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<http://www.avionteq.com/TKM-Michel-NC-2210-NAV-COM-Ramp-Tester.aspx>



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1

INSTRUCTION MANUAL  
FOR  
2210 NAV-COMM RAMP TESTER

TKM, INC  
14811 N. 73<sup>RD</sup> STREET  
SCOTTSDALE, AZ 85260

PART # IMN2210, REV., 1  
OCT. 10, 2003

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## **I. PRODUCT DESCRIPTION**

The TKM NC 2210 is a NAV-COMM Ramp Tester. It provides test signals for Localizer, Glide Slope, VOR, Marker Beacon and Comm. The signals may be radiated or connected directly to the unit under test. A demodulated signal is available for direct connection to some converters.

The unit has improvements over the NC 2200 which it replaces. The improvements include the following:

- Higher RF power
- Precise localizer and glide slope deflection
- Calibrated VOR bearings at 10 degree increments.
- Crystal controlled modulation frequencies
- Longer battery life
- Internal antenna with adjustable length
- Smaller size

### **A) SPECIFICATIONS**

- LOCALIZER:** 108.1 MHz +/- .003%  
 0 +/- 3 dbm at base of antenna.  
 Deviation: Centered, +/- .047 DDM, +/- .094 DDM, +/- .15 DDM  
 Tone delete: 90 and 150 Hz with undeleted tone at 20%.
- GLIDESLOPE:** 334.7 MHz +/- .003%  
 -6 +/- 3 dbm at base of antenna.  
 Deviation: Centered, +/- .094 DDM, +/- .188 DDM, +/- .30 DDM  
 Tone delete: 90 and 150 Hz with undeleted tone at 40%
- ILS** Both the Localizer and Glide slope signals as above.  
 Deviation: Both signals deviated simultaneously.
- VOR** 108.0 MHz +/- .003%  
 0 +/- 3 dbm at base of antenna.  
 Bearing: Selectable in 10 degree increments.
- MARKER:** 75.0 MHz +/- .003 %  
 Modulation: 400, 1300, 3000, 1020 Hz @95% - CW or pulsed.
- COMM:** 118.0 MHz +/- .003%.  
 Modulation: 400, 1300, 3000, 1020 Hz @ 30%.  
 Transmitter test: -10 to + 10 dbm Go-Nogo. Phones to check modulation.
- SIZE:** 3.8 X 7.4 X 2.3 Inches
- WEIGHT:** 1.3 Lbs.
- POWER:** Internal Battery with over 2 Hours running time.

## II. OPERATION

The NC2210 is operated with two selector switches. It also has three LED displays to indicate the selected operating conditions. The FUNCTION switch has 11 positions.

1. Power control: turn off power.
2. LOC: Selects 108.1 MHz RF. (CHANNEL displays 108.1)
3. GS: Selects 334.7 MHz RF. (CHANNEL displays 108.1 for the paired channel)
4. ILS: Selects both 108.1 MHz and 334.7 MHz. (CHANNEL displays 108.1)
5. VOR-0: Selects 108.0 MHz RF. (CHANNEL displays 108.0) Bearing is 0 nominal.
6. VOR-90: Selects 108.0 MHz RF (CHANNEL displays 108.0) Bearing is 90 nominal.
7. VOR-180: Selects 108.0 MHz RF (CHANNEL displays 108.0) Bearing is 180 nominal.
8. VOR-270: Selects 108.0 MHz RF (CHANNEL displays 108.0) Bearing is 270 nominal.
9. MB: Selects 75.0 MHz RF; (CHANNEL displays 75.0)
10. COMM: Selects 118.0 MHz RF. CHANNEL displays 118.0)
11. TX: Transmitter Test. (Channel displays No Power ////) (Power ////).

The MODULATION SELECT switch has 9 positions. The center position provides the nominal operating conditions.

For localizer, glide slope and ILS the "0" position provides balanced 90 and 150 modulation. "1" provides a .047 DDM for localizer and a .094 DDM for glide slope with 150 greater than 90. "-1" provides the reverse of the 90 and 150 levels. "2" provides .094 and .188 DDM with the 150 greater then 90 and "-2" provides the reverse of the 90 and 150 levels. "3" provides .150 and .300 DDM eith the 150 greater than 90 and "-3" provides the reverse of the 90 and 150 levels. "4" provides 150 Hz at 20% for LOC and 40% for Glide Slope. "-4" provides 90 Hz ant 20% for LOC and 40% for Glide Slope.

For VOR the selector switch provides -40 to +40 degree bearings in 10 degree steps referred to the nominal bearings selected by the FUNCTION switch.

For MB the selector switch provides 400,1300, 3000 and 1020 Hz CW modulation at 95%. Center position is OFF and negative number selection provides a pulsed modulation.

For COMM the selector switch provides the same signals as for MB but at 30% modulation.

For TX the display is deactivated.

### POWER CONSIDERATIONS

The unit contains two five cell NiCad batteries which can power the unit for more than two hours. Even when the unit is operated with the charger activated the batteries will charge. Full battery charge can be obtained in six hours. The unit can be operated when any 12 volt external source such as a car battery is connected.

To indicate a low battery condition the MODULATION display will flash.

### OUTPUT SIGNALS

The 2210 has four output signals: Radiated Signal, RF, DMD and PHN.

For the radiated signal, the antenna should be extended to its maximum length. The signal strength should be adequate to test at distances greater than 100 feet.

The RF output provides a sample of the radiated signal at approximately -20 dbm.

The DMD output provides the modulating signal at the following levels:

LOC and GS: 1.25 V P-P  
 VOR: 2.0 V P-P  
 MB: 3.17 V P-P  
 COMM: 1.0 V P-P

The load on this output should be greater than 10 Kohm.

The PHN provides a sample of the Transmitter modulation when the unit is operated in the TX mode.

### **III. FUNCTIONAL DESCRIPTION**

The unit contains three functional units: Modulation Circuits, RF Circuits and Power Supply.

The Modulation Circuits are comprised of four basic functional units:

Display Circuits are controlled by U1 and provide signals to drive LED displays.

9960 Gen is contained in U2 and digitally generates the 9960 Hz subcarrier with the 30Hz modulation.

Tone Gen. is comprised of U4, U5, U6, U8 and associated components.

Phase Delay and Level Set is comprised of U3 and U7

The RF Circuits include the GS and VHF generators. Each generator is driven by a frequency synthesizer chip to obtain the desired output frequency. U1 generates the properly formatted signal to program the frequency synthesizer chip.

Q2 is the VHF oscillator. Q11 and Q9 are buffer amplifiers which isolate the amplitude modulators D10 and D11. Q10 is the output amplifier. D1 detects the RF output level and compares it in U6 with the modulation signal to control the amplitude modulator.

Q1 is the GS oscillator. The circuit functions of the associated circuitry is similar to the VHF circuits.

The TX circuits are comprised of Q8 as an amplifier, D5 as a detector U6A as a phone amplifier, and U6D as an agc amplifier.

The outputs of the GS and VHF generators are combined through a high pass filter and a low pass filter respectively and connected to the antenna.

### **IV. ALIGNMENT**

#### **TEST EQUIPMENT REQUIRED**

Oscilloscope: TEK – TDS210 or equivalent  
 Multi-meter: FLUKE 75 or equivalent  
 Spectrum Analyzer: TEK2712 or equivalent  
 NAV-COM: TKM - MX170B or equivalent  
 NAV Converter: TKM – MC60 or equivalent

**MODULATION CIRCUITS** The modulation circuits require alignment to provide low distortion on the modulation signals. The LOC centering and VOR zeroing adjustments are located on the modulation board but are described in the calibration section.

**PROCEDURE**

1. Monitor the modulation signal on the DMD output. Select LOC function and “-4” on the MODULATION SELECT. Adjust R32 to obtain minimum distortion on the 90 Hz signal. Select “4” on the MODULATION SELECT and adjust R33 to obtain minimum distortion.
2. Monitor the 9960 signal on Pin 1 of U5. Select any VOR function and any MODULATION SELECT POSITION. Adjust R34 for maximum 9960 level. Monitor the DMD output and adjust R35 for equal amplitudes of the 9960 and 30 Hz signals.

**RF CIRCUITS** The RF circuits require alignment to assure that the oscillators can operate over the desired frequency range.

**PROCEDURE**

1. Monitor either end of R6 . Select GS function and adjust the winding spacing of L16 to obtain a voltage of 2.5 +/- .5 vdc.
2. Monitor either end of R9. Select LOC function and adjust the winding spacing of L21 to obtain a voltage of 2.8 +/- .1 vdc. Select MB and verify a reading of .20 vdc minimum. Make a small adjustment of L21 if necessary. Select COMM and verify a reading of 4.7 vdc maximum.

RF level and modulation level are described in the calibration section.

**V. CALIBRATION**

The following calibration procedure assumes that the preceding alignment procedure has been completed. The antenna should be fully extended for this procedure.

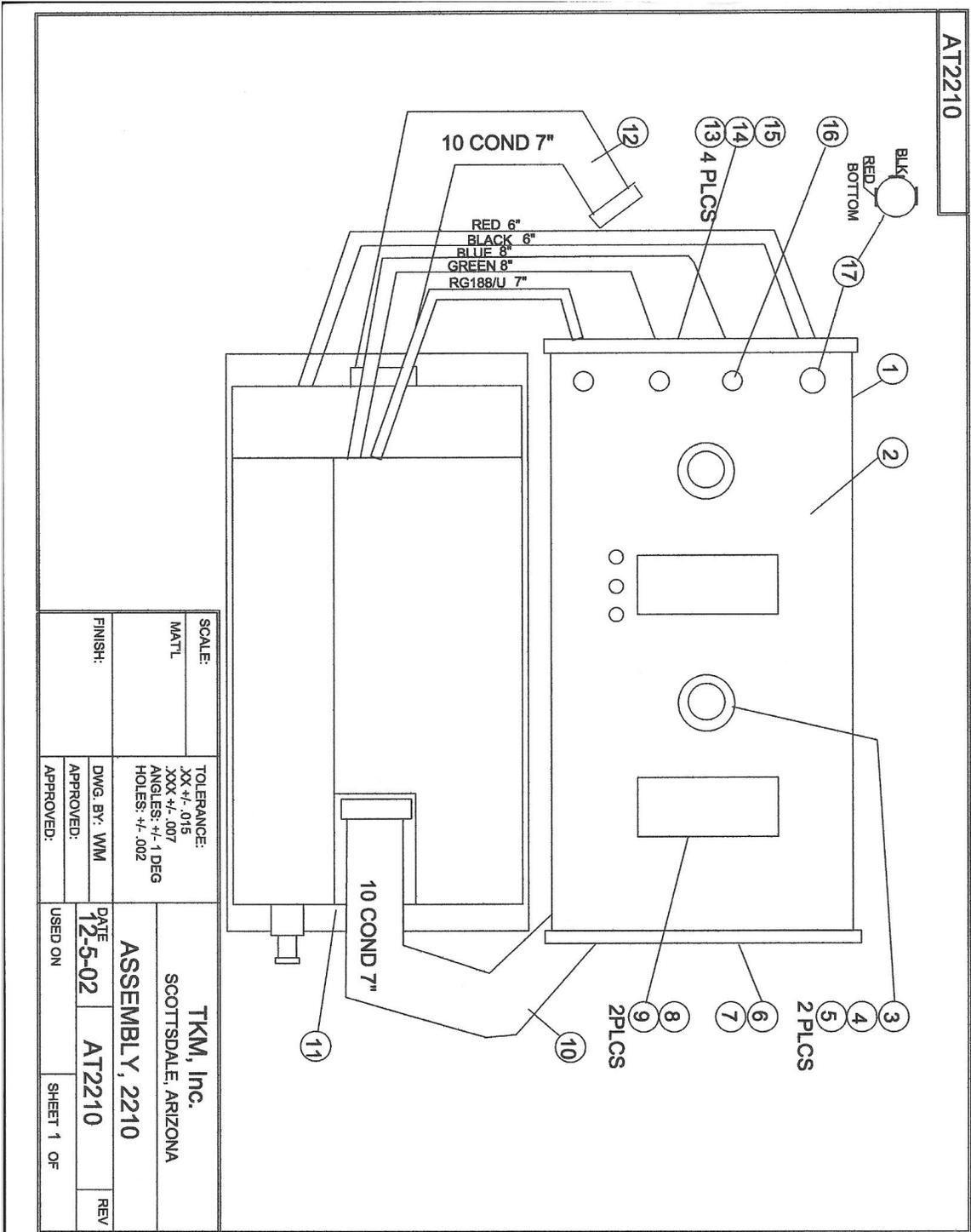
1. Monitor the RF output with spectrum analyzer in the linear detection mode. Select GS function and “4” in MODULATION SELECT. Set R86 for maximum RF level and set the analyzer to 334.7 MHz. Adjust analyzer for full scale reading. Adjust R86 for midscale reading in linear mode and adjust R38 to obtain 40% modulation. Carrier level should be  $-26 \pm 4$  dbm.
2. Monitor the RF output as before but at 108.1 MHz. Select LOC function and “4” in MODULATION SELECT. Adjust R43 for maximum RF output and adjust analyzer for full scale reading in linear mode. Adjust R43 for midscale reading and R37 for 20 % modulation. Carrier level should be  $-20 \pm 4$  dbm.
3. Monitor the LOC signal on a calibrated NAV COMM receiver with a calibrated CDI. With MODULATION SELECT AT “0” Adjust R41 on the MODULATION Board for a centered needle.
4. Monitor the VOR signal as above and adjust R40 for a centered needle with the OBS set to zero. The FUNCTION should be set to VOR-0.

**VI. HARDWARE DESCRIPTION**

The following information includes assembly descriptions, schematics and parts list. For access to the inner components remove the four screws on each side of the case. For access to the batteries remove the four screws holding the RF board. Antenna removal can be accomplished by removing the screw at the base of the antenna and sliding the antenna out of the top.

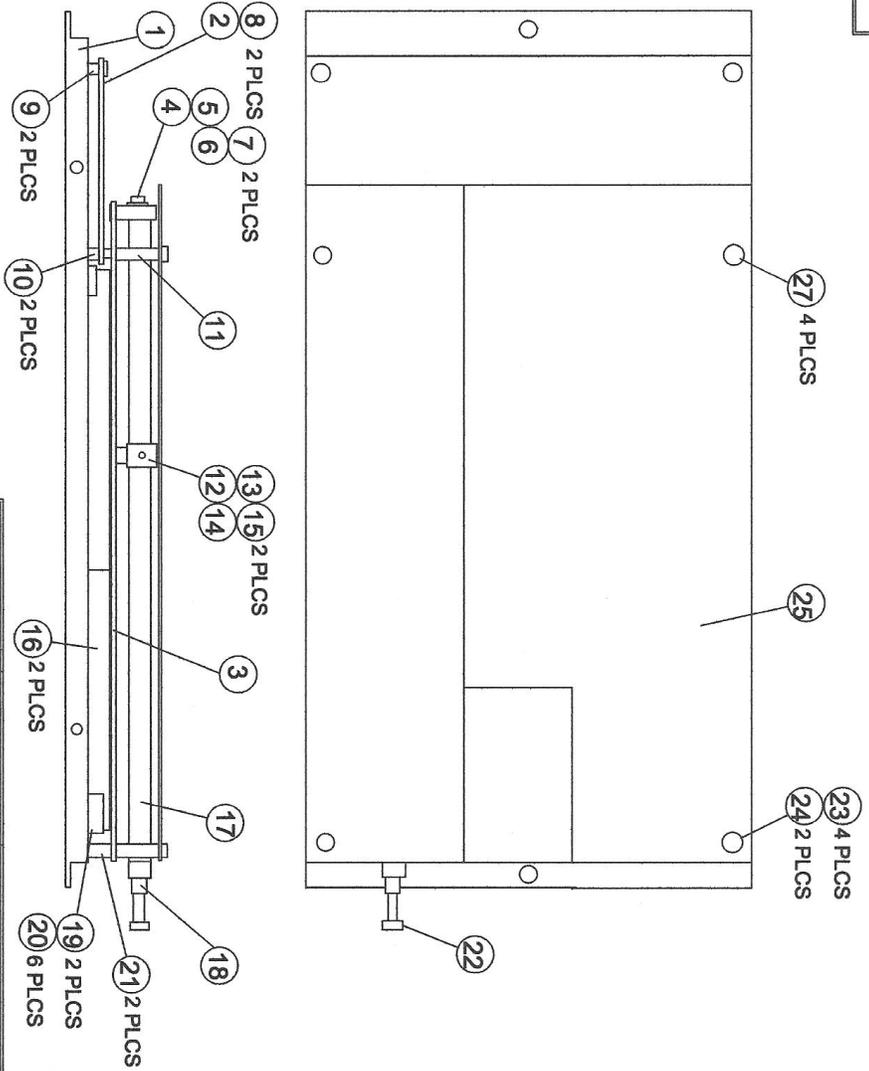
WARRANTY: 2 Years from date of purchase.

**VII. Layouts, Schematics, and Parts Lists**



| NC2210 |          | AT2210-0                               |     |
|--------|----------|----------------------------------------|-----|
| Ref#   | Part #   | Description                            | Qty |
| 01     | SM2210-1 | SHEET METAL CASE; 2210                 | 1   |
| 02     | SS2215-3 | SUB-ASSEMBLY MOD CIRCUITS - 2210       | 1   |
| 03     | MP1145-  | MISC. PARTS KNOB CAP 14.5 mm           | 2   |
| 04     | MP1147-  | MISC. PARTS KNOB, POINTER, 14.5mm      | 2   |
| 05     | MP1148-  | MISC. PARTS NUT COVER, POINTER, 14.5mm | 2   |
| 06     | SM2224-  | SHEET METAL PLATE, END                 | 1   |
| 07     | SM2221-  | SHEET METAL PLATE BACKUP (2210)        | 1   |
| 08     | HM3080-  | HARDWARE; MACHINE Bezel, 3300          | 9   |
| 09     | PL2210-  | PLASTIC VYNL, ORN, 1.53 X .63          | 2   |
| 10     | CA1407-  | CABLE; RIBBON 14 COND. X 7"            | 1   |
| 11     | SS2222-  | SUB-ASSEMBLY RF/PS (2210)              | 1   |
| 12     | CA1007-  | CABLE; RIBBON 10 COND, X 7"            | 1   |
| 13     | NB406F-  | FASTENERS 4-40 x 3/8 Phil Flat-100     | 4   |
| 14     | SM2204-1 | SHEET METAL PLATE, END                 | 1   |
| 15     | SM2220-  | SHEET METAL PLATE, BACKUP              | 1   |
| 16     | MP2201-  | MISC. PARTS NAMEPLATE; MX11            | 1   |
| 17     | EC2020-  | CONNECTOR PHONO JACK                   | 3   |

SS22222

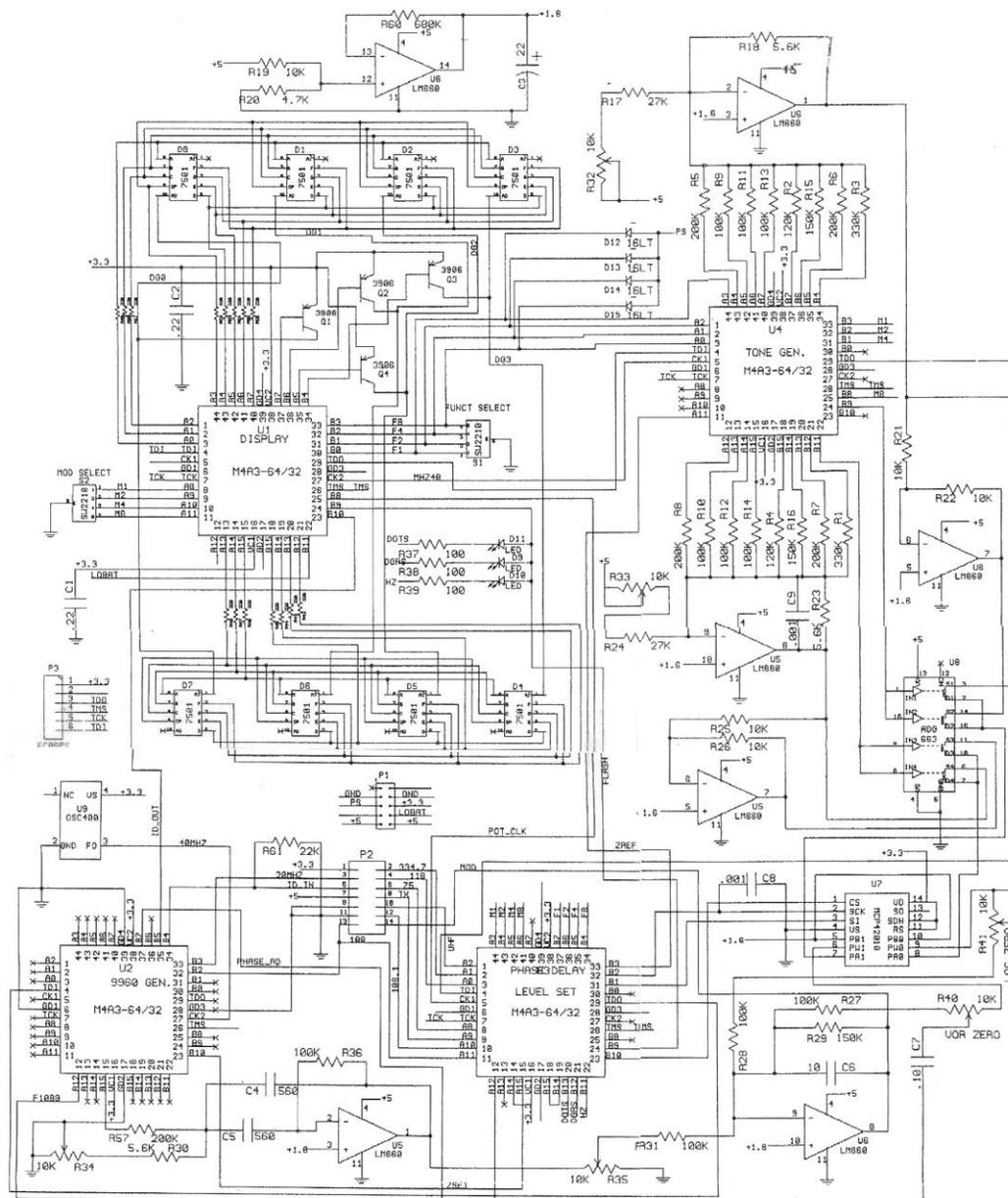


|             |  |                   |  |                        |  |
|-------------|--|-------------------|--|------------------------|--|
| SCALE:      |  | TOLERANCE:        |  | TKM, Inc.              |  |
| MAT'L       |  | XX +/- .015       |  | SCOTTSDALE, ARIZONA    |  |
| FINISH:     |  | XXX +/- .007      |  | <b>ASSEMBLY, RF/PS</b> |  |
| DWG. BY: WM |  | ANGLES: +/- 1 DEG |  | DATE: 2-4-02           |  |
| APPROVED:   |  | HOLES: +/- .002   |  | SS22222                |  |
| APPROVED:   |  | USED ON           |  | REV                    |  |
| APPROVED:   |  | SHEET 1 OF        |  |                        |  |

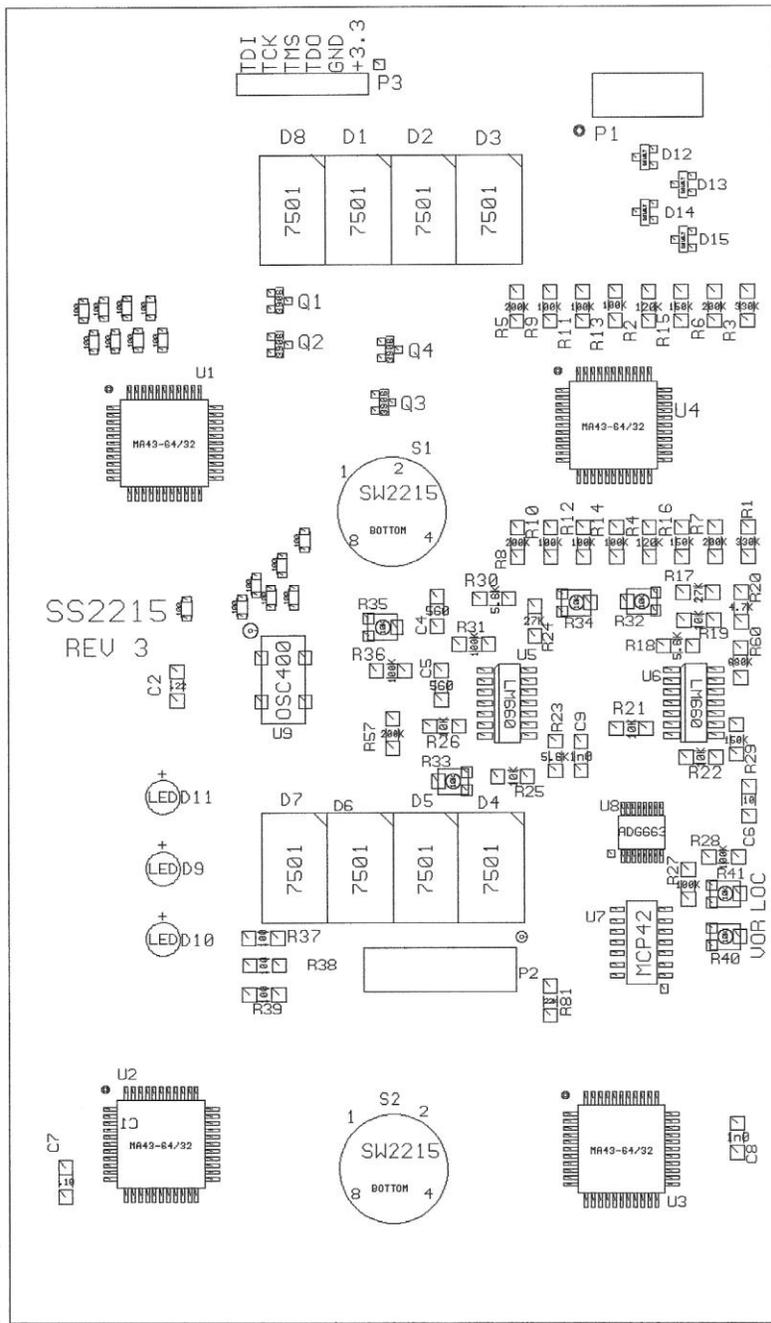
RF/PS; 2210

SS2222-3

| Ref# | Part #   | Description                            | Qty |
|------|----------|----------------------------------------|-----|
| 01   | SM2212-  | SHEET METAL REAR PANEL; 2210           | 1   |
| 02   | SS3310-  | SUB-ASSEMBLY ASSEMBLY, PS              | 1   |
| 03   | SS2220-1 | SUB-ASSEMBLY RF CIRCUITS - 2210        | 1   |
| 04   | HM2218-  | HARDWARE; MACHINE SUPPORT, ANTENNA     | 1   |
| 05   | NB405P-  | FASTENERS 4-40x5/16 PP SS              | 1   |
| 06   | NB1488-  | FASTENERS #4 SOLDER LUG                | 1   |
| 07   | NB404F-  | FASTENERS 4-40x1/4 P100 SS             | 2   |
| 08   | NB403P-  | FASTENERS 4-40x3/16 PP SS              | 2   |
| 09   | HS2224-  | SPACER .187 HEX X .42; 4-40            | 2   |
| 10   | HS2221-  | SPACER HS1815 CUT TO .51               | 2   |
| 11   | HS2222-  | SPACER .187 HEX X .80; 4-40            | 2   |
| 12   | HM2216-  | HARDWARE; MACHINE MTG BLOCK, ANT       | 1   |
| 13   | NB402A-  | FASTENERS 2-56x1/8 ASET PNT SS         | 1   |
| 14   | HS1010-  | SPACER 3/16 HEX x .187; THRU           | 2   |
| 15   | NB407F-  | FASTENERS 4-40x7/16 P100 SS            | 2   |
| 16   | BA3300-  | BATTERY 6V Nicad (5 AA) 800 mah.       | 2   |
| 17   | HM2240-  | HARDWARE; MACHINE .437 RD. TUBE X 5.12 | 1   |
| 18   | PL2202-  | PLASTIC ANTENNA INSULATOR              | 1   |
| 19   | SM3303-  | SHEET METAL HOLDER, BATT               | 2   |
| 20   | NB404F-  | FASTENERS 4-40x1/4 P100 SS             | 6   |
| 21   | HS2205-  | SPACER 3/16 HEX x 9/16; 4-40 THD       | 2   |
| 22   | MP2202-  | MISC. PARTS ANTENNA; VHF               | 1   |
| 23   | NB408A-  | FASTENERS 4-40x1/2 ASET SS             | 4   |
| 24   | HS2223-  | SPACER .187 HEX X .375; 4-40           | 2   |
| 25   | SM2240-  | SHEET METAL SHIELD; RF                 | 1   |
| 26   | MP2210-  | MISC. PARTS NAMEPLATE 2210             | 1   |
| 27   | NB404P-  | FASTENERS 4-40x1/4 PP SS               | 4   |



MODULATION CIRCUITS SS2215 REV 3



MOD GEN - 2210

SS2215-3

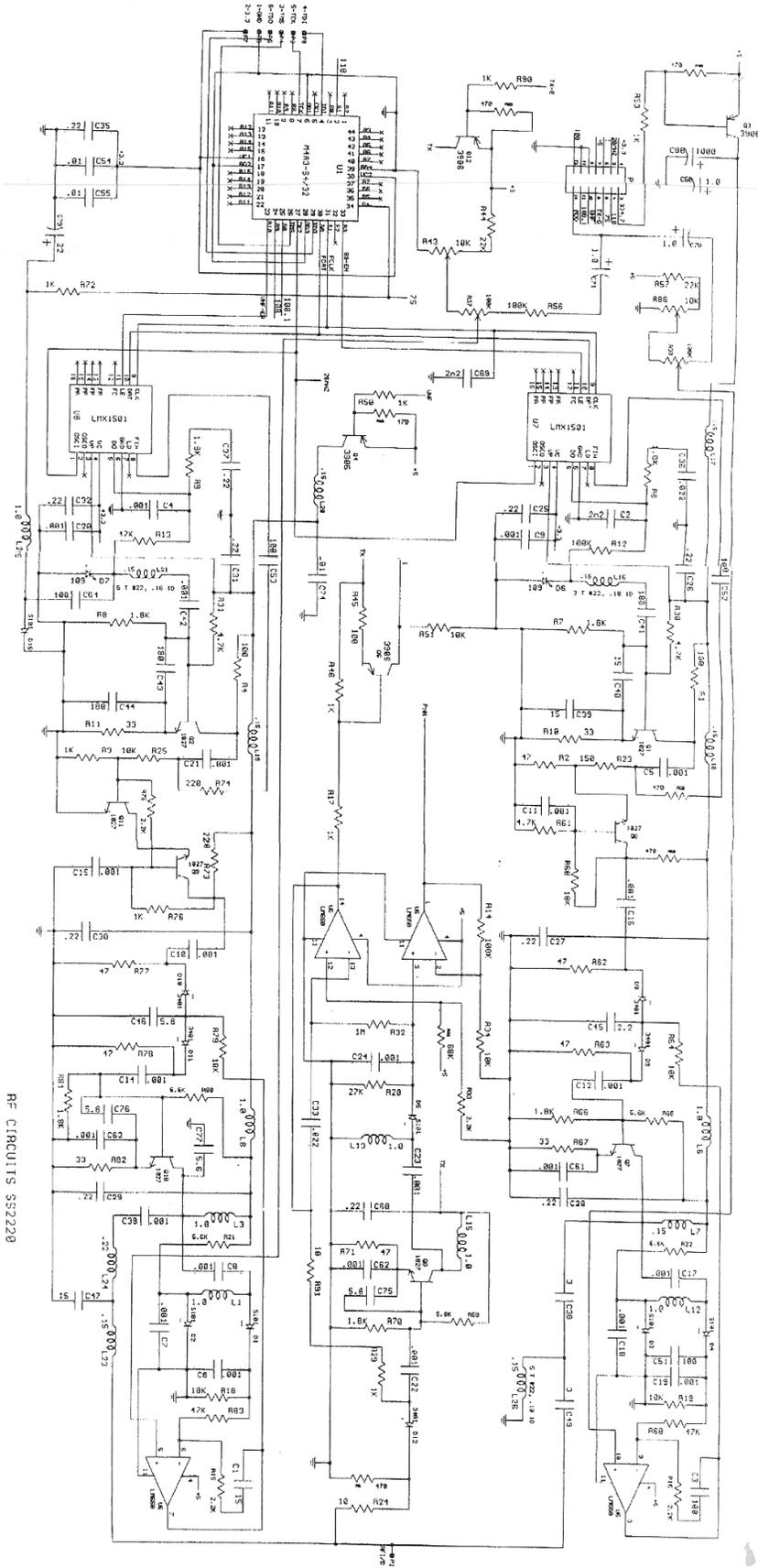
| Ref# | Part #   | Description                            | Qty |
|------|----------|----------------------------------------|-----|
| 1    | PC2215-3 | PCB BOARD; MODULATION                  | 1   |
| C1   | CS0224-  | CAP; SMT; CER; .22 uF; 50 V; 1206 case | 1   |
| C2   | CS0224-  | CAP; SMT; CER; .22 uF; 50 V; 1206 case | 1   |
| C4   | CS0561-  | CAP; SMT; CER; 560 PF 1206             | 1   |
| C5   | CS0561-  | CAP; SMT; CER; 560 PF 1206             | 1   |
| C6   | CS0100-  | CAP; SMT; CER; 10 PF, 1206             | 1   |
| C7   | CS0104-  | CAP; SMT; CER; .1 UF 1206              | 1   |
| C8   | CS0102-  | CAP; SMT; CER; .001 uF; 100V; 1206     | 1   |
| C9   | CS0102-  | CAP; SMT; CER; .001 uF; 100V; 1206     | 1   |
| D1   | DL7501-  | OPTICAL RED; 7 SEGMENT LED             | 1   |
| D10  | DDSLED-  | DIODE LED, RED                         | 1   |
| D11  | DDSLED-  | DIODE LED, RED                         | 1   |
| D12  | DS0016-  | DIODE; SMT SWITCHING                   | 1   |
| D13  | DS0016-  | DIODE; SMT SWITCHING                   | 1   |
| D14  | DS0016-  | DIODE; SMT SWITCHING                   | 1   |
| D15  | DS0016-  | DIODE; SMT SWITCHING                   | 1   |
| D2   | DL7501-  | OPTICAL RED; 7 SEGMENT LED             | 1   |
| D3   | DL7501-  | OPTICAL RED; 7 SEGMENT LED             | 1   |
| D4   | DL7501-  | OPTICAL RED; 7 SEGMENT LED             | 1   |
| D5   | DL7501-  | OPTICAL RED; 7 SEGMENT LED             | 1   |
| D6   | DL7501-  | OPTICAL RED; 7 SEGMENT LED             | 1   |
| D7   | DL7501-  | OPTICAL RED; 7 SEGMENT LED             | 1   |
| D8   | DL7501-  | OPTICAL RED; 7 SEGMENT LED             | 1   |
| D9   | DDSLED-  | DIODE LED, RED                         | 1   |
| P1   | ECGP10-  | CONNECTOR 10 PIN BOARD PLUG            | 1   |
| P2   | ECGP14-  | CONNECTOR 14 PIN Board Plug            | 1   |
| P3   | EC06PS-  | CONNECTOR                              | 1   |
| Q1   | QS3906-  | TRANSISTOR; SMT PNP 2N3906             | 1   |
| Q2   | QS3906-  | TRANSISTOR; SMT PNP 2N3906             | 1   |
| Q3   | QS3906-  | TRANSISTOR; SMT PNP 2N3906             | 1   |
| Q4   | QS3906-  | TRANSISTOR; SMT PNP 2N3906             | 1   |
| R1   | RS0334-  | RES; SMT; FILM; 330K, 1/4 W, 1206      | 1   |
| R10  | RS0104-  | RES; SMT; FILM; 100K; 1/4W 5%;1206     | 1   |
| R11  | RS0104-  | RES; SMT; FILM; 100K; 1/4W 5%;1206     | 1   |
| R12  | RS0104-  | RES; SMT; FILM; 100K; 1/4W 5%;1206     | 1   |
| R13  | RS0104-  | RES; SMT; FILM; 100K; 1/4W 5%;1206     | 1   |
| R14  | RS0104-  | RES; SMT; FILM; 100K; 1/4W 5%;1206     | 1   |
| R15  | RS0154-  | RES; SMT; FILM; 150K ; 5%; 1206        | 1   |
| R16  | RS0154-  | RES; SMT; FILM; 150K ; 5%; 1206        | 1   |
| R17  | RS0273-  | RES; SMT; FILM; 27K; 1/4W 5%; 1206     | 1   |
| R18  | RS0562-  | RES; SMT; FILM; 5.6K; 5%; 1206         | 1   |
| R19  | RS0103-  | RES; SMT; FILM; 10K; 1/4W 5%; 1206     | 1   |
| R2   | RS0124-  | RES; SMT; FILM; 120 Kohm, 5%, 1206     | 1   |
| R20  | RS0472-  | RES; SMT; FILM; 4.7K; 1/4W 5%; 1206    | 1   |
| R21  | RS0103-  | RES; SMT; FILM; 10K; 1/4W 5%; 1206     | 1   |
| R22  | RS0103-  | RES; SMT; FILM; 10K; 1/4W 5%; 1206     | 1   |
| R23  | RS0562-  | RES; SMT; FILM; 5.6K; 5%; 1206         | 1   |
| R24  | RS0273-  | RES; SMT; FILM; 27K; 1/4W 5%; 1206     | 1   |
| R25  | RS0103-  | RES; SMT; FILM; 10K; 1/4W 5%; 1206     | 1   |
| R26  | RS0103-  | RES; SMT; FILM; 10K; 1/4W 5%; 1206     | 1   |

MOD GEN - 2210

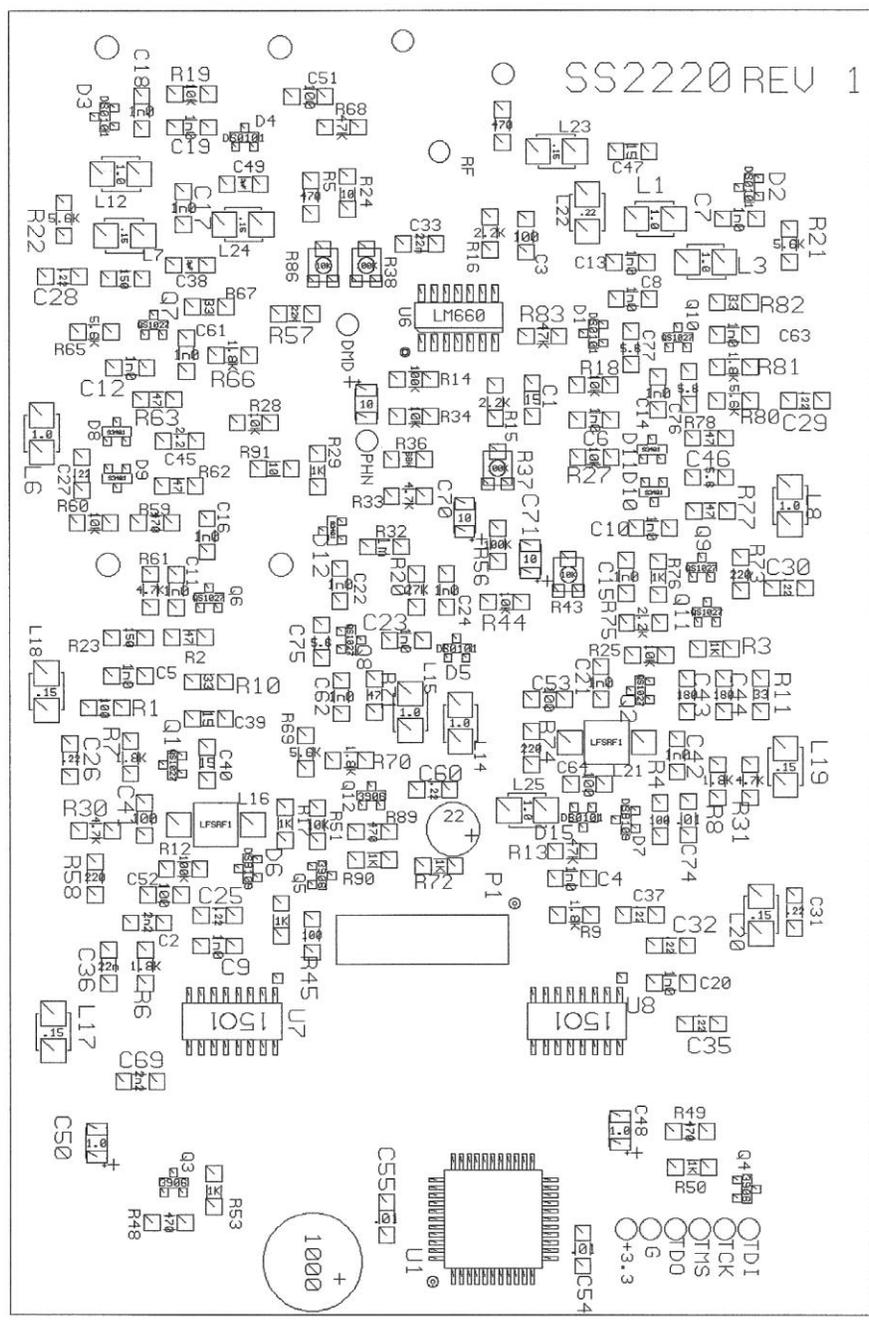
SS2215-3

| Ref# | Part #  | Description                           | Qty |
|------|---------|---------------------------------------|-----|
| R27  | RS0104- | RES; SMT; FILM; 100K; 1/4W 5%;1206    | 1   |
| R28  | RS0104- | RES; SMT; FILM; 100K; 1/4W 5%;1206    | 1   |
| R29  | RS0154- | RES; SMT; FILM; 150K ; 5%; 1206       | 1   |
| R3   | RS0334- | RES; SMT; FILM; 330K, 1/4 W, 1206     | 1   |
| R30  | RS0562- | RES; SMT; FILM; 5.6K; 5%; 1206        | 1   |
| R31  | RS0104- | RES; SMT; FILM; 100K; 1/4W 5%;1206    | 1   |
| R32  | PS0103- | POT; SMT; 10 Kohm, 3 mm.              | 1   |
| R33  | PS0103- | POT; SMT; 10 Kohm, 3 mm.              | 1   |
| R34  | PS0103- | POT; SMT; 10 Kohm, 3 mm.              | 1   |
| R35  | PS0103- | POT; SMT; 10 Kohm, 3 mm.              | 1   |
| R36  | RS0104- | RES; SMT; FILM; 100K; 1/4W 5%;1206    | 1   |
| R37  | RS0101- | RES; SMT; FILM; 100 OHM;1/4W 5%; 1206 | 1   |
| R38  | RS0101- | RES; SMT; FILM; 100 OHM;1/4W 5%; 1206 | 1   |
| R39  | RS0101- | RES; SMT; FILM; 100 OHM;1/4W 5%; 1206 | 1   |
| R4   | RS0124- | RES; SMT; FILM; 120 Kohm, 5%, 1206    | 1   |
| R40  | PS0103- | POT; SMT; 10 Kohm, 3 mm.              | 1   |
| R41  | PS0103- | POT; SMT; 10 Kohm, 3 mm.              | 1   |
| R42  | RS6221- | RES; SMT; FILM; 220 Ohm; 603          | 1   |
| R43  | RS6221- | RES; SMT; FILM; 220 Ohm; 603          | 1   |
| R44  | RS6221- | RES; SMT; FILM; 220 Ohm; 603          | 1   |
| R45  | RS6221- | RES; SMT; FILM; 220 Ohm; 603          | 1   |
| R46  | RS6221- | RES; SMT; FILM; 220 Ohm; 603          | 1   |
| R47  | RS6221- | RES; SMT; FILM; 220 Ohm; 603          | 1   |
| R48  | RS6221- | RES; SMT; FILM; 220 Ohm; 603          | 1   |
| R49  | RS6221- | RES; SMT; FILM; 220 Ohm; 603          | 1   |
| R5   | RS0204- | RES; SMT; FILM; 200K, 1206, 1/4 W     | 1   |
| R50  | RS6221- | RES; SMT; FILM; 220 Ohm; 603          | 1   |
| R51  | RS6221- | RES; SMT; FILM; 220 Ohm; 603          | 1   |
| R52  | RS6221- | RES; SMT; FILM; 220 Ohm; 603          | 1   |
| R53  | RS6221- | RES; SMT; FILM; 220 Ohm; 603          | 1   |
| R54  | RS6221- | RES; SMT; FILM; 220 Ohm; 603          | 1   |
| R55  | RS6221- | RES; SMT; FILM; 220 Ohm; 603          | 1   |
| R56  | RS6221- | RES; SMT; FILM; 220 Ohm; 603          | 1   |
| R57  | RS0204- | RES; SMT; FILM; 200K, 1206, 1/4 W     | 1   |
| R6   | RS0204- | RES; SMT; FILM; 200K, 1206, 1/4 W     | 1   |
| R60  | RS0684- | RES; SMT; FILM; 680K; 1/4W 5%; 1206   | 1   |
| R61  | RS0223- | RES; SMT; FILM; 22K, 5%, 1206         | 1   |
| R7   | RS0204- | RES; SMT; FILM; 200K, 1206, 1/4 W     | 1   |
| R8   | RS0204- | RES; SMT; FILM; 200K, 1206, 1/4 W     | 1   |
| R9   | RS0104- | RES; SMT; FILM; 100K; 1/4W 5%;1206    | 1   |
| S1   | SW2210- | SWITCHES 16 POS BCD PC MOUNT          | 1   |
| S2   | SW2210- | SWITCHES 16 POS BCD PC MOUNT          | 1   |
| U1   | ISM364- | INT. CKT.; SMT M4A3-64/32-10VC        | 1   |
| U2   | ISM364- | INT. CKT.; SMT M4A3-64/32-10VC        | 1   |
| U3   | ISM364- | INT. CKT.; SMT M4A3-64/32-10VC        | 1   |
| U4   | ISM364- | INT. CKT.; SMT M4A3-64/32-10VC        | 1   |
| U5   | IS0660- | INT. CKT.; SMT LM660 QUAD OP AMP      | 1   |
| U6   | IS0660- | INT. CKT.; SMT LM660 QUAD OP AMP      | 1   |
| U7   | ISCP42- | INT. CKT.; SMT DUAL DIGITAL POT       | 1   |
| U8   | ISG663- | INT. CKT.; SMT Quad Analog Switch     | 1   |

|      |         | MOD GEN - 2210        | SS2215-3 |  |
|------|---------|-----------------------|----------|--|
| Ref# | Part #  | Description           | Qty      |  |
| U9   | OSC400- | OSCILLATOR 40 MHz SOT | 1        |  |



RF CIRCUITS SS2228



## RF CIRCUITS

SS2220-4

| Ref# | Part #  | Description                            | Qty |
|------|---------|----------------------------------------|-----|
| C1   | CS0150- | CAP; SMT; CER; 15pf; 100V; 1206        | 1   |
| C10  | CS0102- | CAP; SMT; CER; .001 uF; 100V; 1206     | 1   |
| C11  | CS0102- | CAP; SMT; CER; .001 uF; 100V; 1206     | 1   |
| C12  | CS0102- | CAP; SMT; CER; .001 uF; 100V; 1206     | 1   |
| C14  | CS0102- | CAP; SMT; CER; .001 uF; 100V; 1206     | 1   |
| C15  | CS0102- | CAP; SMT; CER; .001 uF; 100V; 1206     | 1   |
| C16  | CS0102- | CAP; SMT; CER; .001 uF; 100V; 1206     | 1   |
| C17  | CS0102- | CAP; SMT; CER; .001 uF; 100V; 1206     | 1   |
| C18  | CS0102- | CAP; SMT; CER; .001 uF; 100V; 1206     | 1   |
| C19  | CS0102- | CAP; SMT; CER; .001 uF; 100V; 1206     | 1   |
| C2   | CS0222- | CAP; SMT; CER; 2200 PF, X7R, 10%, 1206 | 1   |
| C20  | CS0102- | CAP; SMT; CER; .001 uF; 100V; 1206     | 1   |
| C21  | CS0102- | CAP; SMT; CER; .001 uF; 100V; 1206     | 1   |
| C22  | CS0102- | CAP; SMT; CER; .001 uF; 100V; 1206     | 1   |
| C23  | CS0102- | CAP; SMT; CER; .001 uF; 100V; 1206     | 1   |
| C24  | CS0102- | CAP; SMT; CER; .001 uF; 100V; 1206     | 1   |
| C25  | CS0224- | CAP; SMT; CER; .22 uF; 50 V; 1206 case | 1   |
| C26  | CS0224- | CAP; SMT; CER; .22 uF; 50 V; 1206 case | 1   |
| C27  | CS0224- | CAP; SMT; CER; .22 uF; 50 V; 1206 case | 1   |
| C28  | CS0224- | CAP; SMT; CER; .22 uF; 50 V; 1206 case | 1   |
| C29  | CS0224- | CAP; SMT; CER; .22 uF; 50 V; 1206 case | 1   |
| C3   | CS0101- | CAP; SMT; CER; 100PF; 100V; 1206       | 1   |
| C30  | CS0224- | CAP; SMT; CER; .22 uF; 50 V; 1206 case | 1   |
| C31  | CS0224- | CAP; SMT; CER; .22 uF; 50 V; 1206 case | 1   |
| C32  | CS0224- | CAP; SMT; CER; .22 uF; 50 V; 1206 case | 1   |
| C33  | CS0223- | CAP; SMT; CER; .022 UF, X7R, 10%, 1206 | 1   |
| C35  | CS0224- | CAP; SMT; CER; .22 uF; 50 V; 1206 case | 1   |
| C36  | CS0223- | CAP; SMT; CER; .022 UF, X7R, 10%, 1206 | 1   |
| C37  | CS0224- | CAP; SMT; CER; .22 uF; 50 V; 1206 case | 1   |
| C38  | CS03R0- | CAP; SMT; CER; 3.0 pF, 10%, 1206       | 1   |
| C38  | CS0102- | CAP; SMT; CER; .001 uF; 100V; 1206     | 1   |
| C39  | CS0150- | CAP; SMT; CER; 15pf; 100V; 1206        | 1   |
| C4   | CS0102- | CAP; SMT; CER; .001 uF; 100V; 1206     | 1   |
| C40  | CS0150- | CAP; SMT; CER; 15pf; 100V; 1206        | 1   |
| C41  | CS0181- | CAP; SMT; CER; 180PF; 100V; 1206       | 1   |
| C42  | CS0102- | CAP; SMT; CER; .001 uF; 100V; 1206     | 1   |
| C43  | CS0181- | CAP; SMT; CER; 180PF; 100V; 1206       | 1   |
| C44  | CS0181- | CAP; SMT; CER; 180PF; 100V; 1206       | 1   |
| C45  | CS02R2- | CAP; SMT; CER; 2.2 PF, NPO, 5%, 1206   | 1   |
| C46  | CS05R6- | CAP; SMT; CER; 5.6pF; 100V; 1206       | 1   |
| C47  | CS0150- | CAP; SMT; CER; 15pf; 100V; 1206        | 1   |
| C49  | CS03R0- | CAP; SMT; CER; 3.0 pF, 10%, 1206       | 1   |
| C5   | CS0102- | CAP; SMT; CER; .001 uF; 100V; 1206     | 1   |
| C50  | CX0105- | CAP; SMT; TANT 1.0 uF; 35 V            | 1   |
| C51  | CS0101- | CAP; SMT; CER; 100PF; 100V; 1206       | 1   |
| C52  | CS0101- | CAP; SMT; CER; 100PF; 100V; 1206       | 1   |
| C53  | CS0101- | CAP; SMT; CER; 100PF; 100V; 1206       | 1   |
| C54  | CS0103- | CAP; SMT; CER; .01 uF; 100V; 1206      | 1   |
| C55  | CS0103- | CAP; SMT; CER; .01 uF; 100V; 1206      | 1   |
| C6   | CS0102- | CAP; SMT; CER; .001 uF; 100V; 1206     | 1   |

## RF CIRCUITS

SS2220-4

| Ref# | Part #  | Description                            | Qty |
|------|---------|----------------------------------------|-----|
| C60  | CS0224- | CAP; SMT; CER; .22 uF; 50 V; 1206 case | 1   |
| C61  | CS0102- | CAP; SMT; CER; .001 uF; 100V; 1206     | 1   |
| C62  | CS0102- | CAP; SMT; CER; .001 uF; 100V; 1206     | 1   |
| C63  | CS0102- | CAP; SMT; CER; .001 uF; 100V; 1206     | 1   |
| C64  | CS0101- | CAP; SMT; CER; 100PF; 100V; 1206       | 1   |
| C69  | CS0222- | CAP; SMT; CER; 2200 PF, X7R, 10%, 1206 | 1   |
| C7   | CS0102- | CAP; SMT; CER; .001 uF; 100V; 1206     | 1   |
| C70  | CX0105- | CAP; SMT; TANT 1.0 uF; 35 V            | 1   |
| C71  | CX0105- | CAP; SMT; TANT 1.0 uF; 35 V            | 1   |
| C74  | CS0103- | CAP; SMT; CER; .01 uF; 100V; 1206      | 1   |
| C75  | CS05R6- | CAP; SMT; CER; 5.6pF; 100V; 1206       | 1   |
| C76  | CS05R6- | CAP; SMT; CER; 5.6pF; 100V; 1206       | 1   |
| C77  | CS05R6- | CAP; SMT; CER; 5.6pF; 100V; 1206       | 1   |
| C79  | CE2263- | CAP; ALUM ELECT. 22 uF, 35 V, LOW      | 1   |
| C8   | CS0102- | CAP; SMT; CER; .001 uF; 100V; 1206     | 1   |
| C80  | CE1081- | CAP; ALUM ELECT. 1000/6.3-10V; RADIAL  | 1   |
| C9   | CS0102- | CAP; SMT; CER; .001 uF; 100V; 1206     | 1   |
| D1   | DS0101- | DIODE; SMT MMBD101                     | 1   |
| D10  | DS3401- | DIODE; SMT MMBV3401                    | 1   |
| D11  | DS3401- | DIODE; SMT MMBV3401                    | 1   |
| D12  | DS3401- | DIODE; SMT MMBV3401                    | 1   |
| D15  | DS0101- | DIODE; SMT MMBD101                     | 1   |
| D2   | DS0101- | DIODE; SMT MMBD101                     | 1   |
| D3   | DS0101- | DIODE; SMT MMBD101                     | 1   |
| D4   | DS0101- | DIODE; SMT MMBD101                     | 1   |
| D5   | DS0101- | DIODE; SMT MMBD101                     | 1   |
| D6   | DS0109- | DIODE; SMT MMBV109                     | 1   |
| D7   | DS0109- | DIODE; SMT MMBV109                     | 1   |
| D8   | DS3401- | DIODE; SMT MMBV3401                    | 1   |
| D9   | DS3401- | DIODE; SMT MMBV3401                    | 1   |
| L1   | LS01R0- | IND; FIXED; SMT 1.0 UH, 1210, 10%      | 1   |
| L12  | LS01R0- | IND; FIXED; SMT 1.0 UH, 1210, 10%      | 1   |
| L13  | LS01R0- | IND; FIXED; SMT 1.0 UH, 1210, 10%      | 1   |
| L15  | LS01R0- | IND; FIXED; SMT 1.0 UH, 1210, 10%      | 1   |
| L16  | LS0154- | IND; FIXED; SMT .15 uH; 10% SMT        | 1   |
| L17  | LS0154- | IND; FIXED; SMT .15 uH; 10% SMT        | 1   |
| L18  | LS0154- | IND; FIXED; SMT .15 uH; 10% SMT        | 1   |
| L19  | LS0154- | IND; FIXED; SMT .15 uH; 10% SMT        | 1   |
| L20  | LS0154- | IND; FIXED; SMT .15 uH; 10% SMT        | 1   |
| L21  | LS0154- | IND; FIXED; SMT .15 uH; 10% SMT        | 1   |
| L23  | LS0R15- | IND; FIXED; SMT .15 UH, 1210, 10%      | 1   |
| L24  | LS0R22- | IND; FIXED; SMT .22 UH, 1210, 10%      | 1   |
| L25  | LS01R0- | IND; FIXED; SMT 1.0 UH, 1210, 10%      | 1   |
| L26  | LS0R15- | IND; FIXED; SMT .15 UH, 1210, 10%      | 1   |
| L3   | LS01R0- | IND; FIXED; SMT 1.0 UH, 1210, 10%      | 1   |
| L6   | LS01R0- | IND; FIXED; SMT 1.0 UH, 1210, 10%      | 1   |
| L7   | LS0R15- | IND; FIXED; SMT .15 UH, 1210, 10%      | 1   |
| L8   | LS01R0- | IND; FIXED; SMT 1.0 UH, 1210, 10%      | 1   |
| Q1   | QS1027- | TRANSISTOR; SMT NPN RF Amp; MRF1027T1  | 1   |
| Q10  | QS1027- | TRANSISTOR; SMT NPN RF Amp; MRF1027T1  | 1   |

## RF CIRCUITS

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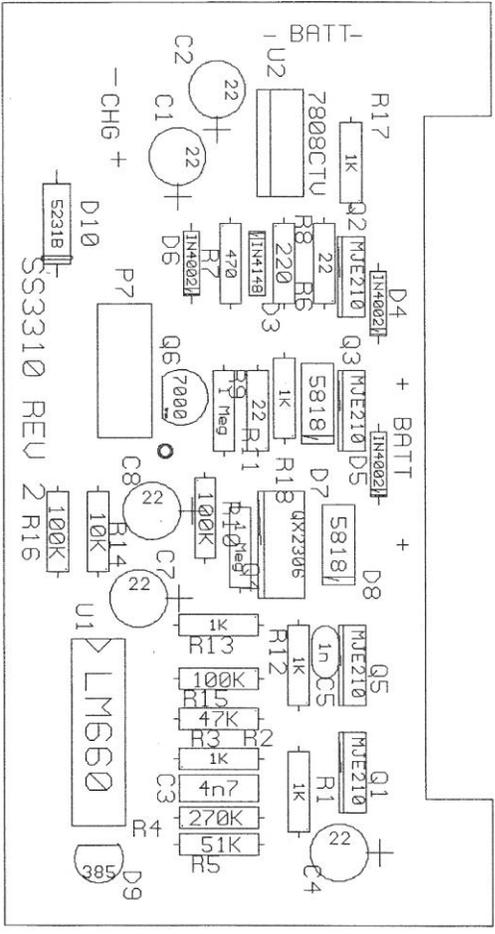
| Ref# | Part #  | Description                            | Qty |
|------|---------|----------------------------------------|-----|
| Q11  | QS1027- | TRANSISTOR; SMT NPN RF Amp; MRF1027T1  | 1   |
| Q12  | QS3906- | TRANSISTOR; SMT PNP 2N3906             | 1   |
| Q2   | QS1027- | TRANSISTOR; SMT NPN RF Amp; MRF1027T1  | 1   |
| Q3   | QS3906- | TRANSISTOR; SMT PNP 2N3906             | 1   |
| Q4   | QS3906- | TRANSISTOR; SMT PNP 2N3906             | 1   |
| Q5   | QS3906- | TRANSISTOR; SMT PNP 2N3906             | 1   |
| Q6   | QS1027- | TRANSISTOR; SMT NPN RF Amp; MRF1027T1  | 1   |
| Q7   | QS1027- | TRANSISTOR; SMT NPN RF Amp; MRF1027T1  | 1   |
| Q8   | QS1027- | TRANSISTOR; SMT NPN RF Amp; MRF1027T1  | 1   |
| Q9   | QS1027- | TRANSISTOR; SMT NPN RF Amp; MRF1027T1  | 1   |
| R1   | RS0101- | RES; SMT; FILM; 100 OHM; 1/4W 5%; 1206 | 1   |
| R10  | RS0330- | RES; SMT; FILM; 33 OHM; 5%; 1206       | 1   |
| R11  | RS0330- | RES; SMT; FILM; 33 OHM; 5%; 1206       | 1   |
| R12  | RS0104- | RES; SMT; FILM; 100K; 1/4W 5%; 1206    | 1   |
| R13  | RS0473- | RES; SMT; FILM; 47K; 1/4W 5%; 1206     | 1   |
| R14  | RS0104- | RES; SMT; FILM; 100K; 1/4W 5%; 1206    | 1   |
| R15  | RS0222- | RES; SMT; FILM; 2.2K; 5%; 1206         | 1   |
| R16  | RS0222- | RES; SMT; FILM; 2.2K; 5%; 1206         | 1   |
| R17  | RS0102- | RES; SMT; FILM; 1K; 1/4W 5%; 1206      | 1   |
| R18  | RS0103- | RES; SMT; FILM; 10K; 1/4W 5%; 1206     | 1   |
| R19  | RS0103- | RES; SMT; FILM; 10K; 1/4W 5%; 1206     | 1   |
| R2   | RS0470- | RES; SMT; FILM; 47 ohm, 1206, 5%       | 1   |
| R20  | RS0273- | RES; SMT; FILM; 27K; 1/4W 5%; 1206     | 1   |
| R21  | RS0562- | RES; SMT; FILM; 5.6K; 5%; 1206         | 1   |
| R22  | RS0562- | RES; SMT; FILM; 5.6K; 5%; 1206         | 1   |
| R23  | RS0151- | RES; SMT; FILM; 150 OHM; 5%; 1206      | 1   |
| R24  | RS0100- | RES; SMT; FILM; 10 OHM; 5%; 1206       | 1   |
| R25  | RS0103- | RES; SMT; FILM; 10K; 1/4W 5%; 1206     | 1   |
| R29  | RS0102- | RES; SMT; FILM; 1K; 1/4W 5%; 1206      | 1   |
| R3   | RS0102- | RES; SMT; FILM; 1K; 1/4W 5%; 1206      | 1   |
| R30  | RS0472- | RES; SMT; FILM; 4.7K; 1/4W 5%; 1206    | 1   |
| R31  | RS0472- | RES; SMT; FILM; 4.7K; 1/4W 5%; 1206    | 1   |
| R32  | RS0105- | RES; SMT; FILM; 1 MEG; 1/4W 5%; 1206   | 1   |
| R33  | RS0222- | RES; SMT; FILM; 2.2K; 5%; 1206         | 1   |
| R34  | RS0103- | RES; SMT; FILM; 10K; 1/4W 5%; 1206     | 1   |
| R36  | RS0683- | RES; SMT; FILM; 68K; 1/4W 5%; 1206     | 1   |
| R37  | PS0104- | POT; SMT; 100K, 20%                    | 1   |
| R38  | PS0104- | POT; SMT; 100K, 20%                    | 1   |
| R4   | RS0101- | RES; SMT; FILM; 100 OHM; 1/4W 5%; 1206 | 1   |
| R43  | PS0103- | POT; SMT; 10 Kohm, 3 mm.               | 1   |
| R44  | RS0223- | RES; SMT; FILM; 22K, 5%, 1206          | 1   |
| R45  | RS0101- | RES; SMT; FILM; 100 OHM; 1/4W 5%; 1206 | 1   |
| R46  | RS0102- | RES; SMT; FILM; 1K; 1/4W 5%; 1206      | 1   |
| R48  | RS0471- | RES; SMT; FILM; 470 OHM; 1/4W 5%; 1206 | 1   |
| R49  | RS0471- | RES; SMT; FILM; 470 OHM; 1/4W 5%; 1206 | 1   |
| R5   | RS0471- | RES; SMT; FILM; 470 OHM; 1/4W 5%; 1206 | 1   |
| R50  | RS0102- | RES; SMT; FILM; 1K; 1/4W 5%; 1206      | 1   |
| R51  | RS0103- | RES; SMT; FILM; 10K; 1/4W 5%; 1206     | 1   |
| R53  | RS0102- | RES; SMT; FILM; 1K; 1/4W 5%; 1206      | 1   |
| R56  | RS0104- | RES; SMT; FILM; 100K; 1/4W 5%; 1206    | 1   |

## RF CIRCUITS

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| Ref# | Part #  | Description                            | Qty |
|------|---------|----------------------------------------|-----|
| R57  | RS0223- | RES; SMT; FILM; 22K, 5%, 1206          | 1   |
| R58  | RS0471- | RES; SMT; FILM; 470 OHM; 1/4W 5%; 1206 | 1   |
| R59  | RS0471- | RES; SMT; FILM; 470 OHM; 1/4W 5%; 1206 | 1   |
| R6   | RS0182- | RES; SMT; FILM; 1.8K; 1/4W 5%; 1206    | 1   |
| R60  | RS0103- | RES; SMT; FILM; 10K; 1/4W 5%; 1206     | 1   |
| R61  | RS0472- | RES; SMT; FILM; 4.7K; 1/4W 5%; 1206    | 1   |
| R62  | RS0470- | RES; SMT; FILM; 47 ohm,1206, 5%        | 1   |
| R63  | RS0470- | RES; SMT; FILM; 47 ohm,1206, 5%        | 1   |
| R64  | RS0103- | RES; SMT; FILM; 10K; 1/4W 5%; 1206     | 1   |
| R65  | RS0562- | RES; SMT; FILM; 5.6K; 5%; 1206         | 1   |
| R66  | RS0182- | RES; SMT; FILM; 1.8K; 1/4W 5%; 1206    | 1   |
| R67  | RS0330- | RES; SMT; FILM; 33 OHM; 5%; 1206       | 1   |
| R68  | RS0473- | RES; SMT; FILM; 47K; 1/4W 5%; 1206     | 1   |
| R69  | RS0562- | RES; SMT; FILM; 5.6K; 5%; 1206         | 1   |
| R7   | RS0182- | RES; SMT; FILM; 1.8K; 1/4W 5%; 1206    | 1   |
| R70  | RS0182- | RES; SMT; FILM; 1.8K; 1/4W 5%; 1206    | 1   |
| R71  | RS0470- | RES; SMT; FILM; 47 ohm,1206, 5%        | 1   |
| R72  | RS0102- | RES; SMT; FILM; 1K; 1/4W 5%; 1206      | 1   |
| R73  | RS0221- | RES; SMT; FILM; 220 OHM; 1/4W 5%;1206  | 1   |
| R74  | RS0221- | RES; SMT; FILM; 220 OHM; 1/4W 5%;1206  | 1   |
| R75  | RS0222- | RES; SMT; FILM; 2.2K; 5%; 1206         | 1   |
| R76  | RS0102- | RES; SMT; FILM; 1K; 1/4W 5%; 1206      | 1   |
| R77  | RS0470- | RES; SMT; FILM; 47 ohm,1206, 5%        | 1   |
| R78  | RS0470- | RES; SMT; FILM; 47 ohm,1206, 5%        | 1   |
| R79  | RS0103- | RES; SMT; FILM; 10K; 1/4W 5%; 1206     | 1   |
| R8   | RS0182- | RES; SMT; FILM; 1.8K; 1/4W 5%; 1206    | 1   |
| R80  | RS0562- | RES; SMT; FILM; 5.6K; 5%; 1206         | 1   |
| R81  | RS0182- | RES; SMT; FILM; 1.8K; 1/4W 5%; 1206    | 1   |
| R82  | RS0330- | RES; SMT; FILM; 33 OHM; 5%; 1206       | 1   |
| R83  | RS0473- | RES; SMT; FILM; 47K; 1/4W 5%; 1206     | 1   |
| R86  | PS0103- | POT; SMT; 10 Kohm, 3 mm.               | 1   |
| R89  | RS0471- | RES; SMT; FILM; 470 OHM; 1/4W 5%; 1206 | 1   |
| R9   | RS0182- | RES; SMT; FILM; 1.8K; 1/4W 5%; 1206    | 1   |
| R90  | RS0102- | RES; SMT; FILM; 1K; 1/4W 5%; 1206      | 1   |
| R91  | RS0100- | RES; SMT; FILM; 10 OHM; 5%; 1206       | 1   |
| U1   | ISM364- | INT. CKT.; SMT M4A3-64/32-10VC         | 1   |
| U6   | IS0660- | INT. CKT.; SMT LM660 QUAD OP AMP       | 1   |
| U6   | IS0660- | INT. CKT.; SMT LM660 QUAD OP AMP       | 1   |
| U6   | IS0660- | INT. CKT.; SMT LM660 QUAD OP AMP       | 1   |
| U6   | IS0660- | INT. CKT.; SMT LM660 QUAD OP AMP       | 1   |
| U7   | IS1501- | INT. CKT.; SMT FREQ. SYNTH             | 1   |
| U8   | IS1501- | INT. CKT.; SMT FREQ. SYNTH             | 1   |





POWER SUPPLY  
SS3310 REV 2

## POWER SUPPLY, 3300

SS3310-3

| Ref# | Part #  | Description                            | Qty |
|------|---------|----------------------------------------|-----|
| C1   | CE2263- | CAP; ALUM ELECT. 22 uF, 35 V, LOW      | 1   |
| C2   | CE2263- | CAP; ALUM ELECT. 22 uF, 35 V, LOW      | 1   |
| C3   | CR1034- | CAP; MONO-CERAMIC .01; 50V AXIAL       | 1   |
| C4   | CE2263- | CAP; ALUM ELECT. 22 uF, 35 V, LOW      | 1   |
| C5   | CR1024- | CAP; MONO-CERAMIC .001uF; 100V         | 1   |
| C7   | CE2263- | CAP; ALUM ELECT. 22 uF, 35 V, LOW      | 1   |
| C8   | CE2263- | CAP; ALUM ELECT. 22 uF, 35 V, LOW      | 1   |
| C9   | CR1034- | CAP; MONO-CERAMIC .01; 50V AXIAL       | 1   |
| D10  | DD5231- | DIODE ZENER; 1N5231                    | 1   |
| D3   | DD4148- | DIODE 1N4148                           | 1   |
| D4   | DD4002- | DIODE 1N4002                           | 1   |
| D5   | DD4002- | DIODE 1N4002                           | 1   |
| D6   | DD4002- | DIODE 1N4002                           | 1   |
| D7   | DD5819- | DIODE 1N5819                           | 1   |
| D8   | DD5819- | DIODE 1N5819                           | 1   |
| D9   | DD0385- | DIODE REFERENCE 2.5V                   | 1   |
| P7   | ECGP10- | CONNECTOR 10 PIN BOARD PLUG            | 1   |
| Q1   | QX0210- | TRANSISTOR MJE210                      | 1   |
| Q2   | QX0210- | TRANSISTOR MJE210                      | 1   |
| Q3   | QX0210- | TRANSISTOR MJE210                      | 1   |
| Q4   | QX2306- | TRANSISTOR 23P06                       | 1   |
| Q5   | QX0210- | TRANSISTOR MJE210                      | 1   |
| Q6   | QX7000- | TRANSISTOR 2N7000                      | 1   |
| R1   | RC0102- | RESISTOR; CARB. 1 Kohm; 5%; 1/4 watt   | 1   |
| R10  | RC0104- | RESISTOR; CARB. 100K 5% 1/4W           | 1   |
| R11  | RC0105- | RESISTOR; CARB. 1 Megohm; 5%; 1/4 watt | 1   |
| R12  | RC0102- | RESISTOR; CARB. 1 Kohm; 5%; 1/4 watt   | 1   |
| R13  | RC0102- | RESISTOR; CARB. 1 Kohm; 5%; 1/4 watt   | 1   |
| R14  | RC0103- | RESISTOR; CARB. 10 Kohm; 5%; 1/4 watt  | 1   |
| R15  | RC0104- | RESISTOR; CARB. 100K 5% 1/4W           | 1   |
| R16  | RC0104- | RESISTOR; CARB. 100K 5% 1/4W           | 1   |
| R17  | RC0102- | RESISTOR; CARB. 1 Kohm; 5%; 1/4 watt   | 1   |
| R18  | RC0102- | RESISTOR; CARB. 1 Kohm; 5%; 1/4 watt   | 1   |
| R19  | RC0105- | RESISTOR; CARB. 1 Megohm; 5%; 1/4 watt | 1   |
| R2   | RC0102- | RESISTOR; CARB. 1 Kohm; 5%; 1/4 watt   | 1   |
| R20  | RC0182- | RESISTOR; CARB. 1.8 Kohm; 5%; 1/4 watt | 1   |
| R21  | RC0182- | RESISTOR; CARB. 1.8 Kohm; 5%; 1/4 watt | 1   |
| R3   | RC0473- | RESISTOR; CARB. 47 Kohm; 5%; 1/4 watt  | 1   |
| R4   | RC0184- | RESISTOR; CARB. 180K 1/4W 5%           | 1   |
| R5   | RC0513- | RESISTOR; CARB. 51K; 1/4W;5%           | 1   |
| R6   | RC0221- | RESISTOR; CARB. 220 Ohm; 5%; 1/4 watt  | 1   |
| R7   | RC0471- | RESISTOR; CARB. 470 Ohm; 5%; 1/4 watt  | 1   |
| R8   | RC0220- | RESISTOR; CARB. 22 Ohm; 5%; 1/4 watt   | 1   |
| R9   | RC0220- | RESISTOR; CARB. 22 Ohm; 5%; 1/4 watt   | 1   |
| U1   | IM0660- | INT. CKT.; MISC. LMC660                | 1   |
| U1   | IM0660- | INT. CKT.; MISC. LMC660                | 1   |
| U2   | IM7808- | INT. CKT.; MISC. REGULATOR; 8V 7808    | 1   |