RECEIVER CONTROLLER

MODEL RC 1T5A
CONFORMS TO FAA – L – 854

FIELD SERVICE INSTRUCTIONS

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HANDBOOK OF OPERATING AND MAINTENANCE INSTRUCTIONS
RECEIVER CONTROLLER RC-1T5A

1.0 *GENERAL:*

The model RC-1T5A controller has been specifically designed to provide remote control of airport lighting systems which require three separate control functions. The design and contsruction are compliant with FAA specification L-854. This control system will allow the approaching pilot to select high, medium or low levels of runway light intensity at his discretion. The RC-1T5A is enclosed in a weather-proof water-tight housing and is conservatively designed for continuous outdoor unattended operation.

The RC-1T5-A receiver controller complies with FCC rules and regulations part 15.

2.0 *ELECTRICAL:*

The receiver is of combination field-effect transistor and integrated-circuit design. The sensitivity is adjustable from 1 microvolt to 30 microvolts as desired by the user, permitting a control range of 1 to 20 miles. Receivers are shipped normally adjusted to a sensitivity of 10 microvolts. The unit is designed to operate from 120 volt ±20% 50-60 HZ single phase power.

3.0 *THEORY OF OPERATION:*

The system is activated upon receiving a series of pulses of R.F. energy within a five second period. At the third pulse the first relay closes, at the fifth pulse the second relay closes, at the seventh pulse the third relay closes. NOTE: At any time in the sequence the pilot has the option of sending three, five or seven pulses to command the intensity level to his requirements. The system will remain at the intensity level of the last command received. The solid state timer will continue to operate for 15 minutes after which it will cause the system to revert to the original "off" condition. The timer is reset by the receipt of any command at anytime, reinitiating the 15 minute "run" cycle.

The solid state receiver-controller is composed of four printed circuit cards which include the regulated power supply and maintenance test oscillator. The following describes the theory of operating for each of the receiver-controller basic elements. Reference: Functional Diagram Figure A.

3.1 *RADIO FREQUENCY CARD (C.I. PART #11-0155)*

The radio receiver is a single conversion superheterodyne design operating at a nominal R.F. frequency within the VHF band of 118 to 136 MHz. An IF frequency of 21.4 MHz is utilized with the bandwidth controlled by a 6 pole crystal lattice filter. This filter establishes nominal -60 db rejection at adjacent channel frequencies of ±25 KHz or more. It also establishes an on-frequency bandwidth of nominally ±9 KHz at the -6.0 db points. Intermediate frequency amplification is provided in part by a dual gate FET first IF amplifier. A communications type integrated circuit provides the remainder of the IF gain, AM detection, AGC and audio output. The audio output is buffered and delivered to a service jack for maintenance and test purposes. The AGC Voltage controls the overall gain of the receiver and is also used to sense the presence of a desired signal. The AGC voltage level is amplified and utilized to change the state of an intregrated circuit schmitt trigger. The schmitt trigger is required to condition incoming R.F. pulses in terms of amplitude and rise time. It also eliminates the undesirable effects of aircraft transmitter modulation. The output binary condition of the schmitt trigger is buffered and utilized as the input to the Decoder Card. A red LED indicator is included on the receiver card to visibly show the state of the receiver logic.

3.2 *DECODER CARD (C.I. PART #11-0166):*

The functional purpose of the decoder card is to sense the presence of 3, 5, or 7 pulses within a 5 second time period, determine if any of these conditions exist and effect the proper relay closures. The following is the sequence of operation:

Upon receipt of the first pulse from the schmitt trigger a five second time delay period is initiated by the 5 second delay circuit. This first pulse is stored in binary counter #1, as are all subsequent pulses. After 3 pulses are received and stored in binary counter #1 its electrical state and connection are such that the three input gate logic block is caused to command relay #1 to close. If for any reason the 3 pulses are not received and stored in binary counter #1 within 5 seconds, the 5 second delay circuit causes counter #1 to reset to its original condition.

In similar fashion, the binary counter and 3 input gate decoder sense the presence and storage of 5 pulses for the control of relay #2 and the presence and storage of 7 pulses for the control of relay #3.

Relay control interface circuitry is included on the decoder card for the purpose of matching the low impedance relay coils to the high impedance solid state counting devices.

3.3 *TIMER CARD (C.I. PART #11-0177):*

The purpose of the timer card in the RC-1T5A is to provide a 15 minute "hold-on" period for relays R-1, R-2 and R-3.

The basic timing of this card is derived from the stable time pulse generator which starts its cycle only after receipt and decoding by the decoder card of 3 incoming pulses of R.F. The period of the time pulse generator is selected such that counting down by a given constant will produce only one pulse in a 15 minute period. The output of the time pulse generator is divided by summation shift register #2. These two registers are identical. Upon total summation (15 minutes) the "off" control SCR circuit is caused to open all relays (R-1, R-2, R-3) effecting system "shut-down".

To allow for re-start of the 15 minute timing cycle, a summation reset all shift registers to zero. This allows the pilot to re-cycle the system for a full 15 minute period at any time during its activation by commanding R-1, R-2 or R-3. (3-5 or 7 pulses). The summation reset circuitry additionally insures that all registers always start from their zero state.

3.4 *POWER SUPPLY/TEST OSCILLATOR CARD (C.I. PART #11-0088):*

This printed circuit board includes the rectifier and electronic regulator portions of the regulated D.C.supply and the crystal controlled test oscillator. The power transformer and dual section hum filter components of the power supply are on the chassis main-frame.

The power supply is composed of a power transformer, diode bridge rectifier, dual section hum filter, and a series pass transistor constant voltage regulator. The output voltage is regulated at 12.0 volts D.C. This regulated voltagge level is further divided and clamped by Zener diodes at 6.1 volts for the receiver electronics and 5.1 volts for the solid state logic circuits. The range of control is approximately 95 volts 50-60 cycle AC to 140 volts 50-60 cycle AC. Within this excursion range the D.C. supply voltages remain constant. The test oscillator is included within the power supply card to provide a complete system test from RF input to output relay closure. The oscillator is a third mode crystal circuit activated by the red test switch button. No direct coupling of the test oscillator output is made to the receiver card. Stray coupling is sufficient for this purpose.

The test signal frequency generated is the same as that for which the receiver is designed and is provided for use by maintenance personnel to check for proper operation of the system.

4.0 *TROUBLE ANALYSIS:*

A malfunction chart including several possible failure modes is supplied to assist the technician in analyzing the probable cause. The receiver-controller is warranted for one year from date of purchase. Failures not caused by improper installation or abnormal treatment will be corrected by the manufacturer free of charge within the warranty period.

4.1 *TROUBLE ANALYSIS CHART:*

The following tabulations will provide guidance for recognizing possible trouble and correction.

MALFUNCTION	*POSSIBLE CAUSE*	*TEST AND REMEDY*
AC voltage present but no DC LED indication	Open 1.0 A. Fuse	Test & Replace
	Bad AC Switch	Test & Replace
	Defect in power supply, electronic board, power transformer or series regulator transistors	Return receiver to manufacturer for service.

MALFUNCTION	*POSSIBLE CAUSE*	*TEST AND REMEDY*
DC O.K., no binary LED indication, no audio indication	Defect in receiver card part number 11-0155	Replace card; retest. Send defective card to manufacturer for repair or replacement if in warranty.
DC O.K., no binary count. Audio O.K.	Defect in decoder card part number 11-0166	Replace card; retest. Send defective card to manufacturer for repair.
DC O.K. Binary count O.K. Relay closures normal — No output voltage any control line	Open 5A SLO BLO Fuse	Test & Replace fuse with same type only.
Failure to reset binary indicators after 5 seconds	Defective Decoder card, part number 11-0166	Use replacement card and retest.
Fails to turn off after 15 minutes.	Defective Timer Card, part number 11-0177	Use replacement card and retest. Return defective card to manufacturer for repair or replacement if in warranty.
	Defective Relay R-1, R-2, or R-3	Replace relay with same original manufacturer's part number R1012D
DC O.K., Binary indications normal - output indicator LED's fail to activate	Defective Relay R-1, R-2, or R-3, whichever circuit defective	Replace relay with original part number and retest.

5.0 *MAINTENANCE:*

The Model RC-1T5A is designed to require a minimum of maintenance under all ranges of service conditions. There are no moving parts except the output contactor relays. With proper installation, no abuse or tampering, the unit should deliver at least 10,000 hours of trouble free operation.

5.1 *MAINTENANCE CONCEPT:*

The unit may be maintained readily by technician level personnel. Only qualified personnel should attempt to repair a defective solid-state card in the field. A stock of one each substitute cards should be retained to verify a suspected defective card by simple substitution procedures. All other elements of the receiver-controller may readily be checked utilizing normal electrical test procedures involving no special testing equipment other than a standard volt-ohmeter. A standard headset may be used to monitor the receiver at the audio jack.

5.2 *OPERATING CHECKOUT:*

The service technician may determine proper operation of the receiver-controller by completing the following checklist:

(1) Check the presence of primary line voltage as measured between input terminals marked 115V AC and neutral.

(2) Press AC power switch and observe red DC power indicating LED inside the controller housing. Illumination of this DC indicator implies proper power supply operation.

(3) Depress red test button three consecutive times within five seconds. This action should cause the binary indicators to follow the pattern described in Figure D and result in closure of Relay-1 and illumination of the red LED indicator adjacent to relay R-1.

(4) After elapse of 5 seconds all binary indicators should extinguish.

(5) Depress red test button five times within five seconds. This should result in closure of Relay R-2 and illumination of the red LED indicator adjacent to relay R-2. Relay R-1 will remain closed.

(6) After elapse of 5 seconds all binary indicators should again extinguish.

(7) Depress red test button seven times within 5 seconds. This should result in closure of relay R-3 and illumination of the red LED indicator adjacent to relay R-3. Relays R-1 and R-2 will remain closed.

The above procedures accomplish a complete operating check of all elements and functions of the Receiver-Controller RC-1T5A.

5.3 *DETAILED MAINTENANCE INSTRUCTIONS:*

If during the performance of check out as specified in paragraph 4.1 improper operation is noted, the following explanations and instruction procedures will simplify servicing the controller:

5.3.1 *POWER SUPPLY:*

It should first be determined that proper power 115V AC, 60 cycles is being applied to the input connector terminals labeled 115V AC and Neutral (Figure C). This may be determined by use of a suitable volt-ohmeter; Simpson Model 260 or equivalent.

The power supply board (C.I. Part #11-0088) is included as one of the printed circuit cards located beneath the dust cover. All power supply electronics are located on this card except the power transformer, dual section hum filter and the series-pass regulator transistor. These latter elements are located on the chassis main-frame. An LED indicator is provided to indicate presence of 12 volts DC. This indicator is the upper-most of a series of indicators located on the right hand side of the main chassis. This indicator glows at all times the receiver is turned on and D.C. is present. The location of this D.C. power indicator is depicted in Figure C.

Indication of the presence of A.C. power as measured by an appropriate A.C. voltmeter and failure of the D.C. indicator indicates a power supply failure. The following steps should be accomplished in sequence. Remove the receiver, decoder, and timer cards one at a time and observe the D.C. indicator. This procedure removes and isolates any possible shorts in the logic or radio boards. Recheck for proper D.C. indicator operation. If a failure remains refer to power supply schematic Figure E and perform normal check out procedures of the solid state components, capacitors and resistors. Check for shorts or opens of components, or other normal failures. The output voltage of the power transformer (T-1) should be approximately 16V AC. Replace defective components and retest.

5.3.2 *RECEIVER BOARD:*

The receiver board is a printed circuit card identified as C.I. part #11-0155. This board comprises the complete receiver and a schmitt trigger driver for the logic circuitry.

An effective method of determining condition of the receiver board may be accomplished by listening to the audio at the output jack identified in Figure C. A head set or suitable audio amplifier will reveal a slight pressure of noise which gives a general indication if the receiver is operative or inoperative. Depressing the red test button should cause a loud hum to occur in the head-set and also cause the first binary indicator LDC to light. Absence of either of these indications represents probable receiver board failure.

5.3.2.1 *SERVICING RECEIVER BOARD:*

The receiver board may be tested and aligned while installed in the unit however tuning adjustments are more accessible if the receiver card is operated in a special external test jig designed for the purpose. The following test equipment is required for proper alignment of the receiver board:

(1) A VHF signal generator AM modulated. (Hewlett Packard Model 608A or equivalent).

(2) A vacuum tube type voltmeter (VTVM) capable or measuring 5.0 volts D.C.

(3) An accurate frequency counter or other suitable means to insure the accuracy of the signal generator is required.

(4) A standard headset or audio amplifier. Refer to receiver board schematic Figure F.

5.3.2.2 *ALIGNMENT PROCEDURE: RECEIVER BOARD*

(a) Connect the VTVM between ground and the junction of resistor R-10 and R-11. This junction is also the source terminal of the first IF amplifier FET.

(b) Adjust the sensitivity control R-11 for a reading of approximately +1.4 volts. This control is a 10 turn miniature potentiometer.

(c) Connect the signal generator to the input of the receiver with a suitable length of 50 ohn coaxial cable. Adjust the generator to the exact operating frequency of the receiver. Increase the signal generator output until audio modulation is noted in the headset or audio amplifier connected to the audio output jack. Adjust tuning capacitors C-1, C-2, C-3, C-4, C-11, C-19, and C-21 for maximum audio in the headset. The signal generator output must be reduced as alignment progresses to insure that true tuning peaks are discernable and are not masked by AGC action. After maximizing these adjustments audio output should be obtained at approximately 5 microvolts level and above.

(d) Connect the VTVM to test point TP-1. With no signal applied, a voltage of approximately +3.0 volts will appear. As the level of the signal generator is increased, this voltage will decrease. Precisely re-trim each of the tuning capacitors for a minimum reading on the VTVM. Keep the level of the signal generator adjusted to a level that causes a reading of 1.5 to 2.5 volts on the VTVM. This allows the most accurate adjustments to be achieved during this final tuning prodecure. The red LED indicator will trip at approximately 2.0 volts on the VTVM. Below 2.0 volts it will glow. Above approximately 2.0 volts it will not glow.

(e) Adjust the signal generator output to 10 microvolts and recheck on-channel accuracy with the counter. Adjust the sensitivity control R-11 until the logic trip point just occurs at the 10 microvolt signal input level. The logic state is indicated by a red LED indicator on the receiver card. Movement of the sensitivity control R-11 clockwise decreases sensitivity, movement counter-clockwise increases sensitivity. When adjusted as described above the LED will **not** glow with 5 microvolts applied from the signal generator.

5.3.2.3 *RECEIVER BOARD OPERATING THEORY:*

The signal path through the receiver is shown in block form in Functional Diagram Figure A.

The following is a listing of the operating frequencies of the various elements of the receiver.

(a)	R.F. Amplifier	VHF frequency
(b)	Mixer	VHF frequency
(c)	Xtal Oscillator	Input VHF frequency minus 21.4 MHz
(d)	First IF Amplifier	21.4 MHz
(e)	Crystal lattice Filter	Center 21.4 MHz,bandwidth ±9.0 KHz
(f)	IF/Detector Chip	21.4 MHz
(g)	Digital logic	D.C. pulses

5.3.3 *DECODER CARD (C.I. PART #11-0166):*

After determination of proper operation of the Power Supply and receiver section of the controller, and failure remains, the next procedure is examination of the de-coder card. General theory of operation and purpose of this card appears in paragraph 3.2. A volt ohmeter and an oscilloscope are required for proper servicing of the decoder card.

5.3.3.1 *DETAILED OPERATIONAL THEORY:*

Twelve volts D.C. should appear at Pins 2 and 10 of the base connector and 5.1 volts at pins 7. The actuating pulse appears on pin 3 arriving from the receiver/schmitt trigger. This actuating pulse is applied to Pin 14 of IC-1. Proper operation of IC-1 causes start of the 5 second delay unijunction timer Q-2 through switching circuits Q-5 and Q-1. Additionally IC-1 stores the number of pulses received. Use of a suitable oscilloscope can serve to trace the presence or absence of these pulses at IC-1 pins number 1, 12, 14.

Receipt of 3, 5, or 7 pulses determine the state of pins 8, 9 and 12 of IC-1. These high or low voltage states are applied to the 3 input gate, IC-2 as shown in schematic diagram Figure G. Through resistors R-20, R-21, R-22 the state of the 3 input gate decoder is displayed on the 3 binary LED's. Q-13 through Q-18 serve as LED drivers for this function.

Proper counting sequence may be determined as follows:

(a) On the receipt of 3 pulses, IC-2 pin 12 should go low. This turns off Q-10 which gates SCR Q-8, and closes Relay R-1.

(b) On subsequent receipt of 5 pulses, Relay R-1 will remain closed as in (a) above, and IC-2 pin 8 should also go low. This turns off Q-4 which gates Q-11. This action of Q-11 closes Relay R-2.

(c) On subsequent receipt of 7 pulses Relay R-1 and Relay R-2 will remain closed as in (a) and (b) above, and IC-2 pin 6 should go low. The output of this pin is transferred to the timer board where it is utilized to control Q-4. The collector of Q-4 is capacitively coupled to the gate of SCR Q-6. The action of SCR Q-6 closes Relay R-3.

At the third pulse within 5 seconds Relay R-1 will be energized, at the fifth pulse, Relay R-2 will be energized and at the seventh pulse Relay R-3 will be energized.

The decoder board has no adjustment. Proper operating solid state devices and all components measuring within tolerance should achieve proper operation. Failure of the decoder card can usually be attributed to some physical damage or breakage of printing or connector contacts. Schematic of the decoder card is shown in Figure G.

5.3.4 *TIMER BOARD (C.I. PART #11-0177):*

The purpose and general theory of the timer card is described in paragraph 3.3. The timer card is primarily used to perform shut down functions after 15 minutes operation and control of Relay R-3. Unless trouble with these functions exist, likelihood of trouble in the timer card is remote.

Twelve volts enters the timer card on pin 4. 5.1 volts D.C. enters on Pin 7. Disturbance to other parts of the receiver can occur only as the result of direct short circuits associated with these pins.

5.3.4.1 *DETAILED OPERATIONAL THEORY:*

The schematic of the timer board is included as Figure H. The functional block diagram is included as part of Figure A.

The time pulse generator Q-2 is started by application of power through connector Pin 2 derived from closure of Relay #1. The period of the time pulse generator is adjusted by R-2 and is normally 10 seconds. The 10 second output pulses from Q-2 are stored and summed by IC-1. Since IC-1 cannot store the total 15 minutes in 10 second intervals, a second summation of the pulses from IC-1 is performed by IC-2.

At 15 minutes after initial start of the time pulse generator, pins 1, 11 and 12 of IC-2 go high and actuate an additional portion of IC-3 turning off Q-8 which causes complete shut down of the system.

The only adjustment on the timer card is R-2. This timing control has a range of 15 minutes $\pm$2 minutes. A suitable counter which can display period functions may be used to adjust R-2 by observing Pin 1 of IC-1.

5.3.5 *TEST OSCILLATOR:*

An R.F. oscillator operating on the input frequency of the receiver is included to test the overall operation of the receiver. This oscillator is part of the power supply card.

5.3.5.1 *TEST OSCILLATOR FUNCTIONS:*

The test oscillator is keyed on by the red test button. Incoming pulses may be simulated by actuating this test oscillator control. Additionally the test oscillator is momentarily actuated upon application of input power for the purpose of zeroizing all logic circuits at initial start up.

5.3.5.2 *OPERATING THEORY (TEST OSCILLATOR):*

The test oscillator is composed of an FET (Q-4) and a quartz crystal operating on the third mode. The output (drain) of the FET is tuned to 3 times the crystal operating frequency. Coil L-2 is tuned to the 3rd mode frequency of the crystal. L-1 is tuned to 3 times this frequency. No direct coupling of this oscillator into the receiver exists. Stray coupling through the power supply and wiring is sufficient for the purpose. The time constant for momentary initial start up is established by R-1-C-6. Failure of the test oscillator will not disable the operation of the controller. Only testing convenience will be affected.

Transistor Q-1 is a switching transistor effectively in series with the power supply of the test oscillator. Failure of this transistor or associated circuits will cause failure of the test oscillator. The momentary timing network appears in the base circuit of Q-1. The test oscillator schematic is included in the Power Supply schematic Figure E.

5.3.6 *AUDIO OUTPUT MODULE:*

An audio output module is included as an integral part of the receiver. This module is for the purpose of conditioning and sending audio tones over telephone lines to a remote location for control purposes.

5.3.6.1 *AUDIO OUTPUT MODULE FUNCTIONS:*

The audio module provides power amplification of the audio signal. It is present at the audio jack to a level of 1 milliwatt minimum across a 600 ohm balanced to ground resistive load. The audio signal is thus made proper for presentation to standard telephone circuits. Diode limiting is provided to prevent any possibility of excessive level which would cause cross-talk within the telephone system.

5.3.7 *INTERCONNECTING WIRING IS SHOWN IN FIGURE 1.*

6.0 *INSTALLATION:*

The receiver-controller RC-1T5A is designed for all-weather outdoor unattended operation. The weather-tight case will repel the elements and no shelter is required.

Control and power lines should enter by means of the 1/2 inch conduit entry in the bottom of the unit. A maximum of five conductors is required to complete the installation.

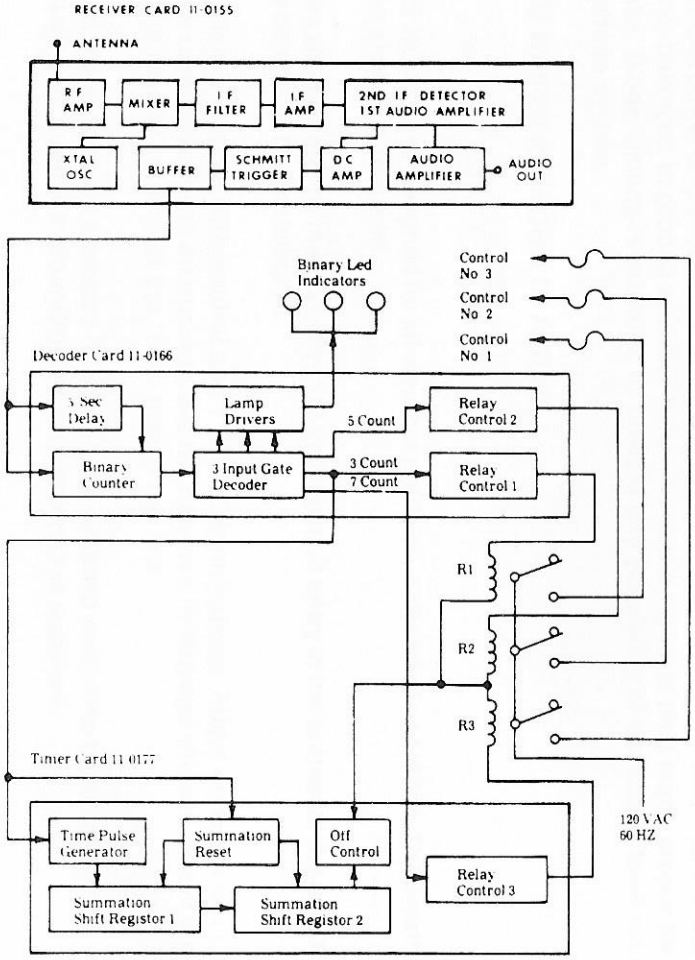
The terminal block is clearly marked with neutral and 115V AC terminations. Attention to correct connection of the neutral is important. Failure to observe these instructions will not necessarily damage the equipment but will result in the undesirable switching of the neutral instead of the "hot" side of the line.

For outdoor installation the antenna is attached directly to the antenna mounting supplied on the top surface of the enclosure. For indoor installation, a remote ground-plane VHF antenna is supplied.

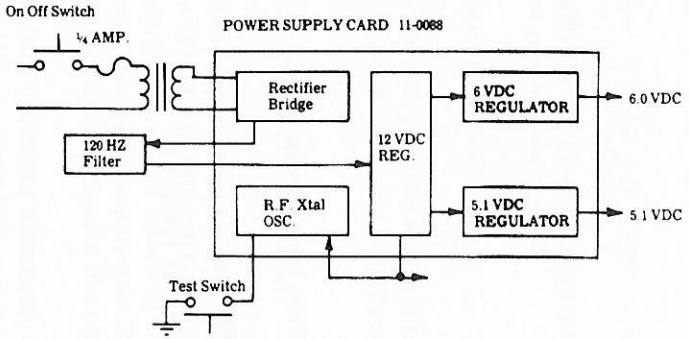
7.0 *SPECIFICATIONS:*

Input	120 VAC±20%, 50-60 HZ
Output	10 amp relay contact
Size	10" W x 12" H x 5" D
Mounting	Any flat surface
Weight	Approximately 15 lbs.
Temperature	-55 C to +55 C
Frequency	Within VHF range as specified by customer
Warranty	1 year from date of purchase
Antenna	VHF whip or remote antenna as required.

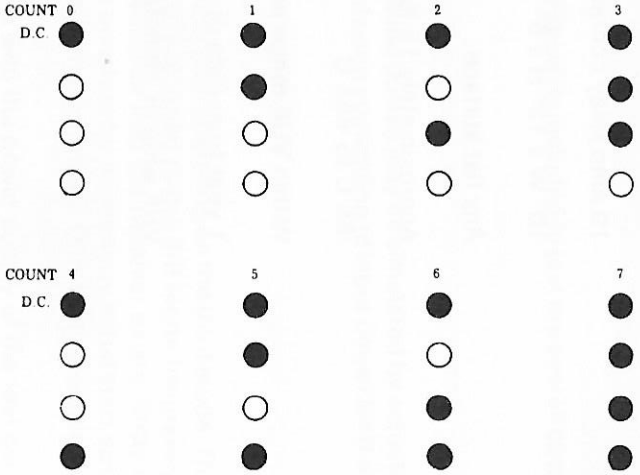
FUNCTIONAL DIAGRAM
FIG. A



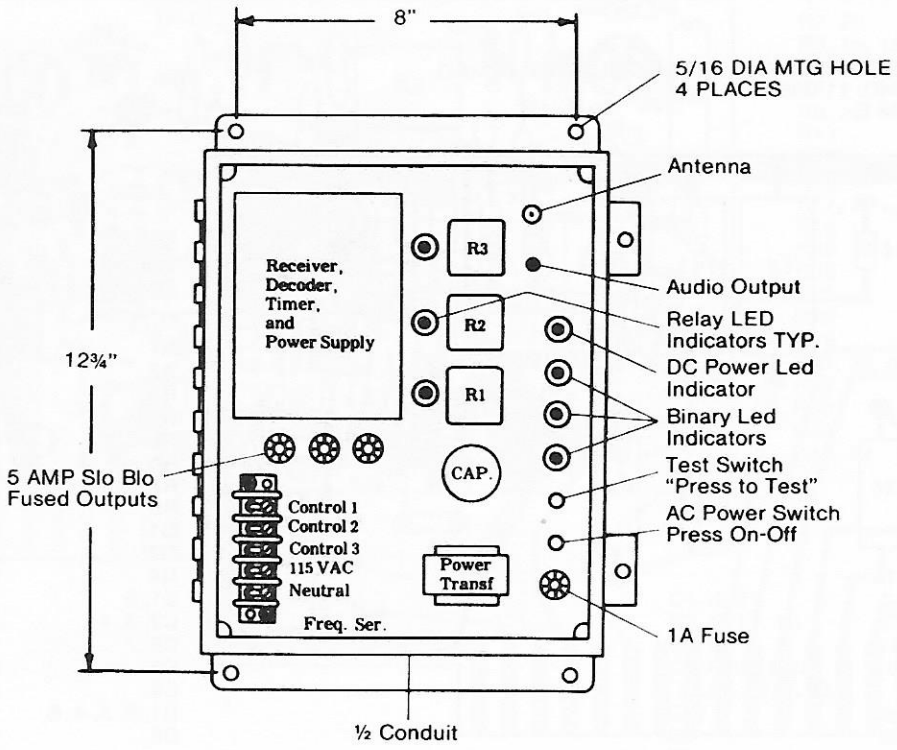
POWER SUPPLY & TEST OSCILLATOR
FIG. B



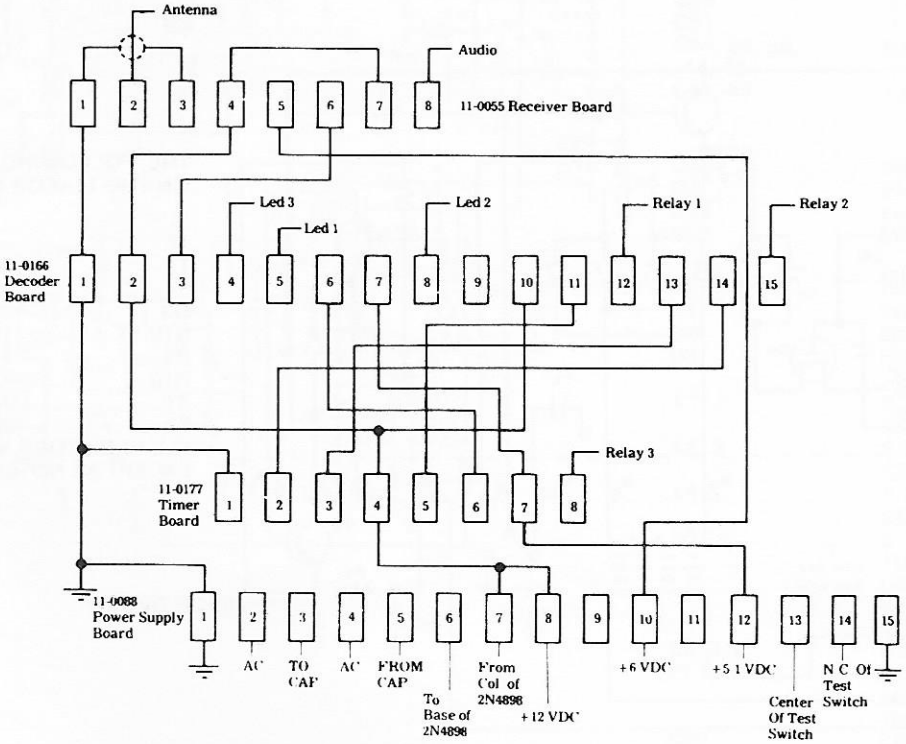
LED INDICATOR SEQUENCE PATTERN
FIG. D



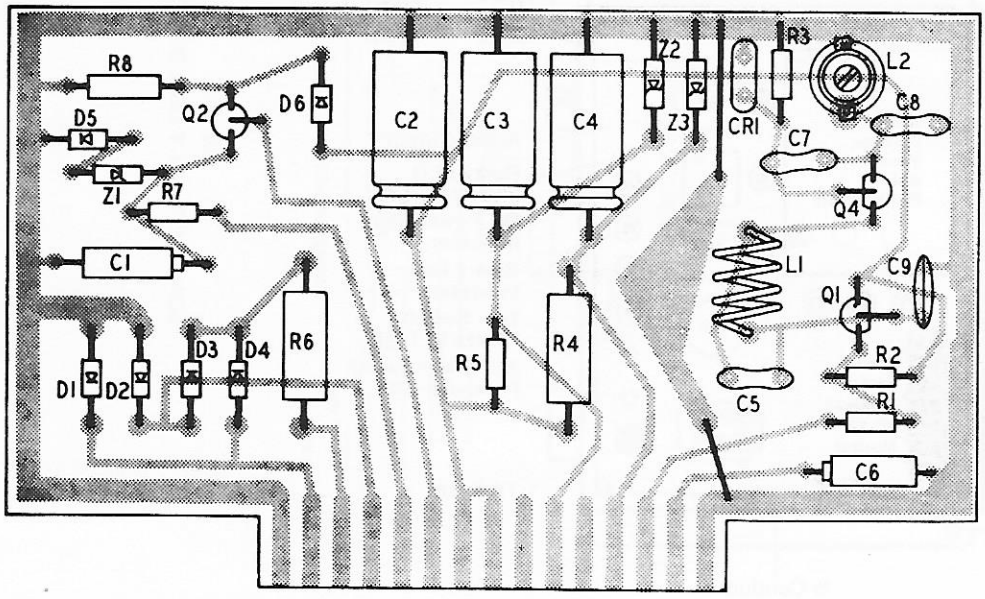
MOUNTING PLAN, PICTORIAL
FIG. C



INTERCONNECTING WIRING DIAGRAM
FIG. I

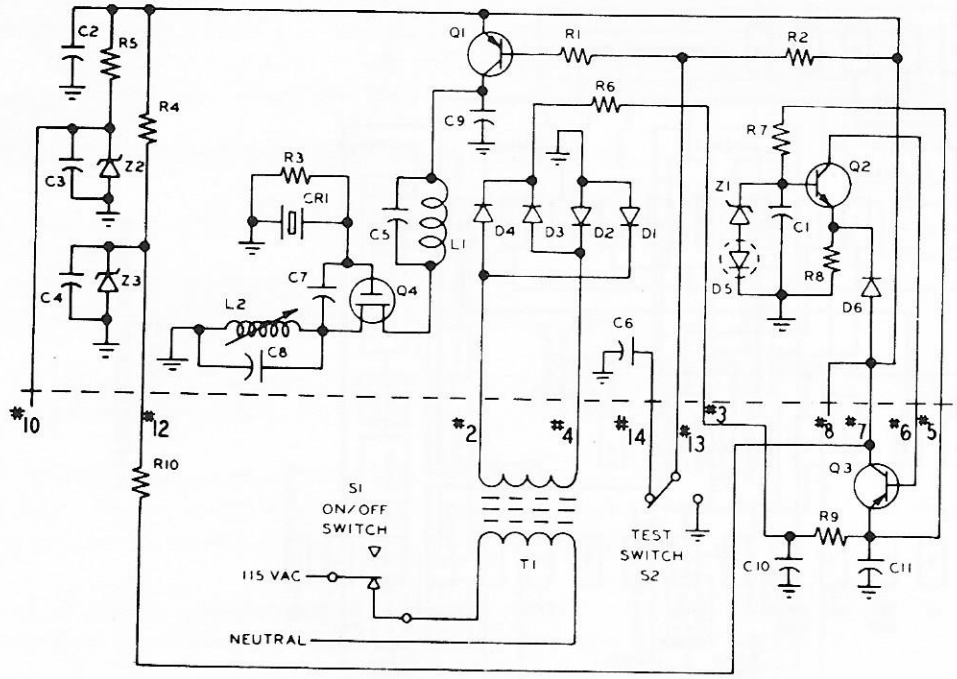


POWER SUPPLY AND TEST OSCILLATOR BOARD
PART NO. 11-0088
FIGURE E



11-0088
PARTS LIST

R1	15K
R2	6.8K
R3	180K
R4	220 1 WATT
R5	330
R6	1 OHM 2 WATT
R7	1K
R8	1K ½ WATT
Q1	2N3702
Q2	2N3704
Q4	2N5248
C1, 6	15MFD 20VDC
C2, 3, 4	75MFD 25 VDC
C5, 7	10pfd MICA
C8	27pfd MICA
C9	.01MFD CERAMIC
D1, 2, 3, 4, 6	1N4004
D5	1N4004 USED TO ADJUST 12VDC
Z1	1N5242B
Z2	1N5234B
Z3	1N5231B
CR1	OPERATING FREQUENCY 3
L1	4 TURNS NO. 18 WIRE, ⅜" I.D.
L2	11 TURNS NO. 22 H.F. ON CERAMIC COIL FORM



WIRING SCHEMATIC

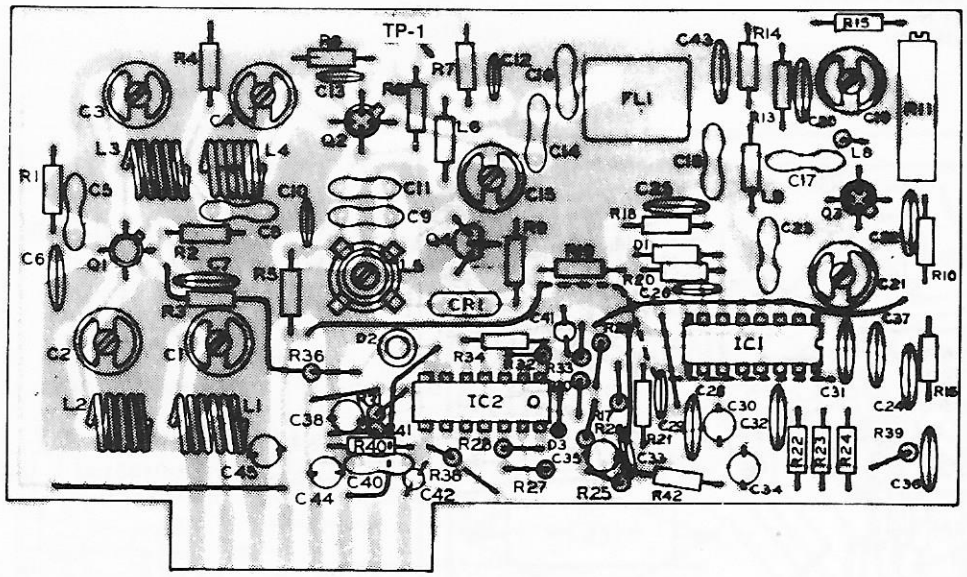
THE FOLLOWING PARTS ARE MOUNTED ON THE 11-0033 BASE ASSEMBLY:

T1	SIGNAL TRANSFORMER 241-5-16
Q3	2N4898
C10,11	1000MFD 35VDC
R9	1 OHM 2 WATT
R10	47OHM 3½ WATT
S1	JBT PB 123
S2	JBT PB 126

ALL RESISTORS ¼ WATT EXCEPT AS NOTED

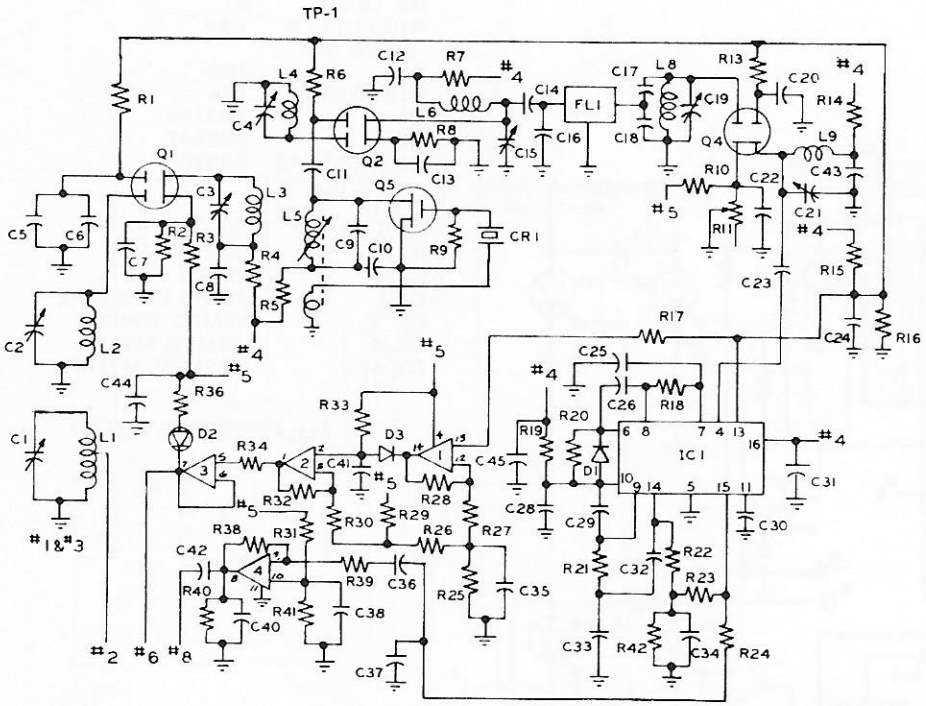
RECEIVER BOARD
PART NO. 11-0155
FIGURE F

11-0155
PARTS LIST



R1, 6, 13	47K
R2, 20	220
R3, 10, 18, 24, 36	1K
R4, 5, 7, 14	47
R8, 21, 26	2.2K
R9, 30	180K
R11	500 VARIABLE
R15	220K
R16, 39	82K
R17, 27	22K
R19	330
R22	5.6K
R23	6.8K
R25	3.3K
R28	1 MEG
R29	4.7K
R31, 38, 41	100K
R3Z	10 MEG
R33	68K
R34	10K
R40, 42	1.5K

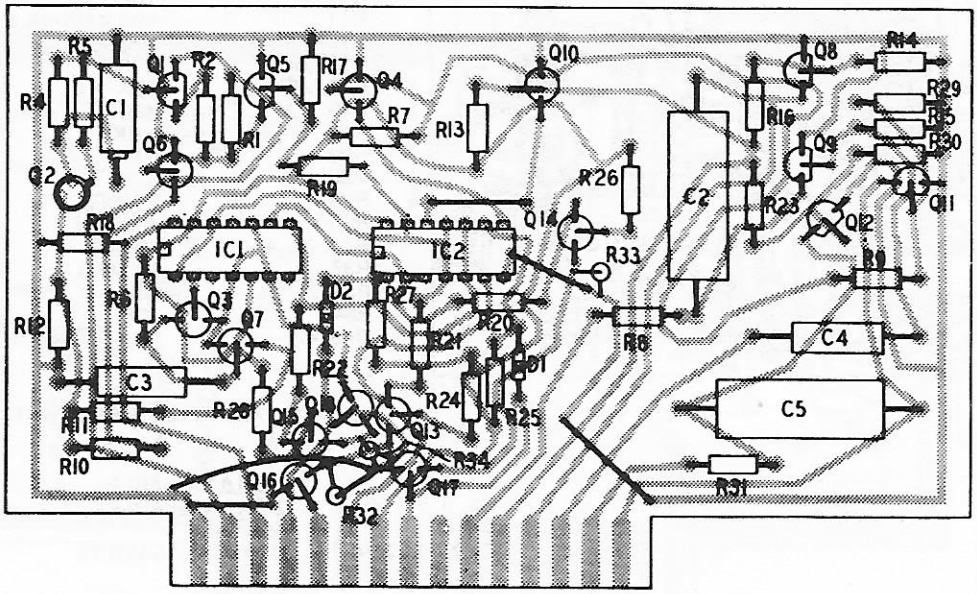
ALL RESISTORS ¼ WATT

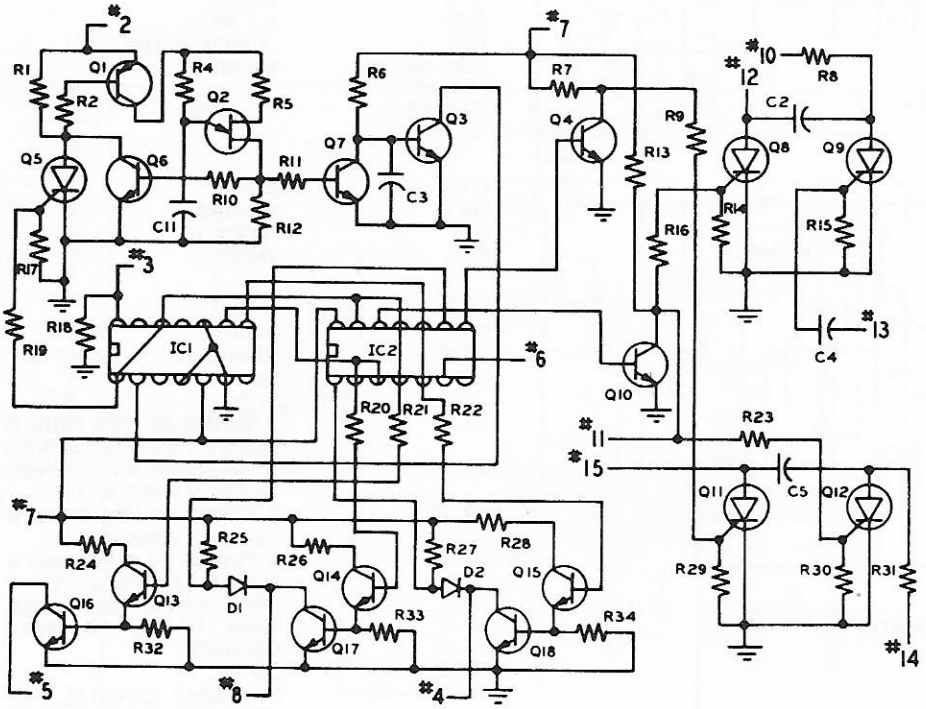


WIRING SCHEMATIC

C1, 4, 21	5.5-18 VARIABLE
C2, 3, 11, 19	2.5-11 VARIABLE
C5, 40	150 pfd.
C6,7,20,22,24, 25,28,32,36,43	.1 MFD @ 10 VOLTS
C37	.001 MFD.
C8	390 pfd.
C9, 23	10 pfd.
C11	1 pfd.
C10, 12, 13, 26, 29, 33	.01 MFD.
C14	22 pfd.
C16, 17	27 pfd.
C18	33 pfd.
C30	4.7 MFD.
C31	.1 MFD. @ 16V
C34, 35, 38, 44, 45	6.8 MFD.
C41, 42	1.5 MFD.
Q1, 2, 3	3N209
Q4	2N5486
IC-1	CA3088E
IC-2	LM324N
D1	IN630
D2	5023 LED
D3	IN914
L1	6 TURNS 20 AWG TINNED COPPER WIRE ¼",TAPPED
L2, 3	5 TURNS 20 AWG TINNED COPPER WIRE ¼" I.D.
L4	6 TURNS 20 AWG TINNED COPPER WIRE ¼" I.D.
L5	2 TURNS 22 AWG AND 4 TURNS 22 AWG ¼" I.D. ON CERAMIC COIL FORM, WIRE TO BE FORMVAR COATED
L6, 8, 9	2.2 ML.
FL1	21.4 MHZ CRYSTAL FILTER PIEZO TECHNOLOGY 1624
CR1	CRYSTAL FREQUENCY EQUALS OPERATING FREQUENCY MINUS 21.4

DECODER BOARD
PART NO. 11-0166
FIGURE G





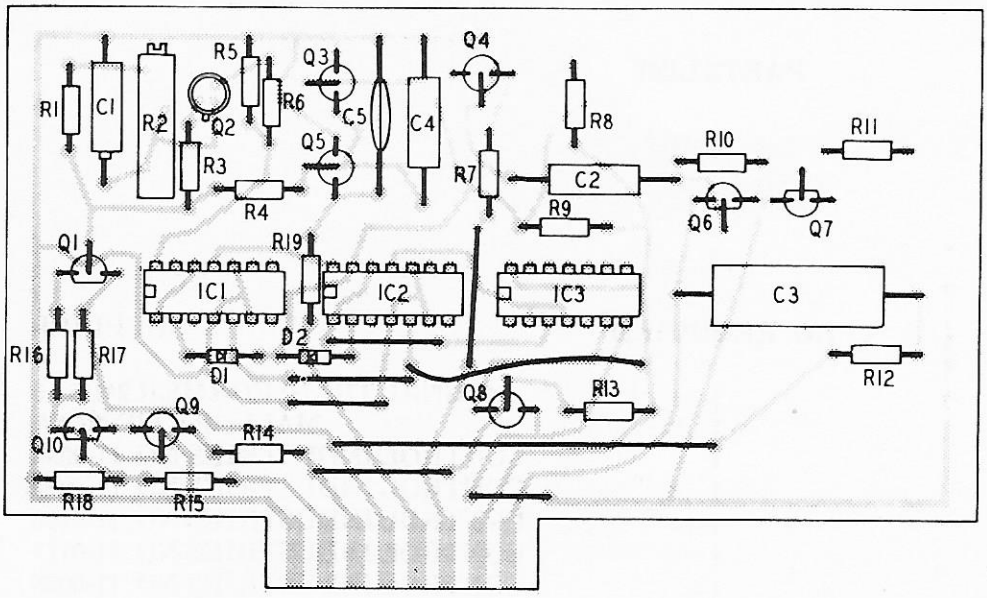
WIRING SCHEMATIC

11-0166
PARTS LIST

R1, 25, 27, 32, 33, 34	2.2K
R2	4.7K
R4	180K TO 36 OK SELECTED
R5,7,13,14,15 29, 30	470
R6	47K
R8, 31	100K
R9, 16, 23	47
R10,11,17,19 24, 26, 28	1.5K
R12	100
R18,20,21,22	15K
Q1	2N3702
Q2	2N2647
Q3,4,6,7,10,13 14,15,16, 17,18	2N3704
Q5,8,9,11,12	2N5062
IC-1	SW7490N
IC-2	962PC
D1,2	1N914 OR EQUAL
C1	15MFD. 20VDC
C2, 5	.33MFD. MYLAR
C3, 4	.022MFD. MYLAR

ALL RESISTORS ¼ WATT

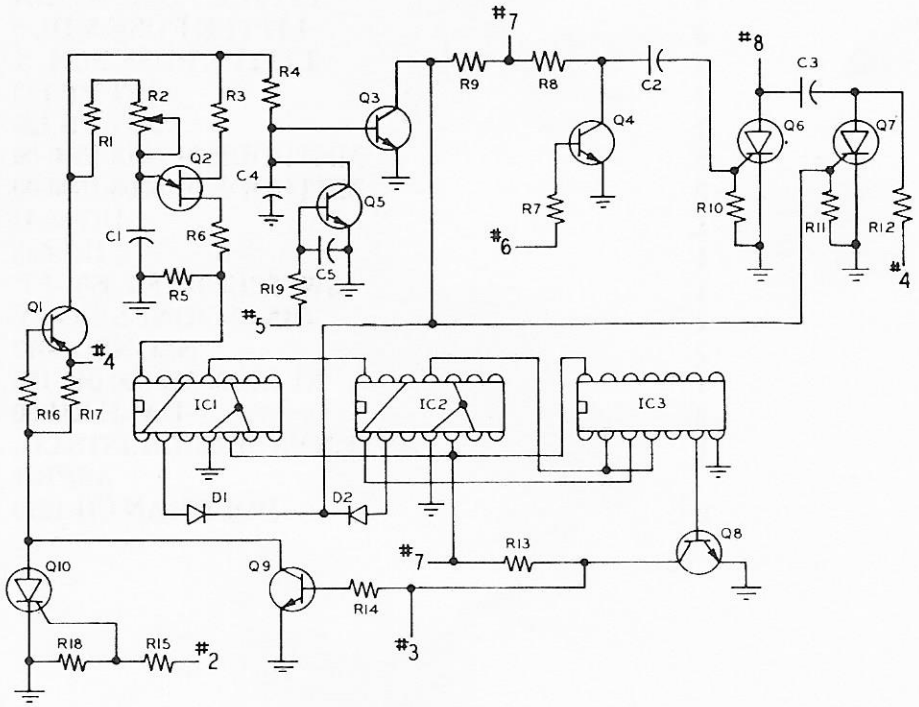
TIMER BOARD
PART NO. 11-0177
FIGURE H



11-0177
PARTS LIST

R1	330K TO 620K SELECTED
R2	100K POT.
R3, 18	470
R4	47K
R8, 9, 10, 11, 13	1K
R10, 19	100
R5, 6, 7	47
R12	100K
R14, 16	4.7K
R15, 17	2.2K
D1, 2	1N914 or EQUAL
C1	15 MFD. 20VDC
C2, 4	.022 MFD. MYLAR
C3	.33MFD. MYLAR
C5	.1 MFD 10 VDC
Q1	2N3702
Q2	2N2647
Q3, 4, 5, 8, 9	2N3704
Q6, 6, 10	2N5062
IC-1, IC-2	SW7490N
IC-3	962PC

ALL RESISTORS ¼ WATT



WIRING SCHEMATIC

PARTS LIST

PART	NO. REQUIRED	SUPPLIER
POWER TRANSFORMER	1	SIGNAL TRANSFORMER 241-5-16
FILTER CAPACITOR	1	MALLORY WP201.5A
BASE ASSEMBLY	1	CONTROL INDUSTRIES NO. 11-0033
RECEIVER BOARD	1	CONTROL INDUSTRIES NO. 11-0155
DECODER BOARD	1	CONTROL INDUSTRIES NO. 11-0166
TIMER BOARD	1	CONTROL INDUSTRIES NO. 11-0177
POWER SUPPLY BOARD	1	CONTROL INDUSTRIES NO. 11-0088
POWER RELAY	3	CONTROL INDUSTRIES NO. R1012D
R-C FILTER	3	CONTROL INDUSTRIES NO. 1014
L-C FILTER	4	CONTROL INDUSTRIES NO. 1016
POWER TRANSISTOR	1	2N4898
OCTAL SOCKETS	3	CINCH JONES 8-AB
FUSE HOLDER	4	LITTLE FUSE 342022A
FUSE	3	LITTLE FUSE MDL 5
FUSE	1	LITTLE FUSE MDL 1
SWITCH ON-OFF	1	JBT PB 123
SWITCH TEST	1	JBT PB 126
P.C. CONNECTOR	2	METHODE 91-6015-1500-00
P.C. CONNECTOR	2	METHODE 91-6008-1500-00
COAXIAL CONNECTOR	1	UG-88-U
COAXIAL CONNECTOR	1	UG-625
AUDIO JACK	1	SWITCHCRAFT 3501-FP
TERMINAL STRIP	1	CINCH JONES 5-141-Y
LIGHT EMITTING DIODE	7	NSC NSL-5023
THERMOSTAT	1	KLIXON MI-060-040-185
RESISTOR	2	DALE RH-50
ANTENNA	1	ANTENNA SPECIALISTS CO. ASPR-1
ENCLOSURE	1	HOFFMAN CH-1210