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RS SYSTEMS

Transmitter (R.F.) See Drawing #100

A Pierce crystal oscillator is used with Q-101 being the active element. Q-101 is biased into the Class A region by bias resistors R-101 and R-102 and emitter resistor R-103. The third overtone series mode crystal provides the 180 degree phase shift necessary to sustain oscillation at one-half the final output frequency. L-101 and C-103 form a tank circuit tuned to the crystal operating frequency. C-101 and C-102 provide feedback to sustain oscillation. L-102 and C-104 are series tuned to the oscillator second harmonic which drives Class C buffer amplifier Q-103 at the output frequency. L-103 is resonated by C-106 form the tank circuit for Q-103. C-113 is a supply bypass. Voltage is supplied to the buffer by modulator Q-102 to the tap of L-103. This tap is used to form the correct impedance match between the collector of Q-102 and L-103. Q-102 is biased off by R-106 until a low voltage from the encoder is presented to the input of Q-102. At this time Q-102 saturates and supplies power to Q-103.

C-105 is used as a Miller integrator to shape the modulator wave form.

Amplified and modulated R.F. voltage is coupled to the bases of Q-104, Q-105 and Q-106 by C-107. These transistors are parallel connected and biased in the Class C mode by R-107. C-108 provides R.F. base stabilization. C-110, C-104 and L-105 form the tank circuit matching the output impedance of the stage to the antenna while supressing higher order harmonics. Inductor L-104 supplies Vcc to the final collectors. Capacitor C-112 couples a small amount of R.F. which is rectified by D-101 and filtered by C-111 to drive the output meter, giving visual indication of relative output. R-106 provides D.C. bias for D-101.

TUNING PROCEDURE FOR TRANSMITTER R.F. SECTION

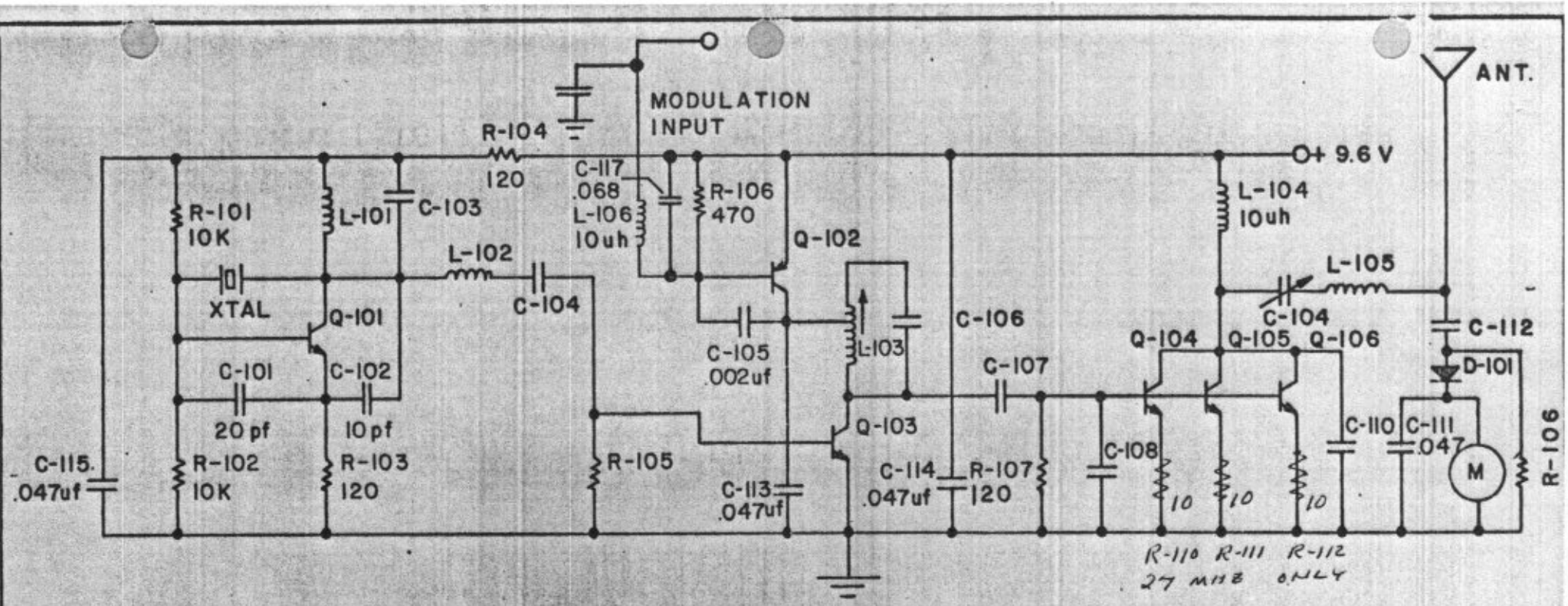
NOTE: Only persons holding a valid Second Class or higher Radio-Telephone Operator's License issed by the Federal Communications Commission may tune transmitters on 27 mhz and 72 mhz.

Tuning transmitters on six meters must be done by an operator possessing an amateur operator's license.

The R.F. Section can be tuned using either the meter on the face of the transmitter or with the use of a field strength meter. Both the buffer inductor and the output stage capacitor are simply tuned for maximum output. The only precaution needed for this R.F. Section is to be certain the buffer coil has two tuning peaks. If the buffer coil has only one peak at the middle of the coil, C-106 should be either replaced or increased in value. If the buffer coil tends to peak toward the end, decrease C-106.

A field strength meter at a set distance from the transmitter will tell the operator if the transmitter in question is radiating properly by comparing it to a known transmitter. This is a relative reading and will vary approximately ± 20%.

If any problems are encountered with the R.F. Section, refer to the trouble shooting section.



Q-101 2N3646

Q-102 MPS6562

Q-103 2N3646

Q-104 2N5770

Q-105 2N5770

Q-106 2N5770

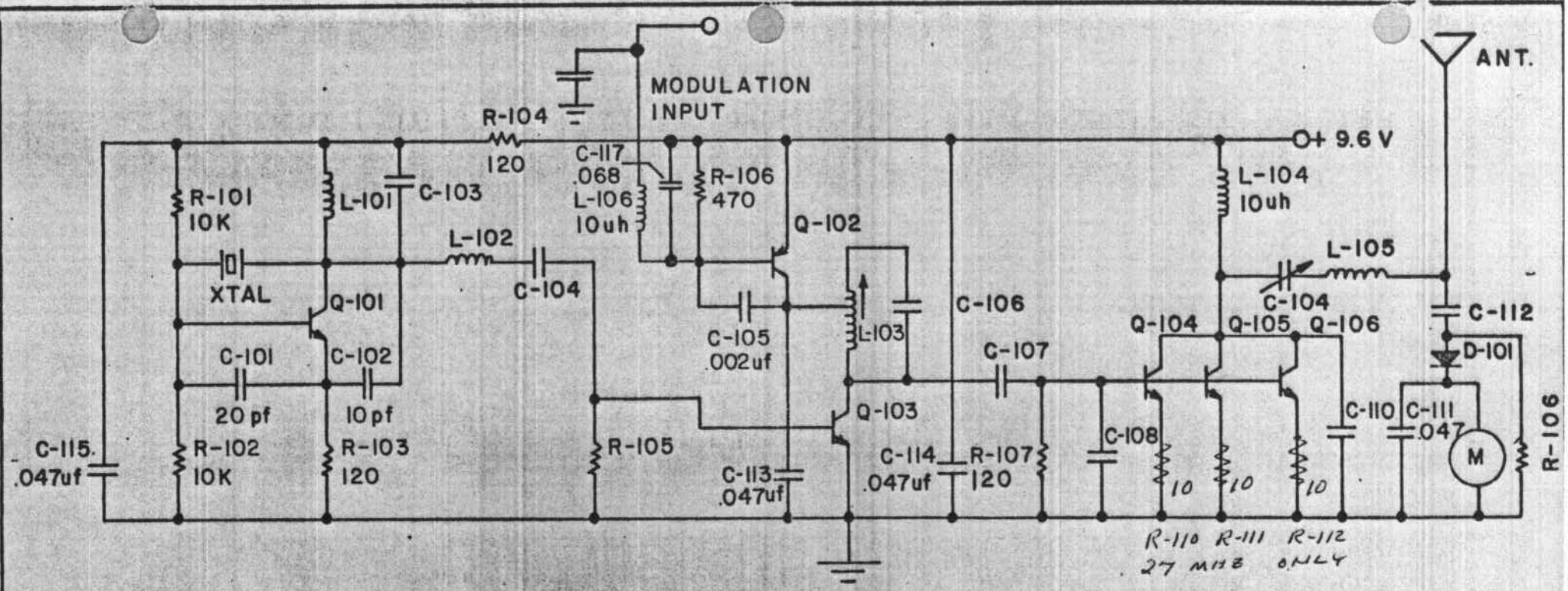
	27 MHZ.	53 MHZ	72 MHZ
L-101	3.9 uh	1.0 uh	1.0 uh
L-102	JUMPER	JUMPER	1.0 uh
L-103	5 1/2-4 3/4	3 1/2-2 3/4	1 1/2-1 3/4
L-105	3.9 uh	1.0 uh	0.68 uh
C-103	10 pf	10 pf	20 pf
C-104	33 pf	10 pf	5 pf
C-106	33 pf	10 pf	20 pf
C-107	50 pf	33 pf	33 pf
C-108	33 pf	33 pf	33 pf
C-109	ARCO 423	ARCO 402	ARCO 402
C-110	20 pf	20 pf	NONE
C-112	2.2 pf	10 pf	5 pf
R-105	1.0 K	1.0 K	120
R-106	4.7 K	IN4148	IN4148

RS SYSTEMS

DRAWN R.E.N.	SCALE	REVISIONS	DATE
CHECKED D.B.M.			
APPROVED			
DATE 12-3-73			

TITLE: 1974 TX RF

NO. 100



	27 MHZ.	53 MHZ	72 MHZ
L-101	3.9 uh	1.0 uh	1.0 uh
L-102	JUMPER	JUMPER	1.0 uh
L-103	5 1/2-4 3/4	3 1/2-2 3/4	1 1/2-13/4
L-105	3.9 uh	1.0 uh	0.68 uh
C-103	10 pf	10 pf	20 pf
C-104	33 pf	10 pf	5 pf
C-106	33 pf	10 pf	20 pf
C-107	50 pf	33 pf	33 pf
C-108	33 pf	33 pf	33 pf
C-109	ARCO 423	ARCO 402	ARCO 402
C-110	20 pf	20 pf	NONE
C-112	2.2 pf	10 pf	5 pf
R-105	1.0 K	1.0 K	120
R-106	4.7 K	IN4148	IN4148

Q-101 2N3646

Q-102 MPS6562

Q-103 2N3646

Q-104 2N5770

Q-105 2N5770

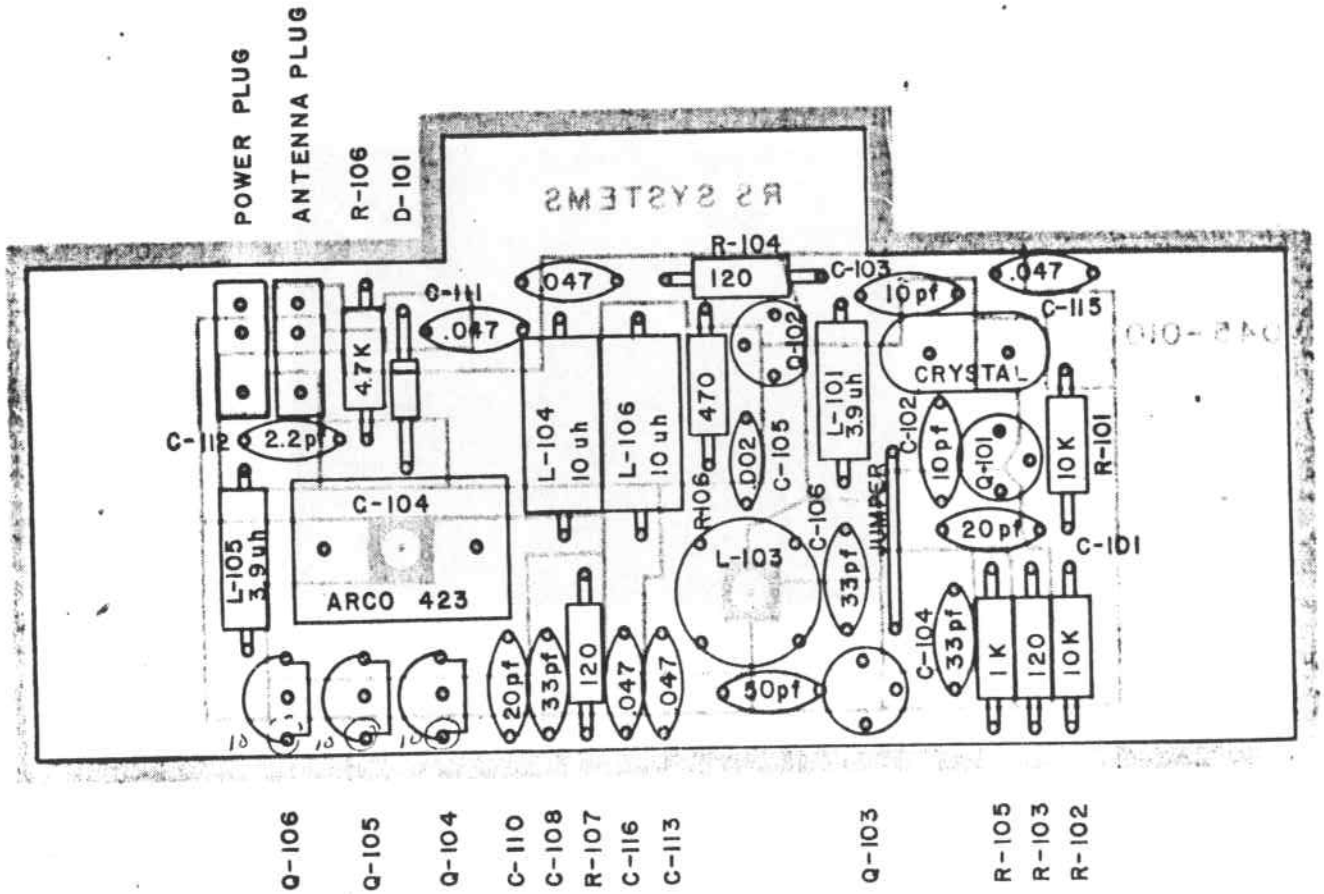
Q-106 2N5770

RS SYSTEMS

DRAWN R.E.N.	SCALE	REVISIONS	DATE
CHECKED D.B.M.			
APPROVED			
DATE 12-3-73			

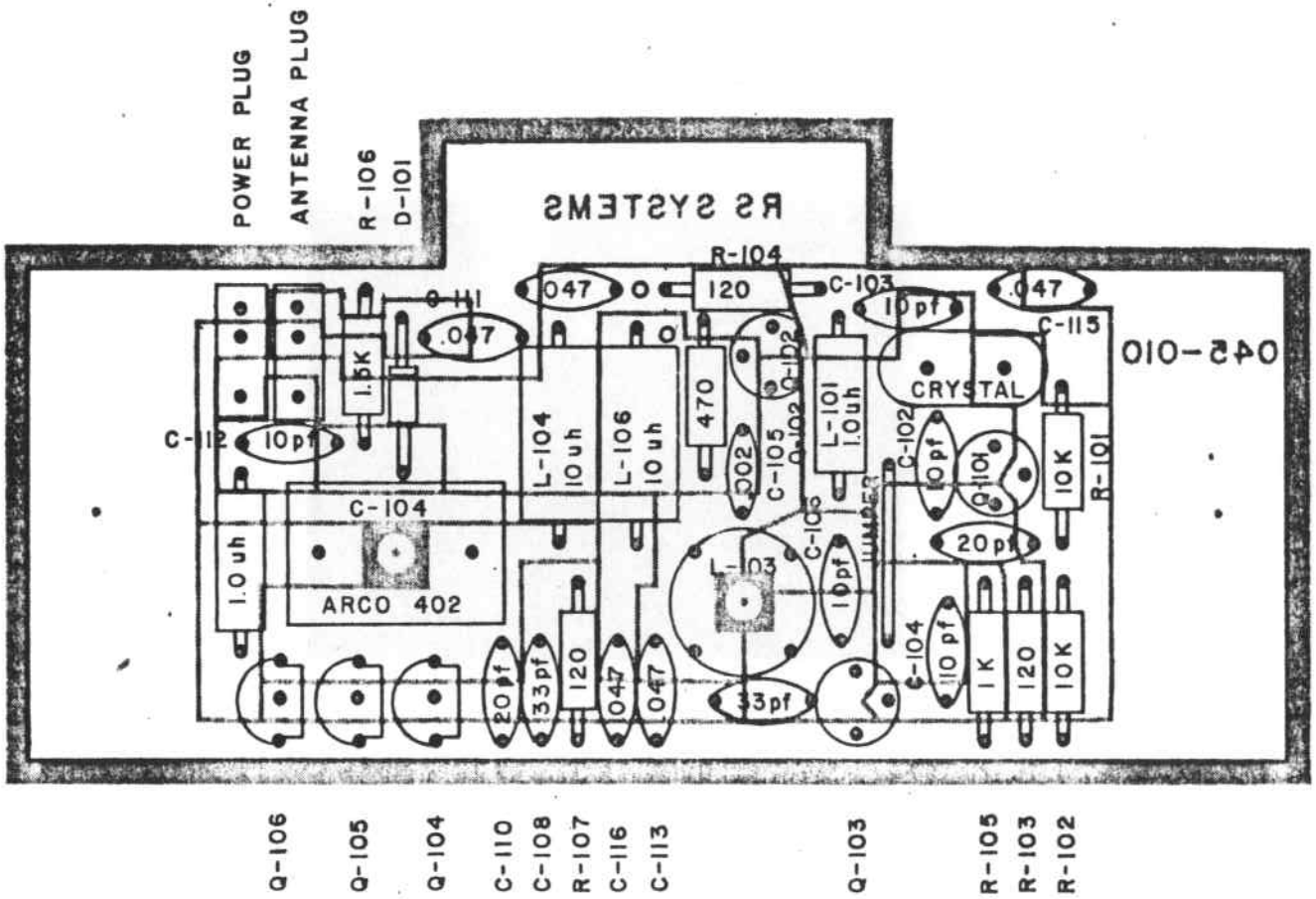
TITLE: 1974 TX RF

NO. 100



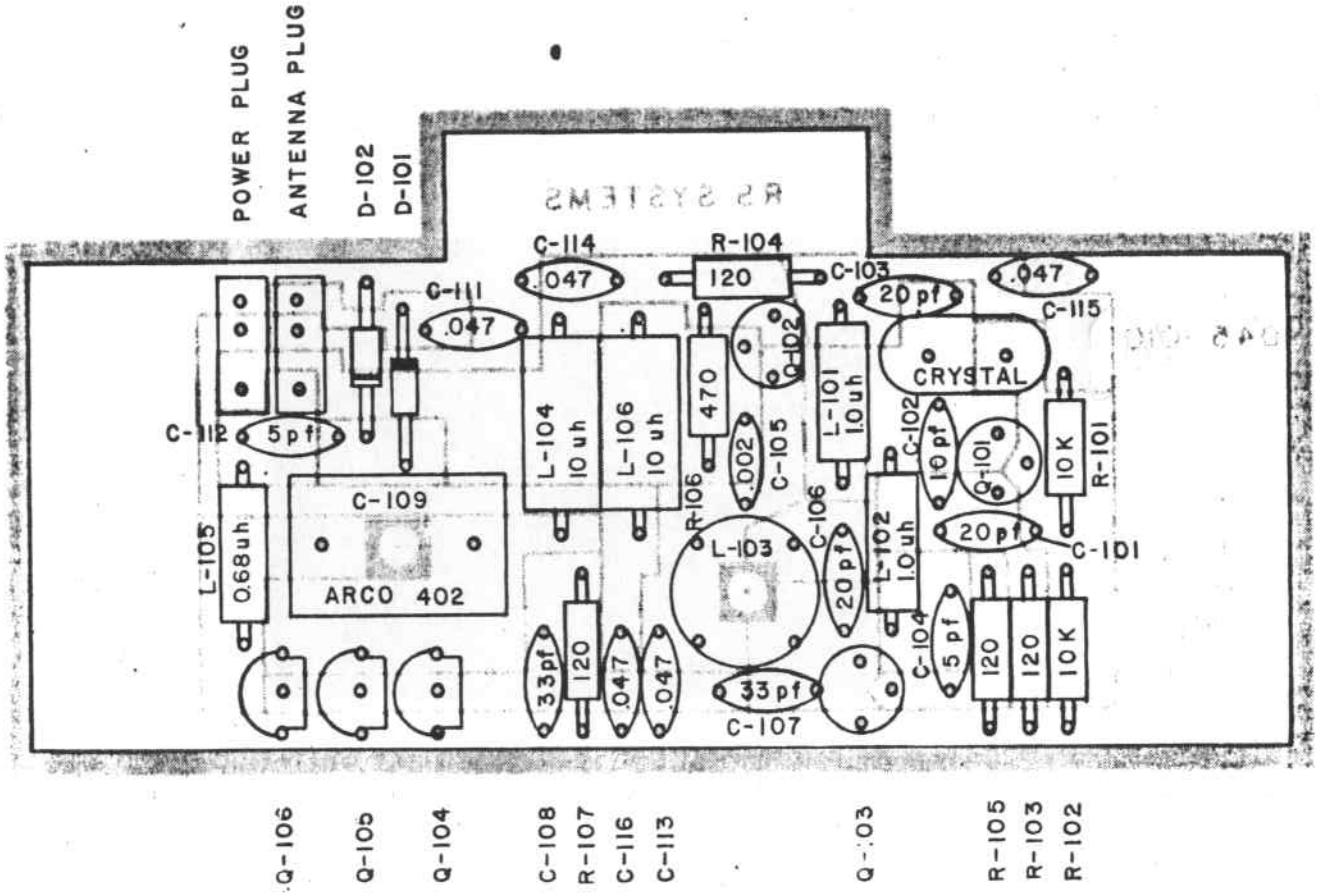
Q-101 2N3646
Q-102 2N4249
Q-103 2N3646
Q-104 2N5770
Q-105 2N5770
Q-106 2N5770

27 MHZ. TRANSMITTER R.F. SECTION



Q-101 2N3646
Q-102 2N4249
Q-103 2N3646
Q-104 2N5770
Q-105 2N5770
Q-106 2N5770

6 METER TRANSMITTER R.F. SECTION



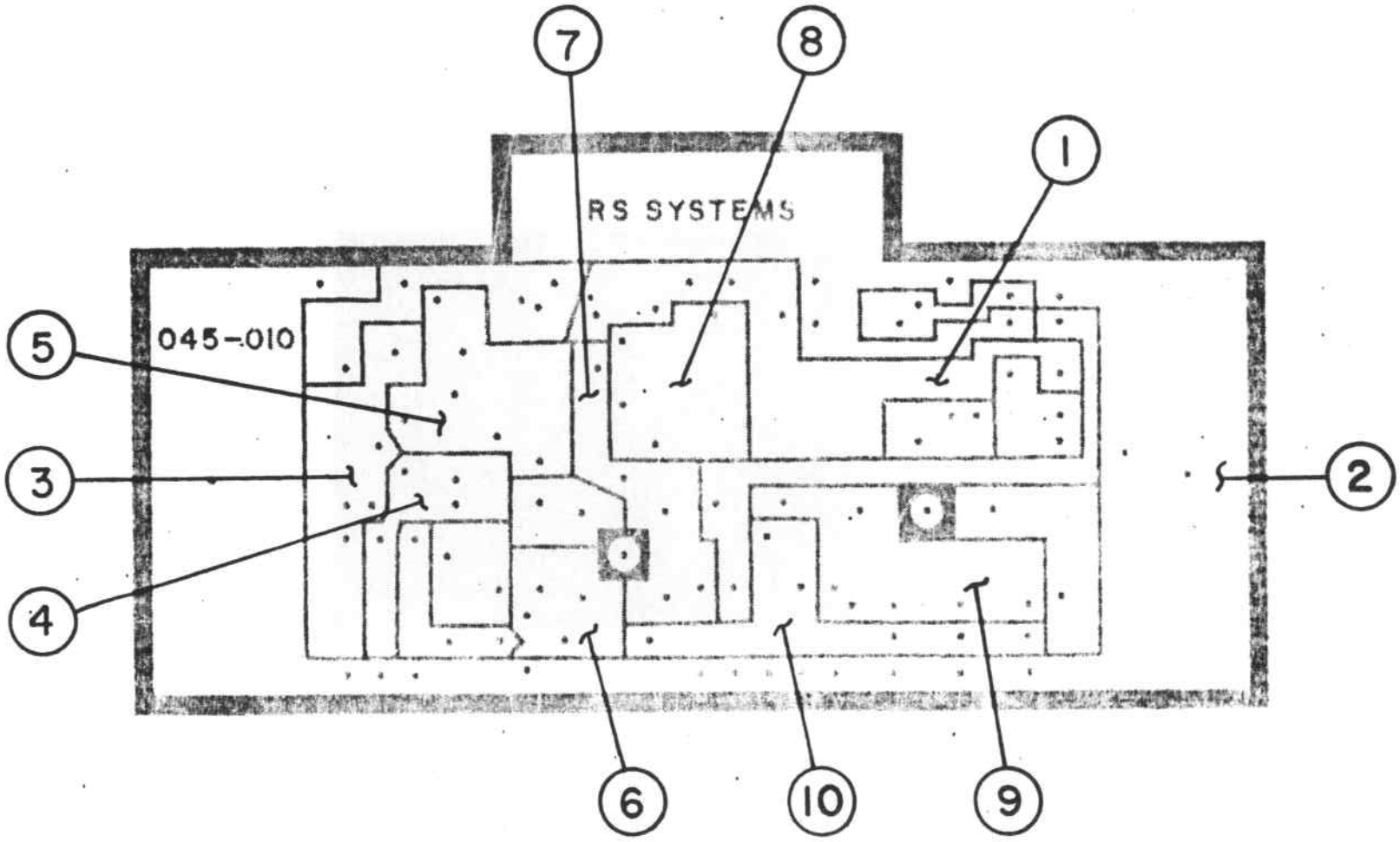
Q-101 2N3646
Q-102 2N4249
Q-103 2N3646
Q-104 2N5770
Q-105 2N5770
Q-106 2N5770
D-101 IN4146
D-102 IN4146

72 MHZ TRANSMITTER R.F. SECTION

Transmitter R.F. Waveform & Voltage Chart - See Drawing # 102

NOTE: All measurements made with oscilloscope or meter referenced to Negative 9.6 VDC (TP2) and transmitter on.

1. Positive 9.6 VDC
2. Negative 9.6 VDC
3. Base of transistor Q-101
4. Emitter of transistor Q-101
5. Collector of transistor Q-101
6. Collector of transistor Q-103
7. Collector of transistor Q-102
8. Base of transistor Q-102
9. Collectors of transistors Q-103,4, &5
10. Base of transistors Q-103,4, &5


RS SYSTEMS
045-010
1
2
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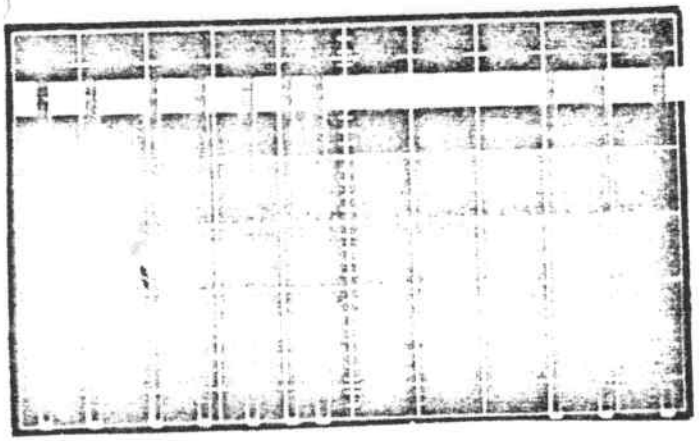
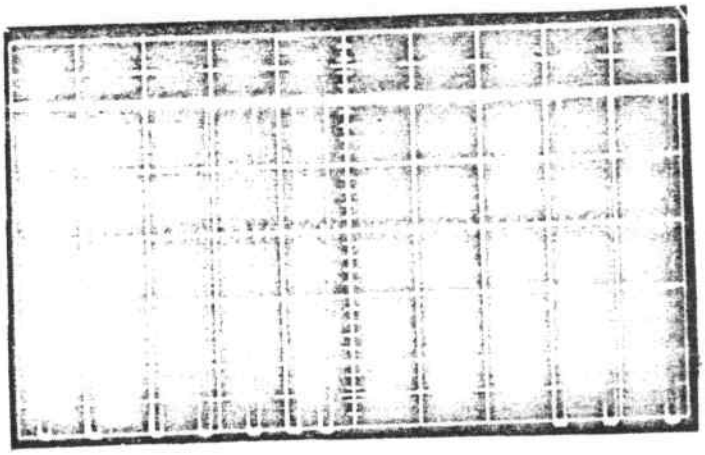
10

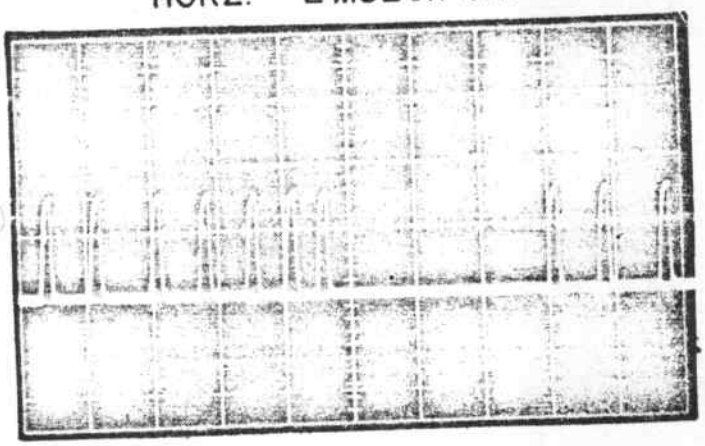
SYMPTOM	PROBABLE CAUSE
1) No output	1. No D.C. Voltage or modulation input signal - check connector. If above is present check test point 6 - No signal here indicates either defective oscillator or defective modulator - See symptom 2 and 3. If signal present at test point 6, check test points 9 and 10. If no signal here, problem is defective C-107, shorted C-110, defective Q-104, Q-105, or Q-106, open L-104 shorted trimmer C-104 or open L-105.
2) Oscillator not operating	1. Defective Q-101, crystal, C-101, C-102, C-103, L-101, R-101, R-102 or R-103.
3) Modulator not operating	1. Check test points 7 and 8. If signal present at test point 8 but not at test point 7, look for defective Q-102, open L-103 or defective Q-103. If no signal at test point 8, check connector.
4) Modulation disappears when antenna is extended	1. Defective or missing C-117 (not installed on some earlier models) 2. Dead battery.
5) Low output power	1. One or more defective output transistor (Q-104, Q-105, or Q-106) 2. Low battery pack 3. One or more shorted cells in transmitter pack.
6) No meter reading. (but transmitter is putting out proper power)	1. Defective meter, C-112, D-101, R-106, or shorted C-111



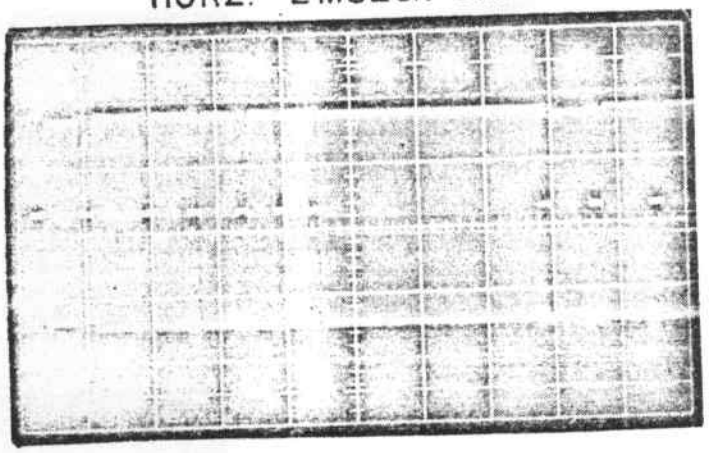
TEST POINT 6
VERT. - 2V. / CM.
HORZ. - 2 MSEC. / CM.



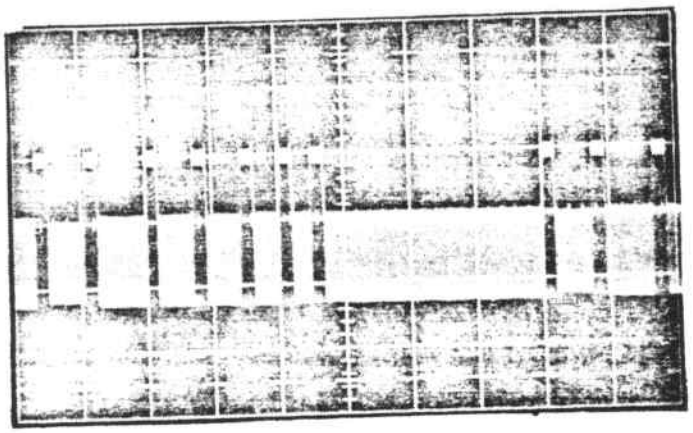
TEST POINT 7
VERT. - 2V. / CM.
HORZ. - 2 MSEC. / CM.



TEST POINT 8
VERT. - 0.5 V. / CM.
HORZ. - 2 MSEC. / CM.



TEST POINT 9
VERT. - 0.5 V. / CM.
HORZ. - 2 MSEC. / CM.



TEST POINT 10
VERT. - 0.2 V / CM.
HORZ. - 2 MSEC. / CM.

Encoder - Transmitter (See Drawing #200)

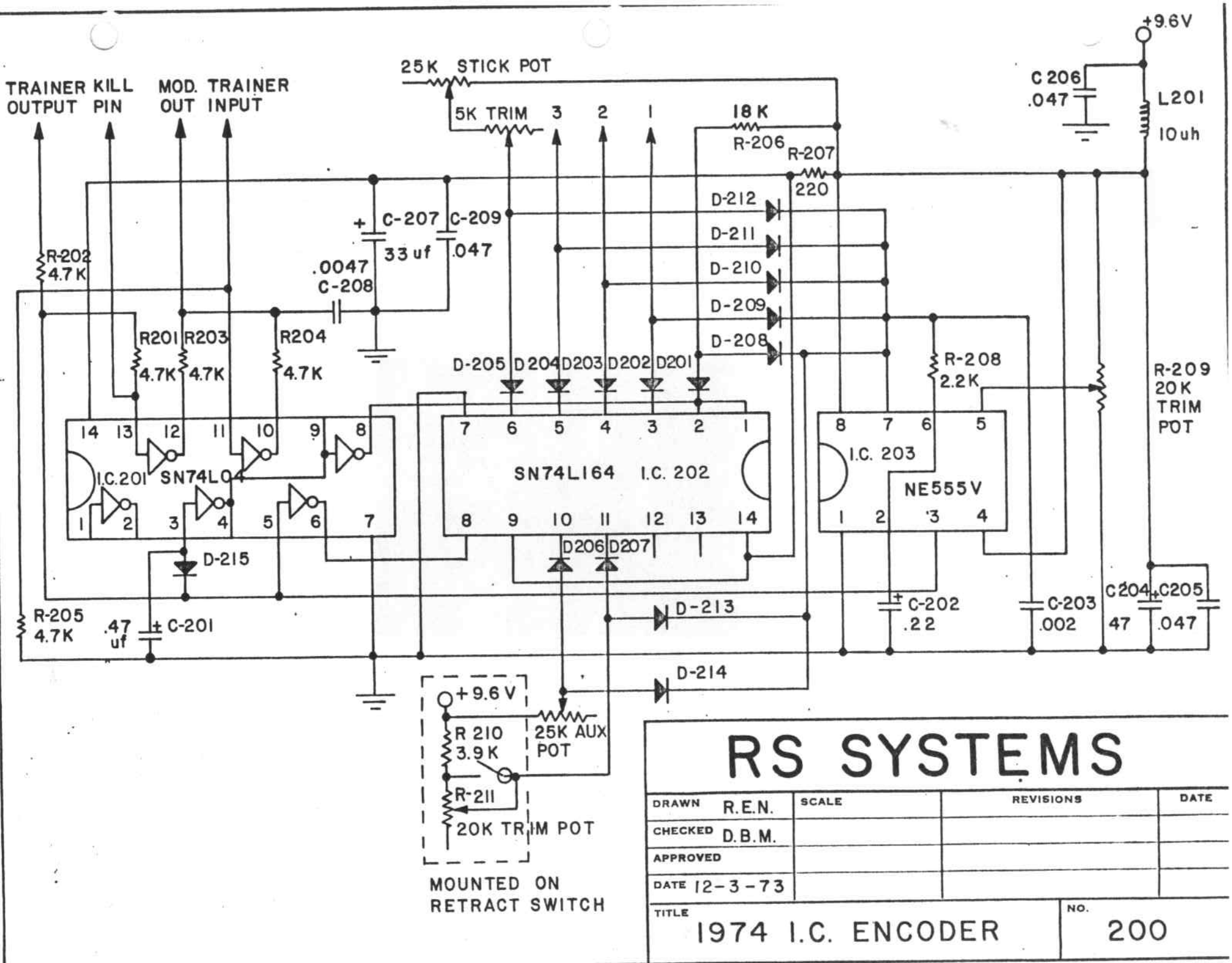
IC-203 is used in its astable mode in conjunction with R-208 and C-202 producing the time constant for the 300 micro-second "off" time of the encoded output. The control pots, R-208 and C-202 also determine the variable channel information time of the encoded output. Since R-208 and C-202 are constants, the channel information time is directly proportional to resistance change of the control pots.

Eight bit shift registor IC202 is clocked from the output of IC-203 through one gate in hex inverter IC-201. Negative clock information is also passed through diode D-215 driving two gates of IC-201 providing serial input to IC-202. The serial input time constant is produced by the internal pullup resistor of this gate and C-201, preventing this input from going high as long as pulses shorter than three milliseconds are presented at the cathode of D-215. This presents a "one" to the serial input of IC-202 enabling positive pulses at the outputs of IC-202.

As each progressive output of IC-202 shifts to "one", diodes D-202 through D-207 become reverse biased and enable each individual control pot to pass current through their respective steering diodes D-209 through D-214 to the discharge input of IC-203. As the serial input presented to IC-202 goes to "one", D-201 is reverse biased and R-206 is steered to the discharge input of IC-203 generating the syncronization period from the encoder. Trim-pot R-209 controls the amount of travel for all channels. The encoded output of IC-203 is fed through R-202 providing "trainer" output and through R-201 to an inverter in IC-201. R-203 connects this output to the input of the modulator which is located on the R.F. module. The "kill" pin is to an inverter in IC-201 and, when grounded causes its output to go to "one", turning off the modulator. The "trainer" input pin is connected to the

trainer output pin of the "slave" transmitter via the buddy box cable and receives information from its modulator, inverting this information to the proper phase to modulate the "master" R.F. module. When the trainer input is not in use, R-205 grounds the inverter input whose output is connected to the modulator through R-204. The retract switch travel adjustments are located on the retract switch P.C. board mounted directly on the retract switch terminals. R-210 sets the length of the short time when the switch is in its closed state, shorting out trim-pot R-211. When the retract switch is in the open position trim-pot R-211 is placed in series with R-210 which is adjustable to set the long pulse period.

C-206, C-204, C-205, C-203, and C-207 are R.F. and power supply bypass capacitors. L-201 is a decoupling inductor presenting high impedance to R.F. which may appear to the input of the encoder. R-207 drops the primary supply voltage to proper Vcc for the TTL integrated circuits.



RS SYSTEMS

DRAWN R.E.N.	SCALE	REVISIONS	DATE
CHECKED D.B.M.			
APPROVED			
DATE 12-3-73			

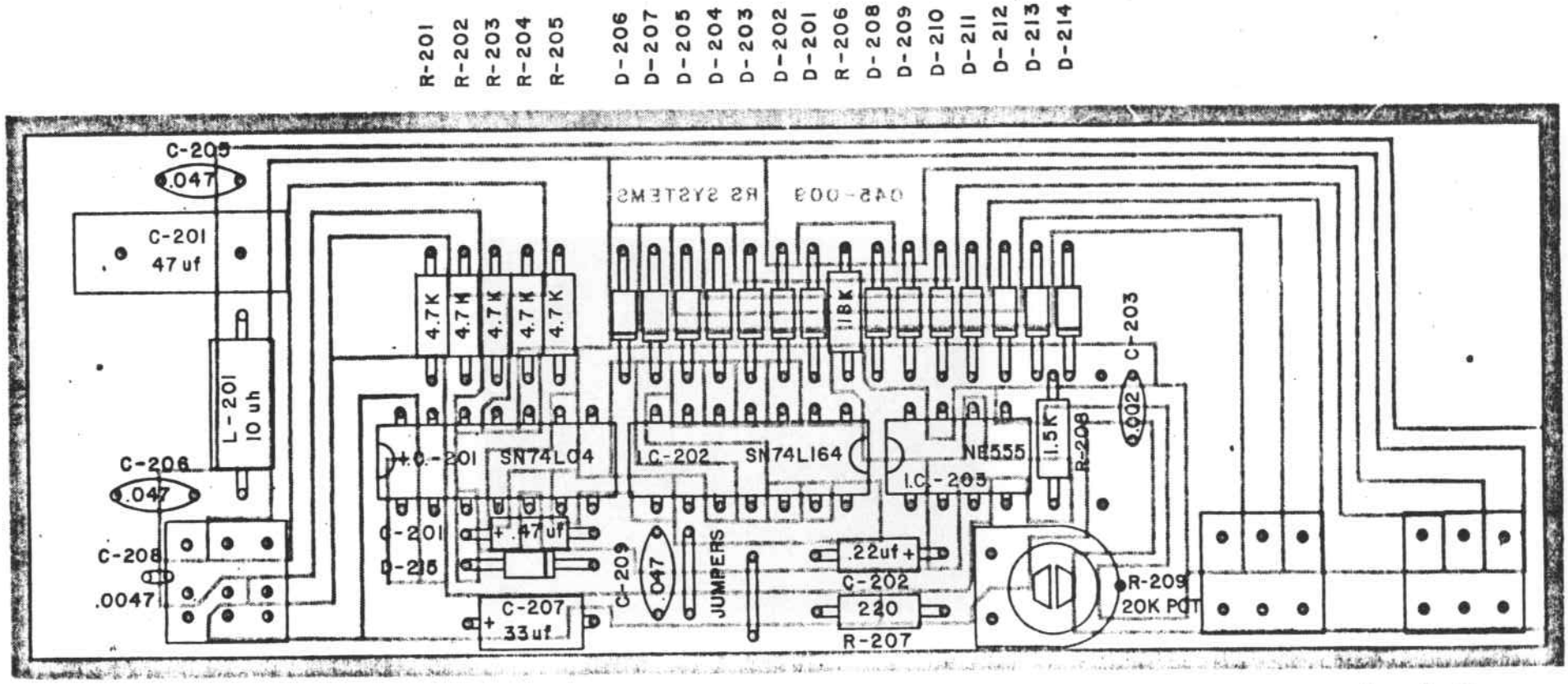
TITLE: 1974 I.C. ENCODER

NO. 200

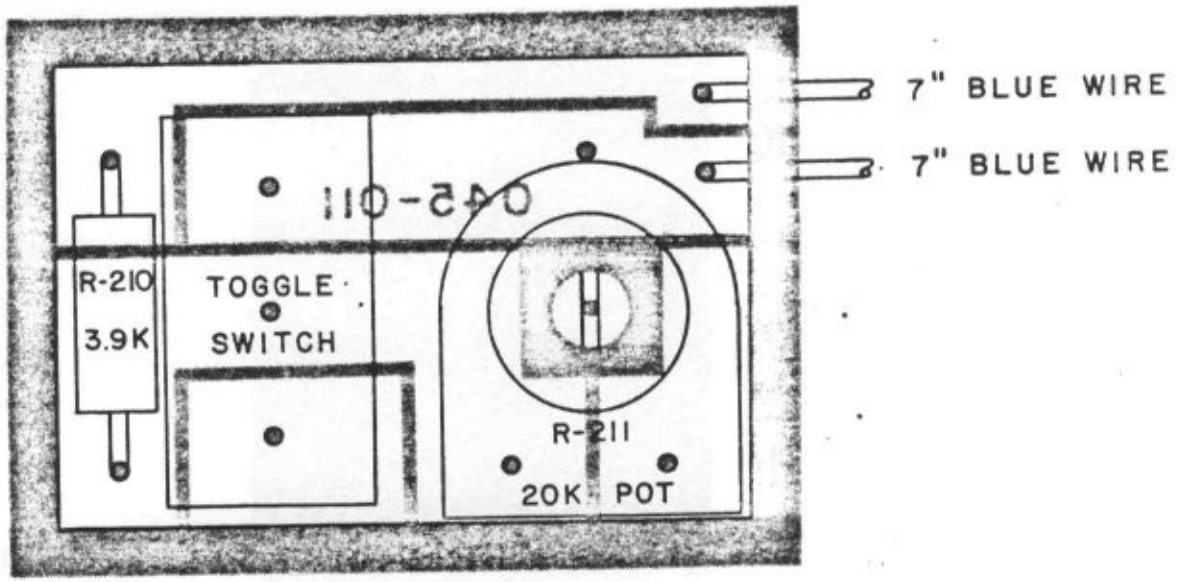
5 CHANNEL - DELETE DIODES D-206 & D-214

4 CHANNEL - DELETE DIODES D-206, D-207, D-213 & D-214

3 CHANNEL - DELETE DIODES D-206, D-207, D-205, D-212, D-213 & D-214



I.C. ENCODER



TRANSMITTER AUX. BOARD

Encoder - Transmitter Waveform & Voltage Chart - See Drawing #203

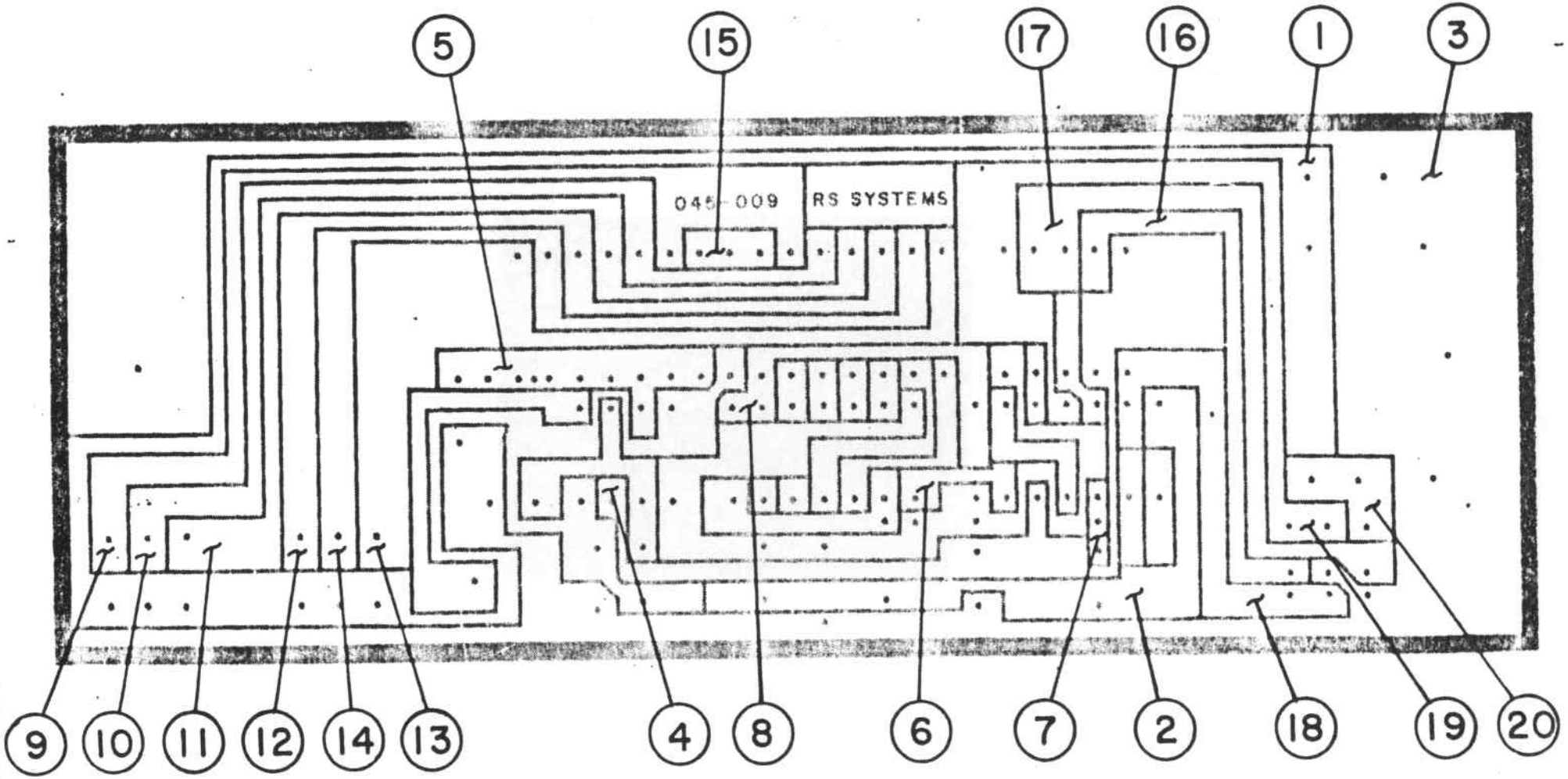
NOTE: All measurements made with oscilloscope or meter referenced to negative 9.6 VDC (TP-3) and transmitter on.

1. Positive 9.6 VDC
2. Decoupled positive
3. Negative 9.6 VDC
4. Modulated output of IC203
5. Variable current input node
6. Clock input to IC202
7. Rectified & filtered sync input signal
8. Sync input to IC202
9. Channel one input (rudder)
10. Channel two input (throttle)
11. Channel three input (elevator)
12. Channel four input (aileron)
13. Channel five input
14. Channel six input
15. Sync pulse input
16. Trainer output
17. Modulation output to R.F.
18. Kill input
19. Trainer input
20. Positive 9.6 VDC input

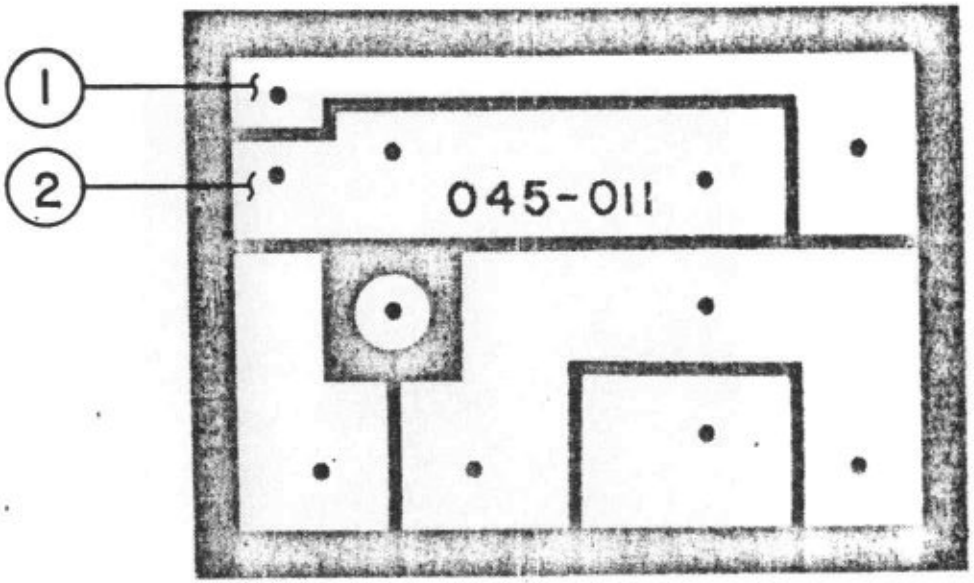
Sixth Channel Auxilary Board - See Drawing #204

NOTE: Measurements same as above - Board must be plugged into encoder.

1. Positive 9.6 VDC input
2. Current output



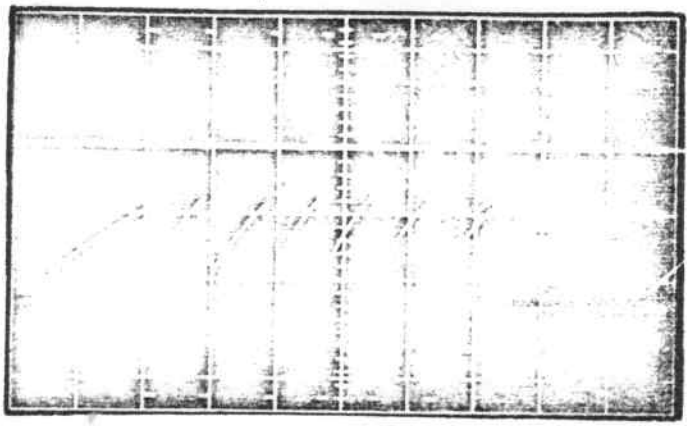
I.C. ENCODER



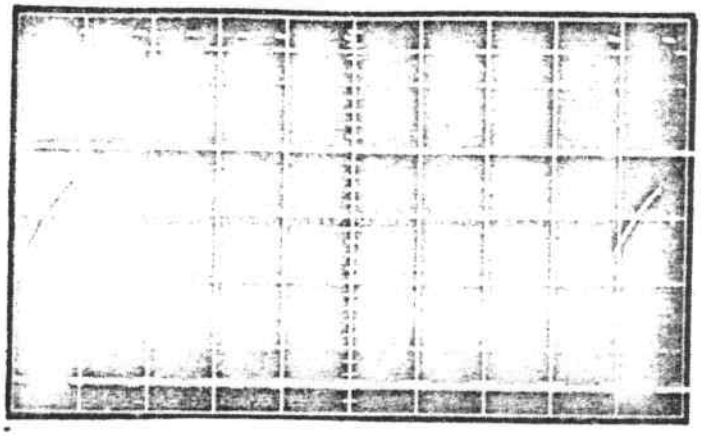
TRANSMITTER AUX. BOARD

ENCODER TROUBLE SHOOTING CHART

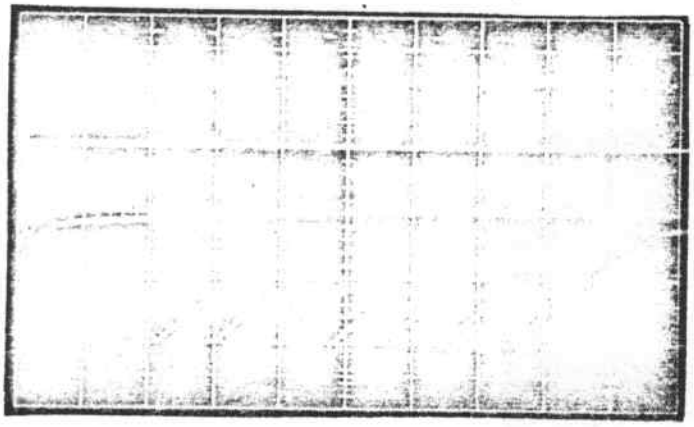
SYMPTOM	PROBABLE CAUSE
One or more channels not operating but at least one channel functional	1. Defective pot, wires or plug associated with inoperative channel 2. Defective steering diode, D-208 thru D-214, defective decoupling diode, D-201 thru D-207 3. Defective IC-202
All channels not operating	1. Due to the complexity of this encoder, service centers are advised to replace the whole board if the following symptom is discovered. a. No output at test point 4 and supply voltages are present
Channel throw is too long or too short	1. Change R-209 and readjust all channel pots until desired throw is achieved



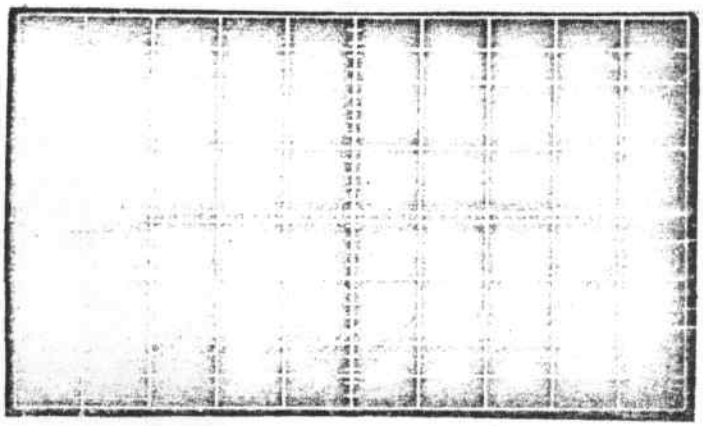
TOP- TEST POINT 6
BOTTOM - TEST POINT 5
VERT. - 2 V / CM.
HORZ. - 2 MSEC. / CM.



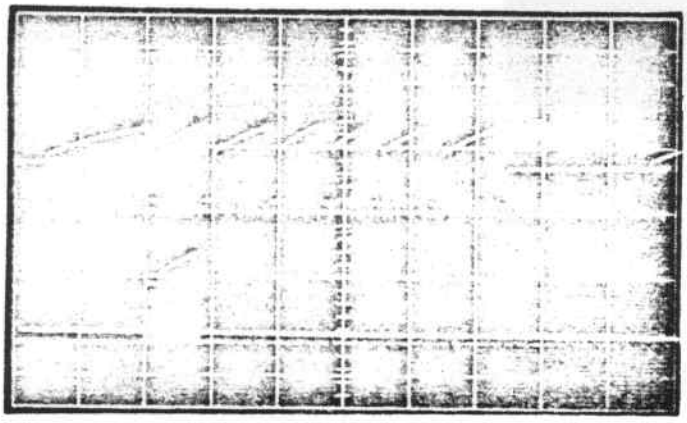
TOP - TEST POINT 6
BOTTOM - TEST POINT 9
VERT. - 2 V / CM.
HORZ. - 2 MSEC. / CM



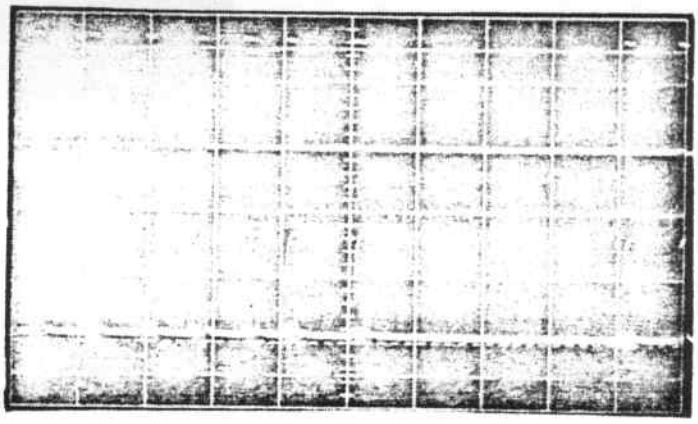
TOP - TEST POINT 6
BOTTOM - TEST POINT 7
VERT. 2V/CM TOP, 0.5 V/CM BOTTOM
HORZ. 2 MSEC. / CM



TOP-TEST POINT 8
BOTTOM - TEST POINT 7
VERT. 2V/CM TOP, 0.5 V/CM. BOTTOM
HORZ. 2 MSEC. / CM.



TOP-TEST POINT 5
BOTTOM - TEST POINT 9
VERT. - 5 V / CM
HORZ. - 2 MSEC. / CM.



TOP - TEST POINT 6
BOTTOM - TEST POINT 17
VERT. 2V/CM. TOP, 0.5 V/CM BOTTOM
HORZ. - 2 MSEC. / CM.

PARTS LIST - ENCODER (IC VERSION)

RESISTORS - All values in OHMS (K=1000)				RS PART NO.
R-201	4.7k	1/4w	5%	000-472
R-202	4.7k	1/4w	5%	000-472
R-203	4.7k	1/4w	5%	000-472
R-204	4.7k	1/4w	5%	000-472
R-205	4.7k	1/4w	5%	000-472
R-206	10k	1/4w	5%	000-103
R-207	220	1/4w	5%	000-220
R-208	2.2k	1/4w	5%	000-222
R-209	25k trim pot			010-253
R-210	3.9k	1/4w	5%	000-392
R-211	25k trim pot			010-253

CAPACITORS				
C-201	0.47MF	Tantalum	10%	030-474
C-202	0.22MF	Tantalum	10%	030-224
C-203	.002MF	Ceramic Disc.	20%	029-202
C-204	47MF 15V	Electrolytic	20%	035-476
C-205	.047MF	Ceramic Disc.	-20%,+80%	029-473
C-206	.047MF	Ceramic Disc.	-20%,+80%	029-473
C-207	33MF 6V	Tantalum	10%	030-336

INTEGRATED CIRCUITS AND DIODES			
I.C.-201	SN74L04N	Hex Inverter	060-001
I.C.-202	SN74L164N	Eight Bit Shift Register	060-002
I.C.-203	NE555V	Timer	060-006
D-201 thru D-215	1N4148	Silicon Diode	062-001

MISCELLANEOUS			
L201	10Mh Inductor	10%	050-106
P.C. Board			045-009
Block Connector (3)			070-001
Male Pins (21) - Six Channel			069-001

Servo Amplifier - See Drawing #300

Positive decoded information is applied to pin 3 of monolythic integrated circuit IC 301. C-308, R-302, and R-304 set the referance monostable multivibrator time constant. R-303 is the feedback element which is mechanically coupled to the servo output shaft. R-301 and C-301 decouple the monostable from the primary power supply. C-302, R-307 and R-308 form a pulse stretching and minimum impulse timing network for one direction of motor rotation. C-303, R-305 and R-306 provide the same function for the opposite direction of rotation. C-304 is the dead band capacitor. D-301 and C-306 provide arc suppression and RF filtering for the motor. R-309 is the damping resistor and C-305 a power supply bypass capacitor.

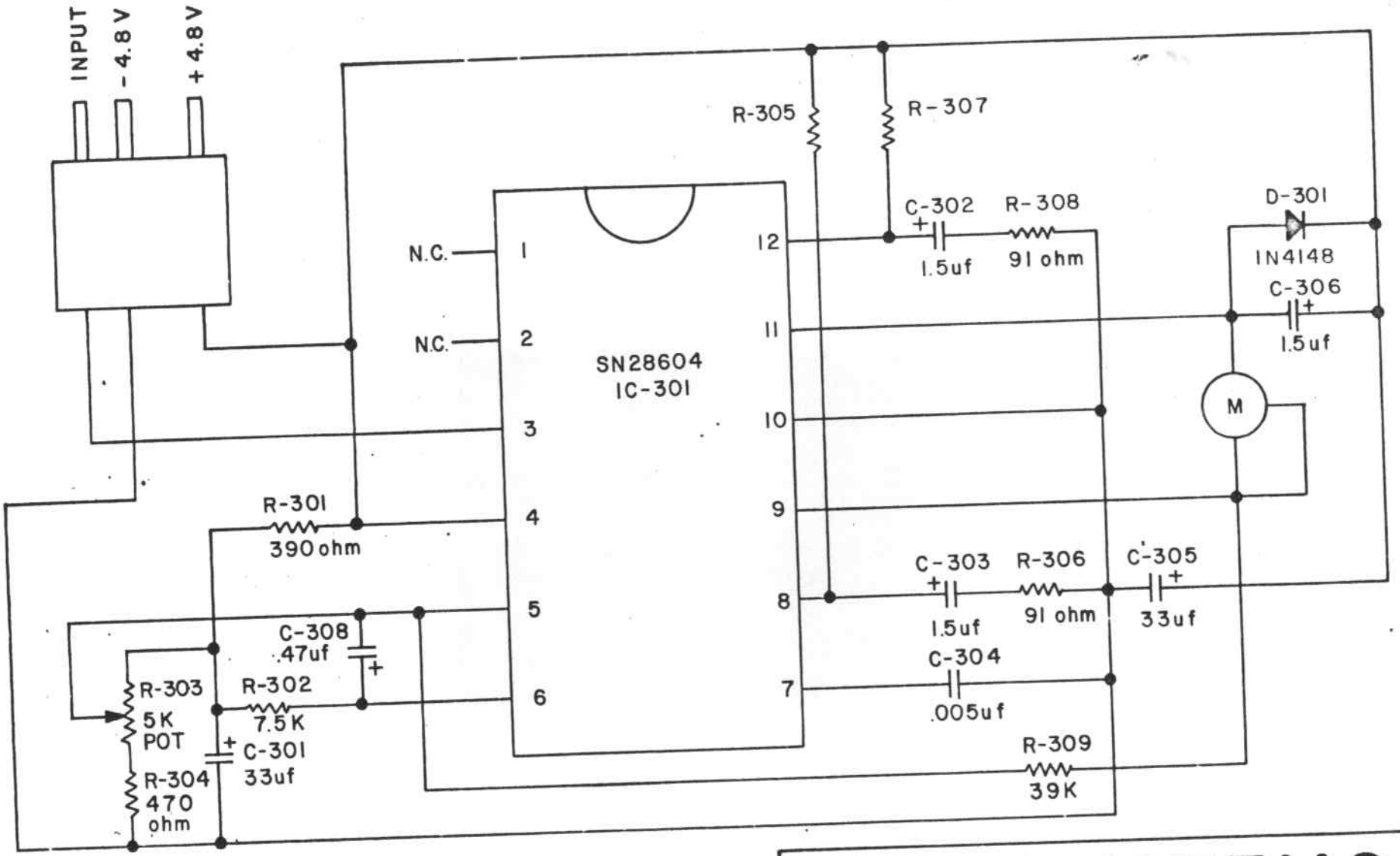
Servo Amplifier Waveform & Voltage Chart - See Drawing #302

NOTE: All measurements made with oscilloscope or meter referenced to negative 4.8 vdc (TP10) and servo in neutral unless noted.

1 = Decoupled Positive
2 = Junction - R-303 and F.B. Pot
3 = Input from decoder
4 = Positive 4.8 vdc
5 = Reference generator output
6 = Reference generator timing
7 = Dead band control
8 = Pulse stretcher (one direction)
9 = Motor output
10 = Negative 4.8 vdc
11 = Motor output
12 = Pulse stretcher (opposite direction)
13 = Amplifier output (Connect scope directly across motor terminals)

13 (b) With 10 us error applied: Minimum impulse (one direction)
Minimum impulse (opposite direction)

Full error applied: Full error (one direction)
Full error (opposite direction)



NOTES

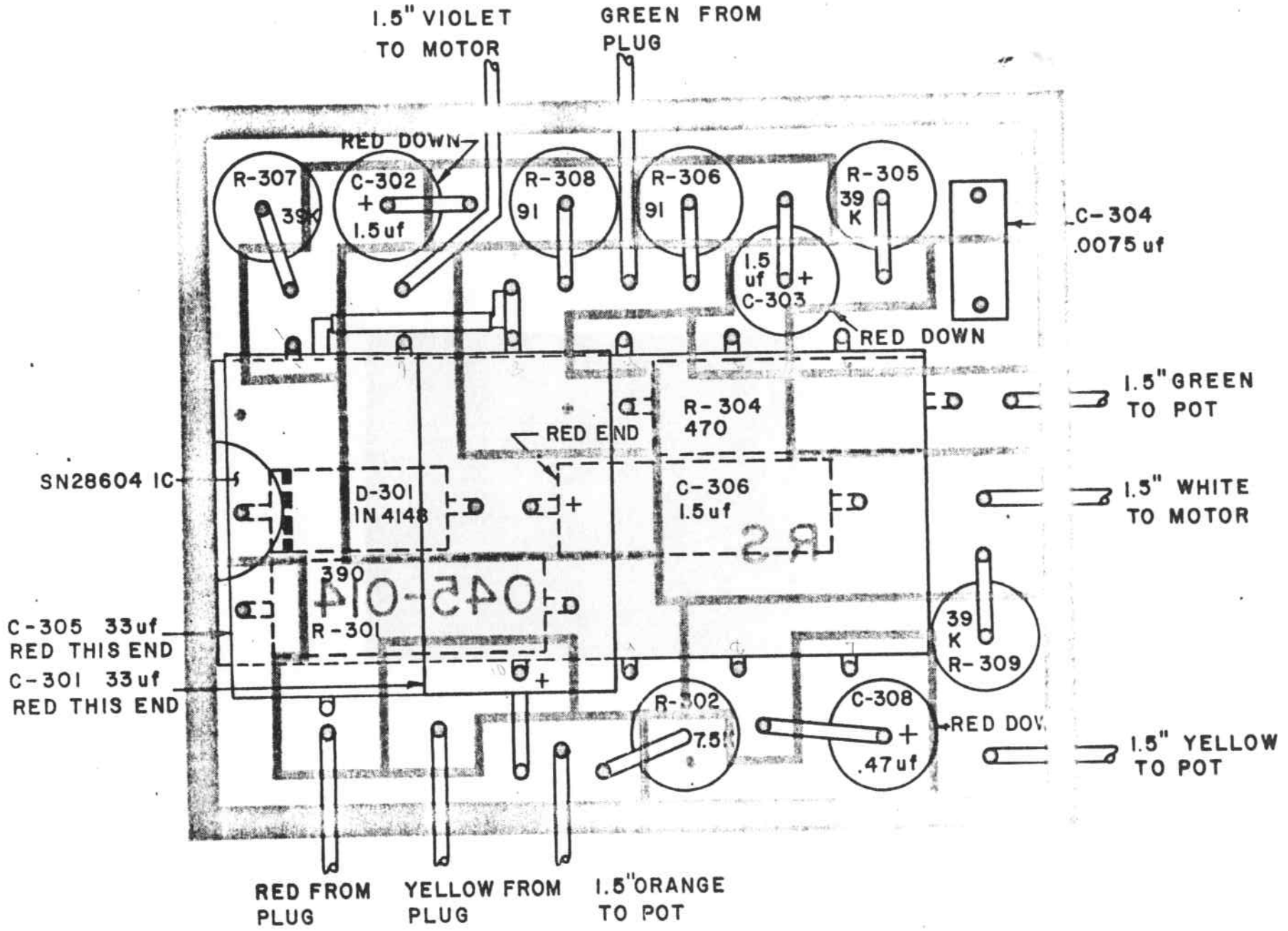
R-302 - DECREASE TO INCREASE THROW
C-304 - ADJUST FOR DESIRED DEADBAND
R-305, R-307 - VALUE VARIES WITH I.C.
NOMINAL VALUE 39K

RS SYSTEMS

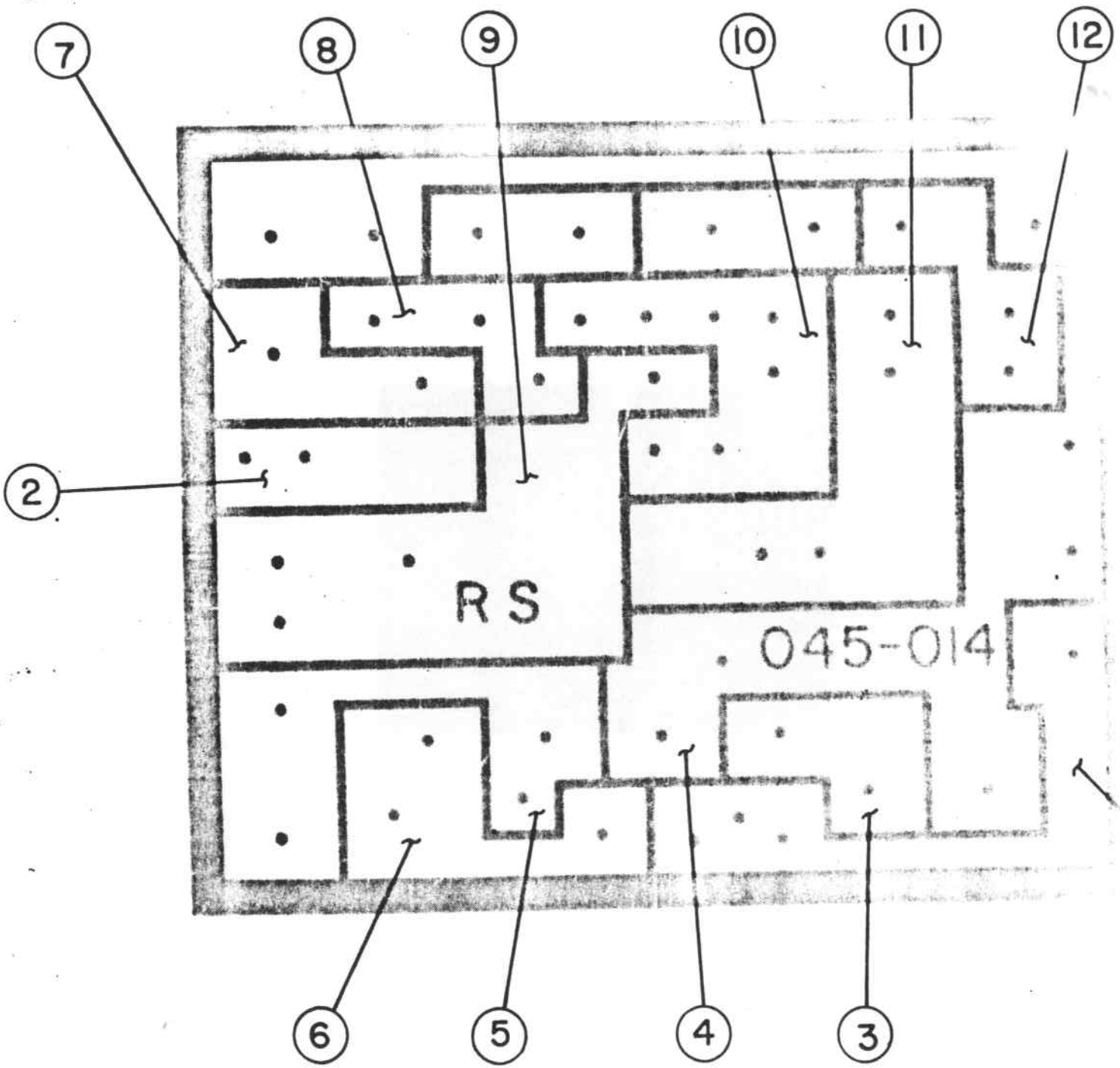
DRAWN R.E.N.	SCALE	REVISIONS	DATE
CHECKED D.B.M.			
APPROVED			
DATE 12-3-73			

TITLE 1974 IC SERVO AMP.

NO 700


1.5" VIOLET TO MOTOR
GREEN FROM PLUG
RED DOWN
R-307 39K
C-302 + 1.5uf
R-308 91
R-306 91
R-305 39 K
C-304 .0075 uf
1.5 uf + C-303
RED DOWN
1.5" GREEN TO POT
R-304 470
RED END
SN28604 IC
D-301 IN4148
C-306 1.5uf
1.5" WHITE TO MOTOR
390
R-301
C-305 33uf RED THIS END
C-301 33uf RED THIS END
39 K R-309
R-302 7.5
C-308 + .47uf
RED DOV
1.5" YELLOW TO POT
RED FROM PLUG
YELLOW FROM PLUG
1.5" ORANGE TO POT

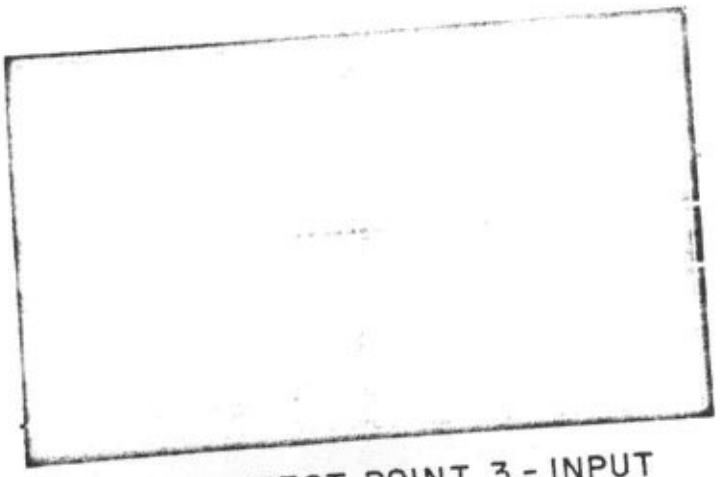
I.C. SERVO AMP.



I.C. SERVO AMP.

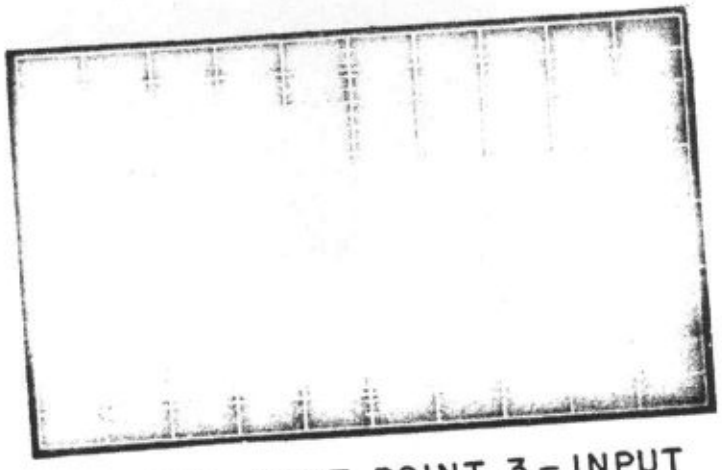
TROUBLE SHOOTING CHART

SYMPTOM	PROBABLE CAUSE
Servo completely inoperative (not hard over against mechanical stops)	1. No dc voltage or input signal. Check connector, cable, motor wires, etc. 2. Gear train locked up due to gear damage, foreign material, etc. 3. Defective IC. 4. Open or shorted motor. 5. C-305 shorted.
Servo runs hard over against mechanical stops upon application of supply voltage and proper input signal.	1. Pot wiper not in contact with feedback element. 2. Broken wire to feedback element. 3. No voltage to reference generator. R-301 open or C-301 shorted. 4. Reference generator inoperative. R-302, R-303, R-304, or C-308 defective. 5. C-302 or C-303 shorted. 6. R-305 or R-307 open. 7. Defective IC. 8. C-306 or D-301 shorted.
Servo responds normally to input signal in one direction only.	1. R-307, R-308 or C-302 defective. 2. R-305, R-306 or C-303 defective. 3. Defective IC.
Servo overshoots at both extremes and when returning to neutral.	1. Broken damping resistor - R-309.
Servo does not follow control stick. Erratic in one or more output arm positions.	1. Dirty or defective feedback pot. 2. Insufficient wiper tension. 3. Defective gear train.
IC-301 heats up upon application of power but operates normally for a short time.	1. Defective IC.
Servo has no deadband.	1. Defective deadband capacitor C-304.
Servo operates in both directions but runs slow.	1. Defective motor. 2. Binding or dirty gear train.
Servo causes interference to receiver.	1. Defective D-301 or C-306. 2. Defective motor.



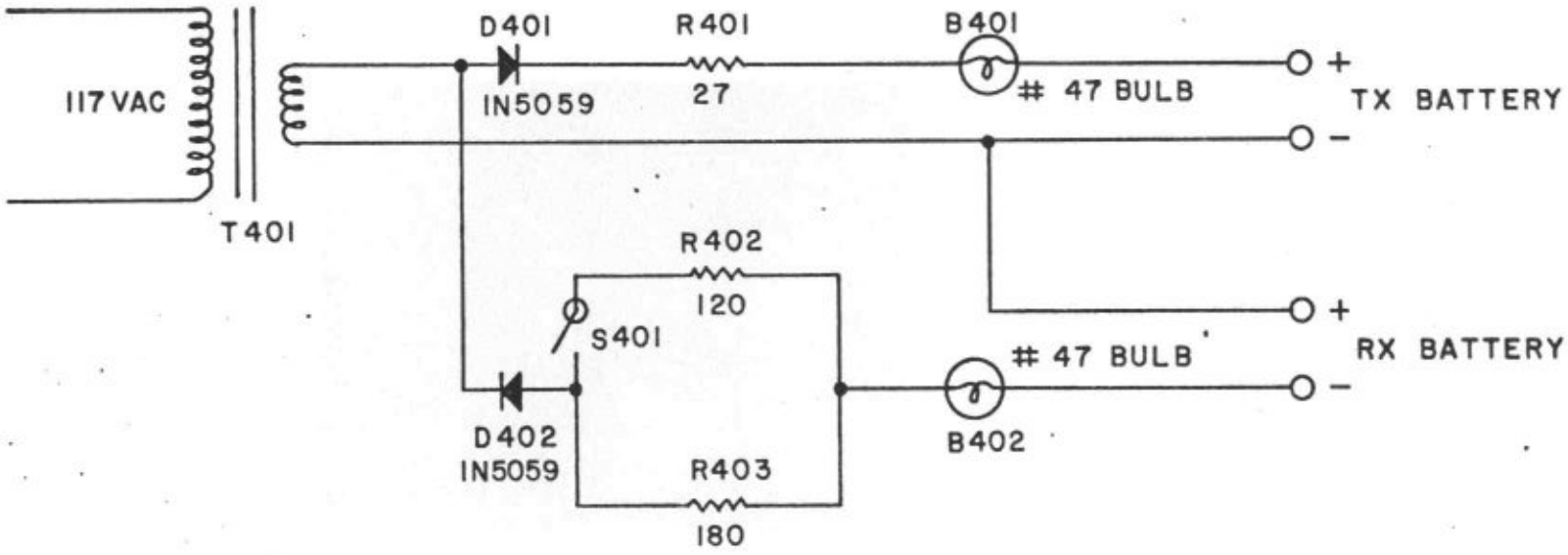
TOP - TEST POINT 3 - INPUT
VERT. - 2 V. / CM.
HORZ. - 0.5 MSEC. / CM.

BOTTOM - TEST POINT 5
VERT. 1 V. / CM.
HORZ. - 0.5 MSEC. / CM.



TOP - TEST POINT 3 - INPUT
VERT. - 2V. / CM
HORZ. - 0.5 MSEC. / CM

BOTTOM - TEST POINT 6
VERT. - 1V. / CM.
HORZ. - 0.5 MSEC. / CM.



NOTE: SWITCH S401 USED ONLY WHEN CHARGER IS MODIFIED FOR CHARGING 225 MAH BATTERY

RS SYSTEMS

DRAWN R.E.N.	SCALE	REVISIONS	DATE
CHECKED D.B.M.			
APPROVED			
DATE 12-3-73			

TITLE: 1974 EXTERNAL CHARGER

NO. 400

CHARGER TROUBLE SHOOTING CHART

SYMPTOM	PROBABLE CAUSE
One or more lights inopperative when properly hooked up.	1. D401, D402 open 2. R401, R402, R403 broken 3. B401 or B402 open 4. T401 open 5. Wire broken
Batteries dead when charged	1. D401 or D402 shorted

TECHNICAL

Receiver: See drawing #500

Transmitted information is acquired by the receiver antenna which is connected to the top of L-502. This combination is resonated by C-501 and the tuning slug. Note L-501, L-502, and L-503 are wound on the same form. L-501 is not used on any frequency and C-501 is omitted for 72MHZ band receivers. Coupling is accomplished by winding L-503 and L-504. (Windings L-504, L-505, and L-506 are on same form. Both coils are identical.) L-505 is resonated by C-502 and the tuning slug to the transmitters frequency. L-506 couples energy to mixer transistor Q-502. R-503 provides base bias for Q-502. C-509 bypasses the "cold" end of L-506 to RF ground. Emitter resistor R-504 is bypassed to ground by C-510 and C-511. C-511 also serves to couple injection voltage from the local oscillator to the emitter of mixer Q-502. C-510 also bypasses oscillator decoupling resistor R-501. Transistor Q-501, the local oscillator, operates at one-half the desired output frequency. Frequency of oscillation is controlled by L-507, the third overtone crystal and capacitor C-503. Base bias is provided by R-502.

The difference frequency of 455 KHZ appears at the collector of mixer transistor Q-502 and coupled through the first IF transformer, T-501, to the base of IF amplifier Q-503. Amplified IF is passed through the second IF transformer, T-503 to the base of IF amplifier Q-504. The output of Q-504 is passed through T-503 to the base of Q-505 which serves as a Class B second detector. All IF transformers are resonated by external capacitors C-504, C-505, andC-506 respectively. Base bias for Q-505 is set

by D-501 and R-507. Demodulated IF appears at the collector of Q-505 and filtered by C-513. AGC voltage is taken from the collector of Q-505. AGC resistor R-508 and emitter resistors R-505 and R-506 serve to set the operating points of Q-503 and Q-504. C-512 is the AGC filter capacitor.

C-507, C-508, and C-509 are decoupled receiver voltage filter and bypass capacitors while C-514 is undecoupled power supply filter. Resistor R-509 is used to decouple the receiver from the power supply. Emitter resistors R-505 and R-506 are used to set receiver sensitivity and will range between 120 OHMS and 330 OHMS.

RECEIVER ALIGNMENT & TESTING

For this procedure a D.C. scope is preferred and should be set at 0.5 volts per CM. Both the positive and negative leads must be isolated by at least 10 MH inductors as close to the scope clips as possible. The output of the receiver can be seen at the black wire in the power plug. The ground of the scope is hooked to the green wire of the power plug. With both the transmitter and receiver turned on and with a good signal from the transmitter a waveform similar to test point 15 should be observed. At this point the signal from the transmitter should be attenuated so that the I.F. strip comes out of saturation. Tune I.F. transformers T-501, T-502, and T-503 to obtain maximum detected signal, again making sure transmitter is attenuated enough to prevent saturation of I.F. strip. It is also best to suspend the receiver antenna vertically from a closepin which is suspended from the ceiling by a string.

The next step is to tune the mixer and antenna coils. This has to be done with all servos plugged into receiver. Tune both coils for maximum detected signal.

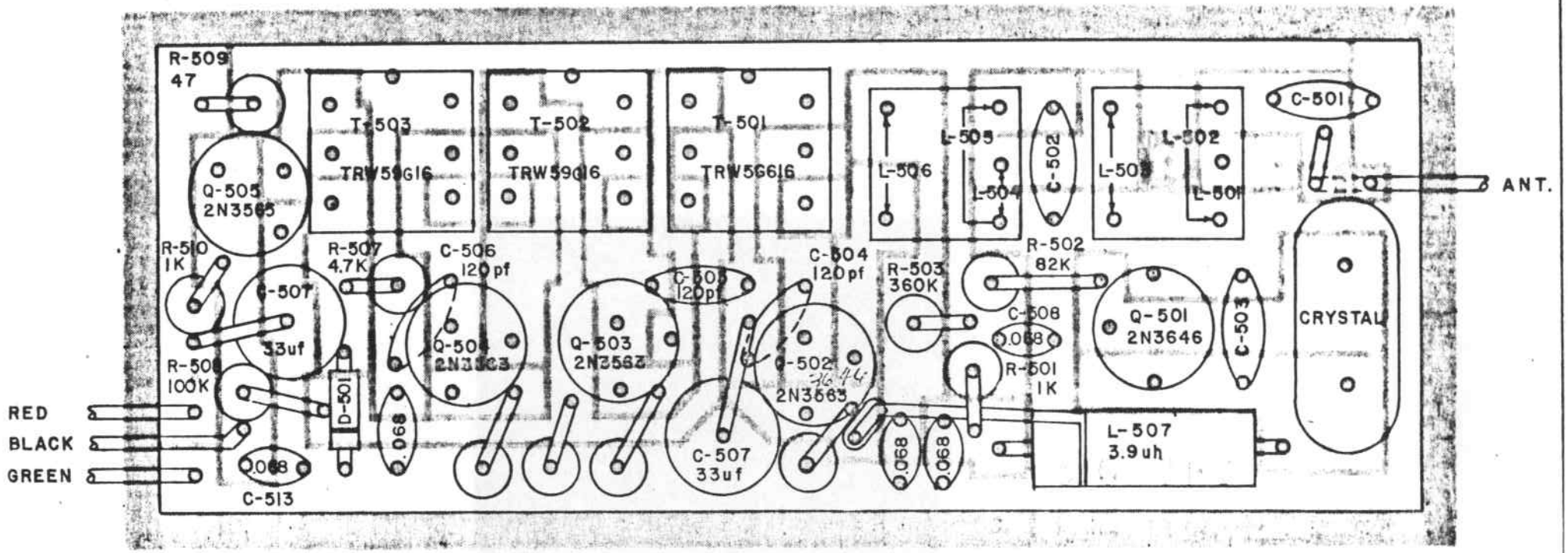
If a calibrated signal generator is available such as the H.P. 608, loop coupling with a one turn loop into the receiver antenna will allow the technician to check sensitivity prior to final tuning. Coil up the receiver antenna and adjust the signal generator for 100% modulation at 400 HZ with the output level at +4db (set level). Use a single turn loop off the end of the signal generator cable to couple around the receiver antenna coil. Peak the antenna and the mixer coils for maximum detected output. Reduce the generator output until 0.5 V is detected.

The signal generator should read between 2.5 and 3.5 microvolts. Resistors R-505 and R-506 should be adjusted to obtain this sensitivity. At no time should a receiver be allowed to operate under 2.0 microvolts.

Emitter resistors R-505 and R-506 should range between 120 OHMS and 330 OHMS. If they fall outside this range a low gain mixer or I.F. transistor should be suspect.

After the receiver is set for the proper sensitivity level at full supply voltage, one cell out operation should not be checked. Sensitivity should not fall above 8 microvolts.

After sensitivity and voltage measurement have been made, uncoil the receiver antenna and retune the receiver as explained above.



C-515

R-506
270 ohm

C-512
4.7uf

R-505
270 ohm

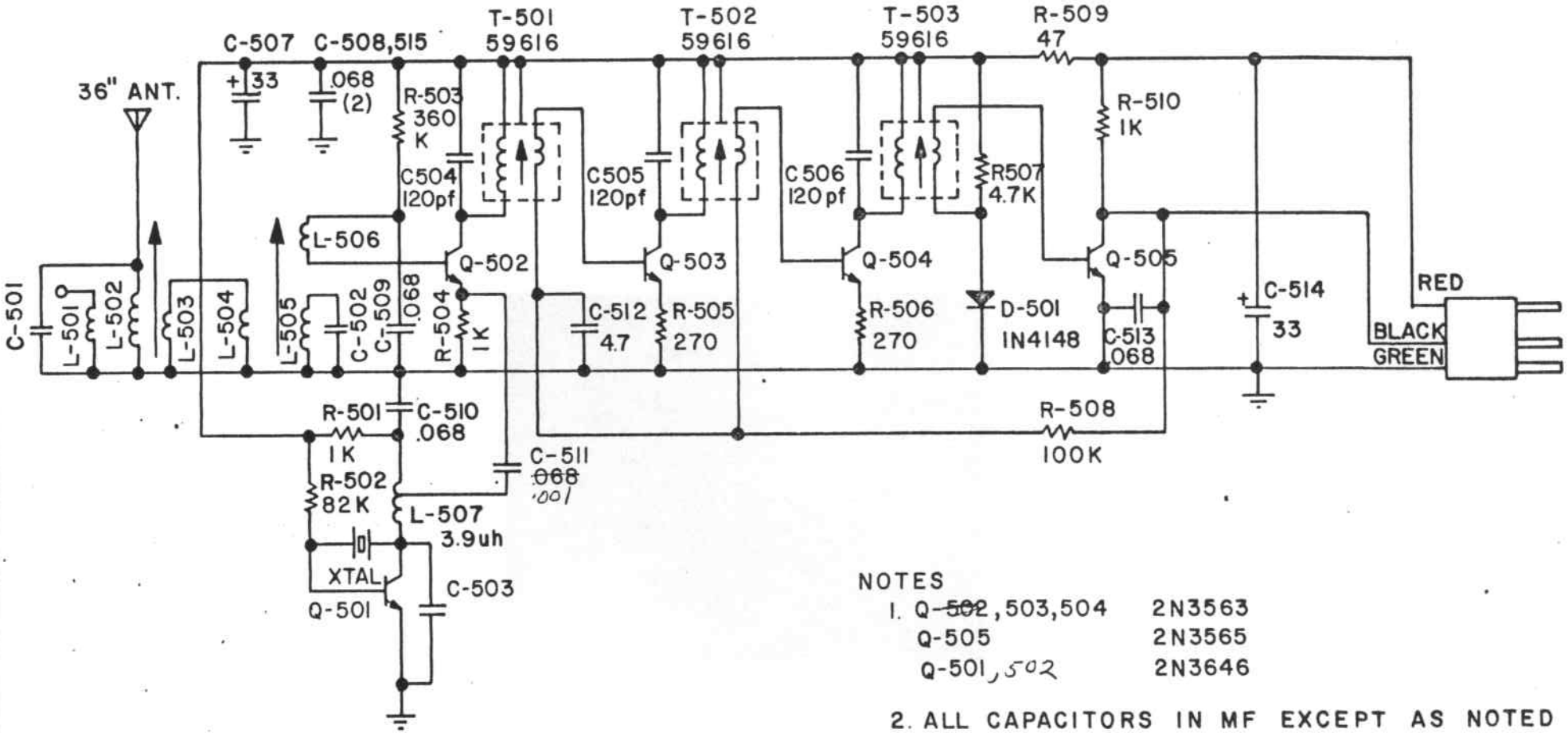
R-504
1K

C-511
~~.068uf~~
.0014f
C-509

C-510

	27MHZ	53MHZ	72MHZ
C-501	~~150pf~~ 33	56pf	NONE
C-502	~~240pf~~ 53	68 pf	33 pf
C-503	120pf	56 pf	33 pf

RECEIVER



NOTES

1. Q-~~502~~,503,504 2N3563
   Q-505 2N3565
   Q-501,502 2N3646

2. ALL CAPACITORS IN MF EXCEPT AS NOTED

	27 MHZ	6 METERS	72 MHZ
L-501	4 1/8 T	1 1/8 T	1 1/8 T
L-502	12 ~~4~~ 1/2 T	4 1/2 T	4 1/2 T
L-503	4 3/4 T	1 3/4 T	1 3/4 T
L-504	4 1/8 T	1 1/8 T	1 1/8 T
L-505	12 ~~4~~ 1/2 T	4 1/2 T	4 1/2 T
L-506	4 3/4 T	1 3/4 T	1 3/4 T
C-501	33 ~~150~~ pf	56 pf	NONE
C-502	33 ~~240~~ pf	68 pf	33 pf
C-503	120 pf	56 pf	10 pf

RS SYSTEMS

DRAWN R.E.N.	SCALE	REVISIONS	DATE
CHECKED D.B.M.			
APPROVED			
DATE 11-17-73			

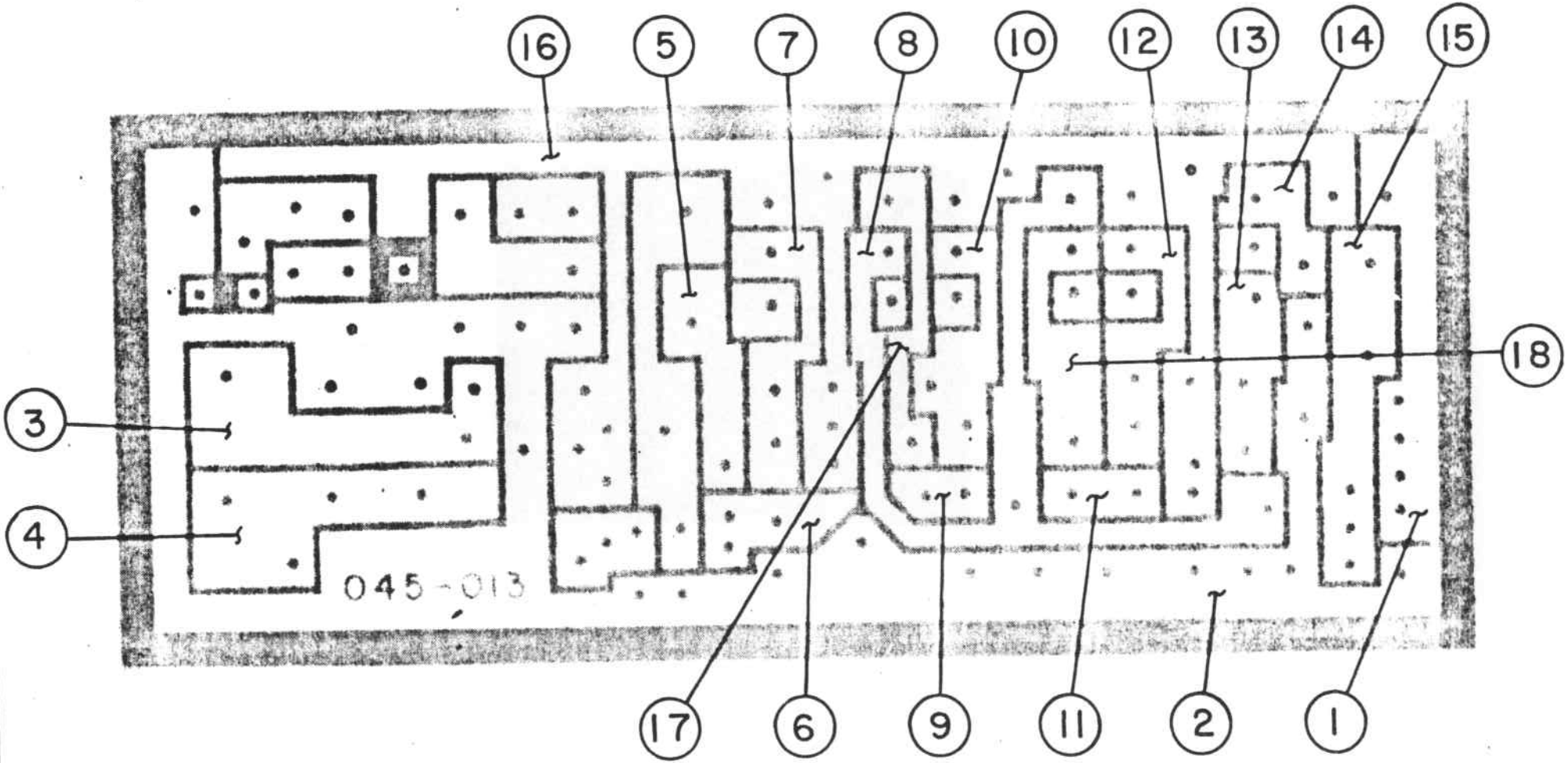
TITLE: 1974 RECEIVER

NO. 500

RECEIVER WAVEFORM AND VOLTAGE CHART - See Drawing # 502

NOTE: All measurements made with oscilloscope or meter referenced to negative 4.8 VDC (TP 2) and receiver and transmitter on. (Signal from transmitter must be attenuated sufficiently to prevent receiver from going into its AGC. range.)

1. Decoupled positive
2. Minus 4.8 VDC
3. Base of transistor Q-501
4. Collector of transistor Q-501
5. Base of transistor Q-502
6. Emitter of transistor Q-502
7. Collector of transistor Q-502
8. AGC Line
9. Emitter of transistor Q-503
10. Collector of transistor Q-503
11. Emitter of transistor Q-504
12. Collector of transistor Q-504
13. Anode of diode D-501
14. Base of transistor Q-505
15. Collector of transistor Q-505
16. Second decoupled positive
17. Base of transistor Q-503
18. Base of transistor Q-504

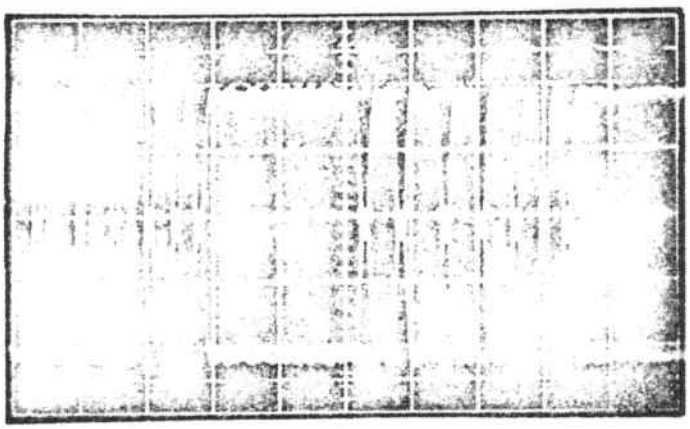


RECEIVER

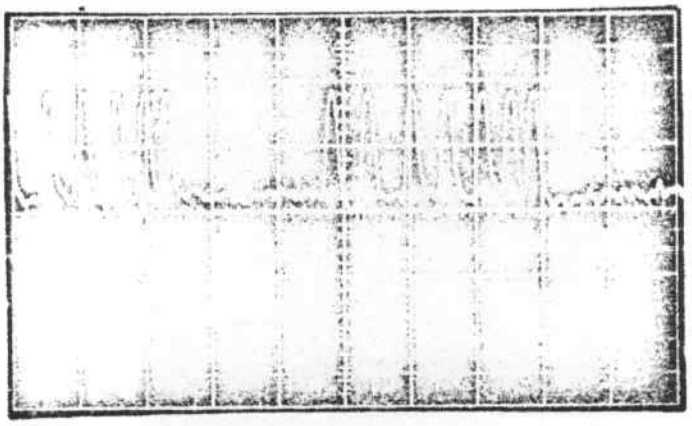
RECEIVER TROUBLE SHOOTING CHART

SYMPTOM	PROBABLE CAUSE
1. No output	1. No oscillator. See Symptom 2 2. No mixer. See Symptom 3 3. No first I.F. amplifier. See symptom 4 4. No second I.F. amplifier. See symptom 5 5. No second detector. See symptom 6
2. No oscillator	1. Check for correct D.C. Voltage at T.P. 4. If no voltage here and correct voltage at T.P. 16 than look for open L-507. 2. If T.P. 4 is correct and voltage at T.P. 3 is the same as T.P. 4 than the base emitter junction of Q-501 is open - replace Q-501 3. If the voltage at T.P. 3 is higher than indicated replace crystal 4. If oscillator still is not functioning replace C-503
3. No mixer	1. Check for correct collector voltage for transistor Q-502 at T.P. 4. If voltage is zero here replace open I.F. transformer T-501 2. Check for correct base voltage of Q-502 at T.P. 5. If zero, check for open R-503 or L-506 or shorted C-509 3. Check for correct voltage at T.P.6. If no voltage here look for defective Q-502 or R-504
4. No first I.F. amplifier	1. Check for correct D.C. voltage at T.P. 10. If no voltage here replace open I.F. transformer T-502 2. Check for correct base voltage of Q-503 at T.P. 17. If no voltage here check for open secondary of I.F. transformer T-501, or defective AGC voltage. If AGC voltage at T.P. 8 is zero check for open R-508, shorted C-512, shorted C-513 or shorted detector transistor Q-505 3. Check for correct D.C. voltage at T.P. 9. If

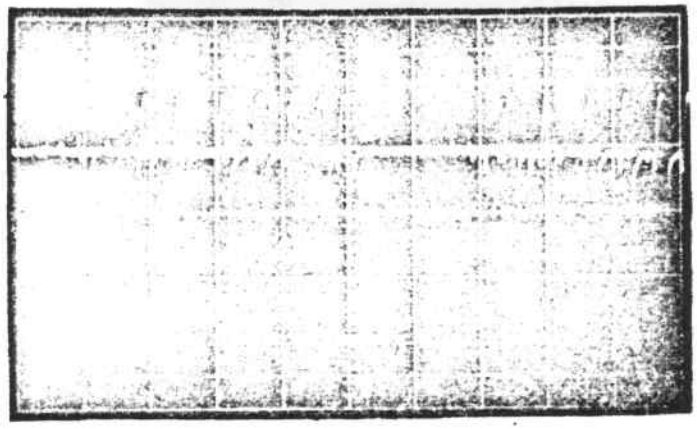
	no voltage here look for defective R-505 or Q-503
5. No second I.F. amplifier	1. Check for correct D.C. voltage at T.P. 12. If no voltage here replace open I.F. transformer T-503 2. Check for correct base voltage of Q-504 at T.P. 18. If no voltage here check for open secondary of I.F. transformer T-502, or defective AGC voltage (See above for AGC problem) 3. Check for correct D.C. voltage at T.P. 11. If no voltage here look for defective R-506 or Q-504
6. No second detector	1. Check for correct D.C. voltage at T.P.13. If no voltage here check for open R-507 or shorted D-501. If voltage is high D-501 is open 2. Check for correct D.C. voltage at T.P. 14. If no voltage here and voltage at T.P. 13 is correct than the secondary of I.F. transformer T-503 is open - replace 3. If there is a detected signal at test point 15 and no output from a known working decoder replace either Q-505 and/or D-501. This phenomenon is caused by transistor Q-505 not turning off completely



TEST POINT 14
VERT. - .05V / CM
455 KHZ I.F. SIGNAL



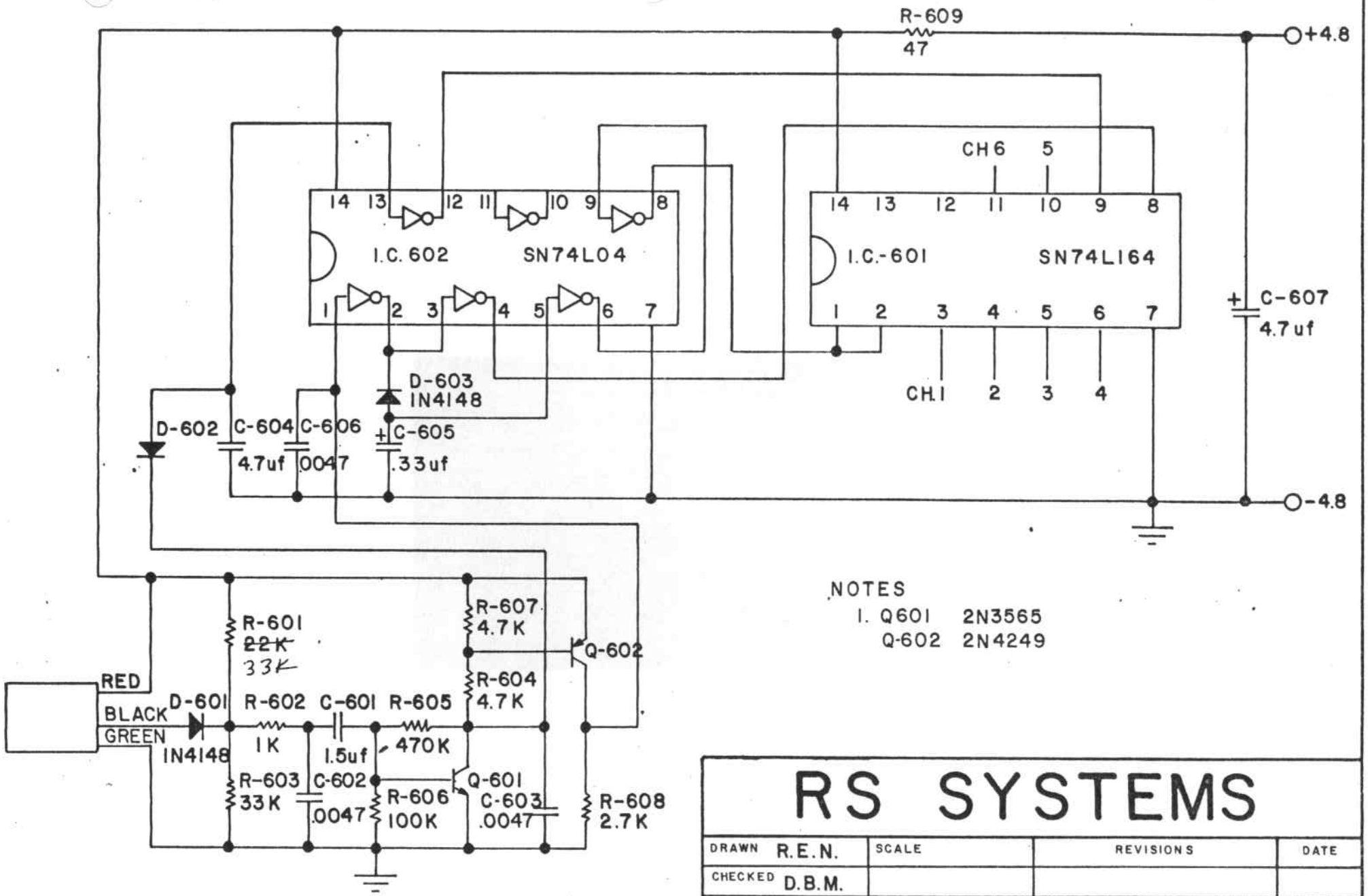
TEST POINT 15
VERT. - .5V / CM
I.F. STRIP PROPERLY TUNED



TEST POINT 15
VERT. - .5V / CM.
I.F. STRIP OUT OF TUNE

Decoder - See Drawing #600

Demodulated information from the receiver is processed by series clipper diode D-601. Clipping level is set by bias resistors R-601 and R-603. R-602 and C-602 serve as a shunt integrator. C-601 couples information to the base of Q-601. Q-601 is biased Class A by resistors R-605 and R-606, driving pulse amplifier Q-602 through collector load resistors R-604 and R-607. Q-601 also drives D-602 and C-604 which rectify and filter the negative pulses appearing at its collector. This voltage is properly phased by IC-601 and applied to shift register IC-602. This information clears the shift register after the transmitter is turned off. Positive pulses appearing at the collector of Q-602 drive two inverters in IC-601 which provide clock pulses to IC-602. D-603 and C-606 rectify negative clock pulses. The time constant is such that a sync pulse is formed in the absence of channel information which is used to reset the shift register preparing it to correctly process the next frame of information. R-609 and C-607 form a decoupling network for the complete receiver and decoder.



NOTES

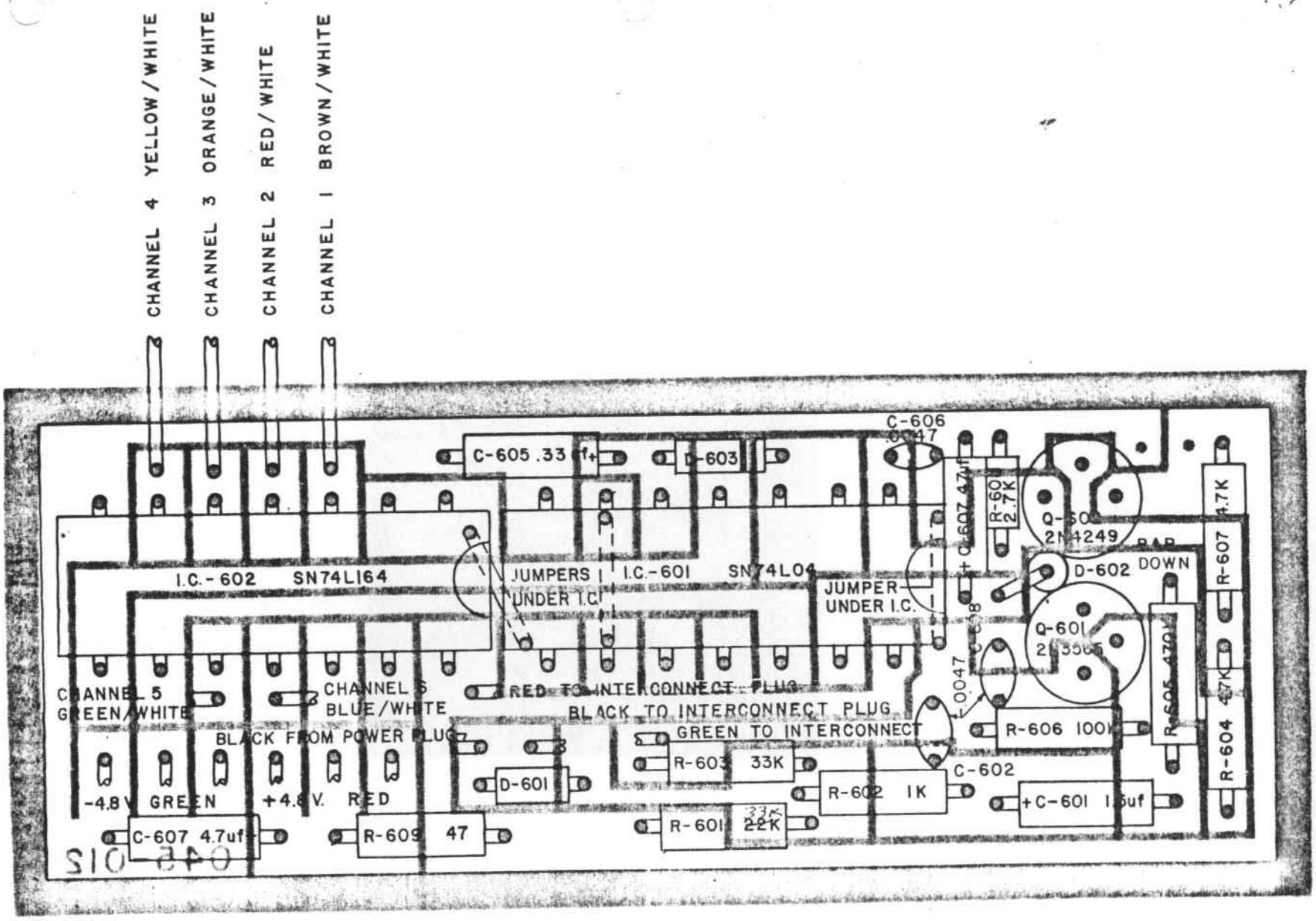
1. Q601 2N3565
   Q-602 2N4249

RS SYSTEMS

DRAWN R.E.N.	SCALE	REVISIONS	DATE
CHECKED D.B.M.			
APPROVED			
DATE 11-17-73			

TITLE: 1974 DECODER

NO. 600

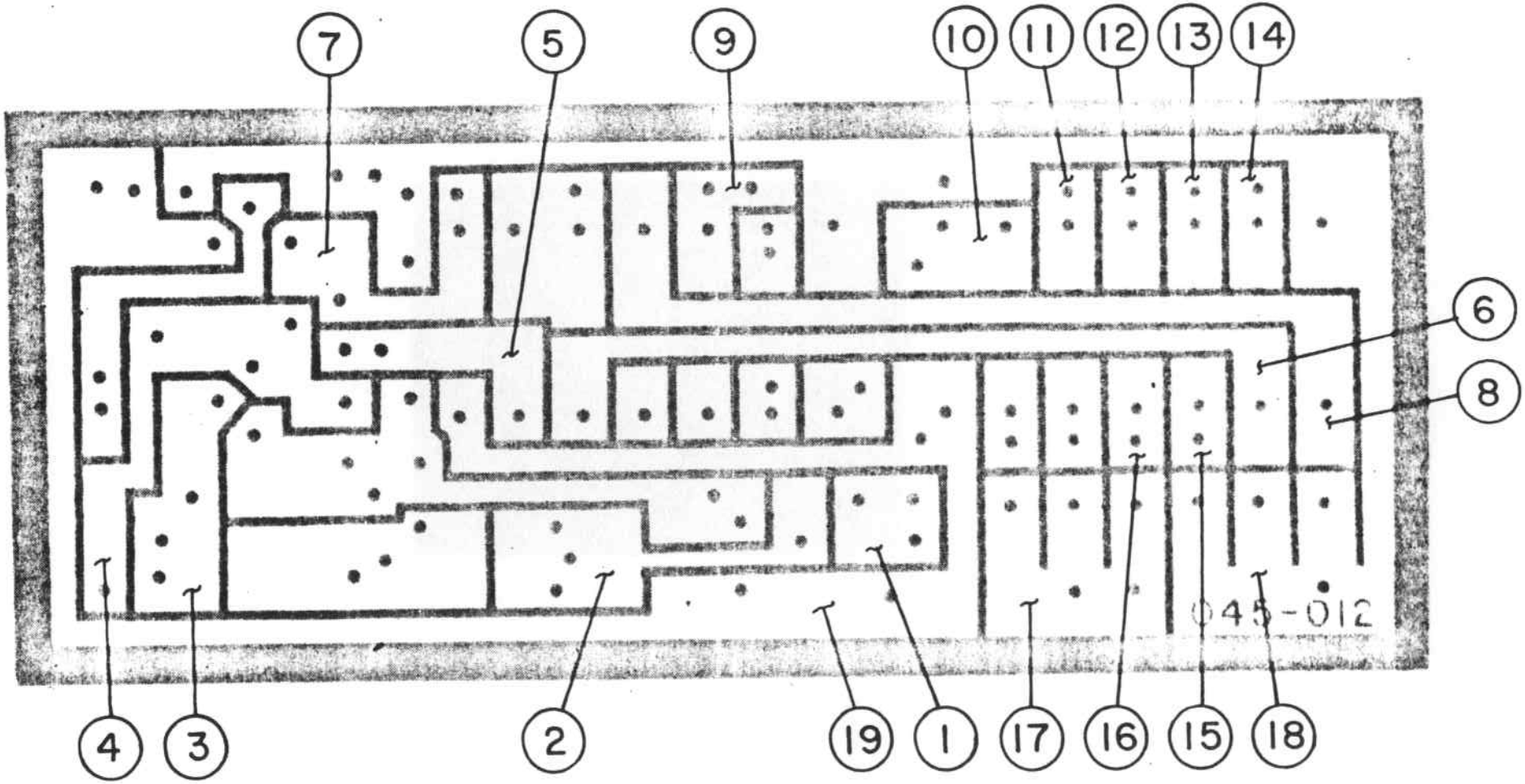

CHANNEL 4 YELLOW/WHITE
CHANNEL 3 ORANGE/WHITE
CHANNEL 2 RED/WHITE
CHANNEL 1 BROWN/WHITE
C-605 .33 uf
D-603
C-606 .0047
C-607 4.7uf
R-605 2.7K
Q-602 2N4249
D-602 DOWN
R-607 4.7K
I.C.-602 SN74L164
JUMPERS UNDER I.C.
I.C.-601 SN74L04
JUMPER UNDER I.C.
Q-601 2N3565
R-605 470
R-604 47K
CHANNEL 5 GREEN/WHITE
CHANNEL 6 BLUE/WHITE
RED TO INTERCONNECT PLUG
BLACK TO INTERCONNECT PLUG
GREEN TO INTERCONNECT
BLACK FROM POWER PLUG
R-606 100K
R-603 33K
D-601
C-602
R-602 1K
+C-601 1.5uf
-4.8V GREEN
+4.8V. RED
C-607 4.7uf
R-609 47
R-601 22K

DECODER

Decoder Waveform & Voltage Chart - See Drawing 602

NOTE: All measurements made with oscilloscope or meter referenced to negative 4.8 VDC (TP 18) and receiver & transmitter on.

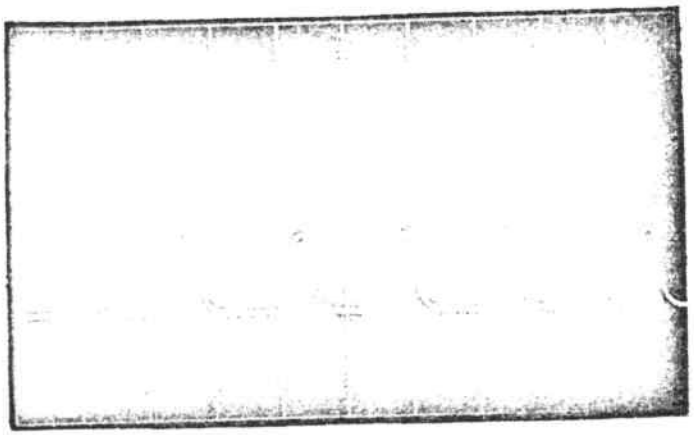
1. Demodulated input
2. Clipped demodulated signal
3. Base of Transistor Q601
4. Collertor of transistor Q601
5. Rectified & filtered clear input signal
6. Clear input to IC 601
7. Collector of transistor Q602
8. Clock input to IC 601
9. Rectified & filtered sync input signal
10. Sync input to IC 601
11. Channel 1 output (rudder)
12. Channel 2 output (throttle)
13. Channel 3 output (elevator)
14. Channel 4 output (aileron)
15. Channel 5 output
16. Channel 6 output
17. +4.8VDC
18. -4.8VDC
19. Decoupled positive



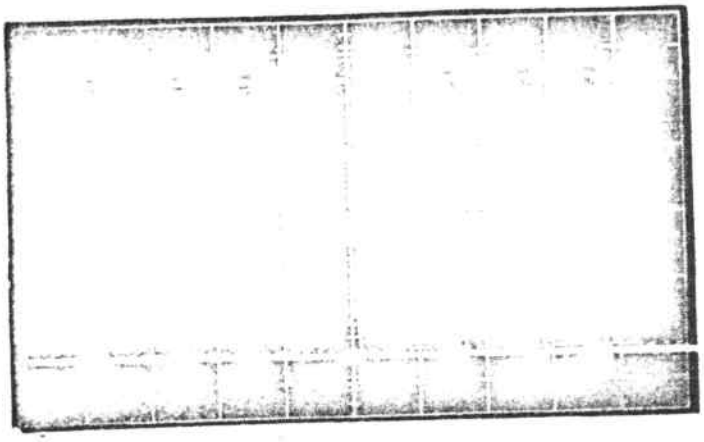
DECODER

DECODER TROUBLE SHOOTING CHART

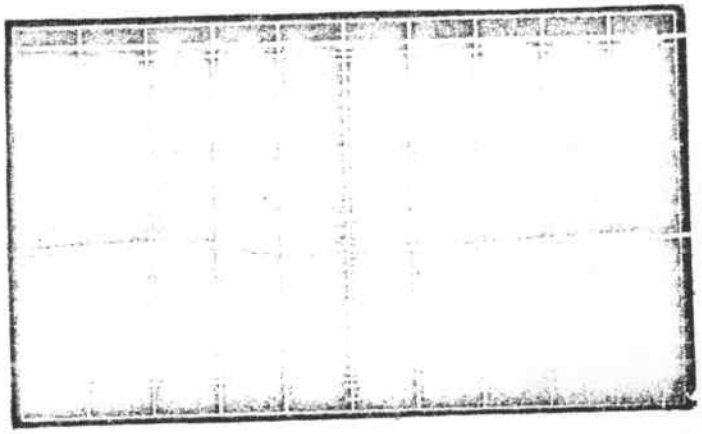
SYMPTOM	PROBABLE CAUSE
No output from one or more channels but output from at least one channel	1. No power to connector. Check connector for proper voltage. 2. Check for broken wires, bad solder joints, etc. 3. Check each output of I.C. replace if necessary.
No output from any channel	1. No D.C. voltage or input signal. 2. Defective or broken R-609 decoupling resistor. 3. No clock input signal to IC 601- defective IC 602. 4. No sync pulse to IC601. Defective IC 602, C-604, or D-602. 5. No output from Q-602. Defective Q-602, R-607, R-604, R-608, or Q-601. 6. No output from Q-601. Defective Q-601,R-605, R-606, C-601, R-602, R-601, R-603, or D-601. 7. Voltage at pin 9 of IC 601 is less than 1.0 volt. Defective D-602, C-604, or IC-602.



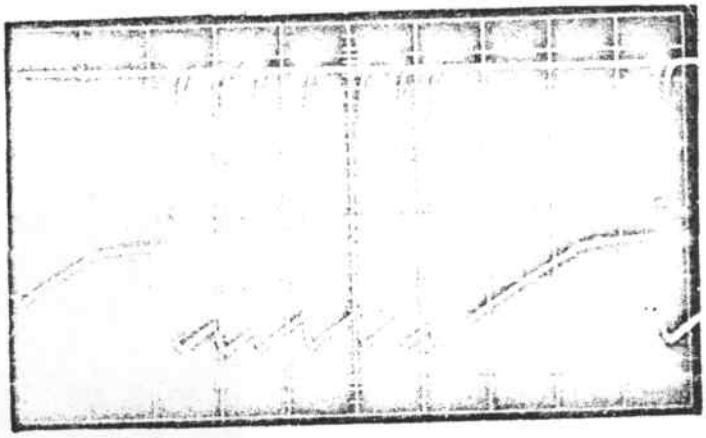
TEST POINT 2
VERT. 0.5 V/CM.
HORZ.- 1MSEC./CM



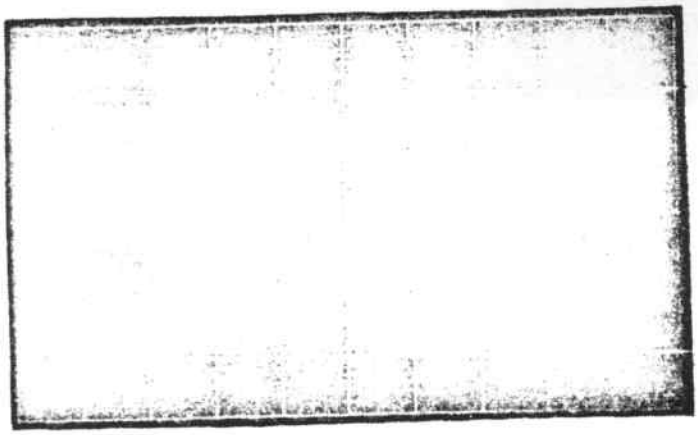
TEST POINT 7
VERT. 1V/CM.
HORZ - 1MSEC./CM.



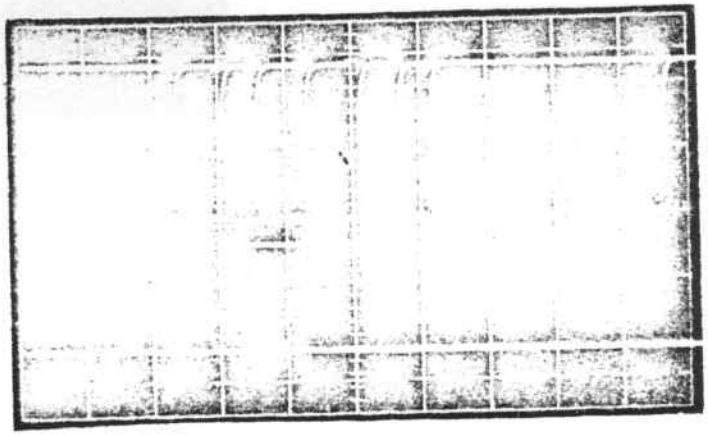
TOP-TEST POINT 4
BOTTOM- TEST POINT 6
VERT.-2V/CM TOP, 0.5V./CM BOTTOM
HORZ. 2 MSEC./ CM.



TOP- TEST POINT 4
BOTTOM- TEST POINT 9
VERT.- 2V/CM TOP, 0.5V/CM BOTTOM
HORZ. 2 MSEC./CM.



TOP-TEST POINT 4
BOTTOM-TEST POINT 10
VERT. - 2V./ CM.
HORZ.-2MSEC./ CM.



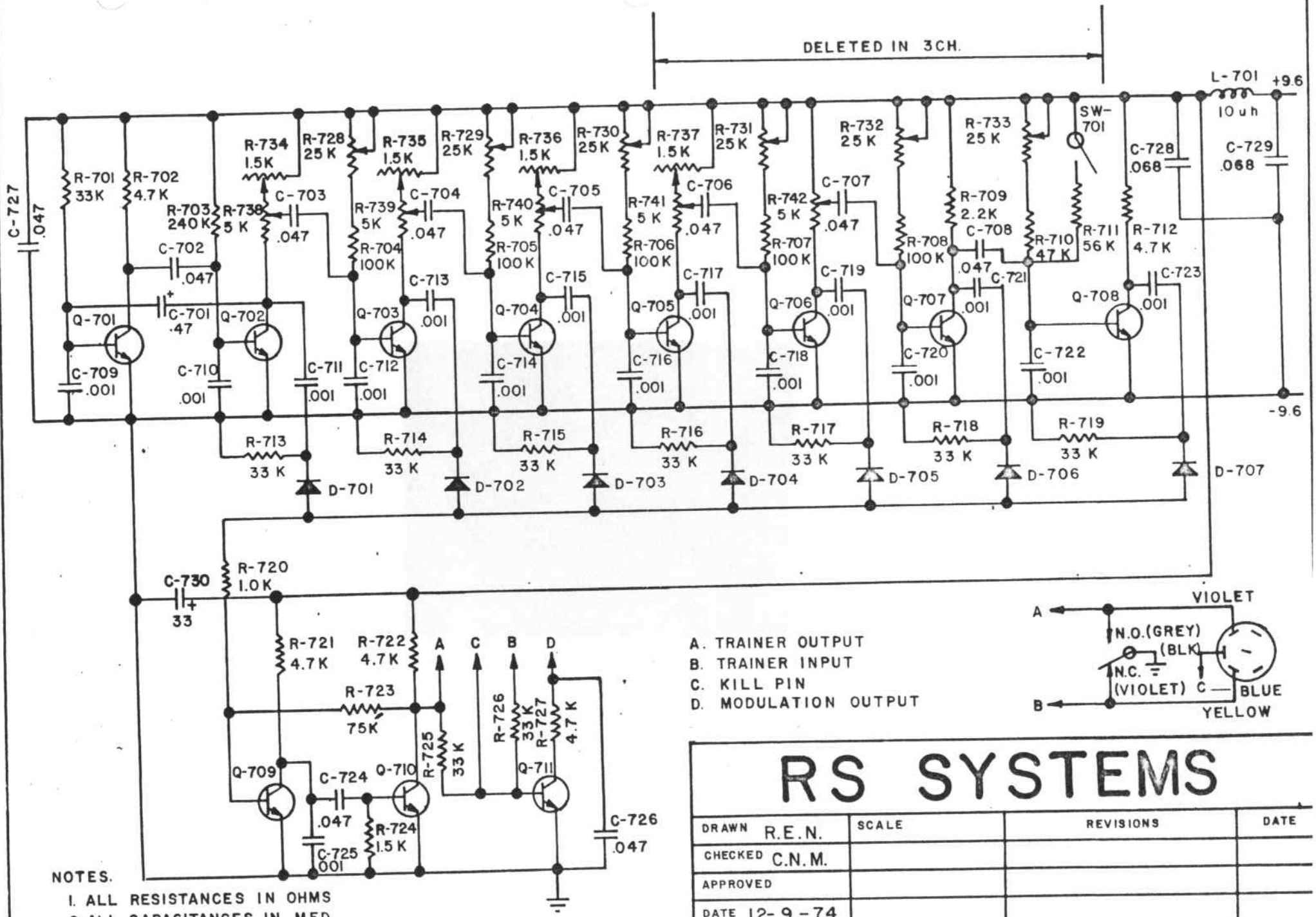
TOP-TEST POINT 4
BOTTOM-TEST POINT 13
VERT.- 2V./ CM.
HORZ.-2 MSEC./ CM.

ENCODER, DESCRETE VERSION: SEE DRAWING #700

Q-701 and Q-702 form an astable multivibrator in conjunction with timing capacitors C-701, C-702 and timing resistors R-701, R-703. Resistor R-702 is the collector load for Q-701 and Rudder control pot R-738 and Rudder trim Pot R-734 forms the collector load for Q-702. This multivibrator sets the frame rate of the transmitter and is followed by a string of half shot monostables. Only one of the proportional channels need be explained as all are alike. Pot R-738 and trim pot R-734 feed a negative voltage to timing capacitor C-703. This voltage is differentiated by C-703 and appears as a negative voltage spike at the base of Q-703, turning it off. Capacitor C-703 is then recharged thru timing resistors R-704 and trim pot R-728. Since both the resistance and the capacitance are fixed values the width of the channel is directly proportional to the amount of voltage appearing at C-703, the stick control pot, R-738, and the trim control pot, R-734. Trim pot R-728 varies the RC time constant and thus affects the amount of channel travel by changing the recharge slope. The larger the base timing resistance the shallower the slope and the more travel will be obtained from the channel with a given amount of voltage swing from the stick pot. As each stage saturates, it generates a negative pulse triggering the following stage, the only stage which is different is the non-proportional switched channel. This is accomplished by shunting the base timing resistor R-709 and trim pot R-733 with resistor R-711 with switch Sw-701. Each bit of channel information is processed and put into serial form on a single line to drive the modulator section of the encoder. This is accomplished by differentiating the collector waveform thru capacitors C-711 thru C-723. Resistors R-713 thru R-719 bias diodes D-701 thru D-707 which pass only negative pulses to the base of Q-709

thru current limiting resistor R-720. Q-709 and Q-710 form a monostable multi-vibrator. Timing is set by R-724 and C-724 at 300 microseconds. In its quiescent state Q-710 is biased off by R-724 and Q-709 is biased on by R-722 and R-723. A negative pulse arriving at the base of Q-709 turns Q-709 off, turning Q-710 on thru capacitor C-724. As C-724 discharges toward ground potential thru R-724, their time constant determines the 300 microsecond time delay of the one shot. The output of Q-710 is feed to the modulation output transistor Q-711 thru resistor R-725. Point A is trainer output. This transfers information from the collector of Q-710 of the slave transmitter to point C of the master transmitter. Point B is the kill pin and is grounded on the slave transmitter when the trainer cord is plugged into the slave transmitter.

Inductor L-701, Capacitors C-727, C-728 and C-729 form a RF decoupling and filter network. Capacitors C-709, 710, 712, 714, 716, 718, 720. 722 and 725 bypass RF from the bases of their respective transistors. Capacitor C-726 bypasses RF on the modulation line. Point D is the modulation output to the base of modulator transistor Q-102 located on the RF board.



A. TRAINER OUTPUT
B. TRAINER INPUT
C. KILL PIN
D. MODULATION OUTPUT

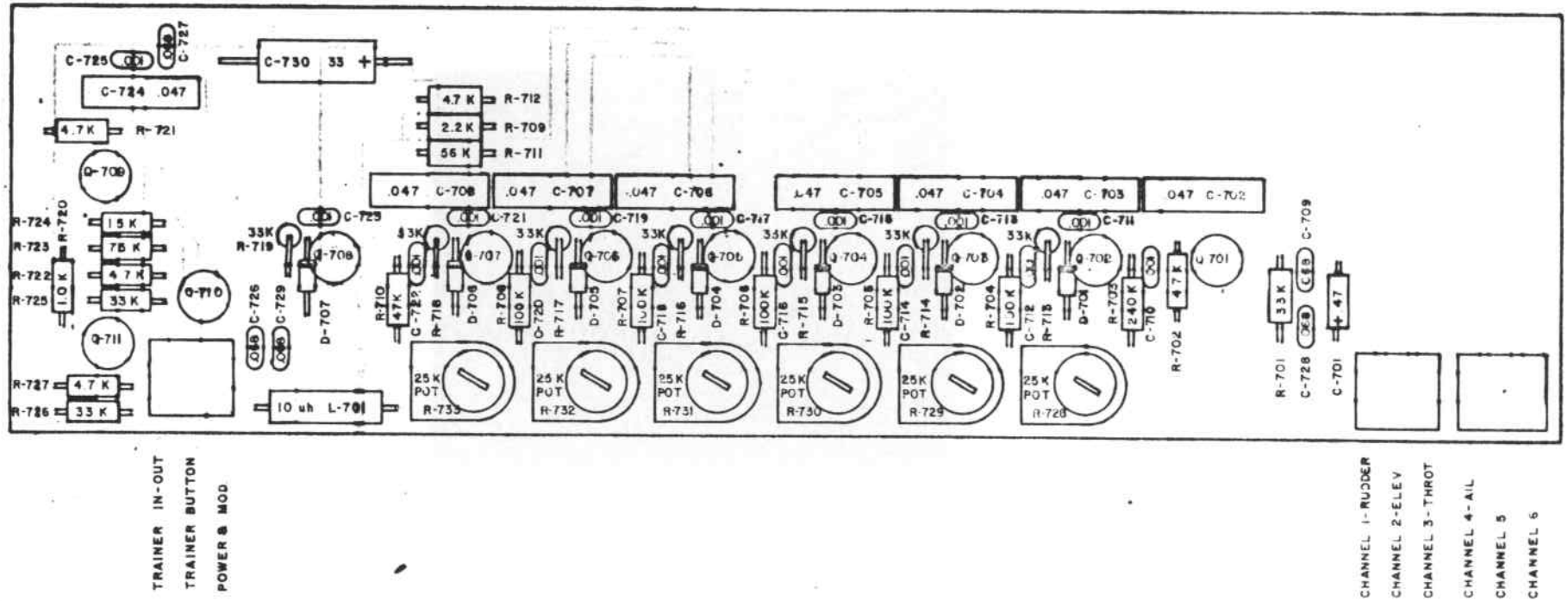
NOTES.
1. ALL RESISTANCES IN OHMS
2. ALL CAPACITANCES IN MFD.
3. C-702 THRU C-708 & C-724 ARE MYLAR
4. Q-701 THRU Q-711 ARE 2N3565
5. D-701 THRU D-707 ARE IN4148

RS SYSTEMS

DRAWN R.E.N.	SCALE	REVISIONS	DATE
CHECKED C.N.M.			
APPROVED			
DATE 12-9-74			

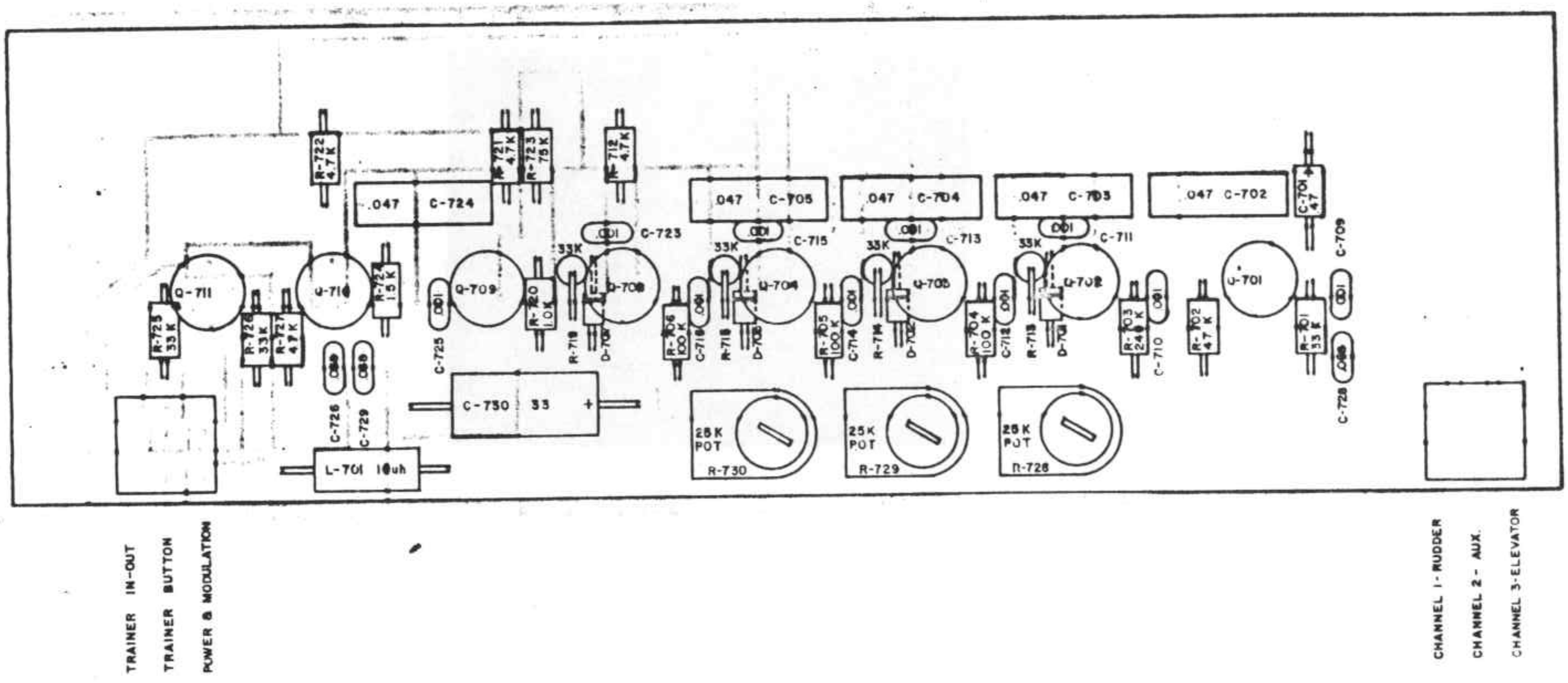
TITLE: DESCRETE ENCODER

NO: 700



5&6 CHANNEL DESCRETE ENCODER

701

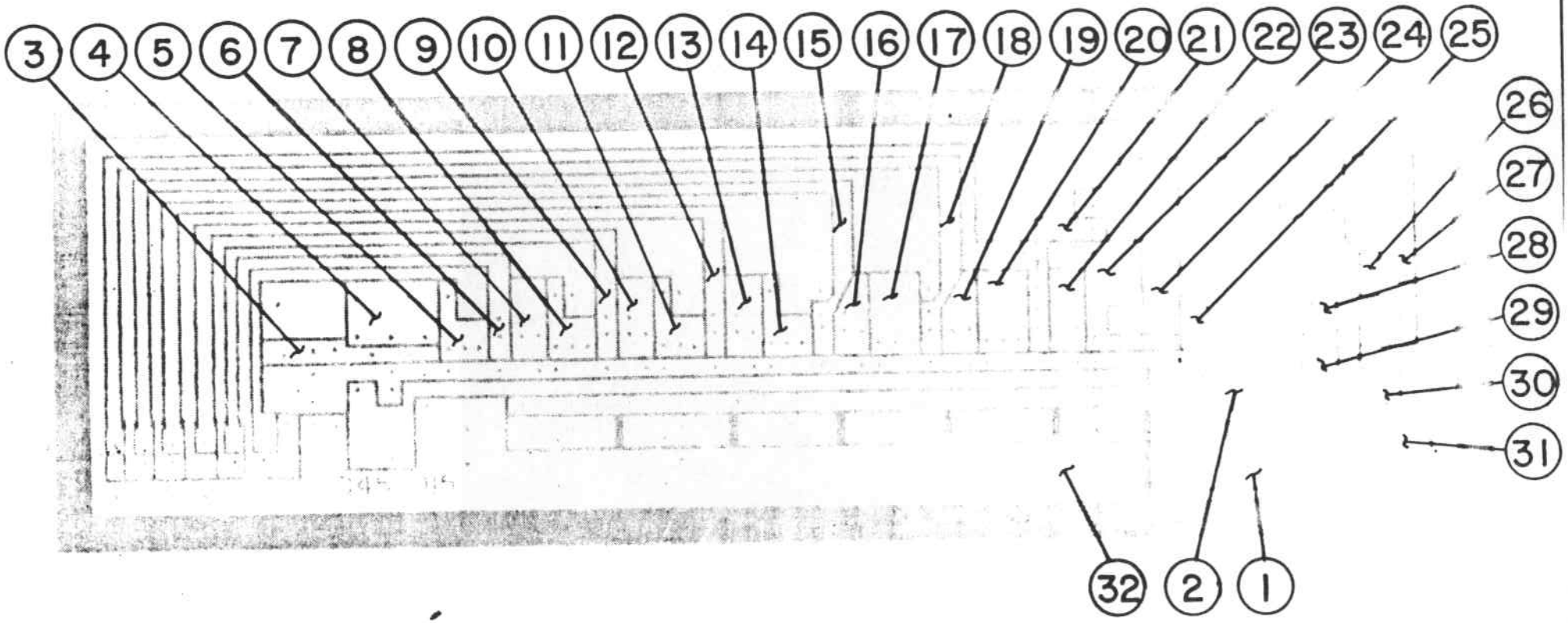


3 CHANNEL DESCRETE ENCODER

Descrete Encoder Waveform & Voltage Chart - See Drawing #703 & #704

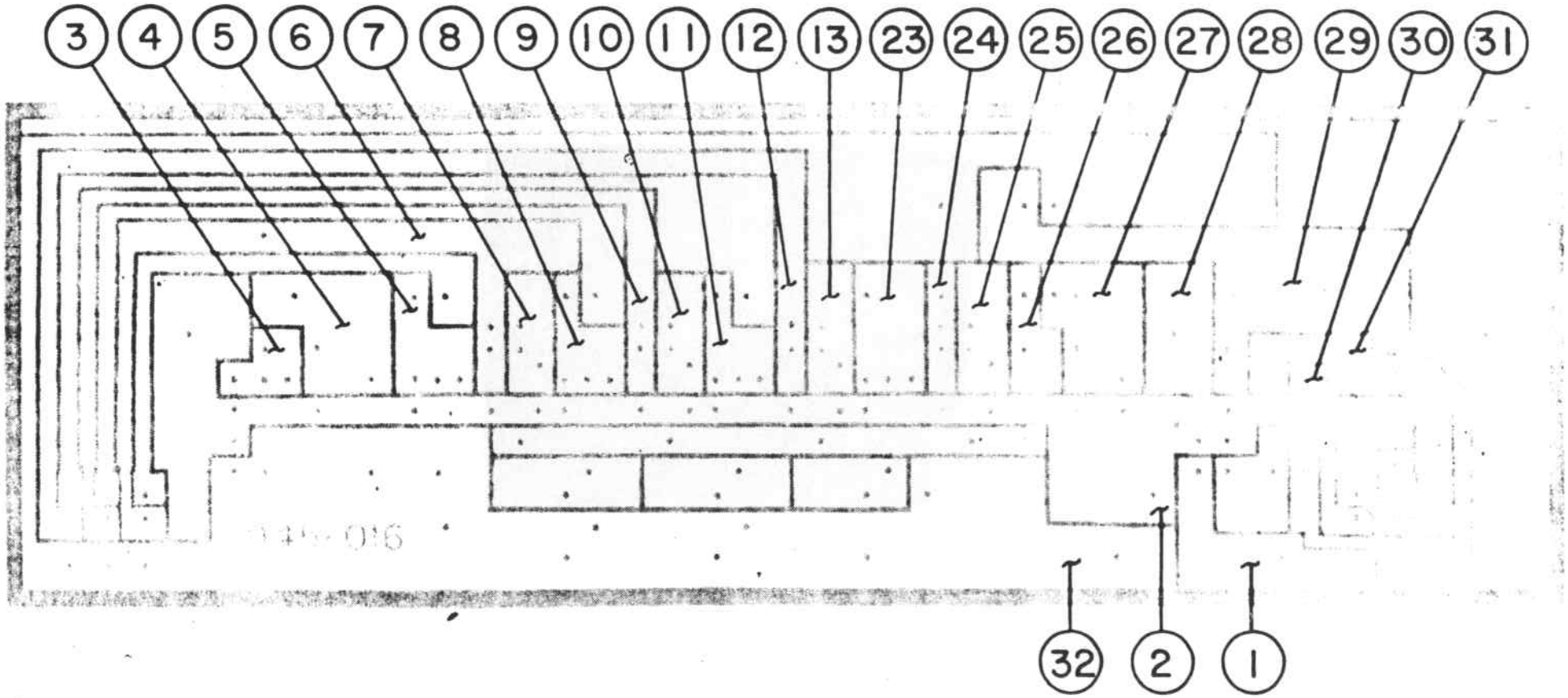
NOTE: All measurements made with oscilloscope or meter referenced to negative 9.6 VDC (TP2) and transmitter on.

1. Positive 9.6 VDC
2. Negative 9.6 VDC
3. Base of Q-701
4. Collector of Q-701
5. Base of Q-702
6. Collector of Q-702
7. Cathode of D-701
8. Base of Q-703
9. Collector of Q-703
10. Cathode of D-702
11. Base of Q-704
12. Collector of Q-704
13. Cathode of D-703
14. Base of Q-705
15. Collector of Q-705
16. Cathode of D-704
17. Base of Q-706
18. Collector of Q-706
19. Cathode of D-705
20. Base of Q-707
21. Collector of Q-707
22. Cathode of D-706
23. Base of Q-708
24. Collector of Q-708
25. Cathode of D-707
26. Base of Q-709
27. Collector of Q-709
28. Base of Q-710
29. Collector of Q-710
30. Base of Q-711
31. Collector of Q-711
32. Decoupled positive 9.6 V.D.C.



5&6 CHANNEL DESCRETE ENCODER

703

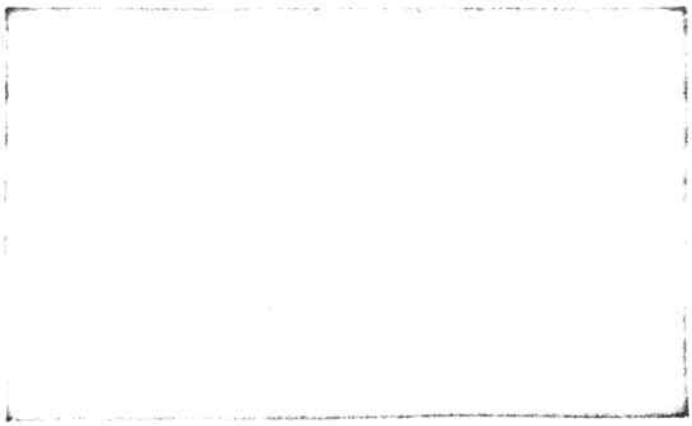


3 CHANNEL DESCRETE ENCODER

DISCRETE ENCODER TROUBLE SHOOTING CHART

SYMPTOM	PROBABLE CAUSE
No output from encoder	1. No supply voltage - check connector, switch or batteries 2. Astable not operating (check test points 3, 4, 5 or 6 for correct waveform.) Defective Q-701, Q-702, R-701, R-702, R-703, open rudder or rudder trim pot. Defective C-701, or C-702 3. Modulator 300 microsec.. One shot not operating. (check test points 26, 27 and 29 for correct waveform) Defective Q-709 or Q-710. Defective R-720, R-721, R-722, R-723 or R-724. Defective C-724 or C-725. 4. Defective modulator. (Check test points 29 and 31 for proper waveform). Defective Q-711, shorted C-726, Defective R-727 or R-725.
One or more channels not operating	1. Locate defective channel by checking test points 9, 12, 15, 18, 21, or 24 for proper waveform. When defective channel is found replace defective transistor, resistor, or capacitor associated with that channel. Normally the problem will be a shorted (or open) transistor or defective control pot (open). 2. If test points 9, 12, 15, 18, 21, or 24 show the correct waveforms and one or more channels are missing from the output of the modulator, than the problem is in the differentiating section of one of the channels. Locate which pulse is missing by monitoring the waveform at test point 26 and moving each control pot. Example: As the elevator stick is moved (No. three channel) no pulse moves at test point 26. Locate and replace defective

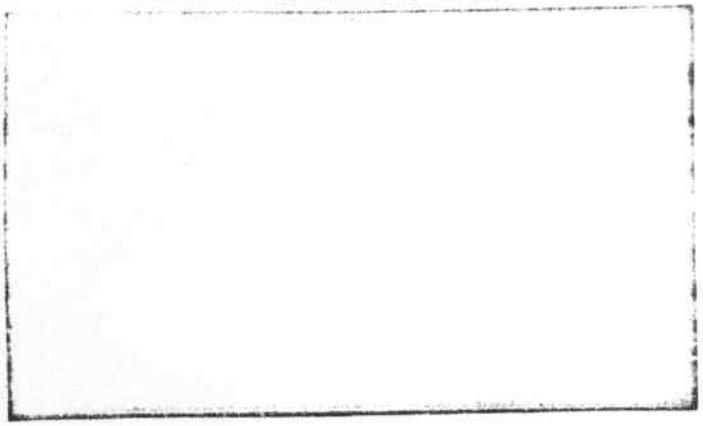
	D-704, C-717, or R-716 associated with the fourth differentiating circuit. Note: The only pulse that will not move when a control pot is moved is the start pulse created by C-711, R-713, and D-701. Therefore, if only six pulses are present in a six channel system and all pulses move at test point 26 then the start pulse circuitry is defective.



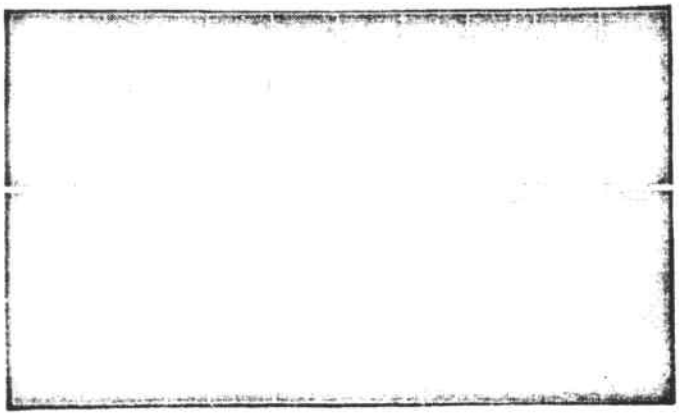
TEST POINT 4
VERT - 2V./CM.
HORZ. - 5 MSEC./CM.

TEST POINT 5
VERT. - 2V./CM.
HORZ. - 5 MSEC./CM.

TEST POINT 6
VERT.-2V./CM.
HORZ.- 5 MSEC./CM.



TEST POINT 9,12,15,18,21,24
VERT. - 2V./CM.
HORZ. - 0.2 MSEC./CM.



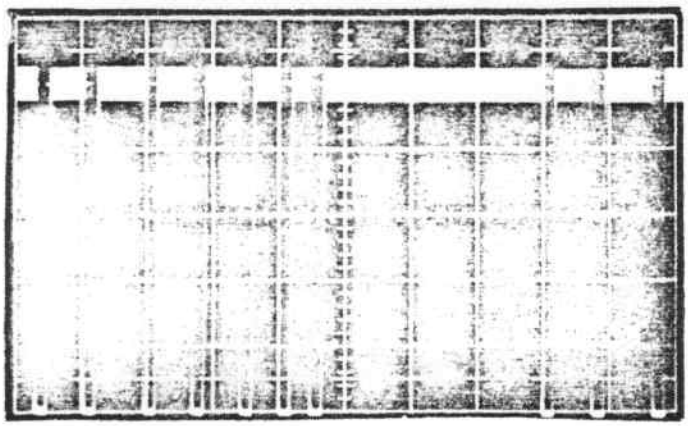
TEST POINT 19
VERT. - 2V./CM.
HORZ. - 1MSEC./CM.

TEST POINT 26
VERT. – 2V./CM.
HORZ. – 1 MSEC./CM.

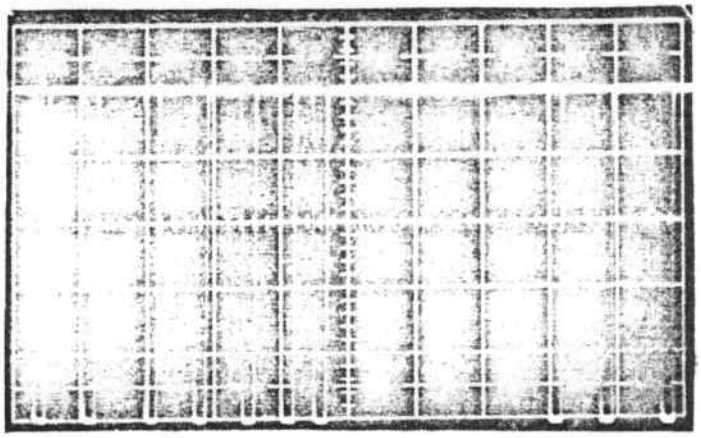
TEST POINT 27
VERT.- 2V./CM.
HORZ.- 1 MSEC./CM.

TEST POINT 29
VERT.- 2V./CM.
HORZ.- 1 MSEC./CM.

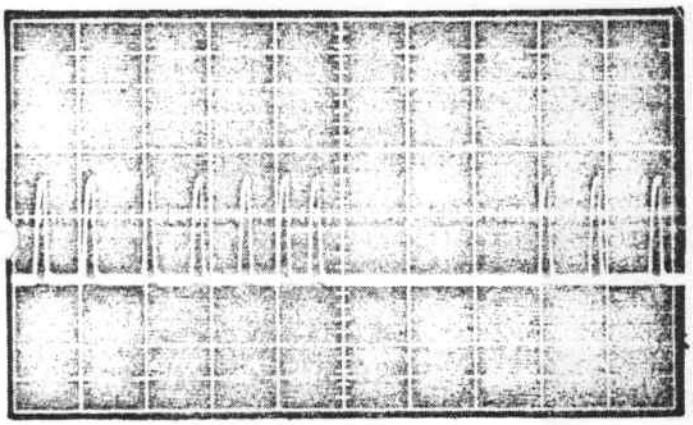
TEST POINT 31
VERT.- 2V./CM.
HORZ.- 1 MSEC./CM.



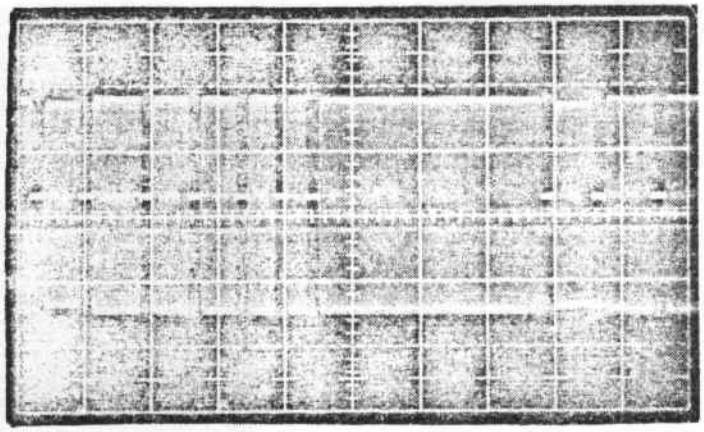
TEST POINT 6
VERT. - 2V. / CM.
HORZ. - 2 MSEC. / CM.



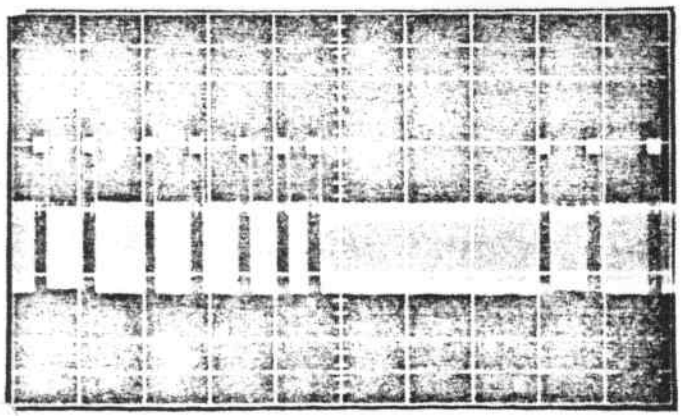
TEST POINT 7
VERT. - 2V. / CM.
HORZ. - 2 MSEC. / CM.



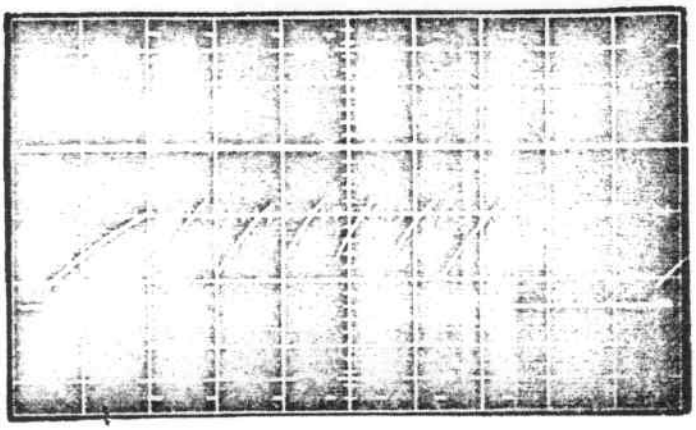
TEST POINT 8
VERT. - 0.5 V. / CM.
HORZ. - 2 MSEC. / CM.



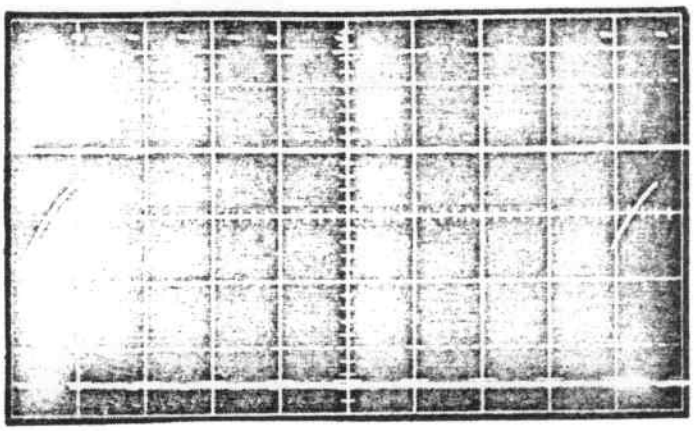
TEST POINT 9
VERT. - 0.5 V. / CM.
HORZ. - 2 MSEC. / CM.



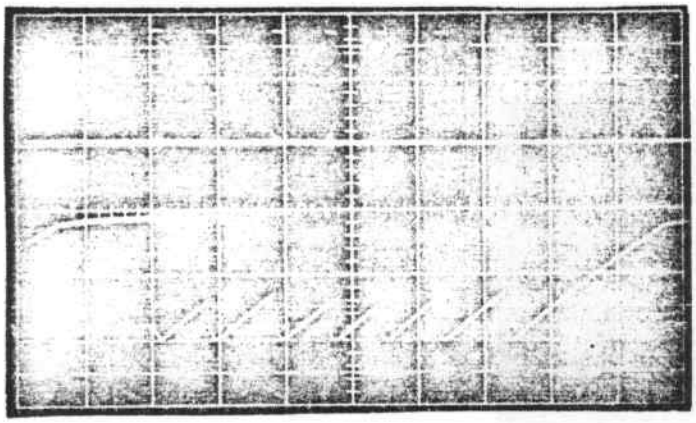
TEST POINT 10
VERT. - 0.2 V / CM.
HORZ. - 2 MSEC. / CM.



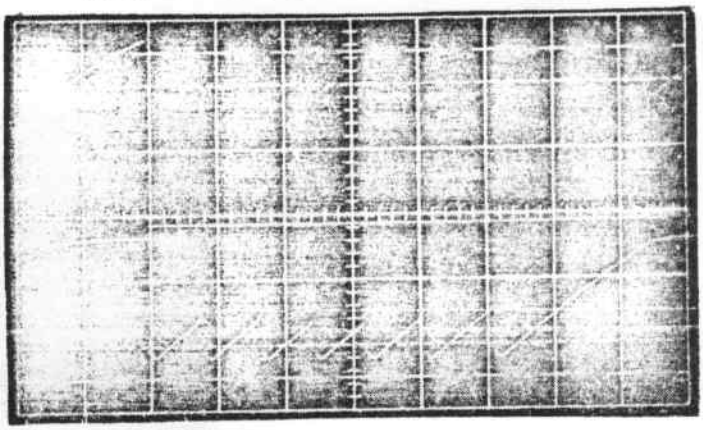
TOP- TEST POINT 6
BOTTOM - TEST POINT 5
VERT. - 2 V / CM.
HORZ. - 2 MSEC. / CM.



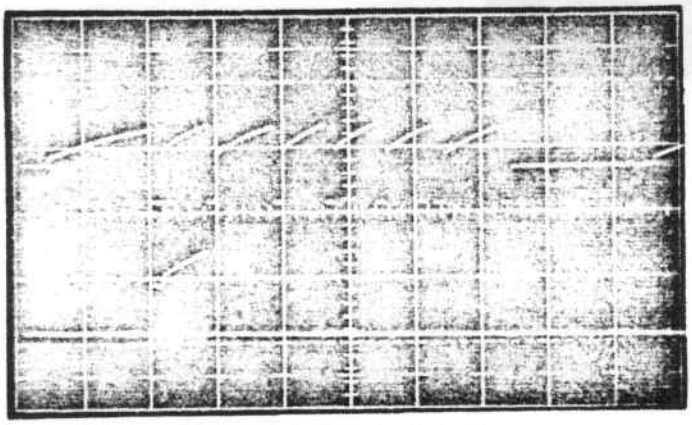
TOP - TEST POINT 6
BOTTOM - TEST POINT 9
VERT. - 2 V / CM.
HORZ. - 2 MSEC. / CM



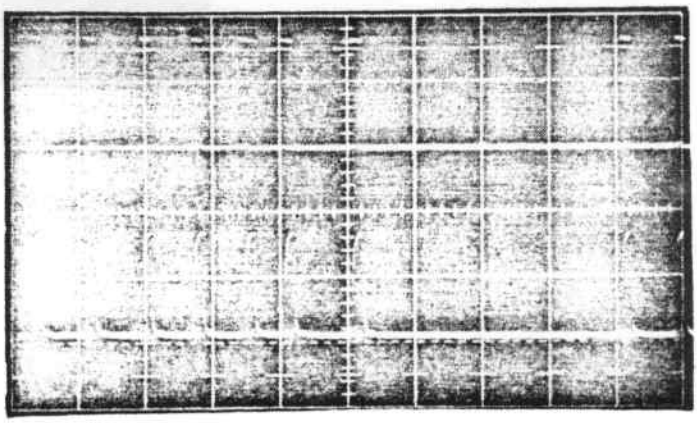
TOP - TEST POINT 6
BOTTOM - TEST POINT 7
VERT. 2V/CM TOP, 0.5 V/CM BOTTOM
HORZ. 2 MSEC. / CM



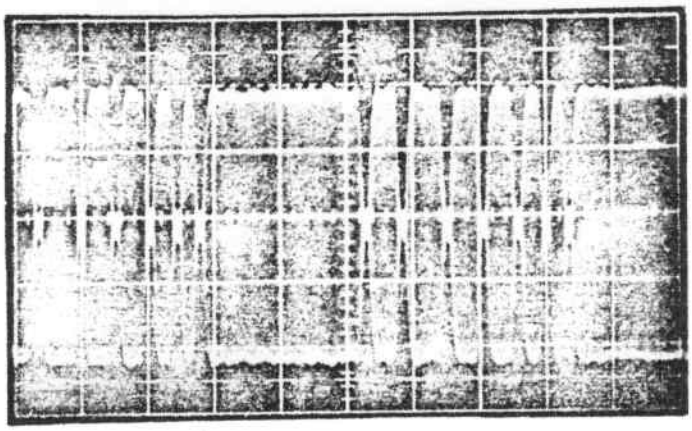
TOP - TEST POINT 8
BOTTOM - TEST POINT 7
VERT. 2V/CM TOP, 0.5 V/CM. BOTTOM
HORZ. 2 MSEC. / CM.



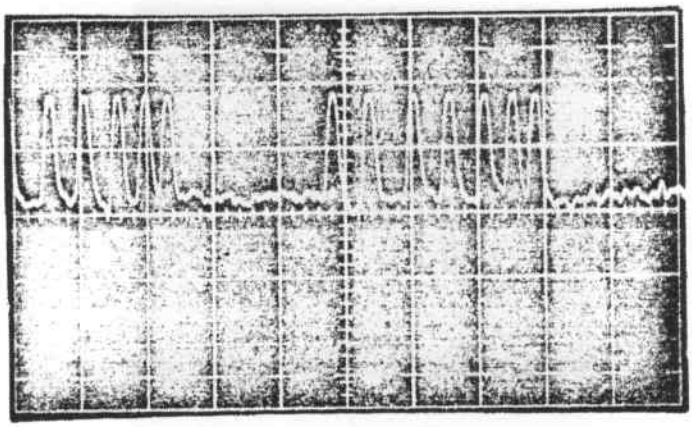
TOP - TEST POINT 5
BOTTOM - TEST POINT 9
VERT. - 5 V / CM
HORZ. - 2 MSEC. / CM.



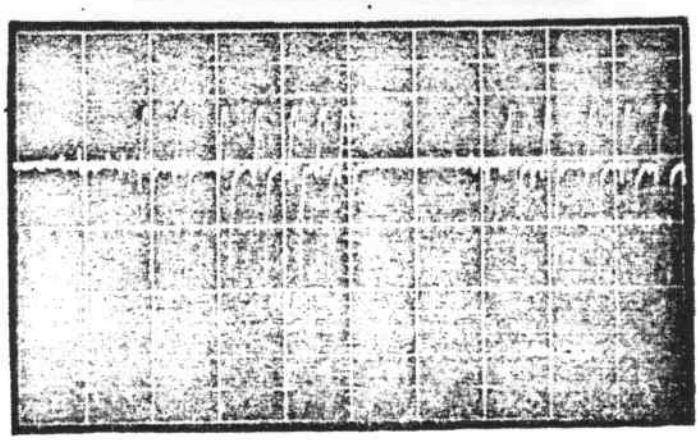
TOP - TEST POINT 6
BOTTOM - TEST POINT 17
VERT. 2V/CM. TOP, 0.5 V/CM BOTTOM
HORZ. - 2 MSEC. / CM.



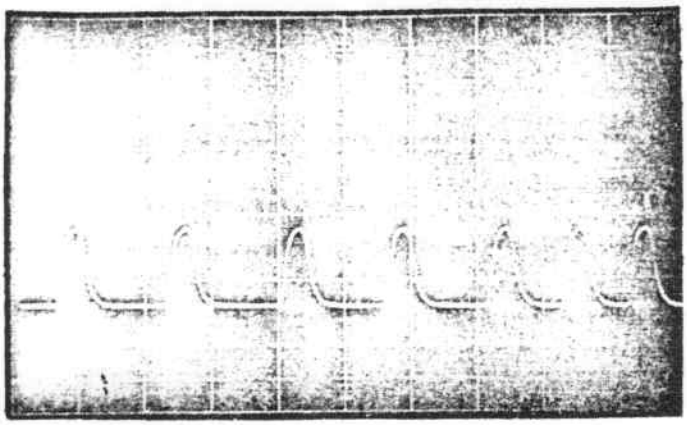
TEST POINT 14
VERT. - .05V / CM
455 KHZ I.F. SIGNAL



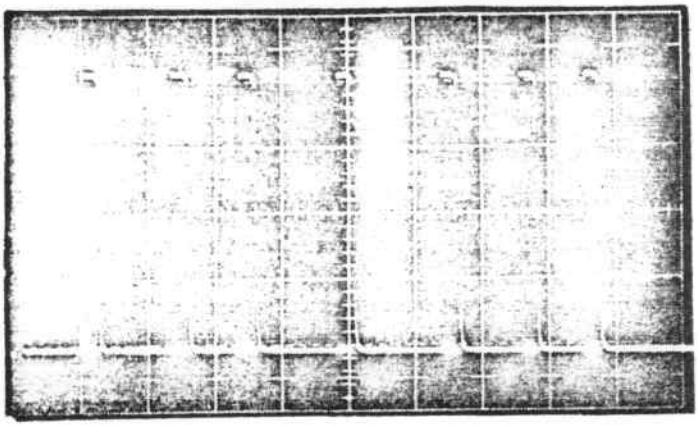
TEST POINT 15
VERT. - .5V / CM
I.F. STRIP PROPERLY TUNED



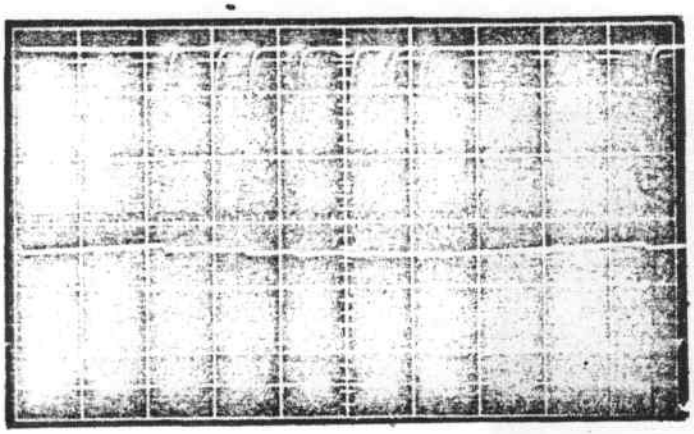
TEST POINT 15
VERT. - .5V / CM.
I.F. STRIP OUT OF TUNE



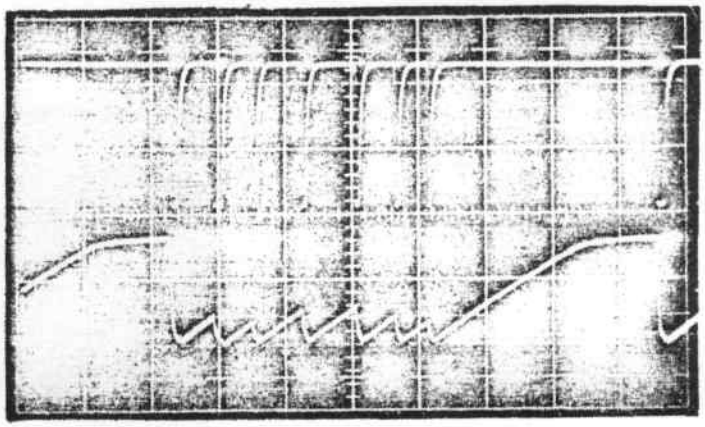
TEST POINT 2
VERT. 0.5 V/CM.
HORZ.- 1MSEC./CM



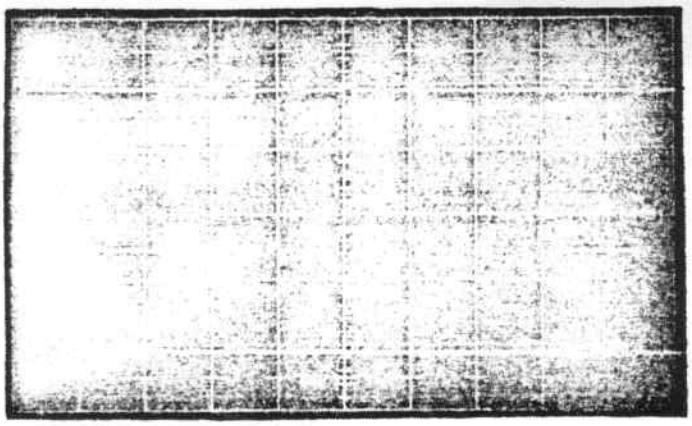
TEST POINT 7
VERT. 1V/CM.
HORZ - 1MSEC./CM.



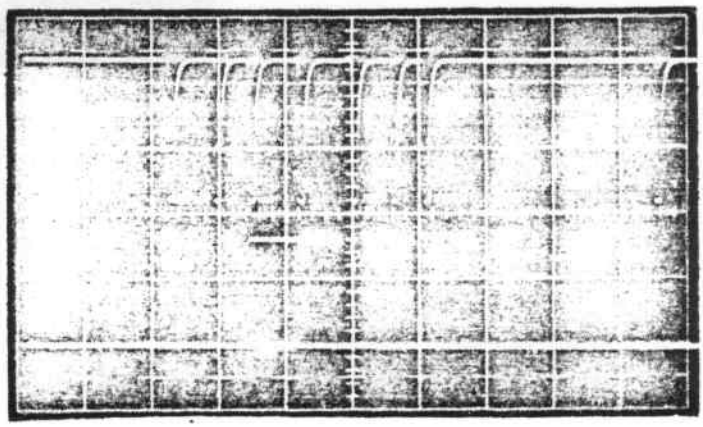
TOP-TEST POINT 4
BOTTOM - TEST POINT 6
VERT.-2 V/CM TOP, 0.5V./CM BOTTOM
HORZ. 2 MSEC./ CM.



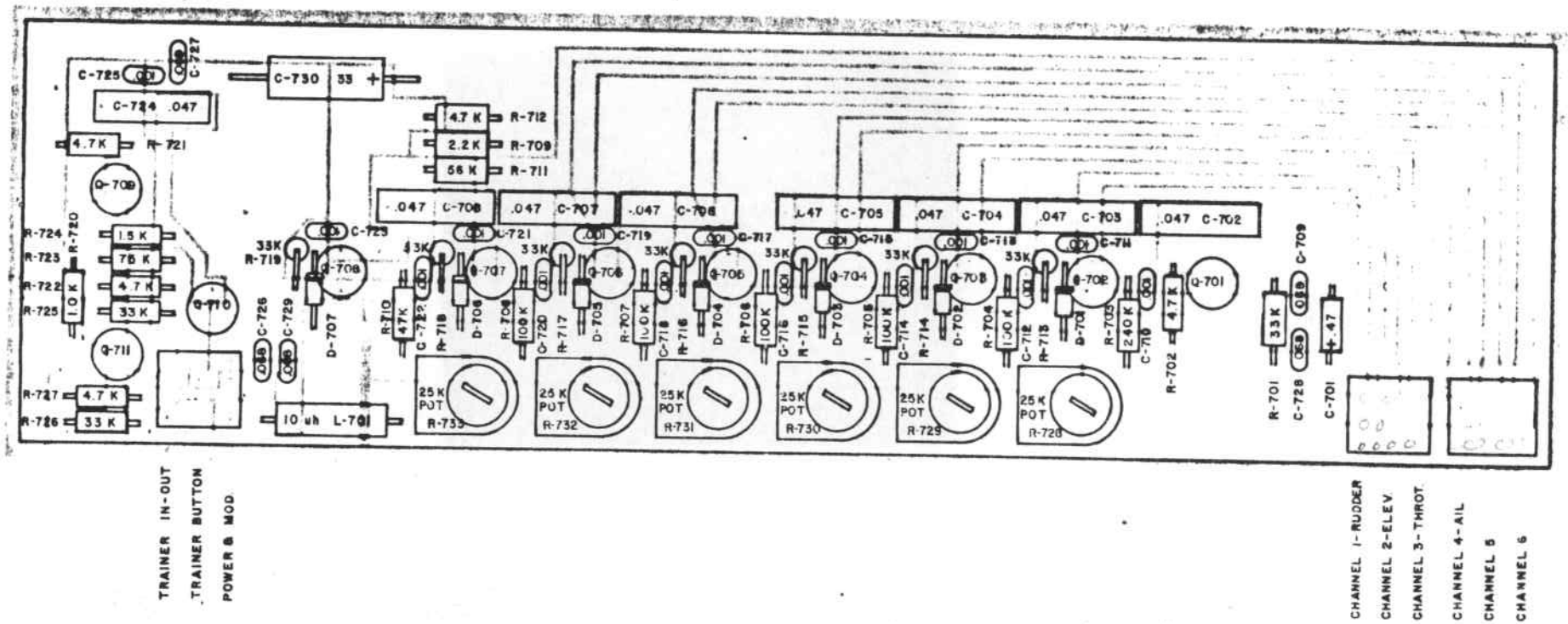
TOP - TEST POINT 4
BOTTOM - TEST POINT 9
VERT.- 2V/CM TOP, 0.5V/CM BOTTOM
HORZ. 2 MSEC./CM.



TOP - TEST POINT 4
BOTTOM - TEST POINT .10
VERT. - 2V./ CM.
HORZ.- 2 MSEC./ CM.

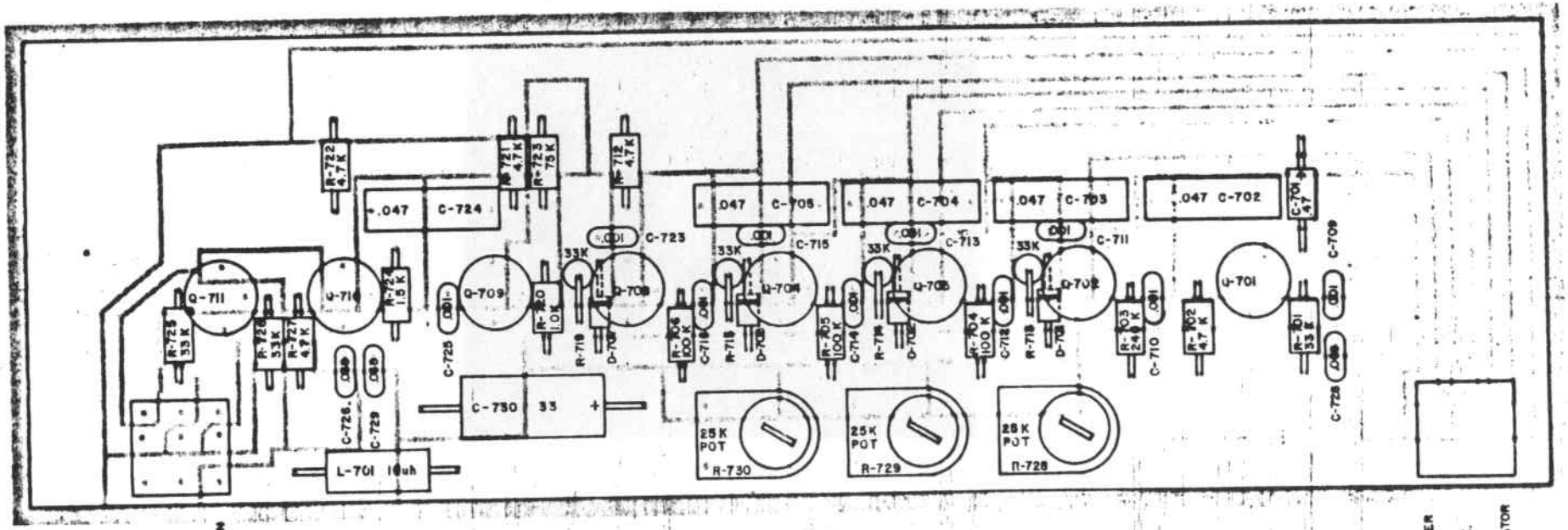


TOP - TEST POINT 4
BOTTOM - TEST POINT 13
VERT.- 2V./CM.
HORZ.- 2 MSEC./CM.



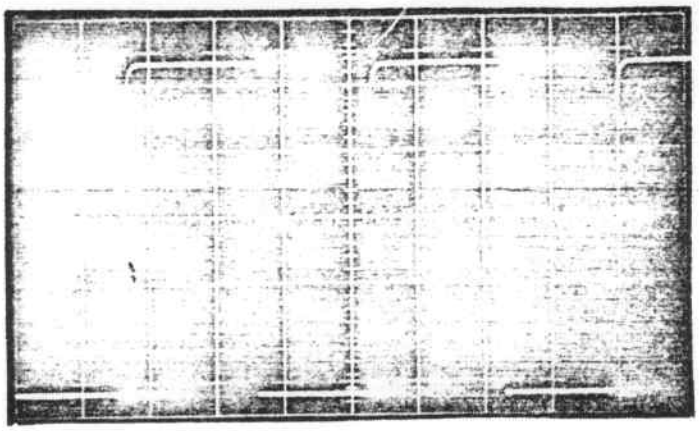
5&6 CHANNEL DESCRETE ENCODER

701

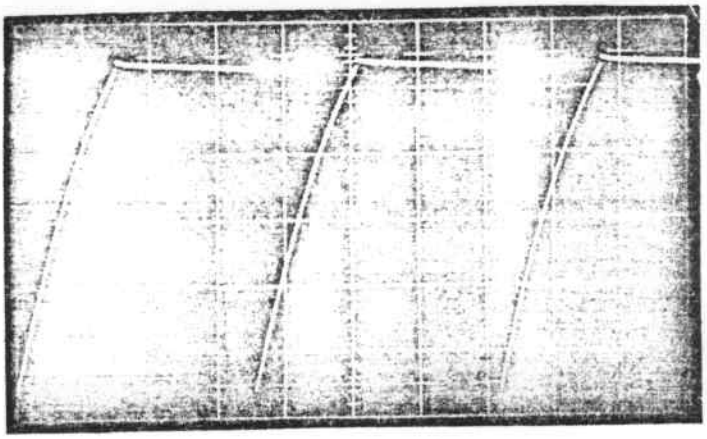


3 CHANNEL DESCRETE ENCODER

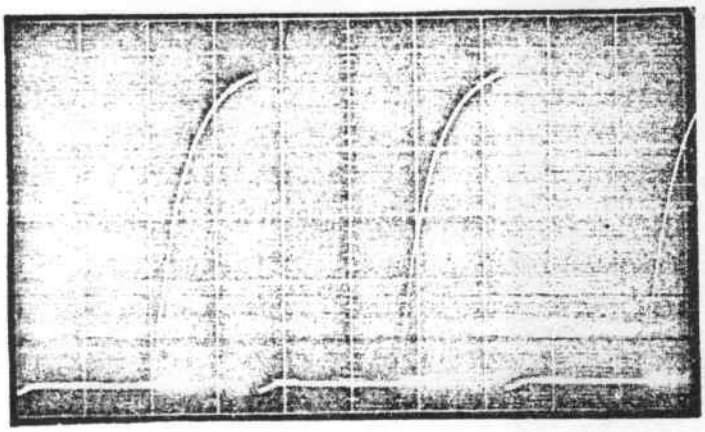
702



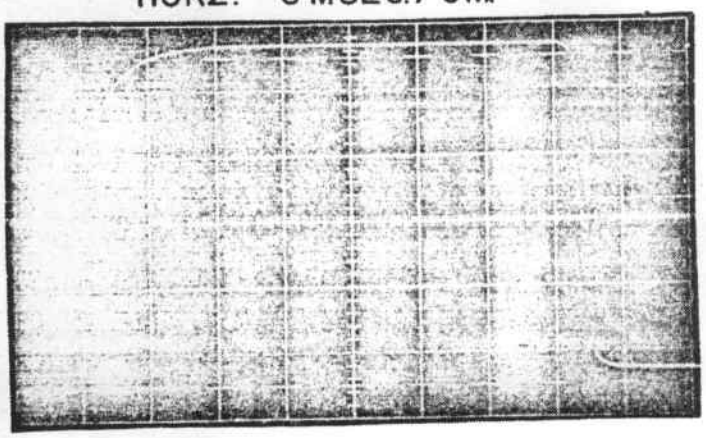
TEST POINT 4
VERT. - 2V./CM.
HORZ. - 5 MSEC./CM.



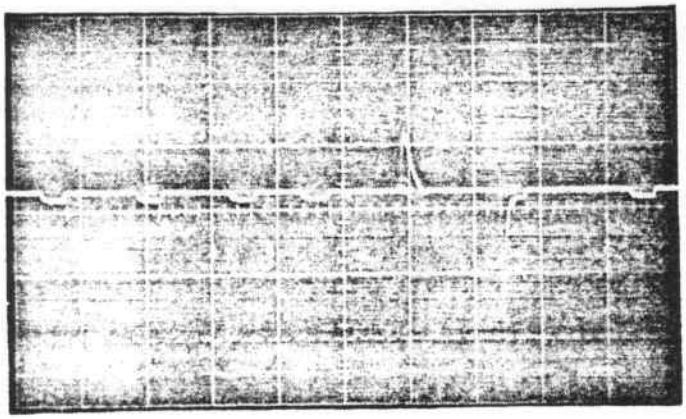
TEST POINT 5
VERT. - 2V./CM.
HORZ. - 5 MSEC./CM.



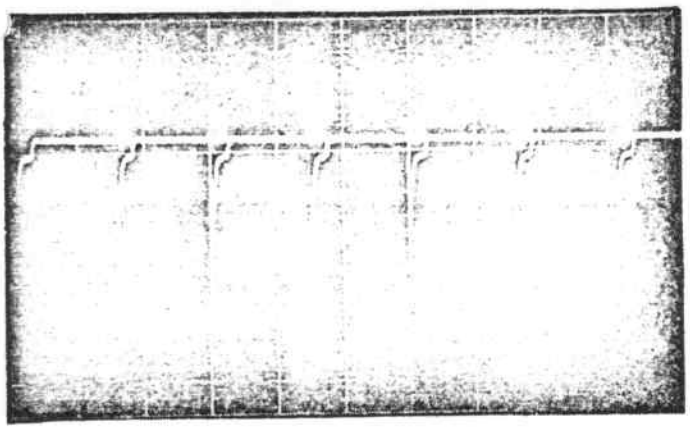
TEST POINT 6
VERT.-2V./CM.
HORZ.- 5 MSEC./CM.



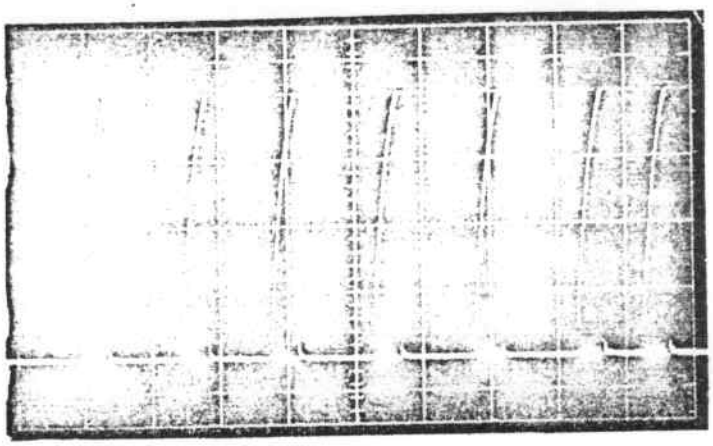
TEST POINT 9,12,15,18,21,24
VERT. - 2V./CM.
HORZ. - 0.2 MSEC./CM.



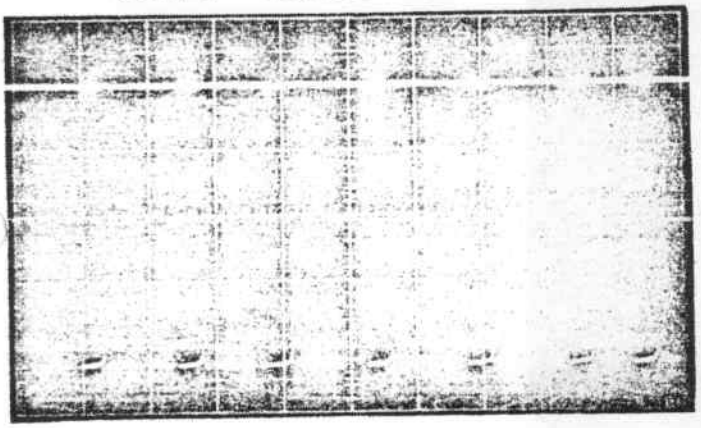
TEST POINT 19
VERT. - 2V./CM.
HORZ. - 1 MSEC./CM.



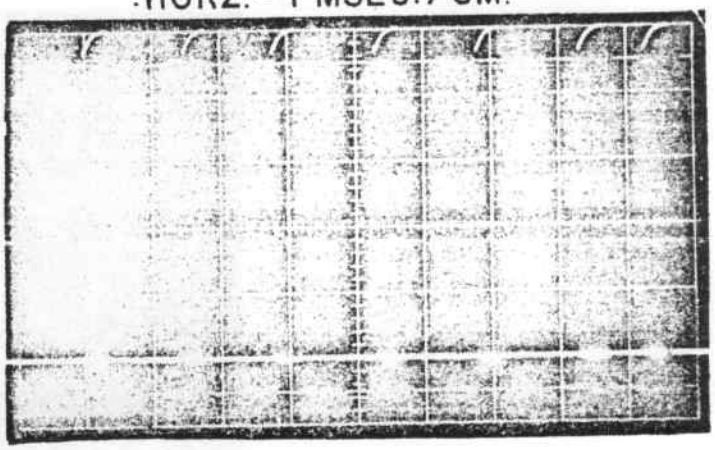
TEST POINT 26
VERT. – 2V./CM.
HORZ. – 1 MSEC./CM.



TEST POINT 27
VERT. - 2V./CM.
HORZ. - 1 MSEC./CM.



TEST POINT 29
VERT. - 2V./CM.
HORZ. - 1 MSEC./CM.



TEST POINT 31
VERT. - 2V./CM.
HORZ. - 1 MSEC./CM.