MAINTENANCE MANUAL
SYSTEM CONTROL BOARD
B19/CMC-473A

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DESCRIPTION

The System Control board (see Figure 1 for location) for EDACS FMD™ interconnects with the power/control cable from the control unit and the power amplifier board. The System Control board contains the audio circuitry, micro-computer, EEPROM, audio processor, and voltage regulators used in the radio. A microcomputer on the board controls all system functions, supplies frequency data to the frequency synthesizer, and provides all trunked functions. In conventional mode it provides Channel Guard and scan.

In addition to the normal radio functions, the microcomputer contains self-diagnostic maintenance routines to aid in troubleshooting the radio. Details and procedures are included in the Service Section of this manual.

The system control and interface circuits consist of the microcomputer, electrically erasable PROM, inter-face circuits for voltage shifting and protection, and a watchdog timer. The EEPROM gives the user the capability to program the radio personality as desired. Receive and transmit frequency data, group and individual IDs, and conventional data are stored in the EEPROM.

----- NOTE -----

The EEPROM may be programmed serially through the front connector using the radio programmer.
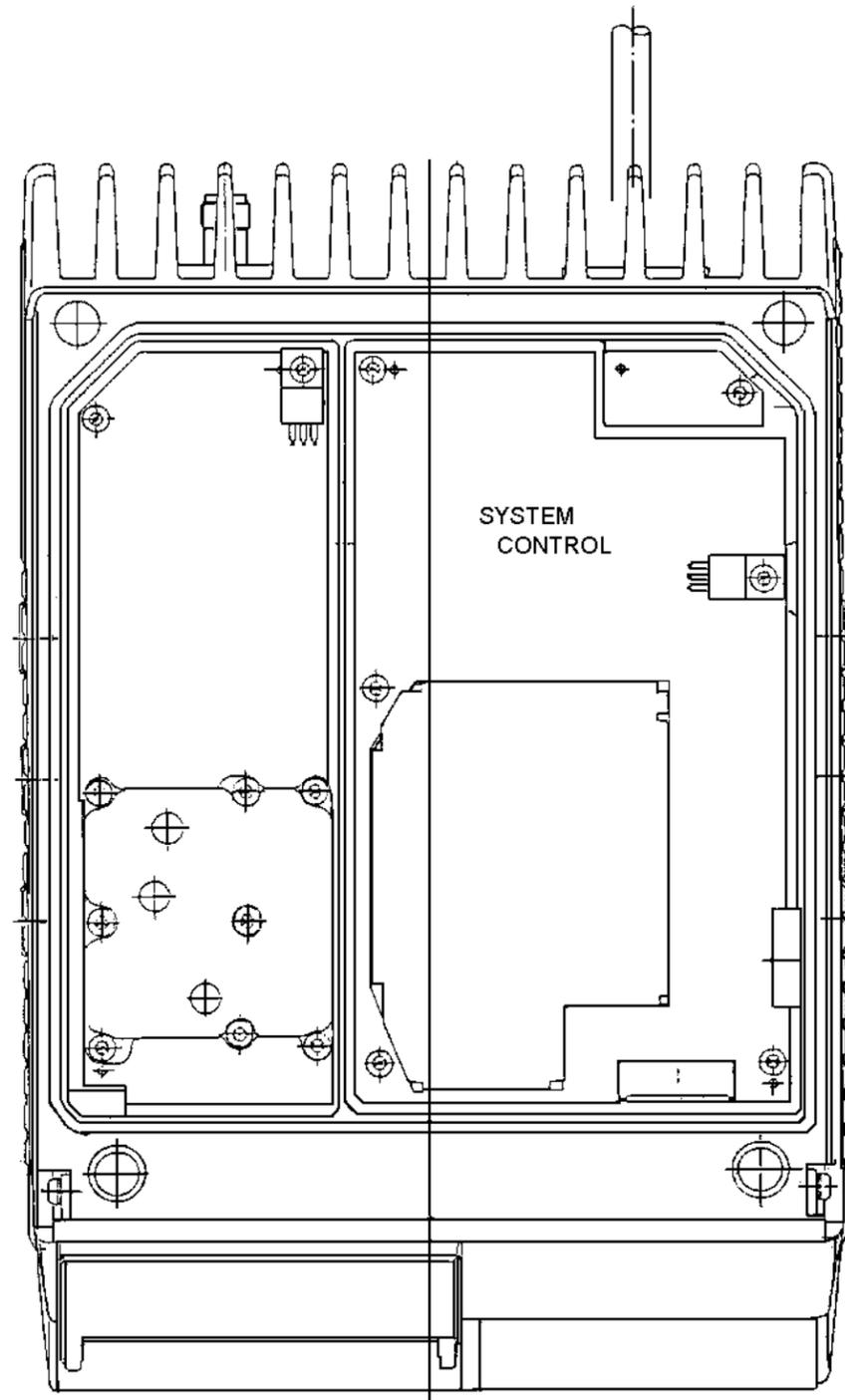
Figure 1 - System Control Board Location
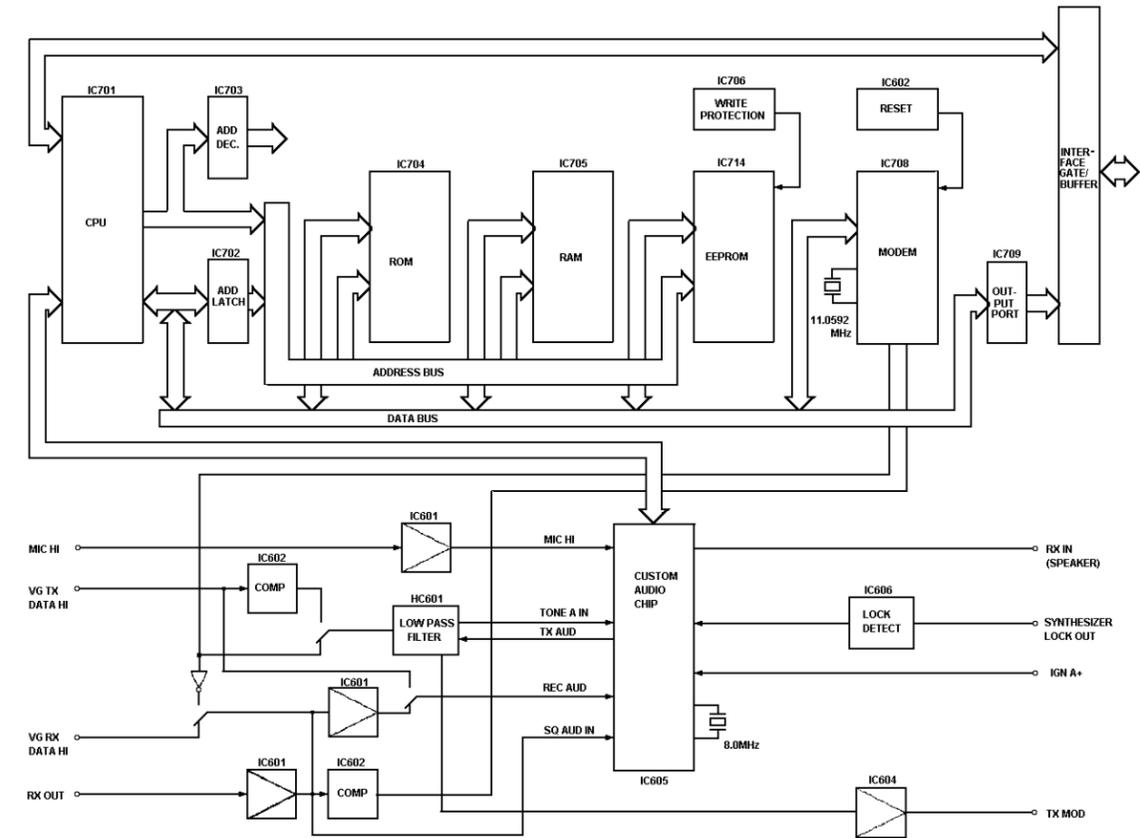
Figure 2 - System Control Board Control Diagram

CIRCUIT ANALYSIS

The following paragraphs explain the theory of operation of the System Control Board. The descriptions are separated into digital and analog circuits. A block diagram of the System Control board is shown in Figure 2.

DIGITAL CIRCUITRY

Reset Circuit

A reset circuit is provided to reset the Microcomputer (IC701), Custom Audio Chip (IC605), Latch (IC 709), and Custom Modem IC (IC 708). The reset is provided by IC602. Resistors R716 and R717 provide a 2.5-volt bias from the digital + 5 volt supply, while R714 and R715 provide a bias at 0.29 times the battery voltage (SW A +). When SW A + falls below approximately 9 volts, IC602-2 goes low. This signal is coupled through diode CD704, causing IC602-6 to remain within one volt of ground which causes IC602-1 to be pulled high through R710.

When SW A + is transitioned quickly, the threshold detector may not provide the required pulse width for reset. Therefore, R711 and C714 are provided to guarantee that the reset pulse will be the correct duration. The output of the power-up reset circuit (IC 602-1) is routed to the Modem IC (IC 708-25) where it is gated with an internal watchdog timer (normally reset by the microcomputer). The reset output of the Modem IC (IC 708-3) is used to reset the microcomputer and is inverted by NOR gate IC710. The inverted reset pulse (IC710-8) is used to reset the latch and custom audio chip.

Personality EEPROM

All personality information is stored in an Electrically Erasable PROM (EEPROM) IC714. Clock and data lines are provided from the microcomputer to read and write to and from the devices.

Serial Port

The heart of the radio system is its serial port. This three-wire port is used to transfer all data to and from any radio option. All communication takes place on the SER TX DATA and SER RX DATA lines and is originated by the radio. When the control unit (Control Unit or Vehicular Repeater) has information to transfer to the radio, they activate (lower) the SER REQ (Serial Request) line. This triggers the mobile to poll the control unit to get the information. Examples of the information transferred on the serial bus are: changes of PTT, Hookswitch/CG disable, CLR (Clear/Moni-

tor). Special Call, System, Group, Scan, Add, Delete, or display information for control units. Even the desired volume is determined in the mobile (the actual volume function is done in the radio and not the control unit). The data is transferred at 9600 baud with filters on the radio interface board to smooth the edges to avoid interference.

Synthesizer Interface

The synthesizer interface consists of the following lines: SYN CH CHG (IC711-2), SYN CLOCK (IC711-12), SYN DATA (IC711-4), SYN ENB (IC711-10), LOCK DET (IC606-2), DPTT (IC711-8) and TALKTHROUGH (IC 709-6/TR706). Frequency information for trunked and conventional frequencies is stored in the EEPROM (IC714) and is transferred to the synthesizer via the microcomputer.

There are 32 data pulses that are clocked into the synthesizer shift register. After the 32 bits are loaded, the SYN ENB pulse transfers the data to the synthesizer counters. The SYN CH CHG pulse is then activated to allow for bypassing the synthesizer low-pass filter increasing the loop bandwidth to achieve a four-millisecond channel acquisition time.

The LOCK DET line is passed through one-shot IC 606 to extend the lock pulse so that the microcomputer can read it. The output of the one-shot drives the UN-LOCKED indicator (CD606) and is fed to the Custom Audio Chip. The custom Audio Chip compares the one-shot output voltage to its mid-range voltage, and routes the result on the COMP line to the microcomputer (IC701-14). This is done by a one-of-four selectable comparator. One side is the selected input and the other side is a digital-to-analog converter whose level is set by the microcomputer.

The TALKTHROUGH bit is used to achieve rapid wide band VCO timing, extending over 806-825 MHz and 851-870 MHz. Components are switched in and out of the VCO tank circuit to set the VCO tuning range. Information about the TALKTHROUGH bit is stored in the EEPROM and is written to the latch IC 709 when the synthesizer is loaded. The TALKTHROUGH data signal is << 1 volt for 806-825 MHz or >> 6 volts for 851-870 MHz.

The DPTT line is used to select the transmit or receive VCO. It is driven from the microcomputer (IC701-5). When pin 5 is high (approximately 3 volts), the receive VCO is selected and when low, the transmit VCO is selected.

Transmitter Enable

Once the synthesizer is loaded for a transmit frequency, the transmitter PA is energized using the TXENB(-) line (TR705). When TR705 is turned on (a logical 1 at IC 709-9),

power to the exciter is enabled and the transmitter PA is turned on.

Custom Modem Chip

The Custom Modem Chip with watchdog timer (IC 708), contains all circuitry necessary to transmit and receive 9600 baud data (used for EDACS and Voice Guard® systems). The chip contains an oscillator which runs at 11.0592 MHz. The frequency is set by crystal X701, resistor R704 and capacitors C713, C712 and C743. If the crystal frequency causes interference, it may be shifted by jumper W 1. This is used as the base for generating/detecting 9600 baud data, as well as supplying the microcomputer clock. The chip communicates with the microcomputer via the eight-bit address/data bus. As data is received from the EDACS system, it is converted from a serial bit stream to an eight-bit byte which is then read by the microcomputer. The microcomputer is interrupted via its INT1(-) line (IC701-13) going low when the modem chip is ready to transfer a byte. The interrupt line is brought high again when the microcomputer has read the available data. When transmitting data, the microcomputer transfers an eight-bit byte to the modem chip. The modem converts the data to a serial data stream (TX DATA) at IC708-21.

Microcomputer

The microcomputer (IC 701) maintains total control of the radio. The microcode memory is provided by an EPROM (IC 704) whose address is latched via IC 702 and the ALE (Address Latch Enable) line from the microcomputer. A RAM chip (IC 705) is provided to allow for additional temporary storage of necessary information. Address decoder IC 703 is used to select the RAM chip, Modem chip, and EEPROM, or the output latch, as well as to provide clock signals to the Custom Audio Chip and the Synthesizer.

The microcomputer controls all radio functions. It interfaces with the Custom Audio Chip to select all audio paths and programmable levels. All received data (9600 baud EDACS data, low-speed data, tone Channel Guard, and Digital Channel Guard) is processed in the microcomputer.

The microcomputer also processes the squelch, synthesizer lock, ignition A + signals and synthesizer type (P603). The four signals are processed through the Custom Audio Chip (as COMP A thru COMP D). Each is an analog signal in the range of 0 to 5 volts. They all enter the Audio Processor, where one of the four inputs is selected and routed to an on-board comparator. The other comparator input is the output of an onboard digital-to-analog converter. The microcomputer programs the level of the digital-to-analog converter corresponding to the signal being examined. The output of the comparator (COMP) is routed to the microcomputer (IC 701-14) for processing. In

the normal receive mode, the microcomputer alternates between checking the synthesizer lock and the squelch level. In the normal transmit mode, the comparator monitors the synthesizer lock only. The ignition A + line is checked only as needed.

The AUX line (IC701-1) is provided for control of external options. Two Walsh bits (IC 701-7 & -8) are provided for all tone generation and low-speed data. Walsh bit 1 is used for generation of Digital Channel Guard while both Walsh bits are used for alert tones and Tone Channel Guard.

ANALOG CIRCUITRY

Custom Audio Chip

The Custom Audio Chip is designed to handle radio audio and data requirements. The chip contains circuitry to perform the following functions: input audio selection, Channel Guard reject, transmit audio limiter, programmable attenuation, post-limiter filter, voice reject filter, Channel Guard limiter, squelch filter (high-pass filter, rectifier), and six open-drain output transistors. The Custom Audio Chip employs switched-capacitor circuit technology. A crystal oscillator circuit (X601, C634, and C635) is employed to generate all necessary frequencies for the chip. A 2.5 volt reference generated by R605, R606, and IC601 is used by all circuitry operating on the analog + 5 volt supply (IC 609). Prior to entering the Audio Processor, the 2.5 volt reference is filtered by R608 and C604.

Transmit Audio

The normal transmit audio path is from MIC HI to TXMOD. Microphone bias is provide by R601, R602, and C637. Amplifier IC601 with R603 and C601 provide audio pre-emphasis, and diode CD601 provides hard-limiting of the audio into the audio processor (within one volt of either side of the 2.5 volt reference).

The MIC audio is brought into the audio processor (IC605-14) where frequencies below 300 Hz are filtered out (prior to adding Channel Guard). The audio is attenuated by R615 and R616 and then limited by the audio processor. The on-board limiter is designed to limit the voice audio to one of two levels: voice plus Channel Guard or voice alone. The radio automatically provides the correct level based on the presence of Channel Guard, so the MIC audio is set to the same level on all radios.

Once limited, any subaudible data (tone or digital) from the tone B input (IC605-21) is added to the MIC audio. The audio is then set via a programmable attenuator to the required level. This attenuator will automatically set the correct level on a per-system basis for either the non-NPSPAC or NPSPAC modula-

tion level. Prior to leaving the audio processor, the audio is passed through a post-limiter filter to remove audio above 3000 Hz at 18 dB/octave. Some additional roll-off is provided by R623, C607, and TR601. When transmit audio is selected, SYN DATA (IC711-4) is held at logic 1 activating TR601. This adds the additional roll-off determined by R623 and C607. When EDACS data is transmitted, SYN DATA is held at logic 0 removing the effect of R623 and C607. The audio is then passed through a Bessel filter with 5 kHz cutoff in HC601. This filter has no effect on the audio but is used when transmitting the EDACS data. The audio is then amplified by IC 604 and routed to the modulator via P701-5.

Subaudible tones and data are generated by the microcomputer (IC701). The tones are generated by two Walsh bits. The two bits are combined in HC601 and the result is brought out on HC601-10. The alert tone is fed from HC601-10 directly to IC605-15 (TONE C IN). The subaudible data level is selected by potentiometer R618. The subaudible tone/data is brought into the audio processor on the Channel Guard input (IC 605-5) and is filtered to remove any harmonics of the base tone. The filtered tone is brought out on pin 6 and routed back to TONE B IN (IC605-21) where it is added to the MIC audio.

Transmit Data

Transmit data is normally generated by the microcomputer (IC 701) and modem chip (IC 708). The modem TX DATA is routed via IC603 to HC601. An Op-Amp is used to set the data level using RV602. The level-adjust data is then fed to the audio processor via TONE A IN (IC 605-20). The data path can then be selected and the data routed to the TX AUD output (IC605-26) of the Custom Audio Chip. The Custom Audio Chip does not filter the data in this mode (except for some rounding of the level transitions due to the nature of the switch capacitor networks). The Custom Audio Chip controls the level of the transmit data. It is automatically selected for the correct level (3.0 kHz for non-NPSPAC channels and 2.4 kHz for NPSPAC channels). The audio is routed to the data filter in HC601, where all final wave shaping is done by the four-pole Bessel filter (5 kHz cutoff). This filtering makes maximum use of the allowed bandwidth. The data is then amplified by IC604 and passed to the modulator.

In addition to generating data signals, the radio has been designed to accept externally generated data from a Voice Guard module through its VG TX DATA HI line. The data is biased about 2.5 volts and is limited via R6 11. It is then processed in the same way as internally generated data.

Internally generated data is also designed to be passed to external devices via the VG RX DATA HI line. The modem data is inverted by TR701 and routed via IC 603 to VG RX DATA HI. The audio processor open-drain switch (IC 605-37)

is used to disable inputs to TR701 and allow the VG RX DATA HI line to operate in a tri-state mode.

Receive Audio

Receive audio from the AF OUT line is set by RV603 to 300 mVrms at IC601-7. The audio is then passed through IC601 (level-adjusting Op-Amp) and IC 603 (analog switch) to the Custom Audio Chip REC AUD input (IC605-12). The audio is then passed through the Channel Guard Reject filter to remove sub-audible data. After filtering, it is then routed through the programmable attenuator to the RX AUD output (IC605-27). The volume level is set by the microcomputer, based on the level selected in the control unit.

The level adjusted VOL/SQHI signal is attenuated by R633 and R634, and fed to the squelch circuit of the Custom Audio Chip. The Custom Audio Chip squelch circuit consists of a 6500 Hz high-pass filter rectifier. The filtered signal is integrated by R643, C618, and C617 to provide a dc level between 2.5 and 5 volts, proportional to the noise on the channel. Capacitor C617 is optionally selected via IC605-35 (SW2) to control fast or slow squelch. When SW2 is off, C617 controls the rate at which the radio adapts to noise (fast squelch). When SW2 is on, both C618 and C617 control the rate at which the mobile adapts to noise (slow squelch). This voltage is then routed to IC 605-56 where it is compared with the Custom Audio Chip digital-to-analog converter output. The comparator output is then routed to the microcomputer (IC701-14).

The System Control board is also designed to allow the received VOL/SW HI to be routed from the radio to optional units such as Voice Guard. The audio is routed to VG RX DATA HI via IC603. It provides the receive data for Voice Guard. When a received Voice Guard signal is detected, it is routed to the radio via the VG AUDIO HI line and is coupled to the audio processor (IC605-13) via C614. It is then processed identically to the receive audio.

The radio can also perform a public address function. When selected, the pre-emphasized MIC HI input can be routed through the Custom Audio Chip to the RX AUD output of the Custom Audio Chip (IC 605-27). It is then de-emphasized and routed to the audio power amp. The radio will direct the control unit to select the external speaker to complete the function.

Receive Data

Data is received on the VOL/SQ HI line from the receiver and passed to the limiter (IC602, R636, R637 and C615). Resistor R637 and capacitor C615 establish the dc level to which the VOL/SQHI signal is compared. The limited data is received from an open-collector output on IC 602 (with pull-up resistor R706) and can be disabled with TR703. Data is disabled to pre-

vent the modem chip from loosing data synchronization when the receiver is absent from the trunked data channel for short intervals. The data is then passed to the modem IC RX DATA line (IC 708-19).

Channel Guard

Channel Guard provides a means of restricting calls to specific radios through the use of a continuous-tone or digitally-coded squelch system (CTCSS or CDCSS). Tone frequencies range from 67 Hz to 210.7 Hz with 33 standard tones and 104 unique digital code available. These tones/codes are identified in Tables 1 and 2.

Table 1 - Channel Guard Tone Frequencies

STANDARD TONE FREQUENCIES (HZ)				
67.0	88.5	107.2	131.8	167.9
71.9	91.5	110.9	136.5	173.8
74.4	94.8	114.8	141.3	179.9
77.0	97.4	118.8	146.2	186.2
79.7	100.0	120.0	151.4	192.8
82.5	103.5	127.3	156.7	203.5
85.4			162.2	210.7

TABLE 2 - CHANNEL GUARD CODES

PRIMARY CODE	EQUIVALENT CODE	PRIMARY CODE	EQUIVALENT CODE	PRIMARY CODE	EQUIVALENT CODE
023	340, 766	132	605, 634, 714	237	464, 642, 772
025		133	413, 620	243	267, 342
026	566	134	273	245	370, 554
031	374, 643	135	205, 610	246	542, 653
032		136	502,712	252	661
036	137	142	174, 270	254	314, 612, 706
037	560, 627	143	333	255	425
043	355	144	466, 666	262	316, 431, 730
047	375, 707	145	525	266	655
051	520, 771	147	303, 306, 761	271	427, 510, 762
053		150	256,703	274	652
054	405, 675	152	366, 415	276	326, 432
056	465, 656	153	606, 630	307	362, 565
057	172	155	233, 660	311	330, 456, 561
060	116,737	156	517, 741	312	515, 663,743
065	301	157	322, 503	315	321, 673
066	734	161	345, 532	317	546, 614, 751
067	516,720	162	416	324	343, 570
071	603, 717, 746	163	460, 607, 654	325	550, 626
072	470, 701	164	207, 732	331	372, 507
073	640	165	354	332	433, 552
074	360, 721	171	265, 426	344	471, 664, 715
075	501, 624	176	244, 417	346	616, 635, 724
076	203, 754	212	253	351	353, 435
104	226, 557	213	263,736	356	521
107	365	217	371, 453, 530	363	463, 443, 444, 662
114	327, 615	222	445, 457, 575	446	467, 511, 672
115	534, 674	223	350, 475, 750	447	473, 474, 731, 744
117	411,756	224	313, 503, 574	452	524,765
122	535	225	536	454	513, 545, 564
123	632, 657	227	261, 567	455	533, 551
125	173	231	504, 631, 636, 745	462	472, 623, 725
127	412, 441, 711	234	423, 563, 621, 713	523	647,726
130	364, 641	235	611, 671, 723	526	562, 645
131	572, 702	236	251, 704, 742		

COMPONENT SIDE
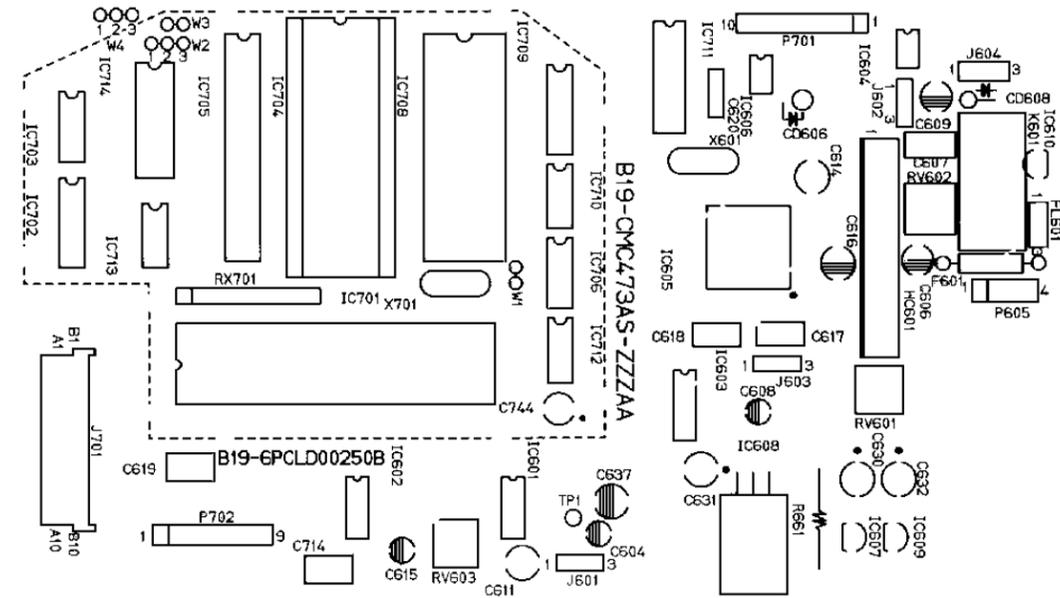
CHIP COMPONENT SIDE
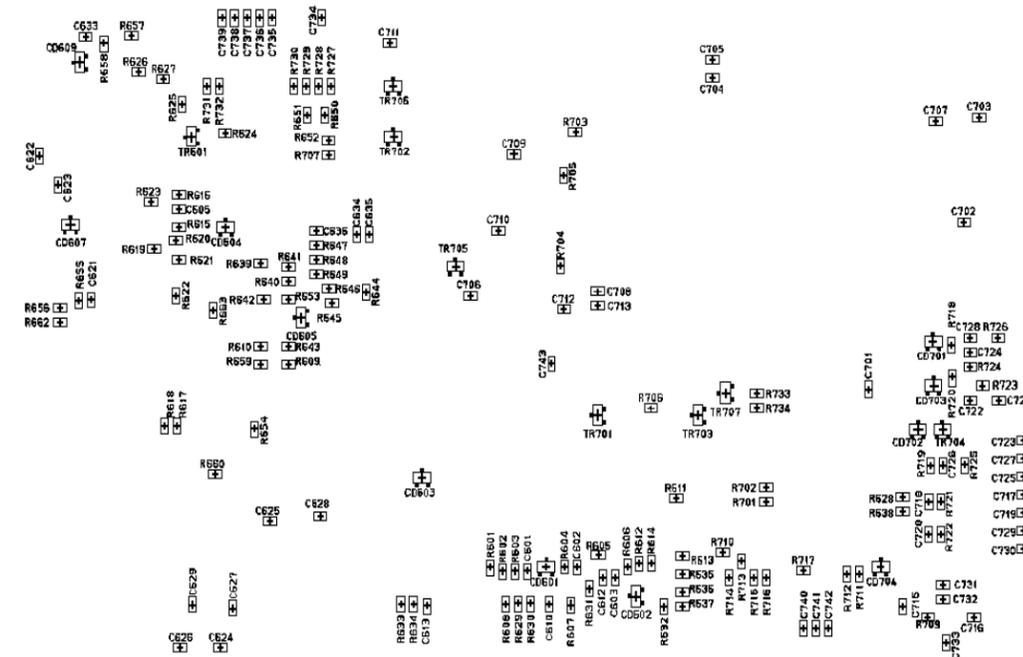
SYSTEM CONTROL BOARD
B19/CMC-473AS
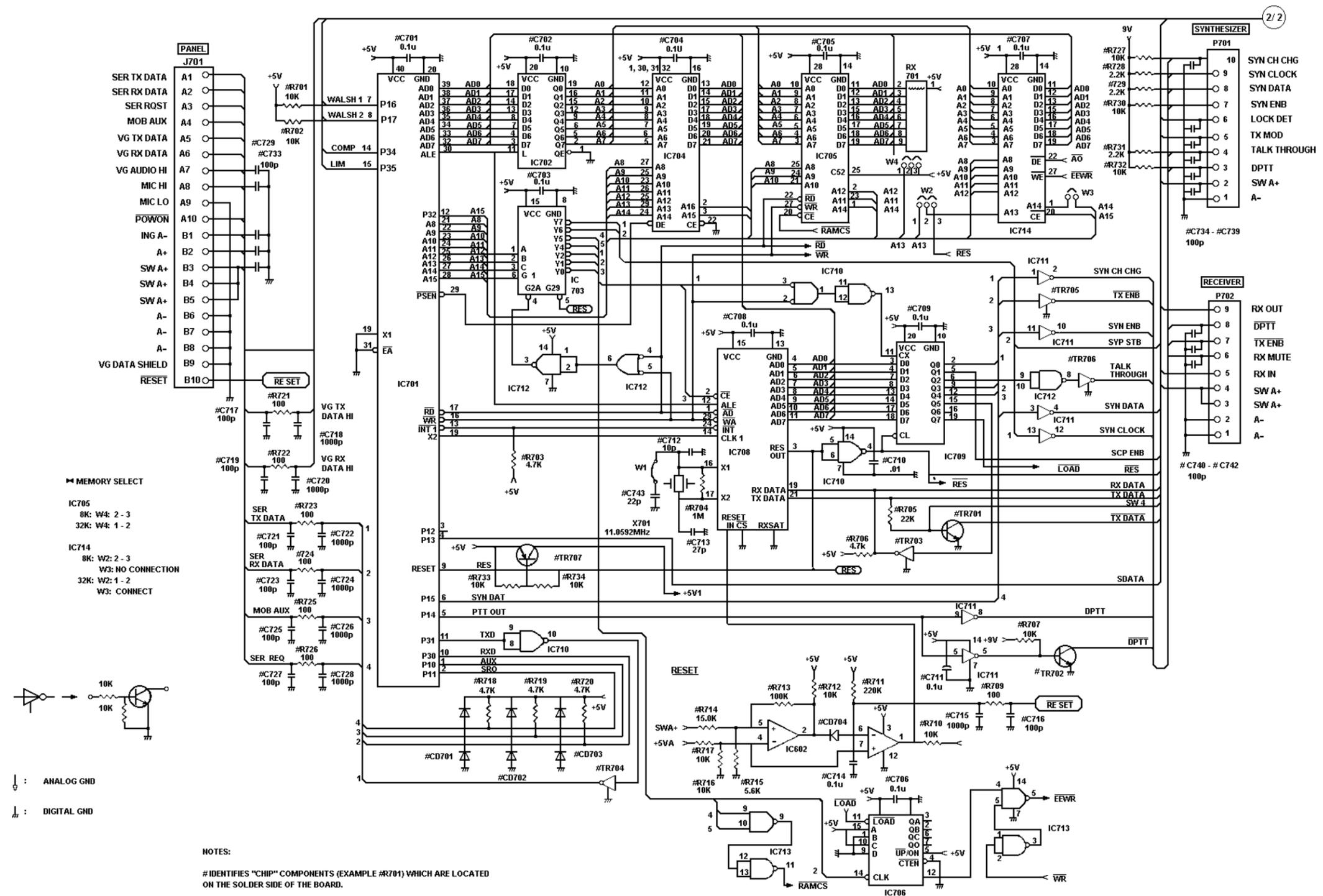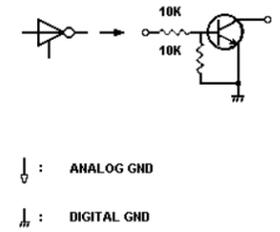
NOTES:

\# IDENTIFIES "CHIP" COMPONENTS (EXAMPLE #R701) WHICH ARE LOCATED ON THE SOLDER SIDE OF THE BOARD.

ALL RESISTORS ARE 1/10 WATT UNLESS OTHERWISE SPECIFIED.
RESISTOR VALUES IN UNLESS FOLLOWED BY MULTIPLIER K OR M.
CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER F.n OR p.

SYSTEM CONTROL BOARD
B19/CMC-473AS

SHEET 1 OF 2
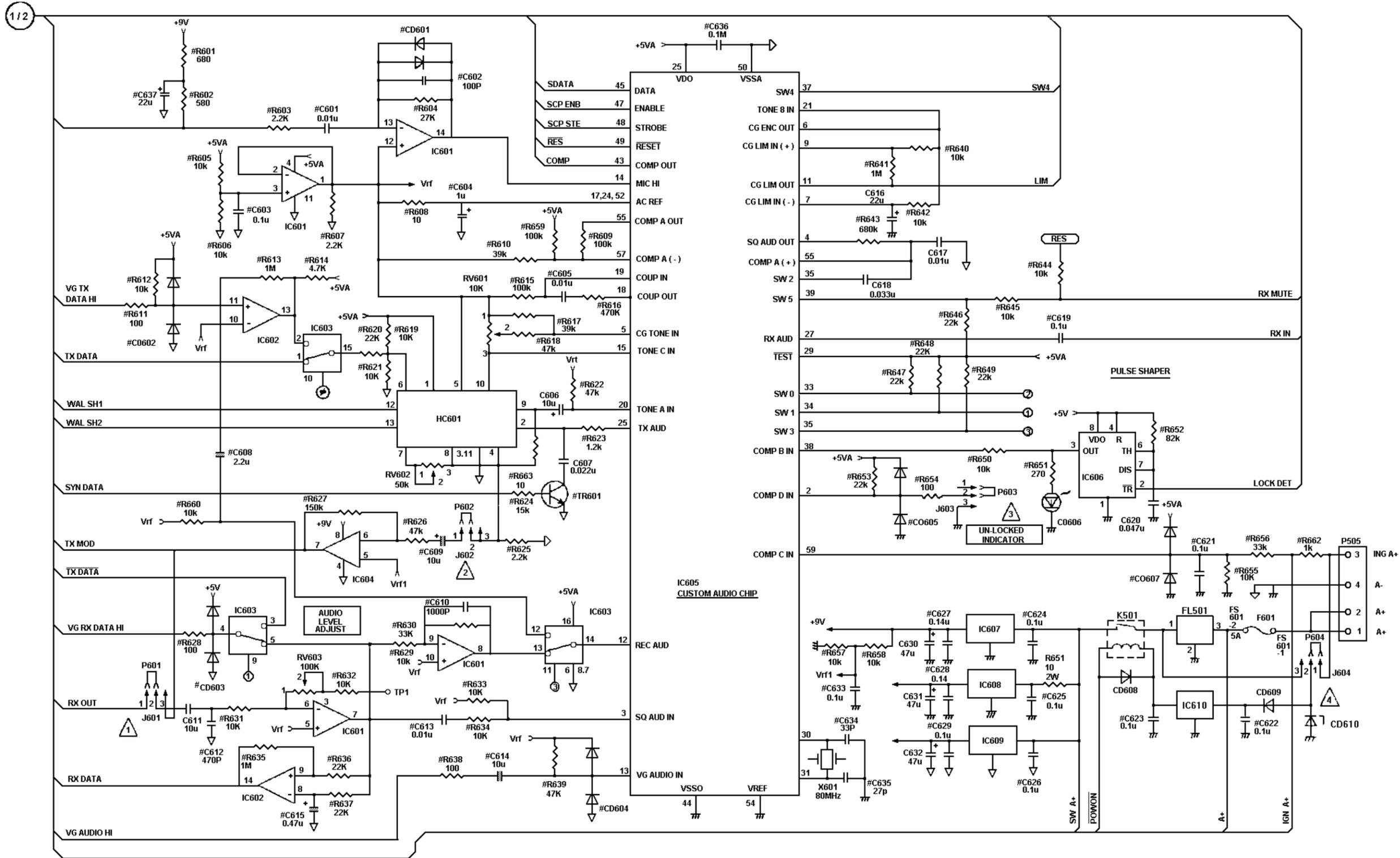
PARTS LIST

ALPHANUMERIC FMD
SYSTEM CONTROL
B19/CMC-473AS

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - CAPACITORS - - - - - - - -
C601	B19/5CAAD00959	Ceramic: 0.01uF, ±10%, 50VDCW, temp coef ±15%.
C602	B19/5CAAD00839	Ceramic: 100pF, ±5%, 50VDCW, temp coef 0±30%.
C603	B19/5CAAD01586	Ceramic: 0.1uF, +80% -20%, 25VDCW.
C604	B19/5CSAC00982	Tantalum: 1uF, ±10%, 35VDCW.
C605	B19/5CAAD00959	Ceramic: 0.01uF, ±10%, 50VDCW, temp coef ±15%.
C606	B19/5CASC00932	Tantalum: 10uF, ±10%, 16VDCW.
C607	B19/5CRAA00816	Polyester: 0.022uF, ±10%, 50VDCW.
C608	B19/5CSAC01069	Tantalum: 2.2uF, ±10%, 35VDCW.
C609	B19/5CASC00932	Tantalum: 10uF, ±10%, 16VDCW.
C610	B19/5CAAD00838	Ceramic: 1000pF, ±10%, 50VDCW, temp coef ±15%.
C611	B19/5CEAA01920	Electrolytic: 10uF, ±20%, 16VDCW.
C612	B19/5CAAD00975	Ceramic: 470pF, ±5%, 50VDCW, temp coef ±30%.
C613	B19/5CAAD00959	Ceramic: 0.01uF, ±10%, 50VDCW, temp coef ±15%.
C614	B19/5CEAA01920	Electrolytic: 10uF, ±20%, 16VDCW.
C615	B19/5CSAC01065	Tantalum: 0.47uF, ±10%, 35VDCW.
C616	B19/5CSAC00939	Tantalum: 22uF, ±10%, 16VDCW.
C617	B19/5CRAA00587	Polyester: 0.01uF, ±5%, 50VDCW.
C618	B19/5CRAA00804	Polyester: 0.033uF, ±5%, 50VDCW.
C619	B19/5CRAA00617	Polyester: 0.1uF, ±5%, 50VDCW.
C620	B19/5CRAA00628	Polyester: 0.047uF, ±5%, 50VDCW.

*COMPONENTS, ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	GE PART NO.	DESCRIPTION
C621 thru C629	B19/5CAAD01586	Ceramic: 0.1uF, +80% -20%, 25VDCW.
C630 thru C632	B19/5CEAA01982	Electrolytic: 47uF, ±20%, 16VDCW.
C633	B19/5CAAD01586	Ceramic: 0.1uF, +80% -20%, 25VDCW.
C634	B19/5CAAD00948	Ceramic: 33pF, ±5%, 50VDCW, temp coef ±30%.
C635	B19/5CAAD00952	Ceramic: 27pF, ±5%, 50VDCW, temp coef ±30%.
C636	B19/5CAAD01586	Ceramic: 0.1uF, +80% -20%, 25VDCW.
C637	B19/5CSAC00939	Tantalum: 22uF, ±10%, 16VDCW.
C701 thru C711	B19/5CAAD01586	Ceramic: 0.1uF, +80% -20%, 25VDCW.
C712	B19/5CAAD00953	Ceramic: 10pF, ±5%, 50VDCW, temp coef ±15%.
C713	B19/5CAAD00952	Ceramic: 270pF, ±5%, 50VDCW, temp coef ±30%.
C714	B19/5CRAA00617	Polyester: 0.1uF, ±5%, 50VDCW.
C715	B19/5CAAD00838	Ceramic: 1000pF, ±10%, 50VDCW, temp coef ±15%.
C716 and C717	B19/5CAAD00839	Ceramic: 100pF, ±5%, 50VDCW, temp coef 0±30%.
C718	B19/5CAAD00838	Ceramic: 1000pF, ±10%, 50VDCW, temp coef ±15%.
C719	B19/5CAAD00839	Ceramic: 100pF, ±5%, 50VDCW, temp coef 0±30%.
C720	B19/5CAAD00838	Ceramic: 1000pF, ±10%, 50VDCW, temp coef ±15%.
C721	B19/5CAAD00839	Ceramic: 100pF, ±5%, 50VDCW, temp coef 0±30%.
C722	B19/5CAAD00838	Ceramic: 1000pF, ±10%, 50VDCW, temp coef ±15%.
C723	B19/5CAAD00839	Ceramic: 100pF, ±5%, 50VDCW, temp coef 0±30%.

SYMBOL	GE PART NO.	DESCRIPTION
C724	B19/5CAAD00838	Ceramic: 1000pF, ±10%, 50VDCW, temp coef ±15%.
C725	B19/5CAAD00839	Ceramic: 100pF, ±5%, 50VDCW, temp coef 0±30%.
C726	B19/5CAAD00838	Ceramic: 1000pF, ±10%, 50VDCW, temp coef ±15%.
C727	B19/5CAAD00839	Ceramic: 100pF, ±5%, 50VDCW, temp coef 0±30%.
C728	B19/5CAAD00838	Ceramic: 1000pF, ±10%, 50VDCW, temp coef ±15%.
C729 thru C742	B19/5CAAD00839	Ceramic: 100pF, ±5%, 50VDCW, temp coef 0±30%.
C743	B19/5CAAD00840	Ceramic: 22pF, ±10%, 50VDCW, temp coef ±15%.
		- - - - - - - - - DIODES - - - - - - - - -
CD601 thru CD605	B19/5TXAD00320	Silicon, fast recovery (2 diodes in series): sim to TOSHIBA 1SS226.
CD606	B19/5TZAD00020	Diode, Optoelectronic: red, sim to TOSHIBA TLR102A.
CD607	B19/5TXAD00320	Silicon, fast recovery (2 diodes in series): sim to TOSHIBA 1SS226.
CD608	B19/5TXAN00068	Silicon, fwd current 1A, 200PIV: sim to SANKEN EM01ZW.
CD609	B19/5TXAN00065	Silicon, fwd current 1A, 200PIV: sim to SANKEN EM-1.
CD610	B19/5TXAE00323	Zener, 20V, sim to HITACHI HZ 20-1.
CD701 thru CD704	B19/5TXAD00320	Silicon, fast recovery (2 diodes in series): sim to TOSHIBA 1SS226.
		- - - - - - - - - FUSES - - - - - - - - -
F601	B19/5ZFED00015	Fuse: 5A.
		- - - - - - - - FILTERS - - - - - - - - -
FL601	B19/5NRAB00023	Filter: sim to MATSUSHITA EXC-EMT103D.
		- - - - - - - - - JACKS - - - - - - - - -
FS601 -1 and -2	B19/5JTEU00008	Terminal: XB-1 1.
		- - - - - HYBRID CIRCUITS - - - - - - - -
HC601	B19/5DHAR00047	Hybrid IC: sim to MURATA AFM14F7500CI.

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - INTEGRATED CIRCUITS - - - - - -
IC601	B19/5DAAN00127	Linear, OP AMP: sim to New JRC NJM3403AM.
IC602	B19/5DAAJ00573	Linear, Comparator: sim to New JRC NJM2901M.
IC603	B19/5DAAJ00565	Analog Multiplexer: sim to MOTOROLA MC14053BF.
IC604	B19/5DAAN00116	Linear, OP AMP: sim to New JRC NJM4560M.
IC605	B19/5DZBG00016	ASP: sim to SEIKO EPSON STC9140F0B.
IC606	B19/5DAAJ00611	Linear, Timer: sim to MOTOROLA MC1455M.
IC607	B19/5DAAR00074	Linear, Positive Voltage Regulator: sim to MATSUSHITA AN78L09.
IC608	B19/5DAAJ00305	Linear, Positive Voltage Regulator: sim to MOTOROLA MC7805CT.
IC609	B19/5DAAJ00588	Linear, Positive Voltage Regulator: sim to MOTOROLA MC78L05ACP.
IC610	B19/5DAAR00074	Linear, Positive Voltage Regulator: sim to MATSUSHITA AN78L09.
IC701	B19/5DDAK00331	Microcomputer: sim to INTEL TP8032AH.
IC702	B19/5DAAJ00455	D-Type Latch: sim to MOTOROLA MC74HC373F.
IC703	B19/5DAAJ00841	Decoder: sim to MOTOROLA MC74HC138AF.
IC704	B19/5DDAB00421	EPROM: sim to MITSUBISHI M5M27C101K.
IC705	B19/5DDAB00422	S-RAM: sim to MITSUBISHI M5M5256BKP.
IC706	B19/5DAAJ00913	Up/Down Counter: sim to MOTOROLA MC74HC191F.
IC708	B19/5DDEL00001	MODEM: sim to NEC 19A704727P2.
IC709	B19/5DAAJ00404	Flip-Flops: sim to MOTOROLA MC74HC273F.
IC710	B19/5DAAJ00734	Nor-Gates: sim to MOTOROLA MC74HC02AF.
IC711	B19/5DDAF00113	Inverter: sim to HITACHI HD7406P.
IC712 and IC713	B19/5DAAJ00635	Nand-Gates: sim to MOTOROLA MC74HC00F.
IC714	B19/5DAAG00644	EEPROM: sim to HITACHI HM58C66FP-25.
ICS704	B19/5ZJCK00193	IC Socket: 32 pins.

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - CONNECTORS - - - - - - - -
J601 thru J604	B19/5JTCA00137	Contact electrical.
J701	B19/5JWAV00116	Connector: 20 pins.
		- - - - - - - - RELAYS - - - - - - - -
K601	B19/5KLAC00112	Relay: sim to TAKAMIZAWA JY9H-K.
		- - - - - - - - PLUGS - - - - - - - -
P601 thru P604	B19/5JDAN00012	Receptacle: 2 position, shorting, rated at 1 amp, sim to HONDA DIC-S252.
P605	B19/6ZCLD00054	Cable Assembly.
P701	B19/6ZCLD00028	Cable Assembly.
P702	B19/6ZCLD00029	Cable Assembly.
		- - - - - - - - RESISTORS - - - - - - - -
R601 and R602	B19/5RDAC02472	Metal film: 680 ohms, ±5%,100VDCW, 1/10W.
R603	B19/5RDAC02451	Metal film: 2.2K ohms, ±5%,100VDCW, 1/10W.
R604	B19/5RDAC02457	Metal film: 27K ohms, ±5%,100VDCW, 1/10W.
R605 and R606	B19/5RDAC02489	Metal film: 10K ohms, ±1%,100VDCW, 1/10W.
R607	B19/5RDAC02451	Metal film: 2.2K ohms, ±5%,100VDCW, 1/10W.
R608	B19/5RDAC02450	Metal film: 10 ohms, ±5%,100VDCW, 1/10W.
R609	B19/5RDAC02487	Metal film: 120K ohms, ±5%,100VDCW, 1/10W.
R610	B19/5RDAC02449	Metal film: 100K ohms, ±5%,100VDCW, 1/10W.
R611	B19/5RDAC02447	Metal film: 100 ohms, ±5%,100VDCW, 1/10W.
R612	B19/5RDAC02445	Metal film: 10K ohms, ±5%,100VDCW, 1/10W.
R613	B19/5RDAC02461	Metal film: 1M ohms, ±5%,100VDCW, 1/10W.
R614	B19/5RDAC02478	Metal film: 4.7K ohms, ±5%,100VDCW, 1/10W.
R615	B19/5RDAC02449	Metal film: 100K ohms, ±5%,100VDCW, 1/10W.
R616	B19/5RDAC02490	Metal film: 470K ohms, ±5%,100VDCW, 1/10W.
R617	B19/5RDAC02484	Metal film: 39K ohms, ±5%,100VDCW, 1/10W.
R618	B19/5RDAC02439	Metal film: 47K ohms, ±5%,100VDCW, 1/10W.
R619	B19/5RDAC02445	Metal film: 10K ohms, ±5%,100VDCW, 1/10W.
R620	B19/5RDAC02454	Metal film: 22K ohms, ±5%,100VDCW, 1/10W.
R621	B19/5RDAC02445	Metal film: 10K ohms, ±5%,100VDCW, 1/10W.
R622	B19/5RDAC02439	Metal film: 47K ohms, ±5%,100VDCW, 1/10W.
R623	B19/5RDAC02473	Metal film: 1.2K ohms, ±5%,100VDCW, 1/10W.
R624	B19/5RDAC02481	Metal film: 15K ohms, ±5%,100VDCW, 1/10W.
R625	B19/5RDAC02451	Metal film: 2.2K ohms, ±5%,100VDCW, 1/10W.
R626	B19/5RDAC02439	Metal film: 47K ohms, ±5%,100VDCW, 1/10W.
R627	B19/5RDAC02455	Metal film: 150K ohms, ±5%,100VDCW, 1/10W.
R628	B19/5RDAC02447	Metal film: 100 ohms, ±5%,100VDCW, 1/10W.
R629	B19/5RDAC02445	Metal film: 10K ohms, ±5%,100VDCW, 1/10W.
R630	B19/5RDAC02483	Metal film: 33K ohms, ±5%,100VDCW, 1/10W.
R631 thru R634	B19/5RDAC02445	Metal film: 10K ohms, ±5%,100VDCW, 1/10W.
R635	B19/5RDAC02461	Metal film: 1M ohms, ±5%,100VDCW, 1/10W.
R636 and R637	B19/5RDAC02454	Metal film: 22K ohms, ±5%,100VDCW, 1/10W.
R638	B19/5RDAC02447	Metal film: 100 ohms, ±5%,100VDCW, 1/10W.
R639	B19/5RDAC02439	Metal film: 47K ohms, ±5%,100VDCW, 1/10W.
R640	B19/5RDAC02445	Metal film: 10K ohms, ±5%,100VDCW, 1/10W.
R641	B19/5RDAC02461	Metal film: 1M ohms, ±5%,100VDCW, 1/10W.
R642	B19/5RDAC02445	Metal film: 10K ohms, ±5%,100VDCW, 1/10W.
R643	B19/5RDAC02588	Metal film: 680K ohms, ±5%,100VDCW, 1/10W.
R644 and R645	B19/5RDAC02445	Metal film: 10K ohms, ±5%,100VDCW, 1/10W.
R646 thru R649	B19/5RDAC02454	Metal film: 22K ohms, ±5%,100VDCW, 1/10W.
R650	B19/5RDAC02445	Metal film: 10K ohms, ±5%,100VDCW, 1/10W.
R651	B19/5RDAC02555	Metal film: 270 ohms, ±5%,100VDCW, 1/10W.
R652	B19/5RDAC02486	Metal film: 82K ohms, ±5%,100VDCW, 1/10W.
R653	B19/5RDAC02454	Metal film: 22 ohms, ±5%,100VDCW, 1/10W.
R654	B19/5RDAC02447	Metal film: 100 ohms, ±5%,100VDCW, 1/10W.
R655	B19/5RDAC02445	Metal film: 10K ohms, ±5%,100VDCW, 1/10W.
R656	B19/5RDAC02483	Metal film: 33K ohms, ±5% 100VDCW, 1/10W.
R657 and R658	B19/5RDAC02445	Metal film: 10K ohms, ±5%,100VDCW, 1/10W.
R659	B19/5RDAC02449	Metal film: 100K ohms, ±5%,100VDCW, 1/10W.
R660	B19/5RDAC02445	Metal film: 10K ohms, ±5%,100VDCW, 1/10W.
R661	B19/5REAG00048	Carbon film: 10 ohms, ±5%, 2W.
R662	B19/5RDAC0244G	Metal film: 1K ohms, ±5%,100VDCW, 1/10W.
R701 and R702	B19/5RDAC02445	Metal film: 10K ohms, ±5%,100VDCW, 1/10W.
R703	B19/5RDAC02478	Metal film: 4.7K ohms, ±5%,100VDCW, 1/10W.
R704	B19/5RDAC02461	Metal film: 1M ohms, ±5%,100VDCW, 1/10W.
R705	B19/5RDAC02454	Metal film: 22K ohms, ±5%,100VDCW, 1/10W.
R706	B19/5RDAC02478	Metal film: 4.7K ohms, ±5%,100VDCW, 1/10W.
R707	B19/5RDAC02445	Metal film: 10K ohms, ±5%,100VDCW, 1/10W.
R709	B19/5RDAC02447	Metal film: 100 ohms, ±5%,100VDCW, 1/10W.
R710	B19/5RDAC02445	Metal film: 10K ohms, ±5%,100VDCW, 1/10W.
R711	B19/5RDAC02453	Metal film: 220K ohms, ±5%,100VDCW, 1/10W.
R712	B19/5RDAC02445	Metal film: 10K ohms, ±5%,100VDCW, 1/10W.
R713	B19/5RDAC02449	Metal film: 100K ohms, ±5%,100VDCW, 1/10W.
R714	B19/5RDAC02481	Metal film: 14K ohms, ±1%,100VDCW, 1/10W.
R715	B19/5RDAC02591	Metal film: 4.99K ohms, ±1%,100VDCW, 1/10W.
R716 and R717	B19/5RDAC02589	Metal film: 10.0K ohms, ±1%,100VDCW, 1/10W.
R718 thru R720	B19/5RDAC02478	Metal film: 4.7K ohms, ±5%,100VDCW, 1/10W.
R721 thru R726	B19/5RDAC02447	Metal film: 100 ohms, ±5%,100VDCW, 1/10W.
R727	B19/5RDAC02445	Metal film: 10K ohms, ±5%,100VDCW, 1/10W.
R728 and R729	B19/5RDAC02451	Metal film: 2.2K ohms, ±5%,100VDCW, 1/10W.
R730	B19/5RDAC02445	Metal film: 10K ohms, ±5%,100VDCW, 1/10W.
R731	B19/5RDAC02451	Metal film: 2.2K ohms, ±5%,100VDCW, 1/10W.
R732 thru R734	B19/5RDAC02445	Metal film: 10K ohms, ±5%,100VDCW, 1/10W.
RV601 and RV602	B19/5RVAB00279	Variable: 10K ohms, ±30%, 0.1w.
RV603	B19/5RVAB00276	Variable: 100K ohms, ±30%, 0.1w.
RX701	B19/5RZAB00136	Octal Resistor Arrary: 10k OHMS, ±5%, 1/8W.
		- - - - - - - - TRANSISTORS - - - - - - - -
TR601	B19/5TDAB00054	Silicon, NPN: sim to NEC 2SD596.
TR701 and TR702	B19/5TDAB00054	Silicon, NPN: sim to NEC 2SD596.
TR703 thru TR706	B19/5TCAZ00011	Silicon, NPN: sim to SANYO 2SC3398.
TR707	B19/5TDAB00054	Silicon, NPN: sim to NEC 2SD596.
		- - - - - - - - CRYSTALS - - - - - - - -
X601	B19/5XHAA00987	Crystal: 8.000MHz.
X701	B19/5XHAA00988	Crystal: 11.0592MHz.

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