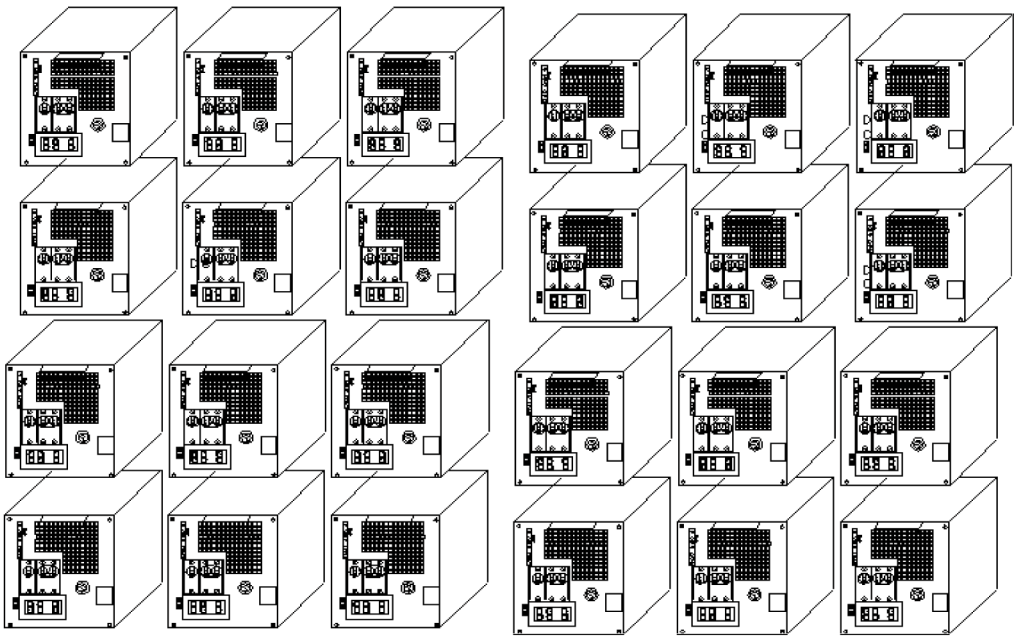
Astec Advanced Power Systems

UM5C06B / C (169-2071-500)

MPR25 / MPR15 Series, Single Phase –48V,
25A Switch Mode Rectifier
NT5C06B/C
Installation and User Manual



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Astec Advanced Power Systems
A part of Emerson Network Power

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About this manual

Purpose of this manual

This manual provides all the necessary information for installing, operating and maintaining an MPR15 (-48 V/15 A) and MPR25 (-48 V, 25 A) series (NT5C06B/C) Switch Mode Rectifier, 19-inch and 23-inch Power Shelf NT5C10 for embedded and system applications, as well as the NT5C13F( ) Low Voltage Disconnect series.

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 required when working on the unit. The latest drawings must be used.

This equipment contains a number of discrete and micro-electronic solid state devices subject to permanent damage, caused by electrostatic potentials, when handling and installing unless appropriate precautions are observed.

How this manual is organized

This manual is divided into nine parts:

- Introduction
- Specifications
- Operation
- Power shelf
- Installation and start-up procedure
- Low voltage disconnect
- Maintenance
- References
- Appendices

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Introduction

Applications

The MPR15 / MPR25 rectifiers are designed to operate continuously in a battery-equipped or batteryless –48 V 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 for operation in a controlled environment. An extended temperature version is capable of withstanding temperatures ranging from -40°C to +65°C while standard models operate from 0° to +65°C ambient. The MPR15EX model operates in an ambient temperature range of –40°C to +50° C, and the standard MPR15E operates in a range of 0°C to +50°C.

The MPR25E and MPR25EX are suitable for various embedded and system applications. These models offer features that facilitate installation, operation and maintenance.

The MPR15EX is intended for low power applications, when only 110 / 120 V AC power is available.

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

Rectifier models

Four models are listed in Table 1.

Table 1 - NT5C06B/C models

MODEL	TYPE	NT(CODE)
MPR25E	25 AMP - Enhanced Basic	NT5C06CA (Brown) NT5C06CC (Grey)
MPR15E	15 AMP - Enhanced Basic 110 V AC	NT5C06CB (Brown) NT5C06CD (Grey)
MPR25EX	Enhanced Extended Temperature	NT5C06BB (Brown) NT5C06BC (Grey)
MPR15EX	15 AMP - Enhanced Extended Temperature, 110 V AC	NT5C06CE

Table 2 - Rectifier feature summary

UNIT FEATURE	MPR15E & MPR25E ENHANCED	MPR15EX & MPR25EX ENH. EXTENDED TEMPERATURE
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

***Note 1*:** For ordering details, consult the Ordering Guide.

***Note 2*:** All units may be ordered in either brown or grey.

***Note 3*:** The air filter option is restricted to applications under 50°C (122°F) and is recommended for Central Office (CO) applications.

Specifications

Mechanical

The MPR25 or MPR15 rectifiers have the following dimensions:

- Height: 168 mm (6.60 inches)
- Depth: 260 mm (10.25 inches)
- Width: 149 mm (5.85 inches)

Electrical

Rectifier voltage and current

The input current requirements of the MPR15 / MPR25 rectifier and the NT5C10 power shelves are listed in Table 3:

Table 3 - MPR15/MPR25 input current requirements

	Input voltage: frequency range	**120 V AC 47-63 Hz 96-132 V AC**	**208 V AC 47-63 Hz 176-264 V AC**	**240 V AC 47-63 Hz 176-264 V AC**
1.	MPR15	10.5 A (16.5 A)	n/a	n/a
2.	MPR25	n/a	11.7 A (15.5 A)	10.2 A (15.5 A)
3.	NT5C10 Shelf: (a) 2 rectifiers	21.0 A (33.0 A)	23.4 A (31.1 A)	20.4 A (31.1 A)
	(b) 3 rectifiers	31.5 A (49.5 A)	35.1 A (46.6 A)	30.6 A (46.6 A)

Condition: Typical input current value for 54 V dc, full load output = maximum input current at Output 54V DC, current limit minimum line.

Input protection: 20 A AC breaker

Output voltage

Floating: -46 V DC to -57 V DC

Equalizing: 0 to -2.5 V DC above float

Output regulation: At the point of regulation: within ±0.5% of the selected value for all specified input and output variations and within ±1% for any combination of specified input, output and environmental conditions.

Output protection: 30 A DC breaker

Output current: at 96-132 V input * - 15 A for MPR15E/EX at 176-264 V input – 25 A for MPR25E/EX

Current limit: 17.5 to 20 A minimum for 96-132 V input and 25.5 to 30 A for 176-264 V input. From -46 V DC to -57 V DC. Constant power for output from -57 V DC to -59.5 V DC

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 dBrnC 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°C to 0° C), measured differentially with an oscilloscope at a 2 MHz bandwidth.

Acoustical noise

The rectifier does not produce sound levels above 60 dB with "A" weighting 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 54 V DC.

Power factor is 0.60 at a nominal voltage of 208 V AC and a maximum load of 25 A with 0.5 ohm line impedance.

Reliability

The rectifier has a mean time between failures (MTBF) greater than 120,000 hours (Bellcore spec. TR-NWT-000057) under normal operating conditions, at 30°C.

Heat dissipation

The maximum heat dissipation is 150 W at -56 V and 25 A 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 Astec for applications requiring less than a 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)
	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.

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 the rectifier must remain in operation, or once a year the equipment must be energized for at least two hours to maintain the electrolytic capacitors in working condition.

Operation

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 inhibition, lightning and surge voltage protection, and input fault protection through 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 RFA/ON 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 detection, and a fan failure LED.

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

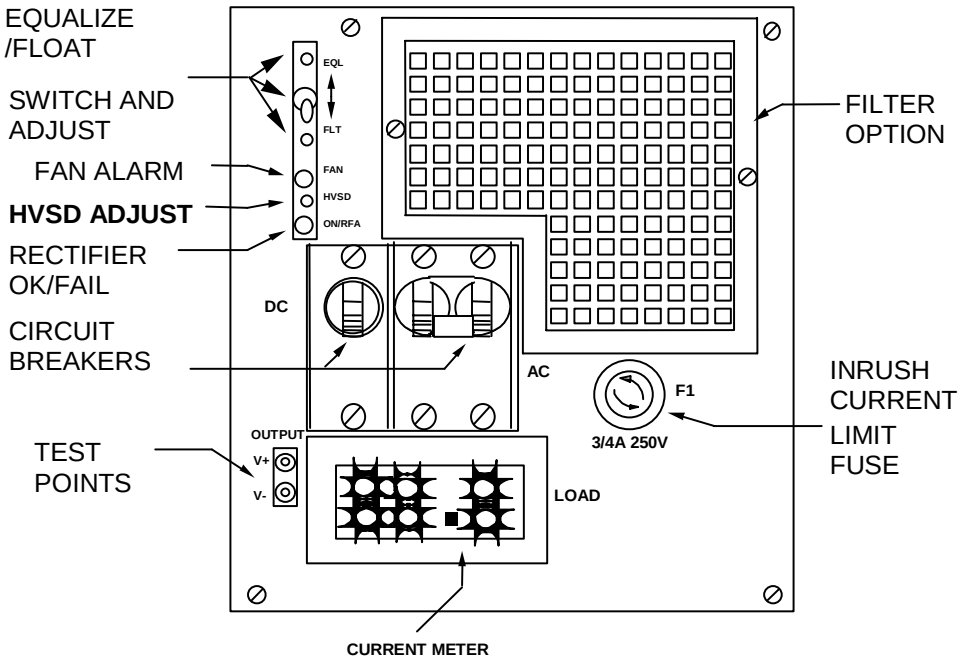
An auxiliary power supply provides the various voltages required by the internal circuitry and cooling fan.

Display and rear interface

Display

Figures 1 and 2 show the front and rear views of the fully equipped rectifier.

Figure 1 - NT5C06B/C Rectifier (front view)



Local float / equalize control

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

Indicator lamps

Designation	Color	Description
RFA/ON	Red	Rect. Failed or no load current *
	Green	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 (see Note below). 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.

Note: Give an alarm at no load condition only for the following releases or under.

NT5C06BB, BB-1, BB-3, BC	Rel. 10
NT5C06CA, CA-1, CA-3, CA-5 ,CC	Rel. 10
NT5C06CB, CB-1, CB-3, CD	Rel. 12
NT5CO6CE-61(-46)	Rel. 12

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 inhibition of the rectifier.

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 it shuts down immediately, locks out, and transmits an RFA. This function is not dependent 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, 250 V 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 modes NT5C06CB/CD/CE, failure of this fuse during operation will disable the unit. See the "Recommended Replacement 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 –48 V lead to prevent short circuits 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.

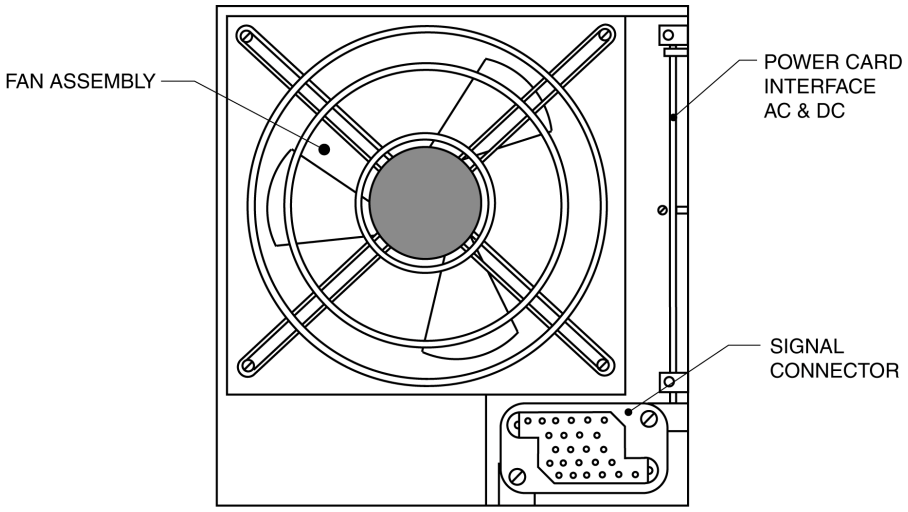
Fan filter option

A fan filter option is available for dusty environments to prevent the dust particles from entering and deteriorating the cooling efficiency of the rectifier. (See the “Recommended Replacement 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

Figure 2 - Rear interface



Fan cooling assembly

The fan cooling assembly ensures adequate cooling of the internal components. This assembly can be replaced in the field. Consult the “Fan Replacement Procedure” section for details.

Signal connector

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

Power interface edge connector

The rectifier AC, DC and chassis ground interface is made through the rear edge connector. Refer to the “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 (operation without batteries) of the plant. The 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 the performance or service life of the rectifier.

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

Transitions from constant-voltage operation to constant-current operation and from constant-current to constant-voltage operation will occur automatically, as determined by the output current. The current limit circuit will continue 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 has been 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 a precision within $\pm$10%.

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 the “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 returned to a safe level.

Output current monitor

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

Note: Give an alarm at no load condition, only for the following releases or under**.**

NT5C06BB, BB-1, BB-3, BC	Rel.10
NT5C06CA, CA-1, CA-3, CA-5, CC	Rel.10
NT5C06CB, CB-1, CB-3, CD	Rel.12
NT5CO6CE-61(-46)	Rel.12

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 Figure 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 locally, by resetting the AC circuit breaker (if so equipped), 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

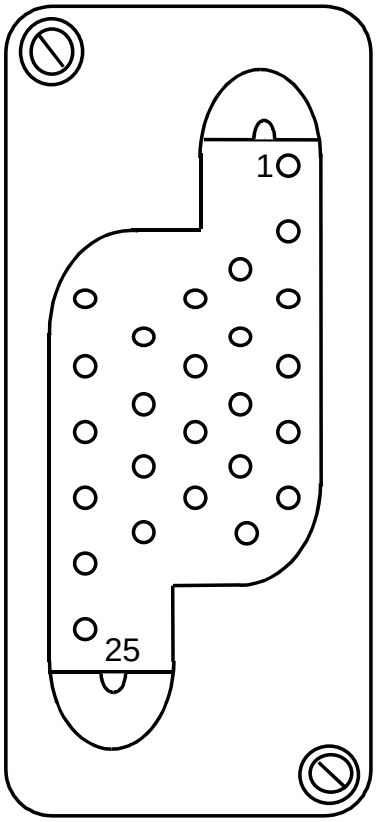
Remote equalize control

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 V DC and 0.5 A.

Figure 3 - Signal Connector



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 Astec controllers are indicated below.

Rectifier and controller interface connections

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

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 4, there are two shelf sizes with the following capacities:

a) 19-inch mounting -
- 2 x MPR25 or MPR15 (Figure 4)
- 2 x MPR25 or MPR15 + LVD
- 3 x MPR25 or MPR15

b) 23-inch mounting -
- 3 x MPR25 or MPR15 (Figure 5)
- 2 x MPR25 or MPR15 + LVD (Figure 7)
- 2 x MPR25 or MPR15 + LVD + RPM1000C (Figure 6)
- 3 x MPR25 or MPR15 + EQL SW Assembly (Figure 8)

c) There are two main application versions:

System

- In the system version (Table 4) the rectifier signals are brought out from the shelf through cables terminated with connectors which connect 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

- In these shelf-specific applications (Table 4) the rectifiers are designed to fit signals that 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 (+V DC), BAT (-V DC) and LOAD (-V DC) where an LVD is installed.

Table 4 - 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	Connectors	Open Cable	Connectors	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

Note: For exact option configurations and ordering, refer to the "References" section.

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

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

Table 5 - Modular power shelf embedded application signal availability

PEC Code	Color	AC Com/ Indiv	HSB FLS	DC EMI FLT	WIDTH (inches)	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 Grey	Individual	FLS		19		NT6C13FG	
NT5C10BB-3	Oxford Grey	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 Grey	Common	FLS	X	23		NT6C13FC	5
NT5C10BE	Brown	N/A	N/A	N/A	8.2	Rectifier adapter	NT6C13FF	
NT5C10BM	Dolphin Grey	Common	FLS	X	23	EQL Switch	N/A	2
NT5C10BJ	Brown	Common	FLS	X	23	LVD+I/F PCB LVD+RPM 1000C	NT6C13FA NT6C13FJ	3, 5 4, 5
NT5C10BK	Dolphin Grey	Common	FLS	X	23	LVD+I/F PCB LVD+RPM 1000C	NT6C13FC NT6C13FK	3, 5 4, 5
NT5C10BL	Oxford Grey	Individual	FLS	X	23		NT6C13FC	5
NT5C10BP	Dolphin Grey	Common	FLS		19		NT6C13FC	
NT5C10BQ-46	Brown	Individual	FLS	X	23	AC delay signal	N/A	

Note 1: When hooked up to an external RPM1000, order a Hot Stand By (HSB) and an equalize switch assembly A0401062 NT5C10KE Free Load Sharing (FLS).

Note 2: When used with the I/F PCB option, order kit P0736446.

Note 3: When used with an RPM1000C, order P0736447.

Note 4: To use the optional AC Fail Alarm, order NT5C10KC A0627571.

Table 6 - Modular power shelf embedded application signal availability

	AVAILABLE SIGNALS																
						RFA			RFA MAJ	FAN				SEN			
PEC CODE	EQL	RG+	RC-	HVSDR	HVSD	NC	NO	C	NC	NC	C	NC	C	ALM	LVA	TR	NSR
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		P1-2	P1-1			P1-3											
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)	P1-1	P1-2	P1-3	P1-5	P1-6	P1-7				P1-4					P3-8	P1-8	
NT5C10BK (4)	PE1-1	PE1-2	PE1-3	PE1-5	PE1-6	PE1-7				PE1-4					P3-1	PE1-8	
NT5C10BK (3)	P1-1	P1-2	P1-3	P1-5	P1-6	P1-7				P1-4					P3-8	P1-8	
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 7 - Modular power shelf system application signal availability

NT CODE	COLOR	AC COM/ INDIV	DC OTP EMI	19/ 23 IN	EQL	RG+	RC-	HVSDR	HVSD	RFA	FAN	RFA MAJ	REG ALM	LV ALM	TR	AC FAIL		NOTES
										NC	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	DOLPHINGREY	COM	X	23	P1-1	P1-2	P1-3	P1-5	P1-6	P1-7	P1-4				P1-8			5
NT5C10CD-1/2	OXFORDGREY	COM	X	23	P1-1	P1-2	P1-3	P1-5	P1-6	P1-7	P1-4				P1-8			5
NT5C10CE	DOLPHINGREY	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	DOLPHINGREY	COM		23	P1-1	P1-2	P1-3	P1-5	P1-6	P1-7	P1-4				P1-8			5
NT5C10CH	DOLPHINGREY	INDIV		23	P1-1	P1-2	P1-3	P1-5	P1-6	P1-7	P1-4				P1-8			5
NT5C10CO-61	DOLPHINGREY	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).

Table 8 - List of abbreviations used in Tables 6 and 7

LEGEND

RG	Rectifier sense (+VC lead)	O:	Orange
RC	Rectifier sense (-VC lead)	BL:	Blue
HVSDR	High Voltage Shutdown Restart	BK:	Black
HVDS	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		

Following are some views of the available power shelf configurations.

Figure 4 - 19-inch power shelf (front view)

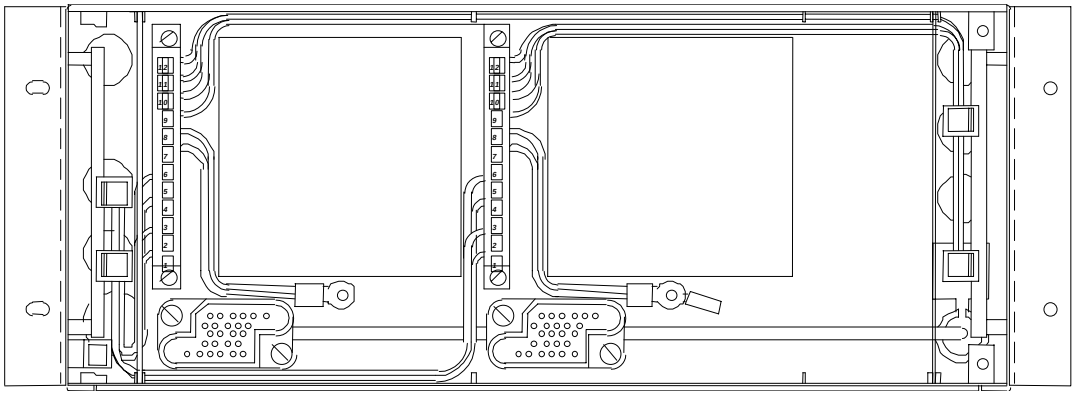


Figure 5 - 23-inch power shelf (front view)

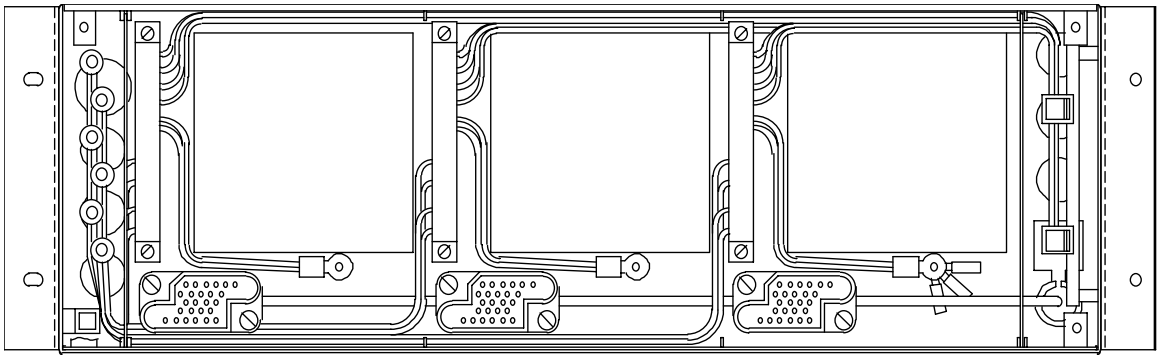


Figure 6 - Power shelf NT5C10BJ or NT5C10BK (exterior view)

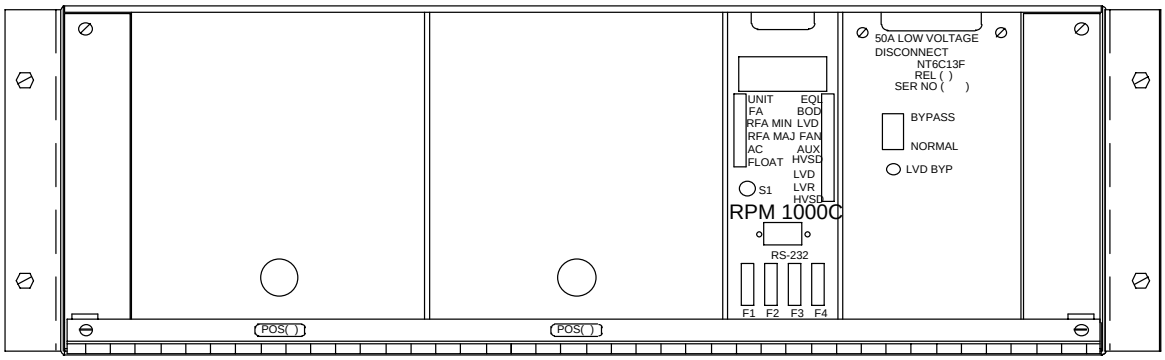


Figure 7 - Power shelf NT5C10BJ or NT5C10BK (interior view)

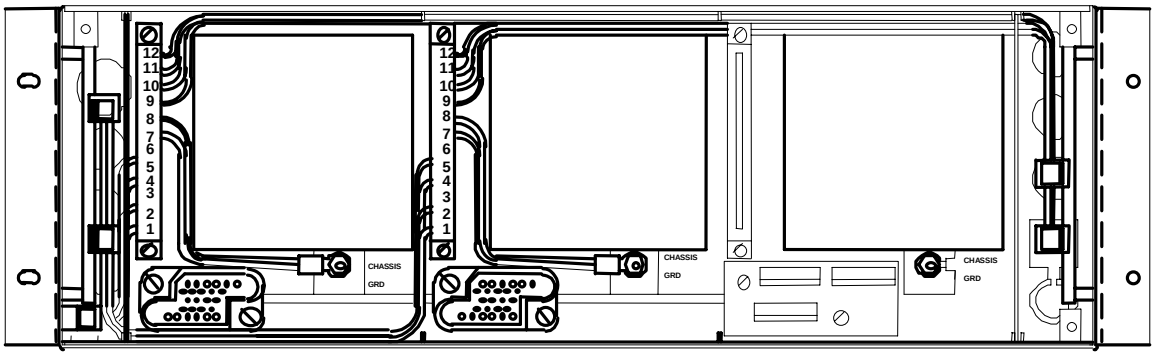


Figure 8 - Power shelf NT5C10BM e/w EQL switch assembly

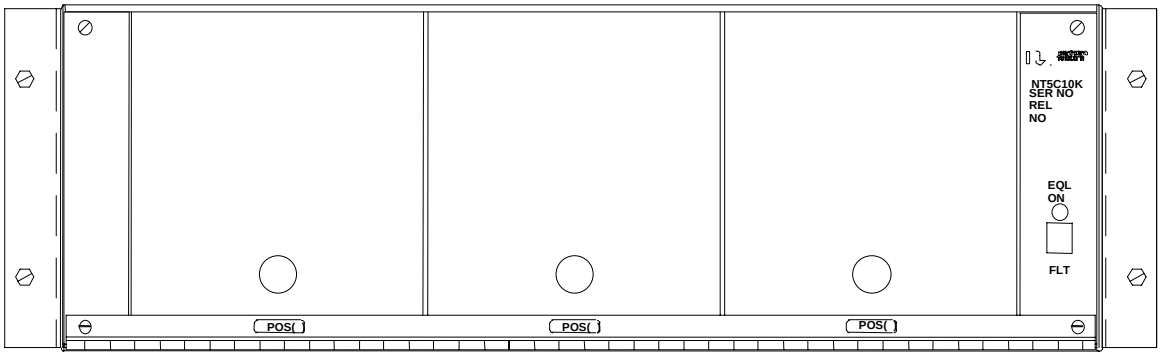
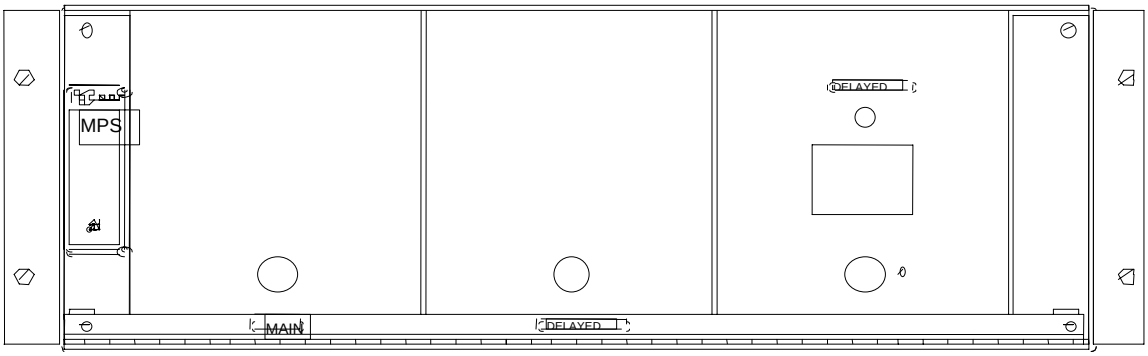


Figure 9 - Power shelf NT5C10CO equipped with start delay LED



Electrical

When using the MPR25 rectifier, powered from 208 / 240 V AC 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 54 V dc, full load output = maximum input current at Output 54 V dc, current limit minimum line	
Input Voltage:	208 V AC	
Frequency:	47-63 Hz	
Range:	176-264 V AC	
Input Current:	one rectifier	11.7 (15.5)
	two rectifiers	23.4 (31.0)
	three rectifiers	35.1 (46.5)
Output Voltage:	-46 V DC TO –57 V DC	

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

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

Use a 20 A breaker or FRN type fuse for individual AC.

Use a 40 A breaker or FRN type fuse for two rectifiers, common AC.

Use a 60 A breaker or FRN type fuse for three rectifiers, common AC.

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

Condition: Typical input current value for 54 V dc, full load output.( ) = maximum input current at Output 54 V dc, current limit minimum line

Input Voltage:	120 V AC	
Frequency:	47-63 Hz	
Range:	96-132 V AC	
Input Current:	one rectifier	10.5 (16.5)
	two rectifiers	21.0 (33.0)
	three rectifiers	31.5 (49.5)

Use a 20 A breaker or FRN type fuse for individual AC.

Use a 40 A breaker or FRN type fuse for two rectifiers, common AC.

Use a 60 A breaker or FRN type fuse for three rectifiers, common AC.

Output Voltage:	-46 V DC to -57 V DC	
Output current:	one rectifier	15 A
	two rectifiers	30 A
	three rectifiers	45 A

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 procedures

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

Procedure 1 - Power shelf installation

Step	Action
1	Position the power shelf against the rack.
2	Fasten the shelf in the position indicated on the drawings (normally directly below the Controller or below another power shelf).
3	Release the clamping bar from the front of the power shelf (Refer to Figures 10, 11 and 12).
4	Remove the AC junction box cover (left side) and store for re-installation.
5	Remove the DC and control wiring area cover (right side) and store for re-installation.
–end–	

Figure 10 - 19-inch power shelf

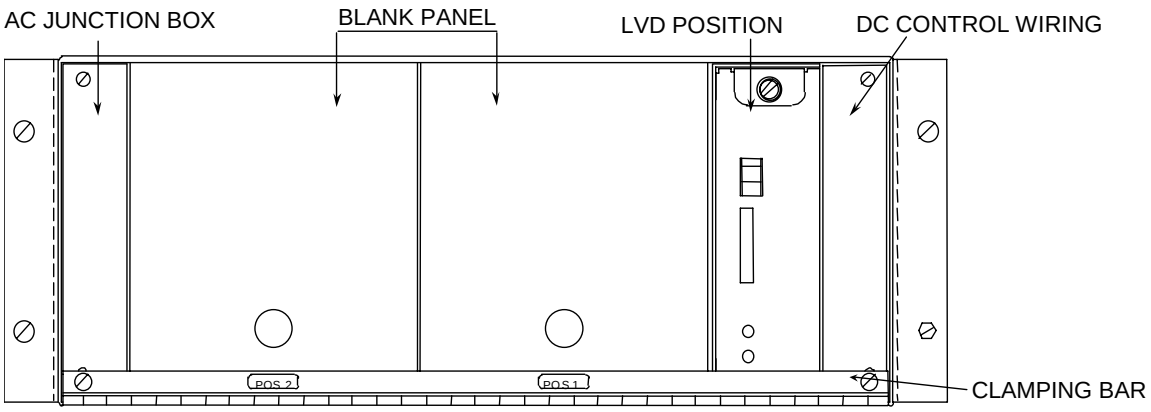


Figure 11 - 23-inch power shelf

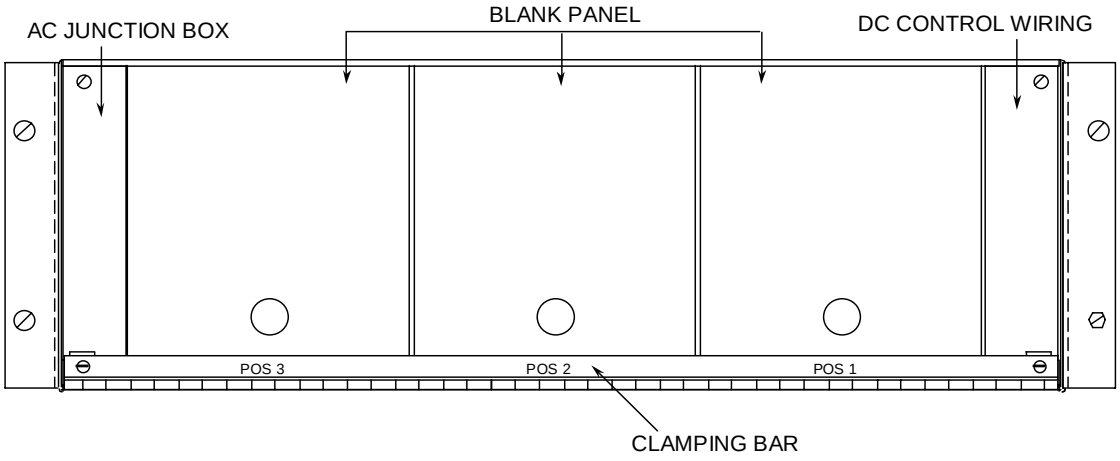
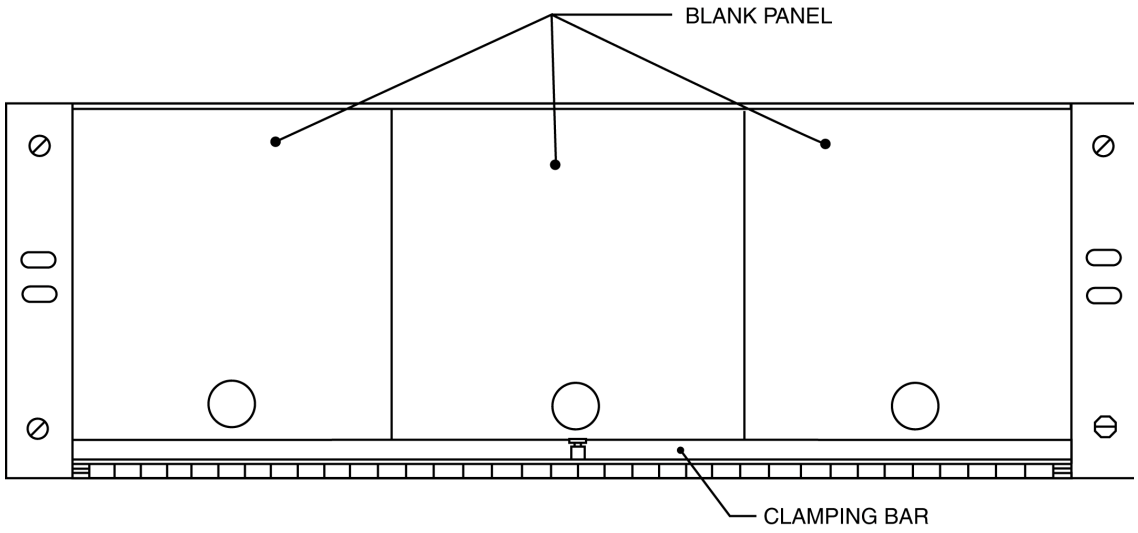


Figure 12 - 19-inch power shelf (NT5C10BF and NT5C10BP only)



Cabling the power shelf

The AC and DC cabling size and routing inside the shelf are determined by the following shelf configurations. Refer to Figures 13 to 20 for routing.

Note: The grounding of the shelf is provided by the AC armored cable ground wire attached to a two-hole ground lug located on the inside wall of the shelf chassis. The shelf is also grounded to the rack or cabinet frame by one of the shelf mounting screws which is installed with an external tooth washer. This grounding method is 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 terminal, the new ground wire can be installed on one of the existing ground lug screws located inside the shelf. Route the wire along the inside top back of the shelf and make it exit out of the right DC cabling side opening. Ensure the wire does not interfere with the rectifier connections. See Figure 13 for the extra ground connection mounting location.

Shelf configuration

19-inch system shelf (NT5C10CA-1/2)

Capacity:	-2 x MPR25
AC common cable:	2/8 AWG armored cable Reference Figure 13 (side)
DC cables:	6 AWG (BAT and BAT RTN) Ref. Figure 19 (side) Figure 20 (rear)

Signals 2 x 8 conductor cables terminated with connectors.

19-inch 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:	- one cable (for remote sensing and alarm)

Note: See Appendix A for additional information.

19-inch 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. Refer to Figure 13 (Side)
DC cables	-	6 AWG (BAT and BAT RTN). Refer to Figure 19 (Side) and Figure 20 (Rear)
Signals:	-	1 cable (for remote sensing and alarm).

19-inch embedded shelf (NT5C10BA-3/4)

Capacity:	-	2 x MPR25
AC individual cable:	-	2/12 AWG armored cable. Refer to Figure 15
DC cables:	-	6 AWG (BAT and BAT RTN). Refer to Figure 19 (side) and to Figure 20 (rear)
Signals:	-	1 cable (for remote sensing and alarm)

19-inch embedded shelf (NT5C10BA-5/6,NT5C10BB-3/4)

Capacity:	-	2 x MPR25 + LVD
AC common cable	-	2/8AWG armored cable. Reference Figure 13
DC cables	-	6 AWG (BAT and BAT RTN). Refer to Figure 19 (Side) and to Figure. 20 (Rear)
Signals:	-	1 cable (for remote sensing and alarm)

19-inch embedded shelf (NT5C10BB-1/2)

Capacity:	-	2 x MPR25 + LVD
AC common cable:	-	2/12 AWG armored cable. Refer to Figure 13
DC cables:	-	6 AWG (BAT and BAT RTN). Refer to Figure 19 (Side) and to Figure 20 (Rear)
Signals:	-	1 cable (for remote sensing and alarm)

23-inch 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. Refer to Figure 13 (side)
DC cables:	- 4 AWG (BAT and BAT RTN). Refer to Figure 19(side) and to Figure 20 (rear)
Signals:	- 2 x 8 conductor cables terminated with connectors.

23-inch system shelf (NT5C10CB-3/4, NT5C10CE, NT5C10CF, NT5C10CH)

Capacity:	- 3 x MPR25
AC individual cable	- 2/12 AWG armored cable. Refer to Figure 17.
DC cables	- 4 AWG (BAT and BAT RTN). Refer to Figure 19 (side) and to Figure 20 (rear)
Signals:	- 2 x 8 conductor cables terminated with connectors.

23-inch embedded shelf (NT5C10BC-1/2)

Capacity:	- 3 x MPR25
AC individual cable:	- 2/12 AWG armored cable. Refer to Figure 16
DC cables:	- 4 AWG (BAT and BAT RTN). Refer to Figure 19(side) and to Figure 20 (rear)
Signals:	- 1 cable (for remote sensing and alarm)

23-inch embedded shelf (NT5C10BC-3, NT5C10BD-3)

Capacity:	- 3 x MPR25
AC common cable:	- 2/6 AWG armored cable. Refer to Figure 13 (Side)
DC cables:	- 4 AWG (BAT and BAT RTN). Refer to Figure 19 (side) and to Figure 20 (rear)
Signals:	- 1 cable (for remote sensing and alarm)

23-inch embedded shelf (NT5C10BM)

Capacity:	- 3 x MPR25
AC common cable:	- 2/6 AWG armored cable. Refer to Figure 13 (side)
DC cables	- 4 AWG (BAT and BAT RTN). Refer to Figure 19 (side) and to Figure 20 (rear)
Signals:	- 1 cable (for remote sensing and alarm)

23-inch embedded shelf (NT5C10BL)

Capacity:	- 3 x MPR25
AC individual cable	- 2/12 AWG armored cable. Refer to Figure 16
DC cables	- 4 AWG (BAT and BAT RTN). Refer to Figure 19 (side) and to Figure 20 (rear)
Signals:	- 1 cable (for remote sensing and alarm)

23-inch embedded shelf (NT5C10BJ, NT5C10BK)

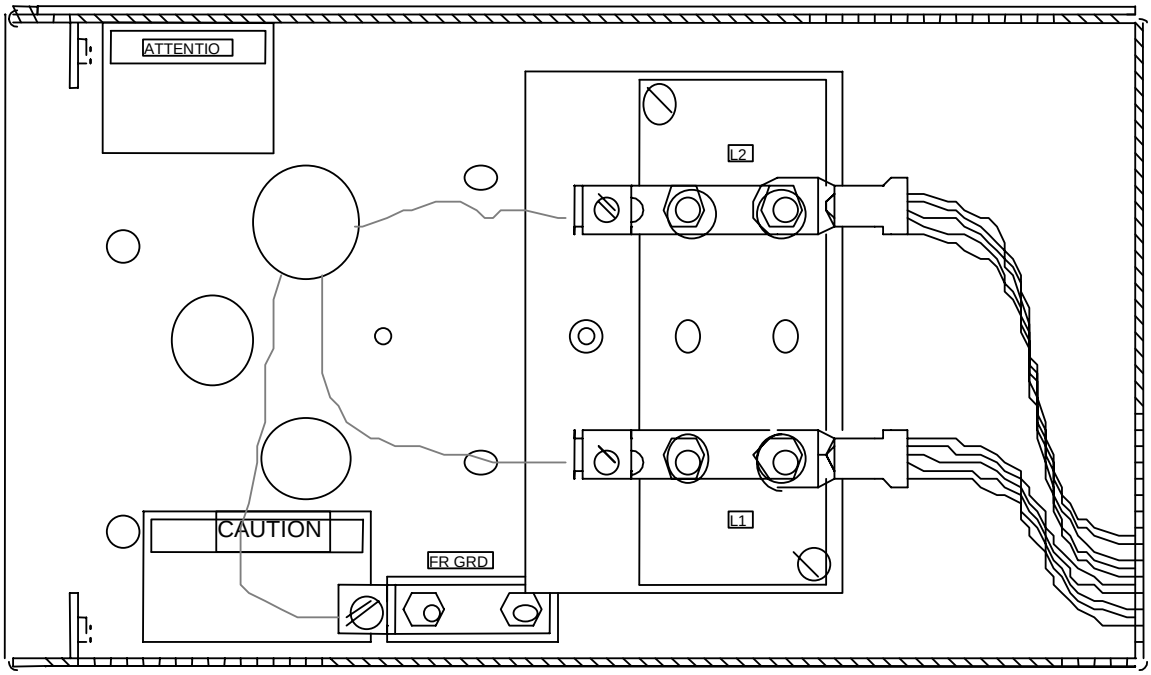
Capacity:	- 2x MPR25
AC common cable	- 2/8 AWG armored cable. Refer to Figure 13 (Side)
DC cables	- 6 AWG (BAT and BAT RTN). Refer to Figure 19 (side) and to Figure 20 (rear)
Signals:	- 2 cables (for remote sensing and alarm)

23-inch system shelf (NT5C10CO)

Capacity:	- 1 x MPR15 + 1 x MPR15 “Delay Start”
AC common cable	- 2/12 AWG armored cable. Refer to Figure 13 (side)
DC cables	- 6 AWG (BAT and BAT RTN). Refer to Figure 18 (side) and to Figure 19 (rear)
Signals:	- 2 cables (for remote sensing and alarm)

Note : See Appendix B for additional information.

Figure 13 - System shelf or embedded (left view) common bussed AC - side access



Procedure 2 - Common bussed AC connection - side access

Step	Action
1	Punch out 1.125-inch dia. knockout on left side of shelf.
2	Mount conduit connector with lock nut.
3	Run and connect wires as illustrated.
4	Re-install the blank panel to prevent access to the connections inside.
–end–	

Figure 14 - Extra ground connection mounting location (optional) (Typical installation view for all shelf models)

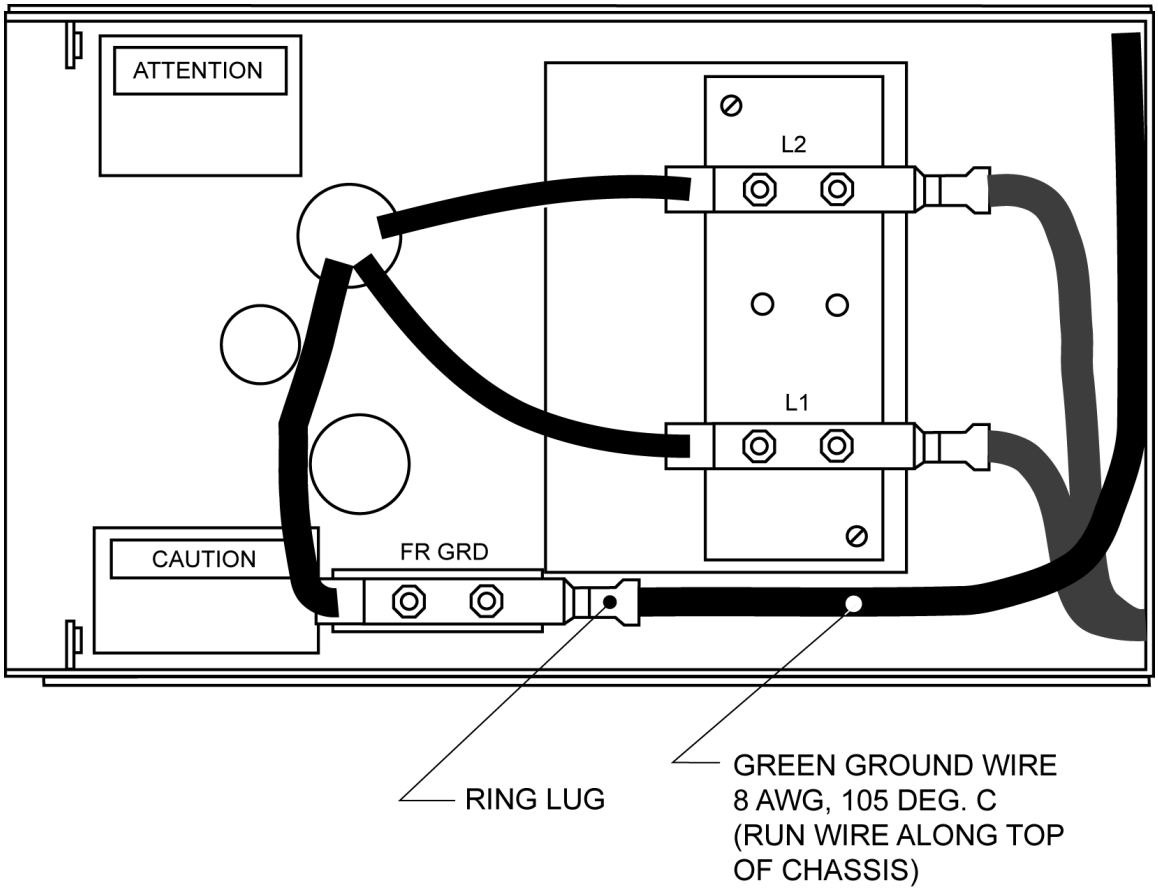
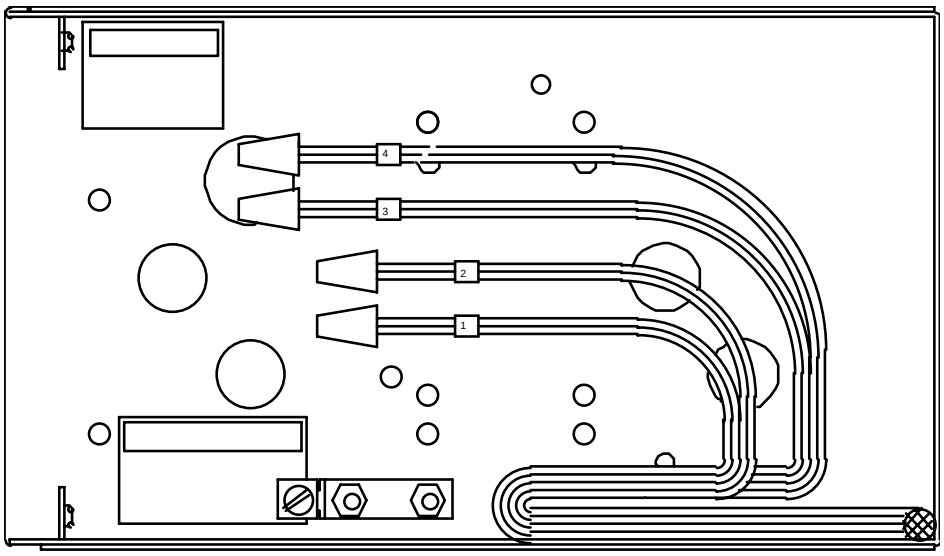


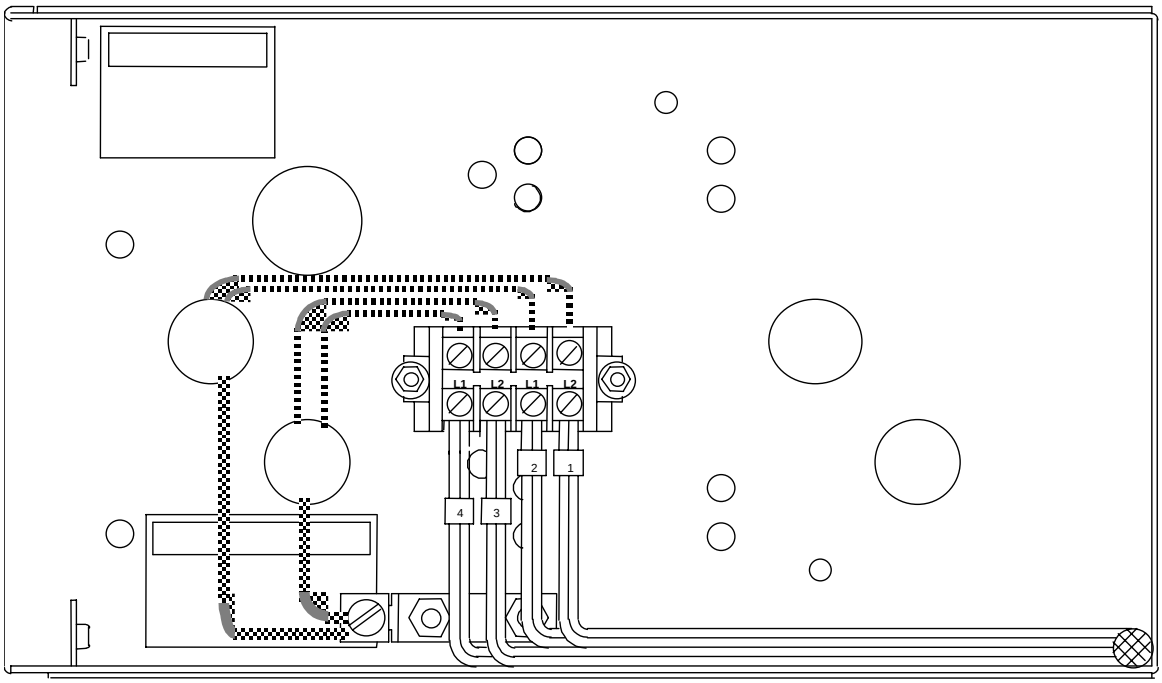
Figure 15 - Embedded shelf (left view) - individual ac - side access old vintage



Procedure 3 - Individual AC connection - side access old vintage

Step	Action
1	Punch out 0.875-inch dia. knockout on left side of shelf.
2	Mount conduit connector with a lock nut.
3	Run and connect wires as illustrated.
4	Re-install the blank panel to prevent access to the connections inside.
–end–	

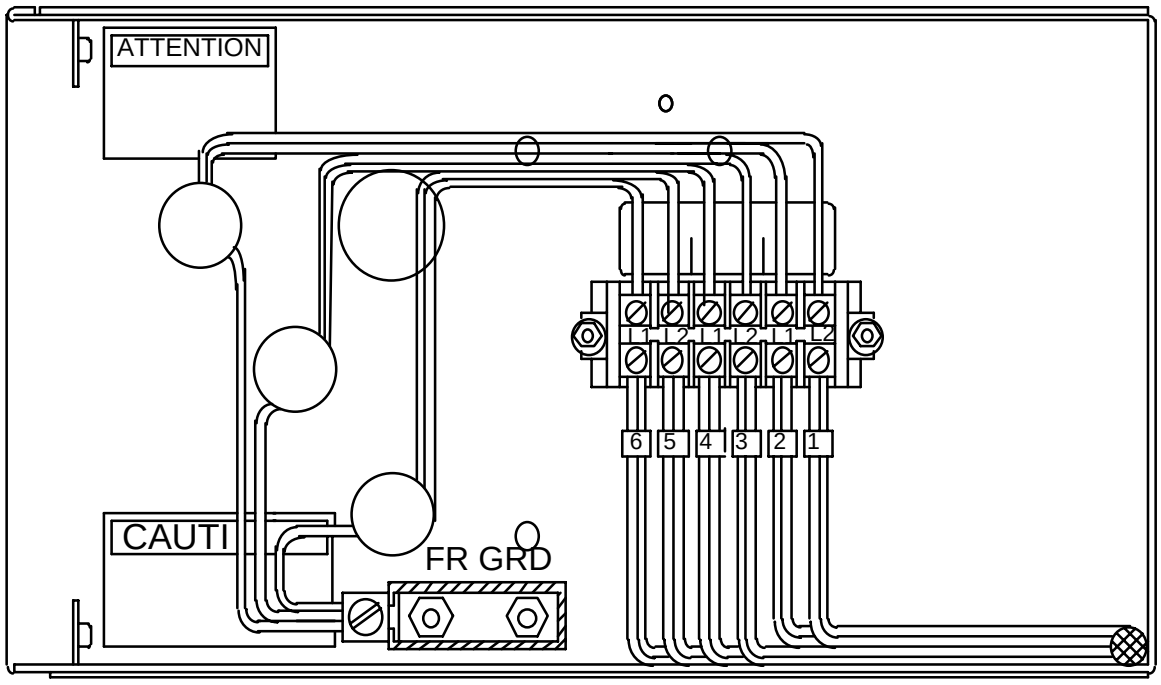
Figure 16 - Embedded shelf (left view) - Individual AC - side access



Procedure 4 - Individual AC connection-side access

Step	Action
1	Punch out the 0.875 in. dia. knockout on the left side of the shelf.
2	Mount the conduit connector with a lock nut.
3	Run and connect wires as illustrated.
4	Re-install the blank panel to prevent access to the connections inside.
–end–	

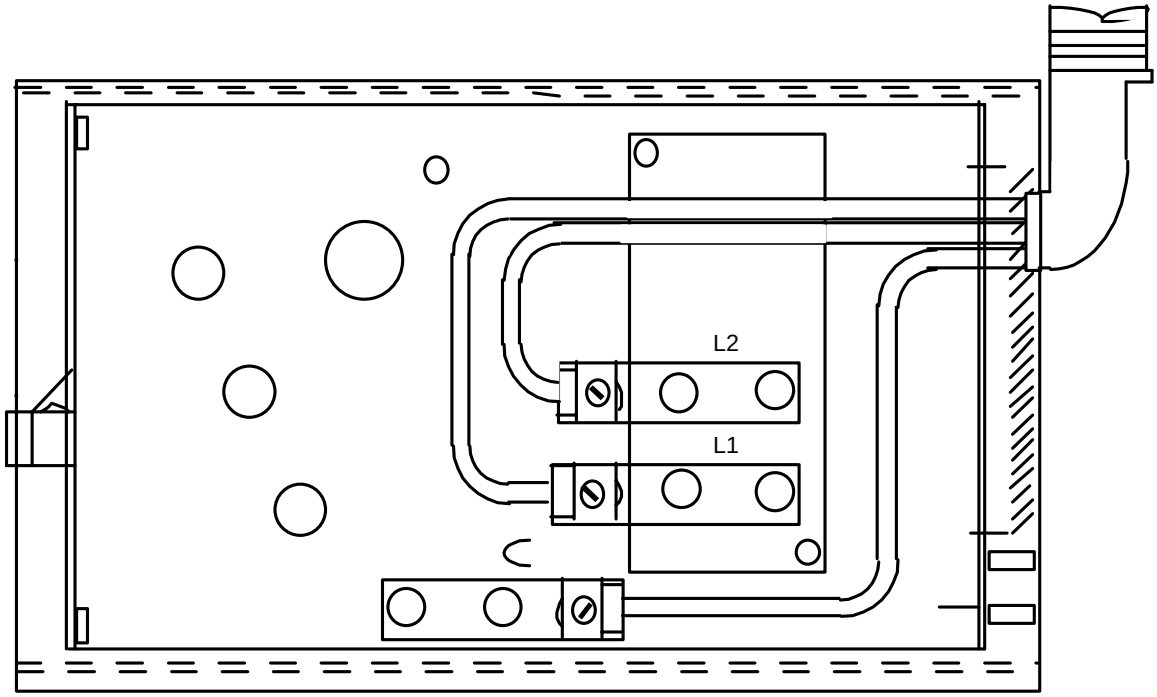
Figure 17 - System or embedded shelf (left view) - individual AC - side access



Procedure 5 - Individual AC connection - side access

Step	Action
1	Punch out the 0.875 in. dia. knockout on the left side of the shelf.
2	Mount the conduit connector with a lock nut.
3	Run and connect wires as illustrated.
4	Re-install the blank panel to prevent access to the connections inside.
–end–	

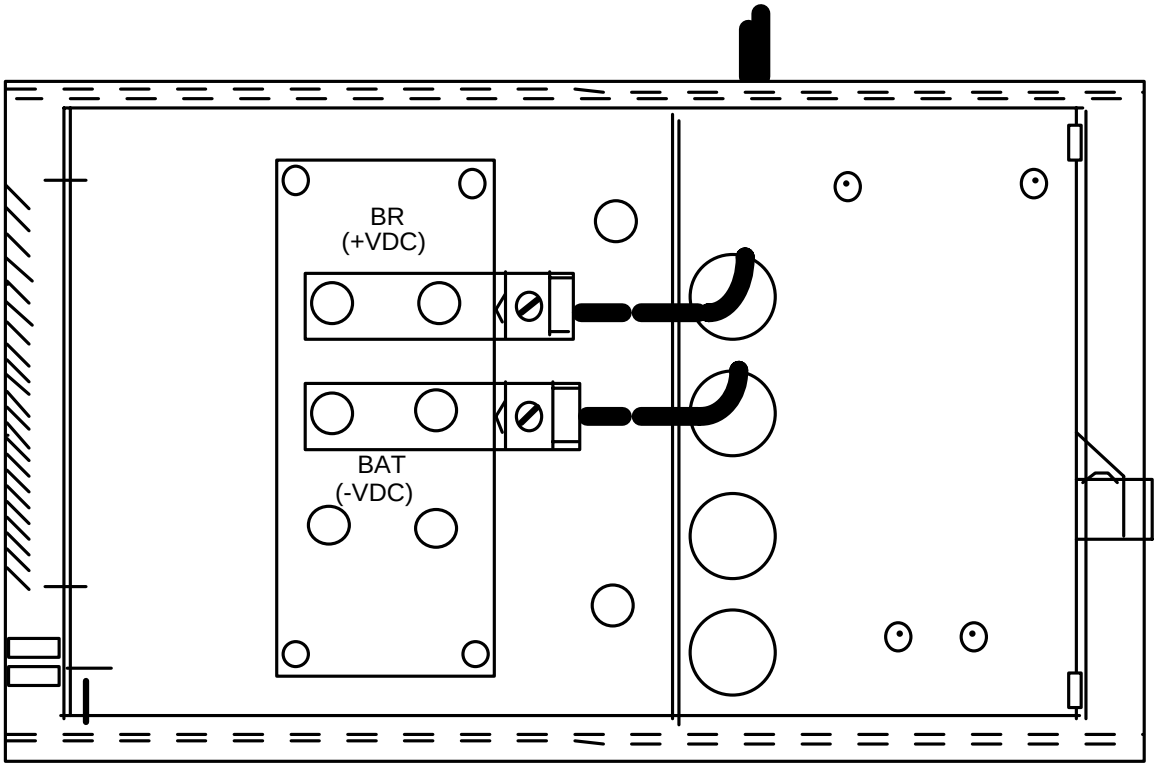
Figure 18 - System shelf (left view) - common bussed AC - rear access



Procedure 6 - Common bussed AC connection - rear access

Step	Action
1	Punch out the 1.125 in. dia. knockout on the left rear of the shelf.
2	Mount the conduit connector with a lock nut.
3	Run and connect the wires as illustrated.
4	Re-install the blank panel to prevent access to the connections inside.
–end–	

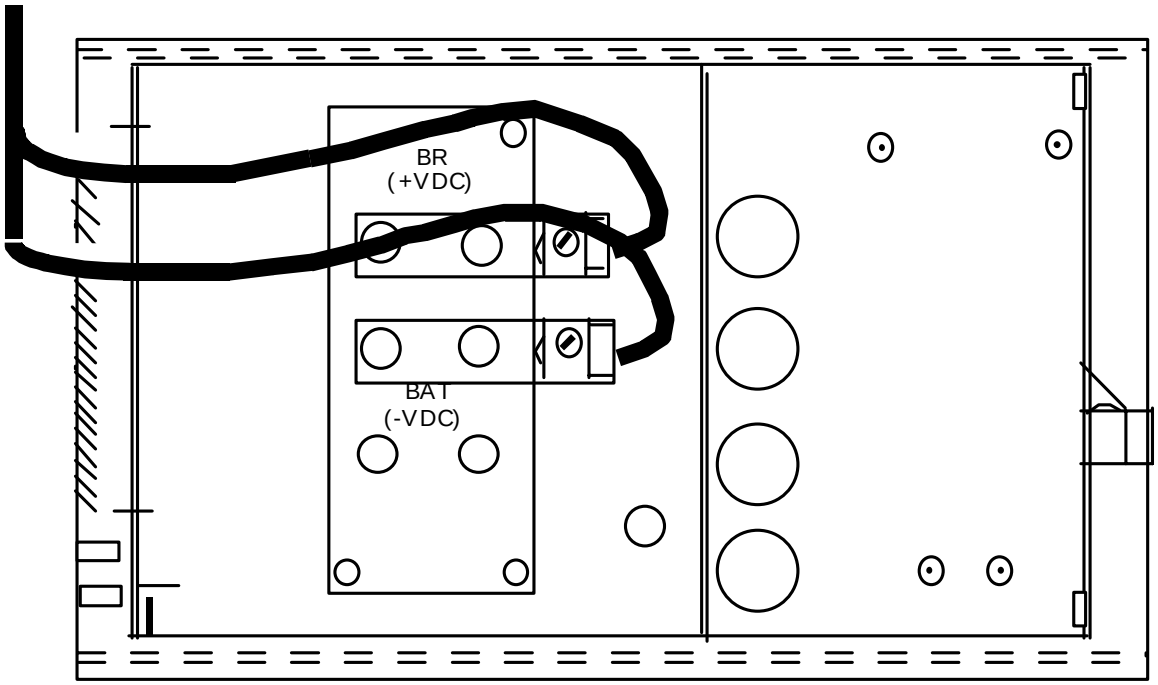
Figure 19 - System or embedded shelf (right view) - DC connecting - side access



Procedure 7 - DC connection - side access

Step	Action
1	Punch out the top two .875-inch dia. knockouts on the right side of the shelf.
2	Insert the bushings, run and connect the wires as illustrated.
3	Re-install the blank panel to prevent access to the connections inside.
–end–	

Figure 20 - System or embedded shelf (right view) - DC cabling - rear access



Procedure 8 - DC connection - rear access

Step	Action
1	Punch out the top two 0.875-inch dia. knockouts on the right rear of the shelf.
2	Insert the bushings, run and connect the wires as illustrated.
3	Re-install the blank panel to prevent access to the connections inside.
–end–	

Power plant interface - signal cabling

Rectifier and Controller interface connections.

Table 9 - Standard system application signal cable connections:

DESIGNATION	DESCRIPTION	SIGNAL ACTIVATES
RG (+) and RC (-)	Sensing Leads	BAT RTN
HVSD	High Voltage Shutdown	
HVSDR	High Voltage Shutdown Reset	BAT RTN
TR	Remote Inhibit	BAT RTN
EQ	Remote Equalize	BAT RTN
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 manual.

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 for specific applications.

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 that provides an alarm signal no standby rectifier (NSR) 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. 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 state of the line input voltage of the left rectifier in the shelf. This relay, which is normally closed, will open after a delay of 8 to 10 seconds following the removal of the AC line input. The indicator should be set to #6.

Note : The standby HVSD rectifier 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 NT5C10BJ is brown and the NT5C10BK is 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 a control circuit pack (NT6C13FJ).

When the NT6C13FJ unit is used, the RPM1000C performs the control and monitoring functions. The NT6C13FJ is equipped with an interface circuit pack that receives the LVD signal from the RPM1000C (battery return) to open the LVD contactor. It 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 is being replaced.

The power shelves are offered in the two configurations 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 is to connect the rectifier control cables (J1 and J2) and the alarm cable (J3). The connector pin assignments are listed in Table 10.

Table 10 - J1, J2 and J3 connector pin assignment

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

Order cable assembly P0739814 to connect the alarm signals (J3) to the alarm monitoring unit.

NT5C10BM

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

When the equalize switch is set to the EQL position, a battery return signal is sent to the 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 individually adjusted to the same equalize voltage level. The yellow LED indicates that the rectifiers are in equalize mode.

NT5C10KA & KB

This option is 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.

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

NT5C10KC

This option is offered to provide an AC Fail Alarm upon loss of the input line power. Selectable for 120 or 208 / 280 V AC operation, the circuit provides a dry C form contact relay, TB1-1 (NC) and TB1-2 (C), to send an alarm. See User Manual (UM) 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 amount of time after an AC power failure. The delayed start is required to allow time for the batteries to recharge, and the required total AC input current for the two rectifiers to be reduced to less than 20 amperes.

The rectifier that is delayed will be activated immediately if the main rectifier fails, 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). The "DELAYED START" yellow LED of the timer will be ON indicating that the rectifier with the red RFA LED is on delayed start mode.

See Appendix B for additional information on the NT5C10CO shelf.

Installing the rectifier

Procedure 9 - Rectifier installation

Step	Action
1	Release the clamping bar and remove the blank panel with a lifting motion, dislodging the lower tables, and place the panel at the bottom of the shelf.
2	Ensure that the AC and 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 V AC 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.
–end–	

CAUTION

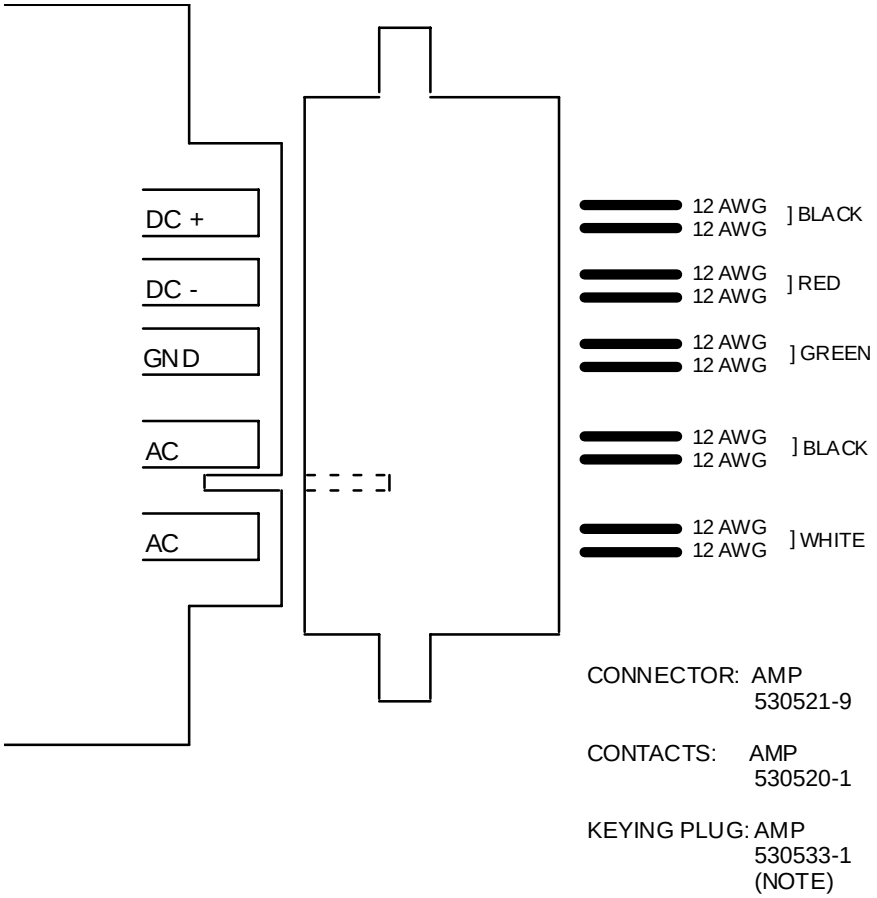
Operating voltage

If the NT5C06CB, CD or CE model is used, ensure that the nominal line voltage is 110 V AC. Operating the unit at 208 / 240 V AC 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.

Figure 21 - Rectifier AC and DC power (internal) cabling harness



Noten: When required, keying plugs (CPC A0377927) can be ordered. Insert one in the third plug from the bottom**.**

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

LVD installation in the shelf

The LVD is installed in the right hand shelf position as describes in Procedure 10.

Procedure 10 - LVD installation in the shelf

Step	Action
1	Release the clamping bar and blank panel (see Procedure 1).
2	Remove the LVD faceplate.
3	Slide the LVD about two thirds of the way into the shelf.
4	Connect the LVD as shown in Figure 22 and 23. (Use 2 X 10 AWG wires for contactors).
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	Secure the clamping bar by tightening the two captive screws.
—end—	

Figure 22 - Embedded shelf - LVD connections - rear access

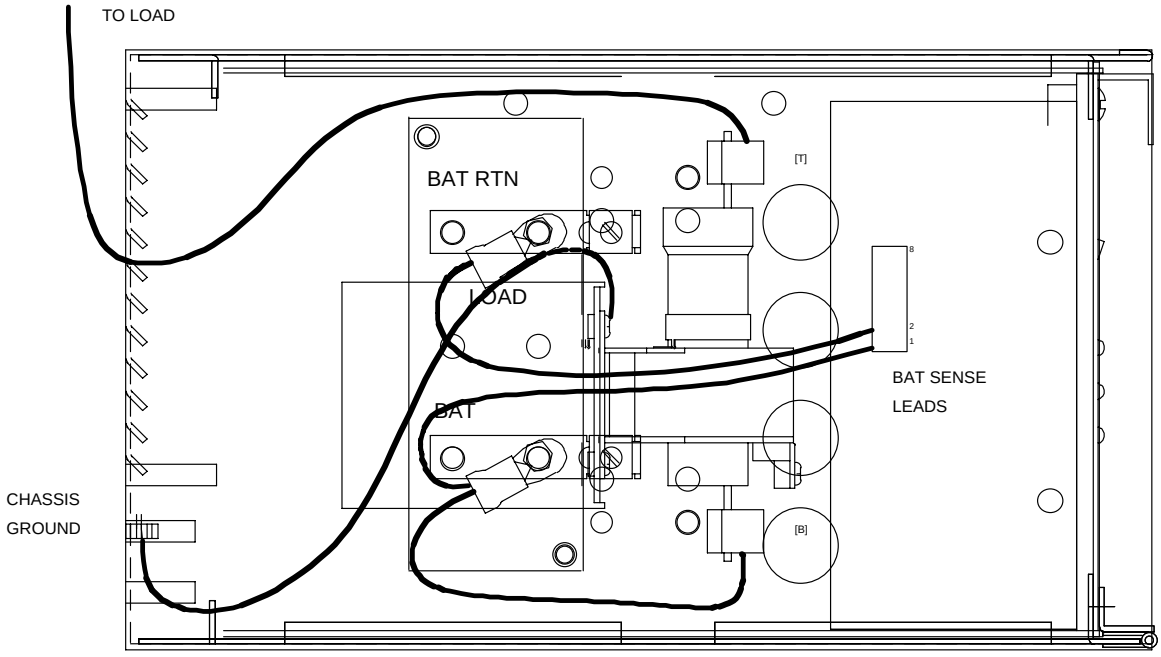
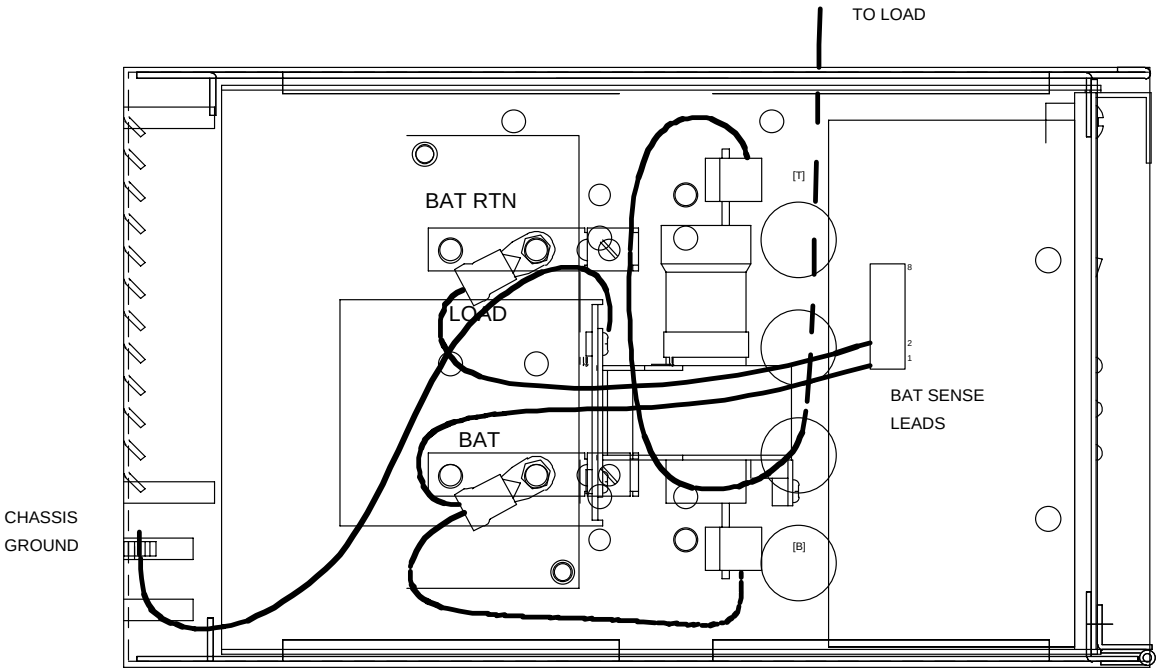


Figure 23 - Embedded shelf - LVD connections - side access



Start-up procedure

Factory set voltage limits

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

	MPR15	**MPR25**
Float Voltage:	52.10 V DC	48.00 V DC
Equalize:	0.70 V DC above float	0.00 V DC above float
HVSD:	59.00 V DC	56.50 V DC
LVD / LVD Alarms		
Low Voltage Alarm (LVA):		47.00 V DC
Low Voltage Disconnect (LVD):		43.50 V DC

Rectifier power-up

If the factory set voltage limits need to be modified or verified, open the sense leads of all the rectifier positions to be turned on:

- by disconnecting a quick disconnect tab of TB-1 on the power shelf

  or

- by removing the controller sense fuse (system application)

  or

- by setting the dip switches to the OFF position (system application)

Then refer to the appropriate section for Float Voltage, HVSD or Equalize adjustments (see User Manual 167-7011-010 *Voltage Level Limits for Power Plants, Rectifiers and Controllers).*

If no change is needed continue with the parallel verification procedure.

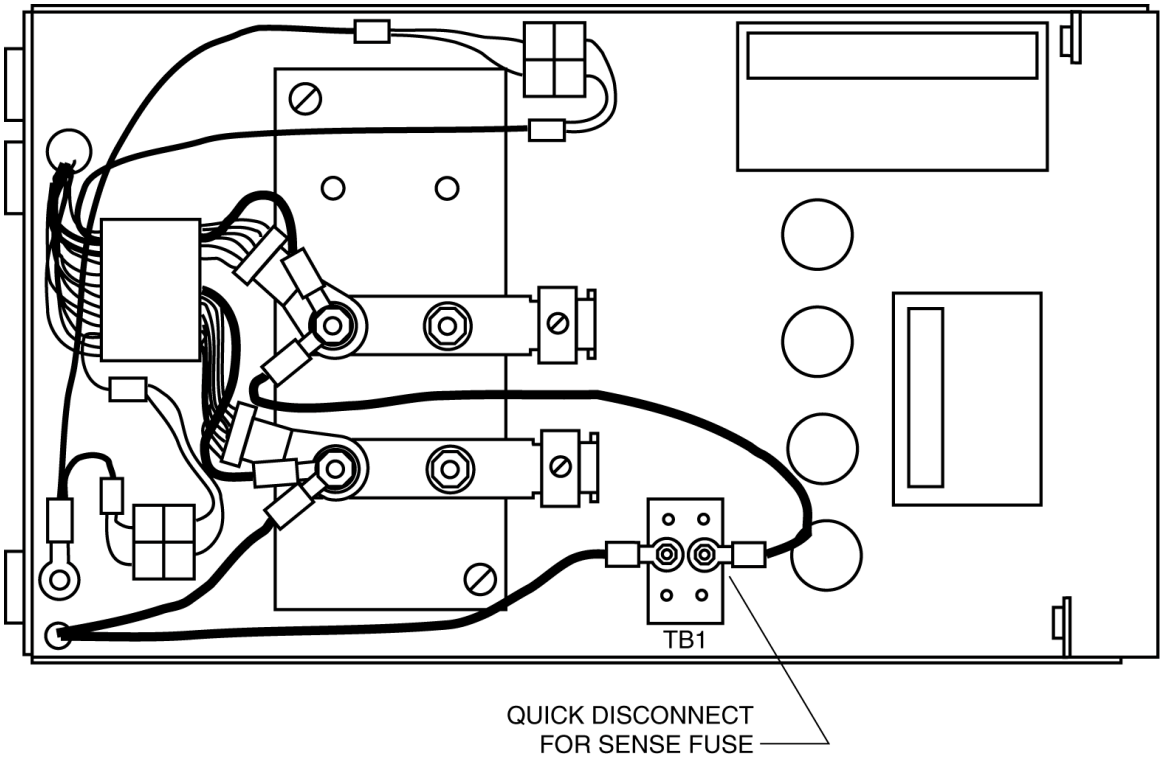
Note: Quick disconnect tab TB1 is located on the right end side of the shelf and can be accessed by removing the front cover (see Figure 24). For system applications, refer to the appropriate system procedure guide for the fuse or dip switch location.

Procedure 11 - Rectifier power-up

Step	Action
1	Verify that the DC and AC rectifier circuit breakers are in the OFF position.
2	If no change is needed continue with the "Parallel verification" procedure found further in this chapter.
3	Turn ON the main AC feed.
4	Turn ON the AC circuit breaker of one rectifier; the rectifier will provide voltage on the front panel test point terminals.
–end–	

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

Figure 24 - Embedded shelf quick disconnect for sense (sectional view)



HVSD adjustment

Procedure 12 - HVSD adjustment

Step	Action
1	Turn the HVSD potentiometer fully clockwise.
2	Monitoring the test points (V+, V-), adjust the float potentiometer FLT to the desired HVSD level.
3	Turn the HVSD potentiometer slowly counterclockwise until the rectifier shuts down. The test point voltage shall start decaying to 0 volt.
4	Turn the float potentiometer counterclockwise, two full revolutions.
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 the unit shuts down. Read the float voltage to verify the disable point. Turn float potentiometer counterclockwise, two full revolutions. Cycle the AC breaker OFF/ON.
7	Re-adjust if needed (return to step 1).
–end–	

Note: If the desired HVSD level is greater than the –57 V float limit, 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.

Float voltage adjustment

Note: For installation where rectifiers can be connected to the charge bus (all rectifiers with DC breakers ON and remote sense leads connected) prior to final adjustment, Procedure 13 can be omitted and be performed in the "Parallel verification" procedure section.

Procedure 13 - Float voltage adjustment

Step	Action
1	Adjust the float potentiometer FLT to 0.5 volt DC (see ***Note*** below) 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 indicated in "Parallel verification" Procedure15, step 4.
–end–	

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

Equalize voltage adjustment

Procedure 14 - Equalize voltage adjustment

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

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

Parallel verification

Note 1 : The following does not apply to rectifier shelf applications with the hot stand-by option. For delayed start shelf applications, wait after the delay expires before performing the next step.

Note 2 : All the rectifiers in the shelf or system must have been individually adjusted as indicated in the Power up, HVSD adjustment, FLT adjustment and Equalize adjustment procedures before proceeding with the following steps.

DANGER
When adding or replacing a rectifier verify that the rectifier DC and AC circuit breakers are in the OFF position.

Reconnect the sense leads (if disconnected before the rectifier power-up) for all the shelf rectifiers

- by connecting the quick tab of TB-1 on the shelf

  or

- re-installing the sense fuse (system application)

  or

- setting the dip switches to the ON position (system application)

Procedure 15 - Parallel verification

Step	Action
1	It is recommended to leave the units functioning for at least 30 minutes to reach full stability prior to final adjustment.
2	Turn all the DC breakers to the ON position.
3	Turn all the AC breakers to the ON position.
4	To achieve the system float voltage determined by the battery vendor or the power engineer, increase the FLT potentiometer of the lowest current rectifier, or reduce the FLT potentiometer of the highest current rectifier to bring the system float voltage up or down respectively. The system float voltage shall be read from the system's meter voltage reading. Verify that the system float voltage level is constant while proceeding through the next step.
5	The load share amperage for each 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 amperes (that is, 9 A for three rectifiers) for best operating results.
–end–	

Note: Some rectifiers may still indicate an RFA (red RFA led). A red RFA indicates a rectifier delivering less than 0.1 A. Rotating the float potentiometer (FLT) slightly clockwise will make the LED illuminate green.

Low voltage disconnect (LVD)

Testing and adjusting the LVD units (NT6C13FA/FH) (Circuit Pack NT6C13PB Rel. 03).

To verify the LVA and LVD/LVDR operating levels on line, without disconnecting the load, proceed as indicated in Procedure 16:

Procedure 16 - Low voltage disconnect adjustment

Step	Action
1	Set the NORMAL/BYPASS switch to the BYPASS position. The TEST LED should light up.
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 verify when the LVA LED lights up. It should light up at -47 +/- 0.5 V.
4	Continue to turn the test potentiometer counterclockwise until the LVD LED lights up. It should light at -43.5 +/-0.5 V.
5	Turn the test potentiometer clockwise. At -47 +/-0.5V 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 any alarm level must be readjusted, follow the steps described below:
–end–	

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

Procedure 17 - LVD 50 A adjustment for unit release 02, 02A, 3 and 3A

Step	Action
1	Set the NORMAL/BYPASS switch to the BYPASS position (if not already in the BYPASS position).
2	Remove the LVD unit's faceplate by turning the fastener, located at the front/top of the unit, one quarter turn counterclockwise.
3	Connect the digital voltmeter to the test jacks located at the front/bottom of the unit's PCB.
–end–	

Low voltage alarm (LVA) adjustment

Procedure 18 - Low voltage alarm adjustment

Step	Action
1	Turn the test potentiometer counterclockwise until the voltage reading on the meter is -47 V. Turn LVA potentiometer R20 (located below the LVA LED) clockwise until the LVA LED lights up, or counterclockwise until it extinguishes.
2	Reinstall the LVD unit faceplate removed in Procedure 17.
–end–	

LVD/low voltage disconnect / reconnect (LVDR) adjustment

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.

Note 1 : To ensure that the potentiometer is turned fully counterclockwise, the pot must be turned 20 full turns, or until a click sound, emitted by the pot's clutch, is heard.

Note2 : The effect of the LVDR potentiometer in setting the reconnect voltage level is approximately 1.6 V for each 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 larger when it is turned clockwise.

Procedure 19 - Low voltage disconnect/reconnect adjustment

Step	Action
1	Turn the LVD and the LVDR potentiometers fully counterclockwise.
2	Turn the LVDR potentiometer four turns clockwise for Release 2 and 2A, or 9 turns for Release 3 and 3A.
3	Adjust the voltage measured at the test jacks to -43.5 V with the Test potentiometer.
4	Turn the LVD potentiometer clockwise until the LVD LED lights up.
—continued—	

Procedure 19 - Low voltage disconnect/reconnect adjustment (continued)

Step	Action
5	The LVD LED should extinguish between -50 and -50.5 V. 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 –50 V.
6	To verify the adjustment, set the test voltage to -43.5 V. Readjust the LVD potentiometer until the LVD LED lights up.
7	Readjust the test voltage to –51 V. The LVD LED should extinguish between -50 and -50.5 V. If it does not, repeat step 17.
8	Set the NORMAL/BYPASS switch to the NORMAL position. The TEST LED should extinguish.
–end–	

Rectifier replacement/add-on procedure

Follow the “Start-up procedure: Rectifier power up”section of this chapter.

Low voltage disconnect

The LVD protects 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 (faceplate only). The nominal dimensions are 6.60 inches high, 10.25 inches deep, and 2.2 inches or 5.85 inches wide. 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 on the LVD unit and can also be monitored externally.

Electrical

-	Input voltage:	-42 to -60 V DC
-	Input current:	0.400 A
-	LVD current capacity	50 A
-	LVD range	-42 to -53 V DC
-	Auto reconnect	8 V above the release level

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

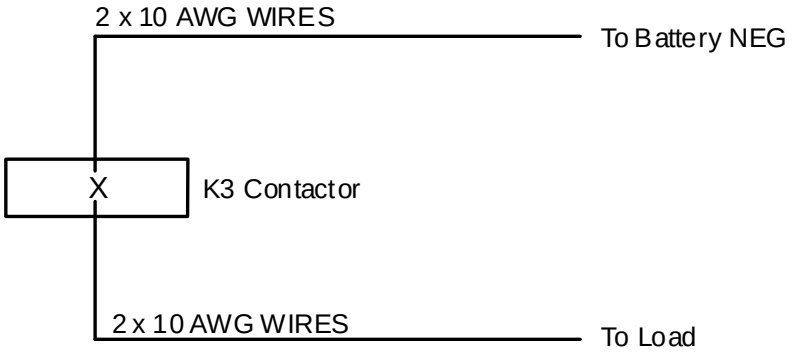
During shipping and storage the unit can withstand the temperature and humidity levels specified below:

-	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. Figure 25 illustrates the connections to be made. The “Installation and start up procedure” chapter indicates the sequence to be followed when the unit is installed in the power shelf.

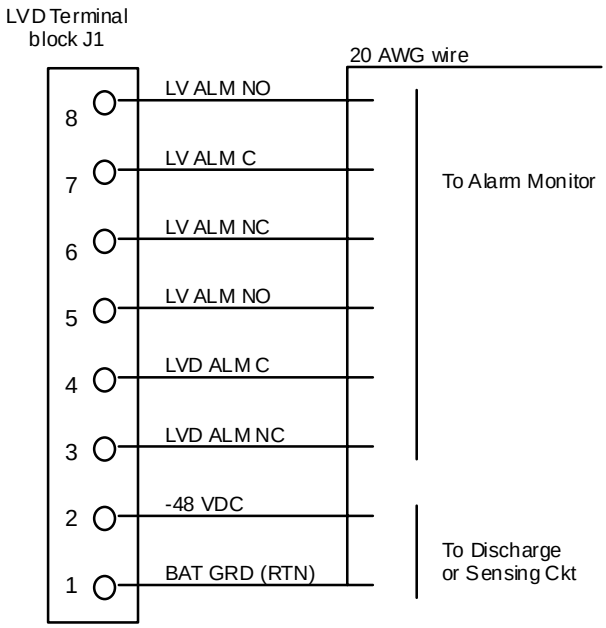
Figure 25 - Low voltage disconnect connections



Control and monitoring signals

The control and monitoring signals for the Low Voltage Disconnect unit are shown below. These signals are accessible on the terminal block in the unit. The “Installation and start-up procedure” describes how to interconnect the LVD in an embedded shelf application.

Figure 26 - 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 V DC, the LVA LED lights up and the alarm is extended to 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 circuitry, 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. Varying this potentiometer will affect the voltage senses by the LVD and LVA detectors. This test voltage can be verified at test jacks TP1 and TP2.

Signal connections

The signal connections are shown in Figure 26 of this manual (see the “Operation” chapter of this manual for the installation of the low voltage disconnect unit).

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Maintenance

Maintenance

Rectifier

Procedure 20 - Float/equalize and remote equalize

Step	Action
1	Disconnect the sense leads from the rectifier, by either disconnecting a quick disconnect tab TB1 on the shelf or removing the appropriate system fuse. (See the "Introduction" chapter for system applications.)
2	Open the output DC breaker. The unit is ready for local adjustment.
3	The unit should provide voltage to the front panel test point terminals. If it does not, cycle the AC breaker to reset the unit.
4	Momentarily hold the FLT/EQL switch to EQL for local equalize.
5	Using a voltmeter, verify and adjust the EQL potentiometer to obtain an output voltage reading of 0.5 volts (see ***Note*** below) above the system equalize requirement.
6	Release the FLT/EQL switch. Verify that the output voltage drops to the float value plus 0.5V (see ***Note*** below).
7	Verify the HVSD level. It is recommended that it be set approximately 3 V above the shutdown limit of the power system. Refer to the "Installation and start-up procedure" chapter, subsection "Start-up procedure", for the verification procedure.
8	Reconnect the sense leads locally to the rectifier. Close the output DC breaker. Cycle the AC breaker to reset the unit. The RFA/ON LED should be green.
–end–	

Note: The 0.5 volt DC extra does not apply to MPR25 rectifiers above Release 30.

Filter

If the unit operates in a dusty environment the optional fan filter is recommended. It must be inspected and replaced, or thoroughly cleaned, at least every 12 months.

CAUTION

Do not install a wet filter in the unit.

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

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 (toggle them to OFF) 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 Astec service facility. The unit must not be opened for on-site servicing.

DANGER

Do not attempt to access the inside of the unit with a tool or finger. Severe electrical shock could result.

Storage

The rectifier contains aluminum electrolytic capacitors. For this reason, the rectifier must be in operation. If not in operation, once a year, the equipment must be energized for at least two hours to maintain the electrolytic capacitors in working condition.

Power shelf

The rectifier shelf requires no maintenance.

Low voltage disconnect

The LVD voltage adjustment levels should be verified periodically (preferably at intervals no greater than one year). Refer to the "Fault diagnosis" section found at the end of this chapter 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 tightened with a torque wrench set at 70 in.-lb. periodically (at one-year intervals) to avoid the build up of hot spots and voltage drops.

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 the "Start-up procedure" section of the "Installation and start-up procedure" chapter of this manual for the adjustment procedure.

If the unit is used in parallel with other units the rectifier may indicate an RFA alarm when the unit produces no current (see ***Note*** below). 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.

Note: Triggers an alarm at no load condition, only for the following releases, or under.

NT5C06BB,BB-1,BB-3,BC	Rel.10
NT5C06CA,CA-1,CA-3,CA-5,CC	Rel.10
NT5C06CB,CB-1,CB-3,CD	Rel.12
NT5CO6CE-61(-46)	Rel.12

- 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 "Appendix C: Recommended replacement parts" to order a replacement fuse.
- The unit must not be opened for on-site servicing. If a problem persists contact your local Astec representative.

Load sharing

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

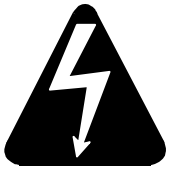
Readjust the rectifier's float voltage until all the rectifiers share the load. It is recommended that the current from each rectifier be 3 amperes minimum for best results.

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 indicated 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



DANGER

Before replacing the fan, turn the rectifier off. Remove the rectifier from the shelf. Wait five minutes to allow all internal capacitors to fully discharge.

CAUTION

Take the necessary precautions to prevent any dirt, dust, moisture, or metallic particles from falling into the unit.

Procedure 21 - Fan replacement

Step	Action
1	With the unit sitting solidly on a clean workbench, carefully remove the five mounting screws that secure the fan assembly (see Figure 27).
2	Slowly and carefully remove the fan assembly by pulling it from the chassis.
3	Take note of which side the wire is connected to the fan and disconnect the fan connector (three pins).
—continued—	

Procedure 21 - Fan replacement (continued)

Step	Action
4	Remove the four retaining screws which hold the chassis plate, fan and fan grill together (see Figure 27).
5	Place the mounting clips on the replacement fan (if it is not so equipped).
6	Mount the replacement fan in the same orientation as the old one, 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.
7	Secure the fan, fan grill and chassis plate with the four retaining screws.
8	Reconnect the fan connector and mount the fan assembly in the unit with the five mounting screws
9	Plug the unit back in and power it up. Holding a piece of paper at the front the unit will confirm that the air is pulled inwards from the front.
10	Listen carefully for any noise from the fan. It should run free. Verify that the fan alarm is OFF.
–end–	

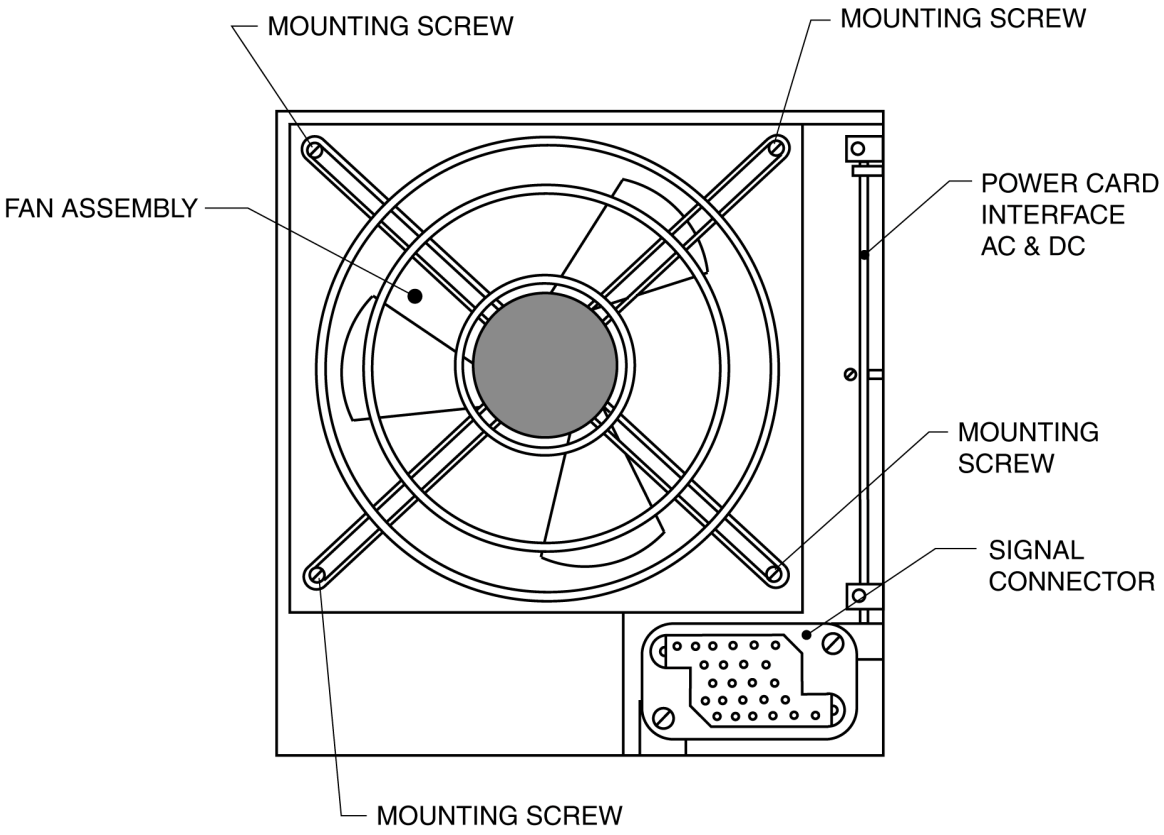
CAUTION

Verify and ensure that the fan spins freely, without interference.

CAUTION

Do not run the rectifier without a fully operational fan or with a fan other than the specified replacement for this cooling application.

Figure 27 - Fan assembly



VIEW SHOWING LOCATION OF
FAN ASSEMBLY MOUNTING SCREWS

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 (using a #6 AWG cable) to maintain power to the load.

CAUTION

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

Fault diagnosis

Symptom:	Possible cause
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 it is 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.

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References

Figure 28 - System application power shelf MPS50S and MPS75S

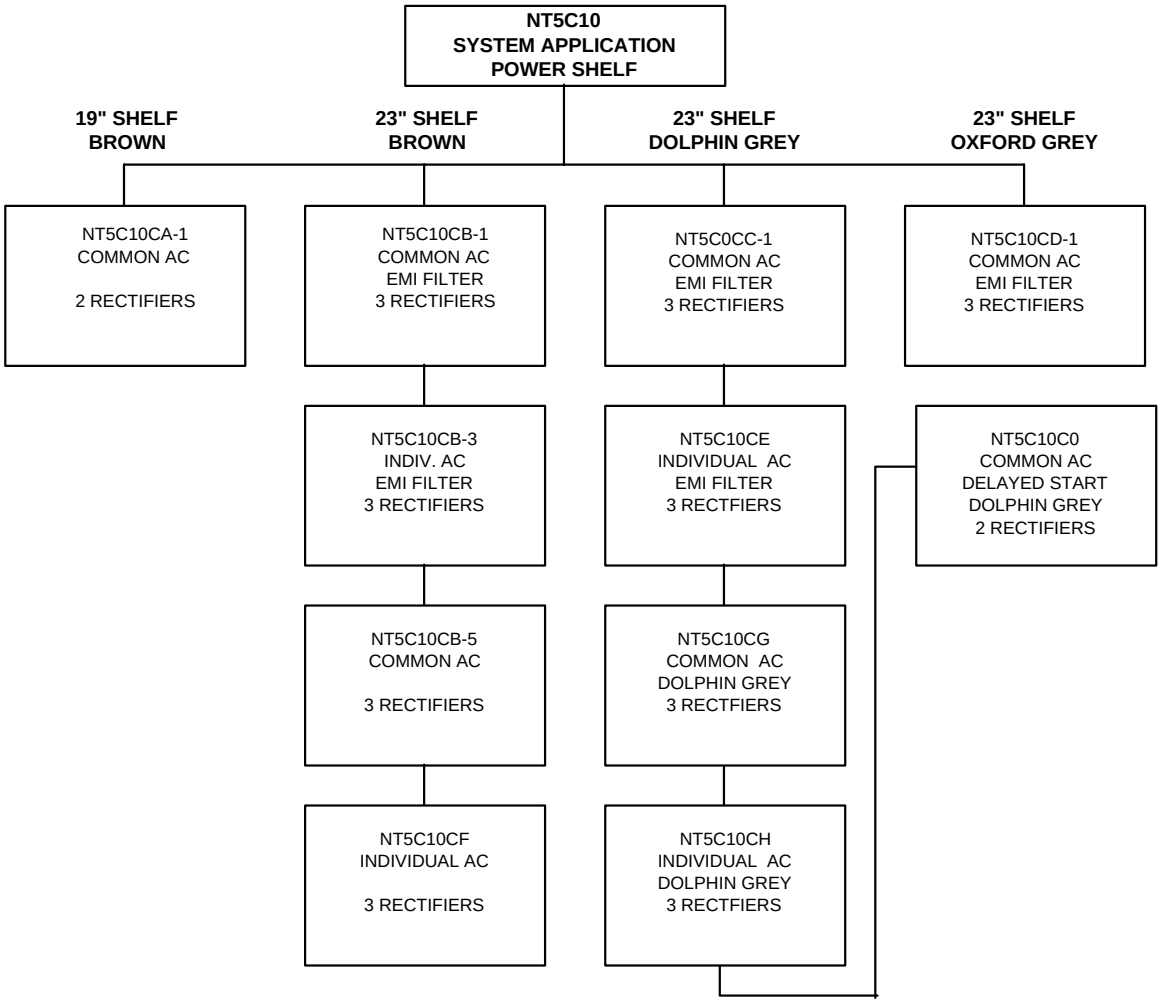


Figure 29 - Embedded application power shelf MPS50E and MPS75E

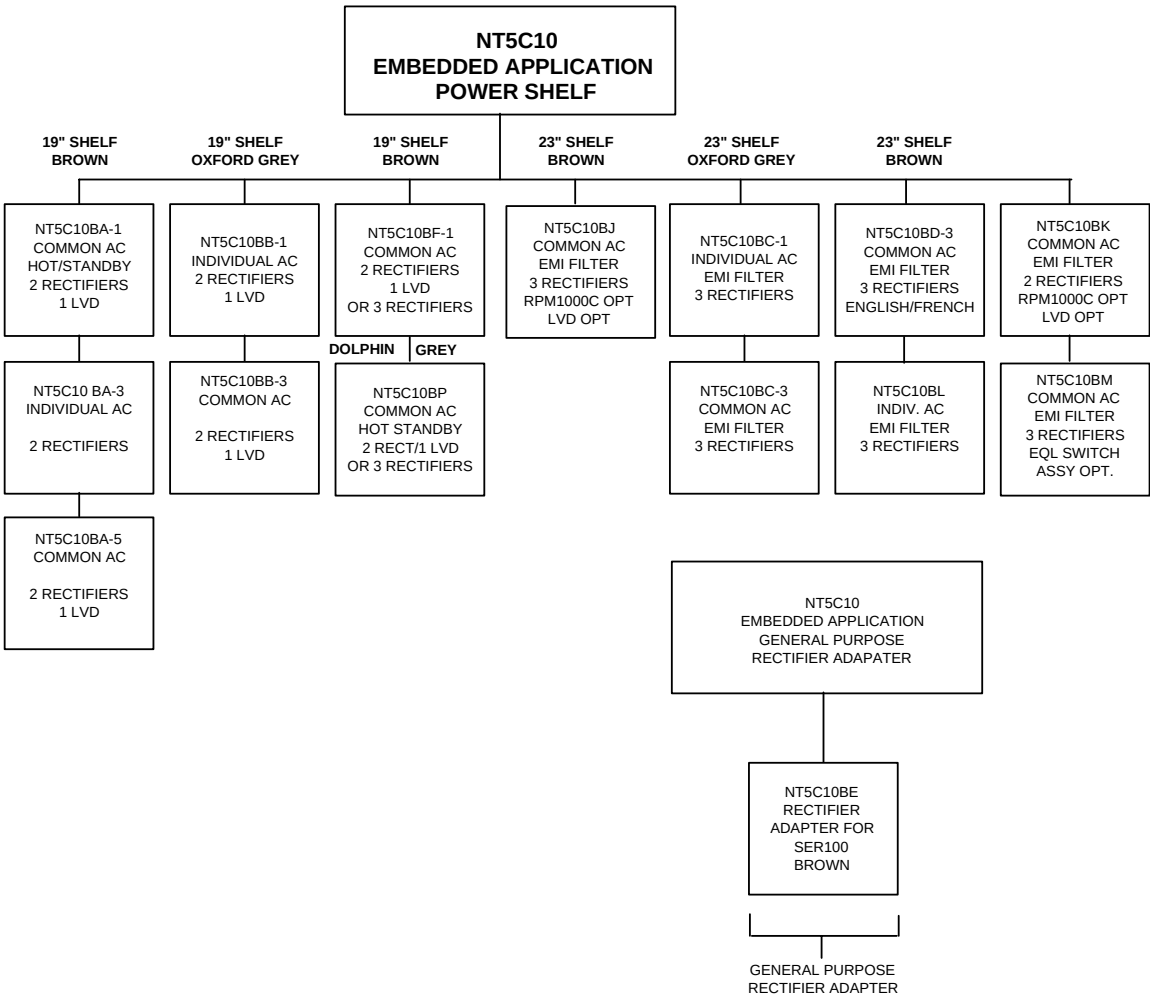


Figure 30 - Low voltage disconnect

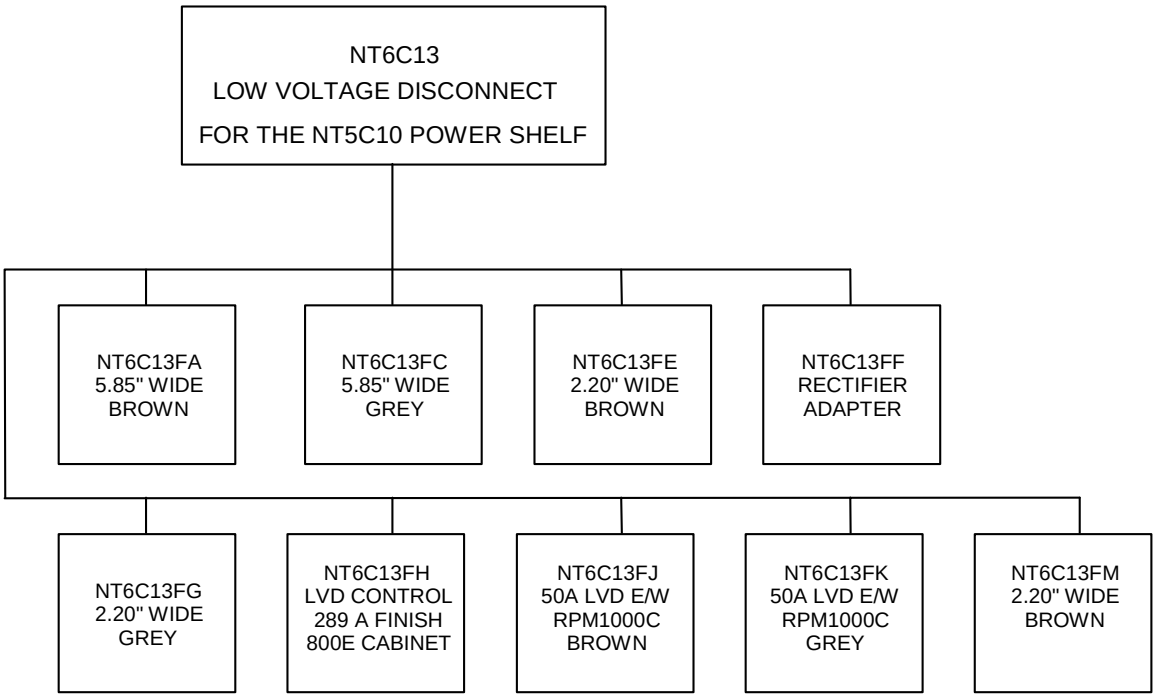


Figure 31 - Power shelf wiring figure index

Embedded application 19" Brown	
NT5C10BA-1	Fig. 33
NT5C10BA-3	Fig. 34
NT5C10BA-5	Fig. 32

System application 19" Brown	
NT5C10CA-1	Fig. 37
NT5C10CA-2	Fig. 37

Embedded application 19" Oxford grey	
NT5C10BB-1	Fig. 32
NT5C10BB-3	Fig. 32

System application 23" Brown	
NT5C10CB-1	Fig. 37
NT5C10CB-2	Fig. 37
NT5C10CB-3	Fig. 37
NT5C10CB-4	Fig. 37
NT5C10CB-5	Fig. 37
NT5C10CB-6	Fig. 37

Embedded application 19" Brown	
NT5C10BF-1	Fig. 34

System application 23" Dolphin grey	
NT5C10CC-1	Fig. 37
NT5C10CC-2	Fig. 37
NT5C10CG	Fig. 37
NT5C10CH	Fig. 37
NT5C10CO	Fig. 45

Embedded application 23" Brown	
NT5C10BC-1	Fig. 38
NT5C10BC-2	Fig. 38
NT5C10BC-3	Fig. 38
NT5C10BJ	Fig. 39

System application 23" Oxford grey	
NT5C10CD-1	Fig. 37
NT5C10CD-2	Fig. 37
NT5C10CE-1	Fig. 37
NT5C10CE-2	Fig. 37
NT5C10CF-1	Fig. 37
NT5C10CF-2	Fig. 37

Embedded application 23" Oxford grey	
NT5C10BD-3	Fig. 35
NT5C10BK	Fig. 40

Embedded application 23” Dolphin grey	
NT5C10BL	Fig. 43
NT5C10BM	Fig.44 ,38

Figure 32 – NT5C10BA-5/6 and NT5C10BB-1/2, 3/4 embedded application

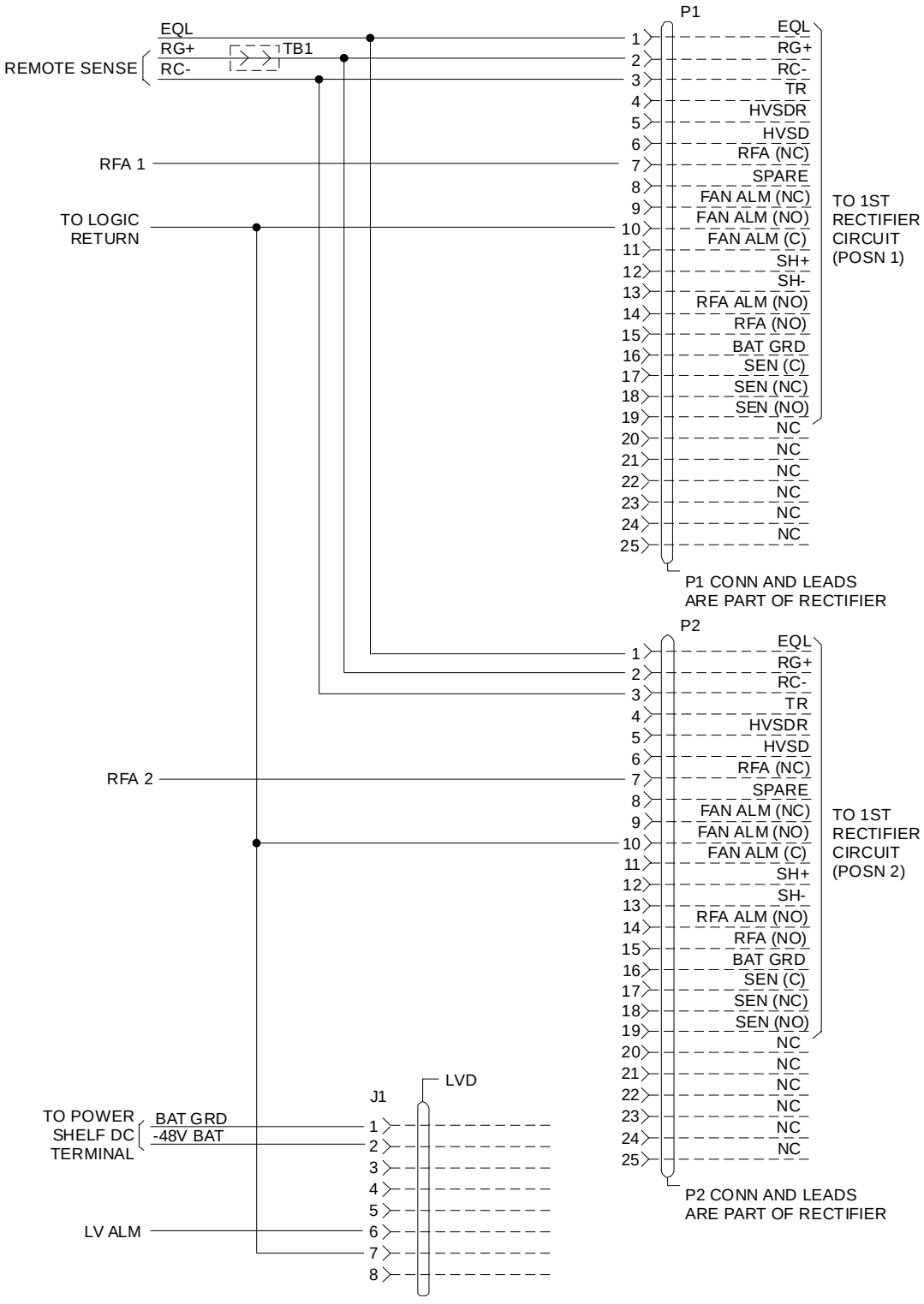


Figure 33 – NT5C10BA-1/2 embedded application

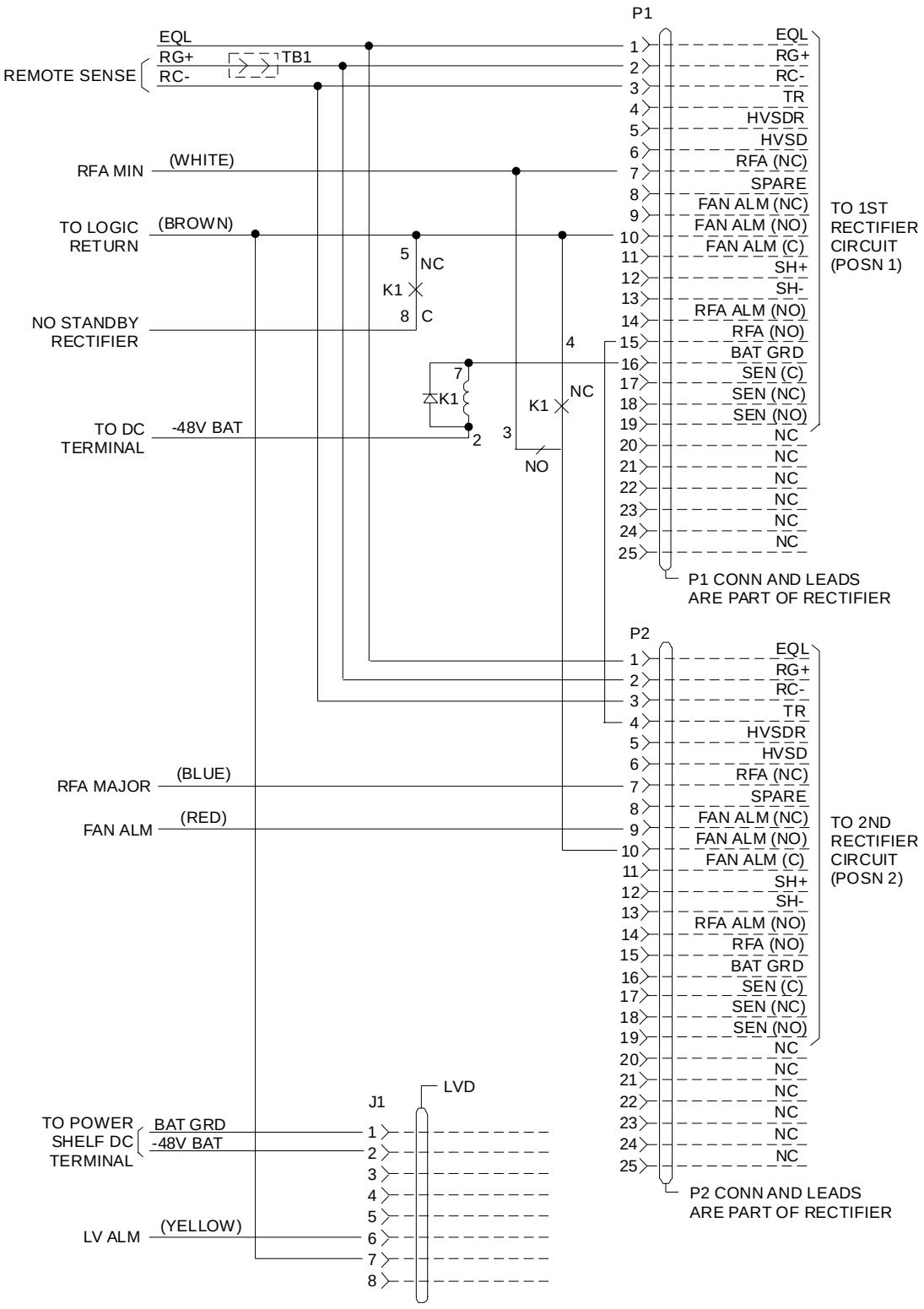


Figure 34 - NT5C10BA-3/4 embedded application

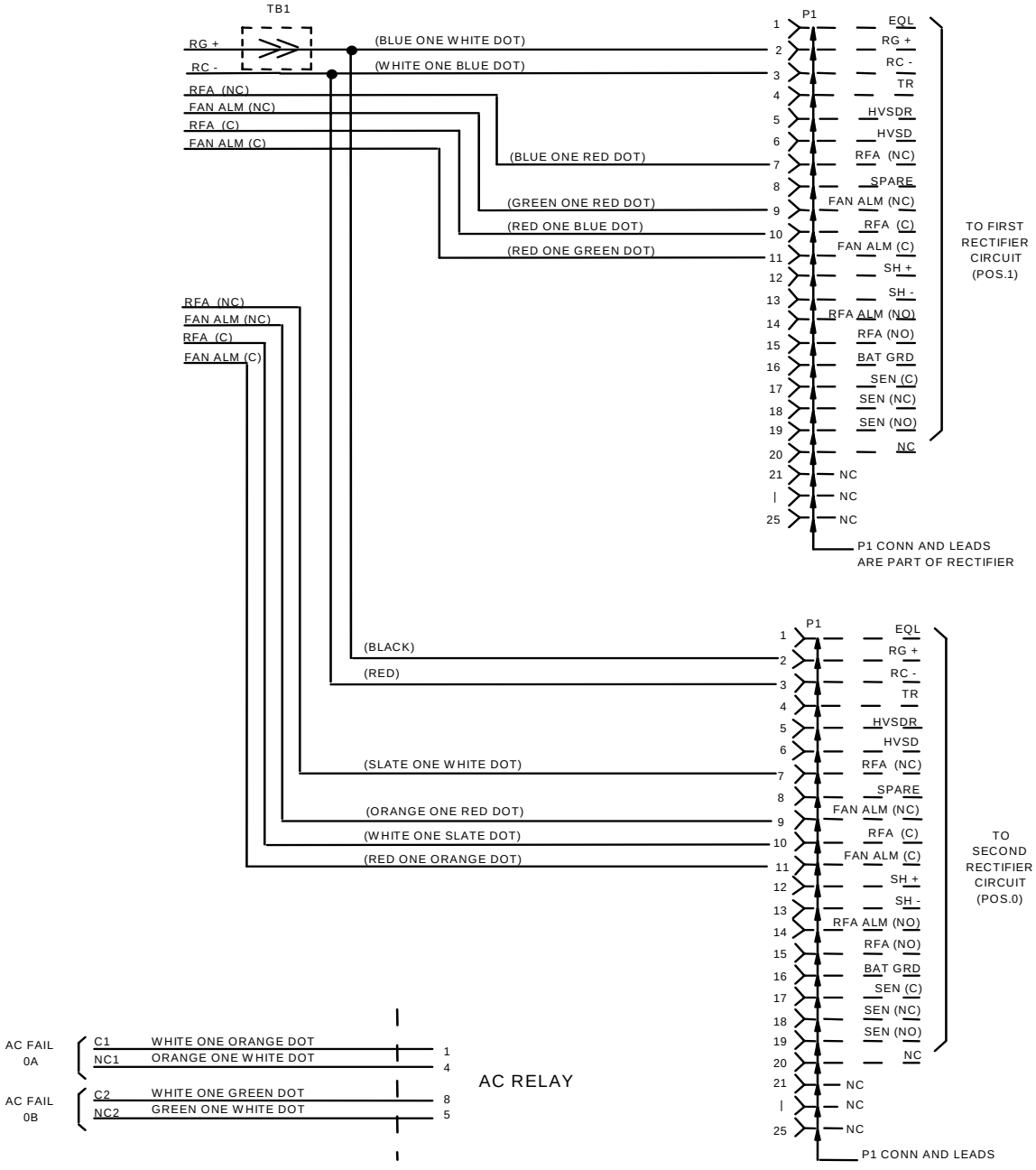


Figure 35 - NT5C10BD embedded application

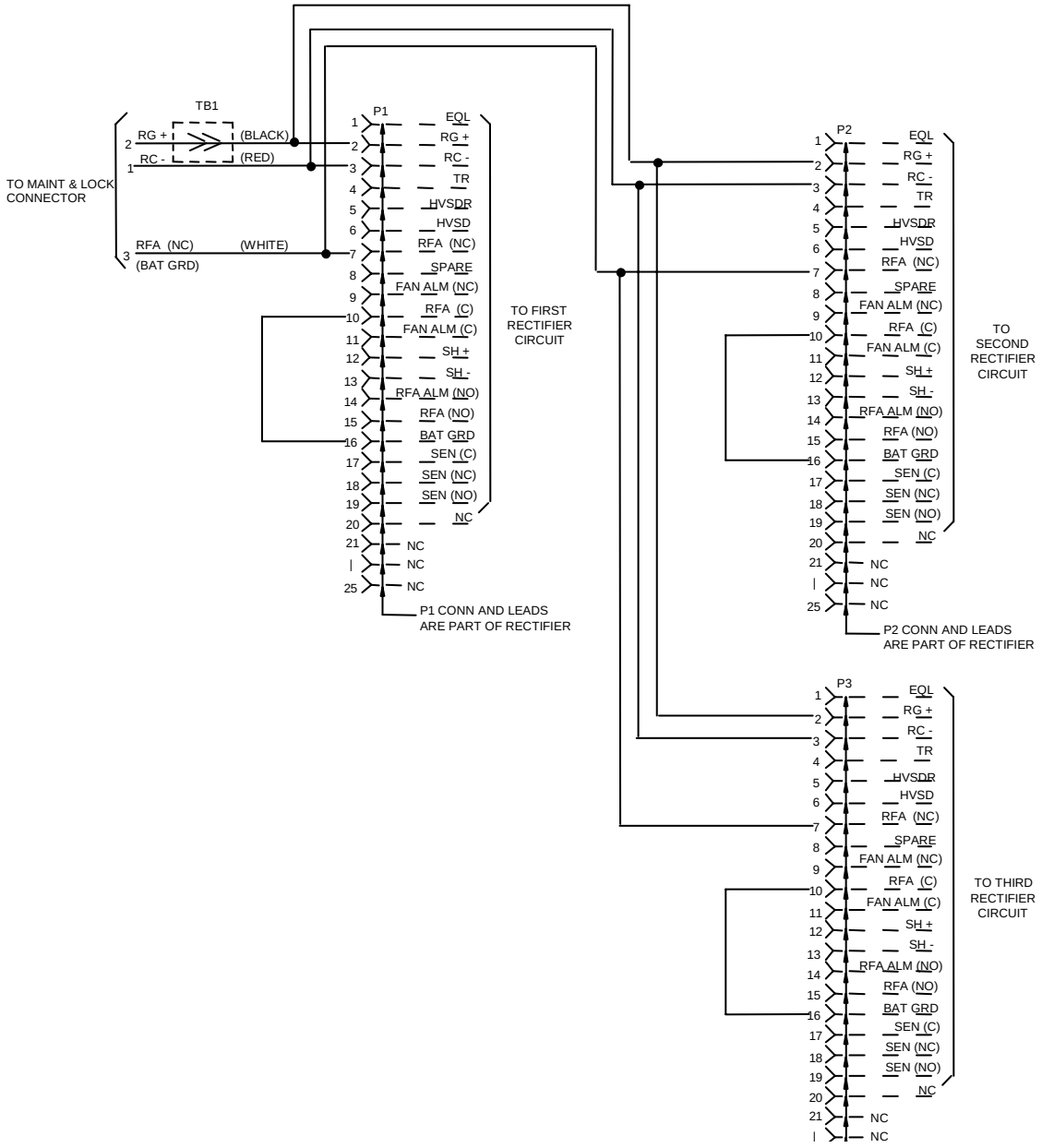


Figure 36 - NT5C10BD and NT5C10BP embedded application

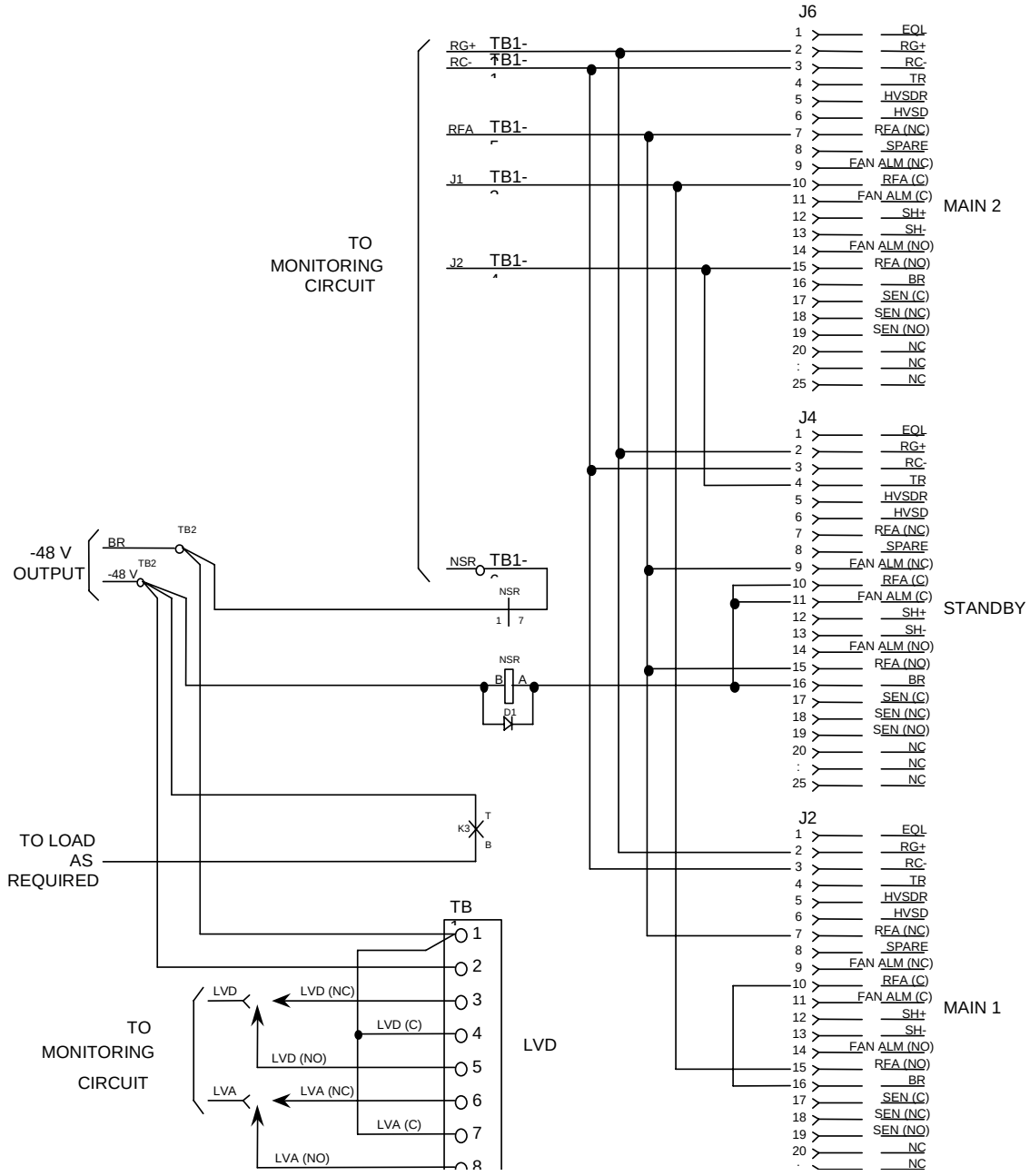


Figure 37 - System application - NT5C10CA-1/2, NT5C10CB-1/2, 3/4, 5/6, NT5C10CC-1/2, NT5C10CD-1/2, NT5C10CE-1/2, NT5C10CF-1/2, NT5C10CG, NT5C10CH

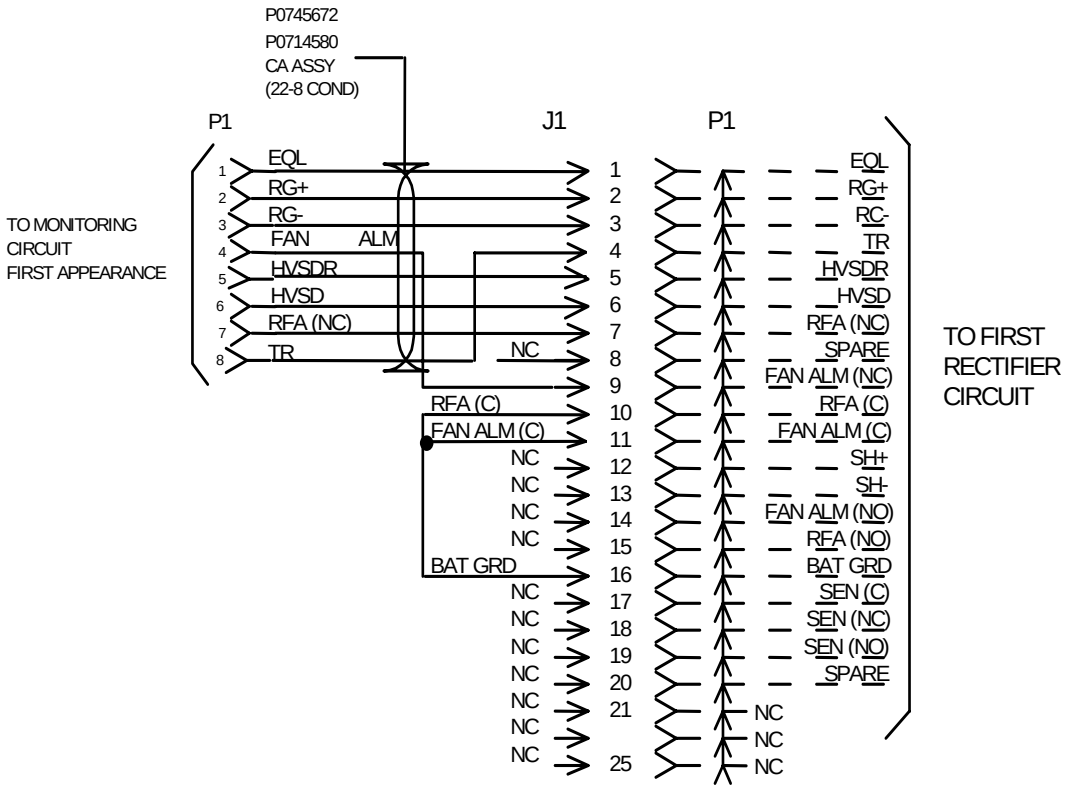


Figure 38 - Embedded application - NT5C10BC-1, NT5C10BC-2, NT5C10BC-3, NT5C10BM

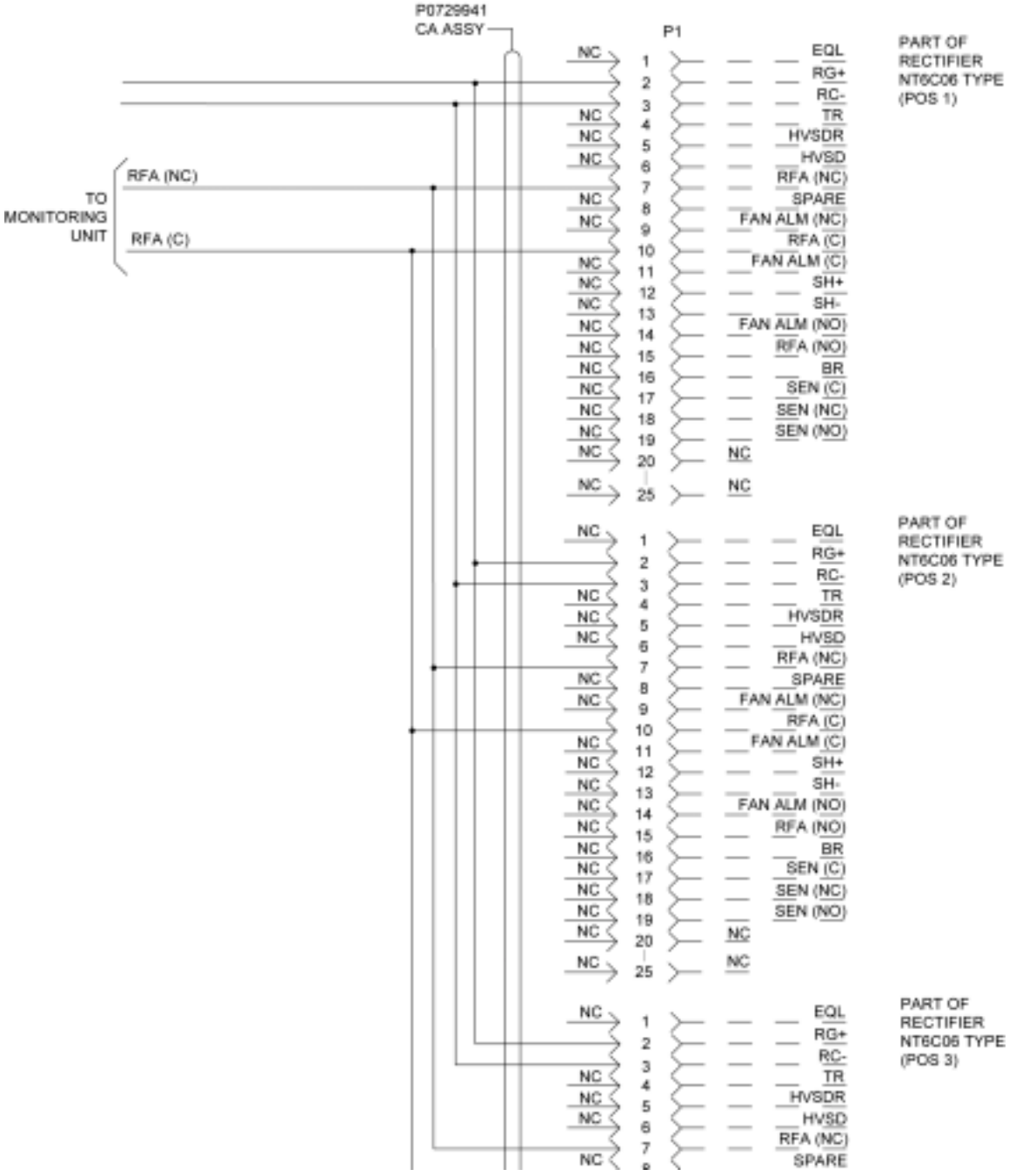


Figure 39 - Embedded application NT5C10BJ, NT5C10BK e/w RPM1000C and LVD Kit

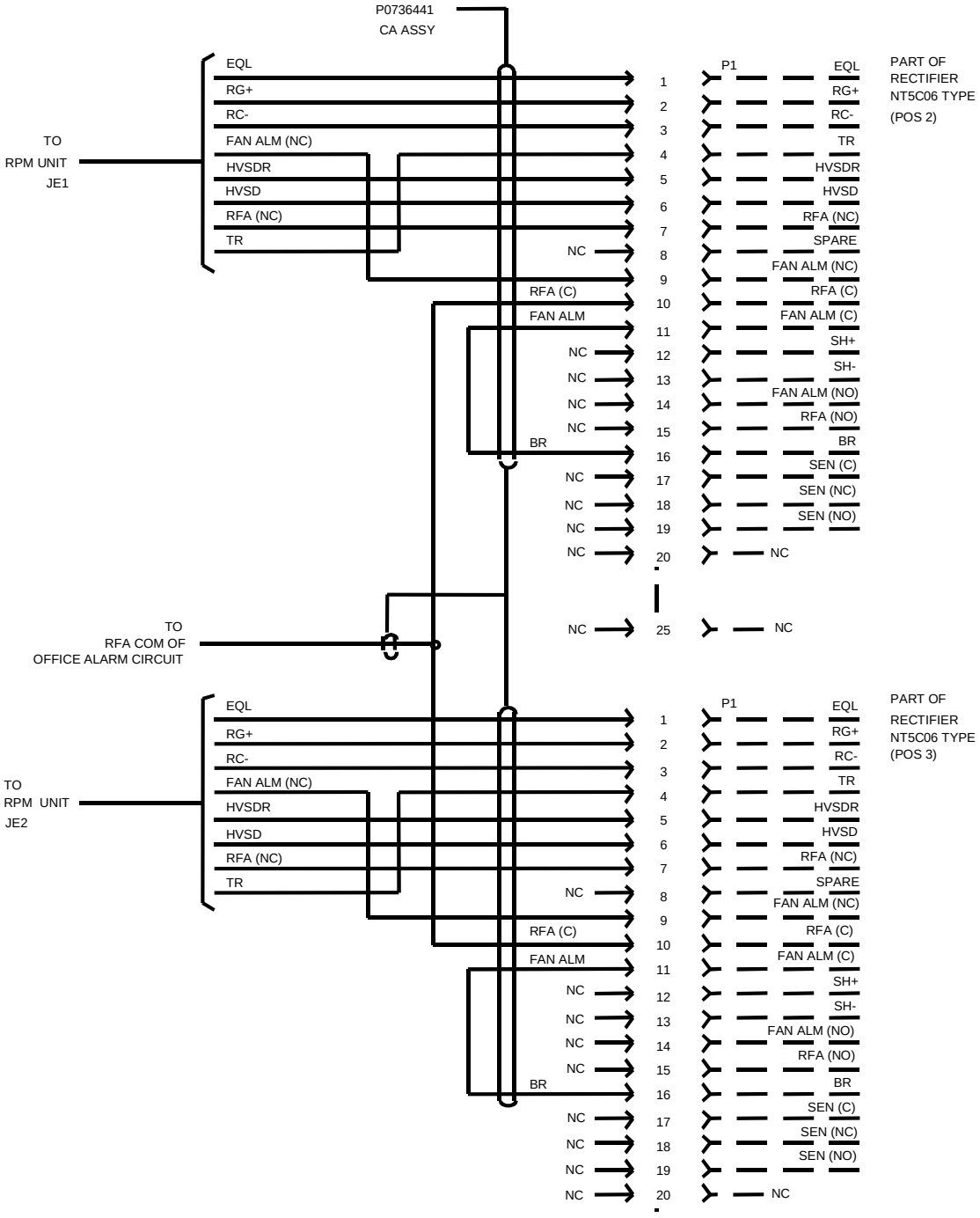


Figure 40 - Embedded application NT5C10BJ, NT5C10BK e/w RPM1000C and LVD Kit

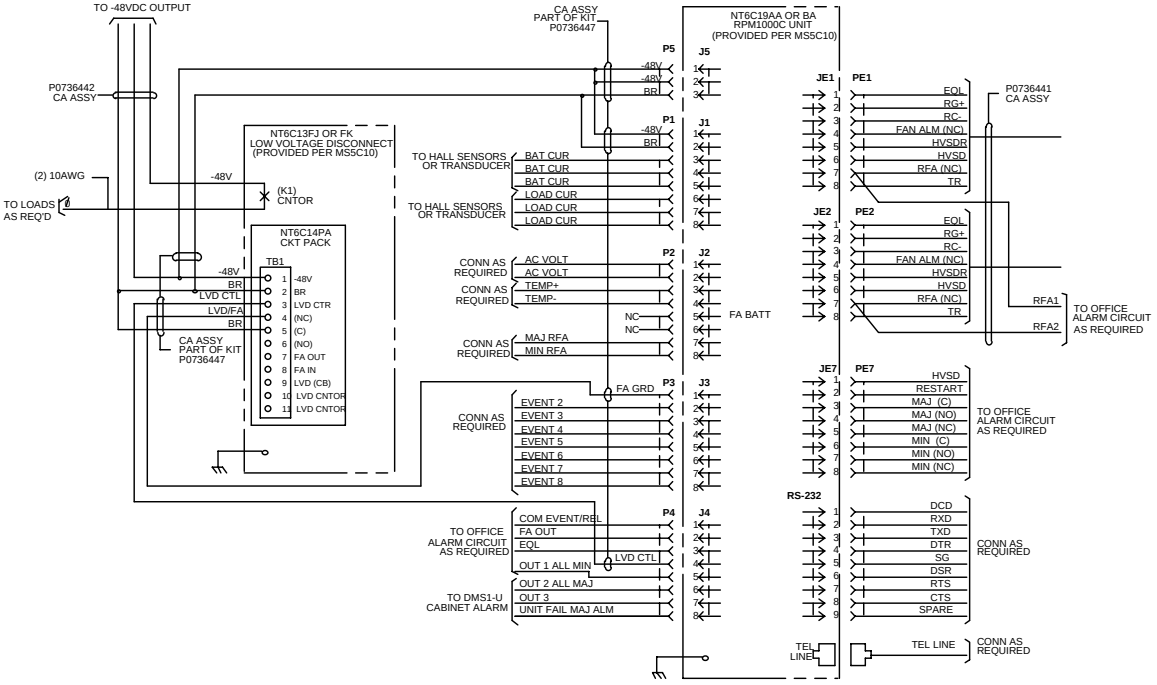


Figure 41 - Embedded application NT5C10BJ, NT5C10BK e/w LVD and I/F Circuit Pack Kit

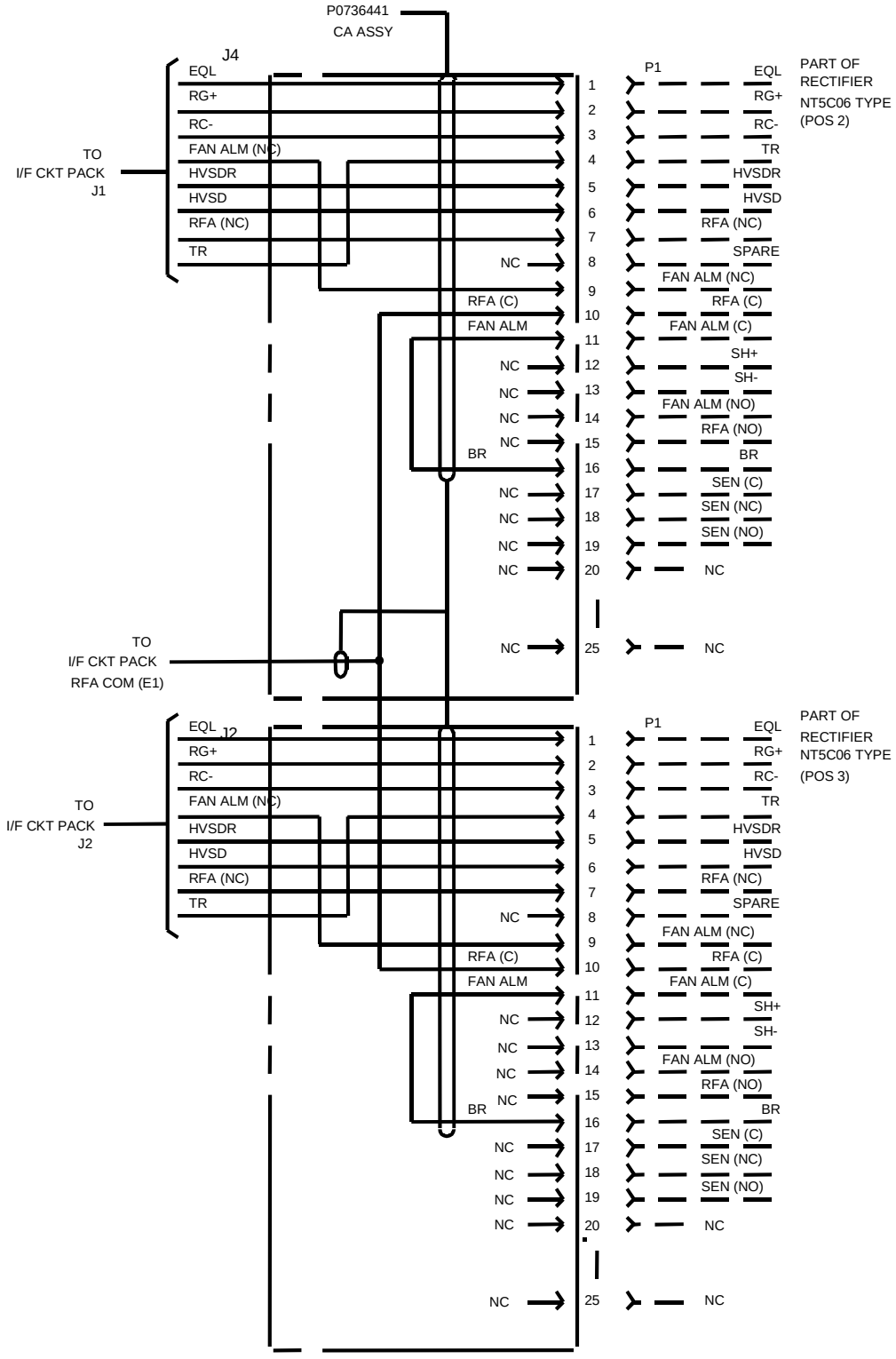


Figure 42 - Embedded application NT5C10BJ, NT5C10BK e/w LVD and I/F Circuit Pack Kit

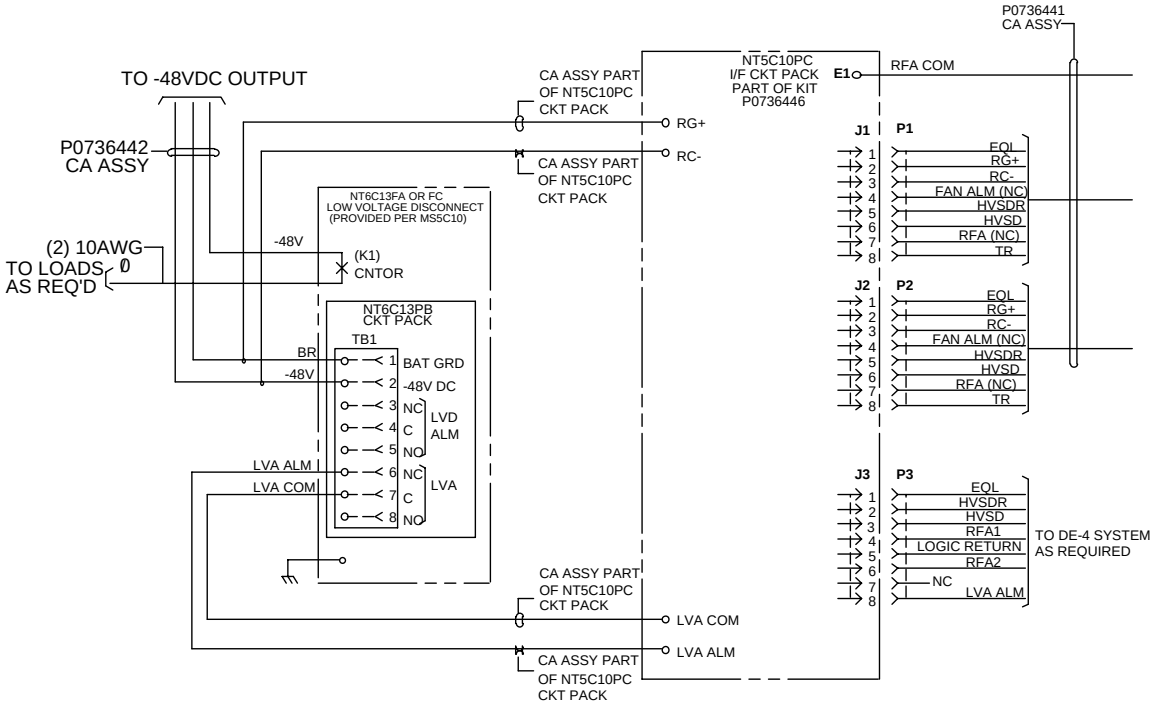


Figure 43 - Embedded application NT5C10BL

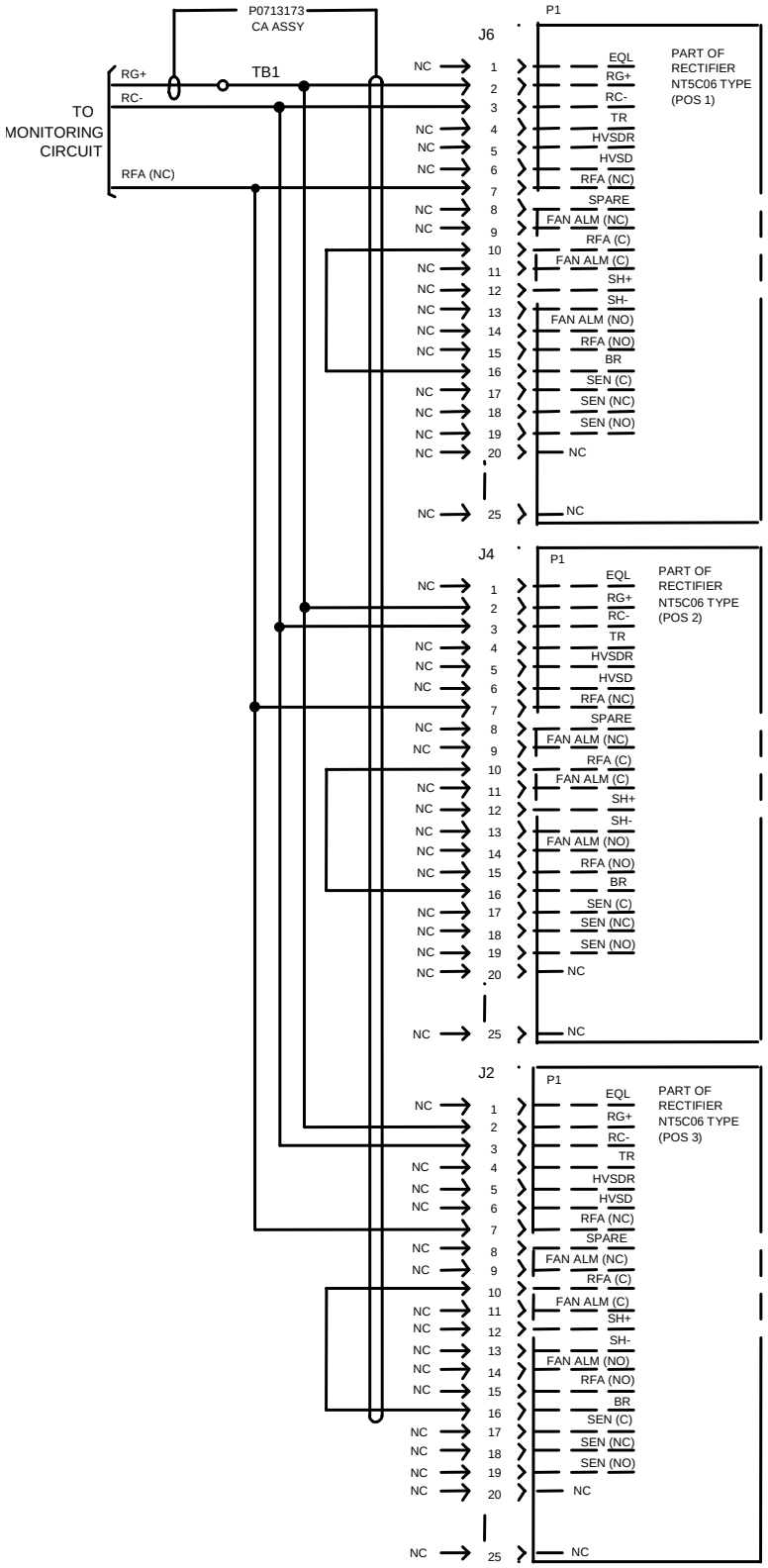


Figure 44 - Embedded application NT5C10BM e/w NT5C10KB

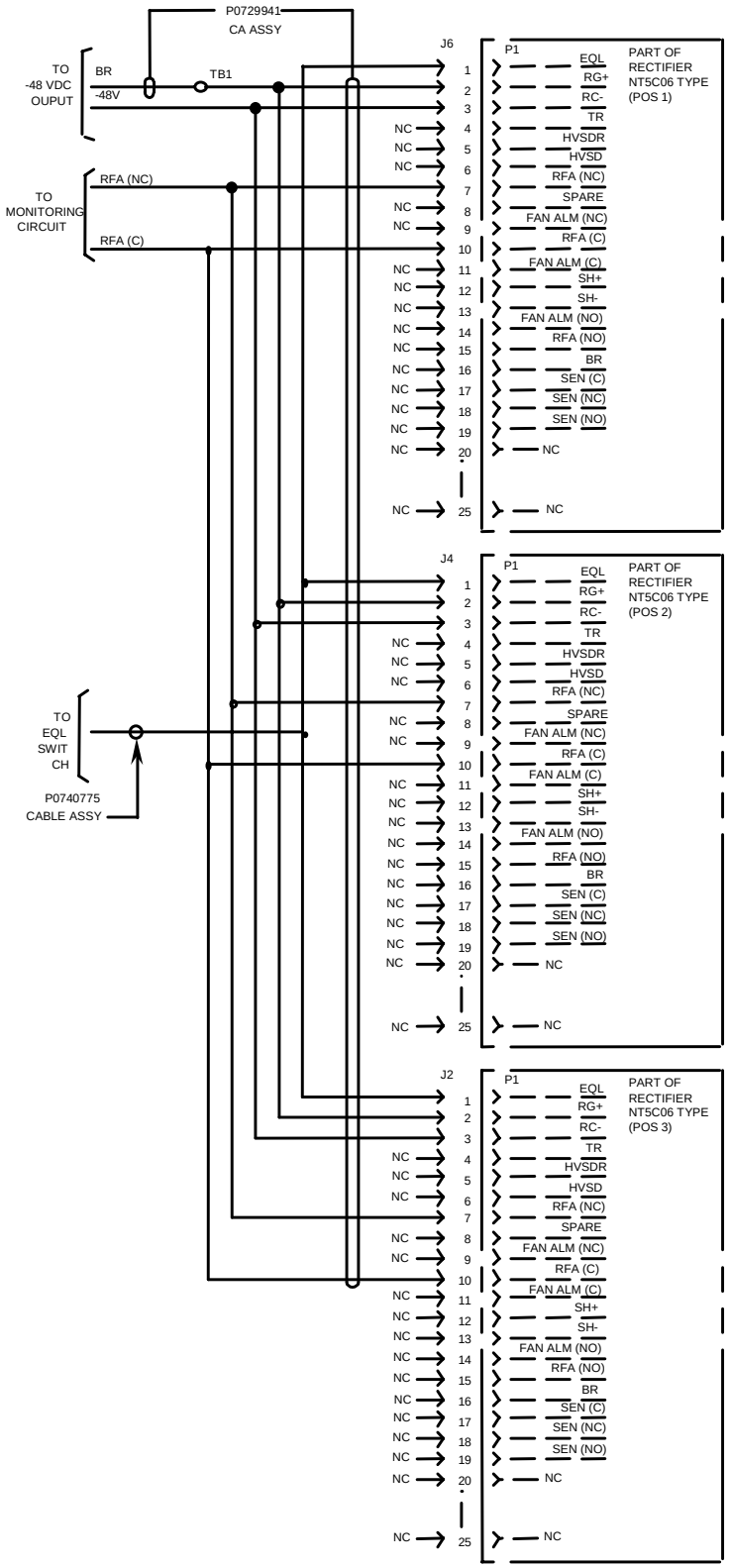


Figure 45 - System application NT5C10CO

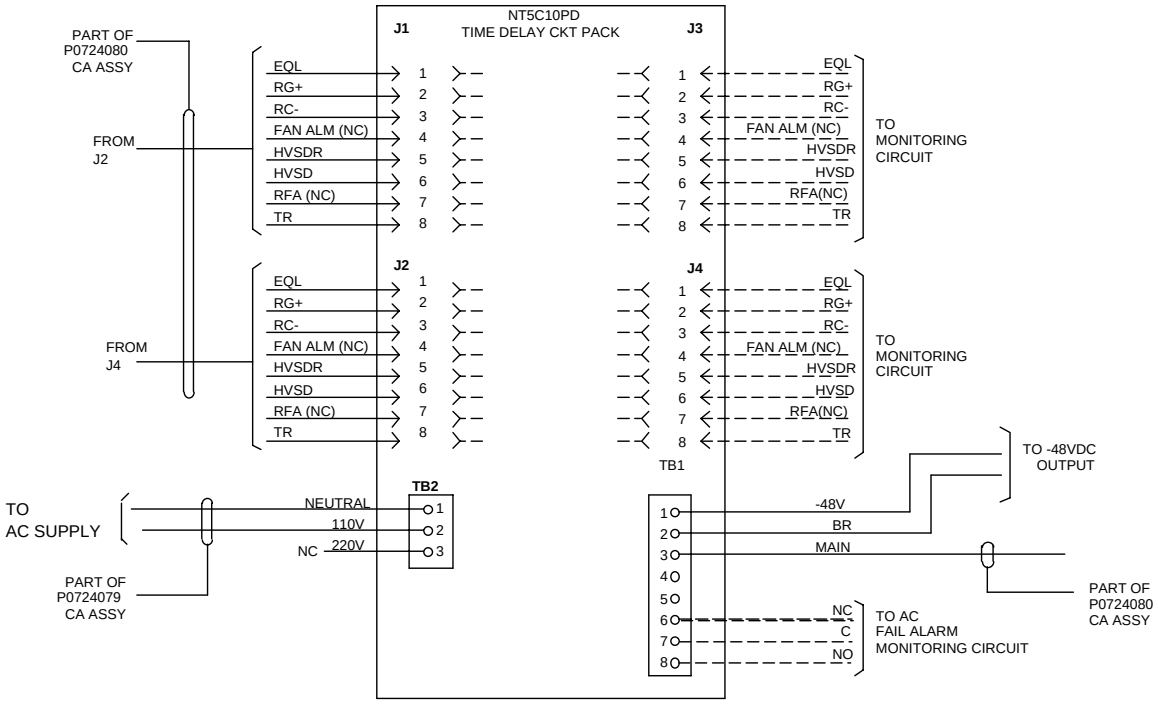
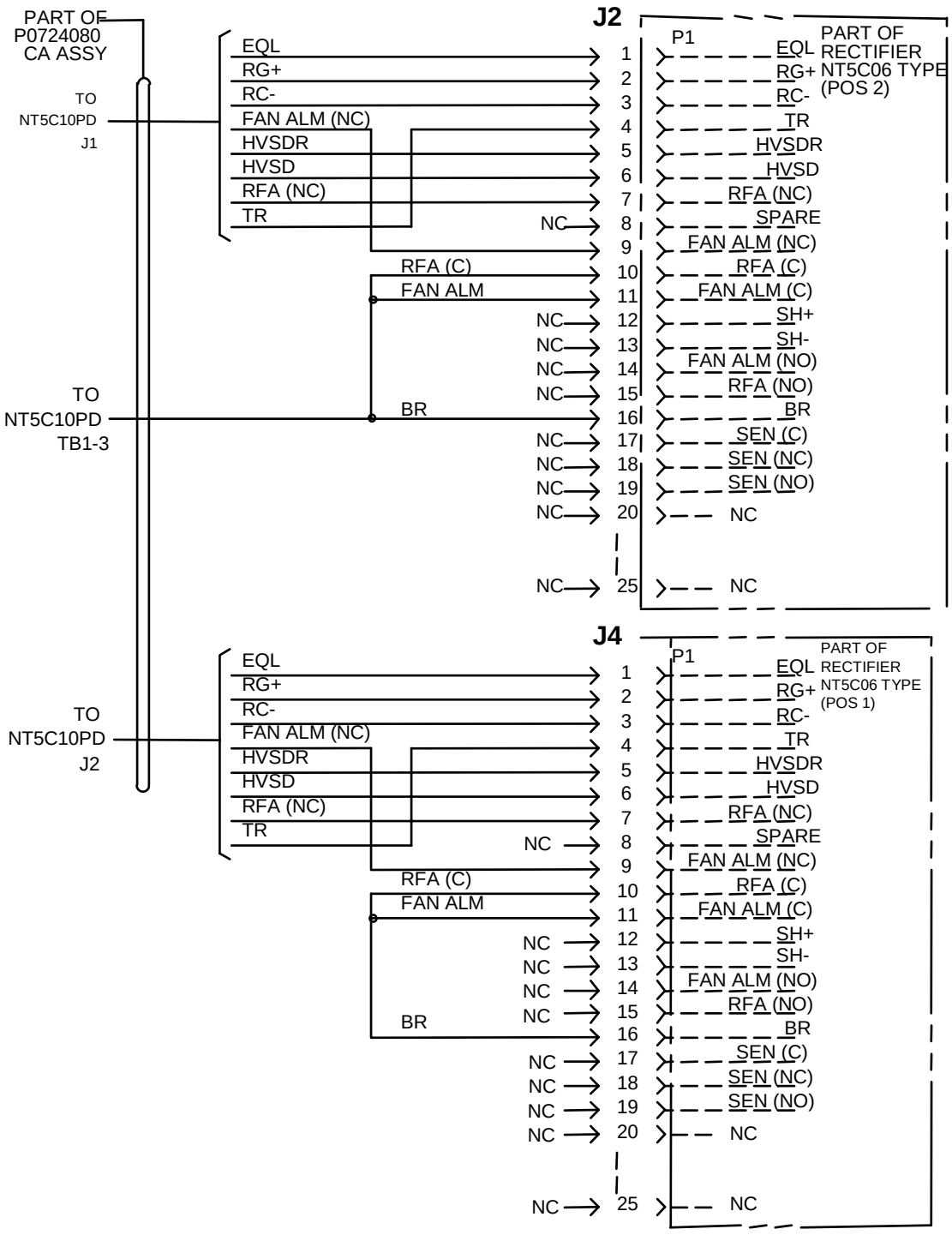


Figure 46 - Application NT5C06B/C

FIG. 41A



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Appendix A: NT5C10BF-1 and NT5C10BP

Purpose

This appendix provides additional information about the NT5C10BF-1 (brown) and NT5C10BP (grey).

Application

The NT5C10BF-1 and NT5C10BP power shelves are used in the FTIP and FTOP application. This power shelf provides housing for two MPR15E rectifiers plus one 50 A 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 this 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 in each system, plus one 50 A 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.

Table 11 - Application configuration table

Rectifier Qty	Function Main/Standby	LVD	Alarms	Current Capacity
1	Main/None/LVD	Yes	RFA/LVA/LVDA	17.5 A
2	Main1/Standby/LVD	Yes	RFA/LVA/LVDA/NSR	17.5 A

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 (see Note below)	TB1-3
-Jumper (see Note below)	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

Note: When the Main 2 rectifier is missing TB1-3 and TB1-4 must be strapped together.

Factory set voltage limits

Refer to User Manual (UM) 167-7011-010 Voltage Level Limits for Power Plants, Rectifiers and Controllers.

FTOP application

The MPR25EX rectifier will be used in FTOP applications. Three rectifiers maximum can be used for a system. One or two of the rectifiers (Main) are active and carry the load, while 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 is 50 A.

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.

Table 12 - Application configuration table

Rectifier 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 –48 V
- Positive Sense (RG+) TB1-2 RTN
- Jumper1 (see Note below) TB1-3
- Jumper2 (see Note below) TB1-4
- Rectifier Fail (RFA) TB1-5
- No Standby Rectifier (NSR) TB1-6

Note: When the Main 2 rectifier is missing TB1-3 and TB1-4 must be strapped together.

Factory set voltage limits

Refer to User Manual (UM) 167-7011-010 *Voltage Level Limits for Power Plants, Rectifiers and Controllers.*

General requirements

Power shelf size

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

Shelf labeling

The following component and connection positions are labeled on the power shelf:

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: 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 supplementary 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 that the required total AC input current for the two rectifiers be reduced to less than 20 amperes.

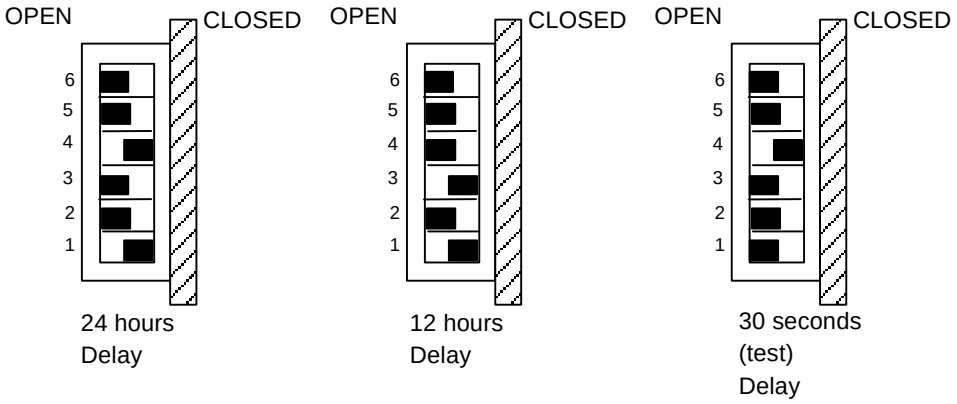
The rectifier that is delayed will be activated immediately if the main rectifier fails, is pulled out or missing, or produces an RFA. The delayed start rectifier will not transmit an RFA signal to the Controller during the time that it is inhibited, but it will permit transmission of an RFA signal to 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), and the "DELAYED START" yellow LED of the timer will be ON to indicate that the rectifier with the red RFA LED is on delayed start mode.

Technical specifications

WARNING
The power shelf must be connected to 120 V AC and a 20-ampere circuit. The AC receptacle must be rated 20 amperes and wired with #12 AWG. Non-conformance to these requirement may cause the AC breaker/fuse at the AC distribution cabinet to open, under certain operational conditions, resulting in loss of power for both rectifiers.

Input AC:	120 V AC/18 A
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 and 24 hours (12 hours for 6 A load application and 24 hours for 10 A load applications). Factory delayed start setting: 24 hours



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.

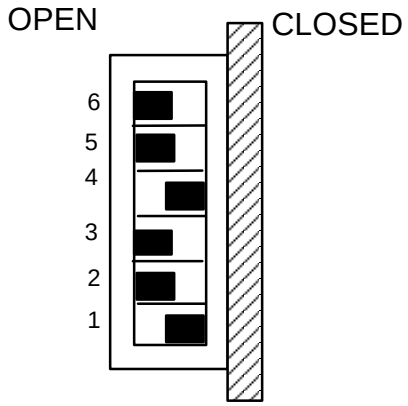
Power-up and verification

Verification

For systems equipped with the NT5C10CO power shelf, proceed as indicated in Procedure 22.

Procedure 22 - Power-up and verification

Step	Action
1	Verify that the AC circuit breakers of the rectifiers are in the "OFF" position.
2	Release the clamping bar of the power shelf, by loosening the two retaining screws.
3	Remove the right blank panel from the power shelf by removing the retaining 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-hour delay):
5	Plug the AC power plug into the wall receptacle.
6	Turn "ON" the AC circuit breakers of the main rectifier. Verify 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 the manufacturer of the battery by referring to the "Start-up procedure" section found in the "Installation and start-up procedure" chapter of this manual.
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: "Adjustment and verification".
–end–	



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

Adjustment and verification

The following steps are required to verify the system's operation.

CAUTION

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

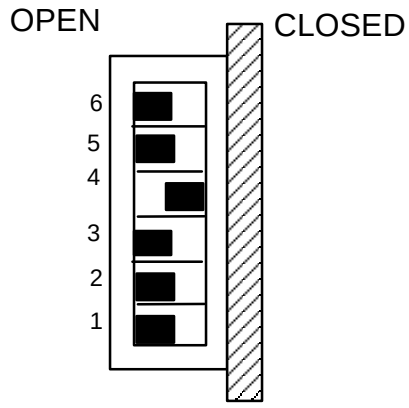
Procedure 23 - Adjustment and verification

Step	Action
1	Release the clamping bar of the power shelf by loosening the two retaining 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 (see the following illustration).
4	Turn "ON" the DC and AC breakers of both rectifiers.
5	Verify that the rectifiers, float and equalize voltage levels are correct. If necessary, adjust them to the battery manufacturer's specifications.

—continued—

Procedure 23 - Adjustment and verification (continued)

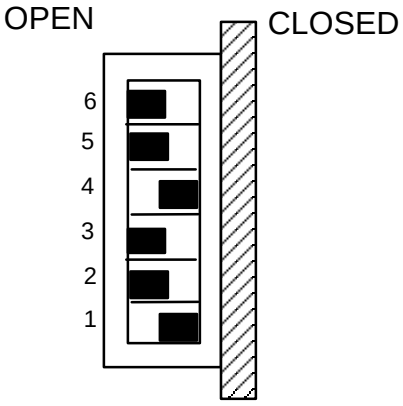
Step	Action
6	Close and open the SW1-6 switch (timer reset).
7	Verify for the following: • The "DELAYED START" yellow LED at the circuit pack is lit. • The RFA red LED of the rectifier at the "DELAYED START" position is lit. • The operation of the rectifier at position "MAIN" is normal. • No RFA alarm signal shall be sent to the system monitoring circuit. • After approximately 30 seconds the yellow LED and the red (RFA) LED will extinguish. The DELAYED START rectifier will resume its normal operation
8	Connect an external 6 ampere load (or use a telecommunication system load) and readjust the float and equalize voltage of the rectifiers so they 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 is lit. • The output current of the main rectifier is approximately 6 A. • The 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 is 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 shown in the following illustration.
–end–	



Note 1: At this point, one rectifier may indicate an RFA. An RFA may be indicated when a rectifier delivers less than 0.1 A (see Note 2). Turning the FLT potentiometer slightly clockwise will return it to normal operation, with no RFA.

Note 2: Sends an alarm at no load condition, only for the following releases or under.

NT5C06BB,BB-1,BB-3,BC	Rel.10
NT5C06CA,CA-1,CA-3,CA-5,CC	Rel.10
NT5C06CB,CB-1,CB-3,CD	Rel.12
NT5CO6CE-61(-46)	Rel.12



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

Troubleshooting

The following are recommended steps for analyzing possible malfunctions of a system equipped with an NT5C10CO power shelf. This is in addition to the information contained in the "Troubleshooting" section of User Manual (UM) 167-9021-107.

Table 13 - Systems equipped with NT5C10CO power shelf fault diagnosis

Fault symptom	Possible causes
Delayed Start did not activate (delayed start LED is not lit):	• No ACV at the power shelf input terminals. • Main rectifier has been removed or generates an RFA. • Faulty circuit pack.
Incorrect time delay:	• Verify that the SW1 switch is properly set. • Faulty circuit pack.
—end—	

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Appendix C: Recommended replacement parts

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

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Appendix D: Technical service assistance

For technical assistance, 24-hours a day / 7 days a week, dial one of the following toll-free numbers. This service complements the services offered by field support organizations such as, the Emergency Technical Assistance Service (ETAS), and the Installation Technical Assistance Service (ITAS).

Local toll-free prefixes

The following prefixes give access to toll-free numbers in various countries. For further information please contact the local service provider.

Country	Prefix
Australia	0011
Belgium	00
Brazil	0021
Denmark	00
Finland	00 or 990
France	00
Germany	00
Hong Kong	001
Ireland	00
Japan	001 (KDD) 041 (ITJ) 0061 (IDC)
Korea	001 (Korea Telecom) 002 (Dacom) 003 (Once)
Malaysia	00
Netherlands	00
New Zealand	00
Singapore	001
Switzerland	00
United Kingdom	00

Toll-free technical assistance numbers

United States:	1-800-992-8417	**Canada:**	1-800-363-2288
In Europe:		**In Asia and the Pacific:**	
Austria	800-213-49156	Australia	800-213-49156
Belgium	800-213-49156	Hong Kong	800-213-49156
Denmark	800-213-49156	Japan	800-213-49156
Finland	800-213-49156	Malaysia	800-213-49156
France	800-213-49156	New Zealand	800-213-49156
Germany	800-213-49156	Philippines	1-800-1-110-0131
Ireland	800-213-49156	Singapore	800-213-49156
Italy	800-213-49156	South Korea	800-213-49156
Netherlands	800-213-49156	Taiwan	800-213-49156
Norway	800-213-49156		
Sweden	800-213-49156		
Switzerland	800-213-49156		
United Kingdom [*1]	800-213-49156		
In the Caribbean and Latin America (CALA):		**In the Middle-East:**	
Bahamas	1-800-389-0081	Israel	800-213-49156
Barbados	1-800-534-0225		
Brazil	08-1571-012288		
Colombia	980-192288		
Dominican Republic	1-888-7514232		
Jamaica	1-800-850-1755		
Mexico	001-800-514-2288		
Puerto Rico	1-888-680-2288		
Trinidad & Tobago	1-800-363-2288		

[*1] The United Kingdom includes England, Guernsey, the Isle of Man, Jersey, Northern Ireland, and Scotland.

For countries not covered by a toll-free service dial Canada (country code 001) at 514–832–6707.

Abbreviations and acronyms

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
NSR	No Standby Rectifier
PCB	Printed Circuit Board
RFA	Rectifier Fail Alarm
TR	Temporary Release
FAN ALM	Fan Alarm

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MPR25 / MPR15 Series, Single Phase -48V,
25A Switch Mode Rectifier
NT5C06B/C
Installation and User Manual

Astec Advanced Power Systems
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St-Laurent (Quebec) Canada
H4S 2A4

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