**GENERAL**

This addendum documents a change to the Data Module (19D904558G1) Maintenance Manual. Torque specification changed from 20 in-lbs. to 12.5 ± 2.50 in-lbs.

**CHANGES**

On page 6, update drawing 19D904558 with revision 1.
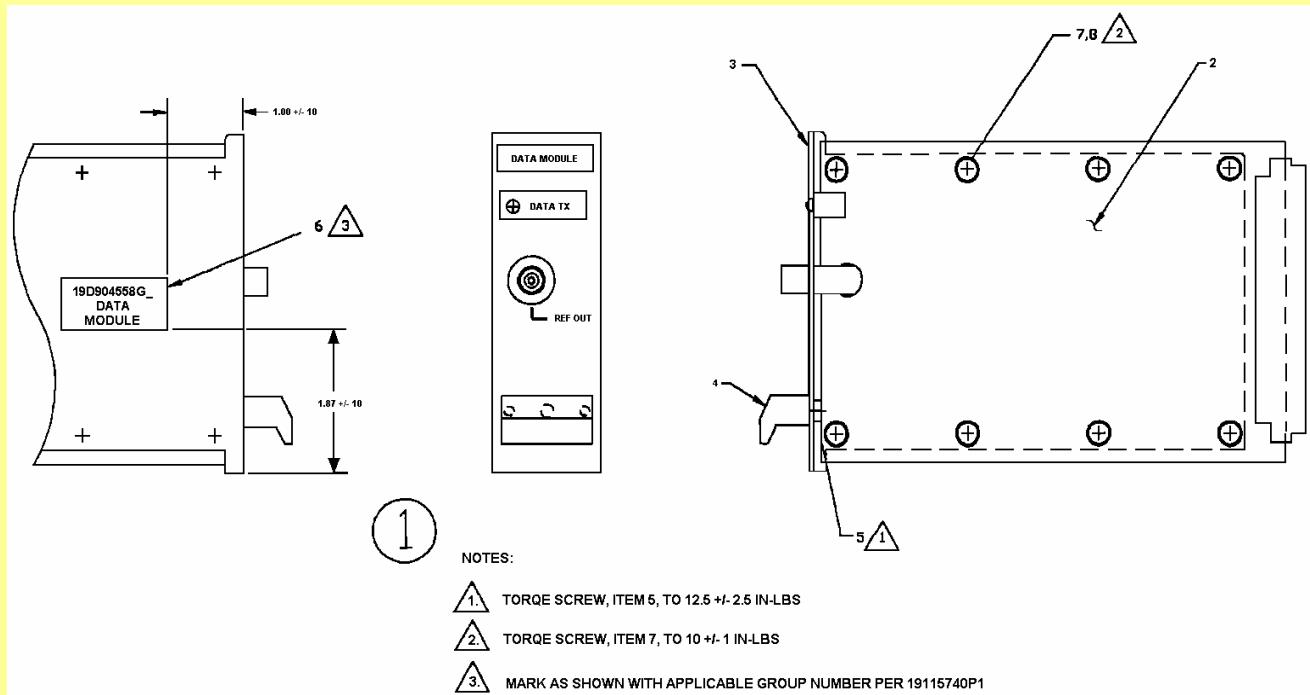


NOTES:

1. TORQE SCREW, ITEM 5, TO 12.5 +/- 2.5 IN-LBS

2. TORQE SCREW, ITEM 7, TO 10 +/- 1 IN-LBS

3. MARK AS SHOWN WITH APPLICABLE GROUP NUMBER PER 19115740P1

**(19D904558, Rev. 1)**

The Future *of* Mobile Radio
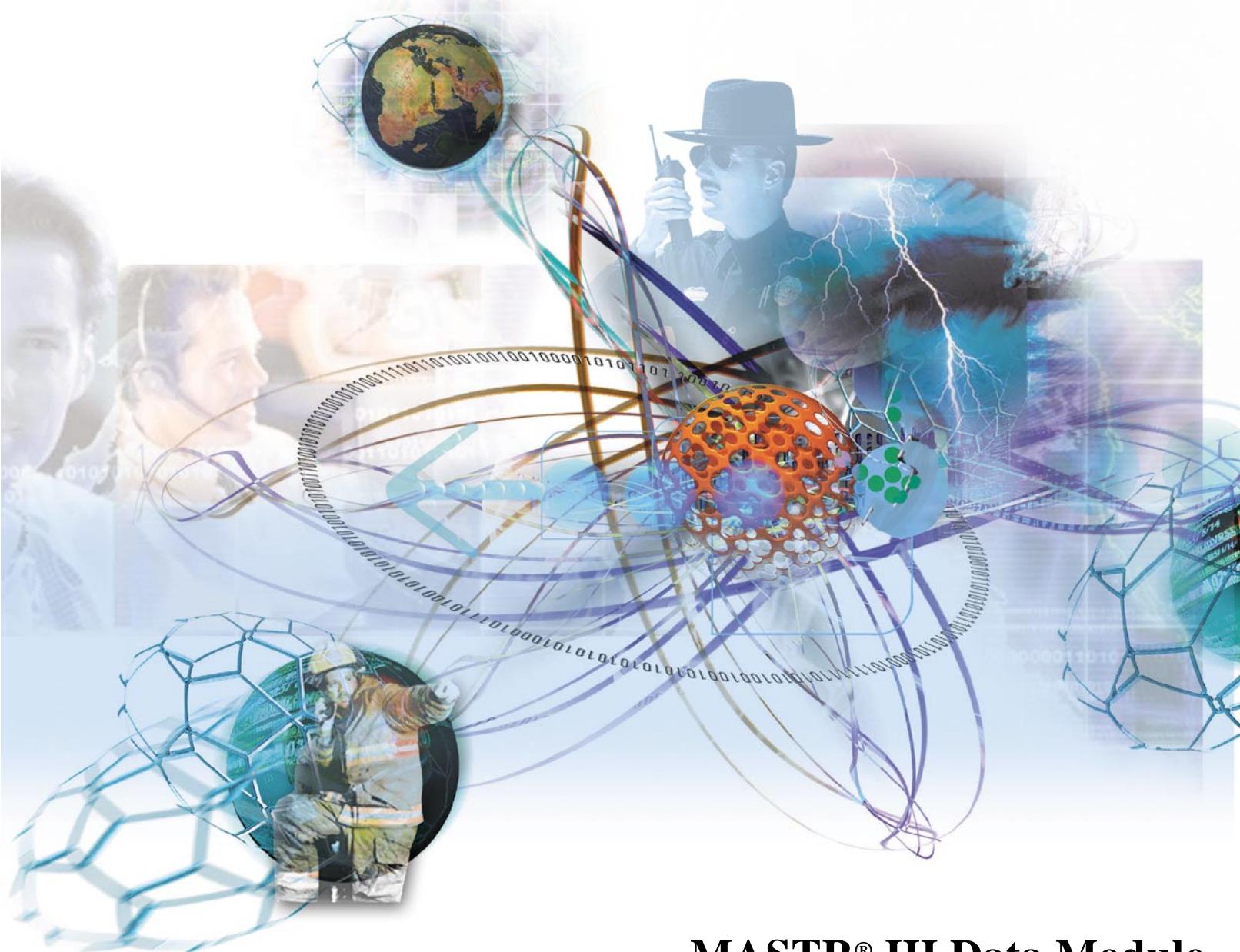
# MASTR® III Data Module
(Paging Adapter) 19D904558G1

# TABLE OF CONTENTS

## SPECIFICATIONS*

| | |
|---|---|
| Input Voltage Range: | -25V to +25V max<br>0V to +5V min |
| Input Data Range: | 0-9600 baud |
| Input Data Type: | 2 level NRZ such as Golay, POCSAG, etc. |
| RF Frequency Stability: | Less than or equal to 2.0 ppm (-30°C to +60°C) |
| RF Output Frequency: | 12.800 MHz |
| RF Output Level: | 0 dBm ± dB |

\* These specifications are intended primarily for the use of the serviceman. Refer to the appropriate Specification Sheet for the complete specifications.

## DESCRIPTION

Data Module 19D904558G1 allows the MASTR III Base Station to transmit **N**on **R**eturn to **Z**ero **(NRZ)** data such as those produced by paging systems. The Data Module accepts data with rates up to 9600 baud within a range of -25V to +25V. The output of the data adapter is a modulated 12.8 MHz reference signal and a filtered data that modulates the Transmit Synthesizer.

## COMPATIBILITY

The Data Module (19D904558G1) is not compatible with EDACS, Voice Guard, Simulcast and Voting Receivers.

Firmware 344A3307G13 and above on the System Module and PC Programmer version 7.0 and above must be installed to use the Data Module.

## CIRCUIT ANALYSIS

The Data Module is designed to operate using the +5V, -5V, +12V, -12V and 13.8V supply voltages generated by the Power Module and applied through the backplane. The voltage regulator, U6 (LM317) and is associated components, maintain +10V for ICOM operation.

A block diagram of the Data Module is given in Figure 2. The Data Module is enabled by grounding **RTS** (on the backplane). The data signal is applied to **DATA** (of the backplane). The Data Module transforms the input data into TTL data using transistor Q1 configured as a common-emitter buffer and inverts the data where appropriate by selecting switch S1 as shown in Table 1. This prepares the data for the modulation process.

Once the data is conditioned by Q1, it is passed to a multiplexer circuit (U1), where U1 is used to select the output deviation level. When the data bit is positive, a voltage divider consisting of resistors R9 and R11 and potentiometer R10 is used to control the negative deviation output. If the data bit is negative, a voltage divider consisting of resistors R6 and R8 and potentiometer R7 is used to control the positive deviation output. To set the positive and negative adjustments refer to the procedure outlined in the adjustments section.

The data is then filtered through two (U3.1, U3.2) or three active low-pass filters (U2.2, U3.1, U3.2) based upon the input data rate selected. For high speed data (1200-9600), S1 is selected, as shown in Table 1, to allow only two filters (U3.1 and U3.2) to be used. For data rates equal to or less than 1200 baud, S1 is configured as shown in Table 1, to use filters U2.2, U3.1 and U3.2. The frequency response of the filters is shown in Figure 3. When U3.1 and U3.2 filters are used the response rolls off at about 1 kHz. When all the filters are used the roll off does not occur until about 5.5 kHz.

After the data is filtered, the output is split into two signals. The first signal is filtered data. This data is amplified by U4.1 and the gain of the data is adjusted by R26. The data is then output on **EXT_HSD** (J1.26B) of the data module and used to modulate the Voltage Controlled Oscillator (VCO) of the transmit synthesizer. The second signal is used to modulate the 12.8 MHz reference ICOM (J2.3). The output of the ICOM (J2.2) is a 12.8 MHz modulated reference with a +10 dBm output. The modulated output is fed to high input impedance buffer Q2 which drives the **MMIC** amplifier (U5) into compression, and the gain of the **MMIC** is about 14 dB. The low pass elliptical filter, consisting of L1 and C20-C22 filters the high frequency harmonics. The next stage is a resistive pad (R35-R37) that provides a constant input/output impedance (50 ohms) and protects the amplifier from externally induced impedance mismatches.

The final output is a 0 dBm, 12.8 MHz modulated reference signal that replaces the receive synthesizer reference normally used to drive the transmit synthesizer.

The above operations enable the Data Module to modulate the 12.8 MHz reference oscillator and allow the high and low frequency components of the input data to be transmitted when using the paging adapter on the MASTR III Base Station.
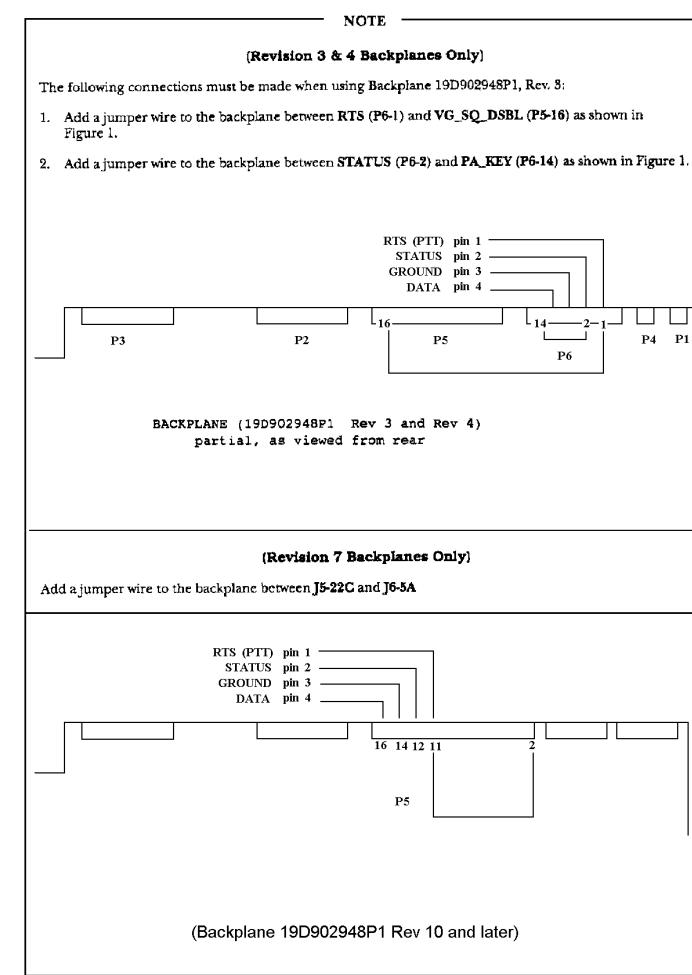


**Figure 1 - MASTR III Backplane**
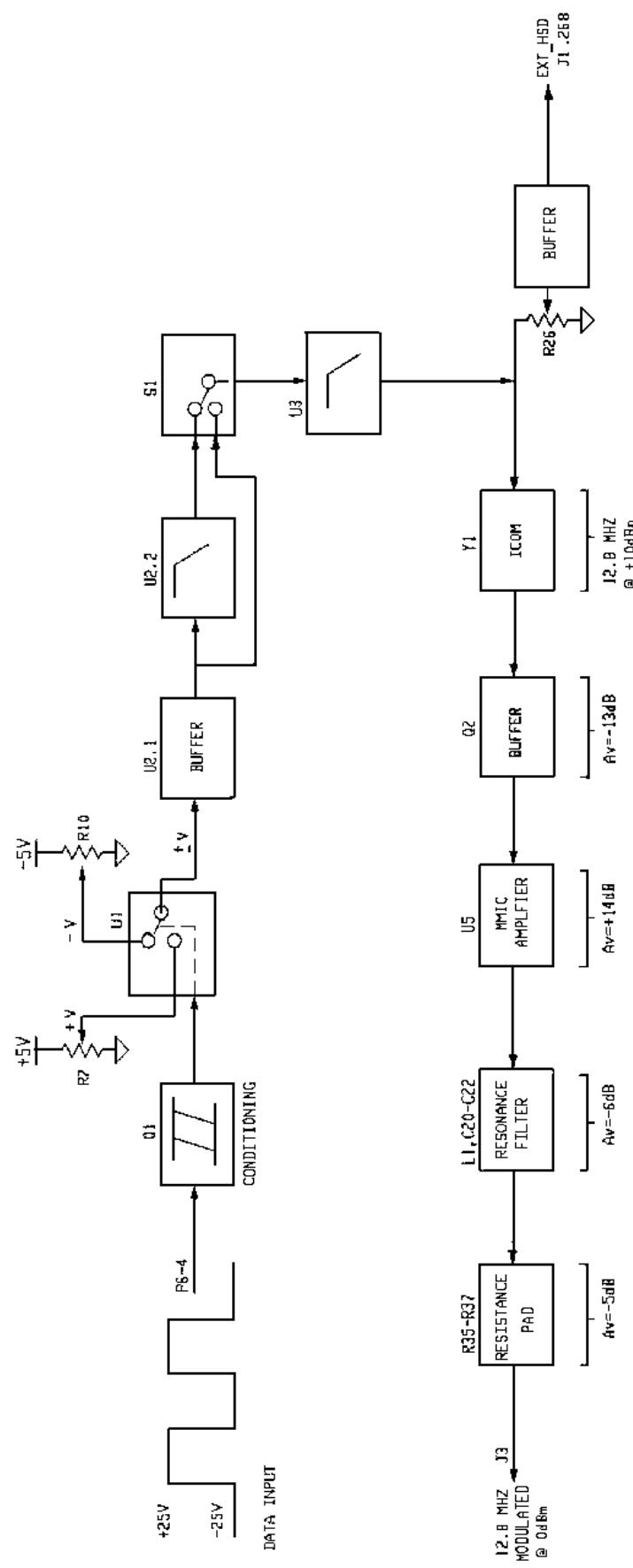
**Figure 2 - Data Module Block Diagram**

**TABLE 1 - Switch S1 Configurations**

| S1.1 | S1.2 | S1.3 | S1.4 | S1.5 | S1.6 | |
|------|------|------|------|------|------|---|
| OFF | OFF | X | X | X | X | Transmit inverted data |
| OFF | ON | X | X | X | X | Transmit normal data |
| X | X | OFF | ON | X | X | Three filters, below 1200 baud |
| X | X | ON | OFF | X | X | Two filters, 1200-9600 baud |
| ON | X | X | X | X | X | Data select over-ride |

X - don't care

## INSTALLATION

### EQUIPMENT

The Data Module options package **SXDE5B** includes the following items:

- Data Adapter Module (19D904558G1)
- BNC-BNC Cable (344A4688P1)

The following equipment is required to install the Data Module:

- Personal Computer (IBM PC compatible)
- PC Programmer versions 7.0 and above (TQ3353)
- Programming Cable (TQ3356)

### MODULE INSTALLATION

1. Connect the computer serial **COM** port and **DATA PORT** on the front of the T/R Shelf using TQ3356 Interconnect cable.

2. Enable the Digital Pager in the Control Shelf Options menu of the PC Programmer installed at the personal computer interfaced with the station.

3. Remove the blank panel from slot #2 of the control section of the station.

4. Remove the U-Link between the Transmit Synthesizer and the Receive Synthesizer. (**RF_IN** and **RF_OUT**)

5. Connect the BNC-BNC Cable (344A4688P1) between **RF_IN** of the Transmit Synthesizer and the Data Module as shown in Figure 5.

6. On the Transmit Synthesizer (19D902780), adjust VR601 for zero modulation.

---
**NOTE**

For stations with Backplane 19D902948P1, Rev. 3 see additions and Figure 1 in the **Compatibility** Section.

---
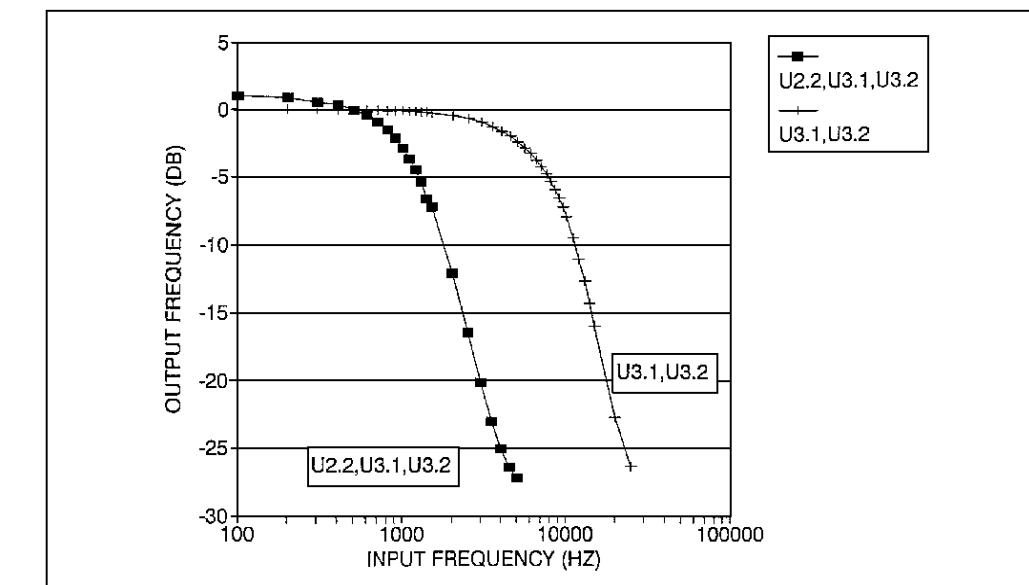
**Figure 3 - Frequency Response Of Filters**
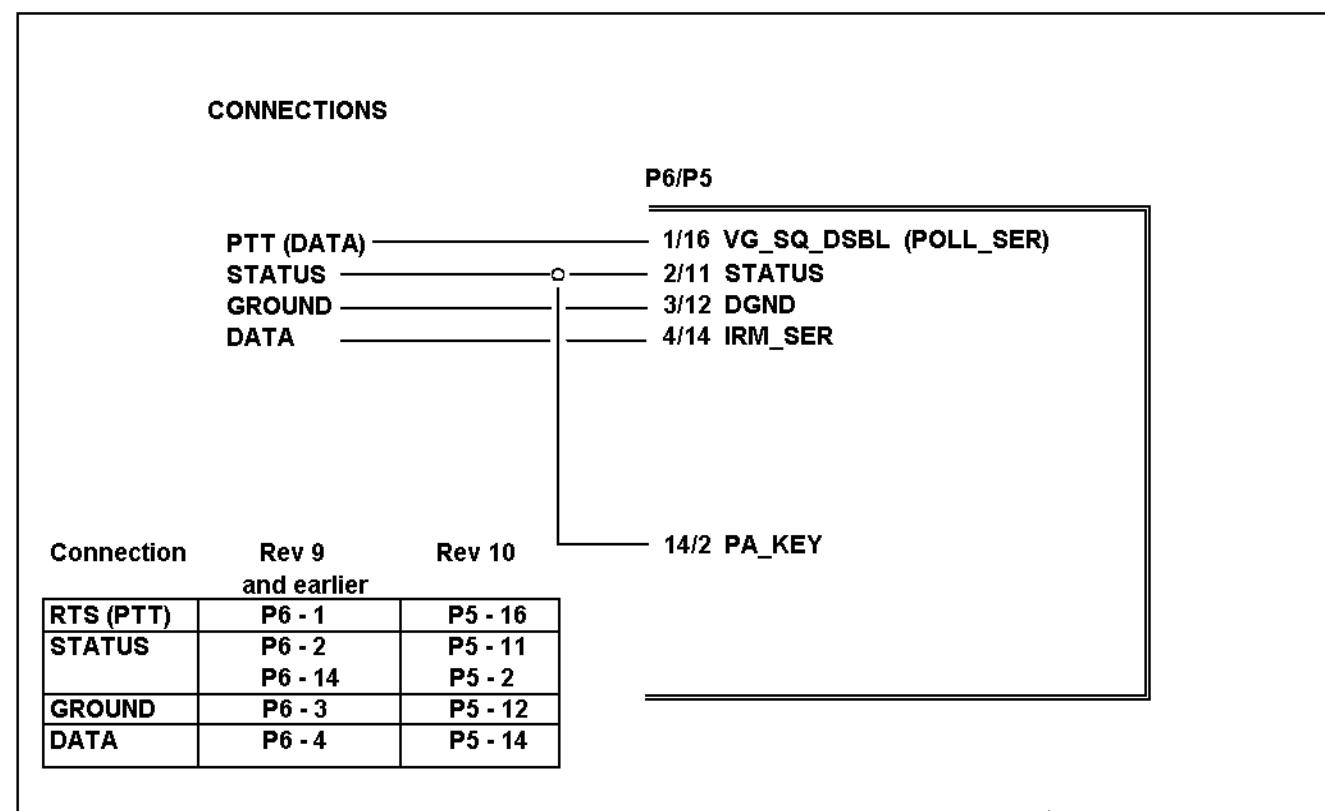
**Figure 4 - Data Interface Connections**
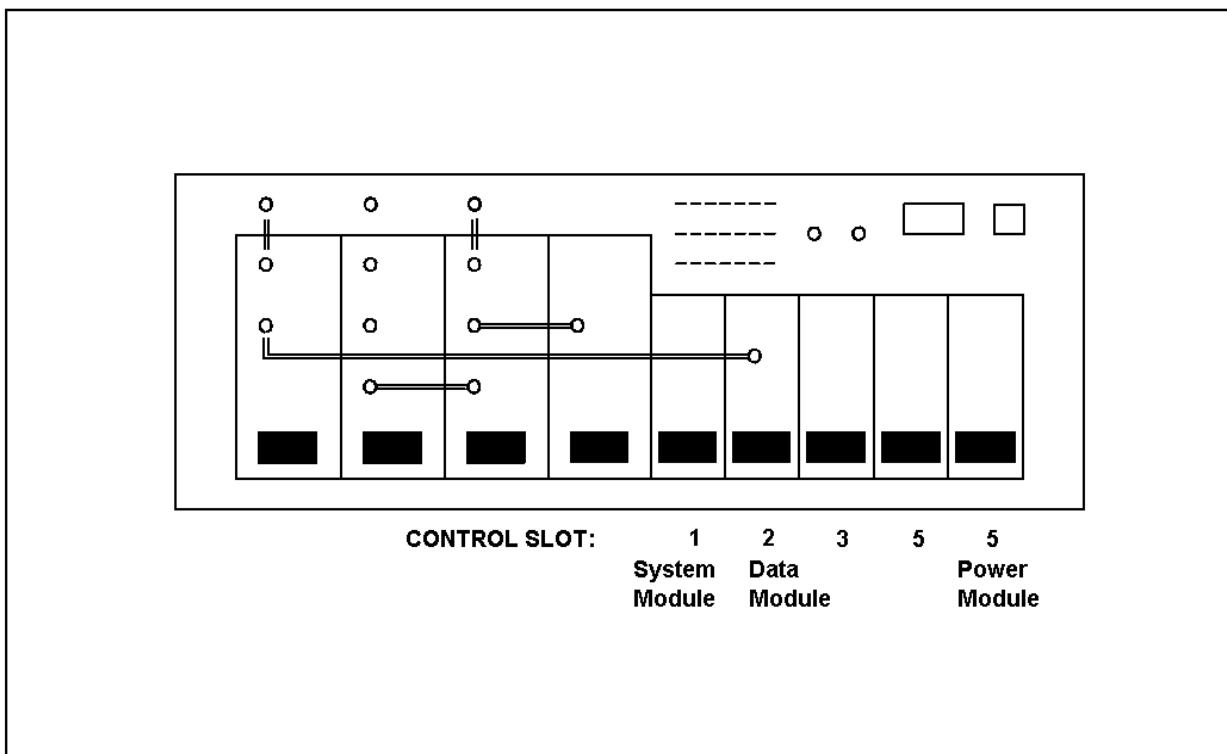


**Figure 5 - MASTR III Station**

## ALIGNMENT

Once the Data Module has been correctly installed, the positive and negative data deviation levels, the average deviation, and the station nominal frequency should be adjusted.

### EQUIPMENT

- Calibrated Frequency Counter:
    0.5 ppm measurements (800 MHz)
    1.0 ppm measurements (UHF, VHF)

- Data Modulated Extender Card (19A903197G2)

- BNC-BNC Cable (344A4688P1)

### DATA DEVIATION ADJUSTMENT

1. Make the following connections to the Backplane as shown in Figure 1:

    **RTS** - Ground this pin to enable the external data to be routed to the transmitter instead of voice.

    **STATUS** - Monitor this output. It should go HIGH (5 volts) when the transmitter is keyed and at full power output.

    **GROUND** - Common ground connection for data and control.

    **DATA** - Connect DATA to data output of paging unit.

2. Attach the Data Adapter Module (19D904558G1) to the Data Module Extender Card (19A903197G2) and insert in slot #2 of the control section of the station.

3. Connect the **RF_OUT** of the transmit synthesizer to the frequency counter to monitor the nominal carrier frequency.

4. Select the filter type by setting S1 according to the data transmission requirements:

| S1.1 | S1.2 | S1.3 | S1.4 | S1.15 | S1.6 | |
|------|------|------|------|-------|------|---|
| XXX | XXX | ON | OFF | XXX | XXX | Data rates 1200-9600 baud |
| XXX | XXX | OFF | ON | XXX | XXX | Data rates up to 1200 baud |

XXX - don't care

5. Select the data mode by setting S1 according to the data polarity requirements:

| S1.1 | S1.2 | S1.3 | S1.4 | S1.5 | S1.6 | |
|------|------|------|------|------|------|---|
| OFF | OFF | XXX | XXX | XXX | XXX | DAT INV, transmit inverted data |
| OFF | ON | XXX | XXX | XXX | XXX | DAT NORM, transmit normal data |

XXX - don't care

6. Set the nominal carrier frequency by opening **RTS** and keying the transmitter with the **REM PTT** on the System Module. Adjust the ICOM frequency until the nominal carrier frequency is obtained on the frequency counter. Release the **REM PTT**.

7. Set the negative frequency shift by grounding **RTS** and adjusting R10 until the nominal carrier frequency is minus 4.5 kHz.

8. Set the positive frequency deviation by grounding **DATA** (or set S1 to **DAT INV**) and keying the data path by grounding **RTS**. Adjust R7 until the nominal carrier frequency is plus 4.5 kHz.

9. Set the data deviation level by grounding **RTS** and applying a periodic data signal to **DATA.** Adjust R26 for a 4.5 kHz peak deviation.

**ANALOG MULTIPLEXER U1**
**19A702705P3 (4051 BM)**

**PIN CONFIGURATION**

| | |
|---|---|
| IN/OUT$_4$ — 1 | 16 — VDD |
| IN/OUT$_6$ — 2 | 15 — IN/OUT$_2$ |
| COM IN/OUT — 3 | 14 — IN/OUT$_1$ |
| IN/OUT$_7$ — 4 | 13 — IN/OUT$_0$ |
| IN/OUT$_5$ — 5 | 12 — IN/OUT$_3$ |
| $\overline{E}$ — 6 | 11 — A$_0$ |
| VEE — 7 | 10 — A$_1$ |
| VSS — 8 | 9 — A$_2$ |
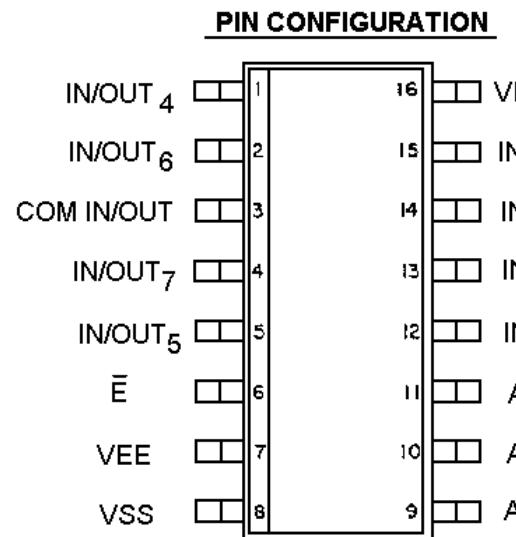
**FUNCTION TABLE**

| INPUTS | | | | CHANNEL ON |
|---|---|---|---|---|
| E | A2 | A1 | A0 | |
| L | L | L | L | Y0 - Z |
| L | L | L | H | Y1 - Z |
| L | L | H | L | Y2 - Z |
| L | L | H | H | Y3 - Z |
| L | H | L | L | Y4 - Z |
| L | H | L | H | Y5 - Z |
| L | H | H | L | Y6 - Z |
| L | H | H | H | Y7 - Z |
| H | X | X | X | NONE |

H = HIGH STATE (THE MORE POSITIVE VOLTAGE)
L = LOW STATE (THE LESS POSITIVE VOLTAGE)
X = STATE IS IMMATERIAL

**BIPOLAR OPERATIONAL AMPLIFIER U5**
**19A705927P1 (AVANTEK MSA-0611)**
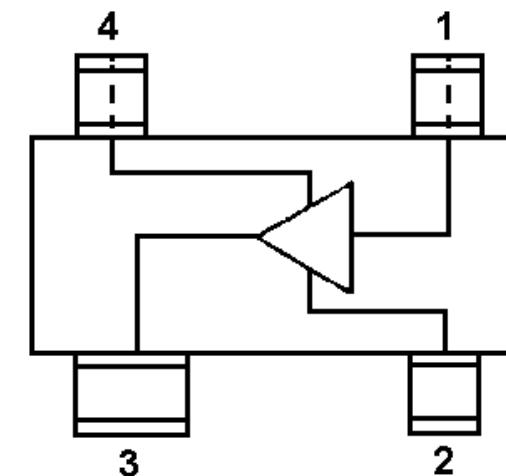


PIN  1. RF INPUT
     2. GROUND
     3. RF OUTPUT AND BIAS
     4. GROUND

**DUAL OPERATIONAL AMPLIFIERS U2, U3, U4**
**19A116297P7 (MC4558DC)**

**PIN CONNECTIONS**

| | | | |
|---|---|---|---|
| OUTPUT 1 | 1 | 8 | Vcc |
| INPUT 1 ( - ) | 2 | 7 | OUTPUT 2 |
| INPUT 1 ( + ) | 3 | 6 | INPUT 2 ( - ) |
| GND | 4 | 5 | INPUT 2 ( + ) |

**VOLTAGE REGULATOR U6**
**19A701999P5 (LM317LD)**
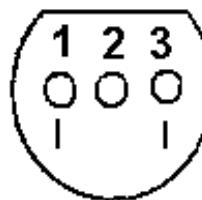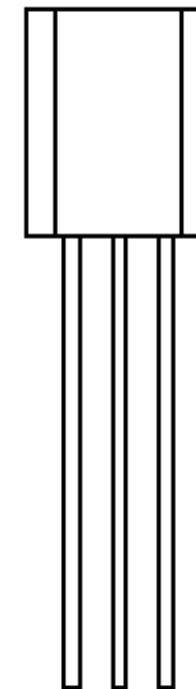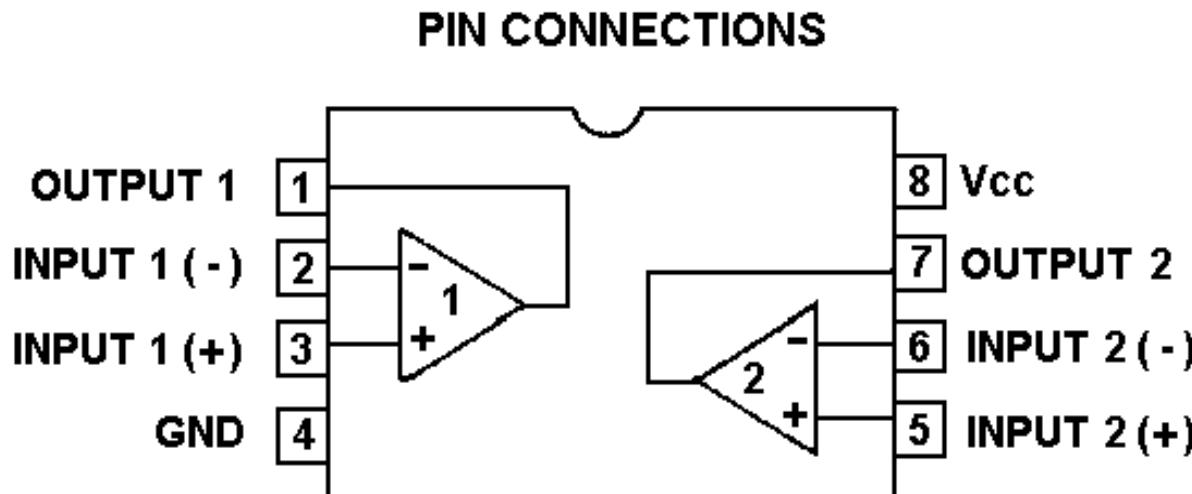


**BOTTOM VIEW**

**PIN IDENTIFICATION**

PIN 1. ADJUST
PIN 2. OUTPUT
PIN 3. INPUT

MASTR III DATA MODULE
19D904558G1
Issue 1

| SYMBOL | PART NUMBER | DESCRIPTION |
|---|---|---|
| | | —— MISCELLANEOUS —— |
| 2 | 19D904549G1 | Board, Data. |
| 3 | 19D904559P1 | Chassis. |
| 4 | 19D902555P1 | Handle. |
| 5 | 19A702381P508 | Screw, thd. form: No. 3.5-0.6 x 8. |
| 6 | 19B235310P1 | Nameplate, Blank. |
| 7 | 19A702364P408 | Machine screw: TORX Drive, M3.5 - 0.6 x 8. |
| 8 | 19A700032P6 | Lockwasher, internal tooth: No. 3.5MM. |

UNIVERSAL DATA ADAPTER
19D904549G1
Issue 1

| SYMBOL | PART NUMBER | DESCRIPTION |
|---|---|---|
| | | ——— CAPACITORS ——— |
| C1 | 19A702052P1 | Ceramic: 220 pF 10%, 50 VDCW. |
| C2 | 19A702052P116 | Ceramic: 0.015 µF 5%, 50VDCW. |
| C3 | 19A702052P110 | Ceramic: 4700 pF 5%, 50 VDCW. |
| C4 | 19A702052P130 | Ceramic: 0.022 µF ±5%, 50 VDCW. |
| C5 | 19A702052P114 | Ceramic: 0.01 µF 5%, 50 VDCW. |
| C6 | 19A702052P105 | Ceramic: 1000 pF 5%, 50 VDCW. |
| C7 | 19A702052P110 | Ceramic: 4700 pF 5%, 50 VDCW. |
| C8 | 19A702052P114 | Ceramic: 0.01 µF 5%, 50 VDCW. |
| C9 | 19A702052P105 | Ceramic: 1000 pF 5%, 50 VDCW. |
| C10 | 19A702052P3 | Ceramic: 470 pF 10%, 50 VDCW. |
| C11 | 19A705205P2 | Tantalum: 1 µF, 16 VDCW; sim to Sprague 293D. |
| C12 | 19A702052P3 | Ceramic: 470 pF 10%, 50 VDCW. |
| C13 and C14 | 19A702052P14 | Ceramic: 0.01 µF 10%, 50 VDCW. |
| C15 | 19A702052P26 | Ceramic: 0.1µF 10%, 50 VDCW |
| C16 | 19A702052P14 | Ceramic: 0.01 µF 10%, 50 VDCW. |
| C17 | 19A702052P5 | Ceramic: 1000 pF ±10%, 50 VDCW. |
| C18 | 19A702052P26 | Ceramic: 0.1µF 10%, 50 VDCW |
| C19 | 19A702052P14 | Ceramic: 0.01 µF 10%, 50 VDCW. |
| C20 | 19A702052P1 | Ceramic: 220 pF 10%, 50 VDCW. |
| C21 | 19A702236P43 | Ceramic: 51 pF ±10%, 50 VDCW. |
| C22 | 19A702052P1 | Ceramic: 220 pF 10%, 50 VDCW. |
| C23 thru C25 | 19A702052P14 | Ceramic: 0.01 µF 10%, 50 VDCW. |
| C27 | 19A705205P2 | Tantalum: 1 µF, 16 VDCW; sim to Sprague 293D. |
| C28 | 19A705205P6 | Tantalum: 10 µF, 16 VDCW; sim to Sprague 293D. |
| C29 and C30 | 19A702052P5 | Ceramic: 1000 pF ±10%, 50 VDCW. |
| C31 and C32 | 19A702052P26 | Ceramic: 0.1µF 10%, 50 VDCW |
| C33 and C34 | 19A702052P5 | Ceramic: 1000 pF ±10%, 50 VDCW. |
| C35 | 19A705205P2 | Tantalum: 1 µF, 16 VDCW; sim to Sprague 293D. |
| C36 | 19A702052P5 | Ceramic: 1000 pF ±10%, 50 VDCW. |
| C37 | 19A705205P2 | Tantalum: 1 µF, 16 VDCW; sim to Sprague 293D. |
| C38 and C39 | 19A702052P5 | Ceramic: 1000 pF ±10%, 50 VDCW. |

| SYMBOL | PART NUMBER | DESCRIPTION |
|---|---|---|
| C40 and C41 | 19A705205P2 | Tantalum: 1 µF, 16 VDCW; sim to Sprague 293D. |
| | | ————— DIODES ————— |
| D1 | 19A700053P3 | Silicon: 2 Diodes in Series, Common Cathode; sim to MBAV70L. |
| D2 | 19A703595P12 | Diode, OPTO ELE |
| | | ————— JACKS ————— |
| J1 | 19B801587P7 | Connector, DIN: 96 male contacts, right angle mounting; sim to AMP 650887-1. |
| J2 | 19A116659P31 | Connector, printed wiring: 9 contacts rated at 5 amps; sim to Molex 09-66-1091. |
| J3 | 19A115938P24 | Connector, Receptacle |
| | | ———— INDUCTORS ———— |
| L1 | 19A705470P24 | Coil, Fixed |
| | | ———— TRANSISTORS ———— |
| Q1 thru Q3 | 19A700076P2 | Silicon, NPN: sim to MMBT3904, low profile. |
| Q4 | 19A700059P2 | Silicon, PNP: sim to MMBT3906, low profile. |
| | | ———— RESISTORS ———— |
| R1 | 19B800607P472 | Metal film: 4.7K ohms ±5%, 1/8 w. |
| R2 and R3 | 19B800607P103 | Metal film: 10K ohms ±5%, 1/8 w. |
| R4 | 19B800607P563 | Metal film: 56K ohms ±5%, 1/8 w. |
| R5 | 19B800607P103 | Metal film: 10K ohms ±5%, 1/8 w. |
| R6 | 19B800607P101 | Metal film: 100 ohms ±5%, 1/8 w. |
| R7 | 19A700043P7 | Resistor, Variable |
| R8 and R9 | 19B800607P101 | Metal film: 100 ohms ±5%, 1/8 w. |
| R10 | 19A700043P7 | Resistor, Variable |
| R11 | 19B800607P101 | Metal film: 100 ohms ±5%, 1/8 w. |
| R12 | 19B800607P103 | Metal film: 10K ohms ±5%, 1/8 w. |
| R13 | 19B800607P153 | Metal film: 15K ohms ±5%, 1/8 w. |
| R14 | 19B800607P562 | Metal film: 5.6K ohms ±5%, 1/8 w. |
| R15 thru R17 | 19A702931P301 | Metal film: 10K ohms ±1%, 200 VDCW, 1/8 w. |
| R18 | 19A702931P269 | Metal film: 5110 ohms ±1%, 200 VDCW, 1/8 w. |
| R19 | 19A702931P201 | Metal film: 1000 ohms ±1%, 200 VDCW, 1/8 w. |
| R20 | 19A702931P322 | Metal film: 16.5K ohms ±1%, 200 VDCW, 1/8 w. |
| R21 | 19A702931P210 | Metal film: 1240 ohms ±1%, 200 VDCW, 1/8 w. |

| SYMBOL | PART NUMBER | DESCRIPTION |
|---|---|---|
| R22 and R23 | 19B800607P103 | Metal film: 10K ohms ±5%, 1/8 w. |
| R24 | 19B800607P472 | Metal film: 4.7K ohms ±5%, 1/8 w. |
| R25 | 19B800607P271 | Metal film: 270 ohms ±5%, 1/8 w. |
| R26 | 19A700043P7 | Resistor, Variable |
| R27 | 19A702931P169 | Metal film: 511 ohms ±1%, 200 VDCW, 1/8 w. |
| R28 | 19B800607P821 | Metal film: 820 ohms ±5%, 1/8 w. |
| R29 | 19B800607P561 | Metal film: 560 ohms ±5%, 1/8 w. |
| R30 | 19B800607P101 | Metal film: 100 ohms ±5%, 1/8 w. |
| R31 and R32 | 19B800607P103 | Metal film: 10K ohms ±5%, 1/8 w. |
| R33 | 19B800607P102 | Metal film: 1K ohms ±5%, 1/8 w. |
| R34 | 19B800607P471 | Metal film: 470 ohms ±5%, 1/8 w. |
| R35 | 19B800607P181 | Metal film: 180 ohms ±5%, 1/8 w. |
| R36 | 19B800607P270 | Metal film: 27 ohms ±5%, 1/8 w. |
| R37 | 19B800607P181 | Metal film: 180 ohms ±5%, 1/8 w. |
| R38 | 19A702931P137 | Metal film: 237 ohms ±1%, 200 VDCW, 1/8 w. |
| R39 | 19A702931P221 | Metal film: 1620 ohms ±1%, 200 VDCW, 1/8 w. |
| R40 | 19B800607P103 | Metal film: 10K ohms ±5%, 1/8 w. |
| R41 | 19B800607P471 | Metal film: 470 ohms ±5%, 1/8 w. |
| R42 | 19B800607P103 | Metal film: 10K ohms ±5%, 1/8 w. |
| | | ————— SWITCHES ————— |
| S1 | 19A149955P2 | Switch, RKR |
| | | —— INTEGRATED CIRCUITS —— |
| U1 | 19A702705P3 | Digital: 8-Channel Analog Multiplexer; sim to 4051BM. |
| U2 thru U4 | 19A116297P7 | Linear: Dual Op Amp; sim to MC4558CD. |
| U5 | 19A705927P1 | Silicon, bipolar: sim to Avantek MSA-0611. |
| U6 | 19A701999P5 | Voltage Regulator, LM317 |
| | | ————— CRYSTAL————— |
| Y1 | 19A130605G37 | FM, Oscillator |
| | | —— MISCELLANEOUS —— |
| 18 | 19C321660G5 | FM, Oscillator |
| 20 | 19A129392P32 | Form, FREQ |

**\***   COMPONENTS, ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

**\***   COMPONENTS, ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES
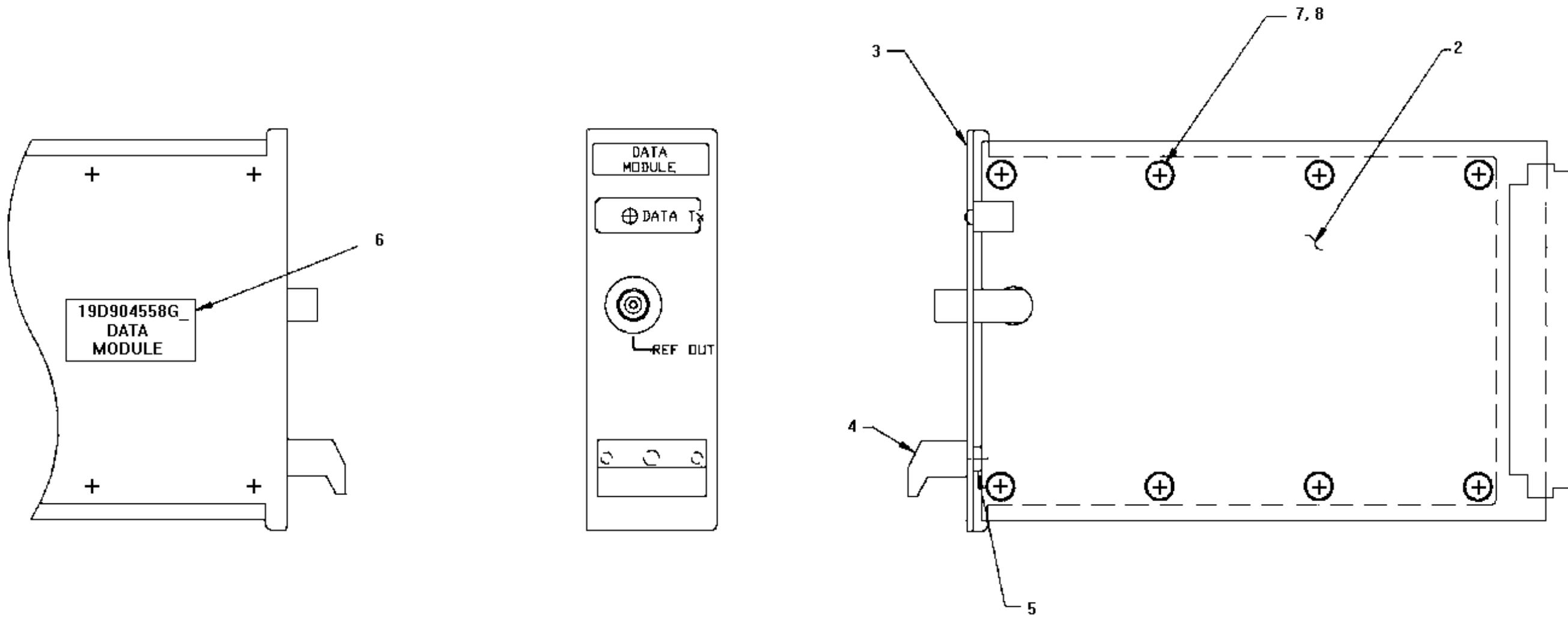
**DATA MODULE**
**19D904558G1**

(19D904558, Rev. 0)

**COMPONENT SIDE**
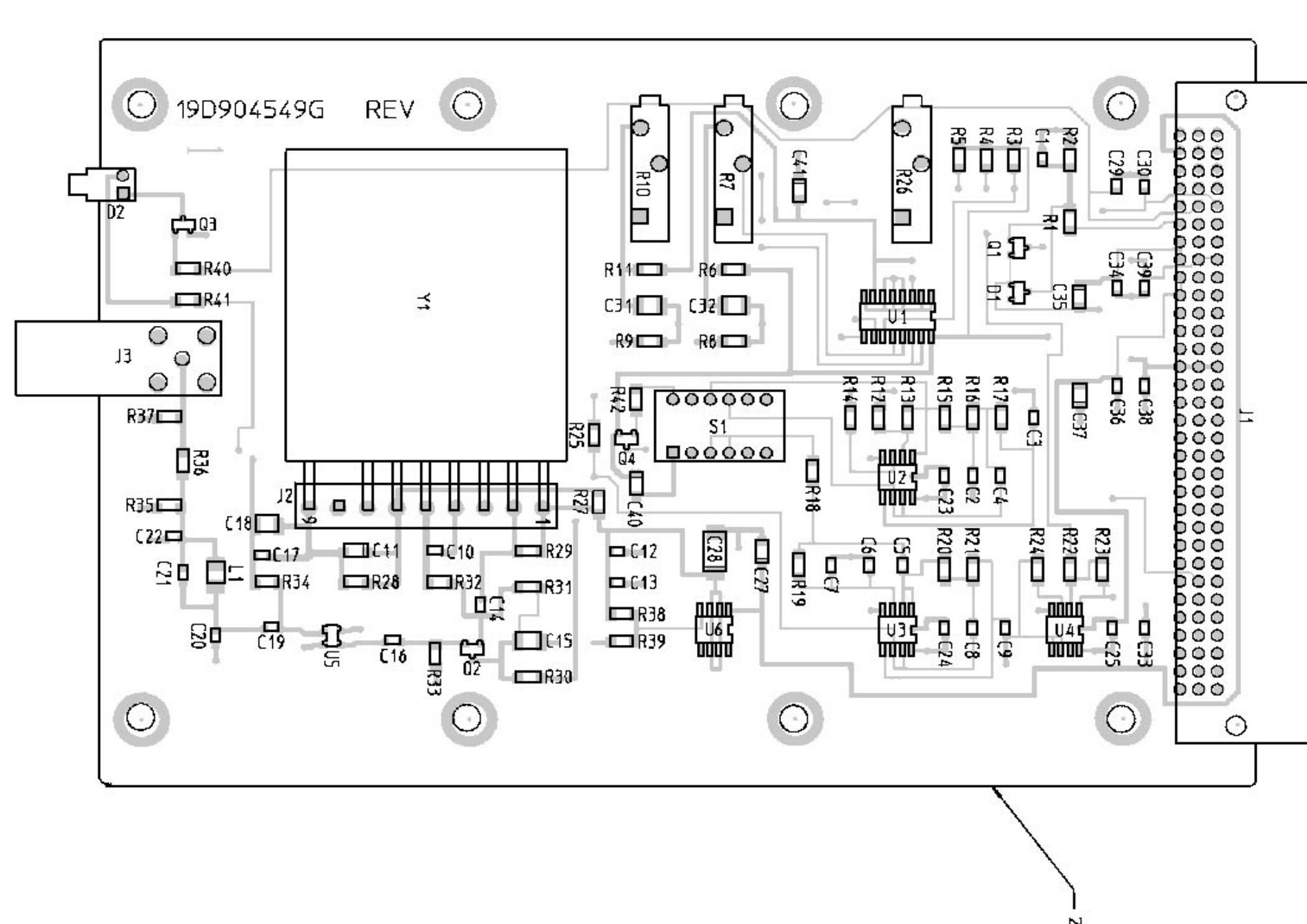


LEAD IDENTIFICATION FOR
Q1
(SOT) DIODES
(TOP VIEW)

(A) ⊏⊐ (C)

LEAD IDENTIFICATION FOR
U5
(SOT) IN CKT
(TOP VIEW)

OUTPUT ⊏⊐ GND
GND ⊏⊐ INPUT
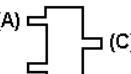
LEAD IDENTIFICATION FOR
Q1-Q4
(SOT) TRANSISTORS
(TOP VIEW)

(B) ⊏⊐ (C)
(E) ⊏⊐
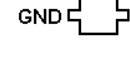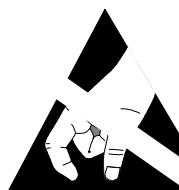
**CAUTION**

OBSERVE PRECAUTIONS
FOR HANDLING

**ELECTROSTATIC
SENSITIVE
DEVICES**

(19D904547, Rev. 0)

**UNIVERSAL DATA ADAPTER
19D904549G1**

(19D904549, Rev. 1)
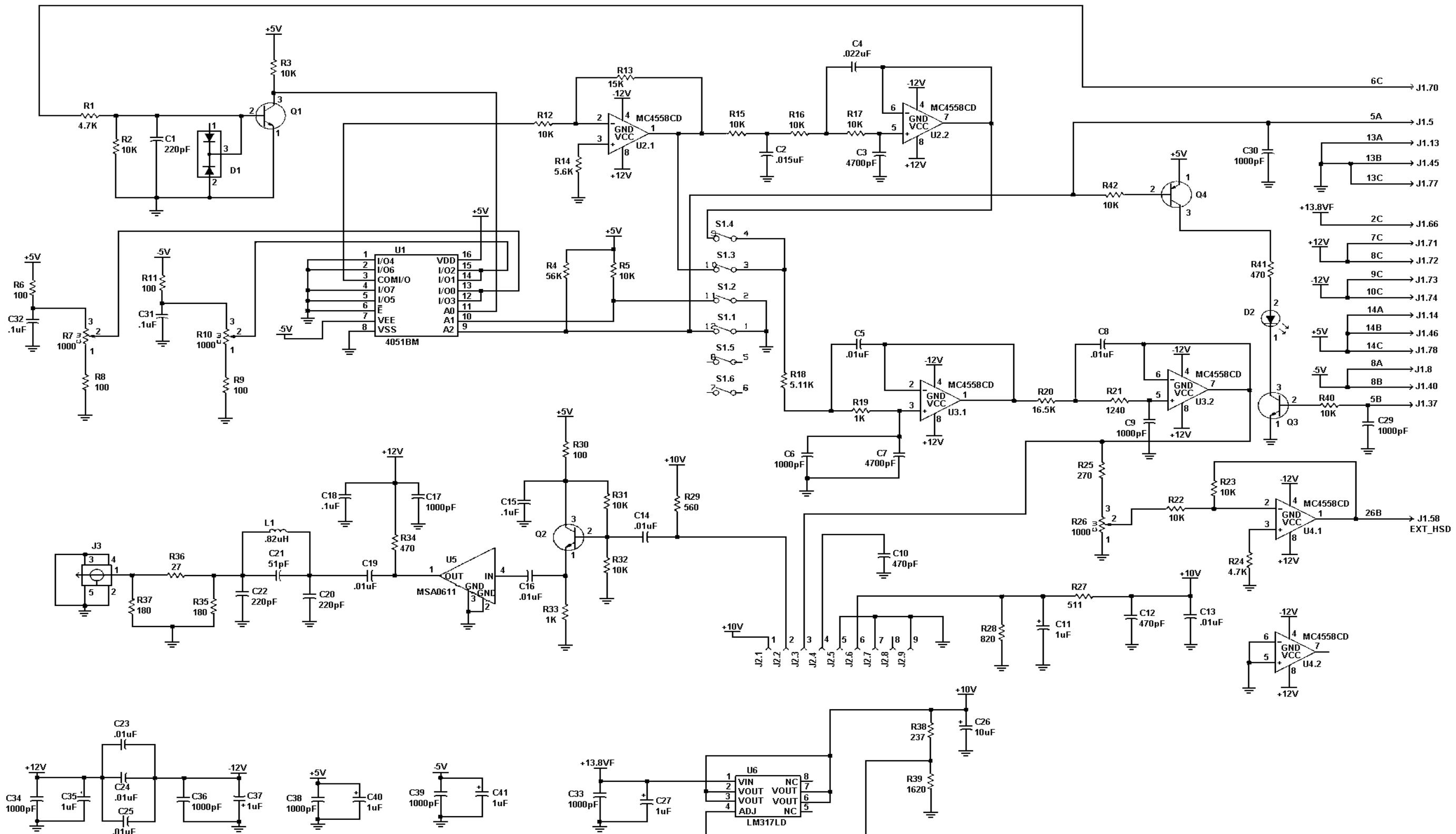
**UNIVERSAL DATA ADAPTER**
**19D904549G1**

(19D904556, Rev. 1)

*This page intentionally left blank*