MOTOROLA

Instruction Manual Revision

GENERAL

This revision outlines changes that have occurred since the printing of your instruction manual. Use this information to correct your manual.

MANUAL AFFECTED

68P81095E45-A CENTRACOM Gold Series™ Console Interface Electronics Maintenance Manual

REVISION DETAILS

Page replaced in the manual

Chapter 10, 9/15 Volt Dual Operator Power Supply, Pg. 12, 50 Hz ac input wiring

Figure 10-3 (AC Input Wiring Details) has been replaced to correct jumper cable connections in the middle diagram at the top of the figure. This supersedes Page 10-12 in SMR-6533.

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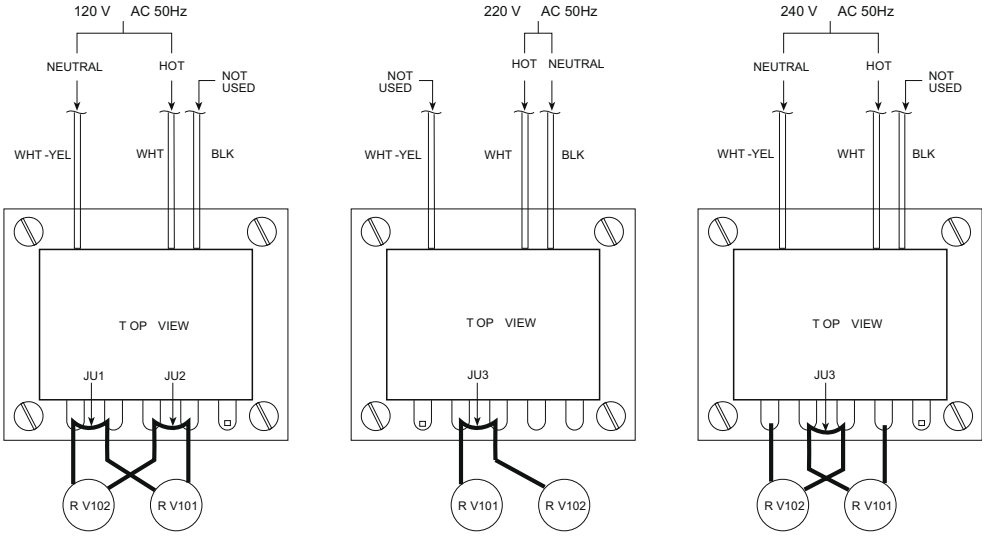
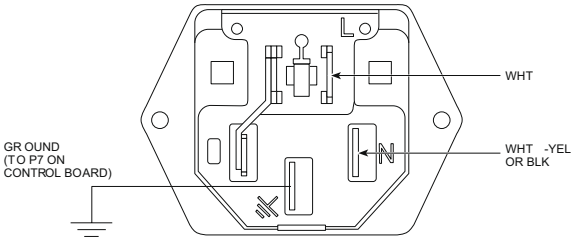
50 Hz ac input wiring



NOTE: PRIMARY AC INPUT CONNECTIONS SHOWN. SECONDARY CONNECTIONS REQUIRE NO MODIFICATION AND ARE NOT SHOWN.



A C RECEPTACLE DETAIL (REAR VIEW)

Figure 10-3 ***AC Input Wiring Details***

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68P81095E45-A CENTRACOM Gold Series™ Console Interface Electronics Maintenance Manual

REVISION DETAILS

Chapter 2, Introduction, Pg. 2 and Pg. 3, Audio Level Sensitivity

To address low-level audio heard by subscriber units when dispatchers employ "relaxed" microphone use, this section is added to the manual and consists of text and two tables to describe increased audio sensitivity and subsequent settings for switch S4.

Brief summary:

"Audio levels at a subscriber unit may be influenced by background noise and/or dispatch personnel who conduct more relaxed microphone usage such as positioning their microphone greater than two inches away from their mouth, or positioning their mouth off-axis from the center of the microphone device. As audio volume can be visually observed on the UV LED-bar on the front of the dispatch position CIE, adequate audio levels will be seen to produce an indication close to or consistently at the zero point of the meter, while peaks can range up to the "+3" location on the meter."

Note: Do not replace any drawing or schematic pages in your existing manual.

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2

Main Board

About this chapter

Section	Page	Description
Introduction	2-2	Provides an overview of the CIE main printed circuit board.
Theory	2-4	Describes the operation of the Main Board circuits.
BLN1228A Parts List	2-25	Contains Main Board parts list.

Models covered

The following models of the Main Board are covered in this chapter:

Model	Description
BLN1228A	Main Board

Introduction

The BLN1228A Main Board contains the central controlling circuitry for the CENTRACOM Gold Series CRT CIE unit. The board provides the interface between the Central Electronics Bank (CEB) and the PC used in the CRT console. The main board resides in the CIE, where it connects to Front Panel Board BGN6029A and various optional devices.

The BLN1228A Main Board kit consists of the Main Board BLN7072A and the Main Board PROM BVN6052A.

The microprocessor controls the main board logic and audio routing circuitry, the serial communication between the PC and the CEB, the Auxiliary I/Os, and (optionally) the channel control modules via the module interface (MINT) board. The board's audio processing circuitry provides console audio to speakers, recorders, and other external devices.

Audio Level Sensitivity

Audio levels at a subscriber unit may be influenced by background noise and/or dispatch personnel who conduct more relaxed microphone usage such as positioning their microphone greater than two inches away from their mouth, or positioning their mouth off-axis from the center of the microphone device. As audio volume can be visually observed on the UV LED-bar on the front of the dispatch position CIE, adequate audio levels will be seen to produce an indication close to or consistently at the zero point of the meter, while peaks can range up to the "+3" location on the meter.

To better accommodate more relaxed microphone usage and provide increased sensitivity, the following table should be used to properly set the S4 switch on a BLN1228C when it is replacing a BLN1228A or BLN1228B CIE Main Board.

Table 2-1 **S4 Switch Setting Translation**

	BLN1228				BLN1228C			
Most Sensitive ↓ Least Sensitive	Switch 1	Switch 2	Switch 3	Switch 4	Switch 1	Switch 2	Switch 3	Switch 4
	N/A	N/A	N/A	N/A	Closed	Open	Open	Open
	N/A	N/A	N/A	N/A	Open	Closed	Open	Open
	Closed	Open	Open	Open	Open	Open	Closed	Open
	Open	Closed	Open	Open	Open	Open	Open	Closed
	Open	Open	Closed	Open	Open	Open	Open	Open
	Open	Open	Open	Closed	Open*	Open*	Open*	Open*
	Open	Open	Open	Open	Open*	Open*	Open*	Open*

* Note the sensitivity enhancement is provided at the two most sensitive settings. If a BLN1228C is being used to replace a BLN1228A or BLN1228B and S4 on the BLN1228A/B was set to one of the least two sensitive positions, set S4 on the BLN1228C

to the least sensitive position. The Automatic Gain Control circuit in the CIE will compensate for the additional sensitivity of the BLN1228C in this case.

For optimum dispatcher audio level when using a headset, it is recommended that the headset microphone be directly in line with the dispatcher's mouth. For optimum audio level when using the gooseneck microphone, it is recommended that the dispatcher speak directly into the microphone and that the following range of distance between the dispatcher's mouth and the microphone be observed for the given settings of S4 (the S4 settings indicated are for the enhanced sensitivity).

Table 2-2 ***Gooseneck Microphone Usage Distance with Enhanced Sensitivity***

	S4 Switch 1	S4 Switch 2	S4 Switch 3	S4 Switch 4	Mouth-to-Microphone Distance
Most Sensitive ↓	Closed	Open	Open	Open	50mm to 400mm (2" to 16")
	Open	Closed	Open	Open	25mm to 200mm (1" to 8")
	Open	Open	Closed	Open	Up to 100mm (up to 4")
	Open	Open	Open	Closed	Up to 50mm (up to 2")
Least Sensitive	Open	Open	Open	Open	Up to 25mm (up to 1")

Note that the gooseneck microphone is very directional and optimized for a close talking distance. Use of the higher sensitivity levels can increase the pickup of background noise. This should be considered when selecting the sensitivity setting.

In all cases, the adequacy of dispatcher audio level should be verified by observing the deflection of the VU indicator on the front of the CIE. An adequate audio level will produce a VU deflection that is consistently at the zero point with peaks going to "+3."

Theory

(Refer to page 2-17.)

NOTE

Active-low signals are indicated either by a bar across the top of a logic name, or by an asterisk (*) after a logic name.

The main board is composed of the following circuitry blocks:

- ❒ Microprocessor and data communications
- ❒ Memory and peripherals
- ❒ MCM and CCM control
- ❒ Auxiliary inputs/outputs
- ❒ Audio processing
- ❒ Voltage regulation

Microprocessor and data communications

General

See Table 2-3 for the main board jumper settings. The main board controls the following microprocessor and data functions:

- ❒ Data communications between the COIM in the CEB and the PC via the RS-232-C port
- ❒ Control of the auxiliary inputs and outputs

The microprocessor is a Motorola 68HC11 operated in the expanded multiplexed mode, meaning that the operating program is contained in an external 32K x 8 EPROM (U3). Additionally, RAM U4 provides 32K bytes of memory.

Communications with the CEB is provided by the serial communications interface (SCI1).

Table 2-3 ***Main Board Jumper Settings***

Jumper	Position	Description
JU4	IN	Customer Gain Resistor
JU7	IN	Handset 2 PTT Enable
JU9	IN	Mic Audio to Logging Recorder
JU10	A	Select Audio to Logging Recorder Mute
JU12	IN	Call Check Load Resistor

Table 2-3 ***Main Board Jumper Settings (continued)***

Jumper	Position	Description
JU16	A	Main Mic Level
JU17	IN	Logging Recorder Load Resistor
JU18	A	Select Speaker Volume Range
JU19	IN	Trunking Tones to Select Speaker
JU20	OUT	Trunking Tones to Unselect Speaker
JU21	A	Unselect Speaker Volume Range
JU22	A	Mute Unselect Speaker During PTT
JU24	IN	Handset 1 PTT Enable
JU25	A	Mute Select Speaker During PTT
JU29	B	Switch Data Source Selector
JU30	A	AUX I/O Enable Source Selector
JU31	OUT	Telephone Receive Pot Delinearization
JU32	B	Mode of Operation (CRT/Compact)
JU33	OUT	Boot Mode Select
JU34	IN	Boot Mode Select
JU35	B	Watchdog Disable
JU36	B	Internal Read Visibility
JU37	OUT	CTS<->DTR Loopback for PC Link
JU38	IN	CTS<->DTR Loopback for SCI3
JU40	B	$\overline{\text{Sel\_Mute}}$ Configuration
JU41	B	$\overline{\text{AUX\_OH}}$ Configuration
JU42	B	Telephone Receive Input Impedance
JU43	B	Telephone Receive Audio Source
JU44	B	Telephone Receive Audio Source

NOTE

The removal of JU22 (Mute Select Speaker) and JU25 (Mute Unselect Speaker), will create a behavioral nuance that can be influenced by the gain setting of the console position microphone:

When a dispatcher interrupts a call in progress by transmitting on the main talkgroup that a subscriber then keys on, merged audio will be heard by another subscriber of that talkgroup because the speakers are not being muted. By physically turning down the volume controls of the speakers this nuance is reduced or eliminated.

Serial communication with the CEB

The CEB communicates to the console through a four-wire, full-duplex serial data link. The baud rate of this link is typically 9600, although other baud rates are available. The baud rates are controlled by setting switch S2. See Table 2-4 for setting information. Since a less than optimal response time is realized when using a baud rate less than 9600 baud, it is recommended that 9600 be used for most applications. The slower speeds are provided for use with long distance data links using modems.

LED data, console switch and potentiometer status of the MCM and CCMs are communicated with the CEB via the serial link. This data is transferred serially between the main board Serial Communication Interface (SCI1) and the COIM via P1. The main board responds to changes of state of the console potentiometers and switches by sending a data packet to the COIM. **CONSOLE SOURCE DATA** sent from the serial peripheral (SPI) is level shifted via U16 and inverted by U17. It is then input to bus driver hybrid Z2 to drive the data differentially out P1-1 & 2. The COIM sends change of state information to the console concerning the display and LEDS. This COIM source data is received differentially on P1-3 & 4. The signal is clamped and input to a comparator, which provides single-ended 5V data to the SPI port of the microprocessor. The links are designed to drive differentially and to have some hysteresis to provide additional noise immunity.

Table 2-4 ***Main Board Switch Settings***

Switch S2 or S3 settings	Link speed	Switch S4 settings	AGC sensitivity	Switch S5 or S6 settings	Volume level
1 closed	2400 baud	1 closed	-35 dBm	1 closed	Full Volume
2 closed	4800 baud	2 closed	-29 dBm	2 closed	-6dB
3 closed	9600 baud	3 closed	-23 dBm	3 closed	-12dB
4 closed	19200 baud	4 closed	-17 dBm	4 closed	-18dB
All closed	38400 baud	None closed	-11 dBm	None closed	-24dB

Serial communication with the PC

Communication with the PC is accomplished via the RS-232 Driver/Receiver U9. The baud rate of the serial data can be set using the switch S3. See Table 2-4 for details. For normal conditions the baud rate is set to 9600. Data is sent to the PC from P2-5. Data received from the PC comes in on P2-3. **Clear To Send** (CTS) comes in on P2-2, and **Data Terminal Ready** (DTR) is asserted on P2-4. The microprocessor does not send or receive data until the CTS goes high. In the Compact operating mode, the microprocessor does not respond to any activity on the serial port.

Power-on and reset

A power-on reset occurs when a positive transition is detected on V_{dd}. The power-on reset (POR) is used strictly to detect power turn-on conditions. At the completion of the POR or the rising edge of reset, whichever comes last, the microprocessor reads the MODA/ MODB pins in order to determine in what mode the microprocessor should operate. In addition, the start-up conditions for the other ports are set.

The **RESET** line goes low when the microprocessor asserts reset, or when the RESET switch S1 is pressed. An onboard undervoltage sensing circuit can also pull **RESET** low, if V_{dd} falls below acceptable values.

COP circuit

The microprocessor has an internal watchdog “computer operating properly” (COP) circuit. This circuit helps protect the microprocessor if it gets lost in the course of executing a program. A COP “strobe” is executed periodically so that the COP timer is never allowed to time out. The COP timeout duration is software controlled. If the COP times out, then a main board reset occurs.

Memory and peripherals

The microprocessor memory consists of EPROM U3, which contains the microprocessor operating program; and RAM U4, which stores the module status information. Additional interface devices facilitate the execution of instructions and program initiated by the microprocessor. These include latch U8, decoder U2, and bus transceiver U6.

The microprocessor memory locations are decoded by U2. The external RAM, which contains the module LED, display, switch, and potentiometer status, is mapped to locations $0480 through $7CFF. The EPROM is mapped to locations $E000 through $FFFF and the internal memory registers and RAM are allocated to $0000 through $047F. The module address latch is dedicated to memory location $7000.

Timing is provided by a 1 MHz crystal. The E clock is generated within the microprocessor and is then used as the timing reference for the memory and peripheral devices. The E clock frequency is four times that of the crystal, or 4.000 MHz. This signal is then divided by 16 to provide the SPI port clock frequency of 250 kHz, which is used for MCM and CCM module data transfers.

MCM and CCM control

NOTE

During operation as a CRT console, the following activities DO NOT occur. The circuitry necessary to perform these functions is included on the main board, but it is never used.

The microprocessor detects status changes of the control module switches and mute potentiometers and communicates that information to the COIM. The COIM microprocessor sends status update information for the console LED clock display. The main board microprocessor will, in turn, transmit this information to the control modules via the module interface board.

Control of the MCM and CCMs is accomplished via the serial peripheral port (SPI) of the main board microprocessor. Module selection is done through eight address lines, which are latched into U8, buffered by U2 and routed to the module interface board.

After selecting a module, the microprocessor indicates whether it is writing LED/display data or reading switch and mute potentiometer status. During the write sequence, the microprocessor pulls its **SS** line high. This signal is NANDed by U21 with a 250 kHz clock from the SPI port, and generates the **LED CLOCK** signal, which is routed to the module interface board via P4, pin 2. The signal is NANDed with each module select line on the MINT board, and therefore is routed to the selected control module only. Synchronously, two 8-bit bytes of **LED DATA** are output on the SPI port, buffered by U16D, and routed to the module interface board via P4, pin 4. The **LED CLOCK** signal then clocks the data into the selected module.

Switch reading is accomplished in a similar manner. The microprocessor selects a module, pulls **SS** low, and serially outputs 8 bits of **SWITCH CLOCK** from the SPI port. The **SWITCH CLOCK** is level-shifted by U16C, inverted by U17, and routed to the module interface board via P4, pin 6. A 8-bit byte of **SWITCH DATA** is clocked serially out of the selected module and input to the main board via P4, pin 8. The data is inverted by U13 and clocked into the SPI port by the falling edge of the microprocessor clock and stored in RAM U4.

The mute potentiometer level from the selected module is routed to the main board via P4, pins 10 and 12, and input to the microprocessor A/D converter. The analog voltage levels of the selected mute potentiometers are converted to an 8-bit digital word and stored in RAM U4.

The microprocessor compares the switch and mute potentiometer readings to the previously stored information. If a status change is detected, then the revised information is communicated to the COIM. The COIM microprocessor interprets the change and initiates communications back to the main board as necessary.

The MCM update is similar to the CCM update, with a few exceptions. The MCM has 19 switches and an 8-character display rather than the eight switches and six LEDs that are present on a CCM. Of the 19 switches, 17 are read using the same method as the CCM switch, except that 24 **SWITCH CLOCK** bits are used to clock three 8-bit bytes of **SWITCH DATA**. The two remaining switches are read via the mute potentiometer lines. In this case, the microprocessor reads the analog voltage level generated by the switch status and determines whether or not the switch has been pressed. The MCM clock display updating is similar to CCM LED updating, except that the update occurs more often than CCM updates and is given priority over CCM updates.

Auxiliary inputs/outputs

When the main board is operating in the mode described in the previous section, the auxiliary inputs/outputs (aux I/O) port is updated in the same manner as the CCM modules. A few of the inputs and outputs of this port are used for control lines on the main board. The others are used to drive relays and opto-couplers on the option board. The microprocessor interprets the inputs of this port as switch closures of a CCM and the outputs as CCM LED updates. The aux I/O port has two serial-to-parallel shift registers and one parallel-to-serial shift register, just as on the CCM modules. Seven of the outputs are inverted via Darlington transistors in peripheral driver array U13 and are used to drive relays on the option (relay) board. All inputs and outputs are provided with static protection circuitry.

During normal operation, position B of JU29 is selected to allow the **SWITCH DATA** to be read directly from U21-4 instead of from the MINT board, and position A of JU30 is selected so the module select line for the aux I/Os comes from U16-15 instead of from the MINT board. This allows the microprocessor to read from and write to the AUX I/Os without using a MINT board. The reading and writing processes are identical to those for reading and writing to CCMs as described above.

Audio processing

The main board audio circuitry provides preamplification of microphone audio, switching between main microphone and auxiliary microphone audio, automatic gain control (AGC) audio level, and balanced audio to the COIM from the console operator position. Additionally, the circuitry provides balanced audio sources for the logging recorder, the VU meter, the telephone transmit audio, and the Call Check recorder. The audio circuitry also drives the select and unselect speaker outputs, as well as the headset and handset outputs.

Transmit audio

The audio signal originating from the console microphone enters the main board through connector P10, which accepts an input from a standard dynamic cardioid microphone. A low noise preamplifier with a gain of 30 dB provides an input sensitivity of -65 dB and 35 dB of dynamic range with less than 1% total harmonic distortion. The preamplifier consists of a common source FET stage (Q6). Operational amplifier U31A provides a low impedance output and additional gain, as well as negative feedback to the first stage. Operational amplifier U23B buffers audio signals originating from either a headset or handset or desktop microphone. In order for this signal to be at the same level as the output of the console mic preamp, this stage provides 10 dB to 16 dB of attenuation, depending on the source. The console microphone signal enters the board connector P9, the handset mic signal enters the board via connector P7, and the headset mic signals enter via P20 and P21. The desktop mic signal enters via connector P6.

The signals from the mic preamp and attenuator are fed to U33A/B, a triple 1-of-2 analog multiplexer. The **AUX ENABLE** input controls which microphone signal is fed to the audio path. This line is pulled low by inserting a headset, taking the handset off-hook, or by pulling P5, pin 4 low (indicating the use of a desk microphone). The output of the multiplexer is biased to 5 V and represents the console transmit audio regardless of the

source the operator is using. For an audio level at any source at the minimum sensitivity point, the level at the multiplex gate output is -35 dBm. The output of the multiplexer is routed to an AGC circuit consisting of operational amplifiers U23C and D and associated components. The AGC provides a constant output of 0 dBm for signals above the input sensitivity level set by switch S4. See Table 2-4 for more information. After the AGC processes the audio, it is routed to three different places: the transmit driver, the VU meter selector, and the logging recorder.

Transmit Driver

The transmit driver consists of notch filter Z3 and current driver U25C. The notch filter prevents base station falsing by attenuating guard tone (2175 Hz) components of operator audio. The notch filter output is applied to current driver U23C, which drives transformer T1. The 0 dBm output of T1 is routed to the COIM via a twisted pair cable. Auxiliary paging tones are input to the final stage of the notch filter (Z3-6), which provides 15 dB of gain. The paging tones are summed with operator transmit audio at the input of U25C.

VU meter

Either select audio or operator transmit audio (AGC audio) is routed to the VU meter by VU selector U33E/F. The VU selector consists of a 1-of-2 multiplexer, which passes AGC audio during transmit (**PTT OUT** high) and the console select audio otherwise (**PTT OUT** low). Since select audio is input to the VU selector at -10 dBm, the 0 dBm level AGC audio is attenuated 10 dB by divider R346/R347 before entering the multiplexer. The VU meter output is routed to the VU meter circuitry on the front panel board via P17-14.

Logging recorder

Operator transmit audio (AGC audio) and select audio are routed to the logging recorder via current driver U25A and transformer T2. The -6 dBm level is routed to the logging recorder via P6, pins 6 and 7.

Telephone transmit audio

When **PTT OUT** is low, operator audio is routed to the telephone transmit driver instead of the AGC circuitry. The telephone transmit driver consists of operational amplifier U30B, which provides 10 dB of gain, and differential voltage source U27A and C, which provides an additional 32 dB of gain. The output of U27A/C drives transformer T8, which provides impedance matching to the 600 ¾ telephone line connected to P5, pins 9 and 10. Telephone transmit audio is normally adjusted to a level of -24 dBm at P5, pins 9 and 10 by potentiometer R453.

The output of the telephone transmit driver can be disabled by the console off-hook signal (**$\overline{\text{CONS OH}}$**). The **$\overline{\text{CONS OH}}$** is derived from the auxiliary off-hook (**$\overline{\text{AUX OH}}$**) input (P5-2), which is low when the operator's telephone is in use; and by aux jack sense (**$\overline{\text{AUX JS}}$**) input (P5-1), which is low when the telephone is being used by someone other than the operator. **$\overline{\text{CONS OH}}$** goes low when **$\overline{\text{AUX OH}}$** is low and **$\overline{\text{AUX JS}}$** is high, thus enabling the telephone

transmit driver only when the operator is using the telephone. Refer to Tables 2-5 and 2-6 for audio routing and muting logic details.

Table 2-5 ***Audio Routing Logic***

Control Signal	Audio Signal	Routing
$\overline{\text{AUX ENABLE}}$ low	Headset or Handset/Desk Mic	Rest of Mic Path
$\overline{\text{AUX ENABLE}}$ high	Main Mic	Rest of Mic Path
PTT OUT high	Mic Audio	AGC
PTT OUT low	Mic Audio	Telephone Transmit

Table 2-6 ***Audio Muting Logic***

Inputs			Outputs (see note)	
$\overline{\text{AUX OH}}$	**$\overline{\text{AUX JS}}$**	**$\overline{\text{AUX ENABLE}}$**	**$\overline{\text{SEL MUTE}}$**	**$\overline{\text{CONS OH}}$**
L	L	L	L	H
L	L	H	H	H
L	H	L	H	L
L	H	H	H	L
H	L	L	L	H
H	L	H	H	H
H	H	L	L	H
H	H	H	H	H

NOTE

If **$\overline{\text{SEL MUTE}}$** is low, then select audio is routed to the headset and the select speaker is muted. Telephone audio to the headset is also muted. If **$\overline{\text{CONS OH}}$** is low, then the telephone transmit driver is enabled and **$\overline{\text{SEL MUTE}}$** goes high. This routes select audio to the select speaker and routes telephone audio to the headset.

Receive audio

In addition to processing the operator's transmit audio, the main board also processes telephone receive audio and the select and unselect audio from the COIM. Telephone receive audio is input to the main board via P5, pins 6 and 7, and routed via transformer T7 to differential receiver U27D, which has a maximum gain of 25 dBm. The output of U27D is normally adjusted to -10 dBm by potentiometer R422. The telephone receive audio is then routed to both the Call Check recorder and to the headset driver. Call check audio is fed to unity gain current driver U27B and transformer T6, and on to the option board for routing to the Call Check recorder. Headset driver audio is routed to 1-of-2 multiplexer U32E/F, when select mute (**$\overline{\text{SEL MUTE}}$**) is high. When **$\overline{\text{SEL MUTE}}$** is low, V_B is routed to U24D-13, and mutes the headset and handset audio.

Select audio

Select audio from the COIM is input at P1, pins 11 and 12, and routed via transformer T3 to unity gain buffer U26A, where it is summed with trunking tones. The output of U26A is routed to low pass filter Z6, buffered by U26B, and attenuated 10 dB by voltage divider R392-R393 to prevent passband clipping by notch filter Z4. The notch filter attenuates 2175 Hz guard tone in order to prevent guard tone from being heard in the select speaker, headset, or handset. The notch filter is strapped to recover the 10 dB voltage divider attenuation. The output of the notch filter (approximately -10 dBm for a -15 dBm input at transformer T3) is routed to 1-of-2 multiplexer U32A/B, which routes the select audio to the headset and handset or the select speaker, depending on the status of the **SEL MUTE** or **PTT** lines. When the **SEL MUTE** or **PTT** lines are low and there is a headset or handset present, the select audio is routed to the headset and handset instead of to the select speaker. The **SEL MUTE** signal is generated by combining the **AUX ENABLE** signal, (which indicates that a headset or handset is active), and the **CONS OH** signal (which indicates that the operator is using the telephone). Select audio is routed to the headset and handset when a headset or handset is active (**AUX ENABLE** low) and when the operator is not using the telephone (**CONS OH** high). In this case, select audio is routed to buffer U24 and sent to headset connectors P20 and P21. The handset driver taps off the differential headset driver. S6 controls the select audio volume in the handset. See Table 2-4 for settings. When **SEL MUTE** is high, select audio is routed to unity gain buffer U24C. The output of U24C is fed to volume potentiometer R399 (located on the front panel board), and amplified 26 dB by audio driver U29A. The output of U29A is routed via P17, pins 25 and 26 to the select speaker. The output of select audio notch filter Z4 is also routed to the VU meter via multiplexer U33D/F, and to the logging recorder regardless of the status of **SEL MUTE**. Refer to Tables 2-5 and 2-6 for audio routing and muting logic details.

Unselect audio

Unselect audio from the COIM is input at P1, pins 9 and 10 and routed via transformer T4 to unity gain buffer U26C, where it is summed with trunking tones. The output of U26C is routed to low pass filter Z7, buffered by U26D, and fed to 1-of-2 multiplexer U32 C/D. The multiplexer is controlled by the **CALL CHECK OFF-HOOK** signal from shift register U14-5, or **PTT**. When **CALL CHECK OFF-HOOK** is low, unselect audio is muted by applying V_B to the notch filter and Call Check audio from the option board is routed to the unselect speaker. When **CALL CHECK OFF-HOOK** is high, unselect audio is attenuated 10 dB by voltage divider R372-R373 to prevent passband clipping by notch filter Z5. The notch filter attenuates 2175 Hz guard tone in order to prevent guard tone from being heard in the unselect speaker. The notch filter is strapped to recover the 10 dB voltage divider attenuation. The output of the notch filter (approximately -10 dBm for a -15 dBm input at transformer T4) is routed to volume potentiometer R377 (located on the front panel board), and amplified 26 dB by audio driver U28A. The output of U28A is routed via P17, pins 1 and 2 to the unselect speaker.

Voltage regulators

B+ supply

Since the B+ voltage level is not critical, the B+ supply circuitry provides a B+ voltage in the range of 9.7 to 14.9 Vdc. As long as the power supply input voltage remains in the acceptable range of 11.0 to 16.5 V, transistor Q15 is saturated and the B+ voltage follows the supply voltage. If the supply voltage exceeds 16.5 V, Zener diode VR6 begins to conduct. When VR6 conducts, Q13 saturates and turns off Q16. When Q16 turns off, it removes the bias current for Q15 and Q12, disabling the B+ output. If the input voltage falls below 11.0 V, VR3 no longer conducts. When VR3 stops conducting sufficiently to saturate Q14, no current can flow from Q13 and Q16, removing the bias from Q15 and Q12 and disabling the B+ supply.

VL supply and SCR protection circuit

The VL voltage regulator is based on a constant current source consisting of Q22, Q23 and R526, which supplies the base drive to series pass transistor Q24. The regulation is controlled by CR26, VR4, R525, R526, and Q22. When VL goes low, less current goes through VR4 and thus less goes through Q23. More current through Q23 causes more base current through Q24, thus increasing VL. The reverse process occurs when VL goes high.

The SCR protection circuit guards against catastrophic device failure. When VL is operating properly, Q20 is off and Q21 is saturated. If a large amount of current is required from the VL supply, there is a sufficient drop across R517 and R518 to turn on Q20, which turns off Q21 by pulling its base high. When Q21 is off, there is no base current provided to Q23, which in turn removes the base drive from Q24. In order to facilitate the rapid cut off of Q24, Zener CR14 is connected from the collector of Q20 to the base of Q24. When Q20 saturates, CR14 forces a 0.4 V drop across the base-emitter junction of Q24, shutting it off. When Q20 first shuts off, there is no charge across C237. The base of Q20 is thus held low until C237 has been fully charged, thus shutting down the VL supply for the time period that C237 is charging through R519. Once C237 is fully charged, Q20 shuts off and Q21 turns on again, thus re-enabling the VL supply. When Q21 turns off, the negative side of C237 goes high, thus forcing the positive side of C237 and the base of Q20 above B+. This state keeps Q20 turned off until C237 discharges again. The entire process causes a pulsing of VL as long as the SCR condition remains.

A second limiter prevents a high current path through Q20, CR60 and Q24. This path is limited by CR20, CR21, and CR22, which clamp the voltage from the B+ input to the base of Q24 to 1.6 V. The VL supply ranges from 9.0 to 10.0 V.

+5 V regulator

B+ is routed to series regulator VR1, which supplies power to the microprocessor and other 5 V logic integrated circuits.

VA supply

The VA supply for the analog circuitry is derived from B+ by regulator circuitry consisting of Q17, VR2, CR30, Q18, and Q19. The base voltage for Q18 is set by VR2 and CR30, which sets the voltage across R511. If the VA output goes high, Q19 provides more of the current through R511. This causes Q18 to provide less base current to Q17 and decrease the output. The reverse process occurs when VA goes low. The VA supply is between 9.2 and 10.6 V.

VB and VB2 supply

The VB supply for biasing the audio circuits is derived from VA by voltage divider R515-R516 and operational amplifier U31B. The voltage divider divides VA in half and the unity gain operational amplifier buffer provides a low output impedance voltage source. Since there are several current drivers which derive current from VB, VB is buffered by U25B to provide VB2. This is done to prevent excessive current and associated noise from affecting VB. VB2 is used to provide current to the logging recorder driver, the PA driver, and the Call Check recorder driver. The VB and VB2 supplies have a range of 4.1 to 5.2 V.

BLN1228A Parts List

Reference	Part Number	Description
		capacitor, fixed:
C1 thru 5	2113741B49	0.015 uF, ±5%; 50V
C7 thru 21	2113741B49	0.015 uF, ±5%; 50V
C24	2113741B49	0.015 uF, ±5%; 50V
C27 thru 29	2113741B49	0.015 uF, ±5%; 50V
C31 thru 34	2113741B49	0.015 uF, ±5%; 50V
C37	2113741B49	0.015 uF, ±5%; 50V
C39 thru 47	2113741B49	0.015 uF, ±5%; 50V
C100,101	2113740B25	10 pF, ±5%; 50 V
C102	0811017A01	1000 pF, ±5%; 50 V
C105	2313748G04	1 uF, ±20%; 50V
C107	2111015D09	470 pF, ±10%; 100V
C129	2111015D09	470 pF, ±10%; 100V
C130,131	0811051A11	0.047 uF, ±5%; 63 V
C132	0811051A12	0.068 uF, ±5%; 63 V
C134	0811051A11	0.047 uF, ±5%; 63 V
C135	0811051A19	1 uF, +5%/-0.5%; 63 V
C136,137	2113741B65	0.068 uF, ±5%; 50 V
C138	0811051A11	0.047 uF, ±5%; 63 V
C142,143	0811051A11	0.047 uF, ±5%; 63 V
C144	2313748G14	22 uF, ±20%; 35V
C145	0811051A12	0.068 uF, ±5%; 63 V
C150	0811051A12	0.068 uF, ±5%; 63 V
C151	2313748G06	4.7 uF, ±20%; 50V
C153,154	2113741B49	0.015 uF, ±5%; 50V
C155,156	2313748G22	100 uF, ±20%; 25 V
C157	2113741B49	0.015 uF, ±5%; 50V
C158,159	0811017A01	1000 pF, ±5%; 50 V
C160	0811051A12	0.068 uF, ±5%; 63 V
C161	2313748G14	22 uF, ±20%; 35V
C162	2313748G09	10 uF, ±20%; 35 V
C163	0811017A08	0.01 uF, ±5%; 50 V
C164	2313748G04	1 uF, ±20%; 50V
C165	0811017A01	1000 pF, ±5%; 50 V
C166	0811051A19	1 uF, +5%/-0.5%; 63 V
C168	2313748G06	4.7 uF, ±20%; 50V
C169	0811017A08	0.01 uF, ±5%; 50 V
C170	2313748G04	1 uF, ±20%; 50V
C171	0811051A12	0.068 uF, ±5%; 63 V
C172,173	2113741B49	0.015 uF, ±5%; 50V
C176	0811017A08	0.01 uF, ±5%; 50 V
C177	0811051A12	0.068 uF, ±5%; 63 V
C178	2111015D01	100 pF, ±10%; 100V
C179	2113741B49	0.015 uF, ±5%; 50V
C180	0811051A12	0.068 uF, ±5%; 63 V
C181	2113741B49	0.015 uF, ±5%; 50V
C182,183	0811051A19	1 uF, +5%/-0.5%; 63 V
C184	0811051A12	0.068 uF, ±5%; 63 V
C185	2313748G04	1 uF, ±20%; 50V
C186	0811051A19	1 uF, +5%/-0.5%; 63 V
C187	2313748G14	22 uF, ±20%; 35V
C188	0811051A19	1 uF, +5%/-0.5%; 63 V
C190	0811051A12	0.068 uF, ±5%; 63 V
C191,192	2313748G04	1 uF, ±20%; 50V
C195	2313748G25	333 uF, ±20%; 35V
C196	2113741B49	0.015 uF, ±5%; 50V
C197	2313748G25	333 uF, ±20%; 35V
C198	2113741B49	0.015 uF, ±5%; 50V
C199	2313748G25	333 uF, ±20%; 35V
C200	2313748G04	1 uF, ±20%; 50V
C203	2313748G25	333 uF, ±20%; 35V
C204	2113741B49	0.015 uF, ±5%; 50V
C205	2313748G25	333 uF, ±20%; 35V
C206	2113741B49	0.015 uF, ±5%; 50V
C207	2313748G25	333 uF, ±20%; 35V
C209	2111015D01	100 pF, ±10%; 100V
C210,211	0811051A12	0.068 uF, ±5%; 63 V
C215	0811017A01	1000 pF, ±5%; 50 V
C216	0811051A11	0.047 uF, ±5%; 63 V
C217	0811051A12	0.068 uF, ±5%; 63 V
C219	2313748G06	4.7 uF, ±20%; 50V
C220	2111015D05	220 pF, ±10%; 100V
C221	2313748G06	4.7 uF, ±20%; 50V
C222	2313748G05	2.2 uF, ±20%; 50V
C223 thru 225	2313748G14	22 uF, ±20%; 35V
C226	2111015D05	220 pF, ±10%; 100V
C230 thru 232	2313748G22	100 uF, ±20%; 25 V
C233	2313748G14	22 uF, ±20%; 35V
C234	2113741B49	0.015 uF, ±5%; 50V
C235	2313748G14	22 uF, ±20%; 35V
C236,237	2313748G06	4.7 uF, ±20%; 50V
C238,239	0811051A12	0.068 uF, ±5%; 63 V
C240	0811017A06	470 pF, ±5%; 50 V
C241	2313748G14	22 uF, ±20%; 35V
C244	2113741B49	0.015 uF, ±5%; 50V
C245,246	2313748G14	22 uF, ±20%; 35V
C252	2313748G04	1 uF, ±20%; 50V
C253	2313748G05	2.2 uF, ±20%; 50V
C254	2313748G14	22 uF, ±20%; 35V
C258	2113741B49	0.015 uF, ±5%; 50V
C259	2313748G09	10 uF, ±20%; 35 V
C260	0811051A12	0.068 uF, ±5%; 63 V
C600	2113741B49	0.015 uF, ±5%; 50V
C700 thru 703	2313748G14	22 uF, ±20%; 35V
C704	2113741B65	0.068 uF, ±5%; 50 V
C800,801	2313748G04	1 uF, ±20%; 50V
C802,803	0811051A12	0.068 uF, ±5%; 63 V
C804,805	2313748G04	1 uF, ±20%; 50V
C900 thru 904	2313748G09	10 uF, ±20%; 35 V
C905 thru 910	2113741B49	0.015 uF, ±5%; 50V
		diode: (see note)
CR1 thru 5	4883654H01	silicon
CR8 thru 12	4883654H01	silicon
CR14	4882592W01	Schottky, Barrier
CR15 thru 17	4813833D08	1A, 600V
CR19 thru 21	4883654H01	silicon
CR22,23	4882592W01	Schottky, Barrier
CR24	4883654H01	silicon
CR26,27	4883654H01	silicon
CR29 thru 42	4883654H01	silicon
CR45 thru 52	4883654H01	silicon
CR54	4882592W01	Schottky, Barrier
CR56,57	4883654H01	silicon
CR59	4882592W01	Schottky, Barrier
CR60,61	4883654H01	silicon
CR600	4883654H01	silicon
CR601,602	4882592W01	Schottky, Barrier
		light emitting diode: (see note)
DS1	4888245C22	GRN
		fuse:
F1	6582408R01	fuse 3A, 125V

BLN1228A Parts List

jumper:

JU4	0611009B23	0 ohm, ±5%; 1/4 W
JU7	0611009B23	0 ohm, ±5%; 1/4 W
JU9	0611009B23	0 ohm, ±5%; 1/4 W
JU12	0611009B23	0 ohm, ±5%; 1/4 W
JU17	0611009B23	0 ohm, ±5%; 1/4 W
JU19	0611009B23	0 ohm, ±5%; 1/4 W
JU24	0611009B23	0 ohm, ±5%; 1/4 W
JU34	0611009B23	0 ohm, ±5%; 1/4 W
JU38	0611009B23	0 ohm, ±5%; 1/4 W

connector:

P1	2883290P04	plug: 20-contact
P2	0983112N02	receptacle: 8-contact
P4	2883290P05	plug: 26-contact
P5,6	2883291R06	PLUG 10 PIN
P7	0983112N02	receptacle: 8-contact
P8	2883689R01	PLUG RIGHT ANGLE HDR 3 PIN
P9	2883499R01	plug, 4-position
P10	0983614R01	RECP PHONO BD MTG 90 DEG
P11	2883636P01	plug: 3-contact
P12	2883290P04	plug: 20-contact
P14,15	0983112N01	receptacle: 6-contact
P16	0983112N02	receptacle: 8-contact
P17	2883290P05	plug: 26-contact
P19	2910231A10	terminal, circuit board
P20,21	2885155U01	plug, 10-contact
P22	2883290P04	plug: 20-contact
P23	2880001R03	plug: 3-pin header
P24	0983365N01	receptacle: 8-contact

transistor: (see note)

Q1	4813824D08	NPN
Q3,4	4800869570	NPN
Q5	4813824D08	NPN
Q6	4813823D01	TSTR N-CH RF JFET 2N5484RLRP
Q7,8	4813824D06	NPN
Q9	4813824D12	PNP
Q10	4800869653	type JFET
Q11	4813824D12	PNP
Q12	4882022N47	TSTR PNP PA MJE15029_
Q13,14	4813824D08	NPN
Q15	4813824D12	PNP
Q16	4813824D08	NPN
Q17	4800869619	PNP; type M9619
Q18,19	4813824D08	NPN
Q20,21	4813824D12	PNP
Q22,23	4813824D08	NPN
Q24	4800869619	PNP; type M9619
Q29	4813824D04	TSTR DARL NPN 30V .3A MPSA13
Q35	4813824D08	NPN
Q600	4813824D08	NPN

resistor, fixed:

R101 thru 108	0611009A97	100K, ±5%; 1/4W
R109 thru 116	0611077B07	22K, ±5%; 1/8 W
R117	0611077A82	2.2K, ±5%; 1/8 W
R118 thru 120	0611077A98	10K, ±5%; 1/8 W
R121 thru 123	0611077A82	2.2K, ±5%; 1/8 W
R124	0611077A98	10K, ±5%; 1/8 W
R125	0611077A82	2.2K, ±5%; 1/8 W
R126	0611077A98	10K, ±5%; 1/8 W
R127	0611077A82	2.2K, ±5%; 1/8 W
R128	0611077A98	10K, ±5%; 1/8 W
R129	0611077A82	2.2K, ±5%; 1/8 W
R130 thru 134	0611077A98	10K, ±5%; 1/8 W
R136 thru 138	0611077A98	10K, ±5%; 1/8 W
R139 thru 141	0611009A73	10K, ±5%; 1/4 W
R142 thru 147	0611077A98	10K, ±5%; 1/8 W
R148	0611077A74	1K, ±5%; 1/8 W
R151	0611077B71	10 meg, ±5%; 1/8 W
R152	0611077A74	1K, ±5%; 1/8 W
R153 thru 155	0611077A98	10K, ±5%; 1/8 W
R175	0611077A74	1K, ±5%; 1/8 W
R176	0611077A98	10K, ±5%; 1/8 W
R209	0611077A74	1K, ±5%; 1/8 W
R210	0611077A98	10K, ±5%; 1/8 W
R214	0611077A98	10K, ±5%; 1/8 W
R215,216	0611077A58	220 ohms, ±5%; 1/8 W
R225	0611077A90	4.7K, ±5%; 1/8 W
R231	0611077A98	10K, ±5%; 1/8 W
R232	0611077A82	2.2K, ±5%; 1/8 W
R233	0611077A68	560 ohms, ±5%; 1/8 W
R234 thru 236	0611077A82	2.2K, ±5%; 1/8 W
R237	0611077A98	10K, ±5%; 1/8 W
R238	0611077B47	1 meg, ±5%; 1/8 W
R239	0611077A94	6.8K, ±5%; 1/8W
R250,251	0611009A81	22K, ±5%; 1/4W
R252	0611077A70	680 ohms, ±5%; 1/8 W
R253	0611077A74	1K, ±5%; 1/8 W
R254	0611077A90	4.7K, ±5%; 1/8 W
R255	0611077A98	10K, ±5%; 1/8 W
R300	0611077B03	15K, ±5%; 1/8 W
R301,302	0611077A66	470 ohms, ±5%; 1/8 W
R303	0611077A90	4.7K, ±5%; 1/8 W
R304	0611009A19	56 ohms, ±5%; 1/4W
R305	0611077A68	560 ohms, ±5%; 1/8 W
R306	0611077B13	39K, ±5%; 1/8 W
R308	0611077B47	1 meg, ±5%; 1/8 W
R309	0611077B23	100K, ±5%; 1/8 W
R310	0611077A98	10K, ±5%; 1/8 W
R311,312	0611077B09	27K, ±5%; 1/8 W
R313,314	0611077B01	12K, ±5%; 1/8 W
R315	0611009A77	15K, ±5%; 1/4W
R316	0611077A98	10K, ±5%; 1/8 W
R317	0611009A77	15K, ±5%; 1/4W
R318	0611077A74	1K, ±5%; 1/8 W
R319	0611077B15	47K, ±5%; 1/8 W
R320,321	0611077B11	33K, ±5%; 1/8 W
R322	0611077A48	82 ohms, ±5%; 1/8W
R323	0611077A90	4.7K, ±5%; 1/8 W
R324,325	0611077B21	82K, ±5%; 1/8W
R326	0611077B43	680K, ±5%; 1/8 W
R327	0611077B19	68K, ±5%; 1/8 W
R328	0611077A90	4.7K, ±5%; 1/8 W
R329,330	0611077B09	27K, ±5%; 1/8W
R331	0611077B07	22K, ±5%; 1/8 W
R332	0611077A74	1K, ±5%; 1/8 W
R333,334	0611077B37	390K, ±5%; 1/8W
R335	0611077B01	12K, ±5%; 1/8 W
R336	0611077A98	10K, ±5%; 1/8 W
R337	0611077B43	680K, ±5%; 1/8 W
R338	0611077B45	820K, ±5%; 1/8 W
R339	0611077B03	15K, ±5%; 1/8 W
R340	0611077A96	8.2K, ±5%; 1/8 W
R341	0611077B31	220K, ±5%; 1/8 W
R342	0611077A98	10K, ±5%; 1/8 W
R343	0611077A74	1K, ±5%; 1/8 W
R344	0611077A48	82 ohms, ±5%; 1/8W
R345	0611077A78	1.5K, ±5%; 1/8 W
R346	0611077B17	56K, ±5%; 1/8 W
R347	0611077B13	39K, ±5%; 1/8 W
R348	0611077A74	1K, ±5%; 1/8 W
R349	0611077B17	56K, ±5%; 1/8 W
R350	0611077B07	22K, ±5%; 1/8 W
R351	0611077A90	4.7K, ±5%; 1/8 W
R352	0611077B23	100K, ±5%; 1/8 W
R353	0611077B17	56K, ±5%; 1/8 W
R354	0611077B23	100K, ±5%; 1/8 W
R355	0611077A58	220 ohms, ±5%; 1/8 W
R356	0611077B21	82K, ±5%; 1/8W
R357	0611077B07	22K, ±5%; 1/8 W
R358	0611077B19	68K, ±5%; 1/8 W
R359	0611077A74	1K, ±5%; 1/8 W
R360	0611077B19	68K, ±5%; 1/8 W
R361	0611077A68	560 ohms, ±5%; 1/8 W
R362	0611077A92	5.6K, ±5%; 1/8 W

MOTOROLA

Instruction Manual Revision

GENERAL

This revision outlines changes that have occurred since the printing of your instruction manual. Use this information to correct your manual.

MANUAL AFFECTED

68P81095E45-A CENTRACOM Gold Series™ Console Interface Electronics Maintenance Manual

REVISION DETAILS

Additional Chapter added to the manual

Chapter 10, 9/15 Volt Dual Operator Power Supply

The CENTRACOM Gold Series™ Classic Buttons and LEDs Manual (68P81095E35) has been discontinued, but Chapter 18 contains information on a power supply that is still relevant. This chapter is now moved to become Chapter 10 in the CENTRACOM Gold Series™ CIE Maintenance Manual (68P81095E45), and includes a parts list and drawing overlay. Also find enclosed the adjusted table of contents for the CIE manual. The power supply referred to is used when Elite Operator Positions (OPs) are installed in furniture.

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MOTOROLA

Contents

MOTOROLA

10

9/15 Volt Dual Operator Power Supply

About this chapter

Section	Page	Description
Introduction	10-4	Provides an overview of the power supplies and options.
Theory	10-6	Describes power supply operation.
Test procedure	10-9	Describes how to test the power supplies to determine satisfactory performance.
50 Hz ac input wiring	10-11	Describes special considerations for 50 Hz installations.
Common Parts List	10-17	Provides a parts list for common electrical components for all power supply models.
Unique Parts List	10-19	Provides a parts list for mechanical parts and electrical components that are unique to each power supply model.

Models covered

The following models of the 9/15 volt dual operator power supply are covered in this chapter:

Model	Description	Contents
BPN1022A	60 Hz 120V ac and +24V dc backup	• BLN6860A Control board • BLN6857A Pass board • BKN6071A AC power cable • BLN6859A Hardware kit
BPN1023A	50 Hz 120V ac and +24V dc backup	• BLN6860A Control board • BLN6857A Pass board • BKN6071A AC power cable • BLN6880A Hardware kit
BPN1024A	60 Hz 240V ac and +24V dc backup	• BLN6860A Control board • BLN6857A Pass board • BKN6071A AC power cable • BLN6885A Hardware kit
BPN1025A	50 Hz 220/240V ac and +24V dc backup	• BLN6860A Control board • BLN6857A Pass board • BKN6071A AC power cable • BLN6886A Hardware kit

Performance specifications

Table 10-1 ***General***

Specification	Value
Temperature	0°-50°C (32°-122°F)
Humidity range	90% maximum RH non-condensing
Line voltage	102-132 V ac for 120 V ac 187-242 V ac for 220 V ac 204-264 V ac for 240 V ac
Line frequency	57-63 Hz or 47-53 Hz
Battery backup voltage	+20-26 V dc
Primary current	3 A maximum

Table 10-2 ***+15.8 V Output***

Specification	Value
Output voltage	+15.3-16.3 V dc (15.8 V dc typical)
Output ripple	50 mV maximum
Overvoltage	+16.4-19.1 V dc (17.5 V dc typical)
Current limit	6-12 A (8A typical)
Short circuit current	3 A maximum (1.5 A typical)

Table 10-3 ***+9 V Output***

Specification	Value
Output voltage	+8.7-9.3 V dc (9 V dc typical)
Output ripple	50 mV maximum
Overvoltage	+12.65-15 V dc (13.5 V dc typical)
Current limit	1.5-4.5 A (2.5A typical)
Short circuit current	1.5 A maximum (0.75 A typical)

Introduction

Refer to Figures 10-1 and 10-2. All four power supply models consist of a dual voltage (+9 V dc and +15.8 V dc) control board, a common power transformer (T1), and an output pass board. Each model also provides the capability (if desired) for a +24 V dc backup source. Each model provides +9 V dc and +15.8 V dc outputs and also provides current limiting, short circuit current foldback, and overvoltage protection. The battery backup feature provides battery current limiting and a dead battery disconnect feature to prevent the deep discharge of batteries.

The BPN1022A Model operates from a 120 V ac, 60 Hz source.

The BPN1023A Model operates from a 120 V ac, 50 Hz source. The only difference between the BPN1023A and BPN1022A Models is the power transformer (T1) and some mechanical hardware.

The BPN1024A Model operates from a 240 V ac, 60 Hz source. It differs from the BPN1022A Model only in the wiring of the power transformer (T1) and the rating of the ac input fuse (F1).

The BPN1025A Model (as shipped) operates from a 220 V ac, 50 Hz source, but can be configured to operate from a 240 V source. It differs from the BPN1023A Model only in the wiring of the power transformer (T1) and the rating of the ac input fuse (F1).

NOTE

When the BPN1025A Operator Power Supply is operated inside a locked cabinet, the power supply is approved by the Bauart Mark/ VDE certification criteria. Removal of the power supply voids this certification. Power supplies shipped loose and/or mounted in an open rack environment do not carry the Bauart Mark certification.

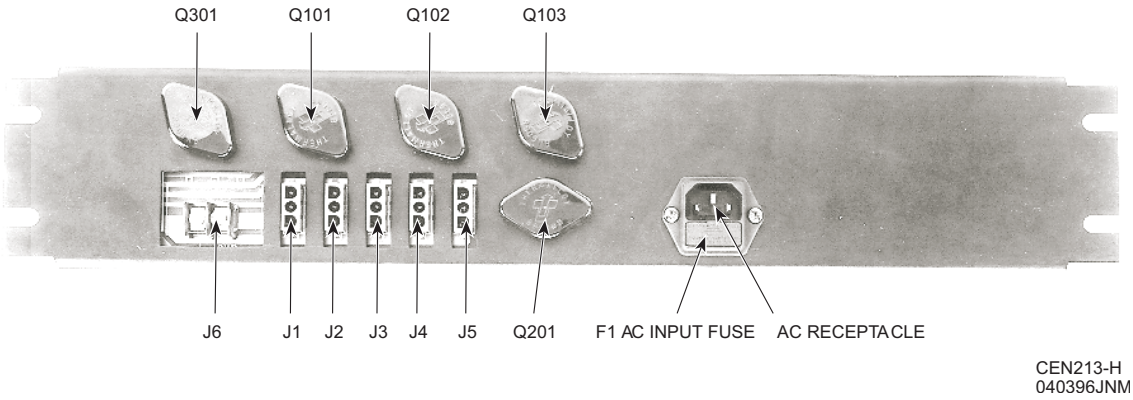


Figure 10-1 ***9/15 Volt Dual Operator Power Supply (Front View)***

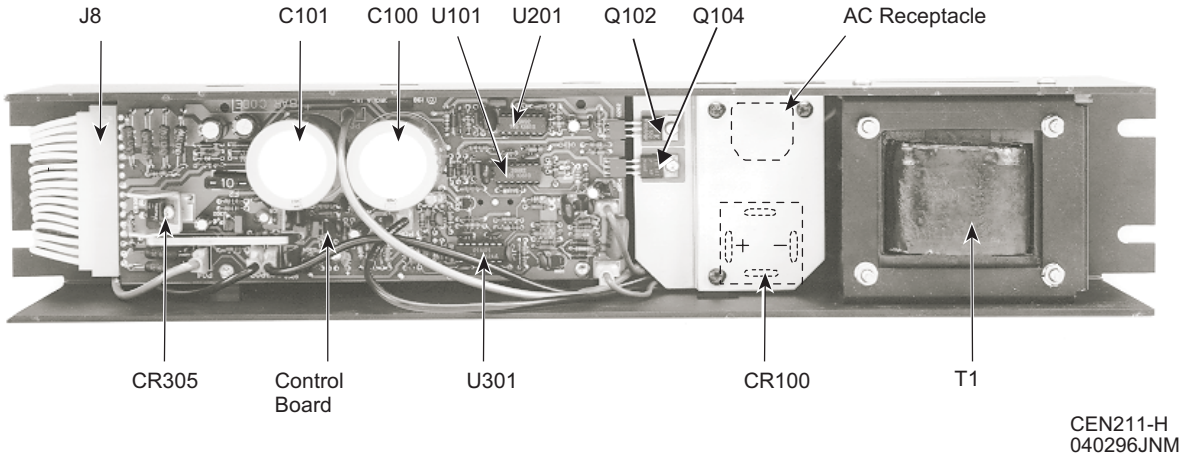


Figure 10-2 ***9/15 Volt Dual Operator Power Supply (Rear View)***

Theory

Refer to the schematic diagram. Only Model BPN1022A is discussed since it is typical. Each power supply is powered by a common power transformer (T1). Overcurrent protection is provided by fuses F1 and F2, and transient suppression is provided by RV101 and RV102. The BPN1022A Model consists primarily of two voltage regulators, two current limiters, overvoltage protection circuitry, a battery backup controller, and a battery gate.

Voltage regulators

The two voltage regulators are the heart of the power supply. Since the regulation of the +9 V side is similar to the +15.8 V side, only the +15.8 V regulation is described. The output voltage is coupled back to the inverting input (U101-4) through resistor divider network R108 and R109. This voltage is compared to the non-inverting input voltage (U101-5) created by R110 and R111 from the reference voltage internal to U101 (U101-6).

After comparing the inverting and non-inverting inputs, U101 increases or decreases the base drive to the series pass transistor driver Q104. The +15.8 V output contains three paralleled series pass transistors (Q101, Q102, and Q103) driven by Q104. The +9 V output has only one series pass transistor (Q201) driven by Q202.

Current limiting

Since the two outputs have the same current limiting schemes, only the +15.8 V output is discussed. Current limiting is provided by a transistor internal to U101. The voltage across the base-emitter junction of series pass transistors Q101, Q102, and Q103, and the voltage caused by the current through R101, R102, and R103, is equivalent to the drop across the R105, R106 divider network. The difference between the voltage across R106 and the output voltage is the voltage drop across the base-emitter junction of the internal current limit transistor (U101-2, -3). As the voltage drop across R101, R102, and R103 increases, the voltage across the base-emitter junction of the internal current limit transistor also increases. This action causes the internal current limit transistor to conduct harder which, in turn, reduces the current from series pass driver Q104.

As the current limiting action begins, the +15.8 V output voltage begins to drop. A lower output voltage dictates that a greater voltage drop across the emitter resistors is required to keep the internal current limit transistor on. In this manner, the foldback action is achieved.

The +9 V current limiter works in a similar manner except that the resistors R201, R203, and R204 are used.

Overvoltage protection

Since the two outputs have the same overvoltage protection schemes, only the +15.8 V output is discussed. If a short circuit occurs across one of the series pass transistors (Q101, Q102, or Q103), the unregulated power supply secondary voltage could be coupled to the console regulators. The console regulators could be destroyed by the excess power. Overvoltage protection is provided to prevent this from happening. The 16 V Zener (VR101) monitors the +15.8 V output and conducts when the output is in the 16.4 to 19.1 V range. When VR101 conducts, current is passed to the gate of SCR401. This current causes the SCR to conduct and open input fuse F2. The +9 V output is protected in the same manner by VR201.

Battery backup controller

The battery backup controller monitors the condition of the power supply and turns the battery gate on and off to allow or inhibit battery backup. The battery backup controller consists of the filter capacitor (C100, C101) level detector, ac input detector, missing pulse detector, and the unlatch delay timer.

Filter capacitor level detector

The filter capacitor level detector (U301A and associated components) monitors the unregulated voltage on the filter capacitors and compares it to the known voltage at which the series pass transistors saturate. When the filter capacitor voltage drops below the saturation voltage, the filter capacitor level detector latches this data and turns on the battery gate, thus backing up the ac input voltage with a +24 V dc input. The filter capacitor level detector can only be reset when the unlatch delay timer is high. During a low ac line voltage and a full load, the filter capacitor level detector may switch between ac power and battery power to ensure a complete backup capability under all operating conditions.

AC input detector

The ac input detector (U301B and associated components) compares the ac line voltage to a given reference. As long as the ac line level exceeds the reference level, a string of pulses is sent to the missing pulse detector and the filter capacitor level detector (as long as the unlatch delay timer is in the off state). The level at which the pulses disappear depends upon the load. With a full load, the pulses are present until the line voltage drops to approximately 104 V ac with a 120 V ac input, or 190 V ac with a 220 V ac input, or 208 V ac with a 240 V ac input.

Missing pulse detector

The missing pulse detector (U301C and associated components) is driven by a string of pulses from the ac input detector. As long as the pulses are present, the missing pulse detector remains reset. If one pulse in the string is missing (ac line failure), the missing pulse detector goes high and triggers the unlatch delay timer, thus inhibiting the unlatching of the batteries.

Unlatch delay timer

The unlatch delay timer (U301D and associated components) is used to provide a two-second delay in the return of the ac line voltage after a power failure. This allows the ac line voltage to stabilize upon return and also inhibits the clearing of the filter capacitor level detector when no ac pulses are present.

The unlatch delay timer is driven by the output of the missing pulse detector. During normal operation, the missing pulse detector is low and the unlatch delay timer is high. If the ac line voltage drops below 104 V ac, or 190 V ac, or 208 V ac, the missing pulse detector goes high and forces the unlatch delay timer to go low. This low inhibits any unlatching of the batteries which are about to be brought in the circuit. When the ac line voltage returns (after a power failure), the missing pulse detector returns to a low condition. When the unlatch delay timer senses this low, it waits two seconds before changing states (low to high) and allowing the batteries to become unlatched.

Battery gate

The battery gate consists of series pass transistors Q301, Q302, Q303, constant current drivers Q306, Q310, and all associated components. The series pass transistors are configured to provide the power dissipation capability to pass the required backup current. A high from the filter capacitor level detector provides the base drive to Q310 and, if VR302 is conducting, Q310 drives Q306. Transistor Q306, in turn, drives the series pass transistors. A constant current through R314 is used to create a dead battery disconnect. If the +24 V battery input voltage drops to the +16.8 V to +20 V range, VR302 fails to conduct and Q310 turns off. With Q310 off, the series pass transistors turn off. A current limiter network (R331, R332), shunted across the base-emitter junction of Q304, prevents the battery gate from passing more than 13 A.

Test procedure

Recommended test equipment

- Digital multimeter, Fluke Model 8000A, or equivalent.
- Variable transformer capable of providing 264 V ac and 3 A.
- Variable resistive loads capable of drawing power supply outputs of +15.8 V dc at 12 A and +9 V dc at 4.5 A.

AC power input operation

CAUTION

A power ON-OFF switch is not provided on any of the power supplies. The power supply is immediately operational when the power cord is plugged into a live ac outlet.

+15.8 V output checks

Output voltage

With the output at half load (3A load), and the ac line input at 120 V ac, or 220 V ac, or 240 V ac, the regulated output voltage should measure between +15.3 V and +16.3 V.

Current limiting

With an ac input voltage of 132 V ac, or 242 V ac, or 264 V ac, reduce the variable load resistance on the +15.8 V output until the current limit point is found. This current should fall within the 6A to 12A range.

Short circuit current

With an ac input voltage of 132 V ac, or 242 V ac, or 264 V ac, short the +15.8 V output and measure the resulting short circuit current. It should be 3A or less.

+9 V output checks

Output voltage

With the output at half load (0.75 A load), and the ac line input at 120 V ac, or 220 V ac, or 240 V ac, the regulated output voltage should measure between +8.7 V and +9.3 V.

Current limiting

With an ac input voltage of 132 V ac, or 242 V ac, or 264 V ac, reduce the variable load resistance on the +9 V output until the current limit point is found. This current should fall within the 1.5 A to 4.5 A range.

Short circuit current

With an ac input voltage of 132 V ac, or 242 V ac, or 264 V ac, short the +9 V output and measure the resulting short circuit current. It should be 1.5A or less.

Battery backup input operation

NOTE

When conditions warrant battery operation, no indication is given to the operator that the battery is switched into the circuit.

Battery backup switchover voltage

With the ac power input set at 120 V ac, or 220 V ac, or 240 V ac, connect proven +24 V batteries to the power supply and set the outputs of +15.8 V dc to 6A and +9 V dc to 1.5 A. Turn off the ac power and verify that the +15.8 V dc and +9 V dc outputs are still present.

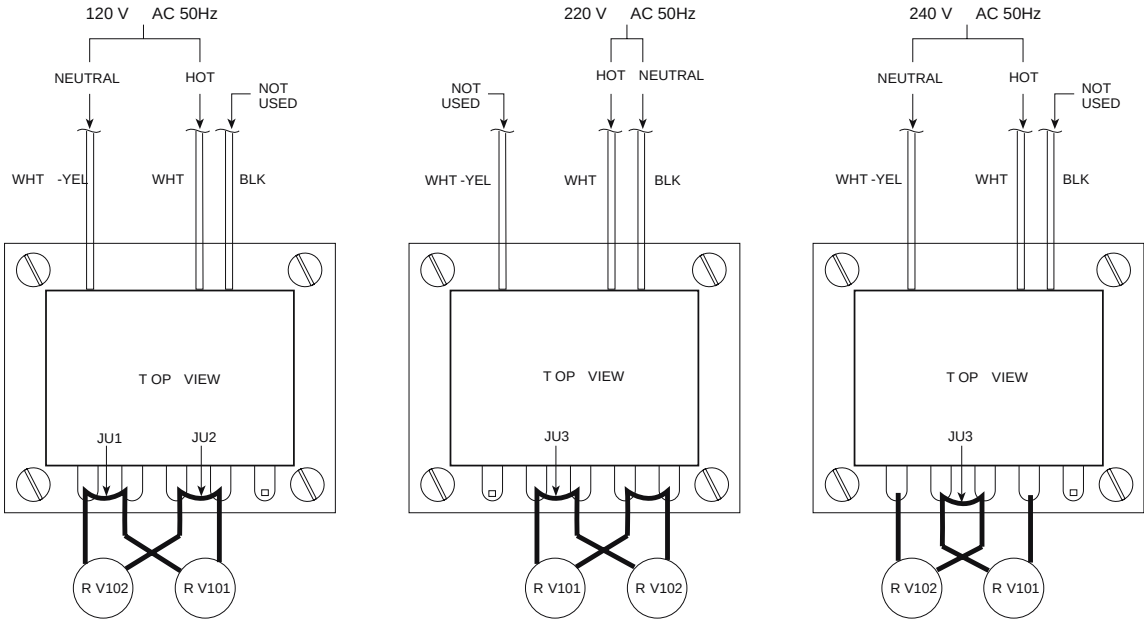
Unlatch voltage

Turn on the ac power of 120 V ac, or 220 V ac, or 240 V ac, and disconnect the +24 V batteries. Verify that the +15.8 V dc and +9 V dc outputs are still present.

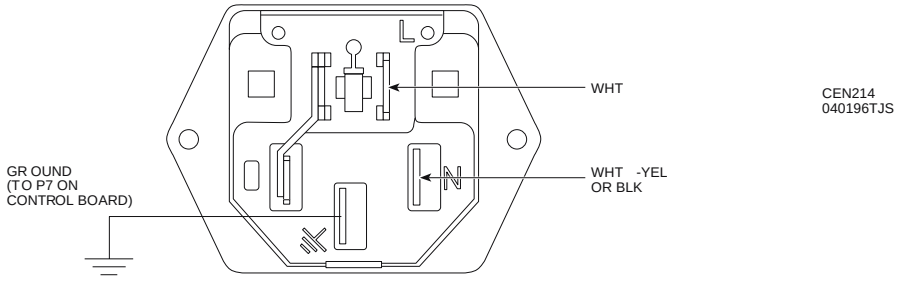
50 Hz ac input wiring

The 50 Hz power supplies allow modification for different ac input voltages other than that specified. Changes are performed on the primary side of the transformer; the secondary side requires no modifications. Figure 10-3 shows the wiring for the primary side of transformer T1. Wiring to the ac receptacle is shown in the AC Receptacle Detail of Figure 10-3. In all cases, the ac line voltage must be connected to the proper transformer windings and jumpers must be installed/removed on the varistors (RV101 and RV102). This ensures adequate protection from ac line voltage transients. For 220 V ac wiring, varistor RV102 is moved from the far left terminal to the far right terminal of the transformer. All connections/modifications must be properly secured and insulated for reliable operation.

50 Hz ac input wiring



NOTE: PRIMARY AC INPUT CONNECTIONS SHOWN. SECONDARY CONNECTIONS REQUIRE NO MODIFICATION AND ARE NOT SHOWN.



A C RECEPTACLE DETAIL (REAR VIEW)

Figure 10-3 ***AC Input Wiring Details***

BPN1022A-BPN1025A Overlay

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Common Parts List

Reference	Part Number	Description
NOTE:		THE ELECTRICAL COMPONENTS ARE COMMON TO ALL POWER SUPPLY MODULES. THE MECHANICA PARTS, TRANSFORMER, AND LINE FUSES ARE SLIGHTLY DIFFERENT FOR EACH MODEL. REFER TO THE HARDWARE PARTS LIST SECTION UNDER THE APPROPRIATE MODEL NUMBER FOR A LIST OF COMPONENTS UNIQUE TO EACH MODEL.
		capacitor, fixed:
C100,101	2383637R01	CAP ALU 15000 ±20% 35V
C102	2313748G14	CAP ELEC 22 uF 35V ±20%
C103	2111015D13	CAP CER DISC 1000 ±10% X5F 100V
C104	0811051A13	CAP MTLZ POLYEST .1 ±5% 63V
C106	2111014A42	CAP CER DISC 51 5 NPO 100V
C109	0811051A14	CAP MTLZ POLYEST .15 ±5% 63V
C110	2313748G25	CAP ELEC 333 uF 35V ±20%
C111	2111015D13	CAP CER DISC 1000 ±10% X5F 100V
C201,202	2111015D13	CAP CER DISC 1000 ±10% X5F 100V
C203	2313748G14	CAP ELEC 22 uF 35V ±20%
C204	2313748G25	CAP ELEC 333 uF 35V ±20%
C205	0811051A13	CAP MTLZ POLYEST .1 ±5% 63V
C206	2111014A42	CAP CER DISC 51 ±5% NPO 100V
C207	0811051A14	CAP MTLZ POLYEST .15 ±5% 63V
C301	2313748G14	CAP ELEC 22 uF 35V ±20%
C302	2111015D05	CAP CER DISC 220 ±10% X5F 100V
C303	0811051A13	CAP MTLZ POLYEST .1 ±5% 63V
C304	2313748G04	CAP ELEC 1.0 uF 50V ±20%
C305	0811051A14	CAP MTLZ POLYEST .15 ±5% 63V
C306	2111014A39	CAP CER DISC 39 ±5% NPO 100V
C307	2111015D05	CAP CER DISC 220 ±10% X5F 100V
C308	2111014A39	CAP CER DISC 39 ±5% NPO 100V
C309	2111015D05	CAP CER DISC 220 ±10% X5F 100V
C310	2111014A39	CAP CER DISC 39 ±5% NPO 100V
C311	2111015D05	CAP CER DISC 220 ±10% X5F 100V
C312	2111015D13	CAP CER DISC 1000 ±10 % X5F 100V
C313	2111014A39	CAP CER DISC 39 ±5% NPO 100V
C314	2111015D05	CAP CER DISC 220 ±10% X5F 100V
C315	2111015D13	CAP CER DISC 1000 ±10% X5F 100V
C316	2313748G04	CAP ELEC 1.0 uF 50V ±20%
C317	0811051A15	CAP MTLZ POLYEST .22 ±5% 63V
C318	0811051A16	CAP MTLZ POLYEST .33 ±5% 63V
C319	2313748G14	CAP ELEC 22 uF 35V ±20%
C320	2111015D05	CAP CER DISC 220 ±10% X5F 100V
C321	0811051A11	CAP MTLZ POLYEST .047 ±5% 63V
C322	0882095G06	CAP POLYEST .100 ±10% 200V
C401	2313748G06	CAP ELEC 4.7 uF 50V ±20%
C402	0811051A13	CAP MTLZ POLYEST .1 ±5% 63V
C403	2111015D05	CAP CER DISC 220 ±10% X5F 100V
		diode: (see note)
CR100	4884751H02	DIODE BRDG
CR102	4811034A01	DIODE 48C83654H01 A/I
CR103,104	4813833D08	DIODE GEN-PUR 1A 600V 1N4005RL (2 used)
CR201	4813833D08	DIODE GEN-PUR 1A 600V 1N4005RL (2 used)
CR203	4813833D08	DIODE GEN-PUR 1A 600V 1N4005RL (2 used)
CR204	4811034A01	DIODE 48C83654H01 A/I
CR301,302	4813833D08	DIODE GEN-PUR 1A 600V 1N4005RL (2 used)
CR303	4811034A01	DIODE 48C83654H01 A/I
CR304	4882592W01	DIODE SCHOTTKY BARRIER
CR305	4884350P01	RECT 35V MBR 1635_
CR306 thru 310	4800869698	TSTR NPN 69698 (5 used)
CR311	4813833D08	DIODE GEN-PUR 1A 600V 1N4005RL (2 used)
		fuse:
F2	2982906N01	TERM FUSE (2 used)
		connector:
J1 thru 5	2883636P01	PLUG CKT BD 3 PIN
J6	3183458P06	BLOCK TERM 2 POS
PO1 thru 7	2910231A10	TERM BRS ELTIN, I/O
PO10 thru 19	0283409R01	NUT HEX M3.5X0.66 STLTIN, XSTR
PO0 thru PO29	0983373H01	CONN, XSTR
		transistor: (see note)
Q101 thru 103	4800869698	TSTR NPN M9698
Q104	4800869807	TSTR PNP M9607
Q201,202	4800869807	TSTR PNP M9807
Q301	4800869807	TSTR PNP M9807
Q302	4800869807	TSTR PNP M9807
Q303,304	4813824D12	TSTR PNP 80V .5A MPSA56RLRP
Q306 thru 310	4813824D08	TSTR NPN 80V .5A MPSA06RLRP
		resistor, fixed:
R101 thru 103	1782291B45	RES WW 0.3Ω ±5 % 3W
R105	0611049G97	RES FMF 100Ω ±1 % 1/4W
R106	0611049C21	RES FMF 1870 Ω±1 % 1/4W
R107	0611009A01	RES FCF 10Ω ±5 % 1/4W
R108	0611049K37	RES FMF 29.4K Ω±1% 1/4W
R109	0611049C91	RES FMF 10KΩ ±1% 1/4W
R110	0611049J42	RES FMF 3090 Ω±1% 1/4W
R111	0611049C52	RES FMF 3920Ω ±1% 1/4W
R112	0611009A41	RES FCF 470Ω ±5% 1/4W
R113	0611009B23	RES JUMPER
R114	0611009A07	RES FCF 18Ω ±5 % 1/4W
R115	0611009B23	RES JUMPER
R116	0611009A01	RES FCF 10Ω ±5% 1/4W
R117	0611009A07	RES FCF 18Ω ±5% 1/4W
R201	1782291B45	RES WW 0.3Ω ±5% 3W
R202	0611009A21	RES FCF 68Ω ±5% 1/4W
R203	0611049B90	RES FMF 909Ω ±1% 1/4W
R204	0611049J98	RES FMF 11.8KΩ ±1 % 1/4W
R205	0611049D09	RES FMF 15KΩ ±1% 1/4W
R206	0611049C99	RES FMF 12.1K Ω±1% 1/4W
R207	0611049J42	RES FMF 3090Ω ±1% 1/4W
R208	0611049C52	RES FMF 3920Ω ±1% 1/4W
R209	0611009A41	RES FCF 470Ω ±5% 1/4W
R210	0611009A39	RES FCF 390 Ω±5% 1/4W
R211	0611009A01	RES FCF 10Ω ±5 % 1/4W
R301	0611009A33	RES FCF 220Ω ±5% 1/4W
R302	0611009A41	RES FCF 470Ω ±5% 1/4W
R303,304	0611009A01	RES FCF 10Ω ±5 % 1/4W
R305	0611009A83	RES FCF 27KΩ ±5% 1/4W
R306	0611009A59	RES FCF 2700Ω ±5 % 1/4W
R307	0611009A89	RES FCF 47KΩ ±5% 1/4W
R308	0611049D21	RES FMF 20KΩ ±1% 1/4W
R309	0611049C67	RES FMF 5620Ω ±1% 1/4W
R310	0611009A89	RES FCF 47KΩ ±5 % 1/4W
R311	0611009A53	RES FCF 1500Ω ±5% 1/4W
R312	0611009A49	RES FCF 1000Ω ±5 % 1/4W

R313	0611009A89	RES FCF 47KΩ ±5% 1/4W
R314	0611009A29	RES FCF 150Ω ±5% 1/4W
R315	0611009A01	RES FCF 10Ω ±5% 1/4W
R316	0611009A21	RES FCF 68Ω ±5% 1/4W
R317	0611040C94	RES FMF 10.7KΩ .5% 1/4W
R318	0611049C37	RES FMF 2740Ω ±1% 1/4W
R319	0611009B22	RES FCF 1MΩ ±5% 1/4W
R320	0611009A73	RES FCF 10KΩ ±5% 1/4W
R321	0611009A63	RES FCF 3900Ω ±5% 1/4W
R322	0611009A73	RES FCF 10KΩ ±5% 1/4W
R323	0611009A99	RES FCF 120KΩ ±5 % 1/4W
R324	0611009A71	RES FCF 8200Ω ±5% 1/4W
R325	0611009A79	RES FCF 18K Ω±5% 1/4W
R326	0611009A63	RES FCF 3900 Ω±5% 1/4W
R327	0611009A73	RES FCF 10KΩ ±5 % 1/4W
R328	0611009B22	RES FCF 1MΩ ±5% 1/4W
R329	0611009A97	RES FCF 100KΩ ±5% 1/4W
R330	0611009A73	RES FCF 10K Ω±5% 1/4W
R331,332	1782291B37	RES FWW .1Ω ±3% 3W
R333	0611049J42	RES FMF 3090Ω ±1% 1/4W
R334	0611049C52	RES FMF 3920 Ω±1% 1/4W
R335	0611009A77	RES FCF 15K Ω±5% 1/4W
R401	0611009A19	RES FCF 56Ω ±5% 1/4W
R404	1780234B04	RESISTOR SHUNT

current regulator: (see note)

RV101,102	0684357M02	VSTR MTL OX
SCR401	4884348P01	RECT SLCN MCR69-2_ MCR69-002_

integrated circuit: (see note)

U101	5183222M07	IC VLTG REGLTR __1723_
U201	5183222M07	IC VLTG REGLTR __1723_
U301	5113819D04	GEN PURPOSE 14 DIP MC3303P
U302	5113816J03	IC 12V POSITIVE REG,100MA

voltage regulator: (see note)

VR101	4882479V16	DIODE ZENER 16V
VR201	4882479V12	DIODE ZENER 12V
VR301	4882479V04	DIODE ZENER 5.6V
VR302	4882479V17	DIODE ZENER 17V

transistor socket:

XU104	0984459M02	RECP HDR 3 CONT
XU202	0984459M02	RECP HDR 3 CONT

NOTE: FOR OPTIMUM PERFORMANCE, DIODES, TRANSISTORS, AND INTEGRATED CIRCUITS MUST BE ORDERED BY MOTOROLA PART NUMBER.

Unique Parts List

Reference	Part Number	Description
		BPN1022A:
	0200007009	NUT 10-32X3/8X1/8 HEX STL CAD (4 used)
	0310907A18	SCRMCH M3X0.5X6 INTSTARPAN (7 used)
	0310907A20	SCRMCH M3X0.5X10 INTSTARPAN
	0310943J09	SCRTPG TT3X0.5X6 INTSTARPAN
	0310943J15	SCRTPG TT3.5X0.6X8 INTSTARPAN (2 used)
	0310943M62	SCRTPG TT3.5X0.6X13 INTSTARSLT (10 used)
	0312016A49	SCRTAP M3.5X0.6X8 STRPANZNCPHO (5 used)
	0383498N04	SCR TPG M4X0.7X7 SLTSTAR STL (4 used)
	0384482M02	SCR MCH 4-40X1/4 SLTBIN SST
	0400002627	WSHRLCK 6 LTSPT STL NKL (10 used)
	0400007650	WSHRLCK 6 INT STL CAD (2 used)
	0400007673	WSHRLCK 10 HVYSPT STL CAD (4 used)
	0484180C01	WASHER SHOULDER NYLON NAT (2 used)
	0783363R01	BRKT TSTR MTG ALU
	0783862R01	BRKT XFMR CRS SHADOW BLK
	0784234B01	BRKT HT SINK
	0983373H01	CONN (used with PO20)
	0983373H01	CONN (used with PO22)
	0983373H01	CONN (used with PO24)
	0983373H01	CONN (used with PO26)
	0983373H01	CONN (used with PO28)
	1483392R01	INS (5 used)
	1484664P04	INS HT SINK (5 used)
	1484664P05	INS HT SINK (2 used)
	1583559L01	COV TSTR (5 used)
	1584576N02	SHROUD FUSE TERM
T1	2583408R01	XFMR PWR 120/240 60 HZ
	2783280R01	CHASSIS PS ALU SHADOW BLK
	2883470R01	PLUG AC W/FUSEHOLDER 3 CONT
	2984709N03	TERM CRIMP INS BLU BRS TIN (2 used)
	3010286A23	18STIVRD
	3010563T40	WR 14STR PVC BLK
	3010563T42	WR 14STR PVC RED
	3082018X01	CBL 9" PS INPUT
	3082018X02	CBL 10" PS INPUT
	3082018X03	CBL 11" PS INPUT
	3083418R01	CBL W/RECP 16 COND
	3084200P01	CORD AC LINE W/CONN 3 COND
	3700122062	TBG TEF 20 NAT
	4383393R01	SPACER (used with PO20)
	4383393R01	SPACER (used with PO22)
	4383393R01	SPACER (used with PO24)
	4383393R01	SPACER (used with PO26)
	4383393R01	SPACER (used with PO28)
	5482928P12	LABEL AC POWER
	5484120T01	LABEL UTILITY
F2	6500139767	FUSE AUTO BLADE TYPE10AMP 32V
F1	6582847N23	FUSE GLS CRTG 5AMP 250V

Reference	Part Number	Description
		BPN1023A:
	0200007009	NUT 10-32X3/8X1/8 HEX STL CAD (4 used)
	0210971A16	NUTMCH M3X0.5 HEX STLCAD (2 used)
	0210971A17	NUTMCH M4X0.7 HEX STLCAD (3 used)
	0310907A18	SCRMCH M3X0.5X6 INTSTARPAN (7 used)
	0310907A20	SCRMCH M3X0.5X10 INTSTARPAN (3 used)
	0310907A27	SCRMCH M3.5X0.6X8 INTSTARPAN (2 used)
	0310943J09	SCRTPG TT3X0.5X6 INTSTARPAN
	0310943M62	SCRTPG TT3.5X0.6X13 INTSTARSLT (10 used)
	0312016A49	SCRTAP M3.5X0.6X8 STRPANZNCPHO (3 used)
	0383498N04	SCR TPG M4X0.7X7 SLTSTAR STL (4 used)
	0384482M02	SCR MCH 4-40X1/4 SLTBIN SST
	0400002627	WSHRLCK 6 LTSPT STL NKL (10 used)
	0400007650	WSHRLCK 6 INT STL CAD (2 used)
	0400007671	WSHRLCK 8 MEDSPT STL CAD (3 used)
	0400007673	WSHRLCK 10 HVYSPT STL CAD (4 used)
	0400009795	WSHRLCK 6 MEDSPT SST PAS (2 used)
	0484180C01	WASHER SHOULDER NYLON NAT (2 used)
	0783363R02	BRKT TSTR MTG ALU
	0784048R01	BRKT MTG XFMR (2 used)
	0784234B01	BRKT HT SINK
	0983373H01	CONN (used with PO20)
	0983373H01	CONN (used with PO22)
	0983373H01	CONN (used with PO24)
	0983373H01	CONN (used with PO26)
	0983373H01	CONN (used with PO28)
	1483392R01	INS (5 used)
	1484164R01	INSULATOR TRANSFORMER MYLAR
	1484664P04	INS HT SINK (5 used)
	1484664P05	INS HT SINK (2 used)
	1584576N02	SHROUD FUSE TERM
	2200400055	STPL 1/4LEG X 1/2 STL PLN
T1	2584024R01	XFMR PWR 120/220/240V 50 HZ
	2783280R02	CHASSIS PS ALU SHADOW BLK
	2883470R01	PLUG AC W/FUSEHOLDER 3 CONT
	2900859665	LUG BLU (2 used)
	2984709N03	TERM CRIMP INS BLU BRS TIN (2 used)
	3010286A23	18STIVRD
	3010563P89	WR 16STR PVC GRNYEL
	3010563T40	WR 14STR PVC BLK
	3010563T42	WR 14STR PVC RED
	3082933N05	LINE CORD W/PLUG & RECP
	3083418R01	CBL W/RECP 16 COND
	3700122062	TBG TEF 20 NAT
	3700134371	TBG HS POLYOL 3/8 BLK
	4210217A02	STRAP TIE .091X3.62 NYL WHT (13 used)

	4383393R01	SPACER (used with PO20)
	4383393R01	SPACER (used with PO22)
	4383393R01	SPACER (used with PO24)
	4383393R01	SPACER (used with PO26)
	4383393R01	SPACER (used with PO28)
	5482006W01	LABEL PCB BARCODE (2 used)
	5482006W02	RIBBON THERMAL XFER (2 used)
	5482928P10	LABEL AC POWER
	5484142R01	LABEL GROUND
	5484497M29	LBL ADH1/2X11/32 BK YL (1) (2 used)
	6500139767	FUSE AUTO BLADE TYPE10AMP 32V
	6582847N23	FUSE GLS CRTG 5AMP 250V

BPN1024A:

	0200007009	NUT 10-32X3/8X1/8 HEX STL CAD (4 used)
	0310907A18	SCRMCH M3X0.5X6 INTSTARPAN (7 used)
	0310907A20	SCRMCH M3X0.5X10 INTSTARPAN
	0310943J09	SCRTPG TT3X0.5X6 INTSTARPAN
	0310943J15	SCRTPG TT3.5X0.6X8 INTSTARPAN (2 used)
	0310943M62	SCRTPG TT3.5X0.6X13 INTSTARSLT (10 used)
	0312016A49	SCRTAP M3.5X0.6X8 STRPANZNCPHO (5 used)
	0383498N04	SCR TPG M4X0.7X7 SLTSTAR STL (4 used)
	0384482M02	SCR MCH 4-40X1/4 SLTBIN SST
	0400002627	WSHRLCK 6 LTSPT STL NKL (10 used)
	0400007650	WSHRLCK 6 INT STL CAD (2 used)
	0400007673	WSHRLCK 10 HVYSPT STL CAD (4 used)
	0484180C01	WASHER SHOULDER NYLON NAT (2 used)
	0783363R01	BRKT TSTR MTG ALU
	0783862R01	BRKT XFMR CRS SHADOW BLK
	0784234B01	BRKT HT SINK
	0983373H01	CONN (used with PO20)
	0983373H01	CONN (used with PO22)
	0983373H01	CONN (used with PO24)
	0983373H01	CONN (used with PO26)
	0983373H01	CONN (used with PO28)
	1483392R01	INS (5 used)
	1484664P04	INS HT SINK (5 used)
	1484664P05	INS HT SINK (2 used)
	1584576N02	SHROUD FUSE TERM
T1	2583408R01	XFMR PWR 120/240 60 HZ
	2783280R01	CHASSIS PS ALU SHADOW BLK
	2883470R01	PLUG AC W/FUSEHOLDER 3 CONT
	2984709N03	TERM CRIMP INS BLU BRS TIN (2 used)
	3010286A23	18STIVRD (1.38 used)
	3010563T40	WR 14STR PVC BLK (7.5 used)
	3010563T42	WR 14STR PVC RED (6.5 used)
	3082018X01	CBL 9” PS INPUT
	3082018X02	CBL 10” PS INPUT
	3082018X03	CBL 11” PS INPUT
	3083418R01	CBL W/RECP 16 COND
	3084200P01	CORD AC LINE W/CONN 3 COND
	3700122062	TBG TEF 20 NAT (1.12 used)
	4383393R01	SPACER (used with PO20)
	4383393R01	SPACER (used with PO22)
	4383393R01	SPACER (used with PO24)
	4383393R01	SPACER (used with PO26)
	4383393R01	SPACER (used with PO28)
	5482928P11	LABEL AC POWER
F2	6500139767	FUSE AUTO BLADE TYPE10AMP 32V
F1	6582847N24	FUSE GLS CRTG 3.15 AMP 250V

BPN1025:

	0200007009	NUT 10-32X3/8X1/8 HEX STL CAD (4 used)
	0210971A16	NUTMCH M3X0.5 HEX STLCAD (2 used)
	0210971A17	NUTMCH M4X0.7 HEX STLCAD (3 used)
	0310907A18	SCRMCH M3X0.5X6 INTSTARPAN (7 used)
	0310907A20	SCRMCH M3X0.5X10 INTSTARPAN (3 used)
	0310907A27	SCRMCH M3.5X0.6X8 INTSTARPAN (2 used)
	0310943J09	SCRTPG TT3X0.5X6 INTSTARPAN
	0310943M62	SCRTPG TT3.5X0.6X13 INTSTARSLT (10 used)
	0312016A49	SCRTAP M3.5X0.6X8 STRPANZNCPHO (3 used)
	0383498N04	SCR TPG M4X0.7X7 SLTSTAR STL (4 used)
	0384482M02	SCR MCH 4-40X1/4 SLTBIN SST
	0400002627	WSHRLCK 6 LTSPT STL NKL (10 used)
	0400007650	WSHRLCK 6 INT STL CAD (2 used)

	0400007671	WSHRLCK 8 MEDSPT STL CAD (3 used)
	0400007673	WSHRLCK 10 HVYSPT STL CAD (4 used)
	0400009795	WSHRLCK 6 MEDSPT SST PAS (2 used)
	0484180C01	WASHER SHOULDER NYLON NAT (2 used)
	0783363R02	BRKT TSTR MTG ALU
	0784048R01	BRKT MTG XFMR (2 used)
	0784234B01	BRKT HT SINK
	0983373H01	CONN (used with PO20)
	0983373H01	CONN (used with PO22)
	0983373H01	CONN (used with PO24)
	0983373H01	CONN (used with PO26)
	0983373H01	CONN (used with PO28)
	1483392R01	INS (5 used)
	1484164R01	INSULATOR TRANSFORMER MYLAR
	1484664P04	INS HT SINK (5 used)
	1484664P05	INS HT SINK (2 used)
	1583559L01	COV TSTR (4 used)
	1584576N02	SHROUD FUSE TERM
	2200400055	STPL 1/4LEG X 1/2 STL PLN
T1	2584024R01	XFMR PWR 120/220/240V 50 HZ
	2783280R02	CHASSIS PS ALU SHADOW BLK
	2883470R01	PLUG AC W/FUSEHOLDER 3 CONT
	2900859665	LUG BLU (2 used)
	2984709N03	TERM CRIMP INS BLU BRS TIN (2 used)
	3010286A23	18STIVRD (1.38 used)
	3010563P89	WR 16STR PVC GRNYEL
	3010563T40	WR 14STR PVC BLK
	3010563T42	WR 14STR PVC RED
	3082933N05	LINE CORD W/PLUG & RECP
	3083418R01	CBL W/RECP 16 COND
	3700122062	TBG TEF 20 NAT
	3700134371	TBG HS POLYOL 3/8 BLK
	4210217A02	STRAP TIE .091X3.62 NYL WHT (13 used)
	4383393R01	SPACER (used with PO20)
	4383393R01	SPACER (used with PO22)
	4383393R01	SPACER (used with PO24)
	4383393R01	SPACER (used with PO26)
	4383393R01	SPACER (used with PO28)
	5482928P09	LABEL AC PWR
	5484120T01	LABEL UTILITY
	5484142R01	LABEL GROUND
F2	6500139767	FUSE AUTO BLADE TYPE10AMP 32V
F1	6582847N24	FUSE GLS CRTG 3.15 AMP 250V

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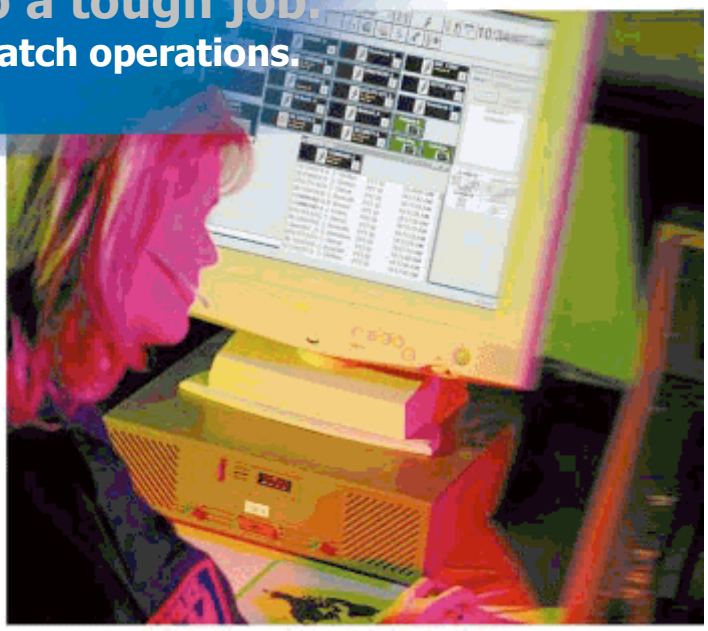
Simplify your radio dispatch operations.



CENTRACOM Gold Series™
Console Interface Electronics
Maintenance Manual

68P81095E45-A

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Instruction Manual Revision

GENERAL

This revision outlines changes that have occurred since the printing of your instruction manual. Use this information to correct your manual.

MANUAL AFFECTED

68P81095E45-A CENTRACOM Gold Series™ Console Interface Electronics Maintenance Manual

REVISION DETAILS

Additional Chapter added to the manual

Chapter 10, 9/15 Volt Dual Operator Power Supply

The CENTRACOM Gold Series™ Classic Buttons and LEDs Manual (68P81095E35) has been discontinued, but Chapter 18 contains information on a power supply that is still relevant. This chapter is now moved to become Chapter 10 in the CENTRACOM Gold Series™ CIE Maintenance Manual (68P81095E45), and includes a parts list and drawing overlay. Also find enclosed the adjusted table of contents for the CIE manual. The power supply referred to is used when Elite Operator Positions (OPs) are installed in furniture.

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MOTOROLA

Contents

Foreword

Scope

This manual is intended for use by experienced technicians familiar with similar types of equipment. It contains all service information required for the equipment described and is current as of the printing date.

Model and kit identification

Motorola equipments are identified by an overall model number on the nameplate. In most cases, assemblies and kits which make up the equipment also have kit model numbers stamped on them. When a production or engineering change is incorporated, the applicable schematic diagrams are updated.

Service information

Motorola's National Service Organization offers one of the finest nation-wide installation and maintenance programs available to communication equipment users. This organization includes approximately 900 authorized Motorola Service Stations (MSS) located throughout the United States, each manned by one or more trained, FCC-licensed technicians.

The MSSs are independently owned and operated and were selected by Motorola to service its customers. Motorola maintenance is available on either a time and materials basis, or on a periodic fixed-fee arrangement.

The administrative staff of the service organization consists of national, area and district service managers and district representatives, all of whom are Motorola employees with the objective to improve the service to our customers.

If you wish to purchase a service contract for your Motorola equipment, contact your Motorola Service Representative, or write to:

National Service Manager
Motorola Communications and Electronics, Inc.
1303 E. Algonquin Road
Schaumburg, Illinois 60196

Replacement parts ordering

United States (except U.S. Federal Government)
Canada (except Quebec)

Hours: 7:00 am - 7:00 pm CST/CDT

Motorola
Americas Parts Division
Attn.: Order Processing
1313 East Algonquin Road
Schaumburg, IL 60196

Tel: 1-800-422-4210
Telex: 280127
Fax: 847-538-8198

United States Federal Government

Hours: 8:30 am - 5:00 pm EST

Motorola
U.S. Federal Government Markets Division
7230 Parkway Drive
Hanover, MD 21076

Telephone: 1-800-826-1913
Fax: 410-712-4991

Canada (Quebec only)

Hours: 8:30 am - 4:30 pm EST

Motorola Canada Limited
8301 Transcanada Highway
St. Laurent, Quebec H4S 1Z1

Tel: 1-800-361-1319
Fax: 514-333-2197

Caribbean

Hours: 8:00 am - 4:30 pm CST/CDT

Telephone: 847-538-8024
Fax: 847-576-3023

Central America

Hours: 8:00 am - 4:30 pm CST/CDT

Telephone: 847-538-8038
Fax: 847-576-3023

Mexico

Hours: 8:30 am - 5:00 pm CST

Motorola De Mexico, S.A.
Huatabampo No. 50 Colonia Roma
Mexico, D.F. 06700

Telephone: 5-574-1543
Fax: 5-584-6843

South America

Hours: 8:00 am - 4:30 pm CST/CDT

Tel: 847-538-8024
Fax: 847-576-3023

All Other Locations Outside the United States

Hours: 8:00 am - 4:30 pm CST/CDT

Motorola
Americas Parts Division
Attn.: International Order Processing
1313 East Algonquin Road
Schaumburg, IL 60196 U.S.A.

Tel: 847-538-8023
Telex: 403305 MOTO PART SHBU UD
Fax: 847-576-3023
TWX: 910-693-0869

Emergency orders

Emergency orders can be placed any time of day or night, including weekends. This special service, called S.O.S., is provided for customers who are repairing equipment destroyed in natural disasters and other hardship cases. All items ordered through our S.O.S. line will be shipped via FEDEX Priority 1 or via air freight priority service.

During business hours, call 1-800-422-4210.

After hours, call 1-800-925-4357.

NOTE

No S.O.S. weekend service is available to customers outside the United States.

Electronic order entry

Partsnet® is a system for inquiry or order processing, using your personal computer. This no-charge option is available seven days a week, 24 hours a day, and includes our Same Day Ship delivery capabilities.

For additional information, please contact our Partsnet® administrator at 847-538-8098 between 8:00 am and 5:00 pm CST. In the United States, call 1-800-422-4210.

Ordering instructions

Mail, fax, and telex orders should include the following:

1. Signed original purchase order with number
2. Motorola 10-digit customer number, “bill to” and “ship to” tags (if applicable)
3. Complete sold to address
4. Complete ship to address
5. Shipping terms/instructions
6. Terms of payment (if applicable)
7. Quantities and correct units of measure
8. Motorola part number (frequency or code required for crystals)
9. Partial or complete shipment specified (shipped partial unless complete requested). Crystal orders are shipped complete.
10. Credit card orders should include card number and expiration date, not applicable to orders outside the United States.
11. Orders from outside the United States must also include the following:
    - Proper documentation, (for example, Letter of Credit, Import Permit)
    - Type of packing desired (export or domestic)
    - Country of ultimate destination

Same day shipping

In the United States, you can place orders until 4:00 pm CST/CDT and Motorola will ship available items the same day.

General safety information

! WARNING !

The following warnings are used within this manual. These warnings are not restricted to maintenance/ installation personnel and should be recognized by operators and all other users of this equipment.

! WARNING !

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case, the user will be required to correct the interference at his own expense.

! WARNING !

High voltages can be present inside the unit with or without the ac input cord connected.

Motorola limited hardware warranty

This warranty for CENTRACOM Gold Series products is provided in lieu of the Commercial Warranty (Standard) for certain Motorola manufactured products, as set forth at Section A, Page 1B of the Motorola product price book. This warranty is extended by Motorola, Inc., 1301 E. Algonquin Road, Schaumburg, Illinois 60196 to the original end user purchaser when purchasing for commercial, agricultural or governmental use. This warranty is not assignable or transferable to any other party and applies only within the 50 United States.

This plan extends the coverage of the Commercial Warranty (Standard) from one year parts and 120 days labor to one year parts and one year labor for CENTRACOM Gold Series products, with the first 120 days labor to be provided on-site, and labor for the remainder of the year to be provided at the designated depot service center. **ALL REFERENCES TO THE WARRANTY PERIOD BEGIN AT TIME OF ORIGINAL SHIPMENT.**

I. GENERAL PROVISIONS

This warranty sets forth the full extent of MOTOROLA'S responsibilities regarding the Product. Repair, replacement, or refund of the purchase price, at MOTOROLA'S option, is the exclusive remedy. THIS WARRANTY IS GIVEN IN LIEU OF ALL OTHER WARRANTIES EXPRESS OR IMPLIED WHICH ARE SPECIFICALLY EXCLUDED, INCLUDING WITHOUT LIMITATION THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL MOTOROLA BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES TO THE FULL EXTENT SUCH MAY BE DISCLAIMED BY LAW.

II. WHAT THIS WARRANTY COVERS

Parts:

All CENTRACOM Gold Series product parts are warranted to be free from defects in material and workmanship for a period of ONE (1) YEAR from the date of shipment. Motorola will furnish free of charge parts that Motorola finds defective within the full warranty period.

Labor:

Labor to repair or replace defective parts within the original shipped products will be provided for one (1) year from the date of purchase. Motorola will pay for on-site labor to repair or replace any defective parts for one hundred twenty (120) days from the date of shipment. For the remainder of the one (1) year period from the date of shipment, defective parts must be returned for depot repair.

THIS PLAN DOES NOT COVER defects, malfunctions, performance failures or damages to the parts resulting from:

A) Use in other than its normal and customary manner

B) Misuse, vandalism, accident or neglect; or

C) Improper disassembly, testing, operation, maintenance, installation, modification, adjustment, alteration, or repair.

HOW TO RECEIVE DEPOT WARRANTY SERVICE

All CENTRACOM Gold Series parts covered by the Warranty for CENTRACOM Gold Series Products that require depot service must be sent or taken to the following depot:

Motorola System Support Center
1311 East Algonquin Road
Schaumburg, IL 60196
Phone: 1-800-448-3245

Motorola limited software warranty

For the first one hundred twenty (120) days following its initial shipment, Motorola warrants that, when properly used, its software will be free from reproducible defects that cause a material variance from its published specification. However, Motorola does not warrant that program operation will be uninterrupted or error-free, that each defect will be corrected, or that any program will meet Licensee's particular requirements.

Motorola's total liability and Licensee's sole remedy for any warranted software shall be limited to, at Motorola's option, software replacement or the payment of Licensee's actual damages, not to exceed the total licensed charge paid by Licensee to Motorola for the item of software that caused the damage.

IN NO EVENT SHALL MOTOROLA BE LIABLE FOR SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES (INCLUDING WITHOUT LIMITATION LOSS OF USE, TIME OR DATA, INCONVENIENCE, COMMERCIAL LOSS, LOST PROFITS OR SAVINGS) TO THE FULL EXTENT SUCH MAY BE DISCLAIMED BY LAW EVEN IF MOTOROLA HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES OR FOR ANY CLAIM AGAINST LICENSEE BY ANY OTHER PARTY.

This warranty extends only to the first licensee; subsequent transferees accept these programs "as is" and without warranties of any kind. **THIS WARRANTY IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.**

The classification of defects in Motorola supplied software shall be the responsibility of Motorola. Remedy of defects is at the sole discretion of Motorola. If Motorola agrees to remedy a software defect, the new software will be warranted until the end of the original warranty period.

Replacement of any software defect shall constitute Motorola supplying the customer with the appropriate software media and authorization key. Field installation and configuration are not included.

All warranty service will be performed at service locations designated by Motorola. Travel and associated expenses of the Licensee or such expenses incurred by Motorola for visits to Licensee's location by Motorola personnel are not covered by this warranty. This warranty does not cover an item of Software (i) used in other than its normal and customary manner; (ii) subjected to misuse; (iii) subjected to modifications by Licensee or by any party other than Motorola without the prior written consent of Motorola.

For the first 120 days following its initial shipment, Motorola warrants that the media carrying the software will be free from defects which damage the performance of the software. Motorola will replace any damaged media free of charge during the warranty period. Warranted media is limited to that which is used to transport the software (e.g. floppy disks and authorization key). PROMs which may store the software in equipment are covered in the hardware warranty.

Field software updates/upgrades and new enhancement option software will be warranted for one hundred twenty (120) days from the date of initial shipment.

All special software (“SP”) provided to customers by Motorola will be warranted as set forth herein.

Maintenance philosophy

The maintenance philosophy for this equipment is to have field technicians perform system troubleshooting to isolate a defective module or assembly. The defective module or assembly should then be returned to Motorola for repair or replacement. Motorola offers a service contract through the National Service Organization, whereby the Motorola System Support Center (SSC) in Schaumburg, IL will provide a kit and module level repair and replacement service. The Motorola System Support Center has the capability of repairing individual modules in the system and providing replacement modules during emergency system failures within the period stated in the service contract agreement.

Motorola System Support Center

If a particular system is covered by a contract with the Motorola System Support Center for the module replacement/repair program, the defective module(s) along with space PROMs (if available) should be mailed to the Motorola System Support Center.

Call the Motorola System Support Center at (800) 448-3245 to request a return authorization (RA) number. Be prepared to provide a model or serial number, shipping address, your name and number, your company's name and number, billing address, preferred shipper, proof of warranty (if covered under warranty) and valid P.O. (if not covered under contract or warranty).

Write the RA# on the shipping documents. Ship the defective item (freight prepaid) to:

Motorola System Support Center
1311 East Algonquin Road
Schaumburg, IL 60196
RA#_____

An invoice will be issued after shipment of the repaired unit for non-maintenance items that are performed on a flat rate basis. Repair charges for units in warranty will be in accordance with the standard Motorola Commercial Warranty.

Technical phone support

Technical Phone Support is available 7 days a week, 24 hours a day. Motorola System Support Center's staff will work with your local service organization to handle questions related to equipment supported by the System Support Center. Technical Support's System Technologies have had the training and experience necessary to answer most questions regarding communications systems. The SSC Systems Technologist may dial into a system to more clearly define a problem and determine the area of failure in order to decide on the most suitable action plan. However, if the problem is beyond the scope of SSC's staff, then they will contact key personnel who are involved with the design, development, and manufacture of your communication products.

Call the Motorola System Support Center at (800) 448-3245 to request technical assistance. For international customers where 800 access is not available, call (847) 576-7300. Be prepared to give your name and number, a description of the problem, remote dial-up numbers (if applicable), system ID, and proof of coverage under warranty, maintenance agreement, or valid P.O. number for flat rate charge.

MOTOROLA

1

Description

About this chapter

Section	Page	Description
Introduction	1-2	Provides an overview of the CIE.
CEB interface	1-3	Describes the interaction between the CIE and the CEB.
Classic CRT and Elite color monitor	1-4	Discusses the Classic CRT and Elite monitor available for use with the CIE.

Introduction

The CENTRACOM Gold Series™ Classic CRT and Elite operator positions consist of a Pentium-based personal computer and a Console Interface Electronics (CIE) unit, which allows the operator to control and operate a console communication system. The CIE unit connects the PC to the Central Electronics Bank (CEB). The operator does not need to manually start up or load disk information into the computer prior to operation from a cold start. Desktop or furniture-mounted consoles are available. Figure 1-1 is a block diagram of a classic CRT or Elite operator position. Figure 1-2 shows a front panel view of the CIE. Classic CRT and Elite operator positions using the CIE may be intermixed with other Classic Buttons and LEDs operator positions on the same CEB system.

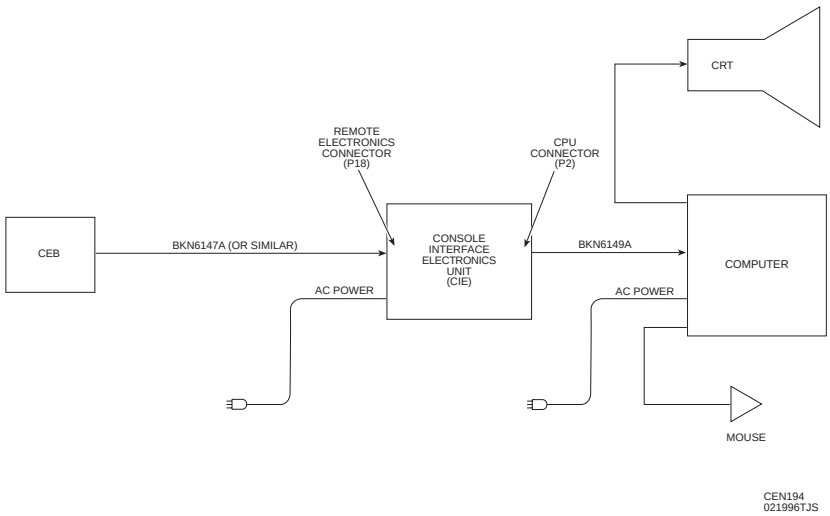

Figure 1-1 ***Block Diagram of a Classic CRT or Elite Operator Position***

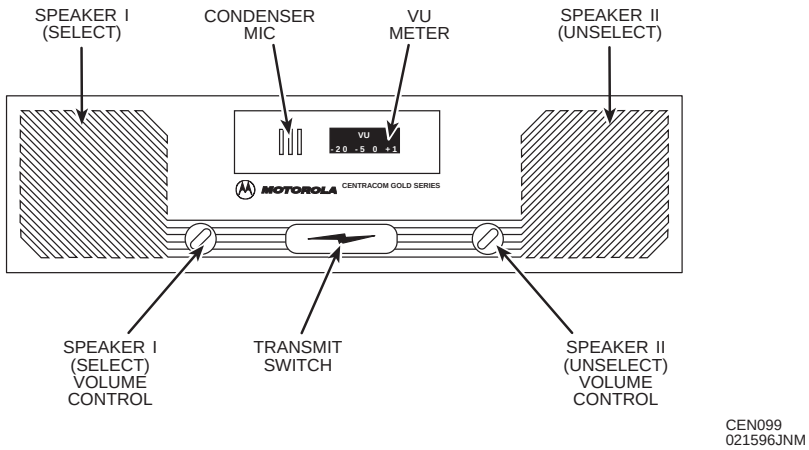

Figure 1-2 ***CIE Front Panel View***

CEB interface

The Classic CRT or Elite console interfaces to the Console Operator Interface Module (COIM) in the CEB via the CIE. Figure 1-3 shows the interconnections between the various components of the CIE.

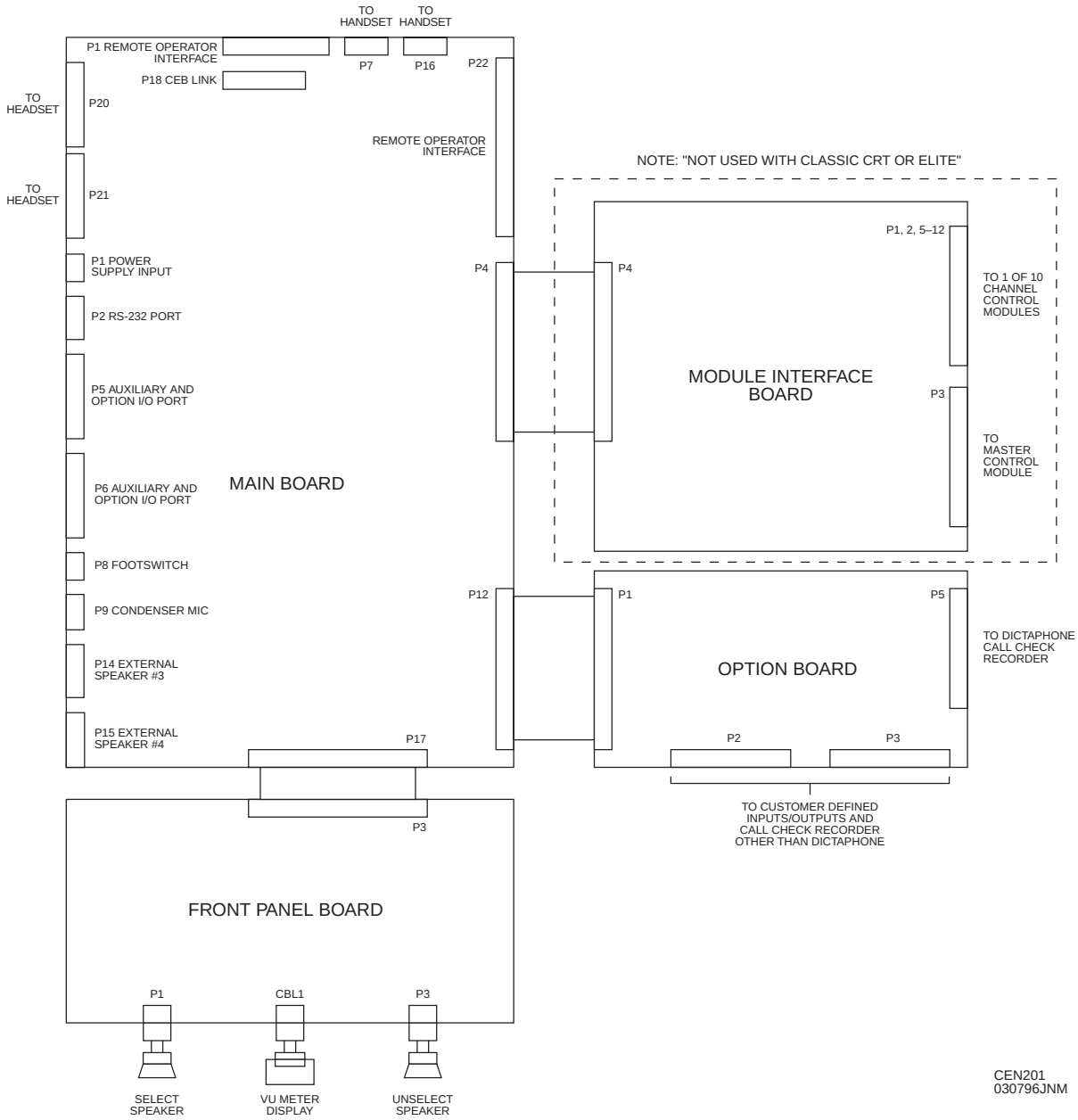

Figure 1-3 ***CIE Internal Connections***

Classic CRT and Elite color monitor

The Classic CRT and Elite consoles use a 17-inch diagonal screen, high resolution color monitor. The Classic CRT and Elite console may be operated by using a 3-button mechanical mouse, touchscreen, trackball, or keyboard.

MOTOROLA

2

Main Board

About this chapter

Section	Page	Description
Introduction	2-2	Provides an overview of the CIE main printed circuit board.
Theory	2-3	Describes the operation of the Main Board circuits.
BLN1228A Parts List	2-25	Contains Main Board parts list.

Models covered

The following models of the Main Board are covered in this chapter:

Model	Description
BLN1228A	Main Board

Introduction

The BLN1228A Main Board contains the central controlling circuitry for the CENTRACOM Gold Series CRT CIE unit. The board provides the interface between the Central Electronics Bank (CEB) and the PC used in the CRT console. The main board resides in the CIE, where it connects to Front Panel Board BGN6029A and various optional devices.

The BLN1228A Main Board kit consists of the Main Board BLN7072A and the Main Board PROM BVN6052A.

The microprocessor controls the main board logic and audio routing circuitry, the serial communication between the PC and the CEB, the Auxiliary I/Os, and (optionally) the channel control modules via the module interface (MINT) board. The board's audio processing circuitry provides console audio to speakers, recorders, and other external devices.

Theory

(Refer to page 2-17.)

NOTE

Active-low signals are indicated either by a bar across the top of a logic name, or by an asterisk (*) after a logic name.

The main board is composed of the following circuitry blocks:

- ❒ Microprocessor and data communications
- ❒ Memory and peripherals
- ❒ MCM and CCM control
- ❒ Auxiliary inputs/outputs
- ❒ Audio processing
- ❒ Voltage regulation

Microprocessor and data communications

General

See Table 2-1 for the main board jumper settings. The main board controls the following microprocessor and data functions:

- ❒ Data communications between the COIM in the CEB and the PC via the RS-232-C port
- ❒ Control of the auxiliary inputs and outputs

The microprocessor is a Motorola 68HC11 operated in the expanded multiplexed mode, meaning that the operating program is contained in an external 32K x 8 EPROM (U3). Additionally, RAM U4 provides 32K bytes of memory.

Communications with the CEB is provided by the serial communications interface (SCI1).

Table 2-1 ***Main Board Jumper Settings***

Jumper	Position	Description
JU4	IN	Customer Gain Resistor
JU7	IN	Handset 2 PTT Enable
JU9	IN	Mic Audio to Logging Recorder
JU10	A	Select Audio to Logging Recorder Mute
JU12	IN	Call Check Load Resistor

Table 2-1 ***Main Board Jumper Settings (continued)***

Jumper	Position	Description
JU16	A	Main Mic Level
JU17	IN	Logging Recorder Load Resistor
JU18	A	Select Speaker Volume Range
JU19	IN	Trunking Tones to Select Speaker
JU20	OUT	Trunking Tones to Unselect Speaker
JU21	A	Unselect Speaker Volume Range
JU22	A	Mute Unselect Speaker During PTT
JU24	IN	Handset 1 PTT Enable
JU25	A	Mute Select Speaker During PTT
JU29	B	Switch Data Source Selector
JU30	A	AUX I/O Enable Source Selector
JU31	OUT	Telephone Receive Pot Delinearization
JU32	B	Mode of Operation (CRT/Compact)
JU33	OUT	Boot Mode Select
JU34	IN	Boot Mode Select
JU35	B	Watchdog Disable
JU36	B	Internal Read Visibility
JU37	OUT	CTS<->DTR Loopback for PC Link
JU38	IN	CTS<->DTR Loopback for SCI3
JU40	B	**$\overline{\text{Sel\_Mute}}$** Configuration
JU41	B	**$\overline{\text{AUX\_OH}}$** Configuration
JU42	B	Telephone Receive Input Impedance
JU43	B	Telephone Receive Audio Source
JU44	B	Telephone Receive Audio Source

Serial communication with the CEB

The CEB communicates to the console through a four-wire, full-duplex serial data link. The baud rate of this link is typically 9600, although other baud rates are available. The baud rates are controlled by setting switch S2. See Table 2-2 for setting information. Since a less than optimal response time is realized when using a baud rate less than 9600 baud, it is recommended that 9600 be used for most applications. The slower speeds are provided for use with long distance data links using modems.

LED data, console switch and potentiometer status of the MCM and CCMs are communicated with the CEB via the serial link. This data is transferred serially between the main board Serial Communication Interface (SCI1) and the COIM via P1. The main board responds to changes of state of the console potentiometers and switches by sending a data packet to the COIM. **CONSOLE SOURCE DATA** sent from the serial peripheral (SPI) is level shifted via U16 and inverted by U17. It is then input to bus driver hybrid Z2 to drive the data differentially out P1-1 & 2. The COIM sends change of state information to the console concerning the display and LEDS. This COIM source data is received differentially on P1-3 & 4. The signal is clamped and input to a comparator, which provides single-ended 5V data to the SPI port of the microprocessor. The links are designed to drive differentially and to have some hysteresis to provide additional noise immunity.

Table 2-2 ***Main Board Switch Settings***

Switch S2 or S3 settings	Link speed	Switch S4 settings	AGC sensitivity	Switch S5 or S6 settings	Volume level
1 closed	2400 baud	1 closed	-35 dBm	1 closed	Full Volume
2 closed	4800 baud	2 closed	-29 dBm	2 closed	-6dB
3 closed	9600 baud	3 closed	-23 dBm	3 closed	-12dB
4 closed	19200 baud	4 closed	-17 dBm	4 closed	-18dB
All closed	38400 baud	None closed	-11 dBm	None closed	-24dB

Serial communication with the PC

Communication with the PC is accomplished via the RS-232 Driver/Receiver U9. The baud rate of the serial data can be set using the switch S3. See Table 2-2 for details. For normal conditions the baud rate is set to 9600. Data is sent to the PC from P2-5. Data received from the PC comes in on P2-3. **Clear To Send** (CTS) comes in on P2-2, and **Data Terminal Ready** (DTR) is asserted on P2-4. The microprocessor does not send or receive data until the CTS goes high. In the Compact operating mode, the microprocessor does not respond to any activity on the serial port.

Power-on and reset

A power-on reset occurs when a positive transition is detected on V_{dd}. The power-on reset (POR) is used strictly to detect power turn-on conditions. At the completion of the POR or the rising edge of reset, whichever comes last, the microprocessor reads the MODA/ MODB pins in order to determine in what mode the microprocessor should operate. In addition, the start-up conditions for the other ports are set.

The **RESET** line goes low when the microprocessor asserts reset, or when the RESET switch S1 is pressed. An onboard undervoltage sensing circuit can also pull **RESET** low, if V_{dd} falls below acceptable values.

COP circuit

The microprocessor has an internal watchdog “computer operating properly” (COP) circuit. This circuit helps protect the microprocessor if it gets lost in the course of executing a program. A COP “strobe” is executed periodically so that the COP timer is never allowed to time out. The COP timeout duration is software controlled. If the COP times out, then a main board reset occurs.

Memory and peripherals

The microprocessor memory consists of EPROM U3, which contains the microprocessor operating program; and RAM U4, which stores the module status information. Additional interface devices facilitate the execution of instructions and program initiated by the microprocessor. These include latch U8, decoder U2, and bus transceiver U6.

The microprocessor memory locations are decoded by U2. The external RAM, which contains the module LED, display, switch, and potentiometer status, is mapped to locations $0480 through $7CFF. The EPROM is mapped to locations $E000 through $FFFF and the internal memory registers and RAM are allocated to $0000 through $047F. The module address latch is dedicated to memory location $7000.

Timing is provided by a 1 MHz crystal. The E clock is generated within the microprocessor and is then used as the timing reference for the memory and peripheral devices. The E clock frequency is four times that of the crystal, or 4.000 MHz. This signal is then divided by 16 to provide the SPI port clock frequency of 250 kHz, which is used for MCM and CCM module data transfers.

MCM and CCM control

NOTE

During operation as a CRT console, the following activities DO NOT occur. The circuitry necessary to perform these functions is included on the main board, but it is never used.

The microprocessor detects status changes of the control module switches and mute potentiometers and communicates that information to the COIM. The COIM microprocessor sends status update information for the console LED clock display. The main board microprocessor will, in turn, transmit this information to the control modules via the module interface board.

Control of the MCM and CCMs is accomplished via the serial peripheral port (SPI) of the main board microprocessor. Module selection is done through eight address lines, which are latched into U8, buffered by U2 and routed to the module interface board.

After selecting a module, the microprocessor indicates whether it is writing LED/display data or reading switch and mute potentiometer status. During the write sequence, the microprocessor pulls its **SS** line high. This signal is NANDed by U21 with a 250 kHz clock from the SPI port, and generates the **LED CLOCK** signal, which is routed to the module interface board via P4, pin 2. The signal is NANDed with each module select line on the MINT board, and therefore is routed to the selected control module only. Synchronously, two 8-bit bytes of **LED DATA** are output on the SPI port, buffered by U16D, and routed to the module interface board via P4, pin 4. The **LED CLOCK** signal then clocks the data into the selected module.

Switch reading is accomplished in a similar manner. The microprocessor selects a module, pulls **SS** low, and serially outputs 8 bits of **SWITCH CLOCK** from the SPI port. The **SWITCH CLOCK** is level-shifted by U16C, inverted by U17, and routed to the module interface board via P4, pin 6. A 8-bit byte of **SWITCH DATA** is clocked serially out of the selected module and input to the main board via P4, pin 8. The data is inverted by U13 and clocked into the SPI port by the falling edge of the microprocessor clock and stored in RAM U4.

The mute potentiometer level from the selected module is routed to the main board via P4, pins 10 and 12, and input to the microprocessor A/D converter. The analog voltage levels of the selected mute potentiometers are converted to an 8-bit digital word and stored in RAM U4.

The microprocessor compares the switch and mute potentiometer readings to the previously stored information. If a status change is detected, then the revised information is communicated to the COIM. The COIM microprocessor interprets the change and initiates communications back to the main board as necessary.

The MCM update is similar to the CCM update, with a few exceptions. The MCM has 19 switches and an 8-character display rather than the eight switches and six LEDs that are present on a CCM. Of the 19 switches, 17 are read using the same method as the CCM switch, except that 24 **SWITCH CLOCK** bits are used to clock three 8-bit bytes of **SWITCH DATA**. The two remaining switches are read via the mute potentiometer lines. In this case, the microprocessor reads the analog voltage level generated by the switch status and determines whether or not the switch has been pressed. The MCM clock display updating is similar to CCM LED updating, except that the update occurs more often than CCM updates and is given priority over CCM updates.

Auxiliary inputs/outputs

When the main board is operating in the mode described in the previous section, the auxiliary inputs/outputs (aux I/O) port is updated in the same manner as the CCM

modules. A few of the inputs and outputs of this port are used for control lines on the main board. The others are used to drive relays and opto-couplers on the option board. The microprocessor interprets the inputs of this port as switch closures of a CCM and the outputs as CCM LED updates. The aux I/O port has two serial-to-parallel shift registers and one parallel-to-serial shift register, just as on the CCM modules. Seven of the outputs are inverted via Darlington transistors in peripheral driver array U13 and are used to drive relays on the option (relay) board. All inputs and outputs are provided with static protection circuitry.

During normal operation, position B of JU29 is selected to allow the **SWITCH DATA** to be read directly from U21-4 instead of from the MINT board, and position A of JU30 is selected so the module select line for the aux I/Os comes from U16-15 instead of from the MINT board. This allows the microprocessor to read from and write to the AUX I/Os without using a MINT board. The reading and writing processes are identical to those for reading and writing to CCMs as described above.

Audio processing

The main board audio circuitry provides preamplification of microphone audio, switching between main microphone and auxiliary microphone audio, automatic gain control (AGC) audio level, and balanced audio to the COIM from the console operator position. Additionally, the circuitry provides balanced audio sources for the logging recorder, the VU meter, the telephone transmit audio, and the Call Check recorder. The audio circuitry also drives the select and unselect speaker outputs, as well as the headset and handset outputs.

Transmit audio

The audio signal originating from the console microphone enters the main board through connector P10, which accepts an input from a standard dynamic cardioid microphone. A low noise preamplifier with a gain of 30 dB provides an input sensitivity of -65 dB and 35 dB of dynamic range with less than 1% total harmonic distortion. The preamplifier consists of a common source FET stage (Q6). Operational amplifier U31A provides a low impedance output and additional gain, as well as negative feedback to the first stage. Operational amplifier U23B buffers audio signals originating from either a headset or handset or desktop microphone. In order for this signal to be at the same level as the output of the console mic preamp, this stage provides 10 dB to 16 dB of attenuation, depending on the source. The console microphone signal enters the board connector P9, the handset mic signal enters the board via connector P7, and the headset mic signals enter via P20 and P21. The desktop mic signal enters via connector P6.

The signals from the mic preamp and attenuator are fed to U33A/B, a triple 1-of-2 analog multiplexer. The **$\overline{\text{AUX ENABLE}}$** input controls which microphone signal is fed to the audio path. This line is pulled low by inserting a headset, taking the handset off-hook, or by pulling P5, pin 4 low (indicating the use of a desk microphone). The output of the multiplexer is biased to 5 V and represents the console transmit audio regardless of the source the operator is using. For an audio level at any source at the minimum sensitivity point, the level at the multiplex gate output is -35 dBm. The output of the multiplexer is routed to an AGC circuit consisting of operational amplifiers U23C and D and associated components. The AGC provides a constant output of 0 dBm for signals above the input

sensitivity level set by switch S4. See Table 2-2 for more information. After the AGC processes the audio, it is routed to three different places: the transmit driver, the VU meter selector, and the logging recorder.

Transmit Driver

The transmit driver consists of notch filter Z3 and current driver U25C. The notch filter prevents base station falsing by attenuating guard tone (2175 Hz) components of operator audio. The notch filter output is applied to current driver U23C, which drives transformer T1. The 0 dBm output of T1 is routed to the COIM via a twisted pair cable. Auxiliary paging tones are input to the final stage of the notch filter (Z3-6), which provides 15 dB of gain. The paging tones are summed with operator transmit audio at the input of U25C.

VU meter

Either select audio or operator transmit audio (AGC audio) is routed to the VU meter by VU selector U33E/F. The VU selector consists of a 1-of-2 multiplexer, which passes AGC audio during transmit (**PTT OUT** high) and the console select audio otherwise (**PTT OUT** low). Since select audio is input to the VU selector at -10 dBm, the 0 dBm level AGC audio is attenuated 10 dB by divider R346/R347 before entering the multiplexer. The VU meter output is routed to the VU meter circuitry on the front panel board via P17-14.

Logging recorder

Operator transmit audio (AGC audio) and select audio are routed to the logging recorder via current driver U25A and transformer T2. The -6 dBm level is routed to the logging recorder via P6, pins 6 and 7.

Telephone transmit audio

When **PTT OUT** is low, operator audio is routed to the telephone transmit driver instead of the AGC circuitry. The telephone transmit driver consists of operational amplifier U30B, which provides 10 dB of gain, and differential voltage source U27A and C, which provides an additional 32 dB of gain. The output of U27A/C drives transformer T8, which provides impedance matching to the 600 ¾ telephone line connected to P5, pins 9 and 10. Telephone transmit audio is normally adjusted to a level of -24 dBm at P5, pins 9 and 10 by potentiometer R453.

The output of the telephone transmit driver can be disabled by the console off-hook signal (**$\overline{\text{CONS OH}}$**). The **$\overline{\text{CONS OH}}$** is derived from the auxiliary off-hook (**$\overline{\text{AUX OH}}$**) input (P5-2), which is low when the operator's telephone is in use; and by aux jack sense (**$\overline{\text{AUX JS}}$**) input (P5-1), which is low when the telephone is being used by someone other than the operator. **$\overline{\text{CONS OH}}$** goes low when **$\overline{\text{AUX OH}}$** is low and **$\overline{\text{AUX JS}}$** is high, thus enabling the

telephone transmit driver only when the operator is using the telephone. Refer to Tables 2-3 and 2-4 for audio routing and muting logic details.

Table 2-3 ***Audio Routing Logic***

Control Signal	Audio Signal	Routing
$\overline{\text{AUX ENABLE}}$ low	Headset or Handset/Desk Mic	Rest of Mic Path
$\overline{\text{AUX ENABLE}}$ high	Main Mic	Rest of Mic Path
PTT OUT high	Mic Audio	AGC
PTT OUT low	Mic Audio	Telephone Transmit

Table 2-4 ***Audio Muting Logic***

Inputs			Outputs (see note)	
$\overline{\text{AUX OH}}$	**$\overline{\text{AUX JS}}$**	**$\overline{\text{AUX ENABLE}}$**	**$\overline{\text{SEL MUTE}}$**	**$\overline{\text{CONS OH}}$**
L	L	L	L	H
L	L	H	H	H
L	H	L	H	L
L	H	H	H	L
H	L	L	L	H
H	L	H	H	H
H	H	L	L	H
H	H	H	H	H

NOTE

If **$\overline{\text{SEL MUTE}}$** is low, then select audio is routed to the headset and the select speaker is muted. Telephone audio to the headset is also muted. If **$\overline{\text{CONS OH}}$** is low, then the telephone transmit driver is enabled and **$\overline{\text{SEL MUTE}}$** goes high. This routes select audio to the select speaker and routes telephone audio to the headset.

Receive audio

In addition to processing the operator's transmit audio, the main board also processes telephone receive audio and the select and unselect audio from the COIM. Telephone receive audio is input to the main board via P5, pins 6 and 7, and routed via transformer T7 to differential receiver U27D, which has a maximum gain of 25 dBm. The output of U27D is normally adjusted to -10 dBm by potentiometer R422. The telephone receive audio is then routed to both the Call Check recorder and to the headset driver. Call check audio is fed to unity gain current driver U27B and transformer T6, and on to the option board for routing to the Call Check recorder. Headset driver audio is routed to 1-of-2 multiplexer U32E/F, when select mute (**$\overline{\text{SEL MUTE}}$**) is high. When **$\overline{\text{SEL MUTE}}$** is low, V_B is routed to U24D-13, and mutes the headset and handset audio.

Select audio

Select audio from the COIM is input at P1, pins 11 and 12, and routed via transformer T3 to unity gain buffer U26A, where it is summed with trunking tones. The output of U26A is routed to low pass filter Z6, buffered by U26B, and attenuated 10 dB by voltage divider R392-R393 to prevent passband clipping by notch filter Z4. The notch filter attenuates 2175 Hz guard tone in order to prevent guard tone from being heard in the select speaker, headset, or handset. The notch filter is strapped to recover the 10 dB voltage divider attenuation. The output of the notch filter (approximately -10 dBm for a -15 dBm input at transformer T3) is routed to 1-of-2 multiplexer U32A/B, which routes the select audio to the headset and handset or the select speaker, depending on the status of the **SEL MUTE** or **PTT** lines. When the **SEL MUTE** or **PTT** lines are low and there is a headset or handset present, the select audio is routed to the headset and handset instead of to the select speaker. The **SEL MUTE** signal is generated by combining the **AUX ENABLE** signal, (which indicates that a headset or handset is active), and the **CONS OH** signal (which indicates that the operator is using the telephone). Select audio is routed to the headset and handset when a headset or handset is active (**AUX ENABLE** low) and when the operator is not using the telephone (**CONS OH** high). In this case, select audio is routed to buffer U24 and sent to headset connectors P20 and P21. The handset driver taps off the differential headset driver. S6 controls the select audio volume in the handset. See Table 2-2 for settings. When **SEL MUTE** is high, select audio is routed to unity gain buffer U24C. The output of U24C is fed to volume potentiometer R399 (located on the front panel board), and amplified 26 dB by audio driver U29A. The output of U29A is routed via P17, pins 25 and 26 to the select speaker. The output of select audio notch filter Z4 is also routed to the VU meter via multiplexer U33D/F, and to the logging recorder regardless of the status of **SEL MUTE**. Refer to Tables 2-3 and 2-4 for audio routing and muting logic details.

Unselect audio

Unselect audio from the COIM is input at P1, pins 9 and 10 and routed via transformer T4 to unity gain buffer U26C, where it is summed with trunking tones. The output of U26C is routed to low pass filter Z7, buffered by U26D, and fed to 1-of-2 multiplexer U32 C/D. The multiplexer is controlled by the **CALL CHECK OFF-HOOK** signal from shift register U14-5, or **PTT**. When **CALL CHECK OFF-HOOK** is low, unselect audio is muted by applying V_B to the notch filter and Call Check audio from the option board is routed to the unselect speaker. When **CALL CHECK OFF-HOOK** is high, unselect audio is attenuated 10 dB by voltage divider R372-R373 to prevent passband clipping by notch filter Z5. The notch filter attenuates 2175 Hz guard tone in order to prevent guard tone from being heard in the unselect speaker. The notch filter is strapped to recover the 10 dB voltage divider attenuation. The output of the notch filter (approximately -10 dBm for a -15 dBm input at transformer T4) is routed to volume potentiometer R377 (located on the front panel board), and amplified 26 dB by audio driver U28A. The output of U28A is routed via P17, pins 1 and 2 to the unselect speaker.

Voltage regulators

B+ supply

Since the B+ voltage level is not critical, the B+ supply circuitry provides a B+ voltage in the range of 9.7 to 14.9 Vdc. As long as the power supply input voltage remains in the acceptable range of 11.0 to 16.5 V, transistor Q15 is saturated and the B+ voltage follows the supply voltage. If the supply voltage exceeds 16.5 V, Zener diode VR6 begins to conduct. When VR6 conducts, Q13 saturates and turns off Q16. When Q16 turns off, it removes the bias current for Q15 and Q12, disabling the B+ output. If the input voltage falls below 11.0 V, VR3 no longer conducts. When VR3 stops conducting sufficiently to saturate Q14, no current can flow from Q13 and Q16, removing the bias from Q15 and Q12 and disabling the B+ supply.

VL supply and SCR protection circuit

The VL voltage regulator is based on a constant current source consisting of Q22, Q23 and R526, which supplies the base drive to series pass transistor Q24. The regulation is controlled by CR26, VR4, R525, R526, and Q22. When VL goes low, less current goes through VR4 and thus less goes through Q23. More current through Q23 causes more base current through Q24, thus increasing VL. The reverse process occurs when VL goes high.

The SCR protection circuit guards against catastrophic device failure. When VL is operating properly, Q20 is off and Q21 is saturated. If a large amount of current is required from the VL supply, there is a sufficient drop across R517 and R518 to turn on Q20, which turns off Q21 by pulling its base high. When Q21 is off, there is no base current provided to Q23, which in turn removes the base drive from Q24. In order to facilitate the rapid cut off of Q24, Zener CR14 is connected from the collector of Q20 to the base of Q24. When Q20 saturates, CR14 forces a 0.4 V drop across the base-emitter junction of Q24, shutting it off. When Q20 first shuts off, there is no charge across C237. The base of Q20 is thus held low until C237 has been fully charged, thus shutting down the VL supply for the time period that C237 is charging through R519. Once C237 is fully charged, Q20 shuts off and Q21 turns on again, thus re-enabling the VL supply. When Q21 turns off, the negative side of C237 goes high, thus forcing the positive side of C237 and the base of Q20 above B+. This state keeps Q20 turned off until C237 discharges again. The entire process causes a pulsing of VL as long as the SCR condition remains.

A second limiter prevents a high current path through Q20, CR60 and Q24. This path is limited by CR20, CR21, and CR22, which clamp the voltage from the B+ input to the base of Q24 to 1.6 V. The VL supply ranges from 9.0 to 10.0 V.

+5 V regulator

B+ is routed to series regulator VR1, which supplies power to the microprocessor and other 5 V logic integrated circuits.

VA supply

The VA supply for the analog circuitry is derived from B+ by regulator circuitry consisting of Q17, VR2, CR30, Q18, and Q19. The base voltage for Q18 is set by VR2

and CR30, which sets the voltage across R511. If the VA output goes high, Q19 provides more of the current through R511. This causes Q18 to provide less base current to Q17 and decrease the output. The reverse process occurs when VA goes low. The VA supply is between 9.2 and 10.6 V.

VB and VB2 supply

The VB supply for biasing the audio circuits is derived from VA by voltage divider R515-R516 and operational amplifier U31B. The voltage divider divides VA in half and the unity gain operational amplifier buffer provides a low output impedance voltage source. Since there are several current drivers which derive current from VB, VB is buffered by U25B to provide VB2. This is done to prevent excessive current and associated noise from affecting VB. VB2 is used to provide current to the logging recorder driver, the PA driver, and the Call Check recorder driver. The VB and VB2 supplies have a range of 4.1 to 5.2 V.

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BLN1228A Overlay

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BLN1228A Schematic
(Sheet 1 of 4)

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BLN1228A Schematic
(Sheet 2 of 4)

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BLN1228A Schematic
(Sheet 3 of 4)

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BLN1228A Schematic/
(Sheet 4 of 4)

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BLN1228A Parts List

Reference	Part Number	Description
		capacitor, fixed:
C1 thru 5	2113741B49	0.015 uF, ±5%; 50V
C7 thru 21	2113741B49	0.015 uF, ±5%; 50V
C24	2113741B49	0.015 uF, ±5%; 50V
C27 thru 29	2113741B49	0.015 uF, ±5%; 50V
C31 thru 34	2113741B49	0.015 uF, ±5%; 50V
C37	2113741B49	0.015 uF, ±5%; 50V
C39 thru 47	2113741B49	0.015 uF, ±5%; 50V
C100,101	2113740B25	10 pF, ±5%; 50 V
C102	0811017A01	1000 pF, ±5%; 50 V
C105	2313748G04	1 uF, ±20%; 50V
C107	2111015D09	470 pF, ±10%; 100V
C129	2111015D09	470 pF, ±10%; 100V
C130,131	0811051A11	0.047 uF, ±5%; 63 V
C132	0811051A12	0.068 uF, ±5%; 63 V
C134	0811051A11	0.047 uF, ±5%; 63 V
C135	0811051A19	1 uF, +5%/-0.5%; 63 V
C136,137	2113741B65	0.068 uF, ±5%; 50 V
C138	0811051A11	0.047 uF, ±5%; 63 V
C142,143	0811051A11	0.047 uF, ±5%; 63 V
C144	2313748G14	22 uF, ±20%; 35V
C145	0811051A12	0.068 uF, ±5%; 63 V
C150	0811051A12	0.068 uF, ±5%; 63 V
C151	2313748G06	4.7 uF, ±20%; 50V
C153,154	2113741B49	0.015 uF, ±5%; 50V
C155,156	2313748G22	100 uF, ±20%; 25 V
C157	2113741B49	0.015 uF, ±5%; 50V
C158,159	0811017A01	1000 pF, ±5%; 50 V
C160	0811051A12	0.068 uF, ±5%; 63 V
C161	2313748G14	22 uF, ±20%; 35V
C162	2313748G09	10 uF, ±20%; 35 V
C163	0811017A08	0.01 uF, ±5%; 50 V
C164	2313748G04	1 uF, ±20%; 50V
C165	0811017A01	1000 pF, ±5%; 50 V
C166	0811051A19	1 uF, +5%/-0.5%; 63 V
C168	2313748G06	4.7 uF, ±20%; 50V
C169	0811017A08	0.01 uF, ±5%; 50 V
C170	2313748G04	1 uF, ±20%; 50V
C171	0811051A12	0.068 uF, ±5%; 63 V
C172,173	2113741B49	0.015 uF, ±5%; 50V
C176	0811017A08	0.01 uF, ±5%; 50 V
C177	0811051A12	0.068 uF, ±5%; 63 V
C178	2111015D01	100 pF, ±10%; 100V
C179	2113741B49	0.015 uF, ±5%; 50V
C180	0811051A12	0.068 uF, ±5%; 63 V
C181	2113741B49	0.015 uF, ±5%; 50V
C182,183	0811051A19	1 uF, +5%/-0.5%; 63 V
C184	0811051A12	0.068 uF, ±5%; 63 V
C185	2313748G04	1 uF, ±20%; 50V
C186	0811051A19	1 uF, +5%/-0.5%; 63 V
C187	2313748G14	22 uF, ±20%; 35V
C188	0811051A19	1 uF, +5%/-0.5%; 63 V
C190	0811051A12	0.068 uF, ±5%; 63 V
C191,192	2313748G04	1 uF, ±20%; 50V
C195	2313748G25	333 uF, ±20%; 35V
C196	2113741B49	0.015 uF, ±5%; 50V
C197	2313748G25	333 uF, ±20%; 35V
C198	2113741B49	0.015 uF, ±5%; 50V
C199	2313748G25	333 uF, ±20%; 35V
C200	2313748G04	1 uF, ±20%; 50V
C203	2313748G25	333 uF, ±20%; 35V
C204	2113741B49	0.015 uF, ±5%; 50V
C205	2313748G25	333 uF, ±20%; 35V
C206	2113741B49	0.015 uF, ±5%; 50V
C207	2313748G25	333 uF, ±20%; 35V
C209	2111015D01	100 pF, ±10%; 100V
C210,211	0811051A12	0.068 uF, ±5%; 63 V
C215	0811017A01	1000 pF, ±5%; 50 V
C216	0811051A11	0.047 uF, ±5%; 63 V
C217	0811051A12	0.068 uF, ±5%; 63 V
C219	2313748G06	4.7 uF, ±20%; 50V
C220	2111015D05	220 pF, ±10%; 100V
C221	2313748G06	4.7 uF, ±20%; 50V
C222	2313748G05	2.2 uF, ±20%; 50V
C223 thru 225	2313748G14	22 uF, ±20%; 35V
C226	2111015D05	220 pF, ±10%; 100V
C230 thru 232	2313748G22	100 uF, ±20%; 25 V
C233	2313748G14	22 uF, ±20%; 35V
C234	2113741B49	0.015 uF, ±5%; 50V
C235	2313748G14	22 uF, ±20%; 35V
C236,237	2313748G06	4.7 uF, ±20%; 50V
C238,239	0811051A12	0.068 uF, ±5%; 63 V
C240	0811017A06	470 pF, ±5%; 50 V
C241	2313748G14	22 uF, ±20%; 35V
C244	2113741B49	0.015 uF, ±5%; 50V
C245,246	2313748G14	22 uF, ±20%; 35V
C252	2313748G04	1 uF, ±20%; 50V
C253	2313748G05	2.2 uF, ±20%; 50V
C254	2313748G14	22 uF, ±20%; 35V
C258	2113741B49	0.015 uF, ±5%; 50V
C259	2313748G09	10 uF, ±20%; 35 V
C260	0811051A12	0.068 uF, ±5%; 63 V
C600	2113741B49	0.015 uF, ±5%; 50V
C700 thru 703	2313748G14	22 uF, ±20%; 35V
C704	2113741B65	0.068 uF, ±5%; 50 V
C800,801	2313748G04	1 uF, ±20%; 50V
C802,803	0811051A12	0.068 uF, ±5%; 63 V
C804,805	2313748G04	1 uF, ±20%; 50V
C900 thru 904	2313748G09	10 uF, ±20%; 35 V
C905 thru 910	2113741B49	0.015 uF, ±5%; 50V
		diode: (see note)
CR1 thru 5	4883654H01	silicon
CR8 thru 12	4883654H01	silicon
CR14	4882592W01	Schottky, Barrier
CR15 thru 17	4813833D08	1A, 600V
CR19 thru 21	4883654H01	silicon
CR22,23	4882592W01	Schottky, Barrier
CR24	4883654H01	silicon
CR26,27	4883654H01	silicon
CR29 thru 42	4883654H01	silicon
CR45 thru 52	4883654H01	silicon
CR54	4882592W01	Schottky, Barrier
CR56,57	4883654H01	silicon
CR59	4882592W01	Schottky, Barrier
CR60,61	4883654H01	silicon
CR600	4883654H01	silicon
CR601,602	4882592W01	Schottky, Barrier
		light emitting diode: (see note)
DS1	4888245C22	GRN
		fuse:
F1	6582408R01	fuse 3A, 125V

BLN1228A Parts List

jumper:

JU4	0611009B23	0 ohm, ±5%; 1/4 W
JU7	0611009B23	0 ohm, ±5%; 1/4 W
JU9	0611009B23	0 ohm, ±5%; 1/4 W
JU12	0611009B23	0 ohm, ±5%; 1/4 W
JU17	0611009B23	0 ohm, ±5%; 1/4 W
JU19	0611009B23	0 ohm, ±5%; 1/4 W
JU24	0611009B23	0 ohm, ±5%; 1/4 W
JU34	0611009B23	0 ohm, ±5%; 1/4 W
JU38	0611009B23	0 ohm, ±5%; 1/4 W

connector:

P1	2883290P04	plug: 20-contact
P2	0983112N02	receptacle: 8-contact
P4	2883290P05	plug: 26-contact
P5,6	2883291R06	PLUG 10 PIN
P7	0983112N02	receptacle: 8-contact
P8	2883689R01	PLUG RIGHT ANGLE HDR 3 PIN
P9	2883499R01	plug, 4-position
P10	0983614R01	RECP PHONO BD MTG 90 DEG
P11	2883636P01	plug: 3-contact
P12	2883290P04	plug: 20-contact
P14,15	0983112N01	receptacle: 6-contact
P16	0983112N02	receptacle: 8-contact
P17	2883290P05	plug: 26-contact
P19	2910231A10	terminal, circuit board
P20,21	2885155U01	plug, 10-contact
P22	2883290P04	plug: 20-contact
P23	2880001R03	plug: 3-pin header
P24	0983365N01	receptacle: 8-contact

transistor: (see note)

Q1	4813824D08	NPN
Q3,4	4800869570	NPN
Q5	4813824D08	NPN
Q6	4813823D01	TSTR N-CH RF JFET 2N5484RLRP
Q7,8	4813824D06	NPN
Q9	4813824D12	PNP
Q10	4800869653	type JFET
Q11	4813824D12	PNP
Q12	4882022N47	TSTR PNP PA MJE15029_
Q13,14	4813824D08	NPN
Q15	4813824D12	PNP
Q16	4813824D08	NPN
Q17	4800869619	PNP; type M9619
Q18,19	4813824D08	NPN
Q20,21	4813824D12	PNP
Q22,23	4813824D08	NPN
Q24	4800869619	PNP; type M9619
Q29	4813824D04	TSTR DARL NPN 30V .3A MPSA13
Q35	4813824D08	NPN
Q600	4813824D08	NPN

resistor, fixed:

R101 thru 108	0611009A97	100K, ±5%; 1/4W
R109 thru 116	0611077B07	22K, ±5%; 1/8 W
R117	0611077A82	2.2K, ±5%; 1/8 W
R118 thru 120	0611077A98	10K, ±5%; 1/8 W
R121 thru 123	0611077A82	2.2K, ±5%; 1/8 W
R124	0611077A98	10K, ±5%; 1/8 W
R125	0611077A82	2.2K, ±5%; 1/8 W
R126	0611077A98	10K, ±5%; 1/8 W
R127	0611077A82	2.2K, ±5%; 1/8 W
R128	0611077A98	10K, ±5%; 1/8 W
R129	0611077A82	2.2K, ±5%; 1/8 W
R130 thru 134	0611077A98	10K, ±5%; 1/8 W
R136 thru 138	0611077A98	10K, ±5%; 1/8 W
R139 thru 141	0611009A73	10K, ±5%; 1/4 W
R142 thru 147	0611077A98	10K, ±5%; 1/8 W
R148	0611077A74	1K, ±5%; 1/8 W
R151	0611077B71	10 meg, ±5%; 1/8 W
R152	0611077A74	1K, ±5%; 1/8 W
R153 thru 155	0611077A98	10K, ±5%; 1/8 W
R175	0611077A74	1K, ±5%; 1/8 W
R176	0611077A98	10K, ±5%; 1/8 W
R209	0611077A74	1K, ±5%; 1/8 W
R210	0611077A98	10K, ±5%; 1/8 W
R214	0611077A98	10K, ±5%; 1/8 W
R215,216	0611077A58	220 ohms, ±5%; 1/8 W
R225	0611077A90	4.7K, ±5%; 1/8 W
R231	0611077A98	10K, ±5%; 1/8 W
R232	0611077A82	2.2K, ±5%; 1/8 W
R233	0611077A68	560 ohms, ±5%; 1/8 W
R234 thru 236	0611077A82	2.2K, ±5%; 1/8 W
R237	0611077A98	10K, ±5%; 1/8 W
R238	0611077B47	1 meg, ±5%; 1/8 W
R239	0611077A94	6.8K, ±5%; 1/8W
R250,251	0611009A81	22K, ±5%; 1/4W
R252	0611077A70	680 ohms, ±5%; 1/8 W
R253	0611077A74	1K, ±5%; 1/8 W
R254	0611077A90	4.7K, ±5%; 1/8 W
R255	0611077A98	10K, ±5%; 1/8 W
R300	0611077B03	15K, ±5%; 1/8 W
R301,302	0611077A66	470 ohms, ±5%; 1/8 W
R303	0611077A90	4.7K, ±5%; 1/8 W
R304	0611009A19	56 ohms, ±5%; 1/4W
R305	0611077A68	560 ohms, ±5%; 1/8 W
R306	0611077B13	39K, ±5%; 1/8 W
R308	0611077B47	1 meg, ±5%; 1/8 W
R309	0611077B23	100K, ±5%; 1/8 W
R310	0611077A98	10K, ±5%; 1/8 W
R311,312	0611077B09	27K, ±5%; 1/8 W
R313,314	0611077B01	12K, ±5%; 1/8 W
R315	0611009A77	15K, ±5%; 1/4W
R316	0611077A98	10K, ±5%; 1/8 W
R317	0611009A77	15K, ±5%; 1/4W
R318	0611077A74	1K, ±5%; 1/8 W
R319	0611077B15	47K, ±5%; 1/8 W
R320,321	0611077B11	33K, ±5%; 1/8 W
R322	0611077A48	82 ohms, ±5%; 1/8W
R323	0611077A90	4.7K, ±5%; 1/8 W
R324,325	0611077B21	82K, ±5%; 1/8W
R326	0611077B43	680K, ±5%; 1/8 W
R327	0611077B19	68K, ±5%; 1/8 W
R328	0611077A90	4.7K, ±5%; 1/8 W
R329,330	0611077A94	6.8K, ±5%; 1/8W
R331	0611077B07	22K, ±5%; 1/8 W
R332	0611077A74	1K, ±5%; 1/8 W
R333,334	0611077B37	390K, ±5%; 1/8W
R335	0611077B01	12K, ±5%; 1/8 W
R336	0611077A98	10K, ±5%; 1/8 W
R337	0611077B43	680K, ±5%; 1/8 W
R338	0611077B45	820K, ±5%; 1/8 W
R339	0611077B03	15K, ±5%; 1/8 W
R340	0611077A96	8.2K, ±5%; 1/8 W
R341	0611077B31	220K, ±5%; 1/8 W
R342	0611077A98	10K, ±5%; 1/8 W
R343	0611077A74	1K, ±5%; 1/8 W
R344	0611077A48	82 ohms, ±5%; 1/8W
R345	0611077A78	1.5K, ±5%; 1/8 W
R346	0611077B17	56K, ±5%; 1/8 W
R347	0611077B13	39K, ±5%; 1/8 W
R348	0611077A74	1K, ±5%; 1/8 W
R349	0611077B17	56K, ±5%; 1/8 W
R350	0611077B07	22K, ±5%; 1/8 W
R351	0611077A90	4.7K, ±5%; 1/8 W
R352	0611077B23	100K, ±5%; 1/8 W
R353	0611077B17	56K, ±5%; 1/8 W
R354	0611077B23	100K, ±5%; 1/8 W
R355	0611077A58	220 ohms, ±5%; 1/8 W
R356	0611077B21	82K, ±5%; 1/8W
R357	0611077B07	22K, ±5%; 1/8 W
R358	0611077B19	68K, ±5%; 1/8 W
R359	0611077A74	1K, ±5%; 1/8 W
R360	0611077B19	68K, ±5%; 1/8 W
R361	0611077A68	560 ohms, ±5%; 1/8 W
R362	0611077A92	5.6K, ±5%; 1/8 W

R363	0611077B05	18K, ±5%; 1/8 W
R364	0611077B19	68K, ±5%; 1/8 W
R365	0611077A82	2.2K, ±5%; 1/8 W
R366 thru 368	0611077B11	33K, ±5%; 1/8 W
R369	0611077A92	5.6K, ±5%; 1/8 W
R370	0611077B47	1 meg, ±5%; 1/8 W
R371	0611077B23	100K, ±5%; 1/8 W
R372	0611077A84	2.7K, ±5%; 1/8 W
R373	0611077B07	22K, ±5%; 1/8 W
R374	0611077B35	330K, ±5%; 1/8 W
R375	0611077B31	220K, ±5%; 1/8 W
R376	0611077B11	33K, ±5%; 1/8 W
R378	0611077A54	150 ohms, ±5%; 1/8 W
R379	0611077A98	10K, ±5%; 1/8 W
R380,381	0611077A50	100 ohms, ±5%; 1/8 W
R382	0611009A01	10 ohms, ±5%; 1/4W
R383	0611009A97	100K, ±5%; 1/4W
R384	0611077A82	2.2K, ±5%; 1/8 W
R385 thru 388	0611077B11	33K, ±5%; 1/8 W
R389	0611077A92	5.6K, ±5%; 1/8 W
R390	0611077B47	1 meg, ±5%; 1/8 W
R391	0611077B23	100K, ±5%; 1/8 W
R392	0611077A94	6.8K, ±5%; 1/8W
R394	0611077B35	330K, ±5%; 1/8 W
R395 thru 398	0611077B11	33K, ±5%; 1/8 W
R400	0611077A54	150 ohms, ±5%; 1/8 W
R401	0611077A98	10K, ±5%; 1/8 W
R402,403	0611077A50	100 ohms, ±5%; 1/8 W
R404 thru 406	0611077B11	33K, ±5%; 1/8 W
R408 thru 410	0611077B07	22K, ±5%; 1/8 W
R412 thru 415	0611077A98	10K, ±5%; 1/8 W
R416 thru 418	0611077B11	33K, ±5%; 1/8 W
R419	0611077A70	680 ohms, ±5%; 1/8 W
R420	0611077B35	330K, ±5%; 1/8 W
R421	0611077A98	10K, ±5%; 1/8 W
R422	1880087E36	POT CERMET 100K
R423	0611077A74	1K, ±5%; 1/8 W
R424	0611077B07	22K, ±5%; 1/8 W
R425	0611077A98	10K, ±5%; 1/8 W
R426	0611077B11	33K, ±5%; 1/8 W
R427	0611077A74	1K, ±5%; 1/8 W
R428	0611077B23	100K, ±5%; 1/8 W
R429	0611077A90	4.7K, ±5%; 1/8 W
R430	0611077B23	100K, ±5%; 1/8 W
R431	0611077A74	1K, ±5%; 1/8 W
R434	0611077B27	150K, ±5%; 1/8W
R435,436	0611077B07	22K, ±5%; 1/8 W
R437	0611077B15	47K, ±5%; 1/8 W
R438	0611077B27	150K, ±5%; 1/8W
R439	0611077B11	33K, ±5%; 1/8 W
R440,441	0611077B07	22K, ±5%; 1/8 W
R442	0611077A88	3.9K, ±5%; 1/8 W
R443	0611077B07	22K, ±5%; 1/8 W
R444	0611077B47	1 meg, ±5%; 1/8 W
R445	1880087E31	POT CERMET 25K
R446,447	0611077B09	27K, ±5%; 1/8 W
R448	0611077A78	1.5K, ±5%; 1/8 W
R449	0611077A70	680 ohms, ±5%; 1/8 W
R450	0611077A88	3.9K, ±5%; 1/8 W
R451	0611077A74	1K, ±5%; 1/8 W
R452	0611009A11	27 ohms, ±5%; 1/4W
R453	1880087E31	POT CERMET 25K
R454	0611077A74	1K, ±5%; 1/8 W
R455	0611077A90	4.7K, ±5%; 1/8 W
R456	0611077A70	680 ohms, ±5%; 1/8 W
R457	0611009A01	10 ohms, ±5%; 1/4W
R458	0611077B11	33K, ±5%; 1/8 W
R459	0611077A74	1K, ±5%; 1/8 W
R460	0611077B09	27K, ±5%; 1/8 W
R461,462	0611077B27	150K, ±5%; 1/8W
R463	0611077A54	150 ohms, ±5%; 1/8 W
R464,465	0611077A98	10K, ±5%; 1/8 W
R466	0611077B05	18K, ±5%; 1/8 W
R467	0611077A90	4.7K, ±5%; 1/8 W
R468	0611077B11	33K, ±5%; 1/8 W
R469	0611077A88	3.9K, ±5%; 1/8 W
R470	0611077B09	27K, ±5%; 1/8 W
R471	0611077A98	10K, ±5%; 1/8 W
R472	0611077B19	68K, ±5%; 1/8 W
R473	0611077A44	56 ohms, ±5%; 1/8 W
R475	0611077B43	680K, ±5%; 1/8 W
R476	0611077B45	820K, ±5%; 1/8 W
R477	0611077A74	1K, ±5%; 1/8 W
R478	0611077A98	10K, ±5%; 1/8 W
R480 thru 482	0611077A98	10K, ±5%; 1/8 W
R483 thru 486	0611009A75	12K, ±5%; 1/4W
R501	0611077B07	22K, ±5%; 1/8 W
R502	0611077A54	150 ohms, ±5%; 1/8 W
R503	0611077A88	3.9K, ±5%; 1/8 W
R504	0611077A78	1.5K, ±5%; 1/8 W
R505	0611077A42	47 ohms, ±5%; 1/8 W
R506	0611077A82	2.2K, ±5%; 1/8 W
R507,508	0611077A70	680 ohms, ±5%; 1/8 W
R509	0611009A53	1.5K, ±5%; 1/4W
R510	0611077A70	680 ohms, ±5%; 1/8 W
R511	0611077A62	330 ohms, ±5%; 1/8W
R512	0611077A94	6.8K, ±5%; 1/8W
R513	0611077A78	1.5K, ±5%; 1/8 W
R514	0611077A86	3.3K, ±5%; 1/8 W
R515,516	0611077B07	22K, ±5%; 1/8 W
R517,518	0611077A26	10 ohms, ±5%; 1/8 W
R519	0611077A84	2.7K, ±5%; 1/8 W
R520	0611077A96	8.2K, ±5%; 1/8 W
R521,522	0611077A94	6.8K, ±5%; 1/8W
R523	0611077A88	3.9K, ±5%; 1/8 W
R524	0611077A66	470 ohms, ±5%; 1/8 W
R525	0611077A26	10 ohms, ±5%; 1/8 W
R526	0611077A42	47 ohms, ±5%; 1/8 W
R533	0611077B05	18K, ±5%; 1/8 W
R534	0611077A74	1K, ±5%; 1/8 W
R541	0611077A90	4.7K, ±5%; 1/8 W
R542	0611009A19	56 ohms, ±5%; 1/4W
R543	0611077A68	560 ohms, ±5%; 1/8 W
R544	0611077B09	27K, ±5%; 1/8 W
R545 thru 548	0611009A25	100 ohms, ±5%; 1/4 W
R561,562	0611077A26	10 ohms, ±5%; 1/8 W
R600	0611077A44	56 ohms, ±5%; 1/8 W
R601 thru 612	0611077A98	10K, ±5%; 1/8 W
R613	0611077A74	1K, ±5%; 1/8 W
R614 thru 617	0611077A98	10K, ±5%; 1/8 W
R618	0611077A90	4.7K, ±5%; 1/8 W
R619 thru 621	0611077A98	10K, ±5%; 1/8 W
R622	0611077A58	220 ohms, ±5%; 1/8 W
R623 thru 625	0611077A44	56 ohms, ±5%; 1/8 W
R626	0611077A98	10K, ±5%; 1/8 W
R627	0611077A78	1.5K, ±5%; 1/8 W
R628	0611077A58	220 ohms, ±5%; 1/8 W
R629,630	0611077A44	56 ohms, ±5%; 1/8 W
R631 thru 633	0611077A98	10K, ±5%; 1/8 W
R700	0611077A90	4.7K, ±5%; 1/8 W
R701	0611077B07	22K, ±5%; 1/8 W
R702	0611077B19	68K, ±5%; 1/8 W
R703 thru 705	0611077B31	220K, ±5%; 1/8 W
R706	0611077A90	4.7K, ±5%; 1/8 W
R707	0611077B07	22K, ±5%; 1/8 W
R708	0611077B19	68K, ±5%; 1/8 W
R709	0611077B31	220K, ±5%; 1/8 W
R710 thru 713	0611077A44	56 ohms, ±5%; 1/8 W
R714	0611077A01	0 ohm, ±5%; 0 W
R715,716	0611077A70	680 ohms, ±5%; 1/8 W
R717	0611077A01	0 ohm, ±5%; 0 W
R718,719	0611077A70	680 ohms, ±5%; 1/8 W
R720	0611077B07	22K, ±5%; 1/8 W
R721	0611077B11	33K, ±5%; 1/8 W
R722	0611077A82	2.2K, ±5%; 1/8 W
R723	0611077A26	10 ohms, ±5%; 1/8 W
R800	0611077A44	56 ohms, ±5%; 1/8 W
R801 thru 803	0611077A98	10K, ±5%; 1/8 W
R804,805	0611077B07	22K, ±5%; 1/8 W
R806	0611077A98	10K, ±5%; 1/8 W
R807	0611077A82	2.2K, ±5%; 1/8 W
R808	0611077A98	10K, ±5%; 1/8 W

R809 thru 812	0611077B13	39K, ±5%; 1/8 W
R813	0611077B07	22K, ±5%; 1/8 W
R814	0611077A98	10K, ±5%; 1/8 W
R815	0611077B07	22K, ±5%; 1/8 W
R816 thru 818	0611077A98	10K, ±5%; 1/8 W
R819	0611077A82	2.2K, ±5%; 1/8 W
R820	0611077A98	10K, ±5%; 1/8 W
R821	0611077A58	220 ohms, ±5%; 1/8 W
R822	0611077A44	56 ohms, ±5%; 1/8 W

switch:

S1	4084961N01	pushbutton: spdt, momentary
S2 thru 6	4083849F04	rocker: 4-position

transformer:

T1 thru 7	2584007C02	Audio Frequency
T8	2584611H01	XFMR AUDIO

integrated circuit: (see note)

U1	5113802A45	IC 68HC11 W/3SCI+ SPI A/D
U2	5191058C01	IC PRGRMD PAL
U3	5191054C02	IC PRGMD EPROM
U4	5184064F76	Static 32Kx8 Bit RAM
U5	5182276R70	Undervoltage sense_
U8	5183808P54	Flip-Flop Octal D-Type
U9	5113811D11	IC RS232-C DRV/RCVR MC145407P
U11,12	5113806D35	IC REG 8-STAGE SHIFT/STORE
U13	5183222M75	Interface 5V Logic to LED Displays
U14	5184887K36	8-Bit Static Shift Register
U15	5184887K64	IC CMOS QUAD NAND __4093_
U16	5184704M19	Hex Level Shifter/Logic Level Converter
U17	5113806D23	IC INVTR HEX MC14069UBCP
U18	5113805D27	IC QUAD 2IN W/SCHMIDT NAND
U20	5184621K84	Voltage Comparator
U21	5184887K64	IC CMOS QUAD NAND __4093_
U22	5184704M19	Hex Level Shifter/Logic Level Converter
U23 thru 27	5113819D04	General Purpose Differential Operational Amplifier
U28,29	5184621K60	8W Class B Audio Power Amplifier
U30,31	5183222M84	Dual, JFET-Input Operational Amplifier
U32,33	5184887K60	Triple 2-Channel Analog Mux/Demux
U34,35	5113819D04	General Purpose Differential Operational Amplifier

voltage regulator: (see note)

VR1	5113816D01	5 V Positive Regulator
VR2	4882256C73	DIODE A/I
VR3,4	4883461E32	Zener 8.2V
VR5	4882479V15	Diode, Zener 15 V
VR6	4883461E33	DIODE ZENER 61E33 18V
VR600 thru 608	4813832C28	Zener 15 V
VR700 thru 704	4813832C28	Zener 15 V
VR800 thru 804	4813832C28	Zener 15 V
VR900 thru 902	4813832A33	Zener 20V

crystal: (see note)

Y1	4883274X01	CRYSTAL, 1.000MHZ, MICROP

network:

Z2	0182989R28	Bus Driver
Z3 thru 5	0180717D13	Notch Filter (3 used)
Z6,7	0182989R31	Low Pass Filter

non-referenced items:

	0210971A16	Nut, hex: 3 x 0.5mm (used with Q12)
	0310907A19	SCREW, machine: M3x0.5x8 (used with Q12)
	0310944A13	SCREW, tapping: P3.12x1.27x13 (2 used with P18)
	0484152B01	WASHER, shoulder (used with Q12)
	0982425R01	Fuseholder
	0982808R10	Socket, IC: 28-contact (used with U3)
	0983264X01	SOCKET PLCC 84 PIN (used with U1)
	0984728L01	Shorting Jumper: 2-contact (used with JU10)
	0984728L01	Shorting Jumper: 2-contact (used with JU16)
	0984728L01	Shorting Jumper: 2-contact (used with JU18)
	0984728L01	Shorting Jumper: 2-contact (used with JU21)
	0984728L01	Shorting Jumper: 2-contact (used with JU22)
	0984728L01	Shorting Jumper: 2-contact (used with JU25)
	0984728L01	Shorting Jumper: 2-contact (used with JU29)
	0984728L01	Shorting Jumper: 2-contact (used with JU30)
	0984728L01	Shorting Jumper: 2-contact (used with JU32)
	0984728L01	Shorting Jumper: 2-contact (used with JU35)
	0984728L01	Shorting Jumper: 2-contact (used with JU36)
	0984728L01	Shorting Jumper: 2-contact (used with JU40)
	0984728L01	Shorting Jumper: 2-contact (used with JU41)
	0984728L01	Shorting Jumper: 2-contact (used with JU42)
	0984728L01	Shorting Jumper: 2-contact (used with JU43)
	0984728L01	Shorting Jumper: 2-contact (used with JU44)
	1483820M02	INSULATOR, heat conductive (used with Q12)
	1484602K02	Insulator, crystal (used with Y1)
	2683373P02	HEAT SINK, transistor (used with U28)
	2683373P02	HEAT SINK, transistor (used with U29)
	2683374P02	HEAT SINK, transistor (used with Q12)
	2880001R03	plug: 3-pin header (used with JU10)
	2880001R03	plug: 3-pin header (used with JU16)
	2880001R03	plug: 3-pin header (used with JU18)
	2880001R03	plug: 3-pin header (used with JU21)
	2880001R03	plug: 3-pin header (used with JU22)
	2880001R03	plug: 3-pin header (used with JU25)

2880001R03	plug: 3-pin header (used with JU29)
2880001R03	plug: 3-pin header (used with JU30)
2880001R03	plug: 3-pin header (used with JU32)
2880001R03	plug: 3-pin header (used with JU35)
2880001R03	plug: 3-pin header (used with JU36)
2880001R03	plug: 3-pin header (used with JU40)
2880001R03	plug: 3-pin header (used with JU41)
2880001R03	plug: 3-pin header (used with JU42)
2880001R03	plug: 3-pin header (used with JU43)
2880001R03	plug: 3-pin header (used with JU44)
2883616P06	PLUG HDR 14 CONT (used with P18)

NOTE: For optimum performance, diodes, transistors, integrated circuits, and crystals must be ordered by Motorola part number.

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MOTOROLA

3

Front Panel Board

About this chapter

Section	Page	Description
Introduction	3-2	Provides an overview of the Front Panel Board.
Theory	3-3	Describes the circuit operation of the Front Panel Board.
BGN6029A Parts List	3-9	Contains the Front Panel Board parts list.

Models covered

The following models of the front panel board are covered in this chapter:

Model	Description
BGN6029A	Front Panel Board

Introduction

The BGN6029A Front Panel Board contains a voice unit (VU) meter bar graph display and associated drive circuitry, two speaker connectors, two volume controls and a transmit switch. When used with the CIE main board in CENTRACOM Gold Series Elite or Classic CRT consoles, the front panel board provides an instant transmit switch. The board provides volume adjust controls for select and unselect speaker audio. The select and unselect speakers connect to this board.

Theory

VU meter

Quad comparators U1, U2, and U3 compare the voltage on P3-14 with their particular reference voltage on the voltage divider ladder formed by CR1 and R12 through R22. When the voltage on P3-14 exceeds the reference voltage, the comparator pulls its output low, thereby turning on one segment of the display DS1. When the voltage goes below the reference voltage, the comparator pulls its output high, thereby turning off one segment of the display. C4 and R11 give the VU meter a “natural” appearance by slowing down the quick transition of the input voltage.

Speaker audio

Select speaker audio is routed from P3 to P1, where the select speaker is connected. Unselect speaker audio is routed from P3 to P2, where the unselect speaker is connected. Audio from the main board is applied to **SPEAKER I** (Select) Volume Level adjust R399 and **SPEAKER II** (Unselect) Volume Level adjust R377 to adjust the final output level to the speakers.

Transmit switch

Switch S1 allows the operator to transmit on the selected channel through P3.

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BGN6029A Overlay

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BLN6029A Schematic

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BGN6029A Parts List

Reference	Part Number	Description
		capacitor, fixed:
C1 thru 3	2113741B69	0.1 uF, ±5%; 50 V
C4	2313748G04	1 uF, ±20%; 50V
		cable:
CBL1	3083139N20	flat, 16-conductor; w/connector
		diode: (see note)
CR1	4813833C10	0.1A, 70 V
		light emitting diode: (see note)
DS1	4882429YO1	10 segment bar graph display
		connector:
P1,2	2880004T02	plug: 2-contact
P3	3083139N21	26-conductor w/cable
		resistor, fixed:
R1 thru 10	0611077A86	3.3K, ±5%; 1/8 W
R11 thru 21	0611077A74	1K, ±5%; 1/8 W
R22	0611077B03	15K, ±5%; 1/8 W
R23,24	0611009B23	0 ohm, ±5%; 1/4 W
R377	1884667R01	variable: 5000 ohm, ±20%; 1W
R399	1884667R01	variable: 5000 ohm, ±20%; 1W
		switch:
S1	4083231X01	SWITCH, SNAP ACTION, THRU HOLE
		integrated circuit: (see note)
U1 thru 3	5182460V02	QUAD OPAMP
		non-referenced items:
	0782111T01	Bracket, pot mounting (used with R377 and R399)
	0982808R06	Socket, IC: 20-contact (used with DS1)

NOTE: For optimum performance, diodes and integrated circuits must be ordered by Motorola part number.

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MOTOROLA

4

Option Board

About this chapter

Section	Page	Description
Introduction	4-2	Provides an overview of the Option Board.
Theory	4-4	Describes the circuit operation of the Option Board.
BLN6866A Parts List	4-13	Provides a parts list for the Option Board.

Models covered

The following models of the Option Board are covered in this chapter:

Model	Description
BLN6866A	Option Board

Introduction

The BLN6866A Option Board provides the interface circuitry for a Dictaphone™ Call Check recorder and the customer-defined input/output applications, as well as an audible transducer for alarm functions. If the Call Check option is ordered, the following components and related circuitry are dedicated to the specified function only, as explained in Table 4-1. The remaining input/output circuits are available for uses as defined by the customer. Relay K9 and associated circuits are dedicated to the Call Check function.

Table 4-1 ***Digital and Analog Call Check Functions***

Call Check equipment	Option Board interface component	Main Board	Call Check functions	
			Analog	Digital
P5-1	-	-	Call Check Power	Call Check Power
P5-2	R14	-	Replay Volume	No Connection
P5-3	-	-	Call Check Gnd	Call Check Gnd
P5-4	K1	P1-4	Heavy Traffic Switch	Pause Switch
P5-5	K9	P1-11	Off Hook	Off Hook
P5-6	T1	P1-8	Playback Audio	Playback Audio
P5-7	-	P1-10	-Tel/Record Audio	-Tel/Record Audio
P5-8	U1	P1-18	Recording Indicator	Paused Indicator
P5-9	U2	P1-16	Recall Indicator	Playing Indicator
P5-10	U3	P1-20	Restore Indicator	Recording Indicator
P5-11	K2	P1-1	Restore Switch	Restore Switch
P5-12	K3	P1-6	Back Switch	Prev/Rwd Switch
P5-13	K4	P1-2	Forward Switch	Next/Fast Fwd Switch
P5-14	-	P1-9	+Tel/Record Audio	+Tel/Record Audio

There are two Dictaphone Call Check recorder models: the B1448B Analog Call Check Recorder, and the B1680A Digital Call Check Recorder. In the following text, parenthesized information refers to the Digital Call Check recorder, while the other refers to the Analog Call Check recorder. The labeling of the CCM that controls the Call Check recorder is shown in Figure 4-1.

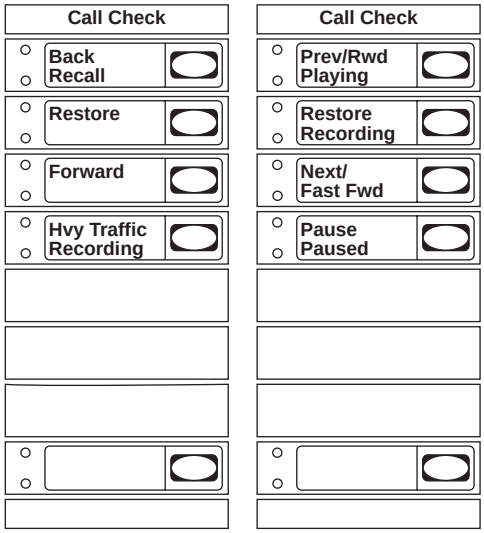

Figure 4-1 ***Call Check CCM Labeling***

Theory

General

In most installations, the Call Check recorder is provided with its own control panel. However, when the Call Check recorder is used with a CENTRACOM Gold Series Classic Compact or Elite/Classic CRT operator position, the control panel is omitted and the recorder is controlled directly from the operator console via the option board and associated onscreen Call Check control module. The option board is designed to eliminate problems caused by ground potential differences between the Call Check recorder and the console electronics.

The Call Check recorder is connected to the option board via connector P5. Screw terminal connector P3 is provided for connecting Call Check recorders supplied by other manufacturers. Power for the board I/O circuitry is derived from the Call Check recorder +24 V(+18 V) power supply.

Opto-coupler operation

To update the status of the Call Check indicators on the console, the Call Check interface circuitry monitors circuits which normally drive the recorder panel LED indicators. To provide ground isolation, the option board is equipped with opto-couplers U1 through U4 for input monitoring. The anodes of the four opto-couplers are connected to the +24 V (+18 V) reference provided by the recorder through R1, R3, R5, and R7 respectively. The outputs of these opto-couplers drive auxiliary I/O lines 1 through 4, which are connected to main board connector P12 via connector P1 on the option board.

For opto-couplers U2 and U3, which are connected to the RECALL (PLAYING) and RESTORE (RECORDING) LED indicators, respectively, the cathodes of the diodes are connected to the recorder through limiting resistors R4 and R6. The diodes of the opto-couplers pass current and photoelectrically turn on their output drivers. These output drivers are open-collector transistors which drive their outputs to ground.

The RECORD (PAUSED) LED indicator from the Call Check recorder (pin 8 of connector P5) is an active-high 5 V input which is inverted and level-shifted by R15, R16, and Q1 to drive opto-coupler U1. Auxiliary I/O line 4 is a general-purpose input that is not used with Call Check.

Relay controls

Relay K1 controls the **HEAVY TRAFFIC (PAUSE)** input to the recorder. The normally high +24 V (+18 V) output of the line, supplied by the recorder, is switched to the recorder ground when relay K1 is activated.

Relays K2, K3, and K4 control the **RESTORE (RESTORE)**, **RECALL (PREV/RWD)**, and **FAST FORWARD (NEXT/FAST FWD)** inputs, respectively. Each relay, when energized,

grounds the otherwise unbiased input. The ground potential used is derived from the recorder and not from the CENTRACOM Gold Series circuits.

Relay K9 is controlled by an off-hook signal generated by the customer's telephone network and associated operator position interfaces. When relay K9 is activated, the **RECORD** input to the Call Check recorder is switched from an open circuit to a Call Check ground, thus causing the Call Check to start recording.

Audio routing

The balanced **TELEPHONE AUDIO/CALL CHECK RECORD AUDIO** from the main board is routed to connector P1 (pins 9 and 10) and directly to the Call Check recorder via connector P5 (pins 7 and 14). This audio is recorded by the Call Check recorder when the **CALL CHECK OFF-HOOK** signal activates the recorder.

The playback audio from the Call Check recorder enters the option board at P5-6. The audio is coupled by a 1:1 transformer (T1), attenuated by voltage divider R13/R35, and routed to the main board via P1-8. Adjust potentiometer R14 for a playback audio level of -10 dBm to the console main board.

Call Check controls and functions

Analog Call Check

Table 4-2 describes the controls and functions shown in Figure 4-1.

Table 4-2 ***Analog Call Check Controls and Functions***

Control/Function	Use
Back – For reversing through the messages	• Listen to Messages – Messages are retrieved using the Back and Forward controls. • Listen to Newest Messages – At the end of the newest message (Restore position), tap the Back button to play back the newest message. • Listen to Older Messages – At any location but the Restore position, tap the Back button to access the previous messages. • Continuous Rewind – Press and hold the Back button to activate continuous rewind. Playback begins automatically when the Back button is released.
Recall LED – Indicates the playback is in progress	
Restore – For returning to the end of the newest message	• Restore – Tap Restore to return to the end of the newest message.
Forward – For advancing through the messages	• Listen to Messages – Messages are retrieved using the Back and Forward controls. • Listen to Newer Messages – At any location except the Restore position, tap the Forward button to allow the recorder to play back from the beginning of the next newest message. Repeated tapping of the Forward button allows the operator to advance through multiple messages. • Continuous Fast Forward – Press and hold the Forward button for continuous fast forward. Playback starts automatically when the Forward button is released.
Hvy Traffic – For periodically updating the recording during heavy traffic	• Heavy Traffic – Pressing the Hvy Traffic button during periods of increased high traffic activity, causes the recorder to automatically update at one- or two-minute intervals to within 12 seconds from the end of the last message; this ensures that the most recent part of the last message is heard.
Recording – For indicating that recording is in progress	• Recording – This automatic function does not require operator intervention.

Digital Call Check

Table 4-3 describes the digital Call Check CCM controls shown in Figure 4-1.

Table 4-3 ***Digital Call Check Controls and Functions***

Control/Function	Definition
Prev/Rwd – For reversing through the messages	• Listen to Messages – Messages are retrieved by using the Prev/Rwd and Next/Fast Fwd controls. • Listen to Newest Message – When at the end of the newest message (Restore position), tap and hold the Prev/Rwd control for less than .5 seconds and the newest message will be played back even if it is still being recorded. • Listen to Older Messages – When at any location except the Restore position, tap the Prev/Rwd control to access previous messages. • Incremental Rewind – Press and hold the Prev/Rwd control for more than .5 seconds until you hear a tone. By releasing the Prev/Rwd control within a second after hearing the tone, the operator can replay the last 4 to 5 seconds of the messages. • Continuous Rewind – By pressing the Prev/Rwd control and holding it until after the incremental rewind tone is heard and the continuous rewind begins, the operator will activate a tone that will sound each time the beginning of a message is reached. Playback begins automatically when the Prev/Rwd control is released.
Playing LED – For indicating that playback is in progress	
Restore – For returning to the end of the newest message	• Restore – Tap the Restore control to return to the end of the newest message; the playback function will also be stopped.
Recording – For indicating that recording is in progress	• Recording – This function is automatic and does not require operator intervention.
Next/Fast Fwd – For advancing through the messages	• Listen to Messages – Messages are retrieved by using the Prev/Rwd and Next/Fast Fwd controls. • Listen to Newer Messages – When at any location but the Restore position, tap the Next/Fast Fwd control to allow the recorder to play back from the beginning of the next newest message. Repeated tapping of this control allows the operator to advance through multiple messages. • Continuous Fast Forward – By pressing and holding the Next/Fast Fwd control for more than 0.5 seconds, the operator activates the continuous fast forward function. A tone is activated each time the beginning of a message is reached. Playback is automatically activated when the Next/Fast Fwd control is released.
Pause – For stopping the playback/resume playback function	To stop playback, tap the Pause/Playing control. All other controls become inoperative when paused. Tapping the Pause/Playing control, when paused, allows resumption of playback and activation of the other controls.
Paused – For indicating a paused playback	

Digital Call Check interface specifications

Table 4-4 provides the functions and specifications of the P5 connector on the BLN6866A Option Board.

Table 4-4 ***P5 Connector Pin Specification***

Pin #	Description	Specifications
1	Call Check supply voltage	18 V nominal, 16.5 V minimum, 22 V maximum.
2	No connection	—
3	Call Check ground	—
4	Pause switch output	Relay closure to Call Check ground (active state). Relay closure to Call Check supply voltage (idle state).
5	Record switch output	Relay closure to Call Check ground (active state).
6	Playback audio input	+ 10 dBm maximum.
7	+ Balanced record audio output	-10 dBm (referenced to pin 14).
8	Paused LED feedback signal input	V (input) high = 3.5 V minimum, 1 mA source capability (paused). V (input) low = 1 V maximum (not paused).
9	Playing LED feedback signal input	V (input) low = 1.5 V max., 30 mA sink capability. V (input) high supplied by 100 k pullup to Call Check supply voltage.
10	Recording LED feedback signal input	V (input) low + 1.5 V max., 30 mA sink capacity. V (input) high supplied by 100 k pullup to Call Check supply voltage.
11	Restore switch output	Relay closure to Call Check ground.
12	Previous/Rewind switch output	Relay closure to Call Check ground.
13	Next/Fast Forward output	Relay closure to Call Check ground.
14	- Balanced record audio output	Refer to + balanced record audio, pin 7.

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BLN6866A Parts List

Reference	Part Number	Description
		diode: (see note)
CR5 thru 13	4813833D08	1A, 600V
		jumper:
JU1	0611009B23	0 ohm, ±5%; 1/4 W
JU3	0611009B23	0 ohm, ±5%; 1/4 W
JU5	0611009B23	0 ohm, ±5%; 1/4 W
		relay:
K1 thru 9	8084090N03	12 V DC, 2A
		speaker:
LS1	5083315R01	XDCR W/INTERNAL DRV CKT
		connector:
P1	2883290P04	plug: 20-contact
P2,3	2883291R03	PLUG 15 PIN
P5	2884008P05	plug: 14-contact
		resistor, fixed:
R1 thru 8	0611009A51	1.2K, ±5%; 1/4W
R9 thru 12	0611009B22	1 meg, ±5%; 1/4W
R13	0611009A73	10K, ±5%; 1/4 W
R14	1883083G03	RES VAR CBN 25K 30 1/4W
R15,16	0611009A59	2.7K, ±5%; 1/4W
R17 thru 22	0611009A51	1.2K, ±5%; 1/4W
R23	0611009A69	6.8K, ±5%; 1/4W
R24	0611009A51	1.2K, ±5%; 1/4W
R25	0611009A69	6.8K, ±5%; 1/4W
R26	0611009A47	820 ohms, ±5%; 1/4W
R27	0611009A49	1K, ±5%; 1/4 W
R28 thru 33	0611009A47	820 ohms, ±5%; 1/4W
R34,35	0611009A49	1K, ±5%; 1/4 W
R36	0611009A73	10K, ±5%; 1/4 W
		transformer:
T1	2584007C02	Audio Frequency
		integrated circuit: (see note)
U1 thru 4	5184339T01	IC OCTOCPLR _4N38_
		non-referenced items:
	0210971A16	Nut, hex: 3 x 0.5mm (2 used)
	0310907A22	Screw, machine: M3x0.5x16 (2 used)
	4284995M02	RETAINER

NOTE: For optimum performance, diodes and integrated circuits must be ordered by Motorola part number.

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MOTOROLA

5

External Speaker

About this chapter

Section	Page	Description
Introduction	5-2	Provides an overview of the External Speaker.
Theory	5-3	Describes the operation of the External Speaker.
BSN6003A Parts List	5-9	Provides a parts list for the External Speaker.

Models covered

The following models of the external speaker are covered in this chapter:

Model	Description
BSN6003A	External Speaker

Introduction

The BSN6003A CIE External Speaker Amplifier is designed to be a stand-alone speaker for use with the CENTRACOM Gold Series CRT or Elite consoles. It provides up to 1.25 watts of audio to an 8 ¾ load and contains the anti-aliasing and guard tone notch filters for reconstructing the receive audio. Two audio inputs allow regular audio and auxiliary audio to be heard in the speaker. The main audio circuit provides volume control and muting of the audio.

Theory

Main audio path

Balanced audio is received on pins 3 and 4 of connector J1 and then applied to transformer T1. The transformer converts the audio to unbalanced and passes it to a unity gain buffer (p/o U1). After the buffer, the audio is applied to the input of a synthesized lowpass ladder filter hybrid (Z1). This filter is based on computer-optimized values for a fifth order elliptic lowpass filter and attenuates the aliasing signals to the level of noise and distortion guaranteed by the system specifications.

The output of the lowpass filter is connected to guard tone notch filter hybrid Z2 through an attenuator comprised of an op amp and some resistors. The attenuator ensures that the guard tone input to the notch filter does not exceed -10 dBm from any parallel system source such as a remote desk set. This prevents the bandpass stage of the filter from clipping. The notch filter is strapped to recover the gain lost in the attenuator. The output level of the notch filter should be approximately -10 dBm for an input level of -15 dBm at T1.

The output of the notch filter then passes through a mute gate (Q1 and Q2) before going to the volume adjust pot and on to a TDA2002 audio amplifier. The audio amplifier has a gain of 26 dB, so the output of the volume pot is attenuated by 2.3 dB before it gets to the input of the audio amplifier to get the correct level at the speaker. The output of the audio amplifier is single sided audio biased to half of B+. The speaker is then AC coupled to the output of the audio amplifier and referenced to audio ground. The audio amplifier is powered directly from Fused B+ to allow the maximum output voltage swing for a given input supply voltage to the board. The output to the speaker is a minimum of a 0.31 watt for each source, with an input level of -16 dBm at T1. Up to four sources can be combined to reach a peak power output of 1.25 watts.

Aux audio path

The aux audio enters the board as unbalanced audio through J1-2. It is then attenuated by about 6 dB and applied to the audio power amplifier. There is no provision for volume control or muting of this audio path.

Voltage regulation

The power and ground for the board enter through pins J1-1 and 6. The voltage passes through a fuse and is then applied to the input of 12 V regulator VR1. The fused voltage is also applied to the power pins of the audio amplifier. The 12 V regulator provides power for the rest of the components on the board. The 12 V is also divided down to approximately 6 V by a resistor divider and a unity gain buffer. The 6 V output is used as an audio reference by various sections of circuitry.

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BSN6003A Schematic

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BSN6003A Parts List

Reference	Part Number	Description
		capacitor, fixed:
C1	2113741B69	0.1 uF, ±5%; 50 V
C2 thru 4	2311049A21	22 uF, ±10%; 20 V
C5	2113741B49	0.015 uF, ±5%; 50V
C6	2311049A08	1 uF, ±10%; 35 V
C7	2113741B69	0.1 uF, ±5%; 50 V
C8,9	2311049A08	1 uF, ±10%; 35 V
C10	2113741B49	0.015 uF, ±5%; 50V
C11,12	2313748G25	333 uF, ±20%; 35V
C13,14	2113741B69	0.1 uF, ±5%; 50 V
C15	2313748G25	333 uF, ±20%; 35V
C16 thru 18	2113741B69	0.1 uF, ±5%; 50 V
		diode: (see note)
CR1,2	4813833C10	0.1A, 70 V
		fuse:
F1	6582408R05	1/2A, 125V
		connector:
J1	0983112N01	receptacle: 6-contact
		jumper:
JU1	0611009B23	0 ohm, ±5%; 1/4 W
		connector:
P2	2880004T02	plug: 2-contact
		transistor: (see note)
Q1	4800869653	type JFET
Q2	4811056B08	PNP
		resistor, fixed:
R1,2	0611077B15	47K, ±5%; 1/8 W
R3	0611077A82	2.2K, ±5%; 1/8 W
R4 thru 6	0611077B11	33K, ±5%; 1/8 W
R7	0611077A92	5.6K, ±5%; 1/8 W
R8	0611077B47	1 meg, ±5%; 1/8 W
R9	0611077B23	100K, ±5%; 1/8 W
R10	0611077A92	5.6K, ±5%; 1/8 W
R12	0611077B31	220K, ±5%; 1/8 W
R13	0611077B15	47K, ±5%; 1/8 W
R14	0611077B47	1 meg, ±5%; 1/8 W
R15	0611077A98	10K, ±5%; 1/8 W
R16	0611077B23	100K, ±5%; 1/8 W
R17	1884667R04	RES VAR 5000 20 0.5
R18	0611077A54	150 ohms, ±5%; 1/8 W
R20	0611077A98	10K, ±5%; 1/8 W
R22 thru 25	0611077A50	100 ohms, ±5%; 1/8 W
R26	0611077A26	10 ohms, ±5%; 1/8 W
R27	0611077A02	1 ohms, ±5%; 1/8 W
R28	0611077A58	220 ohms, ±5%; 1/8 W
		transformer:
T1	2584007C02	Audio Frequency

Reference	Part Number	Description
		integrated circuit: (see note)
U1	5113819A04	Quad Operational Amplifier
U2	5184621K60	8W Class B Audio Power Amplifier
		voltage regulator: (see note)
VR1	5113816J03	12V Positive Regulator,100MA
		network:
Z1	0182989R31	Low Pass Filter
Z2	0180717D13	Notch Filter
		non-referenced items:
	0782111T01	Bracket, pot mounting (used with R17)
	0982425R01	Fuseholder (used with F1)
	2683373P02	HEAT SINK, transistor (used with U2)

NOTE: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part number.

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MOTOROLA

6

Console Operator Remote Interface Board

About this chapter

Section	Page	Description
Introduction	6-2	Provides an overview of the Console Operator Remote Interface Board.
Theory	6-3	Describes circuit operation of Console Operator Remote Interface board.
BLN6832A Parts List	6-13	Provides a parts list for the Console Operator Remote Interface board.

Models covered

The following models of the Console Operator Remote Interface (CORI) board are covered in this chapter:

Model	Description
BLN6832A	Console Operator Remote Interface Board

Introduction

The BLN6832A CORI board provides the interface for a remote operator position. The board contains the following circuits:

- ❒ Speaker receivers
- ❒ Microphone transmitter
- ❒ RS-232-C interface
- ❒ 2175 Hz pilot tone generator
- ❒ Alert tone generator
- ❒ CMOS regulator
- ❒ 10 V audio regulator
- ❒ V_b generator
- ❒ +5 V generator
- ❒ -12 V generator

Theory

Speaker receivers

The two speaker receivers (select audio and unselect audio in most cases) receive audio and a 2175 pilot tone from the phone lines connecting the operator position to the CEB. The expected audio input level is from -25 dBm to + 5 dBm with the 2175 pilot tone 6 dB below the audio signal. From the input transformer, the audio is sent to an automatic level control (ALC) configured for an output of -15 dBm. The 2175 Hz guard tone is only added to provide a reference level at which the ALC remains when the audio signal is not present. A fail detector monitors the ALC to verify that the ALC is constantly in its ALC gain mode (which should be as long as the 2175 Hz pilot tone is present). If the phone line goes silent (including the 2175 Hz pilot tone), the fail detector triggers an alert tone to be sent to the speaker corresponding to the phone line that went silent.

The speaker audio then travels through two notch filters that remove the 2175 Hz pilot tone. Both notch filters reduce the 2175 Hz to an acceptable level. From there, the audio is filtered through a low pass filter and is finally sent to the output transformer driver which sends the audio at -15 dBm to the speaker input of the console radio control board.

Microphone transmitter

The microphone transmitter sends the 0 dBm console microphone audio down the phone lines at 0 dBm along with a 2175 Hz pilot tone set at -6 dBm. The microphone audio is coupled to the CORI board by transformer T2. The audio is then level-shifted by U1A, which is typically configured to provide -2 dB of attenuation. Jumpers JU4, JU5, and JU6 are used to set alternate attenuation output levels of + 10 dBm, 0 dBm, -6 dBm, and -13 dBm. (Refer to the schematic diagram for complete jumper information.) U1A also acts as a summer by adding in the 2175 Hz pilot tone. The low pass filter attenuates all audio above 4 kHz that was produced by the 2175 Hz square wave of the CMOS logic circuit. The audio signal is coupled to U1B (a buffer and gain stage operational amplifier) and finally to the output line driver hybrid Z1.

RS-232-C interface

The RS-232-C circuitry changes the console source data from a ground and 15 V signal to a ±5 V RS-232-C signal. Console source data enters through P5-2. U12B buffers the signal which is then sent to U10C (a RS-232-C transmit IC) and finally out to P4-5. The RS-232-C circuitry also level-shifts the ±5 V Console Operator Interface Module (COIM) source data from the modem to the 0 to 5 V used by the console. A RS-232-C receiver IC (U11) recovers the inbound COIM source data from P4-3. Buffers U12C, D, E, and F are paralleled to provide a greater current sourcing capability to the signal sent to the console through P2-9. The RS-232-C circuitry (via U10B) also provides a Clear To Send line to the modems.

2175 Hz pilot tone generator

The 2175 Hz pilot tone is generated by a 3.9672 MHz crystal/CMOS oscillator. This signal is then divided down by U6, a programmable divide-by-n counter, to 17.4 kHz. From U6, a binary counter generates the 2175 Hz for the pilot tone and a 1087.5 Hz time base for the alert tone generator. The 2175 Hz signal is continually generated; however, if a failure condition exists, it will not be sent down the microphone transmitter line.

Alert tone generator

The alert tone uses U8, a 14-bit binary counter (expanded to a 16-bit binary counter by the addition of U9, a dual D flip-flop) to select the tone period and the tone duty cycle. When a failure occurs, the binary counter is set into a free running mode. When the selected time frame has passed, the output corresponding to that time goes high. This produces a reset pulse, which clears the U7B 4-bit binary counter, and thus enables the 544 Hz tone to be gated to the speaker line on which the failure was detected. After the selected duty cycle has ended, U7B latches up until the tone period has passed and another reset pulse is sent to U7B. Selectable tone duty cycles include 15 ms, 30 ms, 60 ms, 120 ms, 240 ms, and 480 ms. Selectable tone periods include 4 sec, 8 sec, 15 sec, 30 sec, and 60 sec. Refer to the alert tone output table on the schematic diagram for complete details.

CMOS regulator

The CMOS regulator powers all CMOS circuitry on the CORI. The central component of the regulator is a current limiter composed of Q9 and Q10, which supplies base drive for series pass transistor Q8. The regulation is controlled by VR1, R71, R72, CR19, and Q11. Q11 provides the feedback to control the current limiter source and also provides constant current through Zener VR1 to create better voltage regulation. As the output rises, more current is sourced into the base of Q9, turning it on, and thus starving base drive to Q10, which shuts down series pass transistor Q8.

Current limiting is handled primarily by Q6, R50, and R51. As the current to the load increases, the voltage across R50 and R51 increases. This causes Q6 to turn on and sink current into R53. This prevents base drive to Q7 and as Q6 saturates, Q7 shuts off. Once Q7 shuts off, there is no longer any driving current for series pass base driver Q10; therefore, the current limiter and the series pass shut off. To provide a snap-action shutoff of Q8, CR16 is placed from the collector of Q6 to the base of Q8. When Q6 saturates, CR16 forces 0.4 V across the base-emitter junction of Q8 and shuts Q8 off hard and fast. This also protects against any leakage from the emitter to collector of Q7. A second current limiter prevents the high current path through Q6 (emitter-base), CR14, and out through the series pass. This path is limited by CR11, CR12, and CR13, since these three diodes conduct when 1.6 V appears across the input to the base of the series pass Q8. This is a lower voltage than the 1.8 V needed for the high current path to become functional.

Output short-circuit protection is provided by CR17, which places 0.4 V across the base-emitter junction of Q10 when the output is shorted to ground. This holds Q10 off and therefore prevents a base drive path for the series pass Q8. The only current supplied to the short is the current through R66.

If a CMOS device goes into an SCR condition, it creates a high current drain on the regulator and causes the regulator voltage to go low. The high current drain initiates the pulsing by forcing current through the Q6 base-emitter. This turns off Q7 and Q8 which removes the high current demand, allowing Q6 to turn off again. However, Q6 is held on by C17 as C17 charges through the Q6 emitter-base junction and R54. When C17 becomes charged, it releases the base of Q6 and allows Q6 to turn off and Q7 to turn on to supply current to the series pass current limiter (Q9 and Q10). As Q7 turns on, it also discharges C17 by placing a charge on the negative side of C17. If the SCR condition exists, the regulator only pulses for the length of time that it takes to discharge C17.

10 V audio regulator

The 10 V audio regulator used to drive the audio components is similar to the discrete regulator used for the CMOS regulator. No SCR protection is provided, since no CMOS is driven from this regulator. The only current limiting is provided by the base drive generated by the current limiter (Q14, Q15, and R82) and the gain of the Q13 series pass transistor. Short circuit current limiting is provided by CR22. The audio 10 V is used to create the reference voltage.

V_b generator

The reference voltage is divided down from the audio 10 V by R83 and R84. The resulting voltage is then sent through a unity gain buffer to provide a constant reference voltage.

+5 V generator

The +5 V supply is created by VR3, a 5 V regulator from the A+ supply.

-12 V generator

The -12 V generator supplies the negative voltage for the RS-232-C interface circuitry, and is composed of U7A, Q17-Q21, and the associated passive components. The -12 V is derived by level-shifting a frequency, then using it to drive a voltage doubler.

The 8.7 kHz output of U7A provides the frequency and turns on and off the level-shifting driver pair, Q17 and Q18. A logic low from U7A turns off Q17 and turns on Q18. A logic high from U7A turns on Q17 and forces Q18 off. Since the logic high output is only 9.6 volts, and Q18 requires at least 15.4 volts base voltage to guarantee shutoff, C12 creates a dc offset which, when added to the 9.6 V logic high, produces a high enough voltage to assure shutoff of Q18. Q17 and Q18, drive the push-pull pair Q19 and Q20. To prevent a high current path through the collector-emitters of Q20 and Q19 during the finite transition time, Q21 and R46, R47, and R48 were added to form a current limiter that can source a maximum of 200 mA. However, this current limiter is typically nonfunctioning. The created 15.8 V swing sources current into C14, the coupling capacitor. The negative lead of C14 is clamped to ground by CR9, thereby only allowing the negative excursions to occur which, through CR10, provide the negative voltage to develop across filter

capacitor C15. CR34 and CR35 allow Q19 and Q20 to remain off if there is a loss of input signal to the circuit.

Fail detect and alert tone generation

Different pulse periods and duration times are selectable by proper selection of R31 through R42. Pulse periods of 4, 8, 15, 30, and 60 seconds are individually selectable by installation of the proper resistor R33 through R37. Only one resistor may be installed at a time. Pulse durations of 60, 120, 240, and 480 milliseconds are individually selectable by installation of the proper resistor R39 through R42 with R32 installed. Again, only one resistor, R39 through R42, may be installed at a time. If R31 is installed and R32 is out (duration divided by 4 selected), pulse durations of 15 and 30 milliseconds are available by installing either R39 or R40 (60/4 = 15; 120/4 = 30 milliseconds).

Each line receiver contains a fail detect circuit that detects the presence of ALC above the knee of compression. Only the select audio receiver line is discussed here. The circuit consists of Z3 and U2A. Normally, the 2175 Hz audio superimposed on the input signal to Z3 is of sufficient level to keep the ALC level of Z3 above the knee of compression. If the 2175 Hz audio fails for any reason, the voltage at Z3-12 drops below the voltage at Z3-19 and drives the output of U2A low. The low at the output of U2A enables gate U5A and shunts the fail bus's 2175 Hz input to Q5 through CR29, shutting off Q5.

Two events now occur. First, the green LED, DS1, shuts off and the red LED, DS2, turns on. Second, the reset line through R20, R29, and R30 to U8-11 and U9-10 goes low. This resets U8 and U9, and sets all U8 and U9 outputs low at the start of the count cycle. The alert tone resistors are installed at the factory in accordance with Table 2 on the schematic diagram. As factory supplied, R37 is installed and R33 through R36 are not installed (P60 selected). R32 is installed and R31 is removed (D selected). The Q12, Q13, Q14 outputs of U8 and the pin 11 and pin 13 outputs of U9 go high one at a time as counting continues. About 60 seconds after counting begins, U9-13 goes high and with R37 installed, the high at U9-13 charges C59. This action provides a positive reset pulse to U7B-15, enabling U7B and setting all of its outputs low at the beginning of the count cycle. If one of the other resistors, (R33 through R36), had been installed instead of R37, the high reset to U7B through C59 would have occurred earlier.

As factory supplied, R32, R38, and R39 are installed and R40 through R42 are removed to provide an alert tone duration of 60 ms (D60 selected). The low at U7B-11 enables NAND gate U5D, allowing the 544 Hz alert tone to pass to U5A which was enabled by the low output at U2A-1. The 544 Hz tone now passes through U11C, is amplified by U2B, and applied to the select speaker amplifier. The first high to low transition at U8-4 clocks U7B via its enable input at U7B-10. This causes the Q0 output at U7B-11 to go high. Two events now occur.

First, U5D is disabled preventing the 544 Hz tone from passing. Second, the clock input to U7B is pulled high through R39 and R38, preventing any further counting by U7B. Counter U8/U9 continues to function, and after a period of 60 seconds, a high-to-low transition occurs at U9-13. This resets U7B and starts the cycle over again. This action continues until the line failure is corrected.

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BLN6832A Parts List

Reference	Part Number	Description
		capacitor, fixed:
C1	0882045F09	2.2 uF, ±10%; 250V
C2	2313748G22	100 uF, ±20%; 25 V
C3	0811051A14	0.15 uF, ±5%; 63V
C4	2313748G14	22 uF, ±20%; 35V
C5	2111014H34	24 pF, ±5%; 100V
C6	2313748G04	1 uF, ±20%; 50V
C7	2111014H34	24 pF, ±5%; 100V
C8	0811017A01	1000 pF, ±5%; 50 V
C9	0811051A11	0.047 uF, ±5%; 63 V
C10	2313748G06	4.7 uF, ±20%; 50V
C11	2313748G04	1 uF, ±20%; 50V
C12	0811051A12	0.068 uF, ±5%; 63 V
C13	0811017A01	1000 pF, ±5%; 50 V
C14	2313748G14	22 uF, ±20%; 35V
C15	2313748G22	100 uF, ±20%; 25 V
C16	2313748G25	333 uF, ±20%; 35V
C17,18	2313748G06	4.7 uF, ±20%; 50V
C19 thru 21	0811051A12	0.068 uF, ±5%; 63 V
C22	0811017A06	470 pF, ±5%; 50 V
C23	2313748G14	22 uF, ±20%; 35V
C24 thru 26	0811051A14	0.15 uF, ±5%; 63V
C27	2313748G04	1 uF, ±20%; 50V
C28	0811051A14	0.15 uF, ±5%; 63V
C29,30	2313748G14	22 uF, ±20%; 35V
C31	2384665F06	220 uF, +150%/-10%; 25V
C34	2384665F06	220 uF, +150%/-10%; 25V
C35	0811051A12	0.068 uF, ±5%; 63 V
C36	0811017A06	470 pF, ±5%; 50 V
C37	2313748G14	22 uF, ±20%; 35V
C38,39	0811051A14	0.15 uF, ±5%; 63V
C40	0882045F09	2.2 uF, ±10%; 250V
C41	0811051A12	0.068 uF, ±5%; 63 V
C42	2111014H34	24 pF, ±5%; 100V
C43	2313748G06	4.7 uF, ±20%; 50V
C44	2313748G14	22 uF, ±20%; 35V
C45	2111014H34	24 pF, ±5%; 100V
C46	2313748G14	22 uF, ±20%; 35V
C47,48	2111014H34	24 pF, ±5%; 100V
C49	2313748G04	1 uF, ±20%; 50V
C50	2384665F06	220 uF, +150%/-10%; 25V
C51	0811017A01	1000 pF, ±5%; 50 V
C52	0811051A11	0.047 uF, ±5%; 63 V
C53,54	2111022G37	20 pF, ±5%; 50V
C55 thru 59	0811051A14	0.15 uF, ±5%; 63V
C60	0882045F09	2.2 uF, ±10%; 250V
C61	0811051A12	0.068 uF, ±5%; 63 V
C62	2111014H34	24 pF, ±5%; 100V
C63	2313748G06	4.7 uF, ±20%; 50V
C64	2313748G14	22 uF, ±20%; 35V
C65	2111014H34	24 pF, ±5%; 100V
C66	2313748G14	22 uF, ±20%; 35V
C67,68	2111014H34	24 pF, ±5%; 100V
C69	2313748G04	1 uF, ±20%; 50V
C70	2384665F06	220 uF, +150%/-10%; 25V
C71	0811017A01	1000 pF, ±5%; 50 V
C72	0811051A11	0.047 uF, ±5%; 63 V
		diode: (see note)
CR1 thru 4	4813833D08	
CR5 thru 8	4883654H01	silicon
CR9,10	4813833D08	
CR11,12	4883654H01	silicon
CR13	4882592W01	Schottky, Barrier
CR14,15	4883654H01	silicon
CR16,17	4882592W01	Schottky, Barrier
CR18	4813833D08	
CR19,20	4883654H01	silicon
CR21	4813833D08	
CR22	4882592W01	Schottky, Barrier
CR23	4883654H01	silicon
CR24 thru 27	4813833D08	
CR28 thru 33	4883654H01	silicon
		light emitting diode: (see note)
DS1	4888245C22	GRN
DS2	4888245C24	RED
		fuse:
F1	6584539T05	FUSE SUBMIN AXL LD MCR1/2
		jumper:
JU2,3	0611009B23	0 ohm, ±5%; 1/4 W
JU7	0611009B23	0 ohm, ±5%; 1/4 W
JU9	0611009B23	0 ohm, ±5%; 1/4 W
JU11,12	0611009B23	0 ohm, ±5%; 1/4 W
		connector:
P1	2883636P01	plug: 3-contact
P2	2883290P08	plug: 14-contact
P3	3182891M02	terminal block: 6-contact (screw type)
P4	0983365N01	receptacle: 8-contact
P5	2883290P04	plug: 20-contact
P6,7	2883290P02	plug: 10-contact
		transistor: (see note)
Q1,2	4813824D08	NPN
Q3 thru 7	4813824D12	PNP
Q8	4800869641	PNP
Q9,10	4813824D08	NPN
Q11	4813824D12	PNP
Q13	4800869641	PNP
Q14,15	4813824D08	NPN
Q16,17	4813824D12	PNP
Q18	4813824D08	NPN
Q19	4800869640	NPN
Q20	4800869641	PNP
Q21	4813824D12	PNP
Q23,24	4813824D12	PNP
		resistor, fixed:
R1	0611009A31	180 ohms, ±5%; 1/4W
R2	0611009A91	56K, ±5%; 1/4W
R3	0611009A81	22K, ±5%; 1/4W
R4	0611009B22	1 meg, ±5%; 1/4W
R5	0611009A89	47K, ±5%; 1/4W
R6	0611009A85	33K, ±5%; 1/4W
R7	0611009A99	120K, ±5%; 1/4W
R8	0611009B22	1 meg, ±5%; 1/4W
R9	0611009A67	5.6K, ±5%; 1/4W
R10,11	0611009A99	120K, ±5%; 1/4W

BLN6832A Parts List

R12	0611009B02	150K, ±5%; 1/4W
R13	0611009A93	68K, ±5%; 1/4W
R14	0611009A57	2.2K, ±5%; 1/4 W
R15	0611009A81	22K, ±5%; 1/4W
R16	0611009A91	56K, ±5%; 1/4W
R17	0611009A83	27K, ±5%; 1/4W
R18	0611009A93	68K, ±5%; 1/4W
R19	0611009A75	12K, ±5%; 1/4W
R20	0611009A91	56K, ±5%; 1/4W
R21	0611009A79	18K, ±5%; 1/4W
R22	0611009A97	100K, ±5%; 1/4W
R23	0611009A17	47 ohms, ±5%; 1/4W
R24	0611009A16	43 ohms, ±5%; 1/4W
R25	0611009A79	18K, ±5%; 1/4W
R26	0600124B40	5.6 meg, ±5%; 1/4W
R27	0611009A57	2.2K, ±5%; 1/4 W
R28	0611009A49	1K, ±5%; 1/4 W
R29,30	0611009A57	2.2K, ±5%; 1/4 W
R32	0611009A57	2.2K, ±5%; 1/4 W
R37 thru 39	0611009A57	2.2K, ±5%; 1/4 W
R43	0611009A73	10K, ±5%; 1/4 W
R44,45	0611009A85	33K, ±5%; 1/4W
R46 thru 48	0611009A01	10 ohms, ±5%; 1/4W
R50,51	0611009A01	10 ohms, ±5%; 1/4W
R52	0611009A59	2.7K, ±5%; 1/4W
R53	0611009A73	10K, ±5%; 1/4 W
R54,55	0611009A69	6.8K, ±5%; 1/4W
R66	0611009A61	3.3K, ±5%; 1/4 W
R67	0611009A41	470 ohms, ±5%; 1/4W
R68	0611009A51	1.2K, ±5%; 1/4W
R69	0611009A23	82 ohms, ±5%; 1/4 W
R70	0611009A49	1K, ±5%; 1/4 W
R71	0611009A19	56 ohms, ±5%; 1/4W
R72	0611009A03	12 ohms, ±5%; 1/4W
R73	0611009A79	18K, ±5%; 1/4W
R76	0611009A45	680 ohms, ±5%; 1/4W
R77	0611009A87	39K, ±5%; 1/4W
R78	0611009A41	470 ohms, ±5%; 1/4W
R79	0611009A23	82 ohms, ±5%; 1/4 W
R80	0611009A49	1K, ±5%; 1/4 W
R81	0611009A19	56 ohms, ±5%; 1/4W
R82	0611009A03	12 ohms, ±5%; 1/4W
R83	0611009A81	22K, ±5%; 1/4W
R84	0611009A85	33K, ±5%; 1/4W
R88 thru 91	0611009A83	27K, ±5%; 1/4W
R93,94	0611009A43	560 ohms, ±5%; 1/4W
R97,98	0611009A73	10K, ±5%; 1/4 W
R99	0611009A81	22K, ±5%; 1/4W
R100,101	0611009A51	1.2K, ±5%; 1/4W
R102	0611009A91	56K, ±5%; 1/4W
R104	0611009A95	82K, ±5%; 1/4W
R105	0611009A93	68K, ±5%; 1/4W
R106	0611009B22	1 meg, ±5%; 1/4W
R107	0611009A97	100K, ±5%; 1/4W
R108,109	0611009A89	47K, ±5%; 1/4W
R110	0611009B22	1 meg, ±5%; 1/4W
R111	0611009A67	5.6K, ±5%; 1/4W
R112	0611009B22	1 meg, ±5%; 1/4W
R113	0611009A81	22K, ±5%; 1/4W
R114	0611009A85	33K, ±5%; 1/4W
R115	0611009A45	680 ohms, ±5%; 1/4W
R116	0611009A53	1.5K, ±5%; 1/4W
R117	0611009B04	180K, ±5%; 1/4W
R118	0611009A91	56K, ±5%; 1/4W
R119	0611009A81	22K, ±5%; 1/4W
R120,121	0611009A51	1.2K, ±5%; 1/4W
R122	0611009A91	56K, ±5%; 1/4W
R124	0611009A95	82K, ±5%; 1/4W
R125	0611009A93	68K, ±5%; 1/4W
R126	0611009B22	1 meg, ±5%; 1/4W
R127	0611009A97	100K, ±5%; 1/4W
R128,129	0611009A89	47K, ±5%; 1/4W
R130	0611009B22	1 meg, ±5%; 1/4W
R131	0611009A67	5.6K, ±5%; 1/4W
R132	0611009B22	1 meg, ±5%; 1/4W
R133	0611009A81	22K, ±5%; 1/4W
R134	0611009A85	33K, ±5%; 1/4W
R135	0611009A45	680 ohms, ±5%; 1/4W
R136	0611009A53	1.5K, ±5%; 1/4W
R137	0611009B04	180K, ±5%; 1/4W
R138	0611009A91	56K, ±5%; 1/4W
R140,141	0611009A49	1K, ±5%; 1/4 W
R203	0611009E83	27K, ±5%; 1/4W
R223	0611009E83	27K, ±5%; 1/4W

transformer:

T1	2583036L01	Audio Frequency
T2 thru 6	2584007C02	Audio Frequency

integrated circuit: (see note)

U1 thru 4	5184621K89	Dual Operational Amplifier
U5	5184887K09	Quad 2-Input NOR Gate
U6	5184887K78	4-Bit BCD/BIN Divide by N Counter
U7	5184887K06	Dual Bindary Up Counter
U8	5184887K12	14-Stage Bindary Counter/Divider
U9	5184887K13	Dual D-Type Flip-Flop
U10	5184320A91	TTL/DTL to MOS Translator Line Driver
U11	5184320A90	Line Receiver Mos to DTL/TTL Line Converter
U12	5113806D17	Buffer Hex
		voltage regulator: (see note)
VR1,2	4883461E32	Zener 8.2V
VR3	5113816J01	+5V Voltage Regulator

crystal: (see note)

Y1	4882611M03	oscillator: 3.967 MHZ

network:

Z1	0182989R29	Line Driver
Z2	0182989R31	Low Pass Filter
Z3	0182989R36	Automatic Level Control Gain
Z6	0182989R31	Low Pass Filter
Z7	0182989R36	Automatic Level Control Gain
Z10	0182989R31	Low Pass Filter

non-referenced items:

	1484602K02	Insulator, crystal (used with Y1)

NOTE: For optimum performance, diodes, transistors, integrated circuits, and crystals must be ordered by Motorola part number.

Headset Jack

About this chapter

Section	Page	Description
Introduction	7-2	Provides an overview of the Headset Jack.
Theory	7-3	Describes the circuit operation of the Headset Jack.

Models covered

The following models of the headset jack are covered in this chapter:

Model	Description
BLN6717B	Headset Jack PCB
BLN1148B	Headset Jack
BLN1211B	Headset Jack with Extended Cable

Introduction

The Headset Jack Board (model BLN6717B) is part of the BLN1148B and BLN1211B Headset Jacks. These two jacks are identical except for cable length. The BLN1211B has an extended length cable (13 feet) to allow remote mounting of the jack. These jacks provide the interface between the operator's headset and the CENTRACOM Gold Series system. Connector P1 on the headset jack board provides all connections between the headset jack and the operator position.

When a headset plug is inserted into the headset jack, the AUX ENABLE (Headset Enable) line goes low, signaling the operator position to re-route the select audio from the operator position speaker to the headset earphone. If the telephone/headset interface option is connected, the phone receive audio (in an off-hook condition) is routed to the earphone while the select radio audio is routed back to the operator position speakers.

The audio signals to and from the headset jack board are routed through the headset ribbon cable inside the console. The signals are driven differentially for noise protection. Though noise will inevitably be induced on these lines, much of it will be common to the audio pairs. At the receiving end, these lines are applied to a common mode rejection amplifier configuration. This method provides sufficient gain while eliminating common noise.

Theory

The transmit audio signal from the headset microphone (nominal -20 dBm) enters the headset jack board at P2-2 via the red wire and the “tip” of jack receptacle J1. This connection also provides dc power supply current through resistors R20-R23 to the amplifiers inside the headset. The headset mic audio is coupled by capacitor C15 to operational amplifier U2C, which provides about 0 dB of gain. The audio is then differentially driven by operational amplifier buffers U2A and U2B and forwarded to P1-1 and -2. The select audio from the console appears at P1-5 and -6. If the telephone/headset interface option is used, the audio from this source is received at P1-9 and -10. Each differential pair is summed in common-mode rejection circuits comprised of operational amplifiers U3A and U3B. These circuits invert the differential signal of one input and add it to the other. The operational amplifiers have a high common-mode rejection ratio, meaning that common signals appearing at the (+) and (-) inputs are virtually eliminated. Consequently, the signal amplitude is doubled while the common induced noise is eliminated.

The output level of the common mode rejection stage for both the select audio and phone receive signals may be adjusted through potentiometers R11 and R13. The signals are summed at operational amplifier U1A, which provides low pass filtering and attenuation. Zener diode VR2 is placed at the output for static protection.

The BLN1148B and BLN1211B Headset Jacks accept either a 6-wire or 4-wire headset. (Jumper JU1 must be installed for the 6-wire type, and removed for the 4-wire type.) The 6-wire headset has a PTT switch; the 4-wire headset does not. When the operator initiates a PTT on a 6-wire headset, the PTT output at P1-7 goes low, activating the PTT input on the operator position.

When the headset is inserted into the jack, the connections listed in Table 7-1 are made by the tip, ring, and sleeve contacts of J1 and J2. The additional set of contacts at J2 grounds the **AUX ENABLE** output at P1-4, which indicates to the operator position that the headset is in use.

Table 7-1 ***Tip, Ring and Sleeve Contacts of J1 and J2***

Contacts	Remarks
J1 Tip	Transmit Audio & headset power
J1 Ring	PTT (not used with 4-wire)
J1 Sleeve	Receive audio
J2 Tip	Ground for transmit audio & power
J2 Ring	Diode PTT ground (not used for 4-wire)
J2 Sleeve	Ground for receive audio

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BLN6717B Parts List

Reference	Part Number	Description
		capacitor, fixed:
C1 thru 4	2313748G04	1 uF, ±20%; 50V
C5	2313748G14	22 uF, ±20%; 35V
C6,7	2113740B29	15 pF, ±5%; 50 V
C8	2313748G22	100 uF, ±20%; 25 V
C9 thru 12	2313748G09	10 uF, ±20%; 35 V
C13	2313748G14	22 uF, ±20%; 35V
C14	0811017A01	1000 pF, ±5%; 50 V
C15	0811051A12	0.068 uF, ±5%; 63 V
C16 thru 18	2113740B29	15 pF, ±5%; 50 V
C19	2313748G22	100 uF, ±20%; 25 V
		diode: (see note)
CR1,2	4813833C10	0.1A, 70 V
CR3	4882479V19	DIODE ZENER 27V
		jumper:
JU1 thru 5	0611009B23	0 Ω, ±5%; 1/4 W
		connector:
P1	2883290P02	plug: 10-contact
P2	2880001S05	plug: 10-contact
		resistor, fixed:
R1,2	0611077B07	22K, ±5%; 1/8 W
R3 thru 5	0611077A98	10K, ±5%; 1/8 W
R6,7	0611077B07	22K, ±5%; 1/8 W
R8 thru 10	0611077A98	10K, ±5%; 1/8 W
R11	1883903T02	POTENTIOMETER PC MOUNT .5W
R12	0611077B13	39K, ±5%; 1/8 W
R13	1883903T02	POTENTIOMETER PC MOUNT .5W
R14	0611077B05	18K, ±5%; 1/8 W
R15	0611077B07	22K, ±5%; 1/8 W
R16	0611077A98	10K, ±5%; 1/8 W
R17,18	0611077B07	22K, ±5%; 1/8 W
R19	0611077A98	10K, ±5%; 1/8 W
R20 thru 22	0611009A41	470 Ω, ±5%; 1/4W
R23	0611009A19	56 Ω, ±5%; 1/4W
R24	0611077A94	6.8K, ±5%; 1/8 W
25	0611077A98	10K, ±5%; 1/8 W
R26	0611077A90	4.7K, ±5%; 1/8 W
R27,28	0611077A98	10K, ±5%; 1/8 W
R29	0611077A90	4.7K, ±5%; 1/8 W
R30	0611077A98	10K, ±5%; 1/8 W
R32,33	0611077B11	33K, ±5%; 1/8 W
R34	0611077B23	100K, ±5%; 1/8 W
R35	0611077A86	3.3K, ±5%; 1/8 W
R36,37	0611077B07	22K, ±5%; 1/8 W
		integrated circuit: (see note)
U1, U3	5184621K89	Dual Operational Amplifier
U2	5113819D04	General Purpose Differential Operational Amplifier
		voltage regulator: (see note)
VR1	5113816J03	12V Positive Regulator,100mA

Reference	Part Number	Description
		non-referenced items:
	0784197T02	BRACKET POT (used with R11, R13)

NOTE: For optimum performance, diodes and integrated circuits must be ordered by Motorola part number.

BLN1148B Parts List

Reference	Part Number	Description
		non-referenced items:
	BLN6624B	HOUSING AND HDW HSET JACK
	BLN6717B	HSET JACK PCB
	0180724E22	COMP PREP SIS
	0180724E23	CHIP
	0180724E24	A/I
	0210971A16	Nut, hex: 3 x 0.5mm (3 used)
	0310907A17	SCRMCH M3X0.5X4 INTSTARPAN STL (3 used)
	0310928B30	SCREW, locking: TT5 x 0.8 x 10 (2 used)
	0310943J08	SCREW, tapping: TT3X0.5X5 (3 used)
	0310944A20	SCRTPG P3.63X1.34X10 STARPAN (4 used)
	0400007669	WSHRLCK 6 HVYSPT STL CAD (4 used)
	0783572P01	BRKT JK MTG
	0783576P01	BRKT JK
	0784197T02	BRACKET POT (2 used)
	0983782P01	CONN (2 used)
	1583575P01	HSNG JK
	3082024X01	CBL HEADSET JACK
	3083686P01	CBL FLT W/CONN
	3683573P01	KNOB TWHL (2 used)
	3700134389	TBG HS POLYOL 1/8 BLK (6.75 used)
	4283574P01	CLP CBL
	4383766P01	STANDOFF THD (3 used)
	5482006W01	Label, PCB barcode
	5482006W02	ribbon, thermal transfer
	5484497M87	LABEL, ID: 7/8 X 1/4" (2 used)
	5484960T01	Label, barcode: 6.3 x 12.7mm, white
	7582230B14	PAD, rubber

NOTE: For optimum performance, diodes and integrated circuits must be ordered by Motorola part number.

BLN1211B Parts List

Reference	Part Number	Description
		non-referenced items:
	BLN6717V	HSET JACK PCB
	BLN6994B	HSNG AND HDW HSET JACA EXTEND
	0210971A16	Nut, hex: 3 x 0.5mm (3 used)
	0310907A17	SCRMCH M3X0.5X4 INTSTARPAN STL (3 used)
	0310928B30	SCREW, locking: TT5 x 0.8 x 10 (2 used)
	0310943J08	SCREW, tapping: TT3X0.5X5 (3 used)
	0310944A20	SCRTPG P3.63X1.34X10 STARPAN (4 used)
	0400007669	WSHRLCK 6 HVYSPT STL CAD (4 used)
	0783572P01	BRKT JK MTG
	0783576P01	BRKT JK
	0784197T02	BRACKET POT (used with R11, R13)
	0983782P01	CONN (2 used)
	1583575P01	HSNG JK
	3082024X01	CBL HEADSET JACK
	3083643P09	CBL FLT 10 COND 13'
	3683573P01	KNOB TWHL (2 used)
	4283574P01	CLP CBL
	4383766P01	STANDOFF THD (3 used)
	7582230B14	PAD, rubber

NOTE: For optimum performance, diodes and integrated circuits must be ordered by Motorola part number.

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Handset

About this chapter

Section	Page	Description
Theory	8-2	Describes the circuit operation of the Handset.
BLN6869A Parts List	8-5	Provides a parts list for the Handset.

Models covered

The following models of the handset are covered in this chapter:

Model	Description
BLN1190A	Handset

Theory

The BLN1190A Handset takes the place of the console mic and select speaker when it is off-hook. For details on routing of the audio, refer to the Main board chapter of this manual.

BLN1190A Overlay and Mechanical Detail

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BLN6869A Parts List

Reference	Part Number	Description
	0300127644	SCREW, machine: 3-48 x 5/8”; 2 used
	0300135097	SCREW, lock 6-32 x 3/8”
	0300136715	SCREW, lock 6-32 x 1/4”; 4 used
	0300488006	SCREW, machine 6-32 x 1/2”; 4 used
	0310907C02	SCREW, machine M3.5 x 0.6 x 4mm; 5 used
	0784777E01	BRACKET, lever
	1484384G01	INSULATOR
	1584781E04	HOUSING, hangup
	2784782E05	BASE, hangup
	3084225N02	CABLE, w/mode plug: 8 conductor
	4084240G01	SWITCH, leaf
	4284411G01	RETAINER, stud; 2 used
	4384780E04	INSERT, hangup
	4584776E01	LEVER, switch
	7584215A03	BUMPER, recessed; 4 used

BLN6876A Parts List

Reference	Part Number	Description
		connector:
P1	0983112N02	receptacle: female; 8-contact
P2 thru 6	0283409R01	NUT, hex, M3.5 x 0.66mm
		mechanical parts:
	2983167C01	TERMINAL, strain relief; 2 used

TMN6070A Parts List

Reference	Part Number	Description
		cord, handset:
W1	1-80736B99	coiled, 10-1/2 inches long
		non-referenced items:
	3-124432	SCREW, machine: 4-40 x 1/4" 2 used
	7-83352H01	BRACKET, cord retaining
	15-84053A01	COVER, switch
	15-84107A09	HOUSING
	29-10134A66	LUG, terminal; 2 used
	40-84087A10	SWITCH, push
	59-83272G01	CARTRIDGE, dynamic
	59-84058A01	CARTRIDGE, receiver
	75-82230B14	PAD, rubber

Handset Mechanical Parts List

Reference	Part Number	Description
1	3-135097	SCREW, lock: 6-32 x 3/8”
2	5-84872E01	RIVET: .120 x .090”
3	42-84411G01	RETAINER, stud
4	15-84053A01	COVER, switch
5	3-124432	SCREW, machine: 4-40 x 1/4”; 2 used
6	3-136715	SCREW, lock: 6-32 x 1/4”; 4 used
7	3-488006	SCREW, machine: 6-32x 1/2”; 4 used
8	3-127644	SCREW, machine: 3-48 x 5/8”; 2 used
9	75-84215A03	BUMPER, recessed; 4 used
10	3-10907C02	SCREW: M3.5 x 0.6 x 4
11	7-84777E01	BRACKET
12	45-84776E01	LEVER, switch

Power Supply

About this chapter

Section	Page	Description
Introduction	9-2	Provides an overview of the Power Supply.
BPN6014A Parts List	8-5	Provides the parts list for the Power Supply.

Models covered

The following models of the power supply are covered in this chapter:

Model	Description
BPN6014A	Power Supply

Introduction

The BPN6014A Power Supply is located beneath the BLN1228A CENTRACOM Gold Series Main Board in the CIE. The power supply can be plugged into any ac source supplying 90 to 250 volts ac at 44 to 440 Hz with no modifications. It supplies +15 V at up to 4.0 amps dc. The power supply is internally fused. The Power Supply BPN6014A is shown in Figure 9-1.

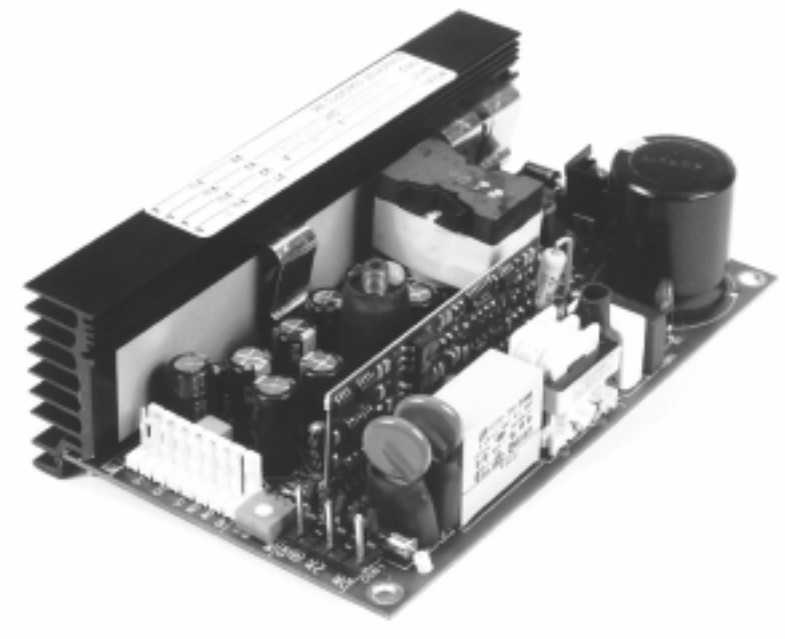

Figure 9-1 ***Power Supply BPN6014A***

Acknowledgment

Information in this instruction section is provided courtesy of Converter Concepts Inc.

Proprietary Notice

Service

Other than the imput fuse, the BPN6014A power supply is not a field serviceable unit nor is there any field adjustment required. Other servicing of this power supply should be performed by the Motorola System Support Center.

The leaded 2.5A slow blow 250 VAC input fuse may be replaced by first removing the main board, power supply and cover. Then remove CON1, unsolder the blown fuse and install the new fuse using the original ceramic spacers.

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BPN6014A Parts List

Reference	Part Number	Description
		non-referenced items:
	0182239T01	SWITCHING PWR SUP 15V 60W
	6582783T71	PIGTAIL FUSE, 2.5A 250V SLO BLO

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MOTOROLA

10

9/15 Volt Dual Operator Power Supply

About this chapter

Section	Page	Description
Introduction	10-4	Provides an overview of the power supplies and options.
Theory	10-6	Describes power supply operation.
Test procedure	10-9	Describes how to test the power supplies to determine satisfactory performance.
50 Hz ac input wiring	10-11	Describes special considerations for 50 Hz installations.
Common Parts List	10-17	Provides a parts list for common electrical components for all power supply models.
Unique Parts List	10-19	Provides a parts list for mechanical parts and electrical components that are unique to each power supply model.

Models covered

The following models of the 9/15 volt dual operator power supply are covered in this chapter:

Model	Description	Contents
BPN1022A	60 Hz 120V ac and +24V dc backup	• BLN6860A Control board • BLN6857A Pass board • BKN6071A AC power cable • BLN6859A Hardware kit
BPN1023A	50 Hz 120V ac and +24V dc backup	• BLN6860A Control board • BLN6857A Pass board • BKN6071A AC power cable • BLN6880A Hardware kit
BPN1024A	60 Hz 240V ac and +24V dc backup	• BLN6860A Control board • BLN6857A Pass board • BKN6071A AC power cable • BLN6885A Hardware kit
BPN1025A	50 Hz 220/240V ac and +24V dc backup	• BLN6860A Control board • BLN6857A Pass board • BKN6071A AC power cable • BLN6886A Hardware kit

Performance specifications

Table 10-1 ***General***

Specification	Value
Temperature	0°-50°C (32°-122°F)
Humidity range	90% maximum RH non-condensing
Line voltage	102-132 V ac for 120 V ac 187-242 V ac for 220 V ac 204-264 V ac for 240 V ac
Line frequency	57-63 Hz or 47-53 Hz
Battery backup voltage	+20-26 V dc
Primary current	3 A maximum

Table 10-2 ***+15.8 V Output***

Specification	Value
Output voltage	+15.3-16.3 V dc (15.8 V dc typical)
Output ripple	50 mV maximum
Overvoltage	+16.4-19.1 V dc (17.5 V dc typical)
Current limit	6-12 A (8A typical)
Short circuit current	3 A maximum (1.5 A typical)

Table 10-3 ***+9 V Output***

Specification	Value
Output voltage	+8.7-9.3 V dc (9 V dc typical)
Output ripple	50 mV maximum
Overvoltage	+12.65-15 V dc (13.5 V dc typical)
Current limit	1.5-4.5 A (2.5A typical)
Short circuit current	1.5 A maximum (0.75 A typical)

Introduction

Refer to Figures 10-1 and 10-2. All four power supply models consist of a dual voltage (+9 V dc and +15.8 V dc) control board, a common power transformer (T1), and an output pass board. Each model also provides the capability (if desired) for a +24 V dc backup source. Each model provides +9 V dc and +15.8 V dc outputs and also provides current limiting, short circuit current foldback, and overvoltage protection. The battery backup feature provides battery current limiting and a dead battery disconnect feature to prevent the deep discharge of batteries.

The BPN1022A Model operates from a 120 V ac, 60 Hz source.

The BPN1023A Model operates from a 120 V ac, 50 Hz source. The only difference between the BPN1023A and BPN1022A Models is the power transformer (T1) and some mechanical hardware.

The BPN1024A Model operates from a 240 V ac, 60 Hz source. It differs from the BPN1022A Model only in the wiring of the power transformer (T1) and the rating of the ac input fuse (F1).

The BPN1025A Model (as shipped) operates from a 220 V ac, 50 Hz source, but can be configured to operate from a 240 V source. It differs from the BPN1023A Model only in the wiring of the power transformer (T1) and the rating of the ac input fuse (F1).

NOTE

When the BPN1025A Operator Power Supply is operated inside a locked cabinet, the power supply is approved by the Bauart Mark/ VDE certification criteria. Removal of the power supply voids this certification. Power supplies shipped loose and/or mounted in an open rack environment do not carry the Bauart Mark certification.

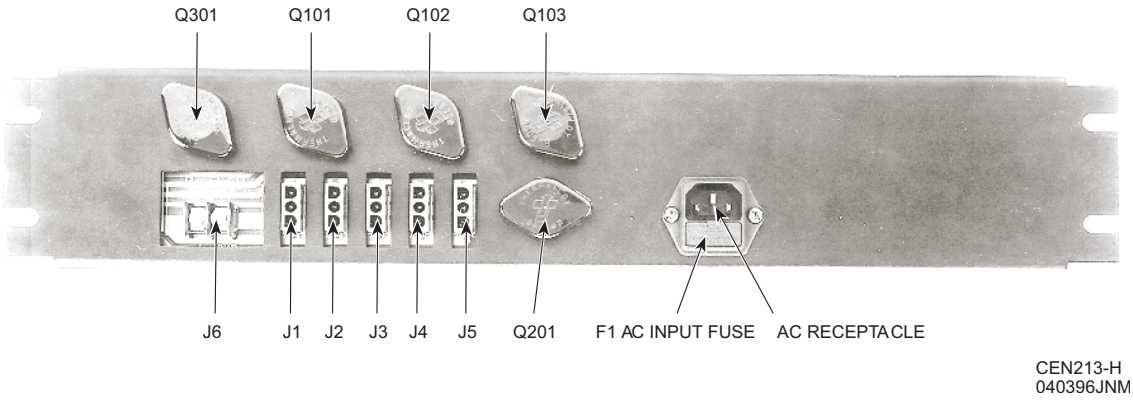


Figure 10-1 ***9/15 Volt Dual Operator Power Supply (Front View)***

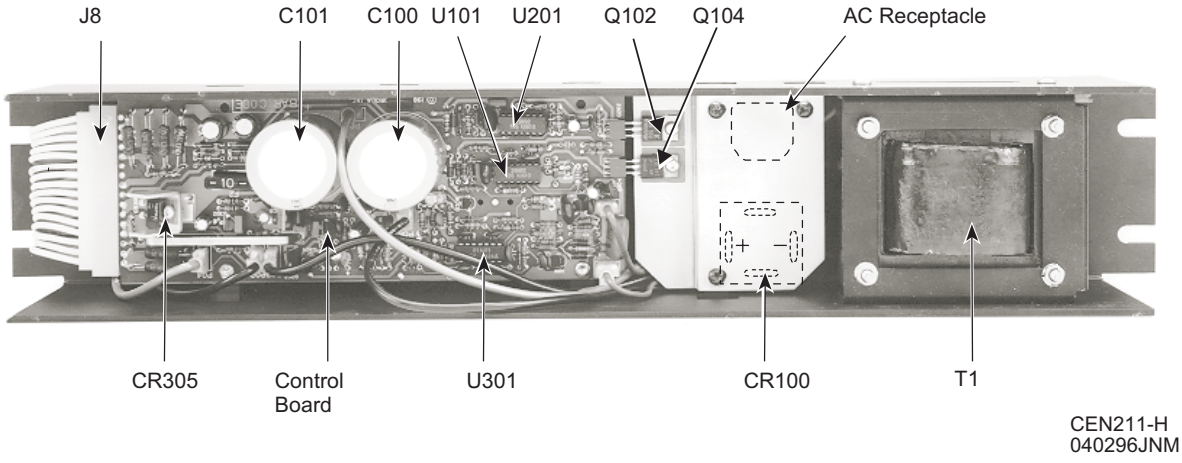


Figure 10-2 ***9/15 Volt Dual Operator Power Supply (Rear View)***

Theory

Refer to the schematic diagram. Only Model BPN1022A is discussed since it is typical. Each power supply is powered by a common power transformer (T1). Overcurrent protection is provided by fuses F1 and F2, and transient suppression is provided by RV101 and RV102. The BPN1022A Model consists primarily of two voltage regulators, two current limiters, overvoltage protection circuitry, a battery backup controller, and a battery gate.

Voltage regulators

The two voltage regulators are the heart of the power supply. Since the regulation of the +9 V side is similar to the +15.8 V side, only the +15.8 V regulation is described. The output voltage is coupled back to the inverting input (U101-4) through resistor divider network R108 and R109. This voltage is compared to the non-inverting input voltage (U101-5) created by R110 and R111 from the reference voltage internal to U101 (U101-6).

After comparing the inverting and non-inverting inputs, U101 increases or decreases the base drive to the series pass transistor driver Q104. The +15.8 V output contains three paralleled series pass transistors (Q101, Q102, and Q103) driven by Q104. The +9 V output has only one series pass transistor (Q201) driven by Q202.

Current limiting

Since the two outputs have the same current limiting schemes, only the +15.8 V output is discussed. Current limiting is provided by a transistor internal to U101. The voltage across the base-emitter junction of series pass transistors Q101, Q102, and Q103, and the voltage caused by the current through R101, R102, and R103, is equivalent to the drop across the R105, R106 divider network. The difference between the voltage across R106 and the output voltage is the voltage drop across the base-emitter junction of the internal current limit transistor (U101-2, -3). As the voltage drop across R101, R102, and R103 increases, the voltage across the base-emitter junction of the internal current limit transistor also increases. This action causes the internal current limit transistor to conduct harder which, in turn, reduces the current from series pass driver Q104.

As the current limiting action begins, the +15.8 V output voltage begins to drop. A lower output voltage dictates that a greater voltage drop across the emitter resistors is required to keep the internal current limit transistor on. In this manner, the foldback action is achieved.

The +9 V current limiter works in a similar manner except that the resistors R201, R203, and R204 are used.

Overvoltage protection

Since the two outputs have the same overvoltage protection schemes, only the +15.8 V output is discussed. If a short circuit occurs across one of the series pass transistors (Q101, Q102, or Q103), the unregulated power supply secondary voltage could be coupled to the console regulators. The console regulators could be destroyed by the excess power. Overvoltage protection is provided to prevent this from happening. The 16 V Zener (VR101) monitors the +15.8 V output and conducts when the output is in the 16.4 to 19.1 V range. When VR101 conducts, current is passed to the gate of SCR401. This current causes the SCR to conduct and open input fuse F2. The +9 V output is protected in the same manner by VR201.

Battery backup controller

The battery backup controller monitors the condition of the power supply and turns the battery gate on and off to allow or inhibit battery backup. The battery backup controller consists of the filter capacitor (C100, C101) level detector, ac input detector, missing pulse detector, and the unlatch delay timer.

Filter capacitor level detector

The filter capacitor level detector (U301A and associated components) monitors the unregulated voltage on the filter capacitors and compares it to the known voltage at which the series pass transistors saturate. When the filter capacitor voltage drops below the saturation voltage, the filter capacitor level detector latches this data and turns on the battery gate, thus backing up the ac input voltage with a +24 V dc input. The filter capacitor level detector can only be reset when the unlatch delay timer is high. During a low ac line voltage and a full load, the filter capacitor level detector may switch between ac power and battery power to ensure a complete backup capability under all operating conditions.

AC input detector

The ac input detector (U301B and associated components) compares the ac line voltage to a given reference. As long as the ac line level exceeds the reference level, a string of pulses is sent to the missing pulse detector and the filter capacitor level detector (as long as the unlatch delay timer is in the off state). The level at which the pulses disappear depends upon the load. With a full load, the pulses are present until the line voltage drops to approximately 104 V ac with a 120 V ac input, or 190 V ac with a 220 V ac input, or 208 V ac with a 240 V ac input.

Missing pulse detector

The missing pulse detector (U301C and associated components) is driven by a string of pulses from the ac input detector. As long as the pulses are present, the missing pulse detector remains reset. If one pulse in the string is missing (ac line failure), the missing pulse detector goes high and triggers the unlatch delay timer, thus inhibiting the unlatching of the batteries.

Unlatch delay timer

The unlatch delay timer (U301D and associated components) is used to provide a two-second delay in the return of the ac line voltage after a power failure. This allows the ac line voltage to stabilize upon return and also inhibits the clearing of the filter capacitor level detector when no ac pulses are present.

The unlatch delay timer is driven by the output of the missing pulse detector. During normal operation, the missing pulse detector is low and the unlatch delay timer is high. If the ac line voltage drops below 104 V ac, or 190 V ac, or 208 V ac, the missing pulse detector goes high and forces the unlatch delay timer to go low. This low inhibits any unlatching of the batteries which are about to be brought in the circuit. When the ac line voltage returns (after a power failure), the missing pulse detector returns to a low condition. When the unlatch delay timer senses this low, it waits two seconds before changing states (low to high) and allowing the batteries to become unlatched.

Battery gate

The battery gate consists of series pass transistors Q301, Q302, Q303, constant current drivers Q306, Q310, and all associated components. The series pass transistors are configured to provide the power dissipation capability to pass the required backup current. A high from the filter capacitor level detector provides the base drive to Q310 and, if VR302 is conducting, Q310 drives Q306. Transistor Q306, in turn, drives the series pass transistors. A constant current through R314 is used to create a dead battery disconnect. If the +24 V battery input voltage drops to the +16.8 V to +20 V range, VR302 fails to conduct and Q310 turns off. With Q310 off, the series pass transistors turn off. A current limiter network (R331, R332), shunted across the base-emitter junction of Q304, prevents the battery gate from passing more than 13 A.

Test procedure

Recommended test equipment

- Digital multimeter, Fluke Model 8000A, or equivalent.
- Variable transformer capable of providing 264 V ac and 3 A.
- Variable resistive loads capable of drawing power supply outputs of +15.8 V dc at 12 A and +9 V dc at 4.5 A.

AC power input operation

CAUTION

A power ON-OFF switch is not provided on any of the power supplies. The power supply is immediately operational when the power cord is plugged into a live ac outlet.

+15.8 V output checks

Output voltage

With the output at half load (3A load), and the ac line input at 120 V ac, or 220 V ac, or 240 V ac, the regulated output voltage should measure between +15.3 V and +16.3 V.

Current limiting

With an ac input voltage of 132 V ac, or 242 V ac, or 264 V ac, reduce the variable load resistance on the +15.8 V output until the current limit point is found. This current should fall within the 6A to 12A range.

Short circuit current

With an ac input voltage of 132 V ac, or 242 V ac, or 264 V ac, short the +15.8 V output and measure the resulting short circuit current. It should be 3A or less.

+9 V output checks

Output voltage

With the output at half load (0.75 A load), and the ac line input at 120 V ac, or 220 V ac, or 240 V ac, the regulated output voltage should measure between +8.7 V and +9.3 V.

Current limiting

With an ac input voltage of 132 V ac, or 242 V ac, or 264 V ac, reduce the variable load resistance on the +9 V output until the current limit point is found. This current should fall within the 1.5 A to 4.5 A range.

Short circuit current

With an ac input voltage of 132 V ac, or 242 V ac, or 264 V ac, short the +9 V output and measure the resulting short circuit current. It should be 1.5A or less.

Battery backup input operation

NOTE

When conditions warrant battery operation, no indication is given to the operator that the battery is switched into the circuit.

Battery backup switchover voltage

With the ac power input set at 120 V ac, or 220 V ac, or 240 V ac, connect proven +24 V batteries to the power supply and set the outputs of +15.8 V dc to 6A and +9 V dc to 1.5 A. Turn off the ac power and verify that the +15.8 V dc and +9 V dc outputs are still present.

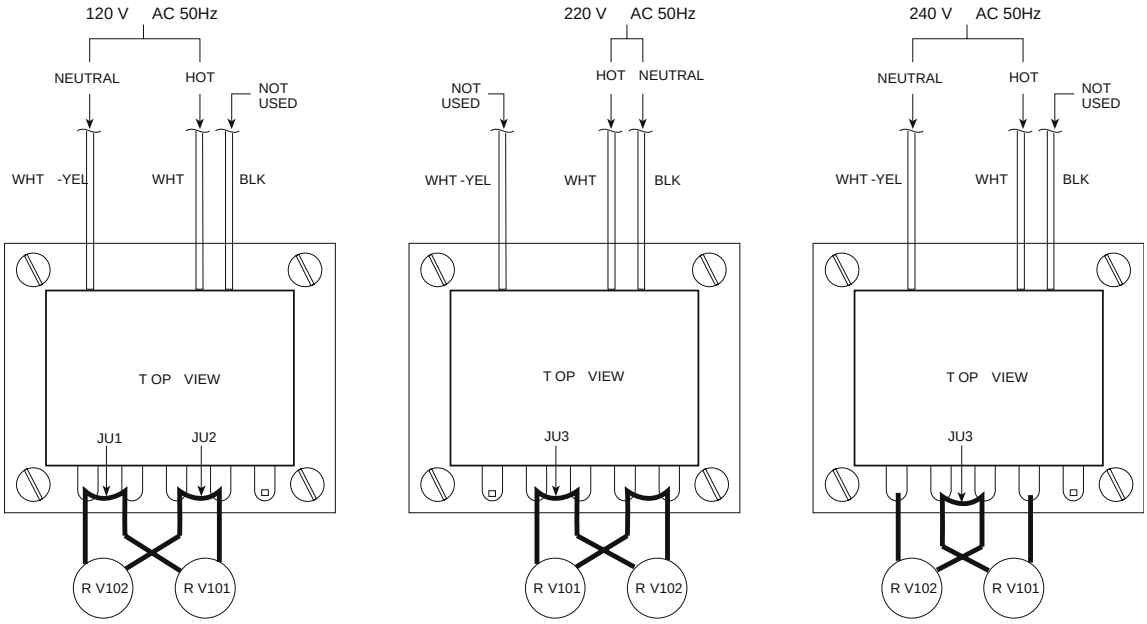
Unlatch voltage

Turn on the ac power of 120 V ac, or 220 V ac, or 240 V ac, and disconnect the +24 V batteries. Verify that the +15.8 V dc and +9 V dc outputs are still present.

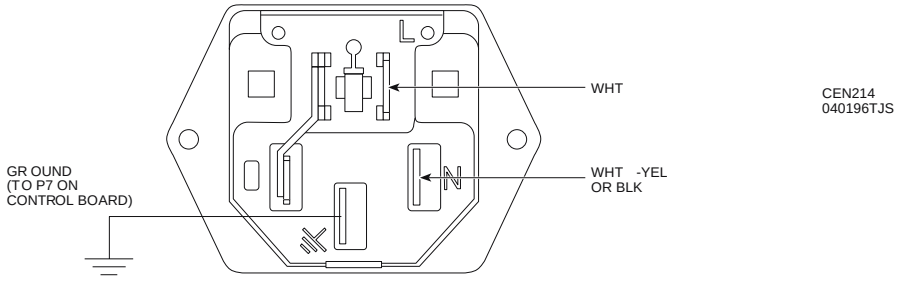
50 Hz ac input wiring

The 50 Hz power supplies allow modification for different ac input voltages other than that specified. Changes are performed on the primary side of the transformer; the secondary side requires no modifications. Figure 10-3 shows the wiring for the primary side of transformer T1. Wiring to the ac receptacle is shown in the AC Receptacle Detail of Figure 10-3. In all cases, the ac line voltage must be connected to the proper transformer windings and jumpers must be installed/removed on the varistors (RV101 and RV102). This ensures adequate protection from ac line voltage transients. For 220 V ac wiring, varistor RV102 is moved from the far left terminal to the far right terminal of the transformer. All connections/modifications must be properly secured and insulated for reliable operation.

50 Hz ac input wiring



NOTE: PRIMARY AC INPUT CONNECTIONS SHOWN. SECONDARY CONNECTIONS REQUIRE NO MODIFICATION AND ARE NOT SHOWN.



A C RECEPTACLE DETAIL (REAR VIEW)

Figure 10-3 ***AC Input Wiring Details***

BPN1022A-BPN1025A Overlay

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Common Parts List

Reference	Part Number	Description
NOTE:		THE ELECTRICAL COMPONENTS ARE COMMON TO ALL POWER SUPPLY MODULES. THE MECHANICA PARTS, TRANSFORMER, AND LINE FUSES ARE SLIGHTLY DIFFERENT FOR EACH MODEL. REFER TO THE HARDWARE PARTS LIST SECTION UNDER THE APPROPRIATE MODEL NUMBER FOR A LIST OF COMPONENTS UNIQUE TO EACH MODEL.
		capacitor, fixed:
C100,101	2383637R01	CAP ALU 15000 ±20% 35V
C102	2313748G14	CAP ELEC 22 uF 35V ±20%
C103	2111015D13	CAP CER DISC 1000 ±10% X5F 100V
C104	0811051A13	CAP MTLZ POLYEST .1 ±5% 63V
C106	2111014A42	CAP CER DISC 51 5 NPO 100V
C109	0811051A14	CAP MTLZ POLYEST .15 ±5% 63V
C110	2313748G25	CAP ELEC 333 uF 35V ±20%
C111	2111015D13	CAP CER DISC 1000 ±10% X5F 100V
C201,202	2111015D13	CAP CER DISC 1000 ±10% X5F 100V
C203	2313748G14	CAP ELEC 22 uF 35V ±20%
C204	2313748G25	CAP ELEC 333 uF 35V ±20%
C205	0811051A13	CAP MTLZ POLYEST .1 ±5% 63V
C206	2111014A42	CAP CER DISC 51 ±5% NPO 100V
C207	0811051A14	CAP MTLZ POLYEST .15 ±5% 63V
C301	2313748G14	CAP ELEC 22 uF 35V ±20%
C302	2111015D05	CAP CER DISC 220 ±10% X5F 100V
C303	0811051A13	CAP MTLZ POLYEST .1 ±5% 63V
C304	2313748G04	CAP ELEC 1.0 uF 50V ±20%
C305	0811051A14	CAP MTLZ POLYEST .15 ±5% 63V
C306	2111014A39	CAP CER DISC 39 ±5% NPO 100V
C307	2111015D05	CAP CER DISC 220 ±10% X5F 100V
C308	2111014A39	CAP CER DISC 39 ±5% NPO 100V
C309	2111015D05	CAP CER DISC 220 ±10% X5F 100V
C310	2111014A39	CAP CER DISC 39 ±5% NPO 100V
C311	2111015D05	CAP CER DISC 220 ±10% X5F 100V
C312	2111015D13	CAP CER DISC 1000 ±10 % X5F 100V
C313	2111014A39	CAP CER DISC 39 ±5% NPO 100V
C314	2111015D05	CAP CER DISC 220 ±10% X5F 100V
C315	2111015D13	CAP CER DISC 1000 ±10% X5F 100V
C316	2313748G04	CAP ELEC 1.0 uF 50V ±20%
C317	0811051A15	CAP MTLZ POLYEST .22 ±5% 63V
C318	0811051A16	CAP MTLZ POLYEST .33 ±5% 63V
C319	2313748G14	CAP ELEC 22 uF 35V ±20%
C320	2111015D05	CAP CER DISC 220 ±10% X5F 100V
C321	0811051A11	CAP MTLZ POLYEST .047 ±5% 63V
C322	0882095G06	CAP POLYEST .100 ±10% 200V
C401	2313748G06	CAP ELEC 4.7 uF 50V ±20%
C402	0811051A13	CAP MTLZ POLYEST .1 ±5% 63V
C403	2111015D05	CAP CER DISC 220 ±10% X5F 100V
		diode: (see note)
CR100	4884751H02	DIODE BRDG
CR102	4811034A01	DIODE 48C83654H01 A/I
CR103,104	4813833D08	DIODE GEN-PUR 1A 600V 1N4005RL (2 used)
CR201	4813833D08	DIODE GEN-PUR 1A 600V 1N4005RL (2 used)
CR203	4813833D08	DIODE GEN-PUR 1A 600V 1N4005RL (2 used)
CR204	4811034A01	DIODE 48C83654H01 A/I
CR301,302	4813833D08	DIODE GEN-PUR 1A 600V 1N4005RL (2 used)
CR303	4811034A01	DIODE 48C83654H01 A/I
CR304	4882592W01	DIODE SCHOTTKY BARRIER
CR305	4884350P01	RECT 35V MBR 1635_
CR306 thru 310	4800869698	TSTR NPN 69698 (5 used)
CR311	4813833D08	DIODE GEN-PUR 1A 600V 1N4005RL (2 used)
		fuse:
F2	2982906N01	TERM FUSE (2 used)
		connector:
J1 thru 5	2883636P01	PLUG CKT BD 3 PIN
J6	3183458P06	BLOCK TERM 2 POS
PO1 thru 7	2910231A10	TERM BRS ELTIN, I/O
PO10 thru 19	0283409R01	NUT HEX M3.5X0.66 STLTIN, XSTR
PO0 thru PO29	0983373H01	CONN, XSTR
		transistor: (see note)
Q101 thru 103	4800869698	TSTR NPN M9698
Q104	4800869807	TSTR PNP M9607
Q201,202	4800869807	TSTR PNP M9807
Q301	4800869807	TSTR PNP M9807
Q302	4800869807	TSTR PNP M9807
Q303,304	4813824D12	TSTR PNP 80V .5A MPSA56RLRP
Q306 thru 310	4813824D08	TSTR NPN 80V .5A MPSA06RLRP
		resistor, fixed:
R101 thru 103	1782291B45	RES WW 0.3Ω ±5 % 3W
R105	0611049G97	RES FMF 100Ω ±1 % 1/4W
R106	0611049C21	RES FMF 1870 Ω±1 % 1/4W
R107	0611009A01	RES FCF 10Ω ±5 % 1/4W
R108	0611049K37	RES FMF 29.4K Ω±1% 1/4W
R109	0611049C91	RES FMF 10KΩ ±1% 1/4W
R110	0611049J42	RES FMF 3090 Ω±1% 1/4W
R111	0611049C52	RES FMF 3920Ω ±1% 1/4W
R112	0611009A41	RES FCF 470Ω ±5% 1/4W
R113	0611009B23	RES JUMPER
R114	0611009A07	RES FCF 18Ω ±5 % 1/4W
R115	0611009B23	RES JUMPER
R116	0611009A01	RES FCF 10Ω ±5% 1/4W
R117	0611009A07	RES FCF 18Ω ±5% 1/4W
R201	1782291B45	RES WW 0.3Ω ±5% 3W
R202	0611009A21	RES FCF 68Ω ±5% 1/4W
R203	0611049B90	RES FMF 909Ω ±1% 1/4W
R204	0611049J98	RES FMF 11.8K Ω ±1 % 1/4W
R205	0611049D09	RES FMF 15KΩ ±1% 1/4W
R206	0611049C99	RES FMF 12.1K Ω±1% 1/4W
R207	0611049J42	RES FMF 3090Ω ±1% 1/4W
R208	0611049C52	RES FMF 3920Ω ±1% 1/4W
R209	0611009A41	RES FCF 470Ω ±5% 1/4W
R210	0611009A39	RES FCF 390 Ω±5% 1/4W
R211	0611009A01	RES FCF 10Ω ±5 % 1/4W
R301	0611009A33	RES FCF 220Ω ±5% 1/4W
R302	0611009A41	RES FCF 470Ω ±5% 1/4W
R303,304	0611009A01	RES FCF 10Ω ±5 % 1/4W
R305	0611009A83	RES FCF 27KΩ ±5% 1/4W
R306	0611009A59	RES FCF 2700Ω ±5 % 1/4W
R307	0611009A89	RES FCF 47KΩ ±5% 1/4W
R308	0611049D21	RES FMF 20KΩ ±1% 1/4W
R309	0611049C67	RES FMF 5620Ω ±1% 1/4W
R310	0611009A89	RES FCF 47KΩ ±5 % 1/4W
R311	0611009A53	RES FCF 1500Ω ±5% 1/4W
R312	0611009A49	RES FCF 1000Ω ±5 % 1/4W

R313	0611009A89	RES FCF 47KΩ ±5% 1/4W
R314	0611009A29	RES FCF 150Ω ±5% 1/4W
R315	0611009A01	RES FCF 10Ω ±5% 1/4W
R316	0611009A21	RES FCF 68Ω ±5% 1/4W
R317	0611040C94	RES FMF 10.7KΩ .5% 1/4W
R318	0611049C37	RES FMF 2740Ω ±1% 1/4W
R319	0611009B22	RES FCF 1MΩ ±5% 1/4W
R320	0611009A73	RES FCF 10KΩ ±5% 1/4W
R321	0611009A63	RES FCF 3900Ω ±5% 1/4W
R322	0611009A73	RES FCF 10KΩ ±5% 1/4W
R323	0611009A99	RES FCF 120KΩ ±5 % 1/4W
R324	0611009A71	RES FCF 8200Ω ±5% 1/4W
R325	0611009A79	RES FCF 18K Ω±5% 1/4W
R326	0611009A63	RES FCF 3900 Ω±5% 1/4W
R327	0611009A73	RES FCF 10KΩ ±5 % 1/4W
R328	0611009B22	RES FCF 1MΩ ±5% 1/4W
R329	0611009A97	RES FCF 100KΩ ±5% 1/4W
R330	0611009A73	RES FCF 10K Ω±5% 1/4W
R331,332	1782291B37	RES FWW .1Ω ±3% 3W
R333	0611049J42	RES FMF 3090Ω ±1% 1/4W
R334	0611049C52	RES FMF 3920 Ω±1% 1/4W
R335	0611009A77	RES FCF 15K Ω±5% 1/4W
R401	0611009A19	RES FCF 56Ω ±5% 1/4W
R404	1780234B04	RESISTOR SHUNT

current regulator: (see note)

RV101,102	0684357M02	VSTR MTL OX
SCR401	4884348P01	RECT SLCN MCR69-2_ MCR69-002_

integrated circuit: (see note)

U101	5183222M07	IC VLTG REGLTR __1723_
U201	5183222M07	IC VLTG REGLTR __1723_
U301	5113819D04	GEN PURPOSE 14 DIP MC3303P
U302	5113816J03	IC 12V POSITIVE REG,100MA

voltage regulator: (see note)

VR101	4882479V16	DIODE ZENER 16V
VR201	4882479V12	DIODE ZENER 12V
VR301	4882479V04	DIODE ZENER 5.6V
VR302	4882479V17	DIODE ZENER 17V

transistor socket:

XU104	0984459M02	RECP HDR 3 CONT
XU202	0984459M02	RECP HDR 3 CONT

NOTE: FOR OPTIMUM PERFORMANCE, DIODES, TRANSISTORS, AND INTEGRATED CIRCUITS MUST BE ORDERED BY MOTOROLA PART NUMBER.

Unique Parts List

Reference	Part Number	Description
		BPN1022A:
	0200007009	NUT 10-32X3/8X1/8 HEX STL CAD (4 used)
	0310907A18	SCRMCH M3X0.5X6 INTSTARPAN (7 used)
	0310907A20	SCRMCH M3X0.5X10 INTSTARPAN
	0310943J09	SCRTPG TT3X0.5X6 INTSTARPAN
	0310943J15	SCRTPG TT3.5X0.6X8 INTSTARPAN (2 used)
	0310943M62	SCRTPG TT3.5X0.6X13 INTSTARSLT (10 used)
	0312016A49	SCRTAP M3.5X0.6X8 STRPANZNCPHO (5 used)
	0383498N04	SCR TPG M4X0.7X7 SLTSTAR STL (4 used)
	0384482M02	SCR MCH 4-40X1/4 SLTBIN SST
	0400002627	WSHRLCK 6 LTSPT STL NKL (10 used)
	0400007650	WSHRLCK 6 INT STL CAD (2 used)
	0400007673	WSHRLCK 10 HVYSPT STL CAD (4 used)
	0484180C01	WASHER SHOULDER NYLON NAT (2 used)
	0783363R01	BRKT TSTR MTG ALU
	0783862R01	BRKT XFMR CRS SHADOW BLK
	0784234B01	BRKT HT SINK
	0983373H01	CONN (used with PO20)
	0983373H01	CONN (used with PO22)
	0983373H01	CONN (used with PO24)
	0983373H01	CONN (used with PO26)
	0983373H01	CONN (used with PO28)
	1483392R01	INS (5 used)
	1484664P04	INS HT SINK (5 used)
	1484664P05	INS HT SINK (2 used)
	1583559L01	COV TSTR (5 used)
	1584576N02	SHROUD FUSE TERM
T1	2583408R01	XFMR PWR 120/240 60 HZ
	2783280R01	CHASSIS PS ALU SHADOW BLK
	2883470R01	PLUG AC W/FUSEHOLDER 3 CONT
	2984709N03	TERM CRIMP INS BLU BRS TIN (2 used)
	3010286A23	18STIVRD
	3010563T40	WR 14STR PVC BLK
	3010563T42	WR 14STR PVC RED
	3082018X01	CBL 9" PS INPUT
	3082018X02	CBL 10" PS INPUT
	3082018X03	CBL 11" PS INPUT
	3083418R01	CBL W/RECP 16 COND
	3084200P01	CORD AC LINE W/CONN 3 COND
	3700122062	TBG TEF 20 NAT
	4383393R01	SPACER (used with PO20)
	4383393R01	SPACER (used with PO22)
	4383393R01	SPACER (used with PO24)
	4383393R01	SPACER (used with PO26)
	4383393R01	SPACER (used with PO28)
	5482928P12	LABEL AC POWER
	5484120T01	LABEL UTILITY
F2	6500139767	FUSE AUTO BLADE TYPE10AMP 32V
F1	6582847N23	FUSE GLS CRTG 5AMP 250V

Reference	Part Number	Description
		BPN1023A:
	0200007009	NUT 10-32X3/8X1/8 HEX STL CAD (4 used)
	0210971A16	NUTMCH M3X0.5 HEX STLCAD (2 used)
	0210971A17	NUTMCH M4X0.7 HEX STLCAD (3 used)
	0310907A18	SCRMCH M3X0.5X6 INTSTARPAN (7 used)
	0310907A20	SCRMCH M3X0.5X10 INTSTARPAN (3 used)
	0310907A27	SCRMCH M3.5X0.6X8 INTSTARPAN (2 used)
	0310943J09	SCRTPG TT3X0.5X6 INTSTARPAN
	0310943M62	SCRTPG TT3.5X0.6X13 INTSTARSLT (10 used)
	0312016A49	SCRTAP M3.5X0.6X8 STRPANZNCPHO (3 used)
	0383498N04	SCR TPG M4X0.7X7 SLTSTAR STL (4 used)
	0384482M02	SCR MCH 4-40X1/4 SLTBIN SST
	0400002627	WSHRLCK 6 LTSPT STL NKL (10 used)
	0400007650	WSHRLCK 6 INT STL CAD (2 used)
	0400007671	WSHRLCK 8 MEDSPT STL CAD (3 used)
	0400007673	WSHRLCK 10 HVYSPT STL CAD (4 used)
	0400009795	WSHRLCK 6 MEDSPT SST PAS (2 used)
	0484180C01	WASHER SHOULDER NYLON NAT (2 used)
	0783363R02	BRKT TSTR MTG ALU
	0784048R01	BRKT MTG XFMR (2 used)
	0784234B01	BRKT HT SINK
	0983373H01	CONN (used with PO20)
	0983373H01	CONN (used with PO22)
	0983373H01	CONN (used with PO24)
	0983373H01	CONN (used with PO26)
	0983373H01	CONN (used with PO28)
	1483392R01	INS (5 used)
	1484164R01	INSULATOR TRANSFORMER MYLAR
	1484664P04	INS HT SINK (5 used)
	1484664P05	INS HT SINK (2 used)
	1584576N02	SHROUD FUSE TERM
	2200400055	STPL 1/4LEG X 1/2 STL PLN
T1	2584024R01	XFMR PWR 120/220/240V 50 HZ
	2783280R02	CHASSIS PS ALU SHADOW BLK
	2883470R01	PLUG AC W/FUSEHOLDER 3 CONT
	2900859665	LUG BLU (2 used)
	2984709N03	TERM CRIMP INS BLU BRS TIN (2 used)
	3010286A23	18STIVRD
	3010563P89	WR 16STR PVC GRNYEL
	3010563T40	WR 14STR PVC BLK
	3010563T42	WR 14STR PVC RED
	3082933N05	LINE CORD W/PLUG & RECP
	3083418R01	CBL W/RECP 16 COND
	3700122062	TBG TEF 20 NAT
	3700134371	TBG HS POLYOL 3/8 BLK
	4210217A02	STRAP TIE .091X3.62 NYL WHT (13 used)

	4383393R01	SPACER (used with PO20)
	4383393R01	SPACER (used with PO22)
	4383393R01	SPACER (used with PO24)
	4383393R01	SPACER (used with PO26)
	4383393R01	SPACER (used with PO28)
	5482006W01	LABEL PCB BARCODE (2 used)
	5482006W02	RIBBON THERMAL XFER (2 used)
	5482928P10	LABEL AC POWER
	5484142R01	LABEL GROUND
	5484497M29	LBL ADH1/2X11/32 BK YL (1) (2 used)
	6500139767	FUSE AUTO BLADE TYPE10AMP 32V
	6582847N23	FUSE GLS CRTG 5AMP 250V

BPN1024A:

	0200007009	NUT 10-32X3/8X1/8 HEX STL CAD (4 used)
	0310907A18	SCRMCH M3X0.5X6 INTSTARPAN (7 used)
	0310907A20	SCRMCH M3X0.5X10 INTSTARPAN
	0310943J09	SCRTPG TT3X0.5X6 INTSTARPAN
	0310943J15	SCRTPG TT3.5X0.6X8 INTSTARPAN (2 used)
	0310943M62	SCRTPG TT3.5X0.6X13 INTSTARSLT (10 used)
	0312016A49	SCRTAP M3.5X0.6X8 STRPANZNCPHO (5 used)
	0383498N04	SCR TPG M4X0.7X7 SLTSTAR STL (4 used)
	0384482M02	SCR MCH 4-40X1/4 SLTBIN SST
	0400002627	WSHRLCK 6 LTSPT STL NKL (10 used)
	0400007650	WSHRLCK 6 INT STL CAD (2 used)
	0400007673	WSHRLCK 10 HVYSPT STL CAD (4 used)
	0484180C01	WASHER SHOULDER NYLON NAT (2 used)
	0783363R01	BRKT TSTR MTG ALU
	0783862R01	BRKT XFMR CRS SHADOW BLK
	0784234B01	BRKT HT SINK
	0983373H01	CONN (used with PO20)
	0983373H01	CONN (used with PO22)
	0983373H01	CONN (used with PO24)
	0983373H01	CONN (used with PO26)
	0983373H01	CONN (used with PO28)
	1483392R01	INS (5 used)
	1484664P04	INS HT SINK (5 used)
	1484664P05	INS HT SINK (2 used)
	1584576N02	SHROUD FUSE TERM
T1	2583408R01	XFMR PWR 120/240 60 HZ
	2783280R01	CHASSIS PS ALU SHADOW BLK
	2883470R01	PLUG AC W/FUSEHOLDER 3 CONT
	2984709N03	TERM CRIMP INS BLU BRS TIN (2 used)
	3010286A23	18STIVRD (1.38 used)
	3010563T40	WR 14STR PVC BLK (7.5 used)
	3010563T42	WR 14STR PVC RED (6.5 used)
	3082018X01	CBL 9” PS INPUT
	3082018X02	CBL 10” PS INPUT
	3082018X03	CBL 11” PS INPUT
	3083418R01	CBL W/RECP 16 COND
	3084200P01	CORD AC LINE W/CONN 3 COND
	3700122062	TBG TEF 20 NAT (1.12 used)
	4383393R01	SPACER (used with PO20)
	4383393R01	SPACER (used with PO22)
	4383393R01	SPACER (used with PO24)
	4383393R01	SPACER (used with PO26)
	4383393R01	SPACER (used with PO28)
	5482928P11	LABEL AC POWER
F2	6500139767	FUSE AUTO BLADE TYPE10AMP 32V
F1	6582847N24	FUSE GLS CRTG 3.15 AMP 250V

BPN1025:

	0200007009	NUT 10-32X3/8X1/8 HEX STL CAD (4 used)
	0210971A16	NUTMCH M3X0.5 HEX STLCAD (2 used)
	0210971A17	NUTMCH M4X0.7 HEX STLCAD (3 used)
	0310907A18	SCRMCH M3X0.5X6 INTSTARPAN (7 used)
	0310907A20	SCRMCH M3X0.5X10 INTSTARPAN (3 used)
	0310907A27	SCRMCH M3.5X0.6X8 INTSTARPAN (2 used)
	0310943J09	SCRTPG TT3X0.5X6 INTSTARPAN
	0310943M62	SCRTPG TT3.5X0.6X13 INTSTARSLT (10 used)
	0312016A49	SCRTAP M3.5X0.6X8 STRPANZNCPHO (3 used)
	0383498N04	SCR TPG M4X0.7X7 SLTSTAR STL (4 used)
	0384482M02	SCR MCH 4-40X1/4 SLTBIN SST
	0400002627	WSHRLCK 6 LTSPT STL NKL (10 used)
	0400007650	WSHRLCK 6 INT STL CAD (2 used)

	0400007671	WSHRLCK 8 MEDSPT STL CAD (3 used)
	0400007673	WSHRLCK 10 HVYSPT STL CAD (4 used)
	0400009795	WSHRLCK 6 MEDSPT SST PAS (2 used)
	0484180C01	WASHER SHOULDER NYLON NAT (2 used)
	0783363R02	BRKT TSTR MTG ALU
	0784048R01	BRKT MTG XFMR (2 used)
	0784234B01	BRKT HT SINK
	0983373H01	CONN (used with PO20)
	0983373H01	CONN (used with PO22)
	0983373H01	CONN (used with PO24)
	0983373H01	CONN (used with PO26)
	0983373H01	CONN (used with PO28)
	1483392R01	INS (5 used)
	1484164R01	INSULATOR TRANSFORMER MYLAR
	1484664P04	INS HT SINK (5 used)
	1484664P05	INS HT SINK (2 used)
	1583559L01	COV TSTR (4 used)
	1584576N02	SHROUD FUSE TERM
	2200400055	STPL 1/4LEG X 1/2 STL PLN
T1	2584024R01	XFMR PWR 120/220/240V 50 HZ
	2783280R02	CHASSIS PS ALU SHADOW BLK
	2883470R01	PLUG AC W/FUSEHOLDER 3 CONT
	2900859665	LUG BLU (2 used)
	2984709N03	TERM CRIMP INS BLU BRS TIN (2 used)
	3010286A23	18STIVRD (1.38 used)
	3010563P89	WR 16STR PVC GRNYEL
	3010563T40	WR 14STR PVC BLK
	3010563T42	WR 14STR PVC RED
	3082933N05	LINE CORD W/PLUG & RECP
	3083418R01	CBL W/RECP 16 COND
	3700122062	TBG TEF 20 NAT
	3700134371	TBG HS POLYOL 3/8 BLK
	4210217A02	STRAP TIE .091X3.62 NYL WHT (13 used)
	4383393R01	SPACER (used with PO20)
	4383393R01	SPACER (used with PO22)
	4383393R01	SPACER (used with PO24)
	4383393R01	SPACER (used with PO26)
	4383393R01	SPACER (used with PO28)
	5482928P09	LABEL AC PWR
	5484120T01	LABEL UTILITY
	5484142R01	LABEL GROUND
F2	6500139767	FUSE AUTO BLADE TYPE10AMP 32V
F1	6582847N24	FUSE GLS CRTG 3.15 AMP 250V

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