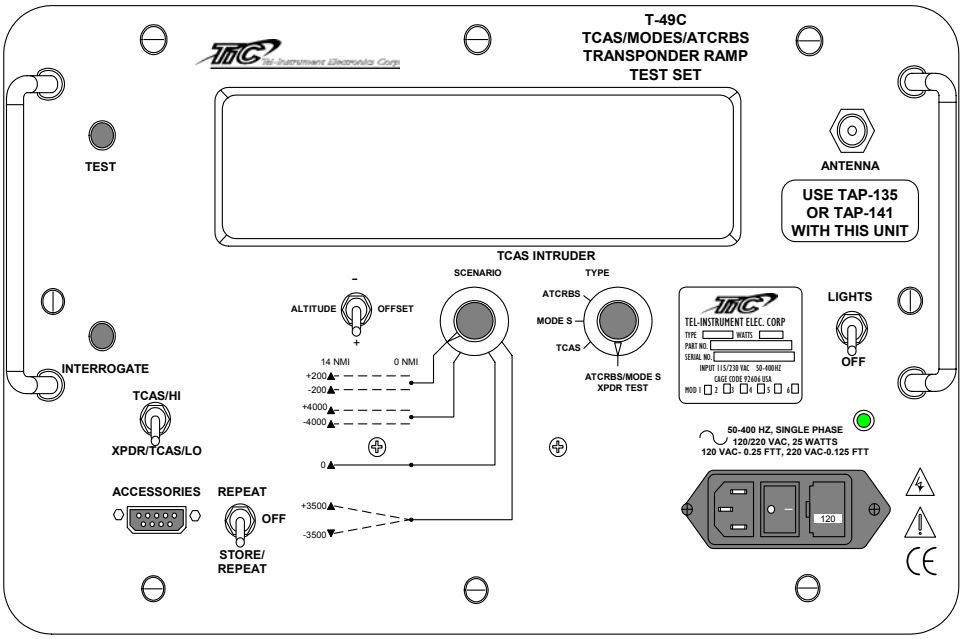
T-49C/CA MOD 2 TRANSPONDER/TCAS TEST SET



Operational and Maintenance Manual
Volumes 1 & 2

REVISION 01-12-03

A	B	C	D	E	F	G	H	I	J	K	L	M
N	O	P	Q	R	S	T	U	V	W	X	Y	Z

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Leading the AVIONICS TEST industry into the 21st Century!

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T-49C/CA MOD 2 TABLE OF CHANGES

Date	REV	ECO	Page	Description
5-28-02	A			Initial Release
01-12-03	B			Complete overhaul of Manual to include but not limited too: Drawings, Parts list, Calibration procedures, and improved Graphics.

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VOLUME 1

Operational Manual

CHAPTER I

INTRODUCTION

SECTION A

1.1 Scope of Manual

This manual is intended to familiarize the operator with the operating procedures necessary to utilize the T-49C/CA MOD 2 Test Set. If you purchased the option of Maintenance and Servicing Instructions, these procedures are included as Chapters IV, V, and VI.

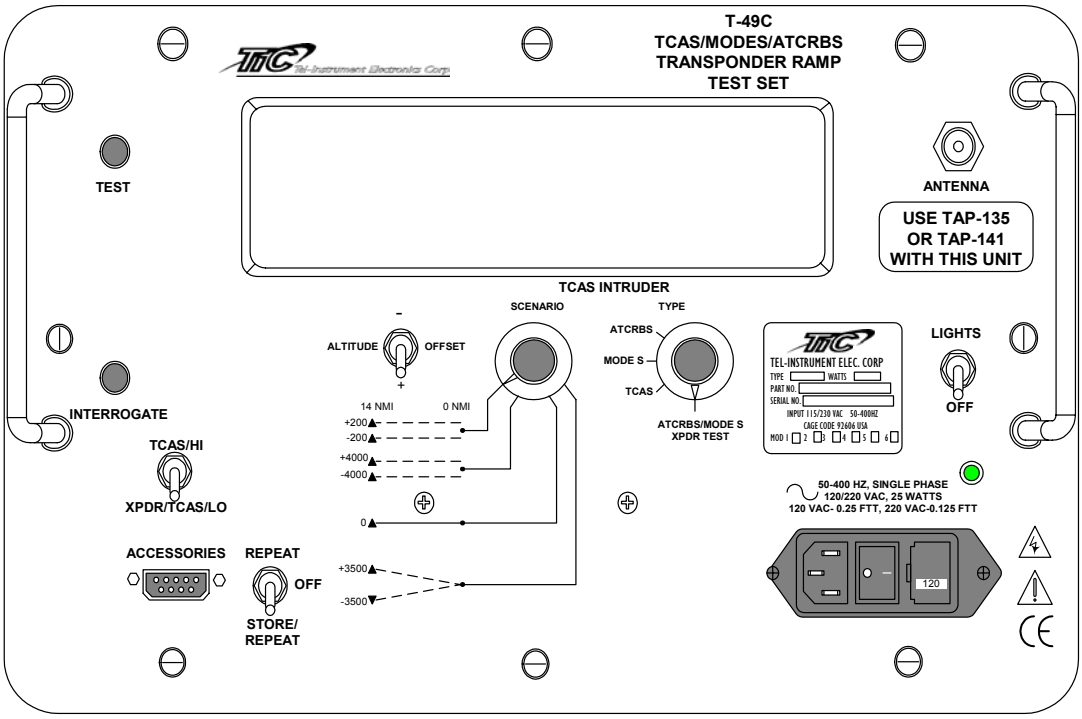


Figure 1-1

T-49C/CA MOD 2, TCAS/Transponder Ramp Test Set

1.2 Purpose and Function of the Equipment

The T-49C/CA MOD 2 Test Set (T/S) tests airborne ATCRBS MODE A & C and MODE S transponders and TCAS I/II systems. It is a self contained and battery operated unit that requires no direct hardware connection to the equipment under test. The Test Set receives and radiates signals to the Unit Under Test (UUT) from an antenna supplied with the T/S. For MODE S and ATCRBS transponder tests, an antenna coupler unit is provided to measure transponder transmitter power, receiver frequency, receiver sensitivity, and diversity operation.

1.3 Regulatory Responsibilities

The Federal Aviation Administration (FAA), requires that transponders operated under *Federal Aviation Regulation (FAR)* Part 91.215(a), 121.345(c), or 135.143(c) be tested and inspected every 24 calendar months in accordance with *FAR Part 43-Appendix F*. The Tel-Instrument Electronics Corp. T-49C/CA Test Sets perform all of the tests as required by *FAR Part 43-Appendix F*, paragraphs (a) through (j).

1.4 Warranty

The Tel-Instrument Electronics Corporation warrants that each product it manufactures is free from defective material and workmanship for a period of two (2) years subject to the following terms and conditions. Tel-Instrument Electronics Corporation will remedy any such warranted defect subject to the following:

This warranty requires the unit to be delivered by the owner to Tel-Instrument intact for examination, with all transportation charges prepaid to the factory, within two (2) years from the date of sale to original purchaser. Tel-Instrument will solely determine when such defect exists.

This warranty does not extend to any of Tel products which have been subject to misuse, neglect, accident, improper installation, or used in violation of operating instructions. This warranty does not extend to units which have been repaired, calibrated, or altered in any way by a facility that is not approved, in writing, by Tel-Instrument Electronics Corp. to perform such work. This warranty does not apply to any product where the seals or serial number thereof has been removed, defaced or changed, nor to accessories not of our own manufacture.

Repair parts will be made available for a minimum period of five (5) years after the manufacture of this equipment has been discontinued.

This warranty is in lieu of all other warranties expressed or implied and all such other warranties are hereby expressly excluded. No representative or person is authorized to assume for us any other liability or warranty in connection with the sale of Tel's products.

This warranty does not cover or include batteries (batteries have a separate 90 day warranty).

Additional information with regard to the applications and maintenance of this equipment will be available from time to time.

SECTION B

EQUIPMENT DESCRIPTION

1.5 Specifications [1]

Transmitter

Frequencies	1030 MHz and 1090 MHz ± 0.1 MHz
Output power, HIGH	+10 dBm ± 1 dBm
LO	-10 dBm ± 1 dBm
Pulse amplitude on/off ratio	greater than 35 dB
Differential Phase Shift Keying (DPSK) accuracy	± 22 degrees
DPSK amplitude modulation	less than 10%

Receiver

Frequency Range	1030 ± 3MHz and 1090 ± 3 MHz
Sensitivity	< -25 dBm

Transponder Measurements Performed (Measured utilizing the TAP-141)

Receiver Sensitivity	Range -65 to -82 dBm, accuracy ± 2 dB
Radiated Power	40 to 60 dBm ± 2 dB (10 to 1000 watts)
Frequency	1087 to 1090 MHz ± 300 KHz
Reply Efficiency	0 to 99 ± 5%

Physical Properties

Packaging	MIL-PRF-28800F, Style C
Operating Temperature	-22 to +122 degrees F (-30 to +50 degrees C)
Size	14.5 x 9.4 x 6.5 inches
Weight	19.0 lbs. W/ line cord, antenna coupler, omni and directional antennas
Battery Life	8 hours Min. at 50% duty cycle
Supplied Antennas	Directional Dipole, Omni-Directional, TAP-135 Antenna Coupler (CA contains 2) TAP-141 Direct Connect Coupler (Optional)

[1] Tel Instrument Electronics Corp. reserves the right to modify and change specifications without notice.

1.6 T-49C TCAS Test Scenarios

Selectable Scenarios	Intruder Speed	Intruder Range	Altitude Separation	Altitude Offset
+3500/-3500	300 kts.	14 to 0 nmi.	3500 ft.	Altitude offset will decrease as distance decreases or Vice-Versa.
0	300 kts.	14 to 0 nmi.	0	Constant
+4000/-4000	300 kts.	14 to 0 nmi.	4000 ft.	Constant
+200/-200	300 kts.	14 to 0 nmi.	200 ft.	Constant

1.7 Safety Considerations

The following are general safety precautions that are not related to a particular test or procedure. These are recommended procedures that all personnel must apply during many phases of operation and maintenance. It is assumed that the operator has general knowledge of electrical theory and the dangers associated with it.

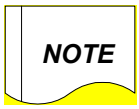
1. When performing any of the tests thoroughly read and understand all procedures before actually performing them.

2. The various front panel connectors, switches, and controls specified can be located by referring to Figure 2-1 on page 2-2.

3. Take the time to learn the proper operation and function of the Test Set as outlined in Chapters 1, 2, and 3. Through knowledge of the Test Set and its capabilities greatly improves the time it takes to complete the tests.

4. Pay particular attention to **NOTES** and **WARNINGS** that may accompany some test procedures.

WARNINGS
Alerts the operator to potential dangers associated with a particular test. Thoroughly understand the warning before proceeding in order to prevent a potentially dangerous situation or damage to the Test Set.



NOTES
Provides supplemental information that enhances the test procedure.

5. Observe all standard safety procedures when working with live voltages. The potential for electric shock exists any time the Test Set is removed from its case.

6. DO-NOT service the unit or make adjustments alone. Always be in the presence of another person when working with live voltages.

7. Be familiar with general first aid procedures and CPR (Cardiopulmonary Resuscitation). Contact your local Red Cross for more information.

8. Ensure the test equipment and the tools you utilize are in good operational condition and not damaged in any way.

1.8 Calibration and Repair

The T-49C/CA Test Set will require Calibration on an Annual Basis. This calibration requires the opening of the Test Set, measuring Inputs and Outputs, and making adjustments when required. This Calibration can be performed at Tel-Instrument Corp or at one of our authorized repair facilities.

When utilizing Tel-Instrument Corp. as your calibration depot, any applicable Service Bulletins and/or Software upgrades that were introduced since you purchased the Test Set will be installed at no charge.[2]

In addition, the owner/operator will maintain the standard warranty that came with your Test Set. See *Paragraph 1.4,* ***Warranty***, for specific information and details regarding our warranty.

To schedule your Calibration and/or repair, please contact:

Tel Instrument Electronics Corp.
728 Garden Street
Carlstadt, NJ 07072
(201) 933-1600 EXT – 322

Or visit our Web Site at www.telinst.com.

[2] Only Service Bulletins and Software revisions affecting the correct operation and/or function of the Test Set will be considered “No Charge”. Modifications to the Test Set which enhances and or changes the performance or features will be subject to charge. Contact your Tel representative for specific information regarding Service Bulletins and repair services.

1.9 Abbreviations, Acronyms and Glossary of Terms[3]

A/A	Air to Air
A/A B	Air to Air Beacon
ac or AC	Alternating Current
A/D	Analog to Digital
Address	The unique code to which a MODE S transponder replies. This is not to be confused with the 4096 code used for identifying ATCRBS transponders. The address of a MODE S transponder is not alterable by the pilot or crew.
Altitude	The pressure altitude of the aircraft as transmitted by an ATCRBS or MODE S transponder. This information is obtained from an external sensor and transmitted to the transponder.
AM	Amplitude Modulation
ATCRBS	Air Traffic Control Radar Beacon System
ATC	Air Traffic Control
AUT	Aircraft Under Test
BIT	Built in Test
Comm	Refers to the communications and data-link capability of a MODE S transponder. There are four (4) capabilities: No Comm, Comm A/B, Comm A/B/C and Comm A/B/C/D. The Comm. capability is displayed when the transponder is determined to be a MODE S.
CW	Continuous Wave
D/A	Digital to Analog
dB	Decibel
dBm	Decibels above 1 milliwatt
dc or DC	Direct Current
DME	Distance Measuring Equipment
DPSK	Differential Phase Shift Keying. The method of modulation used for the selective MODE S uplink interrogations.
DF	Downlink Format. The format included in a MODE S transponder reply to an interrogation or squitter message that indicates the type of message.
ELM	Extended Length Messages
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
FIFO	First In First Out
FREQ	Frequency
ft.	Feet
G/A	Ground to Air
Hz	Hertz
IF	Intermediate Frequency
IFF	Identify Friend or Foe
KHz	Kilohertz
kts.	Knots
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MODE S	A secondary radar system where transponders can be individually interrogated or selected (the “S” in MODE S) so that in a crowded air traffic area, the amount of interference or garble can be reduced to a minimum.
ATCRBS/MODE S All Call	Interrogation that causes all ATCRBS/MODE S transponders to reply.
MHz	Megahertz
nmi.	Nautical mile

[3] Further definitions may be found in the following reference books and documents: Helfrick, A.D. Principles of Avionics. Leesburg: Quality Books, 2000. RTCA/DO-181B. Minimum Operational Performance Standards for Air Traffic Control RADAR Beacon System/Mode Select (ATCRBS/Mode S) Airborne Equipment. Washington D.C.: 1999. United States. Federal Aviation Administration. Federal Register Fed 3, 1987 FAA rules Part 91.

ns	Nanosecond
PAM	Pulse Amplitude Modulation
PDME	Precision Distance Measuring Equipment
PMCS	Preventative Maintenance Checks and Services
PPM	Pulses per Minute
PRF	Pulse Repetition Frequency
PW	Pulse Width
PWR	Power
RA	Resolution Advisories
Receiver Efficiency	The Test Set's Measurement of valid replies received. Displayed as a Percentage.
Reply Codes	A transmitted response, from the airborne transponder, to an interrogation. Commercial transponders responses are designated as either ATCRBS/A where the reply includes the pilot selected 4096 ID code, or ATCRBS/C, where the reply includes the aircraft pressure altitude. These same responses for military transponders are designated as MODE 3A and MODE 3C. The associated intruder type panel designations on the T-48 is "ATCRBS".
RF	Radio Frequency
RMS	Root Mean Square
R/T	Receiver Transmitter
SIF	Selective Identification Feature
SLS	Side Lobe Suppression. A pulse transmitted from an omni-directional antenna, used as a reference level to prevent replies to interrogations received from the secondary radar antenna side lobes.
Squitter	The self-generated transmissions made by a MODE S transponder, not in reply to an interrogation, for the use of the collision avoidance system.
Surveillance Altitude	An interrogation that causes only the addressed MODE S transponder to reply.
Surveillance ID	An interrogation that causes only the addressed MODE S transponder to reply to its "4096" code.
TA	Traffic Advisories
TACAN	Tactical Air Navigation
TCAS	Traffic Alert and Collision Avoidance System
TX	Transmitter
UF	Uplink Format. The format in a MODE S interrogation that indicates the type of reply expected.
VORTAC	VOR and TACAN (co-located)
VOR	VHF Omni-Directional Range
VSWR	Voltage Standing Wave Ratio
WOW	Weight On Wheels
UUT	Unit Under Test
XPDR	Transponder
XPDR UT	Transponder Under Test
4096 Code	This refers to the octal number dialed into either an ATCRBS MODE A or MODE S transponder by the pilot. This is to be distinguished from the address of the MODE S transponder, which cannot be changed.

[3] Further definitions may be found in the following reference books and documents: Helfrick, A.D. Principles of Avionics. Leesburg: Quality Books, 2000. RTCA/DO-181B. Minimum Operational Performance Standards for Air Traffic Control RADAR Beacon System/Mode Select (ATCRBS/Mode S) Airborne Equipment. Washington D.C.: 1999. United States. Federal Aviation Administration. Federal Register Fed 3, 1987 FAA rules Part 91.

CHAPTER II

PREPARATION FOR USE AND OPERATION

SECTION A

2.1 General

This Chapter contains all necessary information on the initial unpacking, inspection, and set-up of the T-49C/CA MOD 2 Test Set. From this point forward, the T-49C/CA MOD 2 Test Set will be known as the T-49C, T-49, Test Set, or T/S.

2.2 Unpacking

When receiving the T-49C for the first time, ensure that there is no damage to the shipping container. Carefully unpack the unit and save the shipping container in a safe location for shipping or extended storage.

Examine the unit for obvious signs of damage. Check all displays, switches, and connectors before utilizing the Test Set.

If any damage is found, DO NOT use the Test Set until a determination of the Test Sets functions can be assessed. Refer to the procedures outlined in Chapter 4, Section B, Test Set Verification and Acceptance Checks. You may also contact Tel-Instrument Electronics Corp. for assistance.

The T-49C batteries were installed and fully charged when shipped from the factory.

2.3 Installation

The T-49C is ready to use from the factory. There are no installation procedures applicable.

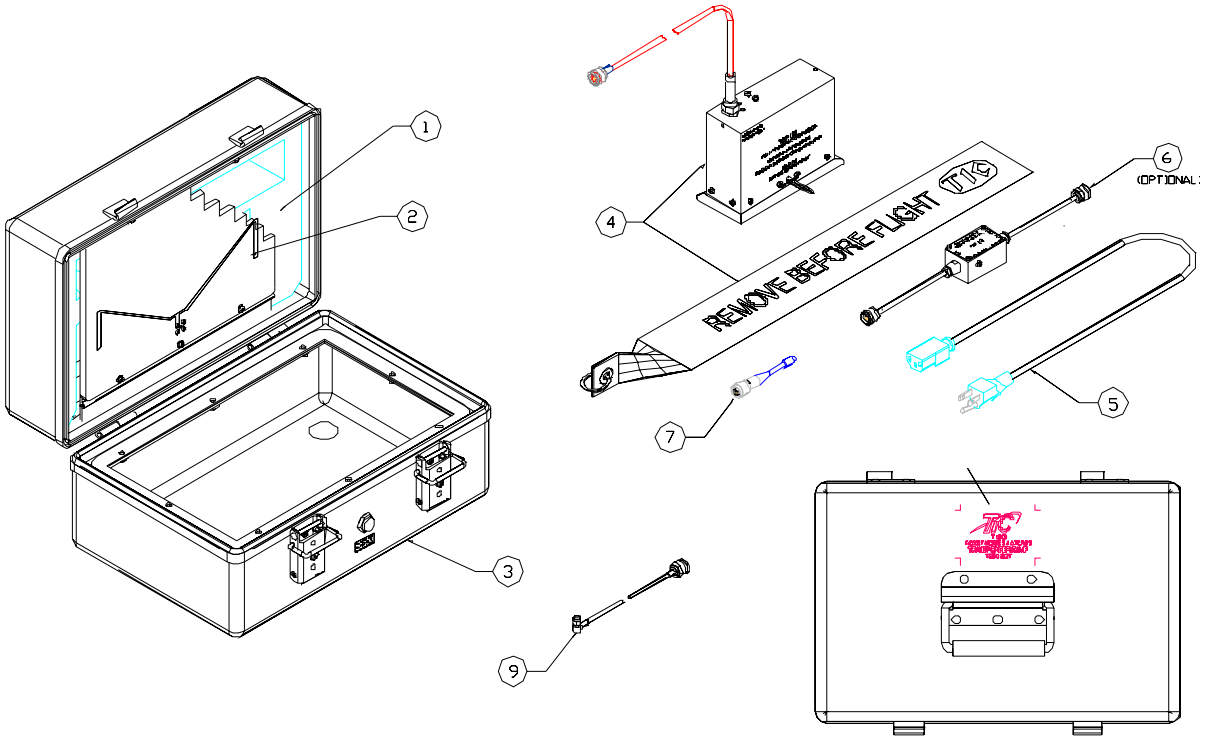
2.4 Accessories

Check that all accessories that were purchased with the Test Set are accounted for. The T-49C comes standard with the following (see Table 2-1 and Figure 2-1):

T-49C/CA MOD 2 Test Set, P/N- 90 000 048 MOD 2

Table 2-1

#	NOMENCLATURE	P/N	QTY
1	Foam Insert, Case	31000007	1
2	Directional Antenna Assembly	89000028	1
3	Case, Universal	64030034	1
4	Coupler, Antenna TAP-135 (10 ft)	89000145	1
5	Cable Assembly, AC Line Cord	75010025	1
6	Direct Connect Coupler, TAP-141	89000147	**OPTIONAL**
7	TSP-1A, Omni Antenna	40030011	1
9	Cable Assembly, Directional Antenna	75010036	1
X	Operational and Maintenance Manual	90008048	1
X	Coupler, Antenna TAP-135 (50 ft)	T-49CA	**OPTIONAL**



T-49C Accessories

Figure 2-1

SECTION B

OPERATING CONTROLS, INDICATORS, AND CONNECTORS

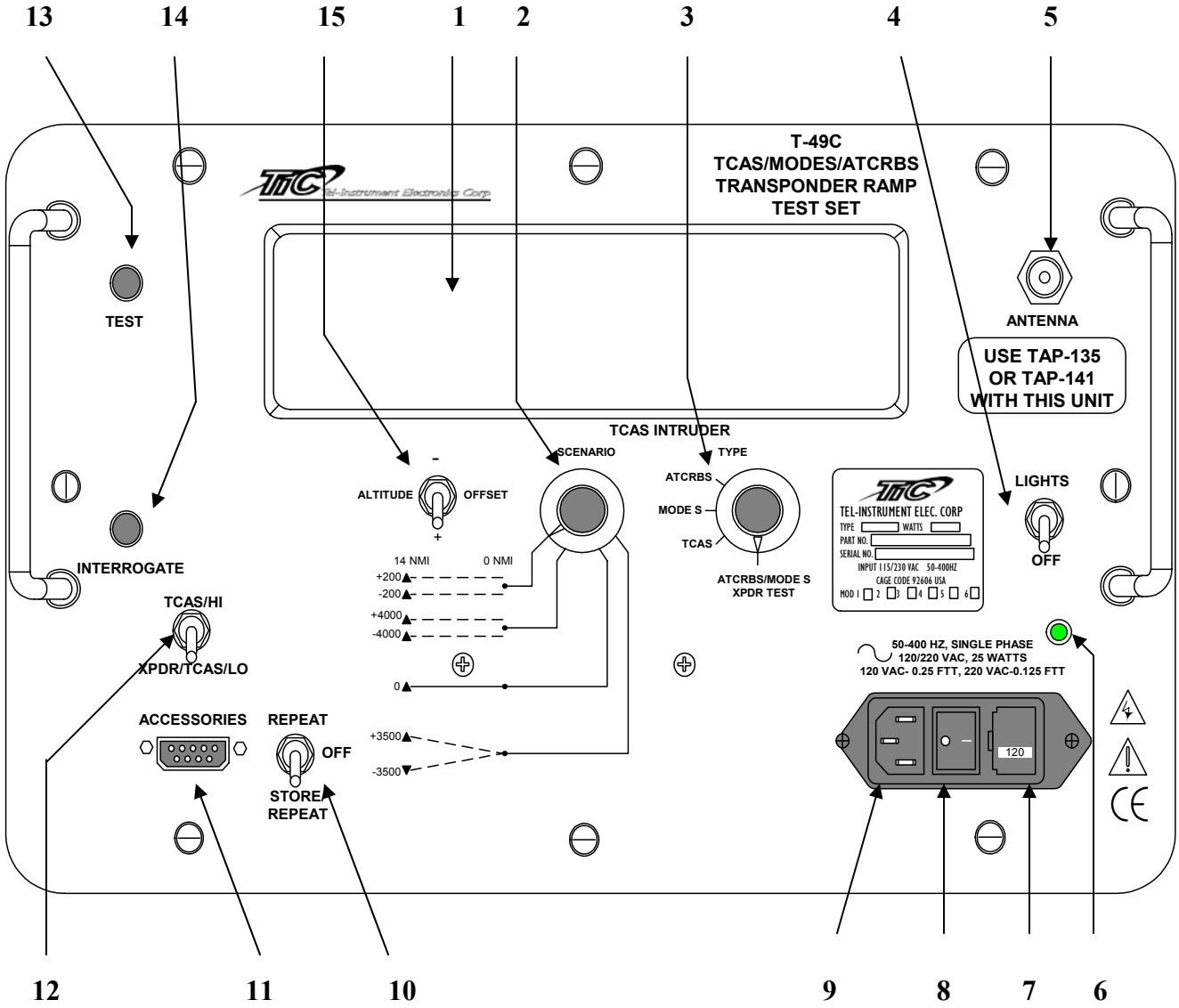
2.5 General

This section covers location and function of the operating controls, indicators, and connectors. All controls, indicators, and connectors are located on the front panel of the Test Set.

2.6 Controls, Indicators, and Connectors

Table 2-2 and Figure 2-2 describes and shows locations for the T-49C Test Set controls, indicators, and connectors.

	Control, Indicator or Connector	FUNCTION (Table 2-2)
1	**DATA DISPLAY WINDOW**	Alpha/Numeric Display (two lines/20 characters) provides operational instructions, error messages, and scenario progress and test results.
2	**SCENARIO** Select Switch	When any TCAS Intruder mode selected, 4 scenarios are available: +200/-200, +4000/-4000, 0 and +3500/-3500.
3	**TCAS INTRUDER** Select Switch	1. Utilized to select Transponder or TCAS test scenarios. 2. In **ATCRBS/MODE S XPDR TEST**, selects transponder tests. 3. In **TCAS**, **MODE S** or **ATCRBS**, selects TCAS selectable test scenarios.
4	**LIGHTS/OFF** Switch	De-energizes Test Set when toggled down. Provides Backlighting for display when toggled up.
5	**ANTENNA** Connector	Connector for Omni-Directional Antenna, Directional Dipole and TAP-135 Antenna Coupler.
6	**AC POWER** Indicator	Green "LED" indicates battery charging and AC power connected. When the battery alone is being used, the LED will not illuminate.
7	VOLTAGE CHANGE/FUSE CARTRIDGE	Contains 2- 250V ¼ amp removable fuses for 115 VAC operations. Permits the operator to also configure for 220VAC operation.
8	**AC POWER** Switch	AC ON/OFF Switch ("-" = ON, "0" = OFF).
9	AC Power Receptacle	Allows the connection of the supplied AC power cord.
10	**STORE/REPEAT** Switch	Permits the operator to repeat a specific test or store data in the T/S RAM for download to a PC. Allows access to "Calibration Mode".
11	**ACCESS** Connector	RS-232 link for download of stored data to a PC (under development).
12	**TCAS/HI** **XPDR/TCAS LO**	Selects T/S RF Power Output of +10 dBm in the **HI** position and –10 dBm in the **LO** position. **FOR SENSITIVITY MEASUREMENTS, LEAVE THE SWITCH IN THE LO POSITION.** Used for TCAS Operation.
13	**TEST SWITCH**	1. Allows manual sequence of tests to run and be displayed. 2. Used in-conjunction with **INTERROGATE** Switch to enter AUT (Aircraft Under Test) altitude. 3. With Test Set "OFF", pressing the **TEST** Switch will turn the Test Set "ON". 4. In the TCAS modes, halts the Intruder range and altitude, pressing it a second time resumes the original track.
14	**INTERROGATE** Switch	1. Initiates Automatic Test Sequence for Transponder and TCAS testing. 2. Serves to enter and store data on the T/S RAM. 3. Used in conjunction with **TEST** switch to enter Aircraft Under Test (AUT) altitude. 4. With Test set "OFF", pressing the **INTERROGATE** Switch will turn it "ON".
15	**ALTITUDE OFFSET**	Select above (+) or below (-) the aircraft intruder scenario.



T-49C Test Set Controls, Indicators, and Connectors

Figure 2-2

SECTION C

OPERATING INSTRUCTIONS

2.7 General

The Test Set utilizes an easy to read display that provides the operator with easy to follow "On Screen" instructions. To run a scenario, in either TCAS or ATCRBS modes, the **TCAS INTRUDER** and **SCENARIO** select switches are set to the desired positions followed by the momentary press of the **INTERROGATE/TEST** switch. A subsequent press of the **INTERROGATE/TEST** switch will commence the scenario or test sequence.

2.8 Battery Operation

The T-49C Test Set is equipped with a rechargeable Ni-Cad battery capable of operating the Test Set using a 50% duty cycle for 8 hours at 77 degrees F (25 Degrees C). This represents a full day of typical testing on a single charge. Operating the Test Set in lower temperatures, will decrease the overall battery life.

Due to the Ni-Cad batteries ability to maintain a constant current level, the operator will be able to utilize the Test Set until the batteries are nearly depleted. The unit may then be plugged into a standard 120 (220 if so configured) VAC power source to continue testing. By observing a Duty Cycle (DC) of 50%, the Test Set batteries will begin regaining their charge while testing is in progress.

It is strongly recommended that the batteries be charged for a short time each week regardless if the Test Set has been utilized or not. A completely discharged battery will require approximately 16 hours to fully charge. Occasional charges of 16 hours on partially depleted batteries will have no adverse effects.

To charge batteries, utilize the following procedures:

1. Remove the power cord from the inside cover and attach it to the **AC POWER** receptacle.
2. Connect the power cord to a suitable 120 or 220 (if configured) VAC outlet. For 220 VAC operations, see paragraph 2.8.1.
3. Turn the **AC POWER** switch to the "ON" position (-).
4. Verify the green LED **AC POWER** indicator is lit signifying that the battery has commenced charging.

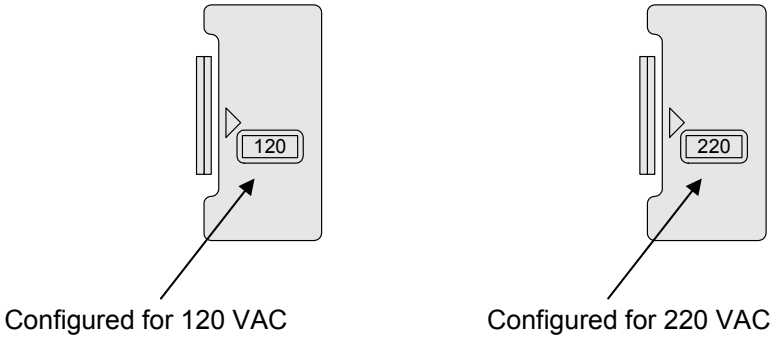
WARNING
If the battery voltage has been depleted to the point the Test Set will not turn "ON". DO NOT attempt to Turn the Test Set "ON" until the Unit has been charging for a minimum of 30 minutes.

2.8.1 220 Volt Operation

The Test Set is configured from the factory for 120 VAC. To operate the Test Set using 220 VAC, follow the procedures as listed below.

WARNING
Failure to properly configure the Test Set for 220 VAC operations before use may result in severe damage to the Test Set.

1. Remove the **FUSE CARTRIDGE** from the Test Set by releasing the Tab and pulling straight the cartridge straight out.
2. Remove and store/dispose of the two fuses.
3. Pull the bottom fuse holder from the rear of the cartridge, rotate, and reinstall the cartridge, ensuring that **220** is viewable through the front window.



Fuse Cartridge

Figure 2-3

4. Replace the fuses with **250V 1/8A, FTT** fuses and reinstall the fuse cartridge in the fuse housing.

2.9 STORE/REPEAT Switch

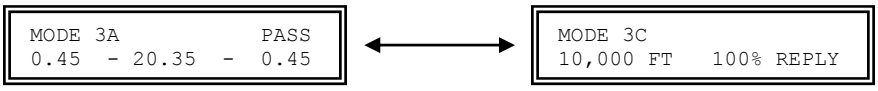
The **STORE/REPEAT** switch allows the operator several options, which enhances the testing procedure. When conducting Transponder Tests, in the Manual mode, toggle the switch to the "*Down"* position. This will *REPEAT* the current test a second time. Subsequent toggles of the switch will continue to repeat the current test.

By placing the **STORE/REPEAT** switch to the "*UP"* position, the Test Set will continually retest the selected mode until the switch is returned to the "OFF" position.

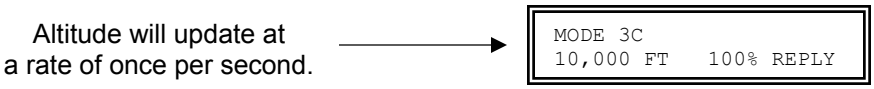
NOTE

Ensure to return the **STORE/REPEAT** switch back to the **OFF** position when testing is complete.

Test Sets having software version **6.20** and greater, also have the capability of conducting Altimeter checks. Access the MODE C test page (see paragraph 2.12.2). Place the **STORE/REPEAT** switch in the "*Up*" position; the Test Set will begin to conduct the MODE C Test continually. The screen will alternate between the MODE C test page and the PW measurement page (See paragraph 2.13 for further information).



After 30 seconds has passed, the Test Set will discontinue the PW measurements and only display the MODE C altitude. This altitude is updated at a rate of approximately once per second. The operator will be able to observe the Mode C altitude while utilizing a Pitot Static Test Set and *Pump Up* the altitude verifying correct transponder altitude information.



When the Altimeter checks are complete, ensure that the **STORE/REPEAT** switch is returned back to the **OFF** position to prevent unintentional battery discharge.

2.10 T-49C Supplied Antennas

The T-49C is equipped with three (3) antennas for a variety of tests. An Omni-Directional Antenna, Directional Antenna, and Antenna Coupler (TAP-135) are supplied as standard equipment.

NOTE

To improve overall accuracy when making power, receiver sensitivity and frequency measurements, utilize the TAP-135 Antenna Coupler or direct connect to the transponder with the ***OPTIONAL* TAP-141** Coupler. The Omni Directional Antenna and Directional Antennas are used for a QUICK check of the system only. Power, Frequency, and Receiver Sensitivity are not displayed.

An *OPTIONAL* Direct Connect Coupler (TAP-141) with an attenuated path to protect the Test Set may be purchased separately for direct connection of a transponder receiver transmitter to the T-49C. This is useful to determine and troubleshoot problems by separating the aircrafts antennas and cables from the rest of the system.

2.10.1 Omni-Directional Antenna

The Omni-Directional Antenna, stored inside the T-49C cover, primary task is to provide a quick-test capability for ATCRBS Mode A/C and Mode S equipment. The following suggestions will improve your overall test results when utilizing the Omni-Directional Antenna. Transponder RF power, receiver sensitivity, and frequency measurements are not displayed.

1. Connect the antenna directly to the **ANTENNA CONNECTOR** located on the front panel of the T-49C Test Set.

2. Maintain a 15-100 ft. separation from the Test Set and the aircraft under test (AUT), and a clear unobstructed path from the antenna and the Test Set (Figure 2-4).

3. Ensure the transponder that you are testing is significantly closer to the Test Set than another operating transponder equipped aircraft. An undesired reply may occur or erroneous indications may result.

4. DME and transponder antennas are similar in shape and appearance. Have positive identification of the correct antenna as to adhere to the 15-100 ft. range.

5. If the aircraft you are testing is dual transponder equipped, ensure the correct antenna and transponder is selected.

2.10.2 Directional Antenna

The Directional Antenna is a printed circuit sandwiched between two opaque Lexan sheets. It is hinged to the T-49C Test Set case cover and primarily utilized for TCAS and Transponder tests. As with the Omni-Directional Antenna: RF power, receiver sensitivity, and frequency measurements are not measured when using the Directional Antenna. Use the TAP-135 or TAP-141 Direct Connect Coupler to conduct power, frequency, and sensitivity measurements.

NOTE

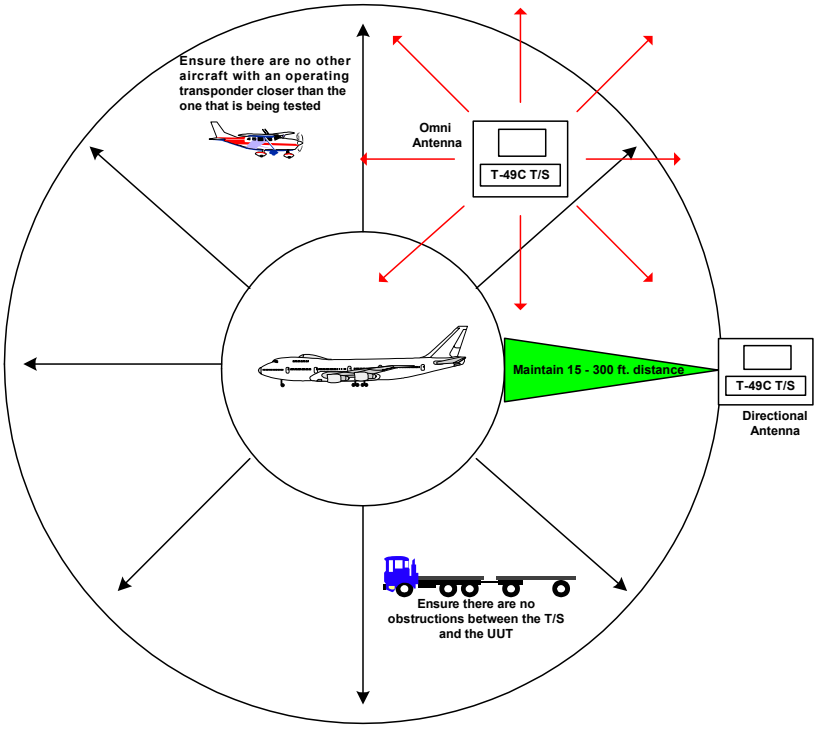
When utilizing the Directional Antenna, remove all accessories from the cover. The cover is designed to act as an antenna reflector. Results with items left in the cover may be inaccurate or vary.

1. Open and remove the T-49C Test Set case cover. Release the two (2) push button holders and fold down the Directional Antenna. Remove the AC power cord, Omni Antenna, and the TAP-135 Antenna Coupler and store them in a safe location.

2. Fold the antenna into position in the case cover and re-engage the push button holders. Attach the antenna cable connector to the **ANTENNA** connector on the Test Set.

3. Position the Test Set and antenna assembly with a 15-300 ft. unobstructed separation from the Aircraft under test (Figure 2-4).

4. Aim the Directional Antenna at the Aircraft Under Test (AUT) antennas and conduct the appropriate test sequence.



Directional Antenna

Figure 2-4

2.10.3 Antenna Coupler (TAP-135) (T-49CA is equipped with 2 TAP-135 Couplers)[1]

The Antenna Couplers provide transponder power, frequency, and sensitivity measurements. The Antenna Couplers may only be utilized on blade type antennas. When using the Antenna Coupler, ensure you have selected the correct antenna to test.

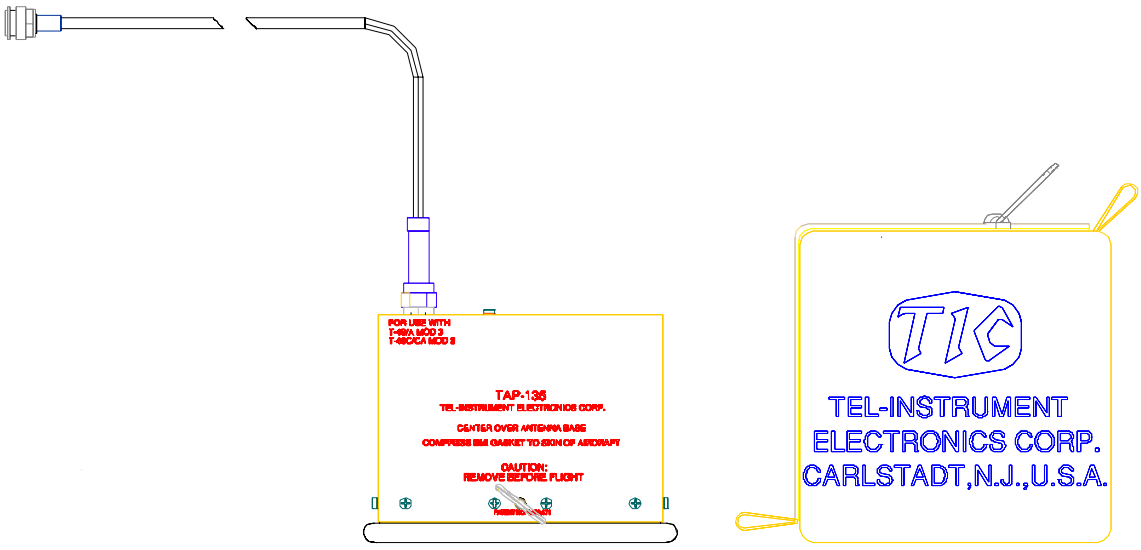
1. Remove the TAP-135 from the Test Set front cover, unwind the cable and connect the cable to the **ANTENNA** connector on the front panel of the T-49C Test Set.

2. Pull the snap ring located on the side of the coupler and slip the coupler onto the antenna to be tested. The TAP-135 utilizes internal springs to maintain pressure on the antenna blade. Ensure a snug fit, flat on the aircraft fuselage.

3. Ensure that the coupler is centered over the antenna to be tested (Fig 2-6).

4. Due to the availability of numerous styles of L-Band antennas, slight adjust of the Coupler may be necessary to receive accurate measurements. If incorrect readings occur, re-position and ensure a snug fit on the antenna. Move the TAP-135 forward or back and double check a firm and snug seal on the aircraft surface. The adjustment is correct when the maximum power is displayed on the *POWER RCVR, FREQ,* page.

4. For Diversity testing, utilize two TAP-135 Couplers simultaneously, one on each antenna. The T-49CA is outfitted with two couplers as standard equipment. The TAP -135's attenuates the RF signal by 20 dB and can be utilized as a shield. The second Coupler can be left disconnected when used for this purpose.

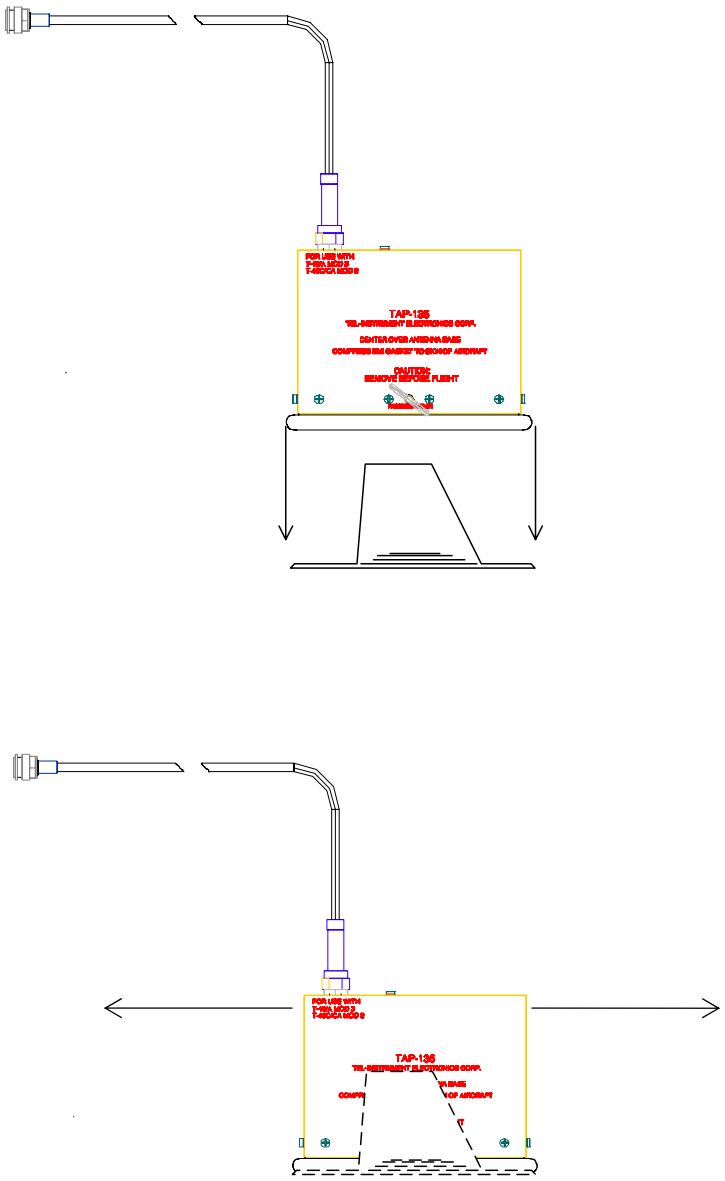


TAP-135 Coupler

Figure 2-5

[1] Measurements utilizing the TAP-135 are accurate within ± 3dB.

Center the TAP-135 as close to center as possible for the style of antenna being tested. If inaccurate results occur, reposition the coupler slightly forward or back and check for a snug flush fit until accurate measurements are displayed. Due to the many styles of antennas available, adjustments may be necessary.



TAP-135 Antenna Placement

Figure 2-6

2.10.4 *Optional* Direct Connect Coupler (TAP-141)[2]

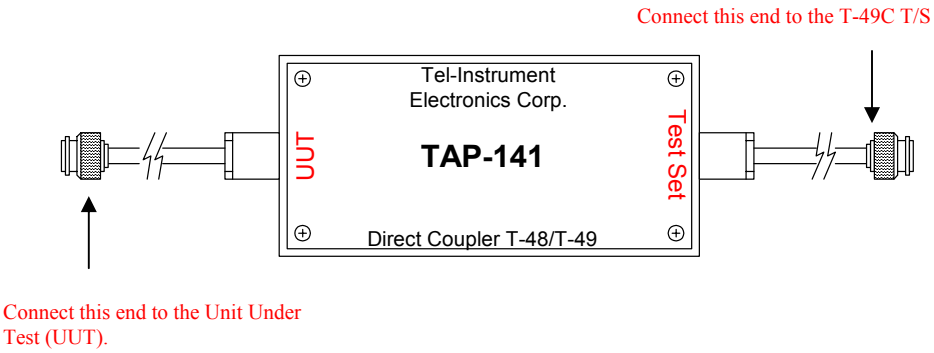
The TAP-141 Direct Connect Coupler provides a means of connecting a transponder directly to the T-49C Test Set, thus providing an accurate means of checking transponder power, frequency, sensitivity, and diversity measurements. The TAP-141 supplies an attenuated path protecting the Test Set from the high RF power associated with transponders.

1. Ensure power to the transponder is secured to prevent accidental transmission without a load connected.

WARNING
The TAP-141 Coupler is labeled as to which end is connected to the Test Set and which end to the UUT. Ensure the proper connections are made before testing the UUT. If the proper connections are not observed, the Test Set and/or UUT may require repair and calibration(Figure 2-7).

2. Connect the TAP-141 **TEST SET** connector to the **ANTENNA** connector located on the front panel of the T-49C Test Set.

3. Connect the TAP-141 **UUT** connector directly to the transponder antenna connector.



TAP-141 Connection Criteria

Figure 2-7

4. Conduct the appropriate tests.

5. When testing is complete, ensure to de-energize the transponder under test and re-connect the antenna connection to your transponder to prevent accidental damage to your unit.

[2] Measurements utilizing the TAP-141 are accurate within ± 2 dB.

2.11 Initial Start-up Procedure

When utilizing the T-49C Test Set, always begin with a fully charged battery or AC power connected. The following displays are shown without a transponder connected.

1. With the **TCAS INTRUDER** type switch selected to **ATCRBS/MODE S - XPDR TEST**, press the **INTERROGATE** button to activate the Test Set. The following display will come into sight, briefly denoting the current software version of the T-49C Test Set:

```
TEL INSTRUMENT
T-49C     REV.6.XX
```

2. The T-49C will then begin searching for a transponder to test. If the transponder is not connected or powered up, the following will be displayed. The *"Rotating Bar"* in the upper right of the display signifies the Test Set searching to acquire a RF signal.

```
XPDR TESTING ... /
NO REPLY
```

Rotating Bar

3. Hold the **LIGHTS/OFF** switch in the "UP" position to verify that the backlighting for the display is operating. Once the operator releases the switch, the backlighting extinguishes to conserve battery power.

4. Press "DOWN" and release the **LIGHTS/OFF** switch to turn power *OFF* to the Test Set.

5. Ensure that the **TCAS HI/LO** switch is in the **XPDR/TCAS/LO** position when conducting Transponder Tests.

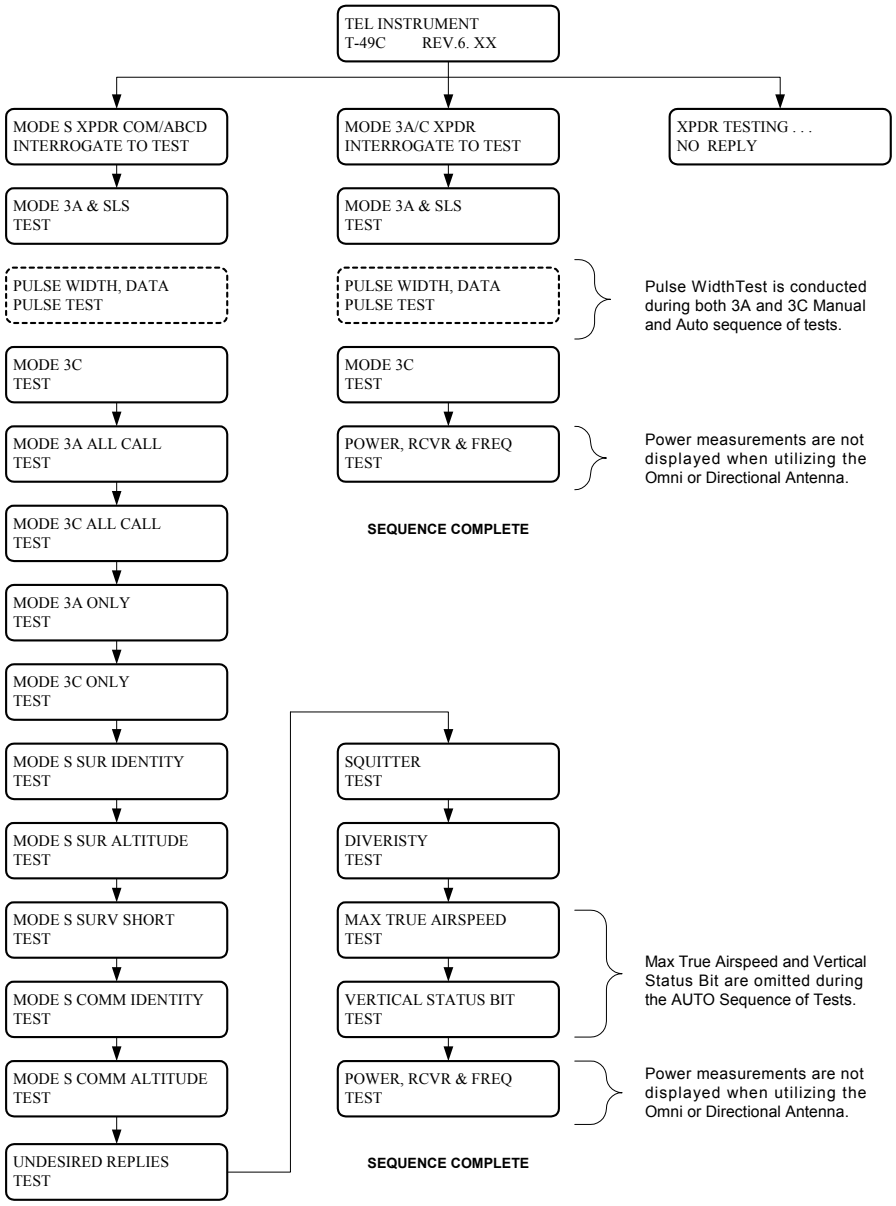
NOTE

Transponder Sensitivity measurements may be inaccurate if left in the **HI** position.

2.12 Transponder Test Sequence

The T-49C is capable of testing ATCRBS Mode A, Mode C, and Mode S transponders. The operator may select an Automatic sequence of tests ending in the Power, Receiver Sensitivity, and Frequency display or manually select the tests one at a time. Figure 2-8 lists the sequence of tests available in the Auto and Manual sequence of tests.

The T-49C will determine upon receiving the transponder RF signal the appropriate sequence. If the transponder is Mode S equipped, the T-49C will automatically select the Mode S menu. If the transponder is Mode A/C capable, the T-49C will initiate the Mode 3A/C transponder tests.



Transponder Sequence of Tests

Figure 2-8

NOTE

Any displays illustrated were the actual results from a calibrated Transponder. The results may be typical of tests performed, but operators must utilize the literature provided by their transponder manufacturer or FAA guidelines when testing their transponder. The results displayed throughout this manual are for **ILLUSTRATION PURPOSES ONLY**.

2.12.1 Mode 3A/C Automatic Sequence of Transponder Tests

Upon energizing the Transponder Under Test, the T-49C will recognize the transponder as having only Mode 3A and/or Mode C capabilities. The appropriate menu will be initiated and shown on the T-49C display.

```
MODE 3A/C XPDR
INTERROGATE TO TEST
```

The operator may now choose to select the automatic sequence of tests or the manual sequence. By depressing the **INTERROGATE** switch (as indicated on the display), the automatic sequence will commence.

The tests will proceed in order (Figure 2-8) and conclude at the POWER, RCVR & FREQ Test Page. The automatic mode does not display results of an individual test as long as the tests performed "PASS".

If a failure occurs in any one test, the T-49C will stop the automatic sequence and display the failure.

```
FAIL    09% REPLY
CONTINUE: PRESS INT
```

By stopping the test sequence, the operator is alerted to continued and potential failures if testing is resumed. Once the sequence is stopped due to a failure, the operator may override and continue testing by depressing the **INTERROGATE** button. The T-49C will then proceed to the next test in sequence. The operator may also choose to repeat the test by toggling the **STORE/REPEAT** switch down, to initiate the failed test a second time.

When all tests are complete, with no failures, the T-49C test sequence will end with an alternating display of measured power, receiver sensitivity, and frequency (Shown with results utilizing TAP-141). The second alternating page displays power measured in watts.

```
POWER, RCVR & FREQ
54dB-75dB 1090.0 MHz
```

```
POWER, RCVR & FREQ
250W -75dB 1090.0MHz
```

When utilizing the Omni Directional Antenna or the Directional Antenna: power, frequency and sensitivity will not be shown. Aircraft 4096 code and altitude are displayed.

```
1234        10,000'
NO MEASURED POWER
```

2.12.2 Mode 3A/C Manual Sequence of Transponder Tests

To manually display each test performed by the T-49C Test Set, the operator must select the **TEST** switch. The T-49C will then run each test in order (Figure 2-8) but pause and display the results of each test. The operator must then depress the **TEST** button again to proceed to the next test in sequence.

MODE 3A/C XPDR INTERROGATE TO TEST	**TEST** button depressed.
MODE 3A & SLS TESTING . . .	MODE 3A Test Initiated.
MODE 3A 1234 100% REPLY	MODE 3A Test Complete. Display indicates transponders 4096 Octal Code (1234) and Receiver Efficiency (100%) as a percentage. Framing Pulse Widths and Spacing are also tested. Refer to paragraph 2.13 for further information.

To check the transponder under test *"IDENT"* function. Press the appropriate button in the aircraft or on the test fixture. Toggle the **STORE/REPEAT** switch on the T-49C. The MODE 3A test will commence and the display will indicate *"IDENT",* verifying the SPI was received.

MODE 3A IDENT 1234 100% REPLY	*"IDENT"* signal received.

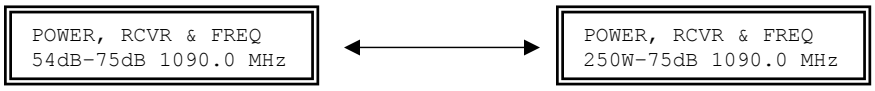
The **TEST** button must then be pressed to proceed to the next test.

MODE 3C TESTING . . .	MODE 3C Test Initiated.
MODE 3C 10,000FT 100% REPLY	MODE 3C Test completed. Display indicates transponder reported altitude in feet (to the nearest 100^{th}) and receiver efficiency as a percentage. Framing Pulse Widths and Spacing are also tested.

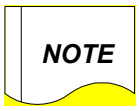
TEST button depressed to proceed to the final Mode 3A/C Transponder Test.

POWER, RCVR & FREQ TEST	Transponder power, receiver efficiency and frequency test initiated.

Test Set measures transponder RF output (54dBm) Receiver Sensitivity (-75dBm) and Frequency (1090.0 MHz). Second alternating page displays power as watts (250W).



During any test in the manual mode of operation, the operator may chose to repeat a particular test by toggling the **STORE/REPEAT** switch. The current test displayed will commence again. The operator may continue doing this as long as the Test Set remains "ON". Turning the Test Set "OFF" and then "ON" will require the operator to go through all previous tests again to reach the desired test they want to repeat. By leaving the switch in **REPEAT**, the Test Set will continue testing until toggled back to **STORE.**



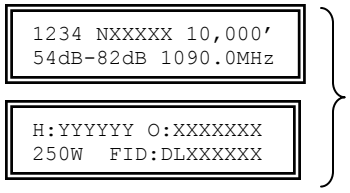
Always return the **REPEAT** switch to **STORE** when testing is completed.

2.12.3 Mode S Automatic Sequence of Transponder Tests

Figure 2-8 lists the sequence of tests performed with a Mode S equipped transponder under test. Paragraph 2.12.4; Mode S Manual Sequence of Transponder Tests, describes in detail each test performed. When the **INTERROGATE** button is pressed, the sequence will continue as long as normal indications are received for each test. If an abnormal result occurs, the sequence will stop at that test and a "FAIL" message will be displayed. To override after a "FAIL" message, press the **INTERROGATE** switch to continue testing with the failure.

First display shown once the T-49C has determined a Mode S equipped Transponder is being received.

When selecting the Automatic sequence of tests, the results of the tests will not be displayed until the final test is completed. At that point, the POWER, RCVR & FREQ display will appear and testing will cease until the **INTERROGATE** or **TEST** button is depressed again to initialize another series of tests.



The final displays of Mode S Transponder tests alternates between two (2) pages. The first page indicates the 4096 octal code, the decoded aircraft address, aircraft altitude and power, sensitivity, and frequency measurements.
The second page displays the aircraft address in both Hexadecimal and Octal, power measured in watts and the decoded Flight Identity.

In the Automatic sequence of tests, "**MAX TRUE AIRSPEED**" and "**VERTICAL STATUS BIT**" tests are omitted. In addition- The operator will be unable to verify the testing of the UUT *"IDENT"* function

.

If the operator requires the results of either of them, the Manual sequence must be utilized. Paragraph 2.12.4; Mode S Manual Sequence of Tests, explains each test and typical results.

2.12.4 Mode S Manual Sequence of Transponder Tests

By selecting the manual sequence of Mode S tests, the operator will be able to view the results of each test, repeat them as necessary, test the function of the transponders "IDENT" function, and display Pulse Width, Pulse Spacing and Data Pulse measurements.

To commence the manual sequence, the operator must depress the **TEST** button after the Test Set has verified a RF signal and the first test display is shown on the front panel of the T-49C.

MODE S XPDR COM/AB INTERROGATE TO TEST	The T-49C has determined a Mode S equipped transponder is being received. To continue testing, the operator must depress the "**TEST**" button.
MODE 3A & SLS TESTING . . .	MODE 3A test initiated. Framing Pulse width, data pulse, and spacing are also tested but are not displayed unless a failure was detected.
MODE 3A 1234 100% REPLY	Mode 3A Test Complete. Display indicates the transponders 4096 Octal code (1234) and receiver efficiency (100%) as a percentage.

To test the transponder *"IDENT"* function, press the appropriate button in the aircraft or on the Test Fixture. Toggle **STORE/REPEAT** on the T-49C. The MODE 3A test will be repeated. *"IDENT"* should appear on the display indicating the receipt of the SPI pulse.

MODE 3A IDENT 1234 100% REPLY	*"IDENT"* indication displayed confirming a SPI pulse was transmitted following the last framing pulse.

To advance to the next test, the **TEST** button must be depressed.

MODE 3C TESTING . . .	MODE 3C test initiated.
MODE 3C 10,000FT 100% REPLY	The transponders reported altitude in feet (in 100 ft increments) and receiver efficiency as a percentage.

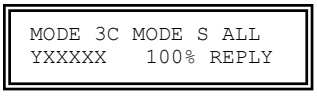
TEST button depressed to advance to next test.

MODE 3A ALL CALL test initiated. Test Set transmits a M3A All Call.

Reported aircraft address in Hexadecimal (YXXXXX) and receiver efficiency is displayed.

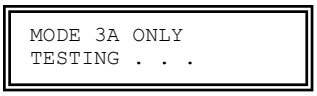
TEST button depressed to advance to next test.

MODE 3C ALL CALL test initiated. Test Set transmits a MODE 3C-Only All Call.

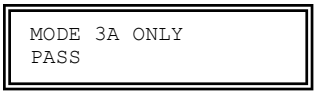


Reported aircraft address in Hexadecimal (YXXXXX) and receiver efficiency is displayed.

TEST button depressed to advance to next test.

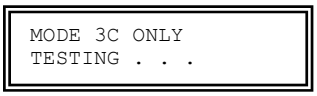


Mode 3A ONLY test initiated. Test Set transmits an ATCRBS-Only All-Call.

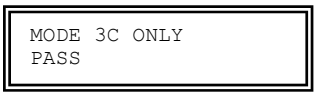


A MODE S transponder will not accept an ATCRBS Only All Call. A "*PASS"* displayed, indicates that the Mode S transponder did not reply.

TEST button depressed to advance to next test.



MODE 3C ONLY test initiated. Test Set transmits an ATCRBS Only All Call.



A MODE S transponder will not accept an ATCRBS Only All Call. A *"PASS"* displayed, indicates that the Mode S transponder did not reply.

TEST button depressed to advance to next test.

```
MODE S SURV IDENTITY
TESTING . . .
```

MODE S Surveillance Identity test initiated. The Test Set transmits an UF=5 Interrogation.

```
MODE S SURV FS: AIR
1234      100% REPLY
```

A DF=5 reply will display the decoded 4096 field (1234) and Flight Status (FS). FS is utilized in the DF=4, 5, 20 and 21 formats.

NOTE

Possible FS displays are **AIR** (Airborne), **GND** (On Ground), **AL/AR** (Alert/Airborne), **AL/GD** (Alert/Ground), **AL/SP** (Alert/SPI), and SPI.

TEST button depressed to advance to next test.

```
MODE S SURV ALTITUDE
TESTING . . .
```

MODE S Surveillance Altitude test initiated. The Test Set transmits an UF=4 Interrogation.

```
MODE S SURV FS: AIR
10,000FT  100% REPLY
```

The DF=4 reply will display reported altitude (to the nearest 25 ft. level), flight status and the receiver efficiency.

TEST button depressed to advance to next test.

```
MODE S SURV SHORT
TESTING . . .
```

MODE S Short Air to Air Surveillance test initiated. The Test Set will transmit a short special interrogation, UF=0 format.

```
MODE S SRV 100%REPLY
YXXXXX  GND 10,000FT
```

The Mode S Transponder will reply with a short special reply in DF=0 format. Aircraft address in Hexadecimal, aircraft altitude, and flight status is displayed.

TEST button depressed to advance to next test.

```
MODE S COMM IDENTITY
TESTING . . .
```

MODE S COMM A Identity test initiated. The Test Set transmits a COMM A/B, ABCD transmission utilizing a UF=5/RR:18 format. This tests a transponders communication and data-link capabilities.

```
IDENTITY: DLXXXXXXX
1234      100% REPLY
```

The transponder will reply in the DF=21 format. The display will show the Flight ID code and decoded 4096 field. Receiver efficiency as a percentage is also displayed.

TEST button depressed to advance to next test.

```
MODE S COMM ALTITUDE
TESTING . . .
```

MODE S COMM A Altitude test initiated. The Test Set transmits a COMM A/B, ABCD transmission utilizing a UF=5/RR:18 format. This tests a transponders communication and data-link capabilities.

```
MODE S COMM YXXXXX
10,000FT  100% REPLY
```

The transponder will reply in the DF=20 format. Aircraft Address in Hexadecimal, aircraft altitude, and the receiver efficiency will be displayed.

TEST button depressed to advance to next test.

```
UNDESIRED REPLIES
TESTING . . .
```

Undesired Replies test initiated. The Test Set will make randomly addressed interrogations. Only the correctly addressed interrogation will be accepted.

```
UNDESIRED REPLIES
NO REPLIES
```

If the transponder replies to any of the random addresses, an error message will be displayed. “NO REPLIES” indicates the transponder did not reply and has passed the test.

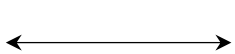
TEST button depressed to advance to next test.

```
SQUITTER
TESTING . . .
```

The Test Set will transmit no interrogations but receives and processes DF=11 and extended DF=17 replies. After detection of the replies is received, two alternating pages will appear displaying the time interval of received replies.

DF=11 Acquisition

```
ACQ:PASS DIV 1021 MS
ADD: AXXXXX  II:0
```



DF=17 Extended Squitter

```
EXT: PASS DIV 520 MS
ADD: AXXXXX
```

The detection time of each DF=11 and/or DF=17 message will be displayed. If the time interval is between 0.8-1.2 sec. - “PASS” is displayed. If the time interval falls in the 1.6-2.4 sec. range – “DIV” (Diversity) is also displayed. The aircraft address is also shown.

ACQ: NOT DETECTED	If a DF=11 or DF=17 message is not received- "NOT DETECTED" will be displayed.
EXT: FAIL ADD: AXXXXX	If only one message of either DF=11 or DF=17 is received in the 5.1 second measuring period, "FAIL" will be displayed and no time will be shown.

TEST button depressed to advance to next test.

DIVERSITY TESTING . . .	Diversity test initiated.
DIVERSITY PASS	Display indicates a "PASS" when the Test Set determines whether leakage relative to the inactive antenna is less than -20 dB.

TEST button depressed to advance to next test. The **MAX TRUE AIRSPEED** test is not performed during the auto sequence of Mode S tests.

MAX TRUE AIRSPEED TESTING . . .	Test Set initiates a UF=0 interrogation. Verifies that the transponder airspeed code is one of seven possible RI field codes.
MAX TRUE AIRSPEED GT 300 & LE 600 KTS	The DF=0 reply reports the aircraft maximum cruising true airspeed in the RI Field of the DF=0 format.

NOTE

Eight possible RI field codes are available.
1) *NO Max airspeed data*
2) *LE 75 knots*
3) *GT 75 & LE 150 kts*
4) *GT 150 & LE 300 kts*
5) *GT 300 & LE 600 kts*
6) *GT 600 & LE 1200 kts*
7) *GT 1200 kts*
8) Not Assigned.
GT denote "Greater Than", **LE** denotes "Less than or Equal

TEST button depressed to advance to next test. The **VERTICAL STATUS BIT** test is not performed during the auto sequence of Mode S tests.

VERTICAL STATUS BIT VS=1 (ON GROUND)

Test Set receives the Vertical Status as part of the UF=0 format. A display of ONE (VS=1) is aircraft on ground. A display 0f ZERO (VS=0) is aircraft airborne.

TEST button depressed to advance to next test.

POWER, RCVR & FREQ TESTING . . .

The Test Set begins transponder RF power, receiver sensitivity, and frequency tests.

POWER,RCVR & FREQ 01 TESTING

The Test Set will take the receiver sensitivity measurement four (4) times and average the results. The number in the upper right corner counting; **01-02-03** signifies the sensitivity test progressing.

The final test in the manual sequence will end with an alternating display of transponder RF power output (54dBm), receiver sensitivity (-75dBm) and transponder frequency (1090.0 MHz). The second page displays power in watts.

POWER,RCVR & FREQ 54dB-75dB 1090.0 MHz

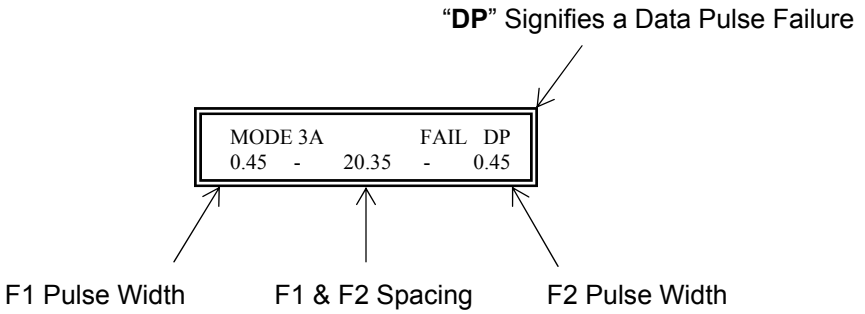
POWER,RCVR & FREQ 250W-75dB 1090.0 MHz

2.13 Pulse Width, Spacing and Data Pulse Measurements

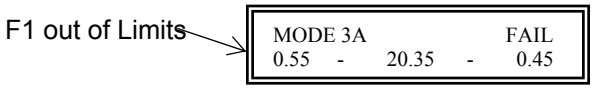
NOTE

Pulse Width, Pulse Spacing, and Data Pulse measurements are not reliable if the T-49CTest Set Receiver efficiency is less than 90%.

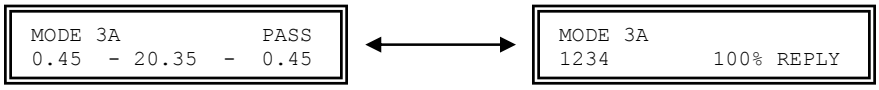
The T-49C/CA accurately measures each Framing Pulse, Pulse Width, and Pulse Spacing. Each Data Pulse entered will also have the width and spacing measured. Both Mode S and ATCRBS transponders are tested during the Mode 3A and Mode C portion of the **MANUAL** and **AUTO** test sequence. If no failures are detected, no display is shown. In the event of a failure, the Test Set will cease testing and display the failure. The Test Set will display the measured Framing Pulse Width (F1), Spacing between F1 and F2, and Pulse width of F2 (see figure 2-9).



A "**FAIL"** signifies a F1/F2 Width failure, or a Framing Pulse Spacing Failure.



The operator may also chose to repeatedly measure and test the Pulse Width, Spacing and Data Pulses by placing the **STORE/REPEAT** toggle in the "UP" position after completing either the Mode 3A or Mode C test. The Test Set will then alternately test the appropriate Test (Mode 3A or C) and the Pulse Width measurements. The display will also alternate showing the results each time it is tested.



When conducting the PW test in the MODE C test page, after 30 seconds has passed, the Test Set will discontinue the PW measurements. To continue to measure the PW, the operator must cycle the **STORE/REPEAT** switch to begin another 30 seconds of PW measurements.

2.13.1 PW, Spacing and Data Pulse Test Example

As an example, the operator of an ATCRBS transponder selects 1234 as the 4096 code. Turn the Test Set "ON" by pressing the **INTERROGATE** button. The Test Set will automatically determine an ATCRBS only transponder is transmitting. Press the **TEST** button to initialize the manual sequence of tests.

```
MODE 3A & SLS
TESTING . . .
```

MODE 3A Test Initialized. Test Set also performs Framing Pulse Width and Data Pulse Tests. With 1234 entered, the T-49C will measure Framing Pulses, their width, and their spacing. The Test Set will also measure each Data Pulse in each time slot and their separation (D4, C2, C1, B2 and A1).

```
MODE 3A
1234    100% REPLY
```

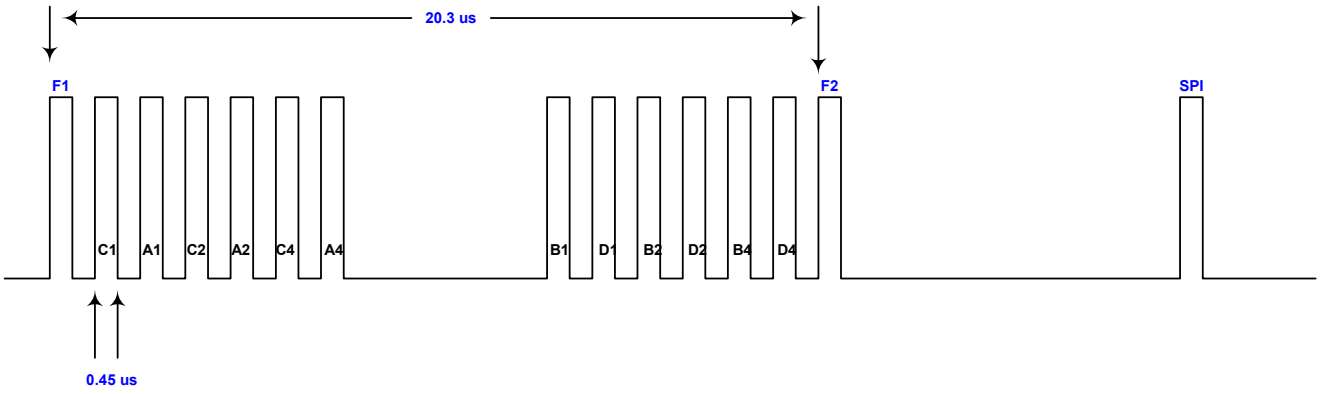
Display indicating no failures.

Table 2-3 contains each parameter and their failure criteria.

PARAMETER	NORMAL INDICATION	LIMITATIONS
Framing Pulse Width	.45 µs	± .1µs
Framing Pulse Separation	20.3 µs	± .1µs
Data Pulse Width	.45µs	± .1µs
Data Pulse Separation	1.45µs	± .1µs

Pulse Width and Spacing Criteria

Table 2-3



Framing and Data Pulses

Figure 2-9

2.14 TCAS Test Scenarios

The T-49C Test Set is capable of testing ATCRBS and Mode S, TCAS I/II systems (Traffic Alert and Collision Avoidance System). The operator is able to select four separate Intruder scenarios. When properly configured, the Test Set will simulate an Intruder aircraft converging on the position of the UUT. The operator may then observe the UUT TCAS display to ensure correct heading and altitude displays are shown. The appropriate TA's (Traffic Advisory) and RA's (Resolution Advisory) will also be heard and displayed.

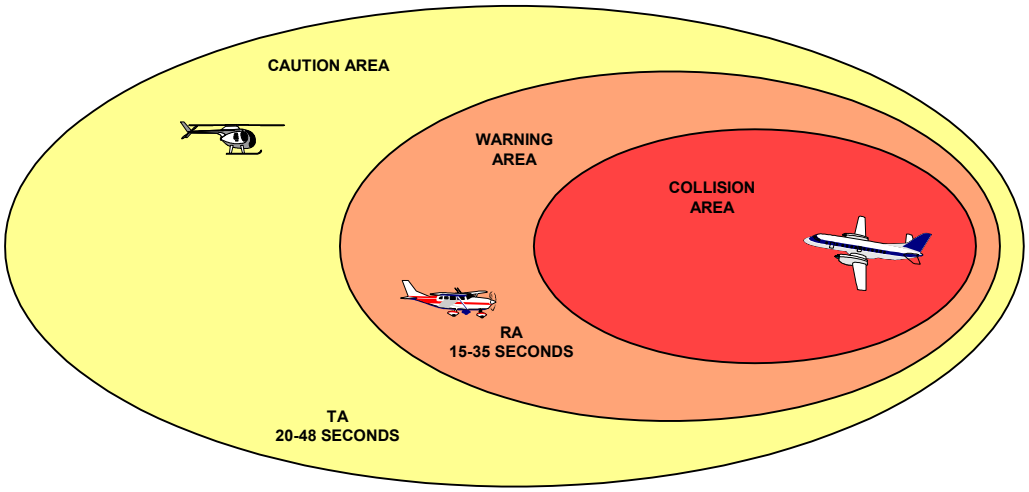
2.14.1 Typical TCAS Concepts

NOTE

All illustrations shown are for demonstration purposes. Though the test results may be typical, they are not meant to replace FAA guidelines and manufacturer recommendations.

TCAS is a system, which provides situational awareness of the surrounding airspace of an aircraft to the pilot and crew. A TCAS establishes a volume of airspace around the aircraft. The size of the airspace is based on range, speed and altitude. By working in-conjunction with the aircraft Transponder system, the TCAS can determine the relative threat of an aircraft, issue visual and audible advisories to assist the crew in locating and/or take action to prevent a collision.

The perimeter of the *CAUTION AREA* is approximately 20 to 48 seconds to the time the intruder would enter the *COLLISION AREA*. Refer to Figure 2-10.



Caution, Warning, and Collision Areas

Figure 2-10

The perimeter of the *WARNING AREA* is approximately 15-35 seconds from entering the *COLLISION AREA*.

When an aircraft enters the *CAUTION AREA*, a "TA" (Traffic Advisory) is issued. This would consist of an audible and visual warning in the cockpit.

When an intruder enters the *WARNING AREA*, the TCAS will issue a "RA" (Resolution Advisory). "RA's" consist of audible and visual warnings and possible instructions and/or automatic aircraft avoidance maneuvers.

A TCAS display will vary dependent on the manufacturer. Typically, they are incorporated with a VSI (Vertical Speed Indicator).

2.14.2 TCAS Intruder Types and Scenarios

The operator is able to select four (4) separate Intruder scenarios by means of the **SCENARIO** select knob on the front of the T-49C Test Set. Table 2-4 lists each scenario available.

Selectable Scenarios	Intruder Speed	Intruder Range	Altitude Separation	Altitude Offset
+3500/-3500	300 kts.	14 to 0 nmi.	3500 ft.	Altitude offset will decrease as distance decreases or Vice-Versa
0	300 kts.	14 to 0 nmi.	0	Constant
+4000/-4000	300 kts.	14 to 0 nmi.	4000 ft.	Constant
+200/-200	300 kts.	14 to 0 nmi.	200 ft.	Constant

TCAS Intruder Scenarios

Table 2-4

The operator may also select what type of Intruder to simulate. MODE 3A/C and MODE S are available by turning the **TCAS INTRUDER** select knob on the T-49C.

NOTE

The **TCAS** position on the **TCAS INTRUDER** select knob is identical in use as the **MODE S** position. This was incorporated into the T-49 T/S for possible future expansion.

2.14.3 TCAS Testing Cautions

Due to the nature of operating a TCAS system, especially Mode S equipped, the potential exists to create false targets in the airspace surrounding the test area, causing local aircraft and FAA ATC Centers to display false intruders.

The TAP-135 antenna couplers offer sufficient attenuation to suppress the transponder output during TCAS testing. Place the coupler tightly over the unused antenna during TCAS testing to

minimize false target problems. The coupler does not require connector termination when utilized in this fashion.

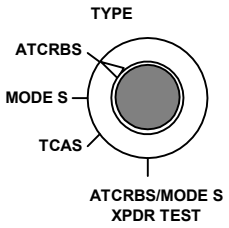
2.14.4 TCAS Test Sequence

The Test Set utilizes the Directional Antenna for TCAS simulation. This offers the operator the ability to move the Test Set to different locations around the aircraft to check if correct heading information is being shown on the TCAS Display. Refer to Paragraph 2.10.2 on Directional Antenna procedures.

To configure the Test Set to simulate an intruder aircraft, the AUT (Aircraft Under Test) altitude must be known. *Typically*, the Intruder Altitude is set to the same altitude as the AUT to ensure that the simulated Intruder converges with the AUT for verification of al RA's and TA's.

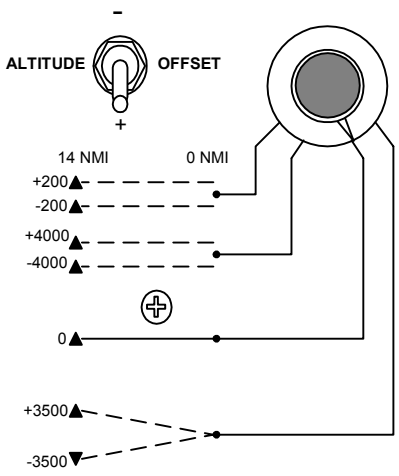
The T-49 will automatically acquire the AUT altitude by conducting a MODE C test upon turning on the Test Set. If the transponder is not operating properly, or is powered down, the operator may still enter the altitude manually.

1. Start the Intruder Scenario by selecting the type of intruder to be simulated. Utilize the **TCAS INTRUDER TYPE** switch to select either a **MODE S** or an **ATCRBS** intruder.



An **ATCRBS** Intruder is shown selected.

2. Use the **SCENARIO** switch to select the appropriate Intruder simulation. The operator may also select an offset of above the AUT (+) or below the AUT (-) for any scenario, with the exception of the **0** Offset Scenario (as shown here).



The 0 ft. Offset Scenario is shown selected.

3. Turn the Test Set "*ON*" by depressing the **TEST** or **INTERROGATE** button.

4. The Test Set will briefly display the *Start* Screen.

```
TEL INSTRUMENT
T-49C    REV . 6.10
```

5. The Test Set will automatically conduct a MODE C Test to obtain the current aircraft altitude. If the Altitude is unavailable, the Test Set will briefly display:

```
MODE C ALTITUDE
NOT AVAILABLE
```

Followed by the TCAS SETUP Screen.

```
ALT  3,800'  CONT: STR
SLEW UP: TEST DN: INTR
```

6. Enter the AUT Altitude, if not obtained as in *Step 5,* by pressing the **TEST** and **INTERROGATE** buttons to the desired altitude. The Altitude is adjustable in 100' increments from -1000 ft. to +99,900 ft.

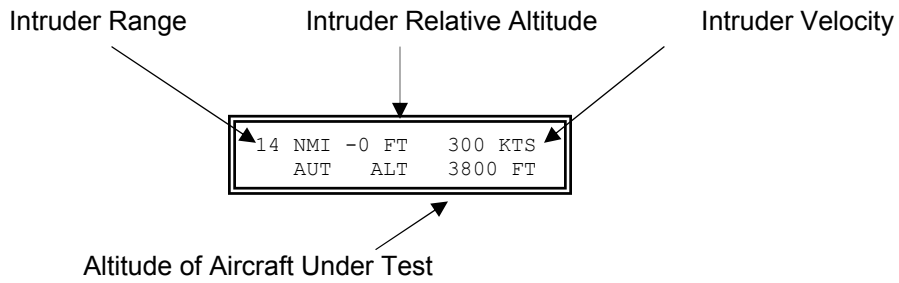
NOTE

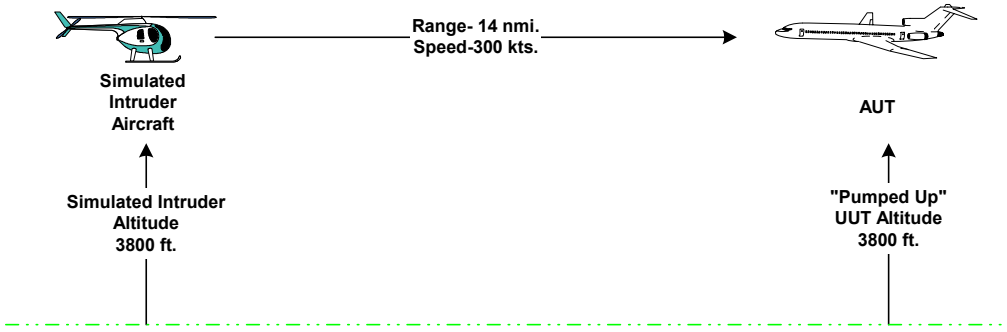
If the AUT altitude is changed while testing is in progress, the operator may have to reinitialize the Test over to reacquire the MODE C altitude or manually insert the altitude.

7. Toggle the **STORE/REPEAT** switch "*Down"* to store the entered values. The Test Set will display the selected intruder Start Page.

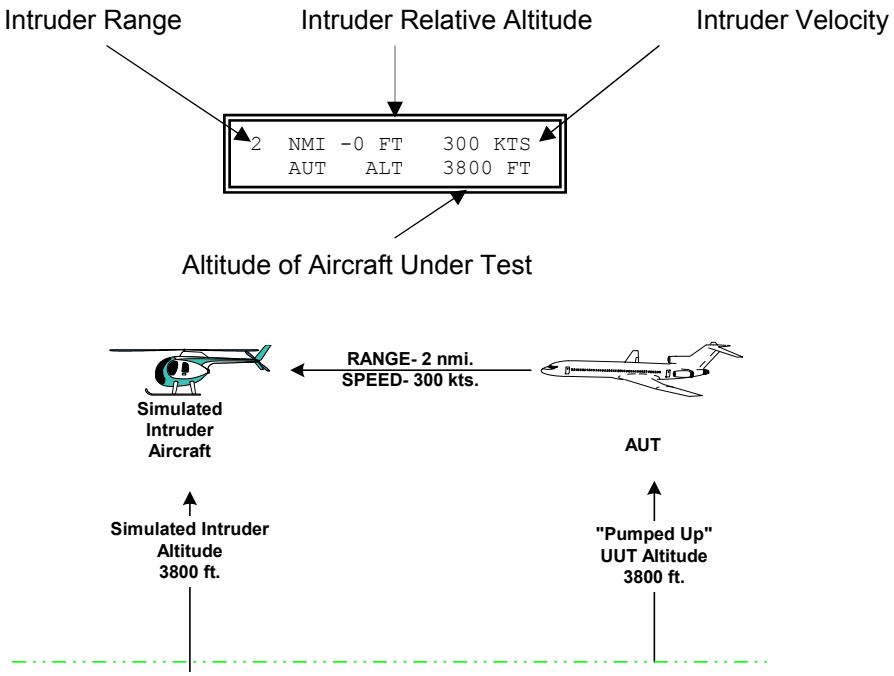
TCAS INTRUDER PRESS INTERROGATE	MODE S INTRUDER PRESS INTERROGATE	MODE 3A/C INTRUDER PRESS INTERROGATE

8. Press the **INTERROGATE** button to initiate the TCAS Simulation.

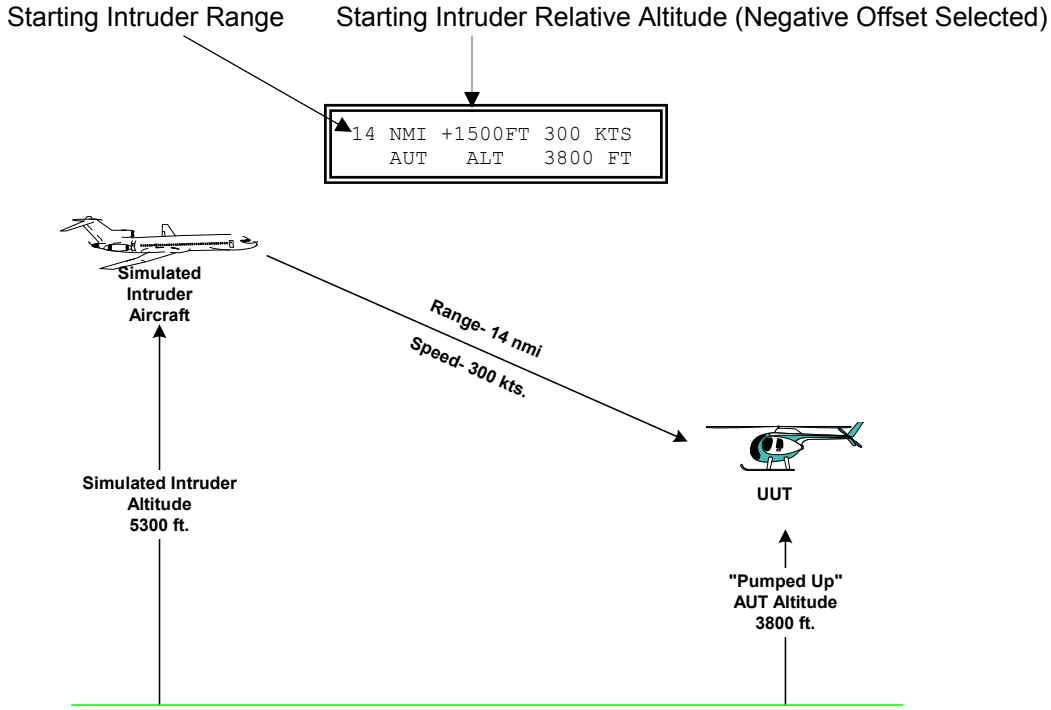




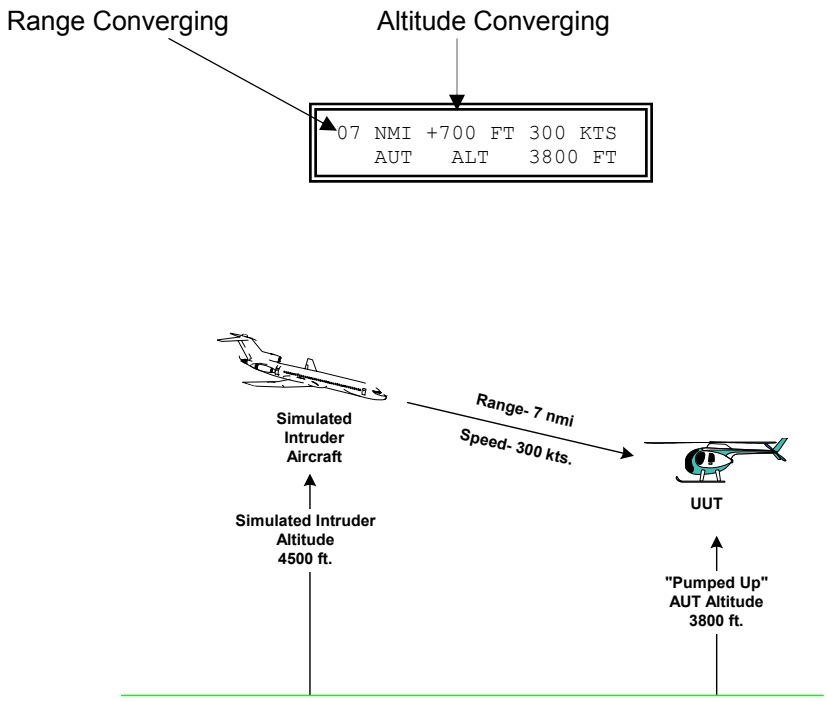
The Scenario will run from 14 nmi. to 0 nmi. and return back to 14 nmi. It will continue this cycle until another scenario is selected, the Test Set is turned "*OFF*" or times out.



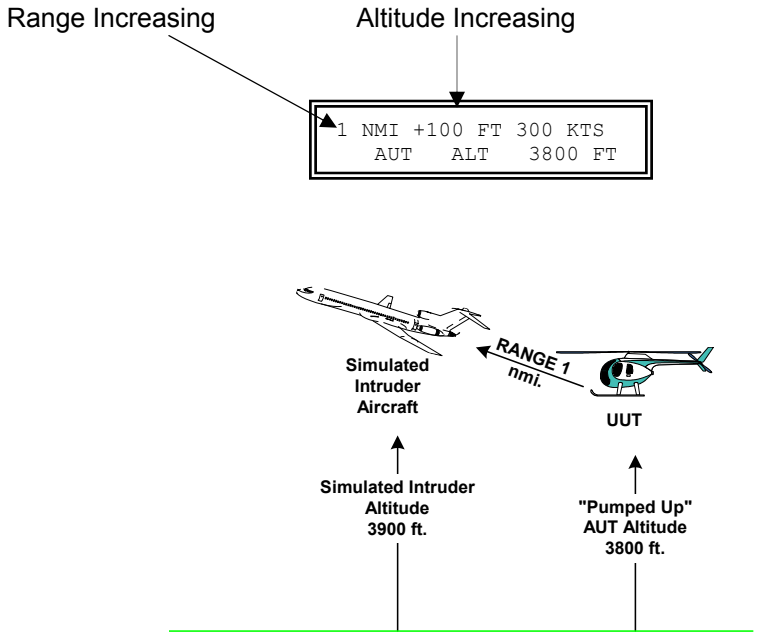
When utilizing the **+3500/-3500** Intruder Selection. The T-49C altitude will also increase or decrease (dependent on offset selected) altitude to intercept the Aircraft Under Test altitude. When the altitude and range converge, the test will reverse back out to the 14 nmi. initial range.



As the Range Decreases, the relative Altitude also decreases until they converge at 0 nmi. and 0 FT.



Once the Intruder Simulation reaches **0**, the simulation will reverse direction and return back to 14 nmi.



9. When you are unable to observe the simulated target on the TCAS display, reposition the TCAS directional Antenna to a different location. Observe that there are no obstructions between the Test Set and the AUT TCAS Antenna. If no display is still present, place the **TCAS/HI-XPDR/TCAS/LO** switch to the **HI** position**.**

By placing the switch in **HI**, the Test Set power was increased by +10 dBm. Ensure to return the switch back to the **LO** position when testing is complete.

10. At any time during the sequence, the operator may *HALT* the simulation at any point. The Test Set can then be moved to another location around the AUT to verify correct bearing and heading. Press the **TEST** button a second time to resume the simulation.

VOLUME 2

Maintenance Manual

CHAPTER III

PRINCIPLES OF OPERATION

3.1 General

The Test Set contains a transmitter and receiver that communicate with the Traffic Alert and Collision Avoidance System (TCAS) or transponder (XPDR) under test. Both transmitter and receiver are capable of operating on either 1030 MHz or 1090 MHz, with both pulse amplitude and Differential Phase Shift Keying (DPSK) modulation.

3.2 Test Modes

3.2.1 ATCRBS (Mode A/C) and Mode S Transponder Testing

When the **TYPE** switch is set to **ATCRBS/MODE S, XPDR TEST** the test set simulates secondary radar, radiates interrogations Mode A/C to the transponder under test, and receives the reply. A series of ATCRBS (Mode A/C) interrogations are transmitted, followed by Mode S interrogations. The test set analyzes the replies of the transponder under test, both Mode A/C and Mode S, to insure that they are the correct reply for the interrogation.

3.2.2 TCAS Testing

For TCAS testing, the Test Set simulates an intruder by replying to UUT TCAS interrogations with the characteristics of a specific transponder type, as selected by the front panel rotary switch. Squitter and other un-requested third party reply transmissions are also provided.

When the **TCAS INTRUDER TYPE** switch is set to TCAS or MODE S, the Test Set will only respond to Mode S interrogations. In addition to replies, the Test Set also provides normal squitter with downlink format 11 (All-Call Reply), as well as simulated replies to interrogators other than the TCAS system with downlink format 4 (Surveillance, Altitude). Replies to Mode S interrogations from the TCAS UUT will be in downlink format 0 (Short Special Surveillance).

The TCAS system determines the existence of a potential Mode S intruder by receiving squitter and other simulated interrogation replies from the Test Set. The Test Set intruder's address may be obtained from the squitters, while the altitude is available from downlink format 4. Thus, without interrogating the potential intruder, the TCAS system may discern the altitude and the address of the Test Set simulated intruder.

If the Test Set intruder altitude, or altitude rate, are determined by the TCAS system to require further information, the TCAS system will interrogate the simulated intruder using the address obtained from the received squitter or simulated third party replies. By measuring the elapsed time from the initiation of the interrogation to the receipt of the reply, the TCAS system will determine its distance from the Test Set intruder. The Test Set computes and reduces the time delay (and altitude offset) in order to simulate a converging track.

When in the TCAS intruder mode, the address used for the Test Set is selected to be one digit lower than the UUT address. Should two TCAS equipped aircraft decide to issue a resolution advisory simultaneously, the TCAS aircraft with the higher address will be given priority. To insure that the aircraft under test issues the correct advisory, the Test Set address will be forced to be the lower address for all cases.

When the **TCAS INTRUDER TYPE** switch is set to **ATCRBS** for TCAS Testing, the Test Set will provide replies to ATCRBS Mode 3A or C interrogations. Simulated reply distances at 14 nautical miles down to 0 nautical miles are provided by varying the reply time delay. The TCAS UUT sees the Test Set reply as an aircraft converging on the TCAS equipped aircraft under test. The altitude of the aircraft under test (AUT) may be obtained by using the Test Set in **ATCRBS/MODE S XPDR TEST** and interrogating the AUT in Mode C or entered manually by pressing the **TEST** and **INTERROGATE** buttons at the TCAS start page. An offset altitude is added or subtracted from the AUT altitude to represent the altitude of the Test Set simulated intruder aircraft. This offset altitude may be fixed or variable depending on the scenario selection using the Test Set front panel switches.

3.3 Theory of Operation

The T-49C Test Set contains a transmitter and receiver which communicates with the TCAS or Transponder under test. The Test Set transmitter and receiver are capable of operating on either 1030.0 MHz or 1090.0 MHz, with both pulse amplitude and DPSK modulation (1030.0 MHz only).

3.3.1 RF Transmitter

The transmitter section generates the desired carrier frequency using a frequency synthesizer. The Oscillator, Q6, is a varactor-tuned oscillator that is followed by two stages of buffer amplifiers, U22 and U23, to ensure minimal frequency modulation due to the phased amplitude modulation applied to the carrier. A divide-by256 prescaler, U33, is fed from the first buffer amplifier and drives the phase detector U36. The phase detector output drives a single loop filter/amplifier, which in turn closes the loop by feeding the varactor diode, Q8 and Q11, of the VCO.

The transmitter oscillator is operated on one of two frequencies. By selecting one of two crystal oscillators at 1090.0/256 = 4.257812 MHz, Y3, or 1030.0/256 = 4.0234225 MHz, Y4. The desired oscillator, Y3 or Y4 is selected by applying power to oscillator.

Modulation is applied to the transmitter carrier by using a combination of two methods. A balanced mixer, U28, provides either amplitude modulation or Phase Shift Keying Modulation. Following the balanced mixer, buffer amplifiers U25 and U26 are modulated by the DAC. These amplifiers provide 20 dB of gain variation. U11 is gated to provide

further amplitude modulation since the balanced mixer would not provide sufficient on/off ratio.

An analog switch, U27, under digital control, provides the modulation to the balanced mixer. This analog switch provides positive and negative current into the balanced mixer to provide both phase in-phase and reverse-phase for DPSK modulation. In addition, this chip provides power switching for the buffer amplifier U11 through Q12 and Q13. R96 is utilized to adjust the Side Lobe Suppression (SLS) P2 power level.

3.3.2 RF Receiver

The receiver is a single-conversion superheterodyne using an IF of 45.00 MHz. The local oscillator frequencies used are 1045 MHz, for receiving 1090 MHz, and 1075 MHz, for receiving 1030 MHz. Since the pulse and DPSK modulations employed in transponder and TCAS technologies are not spectrum sensitive, the resultant inverted spectra are not a factor. The use of both high side and low side injection was done to reduce the frequency spread of the local oscillator and therefore, enhance the lock-up time. In addition, the 45 MHz IF, rather than the conventional 60 MHz, prevents the receiver local oscillator from being present at the transmit frequency and, therefore, avoiding the difficult task of reducing to an acceptable level the amount of local oscillator radiation.

The receiver input feeds a broadly tuned transmission line resonator filter which passes both 1030 and 1090 MHz. The mixer follows, which is fed the local oscillator from the output of the two buffer amplifiers, U19 and U3). The mixer output is followed by amplifier U4 which feeds a two-pole IF filter tuned to 45 MHz.

The IF amplifier is a logarithmic amplifier. It is important that the receiver have characteristics similar to an airborne transponder so that it will react in a similar fashion to the "whisper-shout" interrogations from the TCAS computer. Therefore, the receiver uses a pulse amplitude-following detector to provide pulse amplitude discrimination similar to that found in a typical ATCRBS (Mode A/C) transponder.

3.3.3 Power, Frequency and Sensitivity Measurements

With a TAP-135 or TAP-141 connected, the Test Set measures the frequency and the power output of the MODE S or ATCRBS transponder under test. The frequency measurement is made using a frequency discriminator in the receiver IF at 45 MHz. Whenever pulses are received, the output of the frequency discriminator is gated to an integrator. Immediately preceding the measurement period, a 45 MHz calibration oscillator is energized and the center frequency of the discriminator is adjusted using a varactor diode. The analog output from the discriminator is fed to an A/D converter for conversion and reading by the microprocessor.

To measure transponder power and receiver sensitivity, a TAP-135 or TAP-141 must be connected to the Test Set.

Rectified transmitter pulses are fed to the peak power measuring circuit consisting of U29, U30, Q14 and Q15. This is a peak following circuit where a capacitor, C121, is charged by the comparator, U29, to the peak of the input pulse. The capacitor voltage is

fed to a buffer amplifier and amplified by an op-amp, U30. The output of this amplifier is converted with the A/D converter U32 and is read by the microprocessor.

To measure receiver sensitivity, the signal level from the test set is steadily reduced while the replies from the transponder under test are monitored. The level of output signal is controlled by applying a negative bias to the output amplifiers through a D/A converter, (U3, located on the digital board) under control of the microprocessor. When the reply efficiency has reduced to 90% in the ATCRBS mode and 99% in the Mode S mode, the microprocessor reads the last level applied to the D/A converter and calculates the equivalent receiver sensitivity.

3.3.4 Diversity Measurements

Diversity is measured by comparing the magnitude of two successive squitter transmissions from a Mode S transponder using the peak power measurements described above. The TAP-135 anti-radiation/diversity couplers are placed over both Mode S transponder antennas. The coax cable from one coupler is first connected, and the diversity check run, and then this test is repeated with the other coupler connected. The cable from the unused coupler does not have to be terminated. These tests determine whether the leakage from the active antenna is less than 20dB. The use of the TAP-135 couplers also reduces external radiation by over 20dB.

3.3.5 Microprocessor

The digital board contains the microprocessor and all of the bus-connected peripheral chips. The microprocessor, U4, is a CMOS 80C31AH. The program memory, U13, has 256K bits. The RAM, U11, is battery backed for storing test data while IC's U1-U9 are latches for interfacing with various peripheral circuits including those located on the RF board. U14 is a latched demultiplexer decoder that is used for demultiplexing some of the latches and providing other control signals.

When testing transponders, the transmitter modulation is generated by a first-in first-out (FIFO) chip, U46. The required pulse train for the modulation envelope is loaded into the FIFO at a slow rate and clocked out at a much faster rate for the interrogations. This is necessary, because the microprocessor is not capable of providing the necessary pulse manipulations at the necessary clock speeds. The microprocessor is incapable of storing and analyzing the data as received from the transponder under test. Therefore, the received data are clocked into the same FIFO at real time, to be stored temporarily, and then clocked out by the microprocessor at a slower rate for analysis. Since transmitting and receiving occur at two different times, the same FIFO may serve both purposes. FIFO, U46, is used for receiving and transmitting transponder tests.

In the case of TCAS testing, the possible replies are loaded and stored into a second FIFO, U37. The received interrogations are decoded, using logic elements, and the desired reply is selected and transmitted without microprocessor assistance. The nature of the interrogation is then investigated and should any changes be made to the reply, the FIFO is loaded with the new data, which will constitute the next reply. Because of the need to retain the reply message within a FIFO, while the test set is receiving, two FIFO's are required. U46 is used for receiving while U37 contains the possible transmit messages.

The received interrogation for TCAS testing is decoded using discrete logic due to the time constraints involving the microprocessor. The Mode C and Mode S decode circuitry are clocked using a 20 MHz clock for 50 ns maximum jitter. Decoding either a valid Mode C or Mode S interrogation results in a reply for the interrogation mode. U18 through U27 are the ICs involved in this decoding process.

After either a Mode S or Mode C interrogation has been decoded, a range delay is inserted before a reply is transmitted. This time delay is variable and programmed by the microprocessor.

3.3.6 Battery Charger and Power Supply

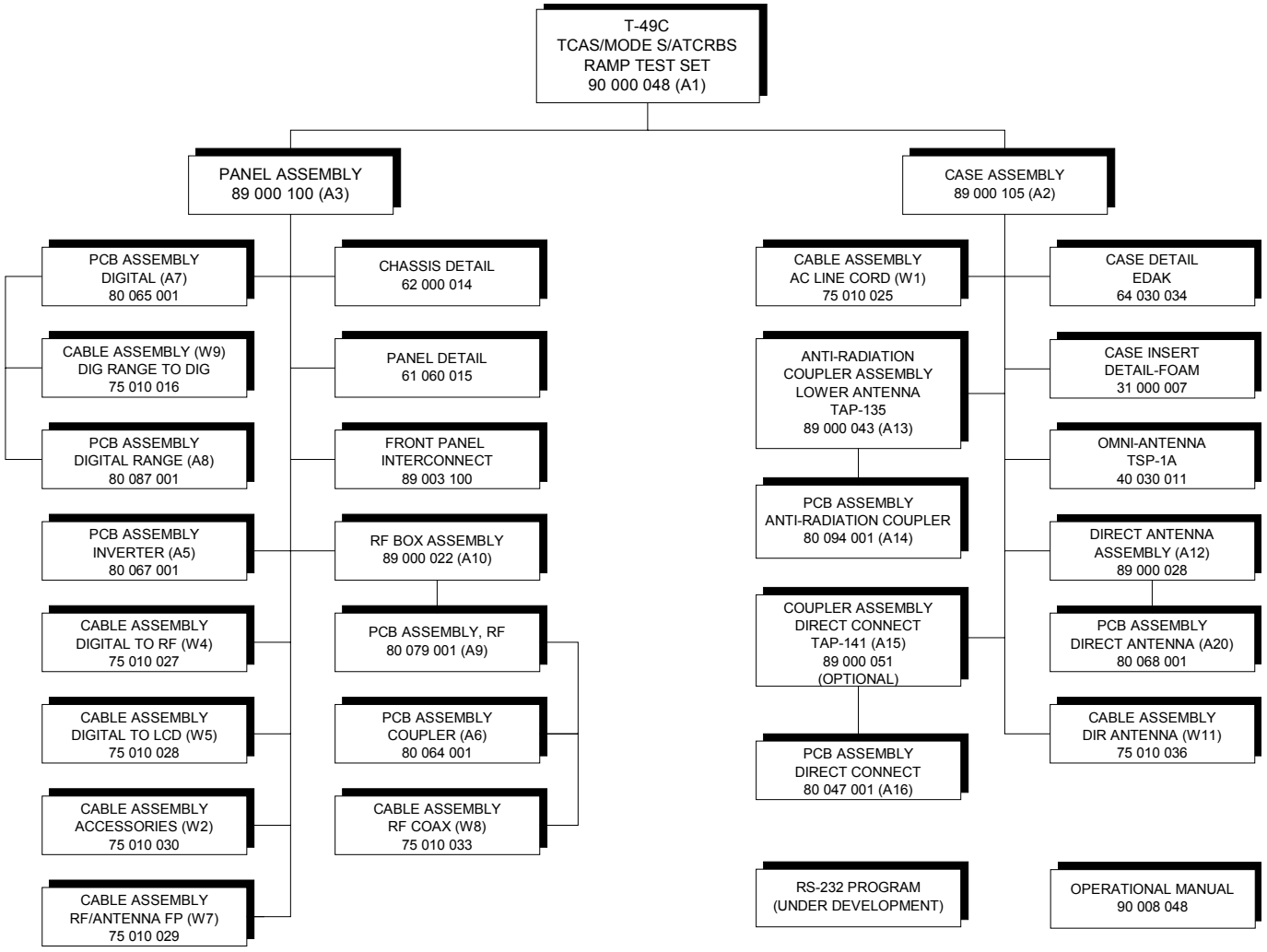
Power for the Test Set is supplied by a set of rechargeable Ni-Cad cells, B1. A battery charging circuit, capable of fully charging a depleted battery in 16 hours, is provided. Charging current level is only about half of that required to operate the Test Set. Operating the Test Set at 50% duty cycle, with the charger on, will result in a no net change in the state of charge of the battery.

The battery charger is a simple full wave bridge rectifier consisting of diodes CR4-CR7 with a series resistor for current limiting. The battery charger also supplies current to the front panel green LED indicator that will indicate that the battery charger is operating. The power supply control circuits are located on the digital board.

The Test Set is provided with two DC fuses, F1 and F2 both of which are located behind the front panel in the return line of the battery. This is done so that if a tool touches the fuse holders during assembly or disassembly or when removing the fuses, it will not result in a short across the battery. The Ni-Cad battery is capable of providing very large peak energy and a direct short across the battery could result in damage to the interconnecting wires.

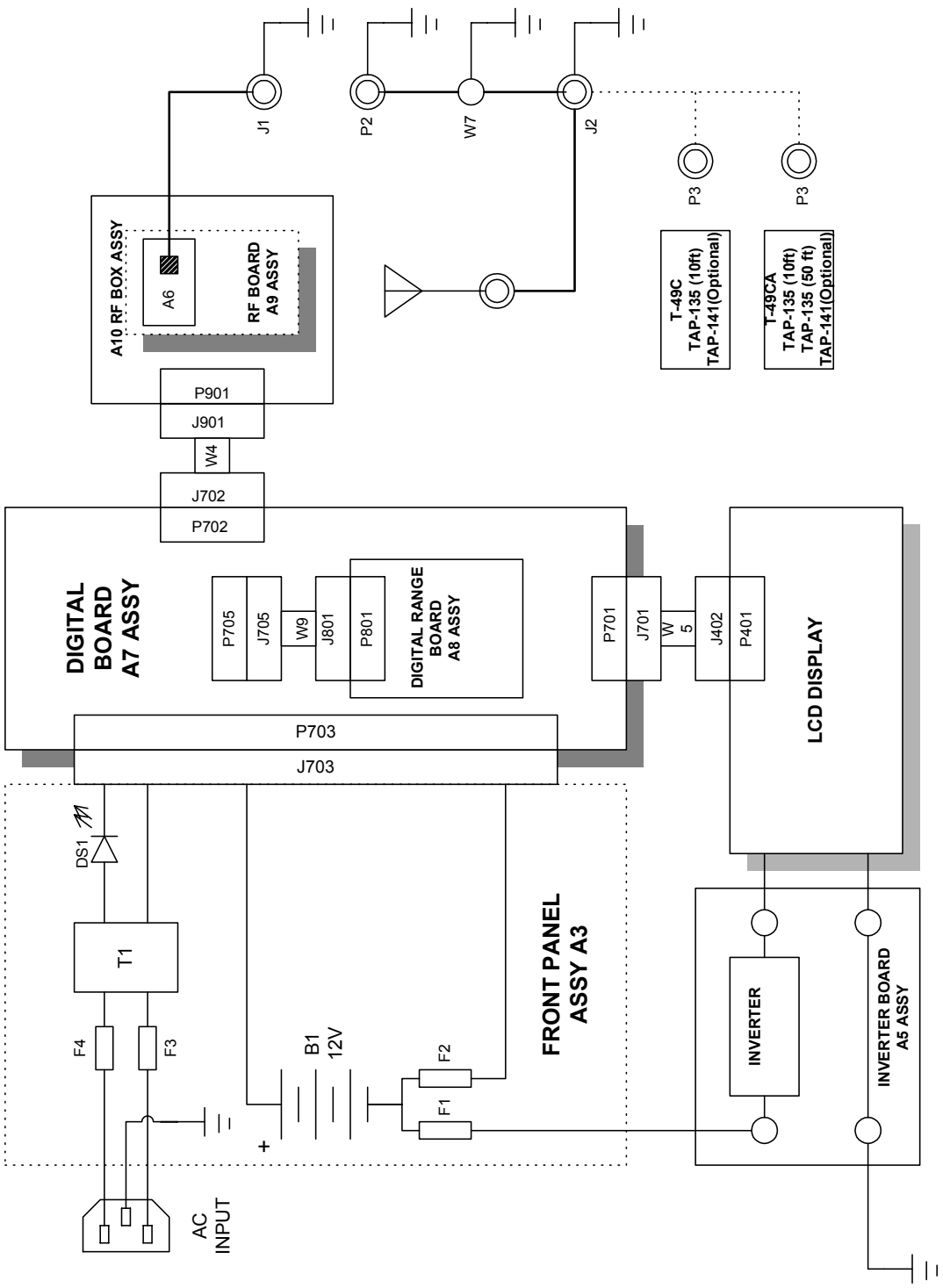
The battery charger has a separate fuse so that if the battery fuse is open, the unit will not operate on the battery charger voltage that is uncontrolled and is capable of causing damage to the unit. The unit is provided with a dual primary transformer T1 for operation at supply voltages of 110 VAC. Two line voltage fuses F3 and F4 are provided for protection. An inverter located on inverter board A5 provides 70 VRMS, 400 Hz power for the LCD backlighting.

All positive operating voltages for the test set are derived from linear integrated circuit regulators U56 and U55. A switching regulator, U51, is provided to supply -10 volts for those circuits requiring a negative supply voltage. A 900 second timer circuit automatically shuts-off the unit if there are no front panel switch actions for a fifteen-minute period. The output is fed to 4096 counter U17 that in turn shuts the unit off if the time has expired. This timer is reset each time the **INTERROGATE** or **TEST** buttons are pressed. The LIGHTS/OFF front panel switch may be used to force the unit to off before the 200-second period has elapsed. The integrated circuit, U21, provides interfacing for the RS-232 connector. This circuit provides -9VDC for this interface.



T-49C Configuration Chart

Figure 3-1



T-49C/CA Simplified Block Diagram

Figure 3-2

CHAPTER IV

GENERAL MAINTENANCE AND SERVICING INSTRUCTIONS

4.1 General

The use of the current generation of electronic components has dramatically decreased the cost of maintaining and calibrating test equipment. Tel-Instrument Corp. has recommended an annual calibration interval and periodic checks to keep the T-49C Test Set in operational condition. Performing preventative maintenance checks of the Test Set and Test Set Verification and Acceptance Checks if a failure is suspected, will reduce down time by detecting and correcting potential problems at their onset. This chapter is broken down in four sections:

1. Routine Maintenance (Section A).
2. Test Set Verification and Acceptance Checks (Section B).
3. Annual Calibration and Alignment (Section C).
4. Battery Replacement (Section D).

Routine Maintenance: By routinely cleaning and inspecting the T-49C Test Set, the operator will be able to reduce down time due to unexpected failures. Routine Maintenance, as outlined in *Section A*, consists of checks and observations performed to maintain the Test Set in a serviceable and ready condition. They should be accomplished each time the Test Set is utilized and after extended storage.

Test Set Verification and Acceptance Checks: If during normal operation, a failure is suspected or unusual or erratic results are displayed, perform the procedures as listed in *Section B*. By conducting and verifying the Test Sets condition when abnormal results occur, the operator will be able to determine if the Test Set is malfunctioning or the UUT is at fault. Periodic checks will also alert the operator to possible problems and ensure the Test Set is in full operational condition before it is used.

Annual Calibration and Alignment: A full Calibration and Alignment of the Test Set shall be performed under the following conditions:

1. Tel-Instrument Corporation recommends an Annual Calibration & Alignment to ensure accurate test results and improved performance.
2. If any failure occurs or is suspected during *Routine* or *Test Set Verification Checks*, a full Calibration and Alignment shall be performed.
3. If any major assembly is replaced.
4. If during normal operation, the Test Set fails to meet any specification outlined in Chapter 1, Section B.

SECTION A

ROUTINE MAINTENANCE

4.2 General

By routinely cleaning and inspecting the T-49C Test Set, the operator will be able to reduce down time due to unexpected failures. Routine Maintenance consists of checks and observations performed to maintain the Test Set in a serviceable and ready condition. They should be accomplished each time the Test Set is utilized and before extended storage.

Routine maintenance consists of the following:

1. Cleaning of the T-49C Test Set exterior case.
2. Inspection of all connectors, cables and the Test Set assembly.
3. Battery check and charging.

4.2.1 Cleaning Procedure

Keep the Test Set clean by removing any loose dirt, mildew or mild corrosion with a soft cloth moistened with warm water and a mild detergent. Do not spray any cleaning detergent or water directly on the Test Set. Ensure to dry off the Test Set with a Lint free cloth to remove all deposits and remaining cleaning solution. Strong cleaners and chemicals should be avoided to prevent damage to the display and switches.

4.2.2 Inspection of all Connectors, Cables and Test Set Assembly

By inspecting the cables, connectors, and the Test Set periodically, potential inaccurate test results can be alleviated.

1. Check each cable for kinks, crushed insulation, frayed cables and rusty connectors.
2. Check each antenna supplied with your Test Set for obvious signs of rust, dents and loose parts.
3. Inspect the Test Set case for signs of abuse. Large dents and cracked displays may render the Test Set inoperable.
4. Toggle and push each switch for proper operation. Sticking switches may result in erroneous test results.
5. Inspect for loose bolts, nuts, and screws; tighten if necessary.
6. Periodically clean all exposed connectors with an approved avionics cleaner.

4.2.3 Battery Check and Charging

Check the Ni-Cad battery before each use to ensure a sufficient charge is available to complete the required tests. By charging the battery a few hours each week, you will keep the Ni-Cad battery in a fully charged state ensuring a significant charge is available for extended testing. A fully depleted battery will require a full 16 hours to completely charge.

An indication of **BATTERY LOW, RECHARGE** signifies a depleted battery.

```
BATTERY LOW
RECHARGE
```

Charge the battery IAW the following procedure:

1. Connect the supplied power cable to the Test Sets **AC** Power receptacle.
2. Plug the cord into a standard 115 VAC socket (220V if properly configured).
3. Toggle the **AC POWER** switch to the “ON” position. A Green LED indicates that charging is commencing.
4. When charging is completed, unplug the AC cord and stow back in the cover.

The Test Set may be utilized with a depleted battery by using 115 or 220 VAC (if configured) power. By maintaining a 50% Duty Cycle, the Test Set battery will continue to charge even during use.

The total time of charging should be at least two (2) times as long as the Test Set was operated since its last full charge. A charge time of up to 16 hours will not damage the Ni-Cad battery.

WARNING
If the battery voltage has been depleted to the point the Test Set will not turn “ON”. DO NOT attempt to Turn the Test Set “ON” until the Unit has been charging for a minimum of 30 minutes.

SECTION B

TEST SET VERIFICATION AND ACCEPTANCE CHECKS

4.3 General

These procedures will be performed on an unopened Test Set by measuring inputs/outputs. If the Test Set results are not within tolerances, the Test Set will require a full alignment.

4.3.1 Test Equipment Required

The following support equipment (or their equivalent) is necessary to perform the Closed Box checks of the T-49C Test Set.

1. Spectrum Analyzer (Hewlett Packard 8558B/182T).
2. 3' x 3'L-Band Antenna and Base Plate.
3. Calibrated Transponder and TCAS R/T.
4. Signal Generator (Hewlett Packard 8648B).
5. Power Meter (Optional).
6. Photo Copy of the ***Calibration Test Report*** (APPENDIX A).

4.3.2 Display Operation

1. Using the **TCAS INTRUDER TYPE** switch; select **ATCRBS/MODE S-XPDR TEST.**

2. Press the **INTERROGATE** switch. Check the T-49C Test Set Display for the following indications.

Start Screen is briefly displayed.

```
TEL INSTRUMENT
T-49C    REV.6.XX
```

Immediately followed by:

```
XPDR TESTING . . . /
NO REPLY
```

3. Toggle the **LIGHTS/OFF** switch to the **LIGHTS** position and hold. Verify that the backlighting is illuminated. Release the switch and the lights will extinguish.

4. Turn the Test Set "OFF" by toggling the **LIGHTS/OFF** switch down.

4. Turn the Test Set “OFF” by toggling the **LIGHTS/OFF** switch down.

4.3.3 Transmitter Frequency Test

There are two (2) tests available for the Transmitter Frequency Test; Direct Method or Reference Method. The only difference being, the method utilized to measure power levels. Only ONE test is required.

4.3.3.1 Direct Method

1. Connect the output of the Test Set **ANTENNA** port directly to a spectrum analyzer.
2. Set the spectrum analyzer to the following settings:

Frequency	1030 MHz
Reference Power Level	-10 dBm
Span	1 MHz
Bandwidth	10 KHz

3. Set the **TCAS/HI – XPDR/TCAS/LO** to **LO.**
4. Select **ATCRBS/MODE S-XPDR TEST** using the **TCAS INTRUDER** switch.
5. Press the **INTERROGATE** button. Verify a carrier signal of 1030.0 MHz / ± 0.1 MHz.
6. Connect the output of the antenna connector directly to a power meter.
7. Verify a power level of -10 dBm / ± 1 dB.
8. Set the **TCAS/HI – XPDR/TCAS/LO** switch to **HI** and verify a level of +10 dBm / ± 1 dB.
9. Return the **TCAS/HI – XPDR/TCAS/LO** switch to **LO**.

4.3.3.2 Reference Method

1. Connect the output of the Test Set **ANTENNA** connector port directly to a spectrum analyzer.
2. Set the spectrum analyzer to the following settings.

Frequency	1030 MHz
Reference Power Level	-10 dBm
Span	1 MHz
Bandwidth	10 KHz

NOTE

It may be necessary to adjust your spectrum analyzer sweep rate for correct display of Test Set signals.

3. Connect the "detected video" output of the spectrum analyzer to the input of an oscilloscope.

4. Press the **INTERROGATE** button. Ensure the spectrum analyzer signal is 1030.0 MHz / ± 0.1 MHz.

5. Change the spectrum analyzer Span to 0 MHz and BW to 3 MHz; observe the alignment and reference peak of the video on the oscilloscope.

6. Mark or document the Peak Level of the first detected pulse on the oscilloscope. Disconnect the T-49C antenna output and connect it to the "RF OUT" of the signal generator. The spectrum analyzer and the signal generator are now connected.

7. Set the signal generator to 1030.0 MHz / -10 dB level. Modulate the signal with a 1µs pulse and vary the signal generator output to match the noted (marked) measurement observed on the oscilloscope in step 6. The difference between the 2 measurements should be ± 1dB.

8. Perform the same procedure with the **TCAS/HI-XPDR/TCAS/LO** switch in **HI.** The measurement and frequency should be 1030.0 MHz /± 0.1 MHz and +10 dBm / ±1 dB.

4.3.4 Receiver Local Oscillator Test

1. Set the spectrum analyzer to the following settings:

Frequency	1045 MHz
Power Level	-10 dBm
Span	1 MHz
Bandwidth	10 KHz

2. Confirm the presence of the receiver local oscillator signal measured at 1045 MHz / ± 0.1 MHz.

3. Disconnect the Test Set from the spectrum analyzer and power down the T-49C Test Set.

4.3.5 Mode S Pulse Modulated Signal Test

1. Set the **TCAS INTRUDER** switch to **MODE S**.

2. Utilizing the **INTERROGATE** and **TEST** buttons, insert a 0 FT altitude.

3. Set the spectrum analyzer to the following:

Frequency	1090 MHz
Power Level	-10 dBm

4. Toggle the **STORE/REPEAT** switch to **STORE**.

5. Press the **INTERROGATE** switch and observe a pulse modulated signal at a frequency of 1090.0 MHz / ± 0.1 MHz.

6. Connect the "detected video" output of the spectrum analyzer to an oscilloscope and observe the proper Mode S reply sequence.

7. Turn the Test Set off and disconnect all associated test equipment.

4.3.6 Omni-Directional Antenna Transponder Test

1. Connect the Omni-Directional antenna directly to the **ANTENNA** connector of the T-49C. Refer to Fig 4-1.

2. Have a calibrated and functional transponder connected to the 3' x 3' Blade antenna and turned "ON".

3. Set the **TCAS INTRUDER TYPE** switch to **ATCRBS/MODE S, XPDR TEST.**

4. Press the **INTERROGATE** switch on the T-49C. The Test Set will identify the type of transponder (Mode A/C or Mode S).

5. Press the **INTERROGATE** switch again to initiate the Auto Sequence of transponder tests.

6. Upon successful completion of all tests, ensure the correct display for the appropriate transponder is shown.

NOTE

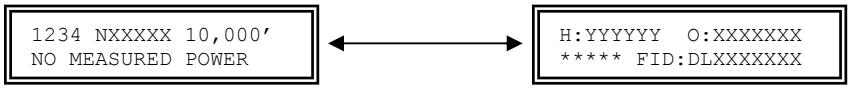
Displays are shown for illustration purposes only. Utilize the literature provided by the transponders manufacturer for correct levels.

4096 Octal	Always displayed
Altitude	Mode C & S Equipped
Tail Number	Mode S Equipped
Aircraft Address in both Hex & Octal	Mode S Equipped

Mode 3A/C Transponder

```
1234          10,000'
NO MEASURED POWER
```

Mode S Transponder



7. Disconnect the Omni-Directional antenna and power down the Test Set and transponder.

4.3.7 TAP-135 Antenna Coupler Test

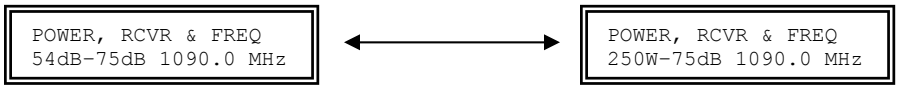
1. Connect the TAP-135 Antenna Coupler to the 3'x 3' blade antenna and the T-49C Test Set as shown in Figure 4-1. Connect the transponder to the blade antenna and apply power.

2. Press the **INTERROGATE** button on the Test Set to turn it "ON".

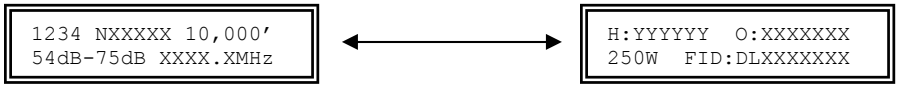
3. Press the **INTERROGATE** button a second time to commence Automatic testing of the transponder by the T-49C.

4. Ensure successful completion of the transponder test sequence, ending in the appropriate display for the type of transponder tested.

Mode 3A/C Transponder



Mode S Transponder



5. Ensure the following parameters were shown on the final display:

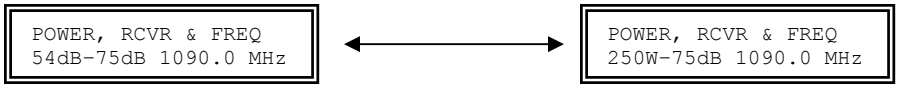
4096 Octal	Always displayed
Altitude	Mode C & S Equipped
Tail Number	Mode S Equipped
Aircraft Address in both Hex & Octal	Mode S Equipped
Frequency	± 300 KHz
Power	± 3 dB
Sensitivity	± 3 dB

6. Turn power “OFF” to the transponder and the Test Set. Disconnect the Antenna Coupler, TAP-135, and stow in the Test Set cover.

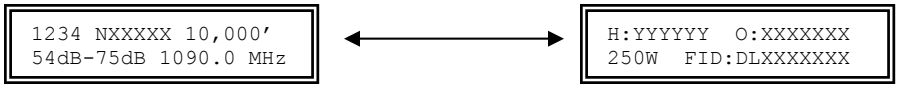
4.3.8 TAP-141 Direct Connect Antenna (*Optional Item*)

1. Connect the TAP-141 Direct Connect Coupler to the Test Set and the Transponder IAW paragraph 2.10.4.
2. Apply power to the transponder.
3. Press the **INTERROGATE** button to initialize the T-49C.
4. Press the **INTERROGATE** button a second time to initiate the auto sequence of tests.
5. Ensure successful completion of the transponder test sequence, ending in the appropriate display for the type of transponder tested.

Mode 3A/C Transponder



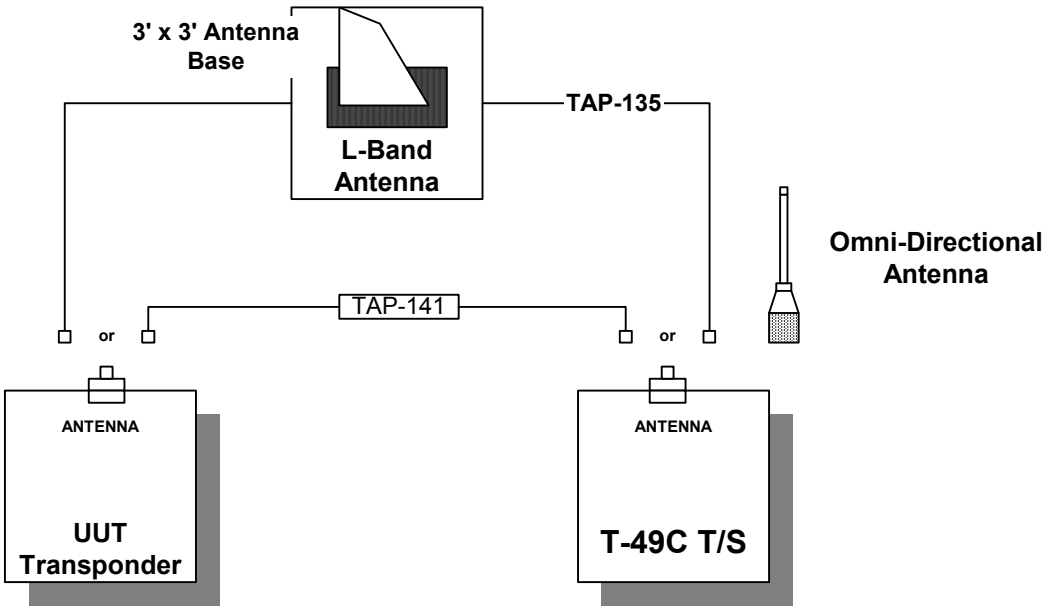
Mode S Transponder



6. Ensure the following parameters were shown on the final display:

4096 Octal	Always Displayed
Altitude	Mode C & S Equipped
Tail Number	Mode S Equipped
Aircraft Address in both Hex & Octal	Mode S Equipped
Frequency	± 300 KHz
Power	± 2 dB
Sensitivity	± 2 dB

7. Turn power “OFF” to the transponder and the Test Set. Disconnect the Direct Connect Antenna Coupler, TAP-141, and stow in the Test Set cover.



T-49C Antenna Tests Setup

Figure 4-1

4.3.9 TCAS Testing

1. Utilize a TCAS Test fixture to verify correct TCAS operation.
2. Set the **TCAS INTRUDER** select to **ATCRBS**.
3. Using the **SCENARIO** switch, select the **0** ft scenario.
4. Connect the Directional Antenna to the T-49C IAW Para. 2.10.2.
5. Press the **INTERROGATE** button and enter the desired altitude by depressing the **INTERROGATE** and **TEST** buttons.
6. Toggle the **STORE/REPEAT** switch down.
7. Press the **INTERROGATE** button to commence the scenario.
8. Verify that a target can be seen on the TCAS mock-up display corresponding to the altitude selected and the heading relevant to the Test Set. Ensure the intruder converges at 0 nmi. and then returns back to a 14 nmi. Range.
9. Repeat the test for each scenario: **+200/-200**, **+4000/-4000**, and **+3500/-3500.**
10. Repeat the test again by selecting **MODE S**, using the **TCAS INTRUDER** switch.

SECTION C

ANNUAL CALIBRATION AND ALIGNMENT TESTS

4.4 General

These procedures will be performed on an opened box to allow access to the RF and digital printed circuit boards. Access will be gained to test points and alignment controls to align the Test Set back to manufacturer's specifications. If these adjustments fail to return the Test Set to the specified parameters, the unit will require additional maintenance and/or troubleshooting.

4.5 Test Equipment Required

The following support equipment (or their equivalent) is necessary to perform the Open Box checks of the T-49C Test Set.

1. Digital Voltmeter (Fluke 8000A).
2. Spectrum Analyzer (HP 8558B/182T).
3. RF Signal Generator capable of providing a pulsed RF carrier at a frequency of 1030 MHz and 1090 MHz (Wavetek Model 2520).
4. Pulse Generator (Tektronix Type 114).
5. Oscilloscope with a 50 MHz bandwidth minimum and 10X probe (Tektronix 2235).
6. Frequency Counter with a high impedance input that may be used with a 10X probe (HP 5327A).
7. L Band pulse generator (Hewlett Packard 8648B).
8. Standard hand tools (Phillips Head, Straight Slot etc…).
9. RF Network Analyzer (Hewlett Packard 8712ES).
10. 3' x 3' L-Band Antenna and Base Plate.
11. Photocopy of "**Appendix B**" for documentation of test results.

4.6 Disassembly

Disassembly of the T-49C Test Set can easily be accomplished by following the prescribed steps.

1. Disconnect the Test Set from any external power source.
2. Ensure the Test Set is "OFF" by toggling the **LIGHTS/OFF** switch to **OFF**.

3. Using a #2 straight slot screwdriver; loosen the 8 captive screws located on the front panel of the Test Set enough to release their grasp of the threads. Do not remove the screws entirely.

4. Grasp both handles on the front face and pull the assembly straight out of the Test Set enclosure. Place the assembly in a safe place.

WARNING
Any time you are working with exposed wiring, the potential for electrical shock increases. Ensure all standard electrical safety procedures are strictly enforced to prevent injury.

4.7 Digital Board Adjustment Procedures

4.7.1 Frequency and Voltage Settings

1. Remove the Test Set from the chassis IAW Para. 4.6.

2. Gain access to the Digital Board Assembly by removing the 5 screws that secure the RF assembly to the chassis. Be sure to leave the RF coax and RF to Digital Board electrical ribbon connected.

3. Using the **TCAS INTRUDER** switch, select **ATCRBS/MODE S-XPDR**. Turn the Test Set on by pressing the **INTERROGATE** button and verify the correct Software version for your T-49C.

```
TEL-INSTRUMENT
T-49C    REV. 6.XX
```

4. Turn the Test Set "OFF" by toggling the **LIGHTS/OFF** switch to **OFF.**

5. Place the Test Set in "Calibration Mode" by toggling the **STORE/REPEAT** switch to the **REPEAT** position. Verify the following display:

```
CALIBRATION MODE
00 dBm   XXXX.X MHz
```

6. With a DVM and utilizing **TP10** as ground, check for the following voltages (Utilize Fig 4-8 for Test Point Locations):

COMPONENT	LEAD/PIN #	RESULT
TP8		+10 V/ ± 0.2 V
TP7		-10 V/ ± 0.5 V
U55	Pin 3	+5 V/ ± 0.2 V

7. Gain access to **TP2 & TP3** by removing the 2 screws attaching the Digital Range Board to the Digital Board. Leave the wiring connected.

8. With an oscilloscope, verify the following 5 Vpp ± 1 V signals:

COMPONENT	RESULT
TP3	5 Vpp / 0.20 µs ± 0.05 µs
TP2	5 Vpp / 0.25 µs ± 0.05 µs

9. Using an oscilloscope, verify a negative sloping pulse of -3V to -6.0V/ ± 0.5V at **P2, pin 3** or **R-28**.

10. Turn the T-49C "OFF".

4.7.2 ATCRBS/C Interrogation Test

1. Utilizing the L-Band pulse generator, simulate an ATCRBS Mode C interrogation at 1030 MHZ with an RF output of -10 dBm. Figure 4-2 illustrates the necessary signals.

2. Connect the L-Band pulse generator to the **ANTENNA** connector on the T-49C Test Set.

3. Select **ATCRBS** using the **TCAS INTRUDER** switch

4. Select the **+3500/-3500** simulation using the **SCENARIO** switch.

5. Insert 3500' as the offset by Depressing the **TEST** and **INTERROGATE** buttons.

6. Trigger an oscilloscope using **U18, Pin 3**. Monitor **Pin 8** of **P2** with a second oscilloscope probe**.**

7. Turn the Test Set "ON" by depressing the **INTERROGATE** button. Verify the following display:

```
ALT XXXX'   CONT:STR
SLEW UP:TEST DN:INTR
```

8. Press the **STORE/REPEAT** button and verify the following display:

```
MODE 3A/C INTRUDER
PRESS INTERROGATE
```

9. Begin the intruder simulation by depressing the **INTERROGATE** button.

10. At **P2, Pin 8**, verify an ATCRBS, Mode C reply *approximately* 190 µs from the trigger of the ATCRBS Mode C interrogation. This reply is 21 µs long and has a changing pattern which simulates the changing altitude of the intruder aircraft. The reply will move from 190 µs to 28 µs. When the reply reaches 28 µs, the scenario will reverse back out to 190 µs. The pulse will be easier to measure by pressing the **TEST** button. This will stop the intruder range convergence. Pressing the **TEST** button a second time will resume the scenario.

11. After verifying the intruder scenario, vary the L band generator pulse to the following settings IAW Figure 4-2:

Mode S
ATCRBS Mode C with full P2 pulse (SLS)

12. These variations should cause the Test Set to cease replying to the invalid interrogations. No reply signal will be present at **Pin 8** of **P2**.

4.7.3 Mode S Interrogation Test

1. With the L Band pulse generator still connected to the **ANTENNA** connector of the T-49C Test Set, apply a signal simulating a Mode S interrogation at 1030 MHz / -10 dBm IAW figure 4-2.

2. Select **MODE S** or **TCAS** utilizing the **TCAS INTRUDER** select switch. Using the **SCENARIO** switch; select the **+3500/-3500** intruder simulation.

3. Insert a 3500' Offset by depressing the **TEST** and **INTERROGATE** buttons.

4. Press the **INTERROGATE** button and then the **STORE/REPEAT** switch down. Verify the following display:

```
MODE S XPDR COM/AB
INTERROGATE TO TEST
```

5. Press the **INTERROGATE** button to commence the Mode S intruder simulation.

6. Trigger an oscilloscope off of **Pin 3** of **U18.** Connect the other oscilloscope probe to **Pin 8** of **P2.**

7. At **P2, Pin 8**, verify a Mode S reply approximately 300 µs from the trigger of the Mode S interrogation. This reply is 64 µs long and has a changing pattern which simulates the changing altitude of the intruder aircraft. The reply will move from 300 µs to 130 µs. When the reply reaches 130 µs, the scenario will reverse back out to 190 µs.

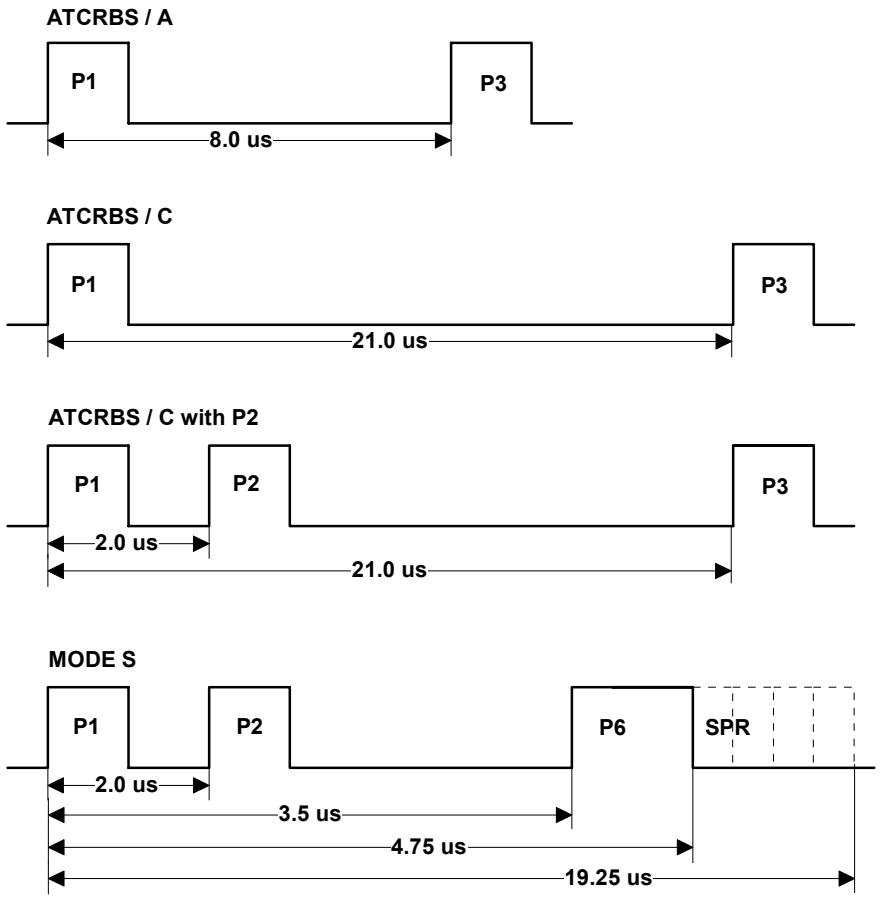
8. After verifying the intruder scenario, vary the L band generator pulse to the following settings IAW Figure 4-2:

ATCRBS Mode A
ATCRBS Mode C

9. These variations should cause the Test Set to cease replying to the invalid interrogations being monitored at **P2, Pin 8**.

10. Secure power to the T-49C Test Set and disconnect all associated test equipment.

11. Re-attach the “Range Board” to the “Digital Board” by reinstalling the 2 Phillips head screws.



Note:

1. The width of P1, P2, and P3 is 0.8 µs
2. P6 can be any combination of logic ones or zeros

Interrogation Waveforms

Figure 4-2

4.8 RF-PCB Procedure

WARNING
Any time you are working with exposed wiring, the potential for electrical shock increases. Ensure all standard electrical safety procedures are strictly enforced to prevent injury.

4.8.1 Voltage Settings

1. Gain access to the RF Board assembly by removing the 6 small screws with a #1 Phillips screwdriver and remove the cover.
2. On the T-49C select **ATCRBS/MODES, XPDR TEST** using the **TCAS INTRUDER SWITCH.**
3. Turn the Test Set on by pressing the **INTERROGATE** button.
4. Check the output of the following utilizing a DVM (see Fig 4-8 for locations):

COMPONENT	LEAD/PIN #	RESULT
U18	Pin 3	+5 V / ± .5V
U34	Pin 3	+6 V / ± .5V
C76	Negative Lead	-4 V / ± .5V

5. Connect the DVM to **Pin 5** of **U21**. Adjust **R52** for 10V / ± 0.1 VDC.
6. Disconnect the DVM and secure Test Set power by toggling the **LIGHTS/OFF** switch to **OFF**.

4.8.2 Frequency Settings

1. Place the **TCAS INTRUDER** select switch in **ATCRBS**.
2. Set the **TCAS/HI – XPDR/TCAS/LO** switch to **LO**.
3. Press the **INTERROGATE** button.
4. Toggle the **STORE/REPEAT** switch down and verify the following display:

```
MODE 3A/C INTRUDER
PRESS INTERROGATE
```

5. With a 10X probe, connect the frequency counter to **TP1**.

6. Adjust **C99** for a frequency of 4.023423 MHz / ± 45 Hz.

7. With a spectrum analyzer connected directly to the T-49C Test Set **ANTENNA** connection, Observe and measure a carrier signal of 1030.0 MHz / ± 0.1 MHz.

8. Connect the frequency counter with a 10X probe to **U17 Pin 1**.

9. Adjust **C70** for a frequency of 8.164063 MHz / ± 45 Hz.

10. On the spectrum analyzer, verify a pulse-modulated signal of 1045.0 MHz / ± 0.1 MHz.

11. Press the **INTERROGATE** button and ensure the following display:

```
14NMI +XXXXFT 300KTS
  AUT  ALT    XXXXFT
```

12. With a 10X probe, connect the frequency counter at **TP1**.

13. Adjust **C106** for 4.257813 MHZ / ± 45 Hz.

14. On the spectrum analyzer, verify a pulse-modulated signal of 1090.0 MHz / ± 0.1 MHz.

15. Connect the frequency counter probe to **Pin 1 of U17**.

16. Adjust **C65** for 8.398438 MHZ / ± 45 Hz.

17. Measure and verify the pulse-modulated signal of 1075 MHz / ± 0.1 MHz.

18. Secure power to the Test Set by toggling the **LIGHTS/OFF** switch to **OFF** and remove all associated test equipment.

4.8.3 Dynamic Range and RF Output Power Level Setting

1. Turn the T-49C Test Set "ON" and place in the "Calibration Mode" by toggling the **STORE/REPEAT** switch to the **REPEAT** position.

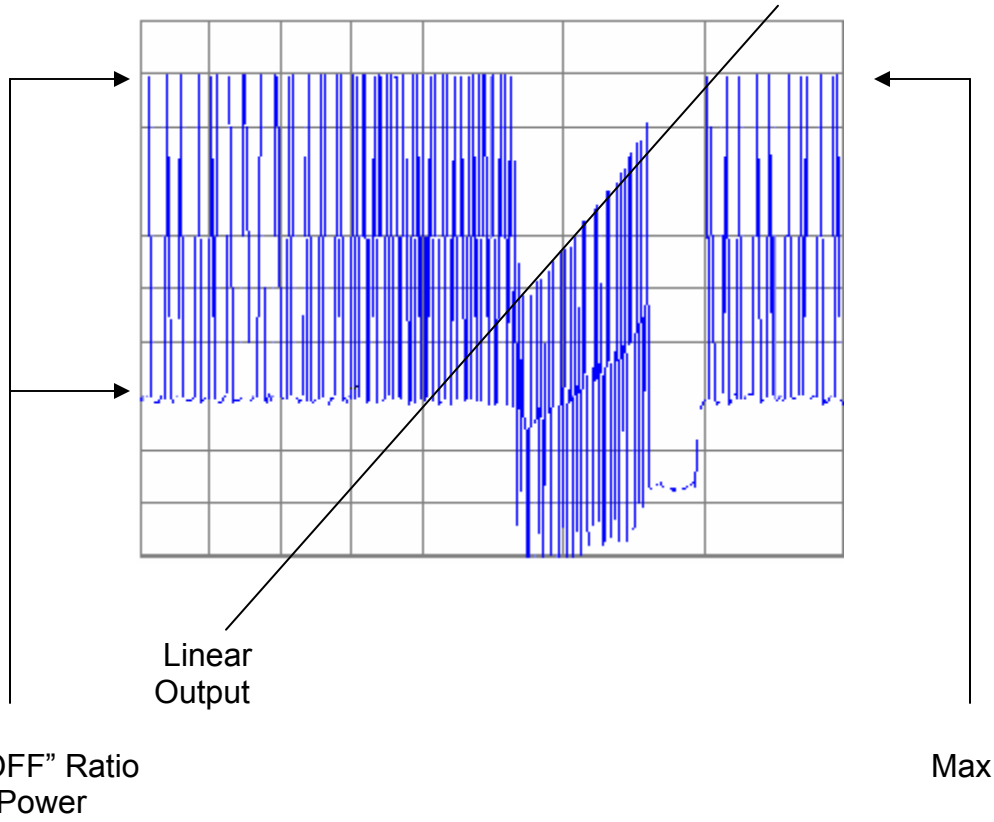
```
CALIBRATION MODE
00 dBm    XXXX.X MHz
```

2. Connect a spectrum analyzer directly to the **ANTENNA** port on the Test Set. Set the spectrum analyzer to the following:

Frequency	1030.0 MHz
Power Level	-10 dBm
Span	Zero
Bandwidth	5 MHz

3. Toggle the **TCAS/HI – XPDR/TCAS/LO** switch to the **HI** position. The T-49C Test Set will transmit on a frequency of 1030 MHz.

4. Observe an “Output Response” signal as shown in Figure 4-3.



Linear Output Response

Figure 4-3

5. Verify the “ON/OFF” ratio is greater than 30 dB. Adjust **R101**, if required.

6. Measure and verify a maximum peak power output of +10 ± 1dBm.

7. Toggle the **TCAS/HI – XPDR/TCAS/LO** switch to **LO**.

8. Measure and confirm the max peak power output at -10 ± 1 dBm. Adjust **C12**, if required. Adjust **R28** and **R30** (on "Digital PCB Board") in order to achieve a linear output response during the saw-tooth signal beginning at -22 ± 1dB and ending at -5 ± 1dB relative to the maximum output level. Make sure the maximum output level remains at -10 ± 1dBm. Adjust **C12**, if necessary.

9. Turn power "OFF" to the T-49C Test Set and turn back "ON" in the **ATCRBS/MODE S, XPDR TEST** mode.

10. Connect the vertical output of the spectrum analyzer to the oscilloscope and measure **P2** to read -9 ± 1dB relative to **P1**. Adjust **R96**, if required. If the ratio cannot be set, continue with steps 10a and 10b.

    10a. Adjust **R96** fully counterclockwise. Adjust **R101** for minimum amplitude of the **P2** pulse.

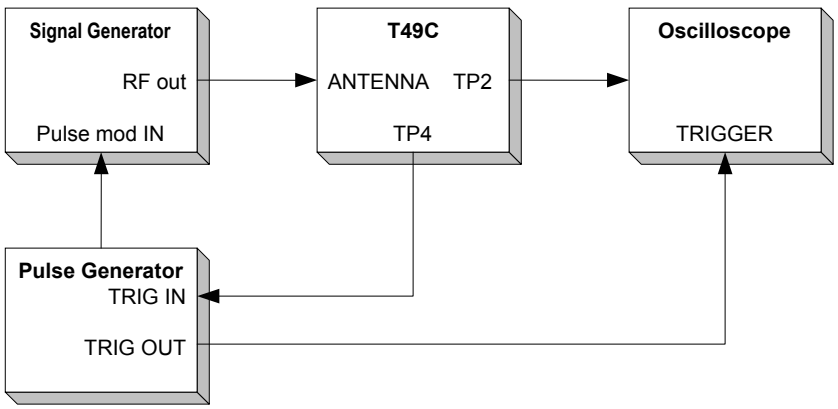
    10b. Adjust **R96** for a power level of -9 dB from the peak power of the **P1** pulse.

4.8.4 1030 MHz Receiver Sensitivity Test

1. Connect the T-49C IAW Figure 4-4 and set the signal generator frequency to 1030.0 MHz at 0 dB. Modulate the signal with a 1.0 µs pulse at a 1 KHz rate. Feed the pulse modulated signal into the **ANTENNA** connector on the T-49C.

2. Place the **TCAS INTRUDER** switch to the **ATCRBS** position and turn the Test Set "ON" by pressing the **INTERROGATE** button.

3. Toggle the **STORE/REPEAT** switch down and press the **INTERROGATE** button a second time.



Receiver Sensitivity Setup

Figure 4-4

4. Monitor the demodulated pulse at **TP2** (Digital Board) while triggering the oscilloscope from the pulse generator.

5. Reduce the signal level until the demodulated pulses begin to break up. This should occur at a level of -25 to -30 dBm. If the receiver lacks sensitivity, the input band-pass filter requires alignment. *It is not recommended that this be adjusted in the field. Contact Tel-Instruments for further assistance.*

4.8.5 1090 MHz Receiver Sensitivity Test

1. Reset the T-49C by toggling the **LIGHTS/OFF** switch down and then pressing the **INTERROGATE** button.

2. Set the signal generator frequency to 1090.0 MHz.

3. Monitor the demodulated pulses at **TP2** (Digital Board), while triggering the oscilloscope from the pulse generator.

4. Reduce the signal level until the demodulated pulses begin to break up. This should occur at a level of -25 dBm to -30 dBm. This difference in receiver sensitivity between the 1090 and 1030 MHZ inputs should not exceed about 5 dB. A disparity greater than this indicates a mis-tuning of the receiver input filter. *It is not recommended that this item be adjusted in the field. Contact Tel-Instruments for further assistance.*

4.8.6 RF Power and Frequency Measurement/Calibration Setting

1. Synchronize the pulse generator to the Test Set transmitted signal **TP4** (RF Board). Modulate the signal generator with two (2) pulses that are 0.45 ± 0.1 µs wide and spaced 20.3 ± 0.1 µs apart. Ensure the modulation signal is **delayed** from the sync signal by at least 25 µs.

2. Turn the T-49C Test Set "ON" in the **ATCRBS/MODE S – XPDR TEST** mode. Make sure that a "100 Reply" message is shown on the display.

3. Turn the Test Set "OFF".

4. Toggle the **STORE/REPEAT** switch "UP". The Test Set will be placed in "Calibration Mode".

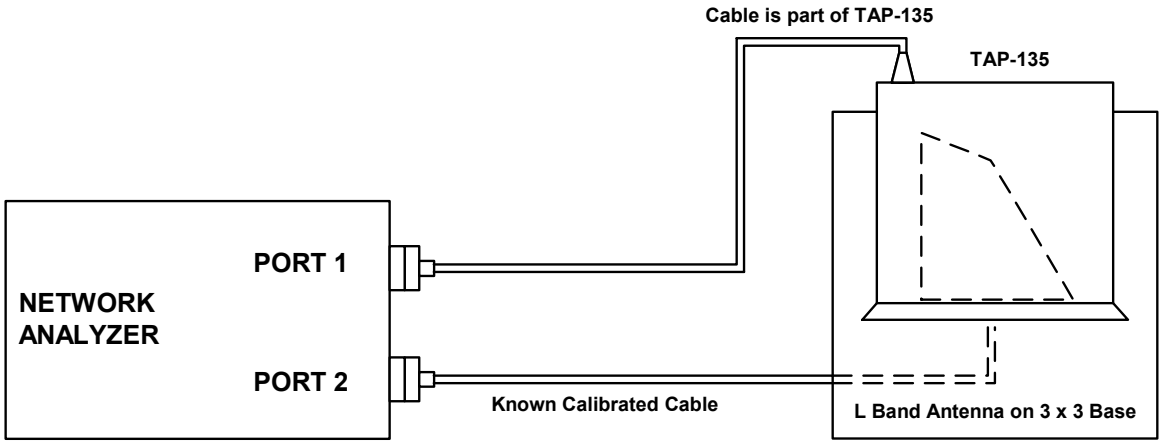
5. Adjust and measure the power output IAW the following chart. Adjust **R137**, if necessary.

POWER INPUT	POWER MEASUREMENT
-10 dBm	40 dBm ± 1 dBm
-5 dBm	45 dBm ± 1 dBm
0 dBm	50 dBm ± 1 dBm
+5 dBm	55 dBm ± 1 dBm
+10 dBm	60 dBm ± 1 dBm

6. Set the signal generator level to +5 dBm. Verify a frequency of 1090.0 MHz / ± 0.1 MHz. Adjust **R23** if necessary. Verify the frequency reading tracks to the input signal frequency in the ± 3.0 MHz range and the accuracy is ± 0.3 MHz.

4.9 TAP-135 Calibration

1. Connect the TAP-135 to a Network Analyzer and L-BAND Antenna IAW Figure 4-5.



TAP-135 Calibration Setup

Figure 4-5

2. Ensure that the TAP-135 is centered directly over the L-Band Antenna.

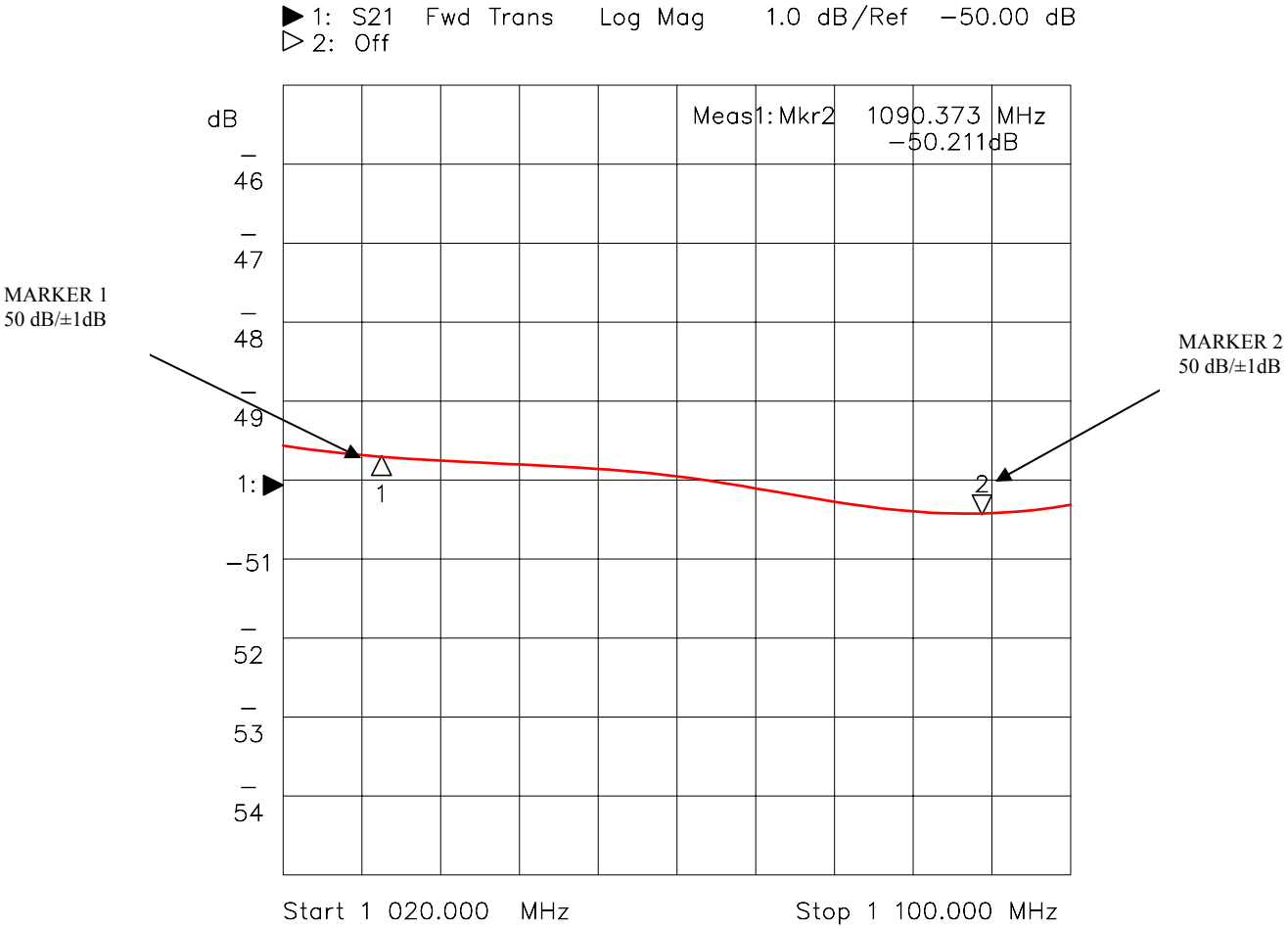
3. Set the Network Analyzer to the following:

Start Frequency	1020.0 MHz
Stop Frequency	1100.0 MHz
Scale Ref. Level	-50 dB (Take into account calibrated cable)
Ref. Position	5
Scale/Div	1.0 dB
Power Level	10 dBm
Averaging	"ON"
Marker 1	1030.0 MHz
Marker 2	1090.0 MHz

4. Observe a display similar to Figure 4-6. Patterns may vary.

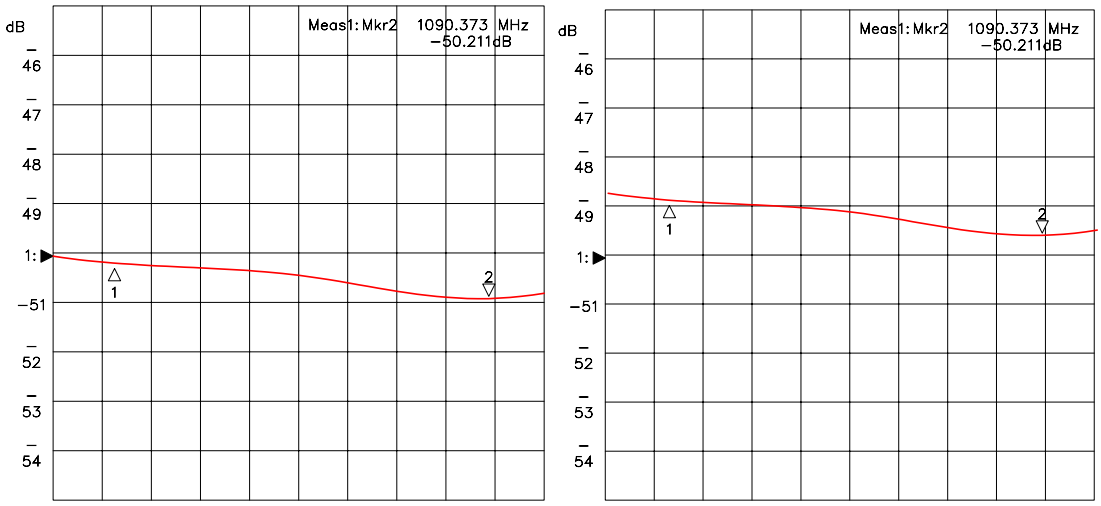
5. Adjust **C4** (located on top of the TAP-135) so that the displayed measurement can be adjusted in a approx ± 3 dB. There is two positions in which **C4** might provide results. Select the location which provides the minimal slope and allows smooth adjustability around its range.

6. Fine tune **C4** so that at *MARKER 1,* the display is at -50 dB/± 1 dB, at the same time, *MARKER 2* is also at -50 dB/± 1 dB (see Figure 4-7). Ensure that the cable loss from Port 2 to the L Band antenna was accounted for. Variations in the displayed measurement are not linear. Do not adjust the measurement in the center, only at the markers.

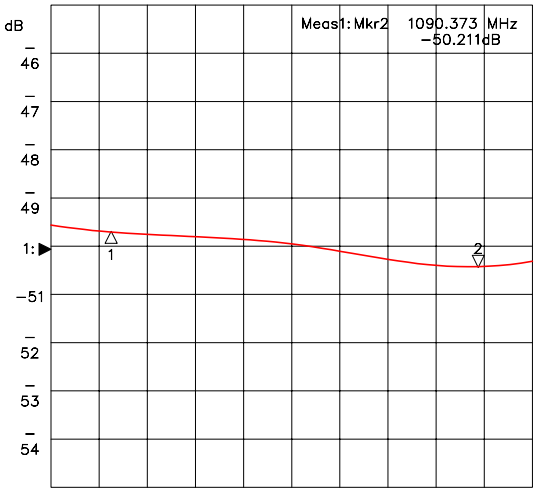


TAP-135 Network Analyzer Display

Figure 4-6



INCORRECTLY ADJUSTED



CORRECT

TAP-135 Adjustment Examples

Figure 4-7

SECTION D

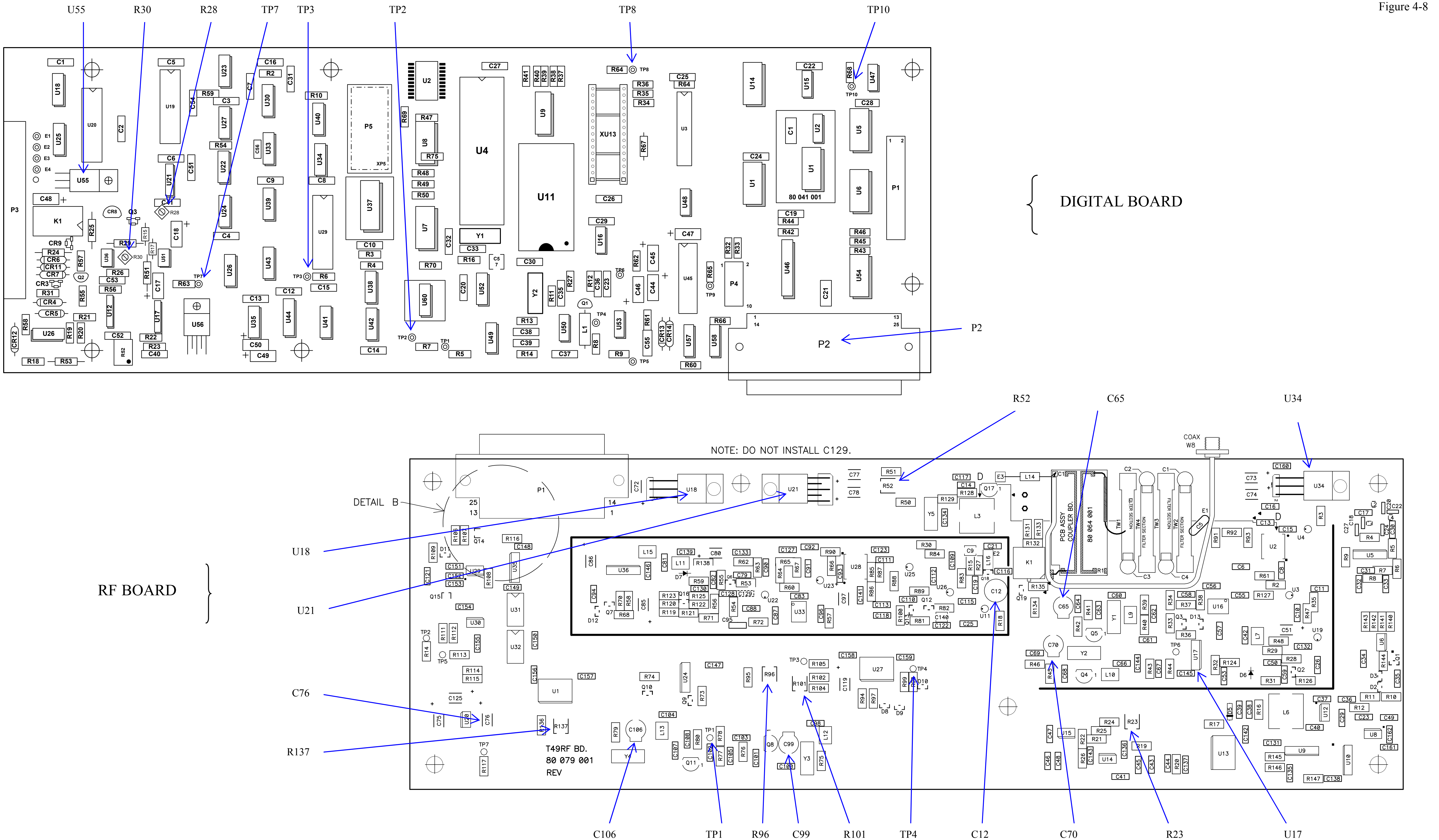
BATTERY REPLACEMENT

4.10 Battery Replacement

In the event the T-49C Test Set batteries require replacement due to age or failure, proceed with the following steps when a replacement battery is available:

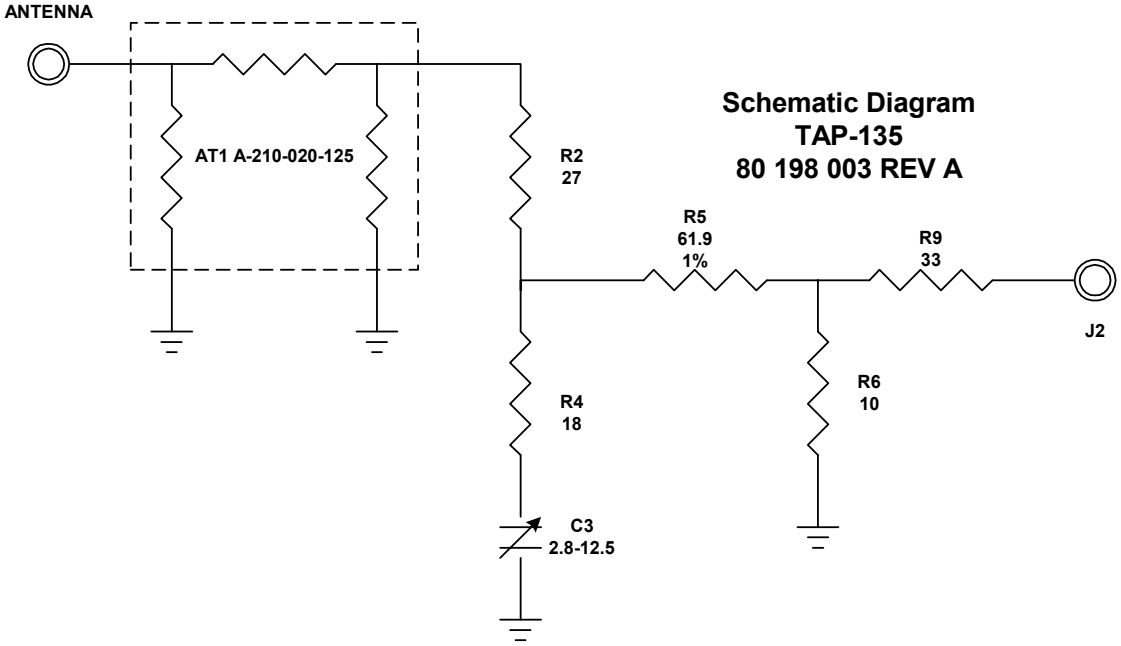
1. Loosen the 8 captive screws on the front panel of the Test Set and carefully remove the unit from the case.
2. Loosen, but do not remove, the 2 nuts on the battery assembly retaining bracket.
3. Turn the unit over so that the front panel is accessible.
4. Back out the center panel retaining screw so that the tip is flush with the rear surface of the panel.
5. Hold the battery assembly and remove the 2 Phillips head screws in the panel that secures the battery assembly.
6. Turn the unit over again and gently slide the battery assembly off the retaining bracket.
7. Remove the top bracket from the battery by pulling straight up with the mounting spacers attached.
8. Remove the battery pack from the lower tray.
9. Remove the tape protecting the solder contacts.
10. Unsolder the **3 RED** leads and the **1 BLACK** lead from the battery assembly.
11. Solder the new leads of the new battery pack. Ensure you follow correct polarity.
12. Replace the protective tape over the terminals.
13. Reassemble the Test Set in the reverse order for disassembly.
14. Plug the unit in and check the display for proper operation.
15. Charge the battery as prescribed in 4.2.3.

Figure 4-8

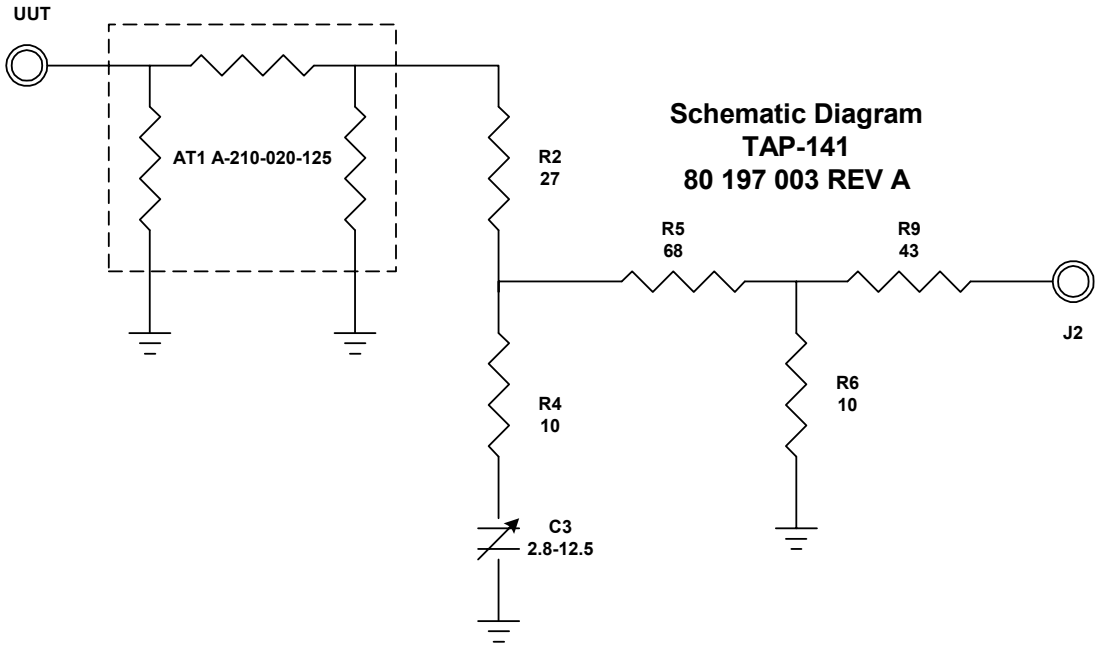

U55
R30
R28
TP7
TP3
TP2
TP8
TP10
DIGITAL BOARD
P2
R52
C65
U34
NOTE: DO NOT INSTALL C129.
DETAIL B
U18
U21
RF BOARD
C76
R137
T49RF BD.
80 079 001
REV
C106
TP1
R96
C99
R101
TP4
C12
C70
R23
U17

CHAPTER V

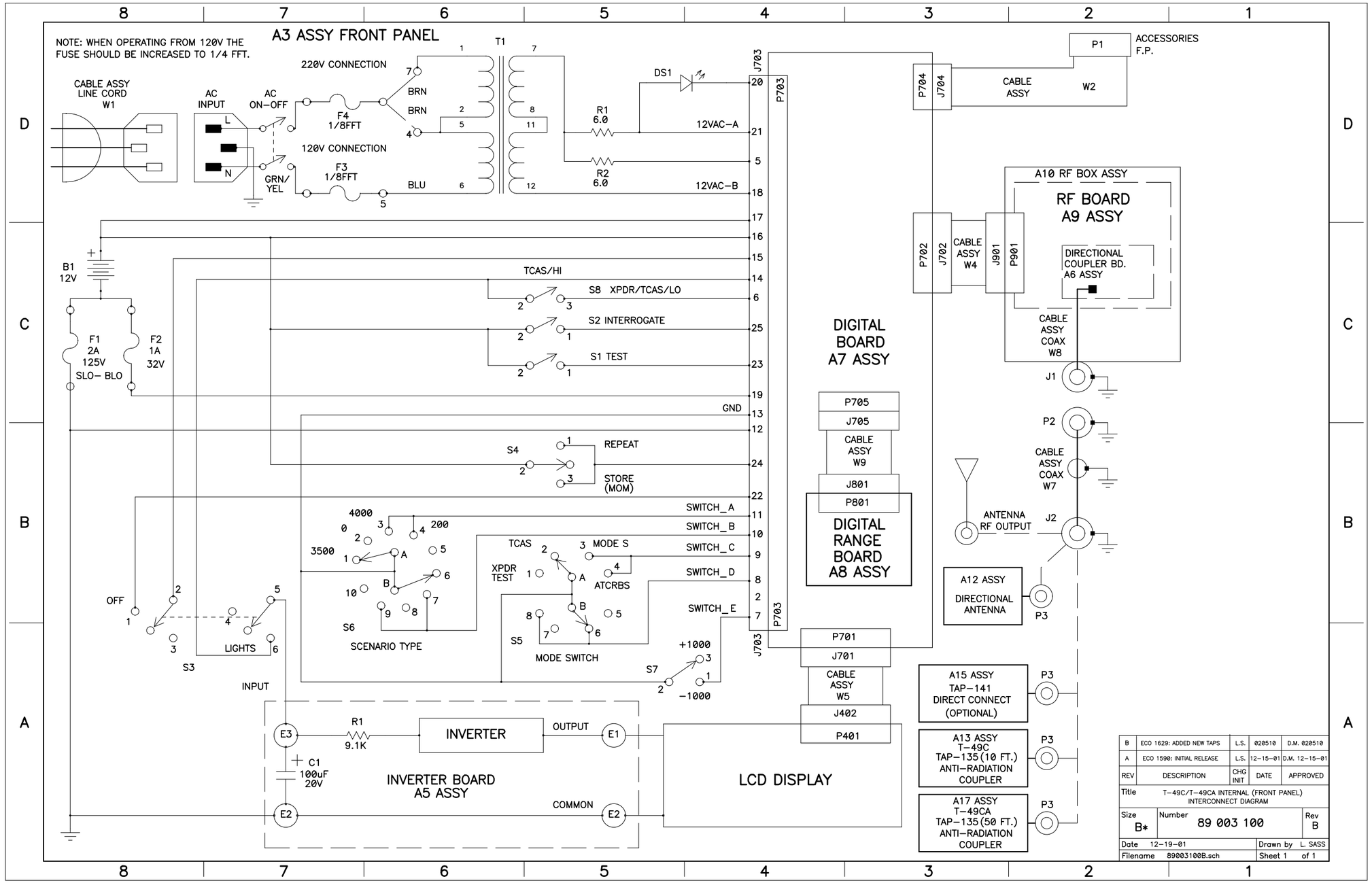
SCHEMATICS

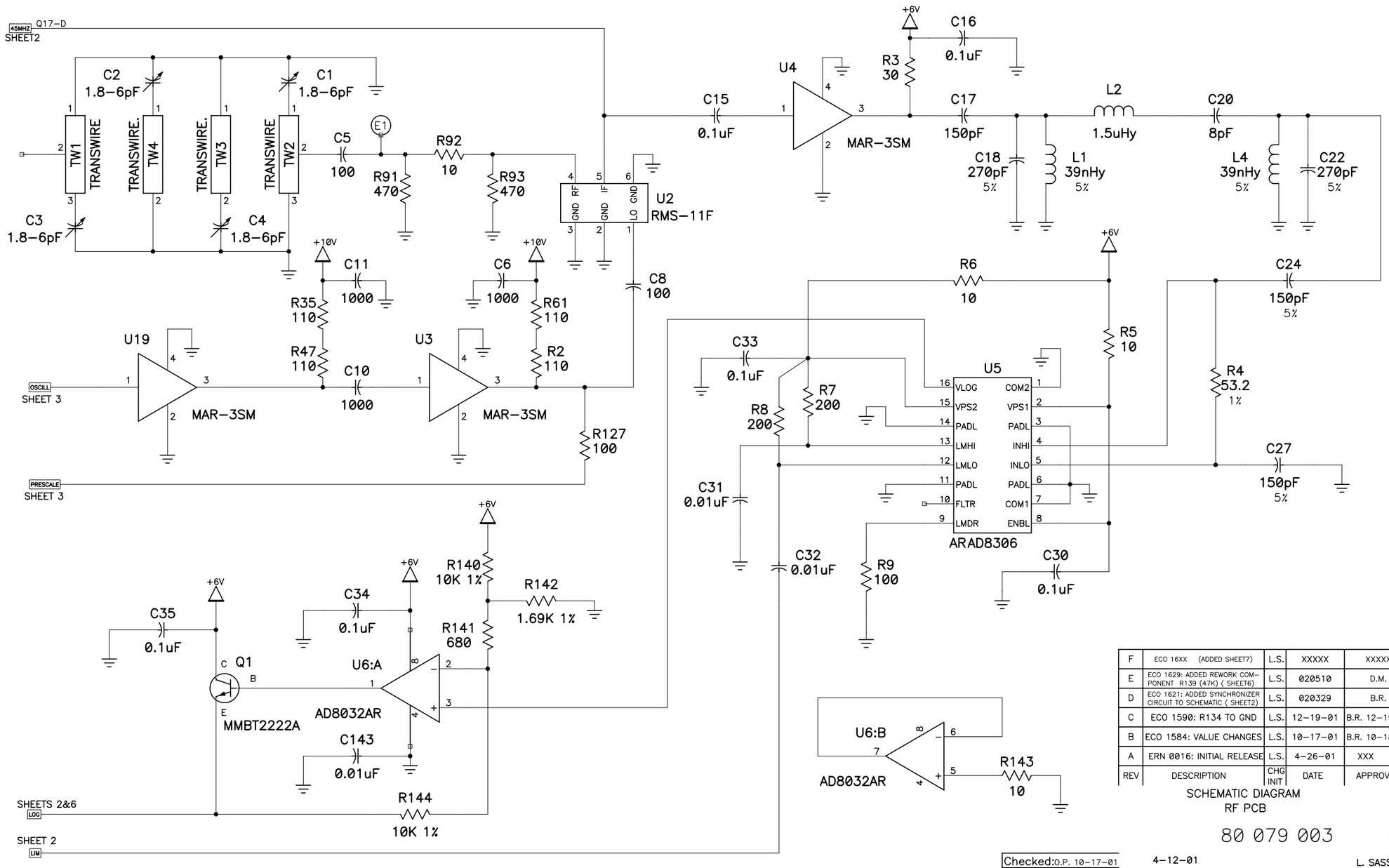


Schematic Diagram
TAP-135
80 198 003 REV A



Schematic Diagram
TAP-141
80 197 003 REV A


A3 ASSY FRONT PANEL
NOTE: WHEN OPERATING FROM 120V THE FUSE SHOULD BE INCREASED TO 1/4 FFT.
CABLE ASSY LINE CORD W1
AC INPUT
AC ON-OFF
220V CONNECTION
120V CONNECTION
F4 1/8FFT
F3 1/8FFT
GRN/ YEL
BRN
BRN
BLU
T1
R1 6.0
R2 6.0
DS1
12VAC-A
12VAC-B
J703
P703
B1 12V
F1 2A 125V SLO- BLO
F2 1A 32V
TCAS/HI
S8 XPDR/TCAS/LO
S2 INTERROGATE
S1 TEST
GND
S4
REPEAT
STORE (MOM)
SWITCH_A
SWITCH_B
SWITCH_C
SWITCH_D
SWITCH_E
S6
SCENARIO TYPE
TCAS
MODE S
ATCRBS
XPDR TEST
S5
MODE SWITCH
S7
+1000
-1000
OFF
LIGHTS
S3
INPUT
E3
E2
E1
R1 9.1K
C1 100uF 20V
INVERTER
OUTPUT
COMMON
INVERTER BOARD A5 ASSY
LCD DISPLAY
DIGITAL BOARD A7 ASSY
P705
J705
CABLE ASSY W9
J801
P801
DIGITAL RANGE BOARD A8 ASSY
P701
J701
CABLE ASSY W5
J402
P401
P1
ACCESSORIES F.P.
P704
J704
CABLE ASSY
W2
A10 RF BOX ASSY
RF BOARD A9 ASSY
DIRECTIONAL COUPLER BD. A6 ASSY
P702
J702
CABLE ASSY W4
J901
P901
CABLE ASSY COAX W8
J1
P2
CABLE ASSY COAX W7
ANTENNA RF OUTPUT
J2
A12 ASSY
DIRECTIONAL ANTENNA
P3
A15 ASSY TAP-141 DIRECT CONNECT (OPTIONAL)
A13 ASSY T-49C TAP-135 (10 FT.) ANTI-RADIATION COUPLER
A17 ASSY T-49CA TAP-135 (50 FT.) ANTI-RADIATION COUPLER
B ECO 1629: ADDED NEW TAPS L.S. 020510 D.M. 020510
A ECO 1590: INITIAL RELEASE L.S. 12-15-01 D.M. 12-15-01
REV DESCRIPTION CHG INIT DATE APPROVED
Title T-49C/T-49CA INTERNAL (FRONT PANEL) INTERCONNECT DIAGRAM
Size B* Number 89 003 100 Rev B
Date 12-19-01 Drawn by L. SASS
Filename 89003100B.sch Sheet 1 of 1



REV	DESCRIPTION	CHG INIT	DATE	APPROVED
F	ECO 16XX (ADDED SHEET7)	L.S.	XXXXX	XXXXX
E	ECO 1629: ADDED REWORK COMPONENT R139 (47K) (SHEET6)	L.S.	020510	D.M.
D	ECO 1621: ADDED SYNCHRONIZER CIRCUIT TO SCHEMATIC (SHEET2)	L.S.	020329	B.R.
C	ECO 1590: R134 TO GND	L.S.	12-19-01	B.R. 12-19-01
B	ECO 1584: VALUE CHANGES	L.S.	10-17-01	B.R. 10-18-01
A	ERN 0016: INITIAL RELEASE	L.S.	4-26-01	XXX

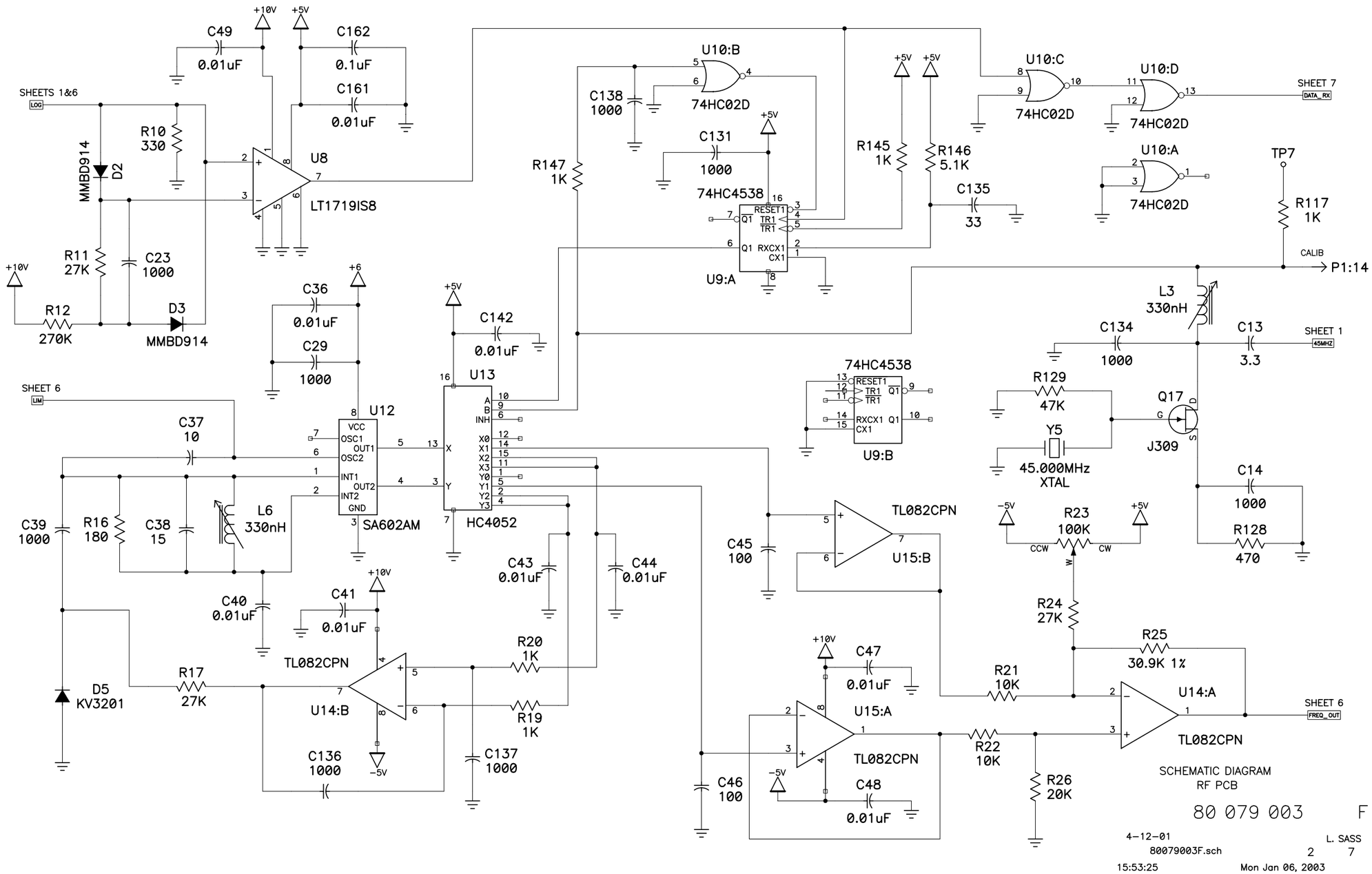
SCHEMATIC DIAGRAM
RF PCB

80 079 003 F

Checked: O.P. 10-17-01
Issued: O.P. 10-17-01

4-12-01
80079003F.sch
15:53:39 Mon Jan 06, 2003

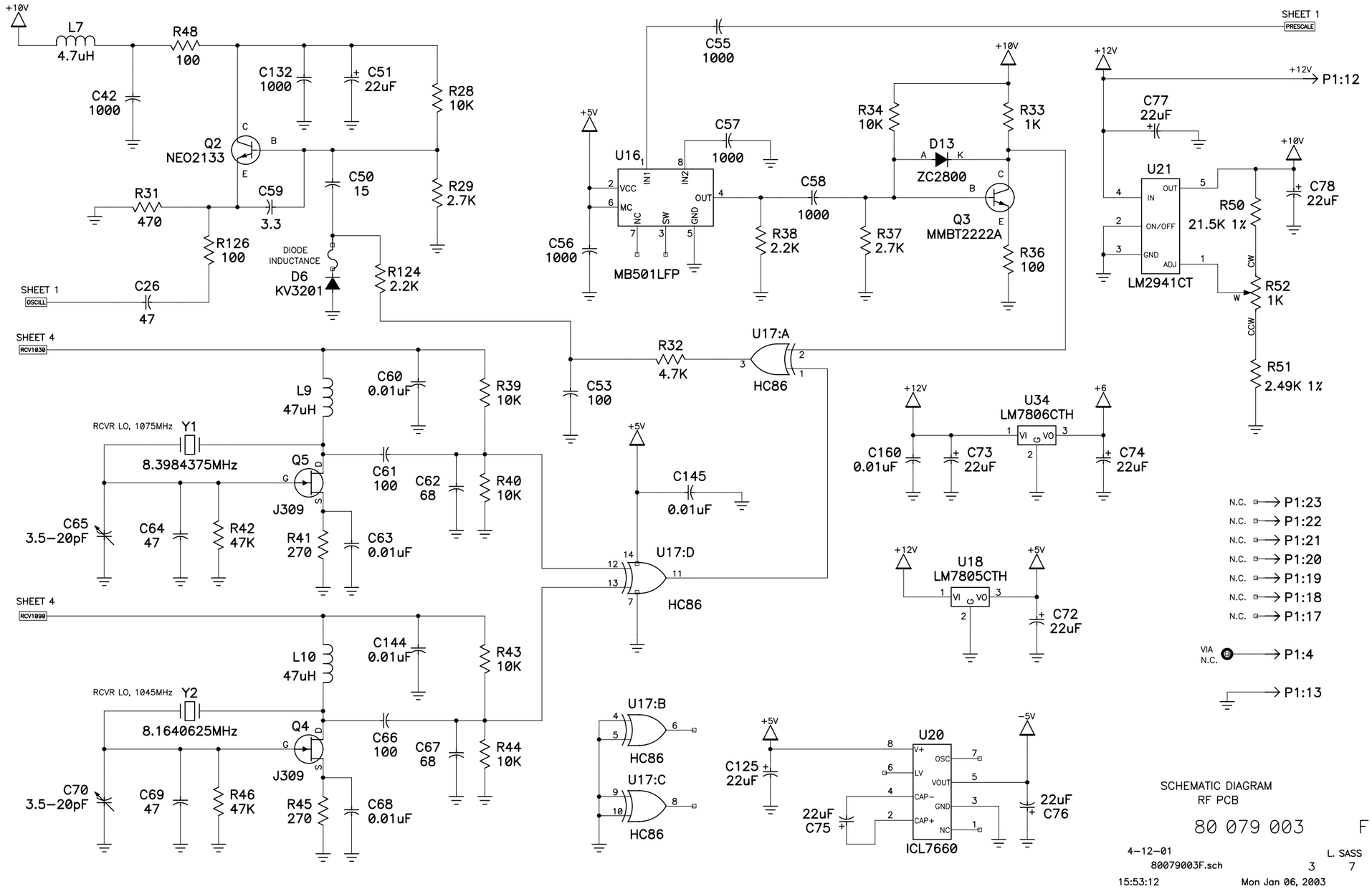
L. SASS
1 7



SCHEMATIC DIAGRAM
RF PCB

80 079 003 F

4-12-01 L. SASS
80079003F.sch 2 7
15:53:25 Mon Jan 06, 2003



SCHEMATIC DIAGRAM
RF PCB

80 079 003 F

4-12-01 L. SASS
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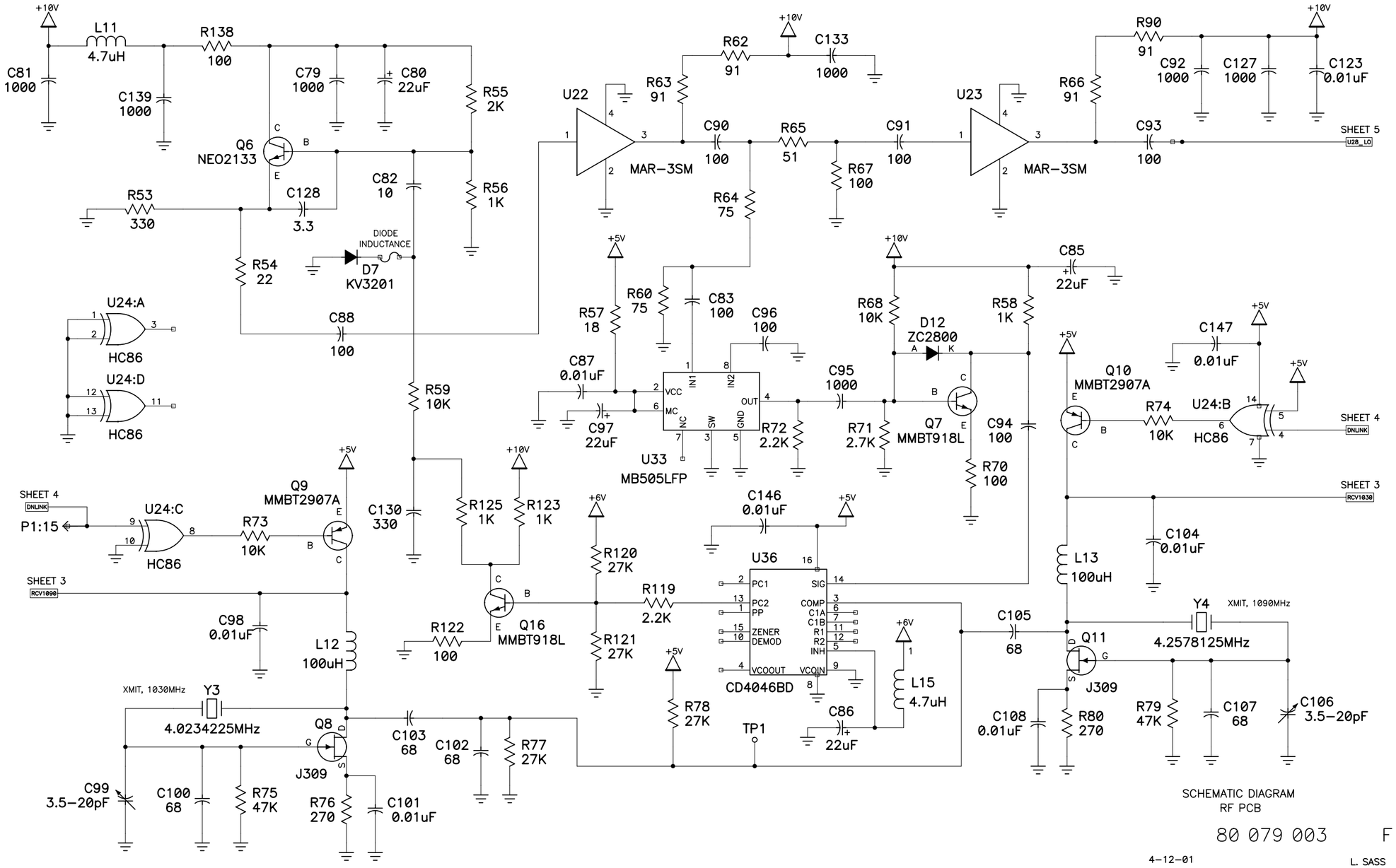

SCHEMATIC DIAGRAM
RF PCB

80 079 003 F

4-12-01 L. SASS
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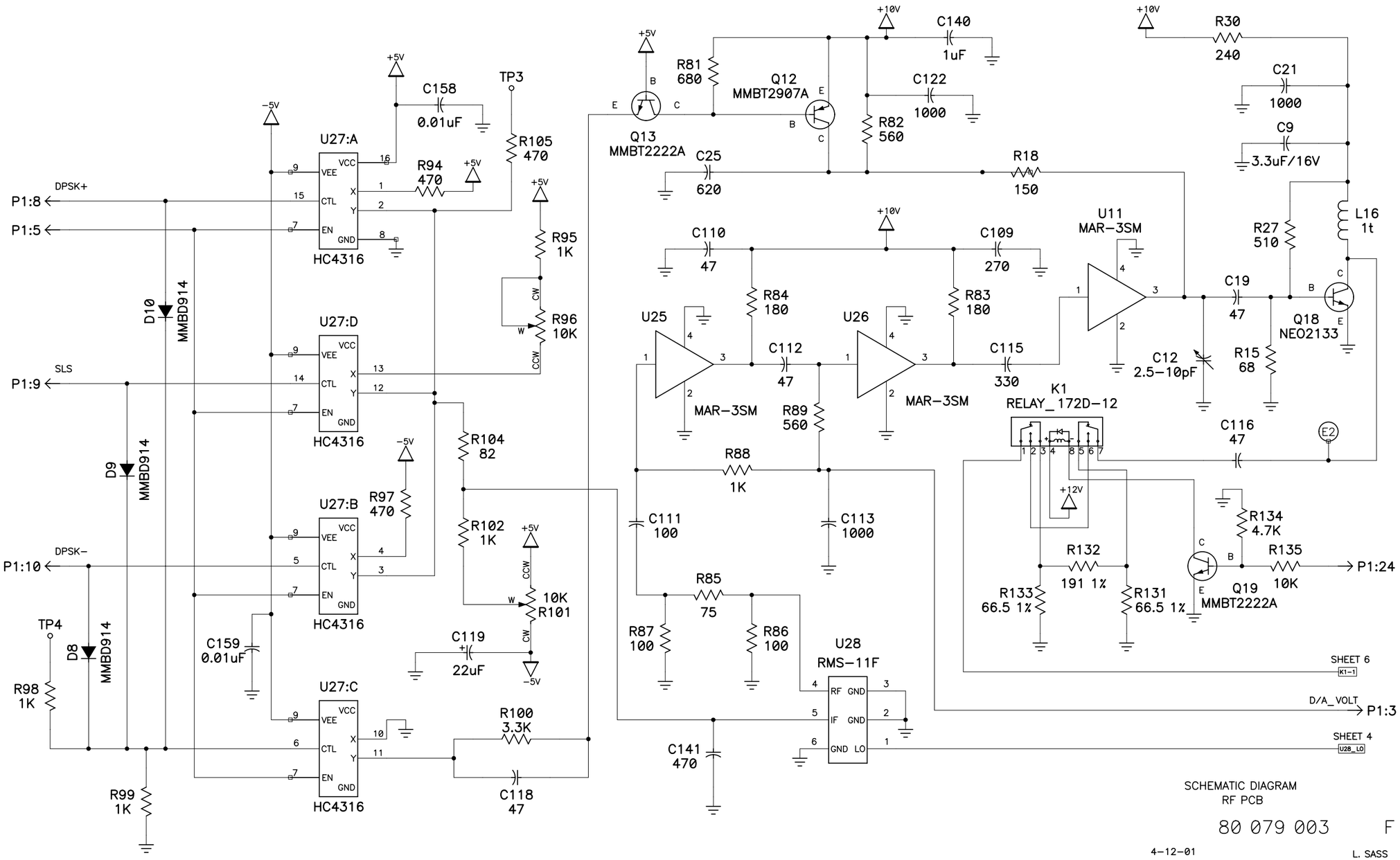
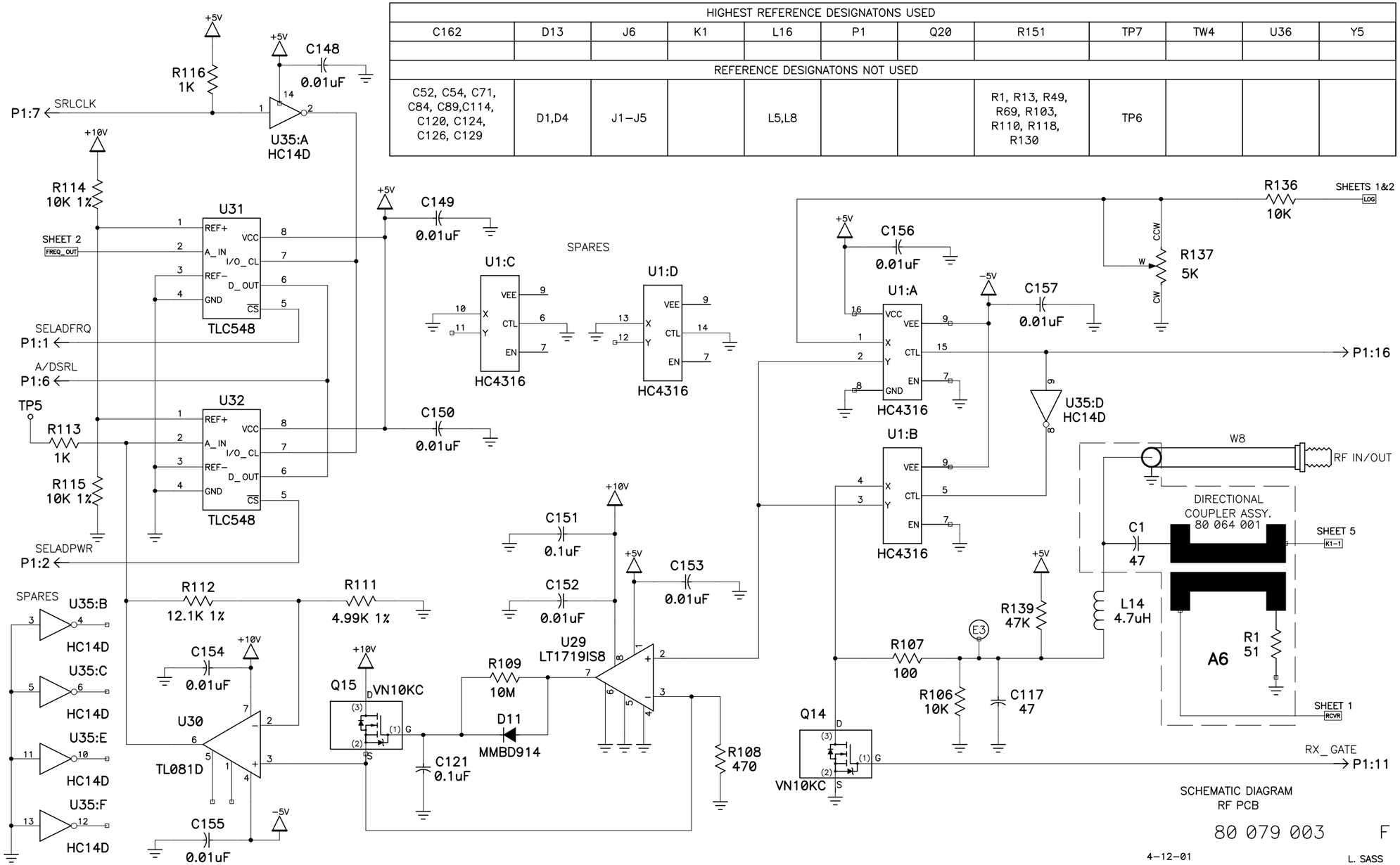


SCHEMATIC DIAGRAM
RF PCB

80 079 003 F

4–12–01 L. SASS
80079003F.sch 5 7
15:52:40 Mon Jan 06, 2003

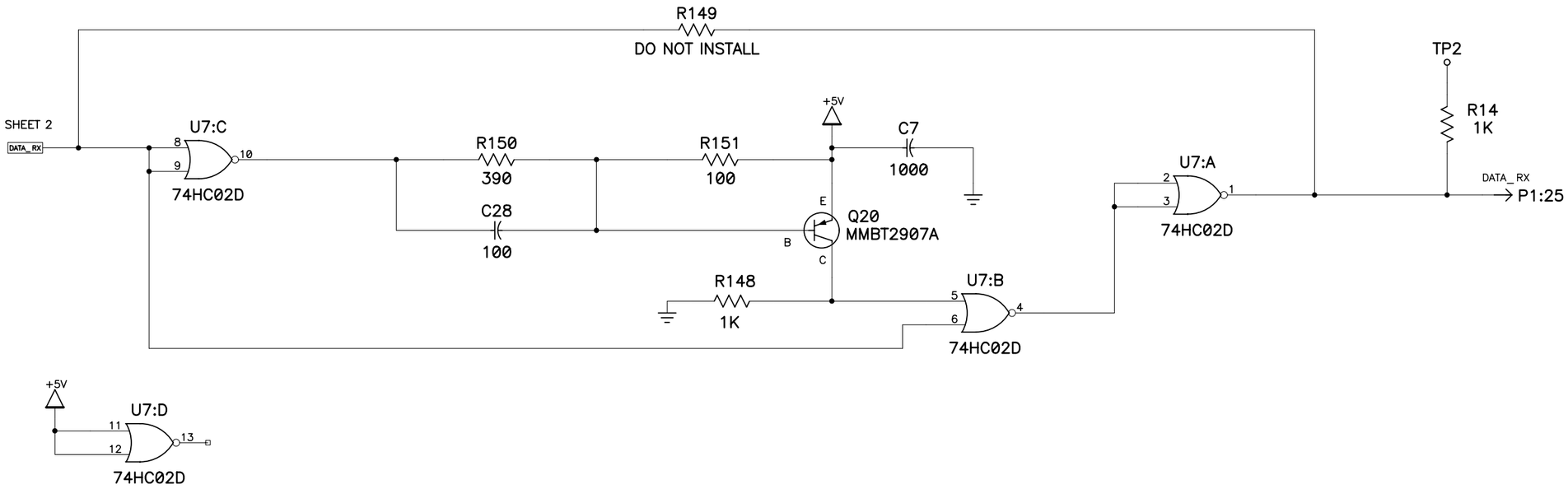
HIGHEST REFERENCE DESIGNATONS USED											
C162	D13	J6	K1	L16	P1	Q20	R151	TP7	TW4	U36	Y5
REFERENCE DESIGNATONS NOT USED											
C52, C54, C71, C84, C89,C114, C120, C124, C126, C129	D1,D4	J1–J5		L5,L8			R1, R13, R49, R69, R103, R110, R118, R130	TP6			



SCHEMATIC DIAGRAM
RF PCB

80 079 003 F

4–12–01 L. SASS
80079003F.sch 6 7
15:52:26 Mon Jan 06, 2003



SCHEMATIC DIAGRAM
RF PCB

80 079 003 F

4-12-01 L. SASS
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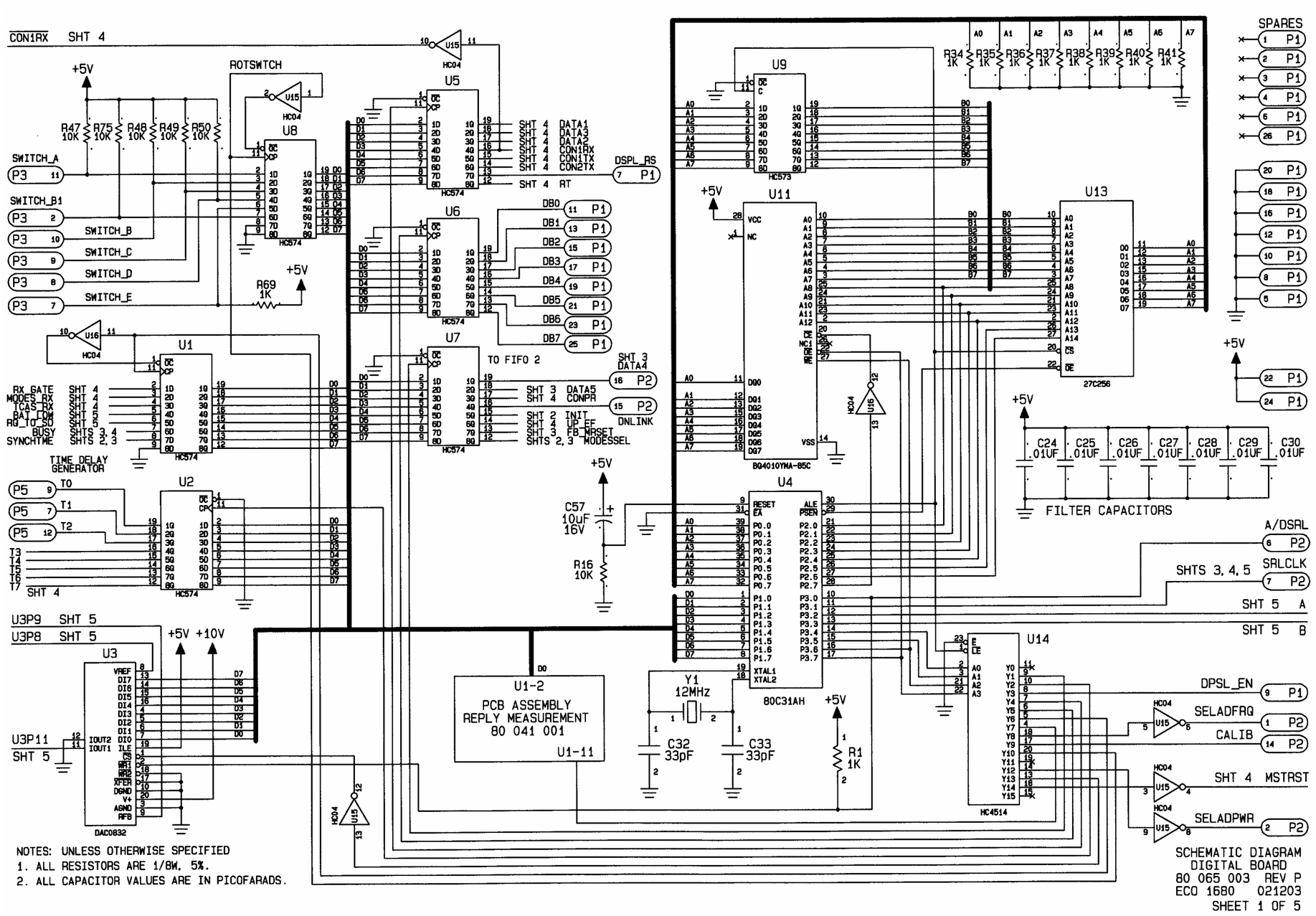
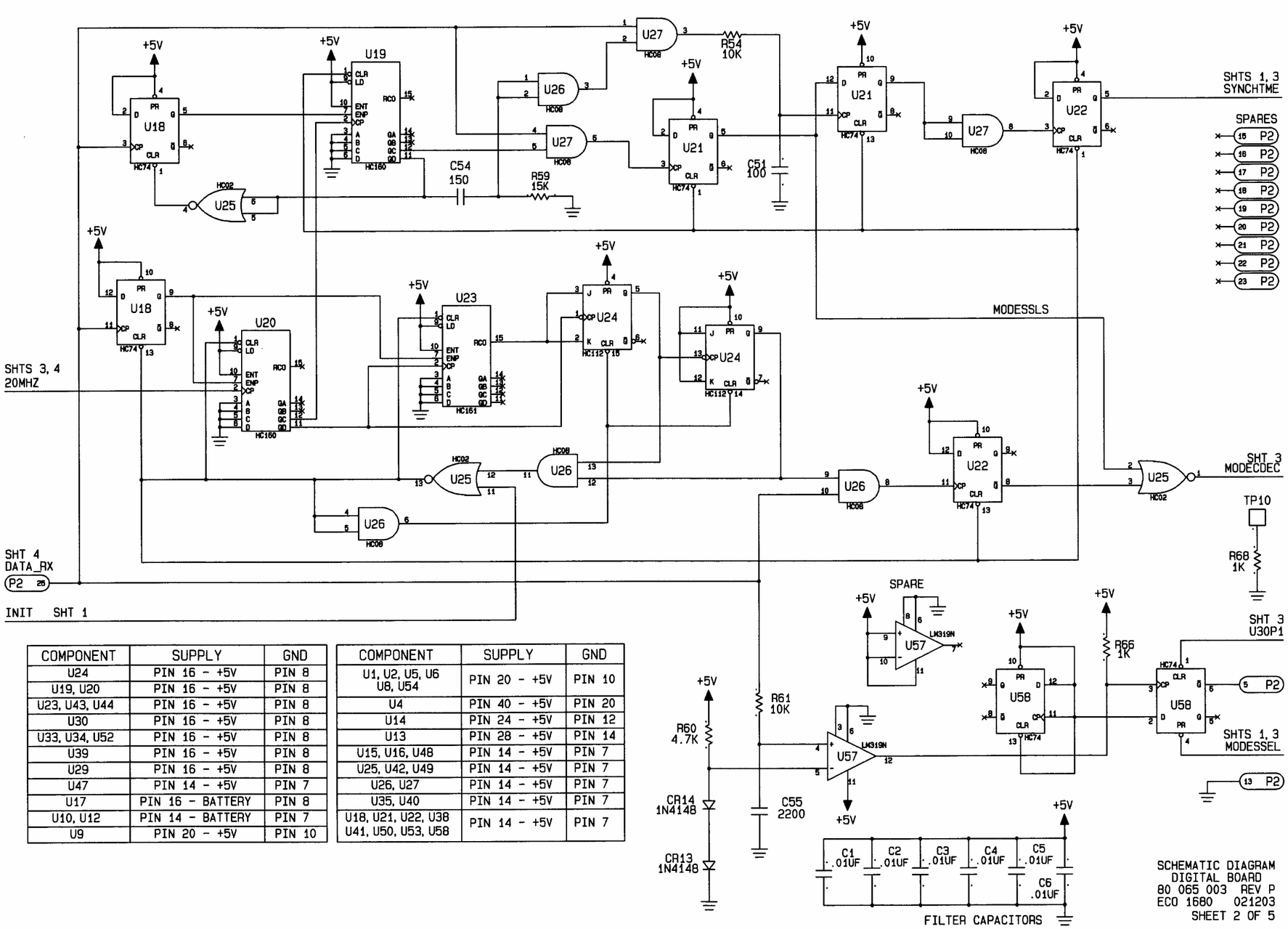
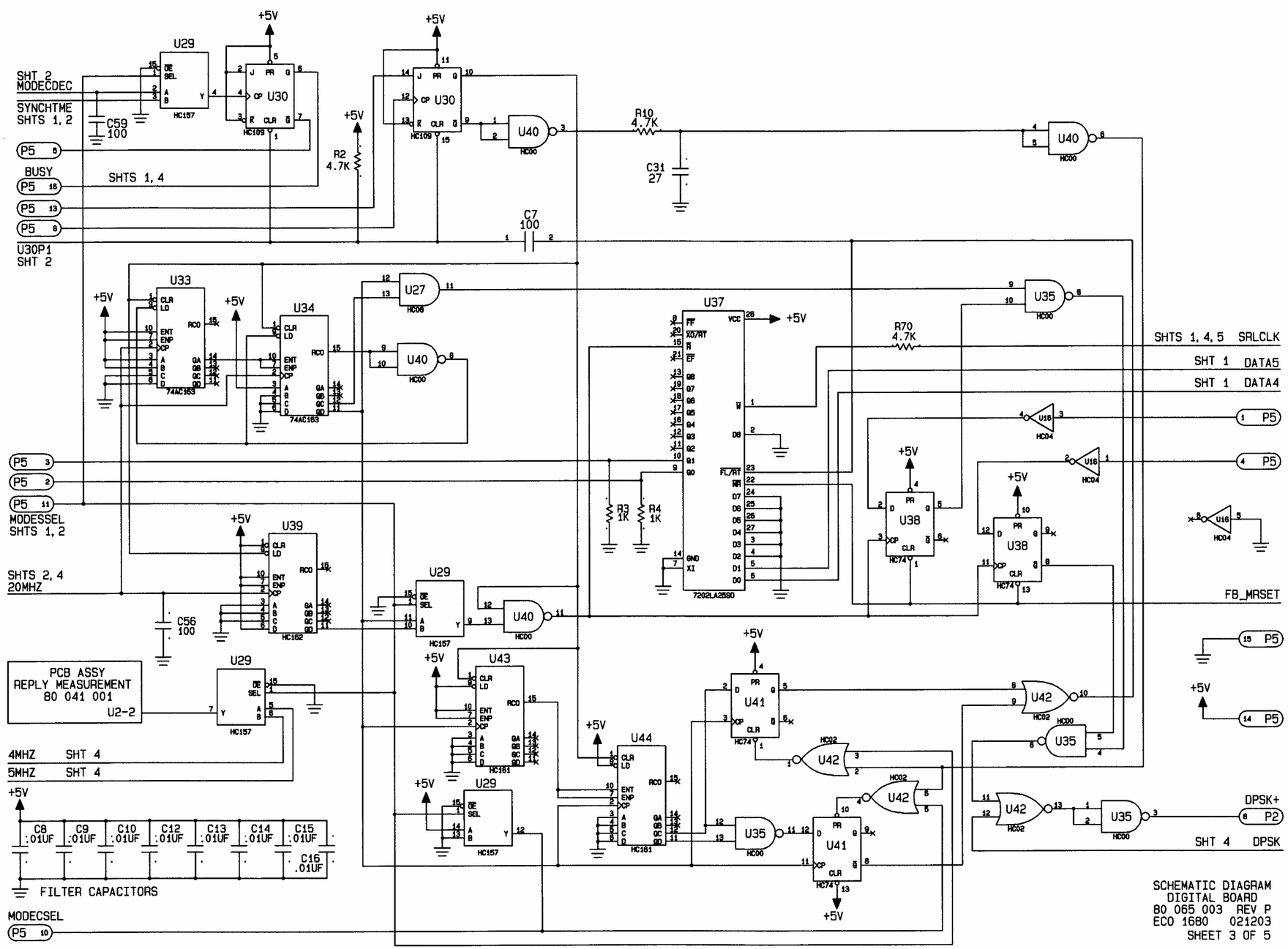
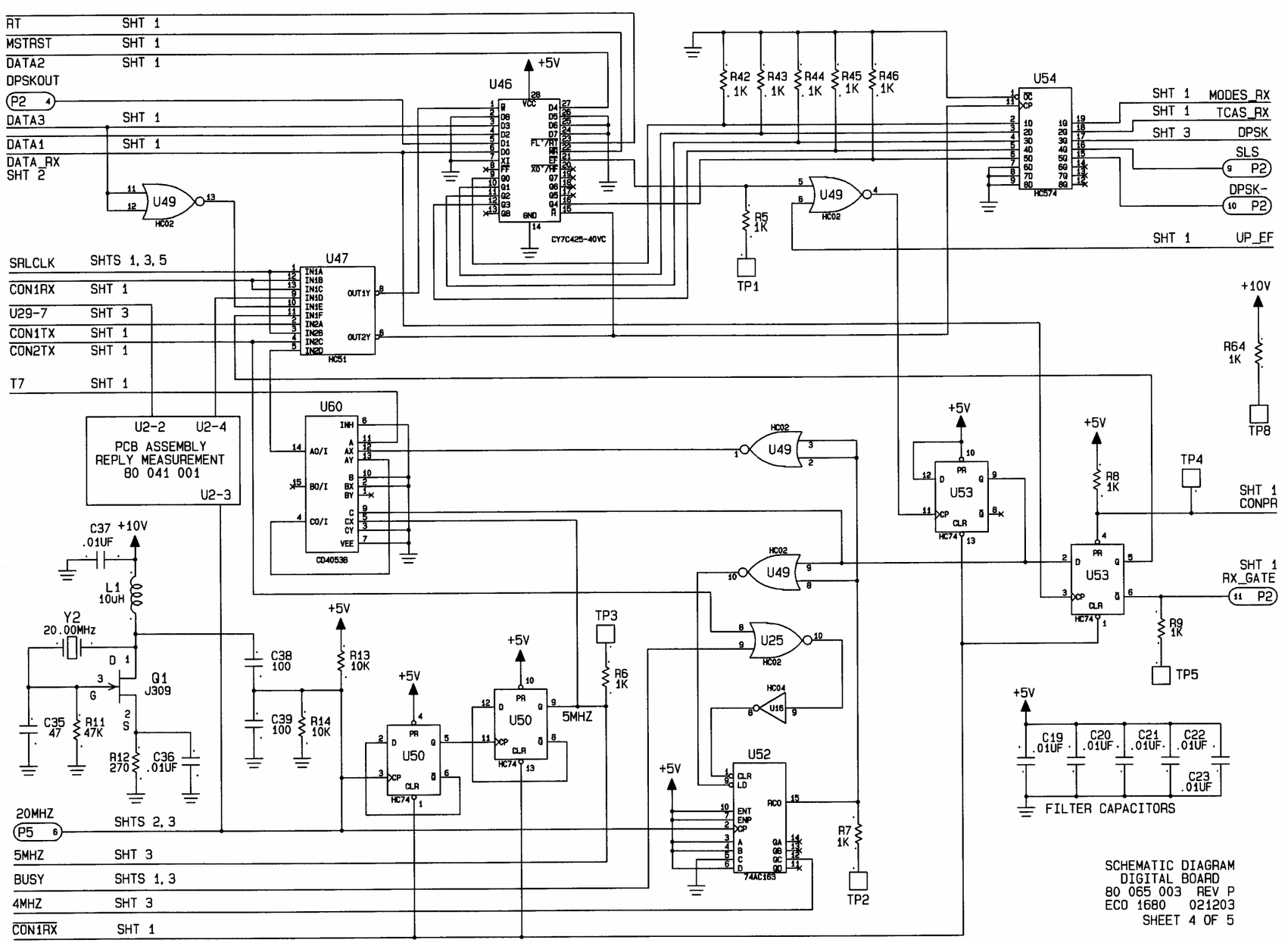

CON1RX SHT 4
+5V
ROTSWITCH
R47 10K
R75 10K
R48 10K
R49 10K
R50 10K
SWITCH_A
SWITCH_B1
SWITCH_B
SWITCH_C
SWITCH_D
SWITCH_E
R69 1K
U8
U5
U6
U7
SHT 4 DATA1
SHT 4 DATA3
SHT 4 DATA2
SHT 4 CON1RX
SHT 4 CON1TX
SHT 4 CON2TX
SHT 4 RT
DSPL_RS
DB0
DB1
DB2
DB3
DB4
DB5
DB6
DB7
TO FIFO 2
SHT 3 DATA4
SHT 3 DATA5
SHT 4 CONPR
DNLINK
SHT 2 INIT
SHT 4 UP_EF
SHT 3 FB_WRSET
SHTS 2, 3 MODESSEL
U1
RX_GATE SHT 4
MODES_RX SHT 4
TCAS_RX SHT 4
BAT_COM SHT 4
RG_TO_SO SHT 4
BUSY SHTS 3, 4
SYNCHTME SHTS 2, 3
TIME DELAY GENERATOR
U2
T0
T1
T2
T3
T4
T5
T6
T7
SHT 4
U3P9 SHT 5
U3P8 SHT 5
U3
+5V +10V
U3P11
SHT 5
DAC0832
U9
B04010YNA-85C
U11
27C256
U13
U4
80C31AH
C57 10uF 16V
R16 10K
Y1 12MHz
C32 33pF
C33 33pF
R1 1K
U1-2
PCB ASSEMBLY
REPLY MEASUREMENT
80 041 001
U1-11
R34 1K
R35 1K
R36 1K
R37 1K
R38 1K
R39 1K
R40 1K
R41 1K
SPARES
C24 .01UF
C25 .01UF
C26 .01UF
C27 .01UF
C28 .01UF
C29 .01UF
C30 .01UF
FILTER CAPACITORS
U14
HC4514
A/DSRL
SRLCLK
SHTS 3, 4, 5
SHT 5 A
SHT 5 B
DPSL_EN
SELADFRQ
CALIB
SHT 4 MSTRST
SELADPWR
NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS ARE 1/8W. 5%.
2. ALL CAPACITOR VALUES ARE IN PICOFARADS.
SCHEMATIC DIAGRAM
DIGITAL BOARD
80 065 003 REV P
ECO 1680 021203
SHEET 1 OF 5

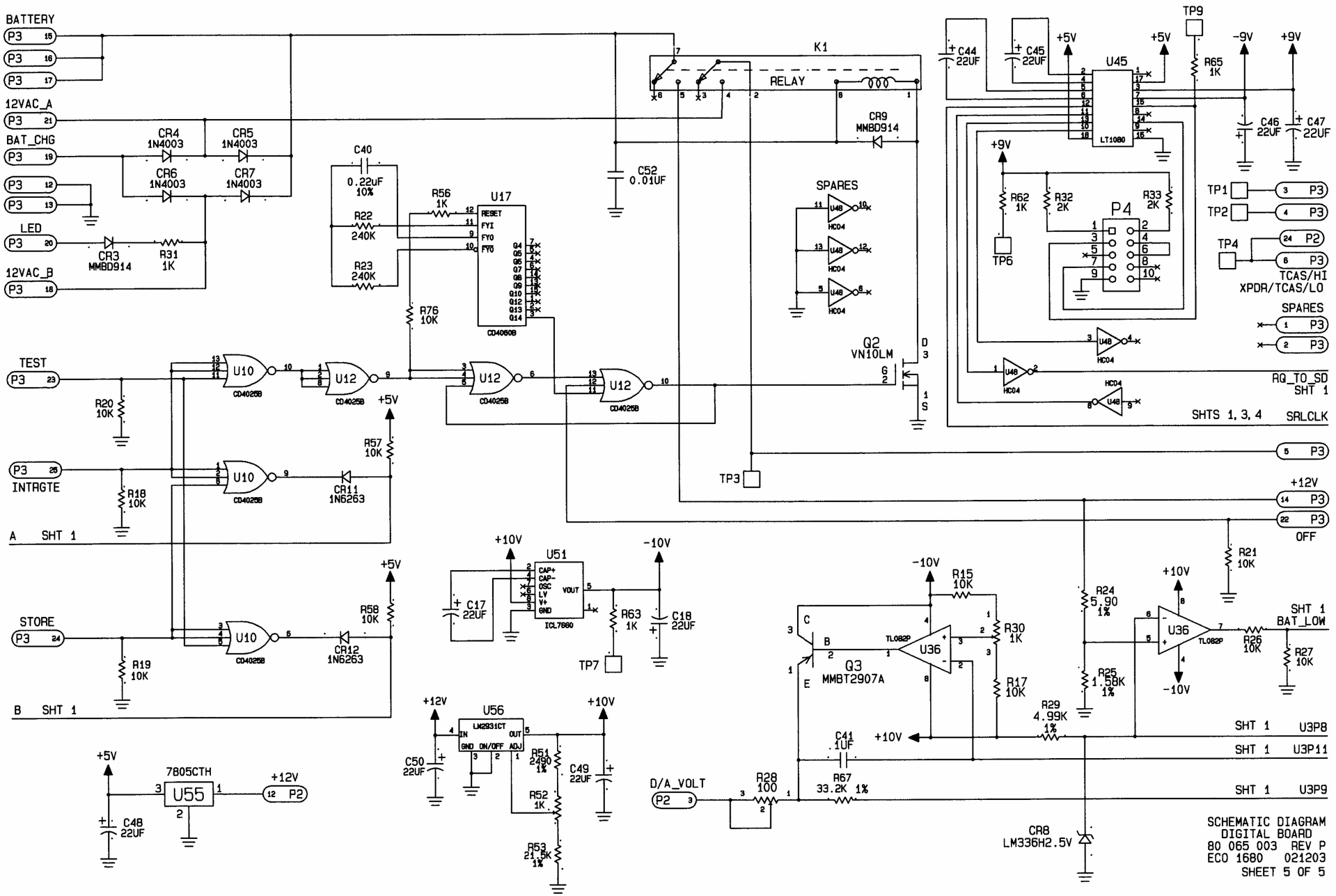


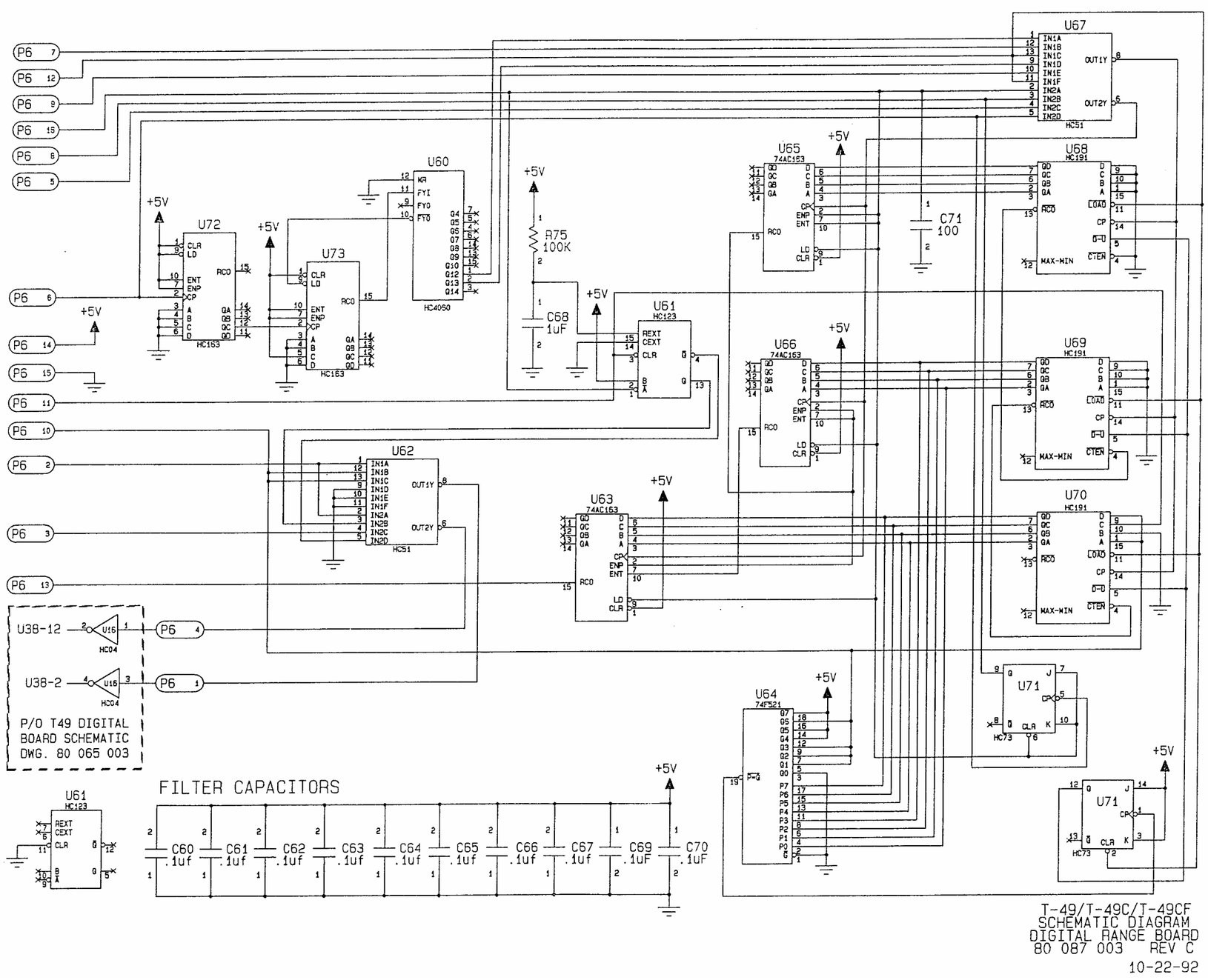
COMPONENT	SUPPLY	GND
U24	PIN 16 - +5V	PIN 8
U19, U20	PIN 16 - +5V	PIN 8
U23, U43, U44	PIN 16 - +5V	PIN 8
U30	PIN 16 - +5V	PIN 8
U33, U34, U52	PIN 16 - +5V	PIN 8
U39	PIN 16 - +5V	PIN 8
U29	PIN 16 - +5V	PIN 8
U47	PIN 14 - +5V	PIN 7
U17	PIN 16 - BATTERY	PIN 8
U10, U12	PIN 14 - BATTERY	PIN 7
U9	PIN 20 - +5V	PIN 10

COMPONENT	SUPPLY	GND
U1, U2, U5, U6 U8, U54	PIN 20 - +5V	PIN 10
U4	PIN 40 - +5V	PIN 20
U14	PIN 24 - +5V	PIN 12
U13	PIN 28 - +5V	PIN 14
U15, U16, U48	PIN 14 - +5V	PIN 7
U25, U42, U49	PIN 14 - +5V	PIN 7
U26, U27	PIN 14 - +5V	PIN 7
U35, U40	PIN 14 - +5V	PIN 7
U18, U21, U22, U38 U41, U50, U53, U58	PIN 14 - +5V	PIN 7


SHT 2
MODECDEC
SYNCHTME
SHTS 1, 2
P5 6
BUSY
P5 15
P5 13
P5 8
U30P1
SHT 2
SHTS 1, 4
U29
U30
U40
U33
U34
U27
U37
U35
U38
U39
U41
U42
U43
U44
C59 100
C7 100
C31 27
C56 100
R2 4.7K
R10 4.7K
R70 4.7K
R3 1K
R4 1K
+5V
74AC163
HC157
HC109
HC00
HC74
HC02
HC04
HC152
HC161
7202LA25S0
P5 3
P5 2
P5 11
MODESSEL
SHTS 1, 2
SHTS 2, 4
20MHZ
PCB ASSY
REPLY MEASUREMENT
80 041 001
U2-2
4MHZ SHT 4
5MHZ SHT 4
C8 .01UF
C9 .01UF
C10 .01UF
C12 .01UF
C13 .01UF
C14 .01UF
C15 .01UF
C16 .01UF
FILTER CAPACITORS
MODECSEL
P5 10
SHTS 1, 4, 5 SRLCLK
SHT 1 DATA5
SHT 1 DATA4
P5 1
P5 4
FB_MRSET
P5 15
P5 14
DPSK+
P2 8
SHT 4 DPSK
SCHEMATIC DIAGRAM
DIGITAL BOARD
80 065 003 REV P
ECO 1680 021203
SHEET 3 OF 5

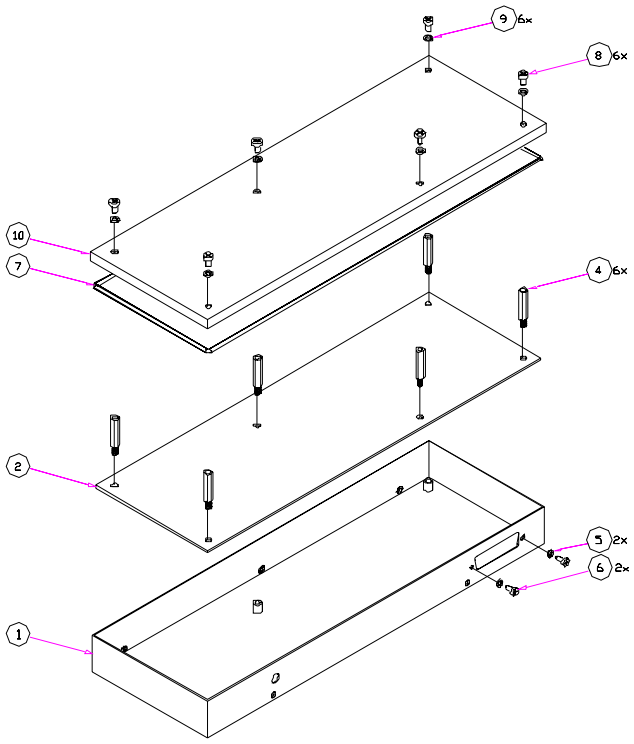

RT SHT 1
MSTRST SHT 1
DATA2 SHT 1
DPSKOUT
P2 4
DATA3 SHT 1
DATA1 SHT 1
DATA_RX SHT 2
SRLCLK SHTS 1, 3, 5
CON1RX SHT 1
U29-7 SHT 3
CON1TX SHT 1
CON2TX SHT 1
T7 SHT 1
20MHZ P5 6 SHTS 2, 3
5MHZ SHT 3
BUSY SHTS 1, 3
4MHZ SHT 3
CON1RX SHT 1
U2-2 U2-4
PCB ASSEMBLY
REPLY MEASUREMENT
80 041 001
U2-3
U46
CY7C425-40VC
U47
HC51
U60
CD40536
U49
HC02
U54
HC574
U53
HC74
U50
U52
74AC163
U25
HC04
R42 1K
R43 1K
R44 1K
R45 1K
R46 1K
R5 1K
TP1
R64 1K
TP8
R8 1K
TP4
R9 1K
TP5
R6 1K
TP3
R7 1K
TP2
R13 10K
R14 10K
C37 .01UF
L1 10UH
Y2 20.00MHz
Q1 J309
C35 47
R11 47K
R12 270
C36 .01UF
C38 100
C39 100
C19 .01UF
C20 .01UF
C21 .01UF
C22 .01UF
C23 .01UF
FILTER CAPACITORS
+5V
+10V
SHT 1 MODES_RX
SHT 1 TCAS_RX
SHT 3 DPSK
SLS P2 9
DPSK- P2 10
SHT 1 UP_EF
SHT 1 CONPR
SHT 1 RX_GATE P2 11
SCHEMATIC DIAGRAM
DIGITAL BOARD
80 065 003 REV P
ECO 1680 021203
SHEET 4 OF 5


BATTERY
P3 15
P3 16
P3 17
12VAC_A
P3 21
BAT_CHG
P3 19
P3 12
P3 13
LED
P3 20
12VAC_B
P3 18
CR4 1N4003
CR5 1N4003
CR6 1N4003
CR7 1N4003
CR3 MMBD914
R31 1K
C40 0.22uF 10%
R22 240K
R23 240K
R56 1K
U17
RESET
FYI
FY0
FY0
CD4060B
R76 10K
K1
RELAY
CR9 MMBD914
C52 0.01UF
SPARES
U48
HC04
Q2 VN10LM
TP3
C44 22UF
C45 22UF
+5V
U45
LT1080
TP9
R65 1K
-9V
+9V
C46 22UF
C47 22UF
+9V
R62 1K
R32 2K
R33 2K
P4
TP6
TP1
TP2
TP4
P3
P2
TCAS/HI
XPDR/TCAS/LO
SPARES
RQ_TO_SD
SHT 1
SHTS 1, 3, 4
SRLCLK
5 P3
+12V
14 P3
22 P3
OFF
TEST
P3 23
U10
CD4025B
U12
CD4025B
R20 10K
+5V
R57 10K
P3 26
INTRGTE
R18 10K
CR11 1N6263
A SHT 1
STORE
P3 24
R19 10K
CR12 1N6263
R58 10K
B SHT 1
+10V
U51
CAP+
CAP-
OSC
LV
V+
GND
VOUT
ICL7660
C17 22UF
R63 1K
C18 22UF
-10V
TP7
R21 10K
-10V
R15 10K
R30 1K
R17 10K
Q3 MMBT2907A
TL082P
U36
R24 5.90 1%
R25 1.58K 1%
R29 4.99K 1%
R26 10K
R27 10K
SHT 1 BAT_LOW
+12V
U56
LM2931CT
IN
OUT
GND ON/OFF ADJ
C50 22UF
R51 2490 1%
R52 1K
R53 21.5K 1%
C49 22UF
+10V
C41 .1UF
R67 33.2K 1%
D/A_VOLT
P2 3
R28 100
SHT 1 U3P8
SHT 1 U3P11
SHT 1 U3P9
CR8 LM336H2.5V
+5V
7805CTH
U55
+12V
12 P2
C48 22UF
SCHEMATIC DIAGRAM
DIGITAL BOARD
80 065 003 REV P
ECO 1680 021203
SHEET 5 OF 5


P6 7
P6 12
P6 9
P6 15
P6 8
P6 5
P6 6
P6 14
P6 15
P6 11
P6 10
P6 2
P6 3
P6 13
P6 4
P6 1
U38-12
U38-2
U16
HC04
P/O T49 DIGITAL BOARD SCHEMATIC DWG. 80 065 003
U72
HC163
U73
HC163
U60
HC4050
U62
HC51
U63
74AC163
U61
HC123
R75 100K
C68 1uF
U65
74AC163
U66
74AC163
U67
HC51
U68
HC191
U69
HC191
U70
HC191
C71 100
U64
74F521
U71
HC73
+5V
FILTER CAPACITORS
C60 .1uf
C61 .1uf
C62 .1uf
C63 .1uf
C64 .1uf
C65 .1uf
C66 .1uf
C67 .1uf
C69 .1uF
C70 .1uF
T-49/T-49C/T-49CF
SCHEMATIC DIAGRAM
DIGITAL RANGE BOARD
80 087 003 REV C
10-22-92

CHAPTER VI

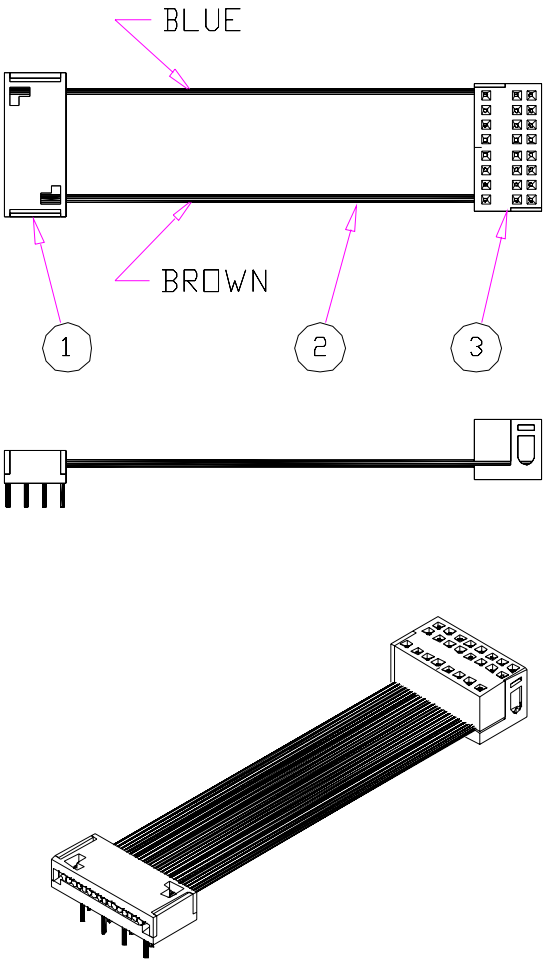
ILLUSTRATED PARTS BREAKDOWN
PARTS LIST



RF Box Assembly

Figure 6-1

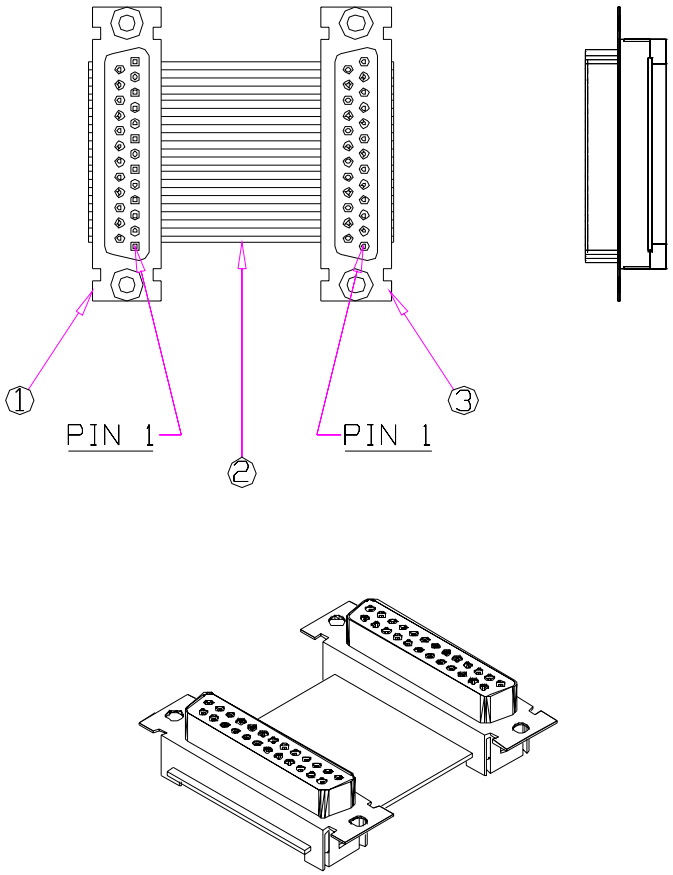
RF Box Assembly			89 004 022 (A10)			
Item No.	**Ref. Designation**	**Nomenclature**	**Tel Designation**	**Vendor P/N**	**Resource**	**Qty**
1		CHASSIS, RF	**62000015**			1
2		PCB ASSEMBLY, RF BOARD	**80079001**			1
3						
4		STANDOFF, 1/4" HEX, ,MALE-FEMALE	**52700001**	#4540-632-SS-20	RAF	6
5		WASHER, LOCK, #4	**52020002**	MS35338-135		2
6		SCREW, PAN HD, #4-40 X 1/4" LONG	**50110002**	MS51957-17		2
7		SHIELDING, SPIROL	**55060001**	#SS-06	SPIRA CORP	3'
8		SCREW, PAN HD, #6-32 X 1/4" LONG	**50110015**	MS51957-26		6
9		WASHER, LOCK, #6	**52020001**	MS35338-136		6
10		COVER, RF	**62040004**			1



Cable Assembly, Digital Range to Digital

Figure 6-2

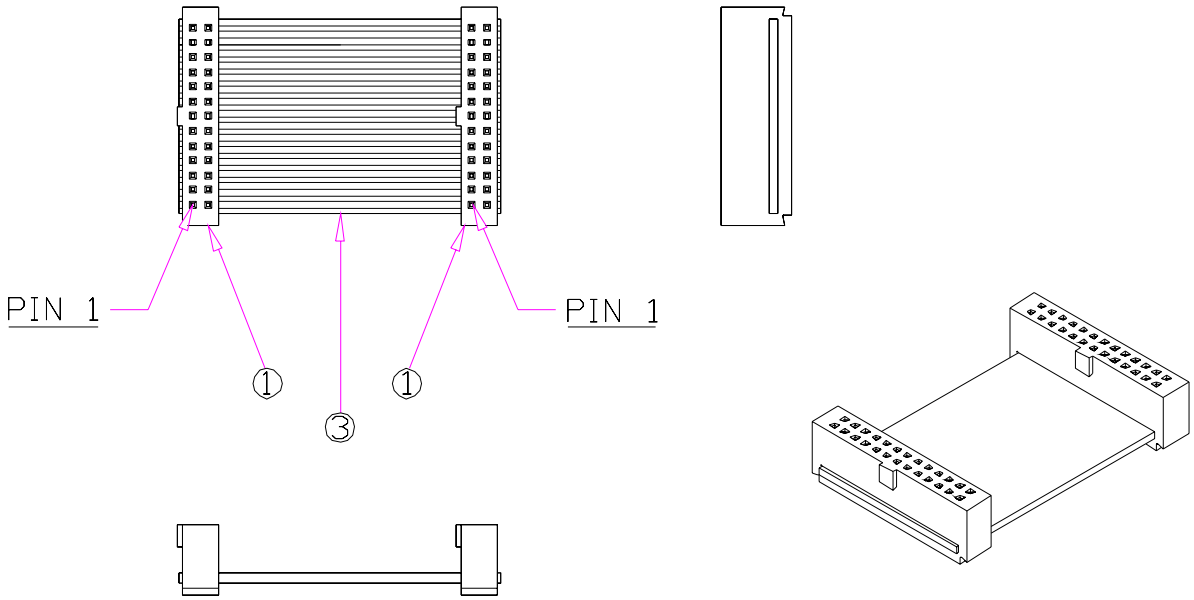
Cable Assembly, Digital Range to Digital			75 010 016 (W9)			
Item No.	**Ref. Designation**	**Nomenclature**	**Tel Designation**	**Vendor P/N**	**Resource**	**Qty**
1		TRANS. CONN, STANDARD 4 ROW PCB SOLDER	**48000043**	609-1603	T & B	1
2		CABLE, FLAT (16 COND.), COLOR CODED	**75000016**	3302-16	3M	
3		CONNECTOR, DIP SOCKET, 16 PIN	**48000044**	609-F161M2	T & B	1



Cable Assembly, Digital Range to RF

Figure 6-3

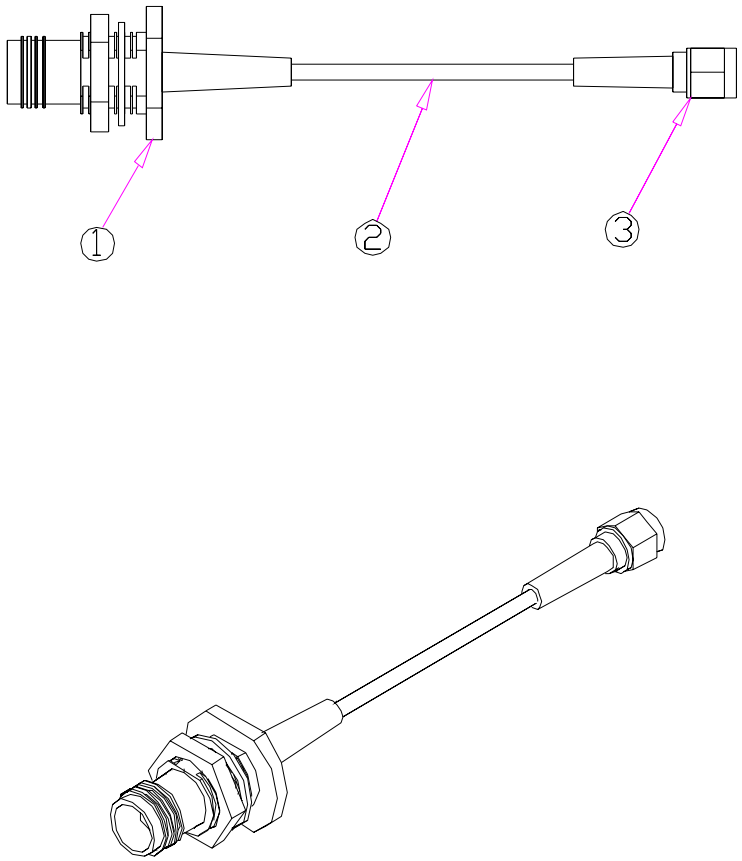
Cable Assembly, Digital Range to RF			75 010 027 (W4)			
Item No.	**Ref. Designation**	**Nomenclature**	**Tel Designation**	**Vendor P/N**	**Resource**	**Qty**
1	J1, J2	CONNECTOR "D" SOCKET	**48000015**	#622-25S-M	T & B	1
2		CABLE, FLAT 26 CONDUCTOR	**75000013**	#3302-26	SCOTCHFLEX	



Cable Assembly, LCD to Digital

Figure 6-4

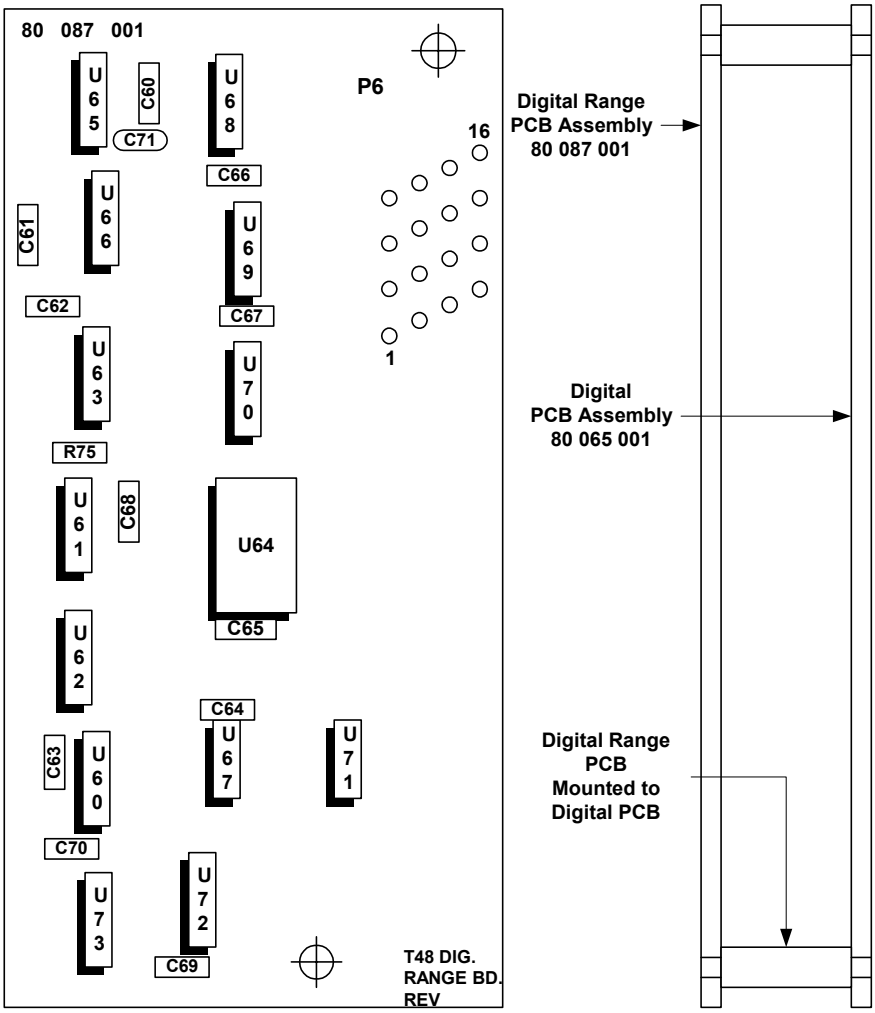
Cable Assembly, LCD to Digital			75 010 028 (W5)			
Item No.	**Ref. Designation**	**Nomenclature**	**Tel Designation**	**Vendor P/N**	**Resource**	**Qty**
1		CONNECTOR, SOCKET, 26OIN, POLARIZED	**48000016**	#622-2630	T & B	2
2		CABLE, FLAT 26 CONDUCTOR	**75000013**	#3302-26	SCOTCHFLEX	



Cable Assembly, RF/ANT FP

Figure 6-5

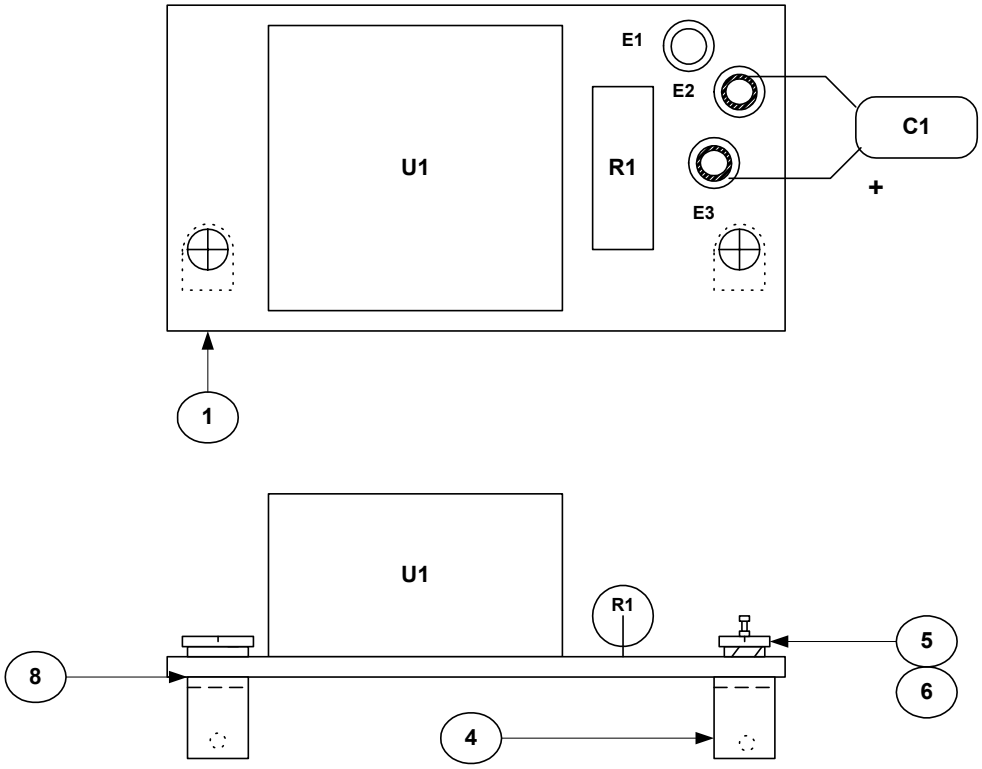
Cable Assembly RF/ANT FP			75 010 029 (W7)			
Item No.	**Ref. Designation**	**Nomenclature**	**Tel Designation**	**Vendor P/N**	**Resource**	**Qty**
1		CONNECTOR, TNC	**48040029**	31-2318	AMPHENOL	1
2		WIRE, COAXIAL	**71110007**	RG-318/U	ALPHA	
3		CONNECTOR, SMA, CRIMP	**48040026**	142-0321-001	E.F.JOHNSON	1



Digital Range PCB Assembly

Figure 6-6

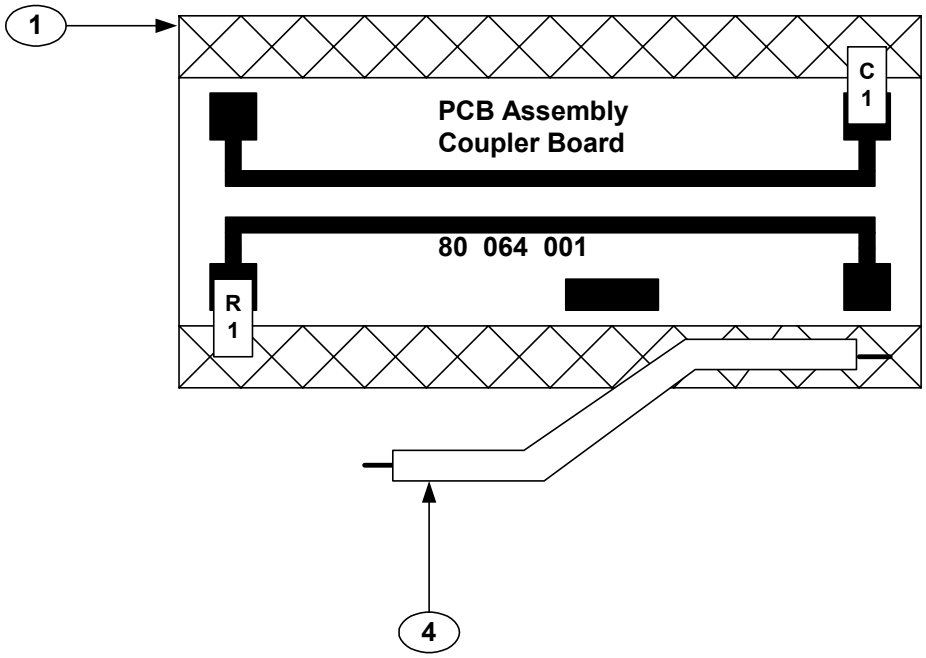
PCB Digital Range			80 087 004 (A8)			
Item No.	**Ref. Designation**	**Nomenclature**	**Tel Designation**	**Vendor P/N**	**Resource**	**Qty.**
1	U62, U67	I.C.-SM	**40201041**	74HC51M	NAT'L SEMI	2
2	U68, U69, U70	I.C.-SM	**40201069**	74HC191D	NAT'L SEMI	3
3	U71	I.C.-SM	**40201070**	74HC73M	NAT'L SEMI	1
4	U63, U65, U66	I.C.-SM	**40201056**	74AC163D	NAT'L SEMI	3
5	U60	I.C.-SM	**40201071**	74HC4060M	NAT'L SEMI	1
6	U64	I.C.-SM	**40201096**	74HC688WM	NAT'L SEMI	1
7	U72, U73	I.C.-SM	**40201002**	74HC163M	NAT'L SEMI	2
8	U61	I.C.-SM	**40201074**	74HC123M1R	NAT'L SEMI	1
9						
10						
11	C60-C67, C69, C70	CAP. CHIP 5% X7R .1uf	**42020013**			10
12	R75	RES. CHIP 5% 100K	**41160025**			1
13	C68	CAP. CHIP 5% X7R 1.0uf	**42026001**			1
14		PCB DRILLING AND FABRICATION, (REV. B)	**80087002**			1
15	C71	CAP., CERAMIC 100pf	**42000031**	CN15C101J	CENTRALAB	1



Inverter PCB Assembly

Figure 6-7

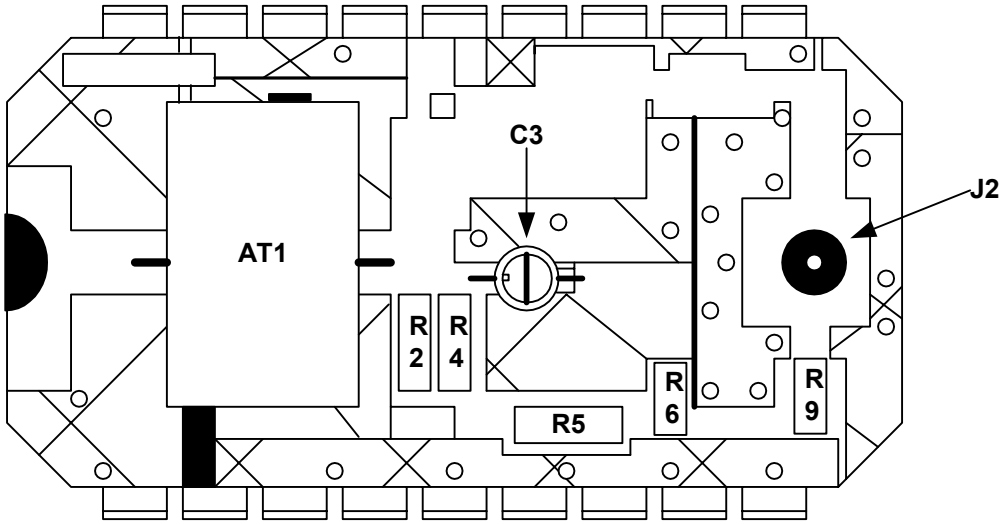
PCB Assembly, Inverter			80 067 004 (A5)			
Item No.	**Ref. Designation**	**Nomenclature**	**Tel Designation**	**Vendor P/N**	**Resource**	**Qty.**
1	A5	DRILLING AND FABRICATION (REV A)	**80067002**			1
2	U1	INVERTER	**48072002**	46713-01	IEE	1
3	E1, E2, E3	TERMINAL, DOUBLE TURRET	**55025002**	160-2043-02-01	CAMBION	3
4		BRACKET, MOUNTING	**62020041**	621	KEYSTONE	2
5		SCREW, PAN HD, #4-40 X 1/4" LONG	**50110007**	MS51957-13		2
6		WASHER, LOCK, #4	**52020002**	MS35338-135		2
7	R1	RESISTOR, W.W. , 9.1 OHMS	**41300003**	SPH-9.1 OHM	INTER. RECT.	1
8		INSULATOR, INVERTER BOARD	**31000002**			AR
9		SOLDER	**31007502**	60/40 Sn60BS	ALPHA METAL	AR
10	C1	CAPACITOR, TANT, 100UF/20V, 10%	**42470021**	199D107X90200 FE2	SPRAGUE	1



Coupler PCB Assembly

Figure 6-8

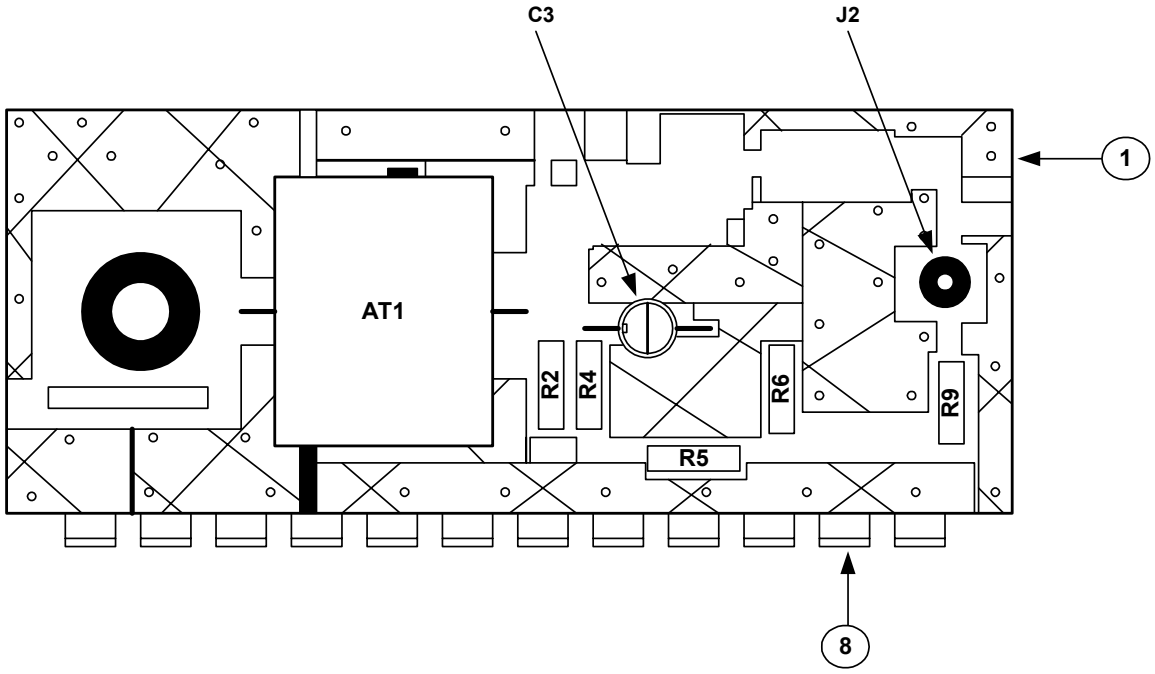
PCB Assembly, Coupler			80 064 004 (A6)			
Item No.	**Ref. Designation**	**Nomenclature**	**Tel Designation**	**Vendor P/N**	**Resource**	**Qty.**
1		DRILLING AND FABRICATION (REV C)	**80064002**			1
2	R1	RESISTOR CHIP 5% RC1206; 51 Ohm	**41160043**			1
3	C1	CAPACITOR CHIP 5% X7R, CC1206; 47pF	**42020004**			1
4		CABLE, COAXIAL	**71110006**	53284 (RG-316/U)	OLYMPIC	AR



Direct Connect PCB Assembly

Figure 6-9

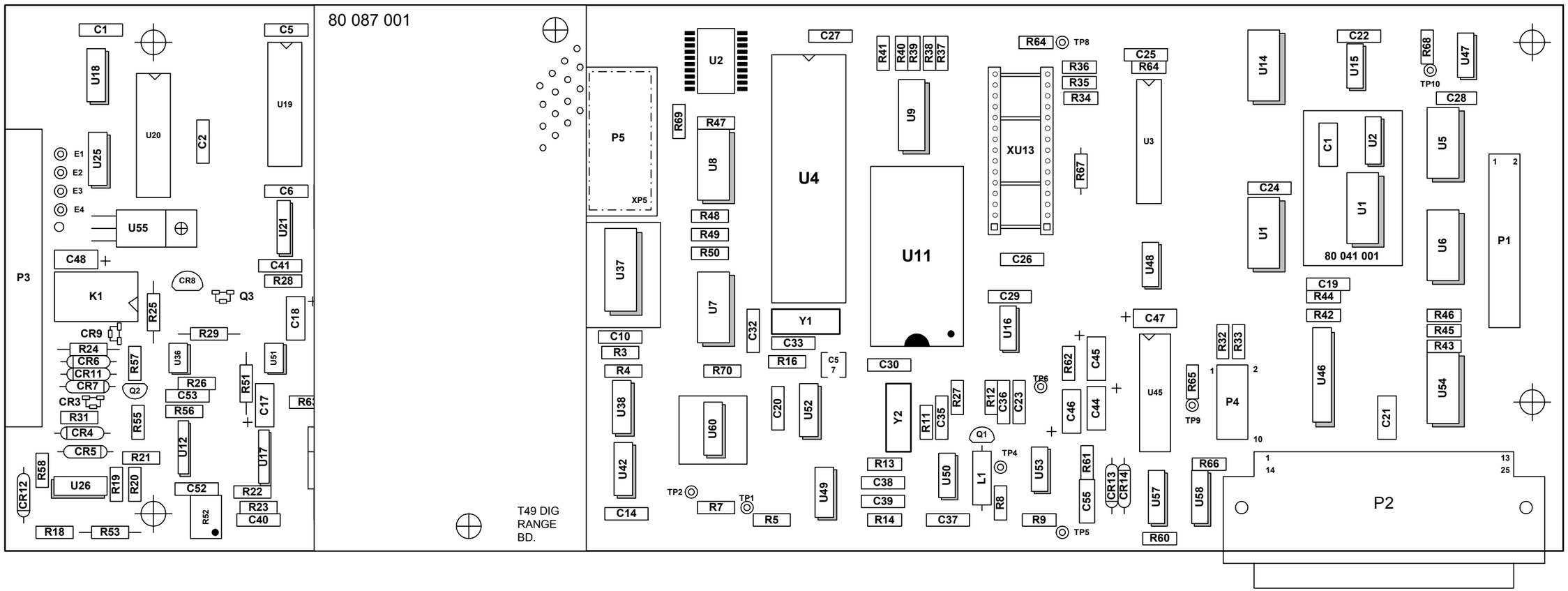
PCB Assembly, Direct Connect			80 197 004 (A16)			
Item No.	**Ref. Designation**	**Nomenclature**	**Tel Designation**	**Vendor P/N**	**Resource**	**Qty.**
1		Drilling and Fabrication, Direct Connect PCB (REV A)	**80094002**			1
2	AT1	Attenuator, 125W, 20db	**44002003**	A210-20-125	JFW	1
3	C3	Cap, SM, Trimmer, 2.8-12.5pf	**42260013**	24AA071	MOUSER	1
4	R2	Resistor, Chip, RC1206 5%, 27 Ohm	**41160012**			1
5	R4, R6	Resistor, Chip, RC1206 5%, 10 Ohm	**41160052**			2
6	R9	Resistor, Chip, RC1206 5%, 43 Ohm	**41160061**			1
7	R5	Resistor, Chip, RC1206 5%, 68 Ohm	**41160100**			2
8		Contact Strip, 1.65 lg.	**55075002**		INST. SPEC.	2



TAP-135 Anti-Radiation Hat PCB Assembly

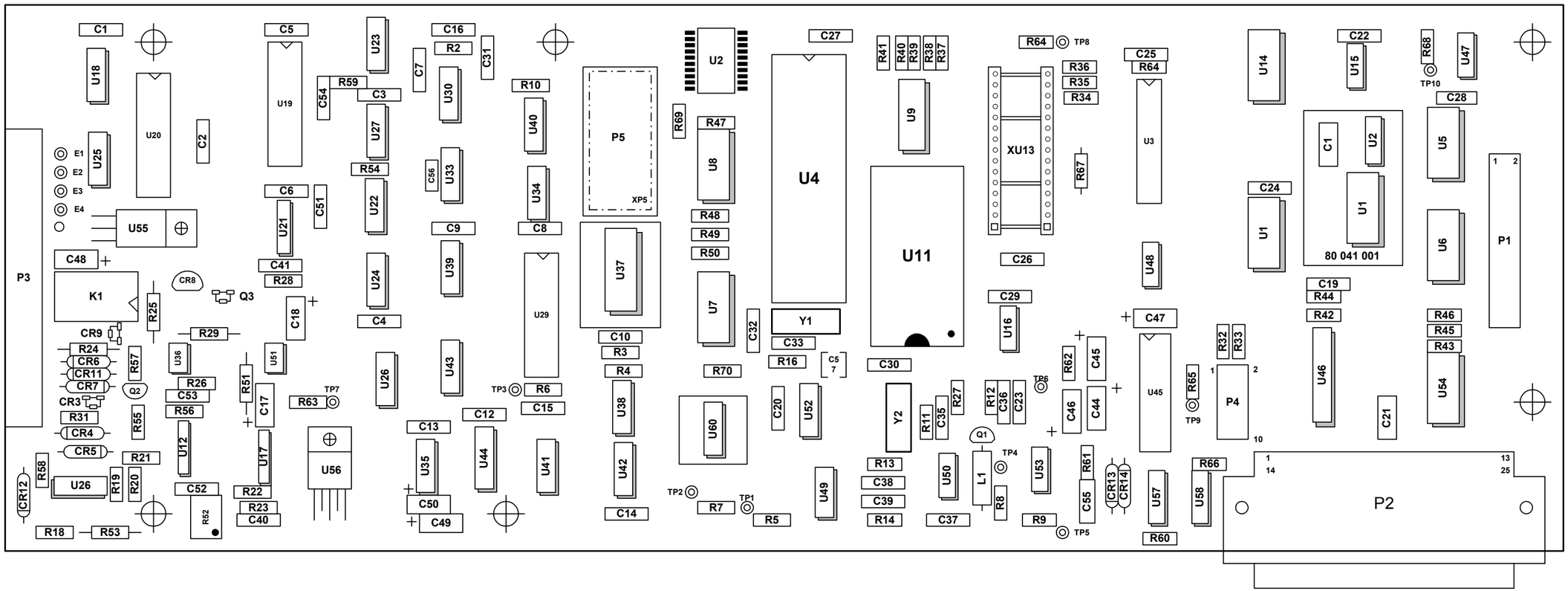
Figure 6-10

PCB Assembly, TAP-135			80 198 004 (A14)			
Item No.	**Ref. Designation**	**Nomenclature**	**Tel Designation**	**Vendor P/N**	**Resource**	**Qty.**
1		Drilling and Fabrication, ARC PCB (REV A)	**80094002**			1
2	AT1	Attenuator, 125W, 20db	**44002003**	A210-20-125	JFW	1
3	C3	Cap, SM, Trimmer, 2.8-12.5pf	**42260013**	24AA071	MOUSER	1
4	R6, R4	Resistor, Chip, 18 Ohm, RC1206	**41160038**			2
5	R2	Resistor, Chip, 27 Ohm, RC1206	**41160012**			1
6	R9	Resistor, Chip, 33 Ohm, RC1206	**41160007**			1
7	R5	Resistor, Chip, 61.9 Ohm, RC1206	**41101077**			1
8		Contact Strip, 2.20” LG.	**55075002**	97-110-01	INST. SPEC.	2



Digital PCB Assembly (1 of 2)

Figure 6-11 (a)



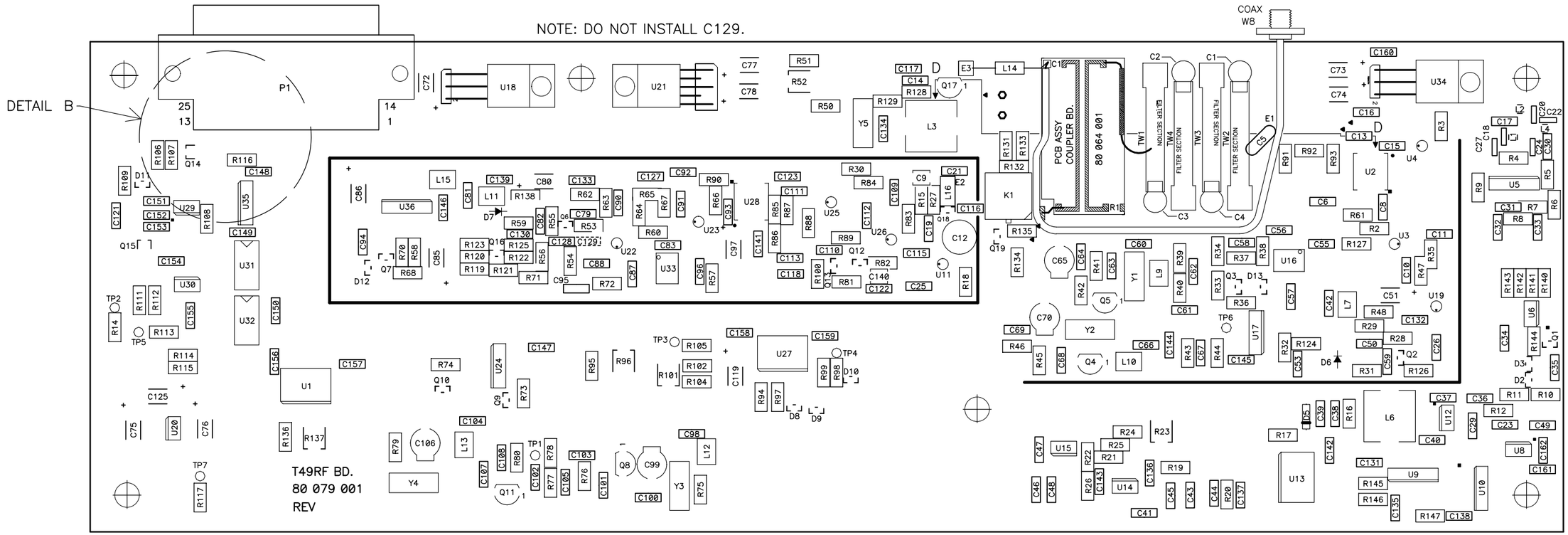
Digital PCB Assembly (2 of 2)

Figure 6-11 (b)

Digital PCB Assembly (1 of 3)			80 065 004 (A7)			
Item No.	**Ref. Designation**	**Nomenclature**	**Tel Designation**	**Vendor P/N**	**Resource**	**Qty.**
1		Blank Bd. Drilling and Fabrication (REV. E)	**80065002**			1
2	U1,U2,U5,U6,U7,U8,U54	I.C.-SM	**40201013**	MM74HC574WM		7
3	U3	I.C.-SM	**40200036**	DAC0832LCN	Nat'l Semicond.	1
4	U4	I.C.	**40200027**	80C31BH	Nat'l Semicond.	1
5	U10, U12	I.C.-SM	**40201015**	CD4025BCM	Intel	2
6	U11	I.C.	**40200103**	BQ4010YMA-85C	Benchmarq	1
7	R30	Trimpot, SM, 1K	**41050007**	3314G-1-102E	Bourns	1
8	U14	I.C.-SM	**40201018**	MM74HC4514WM	Nat'l Semicond.	1
9	U15, U16, U48	I.C.-SM	**40201019**	MM74HC04M	Nat'l Semicond.	3
10	U17	I.C.-SM	**40201020**	CD4060BCM	Nat'l Semicond.	1
11	U18,U21,22, U38,U41,U50,53,58	I.C.-SM	**40201021**	MM74HC74AM	Nat'l Semicond.	8
12	U19, U20	I.C.	**40200077**	MM74HC160N	Nat'l Semicond.	2
13	U23, U43, U44	I.C.-SM	**40201022**	MM74HC161M	Nat'l Semicond.	3
14	U24	I.C.-SM	**40201033**	MM74HC112D	Nat'l Semicond.	1
15	U25, U42, U49	I.C.-SM	**40201034**	MM74HC02M	Nat'l Semicond.	3
16	U26, U27	I.C.-SM	**40201035**	MM74HC08M	Nat'l Semicond.	2
17	U37	I.C.-SM	**40201151**	7202LA25SO	I D T	1
18	U29	I.C.	**40200082**	MM74HC157N	Nat'l Semicond.	1
19	U30	I.C.-SM	**40201036**	MC74HC109D	Nat'l Semicond.	1
20	U33, U34, U52	I.C.-SM	**40201037**	74AC163SC	Fairchild	3
21	U35, U40	I.C.-SM	**40201038**	MM74HC00M	Nat'l Semicond.	2
22		Blank Bd. Drilling and Fabrication (REV. E)	**80065002**			1
23	U1,U2,U5,U6,U7,U8,U54	I.C.-SM	**40201013**	MM74HC574WM		1
24	U3	I.C.-SM	**40200036**	DAC0832LCN	Nat'l Semicond.	1
25	U4	I.C.	**40200027**	80C31BH	Nat'l Semicond.	1
26	U47	I.C.-SM	**40201041**	MM74HC51M	Nat'l Semicond.	1
27	U9	I.C.-SM	**40201014**	MM74HC573WM	Nat'l Semicond.	1
28	U51	I.C.-SM	**40201012**	ICL7660CSA	Maxim	1
29	Q1	Transistor	**40001005**	J-309		1
30	Q2	Transistor	**40001012**	VN10LM	Siliconix	1

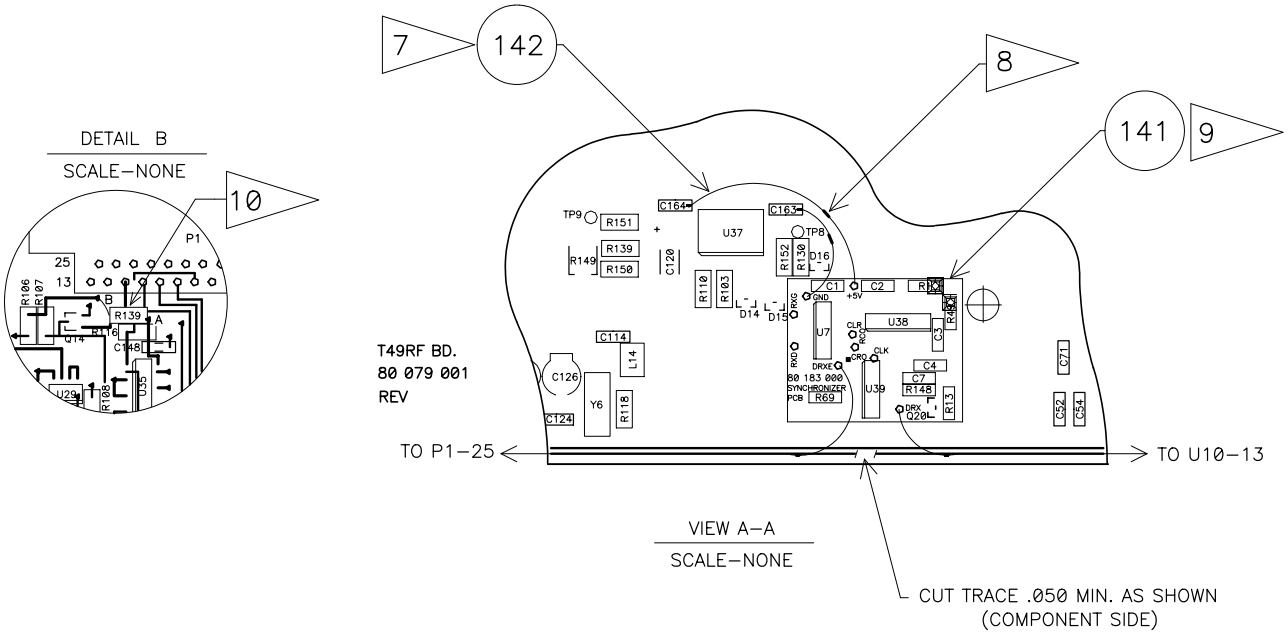
Digital PCB Assembly (2 of 3)			80 065 004 (A7)			
Item No.	**Ref. Designation**	**Nomenclature**	**Tel Designation**	**Vendor P/N**	**Resource**	**Qty.**
31	Q3	Transistor-SM	**40001014**	MMBT2907A	Siliconix	1
32	CR11, CR12	Diode	**40010007**	1N6263	Texas Instrum.	2
33	U60	I.C.-SM	**40201049**	CD4053D	Nat'l Semicond.	1
34	CR3, CR9	Diode-SM	**40010014**	MMBD914	Nat'l Semicond.	2
35	CR4-CR7	Diode	**40010012**	1N4003		4
36	CR8	Diode	**40200040**	LM336BZ2.5	Nat'l Semicond.	1
37	Y1	Crystal 12.000MHZ	**40040016**		Bomar	1
38	Y2	Crystal 20.000MHZ	**40040006**		Bomar	1
39	C1-C6, C8-C10, C12-C16, C19-C30, C36, C37, C52	Cap. Chip X7R 0.01uf	**42020001**			29
40	C7, C38, C39, C51, C59	Cap. Chip NPO 100pf	**42025025**			5
41	C35	Cap. Chip NPO 47pf	**42025021**			1
42	C32, C33	Cap. Chip NPO 33pf	**42025019**			2
43	C31	Cap. Chip X7R 27pf	**42020007**			1
44	C41	Cap. Chip X7R 0.1uf	**42020013**			1
45	C17, C18, C44-C50	Cap. Elect 22uf/16V	**42480001**	PCT-3226-ND	Digikey	9
46	C57	Cap. Elect 10uf/16V	**42185030**	ECE-V1CA100R	Panasonic	1
47	R12	Res. Chip 5% 270 OHM	**41160001**			1
48	R1,R3-R9,R31,R34-R46, R55,R56,R62-R66,R68,R69	Res. Chip 5% 1K	**41160003**			31
49	R28	Potentiometer, SM, 100Ohm	**41050004**	3314G-1-101E	Bourns	1
50	R32, R33	Res. Chip 5% 2K	**41160030**			2
51	R11	Res. Chip 5% 47K	**41160031**			1
52	C56	Cap. Cerm 100pf	**42000031**	CN15C101J	Centra-Labs	1
53	R22, R23	Res. Chip 5% 240K	**41160035**			2
54	R75	Res. Carb 5% RCR07G 10K	**41140014**			1
55	R29	Res. MF 1% RN55C 4.99K	**41000029**			1
56	R24	Res. MF 1% RN55C 5.90K	**41000030**			1
57	R25	Res. MF 1% RN55C 1.58K	**41000031**			1
58	P2	Conn. Rt. Angle 25 Pin	**48000025**	927M21-01-25-30	3M	1
59	P1	Conn. 26 Pin	**48000021**	622-2614ES	T & B	1
60	P4	Conn. 10 Pin	**48000022**	842-800-560-005	Spectra	1
61	P3	Conn. 25 Pin	**48000026**	2-103670-4	AMP	1
62	XU13	Socket-I.C. 28 Pin	**48064001**	RN-ICN-286-S5T	Rob-Nugent	1
63	K1	Relay	**48005001**	FBR46ND012P	Fujitsu	1
64	L1	Inductor 10uh	**43011013**	1641-103	Delevan	1
65	R2, R10, R60, R70	Res. Chip 5% 4.7K	**41160013**			4
66	R13-21,R26,R27, R47-50,R54,R57, R58,R61	Res. Chip 5% 10K	**41160015**			19
67	U56	Voltage Reg.	**56060001**	LM2931CT		1

Digital PCB Assembly (3 of 3)			80 065 004 (A7)			
Item No.	**Ref. Designation**	**Nomenclature**	**Tel Designation**	**Vendor P/N**	**Resource**	**Qty.**
68	U55	Voltage Reg.	**56060003**	LM7805CTH		1
69	R51	Res. MF 1% RN55C 2.49K	**41000014**			1
70	R53	Res. MF 1% RN55C 21.5K	**41000004**			1
71	R52	Res. Var 1K	**41700013**	RT24C2W102		1
72	E1-E4, TP1-TP10	Terminal Double-Turret	**55025002**	160-2043-02-01	Cambion	14
73	C40	Cap. Chip 5% X7R 0.22uf	**42020065**	C1206C224K3RAC	Kemet	1
74	C55	Cap. Chip 5% X7R 2200pf	**42020015**			1
75	C53	Cap. Chip 5% X7R 1000pf	**42020005**			1
76	R59	Res. Chip 5% 15K	**41160041**			1
77	C54	Cap. Chip 5% X7R 150pf	**42020010**			1
78	CR13, CR14	Diode	**41010005**	1N4148	Nat'l Semicond.	2
79	U57	I.C.-SM	**40201044**	LM319M	Nat'l Semicond.	1
80	R67	Res. MF 1% RN55C 33.2K	**41000034**			1
81	N/A	Screw P.H. 4-40 X 5/16LG	**50110009**	MS-51957-14		2
82	N/A	Washer Flat No. 4	**52010002**	MS-15795-804		2
83	N/A	Washer Lock No. 4	**52020002**	MS-35338-135		2
84	N/A	Nut Hex No. 4	**53010002**	MS-35649-244		2
85	N/A	Washer, Lock No.6	**52020001**	MS-35338-136		4
86	XY1, XY2	Mount Crystal	**55080002**	470-025	Bivar	2
87	N/A	Washer Black Fiber	**52062003**			1
88	P5	Conn. Socket 16 Pin	**48000044**	609-F161M	T & B	1
89	XP5	Header 16 Pin	**55050003**	609-1678	T & B	1
90		Pcb Assy, Digital Range	**80087001**			1
91		Standoff, 1/4 Hex (F), 3/16 Lg.	**52400010**	2099-632-SS-20	RAF	2
92		Screw P.H. 6-32 X 3/16 Lg.	**50110033**	MS51957-25		2
93		Cable Assy, Digital Range to Digital	**75010016**			1
94		Drilling and Fabrication	**80160002**			1
95		Drilling and Fabrication	**80161002**			1
96		Wire, Kynar, 28AWG, Blk	**72628001**	461-0	Olympic	A/R
97	N/A	Washer, Flat No. 6	**52010001**	MS-15795-805		2
98		Breadboard, PCB	**63030002**			1
99		PCB Assembly	**80041001**			1
100		Fish Paper, PCB Insulator	**31000022**			1



RF PCB Assembly (1 of 2)

Figure 6-12 (a)



RF Board PCB Assembly (2 of 2)

Figure 6-12 (b)

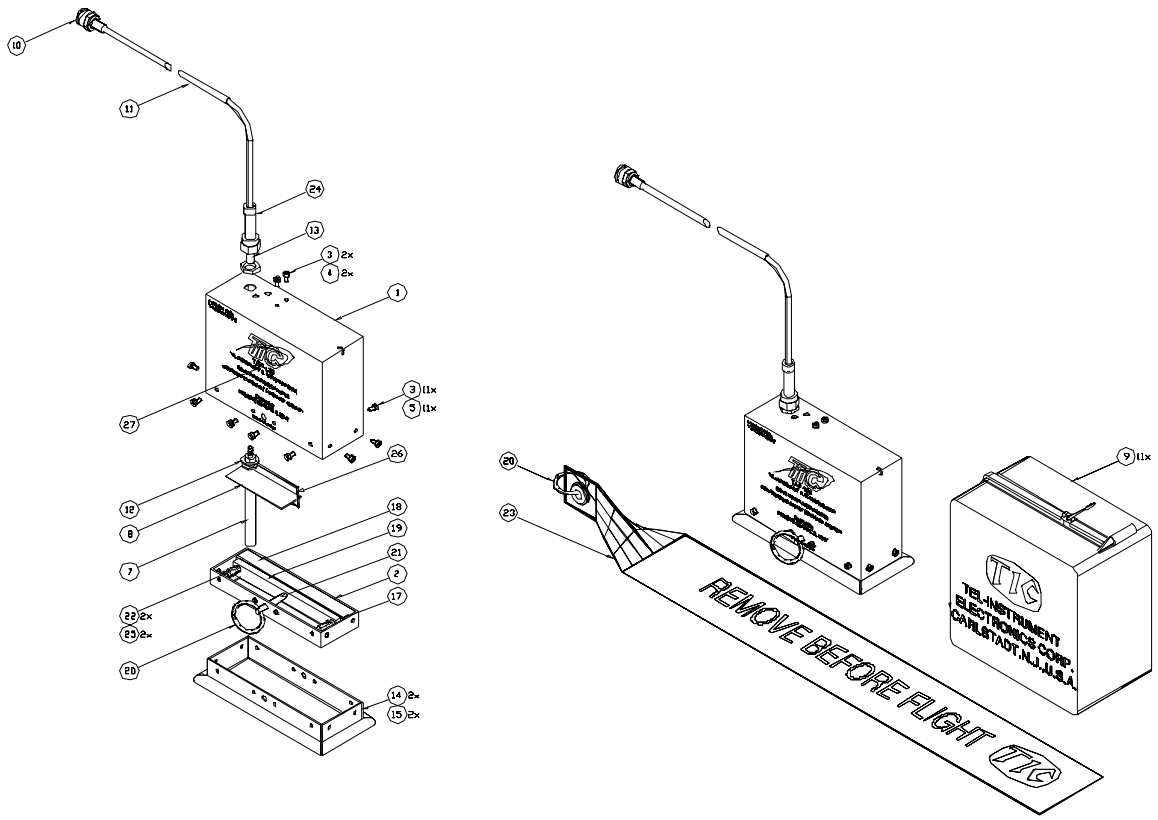
RF PCB Assembly (1 of 5)			80 079 004 (A9)			
Item No.	**Ref. Designation**	**Nomenclature**	**Tel Designation**	**Vendor P/N**	**Resource**	**Qty**
1	A3	Blank Bd. Drilling (REV. A)	**80079002**			1
2	U3,U4,U11, U19,U22-23,U25-26	I.C. RF-Amp. 12dB@1GHz, SM, 86 Plastic	**40201087**	MAR-3SM	Mini-Circuits	8
3	U5	I.C. Precision Limiting-Logarithmic Amp SM, SO-16	**40201166**	AD8306AR	Analog Devices	1
4	U30	I.C. OpAmp. SM, SO-8	**40201007**	TLO81CD	Texas Instrum.	1
5	U14, U15	I.C. OpAmp. SM, SO-8	**40201008**	TLO82CD	Texas Instrum.	2
6	U13	I.C. Dual 4-Channel Analog Multiplexer, SM, M16-B	**40201009**	MM74HC4052WM	Nat'l Semicond	1
7	U17, U24	I.C. Quad 2-InputExclusive OR Gate, SM, SO-14	**40201005**	MM74HC86M	Nat'l Semicond	2
8	U16	I.C.Two Modulus Prescaler 1.1GHz, SM, FPT-08P-M01	**40201003**	MB501LFP	Fujitsu	1
9	U35	I.C. Hex Inverting Schmitt Trigger, SM, SO-14	**40201010**	MM74HC14M	Nat'l Semicond	1
10	U1, U27	I.C.Quad Analog Switch with Lev.Translation,SM,M16-B	**40201011**	MM74HC4316WM	Nat'l Semicond	2
11	U8, U29	I.C.Dual Supply Comparator, SM, SO-8	**40201182**	LT1719IS8	Linear	2
12	U12	I.C.Double-balanced Mixer with Oscillator, SM, SO-8	**40201145**	SA602AM	Philips	1
13	U20	I.C. Voltage Inverter, SM, SO-8	**40201012**	ICL7660CSA	Maxim	1
14	U18	I.C. Voltage Reg. +5V, TO-220	**56060003**	LM7805CTH	Motorola	1
15	U34	I.C. Voltage Reg.+6V, TO-220	**56060004**	LM7806CTH	Motorola	1
16	U21	I.C. Voltage Reg.+10V, TO-220	**56060005**	LM2941CT	Nat'l Semicond	1
17	U31, U32	I.C. 8-Bit Serial A/D Converter, DIP-8	**40200052**	TLC548IP	Texas Instrum.	2
18	U2, U28	I.C. Mixer-RF, SM	**40201086**	RMS11-F	Mini-Circuits	2
19	Q1, Q3, Q13, Q19	Transistor-SM, SOT-23, N-P-N	**40001011**	MMBT2222A	Nat'l Semicond	4
20	Q9, Q10, Q12	Transistor-SM, SOT-23, P-N-P	**40001014**	MMBT2907A	Nat'l Semicond	3
21	Q4, Q5, Q8, Q11, Q17	Transistor	**40001005**	J-309		5
22	Q2, Q6, Q18	Transistor, High Frequency, SM,	**40001013**	NE02133	NEC	3
23	Q14, Q15	Transistor-SM, SC-59, N-Channel	**40001030**	VN10KC	Vishey	2
24	R41, R45, R76, R80	Res. Chip 5% RC1206; 270 OHM	**41160001**			4
25	R7, R8	Res. Chip 5% RC1206; 200 OHM	**41160067**			2
26	R14,R19,R20,R33,R56, R58,R88,R95,R98,R99, R102,R113, R116,R117, R123,R125, R145,R147	Res. Chip 5% RC1206; 1K	**41160003**			18
27	R37, R71, R29	Res. Chip 5% RC1206; 2.7K	**41160004**			3
28	R16,R83, R84	Res. Chip 5% RC1206; 180 OHM	**41160006**			3
29	R3	Res. Chip 5% RC1206; 30 OHM	**41160018**			1

RF PCB Assembly (2 of 5)			80 079 004 (A9)			
Item No.	**Ref. Designation**	**Nomenclature**	**Tel Designation**	**Vendor P/N**	**Resource**	**Qty**
30	R38, R72, R119, R124	Res. Chip 5% RC1206; 2.2K	**41160008**			4
31	R18	Res. Chip 5% RC1206; 150 OHM	**41160009**			1
32						
33	R9,R36,R48 ,R67,R70,R 86, R87,R107,R 122,R126-127,R138	Res. Chip 5% RC1206; 100 OHM	**41160011**			12
34	R25	Res. Chip 1% NRC12TR 1/8W 30.9K	**41101336**			1
35	R32, R134	Res. Chip 5% RC1206; 4.7K	**41160013**			2
36	R65	Res. Chip 5% RC1206; 51 OHM	**41160043**			1
37	R21-22,R28,R34, R39-40,R43-44,R59,R68, R73,-74,R106,R135-136	Res. Chip 5% RC1206,10K	**41160015**			15
38	R15	Res. Chip 5% RC1206, 68 OHM	**41160016**			1
39	R82, R89	Res. Chip 5% RC1206, 560 OHM	**41160017**			2
40	R31,R91,R93-94,R97,R105,R108,R128	Res. Chip 5% RC1206, 470 OHM	**41160021**			8
41	R55	Res. Chip 5% RC1206, 2K	**41160030**			1
42	R10, R53	Res. Chip 5% RC1206, 330 OHM	**41160023**			2
43	R11,R17,R24,R77-78,R120-121	Res. Chip 5% RC1206, 27K	**41160024**			7
44	R5, R6, R92	Res. Chip 5% RC1206; 10 OHM	**41160052**			3
45	R12	Res. Chip 5% RC1206, 270K	**41160026**			1
46	R81, R141	Res. Chip 5% RC1206; 680 OHM	**41160027**			2
47	R54	Res. Chip 5% RC1206, 22 OHM	**41160028**			1
48	R100	Res. Chip 5% RC1206, 3.3K	**41160029**			1
49	R60, R64, R85	Res. Chip 5% RC1206, 75 OHM	**41160040**			3
50	R42,R46,R75,R79,R129, R139	Res. Chip 5% RC1206, 47K	**41160031**			5
51	R104	Res. Chip 5% RC1206, 82 OHM	**41160032**			1
52	R109	Res. Chip 5% RC1206,10M	**41160033**			1
53	R2, R35, R47, R61	Res. Chip 5% RC1206, 110 OHM	**41160044**			4
54	R57	Res. Chip 5% RC1206, 18 OHM	**41160038**			1

RF PCB Assembly (3 of 5)			80 079 004 (A9)			
Item No.	**Ref. Designation**	**Nomenclature**	**Tel Designation**	**Vendor P/N**	**Resource**	**Qty**
55	R62, R63, R66, R90	Res. Chip 5% RC1206, 91 OHM	**41160019**			4
56	R50	Res. Chip MF 1% RC1206; 21.5K	**41101321**			1
57	R111	Res. Chip MF 1% RC1206; 4.99K	**41101260**			1
58	R114, R115, R140, R144	Res. Chip MF 1% RC1206; 10.0K	**41101289**			4
59	R112	Res. Chip.MF 1% RC1206; 12.1K	**41101297**			1
60	R51	Res. Chip.MF 1% RC1206; 2.49K	**41101231**			1
61	R52	Pot., SM, 1K	**41050007**	3314G-1-102	Bourns	1
62	R96, R101	Pot., SM, 10K	**41050010**	3314G-1-103E	Bourns	2
63	R23	Pot., SM, 100K	**41050013**	3314G-1-104	Bourns	1
64	P1	Conn. Rt. Angle 25 Pin	**48000025**	927M21-01-25-30	3M	1
65	A6	PCB Assy Coupler Bd.	**80064001**			1
66	K1	Relay	**46002004**	172D-12	Teledyne	1
67	C15,C31,C32,C40,C41, C43,C44,C47-49,C60,C63, C68,C87,C98, C101,C104, C108,C123, C142-151,C153-161	Cap. Chip 5% X7R, CC1206; 0.01uf	**42020001**			38
68	C8,C45,C46,C53,C61,C66,C83,C88, C90,C91,C93-94,C96,C111	Cap. Chip 5% X7R, CC1206; 100pf	**42020002**			14
69	C6,C11,C10,C14,C21,C23,C29,C39, C42,C55,C56,C57,C58, C79,C81,C92,C95,C113, C122,C127, C131-C133,C134, C136-C139	Cap. Chip 5% X7R, CC1206; 1000pf	**42020005**			28
70						
71	C19,C64,C69,C110,C116,C117,C118,C26	Cap. Chip 5% X7R, CC1206; 47pf	**42020004**			8
72	C135	Cap. Chip 5% NPO, CC1206; 33pf	**42025019**			1
73						
74	C16,C30,33-36,C121,C152,C162	Cap. Chip 5% X7R, CC1206; 0 .1uF	**42020013**			9

RF PCB Assembly (4 of 5)			80 079 004 (A9)			
Item No.	**Ref. Designation**	**Nomenclature**	**Tel Designation**	**Vendor P/N**	**Resource**	**Qty**
75						
76	C17	Cap. Chip 5% NPO, CC1206; 150pf	**42025027**			1
77	C37, C82	Cap. Chip 5% NPO, CC1206; 10pf	**42025013**			2
78	C62,C67,C100,102,103,105,107	Cap. Chip 5% X7R, CC1206; 68pf	**42020012**			7
79	C141	Cap. Chip 5% X7R, CC1206;	**42020020**			1
80	C51,C72-78,C80,C85-86,C97,C119,C125	Cap. Elect. 22uf/16V	**42480001**	PCT3226-ND	Panasonic	14
81	C5	Cap. Cerm 100pf	**42000031**	CN15C101J	C' Lab	1
82	C109	Cap. Chip 5% NPO, CC1206; 270pf	**42025030**			1
83	C1-C4	Cap. Trimmer 1.8-6.0pf	**42260011**	24AA020	Mouser	4
84	U9	I.C. Dual Retrig. Monostable Multivibrator, SM, SO-16	**40201146**	MM74HC4538M	Nat'l Semicond	1
85	C65, C70, C99, C106	Cap. Trimmer 3.5-20pf	**42260002**	24AA022	Mouser	4
86	D12, D13	Diode Shotky, SM	**40010016**	ZC2800	Zetex	2
87	D2, D3, D8-D11	Diode General, SM	**40010014**	MMBD914	Nat'l Semicond	6
88	D5-D7	Diode Tuning	**40010011**	KV3201	Freq. Sources	3
89	Y4	Crystal 4.2578125MHZ	**40040019**		Bomar	1
90	Y1	Crystal 8.3984375MHZ	**40040015**		Bomar	1
91	Y3	Crystal 4.0234225MHZ	**40040018**		Bomar	1
92	Y2	Crystal 8.1640625MHZ	**40040008**			1
93	L3, L6	Inductor 330nHy	**43011009**	BTKXNS-T1047Z	Toko	2
94	C12	Cap. Trimmer 2.5-10pf	**42260008**	9611	Johanson	1
95	L1, L4	Inductor-SM, 1008; 39nHy	**43011067**	ELJ-NC39NKF	Panasonic	2
96	L2	Inductor-SM, 1008; 1.5uHy	**43011068**	FSLM2520-1R5J	Toko	1
97	L14	Inductor .47uh	**43011008**	1641-471	Delevan	1
98	TW1-TW4	Filter	**43020001**			4
99	TP1-TP5	Terminal	**55025008**	TP-105-01-09(white)	Comp. Corp.	5
100	N/A	Shield, Isolation	**31020044**			1
101	N/A	Shield, Isolation	**31020045**			1
102	W8	Coax Assy	**75010033**			1
103	XY1-XY5	Crystal Mt.	**55080002**	470-025	Bivar	5
104	Q7, Q16	Transistor-SM	**40001017**	MMBT918L		2
105	L7, L11, L15	Inductor SM, 43FS; 4.7uh	**43011031**	300LS-4R7K	Toko	3
106	U6	Rail-to-rail I/O Amp, 80MHz, SM, SO-8	**40201150**	AD8032AR	Analog Devices	1
107	U36	I.C. CMOS Phase Lock Loop, SM, SO-16	**40201042**	MM74HC4046M		1
108	L9, L10, L12, L13	Inductor SM, 43FS; 100uh	**43011018**	300LS-101J	Toko	4
109	U33	I.C.Two Modulus Prescaler, 1.6GHz, SM, FPT-08P-MO1	**40201043**	MB505LFP		1
110	C13, C59, C128	Cap. Chip 5% NPO, CC1206; 3.3pf	**42025007**			3
111	Y5	Crystal 45MHZ	**40040020**		Bivar	1
112	C9	Cap. Elect 3.3uf/16V	**42480003**	PCT3335-ND	Panasonic	1
113	L16	Coil Formed 1T 5/32 Dia. 24AWG	**43025023**			1
114	N/A	Screw P.H. 4-40 X 5/16Lg	**50110009**	MS-51957-14		3

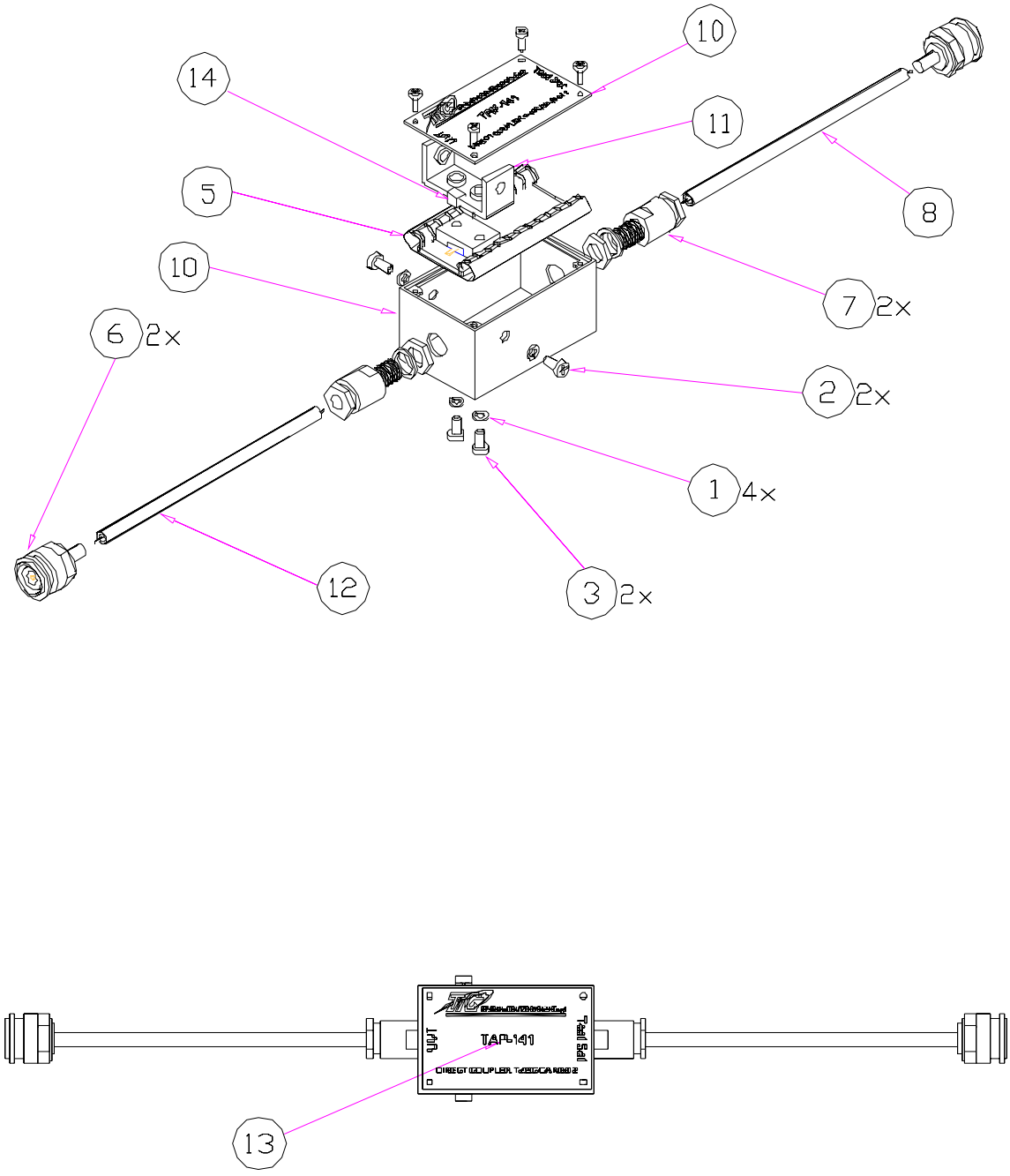
RF PCB Assembly (5 of 5)			80 079 004 (A9)			
Item No.	**Ref. Designation**	**Nomenclature**	**Tel Designation**	**Vendor P/N**	**Resource**	**Qty**
115	N/A	Washer Flat No. 4	**52010002**	MS-15795-804		3
116	N/A	Washer Split-Lock No. 4	**52020002**	MS-35338-135		3
117	N/A	Nut Hex No. 4	**53010002**	MS-35649-244		3
118		Solder	**31007502**	60/40 SN60BS	Alpha Metals	A/R
119	R30	Res. Chip 5% RC1206; 240 OHM	**41160045**			1
120	R27	Res. Chip 5% RC1206; 510 OHM	**41160046**			1
121	C112, C115, C130	Cap. Chip 5% X7R, CC1206; 330pf	**42020018**			3
122	N/A	Washer Nylon	**52062002**	5610-214-20	Seastrom	4
123	R146	Res. Chip 5% RC1206; 5.1K	**41160082**			1
124	R131, R133	Res. Chip 1% RC1206; 66.5 Ohm	**41101080**			2
125	R132	Res. Chip 1% RC1206; 191 Ohm	**41101124**			1
126	U10	I.C. Quad 2-Input NOR Gate, SM, SO-14	**40201034**	MM74HC02D	Nat'l Semicond	1
127	C25	Cap. Chip 5% NPO, CC1206; 620pf	**42025046**			1
128	C140	Cap. Chip 5% CC1210 1uf	**42026001**			1
129	R26	Res Chip 5% 20K	**41160092**			1
130	C50, C38	Cap Chip 5%, NPO, CC1206; 15pF	**42025015**			2
131	C20	Cap. Chip NPO CC0805; 8pF	**42040005**	ECU-V1H080DCN	Panasonic	1
132	C24, C27	Cap. Chip NPO CC0805; 150pF	**42040004**	ECU-V1H151JCG	Panasonic	2
133	C18, C22	Cap. Chip NPO CC0805; 270pF	**42040006**	ECU-V1H271JCG	Panasonic	2
134		Wire, Tefl Insul., Stranded 26AWG, Blk	**72626007**	5853-2	Alpha	A/R
135	R4	Res Chip 1% RC1206; 52.3 Ohm	**41101070**			1
136	R142	Res Chip 1% RC1206; 1.69 K	**41101215**			1
137	R137	Pot., SM, 5K	**41050009**	3314G-1-502	Bourns	1
138		Cover, RF Shielding	**62040006**			1
139		Washer, Split-Lock No. 4	**52020002**	MS35338-135		4
140		Screw, P.H. 4-40 X 1/4 Lg.	**50110007**	MS51957-13		4
141		Synchronizer PCB Assy.	**80183001**			1
142		Wire, Kynar, Insulated 28 Awg.	**72628001**	461-4	Olympic	AR



TAP-135 Assembly

Figure 6-13

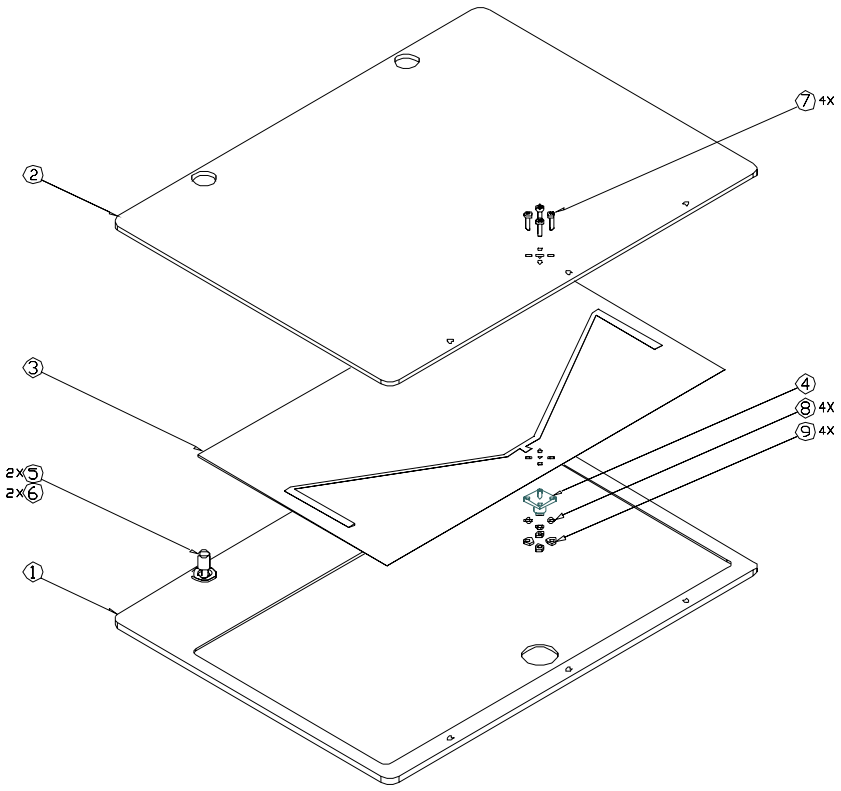
TAP-135 Sub-Assembly			89 004 145 (A13)			
Item No.	**Ref. Designation**	**Nomenclature**	**Tel Designation**	**Vendor P/N**	**Resource**	**Qty**
1		CAN	**64050014**			1
2		FRAME, INNER	**64050015**			1
3		WASHER, LOCK, #4	**52020002**	MS35338-135		13
4		SCREW, PAN HEAD, #4-40 X 1/2" LONG	**50110002**	MS51957-17		2
5		SCREW, PAN HEAD, #4-40 X 5/16" LONG	**50110009**	MS51957-14		11
6						
7		ANTENNA, TUBE ASSEMBLY	**40030006**			1
8		PCB ASSEMBLY, ARC	**80198001**			1
9		POUCH (OPTIONAL)	**64030023**			1
10		CONNECTOR, STRAIGHT, TNC	**48040018**	31-2367	AMPHENOL	1
11		WIRE, COAXIAL, FLEXIBLE	**71110001**	8262 OR EQUIVALENT	BELDEN	10"
12		CONNECTOR, COAX, 1/2 HEX	**48040033**			1
13		FERRULE, CRIMP SLEEVE	**31020071**	31-1357-2G	AMPHENOL	1
14		GASKET. RF FILTER, LARGE	**55082007**			2
15		GASKET. RF FILTER, SMALL	**55082009**			2
16						
17		GASKET, DURO 50, 1/2" X 1/4"	**55082010**			1.5'
18		PLATE, FIXED, PHENOLIC	**62070026**			1
19		PLATE, MOVABLE, PHENOLIC	**62070027**			1
20		RING, KEY	**53700002**	KR-4-Z	WORTH	2
21		ROD, PULL	**51009002**			1
22		STANDOFF, 3/16" HEX	**52400017**	4515-440-SS-40	RAF	2
23		STREAMER, WARNING	**31016001**	30042	AUW	1
24		STRAIN RELIEF, MODIFIED	**55001002**	3237(MODIFIED)	HEYCO	1
25		SPRING	**56023001**	C0300-030-1000-S	ASSOCIATED	2
26		LUG, GROUND	**55010004**	334-.375-.020	ZIERICK	1
27		SILKSCREEN, TAP-135	**57005061**			1



TAP-141 Assembly

Figure 6-14

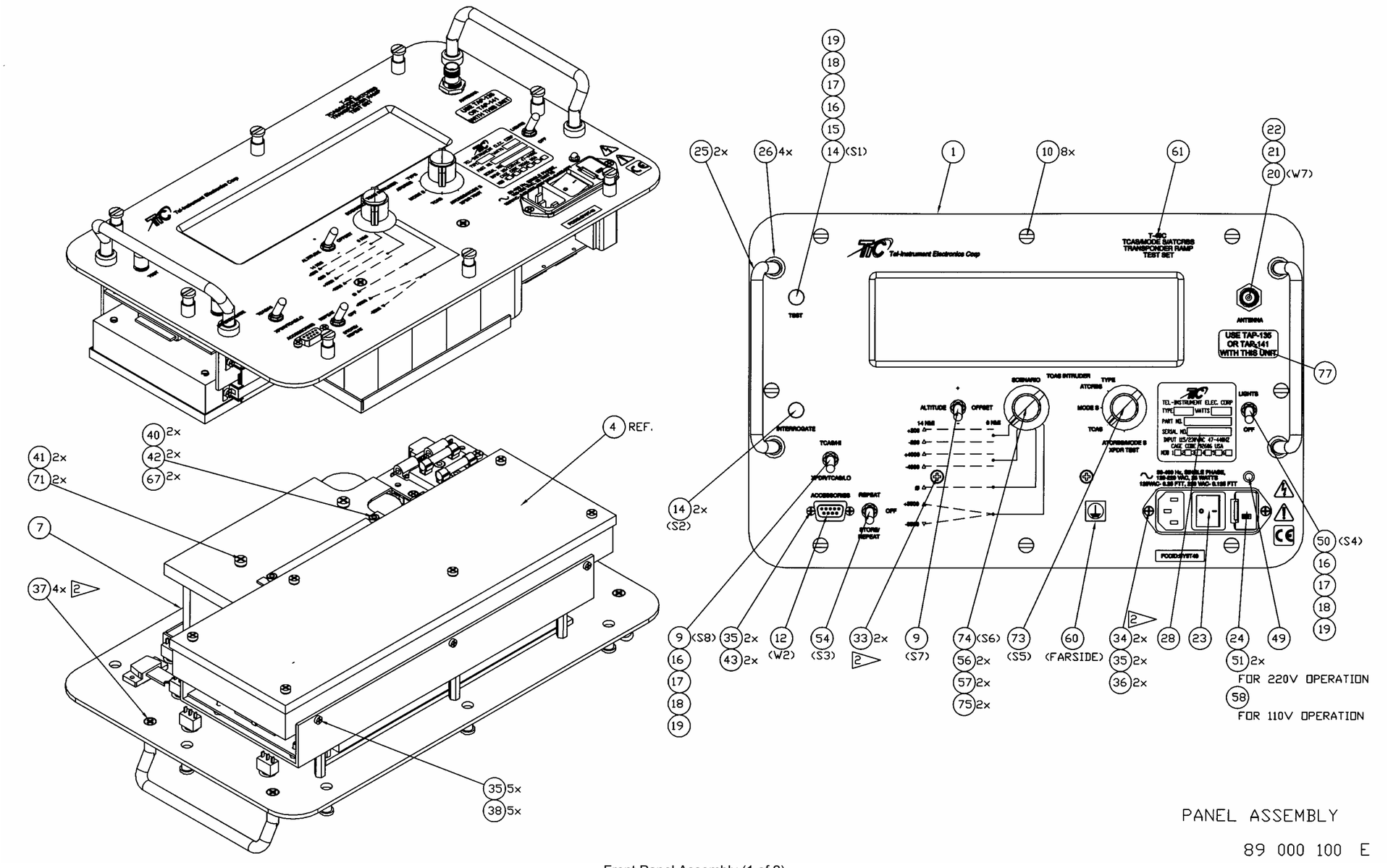
TAP-141 Sub-Assembly			89 004 147 (A15)			
Item No.	**Ref. Designation**	**Nomenclature**	**Tel Designation**	**Vendor P/N**	**Resource**	**Qty**
1		LOCKWASHER, #4	**52020002**	MS35338-135		4
2		SCREW, PAN-HEAD #4-40 X 5/8	**50110017**	MS51957-18		2
3		SCREW, PAN-HEAD #4-40 X 5/16	**50110009**	MS51957-14		2
4						
5		PCB ASSEMBLY	**80197001**			1
6		CONNECTOR, COAX, TNC	**48040018**	AMPHENOL	31-2367	2
7		CONNECTOR, COAX	**48040034**	HUBER-SUHNER	71Z-0-3-4	2
8		CABLE, COAX	**71110001**	BELDEN	RG-58C/U	12.5'
9						
10		CHASSIS, DIRECT CONNECT	**62000029**			1
11		HEAT SINK, ATTENUATOR	**54000007**			1
12		CABLE, COAX	**71110001**	BELDEN	RG-58C/U	5"
13		SILKSCREEN, CHASSIS, DIRECT CONNECT TAP-141	**57005062**			1
14		INSULATOR TAPE, KAPTON 3/8	**31006001**	DUPONT	KPT-3/8	



Directional Antenna Assembly

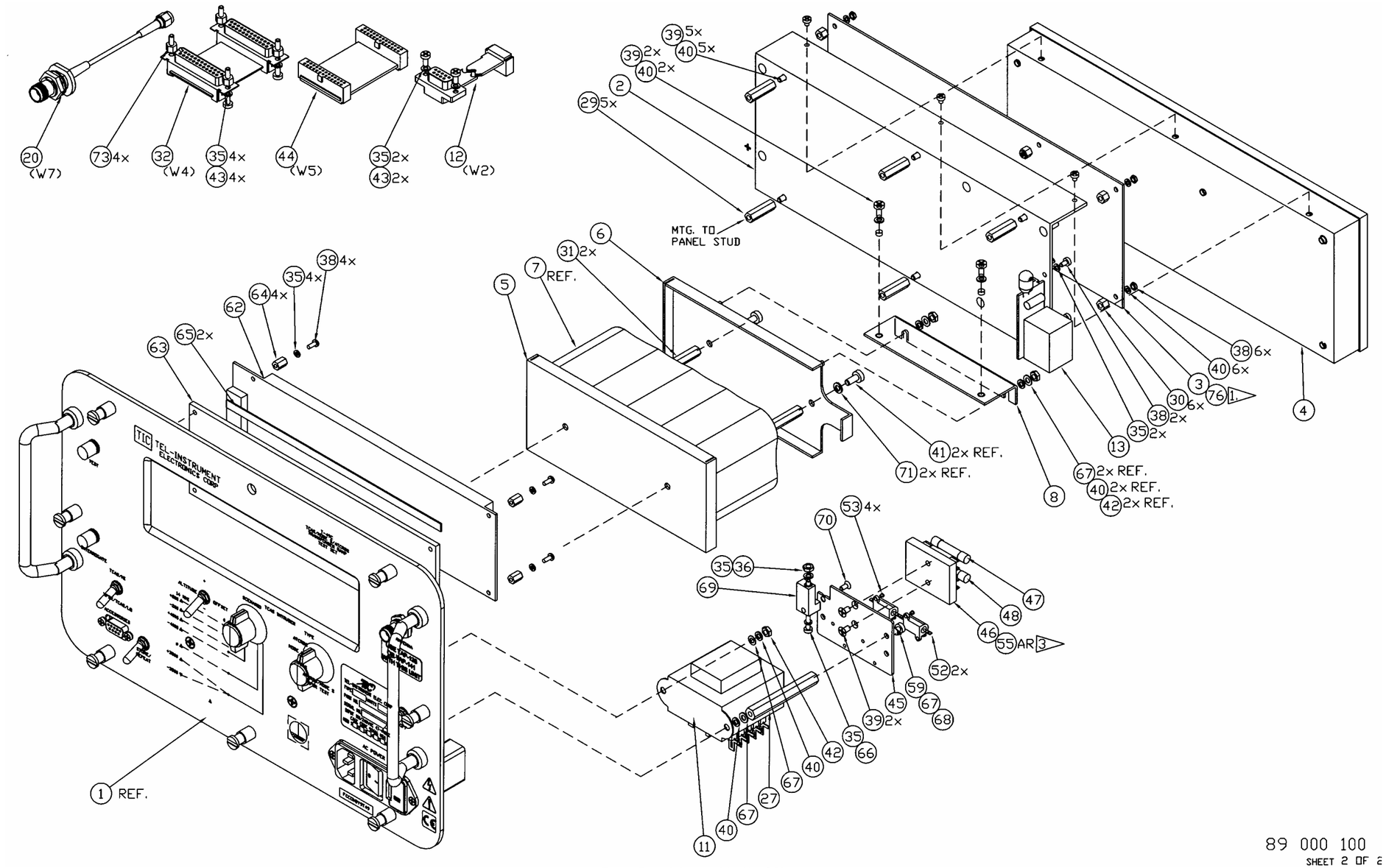
Figure 6-15

Directional Antenna Assembly			89 004 028 (A12)			
Item No.	**Ref. Designation**	**Nomenclature**	**Tel Designation**	**Vendor P/N**	**Resource**	**Qty**
1		COVER, PROTECTIVE, TOP	**62070017**			1
2		COVER, PROTECTIVE, BOTTOM	**62070018**			1
3		PCB, DIRECTIONAL ANTENNA	**80068001**			1
4		CONNECTOR, FLANGE MOUNTING	**48040017**	142-0701-631	E.F. JOHNSON	1
5		STUD	**50700001**	15S1-3-1AF	CAMLOC	2
6		RETAINER RING	**53700001**	15S11-1AD	CAMLOC	2
7		SCREW, PAN HEAD, #3-48 x 5/16 LG-CROSS SLOT	**50110018**			4
8		WASHER, SPLIT-LOCK, #3	**52020006**	92148A150	McMASTER-CARR	4
9		NUT, HEX, #3	**53010003**			4



Front Panel Assembly (1 of 2)

Figure 6-16 (a)



Front Panel Assembly (2 of 2)

Figure 6-16 (b)

T-49C Chassis Breakdown (1 of 2)			89 004 100 (A3)			
Item No.	**Ref. Designation**	**Nomenclature**	**Tel Designation**	**Vendor P/N**	**Resource**	**Qty**
1		FRONT PANEL	**61060015**			1
2		DIGITAL CHASSIS	**62000014**			1
3		DIGITAL PCB ASSEMBLY	**80065001**			1
4		RF BOX ASSEMBLY	**89000022**			1
5		BOTTOM MOUNTING BRACKET, BATTERY	**62020033**			1
6		TOP MOUNTING BRACKET, BATTERY	**62020038**			1
7		BATTERY PACK, FULL D	**48071001**			1
8		BATTERY BRACKET SUPPORT	**62020039**			1
9	S7, S8	SWITCH, TOGGLE	**46027508**	C & K	7101SHZQE	2
10		PANEL FASTENER	**56020001**	PEM	PFC2-832-94	8
11		TRANSFORMER	**43000007**	SIGNAL TRANS.	A41-25-16	1
12	W2	CABLE ASSEMBLY, ACCESSORIES	**75010030**			1
13		PCB ASSEMBLY, INVERTER	**80067001**			1
14	S1, S2	SWITCH, SPDT PUSHBUTTON	**46027506**	C & K	8168-LHZBE	2
15		BUTTON, KNOB				
16		NUT, 1/4 4-40 HEX				
17		WASHER, BLACK NYLON	**52062001**			
18		WASHER, 1/4 O.D.				
19		NUT, 1/4 4-40 HEX				
20	W7	CABLE ASSEMBLY, COAX	**75010029**			1
21		NUT, HEX 1/2-28				
22		LOCK-WASHER, INTERNAL TOOTH				
23		AC RECEPTACLE, CASING	**48035001**	SCHURTER	KD14.4101.15 1	1
24		FUSEDRAWER	**48035016**	SCHURTER	4303.2014.01	1
25		HANDLE	**56025006**	VEMALINE	BZ130-1	2
26		FERRULE	**31020035**	PROMPTUS	288-09ALC	4
27		STANDOFF, 5/16 HEX, #6-32 X 2.375 LG.	**52400057**	RAF	2198-632-SS-20	1
28		NAMEPLATE, GENERIC	**57030014**			1
29		STANDOFF, 1/4 HEX, #6-32 X 7/8	**52400009**	RAF	2110-632-SS-20	5
30		STANDOFF, 1/4 HEX, #6-32 X 3/16	**52400010**	RAF	2099-632-SS-20	6
31		STANDOFF, 1/4 HEX, #8-32 X 2.5	**52400001**	RAF	2132-832-SS-20	2
32	W4	CABLE ASSEMBLY, DIGITAL TO RF	**75010027**			1
33		SCREW, FLAT HEAD, BLACK, #8-32 X 7/16	**50140003**		MS51959-44B	2
34		SCREW, FLAT HEAD, BLACK, #4-40 X 3/8	**50140005**		MS51959-15B	2
35		WASHER, SPLIT-LOCK, #4	**52020002**		MS35338-135	21
36		NUT, HEX , #4	**53010002**		MS35649-244	3
37		SCREW, FLATHEAD, #8-32 X 3/8	**50140002**		MS51959-43	4
38		SCREW, PANHEAD, #4-40 X 1/4	**50110007**		MS51957-13	4
39		SCREW, PANHEAD, #6-32 X 5/16	**50110001**		MS51957-27	7
40		WASHER, SPLIT-LOCK, #6	**52020001**		MS35338-136	16
41		SCREW, PANHEAD, #8-32 X 3/8	**50110013**		MS51957-43	2
42		NUT, HEX, #6	**53010001**		MS35649-264	3
43		SCREW, PANHEAD, #4-40 X 5/16	**50110009**		MS51957-14	3

T-49C Chassis Breakdown (2 of 2)			89 004 100 (A3)			
Item No.	**Ref. Designation**	**Nomenclature**	**Tel Designation**	**Vendor P/N**	**Resource**	**Qty**
44	W5	CABLE ASSEMBLY, LCD TO DIGITAL	**75010028**			1
45		PLATE, MOUNTING (POWER RESISTOR/FUSE)	**62070028**			1
46		FUSE BLOCK	**48063001**	LITTLEFUSE	357002	1
47	F2	FUSE, 1A	**45100004**	BUSSMANN	AGC-1	1
48	F1	FUSE, 2a, SLO-BLO	**45100005**	BUSSMANN	MDL-2	1
49		LED INDICATOR, GREEN	**45001015**	DIALIGHT	559-0201-007	1
50	S4	SWITCH, TOGGLE, DPDT	**46027507**	C & K	7205SHZQ	1
51		FUSE, 125 Ma/250V, SUPER TIME LAG	**45100027**	SHURTER	0034.5004	2
52	R1, R2	RESISTOR, POWER, 6 OHM	**41400002**	DALE	RH-5	2
53		ELELET	**51010001**	STIMPSON	G/S 3-6	4
54	S3	SWITCH, TOGGLE, SPDT	**46027533**	C & K	7107-SHZQE	1
55		FUSE COVER	**48063003**	RICHCO	840836	2
56		NUT. ¼-28 HEX				1
57		WASHER, ¼ O.D.				1
58		FUSE, 250 Ma/250V, SUPER TIME LAG	**45100028**	SCHURTER	0034.5037	2
59		LUG, GROUND #4	**55010001**	KEYSTONE	7311	2
60		LABEL, SAFETY FUNCTION	**57031011**	PANDUIT	PESC-H-EC	1
61		SILKSCREEN, FRONT PANEL	**57005052**			1
62		LCD DISPLAY MODULE	**45010001**	IEE	03857-03-040	1
63		FILTER, LCD DISPLAY	**43015002**	PANELGRAPHICS	901-AG, 75.125 THICK	1
64		STANDOFF, ¼ HEX, 5/16 LG	**52400008**	RAF	2101-440-SS-20	4
65		TAPE, FOAM ¼ x 8”	**31000011**	3M	4032	2
66		SCREW, PAN HEAD, SLOTTED, #4-40 x 1 1/8	**50010002**	ASM	112280-SS-12	1
67		WASHER, FLAT, #6	**52010001**		MS15795-805	4
68		SCREW, PAN HEAD, #6-32 x ¼	**50110005**		MS51957-26	2
69		BRACKET, MOUNTING, FUSE PLATE	**62020082**			1
70		SCREW, FLATHEAD, CROSS REC. #6-32 x ¼	**50140017**		MS51959-41	1
71		WASHER, SPLIT LOCK, #8	**52020003**		MS35338-137	2
72		STANDOFF, JACK SCREWS, 3/16 HEX	**52400032**	RAF	4750-2	4
73	S5	SWITCH, ROTARY	**46020011**	GRAYHILL	50M45-01-2-4NF	1
74	S6	SWITCH, ROTARY	**46020012**	GRAYHILL	50CD36-01-2-4N	1
75		KNOB	**57025023**	ELEC. HARDWARE	MS91528-1II1B	2
76		PROGRAMED MEMORY	**48077005-01**			1
77		LABEL, INSTRUCTION	**40200072**			1

APPENDIX

APPENDIX A
T-49C MOD 2 Test Set Verification Tests
Calibration Test Report

Serial Number	
Technician	
Date of Test	

Para. Ref.	Test Description and/or Location	Normal Value Expected	Actual Value Measured	PASS/FAIL	Initials
4.3.2	**Display Operation**				
2	Verify Start Screen		**Y N**		
3	Toggle Lights, Verify Backlighting	Backlight *ON*	**Y N**		
4	Test Set Turns *OFF*	T/S *OFF*	**Y N**		
4.3.3	**Transmitter Frequency Test**				
4.3.3.1	**Direct Method**				
5	Verify Carrier Signal	1030.0 MHz ± 0.1 MHz			
7	Verify Power Level	-10 dBm ± 1dB			
8	Verify Power Level/TCAS HI	+10 dBm ± 1 dB			
4.3.3.2	**Reference Method**				
6	Document the Peak Level	N/A		N/A	
7	Difference Between Step 6 and 7	± 1 dB			
8	TCAS HI/LO Switch in HI	± 1 dB			
4.3.4	**Receiver Oscillator Test**				
2	Confirm Presence of Local Oscillator Signal	Signal Present	**Y N**		

Para. Ref.	Test Description and/or Location	Normal Value Expected	Actual Value Measured	PASS/FAIL	Initials
4.3.5	**Mode S Pulse Modulation Signal Test**				
5	Observe Pulse Modulated Signal	1090.0 MHz ± 0.1 MHz			
6	Observe Mode S Reply Sequence	Mode S Reply	**Y N**		
4.3.6	**Omni-Directional Antenna Transponder Test**				
4	Test Set Identifies Transponder (Mode 3A, Mode S)		**Y N**		
6	Verify Correct Final Display for appropriate transponder (Mode 3A, Mode S)		**Y N**		
4.3.7	**TAP-135 Antenna Coupler Test**				
4	Ensure successful completion of Tests		**Y N**		
5	Verify Correct Final Display for appropriate transponder (Mode 3A, Mode S)		**Y N**		
4.3.8	**TAP-141 Direct Connect Antenna (Optional Test)**				
5	Ensure successful completion of Tests		**Y N**		
6	Verify Correct Final Display for appropriate transponder (Mode 3A, Mode S)		**Y N**		
4.3.9	**TCAS Testing**				
8	0’ TCAS Scenario	Verify Target on TCAS Display	**Y N**		
9	+200/-200	Verify Target on TCAS Display	**Y N**		
	+4000/-4000	Verify Target on TCAS Display	**Y N**		
	+3500/-3500	Verify Target on TCAS Display	**Y N**		
PASS			**FAIL**		

TECHNICIAN_____

DATE_____

APPENDIX B
T-49C MOD 2 Annual Calibration and Alignment Tests
Calibration Test Report

Serial Number	
Technician	
Date of Test	

Para. Ref.	Test Description and/or Location	Normal Value Expected	Actual Value Measured	Final Adjusted Value	Initials
4.7	**Digital Board Adjustment Procedures**				
4.7.1	**Frequency and Voltage Settings**				
	TP8	+10V/ ± 0.2V	V	V	
	TP7	-10V/ ± 0.5V	V	V	
	U55, Pin 3	+5V/ ± 0.2V	V	V	
	TP3	5 Vpp ± 1V	Vpp	Vpp	
		0.20µs/ ± 0.05µs	µs	µs	
	TP2	5 Vpp ± 1 V	Vpp	Vpp	
		0.25µs/ ± 0.05µs	µs	µs	
	P2, Pin 3 or R-28/Negative Sloping Pulse	─3.0V to ─6.0V ± 0.5V	V	V	
4.7.2	**ATCRBS/C Interrogation Test**				
	ATCRBS Mode C Reply/Intruder Simulation at P2, Pin 8	Mode C/Intruder at 190µs moving to 28µs & back			
	Mode S Interrogation Non-Reply	No Intruder			
	ATCRBS/C with P2 Pulse Interrogation Non-Reply	No Intruder			
4.7.3	**Mode S Interrogation Test**				
	Mode S Reply/Intruder Simulation at P2, Pin 8	Mode S/Intruder at 300µs moving to 130µs & back			
	ATCRBS Mode A Non-Reply	No Intruder			
	ATCRBS Mode C Non-Reply	No Intruder			

Para. Ref.	Test Description and/or Location	Normal Value Expected	Actual Value Measured	Final Adjusted Value	Initials
4.8	**RF-PCB Procedure**				
4.8.1	**Voltage Settings**				
	U18, Pin 3	+5 V / ± 0.5 V	V	V	
	U34, Pin 3	+6 V / ± 0.5V	V	V	
	C76 Negative Lead	-4 V / ± 0.5 V	V	V	
	U21, Pin 5	10 V / ± 0.1 V	V	V	
4.8.2	**Frequency Settings**				
	TP1	4.023423 MHz ± 45 Hz	MHz	MHz	
	Antenna Direct Connect Carrier Frequency Verification	1030.0 MHz ± 0.1 MHz	MHz	MHz	
	U17, Pin 1	8.164063 MHz ± 45 Hz	MHz	MHz	
	Antenna Direct Connect Carrier Frequency Verification	1045.0 MHz + 0.1 MHz	MHz	MHz	
	TP1	4.257813 MHz ± 45 Hz	MHz	MHz	
	Antenna Direct Connect Carrier Frequency Verification	1090.0 MHz + 0.1 MHz	MHz	MHz	
	U17, Pin 1	8.398438 MHz ± 45 Hz	MHz	MHz	
	Antenna Direct Connect Carrier Frequency Verification	1075.0 MHz ± 0.1 MHz	MHz	MHz	
4.8.3	**Dynamic Range and RF Output Power Level Setting**				
	Linear Output Response	Verify Signal			
	ON/OFF Ratio	> 30 dB	dB	dB	
	Power Output and Linear Response during saw-tooth signal	-10 dBm	dBm	dBm	
		Begin -22 ± 1dB End -5 ± 1dB			
	P2 relative to P1	-9 dB ± 1 dB	dB	dB	

Para. Ref.	Test Description and/or Location	Normal Value Expected	Actual Value Measured	Final Adjusted Value	Initials
4.8.4	**1030.0 MHz Receiver Sensitivity Test**				
	TP2/Demodulated Pulse Breakup	-25 to -30 dBm	dBm	dBm	
4.8.5	**1090.0 MHz Receiver Sensitivity Test**				
	TP2/Demodulated Pulse Breakup	-25 to -30 dBm	dBm	dBm	
4.8.6	**RF Power Frequency Measurement Calibration Setting**				
	-10 dBm	40 dBm ± 1 dBm	dBm	dBm	
	-5 dBm	45 dBm ± 1 dBm	dBm	dBm	
	-0 dBm	50 dBm ± 1 dBm	dBm	dBm	
	+5 dBm	55 dBm ± 1 dBm	dBm	dBm	
	+10 dBm	60 dBm ± 1 dBm	dBm	dBm	
4.9	**TAP-135 Calibration**				
	Observe Display, Adjust C4, if necessary				

Technician Signature	
Date of Completion	

APPENDIX C
dBm to Watts Conversion Table

dBm	Watts
0	0.0010
1	0.0013
2	0.0016
3	0.0020
4	0.0025
5	0.0032
6	0.0040
7	0.0050
8	0.0063
9	0.0079
10	0.0100
11	0.0126
12	0.0159
13	0.0200
14	0.0251
15	0.0316
16	0.0398
17	0.0501
18	0.0631
19	0.0794
20	0.1
30	1.0
40	10.0
50	100
51	125
52	150
53	200
54	250
55	300
56	400
57	500
58	620
59	800
60	1000

APPENDIX D

TEST MODES OF THE T-49C MOD 2 TEST SET

A single asterisk, *, following a test indicates the test is required by FAR part 43 section 91 for ATCRBS (Mode A/C) and Mode S transponders. A double asterisk, **, indicates the test is required for Mode S transponders only. All of the tests required by the FARs are performed by the Test Set.

ATCRBS MODE A * This mode interrogates transponders with the ATCRBS Mode A interrogation with nominal pulse width and separation and a P2 amplitude 9dB below P1 and P3. SLS operation is verified by transmitting interrogations with nominal pulse width and separation but a P2 level equal to P1 and P3. Both ATCRBS (Mode A/C) transponders and Mode S transponders should reply with the "4096" code. A typical main display would be: ATCRBS/A 1200. The percent reply will also be displayed. The pass criteria are a 90% or greater reply efficiency for the normal Mode A interrogation and 10% or less for the SLS interrogation.

ATCRBS MODE C * This mode interrogates transponders with the ATCRBS Mode C interrogation with nominal pulse width and separation, P2 amplitude 9dB below P1 and P3, and with SLS. Both ATCRBS (Mode A/C) transponders and Mode S transponders should reply with an altitude reply. The altitude will be displayed with the percent reply. The pass criteria is a 90% or greater reply efficiency.

ATCRBS MODE A/ MODE S ALL-CALL ** In this mode, the transponder is interrogated with nominal pulse amplitudes, widths, and separations, with P2 9dB below P1, P3, and P4, and with SLS. ATCRBS (Mode A/C) transponders will respond with a Mode A reply while Mode S transponders will respond with the Mode S all-call reply. The pass criteria are a 90% or greater reply efficiency for an ATCRBS transponder and 99% or greater reply efficiency for a Mode S transponder.

ATCRBS MODE C/ MODE S ALL-CALL ** In this mode, the transponder is interrogated with nominal pulse amplitudes, widths, and separations, with P2 9dB below P1, P3, and P4, and with SLS. ATCRBS (Mode A/C) transponders will respond with the Mode S address reply. The pass criteria is a 90% or greater reply efficiency for an ATCRBS transponder and 99% or greater reply efficiency for a Mode S transponder.

ATCRBS MODE A ONLY ** The transponder is interrogated with nominal pulse width and separation, with P2 amplitude 9dB below P1 and P3, and with SLS. This interrogation causes only ATCRBS (Mode A/C) transponders to reply. Although a Mode S transponder will respond to both Mode A and Mode C ATCRBS interrogations, the Mode A only interrogation will not cause a reply from Mode S transponders. The pass criterion for an ATCRBS (Mode A/C) transponder is 90% or greater reply efficiency. For a Mode S transponder, the pass criterion is less than 1% reply efficiency.

ATCRBS MODE C ONLY ** The transponder is interrogated with nominal pulse width and separation, with P2 amplitude 9dB below P1 and P3, and with SLS. This interrogation causes only ATCRBS (Mode A/C) transponders to reply. Although a Mode S transponder will respond to both Mode A and Mode C ATCRBS interrogations, the Mode C only interrogation will not cause a reply from Mode S transponders. ATCRBS (Mode A/C) transponders equipped with Mode C will respond with a Mode C reply. The pass criterion for an ATCRBS (Mode A/C) transponder is 90% or greater reply efficiency. For a Mode S transponder, the pass criterion is less than 1% reply efficiency.

SURVEILLANCE ID. UF=5 ** In this mode, the Mode S address that was received during the previous Mode S all-call test is used to interrogate the transponder. The Mode S transponder will respond with "4096" code. The pass criterion are a reply efficiency of 99% or greater with the correct download format and a valid message.

SURVEILLANCE ALT. UF=4 ** In this mode, the Mode S address that was received during the previous Mode S all-call test is used to interrogate the transponder. The Mode S transponder will respond with altitude code. The pass criterion are a reply efficiency of 99% or greater with the correct download format and a valid message.

SURVEILLANCE SHORT. UF=0 ** In this mode, the Mode S address that was received during the previous Mode S all-call test is used to interrogate the transponder. The Mode S transponder will respond with maximum true airspeed information. The pass criterion are a reply efficiency of 99% or greater with the correct download format and a valid message.

UNDESIRED REPLIES * Random address surveillance ID interrogations are made, with the exception of the transponder's address determined from the Mode S all-call. If the transponder replies an error message is displayed.

SQUITTER ** In this mode, the test set transmits no interrogations but is available to receive download format 11. The receipt of this format within 1.25 seconds constitutes a pass situation.

MAXIMUM TRUE AIRSPEED ** In this mode, the maximum true airspeed is determined by interrogating a Mode S transponder with an UF=0 and with the acquisition bit set to "one." The transponder will reply with its maximum true airspeed capability. This is done only in the test mode.

IDENT * The testing of a transponder's IDENT switch is done only for ATCRBS/A and C in the test mode. If the IDENT switch is pressed during one of the above interrogations, then ATCRBS/A IDENT is displayed along with the "4096" code or altitude and the percent reply.