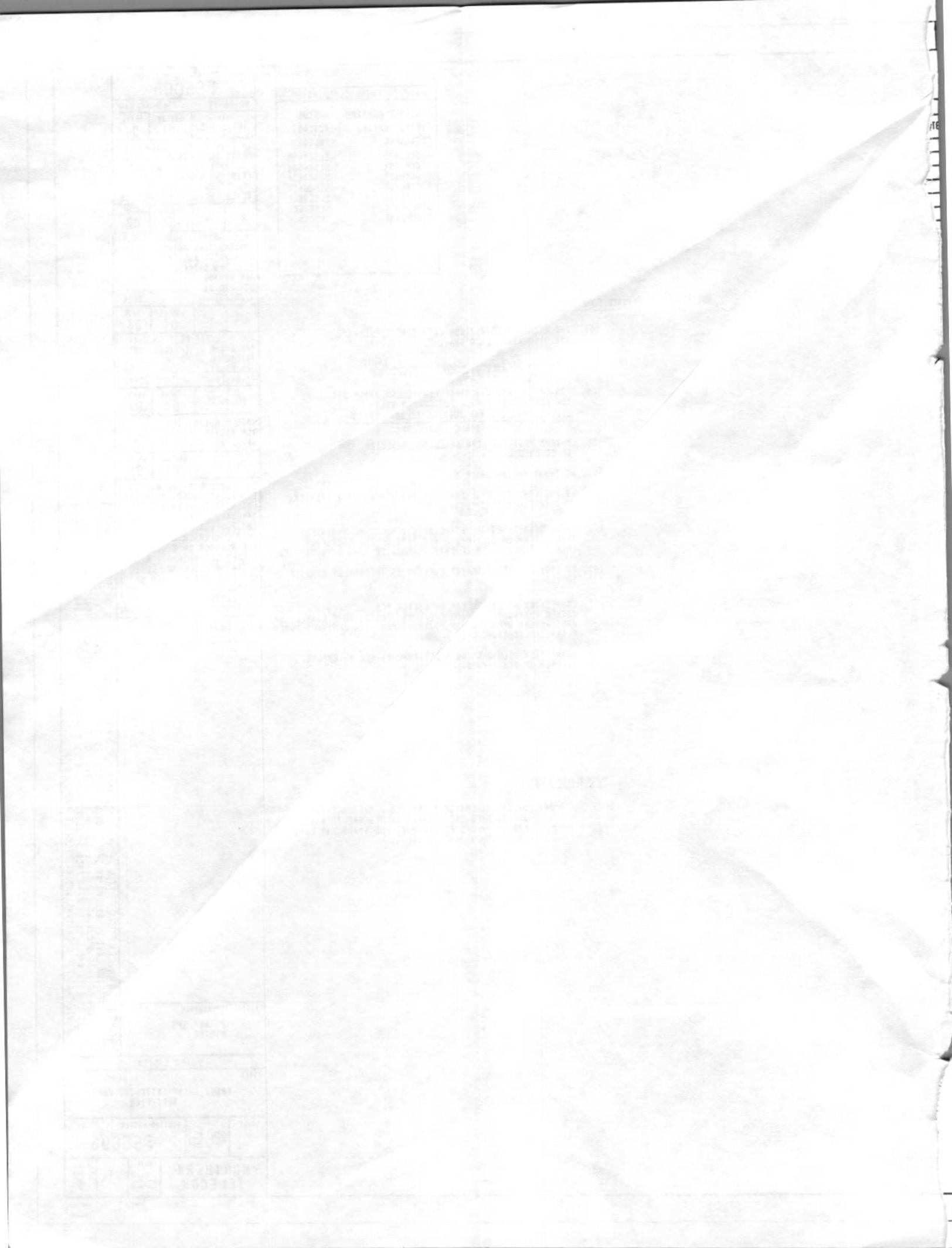
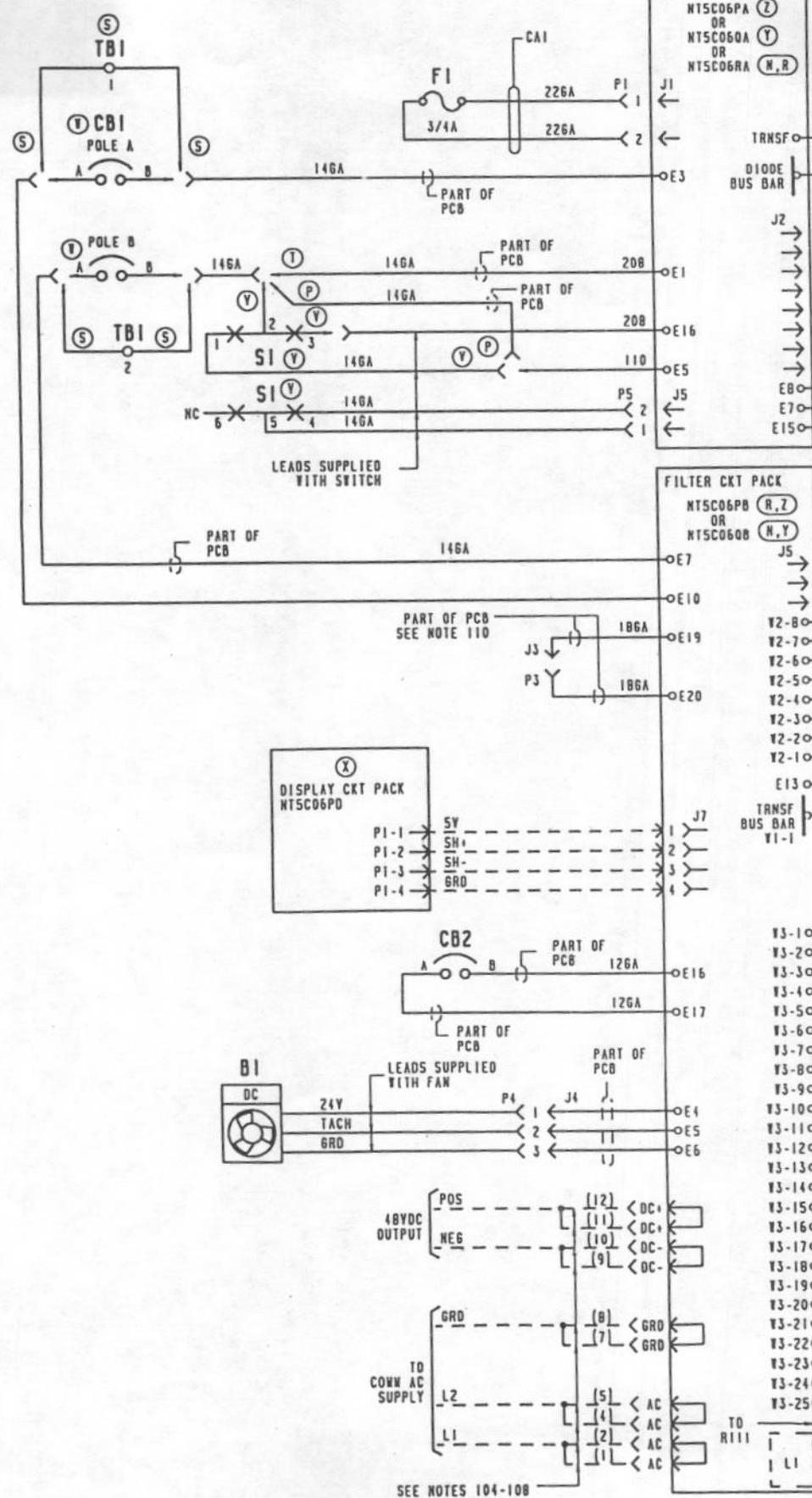


FIG. 1

A  
B  
C  
D  
E  
F  
G



CONVERTER CKT PACK  
NTSC06PA (Z)  
OR  
NTSC060A (Y)  
OR  
NTSC06RA (N,R)

FILTER CKT PACK  
NTSC06PB (R,Z)  
OR  
NTSC060B (N,Y)

DISPLAY CKT PACK  
NTSC06PD

- J1
- J2
- J3
- J4
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- J100

FS5C06  
PAGE 2

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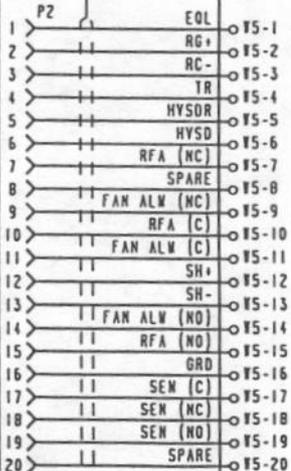
54.2 EQ.  
54.6 53.2 LT

ART OF  
DRAWER

PART OF  
PCB

LOGIC CKT PACK  
NT5C06PC (R,Z)  
OR  
NT5C06OC (N,Y)

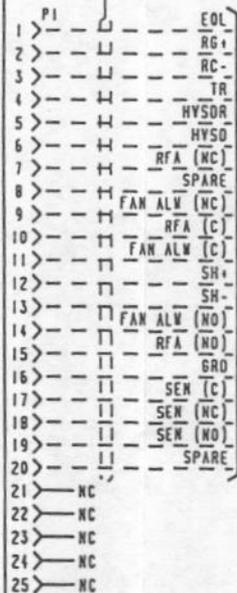
J2



PART OF  
PCB

CONNECTOR CKT PACK  
NT5C06PE

J1



SEE NOTE 108

TO  
MONITORING  
CIRCUIT

E3

TO O2 BASE

E1  
E2

PART OF NT5C06PB (SEE NOTE 111)

DRAWING NUMBER <b>FS5C06</b>	SIRCAN <b>01</b>	ISSUE <b>06</b>
<b>NORTHERN TELECOM</b>	SIZE <b>6S</b>	MTL <b>PAGE 2</b>



1902

**MPR25/MPR15 SERIES**  
**Single Phase -48V, 25A Switch Mode Rectifier**  
**NT5C06**

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