MAINTENANCE MANUAL
FRONT PANEL B19/CMD-386
AND
DISPLAY BOARD B19/CML-263

TABLE OF CONTENTS

DESCRIPTION

The Panel Control and Display boards are located behind the front panel of the radio (Figure 1). The Display board contains the control switches, indicators, and display used to communicate information between the radio and the operator. The Panel Control board interfaces and processes signals between the Display board and the rest of the radio.

CIRCUIT ANALYSIS

PANEL CONTROL BOARD

The Panel Control board (Figure 2) interfaces between the Display board, the System Control board, speaker, microphone, and the MDT connector. The board contains an 8751 microcontroller (IC922), voltage regulators, power reset and interface circuitry, and backlighting control.

Power enters the board through connector P921-2 from the System Control board. Switched A+ (SW A+) is applied to two voltage regulators (IC921 and IC924). Regulator IC921 provides +5 Vdc to power the logic circuitry, and IC924 provides +9 Vdc for the backlight LED indicators. Power-on reset is provided by the 5-volt regulator (RST line) and is applied through inverter TR927 to the RESET input of the microcontroller (IC922-9).

Microphone connections are made to the board through P922. No audio processing is performed on the Panel Control board and the microphone lines (MIC HI and MIC LO) are passed to the System Control board through P921-1.

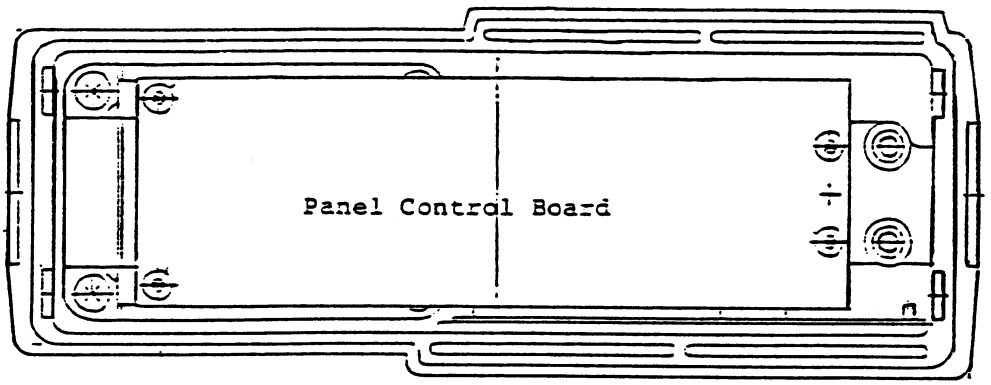


FIGURE 1 - PANEL CONTROL AND DISPLAY BOARD LOCATION

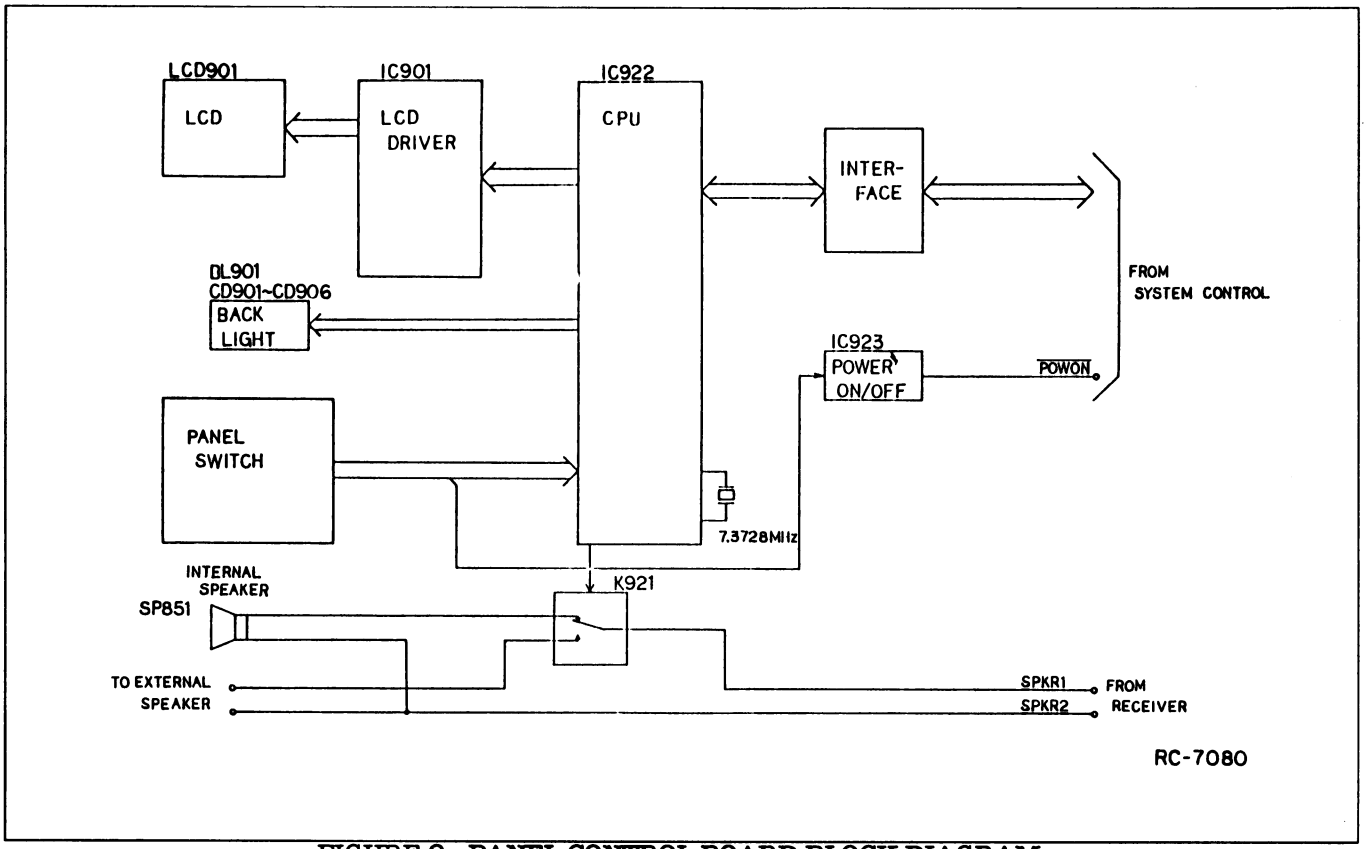


FIGURE 2 - PANEL CONTROL BOARD BLOCK DIAGRAM

Signal lines from the operating control switches (GRP DWN, VOL UP, etc.) on the Display board enter the Panel Control board at J921. These active-low lines are diode protected by CD921 thru CD931 and pulled up to 5 volts by R921 thru R932. All lines, with the exception of the POWER switch, connect directly to microcontroller IC922.

The POWER switch is handled differently from the rest of the switch lines. A dual D-type flip-flop (IC923) is used to de-bounce the switch and provide a toggle action to the pushbutton power switch. The POWER switch on the Display board is tied to the Panel Control board at J921-A7 (PWR). The PWR line is diode protected (CD932) and tied to the preset (PR) line of IC923. Power (A+) is applied to the flip-flops and is also used to hold both preset (PR) lines high.

When power is applied to the radio, the Q output (IC923-5) is preset to zero which holds the clock (CK) input (IC923-11) low. The Q output of the second flip-flop (IC923-9) is also preset to zero, which is applied to the input of transistor switch TR928, causing the POW ON(-) output to be held high indicating a power off condition. The Q(-) line (IC923-8) is now high and is fed back to the D input of the flip-flop (IC923-12) ready to be clocked in when CK goes high.

When the POWER switch is pressed, the PWR line is held low and starts to discharge C938 through R944. As the voltage decreases across C938, the preset (PR) line (IC923-4) will go low causing the Q output (IC923-5) to go high. The high on the Q output causes a one to be clocked into the second flip-flop causing its Q output to go high, turning on TR928. When TR928 is turned on, $\overline{\text{POW ON}}$ goes low signalling a power-on condition. At the same time TR928 is turned on, the Q(-) output of the flip-flop goes low causing the D input (IC923-12) to be driven low. The next time the POWER switch is pressed, the zero will be clocked into the flip-flop causing TR928 to turn off.

Backlight levels of the LCD and operating controls is set by current switches TR921 and TR923. The switches complete the path from +9 volts, through the backlight diodes on the Display board and back to ground. Return current from the backlight LEDs flows into the Panel Control board at J921-B7 (BKLT) and is tied to the current switches through R935 and R937. The BK LO (backlight

low) and BK HI (backlight high) lines from the microcontroller (IC922-27 & -28) are connected to switch drivers TR922 and TR924. Depending on the levels of BK LO and BK HI, the two current switches are turned on (or off) in different combinations, effectively placing different values of resistance (R935 and R937) in the return path. Four different backlight levels are possible.

BACKLIGHT LEVEL	SIGNAL LEVELS	
	BK LO	BK HI
OFF	1	1
LOW	0	1
MEDIUM	1	0
HIGH	0	0

Serial data (SER Tx DATA) enters the board at P921-1 pin 1 and is filtered and diode protected before being tied to the microcontroller RXD input (IC922-10). The SER Tx DATA line is also connected to the MDT connector (J923-A1).

Serial data generated by the microcontroller (IC922-11) is applied to driver TR926 which controls open-collector driver TR925. The output of TR925 is filtered and connected to P921-1 pin 2 and J923-A2.

If the microcontroller has data to send over the serial link, it lowers the SER RQST (serial request) line (IC922-35). When SER RQST is lowered it causes open-collector driver TR930 to pull the SER RQST line (J923-A3) low.

The microcontroller clock frequency is set by X921 which is connected to IC922 pins 18 & 19. Jumper F and capacitor C941 are used to shift the oscillator frequency when required. Should the 7.3728 MHz frequency become incompatible with any units in the system, jumper F may be removed to shift the frequency.

An optional external alarm may be controlled by the radio through the EXTERNAL ALARM line (J923-B1). When the microcontroller lowers the EXTRLY (IC922-33) line, open-collector driver TR932 turns on and activates the external equipment.

The radio will support an internal or external speaker system. Relay K921 determines the audio path between the speaker connector P922 and the MDT connector J923. The relay is controlled by the microcontroller INT(-)/EXT line (IC922-32). When this line is high, driver TR933 is turned on keeping K921 energized and routing audio to the external speaker. When INT(-)/EXT is low, TR933 is off and the internal speaker is selected.

DISPLAY BOARD

The Display board contains the LCD, display decoder/driver, indicator, front panel controls, and the backlight unit. The Display board interfaces directly to the Panel Control board through connector P901.

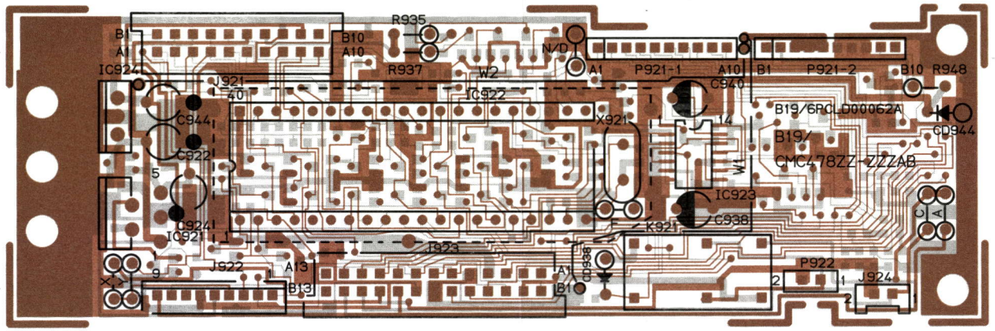
The LCD has four seven-segment digits and 12 status flags. Lines 38-44 and 46-52 coming from decoder/driver IC901 control the group number display, and lines 54-60 and 34-40 control the system number display. Lines 29-36 and 45-16 control the LCD status flags.

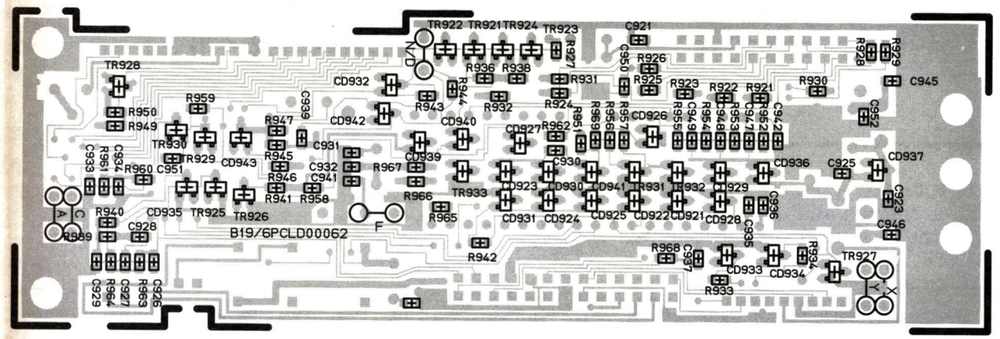
Serial data to be displayed by the LCD comes from the microcontroller bus through the Panel Control Board and is applied to IC901-19. The clock and load pulses are applied to the LCD decoder/driver at pins 18 (CLOCK) and 17 (LOAD).

Backlighting is provided for the LCD and the GROUP, VOLUME, and SYSTEM controls. Diodes CD901 thru CD906 illuminate the operating controls and LED backlight unit BL901 illuminates the LCD. Chip resistors R904 and R905 are used to limit the current through the backlight diodes.

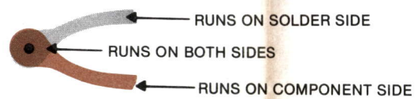
There are four backlight levels (including off) that are available. These levels are set on the Panel Control board through the use of two current switches. The amount of current flowing from +9V through the backlight diodes and returning to ground (BKLT) is controlled by the settings of the current switches on the Panel Control board.

The operating control switches on the front panel are all tied to a bus through connector P901 to the Panel Control board. The switch states are read by the microcontroller on the Panel Control board.

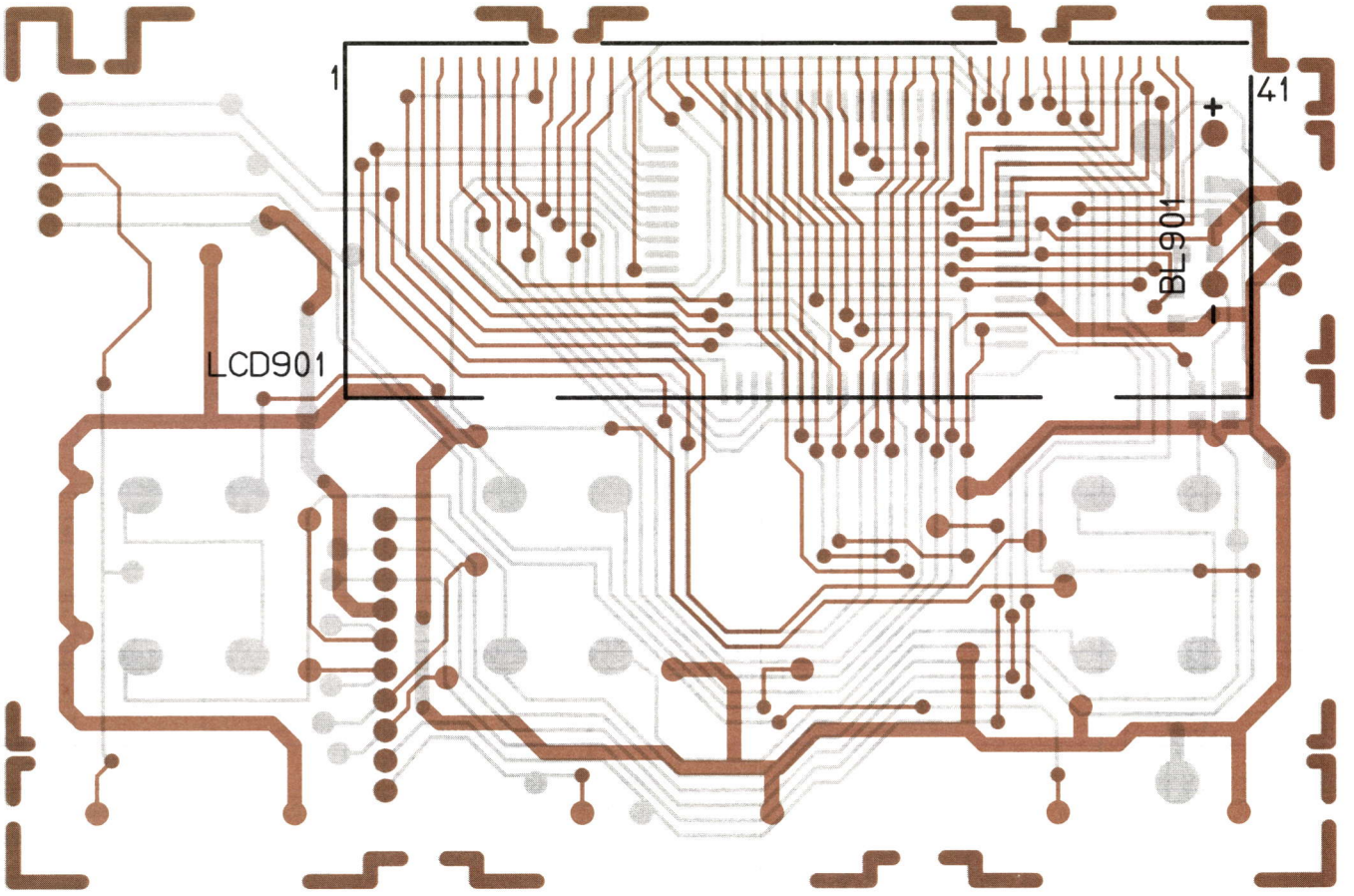




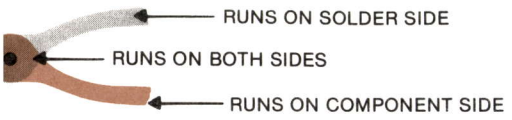
(PCLD00062B, 11-88)



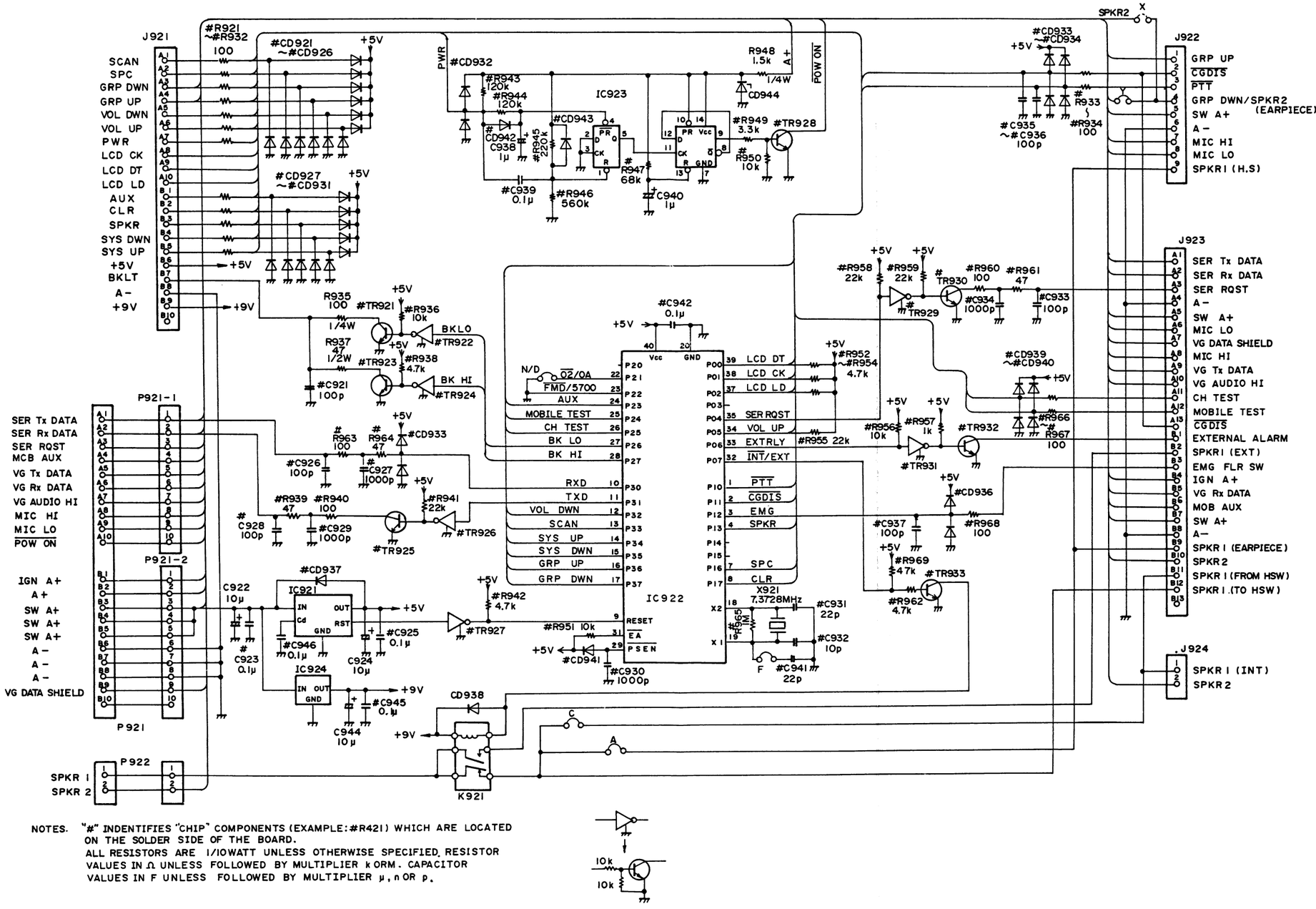
PANEL CONTROL OUTLINE DIAGRAM



(PCLD00061, 11-88)



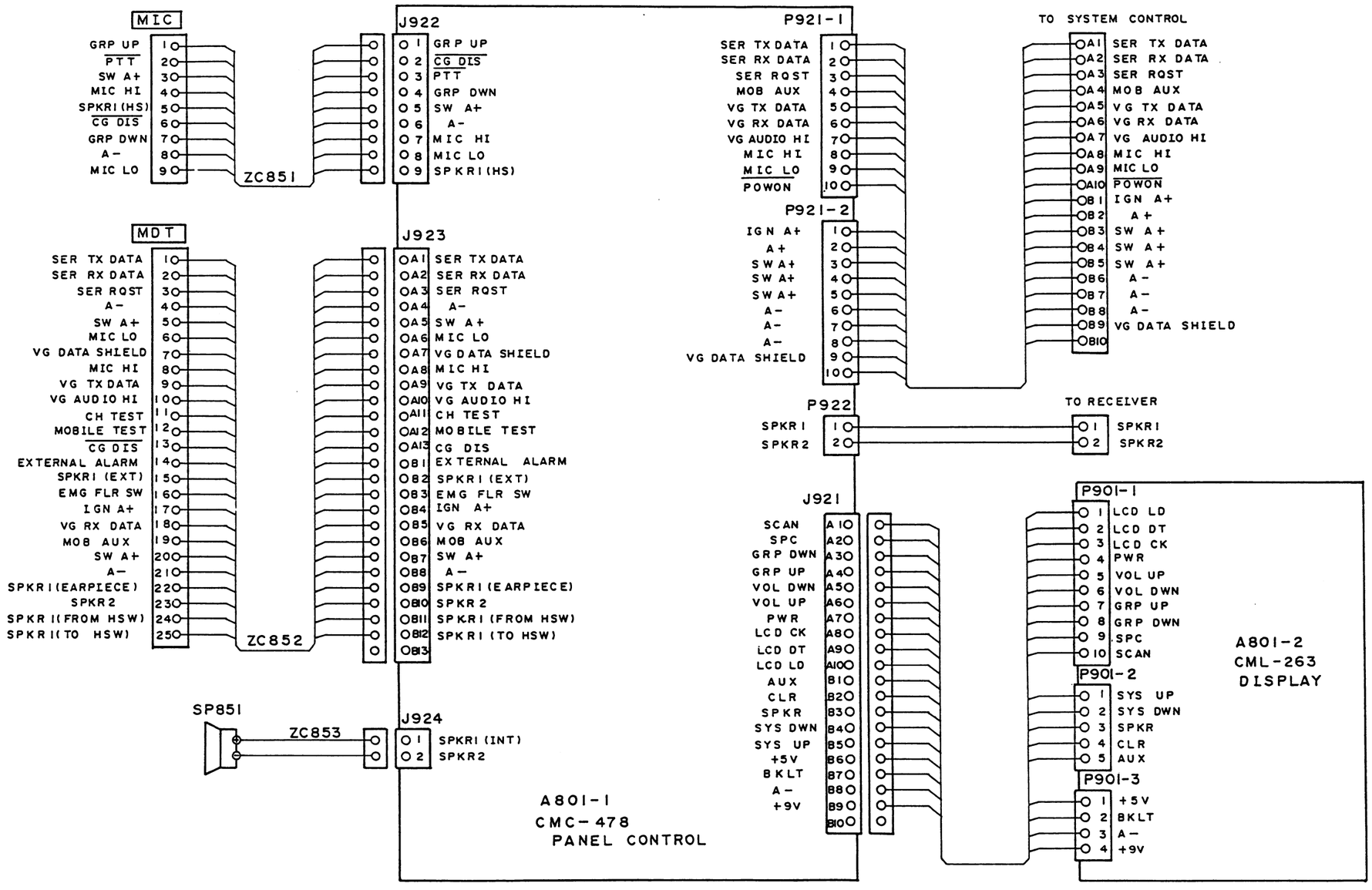
DISPLAY BOARD OUTLINE DIAGRAM



NOTES. "#" INDENTIFIES "CHIP" COMPONENTS (EXAMPLE: #R421) WHICH ARE LOCATED ON THE SOLDER SIDE OF THE BOARD.
ALL RESISTORS ARE 1/10WATT UNLESS OTHERWISE SPECIFIED. RESISTOR VALUES IN Ω UNLESS FOLLOWED BY MULTIPLIER k ORM. CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER µ, n OR p.

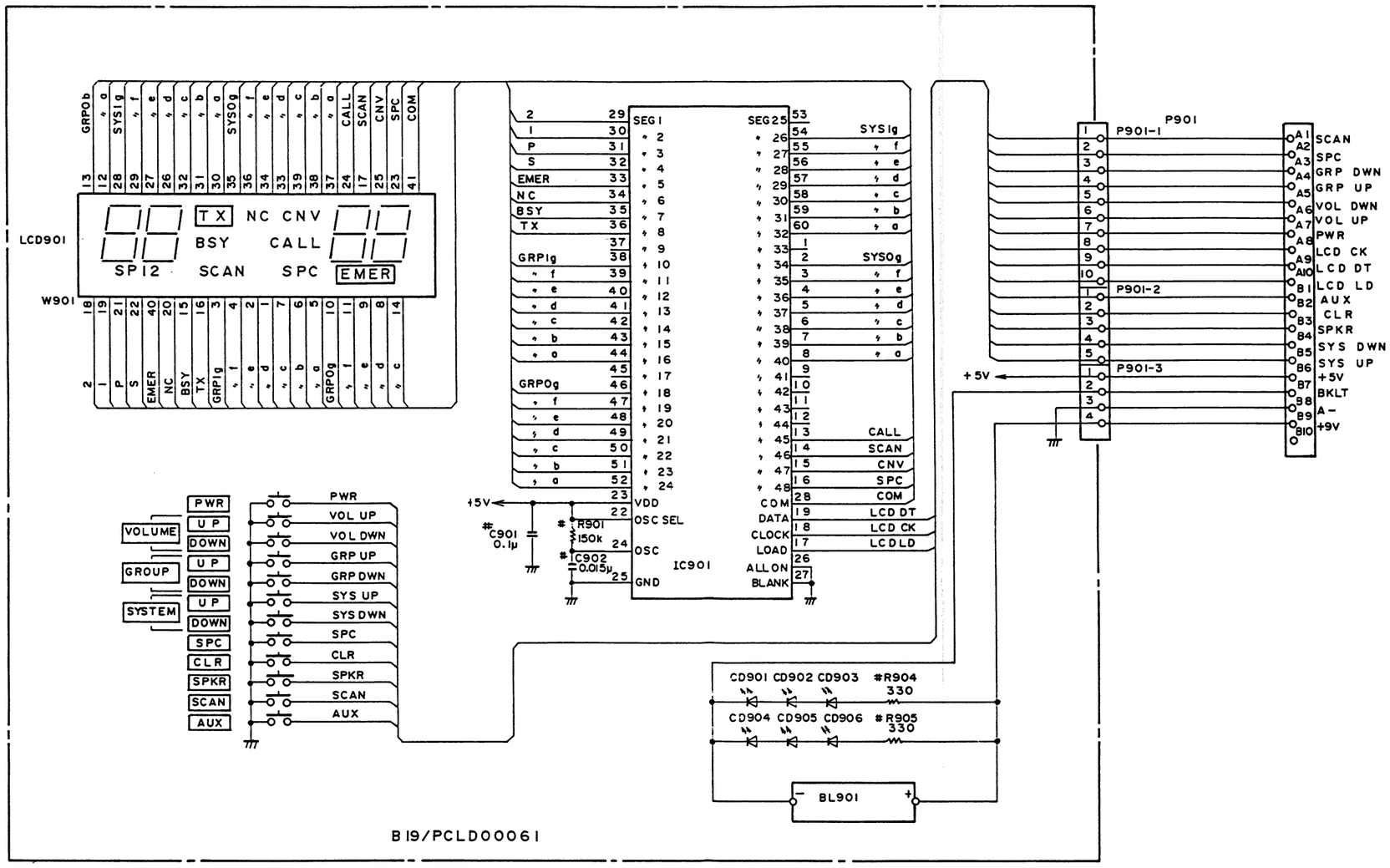
INTERCONNECTION DIAGRAM

(DDOO-CMD-478, 11-88)



(DDOO-CMD-386, 11-88)

PANEL CONTROL SCHEMATIC DIAGRAM



NOTES. "#" INDENTIFIES "CHIP" COMPONENTS (EXAMPLE: #R901) WHICH ARE LOCATED ON THE SOLDER SIDE OF THE BOARD.
ALL RESISTORS ARE 1/10 WATT UNLESS OTHERWISE SPECIFIED.
RESISTOR VALUES IN Ω UNLESS FOLLOWED BY MULTIPLIER k OR M.
CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER µ, n OR p.

(DDOO-CMD-263, 11-88)

DISPLAY BOARD SCHEMATIC DIAGRAM

PARTS LIST

FMD DISPLAY
B19/CML-263
ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
BL901	B19/6WZLD00001	Backlight unit.
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C901	B19/5CAAD01586	Ceramic: 0.1 uF, +80% -20%, 25 VDCW.
C902	B19/5CAAD01500	Ceramic: 0.015 uF, ±10%, 50 VDCW.
		- - - - - - - - - - - DIODES - - - - - - - - - -
CD901 thru CD906	B19/5TXBG00039	Diode, Optoelectronic: orange, sim to: STANLEY AA2222S.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - -
IC901	B19/5DDAG00252	Sim to: OKI MSM5219BGS.
		- - - - - - - - - - - DISPLAY - - - - - - - - - -
LCD901	B19/6WSLD00001	LCD (Liquid Crystal Display).
		- - - - - - - - - - - - PLUG - - - - - - - - - - -
P901	B19/6ZCLD00034	Cable Assembly.
		- - - - - - - - - - - RESISTORS - - - - - - - - - -
R901	B19/5RDAC02455	Metal film: 150K ohms, ±5%, 100 VDCW, 1/10W.
R904 and R905	B19/5RDAC02470	Metal film: 330 ohms, ±5%, 100 VDCW, 1/10W.
		- - - - - - - - - - - - CABLE - - - - - - - - - - -
W901	B19/6JWLD00001	Connector.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

PARTS LIST

FMD PANEL
B19/CMD-386
ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
SP851	B19/5USAF00072	Speaker; 16 ohms.
ZC851	B19/6ZCLD00032	Cable Assembly.
ZC852	B19/6ZCLD00033	Cable Assembly.
ZC853	B19/6ZCLD00046	Cable Assembly.
		PANEL CONTROL B19/CMC-478
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C921	B19/5CAAD00839	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C922	B19/5CEAA01864	Electrolytic: 10 uF, ±20%, 25 VDCW.
C923	B19/5CAAD01586	Ceramic: 0.1 uF, +80% -20%, 25 VDCW.
C924	B19/5CEAA01826	Electrolytic: 10 uF ±20%, 16 VDCW.
C925	B19/5CAAD01586	Ceramic: 0.1 uF, +80% -20%, 25 VDCW.
C926	B19/5CAAD00839	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM
C927	B19/5CAAD00838	Ceramic: 1000 pF ±10%, 50 VDCW, temp coef 0 ±15%
C928	B19/5CAAD00839	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM
C929 and C930	B19/5CAAD00838	Ceramic: 1000 pF ±10%, 50 VDCW, temp coef 0 ±15%
C931	B19/5CAAD00840	Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM
C932	B19/5CAAD00988	Ceramic: 10 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM
C933	B19/5CAAD00839	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM
C934	B19/5CAAD00838	Ceramic: 1000 pF ±10%, 50 VDCW, temp coef 0 ±15 PPM
C935 thru C937	B19/5CAAD00839	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM
C938	B19/5CSAC00982	Tantalum: 1 uF ±10%, 35 VDCW.
C939	B19/5CAAD01586	Ceramic: 0.1 uF +80% -20%, 25 VDCW.
C940	B19/5CSAC00982	Tantalum: 1 uF ±10%, 35 VDCW.
C941	B19/5CAAD00840	Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM
C942	B19/5CAAD01586	Ceramic: 0.1 uF +80% -20%, 25VDCW.
C944	B19/5CEAA01826	Electrolytic: 10 uF ±20%, 16 VDCW.
C945 and C946	B19/5CAAD01586	Ceramic: 0.1 uF +80% -20%, 25 VDCW.
		- - - - - - - - - - - DIODES - - - - - - - - - -
CD921 thru CD936	B19/5TXAD00330	Silicon, fast recovery (2 diodes in series); sim to Toshiba 1SS226.
CD937	B19/5TXAD00291	Silicon, fast recovery (2 diodes in cathode common) sim to Toshiba 1SS184.
CD938	B19/5TXAN00068	Silicon, 200V 1A, sim to SANDEN EM01Z.
CD939 and CD940	B19/5TXAD00330	Silicon, fast recovery (2 diodes in series); sim to Toshiba 1SS226.
CD941 thru CD943	B19/5TXAD00291	Silicon, fast recovery (2 diodes in cathode common); sim to Toshiba 1SS184.
CD944	B19/5TXAE00568	Zener: 500 mW, 5V, sim to HITACHI HZ5C1.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - -
IC921	B19/5DDCC00024	Linear, Positive Voltage Regulator; sim to SANYO L78MR05.
IC922	B19/5DDAK00371	Sim to: INTEL D8751H-8.
IC923	B19/5DAAJ00409	Sim to: MOTOROLA MC74HC74F.
IC924	B19/5DAAJ00581	Linear, Positive Voltage Regulator; sim to MOTOROLA MC7809CT.
ICS922	B19/5ZJAB00029	IC Sockets, 40 pins.
		- - - - - - - - - - CONNECTORS - - - - - - - - - -
J921	B19/5JWAV00116	Connector, 20 pins.
J922	B19/5JWAV00117	Connector, 9 pins.
J923	B19/5JWAV00119	Connector, 26 pins.
J924	B19/5JWAV00120	Connector, 2 pins.
		- - - - - - - - - - - RELAY - - - - - - - - - - -
K921	B19/5KLAD00618	Relay: DC9V, sim to NATIONAL DSPI-DC9V.
		- - - - - - - - - - - PLUGS - - - - - - - - - - -
P921	B19/6ZCLD00030	Cable Assembly.
P922	B19/6ZCLD00040	Cable Assembly.
		- - - - - - - - - - - RESISTORS - - - - - - - - - -
R921 thru R934	B19/5RDAC02447	Metal film: 100 ohms ±5%, 100 VDCW, 1/10W.
R935	B19/5RDAA01321	Carbon film: 100 ohms ±5%, 1/4W.
R936	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R937	B19/5RDAA00803	Carbon film: 47 ohms ±5%, 1/2W.
R938	B19/5RDAC02478	Metal film: 4.7K ohms ±5%, 100 VDCW, 1/10W.
R939	B19/5RDAC02460	Metal film: 47 ohms ±5%, 100 VDCW, 1/10W.
R940	B19/5RDAC02447	Metal film: 100 ohms ±5%, 100 VDCW, 1/10W.
R941	B19/5RDAC02454	Metal film: 22K ohms ±5%, 100 VDCW, 1/10W.
R942	B19/5RDAC02478	Metal film: 4.7K ohms ±5%, 100 VDCW, 1/10W.
R943 and R944	B19/5RDAC02487	Metal film: 120K ohms ±5%, 100 VDCW, 1/10W.
R945	B19/5RDAC02453	Metal film: 220K ohms ±5%, 100 VDCW, 1/10W.
R946	B19/5RDAC02463	Metal film: 560K ohms ±5%, 100 VDCW, 1/10W.
R947	B19/5RDAC02485	Metal film: 68K ohms ±5%, 100 VDCW, 1/10W.
R948	B19/5RDAA01349	Carbon film: 1.5K ohms ±5%, 1/4W.
R949	B19/5RDAC02462	Metal film: 3.3K ohms ±5%, 100 VDCW, 1/10W.
R950 and R951	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R952 thru R954	B19/5RDAC02478	Metal film: 4.7K ohms ±5%, 100 VDCW, 1/10W.
R955	B19/5RDAC02454	Metal film: 22K ohms ±5%, 100 VDCW, 1/10W.
R956	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R957	B19/5RDAC02446	Metal film: 1K ohms ±5%, 100 VDCW, 1/10W.
R958 and R959	B19/5RDAC02454	Metal film: 22K ohms ±5%, 100 VDCW, 1/10W.
R960	B19/5RDAC02447	Metal film: 100 ohms ±5%, 100 VDCW, 1/10W.
R961	B19/5RDAC02460	Metal film: 47 ohms ±5%, 100 VDCW, 1/10W.
R962	B19/5RDAC02478	Metal film: 4.7K ohms ±5%, 100 VDCW, 1/10W.
R963	B19/5RDAC02447	Metal film: 100 ohms ±5%, 100 VDCW, 1/10W.
R964	B19/5RDAC02460	Metal film: 47 ohms ±5%, 100 VDCW, 1/10W.
R965	B19/5RDAC02461	Metal film: 1M ohms ±5%, 100 VDCW, 1/10W.
R966 thru R968	B19/5RDAC02447	Metal film: 100 ohms ±5%, 100 VDCW, 1/10W.
R969	B19/5RDAC02478	Metal film: 4.7K ohms ±5%, 100 VDCW, 1/10W.

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
TR921	B19/5TDAB00054	Silicon, NPN: sim to NEC 2SD596.
TR922	B19/5TCAZ00011	Silicon, NPN: sim to SANYO 2SC3398.
TR923	B19/5TDAB00054	Silicon, NPN: sim to NEC 2SD596.
TR924	B19/5TCAZ00011	Silicon, NPN: sim to SANYO 2SC3398.
TR925	B19/5TDAB00054	Silicon, NPN: sim to NEC 2SD596.
TR926 and TR927	B19/5TCAZ00011	Silicon, NPN: sim to SANYO 2SC3398.
TR928	B19/5TDAB00054	Silicon, NPN: sim to NEC 2SD596.
TR929	B19/5TCAZ00011	Silicon, NPN: sim to SANYO 2SC3398.
TR930	B19/5TDAB00054	Silicon, NPN: sim to NEC 2SD596.
TR931	B19/5TCAZ00011	Silicon, NPN: sim to SANYO 2SC3398.
TR932 thru TR934	B19/5TDAB00054	Silicon, NPN: sim to NEC 2SD596.
		- - - - - - - - - - CRYSTALS - - - - - - - - - -
X921	B19/5XHAA00989	Quartz crystal; 7.3728 MHz.

PARTS LIST