Price $4.00

SIGNAL DIVISION
Federal Signal Corporation

MODELS

MPA 1 & MPA 2

Series 1C

ELECTRONIC SIRENS

INSTALLATION AND SERVICE INSTRUCTIONS

SECTION I
GENERAL DESCRIPTION

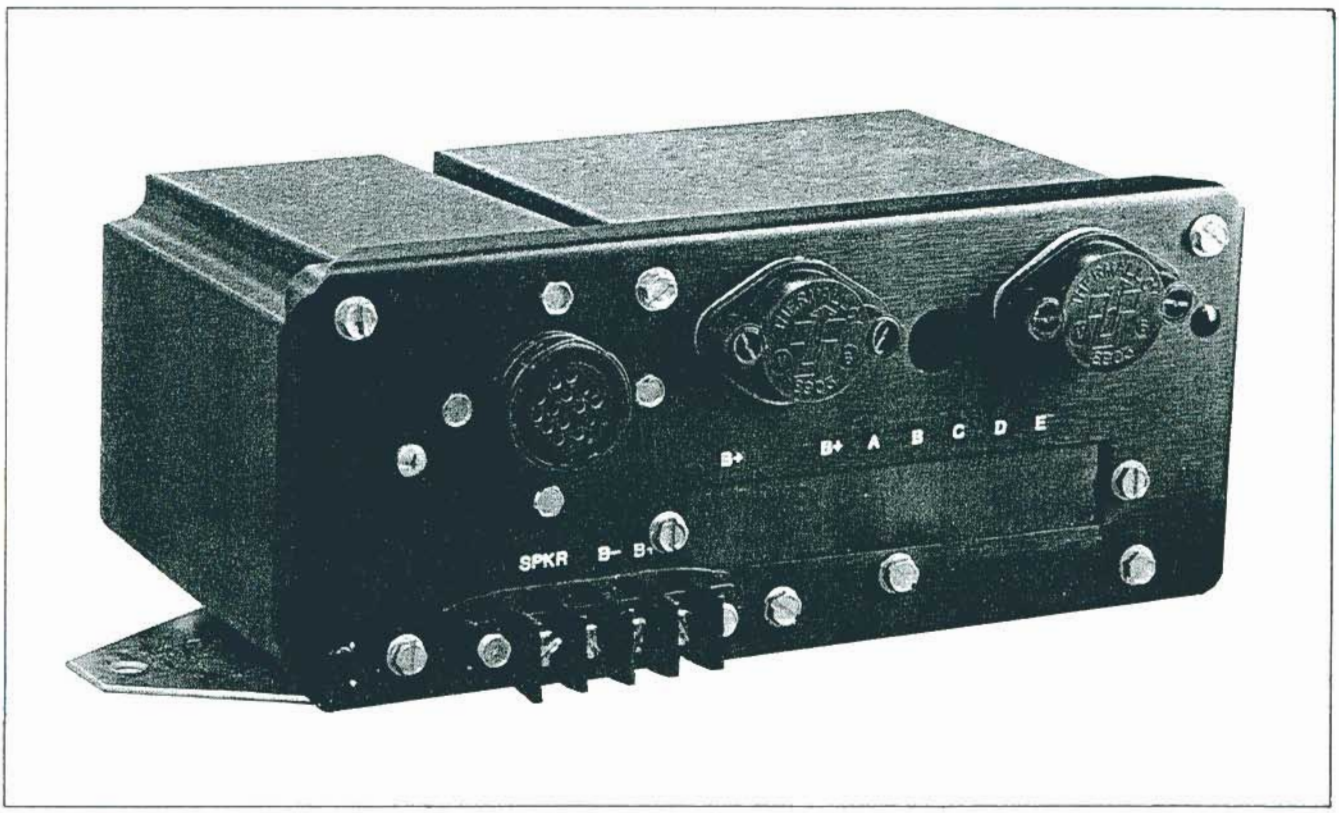


Figure 1-1. Federal Model MPA1 or MPA2 Electronic Siren.

The Federal Models MPA1 and MPA2 (Fig. 1-1) are precisely built, compact, solid state electronic sirens of advanced design. They operate from a nominal 12VDC, negative ground electrical system. The packaging, control figurations and functions are identical, except that the MPA1 operates with one 58 watt speaker, such as the Federal Model TS24, and the MPA2 with one 100 watt speaker, such as the Federal Model TS100. Your Federal dealer has a complete line of speakers for use with these sirens.

A control switch (supplied) provides a convenient method for controlling the electronic siren. The control switch consists of a legend plate, toggle switch, microphone jack and mounting bracket. A power and control cable with solderless connectors at one end is also supplied.

Both siren models are housed in a splashproof enclosure that complies with SAE specification J1211 for splashproof testing. This makes it practical for the user to install the unit in a variety of locations, including some engine compartment locations.

The sirens are capable of producing two distinct siren signals: Wail and Yelp. The units also have provisions for Public Address (PA) operation. An optional Federal Model MNCT Microphone is required if it is desired to make use of the PA capability.

The power/control cable plugs into the siren and allows the unit to be removed from the vehicle for servicing without disturbing the wiring to the control switch. The siren and vehicle electrical system are protected by a 15-amp in-line fuse in the power lead.

SECTION II
SPECIFICATIONS

2-1. GENERAL.

Input Voltage	10VDC to 16VDC (16VDC operation limited to 15 minutes)
Polarity	Negative ground
Standby Current (Siren Control Switch set to OFF)	0mA
Operating Temperature Range	-30°C to +75°C
Dimensions (HWD-overall)	3-5/8" x 8-1/4" x 5" (82mm x 210mm x 127mm)
Weight (approx.)	3.75 lb. (1.6 kg.)

2-2. SIREN.

Operating Current (14.0Vdc-WAIL)	
100 Watt Speaker (MPA2)	10 amperes (max.)
58 Watt Speaker (MPA1)	6 amperes (max.)
Frequency Range	550 to 1500Hz
Cycle Rate (approx.)	WAIL - 10 cycles/min. YELP - 180 cycles/min.
Voltage Output (approx.)	
100 Watt Speaker (MPA2)	64V p-p
58 Watt Speaker (MPA1)	45V p-p

SECTION III
INSTALLATION

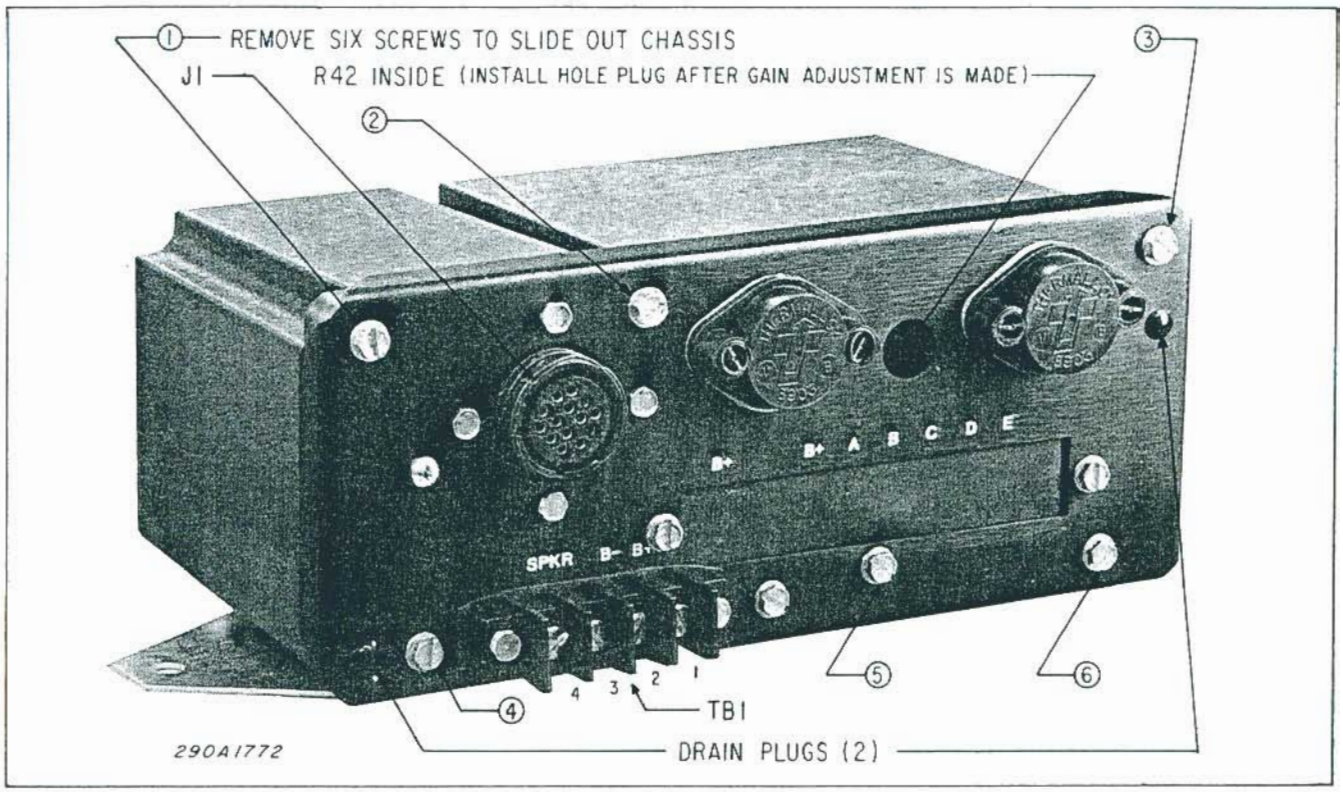


Figure 3-1. Siren Front Panel.

3-1. UNPACKING.

After unpacking the siren, examine it for damage that may have occurred in transit. If the equipment has been damaged, file a claim immediately with the carrier stating the extent of the damage. Carefully check all envelopes, shipping labels and tags before removing or destroying them. All small parts and accessories are packed in plastic bags.

CAUTION

When drilling holes in ANY part of the vehicle ensure that both sides of the mounting surface are clear of parts that could be damaged, such as electrical wiring, brake lines, fuel lines or other vital parts.

3-2. SIREN INSTALLATION.

Locate the plastic bag containing the accessory kit. The accessory kit contains the power and control cable assembly, switch and bracket assembly, the power cable extension, the amplifier ground lead (with lugs) and assorted hardware. To install the siren, proceed as follows:

NOTE

The power cable extension is about 8 ft. (244cm) long. Make sure the mounting location selected for the siren is not more than 8 ft. (244cm) from the vehicle battery.

A. Select the siren mounting location and bend the siren mounting flanges to conform to the contours of the mounting surface. Use the holes in the flanges as a template and scribe two screw location marks at the mounting location.

B. The siren accessory mounting kit provides sheet metal screws with lockwashers of 1/4" - 20 cap screws with lockwashers and hex nuts. The holes

1 page

A. Use one of the mounting brackets as a template and scribe two drill positioning marks at the selected mounting location under the dash.

CAUTION

Before drilling holes in ANY part of a vehicle, be sure that both sides of the mounting surface are clear of parts that could be damaged; such as brake lines, electrical wiring or other vital parts.

B. Drill two 1/4-inch diameter holes at the position marks.

C. Secure the mounting bracket to the dash with (2 each) 1/4-20 x 3/4 hex head screws, 1/4 split lockwashers and 1/4-20 hex nuts as shown in figure 3-1.

D. Secure the electronic siren to the mounting bracket with 1/4-20 x 3/8 hex head screws and 1/4 split lockwashers.

E. Tilt the unit to the desired position. Tighten the 1/4-20 x 3/8 hex head screws.

NOTE: When installing the unit on the transmission hump, a Federal Model TU-70 Tunnel Mount is recommended. The TU-70 is drilled and tapped to accommodate the PA300* mounting bracket. Follow the installation instructions packed with each unit.

3-3. POWER CABLE INSTALLATION.

The power cable included in the carton is equipped with a twelve-prong plug (P5) that mates with the connector (J5) on the rear of the electronic siren (see figure 3-2). The various wires on the connector must be connected as follows:

WARNING

Failure to observe this WARNING may result in fire, burns or blindness.

If shorted to vehicle frame, high current conductors can cause hazardous sparks resulting in electrical fires or molten metal.

DO NOT connect this system to vehicle battery until ALL other electrical connections are made and mounting of all components is complete.

Verify that no short circuits exist, before connecting to the Positive (+) battery terminal.

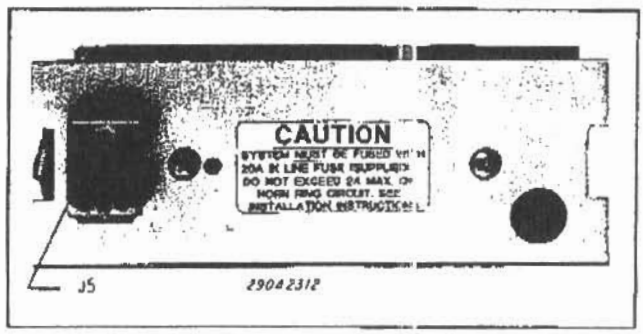


Figure 3-2. Rear View of PA300.*

A. *Speaker.*

The unit is designed to operate with one 11-ohm impedance speaker or two 11-ohm impedance speakers connected in parallel.

A speaker is not included as part of the electronic siren. FEDERAL speakers are weatherproof and may be installed in any convenient location; on the roof, fender, behind the grill, etc. Any special mounting instructions applicable to the type of speaker you have selected will be found in the speaker carton.

Connect the speaker leads (18 gauge wire) as shown in Control Cable Wiring Diagram, figure 3-3.

B. *Radio.*

To allow incoming radio messages to be rebroadcast over the outside speakers, connect the two brown zip cord leads (P5, pins 9 and 12) across the two-way radio's speaker.

C. *Horn Ring.*

In order to utilize the Tap II and Press-and-Hold features of the siren, the following procedure must be performed.

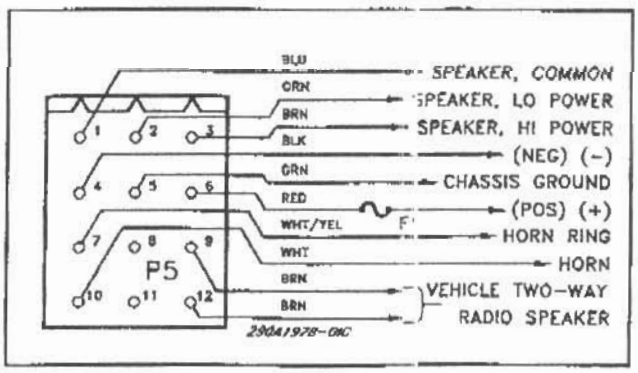


Figure 3-3. Control Cable Wiring Diagram.

PA300-012 MSB

drilled in the mounting surface must be appropriate for the mounting screws selected. If sheet metal screws are used, drill 3/16" holes at the position marks located in Step A. Drill 9/32" holes at the position marks if 1/4" - 20 screws, lockwashers and nuts are used.

Secure the siren to the mounting surface using the mounting hardware, including lockwashers.

The siren housing is splashproof, however, it is NOT waterproof. If the siren is installed in the engine compartment, moisture can enter and accumulate, possibly causing damage to electronic circuitry. To forestall this condition, the housing has been equipped with several plugged drain holes. As indicated in figure 3-1, two of these holes are located in corners of the front panel, diagonally opposite each other. There are two similar plugged drain holes on the rear of the housing in the corners closest to the mounting flanges. Remove the plug(s) at the lowest point of the installation.

3-3. SPEAKER INSTALLATION.

CAUTION

The Model MPA1 is designed to operate with a 58 watt speaker. The Model MPA2, however, must use a 100 watt speaker. If a 58 watt speaker is used with an MPA2, it will be destroyed.

Install speaker following manufacturer's instructions. If Federal Model TS100 (100W) or TS24 (58W) is used, order Federal Model TSKC Concealed Mounting Kit to install speaker under the hood.

3-4. CONTROL SWITCH INSTALLATION.

To install the control switch, proceed as follows:

A. Peel the protective paper backing from the legend plate. Carefully align the hole in the legend plate with the hole at the right in the mounting bracket, as viewed from the front (see figure 3-2). Press the legend plate firmly against the bracket to ensure that the plate adheres to the bracket.

B. Select a suitable mounting location for the control switch under the vehicle dashboard or other area that allows easy access for the siren operator.

C. Use the mounting bracket as a template and scribe two drill positioning marks at the selected mounting location.

CAUTION

When drilling holes in ANY part of the vehicle, ensure that the back side of the surface to be drilled is clear of parts that could be damaged; such as lines, linkages, electrical wiring or other vital parts.

D. Drill a 1/8-inch hole at each position mark. Using the short #8 sheet metal screws (supplied), secure the bracket/legend plate assembly to the mounting surface.

E. Remove the retaining nut from the single pole-double throw (SPDT), center-off switch. There are three lugs on the SPDT switch. Align the keyway on the switch with the alignment tab in the hole as shown in figure 3-2. Secure the switch to the mounting bracket with the retaining ring.

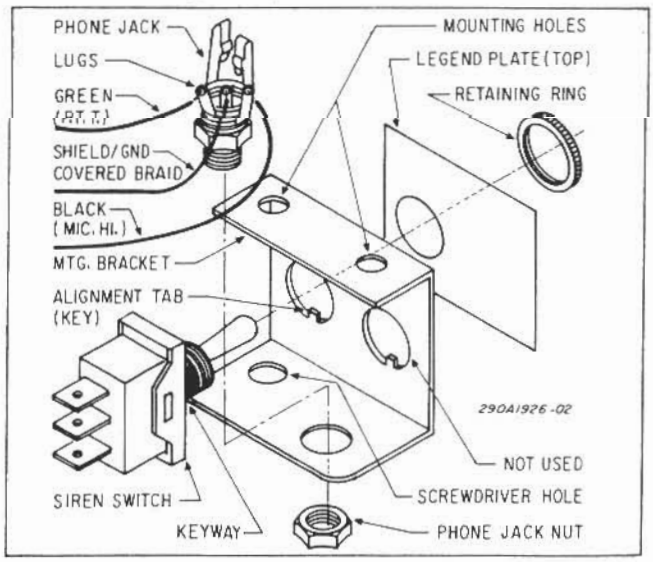


Figure 3-2. Control Switch Installation.

F. Install the phone jack in the large hole in the bottom bend of the mounting bracket, as shown in figure 3-2. Position the phone jack so that the three lugs are toward the rear of the bracket (see figure 3-2). Use the supplied nut to secure the phone jack to the mounting bracket.

3-5. ELECTRICAL CONNECTIONS.

A. Power/Control Cable.

1. Plug the plastic connector on the power/control cable into the receptacle on the siren.

2. Connect the red AWG16 wire having the in-line fuseholder to the vehicle's positive battery terminal. If necessary, splice additional AWG16, or larger, wire to the red wire.

3. Connect the black AWG16 wire directly to the vehicle frame as close as possible to the siren.

4. Connect the brown 2-conductor (zip) cord in the power/control cable to the siren's speaker. If necessary, splice additional AWG18 wire.

B. Control Connections.

1. Locate the red and yellow wires in the power/control cable. Connect the red lead to the top lug and the yellow lead to the bottom lug of the SPDT switch (see figure 3-3).

2. Locate the green and black wires and the covered braid (shield/ground) in the power control cable. Connect the three leads to the phone jack as shown in figure 3-2. The function of each wire is shown below:

WIRE COLOR	FUNCTION
Black	Mic, Hi
Green	Push-to-talk
Covered braid	Shield/ground

3. Connect the slip-on terminal of the fused two-foot length of red wire (supplied) to the center lug of the SPDT switch. Connect the other end of this wire to the vehicle ignition switch as shown in figure 3-3 .

3-6. PA LOUDNESS ADJUSTMENT.

After the siren is completely installed, depress the microphone push-to-talk switch and speak into the microphone in a normal speaking voice. Using a small screwdriver, adjust R42 for the desired PA loudness level. See figure 3-1 for the location of R42. It may be desirable to station another person outside of the vehicle, approximately 10 feet from the front of the speaker, to assist the operator while making the adjustment.

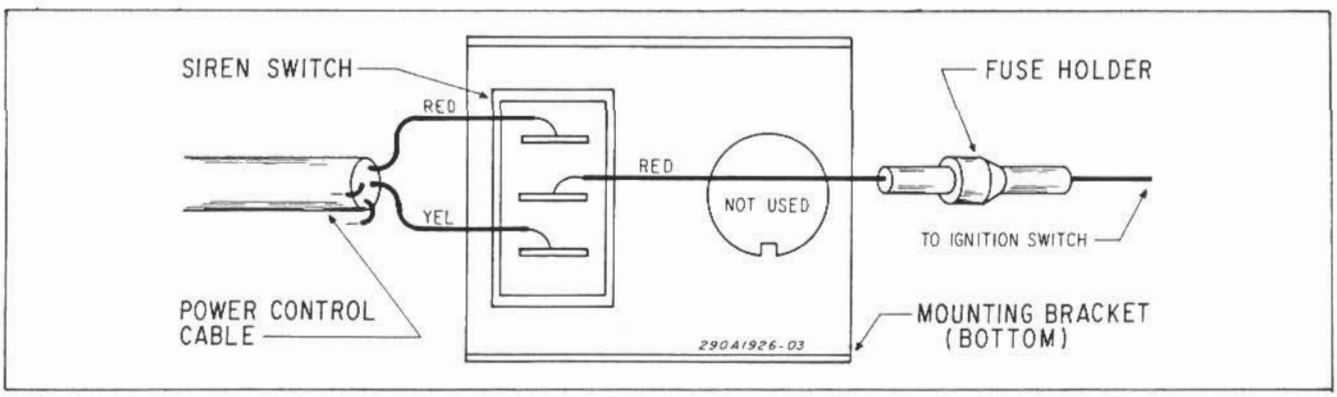
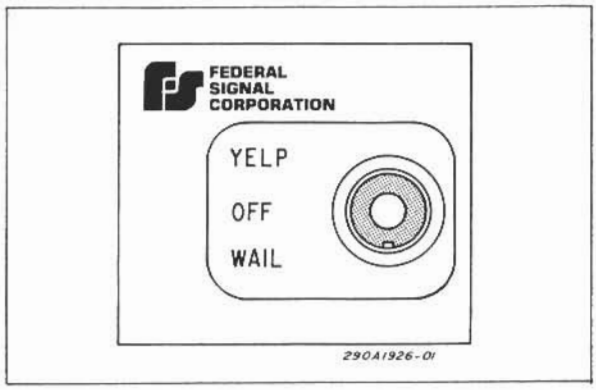


Figure 3-3. Control Switch Wiring.

SECTION IV
OPERATION

The operation of the electronic siren is controlled by the single-pole, double-throw (SPDT) center-off control switch. The following are positions on the switch. (See figure 4-1).



4-1. Control Switch.

A. WAIL causes the siren to produce a "wailing" sound whose frequency varies between 500Hz and 1500Hz at a rate of 10 to 15 cycles per minute. Public address overrides the Wail signal when the microphone push-to-talk (PTT) switch is depressed.

B. OFF. The siren produces no sound. However, public address is operational when the microphone PTT switch is depressed.

C. YELP produces a signal similar to WAIL, but at a much faster rate. The siren signal frequency varies between 550Hz and 1500Hz at a rate of approximately 180 cycles per minute. Pressing the PTT switch causes public address to override the signal.

SECTION V
THEORY OF OPERATION

5-1. GENERAL.

Operation of the siren is controlled by a control switch.

The circuit theory of the Models MPA1 and MPA2 is nearly identical. Therefore, all circuit descriptions are applicable to both models unless otherwise specified. Refer to the schematic diagram (figure 6-1), while reading the paragraphs in this section.

5-2. POWER CONTROL CIRCUITRY.

The Power Control circuitry applies regulated 8.2VDC to the Tone Control Oscillator and Tone Generator when a WAIL or YELP signal is activated. The Power Control circuit also applies unregulated operating voltage to the Audio Amplifier stages from the vehicle battery when a siren signal is initiated or when the microphone push-to-talk (PTT) switch is operated.

When the SIREN switch is set to the WAIL position, 12VDC is applied through the power/control cable to J1-9 and P1-9. This voltage is then filtered by C17, and applied to the anode of CR14, forward biasing CR14. CR14 couples the battery voltage through R59 to the base of Q9, causing Q9 to conduct through CR5 and R14. The conduction of Q9 allows Q8 to conduct through DS1, R47 and zener diode CR6. CR6, with DS1 and Q8 regulates the supply voltage to the Tone Control Oscillator and Tone Generator circuits at 8.2 volts DC. This regulated voltage is required to prevent undesired variations in the signal frequency that could otherwise occur.

Q3 and associated components ensure that the timing capacitors in the Tone Control Oscillator are fully discharged when the siren signal is changed from YELP to WAIL, or vice versa. The mechanical structure of the SIREN switch is such that when the switch is set from one signal position to the other, it must pass through the center-OFF position. During the interval that the switch is in the OFF position, 12VDC is not applied to the Power Control Circuit. As a result, Q9 and Q8 are cut off. However, the residual positive charge on C12 is applied through the supply lines, R14 and R15 to the base of Q3. This allows Q3 to conduct through CR3 and CR4, discharging them and ensuring that these capacitors are initialized in preparation for the generation of the selected signal. After the SIREN switch is set to the desired signal position, 12VDC is reapplied to the base of Q9, allowing Q9 to resume conduction. This cuts off Q3 and allows C2 and C4 to control the Tone Control Oscillator output waveform as will be described in paragraph 5-3B.

The operation of the Power Control circuit is nearly identical when the SIREN switch is set to YELP. Battery voltage (12V) is applied through J1-6 and P1-6, filtered by C16, and to the anode of CR13. CR13 then couples the positive voltage through R59, causing the remainder of the Power Control circuitry to operate as already described.

5-3. TONE CONTROL CIRCUITRY.

A. General.

The Tone Control Oscillator (TCO) produces the control voltage waveforms necessary for the generation of the WAIL and YELP siren signals. The shapes of the control waveforms for both signals are similar. However, the frequency of the YELP control waveform is higher than that of the WAIL waveform. The control voltage waveform controls the output frequency of the VCO voltage-controlled oscillator in the Tone Generator.

B. WAIL.

When the SIREN switch is set to WAIL, the WAIL tone control voltage is initiated by IC1. IC1 is a timing circuit acting as a free running (astable) multi-

vibrator whose output frequency is determined by the charge and discharge rates of C2. C2 charges through CR1 and R3 until it reaches the threshold voltage of IC1, approximately 5.5 volts. IC1 changes states when the voltage at IC1-6 reaches approximately 5.5 volts. This causes the voltage at IC1-7 to almost instantly drop to zero volts. This reverse biases CR1 and interrupts the charge path of C2. As a result, C2 discharges through R5 to approximately 2.7 volts; IC1-2 causes IC1 to return to its original state and the cycle repeats.

C2 charges to 5.5 volts much more rapidly than it discharges to 2.7 volts. This is because the RC time constant of the charge path is much shorter than that of the discharge path. This controls the frequency of the output signal at IC1-3.

The output waveform from IC1 at IC1-3 is an asymmetrical square wave. However, the circuits that process the signal require a symmetrical waveform for proper operation. In addition, the frequency of the signal at IC1-3 is too high for proper circuit operation. IC2A converts the signal to a symmetrical square wave and divides the frequency by two before applying it to Q4.

The collector of Q2 is connected to IC2A-4. Q2 ensures that IC2A is initialized when switching from one signal to the other. The stage is activated by the Power Control circuit as described in paragraph 5-2.

Q4 acts as an electronic switch that is activated by the series of symmetrical alternating highs and lows from IC2A-1. Q4 conducts when the signal is low and cuts off when high. Q4 controls the operation of R26, C5 and R25, the integrator circuit. The conduction of Q4 through R26 and R25 causes C5 to charge exponentially. During the interval that Q4 is cut-off, C5 discharges exponentially through R25. The charge and discharge rate of C5 is determined by the values of the components in the circuit. The integrated waveform produced by this circuit is coupled through R23 and IC3A-2 in the Tone Generator.

The output signal from IC2A-1 is also applied to the base of Q5. However, when the WAIL signal is selected, 12VDC from P1-9 is applied through R20 to the base of Q7. As a result, Q7 conducts heavily, bypassing C6 and R18 to ground. Therefore, Q5, C6 and associated components have no effect on the WAIL control waveform.

C. YELP.

Circuit operation when YELP is being generated is similar to that of the WAIL signal. However, the cycle rate of the YELP signal is faster than that of WAIL, because it uses electrical switching to shorten the RC time constant of the Tone Control Oscillator and charge integrator circuits.

When the YELP signal is selected, 12VDC from the vehicle battery is present at P1-6. This voltage is coupled through CR12 and R1 to the base of Q1, causing Q1 to conduct (Q1 does NOT conduct when the WAIL signal is being generated). The conduction of Q1 through R4, CR1, and R3 effectively bypasses (shorts out) R5. This does not significantly affect the RC charge time of C2, because C2 charges to 5.5V through CR1 and R3 as it does in WAIL. However, the discharge time of C2 is much shorter because the discharge path is through Q1 and R4. The combined DC resistance of these two components is much less than that of R5 (C2 discharges through R5 in WAIL). As a result, the upper and lower threshold levels of IC1 occur at a faster rate than in WAIL. Therefore, the square wave output frequency at IC1-3 is higher. The frequency of the signal at IC2A-1 is therefore also higher than in WAIL.

The 12VDC at P1-6 is also applied through R22 to the base of Q6, causing Q6 to conduct. This bypasses C5 and R25 to ground, preventing these components from having any effect on the signal. 12VDC is not applied to Q7 when YELP is selected. Therefore, Q7 is cut off and allows Q5 to activate the integrator consisting of C6 and R18.

Two distinct integrator circuits are used because circuit characteristics

require that both WAIL and YELP control waveforms have similar shapes even though their frequencies are different. The smaller circuit values in the YELP integrator compensate for the higher frequency of the YELP control waveform.

5-4. TONE GENERATOR.

The Tone Generator consists of the scaling amplifier IC3A, and its associated control circuit, IC3B, the voltage controlled oscillator (VCO) and a divider circuit, IC2B.

The Scaling Amplifier shifts the signal dc level and inverts the control waveform from the integrator circuit in use, to the level necessary to control the VCO. The scaling has no significant affect on the shape of the waveform. The gain of IC3A is controlled by IC3B. The scaled control voltage waveform at IC3A-1 is applied to the VCO control point, IC4-5.

The output signal from the Voltage Controlled Oscillator, IC4, is a series of pulses whose frequency is determined by R36, R37, C14 and the voltage at the VCO control point. As the control voltage at IC4-5 increases, the frequency of the output decreases. Conversely, as the control voltage decreases, the output frequency increases. The output signal from IC4 is applied to the divide-by-two circuit at IC2B-13.

The divide-by-two circuit, IC2B, is a toggle flip-flop that divides the IC4 pulse frequency by two. The symmetrical output from this circuit is present at IC2B-15.

5-5. AUDIO AMPLIFIER.

The frequency-modulated signal from the Tone Generator is applied to the audio preamplifier stage in the Audio Amplifier at IC5-6. The audio preamplifier amplifies the signal voltage to the level necessary to drive the power amplifier stages. After IC5 amplifies the signal, it is coupled from IC5-8 through C10 to the primary of T1. T1 applies a paraphase input to the push-pull amplifier stages. The network consisting of R52, R53, CR17, R54, R55, and RT1 is a biasing circuit that improves amplifier linearity. The power amplifier consists of Q10, Q11, Q12 and Q13. These stages amplify the signal power to the level required to drive the speaker. This amplified signal is coupled through T2 to TB1 and the speaker.

SECTION VI
SERVICE & MAINTENANCE

The factory will service your equipment or provide technical assistance with problems that cannot be handled satisfactorily and promptly locally.

If any unit is returned for adjustment or repair, it can be accepted only if we are notified by mail or phone in advance of its arrival. Such notice should clearly indicate the service requested and give all pertinent information regarding the nature of the malfunction and, if possible, its cause.

Address all communications and shipments to:

Service Department
Federal Signal Corporation
Signal Division
2645 Federal Signal Drive
University Park, IL. 60466

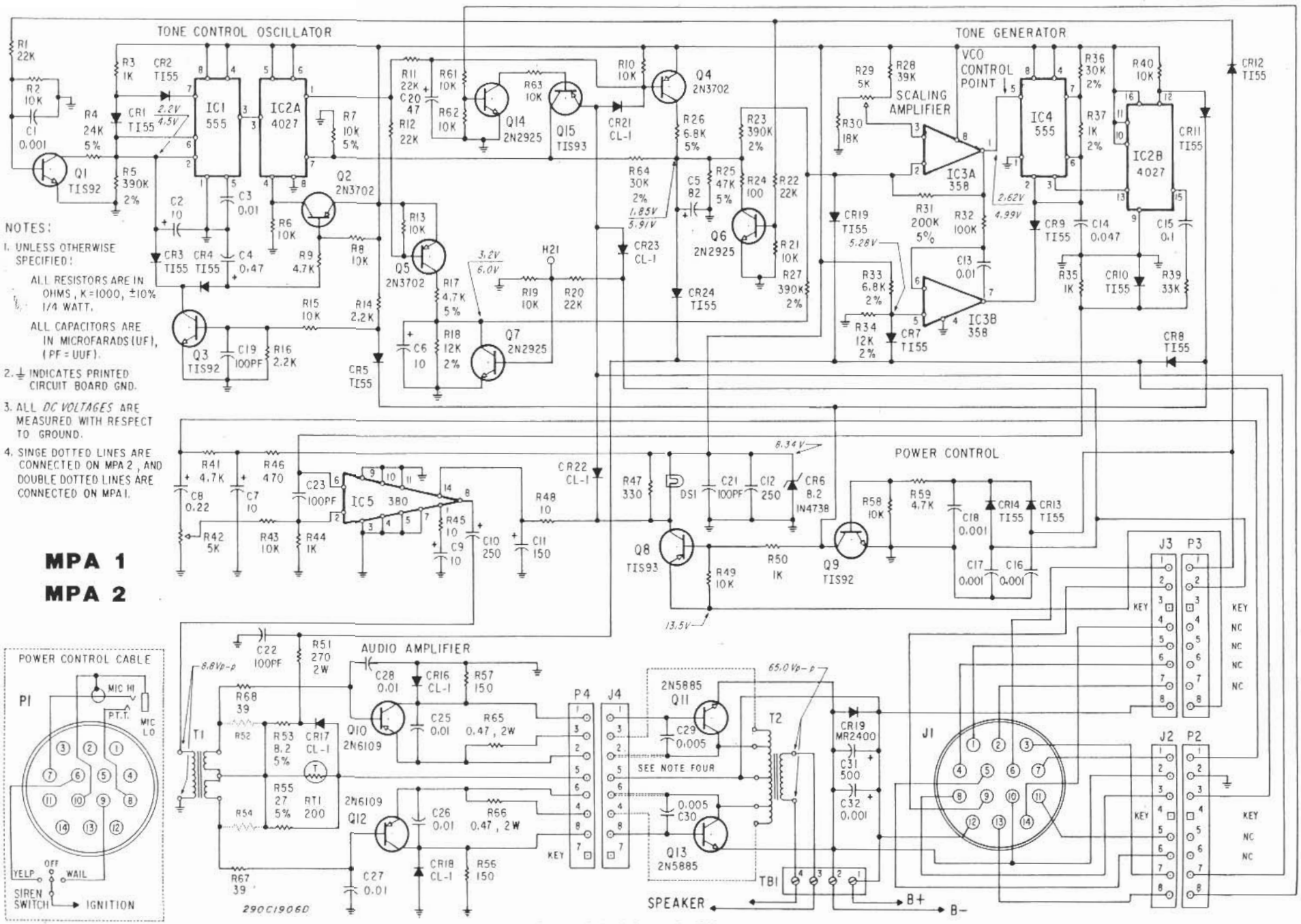


Figure 6-1. Schematic Diagram.

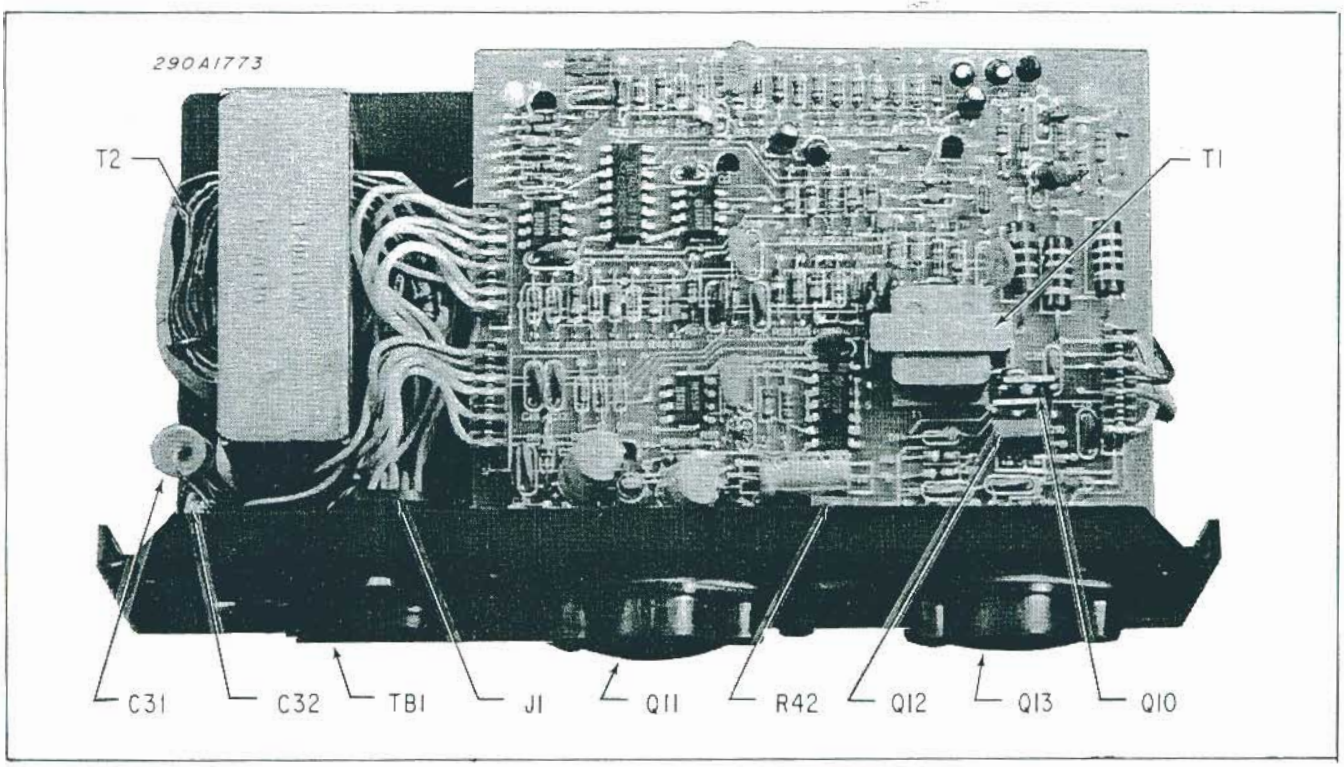


Figure 6-2. Interior View.

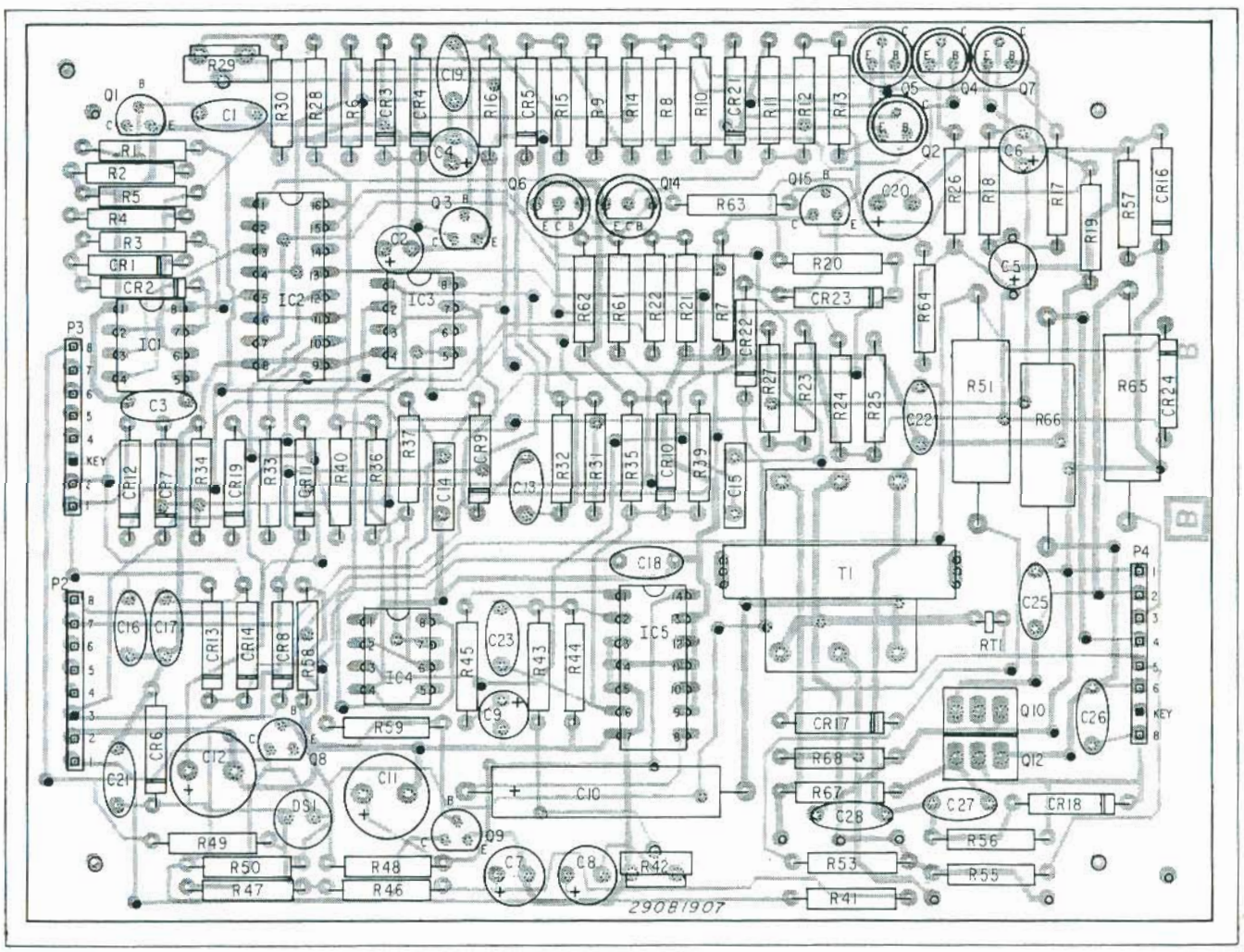


Figure 6-3. Circuit Board Parts Location Diagram.

PARTS LIST

Schematic Symbol	Description	Part No.
	* RESISTORS	
R1,11,12,20 22	22K Ohm	100A208
R2,6,7,8,10 13,15,19,21, 40,43,49,58, 61,62,63	10K Ohm	100A207
R3,35,44,50	1K Ohm	100A233
R4	24K Ohm,2%	100A764A
R5,23,27	390K Ohm,2%	100A760A
R9,41,59	4.7K Ohm	100A224
R14,16,	2.2K Ohm	100A221
R17	4.7K Ohm,5%	100A298A
R18,34	12K Ohm,2%	100A716A
R24	100 Ohm	100A236
R25	47K Ohm,5%	100A701
R26,33	6.8K Ohm,2%	100A762A
R28	39K Ohm	100A214
R29,42	5K Ohm Potentiometer	105A248A
R30	18K Ohm	100A204
R31	220K Ohm,2%	100A719A
R32	100K Ohm	100A222
R36	30K Ohm,2%	100A717A
R37	1K Ohm,2%	100A712A
R39	33K Ohm	100A211
R45,48	10 Ohm	100A251
R46	470 Ohm	100A255
R47	330 Ohm	100A201
R51	270 Ohm,2 watt, WW	103A128
R53	8.2 Ohm,5%	100A724A
R55	27 Ohm,5%	100A290
R56,57	150 Ohm	100A238
R64	30K Ohm,2%	100A717A
R65,66	.47 Ohm,2 watt, WW	103A130
R67,68	39 Ohm	100A286
RT1	Thermister, 200 Ohm	104A111

*Unless otherwise specified, all resistors are carbon type, ±10%, 1/4 watt.

	CAPACITORS	
C1,16,17,18 32	0.001UF,500V,Disc	107A263
C2,6,7,8,9	10UF,10V,Tantalum	107A634
C3,13,25,26, 27,28	0.01UF,25V,Disc	107A226
C4	0.47UF,35V,Tantalum	107A645
C5	82UF,15V,Tantalum	107A650
C8	0.22UF,10V,Tantalum	107A1101
C10	250UF,15V,Electrolytic	108A107
C11,12	150UF,16V,Electrolytic	108A147A
C14	0.047UF,50V,Mylar	107A418
C15	0.1UF,100V,Mylar	107A406
C19,21,22,23	100PF,100V,Disc	107A235
C20	47UF,16V,Electrolytic	108A145
C29,30	0.005UF,100V,Disc	107A211
C31	500UF,15V,Electrolytic	108A122

Schematic Symbol	Description	Part No.
	SEMICONDUCTORS	
IC1,4	Integrated Circuit, LM555C	128A043A-02
IC2	Integrated Circuit, RCACD4027AE	128A044A
IC3	Integrated Circuit, LM358	128A045A
IC5	Integrated Circuit, LM380N	128A046A
Q1,3,9	Transistor,NPN, TIS92	125B132
Q2,4,5	Transistor,PNP, 2N3702	125A113
Q6,7,14	Transistor,NPN, 2N2925	125A119
Q8,15	Transistor,PNP,TIS93	125B133
Q10,12	Transistor,PNP, 2N6109	125B431A
Q11,13	Transistor,NPN, 2N5885	125B432
CR1,2,3,4,5, 7,8,9,10,11, 12,13,14,19, 24	Diode, TI55	115B101
CR6	Diode,Zener,8.2V, IN4783A	115A232
CR16,17,18, 21,22,23	Diode,ED3002S(CL-1)	115B301
CR20	Diode,Rectifier,MR2400	115A316
	MISCELLANEOUS	
DS1	Lamp,Subminiature, bi-pin base	149A117A
P2,3,4	Connector,Wafer,8 circuit	140A170A
T1	Transformer,Driver	120B145A
T2	Transformer,Output (MPA1)	120B124
T2	Transformer,Output (MPA2)	120C154
TB1	Block,Terminal, 4-position	229A143
J1	Connector,14-pin	139A171
	Socket,Transistor (Q11,13)	138A125
	Circuit Board (with parts installed)	200C853B
	Circuit Board (without parts)	130C297B
	Control Cable Assy.	146C604A
	Toggle Switch	122A174A