MAINTENANCE MANUAL

SYSTEM BOARD 19D901987G1 5 WATT AUDIO AMP/REGULATOR BOARD 19C851692G1

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OVERVIEW

The System board controls the functioning of the Desk Top or Wall Mount Station. Commands entered by the operator through the station keyboard(s), are processed by the microprocessor on the System board. Responses to these commands are then issued by the System board through the Display board indicators and audio tones. The System board also interfaces with the optional clock/VU meter, remote control option, VoiceGuard option, the regulator and power supply, and the radio. A block diagram of the System board is shown in Figure 1.

KEYBOARD INTERFACE

There are three keyboards on the Desk Top Station and a single keyboard on the Wall Mount Station which interface directly with the System board. Keyboard assembly A1S2 (part of Key/Display board on Wall Mount Station) is a three-by-four matrix keypad similar to that found on a standard telephone. This keyboard connects to the System board at J11. Pressing a key holds the applicable ROW and COL lines low. The state of the keypad is latched into octal tri-state latch U11, and later read by the microprocessor (U1) over the AD bus.



Figure 1 - System Board Block Diagram (Sheet 1 of 2)

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Figure 1 - System Board Block Diagram (Sheet 2 of 2)

The remaining two keyboards (Desk Top Station only), A1S3 and A1S1, are electrically identical to each other. The only difference is the key labels. These keyboards provide nine separate key closures. Keyboard A1S3 connects to the System board at J10 and keyboard A1S1 connects at J1. Output from keyboard A1S3 (GRP▲, GRP▼, VOL▼, SPARE, SYS▼, VOL▲, and PHONE) are latched into U8 and U9 (SPEC CALL). Keyboard A1S1 output lines SCAN, VOICE GUARD, ADD, DEL, INTERCOM, MUTE, and EMERGENCY are latched into the upper seven inputs of U9. The REMOTE INH and SUPV CALL lines go directly to microprocessor ports P1.2 and P3.5.

DISPLAY INTERFACE

The System board interfaces with the Display board at connectors J5 and J6. Information to be displayed (with the exception of the decimal point and STANDBY POWER lines) originates at the microprocessor address bus (AD0-AD7) and is latched into registers U6 and U7.

The GROUP display decimal point is controlled by Q7. When microprocessor port P2.7 goes low, O7 conducts causing the DECIMAL PT line (J5-5) to go high lighting the GROUP decimal point. Control of the STANDBY POWER

Both digital and analog signals are supplied to the radio. The System board interfaces with the radio at connectors J2 and J3 through Power/Control Cable 19C85141309. Digital signals (VG TX DATA, SER TX DATA, SER SERV RQST, and SER RX DATA) are present at J2-1 thru -4, and analog signals (GROUND, MIC HI, VG RX DATA, MIC LO, VG RX DATA LO, SPKR 1, RESET (-), and AUX/URP LATCH) are present at J3-1 thru -8.

indicator is performed by a transistor switch formed from Q7, R44, R45, and D14. Normally, the station power supply provides +13 volts to R44. The standby battery would supply about +12 volts (J4-2) to the cathode of D14, holding the base of Q6 near cutoff. During a failure of the station supply, +13volts would be removed from R44, causing D14 to be reverse biased by the +12 volt battery supply. The resulting voltage developed across R45 will turn Q6 on, allowing the STANDBY POWER indicator to illuminate.

RADIO INTERFACE

DIGITAL INTERFACE

The radio is controlled by serial control lines. If the VoiceGuard option is used, the VG TX DATA line originates at the VoiceGuard option (J13-9) and is passed through the System board to J2-1.

A serial request (SER SERV ROST) line (J2-3) is used by the microprocessor to signal the radio unit that there is serial data to be sent. Serial data is sent from the System board over the SER TX DATA line (J2-2). Data coming from the radio unit is received over the SER RX DATA line (J2-4).

The SER SERV RQST signal originates at the microcomputer port P1.4. It is applied to the input of transistor switch Q3, and filtered by C5, R8, and C6. Serial transmit data originates at microprocessor TXD port, and is applied to a transistor switch (Q1 and Q2). The output from the switch is filtered by R4, R5, C3, and C4, before exiting at SER TX DATA at J2-2.

Serial data from the mobile radio enters as SER RX DATA at J2-4. The line is filtered by R1, R2, C1, C2, D1 and D2 before it is tied to the RXD input of the microprocessor.

ANALOG INTERFACE

All analog signals (speaker audio and modulation audio) between the radio unit and the System board go through connector J3. The modulating audio signal from the output of the microphone amplifier (U21-14) is sent to the radio unit at J3-2 as MIC HI. The return connection for microphone audio is made at J3-4 (MIC LO).

Receive audio from the radio unit enters the System board at J3-6 (SPKR 1). It is then coupled to the audio amplifier through C72, R83, and C70. If VoiceGuard encryption is being used, the VG RX DATA (J3-3) and VG RX DATA LO (J3-5) lines are audio paths between the radio unit and System board.

AUDIO PROCESSING

Audio processing on the System board consists of processing microphone audio to be sent to the radio unit. Amplifying and filtering receive (clear voice) audio. Routing encrypted audio to the optional VoiceGuard board, and filtering tone-coded squelch signals to the optional tone decoder. Audio processing also includes, receive and transmit audio for an optional remote controller.

There are seven microprocessor-controlled switches on the System board that are used to change the audio paths on the board. The data word written to the microprocessor AD bus determines which switches are closed, and the resulting audio path. Table 1 shows the function of each switch.

Table 1 - Audio Switch Functions

SWITCH	FUNCTION
0	Connect station mic to radio unit
1	Connects remote controller mic to radio unit
2	Connects station mic to remote speaker (intercom)
3	Connects remote mic to station speaker (intercom)
4	Connects remote speaker to radio unit receive audio
5	Connects station speaker to radio unit receive audio
6	Connects decrypted audio to radio speaker

MICROPHONE AUDIO

Microphone audio originates as MIC HI (J7-4) and is routed to input capacitors C18 and C12. Capacitor C18 is the input to the remote option amplifier (covered elsewhere) and C12 in the input to the microphone amplifier. When transmit audio is being processed, switch 0 is closed allowing audio to be applied to the audio input level adjustment (MIC AD-JUST) R22 before going amplifier U21. After the amplifier, audio is routed through jumper plug J24/P2 to coupling capacitor C26 and the transmit modulation adjustment (TX MOD ADJ) control R37. This control sets the audio level applied to the last stage of amplification (U21). The amplified microphone audio is capacitor coupled (C69) to the radio unit at J3-2 (MIC HI). The return connection from the radio unit to the microphone is provided through the MIC LO line (J3-4) which is tied directly to the microphone at J7-3 (MIC LO).

When optional Channel Guard is used during conventional operation, the MONITOR button on the microphone can be used to listen to all calls on a channel (Channel Guard disabled). Pressing the MONITOR button will hold J7-5 (CG MONITOR(-)) low, which signals the microprocessor disabled). Pressing the MONITOR button will hold J7-5 (CG MONITOR(-)) low, which signals the microprocessor (port P3.2) that Channel Guard is to be disabled.

RECEIVE AUDIO

Receive audio (clear voice and subaudible tone encoding) from the radio unit enters the System board as SPKR 1 (J3-6) and is coupled through C72, R83, and C70 to the input of eight-channel selector U13. Each of the eight inputs to the selector are connected to a different value resistor (R73 thru R80). These resistors and the selector are used to set the volume (audio) level to the input of the speaker amplifier. When the microprocessor reads a volume control key press, it begins incrementing the value placed on the AD bus, which is latched into U12. The Q1 thru Q3 outputs from latch U12 are applied to the control lines (A, B, and C) of selector U13. The selector value determines which input path is followed to the speaker amplifier, setting volume level. When the volume key is released, the last value output will be latched.

After the selector (U13), receive audio is coupled to the input of the first speaker amplifier at C47. Input audio level can be adjusted at R67 before it is applied to amplifier U15. Receive audio is capacitor coupled through C52 and C53 to the audio power amplifier U14, and output to the speaker at J26-2. If subaudible tones are not used, jumper plug P1 completes the path between J18-1 and -2. An audio mute button is provided to lower the receive audio level for a preset time. When the microprocessor senses that the mute button has been pressed, a low is written through microprocessor port P1.7. This holds the base of Q4 low, allowing the transistor to conduct and ground the input to audio power amplifier U14.

SUBAUDIBLE SIGNALLING

If subaudible encoding (tone-controlled squelch) is used, receive and transmit audio is processed slightly different from the normal receive and microphone audio paths. Receive audio is routed from the output of the audio power amplifier (U14) to the optional tone decoder through J18-1 (jumper plug P1 removed). Audio from the optional tone decoder returns to the speaker through J18-2. The tone decoder will open this audio path when it detects the proper subaudible tones on the receive audio. The tone decoder receives power through J27-1.

The tone encoder option is connected to the System board through connector J19. Power is supplied at J19-3 and the tone signals from the encoder enter the board at J19-1. When the microprocessor senses PTT, it lowers the REMOTE PTT line at latch U23-4. This signal line (REMOTE PTT) tells the tone encoder to generate the subaudible tones at J19-1. These tones are applied to the TX AUDIO HI line and coupled through C13 and switch U19-2 to be combined with the microphone audio at the input of the audio amplifier U21. The microphone audio and subaudible tones are then sent to the radio unit.

REMOTE OPTION

The Desk Top or Wall Mount Station can be controlled by an optional remote control point. When the remote option is installed, transmit audio will be received through the remote option. Additionally, a remote intercom function is available.

Audio from the remote microphone is obtained at J9-1 (TX AUDIO HI) and J9-2 (TX AUDIO LO). The TX AUDIO HI line is tied to the INTERCOM ADJUST control (R32) and coupling capacitor C13. When the intercom is active, R32 sets the input audio level to amplifier U21. The output of the amplifier is coupled through C25, R36, and switch U19-8 to the input of selector U13. The audio is then amplified and sent to the station speaker, the same as when receive audio is processed.

When the remote controller is used to transmit, switch U19-8 is kept open (disabling the intercom) and switch U19-2 is closed. This allows microphone audio to be input to the microphone amplifier U21. Processing from here on is the same as local transmit audio.

When the Station operator wishes to communicate with the remote controller operator, switch U20-8 is opened to disable the path to the radio unit. Microphone audio is coupled through C18, R28, and R29 to the input of the intercom amplifier (U21-6). The LINE MIC ADJUST control (R28) sets the audio input level to the intercom amplifier. Output from the amplifier is routed through C21, R31, and U20-1 to connector J9-9 (VOL HI). This line (VOL HI) is the audio path back to the remote controller.

When receive audio is sent back to the remote controller, switch U20-3 is closed. This allows receive audio (SPKR 1) from the radio unit to be routed to J9-9 (VOL-HI) and sent to the remote controller.

The remote controller microphone PTT signal and MONI-TOR button signal enter the System board at J9-4 (REMOTE PTT(-)) and J9-11 (REMOTE CG MON(-)). These signals are sent to the microprocessor through latch U23.

The VoiceGuard option allows the Desk Top Station to send and receive encrypted messages. When a transmission is made, the output from the microphone amplifier (U21-1) is sent to the VoiceGuard board as MIC HI IN (J13-5). On the VoiceGuard board the audio is encrypted and the encrypted signal is returned to the system board as MIC HI OUT (J13-4). When VoiceGuard is used, jumper plug P2 is connected between J24-2 and J24-1. This allows the encrypted audio to be coupled through C26, R37, and R38 to the input of amplifier U21.

VOICE GUARD OPTION

Serial data to and from the VoiceGuard board is handled by the SER SERV ROST (J13-10), SER TX DATA (J13-6), and SER RX DATA (J13-14) lines. Serial data sent to the VoiceGuard board is handled by the SER TX DATA line, and data received from the board comes over the SER RX DATA line. The SER SERV RQST line is used to poll the microprocessor when data is to be sent.

Receive audio containing encrypted voice comes from the radio unit as VG RX DATA at J3-3. This line is then routed to the VoiceGuard board at J13-8. Clear voice audio comes from the VoiceGuard board as VG AUDIO HI (J13-1). The clear audio is routed through switch U19-10 to the input of selector U13. Audio processing from this point on is the same as normal receive audio.

PROGRAMMER INTERFACE

The radio unit in the Station is field programmable. A field programmer connects to the System board at J17. Serial data from the programmer (URP DATA) enters the board at J17-2 and connects to the system board SER RX DATA line. The (URPLARCH J17-2) line latches the data loaded from the programmer. Serial service request (SER SERV ROST) from the System board microprocessor goes to the field programmer as URP CLOCK at J17-6.

CLOCK/VU METER INTERFACE

An optional Clock and VU meter is available for use with the Desk Top Station. This option connects to the System board at J14. This option is powered by station A+ and has a self-contained battery for backup during loss of power. When the station is transmitting, the microprocessor P1.3 line goes high which turns on Q5 holding the CLOCK/VU PTT line low. When this line is low, the VU (volume unit) meter displays a relative indication of the microphone audio at J14-2 (MIC HI).

POWER DISTRIBUTION AND REGULATION

The System board receives power from the 5 Watt Audio Amp/Regulator board and directly from the station power supply. In addition, the System board contains a +5 Vdc regulator, a +10 Vdc supply, and a bias supply circuit.

5 WATT AMP/REGULATOR BOARD

The 5 Watt Audio Amp/Regulator board performs voltage regulation using a 5 volt linear voltage regulator (U3) and audio power amplification using two audio amplifier components (U1 & U2). Station power is applied at J3-1 (A+) and regulated +5 Vdc at J2-1 is supplied to the System board at J12-1. C17, C18 and C22 provide input and output filtering and RF bypass respectively. The audio from the System board is set to 2.5 Vrms using the audio level adjust which is then applied to J2-1 on the 5 Watt Audio Amp/Regulator board. U1 and U2 are connected in a bridge configuration. A block diagram of the board is shown in Figure 2.

TEST AND TROUBLESHOOTING

The test procedure listed in Table 2 is provided as an aid in testing and troubleshooting the 5 Watt Audio AMP/Regulator board while connected to the System.

The IF INCORRECT: column in the test procedure table lists possible component failures that may cause unexpected results for the test step.

ON-BOARD SUPPLIES

Station power (+13 Vdc) is also supplied directly to System board connector J2-5 thru -7. A five-volt regulator (U16) is used to supply regulated power to the microprocessor. Regulated 10 Vdc is supplied by U18 and associated circuitry, and U15-7 is the heart of a bias supply.

STEP	PROCEDURE	NOMINAL READING	IF INCORRECT:
1.	Measure current at J3-1.	Power supply current 125 mA.	a. Check U3, CR1, C17, C18, and C22. Check U1, U2, C13, C12, and C16.
			b.
2.	Measure voltage across J4-1 and J4-2.	4.75 to 5.25 Vdc	Check U3, CR1 and R8.
3.	Disconnect J4. Connect a signal generator to J2-1 and J2-2 (ground). Apply	Power supply current 1.5 amps.	a. Check U1 and U2 for excessive current drain.
a 2.5 Vrms audio signal to J2.			b. Check amplifier biasing R2, R4, R1, and R2.
			c. Check input attenuator (C23, R9, R10, C15).
4.	Measure audio voltage across the speaker or an	6.3 Vrms	a. Check input attenuator (C23, R9, R10, and C15).
	connected to J1.		b. Check U1, U2, C10, C11, C1, C2, R5, and R6.
5.	Measure audio distortion at J1 with load.	5%	a. Verify correct input level at J2.
			b. Check input attenuator (C23, R9, and C15).



Table 2 - Test Procedure



COMPONENT SIDE







(19C851692, Sh. 1, Rev. 1) (19C8551691, Solder Side, Rev. 0)

LBI-31892



(19D901529, Rev. 0) (19A704391, Sh. 2, Rev. 1)

5 WATT AUDIO AMP/REGULATOR BOARD

19C851692G1

KEYBOARD

19D901529G1



(19D901984, Sh. 1, Rev. 2)

SYSTEM BOARD

19D901087G1 (Sheet 1 of 3)



(19D901984, Sh. 2, Rev. 2)

LBI-31892





SYSTEM BOARD

19D901987G1 (Sheet 2 of 3)



19D901087G1

(Sheet 3 of 3)



5 WATT AUDIO AMP/REGULATOR BOARD 19C851692G1

PARTS LIST

			SYMBOL	GE PART NO.	DESCRIPTION	SYMBOL	GE PART NO.	DESCRIPTION
	:	16 ^{PLUS} DESK TOP STATION System Board	058	19220153404	Wantalum: 10 VE 4208 16 VOVEL			
		19D9019B7G1 ISSUE 2	C59	19A134730P2	Electrolytic: 220 μ +100 100 25 μ CM		19570002382	Silicon WOW, sim to 202004
			C60	19A703314₽5	Electrolytic: 22 uF -10+50% tol, 25 VDCH; sim to to Panasonic LS Series.	thru Q5	19870002522	STITCH, NEW, Starto 203901.
			C61	19A701534P1	Tantalum: 0.1 uF <u>+</u> 20%, 35 VDCW,	Q6 and	1.9870002292	Silicon, PNP: sim to 2N3906.
SYMBOL	GE PART NO.	DESCRIPTION	C62	19A703314P10	Electrolytic: 10 uP -10+50%, 50 VDCW; sim to Panasonic LS Series.	Q7 Q8	19A700023P2	Silicon, NPN: sim to 2N3904.
			C63	198701534P1	Tantalum: 0.1 uF ±20%, 35 VDCW.	010		
		CAPACITORS	C64	19A703314P5	Electrolytic: 22 uF -10+50% tol, 25 VDCW; sim to Panasonic LE Series.			Resistors
C1	19A700233P2	Ceramic: 150 pF ±20%, 50 VDCW.	C65	19A701602P13	Ceramic: 470 pF ±20%, 1000 VDCW; sim to	Rl	H212CRP110C	Deposited carbon: 100 ohms ±5%, 1/4 w.
C2	T644ACP210K	Polyester: .0010 uF ±10%, 50 VDCW.	066	19A701534P1	Tantalum: 0.1 uF 420%, 35 Vnrw	R 2	H212CRP047C	Deposited carbon: 47 ohms $\pm 5\%$, 1/4 w.
C3	19A700233P2	Ceramic: 150 pF <u>+</u> 20%, 50 VDCW.	C67	19A703314P6	Electrolytic: 1 uF 10+50% tol. 50 VDCW: sim to	R3	K212CRP310C	Deposited carbon: 10K ohms ± 5 %, 1/4 w.
C4	T644ACP210K	Polyester: .0010 uF <u>+</u> 10%, 50 VDCW.			Panasonic LS Series.	R 4	H212CRP047C	Deposited carbon: 47 ohms $\pm 5\%$, 1/4 w.
C5	19A700233P2	Ceramic: 150 pF <u>+</u> 20%, 50 VDCW.	C69	19A703314P7	Electrolytic: 2.2 uF -10+50%, 50 VDCW; sim to Panasonic LS Series.	R5	H212CRP110C	Deposited carbon: 100 ohms $\pm 5\%$, $1/4$ W.
C6	T644ACP210K	Polyester: .0010 uF <u>+</u> 10%, 50 VDCW.	C70	1.9A701534P1	Tantalum: 0.1 uF ±20%, 35 VDCW.	R6	H212CRP210C	Deposited carbon: 1K ohms ±5%, 1/4 W.
C7	19A700235P17	Ceramic: 22 pF ±5%, 50 VDCW.	C71	19A702250P111	Polgester: .047 uF ±10%, 50 VDCW.	R7	H212CRF247C	Deposited carbon: 4.7K ohms ±5%, 1/4 w.
C8	19A700235P18	Ceramic, disc: 27 pF <u>+</u> 5%, 50 VDCW.	C72	19870331427	Electrolytic: 2.2 uF -10+50%, 50 VDCW; sim to	88	H212CRP110C	Deposited carbon: 100 ohms $\pm 5\%$, 1/4 w.
C)	19870153484	Tantalum: 0.1 uF $\pm 20\%$, 35 VDCW.		10.000014-0	Panasonic LS Series.	R9	H212CRP247C	Deposited carbon: $4.7R$ ohms $\pm 5\%$, $1/4$ w.
and	198/01602213	Ceramics 470 pr ±20%, 1000 VDCW; sim to Type Jr Discap.	C/3	198703314P5	Electrolytic: 22 uF -10+50% to1, 25 VDCW; sim to Panasonic LS Series.	R10	H212CRP310C	Deposited carbon: 10K ohms ±5%, 1/4 w.
C12	19370331406		C74	19A700233F2	Ceramic: 150 pF ±20%, 50 VECW.	R11	19A701537P1	Composition: 10M ohms <u>4</u> 5%, 250 VDCW, 1/4 w.
thru cl4	198/0331460	Panasonic LS Series.				R12	19A701250P310	Metal film: 12.4K ohms <u>+</u> 1%, 1/4 w.
c15	19870023382	Ceramin: 150 pF 4203 50 UD/50	D1	19370002991	Silicony 75 mb TE Dive sin to 194140	R13	H212CRP410C	Deposited carbon: 100K ohms <u>+</u> 5%, 1/4 w.
C16	198703314P5	Electrolytic: 22 ν F -10+50% tol 25 ν DCW; sim to	thru D18	17470002011	STREEM, IS WA, IS PIN; SIN LO IN4148.	RL4 and	H212CRP310C	Deposited carbon: 10K ohms <u>+</u> 5%, 1/4 w.
		Panasonic LS Series.				R15	1012012500260	
C17	T644ACP247K	Polyester: ,0047 uF ±10%, 50 VDCN.			FILTERS	RID D)7	198/012509200	Metal IIIm: 4.99K onms \pm 1%, 1/4 W.
C18	19870331426	Electrolytic: 1 uF -10+50% tol, 50 VDCW; sim to Panasonic LS Series.	FL1 thru	19A705217P1	Filter, EMI Suppression.	P12	N212CRP1/2C	Deposited carbon: $0.22M$ onms ± 36 , 1/4 w.
C1.9	19A700233P2	Ceramic: 150 pF ±20%, 50 VDCW.	FL28			R19	H212CRP310C	Deposited carbon: 10K obm/s +5k 1/4 w
C20	19A703314P6	Electrolytic: 1 uF10+50% tol, 50 VDCW; sim to			JACKS	R20	H212CRP210C	Deposited carbon: 1X ohms +5%, 1/4 w.
C21		Panasonic LS Series.	J1		Contact, electrical.	R21	H212CRP156C	Deposited carbon: 560 ohms +5%, 1/4 w.
C22	19A702250P111	Polyester: .047 uF $\pm 10\%$, 50 VDCW.	J3			R22	19B800784P109	Variable: 22K ohms ±20%, 1/3 w.
C23	198700233P2	Ceramic: 150 pF ±20%, 50 VDCW.	J4	19A700072P28	Printed wire: 2 contacts rated @ 2.5 amps; sim	R23	H212CRP247C	Deposited carbon: 4.7K chms ±5%, 1/4 w.
C24	198703314P6	Electrolytic: 1 uF -10+50% tol, 50 VDCW; sim to Personnic 18 Sector	75		Contest slasters	R24	H212CRP312C	Deposited carbon: 12K ohms <u>+</u> 5%, 1/4 w.
C25	198703314P7	Finatoria : $2.2 \text{ uF} = 10 \pm 50$ 50 VDCU: sim to	and J6		contact, efectrical.	R25	H212CRP310C	Deposited carbon: 10K ohms ± 5 %, 1/4 w.
		Panasonic LS Series.		198116659252	Connector printed wirings & contents and at	and R26		
C26 and C27	19A703314P6	Electrolytic: 1 uF -10+50% tol, 50 VDCW; sim to Panasonic LS Series.		191110009191	5 amps; sim to Molex 09-65-1081.	R27	H212CRP110C	Deposited carbon: 100 ohms ± 5 %, 1/4 w.
C27	10570000000		and		Contact, electrical; sim to Molex 08-50-0404.	R2B	198800784P109	Variable: 22K ohms <u>+</u> 20%, 1/3 w.
C20	19870153481	Ceramic: 150 pr ±20%, 50 VDCW.	710			R29	H212CRP210C	Deposited carbon: 1K ohms ± 5 %, $1/4$ w.
and	154,0155411	Tancardin. U.1 MF #208, 35 VDCW.	and		Contact, electrical.	R30	H212CRF310C	Deposited carbon: $10K$ ohms $\pm 5\%$, $1/4$ w.
C34	198703314010	Ricctrolytic: 10 NF -10+50% 50 NDCP: sim to	312	1947000720132	Printed wire: I contacts rated at 3.5 and it.	R31	H212CRP210C	Deposited carbon: 1K ohms ± 5 %, 1/4 w.
		Panasonic LS Series.		1501000741202	to Nolex 22-05-3021.	R32	1988007842106	Variable: 5K obms <u>+</u> 20%, 1/2 w.
C36	19A702250P111	Polyester: .047 uF ±10%, 50 VDCW.	J13	19032025782	Pin wafer assembly: 19 contacts.	R.3.5	H212CRP210C	Deposited carbon: IK ohms ±5%, 1/4 w.
C40 thru	19A702250P111	Polyester: .047 uF ±10%, 50 VDCW.	J 3, 4	19A700072P29	Printed wire: 3 contacts rated at 2.5 amps; sim to Molex 22-27-2031.	835	H212CRP312C	Deposited carbon: 12K onms 154, 1/4 W.
C44		~	J15		Contact, electrical.	R36	H212CRP210C	Deposited carbon: 10 ohms ±5%, 1/4 w
C46	19A702250P111	Polyester: .047 uF ± 10 %, 50 VDCW.	and J16			R37	1988007842106	Variable: 5K ohms ± 203 $1/2$ w
C47	19A703314P7	Electrolytic: 2.2 uF -10+50%, 50 VDCW; sim to Panasonic LS Series.	J18		Contact, electrical.	R38	H212GRF210C	Deposited carbon: 1K ohms +5%, 1/4 w.
C48	19A703314P6	Electrolytic: 1 uF -10+50% tol, 50 VDCW; sim to Panasonic LS Series.	J19	19A700072P30	Printed wire: 4 contacts rated at 2.5 amps; sim to Molex 22-27-2041.	R39	H212CRP268C	Deposited carbon: 6.8K ohms ±5%, 1/4 w.
C49	19A700233P2	Ceramic: 150 pF <u>+</u> 20%, 50 VDCW,	J22		Contact, electrical.	R40	H212CRP310C	Deposited carbon: 10K ahms ± 5 %, 1/4 w.
C50	T644ACP210K	Polyester: .0010 uF <u>+</u> 10%, 50 VDCW.	thru J24			R41	H212CRP215C	Deposited carbon: 1.5K ohms ± 5 %, 1/4 w.
C51	T644ACF410K	Polyester: 0.1 uF ±10%, 50 VDCM.	J26	19A700072P28	Printed wire: 2 contacts rated @ 2.5 amps; sim	R42	19A701250P143	Resistor, Metal Film: 274 ohms, 1%, 1/4 Watt.
C52	T644ACP315K	Folyester: .015 uF <u>+</u> 10%, 50 VDCW.	and J27		to Molex 22-27-2021.	R43	19A701250P228	Metal film: 19.1K ohms <u>+</u> 1%, 1/4 w.
C53	T644ACP410K	Polyester: 0.1 uF ±10%, 50 VDCW.				R44	H212CRP210C	Deposited carbon: 1K ohms ± 5 %, 1/4 w.
C54	19A134730P2	Electrolytic: 220 uF +100 10%, 25 VDCN.		1001001010	PLUGS	R45	H212CRP322C	Deposited carbon: 22K ohms ±5%, 1/4 w.
C55	T644ACP410K	Polyester: 0.1 uF ± 10 %, 50 VDCW.	thru	198/0210421	connector: Shorting Jumper, Tin Plated,	R46	H212CRP282C	Deposited carbon: 8.2K ohms ±5%, 1/4 w.
C56	19A700004P6	Metallized polyester: 0.47 uF $\pm 10\%$, 63 VDCW,				R47	HZ12CRP347C	Deposited carbon: 47K ohms ±5%, 1/4 w.
C57	T644ACP410K	Polyester: 0.1 uF <u>+</u> 10%, 50 VDCW.				R48	H212CRP910C	Deposited carbon: 1 ohm ± 5 %, 1/4 w.
						R43	nzizoke1220	Deposited carbon: 220 ohims ±5%, 1/4 W.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	ge part no.	DESCRIPTION] [SYMBOL	GE PART NO.	DESCRIPTION	
R50 R51	H212CRP218C	Deposited carbon: 1.8K ohms ±5%, 1/4 w. Deposited carbon: 10 ohms ±5%, 1/4 w		U18 //19	19A701999P1	Linear: Voltage Regulator; sim to LM317T.	
R55	H212CRP310C	Deposited carbon: $10K$ ohms $\pm 5\%$, $1/4 w$.		and U20	1511/00027144	Digitali Biblicke, Switch.	
R56	19A700018P1	Deposited carbon: 1 ohm <u>+</u> 5%, 1/3 w.		U 2 I	19A700086P1	DUAL OF AMP; sim to Type 1458.	
R57	H212CRP310C	Deposited carbon: 10K ohms $\pm 5\%$, 1/4 w.		U23	19A703471P2	Digital: Octal Data Latch; sim to 74NC373,	
R58 and	H212CRP247C	Deposited carbon: $4.7K$ ohms ± 5 %, $1/4$ w.				SOCKETS	SYMBO
R59				XU 1	19A700156P5	Socket, IC: 40 Pins, Tin Plated.	
ROU	H212CRF312C	Deposited carbon: 12K ohms $\pm 5\%$, 1/4 w.		XU22	19A700156P15	Socket, IC: 8 Pins, Tin Plated.	
R62	H212CRP110C	Deposited carbon: 100 onms ± 3 %, 1/4 W.					C1 and
R64	H212CRP356C	Deposited carbon: 56K ohms ± 58 , 1/4 w.		V)	198702511015	CRYSTALS	C2
R65	H212CRF322C	Deposited carbon: 22K ohms ±5%, 1/4 w.		••	100/0101025	Yuutta, 113120 202.	C3 and
R66	H212CRP247C	Deposited carbon: 4.7K ohmas ±5%, 1/4 w.				· · · · · · MISCELLANEOUS ·	C4
R67	19B600784P106	Variable: 5K ohms ±20%, 1/2 w.			19A701785P1	Contact, electrical; sim to Molex 08-50-0404.	C5
R68	H212CRP222C	Deposited carbon: 2.2K ohms +5%, 1/4 w.		9	19A143578P228	Spacer, Threaded Metallic.	and
R69	#212CRP239C	Deposited carbon: 3.9K ohms ± 5 %, 1/4 w.		11	19090198762	Sub Assembly, 16 Plus System Board	012
R70	H212CRP210C	Deposited carbon: 1K ohms ± 5 %, 1/4 w.		12	19A702917F7	Heat Sink, Transistor: Sim to Thermalloy Cat 6030B-TT.	C12
R71	H212CRF410C	Deposited carbon: 100K ohms ± 5 %, 1/4 w.		13	19A702364P308	Machine screw, TORX Drive: No. M3-0.5 x 8.	c15
R72	H212CRF333C	Deposited carbon: 33K ohms ±5%, 1/4 w.			19A703248P2	Post: Tin Plated, 13 mm length.	c16
R73 .	H212CRP482C	Deposited carbon: 0.82M ohms ± 5 %, 1/4 w.		16	19A700032P5	Lockwasher, internal tooth: No. 3MM.	C17
R74	H212CRP439C	Deposited carbon: 0.39M ±5%, 1/4 w.		17	190901823P1	Shield.	and C18
R75	H212CRP418C	Deposited carbon: 0.18M ohms ± 5 %, 1/4 w.		18	19D901822Pl	Cover.	C22
R76	H212CRP382C	Deposited carbon: 82K ohms ±5%, 1/4 w.		19	198801444P1	Partition.	C23
R77	H212CRP339C	Deposited carbon: 39K ohms ±5%, 1/4 w.		22	19B801549G1	Keat sink.	
R79	H212CRP316C	Deposited carbon: 18K onms ±5%, 1/4 w.					
R80	H212CRF233C	Deposited carbon: 3 3K ohms ± 53 1/4 w					CR1
R81	H212CRF310C	Deposited carbon: 10K ohms +5%, 1/4 w.					
R82	H212CRP312C	Deposited carbon: 12K ohms +5%, 1/4 w.					J1
R83	H212CRP310C	Deposited carbon: 10K ohms $\pm 5\%$, 1/4 w.					thru J3
R64 and R85	H212CRP233C	Deposited carbon: 3.3K ohms ± 5 %, 1/4 w.					J4
R86 thru R90	H212CRP410C	Deposited carbon: 100K ohms ± 5 %, 1/4 w.					Rl
R91 thru R93	H212CRP310C.	Deposited carbon: 10K ohms ± 5 %, 1/4 w.					R2 R3
R94	H212CRP122C	Deposited carbon: 220 ohms ± 5 %, 1/4 w.					R4
R95 thru R97	H212CRP310C	Deposited carbon: 10K ohms $\pm 5\%$, 1/4 w.					and R6
R98	H212CRF210C	Deposited carbon: 1K ohms ± 5 %, 1/4 w.					RS
R99	H212CRP368C	Deposited carbon: $68K$ ohms $\pm 5\%$, $1/4$ w.					
		Resistive Network					R9
RP1 thru RP5	19A701630P2	Resistor, network: 9 resistors rated 10K ohms ± 2 %, 50 VDCW; sim to Bourns 4310R-101-103.					R10
		INTEGRATED CIRCUITS					Ul and U2
U2 U6 and	19A134764P2 19A704380P11	Linear: Dual Voltage Comparator; sim to LM393N. Digital: CHOS Octal Data Flip-Flop; sim to 74BC273.					U 3
UV U8 thru	1987000378415	Digital: Tri-State Octal Transparent Latch; sim to 741.5373.					3
U10 U12	19A704380F11	Digital: CMOS Octal Data Flip-Flop; sim to 74HC273.					4 5
U13	19 A70 0029P36	Digital: Single 8-Channel Multiplexer; sim to 4051B.					6 7
014	19A134769P1	Linear, Audio Amplifier: sim to TDR 2002.					8
V15	19A701789P2	Linear: Dual Op Amp; sim to LM358.					
U16 (117	19813471791	Lincar: 5 Volt Regulator; sim to MC7805CT.					
017	134/0321881	riiter, mign Pass: Sim to Murata AF85F300A4					*0

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SYMBOL	GE PART NO.	DESCRIPTION
		CAPACITORS
Cl and C2	19A700005P11	Polyester: 0.047 uF ±10%, 50 VDCW.
C3 and C4	19A703314P10	glectrolytic: 10 uF -10450%, 50 VDCW; sim to Panasonic LS Series,
C5	19A700005P11	Polyester: 0.047 uF ±10%, 50 VDCW.
Cl0 and Cll	19A701225P8	Rlectrolytic: 470 uF -10+75%, 16 VDCW; sim to Sprague 5002D477-GOl6DGIC.
C12	19A703314P2	Tantalum: 220 uF, -10+50%, 10 VDCW.
C13	19A700005P10	Polyester: 0.033 uF <u>+</u> 10%, S0 VDCW.
C15	19A701534P1	Tantalum: 0.1 uF ± 20 %, 35 VDCW.
C16	19A700005P10	Polyester: 0.033 uP ±10%, 50 VDCW.
C17 and C18	19A703314P10	Electrolytic: 10 uF -10+50%, 50 VDCW; sim to Panesonic LS Series.
C22	19A700005P10	Polyester: 0.033 uP ±10%, 50 VDCW.
C23	19A703314P10	Electrolytic: 10 uF -10+50%, 50 VDCH; sim to Panasonic LS Series.
CR1	19 8700028P 1	Silicon: 75 mA, 75 PIV; sim to 1N4148.
J l thru J3	19A700072P28	Printed wire: 2 contacts rated @ 2.5 amps; sim to Molex 22-27-2021.
J4	19A700041P77	Printed wire: 2.5 amps; sim to Holex 22-15-2026.
		RESISTORS
Rl	H212CRP182C	Deposited carbon: 820 ohms ±5%, 1/4 w.
R2	H212CRP112C	Deposited carbon: 120 obms ± 5 %, 1/4 w.
R3	H212CRP222C	Deposited carbon: 2.2K ohms ± 5 %, 1/4 w.
R4	H212CRP115C	Deposited carbon: 150 ohms ± 5 %, 1/4 w.
R5 and R6	H212CRP947C	Deposited carbon: 4.7 ohms ± 5 %, $1/4$ w.
R7	19A700050P13	Wirewound: 1 ohms ±10%, 2 w.
RS	5493035P1	Wirewound: 5 ohms <u>+</u> 5%, 5 watt; sim to Hamilton Hall Type HR-5W.
R9	H212CRP382C	Deposited carbon: 82K chms <u>+</u> 5%, 1/4 w.
R10	H212CRP310C	Deposited carbon: 10K ohms <u>+</u> 5%, 1/4 w.
Ul and U2	19A701830P1	Linear, Audia AMPLIFIER; sim to TDA 2003.
U 3	19A134717P1	Linear: 5 Volt Regulator; sim to MC7805CF.
3	19A705644G1	Heat sink.
4	N80P9006B6	Screw, Machine: Pan Head; 4-40 x 3/8".
5	7141225P2.	Nut, Hex: 4-40.
6	N404P11B6	Lockwasher; internal: No. 4.
7	7141225P3	Hex Nut: No. 6.32.
8	N4D4P13B6	Lockwasher, internal tooth: No. 6.

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PARTS LIST

REGULATOR BOARD 19C851584G1 ISSUE 1

GE PART NO.	DESCRIPTION
	CAPACITORS
194703314P10	Electrolytic: 10 uF -10+50% tol, 50 VDCW; Sim to Panasonic LS Series .
19A701534PI	Tantalum: 0.1 uF ±20%, 35 VDCW.
194700028P1	DIODES
	JACKS
19A700072P28	Printed wire: 2 contacts rated @ 2.5 amps; sim to Molex 22-27-2021 -
19A700D41P77	Printed wire: 2.5 amps; sim to Molex 22-15-2026.
	RESISTORS
5493035P1	Wirewound: 5 ohms \pm 5%, 5 watt; sim to Hamilton Hall Type HR-5W.
	INTEGRATED CIRCUITS
299A6459P8685	Linear: POSITIVE VOLTAGE REGULATOR; sim to MC7805CT -
	MISCELLANEOUS
19470291793	Heat Sink .
19A702917P8	Heat Sink.

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*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

REGULATOR BOARD

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