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## SUPPORT MANUAL

for the
Apollo Block II Special Test Equipment
PM RECEIVER
$\qquad$

This manual was prepared in accordance with Collins specification 514-0001-001E, Appendix D.
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SUPPORT MANUAL<br>for the<br>Apollo Block II Special Test Equipment<br>PM RECEIVER



MOTOROLA INC.
Military Electronics Division WESTERN CENTER

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## SECTION I. DESCRIPTION

## 1-1. INTRODUCTION

1-2. The PM Receiver, Motorola Part No. 01-22981G01, is manufactured for Collins Radio Company under Contract No. NASA 9-150, by Motorola Inc., Military Electronics Division, Scottsdale, Arizona. This assembly, shown in figures $1-1$ and $1-2$, is supplied as a part of the Special Test Equipment (STE) used in testing the Apollo Block II Unified S-Band Equipment (USBE). 1-3. This manual contains information that will enable an experienced technician to operate, test, calibrate, and repair the PM Receiver.

## 1-4. PURPOSE OF EQUIPMENT

1-5. The PM Receiver converts an S-band input signal of 2287.5 mc from the USBE to a l0-mc intermediate frequency for use in ranging test equipment, and provides four information outputs for monitoring and testing the Unified S-Band Equipment. A simplified block diagram showing the relationship of the PM Receiver to the USBE, and to other STE is shown in figure 1-3.

1-6. EQUIPMENT CHARACTERISTICS
1-7. PHYSICAL CHARACTERISTICS
1-8. The PM Receiver is completely self contained in a standard 19-inch wide electronic equipment drawer. The drawer is provided with slides for mounting in a standard commercial electronic equipment cabinet with an Electronic Industries Association (EIA) mounting pattern. Overall dimensions of the drawer are 21 x $16-1 / 2 \times 8$ inches. The front panel is $19 \times 8-3 / 4$ inches.

1-9. The PM Receiver requires no special cooling, and may be bench operated in addition to its normal equipment cabinet operation. No special mounts are required for bench operation.


Figure 1-1. PM Receiver, Front View


Figure 1-2. PM Receiver, Rear View


Figure 1-3. PM Receiver/STE/USBE System Relationship

1-10. All frequently-used controls, displays, and electrical connections are located on the drawer front panel. The primary power input jack, fuse holder, and ranging output jacks are located on the drawer rear panel and need not be disturbed during normal operation.

1-11. The PM Receiver contains 13 subassemblies, as listed in Table l-1. All subassembly replacements can be accomplished with the drawer mounted in the cabinet. Checkout, troubleshooting, and calibration can be performed on most subassemblies without removing the subassemblies from the drawer. Barrier strips are conveniently located for testing and removal of subassembly interconnect wiring. Adjustments and test points are listed in the checkout and calibration procedures in section $V$.

1-12. Access may be gained to most subassemblies and their components by raising the subassemblies to an extended position and sliding the subassembly cover open. Figures 1-4 and 1-5 illustrate typical subassembly position for checkout, troubleshooting, or calibration operations.

1-13. Table 1-1 lists the subassembly reference designators used throughout this manual. Subassembly input jacks, test points, and output jacks are prefixed with the subassembly reference designator. For example, jack J2 of subassembly A5 is referred to as A5J2. Assembly input jacks, test points, and output jacks are not prefixed with reference designators.

TABLE 1-1. PM RECEIVER SUBASSEMBLIES

| Ref <br> Desig. | Name | Motorola <br> Part No. |
| :---: | :--- | :---: |
| 1A2 | PM Receiver <br> A1 Mc VCO and X96 Multiplier <br> A2 | 23 M-Band Mixer and 50 Mc <br> Pre-Amplifier <br> 50 Mc Mixer and 10 Mc AGC <br> Amplifier |



Figure 1-4. Subassembly Extended and Raised


Figure 1-5. Subassembly with Cover Open

TABLE 1-1. (cont)

| Ref. Desig. | Name | Motorola Part No. |
| :---: | :---: | :---: |
| A 4 | 10 Mc Distribution Amplifier | 01-22806G01 |
| A5 | 10 Mc IF Amplifier | 01-22811G01 |
| A6 | Loop Phase Detector/Loop Filter | 01-22816G01 |
| A 7 | 20 Mc Oscillator and X3 Multiplier | 01-22821G01 |
| A8 | X $1 / 2$ Multiplier and 10 Mc Reference Distribution Amplifier | 01-22826G01 |
| A9 | Coherent Amplitude Detector, AGC Amplifier, and Relay Driver | 01-22831G01 |
| A10 | 10 Mc Wideband Phase Detector and 10 Mc Narrow-Band Discriminator | 01-22836G01 |
| All | Video Amplifier | 01-22841G01 |
| PS2 | -12 VDC Power Supply | 01-29938B22 |
| PSI | $\pm 15$ VDC Power Supply | 01-28091G01 |

1-14. ELECTRICAL CHARACTERISTICS
1-15. The PM Receiver is a phase lock loop, double conversion superheterodyne employing solid-state circuitry. The electrical characteristics of the PM Receiver are listed in Table 1-2.

TABLE 1-2. PM RECEIVER ELECTRICAL CHARACTERISTICS

| INPUTS |  |
| :---: | :---: |
| Frequency | $2287.5 \mathrm{mc} \pm 100 \mathrm{kc}$ |
| Signal Level | 0 to -50 dbm |
| VSWR | 1.3:1 maximum with respect to 50 ohms at $\pm 20 \mathrm{mc}$ of $\mathrm{f}_{\mathrm{o}}$. |
| Noise Figure | 14 db maximum with attenuator set at minimum. |
| Attenuation Range | 30 db |
| First IF Frequency | 50 mc |

## TABLE 1-2. (cont)

## INPUTS (cont)

## Second IF Frequency

Tracking Bandwidth

Phase Stability

Transfer Function

## AGC Loop

Bandwidth
Gain
Range (AGC/MGC)

Transfer Function

## Oscillator Stability

23 mc VCO
20 mc reference

## Manual Acquisition Range at S-Band

Time Delay Variation OUTPUTS

## Information Outputs

Emergency Voice (J5)
(Discriminator Output)
10 kc Subcarrier (J4)

10 mc
$21.2 \mathrm{cps}=\beta_{\mathrm{L}}$
$400 \mathrm{cps}=\beta_{\mathrm{L}}$
$3.0^{\circ}$ maximum in 21.2 cps bandwidth
$H$ (S) $\frac{1+T_{2} S}{1+T_{2} S+\frac{T_{1}}{G} S^{2}}$ for $\frac{1}{G}<T_{2}$

0 db open loop at 5 cps maximum 40 db (minimum)

20 db
$H$ (S) $\frac{1}{1+\frac{T_{S}}{G}}$ for $G<1$
$1 \times 10^{-6} / 3$ hour long term
$2.5 \times 10^{-6} / 3$ hour long term.
$\pm 100 \mathrm{kc}$ in 400 cps Bandwidth $\pm 40 \mathrm{kc}$ in 21.2 cps Bandwidth
1 nanosecond ( $10^{-9}$ ) maximum
. $1 \mathrm{v} / \mathrm{kc}$ Sensitivity
$\mathrm{BW}(3 \mathrm{db})=300 \mathrm{cps}$ to 2 kc
$0 \mathrm{dbm} \pm 1 \mathrm{db} / 50 \Omega$
BW (3 db) $=\mathrm{f}_{\mathrm{o}} \pm 1 \mathrm{kc}$ nominal

TABLE 1-2. (cont)

| OUTPUTS (cont) |  |
| :---: | :---: |
| 100 kc Subcarrier (J4) | $\begin{aligned} & 0 \mathrm{dbm} \pm 1 \mathrm{db} / 50 \Omega \\ & \mathrm{BW}(3 \mathrm{db})=\mathrm{f}_{\mathrm{o}} \pm 5 \mathrm{kc} \text { nominal } \end{aligned}$ |
| 500 kc Subcarrier (J4) | $\begin{aligned} & 0 \mathrm{dbm} \pm 1 \mathrm{db} / 50 \Omega \\ & \mathrm{BW}(3 \mathrm{db})=f_{0} \pm 12.5 \mathrm{kc} \text { nominal } \end{aligned}$ |
| 1.024 mc Subcarrier (J4) | $\begin{aligned} & 0 \mathrm{dbm} \pm 1 \mathrm{db} / 50 \Omega \\ & \mathrm{BW}(3 \mathrm{db}) \stackrel{f_{0}}{=} \pm 10 \mathrm{kc} 10 \% \end{aligned}$ |
| 1.25 mc Subcarrier (J4) | $\begin{aligned} & 0 \mathrm{dbm} \pm 1 \mathrm{db} / 50 \Omega \\ & \mathrm{BW}(3 \mathrm{db})=\mathrm{f}_{\mathrm{o}} \pm 10 \mathrm{kc} 10 \% \end{aligned}$ |
| Ranging Outputs |  |
| 10 mc Predetection (J9) | $-10 \mathrm{dbm} \pm 1 \mathrm{db} / 50 \Omega$ with carrier only (i.e., no modulation) |
| 10 mc Reference (J10) | $+10 \mathrm{dbm} \pm 2 \mathrm{db} / 50 \Omega$ |
| Monitor Outputs |  |
| AGC Voltmeter | 0-10 vdc |
| Dynamic Phase Error | Front Panel BNC |
| Static Phase Error | Meter |
| 23 mc VCO Test | Front Panel BNC <br> $0 \mathrm{dbm} \pm 1 \mathrm{db} / 50 \Omega$ |
| 50 mc Spectrum | Front Panel BNC <br> $-22 \mathrm{dbm} \pm 1 \mathrm{db} / 50 \Omega$ |
| POWER SOURCE REQUIRED | 115 vac $\pm 10 \%, 60 \mathrm{cps}$, single phase, 100 watt maximum power consumption |

1-16. CONTROLS, DISPLAYS, AND ELECTRICAL CONNECTIONS
1-17. The PM Receiver controls are all located on the drawer front panel, and are illustrated in figure l-6. The description and function of each control is listed in Table 1-3.

TABLE 1-3. PM RECEIVER CONTROLS

| Control | Description | Function |
| :---: | :---: | :---: |
| ATTENUATOR | Input Variable Attenuator Dial, 0-30 db | Attenuates Large Input Signals |
| VCO MANUAL CONTROL | 10 Turn Potentiometer with Counting Dial | Manual Acquisition |
| MGC/AGC GAIN CONTROL | Illuminated Rectangular Pushbutton Switch | Selects AGC or MGC |
| MGC | Two Watt Potentiometer | Varies MGC Level |
| 400 CPS / 21 | Illuminated Rectangular | Selects 400 cps |
| CPS LOOP CONTROL | Pushbutton Switch | or 21.2 cps Bandwidth |
| OPEN/CLOSED | Illuminated Rectangular | Selects Open Loop |
| LOOP CONTROL | Pushbutton Switch | or Closed Loop Position |
| POWER | Illuminated Rectangular Pushbutton Switch | Turns Prime Power ON or OFF |
| VIDEO OUTPUT | Six Position Rotary Selector Switch | Selects Video Outputs of $10 \mathrm{kc}, 100 \mathrm{kc}$, $500 \mathrm{kc}, 1.024 \mathrm{mc}$, 1.25 mc , or Wideband Video at J4. |

1-18. The PM Receiver displays are all located on the front panel, with the exception of the fuse indicator, which is located on the rear panel. The descriptions and functions of the displays are listed in Table 1-4.

1-19. Electrical connections of the PM Receiver are illustrated in figures 1-6 and 1-7. The descriptions and functions of the electrical connections are contained in Table 1-5.

1-20. TEST EQUIPMENT
1-21. The following test equipment shall be calibrated using standards traceable to the National Bureau of Standards, Boulder, Colorado.


Figure 1-6. PM Receiver Front Panel

$\stackrel{-}{\stackrel{1}{\omega}} \stackrel{+}{\omega}$
Figure 1-7. PM Receiver Rear Panel

TABLE 1-4. PM RECEIVER DISPLAYS

| Display | Description | Function |
| :---: | :---: | :---: |
| FM TUNING | -50 to 0 to 50 vdc Null Meter, calibrated in KC | Aids in tuning VCO Manual Control for Acquisition |
| LOOP STATUS <br> IN LOCK/OUT OF LOCK | Indicator Light | Indicates Status of Loop |
| SIGNAL <br> STRENGTH | 0 to -10 vdc Voltmeter | Indicates Input Signal Level |
| STATIC $\phi$ ERROR | -0.5 to 0 to 0.5 vdc Null Voltmeter | Indicates Phase Error |
| Fuse* | Three Amp Fuse Contained in Indicating Fuse Holder | Protects PM <br> Receiver against <br> Overload and Lights <br> when Fuse is Blown |

*Located on rear of drawer.

TABLE 1-5. PM RECEIVER ELECTRICAL CONNECTIONS

| Electrical Connection | Description | Function |
| :---: | :---: | :---: |
| AC Power*, Jl Hubell male receptacle | 115 vac, 60 cps , Single Phase | Prime Power Input |
| Ground* | Chassis Ground | Chassis Ground |
| DYNAMIC $\varnothing$ ERROR, J3 | BNC | Phase Error Output |
| 50 MC SPECTRUM, J6 | BNC | 1st IF Spectrum Test Output |
| 10 mc Predetection Output*, J9 | BNC | Information Output to Ranging Receiver |
| 10 mc Reference Output*, J10 | BNC | ```Reference Output to Ranging Receiver Drawer, 4A3J3``` |

TABLE 1-5. PM RECEIVER ELECTRICAL CONNECTIONS (cont)

| Electrical Connection | Description | Function |
| :---: | :---: | :---: |
| 20 MC OSC TEST, J7 | BNC | Test 20 mc Oscillator Frequency |
| $23 \mathrm{MC} \mathrm{VCO} \mathrm{TEST}, \mathrm{J8}$ | BNC | Test 23 mc VCO Frequency |
| VIDEO, J4 | BNC | Information Output for USBE Test |
| VOICE, J5 | BNC | Information Output for USBE Test |
| RF INPUT, J2 | BNC | PM Receiver RF Input |

*Located on rear of drawer.

1-22. COMMERCIAL EQUIPMENT REQUIRED.
1-23. The commercial equipment, or its equivalent, required for electrical checkout of the PM Receiver, is listed alphabetically in Table l-6. Where two or more pieces of identical equipment are used in the same test, the number required is listed in parentheses.

NOTE
Refer to individual equipment manuals for correct operating procedures, warmup times, and calibration intervals.

TABLE 1-6. COMMERCIAL TEST EQUIPMENT

| Equipment Name | Manufacturer | Type |
| :--- | :--- | :--- |
| Attenuator, 6 db | Microlab | AB06N |
| Attenuator, 10 db | Microlab | AB10N |
| DC Power Supply (3) | Power Designs | 5015 A |

TABLE 1-6. COMMERCIAL TEST EQUIPMENT (cont)

| Equipment Name | Manufacturer | Type |
| :---: | :---: | :---: |
| DC Null Voltmeter | Hewlett Packard | 413A |
| DC Voltmeter (Electronic) | Hewlett Packard | 410C |
| DC Voltmeter-OhmmeterAmmeter | Hewlett Packard | 412A |
| Differential DC-AC Voltmeter | John Fluke | 803B |
| Digital Recorder | Hewlett Packard | 561B |
| Digital Voltmeter | Cimeron | 7200A |
| Directional Coupler | Narda | $\begin{aligned} & 3003-10,-20 \\ & \text { (one each) } \end{aligned}$ |
| Frequency Counter | Hewlett Packard | 5245L |
| Frequency Converter Unit | Hewlett Packard | 5251A |
| Frequency Converter Unit | Hewlett Packard | 5254A |
| Frequency Meter | Hewlett Packard | 536A |
| Isolator | $E$ and $M$ | S22N |
| Low Frequency Function Generator | Hewlett Packard | 202A |
| Noise Figure Meter | Hewlett Packard | 340B |
| Oscilloscope | Tektronix | 543 |
| Wide-Band <br> Calibrated Preamp | Tektronix | B |
| PM Transmitter | Motorola | 2 Al |
| Power Meter | Hewlett Packard | 431B |
| Thermistor Mount | Hewlett Packard | 478A |
| Recorder | Sanborn | 7714A |
| RF Sweep Generator | Jerrold | 602 |
| RF Voltmeter | Boonton Electronics Corp. | 91-CA |
| Adapter, 50 Ohm | Boonton Electronics Corp. | $91-8 \mathrm{~B}$ |
| Adapter, Unterminated | Boonton Electronics Corp. | 91-6B |

TABLE 1-6. COMMERCIAL TEST EQUIPMENT (cont)

| Equipment Name | Manufacturer | Type |
| :--- | :--- | :--- |
| RMS Voltmeter | Hewlett Packard | 400 D |
| RMS Voltmeter | Hewlett Packard | 3400 A |
| Signal Generator, FM-AM | Boonton Radio Co. | 202 H |
| Signal Generator | Hewlett Packard | 8614 A |
| Signal Generator, HF | Hewlett Packard | 606 A |
| Sampling Oscilloscope | Hewlett Packard | 185 B |
| Dual-Trace Amplifier | Hewlett Packard | 187 C |
| Selektives Mikro- | Rohde and Schwarz | USVH |
| Voltmeter | Hewlett Packard | 805 C |
| Slotted Line |  |  |
| Spectrum Analyzer | Hewlett Packard | 8551 A |
| RF Section | Hewlett Packard | 851 A |
| Display Section | Hewlett Packard | 415 D |
| SWR Meter | Microlab | TA5MN |
| Termination, 50 Ohm (4) | Motorola | 2 A 2 |
| Test Translator | Hewlett Packard | 349 |
| UHF Noise Source | Hewlett Packard | 355 C |
| VHF Attenuator (step) | Triplet | 630 A |
| (one each) | $200 C D$ |  |
| Volt-Ohm-Miliammeter | Hewlett Packard |  |
| Wide-Range Oscillator |  |  |

1-24. SPECIAL TEST FIXTURES
1-25. The special test fixtures, not supplied with the PM Receiver, are necessary to check out and calibrate PM Receiver subassemblies Al, A9, and Al0. The following circuit descriptions, schematic diagrams, and parts lists will enable an experienced technician to construct and operate these test fixtures.

1-26. BIAS BOX TEST FIXTURE. The Bias Box Test Fixture provides a high resolution variable voltage from -7.5 to +7.5 vdc, used to
adjust the sensitivity and linearity of the 23 mc VCO in subassembly Al. The fixture circuitry consists of two 7-1/2 volt dry cell batteries connected in series with a l0-turn 10 K -ohm potentiometer. The wiper of the potentiometer is connected to an output voltage BNC.

1-27. A schematic diagram of the test fixture is shown in figure 1-8. Required parts are listed in Table 1-7.

TABLE 1-7. 23 MC VCO BIAS BOX TEST FIXTURE PARTS LIST

| Part | Mil Part No. or Mfg. Part No. | Manufacturer | No. <br> Required |
| :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { Connector, } \\ & \text { BNC } \end{aligned}$ | UG 1094/U | Schweber Elect | 1 |
| $\begin{aligned} & \text { Banana, Jack, } \\ & \text { Nylon } \end{aligned}$ | 1508 | H. H. Smith | 2 |
| Switch, Toggle DPDT | MS35059-23 | Microswitch | 1 |
| $\begin{aligned} & \text { Battery, } \\ & 6-71 / 2 \mathrm{v} \end{aligned}$ | 773 | Eveready | 2 |
| Potentiometer, Ww, 10-turn, 10 K Ohm | 3500S-2-103 | Bourns | 1 |

1-28. AGC AMPLIFIER TEST FIXTURE. The AGC Amplifier Test Fixture aids in setting the input level to the AGC Amplifier and Relay Driver portion of subassembly A9, and in checkout of the d-c gain, module time constant, and relay switching functions.

1-29. The fixture circuitry consists of a resistive network (25 K-ohm, 1 K -ohm, 10 ohms, and 39 K -ohm) for setting the dc input level, and a switch, $S l$, for changing the input level; a resistive network ( $2700 \mathrm{ohm}, 5 \mathrm{~K}$-ohm, and 560 ohm ), and a switch,


Figure 1-8. Bias Box Test Fixture

S3, for adjusting the MGC level; and associated test points (TPI, $2,4,7$, and 8) for monitoring the dc output and relay output. 1-30. A schematic diagram of the fixture is shown in figure 1-9. Required parts are listed in Table 1-8.

1-31. $50 \mathrm{MC} / 60 \mathrm{MC}, 10 \mathrm{MC}$ MIXER TEST FIXTURE. The $50 \mathrm{Mc} / 60 \mathrm{Mc}$, 10 Mc Test Fixture is necessary as no commercial $10-\mathrm{Mc}$ fm signal generator is available. A $60-\mathrm{Mc}$ fm signal is mixed with a $50-\mathrm{Mc}$ cw signal in the test fixture, and the $10 \mathrm{mc} f \mathrm{~m}$ output is used in testing the 10-Mc Narrow-Band Discriminator and 10 Mc Wideband Phase Detector (subassembly Al0).

1-32. The $50 \mathrm{Mc} / 60 \mathrm{Mc}, 10 \mathrm{Mc}$ Mixer Test Fixture circuitry consists of a balanced set of diodes in a quadrature bridge

TABLE 1-8. AGC AMPLIFIER TEST FIXTURE PARTS LIST

| Part | Mil Part No. or Mfg Part No. | Manufacturer | No. Required |
| :---: | :---: | :---: | :---: |
| Connector, 15 Pin | DAM-15S-C33 | Cinch | 1 |
| Connector, BNC | UG 1094/U | Schweber Elect | 3 |
| Jack, Tip, Nylon (Test Points) | MS16108 | Raytheon | 5 |
| Jack, Banana, Nylon | 1508-102 | H. H. Smith | $\begin{aligned} & \quad 4 \\ & \text { (one with grd } \\ & \text { strap) } \end{aligned}$ |
| Switch Toggle, SPDT | MS35058-23 | Microswitch | 2 |
| Potentiometer, <br> 5 Kilohm, $\frac{1}{2}$ watt, <br> 1 turn | RF6LAYSA 502A | CTS | 1 |
| Potentiometer, 25 Kilohm, $\frac{1}{2}$ watt, 1 turn | RV6LAYSA253A | CTS | 1 |
| Resistor, Fxd, <br> Comp., $\frac{1}{4} \mathrm{~W}$, <br> 560 Ohm, $\pm 5 \%$ | RC07GF561J | Allen-Bradley | 1 |
| $\begin{aligned} & \text { Resistor, Fxd, } \\ & \text { Comp. } \frac{1}{4} \text {, } \\ & 270 \text { Ohm } \pm 5 \% \end{aligned}$ | RC07GH271J | Allen-Bradley | 1 |
| $\begin{aligned} & \text { Resistor, Fxd, } \\ & \text { Comp., } \frac{1}{4} \text { W, } \\ & 10 \text { Ohm } \pm 5 \% \end{aligned}$ | RC07GF100J | Allen-Bradley | 1 |
| Resistor, Fxd, Comp., $\frac{1}{4} \mathrm{~W}$, 39 Kilohm $\pm 5 \%$ | RC07GF393J | Allen-Bradley | 1 |
| Resistor, Fxd, Comp., $\frac{1}{4} \mathrm{~W}$, 1 Kilohm $\pm 5 \%$ | RC07GF102J | Allen-Bradley | 1 |
| Resistor, Fxd, <br> Comp., 1 W , <br> 150 Ohm $\pm 5 \%$ | RC42GF151J | Allen-Bradley | 1 |



Figure 1-9. AGC Amplifier Test Fixture
arrangement, two transformers for the $L O$ and $r-f$ input signals, and a transformer and filter for the i-f output signal.

1-33. A schematic diagram of the fixture is shown in figure l-10. Required parts are listed in Table 1-9.


Figure 1-10. $50 \mathrm{Mc} / 60 \mathrm{Mc}, 10 \mathrm{Mc}$ Mixer Test Fixture.

TABLE 1-9. $50 \mathrm{MC} / 60 \mathrm{MC}$, 10 MC MIXER TEST FIXTURE PARTS LIST

| Part | Mil Part No. or Mfg Part No. | Manufacturer | No. Required |
| :---: | :---: | :---: | :---: |
| Capacitor, Fxd, Mica, 120 pf, $\pm 5 \%$ | DM10-121J | E1 Menco | 4 |
| Choke, 6.8 uH | 1537-32 | Delevan | 2 |
| Connector, BNC | UG 1094/U | Schweber Elect | 3 |
| Diode Bridge | FA 4000 | Fairchild | 1 |
| $\begin{aligned} & \text { Resistor, Fxd, } \\ & \text { Comp, } \frac{1}{4} \mathrm{~W} \text {, } \\ & \pm 5 \% \end{aligned}$ | RC07 GF 560 J | Allen-Bradley | 1 |
| Transformer <br> (T1 \& T2) 8: <br> 12/12 Ratio <br> Transformer Core <br> 30 AWG Magnet Wire | CF 101-Q1 | Indiana General | 2 |
| Transformer (T3) <br> 20: 9 Ratio <br> Transformer Core <br> 30 AWG Magnet Wire | T 25-2 | Micro Metals | 1 |

## SECTION II. INSTALLATION AND OPERATION

## 2-1. INTRODUCTION

2-2. This section contains instructions for unpacking, inspection, packing, installation, and operation of the PM Receiver.

2-3. UNPACKING, INSPECTION, AND PACKING
2-4. UNPACKING
2-5. The PM Receiver is packaged for shipment in a molded polyethylene foam container, a fiberboard carton, and a plywood box, as illustrated in figure 2-1. Unpacking is performed by removing the packing materials and equipment as follows:
a. Remove the 12 Klimp fasteners securing the cover of the plywood box and remove the cover.
b. Remove the latex hair mats from the top and sides of the fiberboard carton.
c. Remove and open the fiberboard carton.
d. Remove the barrier bag enclosed polyethylene container from the fiberboard carton.
e. Remove the barrier bag and banding from the polyethylene container.
f. Remove the top of the polyethylene container.
g. Remove the polyethylene inserts and the desiccant from around the PM Receiver.
h. Remove the PM Receiver from the bottom half of the polyethylene container.

2-6. INSPECTION
2-7. After the equipment has been unpacked, check the package contents against the packing list to ensure that the shipment is complete. Visually inspect the equipment for damage incurred during shipment.

1. BOX TOP
2. HANDBOOKS
3. WATERPROOF ENVELOPE, SIZE $13 \times 11$
4. BANDING, AVISTRAP, AMERICAN VISCOSE CO. OR EQUIVALENT
5. PLASTIC WRAP, 4 MIL
6. END ITEM
7. HUMIDITY INDICATOR
8. KLIMP FA STENERS, SIZE \#3, 12 EACH FOR TOP OF BOX
9. "DELICATE INSTRUMENT" LABEL
10. "FRAGILE" LABEL
11. PACKING LIST
12. "UP" LABEL
13. PLYWOOD BOX
14. HAIR, LATEX, FIRM, 4 INCHES THICK LOADED ON EDGE (2) SIDES, (2) END, TOP AND BOTTOM
15. FIBERBOARD CARTON,
16. BARRIER BAG, MIL SPEC MIL-B-131 CLASS 1, SIZE $52 \times 42$
17. POLYETHYLENE CONTAINER, (*) SEE NOTE 1
18. DESSICANT, 48 UNITS
19. POLYETHYLENE CONTAINER INSERTS, (*) SEE NOTE 2
20. POLYETHYLENE CONTAINER TOP, (*) SEE NOTE 1

NOTES

1. MOLDED POLYETHYLENE FOAM CONTAINER MODEL NUMBER RM-52417. SUPPLIER, W. D. ADAMS CO. , COSTA MESA, CALIF.
2. MOLDED POLYETHYIENE EXPAN-SERTS MODEL NUMBER R1-175-24


Figure 2-1. PM Receiver Packaging

## 2-8. PACKING

2-9. Packaging the PM Receiver for shipment or storage, when required, is performed in the reverse order of unpacking described in paragraph 2-4. The original packaging materials, if available and undamaged, should be used. If the original packaging materials are not available, packaging should conform to Specification MIL-P-116D, Method IIb. All containers should be marked in accordance with Specification MIL-STD-129C.

2-10. EQUIPMENT INSTALLATION
2-11. EQUIPMENT CABINET INSTALLATION.
2-12. Installation of the PM Receiver drawer in an electronic equipment cabinet is accomplished as follows:
a. Extend both cabinet equipment rack slides until they lock in their fully extended positions.
b. Lift the drawer and start the drawer rollers into the rack slides.
c. Push the drawer into the equipment cabinet until the drawer locking detents contact the rack slides.
d. Push the drawer locking detents in and push the drawer into the cabinet until the drawer locking detents lock into position in the rack slide. This is the fully extended position for the drawer when it is cabinet mounted.
e. Unlock the rack slide locking detents on the inside of the equipment cabinet.
f. Push in the drawer locking detents and push the drawer to its fully closed position in the cabinet.
g. Secure the drawer to the cabinet with the four screws on the drawer front panel.
h. Connect the PM Receiver as shown in figure 2-2.

2-13. EQUIPMENT BENCH SETUP
2-14. If the PM Receiver drawer is not to be mounted in an equipment cabinet, place the drawer on a stable base, and connect the PM Receiver as shown in figure 2-2.

2-15. OPERATION

## NOTE

Before using the PM Receiver for any measurements of the Unified S-Band Equipment (USBE), perform the Drawer Checkout procedures given in paragraph 5-7.

2-16. NORMAL OPERATION
2-17. Procedures for operating the PM Receiver are as follows:
a. Connect the PM Receiver as shown in figure 2-3.
b. Push the POWER switch to the ON position.


Figure 2-2. PM Receiver Installation, Block Diagram


Figure 2-3. PM Receiver Operational Setup, Block Diagram NOTE

Allow two hours warmup before using the PM Receiver for any measurements of the USBE.
c. Push the LOOP CONTROL switches to the 400 CPS and OPEN positions.

NOTE
If the 21.2 CPS bandwidth is to be used, lock the PM Receiver to the input signal in the 400 CPS mode, and switch to the 21.2 CPS mode after lock-up.
d. Push the GAIN CONTROL switch to the AGC position.
e. Set the input variable ATTENUATOR dial to zero.
f. Set the VCO MANUAL CONTROL potentiometer dial to 5 (midrange). The LOOP STATUS indicator should indicate OUT OF LOCK.
g. Observe the FM TUNING meter and vary the VCO MANUAL CONTROL potentiometer dial from 5 to 10 or from 5 to 0 until the $F M$ TUNING meter nulls.
h. Observe the oscilloscope at J3; a low frequency beat note will appear. Adjust the VCO MANUAL CONTROL until the beat note on the oscilloscope decreases to a dc level.
i. Push the LOOP CONTROL switch to the CLOSED position. PM Receiver lock-up with the input signal will be indicated on the oscilloscope by a sweeping trace.
j. Adjust the input variable ATTENUATOR dial until the SIGNAL STRENGTH meter reads in the green area ( $-51 / 2$ to $-61 / 2$ vdc). The LOOP STATUS indicator should indicate IN LOCK.
$2-18$. After lock-up of the PM Receiver to the USBE, ranging information is provided to the Ranging Receiver, 4A3. Other USBE test information is available at PM Receiver front panel outputs J3, J4, J5, and J6.

2-19. MGC OPERATION
2-20. Procedures for operating the PM Receiver when the AGC mode is disabled, are as follows:
a. Repeat steps (a) through (c) of paragraph 2-17.
b. Push the GAIN CONTROL switch to the MGC position.
c. Repeat steps (e) through (j) of paragraph 2-17.

## NOTE

## The IN LOCK/OUT OF LOCK indicator will light in the MGC mode, but it is not calibrated for an MGC threshold, making its indications erroneous.

d. Subtract the known input signal level at J2 from -30 dbm. Set the input variable ATTENUATOR dial to the difference in db . For example, if the input signal is -10 dbm , then
$-30 \mathrm{dbm}$
$-10 \mathrm{dbm}$
20 db , and -20 db is the ATTENUATOR dial setting.
e. Set the MGC control potentiometer such that the SIGNAL STRENGTH meter reads in the green area (-5 1/2 to -6 1/2 vdc).

## SECTION III. THEORY OF OPERATION

## 3-1. INTRODUCTION

3-2. This section presents the theory of operation of the PM Receiver at the functional block level. Each subassembly is discussed separately. Where two or more functions are performed by a single subassembly, each function is presented individually. Where two or more subassemblies are required to perform a single function, the subassemblies are discussed in relation to that particular function.

3-3. Throughout this section, all references to subassembly input and output connections are preceded by the subassembly reference designator. For example, input jack J2 of subassembly A4 is referred to as A4J2. Assembly input and output connections are not preceded by a reference designator. A list of the 13 PM Receiver subassemblies and their reference designators is contained in Table 1-1. Figures 6-1, PM Receiver Block Diagram, and 6-2, PM Receiver Interconnection Diagram, are to be used in conjunction with the text of this section.

3-4. RF FRONT END (Figure 6-4)
3-5. The rf front end consists of an input variable attenuator, a coaxial isolator, and the $S$-Band Mixer and 50 Mc Preamplifier A2.

3-6. INPUT VARIABLE ATTENUATOR AND COAXIAL ISOLATOR
3-7. The PM Receiver is provided with an rf input signal of 2287.5 $\mathrm{mc} \pm 100 \mathrm{kc}$, at a level of 0 dbm to -50 dbm . The signal is applied through front panel jack J2, RF INPUT, to an S-band variable attenuator calibrated at 2287.5 mc . The attenuator has an attenuation range of 30 db , and a calibration accuracy of 0.1 db . The attenuator is adjusted manually for a -30 dbm output (an indication of 5.5 to 6.5 volts on the SIGNAL STRENGTH meter) into the coaxial isolator. The isolator has a nominal insertion loss of
0.6 db , a vswr of $1.1: 1$, and reverse isolation of 30 db to isolate the local oscillator signal from the RF INPUT jack. The rf input signal is applied through the isolator to the $S$-Band Mixer and 50 Mc Preamplifier, subassembly A2.

3-8. S-BAND MIXER AND 50 MC PREAMPLIFIER, 1A2A2
3-9. At subassembly A2 the $2287.5 \mathrm{mc},-30 \mathrm{dbm}$ signal input (through A2J2) is mixed with a $2237.5 \mathrm{mc}, 0 \mathrm{dbm}$ local oscillator signal (input A2J3), from subassembly Al ( 23 Mc VCO and X96 Multiplier). The 50 mc difference frequency from the balanced mixer is amplified in a wideband amplifier consisting of three stages with a 12 mc bandwidth and a nominal conversion gain of 10 db producing a $50 \mathrm{mc},-20 \mathrm{dbm}$ input to the 50 Mc Mixer and 10 Mc AGC Amplifier, subassembly A3.

3-10. 50 MC MIXER AND 10 MC AGC AMPLIFIER, 1A2A3 (Figure 6-5)
3-11. 50 MC Amplifier
3-12. The $50 \mathrm{mc},-20 \mathrm{dbm}$, input signal is inserted through A3J2 where it is isolated by an emitter follower circuit and applied to front panel jack J6, 50 MC SPECTRUM, through output A3J3. The signal is also fed into a 50 mc wideband amplifier with a gain of approximately 6 db .

3-13. 50 MC MIXER
3-i4. The amplifier output is then mixed with a $60 \mathrm{mc},+10 \mathrm{dbm}$ signal from subassembly A7 (20 Mc Reference Oscillator and X3 Multiplier) entering through A3J4. The 10 mc difference signal is then filtered to eliminate 50 and 60 mc components, and unwanted harmonics, and is fed into the 10 mc agc amplifier.

3-15. 10 MC AGC AMPLIFIER
3-16. The agc amplifier has a 4 mc bandwidth and an agc range of 20 db to hold the -40 to -20 dbm input to a constant -20 dbm output. The agc control voltage from subassembly A9 is injected through A3J6 into the amplifier. The agc voltage range is -1 to $-8 v$, with
-lv representing maximum gain, and $-8 v$ representing minimum gain. The output signal is then fed to the 10 Mc Distribution Amplifier, subassembly A4.

3-17. 10 MC DISTRIBUTION AMPLIFIER, IA2A4 (Figure 6-6)
3-18. Subassembly A4 receives the $10 \mathrm{mc},-20 \mathrm{dbm}$ signal from subassembly A3 and provides amplification, proper impedance matching, and distribution of four 10 mc signal outputs. The input at A4J2 is amplified by a wideband amplifier with a bandwidth of 10 $\mathrm{mc} \pm 2 \mathrm{mc}, f l a t$ within 0.05 db , and applied to an emitter follower. The output of the emitter follower is used to drive four circuits that provide the outputs at A4J3, A4J4, A4J5, and A4J6. The first circuit consists of an emitter follower, a wideband amplifier, and an output emitter follower stage that provides a $10 \mathrm{mc},-10 \mathrm{dbm}$ signal through A4J3 to the 10 Mc Predetection Output jack, J9, on the drawer rear panel. The second circuit consists of a wideband amplifier and an emitter follower output stage that provides a 10 mc, - 10 dbm signal through A4J4 to 10 Mc Narrow-band Discriminator, Al0. The third circuit is an emitter follower output stage that provides a $10 \mathrm{mc},-20 \mathrm{dbm}$ signal through A4J5 to the 10 Mc Wideband Phase Detector, subassembly Al0. The fourth circuit is an emitter follower output stage that provides a $10 \mathrm{mc},-20 \mathrm{dbm}$ signal through A4J6 to the 10 Mc IF. Amplifier, subassembly A5.

3-19. 10 MC IF AMPLIFIER, 1A2A5 (figure 6-7)
3-20. The $10 \mathrm{mc},-20 \mathrm{dbm}$ input signal from subassembly A4 is amplified and distributed to two functions. One function, the 10 mc , - 16 dbm linear output, is amplified by a second stage and is fed to the coherent amplitude detector (subassembly A9), by A5J3, to develop loop agc voltage. The other function of the signal is fed to a limiter such that a 10 db signal change on the input will cause an output change of less than 1 db . The limited signal is then amplified by two stages and its $10 \mathrm{mc},+6 \mathrm{dbm}$ output at A5J4 is fed to the loop phase detector (subassembly A6). This is for the phase lock loop portion of the receiver.

## 3-21. LOOP PHASE DETECTOR AND LOOP FILTER, 1A2A6 (Figure 6-8)

3-22. Subassembly A6 is divided into two functional portions. The first portion, the Loop Phase Detector, receives two input signals. The input through A6J2 is from subassembly A8, the $\mathrm{X} 1 / 2$ and 10 Mc Reference Distribution Amplifier, at a level of +10 dbm at 10 mc . This input is crystal controlled from subassembly A7, and is the reference input. The input signal through A6J3 is from subassembly A5, the 10 Mc IF. Amplifier, at a level of +6 dbm at 10 mc. These two signals are detected in a balanced bridge type phase detector. If the input signals are out of phase, a dc error voltage is generated. This error voltage is fed to the second portion of the subassembly, the loop filter. The filter translates the input error signal into a dc correction voltage, which is inserted through A6J6 to subassembly Al, and establishes the tracking bandwidths of the phase lock loop. The filter has two bandwidths, a 400 cps loop bandwidth, $\beta_{\mathrm{L}}$, and a 40 radian loop bandwidth, $\beta_{\mathrm{L}}$, equivalent to 21.2 cps . The 400 cps bandwidth is used for all tests, except phase noise for which the 21.2 cps mode is used. Selection of the different bandwidths is accomplished by relay selection of RC combinations which make up a passive loop filter. Output A6J4 is routed to the receiver front panel J3, DYNAMIC $\varnothing$ ERROR. Output A6J5 is routed to the STATIC $\phi$ ERROR meter on the receiver front panel.

3-23. 23 MC VCO AND X96 MULTIPLIER, 1A2A1, AND COAXIAL ISOLATOR (Figures 6-1, 6-2, and 6-3)

3-24. The 23 Mc VCO and X96 Multiplier consists of four subassemblies: the 23 mc vco and two buffer amplifiers, X2 and X3 multipliers with three stages of power amplification, a Xl6 cavity multiplier, and a coaxial isolator.

3-25. 23 MC VCO
3-26. The 23 mc vco is crystal controlled with two back-biased capacitive diodes (Varicaps), in a series resonant loop. The Loop Phase Detector error voltage (input AlJ2), or front panel adjust

VCO MANUAL CONTROL voltage, (input AlJ3), is injected into the loop, changes the bias on the diodes, causing diode capacities to change, thus shifting the crystal frequency 600 cps per volt of bias (four volt range). The vco output signal is isolated by two buffer-amplifier stages and the 23 MC VCO TEST output is applied through AlJ4 to J8 on the drawer front panel. The vco output then enters the $\mathrm{X} 3, \mathrm{X} 2$, and power amplifiers.

3-27. X6 MULTIPLIER AND AMPLIFIER
$3-28$. In this subassembly the 23 mc signal is multiplied to 140 mc by the X 3 and X 2 multipliers, and amplified to approximately +20 dbm by three stages of power amplification.

3-29. X16 CAVITY MULTIPLIER
3-30. The filtered 140 mc signal is fed into a X16 cavity which uses a step recovery diode for harmonic generation. The multiplied signal is inserted into a three-pole filter, (tuned to 2237.5 mc ) which attenuates the 15 th and 17 th harmonics 50 to 55 db down from the output.

## 3-31. COAXIAL ISOLATOR

3-32. The 2237.5 mc output signal (at AlJ7) is then sent to a coaxial isolator which holds the loading effect of the three-pole filter constant. The isolator has 30 db of reverse isolation, a forward insertion loss of 0.6 db , and a vswr of 1.1:1. The 2237.5 $\mathrm{mc}, 0 \mathrm{dbm}$, output signal is mixed with the 2287.5 mc rf input in the Mixer Preamplifier, which completes the phase lock loop portion of the receiver.

3-33. 20 MC REFERENCE OSCILLATOR AND X3 MULTIPLIER, 1A2A7 (Figure 6-9)

3-34. Subassembly A7 generates the reference frequency for the phase lock loop, and provides a monitor output to the drawer front panel. The signal is also multiplied and sent to the 50 mc mixer portion of subassembly A3, where it is used as the second local oscillator signal.

3-35. The 20 mc oscillator is a crystal controlled circuit with a crystal frequency of $20.000000 \pm 5$ percent. The oscillator output is amplified and performs several functions. The output is multiplied by a X3 multiplier, amplified, and a $60 \mathrm{mc}+10 \mathrm{dbm}$ output signal is sent to the 50 mc mixer (subassembly A3) through output A7J2. The 20 mc amplified oscillator output is also amplified to +10 dbm and sent to subassembly A8 through output A7J3, where it becomes the loop reference frequency. This signal is also divided by a 10 db voltage divider to 0 dbm and sent through output A7J4 to drawer front panel jack J7, 20 MC OSC TEST.

3-36. X1/2 MULTIPLIER AND 10 MC REFERENCE DISTRIBUTION AMPLIFIER, 1A2A8. (Figure 6-10)

3-37. Subassembly A8 receives the 20 mc reference frequency from subassembly A7, divides it by two, isolates, and distributes four 10 mc reference signals, two of which are phase shifted.

3-38. X1/2 MULTIPLIER
3-39. The Xl/2 multiplier is a parametric divider which uses two capacitive diodes (Varicaps). The multiplier output is isolated by a buffer amplifier and distributed to four amplifiers.

3-40. 10 MC REFERENCE DISTRIBUTION AMPLIFIER
3-41. The 10 mc reference signal is applied to two separate single stage isolation amplifiers. After leaving the isolation amplifiers, both signals are $10 \mathrm{mc},+10 \mathrm{dbm}$. Output A8J3 is fed directly into subassembly A6 and is the basic reference frequency for the phase lock loop. Output A8J4 is fed to J10 on the rear drawer panel, and is the 10 mc Reference Output to Ranging Receiver drawer 4A3 (input J3),

3-42. PHASE SHIFTER
3-43. The other two 10 mc signals are sent to single stage isolation amplifiers identical to those used for the reference outputs. From here each signal goes to a variable RL and C network
phase shifter, capable of shifting the signal phase 0 to 180 degrees. One signal is shifted 90 degrees from the phase lock loop signal, and sent to subassembly A9 through output A8J5, where the coherent amplitude detector (subassembly A9) operates in phase quadrature with the loop phase detector (subassembly A6). The second signal is phase shifted to compensate for cable lengths which introduce phase shifts, and to place the signal in phase with the loop phase detector, so that VIDEO information outputs will not be distorted. After being phase shifted, this $10 \mathrm{mc},+10$ dbm, output (A8J6) is sent to the 10 mc wideband phase detector (subassembly Al0).

3-44. COHERENT AMPLITUDE DETECTOR, AGC AMPLIFIER, AND RELAY DRIVER, 1A2A9. (Figure 6-11)

3-45. Subassembly A9 circuitry may be divided into four parts: the coherent amplitude detector, the agc amplifier, the relay driver, and MGC/AGC switching.

## 3-46. COHERENT AMPLITUDE DETECTOR

3-47. The coherent amplitude detector is a balanced bridge type detector, similar to the loop phase detector in subassembly A6. Two inputs are inserted in the detector. The reference input at A9J2 is a $10 \mathrm{mc},+10 \mathrm{dbm}$ output from subassembly A8. The signal input at A9J3 is a $10 \mathrm{mc},-16 \mathrm{dbm}$ output from subassembly A5. The signal input is compared with the reference input in the detector, and a dc error voltage proportional to the amplitude of the signal input is generated. The error voltage is then sent to the AGC amplifier.

3-48. AGC AMPLIFIER
3-49. The AGC amplifier is a dc amplifier which amplifies the error signal for use in the 10 mc AGC amplifier, subassembly A3, as the loop AGC voltage (output A9J5). At the same time the error voltage is sent to the SIGNAL STRENGTH meter through output A9J4.

## 3-50. RELAY DRIVER

3-51. The relay driver is a logic switching circuit which triggers relay K2. When the AGC voltage, as read on the SIGNAL STRENGTH meter, falls below -0.7 volt, the relay driver triggers the IN LOCK/ OUT OF LOCK indicator relay, causing the OUT OF LOCK indicator to light. When the OUT OF LOCK indicator is lit and the AGC voltage rises above -0.7 volt, the relay driver triggers the indicator relay, and the IN LOCK indicator lights.

3-52. MGC/AGC SWITCHING
3-53. MGC/AGC switching is accomplished on the drawer front panel by the GAIN CONTROL switch. Actuation of the switch triggers relay Kl, switching out the AGC circuitry at the AGC Amplifier output. The MGC voltage, controlled by the MGC potentiometer (R2) on the drawer front panel, is fed through outputs A9J4 and A9J5 as in the AGC mode. MGC voltage is then read on the SIGNAL STRENGTH meter. The IN LOCK/OUT OF LOCK indicator will light in the MGC mode, but is not calibrated for an MGC threshold, making its indications erroneous.

3-54. 10 MC NARROW-BAND DISCRIMINATOR, 1A2A10 (Figure 6-12)
3-55. The 10 Mc Narrow-Band Discriminator is a separate functional unit which shares Subassembly AlO with the 10 Mc Wideband Phase Detector.

3-56. The input signal at Al0J2 is $10 \mathrm{mc},-10 \mathrm{dbm}$, from subassembly A4. The signal is amplified in a two stage 10 mc limiting amplifier to prevent amplitude modulation from reaching the discriminator. The discriminator is a double-tuned type having nominal linearities of $\pm 0.5$ percent for a $\pm 20 \mathrm{kc}$ range. Deviation output of the subassembly is 0.1 volt/1000 cps, nominal. One output of the discriminator is sent to the FM TUNING meter, on the drawer front panel, through Al0J4. Another output of the discriminator is fed into an audio amplifier that has a 3 db response from 300 cps to 2 kc . The audio output is then sent through AlOJ3 to drawer front panel output J5, VOICE.

3-57. 10 MC WIDEBAND PHASE DETECTOR, IA2A10, AND VIDEO DISTRIBUTION AMPLIFIER, IA2A11. (Figures 6-12 and 6-13)

3-58. The 10 Mc Wideband Phase Detector and the Video Distribution Amplifier operate together as a functional unit. However, the 10 Mc Wideband Phase Detector physically shares subassembly Al0 with the 10 Mc Narrow-Band Discriminator. The Video Distribution Amplifier is packaged separately in Subassembly All.

3-59. 10 MC WIDEBAND PHASE DETECTOR
3-60. The phase detector receives two 10 mc inputs: a signal input and a reference input. The -20 dbm signal input from subassembly A4 is fed through Al0J5 into a single stage amplifier and two emitter followers, which provide reverse isolation to prevent feedback of the 10 mc reference signal into subassembly A4, a condition which would cause the PM Receiver to acquire its own reference signal (false lock). The $10 \mathrm{mc},+10 \mathrm{dbm}$ reference input is a phase shifted output of subassembly A8. The reference input is fed directly through Al0J6 to the phase detector. The input phases are compared in a balanced quadrature ring type configuration consisting of four diodes. The output of the phase detector, when the reference input is properly phased, consists of 300 cps to 1.5 mc of modulated information which was imposed on the S-band carrier. The subcarriers are amplified to 0 dbm by a four stage amplifier whose bandwidth is flat within 0.05 db from 300 cps to 1.5 mc , and sent to subassembly All through AlOJ7.

## 3-61. VIDEO DISTRIBUTION AMPLIFIER

3-62. The input signals are received at subassembly All through AllJ2. One signal goes directly through this subassembly via AllJ3 to the VIDEO OUTPUT selector switch on the drawer front panel. This is the WB VIDEO output and consists of frequencies from 300 cps to 1.25 mc . The subcarrier frequencies of 10 kc , $100 \mathrm{kc}, 500 \mathrm{kc}, 1.024 \mathrm{mc}$, and 1.25 mc are individually amplified, filtered, amplified again, and sent to the VIDEO OUTPUT selector
switch through outputs J6, J5, J4, J8, and J7, respectively. The VIDEO OUTPUT selector switch selects one of the five subcarrier outputs or the wideband video output, which is then sent to VIDEO output J4, located on the drawer front panel.

## SECTION IV. PROGRAMMING DATA

NOT APPLICABLE

## SECTION V. MAINTENANCE

## 5-1. INTRODUCTION.

5-2. This maintenance section consists of drawer operational checkout, drawer performance checkout, and calibration and adjustment procedures. The checkout procedures will assist the experienced technician in localizing troubles to the subassembly level.

5-3. The drawer operational checkout is primarily confined to using a series of simple tests to determine the location of the catastrophic type of failure. The drawer performance checkout tests are more sophisticated and reveal the circuit design performance.

5-4. When it has been determined that a particular subassembly is contributing to failure in design performance, the calibration and/or adjustment procedure for that subassembly should be performed. If calibration does not restore performance, the defective subassembly must be returned to the factory for repair or troubleshooting carried out using the schematic diagram.

5-5. DRAWER OPERATIONAL CHECKOUT.
5-6. During these tests, terminate all drawer connectors, other than those being used for the particular test, in 50 ohms. Connect the 115 VAC INPUT connector Jl of the PM Receiver drawer to a 115 VAC 60-cycle single-phase power source capable of delivering 10 amperes. Perform the procedure of Table 5-1, in order, by item number.

TABLE 5-1. DRAWER OPERATIONAL CHECKOUT

| Item | Action | Normal Indication |
| :---: | :---: | :---: |
| 1 | Turn on PM Receiver by pressing POWER switch Sl. | A-c power applied when -12 vdc output of power supply lights lamps DS1 and DS2 behind switch button. |
| 2 | ```Check d-c output of -12 vdc and plus and minus l5 vdc supplies. -12 vdc supply (TB5-1 to TB5-4) +15 vdc supply (TB2-6 to TB1-7) -15 vdc supply (TB4-5 to TB1-4)``` | ```-12 vdc \pm volts at TB5-1. +15 vdc \pm volts at TB2-6. -15 vdc \pm volts at TB4-5.``` |
| 3 | Position switches as follows: <br> LOOP CONTROL S2 at 400 CPS <br> LOOP CONTROL S3 at OPEN <br> GAIN CONTROL S4 at MGC |  |
| 4 | Adjust MGC knob | 6 vdc as observed on SIGNAL STRENGTH meter. |
| 5 | Measure 23 Mc VCO subassembly <br> Al frequency and power at the <br> 23 MC VCO TEST jack J8 using <br> a frequency counter and power meter. | $\begin{aligned} & 23.307292 \mathrm{mc} \pm 1050 \text { cycles } \\ & 0 \mathrm{dbm} \pm 2 \mathrm{dbm} \end{aligned}$ |
| 6 | Disconnect the isolator AT3 from the LO input A2J3 of the mixer-preamplifier A2. Terminate the output side of AT3 in 50 ohms and measure frequency and power. Use HP 536A frequency meter and HP 431B power meter. Reconnect AT3 to A2J3. | $\begin{aligned} & 2237.5 \mathrm{mc} \pm 2 \mathrm{mc} \\ & 0 \mathrm{dbm} \pm 1 \mathrm{dbm} \end{aligned}$ |

TABLE 5-1. (cont)

| Item | Action | Normal Indication |
| :---: | :---: | :---: |
| 7 | Apply a 2287.5 mc input signal at -30 dbm to RF INPUT jack J2. Set the ATTENUATOR AT1 to 0 db and measure frequency and power at J6. | 50 mc <br> -22 dbm nominal |
| 8 | Vary the ATTENUATOR ATI in 5 db steps over the dial. <br> Leave ATTENUATOR dial at 0 db and signal input as in step <br> (7) until directed otherwise. | Output power at J6 must change $5 \mathrm{db} \pm 1 \mathrm{db}$ for each step. |
| 9 | Terminate the 20 MC OSC TEST jack J7 in 50 ohms. Measure the 20 mc ref oscillator A7 output frequency and power. | $\begin{aligned} & 20.000000 \mathrm{mc} \pm 200 \mathrm{cps} \\ & 0 \mathrm{dbm} \pm 0.2 \mathrm{dbm} \end{aligned}$ |
| 10 | Terminate the cable tied into subassembly jack A3J4 in 50 ohms and measure the frequency and power of the X 3 output of the 20 Mc Reference Oscillator and X3 subassembly A7. Restore circuit connections. | 60.000000 mc +10 dbm nominal |
| 11 | Terminate output connector A3J5 of the 50 Mc Mixer and 10 MC AGC Amplifier A3 in 50 ohms. Check the output frequency and power at A3J5. Restore circuit connections. | 10.000000 mc -20 dbm nominal |

TABLE 5-1. (cont)

| Item | Action | Normal Indication |
| :---: | :---: | :---: |
| 12 | Terminate the output connector A4J6 of the 10 Mc Distribution Amplifier A4 in 50 ohms. Measure the frequency and output power at A4J6. Restore circuit connections. | 10.000000 mc -20 dbm nominal |
| 13 | Terminate the output connector J9 at the rear of the drawer in 50 ohms. ( 10 mc turn around code.) Measure the frequency and output power at J9. | $\begin{aligned} & 10.000000 \mathrm{mc} \\ & -10 \mathrm{dbm} \pm 1 \mathrm{db} \end{aligned}$ |
| 14 | Disconnect the output cable from the 10 Mc IF. Amplifier at jack A9J3 of subassembly A9. Terminate the cable in 50 ohms. Check the output frequency and power at the terminnated cable end. Restore circuit connections. | 10.000000 mc -16 dbm nominal |
| 15 | Check the frequency and power output of the 10 mc ref distribution amplifier ( $\mathrm{p} / \mathrm{o}$ subassembly A8) at the 10 mc ref connector Jl0 at the rear of the drawer. | 10.000000 mc +10 dbm nominal |
| 16 | Check the 10 mc ref distribution amplifier output at A8J3 in the following manner: |  |

TABLE 5-1. (cont)

| Item | Action | Normal Indication |
| :---: | :---: | :---: |
| 16 cont | a. Remove the cable from connector J2 of subassembly A6. <br> b. Terminate the open end of the cable in 50 ohms. Measure frequency. <br> c. Remove the termination and measure power with the MV-28B (has 50-ohm probe). <br> Check the 10 mc limited amplifier output at A5J4 (p/o subassembly A5) in the following manner: <br> a. Disconnect the cable tied to A6J3. Terminate the open end of the cable in 50 ohms. Measure frequency at the terminated end. <br> b. Remove the termination and measure power at the open cable end with an MV-28B power meter. <br> c. Reconnect cable to A6J3. <br> Check the A5J4 and A5J5 outputs from the 10 Mc Distribution Amplifier A4 as follows: | 10.000000 mc <br> +10 dbm nominal <br> 10 mc <br> +6 dbm nominal |

TABLE 5-1. (cont)

| Item | Action | Normal Indication |
| :---: | :---: | :--- |
| 18 | a. Disconnect cable tied to <br> connector Al0J2. Termi- <br> nate the cable in 50 ohms. <br> Measure frequency at <br> terminated end. | 10 mc |
|  | b. Remove termination and <br> measure power at the open <br> cable end with an MV-28B <br> power meter. Reconnect <br> cable. | -10 dbm nominal |
| c. Perform operation of (a) |  |  |
| and (b) above at connec- |  |  |
| tor Al0J5. |  |  |

## 5-7. DRAWER PERFORMANCE CHECKOUT

5-8. This test procedure contains information required to check out the PM Receiver. The procedures should be performed in the sequence presented.

5-9. Test equipment required for these procedures is listed in Table l-6. Test equipment required for the specific setups is given in text or in the test setup diagram.

5-10. INPUT VSWR
a. Connect the PM Receiver as shown in figure 5-1.
b. Set the UHF signal generator to 2287.5 mc at 0 dbm . Verify the frequency with the frequency meter and power meter.
. c. Modulate the signal generator with. 1000 cps by means of its internal square wave. Do not use the signal generator automatic level control during this test.
d. Tune the slotted line and measure the input vswr. The input vswr should be 1.3:1, or less, with respect to 50 ohms at $\pm 20 \mathrm{mc}$ of $f_{\mathrm{o}}$.

NOTE
If the input vswr is not within limits, check all input cables and their connectors for tightness and continuity. If all input cables are satisfactory, the input attenuator may be defective.

5-11. INPUT VARIABLE ATTENUATOR LINEARITY
a. Connect the equipment as shown in figure 5-2.
b. Set the ATTENUATOR dial to zero.
c. Set the LOOP CONTROL switch to OPEN.
d. Adjust the VCO MANUAL CONTROL for a 50 mc output at J6.
e. Measure the power output level at J6 with the RF voltmeter. This is the reference level.
f. Vary the ATTENUATOR dial in 5 db steps over the dial. The output level for each succeeding setting must be $5 \mathrm{db} \pm 1 \mathrm{db}$ from the previous setting.

NOTE
If the linearity of the input variable attenuator is not within limits, the input attenuator is defective and must be replaced.


Figure 5-1. Input VSWR Test Setup.


Figure 5-2. Input Variable Attenuator Linearity/50 Mc IF Bandwidth/10 Mc IF Bandwidth, Test Setup

5-12. 23 MC VCO AND X96 MULTIPLIER IA2A1 OUTPUT
a. Disconnect the LO isolator from the Mixer Preamplifer, A2J3, and connect it to the Spectrum Analyzer (H-P 8551A/ 851A). The level of all spurious signals from 2000 to 2400 mc should be at least 50 db down from the reference level of 0 dbm at 2237.5 mc .
b. Reconnect the LO isolator to A2J3.

NOTE
If the power, frequency, or spurious outputs at the LO isolator are not within limits, subassembly Al must be checked out.

5-13. 50 MC IF. BANDWIDTH
a. Connect the equipment as shown in figure 5-2.
b. Set the LOOP CONTROL switch to the OPEN position.
c. Adjust the VCO MANUAL CONTROL for a 50 mc output at J6.
d. Vary the frequency on the signal generator plus and minus 2 mc from 2287.5 mc . Ensure that the input power level remains constant over the frequency range. The output power level at J6.should be within $\pm 0.05 \mathrm{db}$ of the reference power output at 2287.5 mc .

NOTE
If the power output levels at J6 are not within limits, subassembly A2 must be checked out.

5-14. 10 MC IF. BANDWIDTH
a. Connect the equipment as shown in figure 5-2 and connect the rf voltmeter and spectrum analyzer to A4J6.(10 mc Distribution Amplifier).
b. Set the LOOP CONTROL switch to the OPEN position and the GAIN CONTROL switch to the MGC position. Select an easily-read MGC voltage for reference.
c. Adjust the VCO MANUAL CONTROL for a 10 mc signal output at A4J5.
d. Vary the input frequency plus and minus 2 mc from 2287.5 mc. The power output deviation at A4J5 should be within $\pm 0.05 \mathrm{db}$ of the reference power output at 2287.5 mc .

NOTE
If the power output levels at the J6 are not within limits, subassembly A3, and, or, subassembly A4 must be checked out.

5-15. MGC RANGE
a. Connect the equipment as shown in figure 5-3.
b. Set the ATTENUATOR dial to zero.
c. Set the LOOP CONTROL switch to the OPEN position. Adjust the MGC control and the VCO MANUAL CONTROL for a $10 \mathrm{mc},-20$ dbm output at A $4 J 5$ with the ATTENUATOR dial set to zero.
d. Vary the ATTENUATOR dial in $5-\mathrm{db}$ steps from 0 to 20 db and readjust the MGC control for -20 dbm output at A4J5. The MGC voltage range should be sufficient to compensate for an input signal change of 20 db .

NOTE
If the MGC range is not sufficient to compensate for a $20-\mathrm{db}$ input signal change, subassembly A3 must be checked out.

5-16. AGC RANGE
a. Connect the equipment as shown in figure 5-3.
b. Set the LOOP CONTROL switches to the 400 CPS and CLOSED positions. Set the ATTENUATOR DIAL to zero.
c. Monitor the 10 mc output at A 4 J 5 .


Figure 5-3. MGC Range/AGC Range, Test Setup
d. Vary the ATTENUATOR dial in 5 db steps from 0 to 20 db . The agc voltage range should be sufficient to compensate for an input signal change of 20 db , while maintaining a constant output of $-20 \mathrm{dbm} \pm 0.1 \mathrm{db}$ at A4J5.

NOTE
If the agc range is not sufficient to compensate for a $20-\mathrm{db}$ input signal change, subassembly A3 must be checked out.

5-17. LOOP GAIN
a. Connect the equipment as shown in figure 5-4.
b. Set the LOOP CONTROL switches to the 400 CPS and CLOSED positions.
c. Adjust the VCO MANUAL CONTROL potentiometer for 0 volt error voltage on the dc null voltmeter. Note the frequency of the 23 mc vco (nominal frequency: 23.307292 mc ).


Figure 5-4. Loop Gain Test Setup
d. Vary the PM Transmitter FREQ SET control for +1 volt error on the dc null voltmeter and note the frequency of the 23 mc vco. It should vary $600 \mathrm{cps} \pm 10 \%$ from the reference noted in step $c$.

NOTE
If the 23 mc vco frequency deviation at +1 v error is not within limits, subassembly Al must be checked out.
e. Repeat step (d) for -1 volt error. Note the 23 mc vco frequency. It should vary $600 \mathrm{cps} \pm 10 \%$ from the reference noted in step (c).

## NOTE

If the 23 mc vco frequency deviation at -l v error is not within limits, subassembly Al must be checked out.
f. Determine the loop gain from the following formula:
$G=\left(K d \frac{\text { volts }}{\text { degree }}\right)\left(\operatorname{Kvco} \frac{\mathrm{cps}}{\text { volt }}\right) \cdot\left(A \frac{\text { volts }}{\text { volts }}\right)\left(M \frac{\mathrm{cps}}{\mathrm{cps}}\right)\left(\alpha \frac{\text { volt }}{\text { volt }}\right)$
$G=(.360 /$ degree $)\left(\Delta f \frac{\mathrm{cps}}{\text { volt }}\right): 553 \times 96 \times 1$
For an error voltage of 1.0 volt,
$G=360 \times 96 \times .360 \times f \times .553$,
where $\Delta f=$ vco frequency change.
Limit: $4.125 \times 10^{6} \pm 10$ percent
NOTE
If the loop gain is not within limits, subassemblies Al, and, or A6 must be checked out.

5-18. LOOP BANDWIDTH
a. Connect the equipment as shown in figure 5-5.
b. Set the LOOP CONTROL switches to the 400 CPS and CLOSED positions. Lock the PM Receiver to the PM Transmitter.
c. Apply 1 kc of modulation from the signal generator to the PM Transmitter. Adjust the signal generator input level until a convenient reference output level is read on the oscilloscope.
d. Vary the frequency of the signal generator from $\mathrm{l} k \mathrm{kc}$ to 10 cps, keeping its level constant, and plot several points on a graph showing relative response versus modulation frequency. The response curve should be within $\pm 10 \%$ of figure 5-6.


Figure 5-5. Loop Bandwidth Test Setup.


Figure 5-6. 400 CPS Loop Bandwidth Response Curve.

## NOTE

If the loop bandwidth response curve is not within $\pm 10$ percent of figure $5-6$, the Loop Filter A3 must be checked out.
e. Set the LOOP CONTROL switch to the 21 CPS position and repeat steps (c) and (d), except vary the frequency of the signal generator from 100 to $l \mathrm{cps}$. The response curve should be within $\pm 10 \%$ of figure 5-7.

NOTE
If the loop bandwidth response curve is not within $\pm 10$ percent of figure 5-7, the Loop Filter A3 must be checked out.

5-19. AGC BANDWIDTH
a. Connect the equipment as shown in figure 5-8.
b. Set the LOOP CONTROL switches to CLOSED and 400 CPS, lock the loop, and set the GAIN CONTROL to AGC.
c. Set the function generator for a 40 cps sine wave signal.
d. Set the power supply (2005) to -2.4 volts.
e. Adjust the output level at the function generator until the 40 cps envelope or the oscilloscope is 20 mv peak-topeak.
f. Decrease the frequency of the function generator, maintaining the output level constant, until the presentation on the oscilloscope has fallen 3 db (0.707) of the original level. The frequency shall be 5 cps maximum.

NOTE
If the agc bandwidth is not within limits, subassembly A9 must be checked out.


Figure 5-7. 21.2 CPS Loop Bandwidth Response Curve.


Figure 5-8. AGC Bandwidth Test Setup

5-20. PHASE NOISE
a. Connect the equipment as shown in figure 5-9.
b. Place the LOOP CONTROL switches to CLOSED and 21 CPS positions and lock the loop.
c. Set the Function switch on the integrating voltmeter to Auto Range.
d. Set the Sample Period selector on the integrating voltmeter to 10 seconds.
e. The reading on the integrating voltmeter is percent of full scale of the rms voltmeter. Note the reading of the integrating voltmeter times full scale of the rms voltmeter.
f. Convert the voltage reading to rms degrees by using the relationship below. Maximum phase noise should be $2.5^{\circ}$. $\frac{\text { rms phase noise (volts) }}{K(v o l t / d e g r e e s)}=$ rms phase noise (degrees)
where $K=$ peak value of open loop beat note (volts/radian) 57.3 (degrees/radian)

NOTE
If the rms phase noise is not within limits, subassembly Al should be checked out.

5-21. 23 MC VCO AND 20 MC OSCILLATOR STABILITY
NOTE
Allow the PM Receiver two hours warm-up before performing this checkout procedure.
a. Connect the equipment as shown in figure 5-10.
b. Set the LOOP CONTROL switch to the OPEN position.
c. Adjust the VCO MANUAL CONTROL to midrange.
d. Measure and note the frequencies at the 20 MC OSC TEST jack and the 23 MC VCO TEST jack at the start and end of a three hour period.


Figure 5-9. Phase Noise Test Setup


Figure 5-10. Oscillator Stability and Manual Frequency Range Test Setup
e. Calculate the difference between the start and stop readings obtained at the 23 MC VCO TEST jack. Total drift for any three hour period should be 23 cps maximum.

NOTE
If the 23 mc vco stability is not within limits, subassembly Al must be checked out.
f. Calculate the difference between the start and stop readings obtained at the 20 MC OSC TEST jack. Total drift for any three hour period should be 50 cps maximum.

NOTE
If the 20 mc crystal oscillator is not within limits, subassembly A7 must be checked out.

5-22. MANUAL FREQUENCY RANGE
a. Connect the equipment as shown in figure 5-10, with the frequency counter connected to the 23 MC VCO TEST jack, and the 20 MC OSC TEST jack terminated.in 50 ohms.
b. Set the LOOP CONTROL switch to the OPEN position.
c. Set the VCO MANUAL CONTROL fully clockwise and note the frequency.
d. Set the VCO MANUAL CONTROL fully counter-clockwise and note the frequency.
e. Calculate the frequency range. The limits for frequency range are $\pm 1050 \mathrm{cps}$ minimum from 23.307292 mc . NOTE

If the manual frequency range is not within limits, subassembly Al must be checked out.

## 5-23. ACQUISITION RANGE

a. Connect the equipment as shown in figure 5-11.
b. Set the PM Transmitter to 2287.4 mc .
c. Set the LOOP CONTROL switches to the 400 CPS and CLOSED positions. Vary the VCO MANUAL CONTROL potentiometer until lockup with the PM Transmitter is accomplished.
d. Set the PM Transmitter to 2287.6 mc and repeat step (c).
e. Set the PM Transmitter to 2287.46 mc .
f. Set the LOOP CONTROL switch to the 21 CPS position. Vary the VCO MANUAL CONTROL potentiometer until lockup with the PM Transmitter is accomplished.
g. Set the PM Transmitter to 2287.54 mc and repeat step (f). NOTE

If the acquisition range of the VCO MANUAL CONTROL is not adequate to accomplish lockup with the PM Transmitter at the frequencies in steps $b, d, e$, and $g$, subassemblies Al and/or A6 must be checked out.


Figure 5-11. Acquisition Range Test Setup

## 5-24. 10 MC PREDETECTION OUTPUT AND 10 MC REFERENCE OUTPUT

a. Connect the equipment as shown in figure 5-12.
b. Measure the frequency and output levels at J9. The frequency at J9 should be 10 mc nominal. The output level should be $-10 \mathrm{dbm} \pm 1 \mathrm{db}$.

NOTE
If the frequency and power output levels at J9 are not within limits, subassembly A4 must be checked out.
c. Connect the rf voltmeter, spectrum analyzer, and frequency counter to JlO.


Figure 5-12. 10 MC Predetection Output and 10 MC Reference Output, Test Setup
d. Measure the frequency and power output levels at Jlo. The frequency at JlO should be $10 \mathrm{mc} \pm 100 \mathrm{cps}$. The power output level should be $+10 \mathrm{dbm} \pm 2 \mathrm{db}$.

NOTE
If the frequency and power output levels at Jl0 are not within limits, subassembly A8 must be checked out.

5-25. PM DEMODULATION
a. Connect the equipment as shown in figure 5-13.
b. Set the LOOP CONTROL switches to the 400 CPS and CLOSED positions. Set the VIDEO OUTPUT selector switch in the 10 KC position. Lock the PM Receiver to the PM Transmitter.
c. Modulate the PM Transmitter carrier with 10 kc at 1.0 radian from the signal generator.
d. Measure the output level at J4. Limit: $0 \mathrm{dbm} \pm 1 \mathrm{db}$.

NOTE
If the power output level at J4 is not within limits, subassemblies Al0, and/ or All must be checked out.
e. Modulate the PM Transmitter carrier successively with $100 \mathrm{kc}, 500 \mathrm{kc}, 1.024 \mathrm{mc}$, and 1.25 mc at 1.0 radian. Measure the output levels at each modulation frequency with the VIDEO OUTPUT selector switch set to the corresponding frequency. The output level for each modulation frequency, measured at $J 4$, should be $0 \mathrm{dbm} \pm 1 \mathrm{db}$.

NOTE
If the power output levels at J4 are not within limits, subassemblies Al0, and/or All must be checked out.
f. Set the VIDEO OUTPUT selector switch to WB VIDEO.


Figure 5-13. PM Demodulation Test Setup
g. Modulate the PM Transmitter successively with $300 \mathrm{cps}, 1 \mathrm{kc}$, $10 \mathrm{kc}, 100 \mathrm{kc}, 1 \mathrm{mc}$, and 1.5 mc at 1.0 radian. The power output level for each modulation frequency at $J 4$ should be $0 \mathrm{dbm} \pm 1 \mathrm{db}$.

NOTE
If the output power levels at J4 are not within limits, subassembly Al0 must be checked out.

5-26. FM DEMODULATION
a. Connect the equipment as shown in figure 5-14.
b. Place the GAIN CONTROL switch in the MGC position. Place the LOOP CONTROL switch in the OPEN position. Null the FM TUNING meter using the VCO MANUAL CONTROL potentiometer.


Figure 5-14. FM Demodulation Test Setup
c. Modulate the PM Transmitter carrier with l kc at a modulation index of 1.0 radian.
d. Measure the power output level at J5 with the rf voltmeter. Limit: 100 mv nominal.
e. Repeat step (c) with deviations of $0.5,1.5$, and 2.0 radians.
f. Measure the power output levels at J5 with the rf voltmeter. Limits: $\pm 5$ percent per radian.

NOTE
If the power output levels at J5 are not within limits, the Narrow-Band Discriminator Al0 must be checked out.

## 5-27. CALIBRATION OF SUBASSEMBLIES

5-28. 23 MC VCO AND X96 MULTIPLIER 1A2A1.
5-29. Calibration of subassembly Al is performed on the bench, due to limited access of electrical connections and components when in the drawer. Refer to paragraph 5-57 for module removal instructions.

5-30. Make the test connections shown in figure 5-15. Set the bias at J 2 to 0 vdc , and the acquisition voltage at J 3 to +9 vdc by means of the 10 k ohm potentiometer.
a. Connect the frequency counter to the 23 mc test connector J4.
b. Adjust L5 for an output of $23.307292 \mathrm{mc} \pm 100 \mathrm{cps}$ at J4.
c. Disconnect the frequency counter and connect the r-f voltmeter (Boonton 91CA) to J4.
d. Adjust C8, C16, and L8 for $0 \mathrm{dbm} \pm 2 \mathrm{db}$ output at J4.
e. Repeat steps (a) through (d) as required.
f. Disconnect cable Wl connecting J5 and J6. Connect the r-f voltmeter (91CA) to J5.
g. Adjust L10, Ll2, L14, L15, L18, L21, and L22 for maximum 140 ms output at J5.
h. Remove the $r-f$ voltmeter and connect the spectrum analyzer to J5. Check that the 2 nd harmonic is down 30 db and any other spurious down at least 40 db .
i. Connect the r-f voltmeter at J4.
j. Vary the bias input to J2 from -2 vdc to +2 vdc and adjust L4 for a VCO sensitivity of 600 cps per volt $\pm 5 \%$ at J4.
k. Disconnect thr r-f voltmeter and spectrum analyzer and reconnect J5 to J6 with cable W1. Connect the test equipment, shown within the dotted enclosure of figure 5-15 to J7.


1. Adjust the three tuned cavities and C56 of Al for maximum power output at 2237.5 mc at J7.
m. Repeat step (1) until the power output is greater than 0 dbm and all spurs are down at least 50 db .
n. Disconnect all test equipment and install subassembly Al in the PM Receiver.

5-31. S-BAND MIXER AND 50 MC PREAMPLIFIER 1A2A2
5-32. Calibration of subassembly lA2A2 can be performed only at the factory. The following calibration checks, however, should be performed at any time the subassembly is suspected of not meeting performance specifications.
a. Connect the equipment as shown in figure 5-16.
b. Set the LOOP CONTROL switch to the OPEN position.
c. Apply a 2287.5 mc input signal at -30 dbm to $R F$ INPUT jack J2.
d. Set the ATTENUATOR ATl dial to 0 db .
e. Measure the frequency at 50 MC SPECTRUM jack J6 and adjust the VCO MANUAL CONTROL for 50 mc output.
f. Measure the power output at J6. It should be -22 dbm nominal.
g. Vary the RF INPUT signal plus and minus 2 mc around 2287.5 mc . The power output should remain flat within 0.05 db .

5-33. 50 MC MIXER AND 10 MC AGC AMPLIFIER 1A2A3
5-34. The subassembly lA2A3 may be calibrated in the drawer assembly. Raise the subassembly to gain access to the connectors and adjustments. Refer to figure 5-17, and remove drawer connections to 1A2A3 at J1, J2, J3, J4, J5, and J6. Connect test equipment to the subassembly as shown in figure 5-17.
a. Set the agc voltage to J6 at -1 vdc.
b. Adjust the signal generator for a 60 mc input at +10 dbm to J4.


> Figure 5-16. Test Setup for Calibration Check of S-Band Mixer and 50 Mc Preamplifier 1A2A2
c. Adjust the signal generator for a 50 mc input at -40 dbm to J2.
d. Adjust R5l for -20 dbm as measured at J5 with the r-f voltmeter.
e. Vary the signal generator input to $J 2$ over the range of 48 to 52 mc , and adjust C6 for a frequency response of $\pm 0.5 \mathrm{db}$. Use the spectrum analyzer and/or microvoltmeter as required. Check that all spurs are at least 40 db down from the 10 mc output signal at J5.


Figure 5-17. Test Setup for Calibration of 50 Mc Mixer and 10 Mc AGC Amplifier 1 A 2 A 3

5-35. 10 MC DISTRIBUTION AMPLIFIER 1A2A4
5-36. There are no adjustments on subassembly lA2A4. In event of repair and replacement of parts, the subassembly should be checked out according to the following procedure. Failure to meet output level requirements may necessitate selection of new values for R4, R22, or R41 (see notes on schematic diagram fig. ). Raise the subassembly to gain access to the connectors.
a. Disconnect cable W4 from connector J2 of subassembly lA2A4.
b. Connect a signal generator (H-P 606A) to J2 and adjust the generator output for 10 mc at $\mathbf{- 2 0} \mathrm{dbm}$.
c. Remove the cable connection at J3 and terminate J3 in 50 ohms.
d. Use an r-f voltmeter (Boonton 91CA/91-8B) and check the power level at J3.
e. Repeat steps (c) and (d) at connectors J4, J5, and J6.
f. If the power levels are not as listed in the following, refer to step (g).

| J3 | -10 | dbm |
| :--- | :--- | :--- |
| J4 | -10 | dbm |
| J5 | -20 | dbm |
| J6 | -20 | dbm |

g. If all outputs are off, select a different value for R4. If the J3 output is off, select a new value for R22. If the J4 output is off, select a new value for R4l.

5-37. 10 MC IF. AMPLIFIER 1A2A5
5-38. Calibration of subassembly 1A2A5 can be performed in the drawer. Refer to the test setup of figure 5-18, and make the connections shown.
a. Set the variable attenuator (H-P 355C \& D) for zero attenuation and adjust the signal generator for 10 mc at -20 dbm at J2.


Figure 5-18. Test Setup for Calibration of 10 Mc I.F. Amplifier 1A2A5.
b. Adjust C5 and C12 for maximum output (-16 dbm) at J3.
c. Observe the power level at J4 and insert attenuation at J2 until the power level at $J 4$ changes (limiting ceases).
d. Adjust C16, C24, and C31 for maximum output at J4.
e. Decrease the attenuation until the input to J2 is $\mathbf{- 2 0} \mathbf{d b m}$. The power output at $J 4$ should be $+6 \mathrm{dbm} \pm 2 \mathrm{db}$.
f. Reduce the input signal at J2 by 5 db . The J4 output should decrease no more than 1 db. If it exceeds this level, select a higher value for R16 and a lower value for R18.
g. If R17 and R18 are changed, repeat steps (c) through (f).

5-39. LOOP PHASE DETECTOR AND LOOP FILTER 1A2A6
5-40. Calibration of subassembly 1A2A6 may be performed in the equipment drawer. Make the test connections shown in figure 5-19.
a. Connect the d-c null voltmeter to A6El. Disconnect R2l from RI6, and connect a 1 k ohm resistor from R16 to ground.
b. Set the reference input signal generator at $J 2$ to 10 mc and -80 dbm . Set the signal input signal generator at J3 to 10 mc and +6 dbm .
c. Adjust C2l and C29 for maximum d-c voltage at test point E1 (approximately 15 vdc ).
d. Set the reference input signal generator at $J 2$ to 10 mc and +10 dbm . Set the signal input signal generator at J3 to 10 mc and -80 dbm .
e. Adjust Cll and Cl5 for maximum d-c voltage at test point El (approximately 20 vdc).
f. Move the d-c null voltmeter to test point E2.
g. Adjust C18 for $0 \pm 5 \mathrm{mvdc}$ at E2.
h. Set the reference input signal generator at $J 2$ to 10 mc and -80 dbm . Set the signal input signal generator at J3 to 10 mc and +6 dbm .


Figure 5-19. Test Setup for Calibration of Loop Phase Detector and Loop Filter 1A2A6.
i. Adjust C 23 for $0 \pm 5 \mathrm{mvdc}$ at test point E2.
j. Repeat steps (a) through (i) until proper balance is achieved.
k . Set the reference input signal generator at J2 to 10 mc and +10 dbm . Set the signal input signal generator at J3 to 10 mc and -80 dbm .

1. Adjust C18 and/or C23 for best balance.
m. Set the signal input signal generator at J3 to +6 dbm.
n. Adjust C18 and/or C23 for $0 \pm 100$ mvdc.
o. Repeat steps $m$ and $n$, above until the balance is within $\pm 100 \mathrm{mvdc}$ for both conditions.
p. Ground the free end of $R 21$ and adjust R25 for 0 vdc $\pm 10$ mvdc at J4. Use the d-c null voltmeter at J4.
q. Free R21 from ground and, using the audio signal generator, apply $a+1$ volt peak of 1 kc to the free end of R2l.
r. Increase the input to +20 volts peak. The voltage at J4 should be 15 volts peak $\pm 20 \%$.
s. Remove the 1 k ohm resistor (step 2) and reconnect Rl 6 to R21.

5-41. 20 MC REFERENCE OSCILLATOR AND X3 MULTIPLIER 1A2A7
5-42. The calibration of subassembly lA2A7 may be performed in the drawer. Make the test connections as directed in the procedure following.
a. Adjust C6, C13, and Ll0, as required, for $10 \mathrm{dbm} \pm 2 \mathrm{db}$ output at J3, as measured with an r-f voltmeter (Boonton 91CA/91-8B).
b. Adjust C21 and C28 for $10 \mathrm{dbm} \pm 2 \mathrm{db}$ at J2, as measured with the $r-f$ voltmeter.

NOTE
Do not adjust C27 at this time.
c. Connect a frequency counter (H-P 5245L) to J3 and adjust L3 for $20 \mathrm{mc} \pm 200 \mathrm{cps}$.
d. Repeat steps (a), (b) and (c) as required.
e. Connect a spectrum analyzer (H-P 8551A/851A) to J2.
f. Adjust C27 so that all spurs are at least 40 db down from the 60 mc output at J2.

5-43. X $\frac{1}{2}$ MULTIPLIER AND 10 MC REF DISTRIBUTION AMPLIFIER 1A2A8
5-44. The subassembly 1 A2A 8 may be calibrated in the equipment drawer. Make the test connections as directed in the procedure following.
a. Connect a signal generator (H-P 606A) to J2. Adjust the generator for a $20 \mathrm{mc}+10 \mathrm{dbm}$ output.
b. Connect a d-c voltmeter (H-P 412A) to test point El. Adjust C5 for 0.32 vdc as measured at El.
c. Measure the power levels at J3, J4, J5, and J6, Use an r-f voltmeter (Boonton 91CA/91-8B). If the outputs are not as listed below, select a different value of resistance, approximately that listed on the schematic diagram, to adjust the power level.

Connector
Power Level
Change Value of
J3 $10 \mathrm{dbm} \pm 2 \mathrm{db}$ R33
J4
$10 \mathrm{dbm} \pm 2 \mathrm{db}$
R30
J5
J6
$10 \mathrm{dbm} \pm 2 \mathrm{db}$
R38
$10 \mathrm{dbm} \pm 2 \mathrm{db}$
R41
5-45. COHERENT AMPLITUDE DET, AGC AMPL AND RELAY DRIVER 1A2A9
5-46. Calibration of subassembly 1A2A9 can be performed in the equipment drawer.

5-47. DETECTOR BALANCE. Adjust the detector balance as directed, with subassembly IA2A9 in the drawer.
a. Disconnect R16 from the input 1 of the operational amplifier ARI. Ground R16 through alk ohm resistor. Adjust Cll, C15, C21, and C29 for mid-range.
b. Connect a signal generator (H-P 606A) to the ref input J2 of subassembly 1 A2A8. Adjust its output for 10 mc at -80 dbm .
c. Connect a signal generator (H-P 606A) to the signal input J3 of subassembly 1 A2A8. Adjust its output for 10 mc at $\pm 10 \mathrm{dbm}$.
d. Connect a d-c null voltmeter (H-P 413A) to test point El. Adjust C21 and C29 for maximum voltage (approx 15 vdc ) as measured at El.
e. Set the input at J 2 to +10 dbm and the input at J 3 to -80 dbm .
f. Adjust Cll and C15 for maximum voltage (approx 20 vdc) as measured at El.
g. Connect the d-c null voltmeter to test point E2. Adjust C18 for $0 \pm 5 \mathrm{mv}$ as measured at E2.
h. Set the input at J 2 to -80 dbm and the input at J 3 to +10 dbm . Adjust C23 for $0 \pm 5 \mathrm{mv}$ as measured at test point E2.
i. Repeat steps (d) through (h) until the proper balance is achieved.
j. Set the input at J 2 to +10 dbm and the input at J3 to -80 dbm . Adjust C18 and/or C23 for best balance as measured at test point E2.
k. Increase the input at $J 3$ to 0 dbm and adjust C18 or C23 for best balance.

1. Alternately repeat steps (j) and (k) until balance is within $0 \pm 100 \mathrm{mvdc}$ for both steps ( $j$ ) and (k).
m. If the repairs called only for recalibration of the balance circuits, remove the $l \mathrm{k}$ ohm resistor (step a) and reconnect R16 to terminal 1 of ARI.

5-48. AGC AMPLIFIER. Before making the test connections to subassembly lA2A9, disconnect pin 1 of the operational amplifier A9ARI from A9R16 and A9C32. Disconnect one end of capacitor A9C36.
a. Make the test connections shown in figure 5-20 and connect pin $l$ of A9AR1 to Jl on the test fixture.
b. Connect the $d-c$ null voltmeter (H-P 413A) to TP1 on the test fixture.
c. Set Sl of the test fixture to position 2 and adjust RI (test fixture) for $3 v \pm 20 \mathrm{mvdc}$ as measured on the $\mathrm{d}-\mathrm{c}$ null voltmeter.
d. Set S3 (test fixture) to AGC and connect the d-c null voltmeter to TP2 on the test fixture.
e. Adjust A9R25 for -1 vdc as measured on the d-c null voltmeter.
f. Remove test equipment and restore connections within subassembly 1A2A9. Reconnect pin 1 of A9ARI to A9R16 and A9C32. Reconnect A9C36.

5-49. 10 MC NB DISCRIMINATOR AND 10 MC WB PHASE DET 1A2A10
5-50. Calibration of the subassembly lA2A10 can be performed in the equipment drawer.
a. Connect a signal generator (H-P 606A) to J2. Set the generator for 10.410 mc at -10 dbm .
b. Connect an $r-f$ voltmeter (Boonton $91 \mathrm{CA} W / 50$-ohm probe) to the high side of R7l.
c. Adjust C 8 for peak response as indicated on the $r-f$ voltmeter.
d. Set the signal generator output to 9.590 mc at -10 dbm .
e. Connect the r-f voltmeter to the high side of R72.
f. Adjust Cll for peak response as indicated on the r-f voltmeter.
g. Set the signal generator output at 10.000 mc at -10 dbm .


Figure 5-20. AGC Amplifier (part of 1A2A9), Test Setup.
h. Connect a d-c microvoltmeter (Rohde \& Schwarz USVH) to the detector output junction of RII and R60 (J4).
i. Adjust Cll for a null on the microvoltmeter.
j. Vary the 10.000 mc input $\pm 10 \mathrm{kc}$ and observe the d-c output voltage variation on the microvoltmeter. The variation should be 20 mv either side of zero (null) for a $2 \mathrm{mv} / \mathrm{kc}$ sensitivity.
k. Refer to the schematic for subassembly lA2Al0 and select a value of $R 7$ as required to give proper sensitivity.

5-51. VIDEO DISTRIBUTION AMPLIFIER 1A2A11
5-52. Calibration of the subassembly 1A2All may be performed in the equipment drawer. When checking one of the outputs $J 4$ through J8, lift the connecting cable and terminate the subassembly output connector in 50 ohms.
a. Adjust the J7 output as follows:
(1) Connect a signal generator (H-P 606A) to J2 and set its output to 1.25 mc at 0 dbm .
(2) Adjust L5 and L6 for maximum power and a 3-db bandwidth of $\pm 10 \mathrm{kc}$ at J7. Use an rms voltmeter (H-P 400D) and oscilloscope (TEK 543/B), as required at J 7 .
(3) The power output at $J 7$ should be $0 \mathrm{dbm} \pm 1 \mathrm{db}$. If it is not, refer to the schematic diagram and select a value of $R 23$ that will satisfy this requirement.
b. Adjust J8 output as follows:
(1) Change the generator input at J2 to 1.024 mc at 0 dbm .
(2) Adjust L7 and L8 for maximum power and a 3-db bandwidth of $\pm 10 \mathrm{kc} \pm 10 \%$ at J8. Use the H-P 400 D and the TEK $543 / B$, as required, at $J 8$.
(3) The power output at $J 8$ should be $0 \mathrm{dbm} \pm 1 \mathrm{db}$. If it is not, refer to the schematic diagram and select a value of $R 33$ that will satisfy this requirement.
c. Adjust the J4 output as follows:
(1) Change the generator input at J2 to 500 kc at 0 dbm .
(2) Adjust L1 and L2 for maximum power and a 3-db bandwidth of $\pm 12.5 \mathrm{kc} \pm 10 \%$ at J4. Use the H-P 400 D and TEK 543/B, as required at $J 4$.
(3) The power output at $J 4$ should be $0 \mathrm{dbm} \pm 1 \mathrm{db}$. If it is not, refer to the schematic diagram and select a value of $R 3$ that will satisfy this requirement.
d. Adjust the output at J5 as follows:
(1) Change the generator input at J2 to 100 kc at 0 dbm .
(2) Adjust L3 and L4 for maximum power and a 3-db bandwidth of $\pm 5 \mathrm{kc} \pm 10 \%$ at J5. Use the H-P 400D and TEK 543/B, as required, at J5.
(3) The power output at $J 5$ should be $0 \mathrm{dbm} \pm 1 \mathrm{db}$. If it is not, refer to the schematic diagram and select a value of $R 13$ that will satisfy this requirement.
e. Adjust the output at J6 as follows:
(1) Remove the generator $\mathrm{H}-\mathrm{P}$ 606A and connect an audio oscillator H-P 200CD to J2. Adjust its signal into J2 to 10 kc at 0 dbm .
(2) Adjust L9 and Ll0 for maximum power and a 3-db bandwidth of $\pm 1 \mathrm{kc} \pm 10 \%$ at J6. Use the H-P 400D and TEK 543/B, as required, at J6.
(3) The power output at $J 6$ should be $0 \mathrm{dbm} \pm 1 \mathrm{db}$. If it
, is not, refer to the schematic diagram and select a value of $R 43$ that will satisfy this requirement.

5-53. -12 VDC POWER SUPPLY 1A2PS2
5-54. The power supply may be adjusted in the equipment drawer.
a. Connect a digital voltmeter (Cimeron 7200A) of pin 1 of TB5 ( -12 vdc ) and pin 4 of TB-5 ( -12 vdc return).
b. Adjust PS2 R1 for $-12 \mathrm{vdc} \pm 0.1 \mathrm{vdc}$.

5-55. $\pm 15$ VDC POWER SUPPLY IA2PSI
5-56. The power supply may be adjusted in the equipment drawer.
a. Check that the input power to PS is $115 \pm 10$ vac at pins 1 and 5 of connector P13.
b. Connect a digital voltmeter (Cimeron 7200A) to TB2-6 (+15v) and any terminal on TB1 ( +15 volt return). Adjust R19 for $+15 \mathrm{vdc} \pm 37 \mathrm{mv}$.
c. Connect the voltmeter to TB4-5 ( -15 v ) and any terminal on TB1 (-15 volt return). Adjust R20 for -15 vdc $\pm 37 \mathrm{mv}$.

5-57. SUBASSEMBLY REMOVAL
5-58. These procedures contain instructions which enable the removal and replacement of PM Receiver subassemblies (fig. l-4). 5-59. 23 MC VCO AND X96 MULTIPLIER IA2A1

5-60. Tools required to remove and replace subassembly Al are as follows: one medium Philips screwdriver and one small common screwdriver.
a. Extend and lock the equipment drawer.
b. Remove the equipment drawer dust cover.
c. Extend subassemblies A3 through A11 and stand them on end on the plastic barrier strip cover.
d. Remove all electrical connections to lA2Al (except cabling between AlJ5 and AlJ6).
e. Remove the four Philips-head screws, washers, and lock washers. Lift the subassembly from the equipment drawer.

5-61. S-BAND MIXER AND 50 MC PREAMPLIFIER IA2A2
5-62. Tools required to remove and replace subassembly A2 are as follows: one medium Philips screwdriver and one $5 / 16$ inch open-end wrench.
a. Extend and lock the equipment drawer.
b. Remove the equipment drawer dust cover.
c. Extend subassemblies A3 through All and stand then on end on the plastic barrier strip cover.
d. Remove all electrical connections.
e. Remove the four Philips-head screws, washers, lock washers, and $5 / 16$ inch nuts, which fasten the subassembly mounting brackets to the drawer support plate. Withdraw the subassembly from the equipment drawer.

5-63. SUBASSEMBLIES A3 THROUGH All
5-64. Removal and installation procedures for subassemblies A3 through All are identical. A small common screwdriver is the only tool required to remove and install subassemblies A3 through All.
a. Extend and lock the equipment drawer.
b. Remove the equipment drawer dust cover.
c. Extend the subassembly, which is to be replaced, on its wire tracks.
d. Slide the connector cover off the right-hand (facing the drawer front panel) end of the module.
e. Lift and turn the subassembly until it is 90 degrees from the extended position, and withdraw the subassembly from the equipment drawer.
f. Installation of subassemblies A3 through All is accomplished by reversing this procedure.

NOTE
Access to the circuitry of subassemblies A3 through All is obtained by removing the small Philips-head screw at the end of each module section and sliding the section cover open (see figure 1-4.)

5-65. -12 VDC POWER SUPPLY, 1A2PS2
5-66. Tools required to remove and replace subassembly PS2 are as follows: one medium Philips screwdriver; one $3 / 8$ inch spintight, and one 40 -watt soldering iron.
a. Extend and lock the equipment drawer.
b. Remove the equipment drawer dust cover.
c. Remove the eight Philips-head screws, washers, and lock washers fastening the plastic barrier strip cover to the equipment drawer. Remove the barrier strip cover.
d. Tag the following wires connected to the module for identification: the 115 vac inputs (black), the 115 vac returns (white), the -12 vdc output (green, connected to the -- terminals), and the -21 vdc return (black, connected to the ++ terminals) (fig. 5-21).
e. Unsolder the wires tagged in step d, above.
f. Support the subassembly and remove the four $3 / 8$ inch nuts, washers, and lock washers.
g. Remove the subassembly through the bottom of the equipment drawer.
h. Installation of subassembly A12 is accomplished by reversing this procedure.

5-67. -15 VDC POWER SUPPLY, 1A2PS1
5-68. Tools required to remove and replace subassembly PSI are as follows: one medium Philips screwdriver and one small common screwdriver.
a. Extend and lock the equipment drawer.
b. Remove the equipment drawer dust cover.
c. Remove the eight Philips-head screws, washers, and lock washers fastening the plastic barrier strip cover to the equipment drawer. Remove the barrier strip plastic cover.


SENSITIVITY
ADJUSTMENT
Figure 5-21. Subassembly P52 Electrical Connections

d. Remove all electrical connections.
e. Support the subassembly and remove the four Philips-head screws, washers, and lock washers.
f. Remove the subassembly through the bottom of the equipment drawer.
g. Installation of subassembly Al3 is accomplished by reversing this procedure.

## SECTION VI. PARTS LISTS AND DRAWINGS

6-1. GENERAL
6-2. This section contains parts lists of electronic parts for the assembly and subassemblies of the PM Receiver. The associated drawings are included and follow the applicable parts lists as shown below.

TABLE 6-1. Related Parts Lists and Drawings

## Title

PM Receiver, Block Diagram
PM Receiver, Interconnecting Diagram
23 MC VCO and X96 Multiplier Al, Schematic Diagram
S-Band Mixer and 50 MC Preamplifier A2, Schematic Diagram
50 MC Mixer and 10 MC AGC Amplifier A3, Schematic Diagram
10 MC Distribution Amplifier A4, Schematic Diagram

10 MC IF Amplifier A5, Schematic Diagram
Loop Phase Detector and Loop Filter A6, Schematic Diagram
20 MC Reference Oscillator and X3 Multiplier A7, Schematic Diagram
X $1 / 2$ Multiplier and 10 MC Reference Distribution Amplifier A8, Schematic Diagram 6-10 6-55
Coherent Amplitude Detector, AGC Amplifier, and Relay Driver A9, Schematic Diagram
10 MC Wideband Phase Detector, and 10 MC Narrowband Discriminator Al0, Schematic Diagram 6-12 6-71
Video Distribution Amplifier All, Schematic Diagram
$\pm 15$ VDC Power Supply PS1, Schematic Diagram
Figure No.
6-1
6-2

6-3

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| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| PM RECEIVER ASSEMBLY |  |  |
| AT1 | ATTENUATOR: variable $0-30 \mathrm{db}$ | 58-29914B37 |
| AT2 | ISOLATOR: coax 2.1-2.3 Gc | 58-29914B36 |
| AT3 | Same as AT2 |  |
| C 1 | CAPACITOR: fixed mylar, $100 \mathrm{mf} \pm 3 \%$, 50 vdc | 08-22551D |
| C2 | Same as Cl |  |
| DS1 | INDICATOR: operator | 01-29938B27 |
| DS2 | INDICATOR: operator | 01-29938B23 |
| DS3 | INDICATOR: operator | 01-29938B26 |
| DS4, DS5 | Same as DS3 |  |
| Fl | FUSE: 1.5 amp | 65-15160A09 |
| J1 | CONNECTOR: recp, elec AC | 28-29965F45 |
| J2 | CONNECTOR: recp, elec | 28-29909F04 |
| J3 | CONNECTOR: recp, elec BNC | 28-29965F42 |
| thru |  |  |
| J10 |  |  |
| M1 | METER: volt null static $\emptyset$ error | 72-23023G01 |
| M2 | METER: milliampere fm tuning | 72-29957A65 |
| M3 | METER: volt signal strength | 72-29957A66 |
| P1 | CONNECTOR: recp, elec DEM-9S | 28-14046A11 |
| thru |  |  |
| P13 |  |  |
| PS2 | POWER SUPPLY: -12 vdc | 01-29938B22 |
| R1 | RESISTOR: variable comp $5 \mathrm{~K} \pm 10 \%$ w | 18-15090A55 |
| R2 | RESISTOR: variable ww, 10 k ohms, 10 turn (Bourns 3500S-2-103) | 18-29925A98 |
| R3 | RESISTOR: fixed comp 2700 ohms $\pm 5 \%$, 1/4w | 06-15021A64 |
| R4 | RESISTOR: fixed comp 560 ohms $\pm 5 \%$, 1/4w | 06-15021A40 |
| R5 | RESISTOR: fixed comp 51 ohms $\pm 5 \%$, l/ 4 w | 06-15021A03 |
| R6 | RESISTOR: fixed comp 220 ohms $\pm 5 \%$, 1/4w | 06-15021A25 |
| S1 | SWITCH: pushbutton | 40-29928B02 |
| S2 | SWITCH: pushbutton | 40-29928B01 |
| thru |  |  |
| S4 |  |  |
| S5 | SWITCH: selector | 40-29928B03 |


| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| PM RECEIVER ASSEMBLY (Cont) |  |  |
| W 1 <br> W2 <br> W 3 <br> W4 <br> W 5 <br> W6 <br> W7 <br> W 8 <br> W9 <br> W 10 <br> Wll <br> W 12 <br> W13 <br> W 14 <br> W 15 <br> W 16 <br> W 17 <br> W 18 <br> W 19 <br> W20 <br> W 21 <br> W22 <br> W23 <br> W24 <br> W25 <br> W26 <br> W27 <br> W28 <br> W29 <br> W 30 <br> W31 <br> W 32 <br> W 33 <br> W 34 <br> W 35 <br> W36 |  | $\begin{aligned} & 30-22747 \mathrm{H} 01 \\ & 30-22747 \mathrm{H} 02 \\ & 30-22747 \mathrm{H} 03 \\ & 30-22747 \mathrm{H} 04 \\ & 30-22747 \mathrm{H} 05 \\ & 30-22747 \mathrm{H} 06 \\ & 30-22747 \mathrm{H} 07 \\ & 30-22747 \mathrm{H} 08 \\ & 30-22747 \mathrm{H} 09 \\ & 30-22747 \mathrm{H} 10 \\ & 30-22747 \mathrm{H} 11 \\ & 30-22747 \mathrm{H} 12 \\ & 30-22747 \mathrm{H} 13 \\ & 30-22747 \mathrm{H} 14 \\ & 30-22747 \mathrm{H} 15 \\ & 30-22747 \mathrm{H} 16 \\ & 30-22747 \mathrm{H} 17 \\ & 30-22747 \mathrm{H} 18 \\ & 30-22747 \mathrm{H} 19 \\ & 30-22747 \mathrm{H} 20 \\ & 30-22747 \mathrm{H} 21 \\ & 30-22747 \mathrm{H} 22 \\ & 30-22747 \mathrm{H} 23 \\ & 30-22747 \mathrm{H} 24 \\ & 30-22747 \mathrm{H} 25 \\ & 30-22747 \mathrm{H} 26 \\ & 30-22747 \mathrm{H} 27 \\ & 30-22747 \mathrm{H} 28 \\ & 30-22747 \mathrm{H} 29 \\ & 30-22747 \mathrm{H} 30 \\ & 30-22747 \mathrm{H} 31 \\ & 30-22747 \mathrm{H} 32 \\ & 30-22747 \mathrm{H} 33 \\ & 30-22747 \mathrm{H} 34 \\ & 30-22747 \mathrm{H} 35 \\ & 30-22747 \mathrm{H} 36 \end{aligned}$ |


| ITEM | DESCRIPTION | PART NUMBER |
| :--- | :--- | :--- | :--- |
|  | PM RECEIVER ASSEMBLY (Cont) |  |
| W37 | CABLE: assembly |  |
| CABLE: assembly | $30-22747 \mathrm{H} 37$ |  |




| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| 23 MC VCO \& X96 MULTIPLIER |  |  |
| C1, C2 | CAPACITOR: fixed cer diel, $1000 \mathrm{pf} \pm 20 \%$, 200 vdc | 21-15144A17 |
| C3 | CAPACITOR: fixed elec, $47 \mathrm{mf} \pm 20 \%$, 20 vdc | 23-14152D67 |
| C4 | CAPACITOR: fixed cer diel, . $01 \mathrm{mf} \pm 20 \%$, 200 vdc | 21-15144A29 |
| C5 | CAPACITOR: fixed mica diel, $82 \mathrm{pf} \pm 2 \%$, 500 vdc | 21-14032G21 |
| C6, C7 | CAPACITOR: fixed cer diel, $4700 \mathrm{pf} \pm 20 \%$, 200 vdc | 21-15144A25 |
| C8 | CAPACITOR: variable gl diel, 0.8-18.0 | 20-14020A04 |
| C9 | Same as C6 |  |
| C 10 | Same as C1 | , |
| C11 | Same as C6 |  |
| C 12 | Same as Cl |  |
| Cl3 | Same as C6 |  |
| C 14 | CAPACITOR: fixed mica diel, $100 \mathrm{pf} \pm 2 \%$, 500 vdc | 21-14032G23 |
| C 15 | Same as C6 |  |
| C16 | Same as C8 |  |
| C 17 | Same as C6 |  |
| C18 | Same as C6 |  |
| C19 | Same as C6 |  |
| C20 | Same as C6 |  |
| C21 | Same as C6 |  |
| C22 | CAPACITOR: fixed mica diel, $68 \mathrm{pf} \pm 2 \%$, 500 vdc | 21-14032G19 |
| C23 | CAPACITOR: fixed mica diel, $51 \mathrm{pf} \pm 2 \%$, 500 vdc | 21-14032G16 |
| C24 | Same as C6 |  |
| C25 | CAPACITOR: fixed $10 \pm 0.5 \mathrm{pf}, 500 \mathrm{vdc}$ | 21-14032G02 |
| C26 | Same as Cl |  |
| C27 | Same as C6 |  |
| C28 | CAPACITOR: fixed mica diel, $5 \pm 0.5 \mathrm{pf}$, 500 vdc | 21-14032G01 |
| C29 | Same as Cl |  |


| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
|  | 23 MC VCO \& X96 MULTIPLIER (Cont) |  |
| C30 | Same as Cl |  |
| C31 | CAPACITOR: fixed cer diel, tub, $1.0 \pm 0.25$ pf, 600 vdc | 21-23422H01 |
| C 32 | CAPACITOR: fixed mica diel, $15 \pm 0.5 \mathrm{pf}$, 500 vdc | 21-14032G04 |
| C33. | CAPACITOR: fixed mica diel, $27 \mathrm{pf} \pm 2 \%$, 500 vdc | 21-14032G09 |
| C 34 | CAPACITOR: fixed mica diel, $150 \mathrm{pf} \pm 2 \%$, 500 vdc | 21-14032G27 |
| C35 | Same as C25 |  |
| C36 | Same as C1 |  |
| C37 | Same as C28 |  |
| C38 | CAPACITOR: fixed mica diel, $220 \mathrm{pf} \pm 2 \%$, 500 vdc | 21-14032G31 |
| C 39 | Same as C4 |  |
| C40 | Same as C38 |  |
| C41 | Same as C38 |  |
| C42 | Same as C38 |  |
| C43 | CAPACITOR: fixed cer diel, tub, 0.5 $\pm 0.25 \mathrm{pf}, 600 \mathrm{vdc}$ | 21-23421H01 |
| C44 | Same as C25 |  |
| C45 | Same as C38 |  |
| C46 | Same as C25 |  |
| C47 | Same as C22 |  |
| C48 | Same as C38 |  |
| C49 | Same as C25 |  |
| C50 | Same as C32 |  |
| C51 | Same as C38 |  |
| C52 | CAPACITOR: fixed mica diel, $22 \pm 0.5 \mathrm{pf}$, 500 vdc | 21-14032G07 |
| C53 | CAPACITOR: fixed mica diel, $39 \mathrm{pf} \pm 2 \%$, 500 vdc | 21-14032G13 |
| C54 | Same as C38 |  |
| C55 | CAPACITOR: fixed mica diel, $56 \mathrm{pf} \pm 2 \%$, 500 vdc | 21-14032G17 |
| C56 | CAPACITOR: variable gl diel, $0.8-10 \mathrm{pf}$ | 19-20469D22 |


| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| 23 MC VCO \& X96 MULTIPLIER (Cont) |  |  |
| C57 | CAPACITOR: made from <br> housing <br> housing diode | $\begin{aligned} & 15-23047 \mathrm{G} 01 \\ & 15-23050 \mathrm{G} 01 \end{aligned}$ |
| CR1 | DIODE | PC 128 |
| CR2 | Same as CRl |  |
| CR3 | DIODE: step recovery | 48-29900E75 |
| J1 | CONNECTOR: recp elec 9-pin (DEM-9P C-33) | 28-14046A01 |
| J2 | CONNECTOR: recp elec (Selectro 51-027- | 28-29965E21 |
| thru | 3196) |  |
| J4 |  |  |
| J5 | CONNECTOR: recp elec (GRFF 2019A) | 28-29532A11 |
| J6, J7 | CONNECTOR: recp elec (GRFF 2088A) | 28-29532A07 |
| L1 | COIL: rf fixed 4.7 uh (value selected in test) | 24-14198A |
| L2, L3 | COIL: rf fixed 3.3 uh | 24-14198A13 |
| L4, L5 | COIL: rf tun-shld 3.2-8.3 uh | 24-14204A04 |
| L6, L7 | Same as L2 |  |
| L8 | COIL: rf variable 0.50-0.95 uh | 24-22704H01 |
| L9 | Same as L2 |  |
| L10 | COIL: rf variable 0.25-0.40 uh | 24-27705H01 |
| L11 | Same as L2 |  |
| L12, L13 | COIL: rf variable 0.15-0.20 uh | 24-22706H01 |
| L14 | COIL: rf variable 0.08-0.12 uh | 24-22707H01 |
| L15 | COIL: rf variable 0.10-0.12 uh | 24-22708H01 |
| L16 | COIL: rf fixed 1.0 uh | 24-14198A07 |
| L17 | Same as L2 |  |
| L18 | COIL: rf variable 0.09-0.11 | 24-22709H01 |
| L19 | Same as L16 |  |
| L20 | Same as L16 |  |
| L21 | COIL: rf variable 0.10-0.12 uh | 24-22710HO1 |
| L22 | COIL: rf variable 0.11-0.14 uh | 24-22711H01 |
| L23 | COIL: rf fixed 0.1 uh | 24-22718H01 |
| L24 | COIL: rf fixed 2.2 uh | 24-14198Al1 |
| L25 | Same as L23 |  |
| L26 | COIL: rf fixed 0.023 uh | 24-22719H01 |


| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| 23 MC VCO \& X96 MULTIPLIER (Cont) |  |  |
| Q1 <br> thru <br> Q6 | TRANSISTOR: 2 N708 | 2N708 |
| Q7, Q8 | TRANSISTOR: 2N707 | 2N707 |
| R1 | RESISTOR: fixed comp, 18 k ohm $\pm 5 \%$, $1 / 4 \mathrm{w}$ | 06-15021A94 |
| R2 | RESISTOR: fixed comp 470 ohms $\pm 5 \%$, 1/4w | 06-15021A37 |
| R3 | RESISTOR: fixed comp 5600 ohms $\pm 5 \%$, 1/4w | 06-15021A76 |
| R4 | RESISTOR: fixed comp 100 k ohms $\pm 5 \%$, 1/4w | 06-15021B22 |
| R5. | RESISTOR: fixed comp 2700 ohms $\pm 5 \%$, 1/4w | 06-15021A64 |
| R6, R7 | RESISTOR: fixed comp 2200 ohms $\pm 5 \%$, 1/4w | 06-15021A61 |
| R8 | RESISTOR: fixed comp 220 ohms $\pm 5 \%$, 1/4w | 06-15021A25 |
| R9 | RESISTOR: fixed comp 270 ohms $\pm 5 \%$, 1/4w | 06-15021A28 |
| R10 | RESISTOR: fixed comp 100 ohms $\pm 5 \%$, 1/4w | 06-15021A13 |
| R11, R12 | RESISTOR: fixed comp 1200 ohms $\pm 5 \%$, 1/4w | 06-15021A52 |
| R13 | RESISTOR: fixed comp 3300 ohms $\pm 5 \%$, 1/4w | 06-15021A67 |
| R14 | Same as R10 |  |
| R15 | RESISTOR: fixed comp $15 \mathrm{ohms} \pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021C15 |
| R16 | RESISTOR: fixed comp 56 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021A04 |
| R17 | Same as R15 |  |
| R18, R19 | RESISTOR: fixed comp 4700 ohms $\pm 5 \%$, 1/4w | 06-15021A73 |
| R20 | RESISTOR: fixed comp 680 ohms $\pm 5 \%$, 1/4w | 06-15021A43 |
| R21 | RESISTOR: fixed comp 22 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021C21 |
| R22, R23 | RESISTOR: fixed comp 33 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | -06-15021C27 |


4.7
4.7
1.70



| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| S-BAND MIXER AND 50 MC PREAMPLIFIER A2 |  |  |
| C 1 <br> thru <br> C 3 <br> C4 <br> th ru <br> C6 <br> C7, C8 <br> C9 <br> C 10 <br> Cll <br> C12, C13 <br> C 14 <br> C 15 <br> C 16 <br> C17 <br> C 18 <br> C19 <br> C20 <br> C21 <br> C22 <br> CR1 <br> CR2 <br> J1 <br> J2, J3 <br> J4 <br> L1 <br> th ru <br> L8 <br> L9 <br> L10 <br> thru <br> L14 <br> L15 <br> Q1 <br> Q2 | CAPACITOR: fixed feed-thru, ceramic, 1000 pf <br> CAPACITOR: fixed feed-thru, ceramic, 1000 pf <br> CAPACITOR: fixed mica, 1500 pf <br> Same as Cl <br> Same as C4 <br> Same as Cl <br> Same as C4 <br> CAPACITOR: fixed 0.022 mf <br> Same as C4 <br> Same as C7 <br> Same as C7 <br> Same as C14 <br> Same as C4 <br> Same as C7 <br> Same as C14 <br> Same as C4 <br> DIODE: 1N416F <br> Same as CR1 <br> CONNECTOR: recp, elec <br> (Integral with Crystal Mixer) <br> CONNECTOR: recp, elec 9-pin <br> CHOKE: rf, fixed 3 uh <br> COIL: rf variable 0.35-0.70 uh <br> Same as Ll <br> COIL: rf variable <br> TRANSISTOR: 2N2996 <br> TRANSISTOR: 2 N1143 |  |


| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| S-BAND MIXER AND $50 \mathrm{MC} \mathrm{PREAMPLIFIER} \mathrm{A2} \mathrm{(Cont)}$ |  |  |
| Q3 <br> R1, R2 <br> R3, R4 <br> R5 <br> R6 <br> R7 <br> R8 <br> R9 <br> R10 <br> R11 <br> R12 <br> F13 <br> R14 <br> R15 <br> R16 <br> T1 <br> T2, T3 <br> VR1, VR2 <br> Z1 | Same as Q2 <br> RESISTOR: fixed comp 100 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ <br> RESISTOR: fixed comp 39 ohms $\pm 10 \%$, lw <br> RESISTOR: fixed comp 6800 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ <br> RESISTOR: fixed comp 270 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ <br> RESISTOR: fixed comp 10 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ <br> RESISTOR: fixed comp 3000 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ <br> RESISTOR: fixed comp 2000 ohms $\pm 5 \%$, <br> 1/4w <br> RESISTOR: variable 1000 ohms <br> RESISTOR: fixed comp 620 ohms $\pm 5 \%, 1 / 4 w$ <br> Same as R7 <br> RESISTOR: fixed comp 750 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ <br> RESISTOR: fixed comp 220 ohms $\pm 5 \%, 1 / 4 w$ <br> Same as R7 <br> RESISTOR: fixed comp 62 ohms $\pm 5 \%, 1 / 4 w$ <br> TRANSFORMER: 6:6 turns ratio <br> TRANSFORMER: 6:6 turns ratio <br> DIODE: zener 1N1594A <br> CRYSTAL MIXER: (Includes CR1 and CR2) |  |

Notes:
 RAE SHOWN. FOR COMPLETE DESIG-
NATIONS PREF IX WTH for reference drawings refer to:





| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| 50 MC MIXER |  |  |
| C 1 <br> thru <br> C 3 <br> C4, C5 <br> C6 <br> C7 <br> thru <br> C9 <br> C 10 <br> Cll <br> C 12 <br> C13 <br> th ru <br> C26 <br> C27, C28 <br> C29 <br> C 30 <br> C 31 <br> C 32 <br> C 33 <br> C34, C35 <br> CR1 <br> th ru <br> CR4 <br> CR5 <br> th ru <br> CR10 <br> J1 <br> J2 <br> thru <br> J6 | CAPACITOR: fixed cer, $1000 \mathrm{pf} \pm 20 \%$, 200 vdc <br> CAPACITOR: fixed cer, $4700 \mathrm{pf} \pm 20 \%$, 200 vdc CAPACITOR: variable air, 0.8-10.0 pf Same as C4 <br> CAPACITOR: fixed mica $120 \mathrm{pf} \pm 2 \%, 500 \mathrm{vdc}$ <br> CAPACITOR: fixed mica $240 \mathrm{pf} \pm 2 \%, 500 \mathrm{vdc}$ <br> Same as Cl0 <br> Same as C4 <br> CAPACITOR: fixed cer $1200 \mathrm{pf}-\mathrm{AMV}-350$ <br> CAPACITOR: fixed mica $180 \mathrm{pf} \pm 2 \%$, <br> 500 vdc <br> CAPACITOR: fixed mica $390 \mathrm{pf} \pm 2 \%$, <br> 500 vdc <br> Same as C29 <br> Same as Cl <br> CAPACITOR: fixed mica $33 \mathrm{pf} \pm 2 \%$, <br> 500 vdc <br> Same as C4 <br> DIODE: switching lN3064 <br> DIODE: FD700 <br> CONNECTOR: recp elec 9-pin (DEM-9P C-33) <br> CONNECTOR: recp elec (Sealectro 51-027-3196) | $\begin{aligned} & 21-15144 \mathrm{Al7} \\ & 21-15144 \mathrm{~A} 25 \\ & 19-20469 \mathrm{D} 22 \\ & 21-14032 \mathrm{G} 25 \\ & 21-14032 \mathrm{G} 32 \\ & 21-14071 \mathrm{~A} 14 \\ & 21-14032 \mathrm{G} 29 \\ & 21-14032 \mathrm{~A} 37 \\ & 21-14032 \mathrm{G} 11 \\ & 48-14189 \mathrm{~A} 03 \\ & 48-29900 \mathrm{D} 91 \\ & 28-14046 \mathrm{~A} 01 \\ & 28-29965 \mathrm{E} 21 \end{aligned}$ |


| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| $50 \mathrm{MC} \mathrm{MIXER} \mathrm{(Cont)}$ |  |  |
| L1, L2 | COIL: rf fixed 0.68 uh | 24-14198A05 |
| L3 | COIL: rf fixed 6.8 uh | 24-14198A17 |
| thru |  |  |
| L5 |  |  |
| L6, L7 | Deleted |  |
| L8 | Same as L3 |  |
| L9, L10 | COIL: rf fixed 1.0 uh | 24-14198A07 |
| Q1 | TRANSISTOR: NPN sil 2N708 | 48-14319A01 |
| Q2 | TRANSISTOR: PNP sil 2N3304 | 48-14294A01 |
| Q3 | TRANSISTOR: NPN sil 2N918 | 48-14310A01 |
| Q4 | Same as Q2 |  |
| Q5 | Same as Q3 |  |
| Q6 | Same as Q2 |  |
| Q7 | Same as Q3 |  |
| Q8, Q9 | TRANSISTOR: NPN sil 2N930 | 48-14258A11 |
| Q10 | TRANSISTOR: PNP sil 2 N3799 | 48-29900E81 |
| Q11, Q12 | TRANSISTOR: PNP sil 2 N1132 | 48-14194A02 |
| R1 | RESISTOR: fixed comp 56 ohms $\pm 5 \%$, 1/4w | 06-15021A04 |
| R2, R3 | RESISTOR: fixed comp 1500 ohms $\pm 5 \%$, 1/4w | 06-15021A55 |
| R4 | RESISTOR: fixed comp 47 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021A01 |
| R5 | RESISTOR: fixed comp 1200 ohms $\pm 5 \%$, 1/4w | 06-15021A52 |
| R6 | RESISTOR: fixed comp 2700 ohms $\pm 5 \%$, 1/4w | 06-15021A64 |
| R7 | RESISTOR: fixed comp 5600 ohms $\pm 5 \%$, 1/4w | 06-15021A76 |
| R8 | RESISTOR: fixed comp 820 ohms $\pm 5 \%$, 1/4w | 06-15021A46 |
| R9 | RESISTOR: fixed comp 10 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021C09 |
| R10 | RESISTOR: fixed comp 82 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021A10 |
| R11 | RESISTOR: fixed comp 330 ohms $\pm 5 \%$, $1 / 4 \mathrm{w}$ | 06-15021A31 |
| R12 | RESISTOR: fixed comp 680 ohms $\pm 5 \%$, 1/4w | 06-15021A43 |


| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| $50 \mathrm{MC} \mathrm{MIXER} \mathrm{(Cont)}$ |  |  |
| R13 | Same as Rll |  |
| R14 | Same as Rl |  |
| R15 | RESISTOR: fixed comp 27 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021C24 |
| R16 | RESISTOR: fixed comp 270 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021A28 |
| R17 | RESISTOR: fixed comp 18 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021C18 |
| R18 | Same as R16 |  |
| R19 | Same as Rl |  |
| R20 | Same as R6 |  |
| R21 | Same as R7 |  |
| R22 | Same as R9 |  |
| R23 | Same as R6 |  |
| R24 | Same as R11 |  |
| R25 | Same as R8 |  |
| R26 | Same as R1 |  |
| R27 | Same as R1l |  |
| R28 | Same as R12 |  |
| R29 | Same as R15 |  |
| R30 | Same as R1 |  |
| R31 | Same as R6 |  |
| R32 | Same as R7 |  |
| R33 | Same as R9 |  |
| R34 | Same as R6 |  |
| R 35 | Same as R8 |  |
| R36 | Same as R1 |  |
| R37 | Same as R11 |  |
| R38 | Same as R1l |  |
| R 39 | Same as R12 |  |
| R40 | Same as R15 |  |
| R41 | Same as R7 |  |
| R42 | RESISTOR: fixed comp 56 k ohms $\pm 5 \%$, l/4w | 06-15021B13 |
| R43 | RESISTOR: fixed film 1000 ohms $\pm 1 \%, 1 / 4 \mathrm{w}$ (Selected in test, nominal value only) | 06-14225 |
| R44 | RESISTOR: fixed comp 10 k ohms $\pm 5 \%$, l/4w | 06-15021A85 |
| R45 | RESISTOR: fixed comp 3300 ohms $\pm 5 \%$, 1/4w | 06-15021A67 |
| R46 | RESISTOR: fixed comp 15 k ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021A91 |


| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| 50 MC MIXER (Cont) |  |  |
| R47 | Same as Rl |  |
| R48 | RESISTOR: fixed comp 10 k ohms $\pm 5 \%$, $\mathrm{l} / 4 \mathrm{w}$ | 06-15021A85 |
| R49 | Same as R12 |  |
| R50 | Same as R6 |  |
| R51 | $\begin{aligned} & \text { RESISTOR: variable comp } 2500 \text { ohms } \pm 10 \% \text {, } \\ & 1 / 2 \mathrm{w} \end{aligned}$ | 18-15089A21 |
| R52 | RESISTOR: fixed comp 3900 ohms $\pm 5 \%$, $1 / 4 \mathrm{w}$ | 06-15021A70 |
| R53 | RESISTOR: fixed comp 1000 ohms $\pm 5 \%$, 1/4w | $06-15021 \mathrm{~A} 49$ |
| R54 | RESISTOR: fixed comp 120 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021A16 |
| R55 | Same as R54 |  |
| R56 | RESISTOR: fixed comp 39 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021C30 |
| R57 | RESISTOR: fixed comp 150 ohms $\pm 5 \%$, 1/4w | 06-151021A19 |
| R58 | Same as R56 |  |
| R59 | Same as R57 |  |
| R60 | RESISTOR: fixed comp 10 k ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021A85 |
| T1 | TRANSFORMER: $10: 10,10$ turns ratio | 24-22889H01 |
| T2 | TRANSFORMER: 12:12, 8 turns ratio | 24-22881H01 |
| T3 | TRANSFORMER: 22:10, turns ratio | 24-22882H01 |
| VR1 | DIODE: zener sil l N936B | 1 N 936 B |
| VR2 | Same as VRI |  |



| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| 10 MC DISTRIBUTION AMPLIFIER |  |  |
| C 1 | CAPACITOR: fixed cer 1200 pf amv-350 | 21-14071A14 |
| C2 | CAPACITOR: fixed cer $0.01 \mathrm{mf} \pm 20 \%$, | 21-15144A29 |
| thru | 200 vdc |  |
| C22 |  |  |
| J 1 | CONNECTOR: recp elec 9-Pin (DEM-9P C-33) | 28-14046A01 |
| J2 | CONNECTOR: recp elec (Sealectro 51-027- | 28-29965E21 |
| thru | 3196) |  |
| J6 |  |  |
| L1 | COIL: rf fixed 10 uh | 24-14198A19 |
| Q1 | TRANSMITTER: NPN sil 2N918 | 48-14310A01 |
| Q2 | TRANSMITTER: NPN sil 2N708 | 48-14319A01 |
| Q3 | Same as Q2 |  |
| Q4 | Same as Q1 |  |
| Q5 | Same as Q2 |  |
| thru |  |  |
| Q8 |  |  |
| Q9 | Same as Ql |  |
| R1 | RESISTOR: fixed comp 56 ohms $\pm 5 \%$, $1 / 4 \mathrm{w}$ | 06-15021A04 |
| R2 | RESISTOR: fixed comp 3300 ohms $\pm 5 \%$, 1/4w | 06-15021A67 |
| R3 | RESISTOR: fixed comp 2200 ohms $\pm 5 \%$, $1 / 4 \mathrm{w}$ | 06-15021A61 |
| R4 | RESISTOR: fixed comp 120 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ (Selected in test, nominal value only) | 06-15021A |
| R5 | RESISTOR: fixed comp 820 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021A46 |
| R6 | RESISTOR: fixed comp 47 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021A01 |
| R7 | RESISTOR: fixed comp 470 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021A37 |
| R8 | Same as R3 |  |
| R9 | Same as R5 |  |
| R10 | Same as R6 |  |
| R11 | RESISTOR: fixed comp 100 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021A13 |
| R12 | Same as Rll |  |
| R13 | Same as R6 |  |
| R14 | Same as R5 |  |




| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| $10 \mathrm{MC} \mathrm{IF}$. |  |  |
| C 1 | CAPACITOR: fixed cer $0.01 \mathrm{mf} \pm 20 \%$, 200 vdc | 21-15144A29 |
| C2 | CAPACITOR: fixed mica $10 \pm 0.5 \mathrm{pf}$, 500 vdc | 21-14032G02 |
| C 3 | Same as Cl |  |
| C4 | Same as Cl |  |
| C5 | CAPACITOR: variable air $0.8-10 \mathrm{pf}$ | 19-20469D22 |
| C6 | Same as Cl |  |
| C7 | Same as Cl |  |
| C8 | CAPACITOR: fixed mica $51 \mathrm{pf} \pm 2 \%$, 500 vdc | 21-14032G16 |
| C9 | Same as Cl |  |
| C10 | Same as Cl |  |
| Cll | Same as . 22 |  |
| C12 | Same as C5 |  |
| C13 | Same as Cl |  |
| C 14 | CAPACITOR: fixed cer 1200 pf amv 350 vdc | 21-14071A14 |
| C 15 | Same as C'l |  |
| C 16 | Same as C5 |  |
| C17 | Same as Cl |  |
| C18 | Same as Cl |  |
| C19 | Same as Cl |  |
| C20 | CAPACITOR: fixed cer $1000 \mathrm{pf} \pm 20 \%$, 200 vdc | 21-15144A17 |
| C21 | Same as Cl |  |
| C22 | Same as C2 |  |
| C23 | Same as Cl |  |
| C24 | Same as C5 |  |
| C25 | Same as Cl |  |
| C26 | Same as Cl |  |
| C27 | CAPACITOR: fixed mica $220 \mathrm{pf} \pm 2 \%$, 500 vdc | 21-14032G31 |
| C28 | Same as Cl |  |
| C29 | Same as Cl |  |
| C 30 | Same as C2 |  |
| C31 | Same as C5 |  |


| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| $10 \mathrm{MC} \mathrm{IF} .\mathrm{AMPLIFIER} \mathrm{(Cont)}$ |  |  |
| C32 | Same as Cl |  |
| C33 | Same as Cl |  |
| C34 | Same as Cl |  |
| CR1 | DIODE: 1 N916 | 48-29900C66 |
| CR2 | Same as CRl |  |
| J1 | CONNECTOR: recp elec 9-pin (DEM-9P C-33) | 28-14046A01 |
| J2 | CONNECTOR: recp elec (Sealectro 51-0273196) | 28-29965E21 |
| J3, J4 | Same as J2 |  |
| L1, L2 | COIL: rf fixed 10 uh | 24-14198A19 |
| L3 | COIL: rf fixed 100 uh | 24-14198A39 |
| L4, L5 | Same as Ll |  |
| Q1, Q2 | TRANSISTOR; NPN sil 2N708 | 48-14319A01 |
| Q3, Q4 | TRANSISTOR: NPN sil 2 N 2369 | 48-14268A01 |
| Q5 | Same as Ql |  |
| R1 | RESISTOR: fixed comp 1200 ohms $\pm 5 \%$, $1 / 4 \mathrm{w}$ | 06-15021A52 |
| R2 | RESISTOR: fixed comp 820 ohms $\pm 5 \%$, 1/4w | 06-15021A46 |
| R3 | RESISTOR: fixed comp 270 ohms $\pm 5 \%$, 1/4w | 06-15021A28 |
| R4 | Same as R2 |  |
| R5 | RESISTOR: fixed comp 47 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021A01 |
| R6 | RESISTOR: fixed comp $56 \mathrm{ohms} \pm 5 \%, 1 / 4 \mathrm{w}$ (Selected in test, nominal value only) | 06-15021A |
| R7 | RESISTOR: fixed comp 560 ohms $\pm 5 \%$, $1 / 4 \mathrm{w}$ | 06-15021A40 |
| R8 | RESISTOR: fixed comp 2200 ohms $\pm 5 \%$, 1/4w | 06-15021A61 |
| R9 | RESISTOR: fixed comp 3300 ohms $\pm 5 \%$, 1/4w | 06-15021A67 |
| R10 | RESISTOR: fixed comp 3900 ohms $\pm 5 \%$, $1 / 4 \mathrm{w}$ | 06-15021A70 |
| R11 | Same as R5 |  |
| R12 | Deleted |  |
| R13 | Deleted |  |


| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| $10 \mathrm{MC} \mathrm{IF} .\mathrm{AMPLIFIER} \mathrm{(Cont)}$ |  |  |
| R14 | Deleted |  |
| R15 | Same as R1 |  |
| R16 | Same as R5 |  |
| R17 | Same as R2 |  |
| R18 | RESISTOR: fixed comp 470 ohms $\pm 5 \%$, 1/4w | 06-15021A37 |
| R19 | RESISTOR: fixed comp 1000 ohms $\pm 5 \%$, 1/4w | 06-15021A49 |
| R20 | Same as R5 |  |
| R21 | Same as Rl8 |  |
| R22 | RESISTOR: fixed comp 56 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021A04 |
| R23 | Same as R2 |  |
| R24 | Same as R1 |  |
| R25 | RESISTOR: fixed comp 1500 ohms $\pm 5 \%$, 1/4w | 06-15021A55 |
| R26 | Same as R5 |  |
| R27 | Same as R8 |  |
| R28 | RESISTOR: fixed comp 10 k ohms $\pm 5 \%$, 1/4w | 06-15021A85 |
| R29 | RESISTOR: fixed comp 22 ohms $\pm 5 \%$, $1 / 4 \mathrm{w}$ | 06-15021C22 |
| R30 | RESISTOR: fixed comp 33 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021C27 |
| R31 | RESISTOR: fixed comp 120 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021A16 |
| R32 | Same as R8 |  |
| R33 | Same as R5 |  |
| R34 | RESISTOR: fixed comp 100 ohms $\pm 5 \%$, $1 / 4 \mathrm{w}$ (Selected in test, nominal value only) | 06-15021A |
| R35 | RESISTOR: fixed comp 47 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ (Selected in test, nominal value only) | 06-15021A |
| R36 | RESISTOR: fixed comp 100 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ (Selected in test, nominal value only) | 06-15021A |
| R37 | RESISTOR: fixed comp 220 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021A25 |
| R38 | Same as Rl |  |
| R39 | RESISTOR: fixed comp 68 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021A07 |
| T1 | TRANSFORMER: 65:10 turns ratio | 24-22883H01 |
| T2 | TRANSFORMER: 65:9 turns ratio | 24-22884H01 |
| T3 | Same as Tl |  |



Notes:

. For referknce drawings refer to:



4. value to be selected in test





| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| LOOP PHASE DETEC TOR AND LOOP FILTER |  |  |
| Cl | CAPACITOR: fixed cer $0.01 \mathrm{mf} \pm 20 \%$, 200 vdc | 21-15144A29 |
| C2 | CAPACITOR: fixed mica $120 \mathrm{pf} \pm 2 \%$, 500 vdc (Selected in test, nominal value only) | 21-14032G |
| C3 | Deleted |  |
| C4 | Deleted |  |
| C5 | Same as Cl |  |
| thru |  |  |
| C8 |  |  |
| C9 | CAPACITOR: fixed mica $39 \mathrm{pf} \pm 2 \%, 500 \mathrm{vdc}$ (Selected in test, nominal value only) | 21-14032G |
| C 10 | Same as Cl |  |
| C11 | CAPACITOR: variable air 0.8-10 pf | 19-20469D22 |
| C12 | Same as Cl |  |
| C13 | CAPACITOR: fixed mica $100 \mathrm{pf} \pm 2 \%$, 500 vdc (Selected in test, nominal value only) | 21-14032G |
| C 14 | Same as Cl |  |
| C15 | Same as Cll |  |
| C16, C17 | Same as Cl |  |
| C18 | Same as Cll |  |
| C 19 | CAPACITOR: fixed mica $130 \mathrm{pf} \pm 2 \%$, 500 vdc (Selected in test, nominal value only) | 21-14032G |
| C20 | CAPACITOR: fixed mica $130 \mathrm{pf} \pm 2 \%$, 500 vdc (Selected in test, nominal value only) | 21-14032G |
| C21 | Same as Cll |  |
| $\mathrm{C} 22$ | CAPACITOR: fixed mica $68 \mathrm{pf} \pm 2 \%, 500 \mathrm{vdc}$ | 21-14032G19 |
| C23 | Same as Cll |  |
| C24 | Same as Cl |  |
| C25 | Same as Cl |  |
| C26 | CAPACITOR: fixed mica $51 \mathrm{pf} \pm 2 \%$, 500 vdc | 21-14032G16 |
| C27, C28 | CAPACITOR: fixed mica $43 \mathrm{pf} \pm 2 \%, 500 \mathrm{vdc}$ | 21-14032G14 |
| C29 | Same as Cll |  |
| C30, C31 | CAPACITOR: fixed mica $240 \mathrm{pf} \pm 2 \%$, 500 vdc | 21-14032G32 |
| C32 | Deleted |  |
| C33 | CAPACITOR: fixed cer $100 \mathrm{pf} \pm 20 \%$, 200 vdc | 21-15144A05 |


| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| LOOP PHASE DETECTOR AND LOOP FILTER (Cont) |  |  |
| C34 | CAPACITOR: fixed cer 1200 pf amv-350 | 21-14071A14 |
| C 35 | Same as C34 |  |
| C36, C37 | CAPACITOR: fixed elec $47 \mathrm{mf} \pm 20 \%$, 20 vdc | 23-14152D67 |
| C38 | CAPACITOR: fixed elec $47 \mathrm{mf} \pm 20 \%, 35 \mathrm{vdc}$ | 23-14152D68 |
| C39 | Same as Cl |  |
| C40 | CAPACITOR: fixed elec $150 \mathrm{mf} \pm 20 \%$, 15 vdc | 23-14152D81 |
| CR1, CR2 | DIODE: sil 1 N916 (Fairchild) | 48-29900C66 |
| CR3 | DIODE: sil lN914 | 48-14309All |
| thru |  |  |
| CR5 |  |  |
| J1 | CONNECTOR: recp elec 15-pin | 28-14046A02 |
| J2 | CONNECTOR: recp elec (Sealectro 51-0273196) | 28-29965E21 |
| J3 | CONNECTOR: recp elec | 28-29965E23 |
| J4 | Same as J2 |  |
| th ru |  |  |
| J6 |  |  |
| K1, K2 | RELAY: (HI-G Inc. $2 \mathrm{~K}-1 \mathrm{~B}-112$ ) | 80- |
| L1 | COIL: fixed rf 47 uh | 24-14198A31 |
| L2, L3 | COIL: fixed rf 100 uh | 24-14198A39 |
| L4 | Same as Ll |  |
| thru |  |  |
| L6 |  |  |
| Q1 | TRANSISTOR: NPN sil 2N708 | 48-14319A01 |
| Q2, Q3 | TRANSISTOR: NPN sil 2N1613 | 48-14120A11 |
| Q4 | TRANSISTOR: PNP sil 2 N1132 | 48-14194A02 |
| Q5 | Same as Q2 |  |
| R1 | RESISTOR: fixed comp 120 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ (Selected in test, nominal value only) | 06-15021A |
| R2 | RESISTOR: fixed comp 18 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021C18 |
| R3 | RESISTOR: fixed comp 47 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021A01. |
| R4 | RESISTOR: fixed comp 1500 ohms $\pm 5 \%$, 1/4w | 06-15021A55 |
| R5 | Same as R3 |  |


| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| LOOP PHASE DETECTOR AND LOOP FILTER (Cont) |  |  |
| R6 | RESISTOR: fixed comp 180 ohms $\pm 5 \%, 1 / 4 w$ (Selected in test, nominal value only) | 06-15021A |
| R7 | RESISTOR: fixed comp 18 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ (Selected in test, nominal value only) | 06-15021C |
| R8 | RESISTOR: fixed comp 330 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021A31 |
| R9 | RESISTOR: fixed comp 1 meg ohm $\pm 5 \%$, 1/4w | 06-15021B58 |
| R10 | RESISTOR: fixed comp 22 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ (Selected in test, nominal value only) | 06-15021G |
| R11, R12 | RESISTOR: fixed comp 3300 ohms $\pm 5 \%$, 1/4w | 06-15021A67 |
| R13, R14 | RESISTOR: fixed film 31.6 k ohms $\pm 1 \%$, 1/4w | 06-14098D39 |
| R15 | Same as R3 |  |
| R16, R17 | RESISTOR: fixed comp 10 k ohms $\pm 5 \%$, 1/4w | 06-15021A85 |
| R18 | RESISTOR: fixed comp 1000 ohms $\pm 5 \%$, 1/4w | 06-15021A49 |
| R19 | Same as R16 |  |
| R20 | Deleted |  |
| R21 | RESISTOR: fixed comp 100 k ohms $\pm 5 \%$, 1/4w | 06-15021B22 |
| R22 | RESISTOR: fixed comp 120 k ohms $\pm 5 \%$, 1/4w | 06-15021B25 |
| R23 | RESISTOR: fixed comp 39 ohms $\pm 5 \%$, $1 / 4 \mathrm{w}$ | 06-15021C30 |
| R24 | RESISTOR: fixed comp 12 k ohms $\pm 5 \%$, 1/4w | 06-15021A88 |
| R25 | RESISTOR: variable comp 50 k ohms $\pm 10 \%$, 1/2w | 18-15089A25 |
| R26 | Same as R23 |  |
| R27 | RESISTOR: fixed comp 1800 ohms $\pm 5 \%$, $1 / 4 \mathrm{w}$ | 06-15021A58 |
| R28 | RESISTOR: fixed comp 39 k ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021B07 |
| R29 | RESISTOR: fixed comp 15 k ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | $06-15021 \mathrm{~A} 91$ |
| R30 | RESISTOR: fixed comp 22 k ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021A97 |



## notes:


2. for reference drawings refer to:



4. values to be selictred in trst.



## 


6. CR1 and cr2 are a matched pair.









Figure 6-8. $\begin{gathered}\text { Loop phase petector and Loop } \\ \text { Filter A6, Scematic } \\ \text { Diagram }\end{gathered}$

| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| 20 MC REFERENCE OSCILLATOR AND X3 MULTIPLIER |  |  |
| C 1 | CAPACITOR: fixed cer 1200 pf ANV-350 | 21-14071A14 |
| C2 | CAPACITOR: fixed mica $200 \mathrm{pf} \pm 2 \%$, 500 vdc | 21-14032G30 |
| C3, C4 | CAPACITOR: fixed cer $0.01 \mathrm{mf} \pm 20 \%$, 200 vdc | 21-15144A29 |
| C5 | CAPACITOR: fixed cer $4700 \mathrm{pf} \pm 20 \%, 200 \mathrm{vdc}$ | 21-15144A25 |
| C6 | CAPACITOR: variable air $0.8-10 \mathrm{pf}$ (JMC-2954) | 19-20469D22 |
| C7 | CAPACITOR: fixed mica $10 \pm 0.5 \mathrm{pf}$, 500 vdc | 21-14032G02 |
| C8 | CAPACITOR: fixed mica $20 \pm 0.5 \mathrm{pf}$, 500 vdc | 21-14032G06 |
| C9 | Same as C3 |  |
| C 10 | CAPACITOR: fixed mica $75 \mathrm{pf} \pm 2 \%, 500 \mathrm{vdc}$ | 21-14032G20 |
| C11 | Same as C2 |  |
| C 12 | Same as C3 |  |
| C13 | Same as C6 |  |
| C 14 | Same as C3 |  |
| $\text { C } 15$ | CAPACITOR: fixed mica $68 \mathrm{pf} \pm 2 \%$, 500 vdc (Selected in test, nominal value only) | 21-14032G |
| $\begin{aligned} & \mathrm{Cl} 6 \\ & \text { thru } \end{aligned}$ | Same as C3 |  |
| C20 |  |  |
| C21 | Same as C6 |  |
| C22 | CAPACITOR: fixed mica $33 \mathrm{pf} \pm 2 \%, 500 \mathrm{vdc}$ | 21-14032G11 |
| C23, C24 | Same as C3 |  |
| C25 | CAPACITOR: fixed cer $1000 \mathrm{pf} \pm 20 \%$, 200 vdc | 21-15144A17 |
| C26 | CAPACITOR: fixed G1, 6.8 pf $\pm 5 \%$, 500 vdc | 21-15087D26 |
| C27, C28 | Same as C6 |  |
| C29 | Same as C3 |  |
| $\begin{aligned} & \text { C } 30, \text { C } 31 \\ & \text { C } 32 \end{aligned}$ | CAPACITOR: fixed mica $27 \mathrm{pf} \pm 2 \%$, 500 vdc Same as C3 | 21-14032G09 |
| C33 | CAPACITOR: fixed mica $39 \mathrm{pf} \pm 2 \%, 500 \mathrm{vdc}$ | 21-14032G13 |
| C34 | CAPACITOR: fixed mica $110 \mathrm{pf} \pm 2 \%$, 500 vdc | 21-14032G24 |



| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| 20 MC REFERENCE OSCILLATOR AND X3 MULTIPLIER (Cont) |  |  |
| R8 | RESISTOR: fixed comp 1200 ohms $\pm 5 \%$, $1 / 4 \mathrm{w}$ | 06-15021A52 |
| R9 | RESISTOR: fixed comp 3300 ohms $\pm 5 \%$, 1/4w | 06-15021A67 |
| R10 | RESISTOR: fixed comp 100 ohms $\pm 5 \%$, $1 / 4 w$ | 06-15021A13 |
| R11 | RESISTOR: fixed comp 47 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ (Selected in test, nominal value only) | 06-15021A |
| R12 | RESISTOR: fixed comp 180 ohms $\pm 5 \%$, $1 / 4 \mathrm{w}$ (Selected in test, nominal value only) | 06-15021A |
| R13 | Same as R4 |  |
| R14 | RESISTOR: fixed comp 560 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021A40 |
| R15 | RESISTOR: fixed comp 26 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021C24 |
| R16 | Same as R6 |  |
| R17, R18 | Same as R9 | - |
| R19, R20 | RESISTOR: fixed comp 47 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021A01 |
| R21 | Same as R6 |  |
| R22 | Same as R9 |  |
| R23 | Same as R14 |  |
| R24 | Same as R19 |  |
| R25 | RESISTOR: fixed comp $15 \mathrm{ohms} \pm 5 \%, 1 / 4 \mathrm{w}$ (Selected in test, nominal value only) | 06-15021C |
| R26 | RESISTOR: fixed comp 100 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ (Selected in test, nominal value only) | 06-15021A |
| R27 | RESISTOR: fixed comp 10 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021C09 |
| R28 | RESISTOR: fixed comp 68 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021A07 |
| R29 | RESISTOR: fixed comp 82 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021A10 |
| T1 | TRANSFORMER: 16:6 turns ratio | 24-22891 H01 |
| T2 | TRANSFORMER: 8:2 turns ratio | 24-22892H01 |
| VR1 | DIODE: zener USN 1N757A | 1N757A |
| Y 1 | CRYSTAL: 20.000000 mc (Midland) | 48- |

UNLESS OTHERWISE SPECIFIED,
ALL RESISTORS ARE IN OHMS,
 ALL CAPACITORS ARE IN UUF.
AL INDCTRS ARE IN UH.
ALL VOUTAGES ARE DC.
4. values to be selected in test
 $\begin{array}{cr}\text { C15 } & 68 \\ \text { R71 } & 100 \\ \text { R11 } & 187 \\ \text { R12 } & 180 \\ \text { R25 } & 15 \\ \text { R26 } & 100\end{array}$
DC Voltages are measured under
NORMAL OPERATING CONDITIONS.


| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| X 1/2 MULTIPLIER AND 10 MC REFERENCE DISTRIBUTION AMPLIFIER |  |  |
| C 1 | CAPACITOR: fixed mica $680 \mathrm{pf} \pm 2 \%, 300$ vdc | 21-14032A43 |
| C 2 | CAPACITOR: fixed mica $180 \mathrm{pf} \pm 2 \%$, 500 vdc | 21-14032G29 |
| C3 | CAPACITOR: fixed mica $100 \mathrm{pf} \pm 2 \%$, 500 vdc | 21-14032G23 |
| C4 | CAPACITOR: fixed cer $0.01 \mathrm{mf} \pm 20 \%, 200$ vdc | 21-15144A29 |
| C5 | CAPACITOR: variable air 0.8-0 pf | 19-20469D22 |
| C6 | Same as C4 |  |
| C7 | CAPACITOR: fixed mica $15 \pm 0.05 \mathrm{pf}, 500$ vdc | 21-14032G04 |
| C8 | Same as C3 |  |
| C9 | CAPACITOR: fixed mica $5 \pm 0.05 \mathrm{pf}, 500 \mathrm{vdc}$ | 21-14032G01 |
| C10 | Same as C4 |  |
| thru |  |  |
| C14 |  |  |
| C15 | CAPACITOR: fixed mica $270 \mathrm{pf} \pm 2 \%, 300$ vdc | 21-14032G33 |
| C16 | Same as C4 |  |
| thru |  |  |
| C19 |  |  |
| C20 | CAPACITOR: fixed cer $1000 \mathrm{pf} \pm 20 \%, 200$ vdc | 21-15144A17 |
| C21 | Same as C20 |  |
| thru |  |  |
| C23 |  |  |
| C24 | Same as C4 |  |
| C25 | CAPACITOR: fixed mica $68 \mathrm{pf} \pm 2 \%, 500 \mathrm{vdc}$ | 21-14032G19 |
| C26 | Same as C4 |  |
| C27 | Same as C25 |  |
| C28 | Same as C4 |  |
| thru |  |  |
| C30 |  |  |
| C31 | Same as C25 |  |


| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| X 1/2 MULTIPLIER AND 10 MC REFERENCE DISTRIBUTION AMPLIFIER (Cont) |  |  |
| C32, C33 | Same as C4 |  |
| C34 | Same as C25 |  |
| C35 | Same as C4 |  |
| C36 | CAPACITOR: fixed mica $82 \mathrm{pf} \pm 2 \%, 500 \mathrm{vdc}$ | 21-14032G21 |
| C37 | Same as C36 |  |
| C38 | Same as C4 |  |
| C39 | Same as C20 |  |
| C40 | Same as C4 |  |
| C41 | Same as C20 |  |
| C42, C43 | Same as C4 |  |
| C44 | Same as C25 |  |
| C45, C46 | Same as C4 |  |
| C47 | Same as C25 |  |
| C48 | Same as C4 |  |
| C49 | CAPACITOR: fixed cer 1200 pf AMV-350vdc | 21-14071A14 |
| CR1 | DIODE: sil 1N916 | 48-29900C66 |
| CR2, CR3 | DIODE: PC112 | 48-14175A07 |
| J1 | CONNECTOR: recp elec 9-pin (DEM-9P C-33) | 28-14046A01 |
| J2 | CONNECTOR: recp elec (Selectro 51-027- | 28-29965E21 |
| thru | 3196) |  |
| J6 |  |  |
| L1 | COIL: rf fixed 0.33 uh | 24-14198A03 |
| L2 | COIL: rf fixed 15 uh | 24-14198A21 |
| L3 | COIL: rf fixed 1.0 uh | 24-14198A07 |
| L4 | Same as L2 |  |
| thru |  |  |
| L7 |  |  |
| L8 | COIL: rf fixed 3.3 uh | 24-14198A13 |
| thru |  |  |
| Lll |  |  |
| L12 | COIL: rf fixed 0.85 uh | 24-22717H01 |
| thru |  |  |
| L15 |  |  |
| L16, L17 | Same as L8 |  |
| L18 | COIL: rf fixed 100 uh | 24-14198A39 |


| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| X 1/2 MULTIPLIER AND 10 MC REFERENCE DISTRIBUTION AMPLIFIER (Cont) |  |  |
| Q1, Q2 | TRANSISTOR: NPN sil 2 N915 | 48-14257A01 |
| Q3 | TRANSISTOR: NPN sil 2 N918 | 48-14310A01 |
| thru |  |  |
| Q6 |  |  |
| Q7, Q8 | TRANSISTOR: NPN sil 2 N708 | 48-14319A01 |
| R1 | RESISTOR: fixed comp 68 ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ (Selected in test, nominal value only) | 06-15021A |
| R2 | RESISTOR: fixed comp $470 \pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021A37 |
| R3 | RESISTOR: fixed comp 10 k ohms $\pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021A85 |
| R4 | RESISTOR: fixed comp 6800 ohms $\pm 5 \%$, $1 / 4 \mathrm{w}$ | 06-15021A79 |
| R5, R6 | RESISTOR: fixed comp 1000 ohms $\pm 5 \%$, 1/4w | 06-15021A49 |
| R7 | RESISTOR: fixed comp 100 ohms $\pm 5 \%$, 1/4w | 06-15021A13 |
| R8 | Same as R2 |  |
| R9 | RESISTOR: fixed comp 1.0 meg ohm $\pm 5 \%$, 1/4w | 06-15021B58 |
| R10 | Same as R4 |  |
| R11 | RESISTOR: fixed comp 15 k ohms $\pm 5 \%$, 1/4w | 06-15021A91 |
| R12 | RESISTOR: fixed comp 560 ohms $\pm 5 \%$, 1/4w | 06-15021A40 |
| R13 | Same as R2 |  |
| thru |  |  |
| R16 |  |  |
| R17 | Same as R7 |  |
| thru |  |  |
| R20 |  |  |
| R21 | Same as R1l |  |
| R22 | Same as R4 |  |
| R23 | Same as Rll |  |
| R24, R25 | Same as R4 |  |
| R26 | Same as Rll |  |
| R27 | Same as R4 |  |
| R28. | Same as Rll |  |


| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| X 1/2 MULTIPLIER AND 10 MC REFERENCE DISTRIBUTION AMPLIFIER (cont) |  |  |
| R29 <br> R30 <br> R31 <br> R 32 <br> R 33 <br> R 34 <br> thru. <br> R37 <br> R38 <br> R39 <br> R40 <br> R41 <br> R42 <br> R43, R44 <br> R45, R46 <br> R47 <br> R48 <br> R49 <br> R50 <br> R 51 <br> R 52 <br> R53 <br> R 54 <br> R 55 <br> R56 <br> R57, R58 <br> Tl <br> T2 <br> T3, T4 | RESISTOR: fixed comp 330 ohms $\pm 5 \%$ l/4w <br> RESISTOR: fixed comp 12 ohms $\pm 5 \% 1 / 4 \mathrm{w}$ <br> Same as R5 <br> Same as R29 <br> Same as R30 <br> Same as R5 <br> Same as R30 <br> Same as R29 <br> Same as R5 <br> Same as R30 <br> Same as R29 <br> Same as R5 <br> RESISTOR: variable comp 2500 ohms $\pm 10 \%$ <br> 1/2w <br> Same as R4 <br> Same as R1l <br> Same as R4 <br> Same as R11 <br> Same as R5 <br> RESISTOR: fixed comp 22 ohms $\pm 5 \% 1 / 4$ w <br> Same as R29 <br> Same as R5 <br> Same as R 52 <br> Same as R29 <br> Same as R5 <br> TRANSFORMER: 30:7 turns ratio <br> TRANSFORMER: 22, 22:2 turns ratio <br> TRANSFORMER: 5:10 turns ratio | $\begin{aligned} & 06-15021 \mathrm{~A} 31 \\ & 06-15021 \mathrm{C} 12 \end{aligned}$ <br> 18-15089A21 <br> 06-15021C21 <br> 24-22893HOL <br> 24-22894HO1 <br> 24-22895HOI |

[^0]3. UNLESS OTHERRTISE SpECIFIED: Asit







| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| CAD |  |  |
| AR 1 | AMPLIFIER: DC (Burr-Brown 1507) | 01-29938B08 |
| Cl | CAPACITOR: fixed, ceramic $0.01 \mathrm{mf} \pm 20 \%$ 200 vdc | 21-15144A29 |
| C2 | CAPACITOR: fixed mica, $120 \mathrm{pf} \pm 2 \%$ 500 vdc (selected in test, nominal value only) | 21-14032G |
| C3 | Deleted |  |
| C4 | Deleted |  |
| C5 | CAPACITOR: fixed mica $39 \mathrm{pf} \pm 2 \%, 500 \mathrm{vdc}$ (selected in test, nominal value only) | 21-14032G |
| C6 | Same as Cl |  |
| thru |  |  |
| C10 |  |  |
| C 11 | CAPACITOR: variable air 0.8-10 pf (JMC 2954) | 19-20469D22 |
| C12 | Same as Cl |  |
| C 13 | CAPACITOR: fixed mica $100 \mathrm{pf} \pm 2 \%$, 500 vdc (selected in test, nominal value only) | 21-14032G |
| C14 | Same as Cl |  |
| C 15 | Same as Cll |  |
| C16, Cl7 | Same as Cl |  |
| C18 | Same as Cll |  |
| C 19 | CAPACITOR: fixed mica $130 \mathrm{pf} \pm 2 \%$, 500 vdc (selected in test, nominal value only) | 21-14032G |
| C20 | Same as C 19 |  |
| C21 | Same as Cll |  |
| C22 | CAPACITOR: fixed mica $68 \mathrm{pf} \pm 2 \%$, 500 vdc | 21-14032G19 |
| C23 | Same as Cll |  |
| C24, C25 | Same as Cl |  |
| C26 | CAPACITOR: fixed mica $51 \mathrm{pf} \pm 2 \%$ 500 vdc | 21-14032G16 |
| C27 | CAPACITOR: fixed mica $43 \mathrm{pf} \pm 2 \%$ 500 vdc | 21-14032G14 |
| C28 | Same as C27 |  |
| C29 | Same as Cll |  |
| C30 | CAPACITOR: fixed mica $240 \mathrm{pf} \pm 2 \%$ 500 vdc | 21-14032G32 |


| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| CAD (Cont) |  |  |
| C31 | Same as C30 |  |
| C32 | CAPACITOR: fixed mica $100 \mathrm{pf} \pm 2 \%$ 500 vdc | 21-14032G23 |
| C33 | CAPACITOR: fixed mica $470 \mathrm{pf} \pm 2 \%$ 300 vdc | 21-14032A39 |
| C34 | CAPACITOR: fixed ceramic 1200 pf AMV350 | 21-14071A14 |
| C35 | Same as C34 |  |
| C36 | CAPACITOR: fixed mylar $5.0 \mathrm{mf} \pm 10 \%$ 100 vdc (Electron Products 2DGl-505E) | 08- |
| C37 | CAPACITOR: fixed elec $47 \mathrm{mf} \pm 20 \%$ 20 vdc | 23-14152D67 |
| C38 | Same as C37 |  |
| C39 | CAPACITOR: fixed elec $10 \mathrm{mf} \pm 20 \%$ 20 vdc | 23-14152D42 |
| CR 1 | DIODE: sil lN916 | 1N916 |
| CR2 | Same as CRl |  |
| CR 3 | DIODE: sil lN914 | 48-14309All |
| CR4 | Same as CR3 |  |
| thru |  |  |
| CR6 |  |  |
| J 1 | CONNECTOR: recp elec 15-pin (DEM15P C-33) | 28-14046A02 |
| J2 | CONNECTOR: recp elec (Selectro 51-027-3196) | 28-29965E21 |
| J3 | CONNECTOR: recp elec (Selectro 5l- 043-4300) | 28-29965E23 |
| J 4 | Same as J2 |  |
| thru |  |  |
| J6 |  |  |
| K1 | RELAY: (HI-G, Inc. $2 \mathrm{~K}-1 \mathrm{~B}-112$ ) | 80- |
| K2 | Same as Kl |  |
| L1 | COIL: rf fixed 47 uh | 24-14198A31 |
| L2 | COIL: rf fixed 100 uh | 24-14198A39 |
| L3 | Same as L2 |  |
| L4 | Same as Ll |  |
| thru L6 |  |  |


| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| CAD (Cont) |  |  |
| L7 | Deleted |  |
| Q1 | TRANSISTOR: NPN sil | 48-14319A01 |
| Q2 | TRANSISTOR: NPN sil | 48-14120Al1 |
| Q3 | TRANSISTOR: NPN sil | 48-14194A02 |
| Q4, Q5 | Same as Q3 |  |
| R1 | RESISTOR: fixed comp 120 ohms $\pm 5 \%$ l/4w (selected in test, nominal value only) | 06-15021A |
| R2 | RESISTOR: fixed comp 18 ohms $\pm 5 \%$ 1/4w | 06-15021C18 |
| R3 | RESISTOR: fixed comp 47 ohms $\pm 5 \%$ 1/4w | 06-15021A01 |
| R4 | RESISTOR: fixed comp 1500 ohms $\pm 5 \%$ 1/4w | 06-15021A55 |
| R 5 | Same as R3 |  |
| R6 | RESISTOR: fixed comp 180 ohms $\pm 5 \%$ l/4w (selected in test, nominal value only) | 06-15021A |
| R7 | RESISTOR: fixed comp 18 ohms $\pm 5 \%$ l/4w (selected in test, nominal value only) | 06-15021C |
| R8 | RESISTOR: fixed comp 1.0 meg ohm $\pm 5 \%$ $1 / 4 \mathrm{w}$ | 06-15021B58 |
| R9 | RESISTOR: fixed comp 330 ohms $\pm 5 \%$ 1/4w | 06-15021A31 |
| R10 | RESISTOR: fixed comp 22 ohms $\pm 5 \%$ l/4w (selected in test, nominal value only) | 06-15021C |
| R11 | RESISTOR: fixed comp 3300 ohms $\pm 5 \%$ 1/4w | 06-15021A67 |
| R 12 |  |  |
| R13 | ```RESISTOR: fixed film 31.6 k ohms }\pm1 l/4w``` | 06-14098D39 |
| R 14 | Same as R13 |  |
| R 15 | Same as R3 |  |
| R16 | RESISTOR: fixed comp 10 k ohms $\pm 5 \%$ 1/4w | 06-15021A85 |
| R17, R18 | Same as R16 |  |
| R19 | Deleted |  |
| R20 | Deleted |  |
| R21 | Deleted |  |


| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| CAD (Cont) |  |  |
| R22 | $\begin{aligned} & \text { RESISTOR: fixed comp } 82 \mathrm{k} \text { ohms } \pm 5 \% \\ & \mathrm{l} / 4 \mathrm{w} \end{aligned}$ | 06-15021B19 |
| R23 | Deleted |  |
| R24 | RESISTOR: fixed comp 6.8 meg ohms $\pm 5 \%$ lw | 06-15023B |
| R25 | RESISTOR: variable comp 50 k ohms $\pm 10 \% 1 / 2 \mathrm{w}$ | 18-15089A25 |
| R26 | RESISTOR: fixed comp 5600 ohms $\pm 5 \%$ 1/4w | 06-15021A76 |
| R27 | RESISTOR: fixed comp 6800 ohms $\pm 5 \%$ 1/4w | 06-15021A79 |
| R28 | Same as R4 |  |
| R29 | RESISTOR: fixed comp 39 ohms $\pm 5 \%$ 1/2w | 06-15022A22 |
| R 30 | $\begin{aligned} & \text { RESISTOR: fixed comp } 100 \text { ohms } \pm 5 \% \\ & 1 / 2 \mathrm{w} \end{aligned}$ | 06-15022A37 |
| R 31 | Same as R 30 |  |
| T1 | TRANSFORMER: 34:5 turns ratio | 24-22896H01 |
| T2 | TRANSFORMER: 5:20, 20 turns ratio | 24-22897H01 |
| T3 | TRANSFORMER: 10, 25:6 turns ratio | 24-22898H01 |
| T4 | TRANSFORMER: 6:30 turns ratio | 24-22899H01 |
| VR1 | DIODE: zener $400 \mathrm{mw}, 1 \mathrm{l} 746 \mathrm{~A}$ | 48-14131A37 |
| VR2 | DIODE: zener 1N2976R | 48-14146A56 |

NOTES:

1. Partial reference designations ARE SHOWN. FOR COMP
NATIONS PREFIX WITH
2. For reference drawings refer to $\begin{array}{ll}\text { O1-22831G } \\ 69-26654 G & \text { ASSEMBLY } \\ \text { INTERCONECTING }\end{array}$ 69-26677G $\begin{aligned} & \text { DIAGRAM } \\ & \text { BLOCK DIAGRAM }\end{aligned}$
3. UNLESS OTHERWISE SPECIFIED, ALL RESISTORS ARE IN OHMS,
$+5 \mathrm{PCT}, 1 / 4 \mathrm{WATT}$. LL CAPACITORS ARE IN UUF, ALL INDUCTORS ARE IN
ALL VOLTAGES ARE DC.
4. 

values to be selected in test REFERENCE APproximate ESIGNATIONS
R1
R6
R7
R1
R6
R7
R10
C2
C5
C13
C19
C2 $\underset{\substack{\text { APPROXIMATE } \\ \text { VALUE }}}{\text { and }}$ Value
120

10
5. CR1 and CR2 are a matched pair
6. C18 MAY BE CONNECTED TO ANODE OF
CR1 OR CR2 AS REQUIRED IN TEST.




10. Dc voltage ane mancrep vingr
 CONNECTED.


| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| NB DETECTOR WB DISCRIMINATOR |  |  |
| C 1 | CAPACITOR: fixed ceramic $0.01 \mathrm{mf} \pm 20 \%$, 200 vdc | 21-15144A29 |
| C2 | Same as Cl |  |
| C3 | CAPACITOR: fixed mica $100 \mathrm{pf} \pm 2 \%$, 500 vdc | 21-14032G23 |
| $\mathrm{C} 4$ | Same as Cl |  |
| C7 |  |  |
| C8 | CAPACITOR: variable air $0.8-10 \mathrm{pf}$, (JMC 2954) | 19-20469D22 |
| C9 | CAPACITOR: fixed mica $15 \pm 0.5 \mathrm{pf}$, 500 vdc | 21-14032G04 |
| C 10 | CAPACITOR: fixed mica $22 \pm 0.5 \mathrm{pf}$, 500 vdc | 21-14032G07 |
| C11 | Same as C8 |  |
| C12 | Same as Cl |  |
| thru |  |  |
| C 14 |  |  |
| C15 | CAPACITOR: fixed elec $22 \mathrm{mf} \pm 20 \%$, 15 vdc | 23-14152D54 |
| C16 | Same as Cl5 |  |
| C 17 | CAPACITOR: fixed ceramic $0.1 \mathrm{mf} \pm 20 \%$, 50 vdc (Sprague 5C50) | 21-29907C93 |
| C 18 | Same as Cl5 |  |
| C19 | Same as Cl |  |
| C20 | Same as C17 |  |
| C21 | Same as C 15 |  |
| C 22 | CAPACITOR: fixed elec $68 \mathrm{mf} \pm 20 \%$, 15 vdc | 23-14152D72 |
| C23 | Same as C22 |  |
| C24 | CAPACITOR: fixed elec $330 \mathrm{mf} \pm 20 \%$, 6 vdc | 23-14152D86 |
| C25, C26 | Same as C 15 |  |
| C27 | Same as C22 |  |
| $\mathrm{C} 28$ | Same as Cl |  |
| thru |  |  |
| C33 |  |  |


| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| NB DETECTOR WB DISCRIMINATOR (Cont) |  |  |
| C34 | CAPACITOR: fixed mica $270 \mathrm{pf} \pm 2 \%$, 300 vdc | 21-14032G33 |
| C35 | Same as Cl7 |  |
| C36 | CAPACITOR: fixed mica $1000 \mathrm{pf} \pm 2 \%$, 500 vdc | 21-14032B47 |
| C37 | Same as C3 |  |
| C38 | CAPACITOR: fixed mica $22 \pm 0.5 \mathrm{pf}$, 500 vdc | 21-14032G |
| C39 | Same as C17 |  |
| C40 | Same as C22 |  |
| C41 | CAPACITOR: fixed elec $1 \mathrm{mf} \pm 20 \%$, 35 vdc | 23-14152D07 |
| C42 | Same as C4l |  |
| C43 | CAPACITOR: fixed elec $100 \mathrm{mf} \pm 20 \%$, 10 vdc | 23-14152D76 |
| C44 | Same as C4l |  |
| C45 | Same as Cl |  |
| C46 | CAPACITOR: fixed elec $22 \mathrm{mf} \pm 20 \%$, 15 vdc | 23-14152D54 |
| C47 | Same as C46 |  |
| C48 | CAPACITOR: fixed ceramic 1200 AMV350 | 21-14071A14 |
| C49 | Same as C48 |  |
| C50 | Same as Cl |  |
| C5l | Same as C46 |  |
| C 52 | CAPACITOR: fixed mica $180 \mathrm{pf} \pm 2 \%$, 500 vdc | 21-14032G29 |
| C 53 | CAPACITOR: fixed Gl 0.8-18 pf (JFD VC23GY) | 20-14020A04 |
| C54, C55 | Same as Cl7 |  |
| C56 | CAPACITOR: fixed elec $10 \mathrm{mf} \pm 20 \%$, 20 vdc | 23-14152D42 |
| C57 | Same as C15 |  |
| C58 | Same as Cl |  |
| C59 | Same as C22 |  |
| C60 | Same as Cl |  |


| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| NB DETECTOR WB DISCRIMINATOR (Cont) |  |  |
| CR1 | DIODE: 1N914 | 48-14309A11 |
| CR2 | Same as CRl |  |
| CR 3 | DIODE: FD700 | 48-29900D91 |
| CR4 | DIODE: FD700 | 48-29900D91 |
| CR5 | DIODE: FD700 | 48-29900D91 |
| CR6 | Same as CR5 |  |
| CR7, CR8 | Same as CRI |  |
| CR9 | DIODE: 1N831 | 48-14132A01 |
| CR10 | Same as CR9 |  |
| thru |  |  |
| CR 12 |  |  |
| CR13 | DIODE: sil lN777 | 48-29900C65 |
| CR14 | Same as CR13 |  |
| J 1 | CONNECTOR: recp elec 9-pin (DEM-9P C-33) | 28-14046A01 |
| J2 | CONNECTOR: recp elec (Selectro 51-043-4300) | 28-29965E23 |
| J3 | CONNECTOR: recp elec (Selectro 5l-027-3196) | 28-29965E21. |
| J4 | Same as J2 |  |
| J5, J6 | Same as J3 |  |
| J7 | Same as J2 |  |
| L1 | COIL: rf fixed 33 uh | 24-14198A27 |
| L2 | Same as Ll |  |
| L3 | Deleted |  |
| L4 | Deleted |  |
| L5 | COIL: rf fixed 10 uh | 24-14198A19 |
| L6 | COIL: rf fixed 2.2 uh | 24-14198Al1 |
| L7 | COIL: rf fixed 22 uh | 24-14198A23 |
| L8 | Same as L7 |  |
| L9 | COIL: rf fixed 10 mh | 24-14198A87 |
| L10 | Same as L9 |  |
| L11 | COIL: rf variable set to 10.85 uh | 24-25240H01 |
| L12 | Same as Lll |  |
| L13, L14 | Same as L9 |  |
| Q1 | TRANSISTOR: NPN sil 2N708 | 48-14319A01 |


| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| NB DETECTOR WB DISCRIMINATOR (Cont) |  |  |
| Q2 | Same as Ql |  |
| Q3 | TRANSISTOR: NPN sil 2N2484 (Keystone Carbon Co.) | 2N2484 |
| Q4 | Same as Ql |  |
| Q5 | TRANSISTOR: NPN sil 2N2218 | 2N2218 |
| Q6 | TRANSISTOR: PNPsil 2N2905 | 2N2905 |
| Q7 | TRANSISTOR: NPN sil 2N918 | 2N918 |
| Q8, Q9 | Same as Ql |  |
| Q10 | TRANSISTOR: NPN sil 2 N 2222 | 48-14267A13 |
| Q11 | TRANSISTOR: PNP sil 2N3307 | 48-29900E68 |
| Q12 | Same as Ql0 |  |
| Q13 | Same as Qll |  |
| Q14 | Same as Q10 |  |
| Q15 | Same as Qll |  |
| R1 | RESISTOR: fixed comp 3300 ohms $\pm 5 \%$, 1/4w | 06-15021A67 |
| R2 | RESISTOR: fixed comp 2200 ohms $\pm 5 \%$, | 06-15021A61 |
|  | 1/4w | 06-15021A61 |
| R 3 | RESISTOR: fixed comp 470 ohms $\pm 5 \%$, 1/4w | 06-15021A37 |
| R 4 | RESISTOR: fixed comp 1000 ohms $\pm 5 \%$, 1/4w | 06-15021A49 |
| R 5 | RESISTOR: fixed comp 2700 ohms $\pm 5 \%$, 1/4w | 06-15021A64 |
| R6 | RESISTOR: fixed comp 8200 ohms $\pm 5 \%$, $1 / 4 \mathrm{w}$ (selected in test, nominal value only) | 06-15021A82 |
| R 7 | RESISTOR: fixed comp 10 ohms $\pm 5 \%$, l/4w (selected in test, nominal value only) | 06-15021C |
| R 8 | RESISTOR: fixed comp 1500 ohms $\pm 5 \%$, 1/4w | 06-15021A55 |
| R9 | RESISTOR: fixed comp 120 ohms $\pm 5 \%$, 1/4w | 06-15021A16 |
| R10 | RESISTOR: fixed comp 820 ohms $\pm 5 \%$, 1/4w | 06-15021A46 |
| R11 | Same as R4 |  |


| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| NB DETECTOR WB DISCRIMINATOR (Cont) |  |  |
| R 12 | $\begin{aligned} & \text { RESISTOR: fixed comp } 68 \mathrm{k} \text { ohms } \pm 5 \% \text {, } \\ & 1 / 4 \mathrm{w} \end{aligned}$ | 06-15021B16 |
| R13 | Same as R12 |  |
| R14 | RESISTOR: fixed comp 3900 ohms $\pm 5 \%$, 1/4w | 06-15021A70 |
| R15 | RESISTOR: fixed comp 150 ohms $\pm 5 \%$, l/4w (selected in test, nominal value only) | 06-15021A |
| R16 | RESISTOR: fixed comp 6800 ohms $\pm 5 \%$, 1/4w (selected in test, nominal value only) | 06-15021A |
| R17 | Same as R1 . |  |
| $\begin{aligned} & \text { R } 18 \\ & \text { thru } \end{aligned}$ | Same as R2 |  |
| R20 |  |  |
| R21 | RESISTOR: fixed comp 47 ohms $\pm 5 \%$, 1/4w | 06-15021A01 |
| R22 | Same as R21 |  |
| R23, R24 | Same as R5 |  |
| R25 | Same as R2l |  |
| R26 | RESISTOR: fixed comp 22 ohms $\pm 5 \%$, 1/4w | 06-15021C21 |
| R27 | Same as R26 |  |
| R28 | Same as R21 |  |
| R29 | RESISTOR: fixed comp 56 ohms $\pm 5 \%$, 1/4w | 06-15021A04 |
| R 30 | Same as R1 |  |
| R31 | Same as R2 |  |
| R32 | RESISTOR: fixed comp 330 ohms $\pm 5 \%$, 1/4w | 06-15021A31 |
| R33 | RESISTOR: fixed comp 47 ohms $\pm 5 \%$, l/4w (selected in test, nominal value only) | 06-15021 |
| R 34 | Same as R10 |  |
| R35 | Same as R21 |  |
| R36 | Same as R4 |  |
| R 37 | Same as R10 |  |
| R38 | RESISTOR: fixed comp 100 ohms $\pm 5 \%$, 1/4w | 06-15021A13 |


| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| NB DETECTOR WB DISCRIMINATOR (Cont) |  |  |
| R 39, R40 | Same as R2I |  |
| R41 | Same as R10 |  |
| R42 | Same as R2l |  |
| R43 | $\begin{aligned} & \text { RESISTOR: fixed comp } 82 \text { ohms } \pm 5 \% \text {, } \\ & 1 / 4 \mathrm{w} \end{aligned}$ | 06-15021A10 |
| R 44 | Same as R3 |  |
| R45 | RESISTOR: fixed comp 1800 ohms $\pm 5 \%$, 1/4w | 06-15021A58 |
| R46 | RESISTOR: fixed comp 680 ohms $\pm 5 \%$, $1 / 4 \mathrm{w}$ | 06-15021A43 |
| R47 | RESISTOR: fixed comp 330 ohms $\pm 5 \%$, 1/2w | 06-15022A55 |
| R 48 | RESISTOR: fixed comp 390 ohms $\pm 5 \%$, 1/4w | 06-15021A34 |
| R 49 | RESISTOR: fixed comp 56 k ohms $\pm 5 \%$, l/4w (selected in test, nominal value only) | 06-15021B |
| R 50 | RESISTOR: fixed comp 2200 ohms $\pm 5 \%$, l/4w (selected in test, nominal value only) | 06-15021A |
| $\text { R } 51$ | Same as R24 |  |
| $\text { R } 52$ | RESISTOR: fixed comp 390 ohms $\pm 5 \%$, l/4w (selected in test, nominal value only) | 06-15021A |
| R 53 | RESISTOR: fixed comp 68 ohms $\pm 5 \%$, 1/4w | 06-15021A07 |
| R 54 | RESISTOR: fixed comp 270 ohms $\pm 5 \%$, 1/2 w | 06-15022A52 |
| R 55 | Same as R 48 |  |
| R 56 | RESISTOR: fixed comp 2200 ohms $\pm 5 \%$, l/4w (selected in test, nominal value only) | 06-15021A |
| R57, R 58 | Same as R21 |  |
| R59 | RESISTOR: fixed comp 220 ohms $\pm 5 \%$, lw | 06-15023A70 |
| R60 | Same as R4 |  |
| R61 | Same as R 32 |  |
| R62 | RESISTOR: fixed comp 39 ohms $\pm 5 \%$, 1/4w | 06-15021C30 |


| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| NB DETECTOR WB DISCRIMINATOR (Cont) |  |  |
| R63 | RESISTOR: fixed comp 180 ohms $\pm 5 \%$, 1/4w | 06-15021A22 |
| R64 | Same as R63 |  |
| R65 | RESISTOR: fixed comp 33 ohms $\pm 5 \%$, l/4w (selected in test, nominal value only) | 06-15021C |
| R66 | RESISTOR: fixed comp 8200 ohms $\pm 5 \%$, 1/4w | 06-15021A82 |
| R67 | RESISTOR: fixed comp 5600 ohms $\pm 5 \%$, 1/4w | 06-15021A76 |
| R68 | Same as R1 |  |
| R69 | Same as R2 |  |
| R 70 | Same as R29 |  |
| R71 | RESISTOR: fixed film 46.4 ohms $\pm 1 \%, 1 / 4 \mathrm{w}$ | 06-14098A07 |
| R 72 | Same as R71 |  |
| R73 | Same as R 32 |  |
| R74, R 75 | Same as R4 |  |
| Tl | TRANSFORMER: 10:5 turns ratio | 24-22702 HOL |
| T2 | TRANSFORMER: 18:4 turns ratio | 24-22701H01 |
| T3 | Deleted |  |
| T4 | TRANSFORMER: 5:14:14 turns ratio | 24-22703H01 |
| T5 | Same as T4 |  |
| T6 | TRANSFORMER: 30 turns C.T. | 24-22799H01 |
| VR1 | DIODE: zener lN936B | 48-14131A07 |
| VR2 | DIODE: zener USN 1N749A | 48-14131A40 |
| VR3 | DIODE: zener USN 1N751A | 48-14131A42 |
| VR4 | Same as VRl |  |


| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| VIDEO DISTRIBUTION AMPLIFIER All |  |  |
| C 1 | CAPACITOR: fixed elec $4.7 \mathrm{mf} \pm 20 \%, 35$ vdc | 23-14152D31 |
| C2 | CAPACITOR: fixed cer $0.1 \mathrm{mf} \pm 20 \%$, 50 vdc | 21-29907C93 |
| C3 | CAPACITOR: fixed mica $1500 \mathrm{pf} \pm 2 \%, 500$ vdc | 21-14032B51 |
| C4 | CAPACITOR: fixed mica $56 \mathrm{pf} \pm 2 \%, 500$ vdc | 21-14032G17 |
| C5 | Same as C3 |  |
| C6 | Same as C2 |  |
| C7 | Same as C2 |  |
| C8 | Same as C2 |  |
| C9 | Same as Cl |  |
| C10 | Same as C2 |  |
| C11 | CAPACITOR: fixed mica $4300 \mathrm{pf} \pm 2 \%, 500$ vdc | 21-14032B62 |
| C 12 | CAPACITOR: fixed mica $330 \mathrm{pf} \pm 2 \%, 500$ vdc | 21-14032A35 |
| C13 | Same as Cll . |  |
| C 14 | Same as C2 |  |
| C 15 | Same as C2 |  |
| C16 | Same as C2 |  |
| C17 | Same as Cl |  |
| C18 | CAPACITOR: fixed cer $0.01 \mathrm{mf} \pm 20 \%, 200$ vdc | 21-15144A29 |
| C19 | CAPACITOR: fixed mica $1000 \mathrm{pf} \pm 2 \%, 500$ vdc | 21-14032B47 |
| C20 | CAPACITOR: fixed mica $12 \pm 0.5 \mathrm{pf}, 500$ vdc | 21-14032G03 |
| C21 | Same as Cl9 |  |
| $\mathrm{C} 22$ | Same as C18 |  |
| C23 | Same as C18 |  |
| C24 | Same as Cl8 |  |
| C25 | Same as Cl |  |
| C26 | Same as Cl8 |  |
| C 27 | Same as C3 |  |


| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| VIDEO DISTRIBUTION AMPLIFIER All (Cont) |  |  |
| C28 | CAPACITOR: fixed mica $22 \pm 0.5 \mathrm{pf}, 500$ vdc | 21-14032G07 |
| C29 | Same as C3 |  |
| C 30 | Same as Cl8 |  |
| C 31 | Same as Cl8 |  |
| C 32 | Same as Cl8 |  |
| C 33 | Same as Cl |  |
| C34 | CAPACITOR: fixed elec $1.0 \mathrm{mf} \pm 20 \%, 35$ vdc | 23-14152D07 |
| C 35 | CAPACITOR: fixed paper. $022 \mathrm{mf} \pm 10 \%$, $500 \mathrm{vdc} \quad$ (Kemet KR022-ML35J) | 08. |
| C 36 | Same as Cll |  |
| C 37 | Same as C 35 |  |
| C 38 | Same as C34 |  |
| C 39 | Same as C34 |  |
| C40 | Same as C34 |  |
| C41 | CAPACITOR: fixed cer AMV-350 | 21-14071A14 |
| C42 | Same as C41 |  |
| J 1 | CONNECTOR: recp elec 9-pin (DEM-9P C-33) | 28-14046A01 |
| J 2 | CONNECTOR: recp elec (Selectro 51-0273196) | 28-29965E21 |
| $\begin{aligned} & \text { J3 } \\ & \text { thru } \end{aligned}$ | Same as J2 |  |
| J 7 |  |  |
| J 8 | CONNECTOR: recp elec (Selectro 51-0434300) | 28-29965E23 |
| L1 | COIL: rf var shld 66-160 uh (Cambridge Thermionic Corp. No. 1505-8) | 24-14204A08 |
| L2 | Same as Ll |  |
| L3 | COIL: rf var shld 400-1000 uh (Cambridge Thermionic Corp. No. 1505-10) | 24-14204A10 |
| L4 | Same as L3 |  |
| L5 <br> thru | COIL: rf var shld 14.5-33 uh (Cambridge Thermionic Corp. No. 1505-6) | 24-14204A06 |
| L8 |  |  |
| L9 | Coil: rf var 12 mh (WEE VEE-L Nytronics) | $24-$ |


| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| VIDEO DISTRIBUTION AMPLIFIER All (Cont) |  |  |
| L10 | Same as L9 |  |
| Q1 | TRANSISTOR: NPN sil 2N708 | 48-14319A01 |
| Q2 | Same as Ql |  |
| Q3 | TRANSISTOR: NPN sil 2 N2222 | 48-14267A13 |
| Q4, Q5 | Same as Ql |  |
| Q6 | Same as Q3 |  |
| Q7, Q8 | Same as Q1 |  |
| Q9 | Same as Q3 |  |
| Q10, Q11 | Same as Q1 |  |
| Q12 | Same as Q3 |  |
| Q13, Q14 | Same as Q1 |  |
| Q15 | Same as Q3 |  |
| R1 | RESISTOR: fixed comp 6800 ohms $\pm 5 \%$, $1 / 4 \mathrm{w}$ | 06-15021A79 |
| R2 | Same as Rl |  |
| R 3 | RESISTOR: var ww 2000 ohms $\pm 5 \%$, l w | 18-14142A15 |
| R4 | RESISTOR: fixed comp 1000 ohms $\pm 5 \%$, 1/4 w | 06-15021A49 |
| R 5 | RESISTOR: fixed comp 10 k ohms $\pm 5 \%$, 1/4 w | 06-15021A85 |
| R6 | Same as R 5 |  |
| R 7 | RESISTOR: fixed comp 2200 ohms $\pm 5 \%$, 1/4 w | 06-15021A.61 |
| R 8 | RESISTOR: fixed comp 120 ohms $\pm 5 \%$, 1/2 w | 06-15022A40 |
| R 9 | RESISTOR: fixed comp 56 ohms $\pm 5 \%, 1 / 2 \mathrm{w}$ | 06-15022A28 |
| $\text { R } 10$ | RESISTOR: fixed comp $39 \mathrm{ohms} \pm 5 \%, 1 / 4 \mathrm{w}$ | 06-15021C30 |
| R11 | Same as R1 |  |
| R12 | Same as Rl |  |
| R13 | RESISTOR: fixed comp 1000 ohms $\pm 5 \%$, 1/4 w (Selected in test, nominal value only.) | 06-15021A |
| R14 | Same as R4 |  |
| R15, R16 | Same as R 5 |  |
| R17 | Same as R7 |  |
| R18 | Same as R8 |  |
| R19 | Same as R9 |  |


| ITEM | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| VIDEO DISTRIBUTION AMPLIFIER All (Cont) |  |  |
| R20 <br> R21, R22 <br> R23 <br> R24 <br> R25, R26 <br> R27 <br> R28 <br> R29 <br> R 30 <br> R31, R32 <br> R33 <br> R 34 <br> R 35 , R 36 <br> R 37 <br> R 38 <br> R 39 <br> R 40 <br> R41, R42 <br> R43 <br> R 44 <br> R45, R46 <br> R47 <br> R 48 <br> R49 <br> R 50 | Same as R10 <br> Same as R1 <br> RESISTOR: fixed comp 1000 ohms $\pm 5 \%$, <br> $1 / 4 \mathrm{w}$ (Selected in test, nominal value only.) <br> Same as R4 <br> Same as R5 <br> Same as R7 <br> Same as R8 <br> Same as R9 <br> Same as R10 <br> Same as Rl <br> RESISTOR: fixed comp 1000 ohms $\pm 5 \%$, <br> $1 / 4 \mathrm{w}$ (Selected in test, nominal value only.) <br> Same as R4 <br> Same as R5 <br> Same as R7 <br> Same as R8 <br> Same as R9 <br> Same as R10 <br> Same as Rl <br> RESISTOR: fixed comp 1000 ohms $\pm 5 \%$, <br> $1 / 4 \mathrm{w}$ (Selected in test, nominal value only.) <br> Same R4 <br> Same as R5 <br> Same as R7 <br> Same as R8 <br> Same as R9 <br> Same as R10 | 06-15021A <br> 06-151021A <br> 06-15021A |

NOTES:
PARTIAL REFERENCE DESIGNATIONS

2. for reference drawings refer to
3. UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE SPECIFIED $\pm 5$ PCT, $1 / 4$ WATT ALL INDUCTORS ARE IN
ALL VOLTAGES ARE DC.
4. DC VOLTAGES ARE MEASURED UNDER
5. VALUES TO BE SELECTED IN TEST VIO
FOR PROPER OUTPUT LEVEL. REFERENCE APPROXIMATE $R 13$
R13
R23
R33
R43
ROXIM
VALU
1 K
1 K
1 K
1 K


$$
\begin{aligned}
& \text { R.F. }=\ldots+31.25= \\
& E= \\
& I= \\
& P_{n / R}= \\
& I= \\
& P_{W R}= \\
& \text { MOD }
\end{aligned}
$$

$F_{\text {MOD }} \frac{V_{Y M S}-2}{\text { RADS }}$
50 ke. $\qquad$
OOK.C. $\qquad$
$768 \mathrm{~K} . \mathrm{C}$ $\qquad$
.024 M.C. $\qquad$
$.5 \cup$ M.C. $\qquad$
EECTRUM $\pm 25$ m.e. $\qquad$
$\underline{L O}$

WEPT RESP. $\qquad$
$\qquad$

SWEPT RESP.


[^0]:    '6-54

