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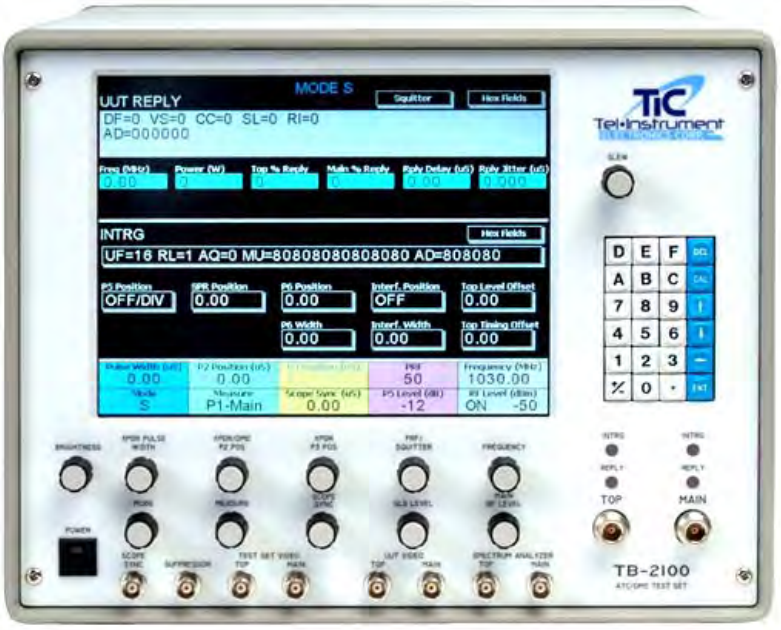
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TB-2100

ATC/DME Test Set



Operational and Maintenance Manual
P/N: 90000106-2

REVISION: C

13 February 2006

Tel-Instrument Electronics Corp
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Leading the AVIONICS TEST industry into the 21st Century!

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PART NUMBER	VOLUMES INCLUDED	CHAPTERS INCLUDED
90008106-1	VOLUME 1	CHAPTERS I & II
90008106-2	VOLUMES 1 & 2	CHAPTERS I - VI

Chapter I – Introduction
Chapter II – Preparation for Use and Operation
Chapter III – Theory of Operation
Chapter IV – General Maintenance and Servicing Procedures
Chapter V – Schematics
Chapter VI – Illustrated Parts Catalog

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Safety Precautions

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 preceding; 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 2-3.

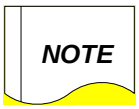
3. Take the time to learn the proper operation and function of the Test Set as outlined in Chapters 1, 2, and 3. Through knowledge of the Test Set and its capabilities greatly improves the time it takes to complete the tests.

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



WARNINGS

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



NOTES

Provides supplemental information that enhances the procedure or further explains in detail additional information to ensure understanding or proper operation.

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. Thoroughly inspect the equipment and the local area for potential hazards. Loose clothing and jewelry should be removed anytime the test set is being utilized or being serviced.

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

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

10. Use only specified replacement parts as listed in the IPB. Failure to utilize factory approved parts may cause damage to personnel; the test set's, and possibly void the warranty.

ESD Safety and Protection

Many parts contained in the Test Set are sensitive to ESD (Electro-Static Discharge) damage. ESD can damage integrated circuits or semiconductors located within the Test Set. Only qualified personnel should service the Test Set to prevent damage. The following are guidelines to avoid ESD damage while still performing tests and or maintenance. These guidelines are meant only as a reminder, consult local directives and follow standard operating procedures before servicing, or repairing the Test Set.

- Wear a properly grounded wrist strap and remain in contact with an approved grounding point.
- Do not touch the connector pins or backplanes of ESD Sensitive circuits or parts.
- Ensure soldering irons are grounded before use.
- Do not remove any components or disconnect any connectors located in the Test Set with the power “ON”.
- Properly ground all test equipment being utilized. Refer to the test equipment operating manual for information.
- Place all removed components or parts in or on an approved conductive package.

Most ESD devices or circuits and common points are readily identified utilizing several different methods. Below are some examples.









VOLUME 1

OPERATIONAL PROCEDURES

TB-2100 TABLE OF CHANGES

Date	REV	ECO	Page	Description
11-30-04	A			Initial Release
1-10-06	B		Entire Re-write	New release, added Chapter 3-6
2-13-06	C		Chapter IV	Added Cal/Alignment Procedures

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CHAPTER I

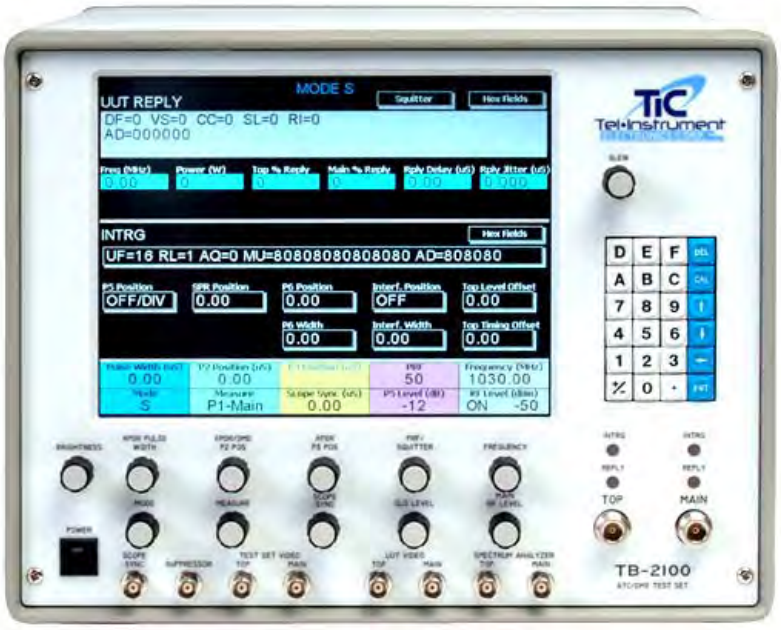
INTRODUCTION

SECTION A

GENERAL INFORMATION

1.1 Scope of Manual

This manual provides operator guidance for the TB-2100 ATC/DME Test Set. The TB-2100, hereafter known as the TB-2100, Test Set, or T/S, is a bench top Test Set for the test and verification of airborne ATC Mode A/C/S Transponders and DME Interrogators. With easy to use menus and an interactive touch sensitive color display, theTB-2100 is capable of verifying numerous parameters, signals, and information generated by ATC Transponders and DME Interrogators. Precise control over pulse width, size, delay, and amplitude offers the operator the capability of generating unlimited scenarios providing unequaled testing capabilities in any current test set.



TB-2100 Test Set

Figure 1-1

1.2 Purpose and Function of the Equipment

The TB-2100 ATC/DME Test Set is designed with the technician in mind, primarily to replace equipment that is incapable of testing newer generation ATC transponders. The TB-2100 incorporates the latest technologies offering precise measurements and virtually unlimited capabilities. Multiple variable selections offer unparalleled versatility; capable of Testing ADS-B (Automatic Dependent Broadcast), Extended Squitters, Elementary/Enhanced Surveillance, and TIS (Traffic Information Systems) The TB-2100 incorporates a flash memory for rapid software updates. An easy to read touch sensitive color display allows the technician easy access to a variety of menus and to change numerous pulse formats and amplitudes for accurate and detailed measurement and analysis of reply signals.

1.3 Warranty[1]

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 Corp. will remedy any such warranted defect subject to the following:

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

This warranty does not extend to any 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 manufactured by Tel Instruments.

Replacement 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 Tel Instrument's liability or warranty in connection with the sale of their products.

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

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

SECTION B EQUIPMENT DESCRIPTION

1.4 Specifications

Signal Generator

Frequency Range	952.00 to 1223.00 MHz
Frequency Accuracy	± 0.001%
Frequency vs. Level Flatness	<1.0 dB
Signal Level Range	0 to -100 dBm into 50 Ω, 1 dB resolution
Signal Level Accuracy	0 to -50 dBm ± 0.75 dB -51 to -79 dBm ± 1.0 dB -80 to -89 dBm ± 1.1 dB -90 to -100 dBm ± 1.2 dB
On/Off Ratio	> 60 dB
Suppressor Pulse Amplitude	Variable from 9 to 28 V
Suppressor Pulse Width	35 ± 5 µs

UUT Measurements

Frequency	1020 to 1155 MHz; ± 20 kHz for ATC; ± 50 KHz for DME
Power	0 to 4000 W pk; ± 0.7 dB 1 to 99 W; ± 0.5 dB 100 to 4000 W

Transponder Modes

Mode	ATCRBS and Mode S

Pulse Characteristics

Rise time (P1)	75 ± 25 ns
Fall time (P1)	150 ± 50 ns

ATCRBS Mode A/C

Pulse Width (P1/P2/P3)	0.80 ± .05 µs, variable -0.3 to 1.4 µs in 50 ns steps
P2 Position (Relative to P1)	2.00 ± .05 µs, variable ± 1.00 µs in 50 ns steps
Mode C P3 Position (Relative to P1)	21.00 ± .05 µs, variable ± 1.00 µs in 50 ns steps
Interference Pulse Width	0.30 to 3.00 µs ± 1%, variable in 50 ns steps
Interference Pulse Position (Relative to P1)	-5 to +45 ± .05 µs , variable in 50 ns steps
Interference Pulse RF source	Selectable for coherent or non-coherent
Interference Pulse/SLS Level (relative to P1)	-15 to +3 dB ± 0.25 dB, variable in 1 dB steps
PRF	0.1 to 2500 Hz
Scope Sync Width	0.8 to 1.2 µs
Scope Sync Position (Relative to P1)	0 to 175 µs in 1 µs steps
A/C Interlace Mode Interrogation Spacing	1.00 ± 0.20 ms
Double Mode Interrogation Interrogation Spacing	3 to 500 µs

Mode S

Pulse Width (P1/P2/P3)	0.80 ± .05 µs, variable -0.3 to 1.4 µs in 50 ns steps
P2 Position (Relative to P1)	2.00 ± .05 µs, variable ± 1.00 µs in 50 ns steps
Mode A P3 Position (Relative to P1)	8.00 ± .05 µs, variable ± 1.00 µs in 50 ns steps
Mode C P3 Position (Relative to P1)	21.00 ± .05 µs, variable ± 1.00 µs in 50 ns steps
P4 Position (Relative to P3)	2.00 ± 0.5 µs, variable ± 1.00 µs in 50 ns steps
P4 Width	0.80 or 1.60 ± 0.5 µs, variable -0.50 to 1.00 µs
Sync Phase Reversal (SPR relative to P2)	2.75 ± 0.05 µs, variable -0.50 to +0.50 µs
P5 Position (Relative to SPR)	0.40 ± 0.05 µs before SPR, variable -1.00 to +1.00 µs
P6 Position (Relative to SPR)	1.25 ± 0.50 µs before SPR, variable -0.40 to +3.00 µs
Interference Pulse Position (Relative to P1)	-1.40 to +45 ± .05 µs , variable in 50 ns steps
Interference Pulse Width	0.30 to 3.00 µs ± 1%, variable in 50 ns steps
Interference Pulse/P5 Level (relative to P1)	-15 to +3 dB ± 0.25 dB, variable in 1 dB steps

DME Mode

Mode	VOR Pair, TACAN Channel, MHz

Pulse Characteristics

P1 Rise time	2.0 +/- 0.5 us
P1 Fall time	2.5 +/- 0.5 us
P1 Width	3.5 +/- 0.2 us
P2 Rise time	2.0 +/- 0.5 us
P2 Fall time	2.5 +/- 0.5 us
P2 Width	3.5 +/- 0.2 us
P2 Position (Relative to P1)	X Mode – 12.0 ± 0.2 µs, variable -6.00 to +6.00 in 0.1 µs steps Y Mode – 30.0 ± 0.2 µs, variable -6.00 to +6.00 in 0.1 µs steps
Echo Position (30 nmi)	426.65 +/- .25 us
Scope Sync Width	0.8 to 1.2 µs
PRF	1 to 5000 Hz
15/135 Hz Modulation	
Percent Modulation	30 to 50 %
15 Hz Modulation	15 +/-1 Hz
135 Hz Modulation	135 +/-2 Hz
Reply Efficiency	0 to 100% ± 5%, selectable in 10% increments
Range	0 to 998 nmi. ± 0.02 nmi. Plus ± 0.005% of selected range
Velocity	0 to 9990 kts. ± 0.05%, selectable in 0.01 nmi. Increments
Echo Level	-12 to +3 dB ± 0.25 dB, variable in 1 dB steps

Front Panel BNC Connectors	Spectrum Analyzer (Top and Main) UUT Video (Top and Main) Test Set Video (Top and Main) Scope Sync Suppressor Pulse (ATC and DME)
Rear Panel BNC Connectors	RS-232 (Calibration and Software Update) DPSK Modulation Input External SLS Video Input for Mode S Interrogation Low Power Input External Trigger

General

Power	100 to 220 VAC, 50/60 Hz; 220 to 240 VAC, 50 Hz
Dimensions	14.5 in. W x 11.0 in. H x 14.25 in. D 368 mm W x 279 mm H x 362 mm D
Weight	28 lbs. (12.7 kg.)
Temperature	5 to 40°C

1.5 Common Avionics Abbreviations, Acronyms and Glossary[2]

A/A	Air to Air
A/A B	Air to Air Beacon
ac or AC	Alternating Current
A/C	Aircraft
A/D	Analog to Digital
AM	Amplitude Modulation
AGC	Automatic Gain Control
ATCRBS	Air Traffic Control Radar Beacon System
ATC	Air Traffic Control
AUT	Aircraft under Test
BIT	Built in Test
CAT I, II & III	Categories of ILS Approaches
CDI	Course Deviation Indicator
COMM	Communications, Communication Equipment
CW	Continuous Wave
D/A	Digital to Analog
DH	Decision Height
dB	Decibel
dBm	Decibels relative to 1 milliwatt
dBw	dB-watts or relative to 1 watt
dc or DC	Direct Current
DF	Downlink Format
DME	Distance Measuring Equipment
EMI	Electromagnetic Interference
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
FD	Flight Director
FIFO	First In First Out
FM	Frequency Modulation
FREQ	Frequency
ft.	Feet
G/A	Ground to Air
GS	Glideslope
Hz	Hertz
HDG	Heading
HSI	Horizontal Situation Indicator
IF	Intermediate Frequency
IFF	Identify Friend or Foe
ILS	Instrument Landing System
IM	Inner Marker (one of three Marker Beacon signals)
kHz	Kilohertz
kts.	Knots
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LOC	Localizer

[2] 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.

MB	Marker beacon
MF	Medium Frequency
MHz	Megahertz
MM	Middle Marker (one of three Marker beacon signals)
NAV	Navigation, Navigational Equipment
nmi.	Nautical mile
ns	Nanosecond
OBS	Omni Bearing Selector
OM	Outer Marker (one of three Marker Beacon signals)
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
RF	Radio Frequency
RMI	Radio Magnetic Indicator
RMS	Root Mean Square
R/T	Receiver Transmitter
TA	Traffic Advisories
TACAN	Tactical Air Navigation
TCAS	Traffic Alert and Collision Avoidance System
TX	Transmitter
UF	Uplink Format
UHF	Ultra High Frequencies, 300 MHz – 3000 MHz
VHF	Very High Frequencies, 30 MHz – 300 MHz
VOR	VHF Omnidirectional Range
VORTAC	VOR and TACAN (co-located)
VSWR	Voltage Standing Wave Ratio
WOW	Weight On Wheels
UUT	Unit Under Test
XPDR	Transponder

CHAPTER II

PREPARATION FOR USE AND OPERATION

SECTION A

GENERAL INFORMATION

2.1 General

This section contains all necessary information for the initial unpacking, inspection, and setup of the TB-2100. Each TB-2100 has undergone a comprehensive series of tests, full calibration and Quality Assurance Checks before shipment from Tel-Instrument Corp.

2.2 Unpacking and Inspection

On receipt of the Test Set, ensure there is no damage to the shipping container. Carefully unpack the unit and save the container for subsequent shipping or extended storage.

Examine the unit for obvious signs of physical damage. Carefully check each switch, connector and display before using the Test Set. Ensure that all accessories are present and undamaged.

If damage is found, DO NOT use the Test Set until a determination of its condition can be assessed. Contact Tel-Instrument Corporation as soon as possible for further instructions.

2.3 Installation

Site the TB-2100 in a suitable location away from any direct heat source. Connect the supplied power cable to the power receptacle on the rear of the unit and to a suitable 115 to 230 VAC, 50 to 60 Hz power outlet. Switch the unit on by pressing the power switch (Fig 2-1, item 6) The TB-2100 is now ready for use

SECTION B

OPERATING CONTROLS, INDICATORS, AND CONNECTORS

2.4 Controls, Indicator, and Connectors

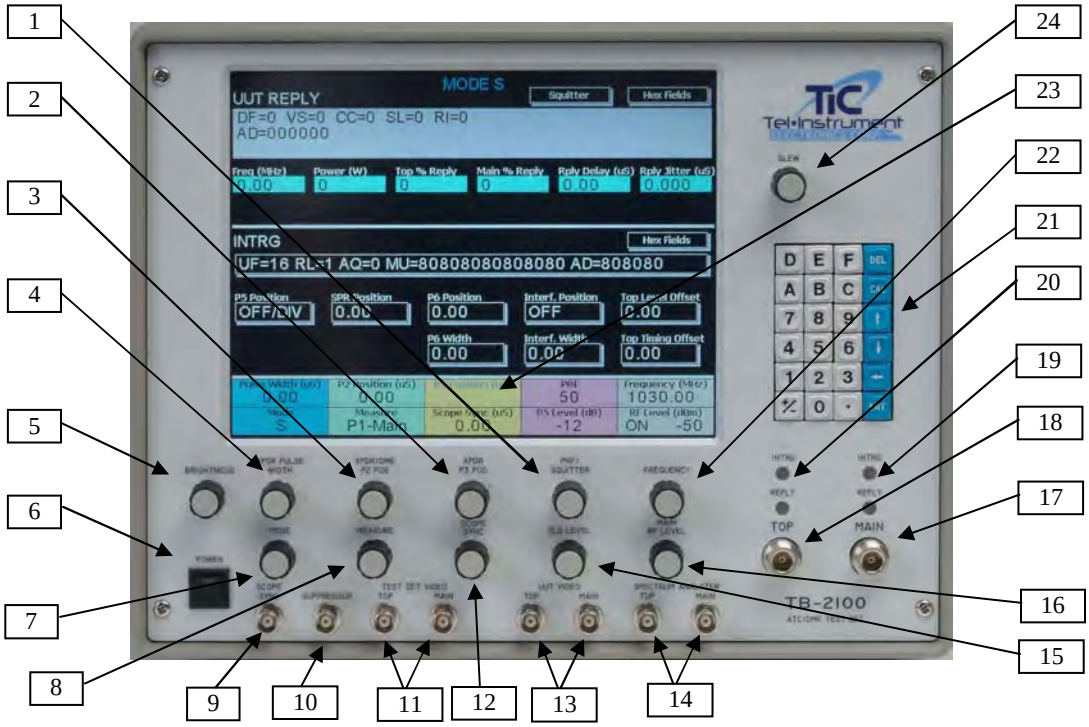
Figures 2-1 & 2-2 and Tables 2-1 & 2-2 show locations for and describe each of the TB-2100 controls, switches and displays. The TB-2100 features a colour liquid crystal display (LCD) with touch screen overlay.

The TB-2100 provides control via control knobs for the most widely used functions, including RF frequency, RF level, pulse repetition frequency (PRF), P2 position, P3 position, SLS level, pulse widths. Other parameters are set using the front panel SLEW knob or numeric keypad.

The TB-2100 displays unit-under-test (UUT) parameters including ATCRBS replies (4096 code and altitude), Mode S down link formats, frequency, power, percent reply, reply delay and reply jitter.

FIG #	Control, Indicator, or Connector	(Table 2-1) FUNCTION
1	**PRF/Squitter**	Knob controls ATC PRF (0 to 1500 Hz) or DME squitter (0 to 5000 Hz)
2	**XPDR P3 POS**	Knob controls P3 position ± 1.00 µsec – Press CAL to select nominal value
3	**XPDR/DME P2 POS**	Knob controls P2 position ± 1.00 µsec – Press CAL to select nominal value
4	**XPDR Pulse Width**	Knob controls ATC pulse width (0.30 to 1.40 µsec) or deviation from nominal 0.45 µsec (-0.50 to +0.60 µsec) -- Push knob to toggle between display of actual width or deviation from nominal – Press CAL to select nominal value
5	**BRIGHTNESS**	Knob controls LCD intensity
6	**POWER**	Button toggles between Stand-by (Red LED) and On (Green LED)
7	**MODE**	Knob selects mode of operation for ATCRBS (A, C, A/C, & Double), DME (VOR Pair, TACAN Channel, & MHz), and Mode S (S, Double, Burst, A, C, A/C, A-ACS, A-ACL, C-ACS, & C-ACL)
8	**MEASURE**	Knob selects Reply Pulse to be used for frequency and power measurements. Push knob to toggle between MAIN and TOP RF ports (Mode S only)
9	**SCOPE SYNC**	Scope sync output connector
10	**SUPPRESSOR**	Mutual suppression output connector
11	**TEST SET VIDEO**	Test set demodulated video output connectors (MAIN and TOP RF ports)
12	**SCOPE SYNC**	Knob controls position of scope sync pulse after ATC P1 rising edge (0 to 175 µsec), after decoding of DME interrogation (INTRG), or before test set DME reply (REPLY)
13	**UUT VIDEO**	Unit-under-test (UUT) demodulated video output connectors (MAIN and TOP RF ports)
14	**SPECTRUM ANALYZER**	UUT input attenuated by 60 dB) for connection to spectrum analyzer
15	**SLS LEVEL**	Knob controls ATC (ATCRBS) P2 Side-lobe-suppression (SLS) level or DME Echo Level (+3 to -12 dB relative to P1)
16	**RF LEVEL**	Knob controls test set RF output level (-10 to -100 dBm) for MAIN and TOP RF ports. Push knob to toggle between MAIN and TOP RF level controls (Mode S)
17	**MAIN**	Test Set RF input/output connectors for Main channel

FIG #	Control, Indicator, or Connector	(Table 2-1) FUNCTION (Continued)
18	**TOP**	Test Set RF input/output connectors for Top channel (Not available for ATCRBS or DME functions)
19	**INTRG/REPLY**	Flashing LED indicates interrogation or reply signal on MAIN RF port
20	**INTRG/REPLY**	Flashing LED indicates interrogation or reply signal on TOP RF port
21	**KEYPAD**	Allows user selection of data contained in highlighted field
22	**FREQUENCY**	Knob controls frequency of RF output. – Push knob to move cursor to desired digit
23	**COMMON CONTROL DISPLAYS**	Displays data controlled by common control knobs located below LCD
	Pulse Width (µS) or Dev	Displays pulse width or deviation from nominal selected by knob #4 (Push knob to toggle between width and deviation) – Press CAL key to select nominal values
	P2 Position (µS)	Displays P2 position selected by XPDR/DME P2 POS knob (#3) – P2 may be turned on/off by touching P2 value on screen and pressing DEL key – Press CAL key to select nominal values
	P3 Position (µS)	Displays P3 position selected by XPDR P3 POS knob (#2) - P3 Position will be greyed out if P3 not available – Press CAL key to select nominal values
	PRF/SQUITTER	Displays PRF rate selected by knob #1 – Press CAL key to select nominal values
	FREQUENCY (MHz)	Displays output frequency that can be selected by FREQUENCY knob (#22) or by pressing display and entering frequency using keypad – Pressing FREQUENCY knob selects resolution to be changed – Press CAL key to select nominal values
	MODE	Displays mode of operation selected by MODE knob (#7)
	MEASURE	Displays pulse used for measurement of power or frequency – Press MEASURE knob (#8) to toggle between MAIN and TOP RF ports – Note: If UUT signal is not present on port selected, UUT REPLY or measured value will not be shown
	SCOPE SYNC	Displays scope sync pulse delays selected by SCOPE SYNC knob (#12)
	SLS/INT/P4/P5	Displays level of P2, Interference Pulse, P4, or P5 selected by SLS LEVEL knob (#15) – Pulses controlled dependent on mode of operation
	RF LEVEL	Displays RF Level for TOP or MAIN RF ports – RF level is set using RF LEVEL knob (#16) or by pressing RF level display and entering RF level using keypad – Normal/CW operation can be selected by pressing RF level value display and pressing C key
24	**SLEW**	Knob allows incremental selection of data contained in highlighted field



TB-2100 Controls, Indicators, and Connectors
Figure 2-1

TB-2100 Rear Panel
Figure 2-2

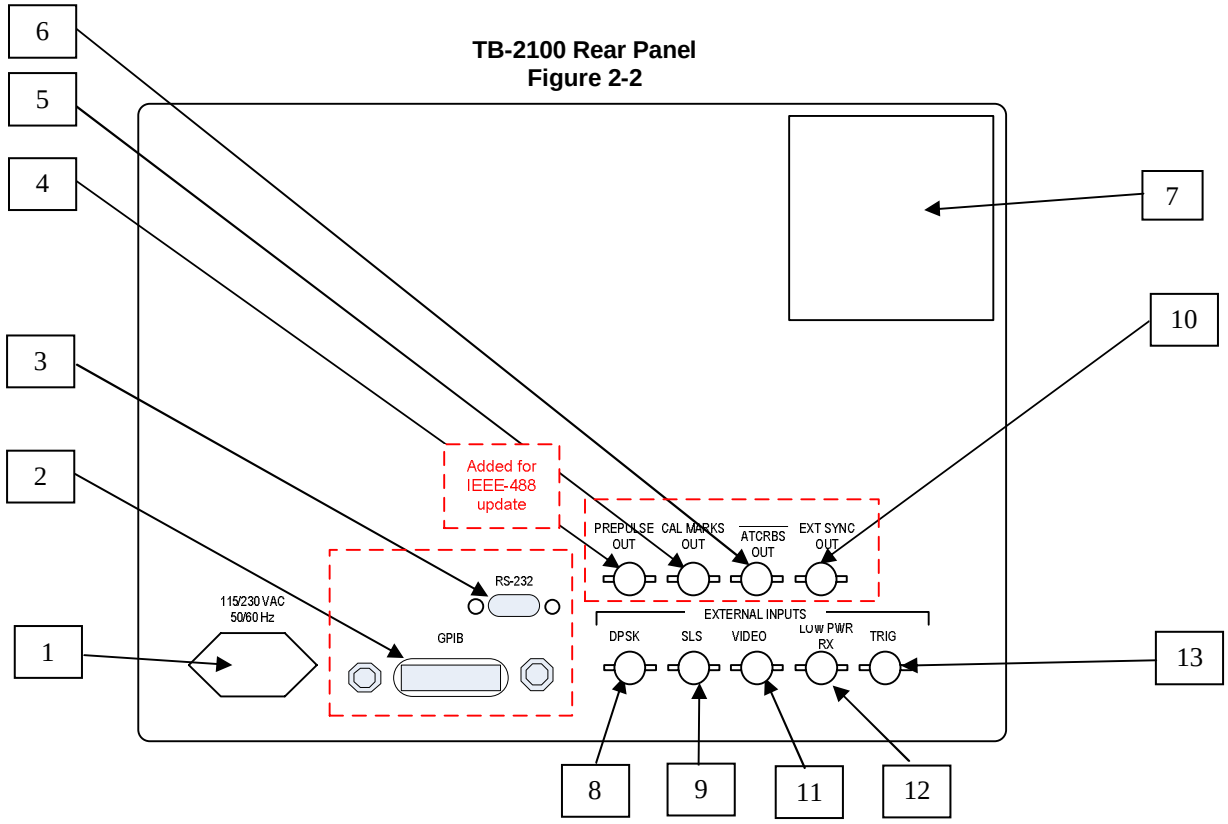


FIG #	Rear Panel	(Table 2-2) FUNCTION
1	Power Connector	Provides input for 115 to 230 VAC, 50 to 60 Hz single phase power
2	GPIB IEEE-488 Connector	Provides interface for general purpose programmable instrumentation bus in accordance with IEEE-488-2l
3	RS-232 Connector	Provides serial input for calibration using terminal emulation program (Tel-Instrument recommends a product called Tera Term Pro that is available for free download on the Internet at (http://hp.vector.co.jp/authors/VA002416/teraterm.html)
4	PREPULSE OUT	Provides 1.0 µS TTL Prepulse controlled via GPIB
5	CAL MARKS OUT	Provides 1.0 and 1.45 µS pulses for timing of signals generated by unit under test that are controlled via GPIB
6	ATCRBS OUT	Provides active low 3.0 µS long that occurs 1.0 µS prior to the leading edge of P1
7	Fan	
8	DPSK Connector	Provides input for externally created Mode S phase reversals
9	SLS Connector	Provides input for generating externally created coherent SLS pulses for ATCRBS interrogations
10	EXT SYNC OUT	Provides sync pulse controlled via GPIB
11	Video Connector	Provides input for generating externally created interrogations minus phase reversal and SLS
12	Low/Power RX Connector	Provides input for low level DME interrogation and transponder reply (nominal 0 dBm)
13	Trig Connector	Provides input to externally trigger transponder interrogation (Push front panel PRF knob to select EXT TRIG)

SECTION C

OPERATING INSTRUCTIONS

2.5 General

The TB-2100 should be installed and powered in accordance with paragraph 2.3. After Power is applied; the Test Set will perform a built in test (BIT) during which time the Tel-Instrument Electronics logo is displayed. Any errors will be shown in red below the Tel logo. After a satisfactory BIT, the display will show the MAIN menu shown in paragraph 2-9

2.5.1 Transponder Testing

The TB-2100 provides capability for simulation of ATCRBS and Mode S interrogations. The TB-2100 generates a 1030 MHz interrogation signal with pulse position modulation for ATCRBS (Modes A and C) interrogations and Differential Phase Shift Keying (DPSK) for Mode S interrogations.

In ATCRBS mode, the TB-2100 allows control of the pulses contained in the interrogation and will receive, decode and display the reply from the UUT. In Mode S, the operator can select various Uplink Formats to solicit the relative Downlink Formats from the UUT. The TB-2100 allows operator selection of individual reply pulses for measurement of frequency and power. The reply data can be displayed in either Hex, Octal. Raw Hex, and raw Octal.

See paragraph 2-10 for ATCRBS and paragraph 2-11 for Mode S detailed descriptions

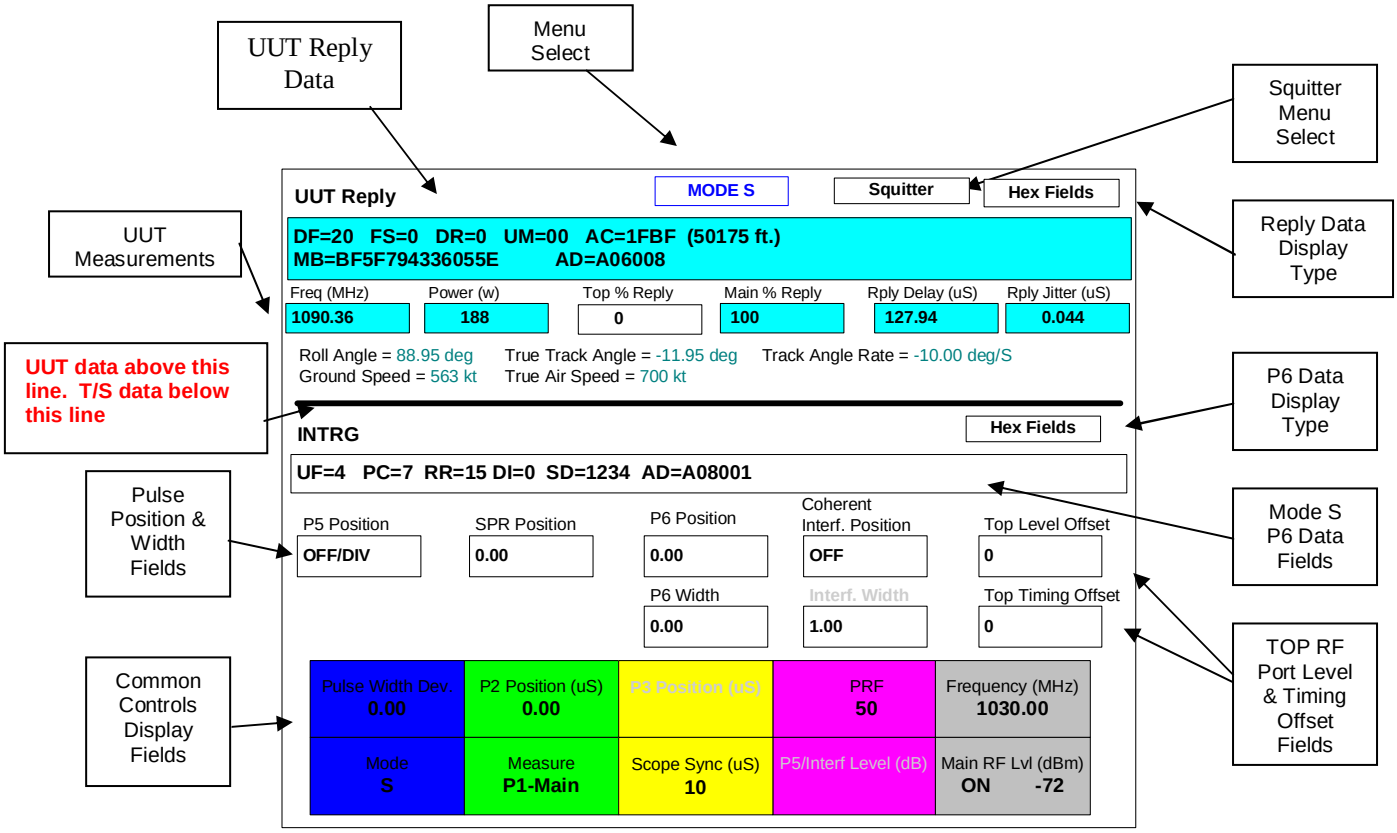
2.5.2 DME Testing

The TB-2100 sends DME squitter and receives the interrogation signal from the DME UUT and simulates a reply accordingly Simulation of distance, velocity and Morse Code/Tone Station Ident can be programmed The UUT Transmitter frequency, power, and interrogation rate (PRF) can be measured and displayed on the TB-2100 LCD.

See paragraph 2.12 for DME detailed description.

2.6 Menus (General)

The TB-2100 menus are arranged such that the test set parameters are located on the lower part of the screen and the unit-under-test (UUT) parameters are located on the upper part of the screen. A horizontal white line separates the two data fields. Figure 2-3 shows the location and general use of each menu item (Mode S menu is displayed). A field which has a shadow can be touched to activate a function or to change a value.

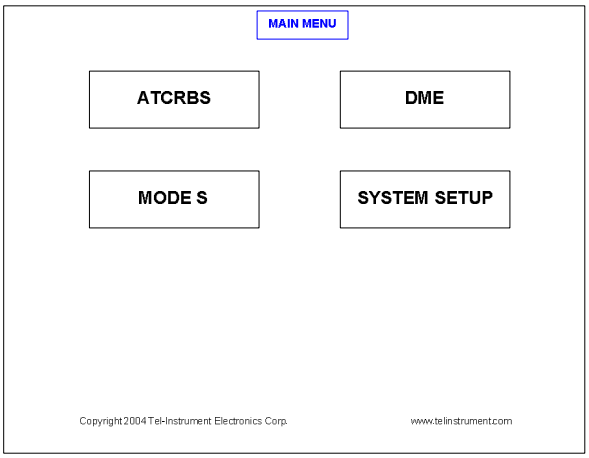


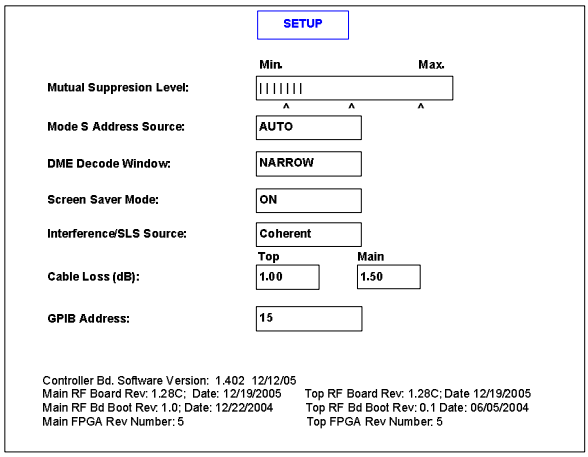
Menu Descriptions

Figure 2-3

Menu Fields	(Table 2-3) Description of Use
Menu Select	Touch field to return to main menu
UUT Data	Displays data received from UUT. When valid data is being received, the Data fields will have a cyan color. When no data the field will be grey. The format for display of data may be changed by touching the reply data display type field (shown as HEX FIELDS but will change to show data type selected as below.). UUT data for Mode S reply can be selected for display in Hex fields, Raw Hex, Octal, or Raw Octal. UUT data for ATCRBS reply can be selected for display in Decoded, Gillham (or binary for Mode A), Raw Hex, or Raw Octal.
UUT Measurements	Displays measurement of UUT signal, including frequency (actual or error from nominal), power (watts or dBm), TOP RF port percent reply, MAIN RF port percent reply, UUT reply delay = SPR to first pulse of transponder preamble. (µsec), and reply jitter (µsec). The frequency and power measurements are made on the pulse displayed in the MEASURE field near the bottom of the LCD. Frequency and power displayed can be changed by pressing the value field.
Pulse Position & Width Fields	Press appropriate field to set position and width of various pulses. The P5, Sync Phase Reversal (SPR), and Interference pulses can be turned on and off. Touch the appropriate field, causing it to be highlighted. Press the Delete (DEL) key on the keypad to turn the pulse on or off. The pulse width and position fields can be changed by touching the field, causing it to be highlighted. The data in the field can be change using the front panel SLEW knob or by entering the value using the keypad and pressing ENT.
Common Controls Display Fields	The 10 fields located at the bottom of the LCD display test parameters for the most commonly controlled parameters. Each of the fields is identified with the name of the parameter. If the field name is gray, that field cannot be changed. Test parameters can be set using the appropriate knob or by touching the desired field and using the keypad to select new parameters. Touching a field will cause it to be highlighted (color will change), indicating that the field is ready for data input from the keypad. To change the data in a field, use the appropriate keys and press ENT (Enter).
Squitter Menu Select	Touch field to select Squitter display menu.
Reply Data Display Type	Touch field to select desired display format for received UUT data including Mode S (Hex Fields, Raw Hex, Octal Fields, or Raw Octal), and ATCRBS (Decoded, Raw Hex, or Raw Octal).
P6 Data Display Type	Touch field to select desired display format for test set Mode S data including Hex Fields, Raw Hex, Octal Fields, or Raw Octal data.
Mode S P6 Data Fields	Displays test set interrogation data for Mode s and ATCRBS functions.
TOP RF Port Level & Timing Offset Fields	The Top Level Offset field is used to set the TOP RF level relative to MAIN RF Port. The Top 99Timing offset field is used to set the timing relative to the MAIN RF Port (Note: P5 must be turned off to change the timing – Top Timing Offset is gray when P5 is turned on). Touch desired field to highlight and use front panel SLEW knob or keypad to enter desired data.

2.7 Main and Setup Menus





MAIN Menu

Select desired UUT Menu by touching the relevant screen field as follows.

ATCRBS. For testing of Mode A/C Transponders

DME for testing DME Interrogators.

MODE S for testing Mode S Transponders.

SYSTEM SETUP for setting fixed parameters as per the adjacent screenshot.

SET UP Menu

Mutual Suppression Level – Displays mutual suppressor output level (front-panel) Adjust by touching screen field and adjusting the level with the SLEW knob.

Mode S Address Source – Touch screen field and set to AUTO for automatic insertion of UUT Mode S address (obtained from Acquisition Squitter) into Mode S interrogations. User must enter UUT Mode S address when set to MANUAL.

DME Decode Window - Touch screen field to set DME decode window width - NARROW (1 µS centered at 12 or 3 µS from P1 in DME Mode) or WIDE (4 µS centered at 12 or 36 µS from P1 in DME Mode)

Screen Saver Mode - Touch screen field and set to ON to enable screen saver mode (screen blanks if not touched for approx. seconds)

Interference/SLS Source - Touch screen field and select Coherent Main RF source) or Non-Coherent (TOP RF Source) mode for SLS and interference pulse

Cable Loss (dB) - Touch screen field and enter cable loss using keypad (press value and ENT) for cables connected to TOP and MAIN RF ports

GPIB Address - Touch screen field and enter GPIB address (0 to 31) using keypad (press value and ENT)

SETUP Touch screen field to return to MAIN MENU

Software Versions (values shown are for illustration purposes only)

2.8 UUT Menus

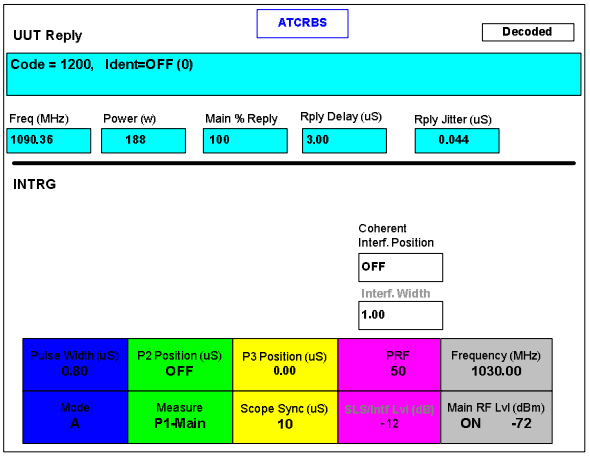
The following are examples of menus which can be selected from the **MAIN** menu by touching the relevant field on the screen. To return to the **MAIN** menu, touch the **PAGE TITLE** window at the top centre of the screen.

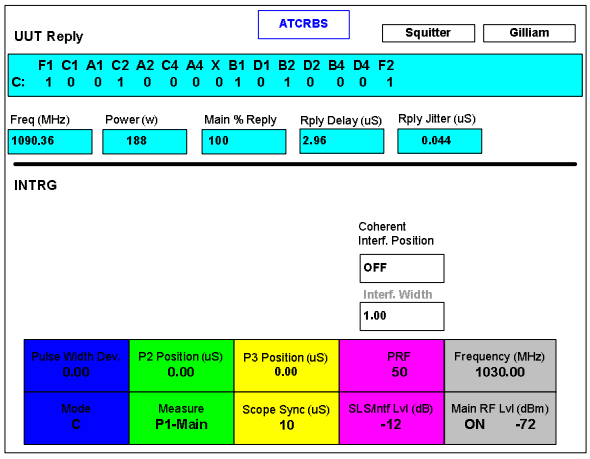
It is important to note that UUT menus will appear with the majority of variables set as they were when the page was last viewed. At any time it is possible to return the menu to a *"DEFAULT"* setting by pressing the CAL button on the keypad. This will only affect the page currently displayed.

Most of the adjustments from within a particular screen can be made in various ways and this will depend on the operator's preference. As an example, the Test Set frequency can be adjusted by turning the frequency control knob. Pressing the control knob will highlight the digit being controlled. Alternatively, touch and highlight the frequency display area of the screen and then enter the absolute value in MHz via the keypad. Values are entered numerically, followed by the **ENTER** key.

Pulse widths and spacing can be altered in a similar way or by highlighting the relevant field and using the **SLEW** knob. This method can also used for altering the data fields in the Mode S uplink formats. (ie Highlight the field by touching the screen and either use **SLEW** or enter a value via the keypad.) Remember to enter the UF field values in the numerical format that is being displayed. I.e. either HEX or OCTAL

2.9 ATCRBS Menus





Mode A Interrogation Menu

The TB-2100 transmits a Mode A interrogation. In the ATCRBS function, the TOP RF Port is not active.

The following parameters can be set:

- Pulse width or deviation (press knob to toggle)
- P2 Position (µS) – Toggle knob to turn on/off
- P3 Position (µS)
- PRF
- Frequency
- Mode
- Select pulse for frequency and power measurement
- Scope Sync
- SLS/Interference Level (dB) - Note: If P2 and Interference Pulse is Off, the SLS/Intf Lvl (dB) will be greyed out
- RF Level
- Interference Pulse position can be On/Off or varied ± 1.00 µsec (Note: P2 is turned off when Interference Pulse is turned on)
- Interference Pulse width can be varied from -0.40 to 3.00 µsec

The UUT data can be displayed in Decoded, Gillham (Binary for Mode A) Raw Hex, or Raw Octal.

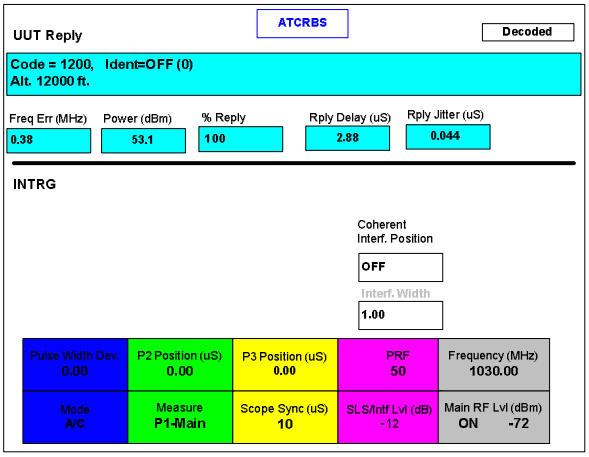
Mode C Interrogation Menu

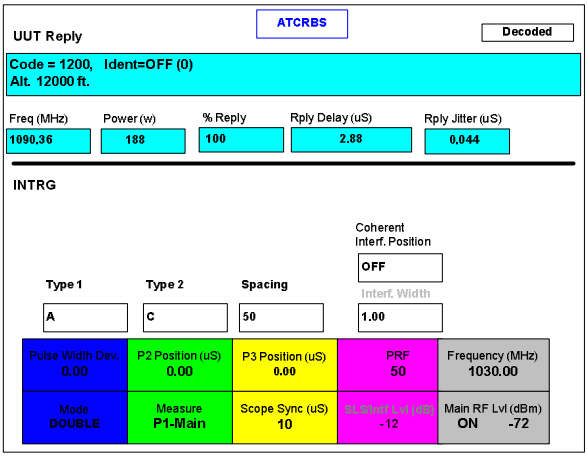
The TB-2100 transmits a Mode C interrogation. In the ATCRBS function, the TOP RF Port is not active.

The following parameters can be set:

- Pulse width or deviation (press knob to toggle)
- P2 Position (µS) – Toggle knob to turn on/off
- P3 Position (µS)
- PRF
- Frequency
- Mode
- Select pulse for frequency and power measurement
- Scope Sync
- SLS/Interference Level (dB) - Note: If P2 and Interference Pulse is Off, the SLS/Intf Lvl (dB) will be greyed out
- RF Level
- Interference Pulse position can be On/Off or varied ± 1.00 µsec (Note: P2 is turned off when Interference Pulse is turned on)
- Interference Pulse width can be varied from -0.40 to 3.00 µsec

The UUT data can be displayed in Decoded, Gillham (Binary for Mode A) Raw Hex, or Raw Octal.





Mode A/C Interrogation Menu

The TB-2100 transmits a Mode A and Mode C interlaced interrogation. The A and C interrogations are separated by a fixed interval. In the ATCRBS Function, the TOP RF Port is not active.

The following parameters can be set:

- Pulse width or deviation (press knob to toggle)
- P2 Position (µS) – Toggle knob to turn on/off
- P3 Position (µS)
- PRF
- Frequency
- Mode
- Select pulse for frequency and power measurement
- Scope Sync
- SLS/Interference Level (dB)
- RF Level
- Interference Pulse position can be On/Off or varied ± 1.00 µsec
- Interference Pulse position can be On/Off or varied ± 1.00 µsec (Note: P2 is turned off when Interference Pulse is turned on)

The UUT data can be displayed in Decoded, Gillham (Binary for Mode A), Raw Hex, or Raw Octal.

Double Interrogation Menu

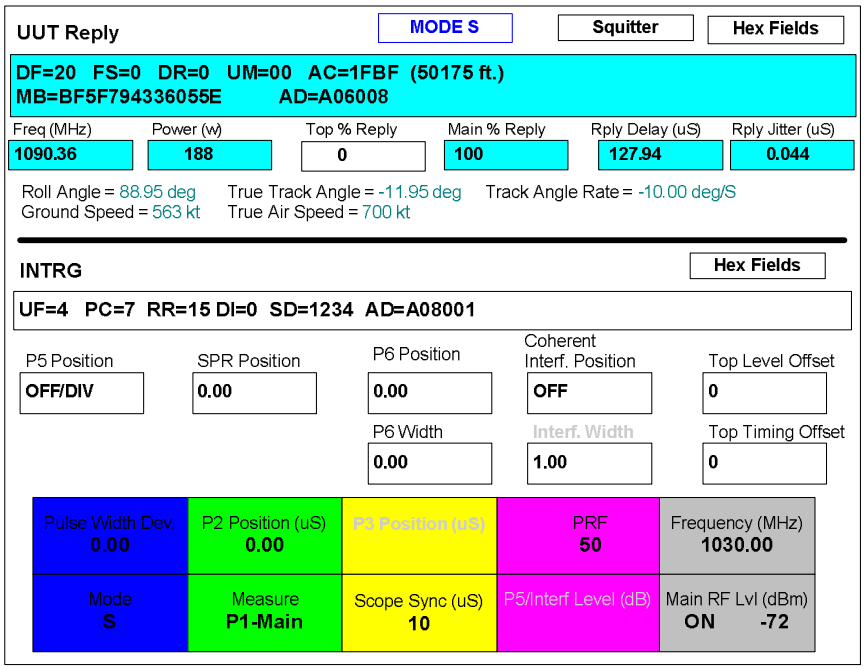
The TB-2100 transmits a Mode A and Mode C interlaced interrogation. The A and C interrogations are separated by a user selectable interval. In the ATCRBS Function, the TOP RF Port is not active.

The following parameters can be set:

- Types of interrogations (A or C)
- Spacing between 2 interrogation types
- Pulse width or deviation (press knob to toggle)
- P2 Position (µS) – Toggle knob to turn on/off
- P3 Position (µS)
- PRF
- Frequency
- Mode
- Select pulse for frequency and power measurement
- Scope Sync
- SLS/Interference Level (dB)
- RF Level
- Interference Pulse position can be On/Off or varied ± 1.00 µsec
- Interference Pulse position can be On/Off or varied ± 1.00 µsec (Note: P2 is turned off when Interference Pulse is turned on)

The UUT data can be displayed in Decoded, Gillham (Binary for Mode A), Raw Hex, or Raw Octal.

2.10 Mode S Menus



Mode S Menu

Mode S Menu

The TB-2100 transmits a Mode S interrogation and displays the reply from the UUT.
The Uplink Format (UF) is set by touching the UF field in the P6 Data Field and entering the field number (0, 4, 5, 11, 16, 20, 21, or 24) using the keypad and ENT key. Additional data fields can be set by touching and using the keypad and ENT key.

If AUTO was selected for Mode S Source in the Setup Menu, the test set will use the address contained in the DF11 acquisition squitter. If MANUAL was selected, the user must manually enter the Mode S address of the UUT. For UF11, you must use Mode S address FFFFFF Hex (Mode S Address Source must be set to MANUAL for UF11) in order to set a DF11 reply from the UUT.

The TB-2100 will decode and display the Mode S Elementary (ELS) and Enhanced (EHS) Surveillance parameters required by Eurocontrol for operation in European airspace. The ELS/EHS data is contained in a DF20 or DF21 reply from the transponder. The DF20/DF21 can be requested by sending a UF4 or UF5 with a specific RR request.

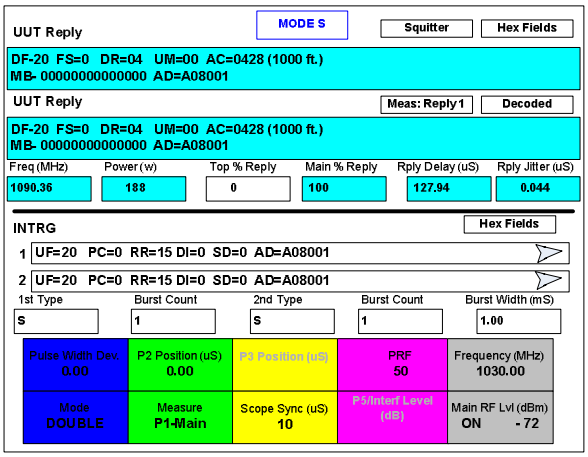
In order to display the ELS/EHS data, set the TB-2100 to display the uplink format in Hex Fields and set the following parameters:

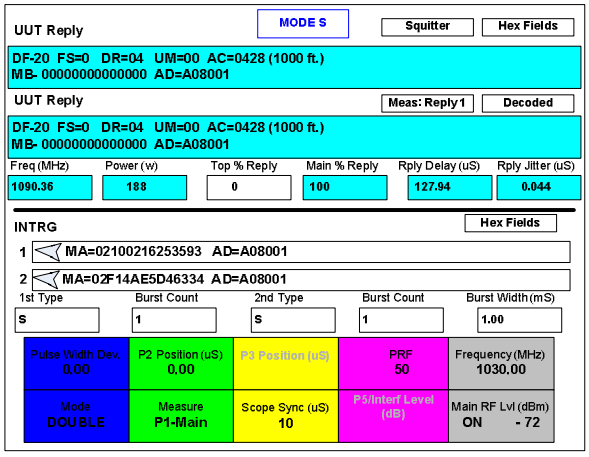
UF	RR (Hex)	Data Displayed
4 or 5	12	Aircraft ID
	14	Target Altitude Source, MCP/FCU Selected Altitude, FMS Selected Altitude, and Barometric Pressure Set
	15	Roll Angle, Ground Speed, True Track Angle, True Airspeed, and Track Angle Rate
	16	Magnetic Heading, Barometric Altitude Rate, Indicated Airspeed, Inertial Vertical Velocity, and Mach Number)

The P6 data display type can be selected for Hex Fields, Raw Hex, Octal Fields, or Raw Octal.

The following parameters can be set:

- Pulse width or deviation
- P2 Position (µS)
- PRF
- Frequency
- Mode
- Select pulse for frequency and power measurement
- Scope Sync
- P5/Interference Level (P5 can be toggled on/off by touching P5 Position display and pressing DEL key)
- RF Level (TOP and MAIN)
- P5 position can be On/Off or varied ± 1.00 µsec
- SPR position can be On/Off or varied ± 0.50 µsec
- P6 position can be varied from -0.40 to + 3.00 µsec
- P6 width deviation can be varied ± 3.00 µsec from nominal
- Interference Pulse position can be On/Off or varied ± 1.00 µsec (Note: Test set allows selection of P5 or Interference Pulse)
- Interference Pulse width can be varied from -0.40 to 3.00 µsec
- Top Level Offset – RF level of TOP RF Port can be varied from -50 to +40 dB relative to MAIN RF Port
- Top Level Offset – Position of interrogation on TOP RF Port can be varied ± 1.00 µsec relative to interrogation on MAIN RF Port





Double Interrogation Menu

The TB-2100 transmits two interrogation types in the same time frame as one normal interrogation. The interrogation types that can be selected are Modes S, A, C, A/C, ATCRBS A/All Call Short (A-ACS), ATCRBS A/All Call Long (A-ACL), ATCRBS C/All Call Short (C-ACS), or ATCRBS C/All Call Long (C-ACL

The Burst Count for Double Interrogation is limited to one (1) set of interrogation types per interrogation. The TB-2100 can be configured to transmit 2 interrogation types with a selectable burst width. The Burst Width (ms) is the time between the two selected interrogation types. The PRF and Burst Width fields are limited by software to prevent overlapping of interrogations. The Double Function is used to check transponder operation and recovery. Press the blue arrow in the INTRG field to toggle between two display fields.

The data in each type of interrogation can be set by touching and using the front panel SLEW knob. The test data display type can be selected for Hex Fields, Raw Hex, Octal Fields, or Raw Octal.

The following parameters can be set:

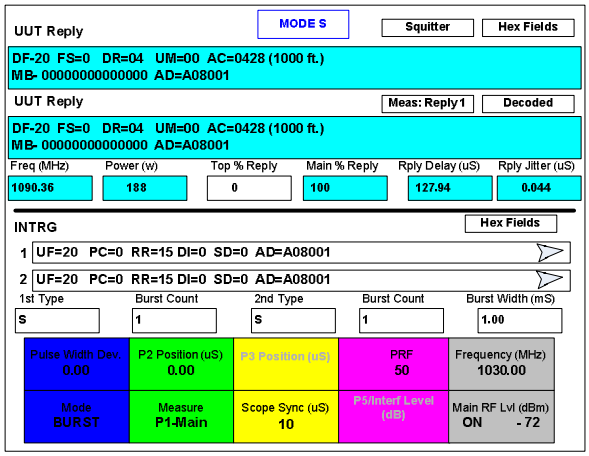
- Pulse width or deviation (press knob to toggle)
- P2 Position (µS)
- PRF
- Frequency
- Mode
- Select pulse for frequency and power measurement
- Scope Sync
- RF Level (TOP and MAIN) - Press RF Level knob to toggle between TOP and MAIN)

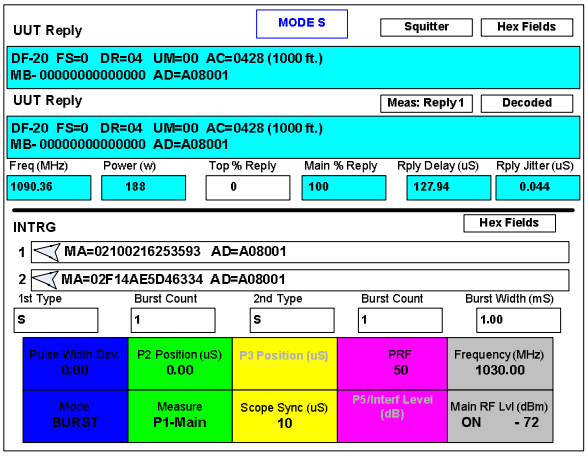
The UUT data and measurements are shown on the upper half of the LCD.

Frequency and power measurements can be made on either reply. Press the MEAS Field to select Reply 1 or Reply 2.

The UUT Mode S data can be displayed in Hex Fields, Raw Hex, Octal Fields, or Raw Octal. The ATCRBS data can be displayed in Decoded, Gillham for Mode C (Binary for Mode A), Raw Hex or Raw Octal. The Raw Hex and Raw Octal Fields display F1 through the SPI (Ident) data pulses.

For transponders capable of supporting Traffic Information System (TIS), the values shown in the MA fields will generate four (4) TIS targets. A slight variation in the Burst Width or PRF may be required for display of TIS data for various transponder manufacturers.





Burst Interrogation Menu

The TB-2100 transmits two selected interrogation types, multiple times, in a selected amount of time. The interrogation types are Modes S, A, C, A/C, ATCRBS A/All Call Short (A-ACS), ATCRBS A/All Call Long (A-ACL), ATCRBS C/All Call Short (C-ACS), or ATCRBS C/All Call Long (C-ACL) in bursts of interrogations.

The TB-2100 can be configured to transmit multiple interrogation types with a selectable burst width. The PRF and Burst Width fields are limited by software to prevent overlapping of interrogations. Press the blue arrow in the INTRG field to toggle between two display fields.

The data in each type of interrogation can be set by touching and using the front panel SLEW knob. The test data display type can be selected for Hex Fields, Raw Hex, Octal Fields, or Raw Octal.

The following parameters can be set:

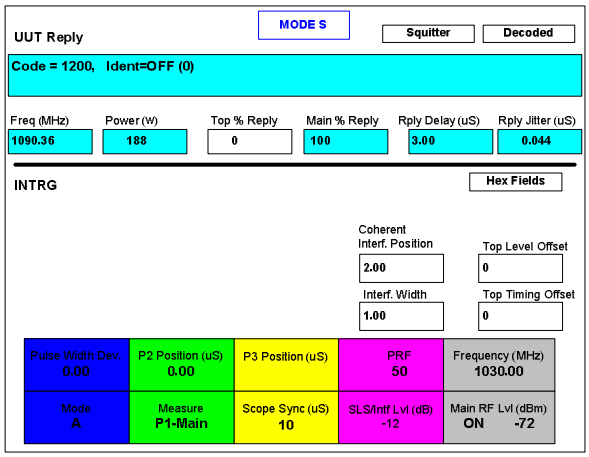
- Pulse width or deviation (press knob to toggle)
- P2 Position (µS)
- PRF
- Frequency
- Mode
- Select pulse for frequency and power measurement
- Scope Sync
- RF Level (TOP and MAIN) - Press RF Level knob to toggle between TOP and MAIN)

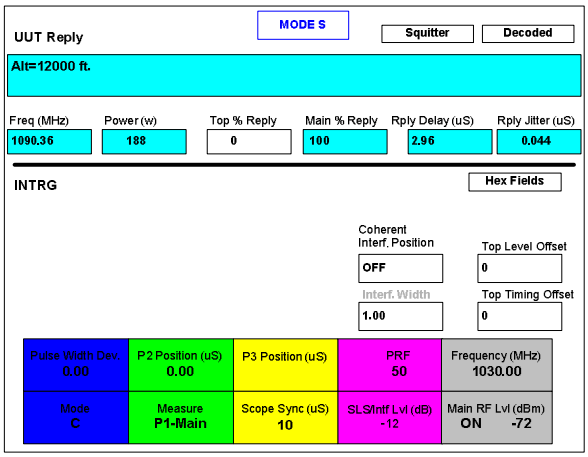
The UUT data and measurements are shown on the upper half of the LCD.

Frequency and power measurements can be made on either reply. Press the MEAS Field to select Reply 1 or Reply 2.

The UUT Mode S data can be displayed in Hex Fields, Raw Hex, Octal Fields, or Raw Octal. The ATCRBS data can be displayed in Decoded, Gillham for Mode C (Binary for Mode A), Raw Hex or Raw Octal. The Raw Hex and Raw Octal Fields display F1 through the SPI (Ident) data pulses.

For transponders capable of supporting Traffic Information System (TIS), the values shown in the MA fields will generate four (4) TIS targets. A slight variation in the Burst Width or PRF may be required for display of TIS data for various transponder manufacturers.





Mode A Interrogation Menu

The TB-2100 transmits a Mode A interrogation.

The following parameters can be set:

- Pulse width or deviation (press knob to toggle)
- P2 Position (µS) – Toggle knob to turn on/off
- P3 Position (µS)
- PRF
- Frequency
- Mode
- Select pulse for frequency and power measurement
- Scope Sync
- SLS/Interference Level (dB)
- RF Level (TOP and MAIN) - Press RF Level knob to toggle between TOP and MAIN)
- Interference Pulse position can be On/Off or varied ± 1.00 µsec (Note: P2 is turned off when Interference Pulse is turned on)
- Interference Pulse width can be varied from -0.40 to 3.00 µsec
- Top Level Offset – RF level of TOP RF Port can be varied from -50 to +40 dB relative to MAIN RF Port
- Top Level Offset – Position of interrogation on TOP RF Port can be varied ± 1.00 µsec relative to interrogation on MAIN RF Port

The UUT data can be displayed in Decoded, Gillham (Binary for Mode A) Raw Hex, or Raw Octal.

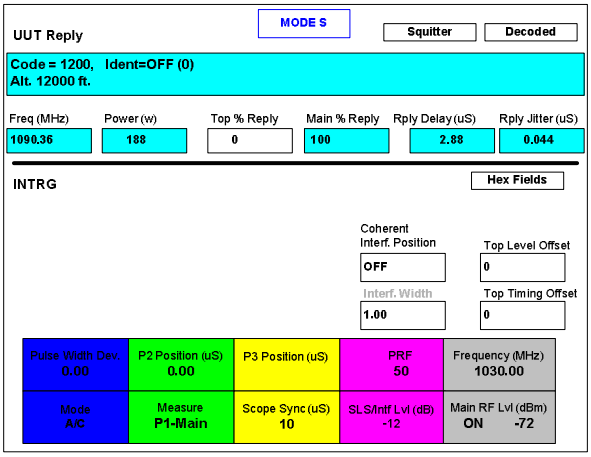
Mode C Interrogation Menu

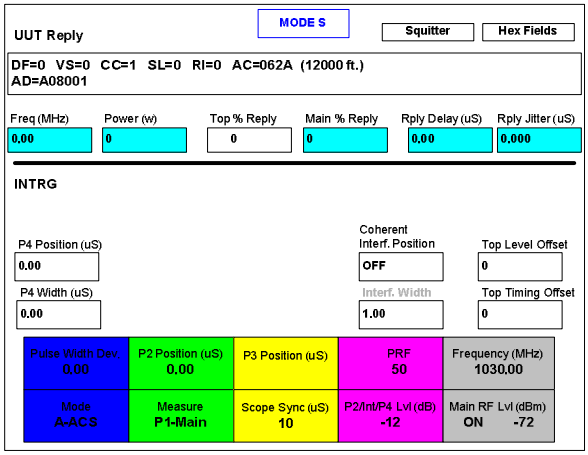
The TB-2100 transmits a Mode C interrogation.

The following parameters can be set:

- Pulse width or deviation (press knob to toggle)
- P2 Position (µS) – Toggle knob to turn on/off
- P3 Position (µS)
- PRF
- Frequency
- Mode
- Select pulse for frequency and power measurement
- Scope Sync
- SLS/Interference Level (dB)
- RF Level (TOP and MAIN) - Press RF Level knob to toggle between TOP and MAIN)
- Interference Pulse position can be On/Off or varied ± 1.00 µsec (Note: P2 is turned off when Interference Pulse is turned on)
- Interference Pulse width can be varied from -0.40 to 3.00 µsec
- Top Level Offset – RF level of TOP RF Port can be varied from -50 to +40 dB relative to MAIN RF Port
- Top Level Offset – Position of interrogation on TOP RF Port can be varied ± 1.00 µsec relative to interrogation on MAIN RF Port

The UUT data can be displayed in Decoded, Gillham (Binary for Mode A) Raw Hex, or Raw Octal.





Mode A/C Interrogation Menu

The TB-2100 transmits a Mode A and Mode C interlaced interrogation.

The following parameters can be set:

- Pulse width or deviation (press knob to toggle)
- P2 Position (µS) – Toggle knob to turn on/off
- P3 Position (µS)
- PRF
- Frequency
- Mode
- Select pulse for frequency and power measurement
- Scope Sync
- SLS/Interference Level (dB)
- RF Level (TOP and MAIN) - Press RF Level knob to toggle between TOP and MAIN)
- Interference Pulse position can be On/Off or varied ± 1.00 µsec
- Interference Pulse position can be On/Off or varied ± 1.00 µsec (Note: P2 is turned off when Interference Pulse is turned on)
- Top Level Offset – RF level of TOP RF Port can be varied from -50 to +40 dB relative to MAIN RF Port
- Top Level Offset – Position of interrogation on TOP RF Port can be varied ± 1.00 µsec relative to interrogation on MAIN RF Port

The UUT data can be displayed in Decoded, Gillham (Binary for Mode A) Raw Hex, or Raw Octal.

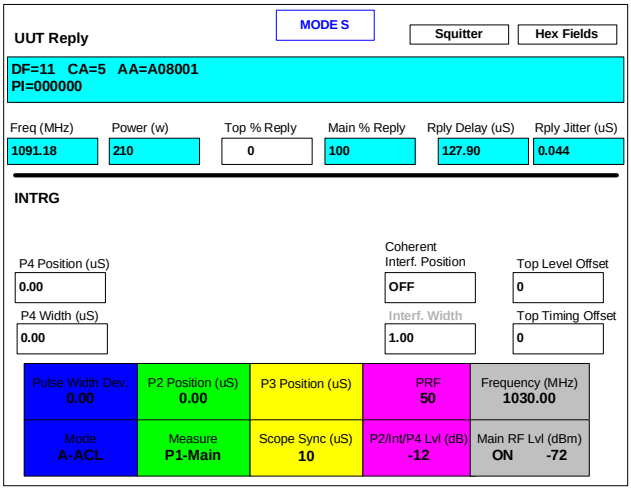
Mode A-ACS Interrogation Menu

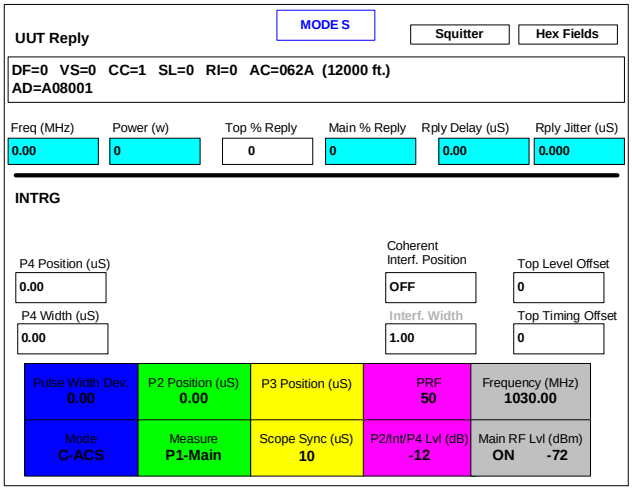
The TB-2100 transmits an ATCRBS A Only All Call (ATCRBS A interrogation plus P4 pulse at normal width (0.8 µsec).

The following parameters can be set:

- Pulse width or deviation (press knob to toggle)
- P2 Position (µS) – Toggle knob to turn on/off
- P3 Position (µS)
- PRF
- Frequency
- Mode
- Select pulse for frequency and power measurement
- Scope Sync
- SLS/Interference Level (dB)
- RF Level (TOP and MAIN) - Press RF Level knob to toggle between TOP and MAIN)
- P4 Position can be varied ± 1.00 µsec
- P4 Width can be varied from -0.50 to +1.00 µsec from normal (0.8 µsec)
- Interference Pulse position can be On/Off or varied ± 1.00 µsec (Note: P2 is turned off when Interference Pulse is turned on)
- Interference Pulse width can be varied from -0.40 to 3.00 µsec
- Top Level Offset – RF level of TOP RF Port can be varied from -50 to +40 dB relative to MAIN RF Port
- Top Level Offset – Position of interrogation on TOP RF Port can be varied ± 1.00 µsec relative to interrogation on MAIN RF Port

The UUT Mode S data can be displayed in Hex Fields, Raw Hex, Octal Fields, or Raw Octal.





Mode A-ACL Interrogation Menu

The TB-2100 transmits an ATCRBS A/Mode S All Call (ATCRBS A interrogation plus wide P4 pulse (1.6 µsec).

The following parameters can be set:

- Pulse width or deviation (press knob to toggle)
- P2 Position (µS) – Toggle knob to turn on/off
- P3 Position (µS)
- PRF
- Frequency
- Mode
- Select pulse for frequency and power measurement
- Scope Sync
- SLS/Interference Level (dB)
- RF Level (TOP and MAIN) - Press RF Level knob to toggle between TOP and MAIN)
- P4 Position can be varied ± 1.00 µsec
- P4 Width can be varied from -0.50 to +1.00 µsec from normal (0.8 µsec)
- Interference Pulse position can be On/Off or varied ± 1.00 µsec (Note: P2 is turned off when Interference Pulse is turned on)
- Interference Pulse width can be varied from -0.40 to 3.00 µsec
- Top Level Offset – RF level of TOP RF Port can be varied from -50 to +40 dB relative to MAIN RF Port
- Top Level Offset – Position of interrogation on TOP RF Port can be varied ± 1.00 µsec relative to interrogation on MAIN RF Port

The UUT Mode S data can be displayed in Hex Fields, Raw Hex, Octal Fields, or Raw Octal.

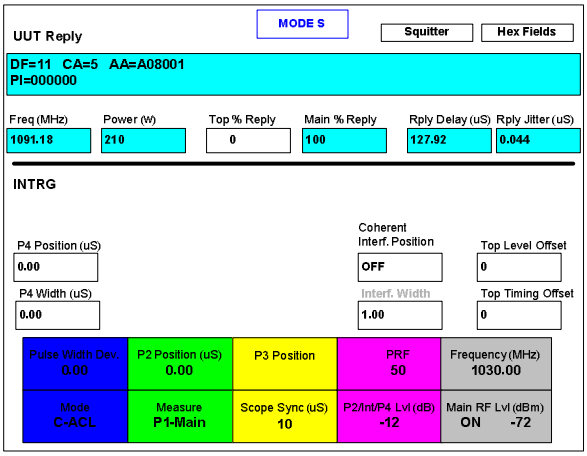
Mode C-ACS Interrogation Menu

The TB-2100 transmits an ATCRBS C Only All Call (ATCRBS C interrogation plus P4 pulse at normal width (0.8 µsec).

The following parameters can be set:

- Pulse width or deviation (press knob to toggle)
- P2 Position (µS) – Toggle knob to turn on/off
- P3 Position (µS)
- PRF
- Frequency
- Mode
- Select pulse for frequency and power measurement
- Scope Sync
- SLS/Interference Level (dB)
- RF Level (TOP and MAIN) - Press RF Level knob to toggle between TOP and MAIN)
- P4 Position can be varied ± 1.00 µsec
- P4 Width can be varied from -0.50 to +1.00 µsec from normal (0.8 µsec)
- Interference Pulse position can be On/Off or varied ± 1.00 µsec (Note: P2 is turned off when Interference Pulse is turned on)
- Interference Pulse width can be varied from -0.40 to 3.00 µsec
- Top Level Offset – RF level of TOP RF Port can be varied from -50 to +40 dB relative to MAIN RF Port
- Top Level Offset – Position of interrogation on TOP RF Port can be varied ± 1.00 µsec relative to interrogation on MAIN RF Port

The UUT Mode S data can be displayed in Hex Fields, Raw Hex, Octal Fields, or Raw Octal.



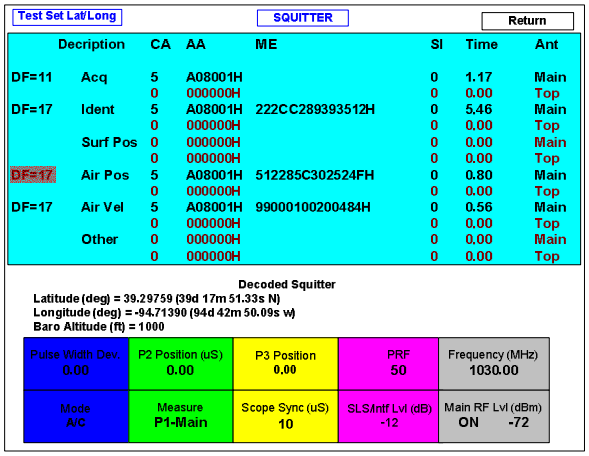
Mode C-ACL Interrogation Menu

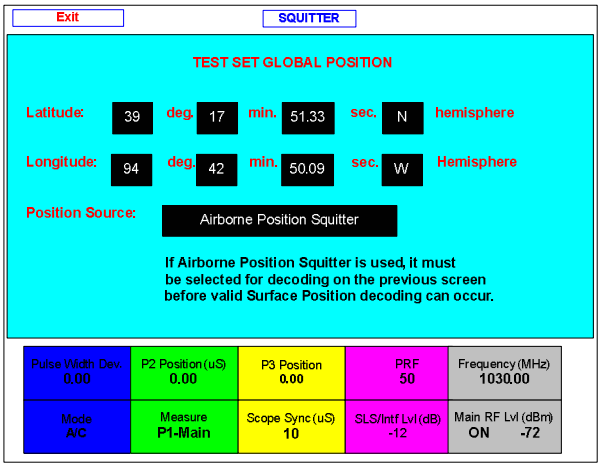
The TB-2100 transmits an ATCRBS C/Mode S All Call (ATCRBS C interrogation plus wide P4 pulse (1.6 µsec).

The following parameters can be set:

- Pulse width or deviation (press knob to toggle)
- P2 Position (µS) – Toggle knob to turn on/off
- P3 Position (µS)
- PRF
- Frequency
- Mode
- Select pulse for frequency and power measurement
- Scope Sync
- SLS/Interference Level (dB)
- RF Level (TOP and MAIN) - Press RF Level knob to toggle between TOP and MAIN)
- P4 Position can be varied ± 1.00 µsec
- P4 Width can be varied from -0.50 to +1.00 µsec from normal (0.8 µsec)
- Interference Pulse position can be On/Off or varied ± 1.00 µsec (Note: P2 is turned off when Interference Pulse is turned on)
- Interference Pulse width can be varied from -0.40 to 3.00 µsec
- Top Level Offset – RF level of TOP RF Port can be varied from -50 to +40 dB relative to MAIN RF Port
- Top Level Offset – Position of interrogation on TOP RF Port can be varied ± 1.00 µsec relative to interrogation on MAIN RF Port

The UUT Mode S data can be displayed in Hex Fields, Raw Hex, Octal Fields, or Raw Octal.





Squitter Menu

The TB-2100 receives and displays Surveillance (DF11) and Extended (DF17) Squitters (if transponder is capable of transmitting DF17 squitters). Squitters are grouped by squitter type and by antenna. For each Squitter, the TB-2100 displays Capability (CA) announced Mode S Address (AA), Message Extended Squitter (ME), Surveillance Identifier (SI), Squitter Period, and Antenna.

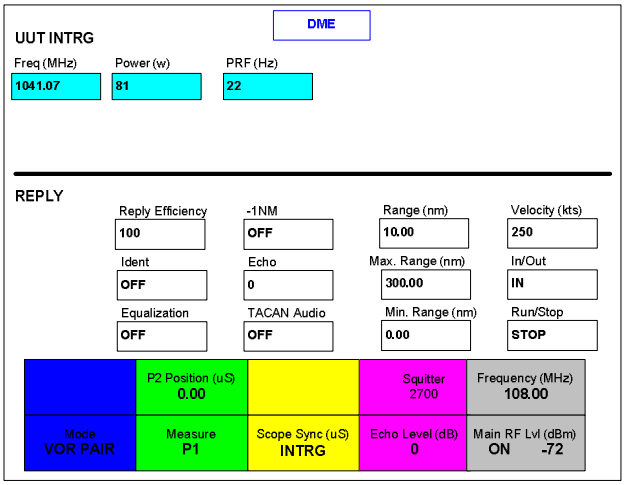
To decode the DF17 squitters, turn the SLEW knob until the ref cursor is adjacent to the desired squitter type. The values decoded for the DF17 squitter will be displayed at the bottom of the screen.

Press the “Test Set Lat/Long” to access the Test Set Global Position screen.

Lat/Long Menu

If the DF17 Airborne Position squitter was received and selected for decoding on the previous page, the TB-2100 will automatically display the latitude and longitude information transmitted by the transponder. The latitude and longitude can be manually set by the user by touching the screen to toggle between Airborne Position Squitter and Manual Entry. If Manual Entry is selected, the latitude and longitude can be set by pressing the appropriate screen position and using the keypad (press value and ENT).

2.11 DME Menu



DME Menu

The TB-2100 replies to valid DME interrogations. The reply can be controlled using various LCD fields.

Common Control Knobs can be used to set:

- Mode – VOR Pair, TACAN Channel, or MHz (Reply Frequency)
- Frequency (depending on Mode above) TACAN Channel, VOR Paired VHF Frequency or actual frquency.
- P2 Position
- Measurement selection of pulse for UUT frequency and power
- Scope Sync – Just after interrogation or just before reply
- Squitter – 0 to 5000 Hz
- Echo Level - +3 to -12 dB relative to Reply
- VOR Paired Frequency/TACAN Channel/MHz

The following Reply parameters can be set:

- Reply Efficiency – 0 to 100%
- Ident – Off, Tone, or Morse Code
- Equalization Pulses – On or Off
- -1 NM – On or Off
- Echo – On of Off
- TACAN Audio – On or Off
- Range – 0 to 998 nautical miles
- Max Range – 0 to 998 nautical miles
- Min Range – 0 to 998 nautical miles
- Velocity – 0 to 9990 knots
- In/Out – Select direction of travel
- Run/Stop – Start or stops simulated DME movement

The following UUT parameters are displayed:

- Frequency (MHz) – Select actual or frequency error by touching screen value
- Power (Watts) – Select watts or dBm by touching screen value
- PRF (Hz) - Scan rate of DME UUT

CHAPTER III

Theory of Operation

GENERAL INFORMATION

3.1 General

The TB-2100 ATC/DME Test Set provides test capability for Transponders (Modes A, C, and S) and Distance Measuring Equipment (DME). The TB-2100 allows testing of Mode S Transponders with new capabilities for Extended Squitter, ADS-B, TIS, and European requirements for Elementary and Enhanced surveillance. The TB-2100 uses Flash memory for easy firmware updates. Test parameters can be updated using keyboard or slew switches. The TB-2100 provides ability to measure true rise and fall times using front-panel connectors. Easy-to-access front-panel connectors allow analysis of signal's with a spectrum analyzer.

The TB-2100 is comprised of several circuit boards and RF modules. The controller board interfaces with the Power Supply PCB, RF Modules, front panel Keypad & Encoder PCBs buttons and knobs, and LCD display to provide the functions used to interact with the UUT.

The RF Modules, controlled by the front panel test parameter fields through the Controller PCB, generate the UUT stimulus signals and receive the UUT responses for measurement. The RF frequencies when transmitted are modulated by signals produced from the RF TX/RX Module and passed to the front panel antenna connectors through the RF Switch, Programmable Attenuator, and RF I/O Modules. The received interrogations from the UUT are measured, delayed, and then replied. Reference Figure 3-1, TB-2100 Block Diagram.

3.2 Controller Board

REF: Schematic Assembly – P/N 80 224 003

The controller board contains the application code that controls the TB-2100 functions. The latest application code, firmware, can be programmed into Flash memory, U7, via the rear panel RS232 connector, J16. Controller board hardware interrupts, logic, & addressing code is programmed into CPLD, U2, at the factory via JTAG connector J1. Operator input from front panel keypad, rotary switches, or color display touch screen is monitored on an I2C bus to place the TB-2100 into various modes or provide additional information to the display's test parameter fields. The controller board communicates with the RF Switch Module and the Programmable Attenuator Control Board via I2C bus and with the TOP & MAIN RF TX/RX modules via the RS232 bus through connectors J4 & J9 respectively.

3.3 Key Pad/Encoder Board

REF: Schematic Assembly – P/N 80 225 003

The keypad board allows the operator to edit the TB-2100 front panel test parameter fields. Microprocessor, U1, monitors inputs from the keyboards buttons and rotary switch, front panel slew knob, as well as the encoder board rotary encoder switches, located directly below the front panel display, and communicates with the controller board over an I2C bus.

3.4 Power Supply Board

REF: Schematic Assembly – P/N 80 231 003

The power supply board provides power to the circuit boards, modules, and cooling fan. It operates from a +12VDC input provided by PS1 at J1. PS1 outputs +12 VDC as soon as the TB-2100 is connected to 110/220 VAC 50/400 Hz line power. Q1 and Q2 provide voltage to front panel switch S1's green and red LED's. When S1 is OFF, Q2 conducts to light the red LED. When S1 is ON, Q1 conducts to light the green LED. With S1 ON, Q5 conducts to turn ON K1 which applies +12VDC to the power supply board. The controller board monitors the state of U13 port 7. With S1 ON, Q7 turns OFF providing a high state at U13 port 7, then the controller board writes to U13 port 2 which turns ON Q6. When S1 is turned OFF Q5 turns OFF but K1 remains ON while Q6 is ON. Q7 turns ON providing a low state at U13 port 7. The controller board reads port 7, indicating that the TB-2100 is to be powered OFF and immediately saves the front panel test parameter fields then writes to U13 port 2 to turn OFF Q6 which opens K1 and removes +12VDC from the power supply board.

When front panel power switch, S1, is ON +12VDC is provided to the displays backlight inverter board through J4. The backlight inverters brightness control is fed back through J4 and out through J5 to the front panel dim pot to control the display brightness. The controller board writes to U13 port 3 which is connected to the backlight inverters remove line through J4 to blank the display during screen saver mode.

The power supply board also controls the amplitude of the suppressor pulse output at J8 which connects directly to the front panel SUPPRESSOR connector. The MAIN RF TX/RX module provides a pulse at J7 which drives Q3 to turn ON Q4. The controller board writes to 8 bit DAC, U16, which controls the feedback to a 35V switching regulator, U15. The regulated voltage from U15 provides the pulse amplitude for the suppressor pulse present at J8. The suppressor pulse amplitude can be set from the TB-2100s System Setup screen Mutual Suppression Level control which is approx. 9 – 28 V unloaded.

3.5 RF I/O Module

REF: Schematic Assembly – P/N 80 227 003

The RF I/O module provides a high power 50 ohm termination for the UUT transmitter and isolation between TB-2100 transmit and receive paths. There is one RF I/O module for each TOP and MAIN RF input. Power from the UUT is attenuated by A3 before entering the dual junction circulator A2. The UUT signal exits A2 at port 3, passes through dual directional coupler A4, and is terminated in the 50 ohm termination R12.

A4 outputs a sample of the UUT signal at pin 1. This signal is attenuated and split into 2 paths by A1. One output of A1 is attenuated and exits through J3 and is connected to front panel

Spectrum Analyzer connector and the other is attenuated and exits through J4 to the RF TX/RX receiver input J9.

The TB-2100 transmit signal is input to the RF I/O at J1. It enters the dual junction circulator A2 at port 1 and exits from port 2 through attenuator A3 to J2.

The received UUT signals from J2 are attenuated by a nominal 50.5 dBm and routed to the RF TX/RX module. Likewise, the RF signals are attenuated approx. 60 dBm and routed to the front panel to be monitored by a Spectrum Analyzer.

3.6 RF Switch Module

REF: Schematic Assembly – P/N 80 228 003

The RF Switch module routes the RF signals from the RF TX/RX modules through the programmable attenuator to the RF I/O modules. The RF Switch module can be placed in two modes, Diversity Mode and Mode S P5 Mode. In 'Diversity Mode', the MAIN and TOP RF transmitters generate individual signals and are routed from the RF Switch MAIN input, J4, to MAIN output, J6, through RF switches U6 and U7 and TOP input, J5, to TOP output, J7, through RF switches U10 and U11. In MODE S 'P5 Mode' the RF Switch combines and splits the MAIN transmitter's MODE S signal and the TOP transmitter's P5 pulse through RF switches U6 and U10 and power splitters U8 and U9. From U9 the MAIN and TOP outputs are attenuated by 10dB. R4, R5, & R6, provide a fixed 10dB attenuation to the TOP output and pin diodes, D1 & D2 provide an adjustable 10dB attenuation to the MAIN output. 8 bit DAC, U13, and op-amps, U12, U14 and U15, control the pin diodes using a pre calibrated value to ensure both MAIN and TOP receive equal attenuation.

3.7 RF Attenuator Control Board

REF: Schematic Assembly – P/N 80 229 003

The RF attenuator control board provides TTL control logic to the TB-2100 solid state programmable attenuators, AT1 and AT2. The seven bit output can provide attenuation control from 0 to 127 dB in 1dB steps.

3.8 RF TX/RX Module

REF: Schematic Assembly – P/N 80 230 003

The RF TX/RX module is a stand alone microprocessor based module controlled by RS-232. It transmits and receives ATC/DME RF signals with an FPGA to generate the ATC pulse patterns. Several I/O ports connect to TB-2100 front and rear panels to connect to external test equipment.

Y1 is a 20MHz voltage controlled temperature compensated oscillator, VCTCXO that supplies the clock to uP U12 and FPGA U13. The FPGA divides the clock by 2 and supplies the 10MHz reference signal to transmitter frequency synthesizer U57 and receiver frequency synthesizer U41.

Microprocessor U12 communicates with the Controller PCB via RS-232 through U9. The serial port parameters are 8 data bits, no parity bit, 1 stop bit, baud rate 115,200, and hardware flow control. U9 provides level translation between U12's 3.3V logic levels and RS232 voltage levels.

At power up, U12 reads the program data stored in Flash memory U4 and writes it into the FPGA U13. It also reads configuration and calibration data from EEPROM U2.

3.8.1 Transmitter

The transmitter carrier signal is generated by frequency synthesizer U57. U57 is tuned with serial data FS_CLK, FS_DATA, and FS_TX_EN signals from the FPGA. The TX_LOCK signal is read by uP U12 to determine if U57 is tuned to the desired frequency. U57's digital circuits are powered by +3.3Vdc. U57's analog circuits are powered by +5Vdc from low noise regulator U67.

The +9 dBm nominal output from U57 is padded by a fixed PI attenuator and applied to the LO input of mixer U58. U58 is configured as a pulse modulator with modulation pulses applied to the IF port. The modulation pulses may be monitored at TP2.

The output of U58 is applied to the variable attenuator consisting of PIN diodes U13 and U14. RF level control to the PIN diodes is provided by U71 and U21 from uP DAC input, TX_AM, with temperature compensating RT1. In DME mode, it is also used to modulate the RF level with a composite 15/135 Hz waveform to simulate TACAN amplitude modulation.

The modulated signal is amplified by U61 which provides 20dB of gain and U62 which provides an additional 17dB of gain. The amplified signal is filtered by low pass filter FL2 and FL3. The uP sets the LOW_BAND signal to a logic HIGH when the transmit frequency is <= 1050MHz and LOW when it is > 1050MHz.

The modulated transmit signal from the low pass filter is applied to dual directional coupler CLP1. A sample of the modulated signal is detected and buffered by D16 and U64 and outputted through J16 to the front panel TEST SET VIDEO connector. RF switches U6, U55, and U56 direct the flow of the modulated transmit signal. PULSE_FRAME goes HIGH before pulse modulation and stays HIGH until after pulse modulation to apply the transmit signal to U56. During normal operation, the BITE signal to switches U55 and U56 is LOW which directs the transmit signal through J13 to the RF Switch and RF I/O modules to front panel RF connector. LOW_PWR_RF_IN, J12, from rear panel connector J14 is directed through U55 to U42.

U42 selects the signal that is applied to the receiver circuits. With CNTRL_1 logic LOW, normal operation, the received signal from the RF I/O module from J9 is selected. With BITE and CNTRL_1 logic HIGH, self test mode, the transmit signal is wrapped around to the receiver circuits.

3.8.2 Transmitter Modulation

The FPGA generates up to 3 serial data streams. For ATCRBS interrogations, DATA1 to analog switch U20 has P1 and P3 pulses and DATA2 to analog switch U28 has P2 pulse. For MODE S interrogations, DATA1 has the preamble and P6 pulses, DATA2 has P5 pulse, and DATA3 to flip-flop U25 has the DPSK data. For DME, DATA1 has reply and squitter pulse pairs and DATA2 has echo pulse pairs.

DAC voltages P1_LEVEL and TX_SLS provide the DC levels for the pulse modulation outputs of U20, U28, and U29 controlled by the DATA1 and DATA2 serial data streams. U30 switches the modulation pulses to pulse shaping networks that provide the correct rise/fall times for the ATCRBS and DME pulses that are applied to op-amp U26.

PULSE_MOD from U26 output drives the IF input of pulse modulator U58. A logic HIGH from DME at pin 6 of U30 switches the ATCRBS/MODE S pulses to the NO pin.

DAC voltages MOD_BIAS and DPSK_LEVEL are adjusted to equal but opposite voltages from op-amps U23 and U59 that cancel each other out when applied to modulator U58 when no RF is transmitted. The DPSK_LEVEL is set to 2X the P1_LEVEL but opposite sign so when it sums with P1_LEVEL the net result is a voltage that is the same magnitude as P1_LEVEL but opposite sign. When DPSK data, DATA3, clocks flip-flop U25, MOD_BIAS voltage is removed allowing the inverted DPSK_LEVEL voltage to produce a phase reversal pulse to the modulator.

3.8.3 Receiver

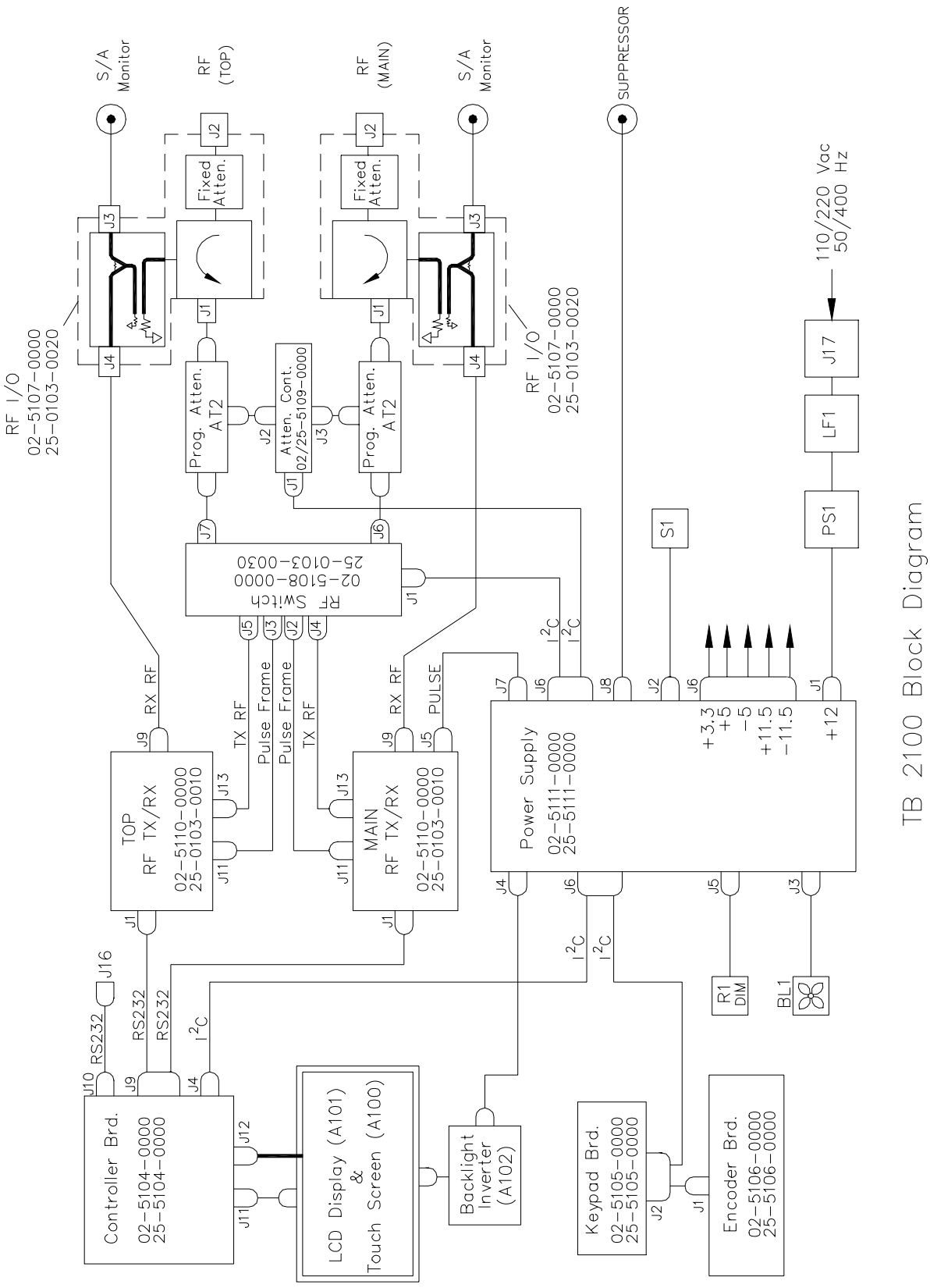
The attenuated UUT RF signal enters the RF TX/RX module through J9. RF switches U43 & U44 switch the RF signal to a high power 15.6dB or low power 5dB pad controlled by LOW_PWR_UUT line. LOW_PWR_UUT logic LOW, default state, selects the high power 15.6dB pad. The UUT signal continues through RF switch U42 to mixer U40.

Frequency synthesizer U41 is tuned 60MHz above the expected received RF signal with serial data FS_CLK, FS_DATA, and FS_TX_EN signals from the FPGA. The TX_LOCK signal is read by uP U12 to determine if U41 is tuned to the desired frequency. U41's digital circuits are powered by +3.3Vdc. U41's analog circuits are powered by +5Vdc from low noise regulator U68.

The +9 dBm nominal output from U41 is padded by a fixed PI attenuator and applied to the LO input of mixer U40. U40 is configured as a mixer to provide IF of 60MHz.
The IF from U40 is split into two paths at U38. One path is to the log amp U48 and the other is to the linear demodulator U37, T1, D10, and U36.

Log amp U48 also splits the IF into two paths. One to U45 to measure UUT frequency and the other to U49 to measure power. The output of the frequency circuit comprised of differential op-amp U45, 60MHz filter FL1, frequency discriminator U47, tuned to 60MHz, and comparator U46, is monitored by FPGA U13 to fine tune frequency synthesizer U41. Analog multiplier U49 is used to calibrate the gain and offset of the UUT signal using DAC voltages LOG_SCALE and LOG_INT. The output of the multiplier is routed through analog switch U50. PWR_SAMPLE from FPGA switches U50 ON to correspond with the UUT pulse that is being measured. The peak detected UUT pulse from U51's output, RX_AMP, is immediately converted by the ADC of uP U12 so that droop from the peak detector does not introduce errors. Once the ADC is complete, RX_PWR_HOLD from uP U12 is sent to flip-flop U73 to turn ON FET Q9 to reset peak detector U51 in preparation for the next measurement.

The UUT pulses from linear demodulator circuit, U37, T1, D10, and U36, mentioned above are filtered and sent to op-amps U7 & U8 and outputted through J7 to front panel UUT VIDEO connectors. The output of U7 is also sent to the 50% Video circuits. Peak detector U34 and multiplier U35 provide UUT pulses to one input of comparator U33. Switches U31 & U32 plus delay lines DL1 & DL2 provide UUT pulses to the other input of U33. Multiplier U35's gain and offset are controlled by DAC voltages VIDEO_GAIN and VIDEO_OFFSET. DL1 provides 250nS delay in Transponder mode and DL2 provides 2.5uS delay in DME mode. U35s VIDEO_GAIN is set to provide the proper 50% Video at TP7, VIDEO-IN, sent to the FPGA.



TB-2100 Block Diagram

Figure 3-1

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 has recommended an annual calibration and alignment interval and periodic checks to keep the TB-2100 in operational condition. Performing preventative maintenance checks of the Test Set and Test Set verification 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 three sections.

1. Routine Maintenance (Section A).

2. Test Set Verification and Acceptance Checks (Section B).

3. Annual Calibration and Alignment (Section C).

Routine Maintenance: By routinely cleaning and inspecting the TB-2100 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 the Test Set passes the Test Set Verification and Acceptance Check, a Calibration and Alignment is not necessary. This Test verifies all hardware related tests to ensure the Test Set is operating at manufacturers specifications.

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.

If by completing the Test Set Verification and Acceptance Checks and the Test Set continues to exhibit unusual or erroneous information, the Test Set may require the Full Alignment as outlined in Section C.

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 Test Set Verification Acceptance Check to determine if a Calibration or Alignment is necessary, and 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 during normal operation, the Test Set fails to meet any specification outlined in Chapter 1, Section B.

4.1.1 Safety Precautions

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 preceding tests thoroughly read and understand all procedures before actually performing them.

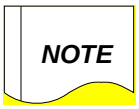
2. The various front panel connectors, switches, and controls specified can be located by referring to Figure 2-1 on page 2-3.

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 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.

4.1.2 Preliminary Considerations

1. Test Equipment- Recommended test equipment is listed before each test. An equivalent type may be substituted in lieu of the listed equipment.

2. Environmental Considerations- Test and align the equipment in conditions similar to the conditions the Test Set will be utilized in.

3. Calibration Test Reports- Test reports are located in Appendix A & Appendix B. Make copies of the test reports before commencing alignment to properly log results.

4. The Test Set should be allowed to warm up for a period of at least 10 minutes before testing begins.

5. Always begin with a fully charged battery.

4.2 General

By routinely cleaning and inspecting the TB-2100 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 after extended storage.

Routine maintenance consists of the following:

Cleaning of the TB-2100 Test Set exterior case.

Inspection of all connectors, switches, and supplied cables.

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.

4.2.2 Display Care

Ensure to dry off the Test Set Display only with a Lint free cloth. Strong cleaners and chemicals shall be avoided to prevent damage to the display.

4.2.3 Inspection of all Connectors, Cables, and Test Set Assembly

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

a) Inspect the Test Set case for signs of abuse. Large dents and cracked displays may render the Test Set inoperable.

b) Toggle and push each switch for proper operation. Sticking switches may result in erroneous test results.

c) Inspect for loose bolts, nuts, and screws; tighten if necessary.

.

SECTION B

TEST SET VERIFICATION AND ACCEPTANCE CHECKS

4.3 General

These procedures will be performed on an Unopened Test Set, except where noted, by measuring inputs/outputs. If the Test Set results are not within tolerances, the Test Set will require a full Calibration and Alignment as outlined in *Section C*. The tests are broken down into individual sections to allow the operator to verify proper operation of individual functions when a discrepancy may arise or repair was accomplished.

4.3.1 Test Equipment Required

The following support equipment (or their equivalent) is necessary to perform the Test Set Verification and Acceptance Checks:

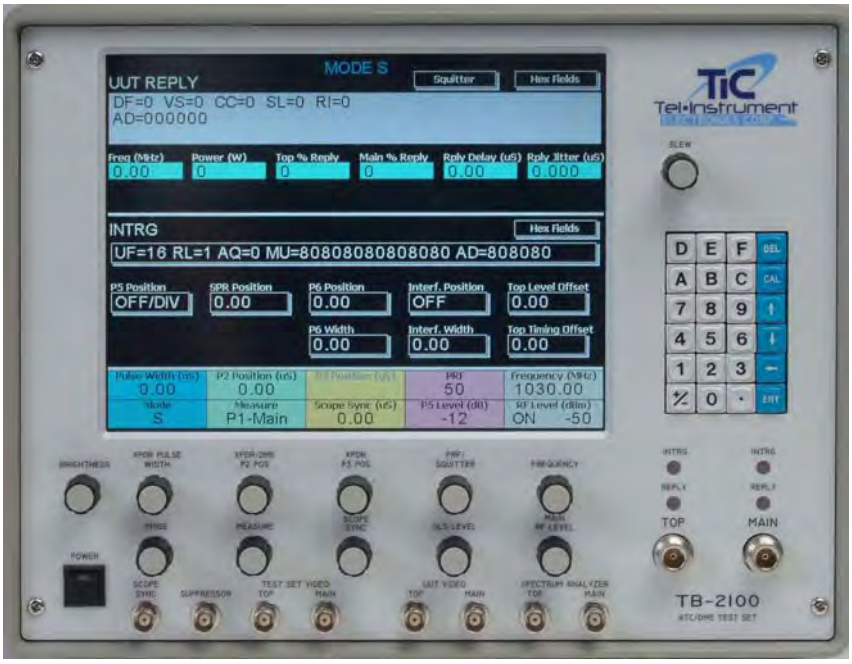
Name	Designation/Description
Oscilloscope	Infinium 54835A
Signal Generator	Hewlett Packard 8648B
Spectrum Analyzer	Agilent E4401B
Pulse Generator	Agilent 81101A
3 dB Attenuator	Mini-Circuits
Frequency Counter	Fluke 1953A
DC Power Supply	0 to 5 VDC
Mixer	Mini-Circuits ZFM-4
Personal Computer or Laptop	Any Preference
Terminal Emulation Software	Tear Term Pro[1]
Measuring Receiver	HP 8902A
Sensor Module	HP 11722A
Transponder**	Bendix/King KT-73**
DME**	Bendix/King KN-64**
Assorted Cables, Connectors, and Adapters	
Copy of Data Sheet	APPENDIX 4-F

Support Equipment

Table 4-1

** In Lieu of a Transponder and DME R/T, a High Power Frequency generator such as the “Model 2770” IFF/TACAN Test Set by “Unique Broad Band Systems Ltd.” can be used.

[1] Provides serial input for calibration using terminal emulation program. Tel-Instrument recommends a product called “Tera Term Pro” which is available for free by downloading on the Internet at http://hp.vector.co.jp/authors/VA002416/teraterm.html.



Initial Settings

Figure 4-1

4.4 ATCRBS Functions, Display and Frequency

For all of the tests in sections 4.5X, the TB 2100 should be configured as an ATCRBS test instrument.

4.4.1 Initial ATCRBS Functions and Frequency

1. Connect the Test Set to an appropriate power source.

2. Turn the **POWER** switch to the **ON** position and ensure that the TB-2100 completes its self test without failure.

3. Turn the **BRIGHTNESS** knob and verify that the display changes Brightness accordingly. Log the results.

4. Set Mode to A in the **ATCRBS** test instrument screen and depress the **CAL** button to preset Mode A to factory settings.

5. Turn the **BRIGHTNESS** knob and verify the ATCRBS display adjusts from minimum to maximum brightness and record on the datasheet.

6. Press the **XPDR PULSE WIDTH** knob and verify the Pulse Width (µS)/Pulse Width Dev. window toggles from Pulse Width (µS) to Pulse Width Dev. and record on the datasheet.

7. Turn the X**PDR PULSE WIDTH** knob and verify the Pulse Width (µS) window adjust from its minimum and maximum range as indicated in the Datasheet.

8. Press the **XPDR PULSE WIDTH** knob to select Pulse Width Dev. Turn the **XPDR PULSE WIDTH** knob and verify the Pulse Width Dev. window adjust from its minimum and maximum range as indicated in the Datasheet.

9. Press the **XPDR/DME P2 POS** knob and verify the P2 Position (µS) window indicates **OFF**.

10. Press the **XPDR/DME P2 POS** knob to turn on the P2 Position (µS) window and turn the **XPDR/DME P2 POS** to verify the P2 Position (µS) window adjust from its minimum and maximum range as indicated in the Datasheet.

11. Turn the **XPDR P3 POS** knob and verify the P3 Position (µS) window adjust from its minimum and maximum range as indicated in the Datasheet.

12. Press the **PRF/SQUITTER** knob and verify the PRF window indicates **Ext Trig** and record in the Datasheet.

13. Press the **PRF/SQUITTER** knob to indicate the default PRF value and verify the **PRF/SQUITTER** knob changes the value as it is turned clockwise and counter clockwise.

14. Press the **FREQUENCY** knob and verify a highlighted box appears in the Frequency (MHz) window and that turning the knob adjust the value of the highlighted box.

15. Turn the **MODE** knob and verify the modes in the Mode window change and record in the Datasheet.

16. Turn the **MEASURE** knob and verify the fields in the Measure window change and record in the Datasheet.

17. Turn the **SCOPE SYNC** knob and verify the Scope Sync (µS) window value changes as it is turned clockwise and counter clockwise.

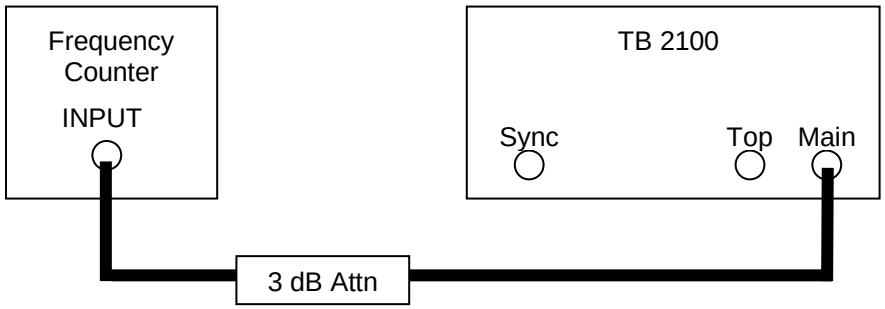
18. Turn the **SLS LEVE**L knob and verify the SLS/Intf Lvl (dB) window adjust from its minimum to maximum range as indicated in the Datasheet.

19. Turn the **MAIN RF LEVEL** knob and verify the MAIN RF Lvl (dBm) window value changes as it is turned clockwise and counter clockwise.

20. Touch the **Interf.** Position field on the ATCRBS display to highlight the field using the key pad, enter Zero and press **ENT** to set Interf. Position to 0.00. Touch the **Interf**. Position field again to highlight the field and turn the **SLEW** knob and verify the Interf. Position value changes as it is turned clockwise and counterclockwise.

21. Press the key pad **CAL** button to reset the **ATCRBS** screen windows.

22. Connect the frequency counter to the **MAIN** connector through the 3 dB attenuator, as shown in Figure 4-2.



Main Power Output Initial Set-Up

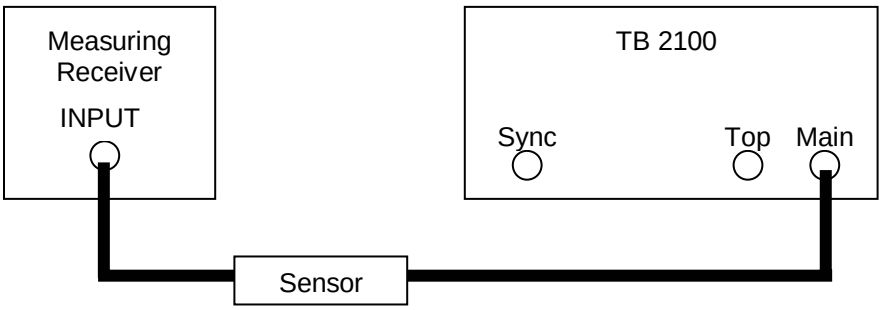
Figure 4-2

23. Set the **MAIN RF Lvl (dBm)** to **CW** with -10 dBm output power. Record the frequency measured by the frequency counter for each entry below:

    a) 1030 MHz / ± 10 kHz
    b) 952 MHz / ± 10 kHz
    c) 1223 MHz ± 10 kHz

4.4.2 MAIN Output Power

1. For the Output Power tests, connect the measuring receiver to the MAIN connector through the sensor module, as shown in Figure 4-3.



Main Output Power Setup

Figure 4-3

4.4.3 MAIN RF Level

1. Set the **MAIN RF Lvl (dBm)** to CW with -10 dBm output power.
2. Set the Frequency to 1030 MHz.
3. Record the power level measured by the measuring receiver for each power level below. Record each value on the Data Sheet.

Step	Main Level Setting	Specification
a	-10 dBm	-10 dBm / ± 0.5 dBm
b	-11 dBm	-11 dBm / ± 0.5 dBm
c	-12 dBm	-12 dBm / ± 0.5 dBm
d	-14 dBm	-14 dBm / ± 0.5 dBm
e	-18 dBm	-18 dBm / ± 0.5 dBm
f	-26 dBm	-26 dBm / ± 0.6 dBm
g	-42 dBm	-42 dBm / ± 0.75 dBm
h	-74 dBm	-74 dBm / ± 1.10 dBm
i	-100 dBm	-100 dBm / ± 1.50 dBm

4.4.4 CW ON/OFF Ratio

1. Set the **MAIN RF Lvl (dBm)** to **CW** with -10 dBm output power.
2. Measure and record the actual output power.
3. Set the **MAIN RF Lvl (dBm**) to *OFF*.
4. Measure and Record the output value ensure a minimum of -60 dBm difference between step 2 and 3.

4.4.5 Level vs. Frequency

1. Set the **MAIN RF Lvl (dBm)** to **CW** with -10 dBm output power, PRF at 500.
2. Measure and record the actual output power Reference at each frequency (Utilize Datasheet).
   a) Freq at 1030 MHz REF =_____
   b) Freq at 952 MHz ± 1.0 dBm of reference
   c) Freq at 1223 MHz ± 1.0 dBm of reference

4.4.6 SLS Level

1. Set the **MAIN RF Lvl (dBm)** to **ON** with -10 dBm output power in **CW**.
2. Set the Frequency (MHz) to 1030 MHz.

3. Connect the PC (Personal Computer) to the TB-2100 RS-232 Connector at the rear of the Test Set utilizing a standard cable (Not supplied),

4. Ensure a Baud rate of 115200, 8 Bit, and ensure the echo is *OFF*.

NOTE

Tel-instrument can not provide 3rd Party Software technical assistance. Please refer to the Software documentation or see your computer administrator for assistance.

5. Start the communication between the Test Set and the PC and enter the following commands. Ensure you enter each parameter one at a time.

   B0 – **CW10** – **P2L0** – **CW21**

6. Measure and record the P2 output power on the Datasheet

7. Enter the next commands in order and record the values against the datasheet specifications:

Step	SLS Level Setting (Command)	Specification
7a	**P2L1** – **CW21 =** 1 dBm	1 dBm / ± 0.25 dBm
7b	**P2L3** – **CW21 =** 3 dBm	3 dBm / ± 0.25 dBm
7c	**P2L-1** – **CW21 =** -1 dBm	-1 dBm / ± 0.25 dBm
7d	**P2L-6** – **CW21 =** -6 dBm	-6 dBm / ± 0.25 dBm
7e	**P2L-12** – **CW21 =** -12 dBm	-12 dBm / ± 0.25 dBm

8. Press the **CAL** button to return the Test Set to factory default settings.

4.4.7 Pulse Shape Rise and Fall times

1. Connect the test equipment to the TB 2100 as shown in Figure 4-4 (following page).

2. Set the frequency of the signal generator to 970 MHz and the output level to +7 dBm in **CW**.

3. Set the frequency of the TB 2100 to 1030.00 MHz and the output level “ON” at -10dBm.

4. Set the TB 2100 PRF to 1000.

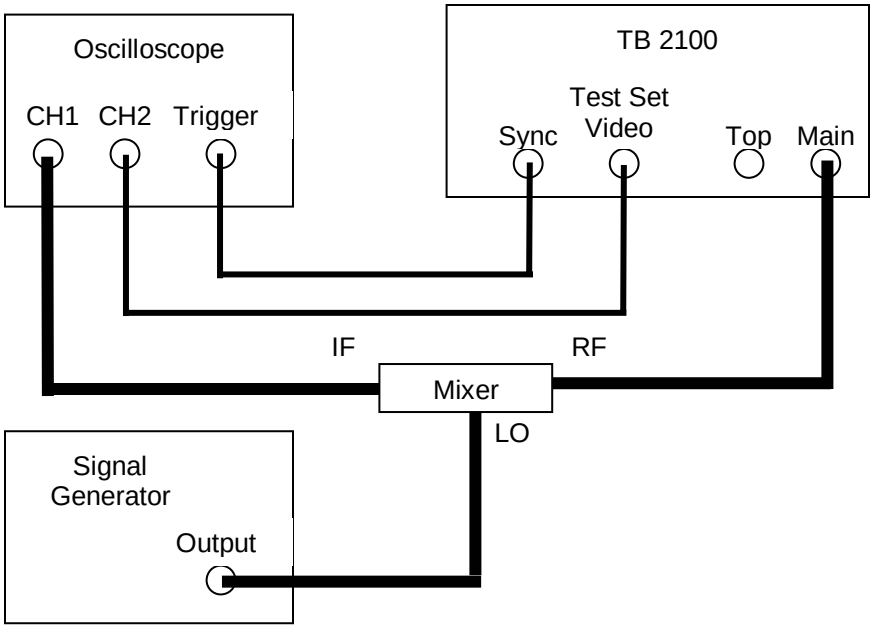
5. Mix the output of the TB 2100 to 60 MHz (utilizing the Signal Generator) and display the 60 MHz signal on channel 1 of the oscilloscope, setting the TB 2100 **SCOPE SYNC** as required.

6. Adjust the oscilloscope vertical gain and offset to establish the peak levels of the 60 MHz IF as close to full scale as practical (85% to 95% FS).

7. Measure and record the 10% to 90% P1 risetime on the IF signal in specification at 75 / ± 25 nSec.

8. Measure and record the 90% to 10% P1 fall time on the IF signal in specification at 125 / ± 75 nSec.

9. Measure and record the 50% to 50% P1 pulse width on the IF signal in specification at 800 / ± 50 nSec.



Pulse Shape Setup

Figure 4-4

4.4.8 Detected TEST SET VIDEO (MAIN) Output

1. With the equipment in the same configuration; measure and record the 10% to 90% risetime of the detected P1 pulse from the **TB 2100 MAIN TEST SET VIDEO** output.

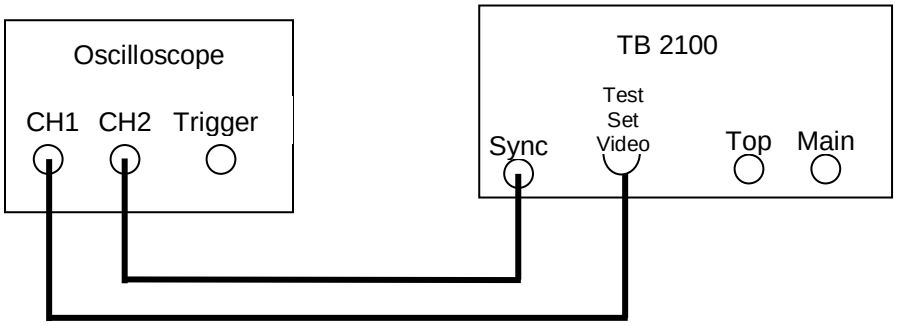
2. Measure and record the 90% to 10% fall time of the detected P1 pulse.

3. Measure and record the 50% to 50% pulse width of the detected P1 pulse.

4.5 Interrogation Pulse Patterns

4.5.1 ATCRBS Mode A – P1, P2, and P3

1. Connect the Test Set as in Figure 4-5.
2. Set the Test Set for Mode A, Frequency 1030 MHz and **MAIN RF Lvl (dBm)** to -10 dBm.



ATCRBS Pulse Patterns

Figure 4-5

3. Set the Pulse Width to 0.80 µsec by press the **XPDR PULSE WIDTH** button.
4. Set the P2 and P3 Positions to 0.00 µsec and the **SLS / Intf Lvl (dB)** to 0.
5. Measure and verify the 50% to 50% pulse widths for P1, P2, and P3 as per the Datasheet.
6. Continue to measure and verify the 50% to 50% pulse widths for each setting as per the datasheet.
7. Return the Pulse Width to 0.80 µsec.
8. Measure and Record the time from the 50% point on the rising edge of P1 to the 50% point of the rising edge of P3.
9. Measure and record the P3 spacing for each P3 Position setting on the Datasheet.
10. Set P3 Position to 0.00.
11. Measure and record the time from the 50% point on the rising edge of P1 to the 50% point on the rising edge of P2.
12. Measure and record the P2 spacing for each P2 Position setting in the Datasheet.
13. Set P2 Position to 0.00.

4.5.2 Interference Pulse and Position

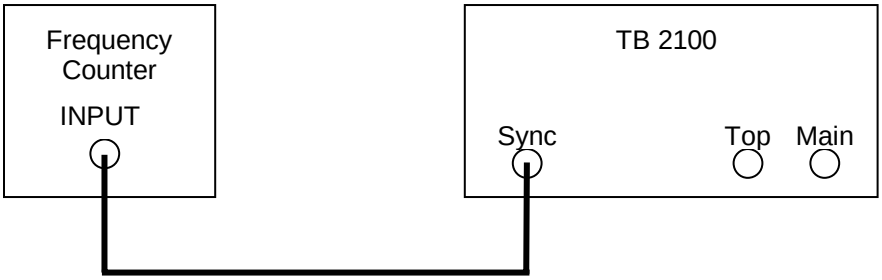
1. Set **Interf.** Position to -5.00.
2. Set **Interf.** Width to 0.30.
3. Measure and record the time from the 50% point on the rising edge of the interference pulse to the 50% point on the falling edge of the interference pulse.
4. Measure and record the interference pulse width for each Interf. Width setting on the Datasheet.
5. Set **Interf.** Position to -5.00.
6. Set **Interf.** Width to 0.30.
7. Measure and record the time from the 50% point on the rising edge of P1 to the 50% point on the rising edge of the interference pulse.
8. Measure and record the interference pulse position for each Interf. Position setting on the Datasheet.
9. Set **Interf.** Position to “OFF”.

4.5.3 Scope Sync Width and Position

1. Connect the test equipment as shown in Figure 4-5.
2. Set the Test Set Scope Sync to 0.
3. Measure and record the width of the scope sync pulse and record in the Datasheet.
4. Measure and record the time from the 50% point on the rising edge of P1 to the 50% point on the rising edge of the sync pulse.
5. Measure and record the sync pulse position for each Scope Sync entry in the Datasheet.
6. Set the Scope Sync to back 0.

4.5.4 PRF

1. Connect the test equipment as shown in Figure 4-6.
2. Set PRF to 1000.
3. Measure and record the actual PRF
4. Measure and record the actual PRF for each PRF entry in the Datasheet.
5. Set PRF to 235.



PRF Measurement

Figure 4-6

4.6 ATCRBS Mode C

1. Connect the equipment as in Figure 4-5.
2. Set the Mode to Mode “C”.
3. Press the **CAL** button to preset to factory Settings, then set the frequency to 1030MHz, -10 dBm output.

4.6.1 P3 Position

1. Measure and record the time from the 50% point on the rising edge of P1 to the 50% point on the rising edge of P3 and record in the Datasheet.

4.6.2 P2 Position

1. Measure and record the time from the 50% point on the rising edge of P1 to the 50% point on the rising edge of P2 and record in the Datasheet.

4.7 Suppressor Pulse

4.7.1 Suppressor Pulse Width

1. Connect the test equipment as shown in Figure 4-5.
2. Move test cable from TB 2100 **SCOPE SYNC** connector and connect to TB 2100 **SUPPRESSOR** connector.
3. Measure the time from the 50% point of the rising edge to the 50% point of the falling edge of the suppressor pulse and record in the Datasheet.

4.7.2 Suppressor Pulse Amplitude

1. Return to the **MAIN** menu and select **SYSTEM SETUP**.
2. Utilizing the **SLEW** knob, set the Mutual Suppression Level to Minimum and record pulse level in Datasheet.
3. Set Mutual Suppression Level to Maximum and record pulse level in Datasheet.
4. Set the Mutual Suppression Level to Minimum and return to the **MAIN** menu and configure the TB 2100 for ATCRBS mode.

4.8 TOP Output Frequency (Mode S Procedure)

NOTE

Ensure to have the TB-2100 Set as a MODE S Transponder during these tests.

1. For the Output Frequency tests, connect the Frequency Counter to the TB 2100 **TOP** connector through the 3 dB attenuator, as shown in Figure 4-2.
2. Set to Mode to **A** in the **MODE S** test instrument screen.
3. Press the **MAIN RF LEVEL** knob to select T**OP RF Lvl (dBm)** and set to **CW** -10 dBm output power.
4. Record the frequency measured by the frequency counter for each entry below:
   a) 1030 MHz / ± 10 kHz
   b) 952 MHz / ± 10 kHz
   c) 1223 MHz ± 10 kHz

4.8.1 TOP Output Power

For the Output Power tests, connect the measuring receiver to the TB 2100 **TOP** connector through the sensor module, as shown in Figure 4-3.

1. Set Frequency (MHz) to 1030.00 MHz.
2. Measure the MAIN power level measured by the measuring receiver for each entry below:
   a) Main Level Set to -10 = -10 dBm / ± 0.5 dBm
   b) Main Level Set to -74 = -74 dBm / ± 0.5 dBm
   c) Main Level Set to -100 = -100 dBm / ± 1.25 dBm

4.8.2 CW ON/OFF Ratio

1. Set the **TOP RF Lvl (dBm**) to **CW** at -10 dBm output power.
2. Measure and record the actual output power.
3. Set the T**OP RF Lvl (dBm)** to "**OFF"** and measure output power.
4. Ensure a minimum 60 dBm difference..

4.8.3 Level vs. Frequency

1. Set the **TOP RF Lvl (dBm)** to **CW** at –10 dBm output power, **PRF** at 500.
2. Measure and record the actual output power for each frequency below versus the Reference at 1030 MHz.

   a) Freq at 1030 MHz REF =_____
   b) Freq at 952 MHz ± 1.0 dBm of reference
   c) Freq at 1223 MHz ± 1.0 dBm of reference

4.8.4 SLS Level

1. Set the Frequency (MHz) to 1030 MHz.
2. Connect the PC (Personal Computer) to the TB-2100 RS-232 Connector at the rear of the Test Set utilizing a standard cable (Not supplied),
3. Ensure a Baud rate of 115200, 8 Bit, flow control to Hardware, and ensure the echo is *OFF*.

NOTE

Tel-instrument is unable to provide 3rd Party Software technical assistance. Please refer to the Software documentation or see your computer administrator for assistance.

4. Start the communication between the Test Set and the PC and enter the following commands. Ensure you enter each parameter one at a time.

   B1 – **CW10** – **P2L0** – **CW21**

5. Measure and record the P2 output power on the Datasheet
6. Enter the next commands in order using **"P5"** and record the values against the datasheet specifications:

Step	SLS Level Setting P5 (Command)	Specification
6a	**P2L3** – **CW21 =** 3 dBm	1 dBm / ± 0.25 dBm
6b	**P2L-6** – **CW21 =** -6 dBm	-6 dBm / ± 0.25 dBm
6c	**P2L-12** – **CW21 =** -12 dBm	-12 dBm / ± 0.25 dBm

7. Press the **CAL** button to reset to factory defaults.

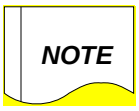
4.8.5 Pulse Shape

1. Connect the test equipment to the TB 2100 as shown in Figure 4-4.
2. Set the frequency of the signal generator to 970 MHz and the output level to +7 dBm.
3. Move the Scope Channel 2 from the TB 2100 **MAIN** to the **TOP** connector.
4. Set the frequency of the TB 2100 to 1030.00 MHz and the output level "ON" utilizing the **MAIN RF Lvl (dBm)** to -10dBm.
5. Set the TB 2100 **PRF** to 1000.
6. Mix the output of the TB 2100 to 60 MHz and display the 60 MHz signal on channel 1 of the oscilloscope, setting the **TB 2100 SCOPE SYNC** as required.
6. Adjust the oscilloscope vertical gain and offset to establish the peak levels of the 60 MHz IF as close to full scale as practical (85% to 95% FS).
7. With the equipment in the same configuration as the end of the previous section, measure and record the 10% to 90% P1 rise time at 75 / ± 25 nsec.
8. Measure and record the 90% to 10% P1 fall time at 125 / ± 25 nsec.
9. Measure and record the 50% to 50% P1 pulse width at 800 / ± 50 nsec.

4.8.6 Detected Test Set Video (TOP) Output

1. With the equipment in the same configuration as the end of the previous section, measure and record the 10% to 90% risetime of the detected P1 pulse from the **TOP** Test Set Video output at 75 / ± 25 nsec.
2. Measure and record the 90% to 10% fall time of the detected P1 pulse from the **TOP** Test Set Video output at 125 / ± 25 nsec.
3. Measure and record the 50% to 50% pulse width of the detected P1 pulse from the **TOP** Test Set Video output 800 / ± 50 nsec.

4.9 DME Functions



Ensure to have the TB-2100 set as a DME R/T.

4.9.1 Pulse Shape

1. Connect the test equipment to the TB 2100 as shown in Figure 4-4.
2. Set the frequency of the signal generator to 970 MHz and the output level to +7 dBm.
3. Set TB 2100 Mode to **MHZ** and Frequency (MHz) to 1030.00.
4. Set TB 2100 **MAIN RF Lvl (dBm)** to "**ON**" at -10dBm output power.
5. Set TB 2100 Squitter to 2700.
6. Mix the output of the TB 2100 to 60 MHz and display the 60 MHz signal on channel 1 of the oscilloscope, setting the TB 2100 SCOPE SYNC as required.
7. Adjust the oscilloscope vertical gain and offset to establish the peak levels of the 60 MHz IF as close to full scale as practical (85% to 95% FS).
8. Measure and record the 10% to 90% P1 rise time on the IF signal at 2.0 / ± 0.5 µsec.
9. Measure and record the 90% to 10% P1 fall time on the IF signal 2.5 / ± 0.5 µsec.
10. Measure and record the 50% to 50% P1 pulse width on the IF signal 3.5 / ± 0.2 µsec.
11. Measure and record the 10% to 90% P2 rise time on the IF signal 2.0 / ± 0.5 µsec.
12. Measure and record the 90% to 10% P2 fall time on the IF signal 2.5 / ± 0.5 µsec.
13. Measure and record the 50% to 50% P2 pulse width on the IF signal 3.5 / ± 0.2 µsec.

4.9.2 Detected TEST SET VIDEO (MAIN) Output

1. With the equipment in the same configuration as the end of the previous section, measure and record the 10% to 90% risetime of the detected P1 pulse from the **TEST SET VIDEO MAIN** connector 2.0 / ± 0.5 µsec.
2. Measure and record the 90% to 10% fall time of the detected P1 pulse 2.5 / ± 0.5 µsec.

3. Measure and record the 50% to 50% pulse width of the detected P1 pulse 3.5 / ± 0.2 µsec.

4. Measure and record the 10% to 90% rise time of the detected P2 pulse 2.0 / ± 0.5 µsec.

5. Measure and record the 90% to 10% fall time of the detected P2 pulse 2.5 / ± 0.5 µsec.

6. Measure and record the 50% to 50% pulse width of the detected P2 pulse 3.5 / ± 0.2 µsec.

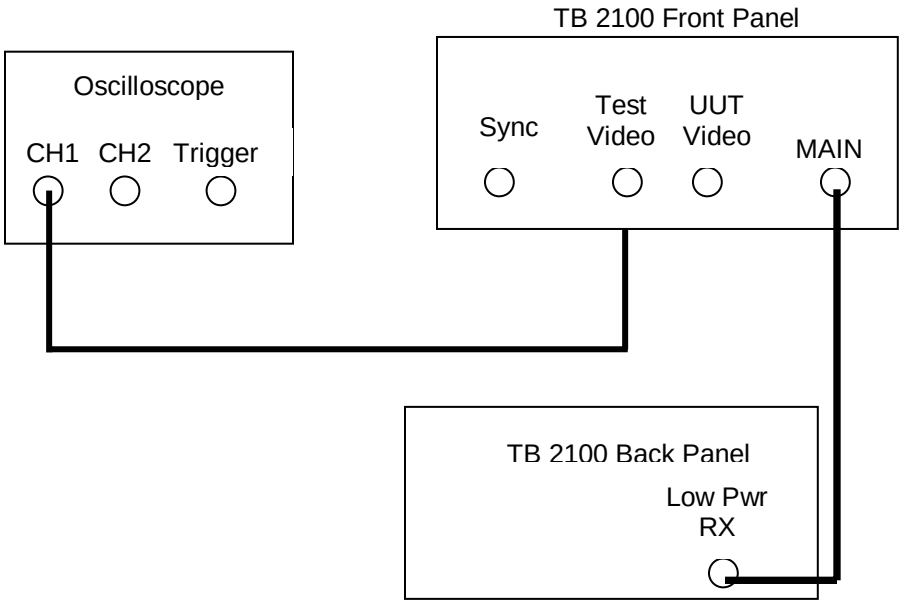
4.10 External Inputs

NOTE

Ensure to have the TB-2100 Set as an ATCRBS Transponder during these tests.

4.10.1 Low Power RX

1. Connect the Test Equipment as shown in Figure 4-7.



External Input Setup

Figure 4-7

2. Set the Mode to **A** in the **ATCRBS** test screens.

3. Set the **MAIN RF Lvl (dBm)** to “ON” at -10 dBm output power.

4. Set the PRF to 235

5. Connect the PC Serial Port to the TB 2100 rear Panel RS-232 connector **J16**.

6. Start the Terminal Emulation Program and type the following command to route Low Power to the front panel **UUT Video (MAIN)** connector.

P2.5=1

7. Verify the presence of the ATCRBS interrogation pulses P1, P2, and P3 greater than 0.10V Peak.

8. Disconnect the **MAIN RF** cable from the **Low Pwr RX** connector.

9. Enter the command **P2.5=0**.

4.10.2 TRIG IN

1. Configure the Pulse Generator to output a 3.3 V 1 µsec pulse and connect it to the TB 2100 Rear Panel connector **J15 (TRIG IN)**. Monitor the output on the oscilloscope Channel 2.

2. Connect the oscilloscope Channel 1 to the TB 2100 Test Set **VIDEO (MAIN)**.

3. Verify the presence of the Mode A interrogation group; P1, P2, and P3.

4. Utilizing the terminal emulation program (connected to the RS-232) enter the command: **PRF0**. Verify no interrogations are present

5. Enter the command **XTRO** and **PRF235** and disconnect the pulse generator from the rear panel (J15).

4.10.3 VIDEO

1. Connect the oscilloscope Channel 1 to the TB 2100 Test Set **VIDEO (MAIN)**.

2. Record the Mode A – P1 pulse Amplitude on the datasheet.

3. Set the TB-2100 PRF to 0.

4. Configure the Pulse Generator to output a 3.3 V 1 µsec pulse and connect it to the TB 2100 Rear Panel connector **J13 (VIDEO)**.

5. Verify the Pulse Amplitude present on the oscilloscope Channel 1 is the same as was recorded in Step 2.

6. Disconnect the Pulse Generator and reset the TB 2100 **PRF** to 235.

4.10.4 SLS

1. Connect the oscilloscope channel 1 to the TB-2100 Test Set **VIDEO (MAIN)**.
2. Set the **SLS** on the TB 2100 to 0.
3. Record the Mode A – P2 Pulse amplitude.
4. Set the PRF on the TB 2100 to 0.
5. Configure the Pulse Generator to output a 3.3V, 1 µsec pulse and connect it to the TB 2100 rear Panel connector **J12 (SLS)**.
6. Verify the Pulse Amplitude present on the Oscilloscope Channel 1 as recorded in step #3.
7. Disconnect the Pulse Generator and set the TB 2100 **PRF** to 235.

4.10.5 DPSK

1. Configure the Pulse Generator to output a 3.3 V 1 µsec pulse and connect it to the TB 2100 Rear Panel connector **J11 (DPSK)**.
2. Connect the Oscilloscope Channel 2 to the TB 2100 Test Set **VIDEO (MAIN)**.
3. Apply a 3.3VDC to the TB-2100 Rear Panel Connector **J13 (VIDEO)**.
4. Verify the DC level on channel 2 has a DPSK phase reversal pulse dip approx. 110µsec from the 50% point of the rising edge of the 1 µsec pulse on Channel 1.
5. Disconnect the Pulse Generator from **J12** and remove the 3.3 VDC Power supply.

4.11 Transponder Mode A, C, S and DME

4.11.1 ATCRBS Mode

1. Configure the TB 2100 as an ATCRBS Test Set.
2. Set the **MAIN RF Lvl (dBm)** to "*ON*" at –50 dBm.
3. Set the Frequency for 1030 MHz.
4. Set to Mode A.
5. Set the PRF at 500
6. Set the **SLS / Intf. Lvl (dBm)** to –9 dBm.

7. Connect the Transponder to the TB 2100 **MAIN** connector.
8. Turn “ON” the Transponder and verify a MODE A Reply and Interrogation.
9. Verify the displayed reply delay is equal to the actual Transponder reply delay ± 1 µsec.
10. Set to measure at **F2-MAIN**.
11. Verify the actual output power (in dBm or Watts) is equal to the actual output power of the Transponder ± 0.5 dBm.
12. Verify the displayed Frequency is equal to the Transponder actual Frequency of the Transponder ± 50 kHz.
13. Connect a Spectrum Analyzer to the **SPECTRUM ANALYZER (MAIN)** connector.
14. Verify the presence of the Transponder reply pulses at 1090 MHz. Remove the Spectrum Analyzer.

4.11.2 Mode C

1. Set the TB 2100 to Mode C.
2. Set the **MAIN RF Lvl (dBm)** to “ON”.
3. Set the Frequency to 1030 MHz.
4. Set the PRF to 500.
5. Set the **SLS / Intf. Lvl (dB)** to –9 dBm.
6. Verify the Transponder Replies to Mode C Interrogations.

4.11.3 Mode S

1. Set the TB 2100 to Mode S.
2. Set the **MAIN RF Lvl (dBm)** to “ON” at –50 dBm.
3. Set the Frequency to 1030 MHz.
4. Set the PRF to 50.
5. Set the **SLS / Intf. Lvl (dB)** to –9 dBm.
6. Verify the Transponder Replies to Mode S Interrogations.

7. Turn “OFF” the Transponder and move the connection to from the **MAIN RF** to the **TOP RF** connector. Push the **RF Lvl** knob to switch to the **TOP RF** connector and turn the Transponder “ON”, then push the **MEASURE** Knob to **P1-Top**.

8. Verify the Transponder Replies to Mode S Interrogations.

9. Connect the Oscilloscope to the **UUT VIDEO (TOP)**.

10. Verify the presence of the Mode S reply pulses > 0.10V Peak .

11. Remove the Spectrum Analyzer, Turn “OFF” the Transponder, and disconnect.

4.11.4 DME

1. Connect the TB 2100 to a DME R/T at the **MAIN** connector.

2. Set the TB 2100 Mode to **VOR PAIR**.

3. Set the **MAIN RF Lvl (dBm)** to “ON” at –50 dBm.

4. Set the Frequency to correspond with the selected DME frequency to be tested.

5. Set the **SQUITTER** to 2700.

6. Set the TB 2100 Range (nm), Velocity (kts), Max. Range (nm), Min Range (nm), In/Out to **IN/OUT** and Run/Stop to **RUN.**

7. Verify the set values are reflected on the DME R/T.

4.12 Final Steps

The TB 2100 Verification and Acceptance Checks are complete. Verify all data on the Data sheet for accuracy and compliance. A Calibration and Alignment is not necessary if the TB 2100 passes all of the parameters.

Disconnect all Test Equipment, sign and Date the Data Sheet and ensure you keep a copy in a safe place and insert another copy at the end of this manual.

SECTION C

CALIBRATION AND ALIGNMENT

4.13 General and Frequency of Calibration

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

1. Tel-Instrument Corporation recommends an Annual Test Set Verification Acceptance Check (Section B) to determine if a Calibration or Alignment is necessary, and to ensure accurate test results and improved performance.

2. If any failure occurs only after completing the *Routine* or *Test Set Verification Checks (Section B)*, 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.

NOTE

At any time during the Annual Calibration, the Test Fails to meet the correct specification and alignment of the Test Set fails to bring the unit within tolerance. The Test Set will require repair at the factory level. Contact Tel-Instrument Electronics Corp. for further guidance.

These procedures will be performed on an opened box to allow access to test points and alignment controls to align the Test Set to manufacturer's specifications. If these adjustments fail to return the Test Set to the specified parameters, the unit may require repair and additional maintenance. By utilizing the following procedures and referring to the schematics (Chapter V), a qualified technician should be able to troubleshoot the problem. **Do not make adjustments for results that meet the specification**.

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.

This section does not require the use of a Data Sheet to record the specified tolerances as in Section B. It is recommended that a copy of the Section (Section C) be made and the values recorded as you conduct the alignment. This then should be saved as a record of the calibration and alignment.

NOTE

See Chapter IV (6) –"Top Level Assembly" 6-1(a) thru 6-1 (e) illustrates locations for connecting the Test Equipment to the TB-2100.

4.14 Test Equipment Required and Test Set Initial Settings

The following support equipment (or their equivalent) is necessary to perform the *Calibration and Alignment* of the TB-2100 Test Set.

Name	Designation/Description
Oscilloscope	Infinium 54835A
Signal Generator	Hewlett Packard 8648B
Spectrum Analyzer	Agilent E4401B
Pulse Generator	Agilent 81101A
3 dB Attenuator	Mini-Circuits
Frequency Counter	Fluke 1953A
DC Power Supply	0 to 5 VDC
Mixer	Mini-Circuits ZFM-4
Personal Computer or Laptop	Any Preference
Terminal Emulation Software	Tear Term Pro[2] or Equivalent
Measuring Receiver	HP 8902A
Sensor Module	HP 11722A
Data Sheet	Copy of Section C
Transponder**	Bendix/King KT-73**
DME**	Bendix/King KN-64**
Assorted Cables, Connectors, and Adapters	

Test Set Annual Calibration Equipment List

Table 4-2



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 possible injury.

4.15 Disassembly of the Test Set and Procedures

The TB-2100 Test Set was designed for ease of maintenance and access. Disassembly of the Test requires only the use of simple hand tools. Ensure that the tools that are utilized are in good working condition.

Electrostatic discharge may also pose a concern. When ever opening the Test Set, be sure to follow standard grounding principles. When ever a potential exists for static electricity to build, damage to the Test Set and the internal electronic components may result.

[2] Provides serial input for calibration using terminal emulation program. Tel-Instrument recommends a product called "Tera Term Pro" which is available for free by downloading on the Internet at http://hp.vector.co.jp/authors/VA002416/teraterm.html.

1. Disassembly and access to the TB-2100 Test Set Test and Adjustment points is easily accomplished by removing the eight (8) Phillips head screws located on the Side Panel of the Test Set.

2. Remove the Top and Bottom Panels, leaving the Center Panel, and place with the attaching hardware in a safe location.

3. Access to the individual circuit boards is accomplished by removing the attaching hardware and covers. Ensure that all attaching cables and connectors remain attached and undue stress is not put on them.

4. Reassembly of the Test Set is accomplished by reversing the order of disassembly. Ensure that all of the connectors, cables and mounting hardware are tight and secure.

4.16 Calibration & Alignment

4.16.1 Test Setup

1. Connect the TB-2100 to 115 VAC / 60 Hz power and turn power *ON*.
2. Connect RS232 cable between TB-2100 rear panel and PC. Open the Tera Term software and establish RS232 communication between the PC and the TB-2100.

4.16.2 Main and Top Transmitter Frequency Calibration

1. Connect frequency counter to TB-2100 front panel **MAIN** port.
2. Select TB-2100 **MODE S** mode.
3. Select TB-2100 **Main RF Level** to **CW**, –10 dBm.
4. Select TB-2100 Frequency to 1000.00 MHz.
5. Type the command B0.

NOTE

Tel-instrument is unable to provide 3rd Party Software technical assistance. Please refer to the Software documentation or see your computer administrator for assistance.

6. Read the current DACD1 value by typing DACD1?

   Record MAIN DAC D1 as: DACD1._____

7. If necessary, adjust DAC D1, TCXO_TUNE, by typing command DACD1.XX, where XX equals 00 through FF, and set TX frequency on counter to 1000MHz +/-100Hz.

   Record MAIN DAC D1 as: DACD1._____

8. Connect frequency counter to TB-2100 front panel **TOP** port.

9. Type the command **B1**.
10. Read the current DACD1 value by typing **DACD1**?

    Record TOP DAC D1 as: DACD1._____

11. If necessary, adjust DAC D1, TCXO_TUNE, by typing command DACD1.XX, where XX equals 00 through FF, and set TX frequency on counter to 1000MHz +/-100Hz.

12. Record TOP DAC D1 as: DACD1._____

13. Disconnect the frequency counter.

4.16.3 Main Transmitter Power Calibration

1. Referencing Appendix 4-G, connect the **MAIN TX** output connector, **J13**, to the measuring receiver sensor input.
2. Type B0.
3. For future reference, read and record the current values of the transmitter DACs.

   DACC1? DACC1_____

   DACB1? DACB1_____

   DACA1? DACA1_____

4. Zero the 3 transmitter DAC's by typing:

   DACC1.00

   DACB1.00

   DACA1.00

5. Select the TB-2100 transmitter frequency to be 1030.00 MHz.
6. Type command CW10 to turn OFF P1 TX output.
7. Type command CW21 to turn ON P2 TX output in CW mode.
8. Set DACS, SLS Level, to maximum by typing command DACS.FFC.
9. Set the PIN diode attenuator to minimum attenuation by typing command DACT.FFC.
10. Record output power from measuring receiver as:

    SLS Power = _____dB

11. Turn OFF P2, SLS, pulse by typing CW20.
12. Turn ON P1 pulse by typing CW11.

13. Adjust DAC C1, P1 Level, so that it is 4 dB down from step 10.

NOTE

DACC1.XX range is from 00 through FF.

14. Record DAC C1 as: DACC1._____

15. Record TX output level: TX power = _____dB.

16. Adjust DAC B1, DPSK Level, from zero (DACB1.00) toward maximum (DACB1.FF), until the power level nulls and then returns to equal the value recorded in step 15.

17. Record DAC B1 as: DACB1._____

18. Adjust DAC A1, Mod Bias, from zero (DACA1.00) toward maximum (DACA1.FF), until the power level nulls and then returns to equal the value recorded in step 6.15.

19. Record DAC A1 as: DACA1._____

20. There are 3 transmitter parameters that are linearized using 6th order polynomial equations. These are the PIN diode attenuator control voltage, the frequency response of the complete transmitter chain, and the diode modulator control voltage. For an example of each set of coefficients, refer to Appendix D.

4.16.4 CTLx Coefficients

1. The CTLx coefficients are used in the equation that translates the value in the TAM command to DACT values. The DACT output drives the PIN diode attenuator.

   Begin by sending the following RS232 commands:

B0
RST
TXF1030
RXF1150
P2.5=0
CW20
CW11
CTF60
CTF50
CTF40
CTF30
CTF20
CTF10
CTF00
CTF60

   The CTLx coefficients are obtained by:

   a) Applying a range of DACT values as required in the following table.

   b) Recording the transmitter output power for each DACT value.

NOTE

Ensure you have selected the **"TAB CTLx"** located at the bottom of the Spread Sheet.

COMMAND	TX POWER
Enter the Command and record the Value	
DACT.FFC	
DACT.FF0	
DACT.F80	
DACT.F00	
DACT.E80	
DACT.E00	
DACT.D80	
DACT.D00	
DACT.C80	
DACT.C00	
DACT.B00	
DACT.A00	
DACT.900	
DACT.800	
DACT.700	
DACT.600	
DACT.500	
DACT.400	
DACT.300	
DACT.280	
DACT.200	
DACT.180	
DACT.100	
DACT.080	
DACT.000	

Entering the recorded data in Excel spreadsheet as supplied on the CD Rom labeled *"Calibration Data Coefficient"*.

The measured transmitter power for each step is entered in the *DATA ENTRY* column (column C) of the spreadsheet (See Figure 4-8 and Appendix 4-D).

The entered data is automatically plotted on the spreadsheet chart as shown in Figure 4-9.

NOM=	11	DATA	
Scale=	5.11	ENTRY	
Decimal	DACT	dBm	Normal
4092	ffc	16.11	5.11
4080	ff0	16.03	5.03
3968	f80	15.45	4.45
3840	f00	14.81	3.81
3712	e80	14.20	3.20
3584	e00	13.62	2.62
3456	d80	13.06	2.06
3328	d00	12.51	1.51

Enter the Values "Top to Bottom" beginning here on the Calibration Data Sheet.

Cal Data Sheet Coefficient Entry

Figure 4-8

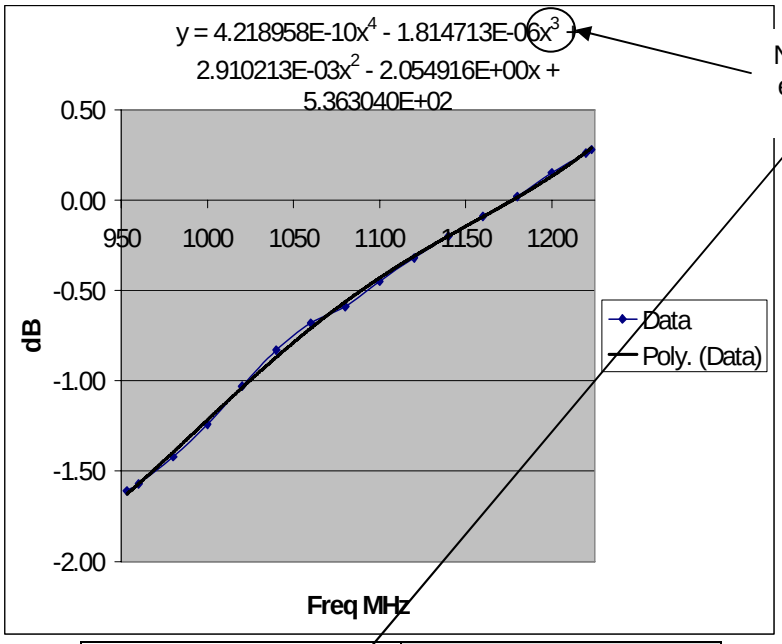
2. Record the coefficients and send them to the TB-2100 (see Figure 4-9).

CTL60	Enter the Values below
CTL50	Enter the Values below
CTL4	
CTL3	
CTL2	
CTL1	
CTL0	

Verify that the coefficients were entered correctly by typing:

CTL?

The coefficients are displayed CTL0 first, CTL6 last as illustrated in below in Figure 4-9. Ensure that the number value, either negative or positive is properly recorded.



Numbers correlate with entry positions in table

CTL60	Enter the Values below
CTL50	Enter the Values below
CTL4	4.218958E-10
CTL3	-1.814713E-06
CTL2	2.910213E-03
CTL1	-2.054916E00
CTL0	5.363040E02

Data Entry Example

Figure 4- 9

3. Check the CTLx coefficients by sending the following commands:

   RST
   CW11
   TXF1030

   TAM0 _____11 dBm +/- 0.5 dBm
   TAM3 _____14 dBm +/- 0.5 dBm
   TAM-10 _____1 dBm +/- 0.5 dB

4.16.5 CTFx Coefficients

1. The CTFx coefficients are used in the equation that corrects the transmitter power as a function of transmitter frequency. The CTLx coefficients must be in place before the CTFx coefficients can be tested.

   Begin by sending the following RS232 commands:

B0
RST
TXF1030
RXF1150
P2.5=0
P2.7=1
CW20
CW11
CTF60
CTF50
CTF40
CTF30
CTF20
CTF10
C0F00
TAM0

2. The CTFx coefficients are obtained by

   a) Applying a range of frequencies

   b) Recording the transmitter output power for each frequency

   c) Entering the recorded data in "*Coefficient*" spreadsheet (see Figures 4-8, 4-9 and Appendix 4-D). The Data is entered the same was as in the "CTLx" measurements but utilizing the "CTFx" Tab at the bottom of the spread sheet.

NOTE

Ensure you have selected the **"TAB CTLx"** located at the bottom of the Spread Sheet.

NOTE

P2.7=1 for frequencies equal to 1050 MHz and below. P2.7=0 for frequencies above 1050 MHz.

COMMAND	TX POWER
Enter the Command and record the Value	
TXF953	
TXF960	
TXF980	
TXF1000	
TXF1020	
TXF1040	
TXF1060	
P2.7=0	
TXF1080	
TXF1100	
TXF1120	
TXF1140	
TXF1160	
TXF1180	
TXF1200	
TXF1220	
TXF1223	

3. The measured transmitter power is entered in the **DATA ENTRY** column (column C) of the spread sheet.

4. The entered data is automatically plotted on a chart as shown in Figure 4-9.

   The CTFx coefficients are displayed at the top of the chart.

   The C6TF and C5TF coefficients are always 0.

5. Record the coefficients and send them to the TB-2100.

CTF60	Enter the Values below
CTF50	Enter the Values below
CTF4	
CTF3	
CTF2	
CTF1	
CTF0	

   When the CTF0 command is received, all the coefficients are stored in EEPROM.

6. Verify the CTFx coefficients were entered correctly by sending the following commands:

   RST
   P2.7=1
   CW11
   TXF1030
   TAM0

7. Record the transmitter power _____ 10 dBm +/- 0.1 dB.

   TXF953
   TAM0

8. Record the transmitter power _____ 10 dBm +/- 0.1 dB.

   TXF1223
   TAM0
   P2.7=0

9. Record the transmitter power _____ 10 dBm +/- 0.1 dB.

4.16.6 CSSx Coefficients

1. The CSSx coefficients are used in the equation that corrects the SLS power as a function of SLS level. The CTLx coefficients must be in place before the CSSx coefficients can be tested.

2. Begin by sending the following RS232 commands:

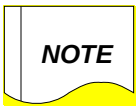
B0
RST
TXF1030
RXF1150
P2.5=0
P2.7=1
CW20
CW11
TAM0

   The CSSx coefficients are obtained by

   a) Applying a range of DACS values

   b) Recording the transmitter output power for each DACS value

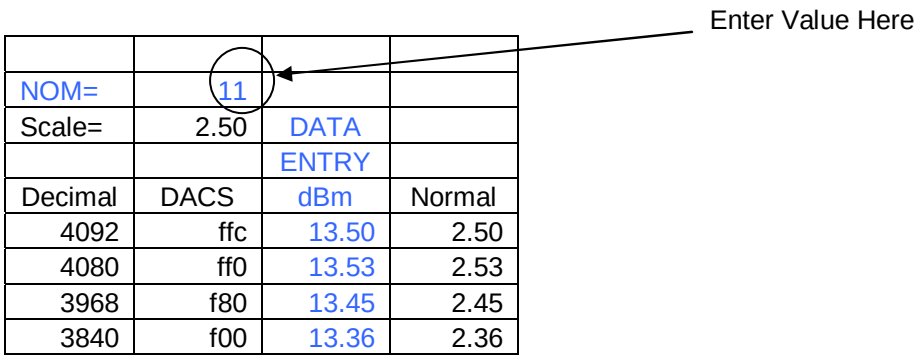
   c) Entering the recorded data in Excel spreadsheet labeled *"Calibration Data Coefficient CSSx Tab".*



Ensure you have selected the **"TAB CSSx"** located at the bottom of the Spread Sheet.

3. Begin by recording the P1 power level as the nominal value (from 4.16.5, Step 9) into cell B2.

   P1 Power (Nominal) _____



NOM=	11		
Scale=	2.50	DATA	
		ENTRY	
Decimal	DACS	dBm	Normal
4092	ffc	13.50	2.50
4080	ff0	13.53	2.53
3968	f80	13.45	2.45
3840	f00	13.36	2.36

Switch to P2 levels by sending the following commands:

CW10
CW21

The DACS values are shown in the DACS column (column B of the spreadsheet).

COMMAND	TX POWER
Enter the Command and record the Value	
DACS.FFC	
DACS.FF0	
DACS.F80	
DACS.F00	
DACS.E80	
DACS.E00	
DACS.D80	
DACS.D00	
DACS.C80	
DACS.C00	
DACS.B00	
DACS.A00	
DACS.900	
DACS.800	
DACS.700	
DACS.600	
DACS.500	
DACS.400	
DACS.300	
DACS.280	
DACS.200	
DACS.180	
DACS.100	

4. The measured transmitter power is entered in the DATA ENTRY column (column C). The entered data is automatically plotted on the chart as shown in Figure 4-9.

   The CSSx coefficients are displayed at the top of the chart.

5. Record the coefficients and send them to the TB-2100.

CSS6	
CSS5	
CSS4	
CSS3	
CSS2	
CSS1	
CSS0	

When the CSS0 command is received, all the coefficients are stored in EEPROM.

6. Verify the CSSx coefficients were entered correctly by sending the following commands:

   RST
   P2.7=1
   TXF1030
   TAM0
   CW10
   P2L0
   CW21

7. Record the transmitter power _____ 10 dBm +/- 0.15 dB.

   P2L3
   CW21

8. Record the transmitter power _____ 13 dBm +/- 0.15 dB.

   P2L-9
   CW21

9. Record the transmitter power _____ 1 dBm +/- 0.15 dB.

10. Disconnect the measuring receiver from the **MAIN** RF TX/RX, J13, and connect the spectrum analyzer to **MAIN** RF RX/TX J13. Configure the spectrum analyzer to display the demodulated pulses (0 span, BW >=5 Mhz, NO video filter).

11. Transmit Mode “A” interrogations:

    TAM0
    A
    PRF500

12. Record the peak pulse power _____.

13. Change to DME mode

    XNAR
    SQX500
    TAM0

14. Record the current value of TAMD? _____

15. If the DME pulse power is not the same as the transponder pulse power, subtract the error from the current value of TAMD and send the new value of

    TAMD _____

16. Verify the DME power is now correct by sending the commands

    TAMD?
    TAM0

    and checking the spectrum analyzer.

4.17 Unit Level Transmitter Coefficients

The purpose of test steps 4.17 is to calibrate the **TOP** RF TX/RX assembly so that it provides +10 dBm transmit power. The purpose of this test step is to add a coarse offset (1 dB steps) to the JFW attenuator and a fine offset (0.01 dB steps) to the **MAIN** RF TX/RX assembly so that the transmit power at the front panel MAIN port is equal to –74 dBm when –74 dBm is selected.

1. Send the following RS232 commands:

   CTX608.040984e-14
   CTX50-5.118937e-10
   CTX401.355827e-06
   CTX30-1.912467e-03
   CTX201.515218e+00
   CTX10-6.393334e+02
   CTX001.122387e+05

2. Disconnect the spectrum analyzer from the **MAIN** RF TX/RX J13 and connect measuring receiver to front panel **MAIN** port. Connect **MAIN** RF TX/RX J13 to RF Switch J4 (Figure 4-G).

   TB-2100 settings:

   Mode = Mode S
   P5 Position/DIV = OFF
   Level = CW
   Level = -74 dB
   Frequency = 1030.00 MHz

   Send *TAMB00*

   Send ABS0xx command to get between –73 and –74 dBm on the measuring receiver. After sending the ABS0 command, set Main RF Level to –73 and then back to –74 dBm before reading the measuring receiver.

   Final ABS0 value = _____

   Send TAMB0x.xx command to get to –74.0 dBm (negative values lower the output power). Each time a TAMB0 command is sent, change frequency to 1031 MHz until measuring receiver loses lock and then change frequency back to 1030.00 MHz.

Final TAMB0 value = _____

4.18 TOP Transmitter Power Calibration

1. Referencing assembly drawing Appendix 4-E, connect the **TOP** TX output connector, J13, to the measuring receiver sensor input.

   Type B1.

2. For future reference, read and record the current values of the transmitter DACs.

DACC1?	DACC1_____
DACB1?	DACB1_____
DACA1?	DACA1_____

3. Zero the 3 transmitter DACs by typing:

   DACC1.00

   DACB1.00

   DACA1.00

4. Select the TB-2100 transmitter frequency to be 1030.00 MHz.

5. Type command CW10 to turn OFF P1 TX output.

6. Type command CW21 to turn ON P2 TX output in CW mode.

7. Set DACS, SLS Level, to maximum by typing command DACS.FFC.

8. Set the PIN diode attenuator to minimum attenuation by typing command DACT.FFC.

   Record output power from measuring receiver as:

   SLS Power = _____dB

9. Turn OFF P2, SLS, pulse by typing CW20.

10. Turn ON P1 pulse by typing CW11.

11. Adjust DAC C1, P1 Level, so that it is 4 dB down from step 7.10. NOTE: DACC1.XX range is from 00 through FF.

    Record DAC C1 as: DACC1._____

    Record TX output level: TX power = _____dB

12. Adjust DAC B1, DPSK Level, from zero (DACB1.00) toward maximum (DACB1.FF), until the power level nulls and then returns to equal the value recorded in step 11.

    Record DAC B1 as: DACB1._____

13. Adjust DAC A1, Mod Bias, from zero (DACA1.00) toward maximum (DACA1.FF), until the power level nulls and then returns to equal the value recorded in Step 11.

    Record DAC A1 as: DACA1._____

14. There are 3 transmitter parameters that are linearized using 6th order polynomial equations. These are the PIN diode attenuator control voltage, the frequency response of the complete transmitter chain, and the diode modulator control voltage.

    For an example of each set of coefficients, refer to Appendix 4-D.

4.18.1 CTLx Coefficients

The CTLx coefficients are used in the equation that translates the value in the TAM command to DACT values. The DACT output drives the PIN diode attenuator.

1. Begin by sending the following RS232 commands:

B1
RST
TXF1030
RXF1150
P2.5=0
CW20
CW11
CTF60
CTF50
CTF40
CTF30
CTF20
CTF10
CTF00

2. The CTLx coefficients are obtained by:

   a) Applying a range of DACT values as listed on the following page.

   b) Recording the transmitter output power for each DACT value

   c) Entering the recorded data in Excel spreadsheet.

NOTE	Ensure you have selected the **"TAB CTLx"** located at the bottom of the Spread Sheet.

COMMAND	TX POWER
Enter the Command and record the Value	
DACT.FFC	
DACT.FF0	
DACT.F80	
DACT.F00	
DACT.E80	
DACT.E00	
DACT.D80	
DACT.D00	
DACT.C80	
DACT.C00	
DACT.B00	
DACT.A00	
DACT.900	
DACT.800	
DACT.700	
DACT.600	
DACT.500	
DACT.400	
DACT.300	
DACT.280	
DACT.200	
DACT.180	
DACT.100	
DACT.080	
DACT.000	

3. The measured transmitter power is entered in the DATA ENTRY column (column C) of the spreadsheet.

4. Record the coefficients and send them to the TB-2100.

CTL60	Enter the Values below
CTL50	Enter the Values below
CTL4	
CTL3	
CTL2	
CTL1	
CTL0	

5. Verify that the coefficients were entered correctly by typing:

   CTL?

   The coefficients are displayed CTL0 first, CTL6 last as illustrated Appendix D.

6. Check the CTLx coefficients by sending the following commands:

   RST
   CW11
   TXF1030

TAM0	_____11 dBm +/- 0.5 dBm
TAM3	_____14 dBm +/- 0.5 dBm
TAM-10	_____1 dBm +/- 0.5 Db

4.18.2 CTFx Coefficients

The CTFx coefficients are used in the equation that corrects the transmitter power as a function of transmitter frequency. The CTLx coefficients must be in place before the CTFx coefficients can be tested.

1. Begin by sending the following RS232 commands:

B1
RST
TXF1030
RXF1150
P2.5=0
P2.7=1
CW20
CW11
CTF60
CTF50
CTF40
CTF30
CTF20
CTF10
C0F00
TAM0

2. The CTFx coefficients are obtained by:

   a) Applying a range of frequencies

   b) Recording the transmitter output power for each frequency

   c) Entering the recorded data in *"Coefficient"* spreadsheet.

NOTE

P2.7=1 for frequencies equal to 1050 MHz and below. P2.7=0 for frequencies above 1050 MHz.

NOTE

Ensure you have selected the **"TAB CTFx"** located at the bottom of the Spread Sheet.

COMMAND	TX POWER
Enter the Command and record the Value	
TXF953	
TXF960	
TXF980	
TXF1000	
TXF1020	
TXF1040	
TXF1060	
P2.7=0	
TXF1080	
TXF1100	
TXF1120	
TXF1140	
TXF1160	
TXF1180	
TXF1200	
TXF1220	
TXF1223	

The measured transmitter power is entered in the DATA ENTRY column (column C).

The CTFx coefficients are displayed at the top of the chart. The C6TF and C5TF coefficients are always 0.

3. Record the coefficients and send them to the TB-2100.

CTF60	Enter the Values below
CTF50	Enter the Values below
CTF4	
CTF3	
CTF2	
CTF1	
CTF0	

When the CTF0 command is received, all the coefficients are stored in EPROM.

4. Verify the CTFx coefficients were entered correctly by sending the following commands:

   RST
   P2.7=1
   CW11
   TXF1030
   TAM0

5. Record the transmitter power _____ 10 dBm +/- 0.1 dB.

   TXF953
   TAM0

6. Record the transmitter power _____ 10 dBm +/- 0.1 dB.

TXF1223
TAM0
P2.7=0

7. Record the transmitter power _____ 10 dBm +/- 0.1 dB.

4.18.3 CSSx Coefficients

The CSSx coefficients are used in the equation that corrects the SLS power as a function of SLS level. The CTLx coefficients must be in place before the CSSx coefficients can be tested.

1. Begin by sending the following RS232 commands:

   B1
   RST
   TXF1030
   RXF1150
   P2.5=0
   P2.7=1
   CW20
   CW11
   TAM0

2. The CSSx coefficients are obtained by:

   a) Applying a range of DACS values

   b) Recording the transmitter output power for each DACS value

   c) Entering the recorded data in Excel spreadsheet.

3. Begin by entering the P1 power level (from step 4.18.2, Step 7) as the nominal value (cell B2).

   P1 Power (Nominal) _____

Enter Value Here

NOM=	11		
Scale=	2.50	DATA	
		ENTRY	
Decimal	DACS	dBm	Normal
4092	ffc	13.50	2.50
4080	ff0	13.53	2.53
3968	f80	13.45	2.45
3840	f00	13.36	2.36

4. Switch to P2 levels by sending the following commands:

   CW10
   CW21

   The DACS values are shown in the DACS column (column B of the spreadsheet).

COMMAND	TX POWER
Enter the Command and record the Value	
DACS.FFC	
DACS.FF0	
DACS.F80	
DACS.F00	
DACS.E80	
DACS.E00	
DACS.D80	
DACS.D00	
DACS.C80	
DACS.C00	
DACS.B00	
DACS.A00	
DACS.900	
DACS.800	
DACS.700	
DACS.600	
DACS.500	
DACS.400	
DACS.300	
DACS.280	
DACS.200	
DACS.180	
DACS.100	
DACS.80	
DACS.000	

5. The measured transmitter power is entered in the DATA ENTRY column (column C). The entered data is automatically plotted.

NOTE

Ensure you have selected the **"TAB CSSx"** located at the bottom of the Spread Sheet.

6. The CSSx coefficients are displayed at the top of the chart.

7. Record the coefficients and send them to the TB-2100.

CSS6	
CSS5	
CSS4	
CSS3	
CSS2	
CSS1	
CSS0	

When the CSS0 command is received, all the coefficients are stored in EEPROM.

8. Verify the CSSx coefficients were entered correctly by sending the following commands:

   RST
   P2.7=1
   TXF1030
   TAM0
   CW10
   P2L0
   CW21

9. Record the transmitter power _____ 10 dBm +/- 0.15 dB.

   P2L3
   CW21

10. Record the transmitter power _____ 13 dBm +/- 0.15 dB.

    P2L-9
    CW21

11. Record the transmitter power _____ 1 dBm +/- 0.15 dB.

12. Disconnect the measuring receiver from the **TOP** RF TX/RX J13 and connect the spectrum analyzer to **TOP** RF TX/RX J13. Configure the spectrum analyzer to display the demodulated pulses (0 span, BW >=5 Mhz, NO video filter).

    Transmit mode A interrogations

    TAM0
    A
    PRF500

13. Record the peak pulse power_____.

14. Change to DME mode

    XNAR
    SQX500
    TAM0

15. Record the current value of TAMD? _____.

16. If the DME pulse power is not the same as the transponder pulse power, subtract the error from the current value of TAMD and send the new value of TAMD _____.

17. Verify the DME power is now correct by sending the commands

    TAMD?
    TAM0

    and checking the spectrum analyzer.

4.19 Unit Level Transmitter Coefficients

The purpose of test steps 4.19 is to calibrate the **TOP** RF TX/RX assembly so that it provides +10 dBm transmit power. The purpose of this test step is to add a coarse offset (1 dB steps) to the JFW attenuator and a fine offset (0.01 dB steps) to the **TOP** RF TX/RX assembly so that the transmit power at the front panel **TOP** port is equal to –74 dBm when –74 dBm is selected.

1. Send the following RS232 commands:

   CTX618.040984e-14
   CTX51-5.118937e-10
   CTX411.355827e-06
   CTX31-1.912467e-03
   CTX211.515218e+00
   CTX11-6.393334e+02
   CTX011.122387e+05

2. Disconnect the measuring receiver from the **TOP** RF TX/RX J13 and connect measuring receiver to front panel **TOP** port. Connect TOP RF TX/RX J13 to RF Switch J5.

   TB-2100 settings:

   a) Main Menu = Mode S
   b) P5 Position/DIV = OFF
   c) Level = CW
   d) Level = -74 dB
   e) Frequency = 1030.00 MHz

   f) Send *TAMB10*

   g) Send ABS1xx command to get between –73 and –74 dBm on the measuring receiver. After sending the ABS1 command, set Main RF Level to –73 and then back to –74 dBm before reading the measuring receiver.

   h) Final ABS1 value = _____

   i) Send TAMB1x.xx command to get to –74.0 dBm (negative values lower the output power). Each time a TAMB1 command is sent, change frequency to 1031 MHz until measuring receiver loses lock and then change frequency back to 1030.00 MHz.

   j) Final TAMB1 value = _____

4.20 P5 Mode Transmitter Power Calibration

In 'Diversity Mode', the Top and Main RF transmitters generate individual signals. The 'P5 Mode' sets the RF Switch to combine the Top and Main transmitters and then split the combined signal evenly between the front panel TOP and MAIN ports. Since the sum-then-split configuration adds attenuation, there must be a second set of offset values (ABS2, ABS3, TAMB2, TAMB3) and a calibration value for the RF Switch (RFSW0) to insure the correct front panel output power.

Start 'P5 Mode' calibration on the Top port with the Top RF in CW. While in 'P5 Mode', adjust the Top JFW offset (ABS3) to get within 1 dB of the desired output power. Next, adjust Top TAMB3 value to get to the desired output power. Next, measure the Top RF power that is output on the Main port. Adjust the Main JFW offset (ABS2) and RF switch attenuator (RFSW0) to read the correct value. Finally, measure the Main RF power at the Main RF port by setting CW10 on Top and CW11 on Main. Adjust Main TAM (TAMB2) to get the desired value. Assuming the 2 RF assemblies have been calibrated to output the same power, the Main TAM (TAMB2) value should be very close to the Top TAM (TAMB3) value. If it is not, the level of the Main output power that is present at the Top port will be incorrect.

1. Connect the measuring receiver to the TB-2100 front panel **TOP** port, Set P5 Position/DIV = 0.00 (P5 ON).

   Set Frequency = 1030.00 MHz

   Set RF Level = CW/-74 dBm

2. Send

   B0
   CW10
   CW20

3. Send ABS3xx command to get between –73 and –74 dBm on the measuring receiver. After sending the ABS3 command, set Main RF Level to –73 and then back to –74 dBm before reading the measuring receiver.

4. Final ABS3 value = _____

5. Send TAMB3x.xx command to get to –74 dBm. Each time a TAMB3 command is sent, change frequency to 1031 MHz until measuring receiver loses lock and then change frequency back to 1030.00 MHz.

6. Final TAMB3 value = _____

7. Disconnect the measuring receiver from the TOP port and connect it to the Main port.

8. Send the command *RFSW00xD8*.

9. Send the ABS2xx command to get as close as possible to –74 dBm on the measuring receiver. After sending the ABS2 command, set Main RF Level to –73 and then back to –74 dBm before reading the measuring receiver.

   a) Final ABS2 value = _____

b) Send the command RFSW00xzz to adjust the measuring receiver reading to –74 dBm. 0xff in highest output power and 0x00 is lowest output power. After sending the RFSW00x command, execute the following steps:

Go to the Main Menu
Go back to the Mode S menu
Power to CW Mode

B0
Send CW10
Send CW20

c) Final RFSW00x value = _____

d) Send the commands:

B1
CW10
CW20
B0
CW11
CW20

e) Send TAMB2x.xx command so that the measuring receiver reads –74 dBm.

f) Final TAMB2 value = _____

The value of TAMB2 should be within ± 0.35 dB of the value of TAMB3 in step 7.

g) Redo Step (d) to get reading.

4.21 Main Receiver Calibration

The frequency measurement function must be working well enough so that the displayed frequency is not at the limit (within +/- 3.5 MHz from nominal).

UUT transmit power is applied to the TB-2100 front panel **TOP** and **MAIN** ports. Each RF I/O assembly provides a nominal 50.5 dB of attenuation to the UUT transmit power and then outputs the lower power signal to each RF TX/RX assembly. The cable loss between the RF I/O assembly and the RF TX/RX assembly is a nominal 0.5 dB. So, for an input power of 1 kW (60 dBm), the power into the RF TX/RX receiver input is (60 dBm – 50.5 dB – 0.5 dB) = 9 dBm. Power measurement calibration is accomplished in several steps.

The first step is to calibrate the RF TX/RX receivers so that +6 dBm input power produces a power reading of 500 W at 1090.00 MHz. This is accomplished by applying a low power input to the RF TX/RX assembly and adjusting the log amp gain and offset. During this step, it is important to stay below a displayed power of 800 W. If 800 W is exceeded, the TB-2100 will switch in the 10 dB receive attenuator. If this happens, the input power must be lowered until the displayed power is below 600 W to return to the low input power state.

The second step is to apply a higher input power and adjust RATT so that the high input range and low input range display the same power. The high input range adds a nominal 10 dB of attenuation in the receive path. RATT is entered in dB. It is nominally 10.00, but may be adjusted up or down to match the exact attenuation value for each RF TX/RX assembly.

The third step is to input a set of curve fit coefficients to correct the RF TX/RX power measurement across the input frequency band.

The fourth step is to input a set of curve fit coefficients to correct the power measurement for the frequency response of the RF I/O assembly.

The final step is to input a calibration factor to correct for the RF I/O assembly loss when it is not exactly 50.5 dB.

1. The received power measurement is frequency compensated using a 6^{th} order polynomial equation.

   Send the following commands:

   B0
   CRF60
   CRF50
   CRF40
   CRF3-2.49547e-7
   CRF28.105916e-4
   CRF1-8.757310E-1
   CRF03.156227E2
   LAO3175
   LAG325
   RATT11.3

2. Disconnect the cable from the **MAIN** RF TX/RX receiver input, J9, and connect the signal generator to J9. Set the signal generator output to 6 dBm at 1090.00 MHz.
3. Connect the pulse generator output to the signal generator pulse modulation input.
4. Set the pulse generator to output a simulated ATCRBS reply: 2 ea. 450 ns pulses spaced 20.3 us apart. Externally trigger the pulse generator with the TB-2100 Scope Sync output.
5. Select:
   a) Main Menu = Mode S
   b) Mode = A
   c) Measure = F1-Main
   d) Scope Sync = 11 µs
6. Set the signal generator to output +6 dBm. If the displayed power is not 500 W (57 dBm), read and record the current value of LAO by typing:

   BO

   LAO? Current value of LAO = _____
7. Adjust the value of LAO to achieve a reading of 500 W (57 dBm). Record the final value of LAO.

LAO = _____

8. When the signal generator output is adjusted between 6 dBm and 0 dBm, the TB-2100 measured power must change by 6 +/- 0.25 dB. If not, read and record the current value of LAG by typing:

   LAG? Current value of LAG = _____.

9. Adjust the log amp gain as necessary to achieve 6 dB change in measured power for 6 dB change in applied power (125W)(51 dBm).
10. Record the final value of LAG.

    LAG = _____

11. Increase the output of the signal generator to +9dBm. Record the displayed power

    _____

12. Compute 10 * LOG (P_{11} / 1000) and record the result _____
13. Read the current value of RATT by typing RATT? _____
14. Subtract the result of step 12 from the current value of RATT and enter the sum as the new value of RATT.
15. Repeat steps 11 through 14 as necessary.
16. Record the final value of RATT = _____(Adjust for 1000W)(60dBm).
17. Send the unit level calibration coefficients with the following commands:

    CRX60-6.360916e-15
    CRX504.064297E-11
    CRX40-1.075629E-07
    CRX301.508837E-04
    CRX20-1.182783E-01
    CRX104.910715E+01
    CRX00-8.430755E+03

18. Remove the signal generator from J9 and reconnect the system cable.
19. Connect a transponder to the front panel MAIN RF connector and record the displayed power _____.
20. Record the current value of PWSC0 (see following steps)? _____.
    a) On the TB-2100 Front panel, select “System Start Up” button then the **CAL** button.
    b) Look for the “**MAIN RX POWER**”.
    c) Press the *DOWN ARROW* until you see “**PWSC0**” and record that value.

d) Return to the Main Menu and reconfigure for a Mode S transponder s in Step #5.

21. Divide the actual power by the displayed power in step 19 and multiply this by the current value of PWSC0 from step 20.
22. Enter the new value of PWSC0 and verify that the displayed power is correct.

    PWSC0=_____
23. Receiver Frequency Measurement (continue to Step #24).
24. Remove the transponder from the MAIN RF connector and reconnect the signal generator to RF TX/RX connector J9.
25. Adjust RF TX/RX L6 as required so that the FREQUENCY display reads 1090.00 ± 0.05 MHz.
26. Receiver Reply Delay Measurement (continue to step #27).
27. Connect the MAIN TEST SET VIDEO output to channel 1 of the oscilloscope and MAIIN UUT VIDEO to channel 2 of the oscilloscope. Measure the delay between the rising edge of TEST SET VIDEO P3 and the rising edge of UUT VIDEO F1.
28. Send the commands

    B0

    RDC0
29. Subtract the displayed value of REPLY DELAY from the measured value of reply delay and enter this as the new value of RDC:

    Final value of RDC = _____
30. Remove the signal generator from J9 and reconnect the system cable.

4.22 Top Receiver Calibration

1. The received power measurement is frequency compensated using a 6^{th} order polynomial equation. One equation is used for all serial numbers.

   Send the following commands:

   B1
   CRF60
   CRF50
   CRF40
   CRF3-2.49547e-7
   CRF28.105916e-4
   CRF1-8.757310E-1
   CRF03.156227E2
   LAO3175
   LAG325
   RATT11.3
2. Disconnect the cable from the **TOP** RF TX/RX receiver input, J9, and connect the signal generator to J9. Set the signal generator output to 6 dBm at 1090.00 MHz.

3. Connect the pulse generator output to the signal generator pulse modulation input.
4. Set the pulse generator to output a simulated ATCRBS reply – 2 ea 450 ns pulses spaced 20.3 us apart. Externally trigger the pulse generator with the TB-2100 Scope Sync output.
5. Select

   Main Menu = Mode S

   Mode = A

   Measure = F1-Top

   Scope Sync = 11 µs
6. Set the signal generator to output +6 dBm. If the displayed power is not 500 W (57 dBm), read and record the current value of LAO by typing:

   B1

   LAO? Current value of LAO = _____
7. Adjust the value of LAO to achieve a reading of 500 W (57dBm). Record the final value of LAO.

   LAO = _____
8. When the signal generator output is adjusted between 6 dBm and 0 dBm, the TB-2100 measured power must change by 6 +/- 0.25 dB. If not, read and record the current value of LAG by typing:

   LAG? Current value of LAG = _____
9. Adjust the log amp gain as necessary to achieve 6 dB change in measured power for 6 dB change in applied power (125W)(51 dBm).
10. Record the final value of LAG

    LAG = _____
11. Increase the output of the signal generator to +9 dBm. Record the displayed power

    _____dBm
12. Compute 10 X LOG (P_{11} / 1000) and record the result

    _____
13. Read the current value of RATT by typing RATT? _____

14. Subtract the result of step 12 from the current value of RATT and enter the sum as the new value of RATT.
15. Repeat steps 11 through 14 as necessary.
16. Record the final value of RATT = _____(Adjust for 1000W)(60 dBm).
17. Send the unit level calibration coefficients with the following commands

    CRX61-6.360916e-15
    CRX514.064297E-11
    CRX41-1.075629E-07
    CRX311.508837E-04
    CRX21-1.182783E-01
    CRX114.910715E+01
    CRX01-8.430755E+03

18. Remove the signal generator from J9 and reconnect the system cable.
19. Connect a transponder to the front panel **TOP RF** connector and record the displayed power:

    _____dBm

20. Record the current value of PWSC1 (See steps below) _____.
    a) On the TB-2100 Front panel, select “System Startup”, then the **CAL** button.
    b) Look for the “**TOP RX POWER**”.
    c) Press the *DOWN ARROW* until you see “**PWSC0**” and record that value.
    d) Return to the Main Menu and reconfigure for a Mode S transponder s in Step #5
21. Divide the actual power by the displayed power in step 19 and multiply this by the current value of PWSC1 from step 20.
22. Enter the new value of PWSC1 and verify that the displayed power is correct.
23. Receiver Frequency Measurement (continue to step # 24)
24. Remove the transponder from the TOP RF connector and reconnect the signal generator to RF TX/RX connector J9.
25. Adjust RF TX/RX L6 as required so that the FREQUENCY display reads 1090.00 ± 0.05 MHz.
26. Receiver Reply Delay Measurement (continue to step # 27)
27. Connect the **TOP TEST SET VIDEO** output to channel 1 of the oscilloscope and **TOP UUT VIDEO** to channel 2 of the oscilloscope. Measure the delay between the rising edge of TEST SET VIDEO P3 and the rising edge of UUT VIDEO F1.
28. Send the commands

    B1

    RDC0

29. Subtract the displayed value of REPLY DELAY from the measured value of reply delay and enter this as the new value of RDC:

Final value of RDC = _____

30. Remove the signal generator from J9 and reconnect the system cable.

4.23 DME Range Delay Calibration

1. Configure the pulse generator to output 2 pulses, 3.5 us wide, spaced 12 us apart, at an internal trigger rate of approximately 50 Hz.
2. Set the signal generator frequency to 1041.00 MHz at a level of 0 dBm. Connect the signal generator to the LOW POWER INPUT on the TB-2100 rear panel and send the commands:

   B0

   P2.5=1
3. Set the TB-2100 to DME mode, VOR PAIR 108.00.
4. Set the range to 1 nm.
5. Connect the UUT Video to channel 1 of the oscilloscope and Test Set Video to channel 2 of the oscilloscope.
6. Measure the time between the 50% point on the leading edge of P1 of the UUT Video to 50% on the leading edge of P1 of the Reply Video and record:

   _____ 62.355 ± 0.125 us.
7. Send the commands:

   B0

   DDC?
8. If necessary subtract the reading in step 6 from 62.355, add the result to the current value of DDC, and write the new value of DDC to the TB-2100.
9. XNAR to update DDC value

   Final value of DDC = _____

4.24 Final Steps

1. Complete the "*Test Set Acceptance and Verification Checks*" IAW "Section B" of this Chapter.

APPENDIX 4-A

Discrete Function	Command	Value	Notes
Transponder Pulse Shape	P2.2 =	1	0 = DME shape
Transponder Delay	P2.3 =	0	1 = DME delay
/BITE	P2.4 =	1	0 = self test
Wrap Around	P2.5 =	0	1 = self test
Low Power UUT	P2.6 =	0	1 = low power UUT
Low TX Band	P2.7 =		Set to 1 when TX frequency is 1050 MHz and below. Otherwise set to 0.

APPENDIX 4-B

SUMMARY OF RF TX/RX CALIBRATION DATA

COMMAND	DATA RANGE	EXAMPLE	DESCRIPTION
CTL6 - CTL0	Single precision float	ctl60 ctl50 ctl42.950338e-03 ctl3-6.080177e-01 ctl2-4.238576 ctl12.607372e+02 ctl02.7351275e+03	TX PIN diode attenuator
CTF6 - CTF0	Single precision float	ctf60 ctf50 ctf41.130618e-9 ctf3-4.9105665e-06 ctf27.956204e-03 ctf1-5.691951 ctf01.514805e03	TX power vs frequency
CSS6 – CSS0	Single precision float	css64.134944e-04 css52.016596e-02 css43.829616e-01 css33.781816 css22.657771e+01 css12.358292e+02 css01.681896e+03	TX SLS Level
CRF6 - CRF0	Single precision float		RX Power measurement vs frequency
DACC1	0x00 to 0xFF	DACC1.A0	P1 Power level
DACB1 & DACA1	0x00 to 0xFF	DACB1.A0	DPSK Power level
RDC	-1.00 to 1.00 (us)	RDC0.12	Measured Transponder Reply Delay
DDC	-2.000 to 2.000 (us) in 0.025 steps	DDC1	DME Range Delay calibration
LAG	200 to 700	LAG410	Log Amp Gain for received power measurement
LAO	1000 to 4000	LAG2700	Log Amp Offset for received power measurement
TAMD	-2.00 to 2.00	TAMB0	DME TX power calibration
DACD1	0x00 to 0xFF	DACD1.A0	TX frequency
DACA0	0x00 to 0xFF	DACA0.A0	RX 50% video detector offset
DACB0T	0x00 to 0xFF	DACB0T.A0	RX 50% video gain – Transponder
DACB0D	0x00 to 0xFF	DACB0D.A0	RX 50% video gain – DME
DACC0	0x00 to 0xFF	DACC0.A0	RX power measurement offset
DACD0	0x00 to 0xFF	DACD0.A0	RX power measurement gain
RATT	9.00 to 11.00 (dB)	RATT10.6	RX added attenuation when a high power UUT is being tested

APPENDIX 4-C

SUMMARY OF TOP LEVEL CALIBRATION DATA

COMMAND	DATA RANGE	EXAMPLE	DESCRIPTION
CTX60 – CTX00	Single precision float	CTX608.040984e-14 CTX50-5.118937e-10 CTX401.355827e-06 CTX30-1.912467e-03 CTX201.515218e+00 CTX10-6.393334e+02 CTX001.122387e+05	TX power vs frequency – Main
CTX61 – CTX01	Single precision float	CTX61-2.359774e-14 CTX511.670523e-10 CTX41-4.882499e-07 CTX317.549352e-04 CTX21-6.518401e-01 CTX112.981984e+02 CTX01-5.649869e+04	TX power vs frequency – Top
CRX60 – CRX00	Single precision float	CRX60-6.360916e-15 CRX504.064297E-11 CRX40-1.075629E-07 CRX301.508837E-04 CRX20-1.182783E-01 CRX104.910715E+01 CRX00-8.430755E+03	RX power vs frequency – Main
CRX61 – CRX01	Single precision float	CRX61-6.360916e-15 CRX514.064297E-11 CRX41-1.075629E-07 CRX311.508837E-04 CRX21-1.182783E-01 CRX114.910715E+01 CRX01-8.430755E+03	RX Power vs frequency - Top
PWSC0	0 to 2	PWSC01	Main measured power cal factor
PWSC1	0 to 2	PWSC11	Top measured power cal factor
ABS0	0 to 20 (1 dB steps)	ABS010	JFW attenuator offset in Diversity mode - Main
ABS1	0 to 20 (1 dB steps)	ABS110	JFW attenuator offset in Diversity mode – Top
ABS2	0 to 20 (1 dB steps)	ABS22	JFW attenuator offset in P5 mode - Main
ABS3	0 to 20 (1 dB steps)	ABS32	JFW attenuator offset in P5 mode - Top
TAMB0	-0.99 to 0.99 (0.01 dB steps)	TAMB0-0.05	TX power offset in Diversity mode - Main
TAMB1	-0.99 to 0.99 (0.01 dB steps)	TAMB1-0.05	TX power offset in Diversity mode - Top
TAMB2	-0.99 to 0.99 (0.01 dB steps)	TAMB2-0.05	TX power offset in P5 mode - Main
TAMB3	-0.99 to 0.99 (0.01 dB	TAMB3-0.05	TX power offset in P5 mode

COMMAND	DATA RANGE	EXAMPLE	DESCRIPTION
	steps)		- Top
RFSW0	0x00 to 0xFF (8 bit DAC)	RFSW00xD8	TX power Main to Top match in P5 mode

Single data values may be read by sending the command followed by a question mark, in place of data. For example, DACC1? returns the current value of DACC1. Sets of coefficients may be read by sending the base command followed by a question mark. For example, the command CTL? returns all seven CTL coefficients, beginning with CTL0 and ending with CTL6.

APPENDIX 4-D

EXAMPLES OF TRANSMITTER CURVE FIT COEFFICIENTS

Each curve fit coefficient has a command with the data in scientific notation. For example, the command to enter the 6th order coefficient for the PIN diode attenuator is CTL6. For a coefficient of 0, the command+data is CTL60. Coefficients are not stored in EEPROM until the '0' coefficient (i.e. CTL0) is entered and then all coefficients are stored at the same time. Coefficients may be read by entering the coefficient command followed by a question mark. For example, all the PIN diode attenuator coefficients may be read by entering CTL?

The PIN diode attenuator has a fairly linear (dB vs volts) control voltage response in the middle of its range, but rolls off at each end. This is illustrated in Figure 2. The software has the capability to do a 6th order curve fit, but only a 4th order fit is needed. So the 6th order and 5th order coefficients are entered as 0 (CTL60, CTL50).

The transmitter output power decreases with increasing frequency, as shown in Figure 4. To compensate for this, an offset attenuation is applied to the PIN diode attenuator as a function of frequency. The software has the capability to do a 6th order curve fit, but only a 4th order fit is needed. So the 6th order and 5th order coefficients are entered as 0.

The input voltage to the pulse modulator is varied to provide a variable SLS/interference/echo level. The response of the pulse modulator is linear in volts and non-linear in dB, as shown in Figure 6 The polynomial curve fit is used to calibrate it to be linear in dB. All 6 coefficients are used.

4-D.1

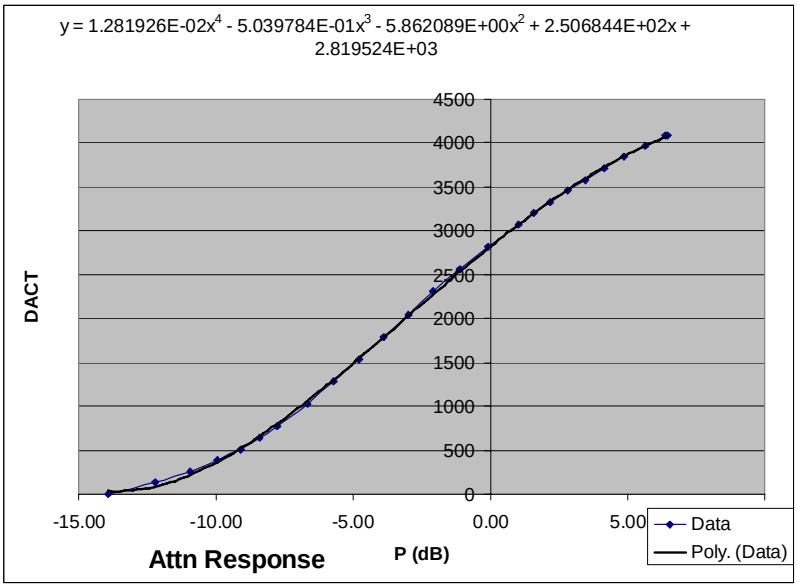
CTLx Coefficients

NOM=	11	DATA	
Scale=	6.44	ENTRY	
Decimal	DACT	dBm	Normal
4092	ffc	17.44	6.44
4080	ff0	17.35	6.35
3968	f80	16.65	5.65
3840	f00	15.88	4.88
3712	e80	15.16	4.16
3584	e00	14.47	3.47
3456	d80	13.82	2.82
3328	d00	13.19	2.19
3200	c80	12.59	1.59
3072	c00	12.01	1.01
2816	b00	10.92	-0.08
2560	a00	9.89	-1.11
2304	900	8.92	-2.08
2048	800	8.00	-3.00
1792	700	7.09	-3.91
1536	600	6.20	-4.80
1280	500	5.28	-5.72
1024	400	4.32	-6.68
768	300	3.22	-7.78
640	280	2.59	-8.41
512	200	1.88	-9.12
384	180	1.06	-9.94
256	100	0.05	-10.95
128	80	-1.23	-12.23
0	0	-2.95	-13.95

NOTE

It is recommended that a copy of the Calibration Data Coefficient spread sheet be saved as a master.

The Spread Sheet is protected to prevent accidental changes to the “Mathematical Functions”. If needed, the protection can be removed (though not recommended). Select the File Menu: **TOOLS** then **PROTECTION**. Select either “Protect” or “Unprotect” from the menu.



CTLx Coefficients

The CTLx coefficients are displayed at the top of the chart. The C6TL and C5TL coefficients are always 0. So, in this example the commands that are sent to the RF TX/RX assembly are:

CTL60
CTL50
CTL41.281926E-02
CTL3-5.039784E-01
CTL2-5.862089E00
CTL12.506844E02
CTL02.819524E03

When the CTL0 command is received, all the coefficients are stored in EEPROM.

CTL?

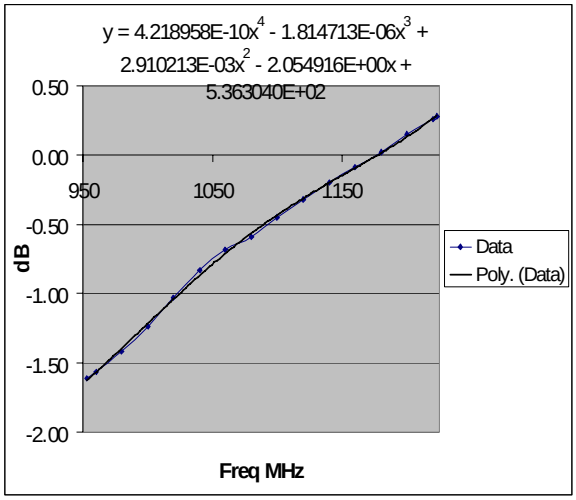
The coefficients are displayed CTL0 first, CTL6 last. In the example, the response will be:

2.819524E03
2.506844E02
-5.862089E00
-5.039784E-01
1.281926E-02
0
0

4-D.2 CTFx Coefficients

NOM=	10		
Scale=	0.28	DATA	
		ENTRY	
	Freq	dBm	Variation
	953	11.61	-1.61
	960	11.57	-1.57
	980	11.42	-1.42
	1000	11.24	-1.24
	1020	11.03	-1.03
	1040	10.83	-0.83
	1060	10.68	-0.68
	1080	10.59	-0.59
	1100	10.45	-0.45
	1120	10.32	-0.32
	1140	10.20	-0.20
	1160	10.09	-0.09
	1180	9.98	0.02
	1200	9.85	0.15
	1220	9.74	0.26
	1223	9.72	0.28

CTFx Data Entry



CTFx Coefficients

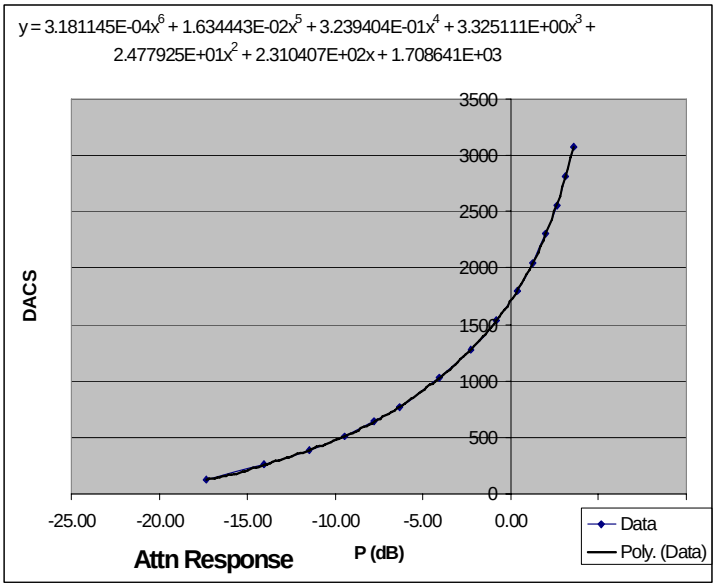
So, in this example the commands that are sent to the RF TX/RX assembly are:

C6TF0
C5TF0
C4TF4.218958E-10
C3TF-1.814713E-06
C2TF2.910213E-03
C1TF-2.054916E00
C0TF5.363040E02

4-D.3 CSSx Coefficients

NOM=	10.92		
Scale=	4.66	DATA	
		ENTRY	
Decimal	DACS	dBm	Normal
4092	ffc	15.58	4.66
4080	ff0	15.57	4.65
3968	f80	15.50	4.58
3840	f00	15.40	4.48
3712	e80	15.29	4.37
3584	e00	15.17	4.25
3456	d80	15.02	4.10
3328	d00	14.86	3.94
3200	c80	14.69	3.77
3072	c00	14.50	3.58
2816	b00	14.06	3.14
2560	a00	13.54	2.62
2304	900	12.93	2.01
2048	800	12.18	1.26
1792	700	11.26	0.34
1536	600	10.10	-0.82
1280	500	8.65	-2.27
1024	400	6.86	-4.06
768	300	4.56	-6.36
640	280	3.15	-7.77
512	200	1.48	-9.44
384	180	-0.55	-11.47
256	100	-3.11	-14.03
128	80	-6.40	-17.32
0	0	-9.96	-20.88

CSSx Data Entry



CSSx Coefficients

In this example the commands that are sent to the RF TX/RX assembly are:

CSS63.181145E-04
CSS51.634443E-02
CSS43.239404E-01
CSS33.325111E00
CSS22.477925E01
CSS12.310407E02
CSS01.708641E03

APPENDIX 4-E

INITIAL VALUES OF CALIBRATION COEFFICIENTS

The following commands can be put in a text file and sent to the TB-2100 to initialize a new unit.

CTX608.040984e-14
CTX50-5.118937e-10
CTX401.355827e-06
CTX30-1.912467e-03
CTX201.515218e+00
CTX10-6.393334e+02
CTX001.122387e+05
CTX61-2.359774e-14
CTX511.670523e-10
CTX41-4.882499e-07
CTX317.549352e-04
CTX21-6.518401e-01
CTX112.981984e+02
CTX01-5.649869e+04
CRX60-6.360916e-15
CRX504.064297E-11
CRX40-1.075629E-07
CRX301.508837E-04
CRX20-1.182783E-01
CRX104.910715E+01
CRX00-8.430755E+03
CRX61-6.360916e-15
CRX514.064297E-11
CRX41-1.075629E-07
CRX311.508837E-04
CRX21-1.182783E-01
CRX114.910715E+01
CRX01-8.430755E+03
PWSC01
PWSC11
ABS00
ABS10
ABS20
ABS30
TAMB00.00
TAMB10.00
TAMB20.00
TAMB30.00
RFSW00XD8
B0
RATT10
RDC0
DDC0
LAO3175
LAG325
RATT11.3TAMD-1.3
CTL60
CTL50
CTL40
CTL30
CTL20
CTL10
CTL00
CTF60
CTF50
CTF40

CTF30
CTF20
CTF10
CSS00
CSS60
CSS50
CSS40
CSS30
CSS20
CSS10
CSS00
CRF60
CRF50
CRF40
CRF3-2.49547e-7
CRF28.105916e-4
CRF1-8.757310E-1
CRF03.156227E2
B1
RATT10
RDC0
DDC0
LAO3175
LAG325
RATT11.3
TAMD-1.3
CTL60
CTL50
CTL40
CTL30
CTL20
CTL10
CTL00
CTF60
CTF50
CTF40
CTF30
CTF20
CTF10
CSS00
CSS60
CSS50
CSS40
CSS30
CSS20
CSS10
CSS00
CRF60
CRF50
CRF40
CRF3-2.49547e-7
CRF28.105916e-4
CRF1-8.757310E-1
CRF03.156227E2

APPENDIX 4-F

TB 2100 Test Set Verification and Acceptance Checks Data Sheet

DATE	
Model	
Serial #	
Technician	

4.4 ATCRBS Functions, Display, and Frequency				
Step #	Test Description or Specification	Measured Value Log the result	Result Circle	Initial
2	Power "ON" – Self Test	PASS	PASS FAIL	
5	Brightness Knob	Minimum to Maximum	PASS FAIL	
6	Press XPDR Pulse Width Knob	Changes State	PASS FAIL	
7	Turn XPDR Pulse Width	0.30 to 1.40	PASS FAIL	
8	Pulse Width Dev	-.50 to 0.60	PASS FAIL	
9	XPDR/DME P2 POS Knob	Indicates "OFF"	PASS FAIL	
10	Vary XPDR/DME P2 POS Knob	-1.00 to 1.00	PASS FAIL	
11	Vary XPDR/DME P3 POS Knob	-1.00 to 1.00	PASS FAIL	
12	PRF/SQUITTER Knob	Changes State	PASS FAIL	
13	PRF Adjust	Changes Value	PASS FAIL	
14	FREQUENCY Knob	Changes Frequency	PASS FAIL	
15	MODE Knob	Selects A,C, A/C Double	PASS FAIL	
16	MEASURE Knob	Changes State	PASS FAIL	
17	SCOPE SYNC	Changes Value	PASS FAIL	
18	SLS Knob	-12 to 3	PASS FAIL	
19	MAIN RF Level Knob	Changes Value	PASS FAIL	
20	Interf. Position Field	Changes Value	PASS FAIL	
23a	Frequency 1030 MHz / ± 10 kHz	kHz	PASS FAIL	
23b	Frequency 952 MHz / ± 10 kHz	kHz	PASS FAIL	
23c	Frequency 1223 MHz / ± 10 kHz	kHz	PASS FAIL	
4.4.3 MAIN RF Level				
3a	Main RF Level at -10 dBm / ± 0.5 dBm	dBm	PASS FAIL	
3b	Main RF Level at -11 dBm / ± 0.5 dBm	dBm	PASS FAIL	
3c	Main RF Level at -12 dBm / ± 0.5 dBm	dBm	PASS FAIL	
3d	Main RF Level at -14 dBm / ± 0.5 dBm	dBm	PASS FAIL	
3e	Main RF Level at -18 dBm / ± 0.5 dBm	dBm	PASS FAIL	
3f	Main RF Level at -26 dBm / ± 0.6 dBm	dBm	PASS FAIL	
3g	Main RF Level at -42 dBm / ± 0.75 dBm	dBm	PASS FAIL	
3h	Main RF Level at -74 dBm / ± 1.10 dBm	dBm	PASS FAIL	
3i	Main RF Level at -100 dBm / ± 1.50 dBm	dBm	PASS FAIL	

4.4.4 CW ON/OFF Ratio				
Step #	Test Description or Specification	Measured Value Log the result	Result Circle	Initial
2	CW ON/OFF Ratio t -10 dBm	-10 dBm =		
3	"OFF" Power	"OFF" =		
4	-10 dBm Power – "OFF" power 60 dB Minimum	dBm	PASS FAIL	
4.4.5 Level vs. Frequency				
2a	Frequency at 1030 MHz REF =	REF MHz		
2b	Freq. at 952 MHz ± 1.0 dBm from REF	dBm	PASS FAIL	
2c	Freq at 1223 MHz ± 1.0 dBm from REF	dBm	PASS FAIL	
4.4.6 SLS Level				
6	P2 at -10 dBm at -10 dBm / ± 0.50 dBm	dBm	PASS FAIL	
7a	SLS Level at 1 dBm / ± 0.25 dBm	dBm	PASS FAIL	
7b	SLS Level at 3 dBm / ± 0.25 dBm	dBm	PASS FAIL	
7c	SLS Level at -1 dBm / ± 0.25 dBm	dBm	PASS FAIL	
7d	SLS Level at -6 dBm / ± 0.25 dBm	dBm	PASS FAIL	
7e	SLS Level at -12 dBm / ± 0.25 dBm	dBm	PASS FAIL	
4.4.7 Pulse Shape, Rise and Fall Times				
7	P1 Rise Time at 75 / ± 25 nSec	nSec	PASS FAIL	
8	P1 Fall Time at 125 / ± 75 nSec	nSec	PASS FAIL	
9	P1 Pulse Width at 800 / ± 50 nSec	nSec	PASS FAIL	
4.4.8 Detected TEST VIDEO OUT (Main) Output				
1	P1 Rise Time at 75 / ± 25 nSec	nSec	PASS FAIL	
2	P1 Fall Time at 125 / ± 75 nSec	nSec	PASS FAIL	
3	P1 Pulse Width at 800 / ± 50 nSec	nSec	PASS FAIL	
4.5 Interrogation Pulse Patterns				
4.5.1 ATCRBS Mode A – P1, P2, and P3				
5	Setting 0.80 nSec P1 Width 750 to 850 nSec	nSec	PASS FAIL	
	Setting 0.80 nSec P2 Width 750 to 850 nSec	nSec	PASS FAIL	
	Setting 0.80 nSec P3 Width 750 to 850 nSec	nSec	PASS FAIL	
6	Setting 1.40 nSec P1 Width 1350 to 1450 nSec	nSec	PASS FAIL	
	Setting 1.40 nSec P2 Width 1350 to 1450 nSec	nSec	PASS FAIL	
	Setting 1.40 nSec P3 Width 1350 to 1450 nSec	nSec	PASS FAIL	
	Setting 0.30 nSec P1 Width 250 to 350 nSec	nSec	PASS FAIL	
	Setting 1.40 nSec P2 Width 250 to 350 nSec	nSec	PASS FAIL	
	Setting 1.40 nSec P3 Width 250 to 350 nSec	nSec	PASS FAIL	

4.5.1 ATCRBS Mode A – P1, P2, and P3 (Continued)				
Step #	Test Description or Specification	Measured Value Log the result	Result Circle	Initial
8	P1 to P3 Spacing (Record Data)	µsec		
9	P3 Setting at 0.00 µsec 7.95 to 8.05 µsec	µsec	PASS FAIL	
	P3 Setting at 1.00 µsec 2.95 to 3.05 µsec	µsec	PASS FAIL	
	P3 Setting at -1.00 µsec 6.95 to 7.05 µsec	µsec	PASS FAIL	
11	P1 to P2 Spacing (Record Data)	µsec		
12	P2 Setting at 0.00 µsec 1.95 to 2.05 µsec	µsec	PASS FAIL	
	P2 Setting at 1.00 µsec 2.95 to 3.05 µsec	µsec	PASS FAIL	
	P2 Setting at -1.00 µsec 0.95 to 1.05 µsec	µsec	PASS FAIL	
4.5.2 Interference Pulse and Position				
3	Interference Pulse Position at -5.00 µsec Width at 0.30 µsec – 0.28 t0 0.32 µsec	µsec	PASS FAIL	
4	Interference Pulse Position at -5.00 µsec Width at 3.00 µsec – 2.97 to 3.03 µsec	µsec	PASS FAIL	
7	Interference Pulse Position at -5.00 µsec -5.05 to -4.95 µsec	µsec	PASS FAIL	
8	Interference Pulse Position at 45 µsec 44.95 to 45.05 µsec	µsec	PASS FAIL	
4.5.3 Scope Sync Width Position				
2	Scope Sync Pulse Width at “0”	µsec		
5	Scope Sync Setting at “0” Scope Sync Position 0 /± 1 µsec	µsec	PASS FAIL	
	Scope Sync Setting at “10” Scope Sync Position 10 /± 1 µsec	µsec	PASS FAIL	
	Scope Sync Setting at “18” Scope Sync Position 18 /± 1 µsec	µsec	PASS FAIL	
	Scope Sync Setting at “39” Scope Sync Position 39 /± 1 µsec	µsec	PASS FAIL	
	Scope Sync Setting at “51” Scope Sync Position 51 /± 1 µsec	µsec	PASS FAIL	
	Scope Sync Setting at “72” Scope Sync Position 72 /± 1 µsec	µsec	PASS FAIL	
	Scope Sync Setting at “94” Scope Sync Position 94 /± 1 µsec	µsec	PASS FAIL	
	Scope Sync Setting at “117” Scope Sync Position 117 /± 1 µsec	µsec	PASS FAIL	
	Scope Sync Setting at “136” Scope Sync Position 136 /± 1 µsec	µsec	PASS FAIL	
	Scope Sync Setting at “153” Scope Sync Position 153 /± 1 µsec	µsec	PASS FAIL	
	Scope Sync Setting at “175” Scope Sync Position 175 /± 1 µsec	µsec	PASS FAIL	

4.5.4 PRF				
Step #	Test Description or Specification	Measured Value Log the result	Result Circle	Initial
3	PRF at 1000 = 999 to 1001 Hz	Hz	PASS FAIL	
4	PRF at 1 = 0 to 2 Hz	Hz	PASS FAIL	
	PRF at 51 = 50 to 52 Hz	Hz	PASS FAIL	
	PRF at 1500 = 1499 to 1501 Hz	Hz	PASS FAIL	
4.6 ATCRBS Mode C				
4.6.1 P3 Position				
1	P1 to P3 Position 20.95 to 21.05 µsec	µsec	PASS FAIL	
4.6.2 P2 Position				
1	P1 to P2 Position 1.95 to 2.05 µsec	µsec	PASS FAIL	
4.7 Suppressor Pulse				
4.7.1 Suppressor Pulse Width				
3	Suppressor Pulse Width at 35 / ± 5 µsec	µsec	PASS FAIL	
4.7.2 Suppressor Amplitude				
2	Suppressor Pulse Level at Minimum 9.00 / ± 0.5 V	V	PASS FAIL	
3	Suppressor Pulse Level at Maximum 28.00 / ± 0.5 V	V	PASS FAIL	
4.8 TOP Output Frequency (Mode S) Suppressor Amplitude				
4a	Output Frequency at 1030 MHz 1030 MHz / ± 10 kHz	MHz	PASS FAIL	
4b	Output Frequency at 952 MHz 952 MHz / ± 10 kHz	MHz	PASS FAIL	
4c	Output Frequency at 1223 MHz 1223 MHz / ± 10 kHz	MHz	PASS FAIL	
4.8.1 TOP Output Frequency				
2a	Main Level Set to -10 dBm 10 / ± 0.5 dBm	dBm	PASS FAIL	
2b	Main Level Set to -74 dBm 74 / ± 0.99 dBm	dBm	PASS FAIL	
2c	Main Level Set to -100 dBm 100 / ± 1.25 dBm	dBm	PASS FAIL	
4.8.2 CW ON/OFF Ratio				
2	Output power at -10 dBm / ± 0.50 dBm	dBm	PASS FAIL	
3	Output Power "OFF"	dBm		
4	Difference in Power (Step 1 – Step 2) >60 dBm Difference	dBm	PASS FAIL	
4.8.3 Level vs. Frequency				
2a	Freq Ref = 1030 MHz Output Power in dBm	REF = dBm		
2b	Freq at 952 MHz – REF ± 1.0 dBm	dBm		
2c	Freq at 1223 MHz – REF ± 1.0 dBm	dBm		

4.8.4 SLS Level				
Step #	Test Description or Specification	Measured Value Log the result	Result Circle	Initial
5	P2 at -10 dBm ± 0.5dBm	dBm	PASS FAIL	
6a	P5 at 3 dBm ± 0.25 dBm	dBm	PASS FAIL	
6b	P5 at -6 dBm ± 0.25 dBm	dBm	PASS FAIL	
	P5 at -12 dBm ± 0.25 dBm	dBm	PASS FAIL	
4.8.5 Pulse Shape				
7	P1 Rise Time at 75 / ± 25 nSec	nSec	PASS FAIL	
8	P1 Fall Time at 125 / ± 75 nSec	nSec	PASS FAIL	
9	P1 Pulse Width at 800 / ± 50 nSec	nSec	PASS FAIL	
4.8.6 Detected Test Set Video (TOP) Output				
1	P1 Rise Time at 75 / ± 25 nSec	nSec	PASS FAIL	
2	P1 Fall Time at 125 / ± 75 nSec	nSec	PASS FAIL	
3	P1 Pulse Width at 800 / ± 50 nSec	nSec	PASS FAIL	
4.9 DME Functions				
4.9.1 Pulse Shape				
8	P1 Rise Time at 2.0 / ± 0.5 µsec	µsec	PASS FAIL	
9	P1 Fall Time at 2.5 / ± 0.5 µsec	µsec	PASS FAIL	
10	P1 Width at 3.5 / ± 0.2 µsec	µsec	PASS FAIL	
11	P2 Rise Time at 2.0 / ± 0.5 µsec	µsec	PASS FAIL	
12	P2 Fall Time at 2.5 / ± 0.5 µsec	µsec	PASS FAIL	
13	P2 Width at 3.5 / ± 0.2 µsec	µsec	PASS FAIL	
4.9.2 Detected Test Set Video (MAIN) Output				
1	P1 Rise Time at 2.0 / ± 0.5 µsec	µsec	PASS FAIL	
2	P1 Fall Time at 2.5 / ± 0.5 µsec	µsec	PASS FAIL	
3	P1 Width at 3.5 / ± 0.2 µsec	µsec	PASS FAIL	
4	P2 Rise Time at 2.0 / ± 0.5 µsec	µsec	PASS FAIL	
5	P2 Fall Time at 2.5 / ± 0.5 µsec	µsec	PASS FAIL	
6	P2 Width at 3.5 / ± 0.2 µsec	µsec	PASS FAIL	
4.10 External Inputs				
4.10.1 Low Power RX				
6	Verify Presence P1, P2, P3 at >0.10VPk	V Pk	PASS FAIL	
4.10.2 Trig IN				
3	Verify Presence of P1, P2, and P3	Pulses present	PASS FAIL	
4	No Pulses Present	Not Present	PASS FAIL	
4.10.3 Video				
2	Mode A – P1 Amplitude REF	REF = V		
5	Verify Mode A P1 same as Step 2	REF = V	PASS FAIL	
4.10.4 SLS				
3	Mode A – P2 Amplitude REF	REF = V		
6	Verify Mode A P2 same as Step 2	REF = V	PASS FAIL	

4.10.5 DPSK				
Step #	Test Description or Specification	Measured Value Log the result	Result Circle	Initial
4.11 Transponder Mode A, C, S, and DME				
4.11.1 ATCRBS Mode				
8	Verify Mode A Replay and Interrogations	Verify	PASS FAIL	
9	Verify Reply Delay is Equal to Actual ± 1µsec	µsec	PASS FAIL	
11	Verify Output Power is Equal to Actual ±0.5 dBm	dBm	PASS FAIL	
12	Verify Freq, is same as Actual ± 50 kHz	kHz	PASS FAIL	
14	Verify Presence of Reply Pulses at 1090 MHz	Verify	PASS FAIL	
4.11.2 Mode C				
6	Verify Transponder Replies to Mode C Interrogations	Verify	PASS FAIL	
4.11.3 Mode S				
12	Verify Transponder Replies to Mode S Interrogations (MAIN)	Verify	PASS FAIL	
14	Verify Transponder Replies to Mode S Interrogations (TOP)	Verify	PASS FAIL	
16	Verify Mode S Replies at > 0.10VPk	V Pk	PASS FAIL	
4.11.4 DME				
7	Verify all DME Parameters are accurate	Verify	PASS FAIL	

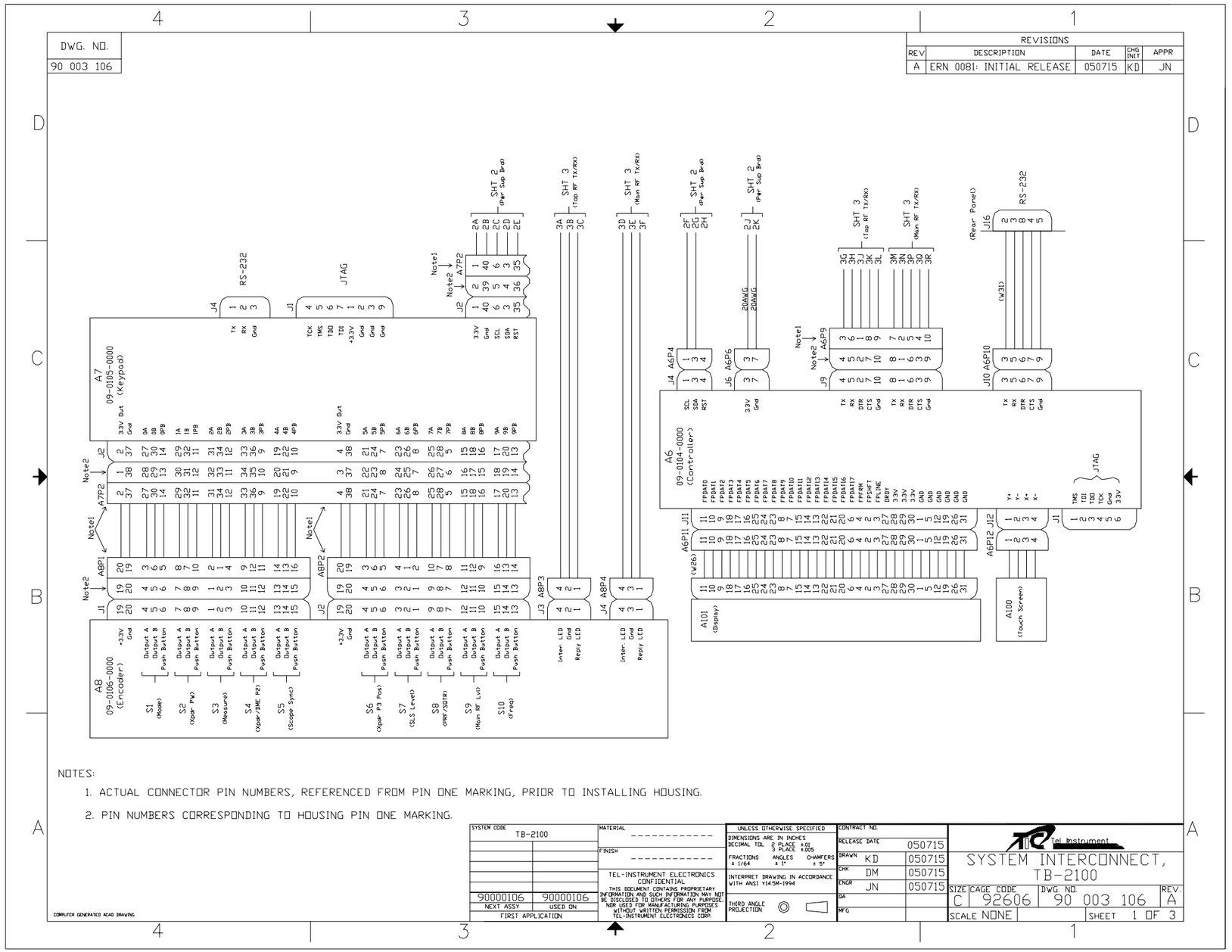
DATE	
PASS/FAIL	
Technician	

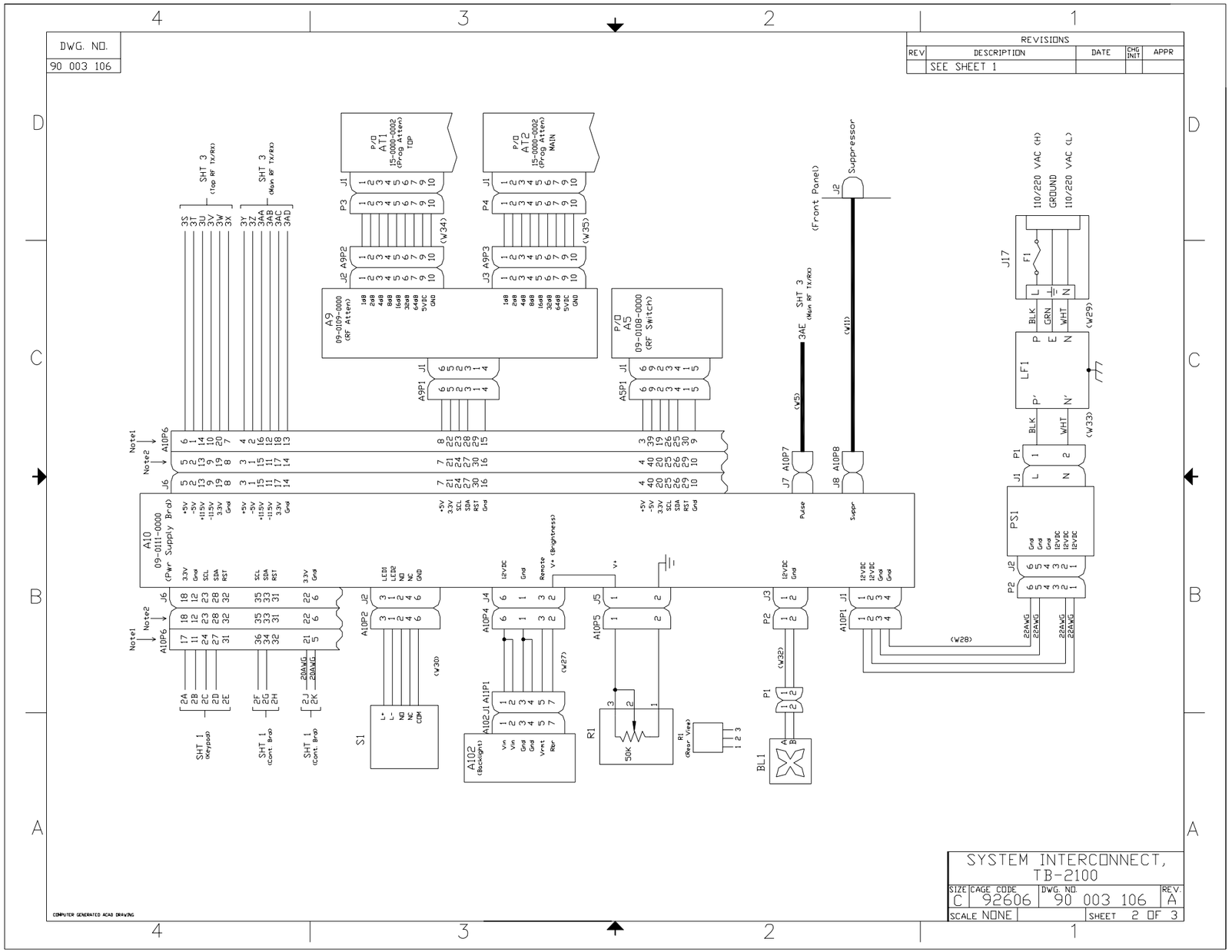
FAILED TEST RESULTS LOG			
Step #	Failed Test	Value Measured	Initial

Unit Disposition - _____

CHAPTER V

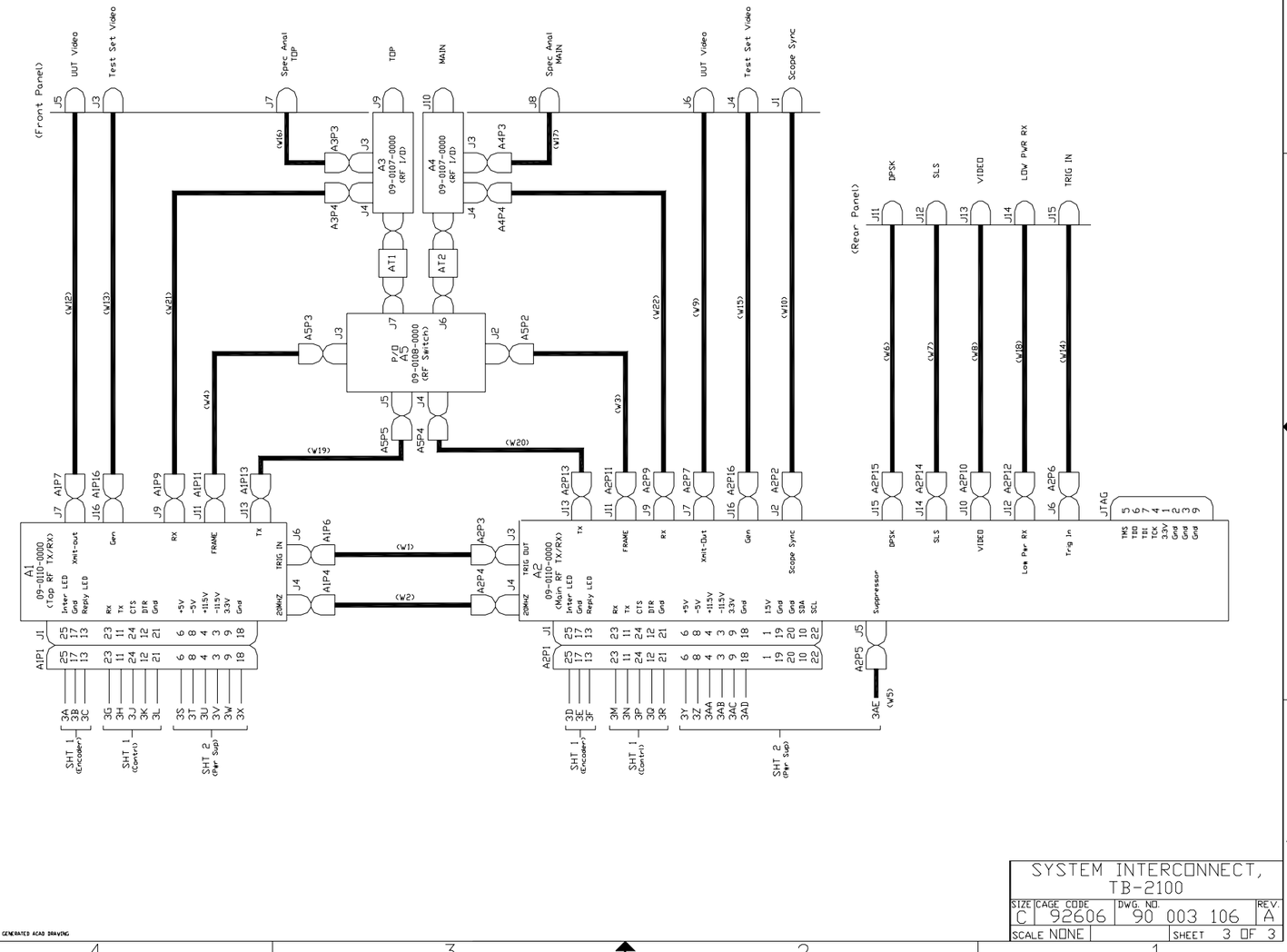
SCHEMATICS


DWG. NO.
90 003 106
REVISIONS
REV | DESCRIPTION | DATE | CHG INIT | APPR
A | ERN 0081: INITIAL RELEASE | 050715 | KD | JN
A7 09-0105-0000 (Keypad)
A6 09-0104-0000 (Controller)
A8 09-0106-0000 (Encoder)
A101 (Display)
A100 (Touch Screen)
RS-232
JTAG
SHT 2 (Pwr Sup Brd)
SHT 3 (Top RF TX/RX)
SHT 3 (Main RF TX/RX)
(Rear Panel)
(CW26)
(CW31)
Note1
Note2
S1 (Mode)
S2 (Xpdr PW)
S3 (Measure)
S4 (Xpdr/DME P2)
S5 (Scope Sync)
S6 (Xpdr P3 Pos)
S7 (CDLS Level)
S8 (PRF/SSTR)
S9 (Main RF Lvl)
S10 (Freq)
NOTES:
1. ACTUAL CONNECTOR PIN NUMBERS, REFERENCED FROM PIN ONE MARKING, PRIOR TO INSTALLING HOUSING.
2. PIN NUMBERS CORRESPONDING TO HOUSING PIN ONE MARKING.
SYSTEM CODE TB-2100
90000106 NEXT ASSY
90000106 USED ON
FIRST APPLICATION
MATERIAL
FINISH
TEL-INSTRUMENT ELECTRONICS CONFIDENTIAL
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UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
DECIMAL TOL 2 PLACE ±.01 3 PLACE ±.005
FRACTIONS ± 1/64 ANGLES ± 1° CHAMFERS ± 5°
INTERPRET DRAWING IN ACCORDANCE WITH ANSI Y14.5M-1994
THIRD ANGLE PROJECTION
CONTRACT NO.
RELEASE DATE 050715
DRAWN KD 050715
CHK DM 050715
ENGR JN 050715
QA
MFG
Tel Instrument
SYSTEM INTERCONNECT, TB-2100
SIZE C | CAGE CODE 92606 | DWG. NO. 90 003 106 | REV. A
SCALE NONE | SHEET 1 OF 3
COMPUTER GENERATED ACAD DRAWING


DWG. NO.
90 003 106
REVISIONS
REV
DESCRIPTION
DATE
CHG INIT
APPR
SEE SHEET 1
A10
09-0111-0000
(Pwr Supply Brd)
A9
09-0109-0000
(RF Atten)
P/O
AT1
15-0000-0002
(Prog Atten)
TDP
P/O
AT2
15-0000-0002
(Prog Atten)
MAIN
P/O
A5
09-0108-0000
(RF Switch)
A102
(Backlight)
S1
R1
50K
BL1
PS1
LF1
F1
J17
J2
(Front Panel)
Suppressor
110/220 VAC (H)
GROUND
110/220 VAC (L)
SHT 3
(Top RF TX/RX)
SHT 3
(Main RF TX/RX)
SHT 1
(Keypad)
SHT 1
(Cont. Brd)
SHT 1
(Cont. Brd)
Note1
Note2
COMPUTER GENERATED ACAD DRAWING
SYSTEM INTERCONNECT,
TB-2100
SIZE
CAGE CODE
DWG. NO.
REV.
C
92606
90 003 106
A
SCALE NONE
SHEET 2 OF 3

DWG. NO.
90 003 106

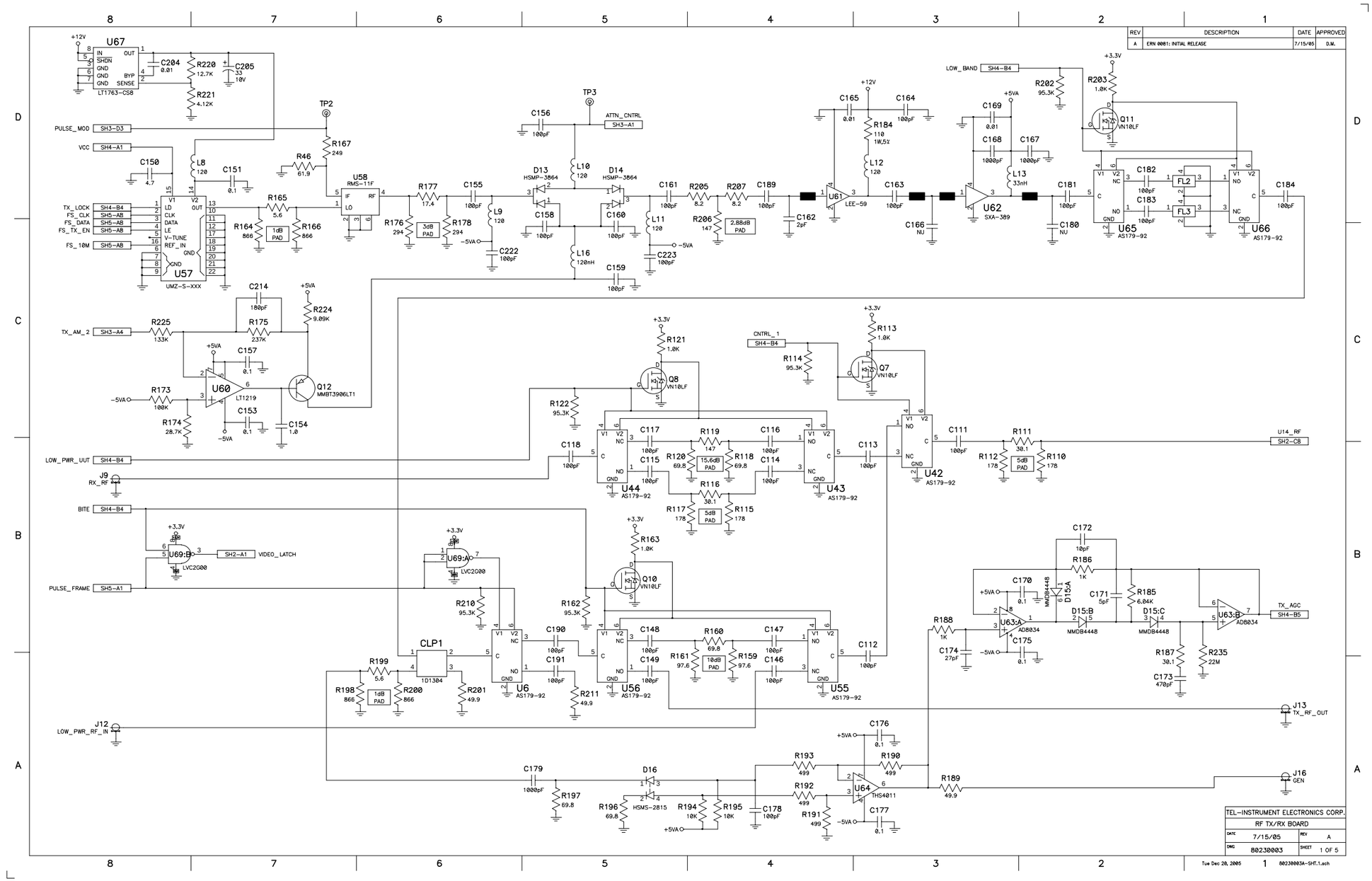
REVISIONS				
REV	DESCRIPTION	DATE	CHG INT	APPR
	SEE SHEET 1			

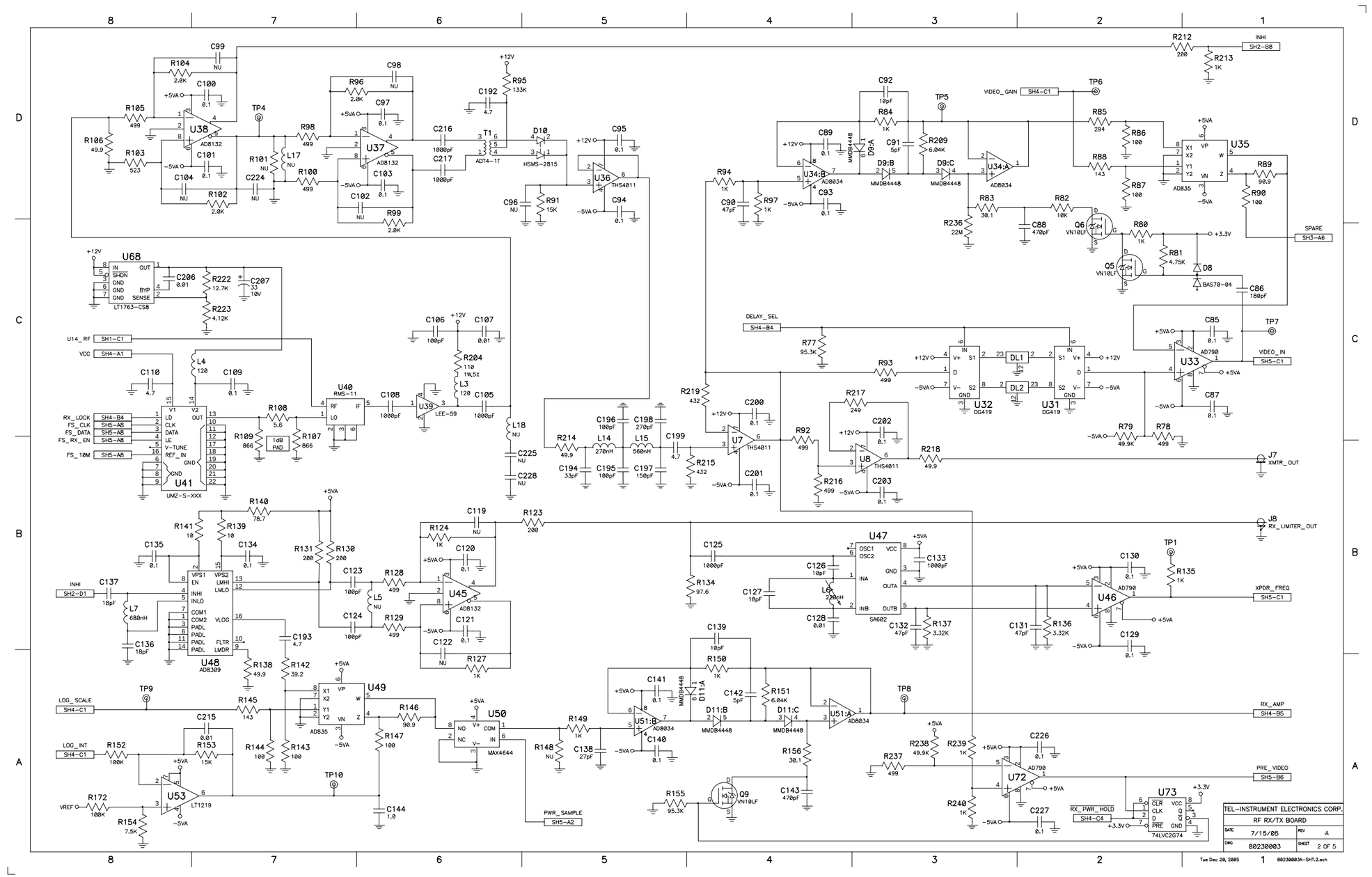


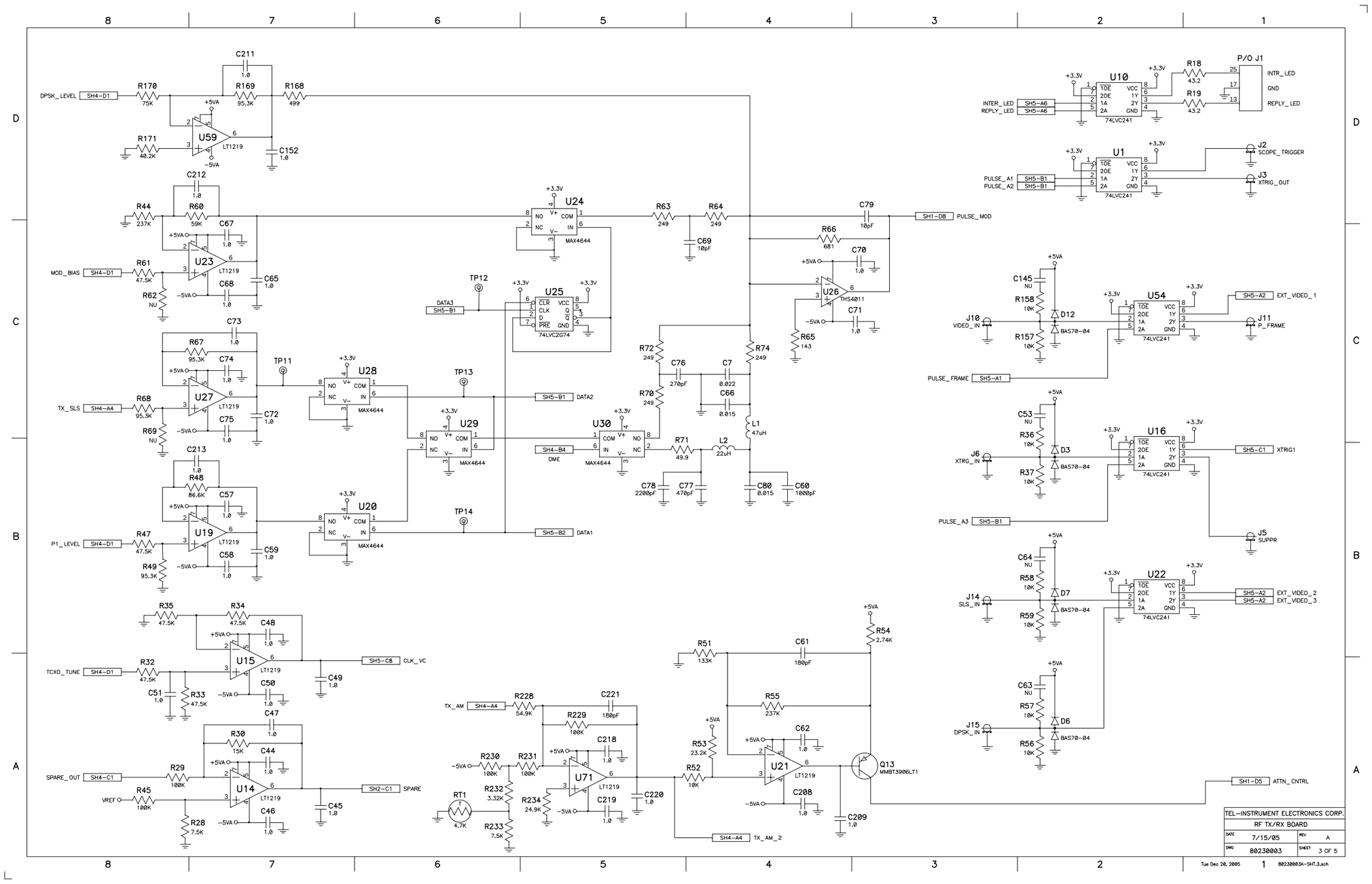
SYSTEM INTERCONNECT, TB-2100

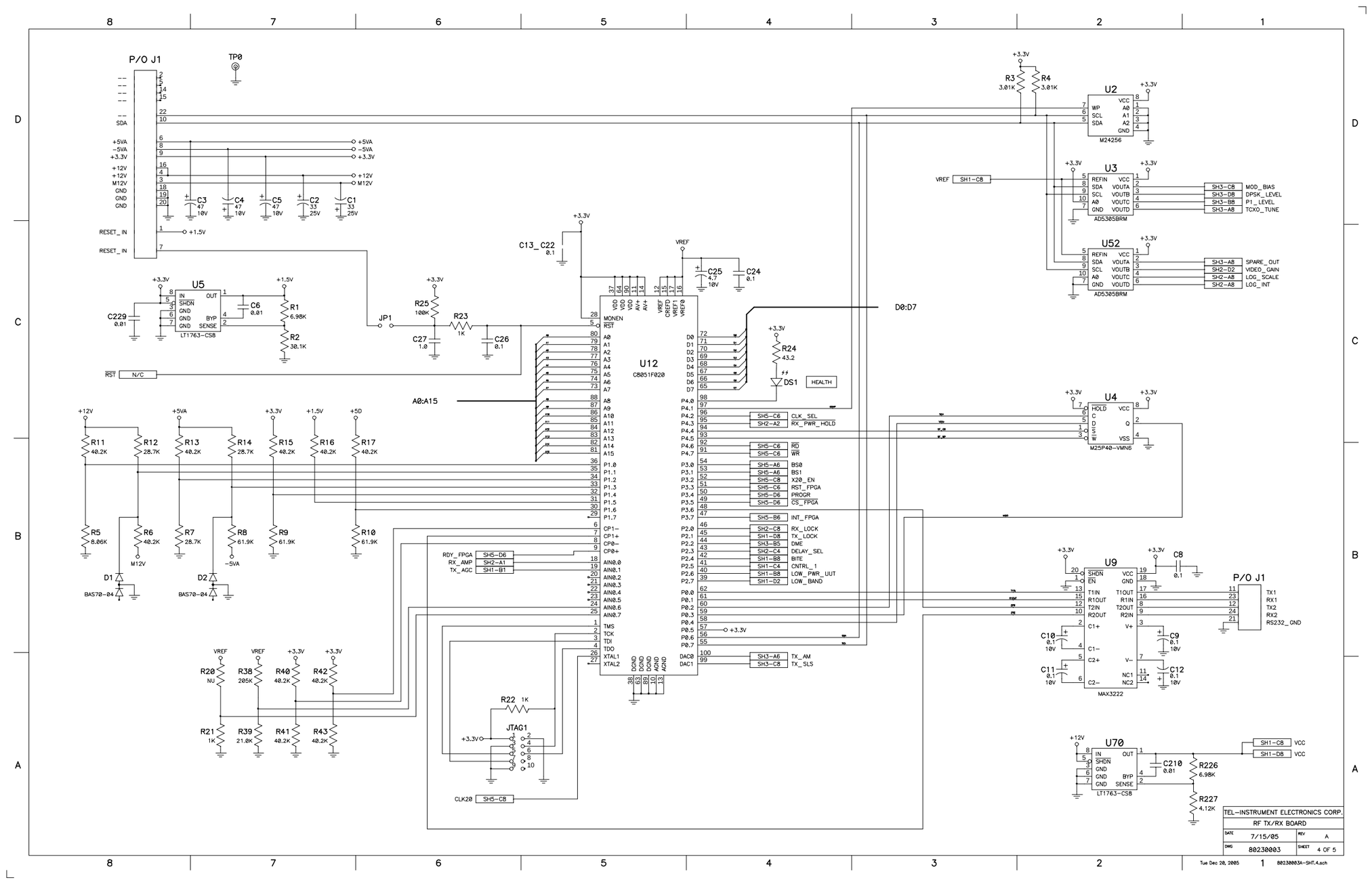
SIZE	CAGE CODE	DWG. NO.	REV.
C	92606	90 003 106	A
SCALE NONE		SHEET 3 OF 3	

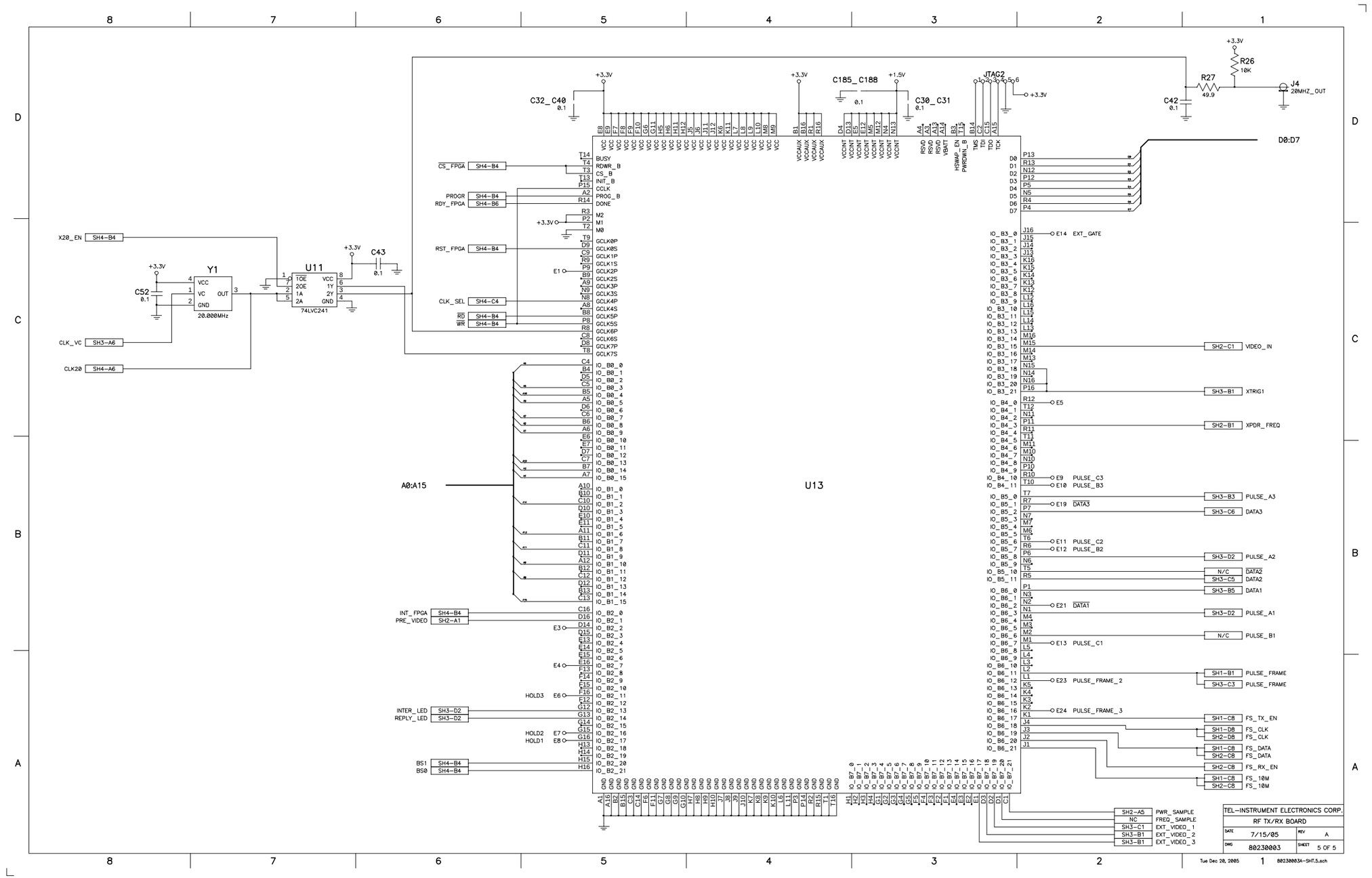
COMPUTER GENERATED ACAD DRAWING


REV | DESCRIPTION | DATE | APPROVED
A | ERN 0081: INITIAL RELEASE | 7/15/05 | D.M.
U67 LT1763-CS8
C204 0.01
R220 12.7K
C205 33 10V
R221 4.12K
TP2
TP3
PULSE_MOD SH3-D3
VCC SH4-A1
C150 4.7
L8 120
C151 0.1
R46 61.9
R167 249
U58 RMS-11F
C156 100pF
ATTN_CNTRL SH3-A1
L10 120
D13 HSMP-3864
D14 HSMP-3864
C161 100pF
R205 8.2
R207 8.2
C189 100pF
C162 2pF
U61 LEE-59
C165 0.01
C164 100pF
R184 110 1W,5%
L12 120
C163 100pF
C166 NU
LOW_BAND SH4-B4
+5VA
R202 95.3K
C169 0.01
C168 1000pF
C167 1000pF
L13 33nH
U62 SXA-389
C181 100pF
C180 NU
+3.3V
R203 1.0K
Q11 VN10LF
U65 AS179-92
C182 100pF
C183 100pF
FL2
FL3
U66 AS179-92
C184 100pF
TX_LOCK SH4-B4
FS_CLK SH5-A8
FS_DATA SH5-A8
FS_TX_EN SH5-A8
FS_10M SH5-A8
U57 UMZ-5-XXX
R165 5.6
R164 866
1dB PAD
R166 866
R176 294
3dB PAD
R177 17.4
R178 294
C155 100pF
C222 100pF
C158 100pF
C160 100pF
L9 120
L11 120
L16 120nH
C159 100pF
C223 100pF
-5VA
C214 180pF
R224 9.09K
TX_AM_2 SH3-A4
R225 133K
R175 237K
C157 0.1
U60 LT1219
Q12 MMBT3906LT1
R173 100K
R174 28.7K
C153 0.1
C154 1.0
+3.3V
R121 1.0K
Q8 VN10LF
CNTRL_1 SH4-B4
R114 95.3K
R113 1.0K
Q7 VN10LF
R122 95.3K
C118 100pF
C117 100pF
C115 100pF
R119 147
R120 69.8
15.6dB PAD
R118 69.8
C116 100pF
C114 100pF
U44 AS179-92
R116 30.1
R117 178
5dB PAD
R115 178
U43 AS179-92
C113 100pF
U42 AS179-92
C111 100pF
R111 30.1
R112 178
5dB PAD
R110 178
U14_RF SH2-C8
LOW_PWR_UUT SH4-B4
J9 RX_RF
BITE SH4-B4
U69:B LVC2G00
SH2-A1 VIDEO_LATCH
PULSE_FRAME SH5-A1
U69:A LVC2G00
R163 1.0K
Q10 VN10LF
R210 95.3K
R162 95.3K
C172 10pF
R186 1K
C170 0.1
MMDB4448
D15:A
C171 5pF
R185 6.04K
D15:B
D15:C
U63:A AD8034
U63:B AD8034
TX_AGC SH4-B5
R188 1K
C174 27pF
C175 0.1
R187 30.1
R235 22M
C173 470pF
CLP1 1D1304
R199 5.6
R198 866
1dB PAD
R200 866
R201 49.9
C190 100pF
C191 100pF
R211 49.9
U6 AS179-92
C148 100pF
C149 100pF
R160 69.8
10dB PAD
R161 97.6
R159 97.6
C147 100pF
C146 100pF
U56 AS179-92
U55 AS179-92
C112 100pF
J13 TX_RF_OUT
J12 LOW_PWR_RF_IN
C176 0.1
R193 499
R190 499
R192 499
R191 499
U64 THS4011
R189 49.9
J16 GEN
C179 1000pF
R197 69.8
D16 HSMS-2815
R196 69.8
R194 10K
R195 10K
C178 100pF
C177 0.1
TEL-INSTRUMENT ELECTRONICS CORP.
RF TX/RX BOARD
DATE 7/15/05 REV A
DWG 80230003 SHEET 1 OF 5
Tue Dec 20, 2005 80230003A-Sht1.sch

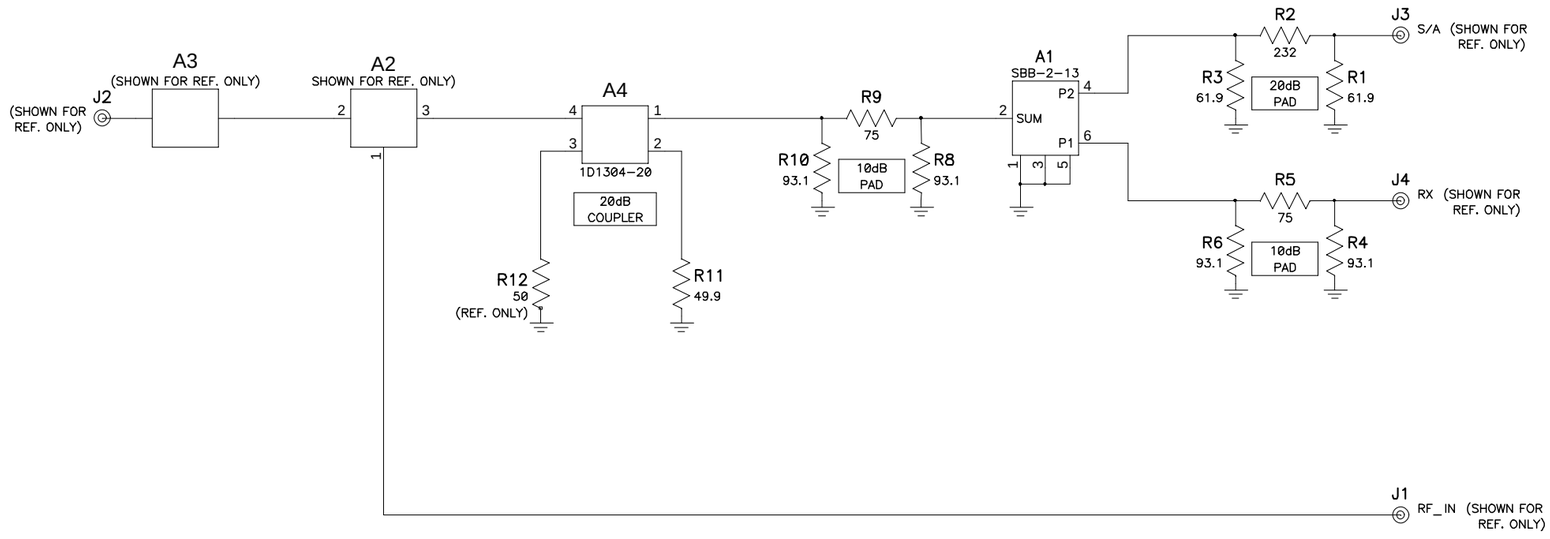

INHI
SH2-B8
VIDEO_GAIN
SH4-C1
SPARE
SH3-A6
DELAY_SEL
SH4-B4
VIDEO_IN
SH5-C1
XMTR_OUT
RX_LIMITER_OUT
XPDR_FREQ
SH5-C1
RX_AMP
SH4-B5
PRE_VIDEO
SH5-B6
U14_RF
SH1-C1
VCC
SH4-A1
LOG_SCALE
SH4-C1
LOG_INT
SH4-C1
VREF
RX_CLOCK
SH4-B4
FS_CLK
SH5-A8
FS_DATA
SH5-A8
FS_RX_EN
SH5-A8
FS_10M
SH5-A8
INHI
SH2-D1
PWR_SAMPLE
SH5-A2
RX_PWR_HOLD
SH4-C4
U38
AD8132
U37
AD8132
U36
THS4011
U34:A
AD8034
U34:B
AD8034
U35
AD835
U33
AD798
U32
DG419
U31
DG419
U68
LT1763-CS8
U40
RMS-11
U39
LEE-59
U41
UMZ-S-XXX
U7
THS4011
U8
THS4011
U45
AD8132
U49
AD8351
U50
MAX4644
U48
AD8309
U47
SA602
U46
AD790
U72
AD790
U53
LT1219
U51:B
AD8034
U51:A
AD8034
U73
74LVC2G74
D9:A
D9:B
D9:C
D11:A
D11:B
D11:C
MMDB4448
Q6
VN10LF
Q5
VN10LF
Q9
VN10LF
D8
BAS70-04
HSMS-2815
ADT4-1T
TP4
TP5
TP6
TP7
TP8
TP9
TP10
TP1
J7
J8
DL1
DL2
+12V
+5VA
-5VA
+3.3V
TEL-INSTRUMENT ELECTRONICS CORP.
RF RX/TX BOARD
DATE: 7/15/05
REV: A
DWG: 80230003
SHEET: 2 OF 5
Tue Dec 20, 2005
80230003A-SHT.2.sch


DPSK_LEVEL
MOD_BIAS
TX_SLS
P1_LEVEL
TCXO_TUNE
SPARE_OUT
VREF
TX_AM
INTER_LED
REPLY_LED
PULSE_A1
PULSE_A2
VIDEO_IN
PULSE_FRAME
XTRG_IN
SLS_IN
DPSK_IN
PULSE_A3
DME
DATA3
DATA2
DATA1
CLK_VC
SPARE
TX_AM_2
PULSE_MOD
ATTN_CNTRL
INTR_LED
GND
REPLY_LED
SCOPE_TRIGGER
XTRIG_OUT
EXT_VIDEO_1
P_FRAME
XTRIG1
SUPPR
EXT_VIDEO_2
EXT_VIDEO_3
U10
U1
U54
U16
U22
U59
U23
U27
U19
U15
U14
U24
U25
U26
U28
U29
U30
U20
U71
U21
Q13
MMBT3906LT1
MAX4644
74LVC241
74LVC2G74
LT1219
THS4011
BAS70-04
TEL-INSTRUMENT ELECTRONICS CORP.
RF TX/RX BOARD
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P/O J1
TP0
U2
M24256
U3
AD5305BRM
U52
AD5305BRM
U5
LT1763-CS8
U12
C8051F020
U4
M25P40-VMN6
U9
MAX3222
U70
LT1763-CS8
JP1
D0:D7
A0:A15
VREF
+3.3V
+5VA
-5VA
+12V
M12V
+1.5V
+5D
-5VA
RESET_IN
SDA
MOD_BIAS
DPSK_LEVEL
P1_LEVEL
TCXO_TUNE
SPARE_OUT
VIDEO_GAIN
LOG_SCALE
LOG_INT
CLK_SEL
RX_PWR_HOLD
RD
WR
BS0
BS1
X20_EN
RST_FPGA
PROGR
CS_FPGA
INT_FPGA
RX_LOCK
TX_LOCK
DME
DELAY_SEL
BITE
CNTRL_1
LOW_PWR_UUT
LOW_BAND
TX_AM
TX_SLS
HEALTH
JTAG1
TX1
RX1
TX2
RX2
RS232_GND
TEL-INSTRUMENT ELECTRONICS CORP.
RF TX/RX BOARD
DATE 7/15/05
REV A
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U13
74LVC241
20.000MHz
Y1
C52 0.1
C43 0.1
C32_C40 0.1
C185_C188 0.1
C30_C31 0.1
C42 0.1
R26 10K
R27 49.9
J4 20MHZ_OUT
JTAG2
X20_EN
CLK_VC
CLK20
A0:A15
D0:D7
EXT_GATE
VIDEO_IN
XTRIG1
XPDR_FREQ
PULSE_C3
PULSE_B3
PULSE_A3
DATA3
PULSE_A2
DATA2
DATA1
PULSE_A1
PULSE_B1
PULSE_C1
PULSE_FRAME
PULSE_FRAME_2
PULSE_FRAME_3
FS_TX_EN
FS_CLK
FS_DATA
FS_RX_EN
FS_10M
PWR_SAMPLE
FREQ_SAMPLE
EXT_VIDEO_1
EXT_VIDEO_2
EXT_VIDEO_3
TEL-INSTRUMENT ELECTRONICS CORP.
RF TX/RX BOARD
DATE 7/15/05
REV A
DWG 80230003
SHEET 5 OF 5
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REV	DESCRIPTION	DATE	APPROVED
A	ERN 0081: INITIAL RELEASE	7/15/05	D.M.



Note Table

1 A2, A3, R12, & J1 – J4 shown for reference only. Reference assembly 25-0103-0020 for parts placement. Reference 20-5107-0000 for part description.

TEL-INSTRUMENT ELECTRONICS CORP.			
NAME	I/O BOARD		
DATE	7/15/05	REV	A
DWG	80227003	SHEET	1 OF 1

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REV	DESCRIPTION	DATE	APPROVED
A	ERN 0081: INITIAL RELEASE	7/15/05	D.M.

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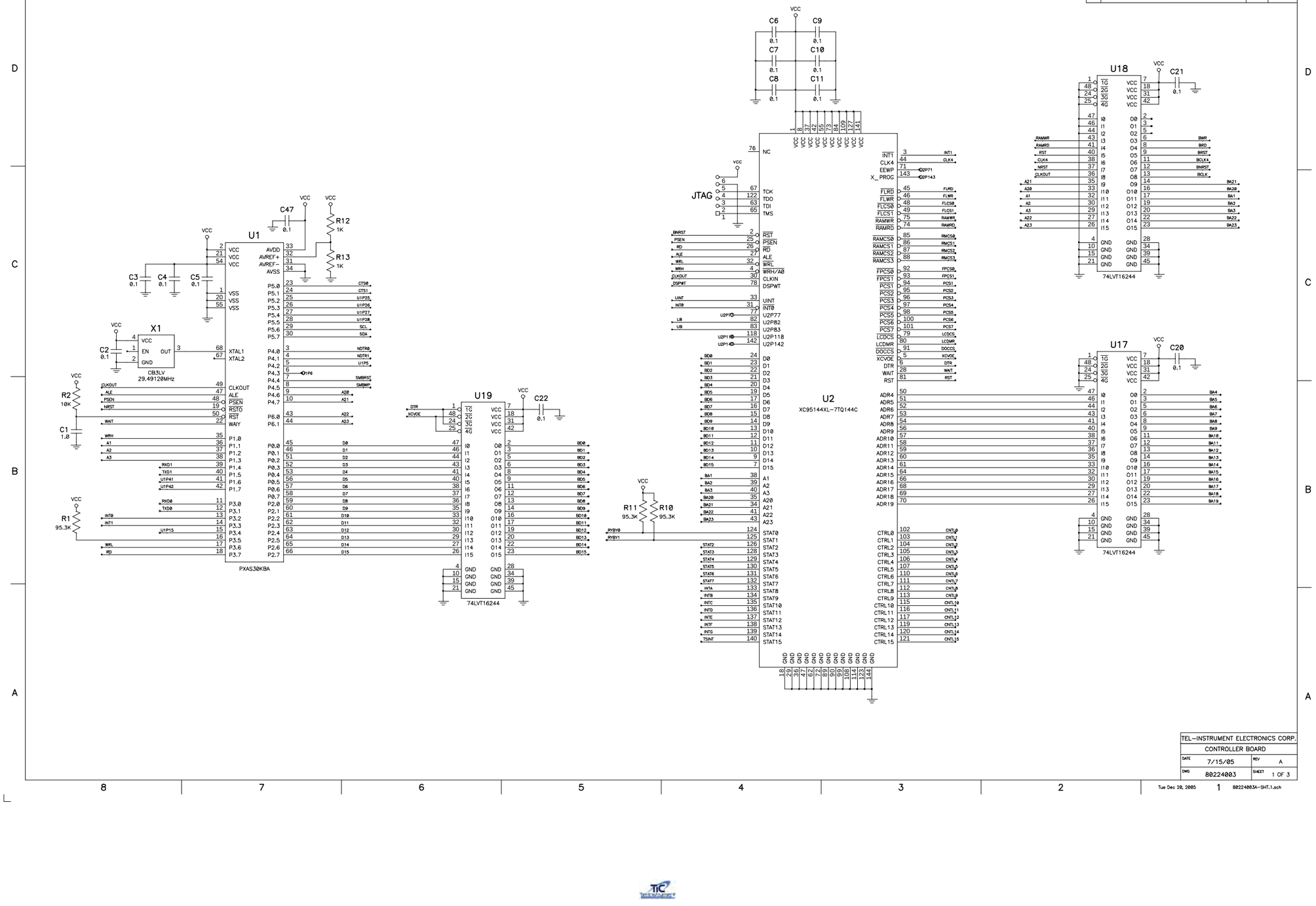
RF SWITCH BOARD

DATE 7/15/05 REV A

DWG 80228003 SHEET 1 OF 1

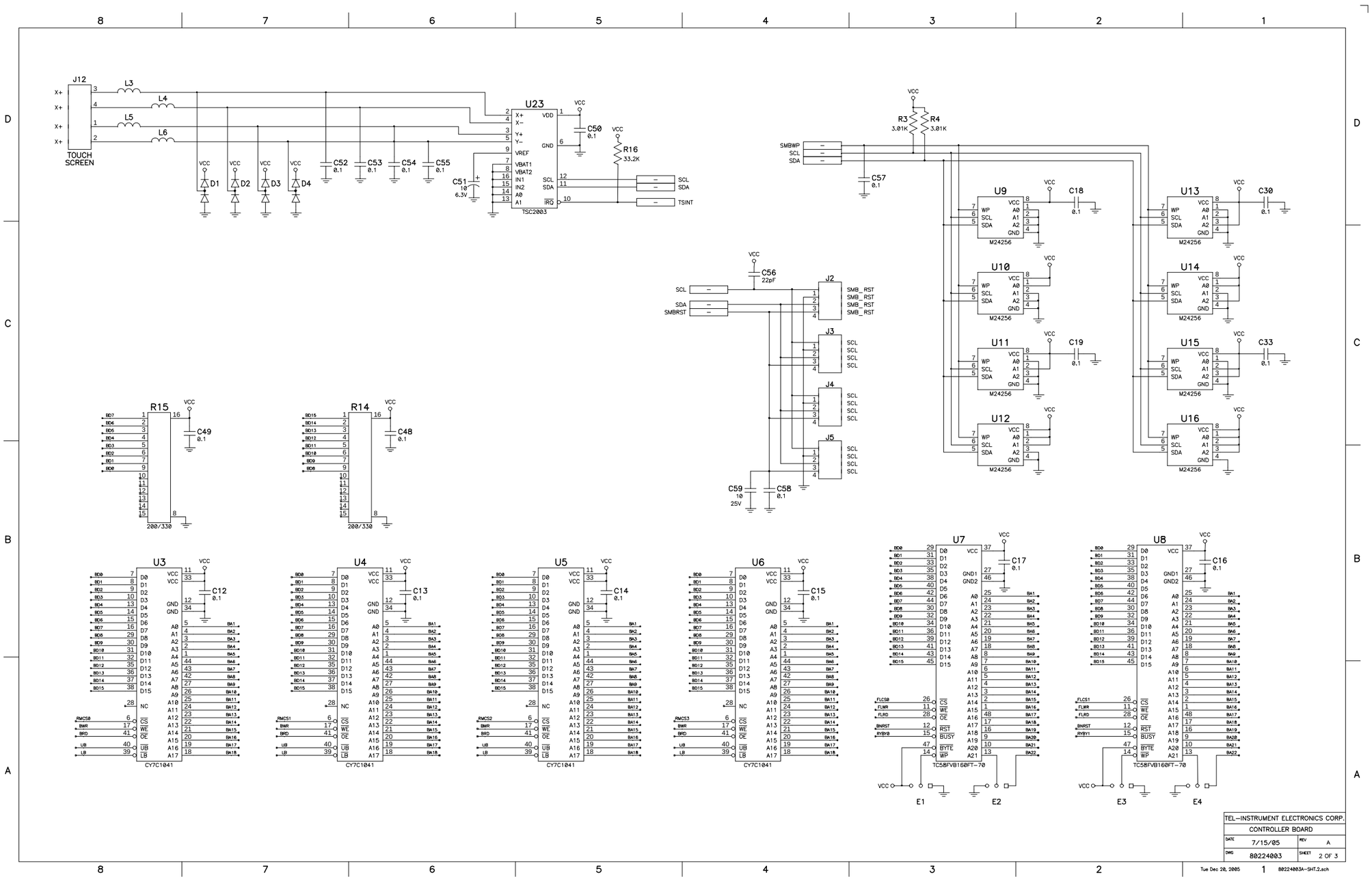
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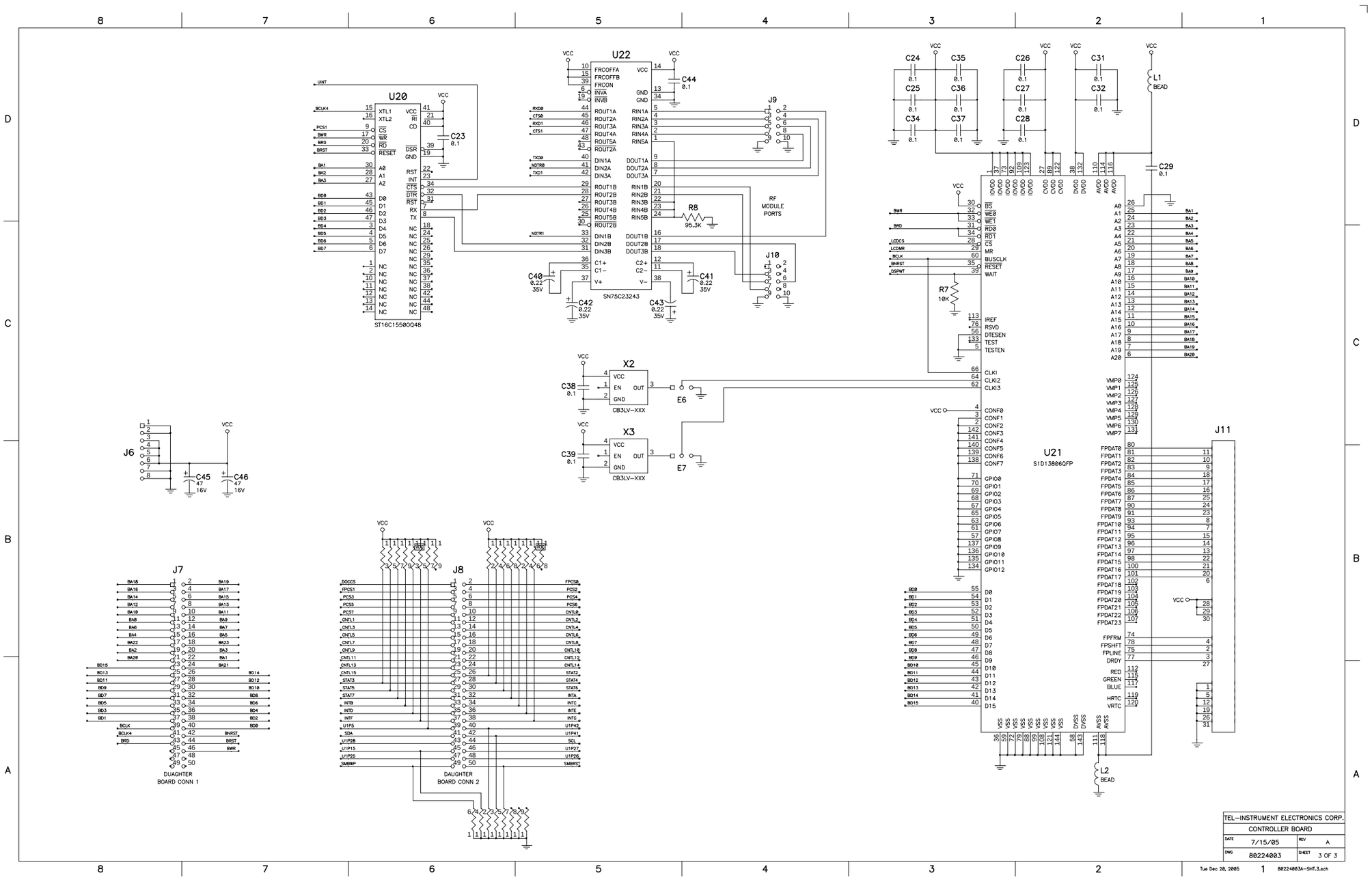
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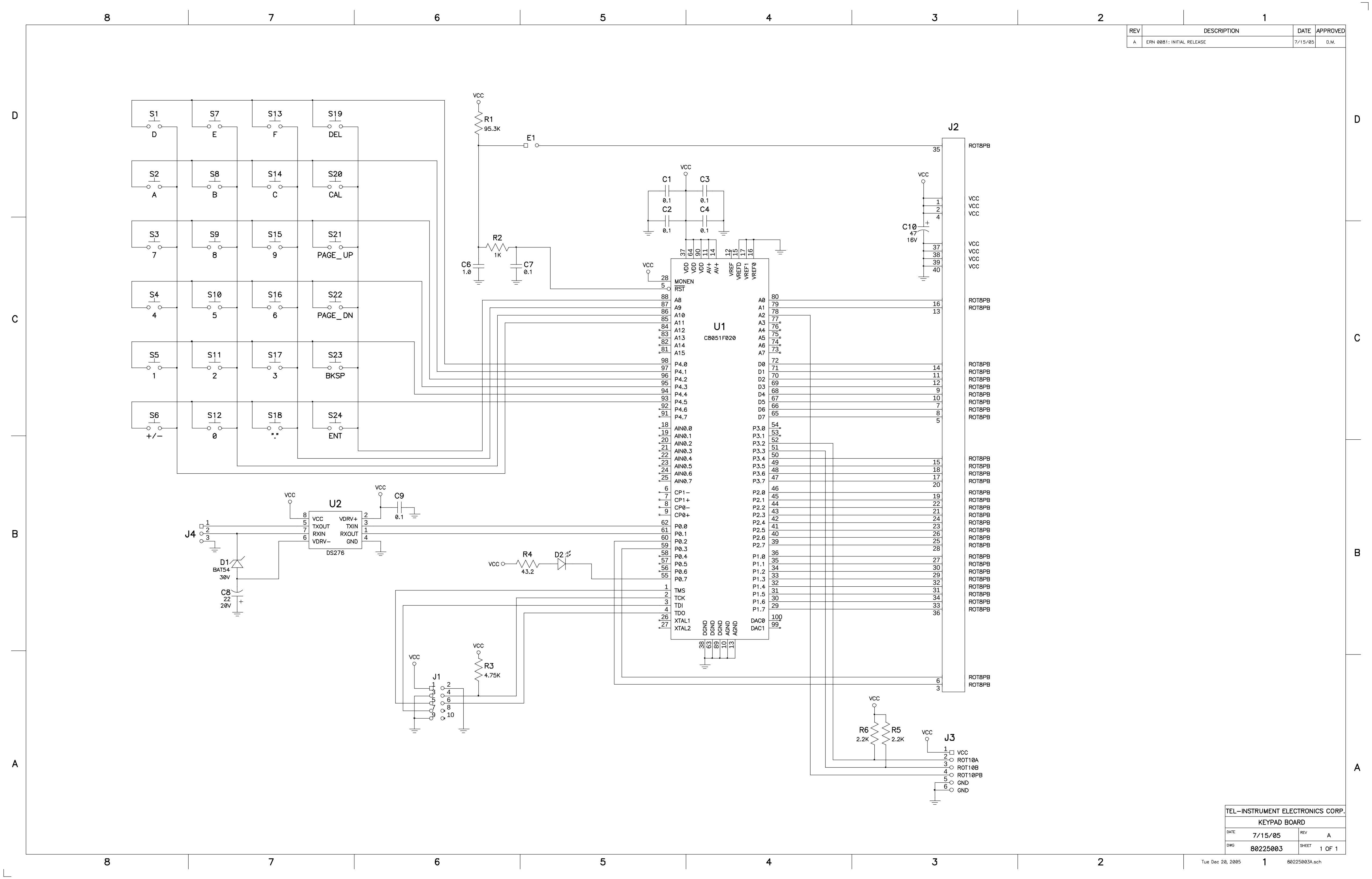


TEL—INSTRUMENT ELECTRONICS CORP.	
CONTROLLER BOARD	
DATE 7/15/05	REV A
DWG 80224003	SHEET 1 OF 3

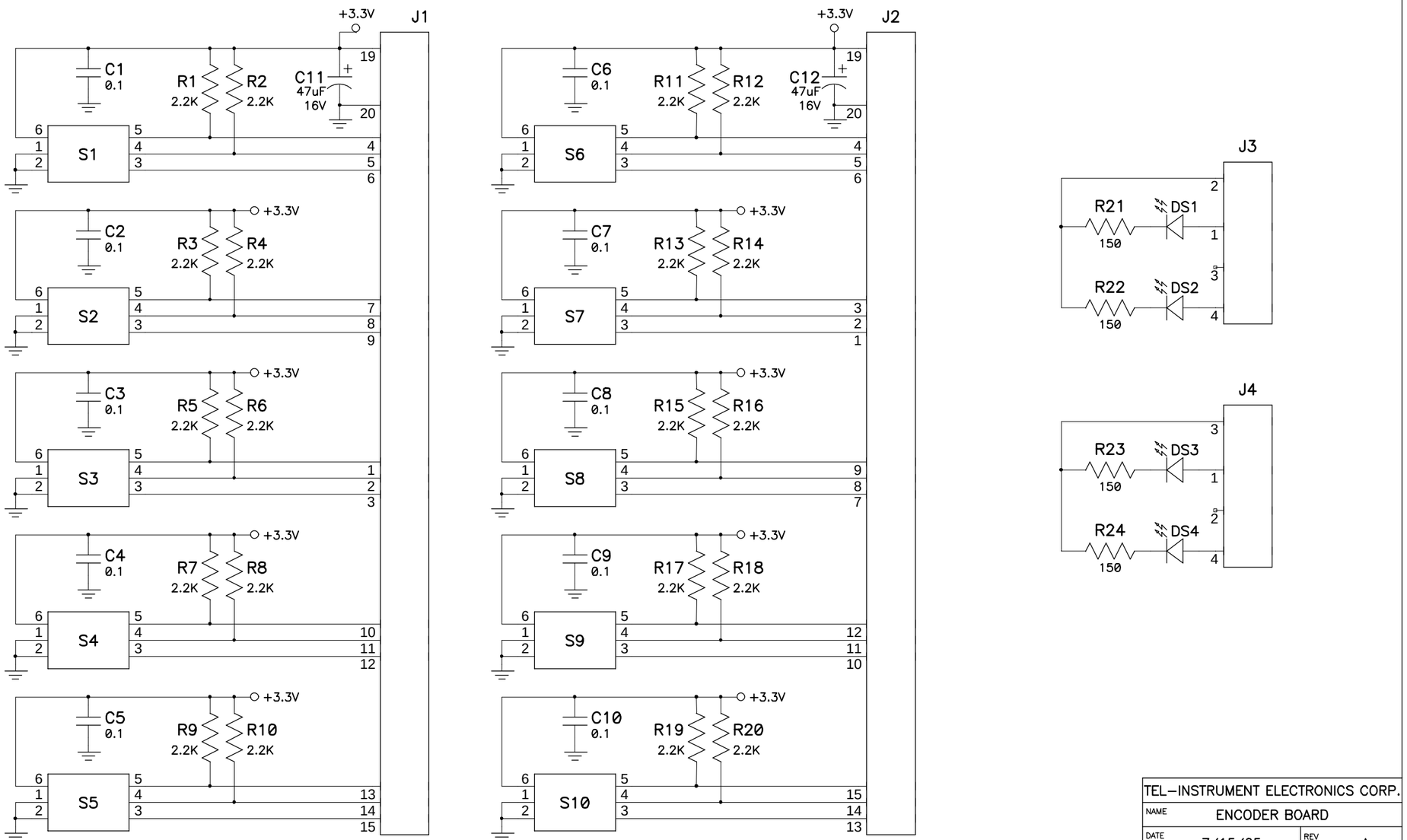
Tue Dec 20, 2005 1 80224003A-SHT.1.sch


J12
TOUCH SCREEN
L3
L4
L5
L6
D1
D2
D3
D4
C52 0.1
C53 0.1
C54 0.1
C55 0.1
U23
TSC2003
C50 0.1
C51 10 6.3V
R16 33.2K
SCL
SDA
TSINT
R3 3.01K
R4 3.01K
SMBWP
C57 0.1
U9
U10
U11
U12
U13
U14
U15
U16
M24256
C18 0.1
C19 0.1
C30 0.1
C33 0.1
C56 22pF
SMBRST
J2
J3
J4
J5
SMB_RST
C59 10 25V
C58 0.1
R15
R14
C49 0.1
C48 0.1
200/330
U3
U4
U5
U6
CY7C1041
C12 0.1
C13 0.1
C14 0.1
C15 0.1
U7
U8
TC58FVB160FT-70
C17 0.1
C16 0.1
E1
E2
E3
E4
TEL—INSTRUMENT ELECTRONICS CORP.
CONTROLLER BOARD
DATE 7/15/05
REV A
DWG 80224003
SHEET 2 OF 3
Tue Dec 20, 2005
80224003A-SHT2.sch


U20
ST16C1550Q48
U22
SN75C23243
U21
S1D13806QFP
J6
J7
J8
J9
J10
J11
X2
X3
E6
E7
R7 10K
R8 95.3K
C23 0.1
C24 0.1
C25 0.1
C26 0.1
C27 0.1
C28 0.1
C29 0.1
C31 0.1
C32 0.1
C34 0.1
C35 0.1
C36 0.1
C37 0.1
C38 0.1
C39 0.1
C40 0.22 35V
C41 0.22 35V
C42 0.22 35V
C43 0.22 35V
C44 0.1
C45 47 16V
C46 47 16V
L1 BEAD
L2 BEAD
RF MODULE PORTS
DAUGHTER BOARD CONN 1
DAUGHTER BOARD CONN 2
VCC
TEL—INSTRUMENT ELECTRONICS CORP.
CONTROLLER BOARD
DATE 7/15/05
REV A
DWG 80224003
SHEET 3 OF 3
Tue Dec 20, 2005
80224003A-SHT.3.sch


TEL-INSTRUMENT ELECTRONICS CORP.
KEYPAD BOARD
DATE 7/15/05
REV A
DWG 80225003
SHEET 1 OF 1
REV A ERN 0081: INITIAL RELEASE 7/15/05 D.M.
U1 C8051F020
U2 DS276
J1
J2
J3
J4

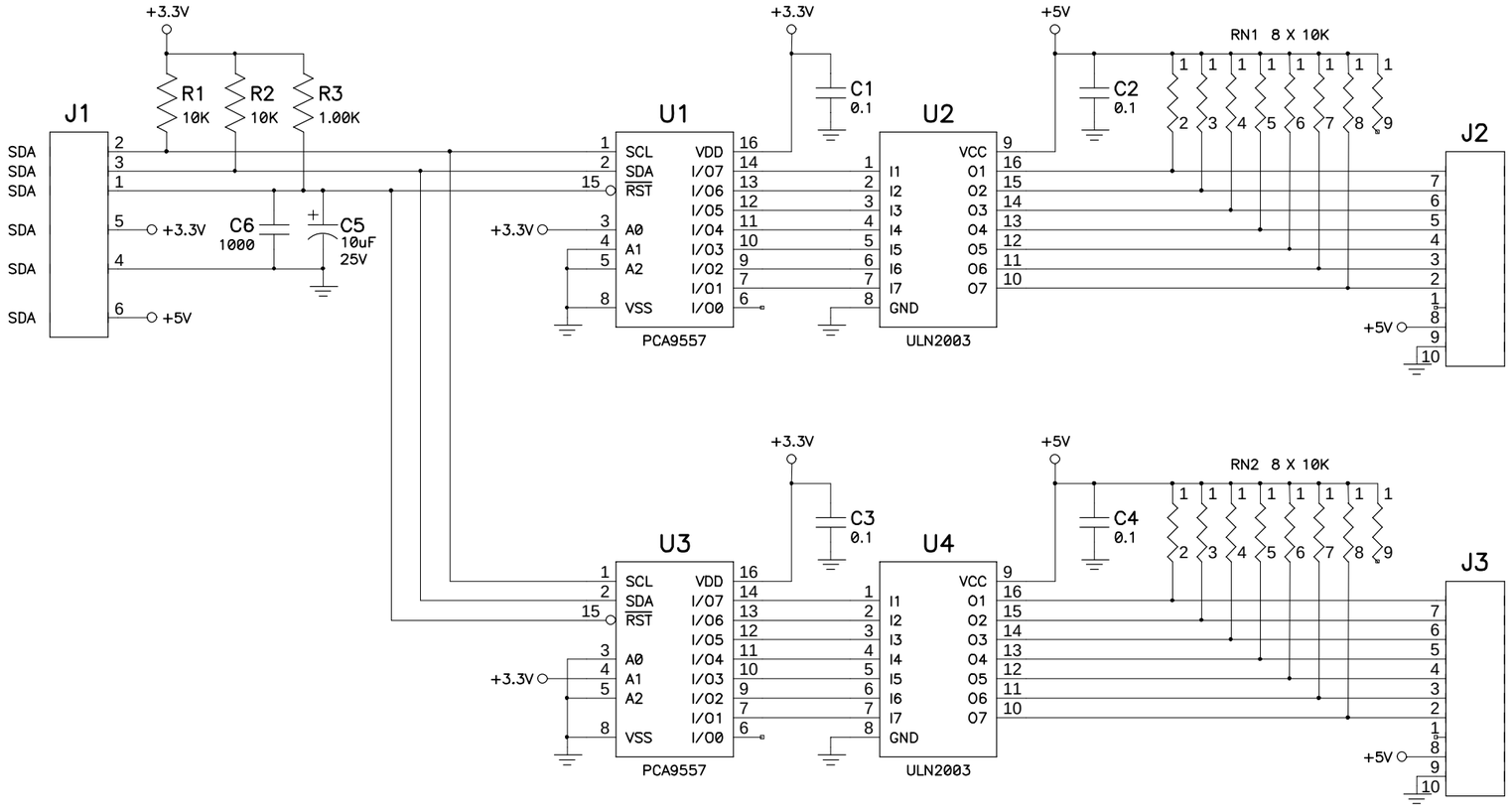
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A	ERN 0081: INITIAL RELEASE	7/15/05	D.M.



TEL–INSTRUMENT ELECTRONICS CORP.	
NAME	ENCODER BOARD
DATE 7/15/05	REV A
DWG 80226003	SHEET 1 OF 1

Tue Dec 20, 2005 80226003A.sch

REV	DESCRIPTION	DATE	APPROVED
A	ERN 0081: INITIAL RELEASE	7/15/05	D.M.



TEL–INSTRUMENT ELECTRONICS CORP.		
NAME	RF ATTN CONTROL	
DATE	7/15/05	REV A
DWG	80229003	SHEET 1 OF 1

Tue Dec 20, 2005 80229003A.sch

REV	DESCRIPTION	DATE	APPROVED
A	ERN 0081: INITIAL RELEASE	7/15/05	D.M.
B	ECO1928: ADDED R60 1.00K 1/10 WATT RESISTOR BETWEEN U13 PINS 15 AN 16.	10/14/05	D.M.

J1 +12V IN (+12V, +12V, GND, GND) · R2 6.04K · R3 604 · R5 6.04K · R6 604 · K1 G2RL-1A · Z1 30BQ060 · +12V

J3 PWR / GND — FAN

J4 PWR / VRMT / V+ / -- / -- / GND — BACKLIGHT

J5 V+ / GND — DIM POT

J2 POWER SWITCH · R1 61.9 · R4 61.9 · Q1 VN10KLF · Q2 VN10KLF · Q5 BSS84 · Q6 VN10KLF · Q7 VN10KLF · Q6-G SH1-A3 · SH1-A3 Q7-D · VRMT SH1-A3 · C51 1000pF · C52 10 25V

U1 LT1763-CS8 (IN, OUT, SHDN, GND, GND, GND, BYP, ADJ) · R7 95.3K · C1 0.01 · R8 18.7K · C2 33 25V · R9 2.21K · +11.5V

U2 (V+, OUT1–OUT4, SET, MOD DIV, PH GND) NU · R12 NU · C3 NU · R10 NU · R11 NU · CJ1 · +5.5V SH2-D6 · SH2-A8 SYNC1 · SH2-D8 SYNC2 · SH1-C4 SYNC3 · SH2-B8 SYNC4

U3 LT1763-CS8 · R13 0.1 · C4 0.01 · R14 12.7K · C5 10 25V · R15 4.12K · +5V3

U4 LT1763-CS8 · R16 0.1 · C6 0.01 · R17 12.7K · C7 10 25V · R21 40.2K · R18 4.12K · R20 2.21K · C8 0.01 · R19 2.21K · U5 LT1219LCS8 · C9 1.0

RT1 FUSE · +5.5V · L5 15uH · Z6 30BQ060

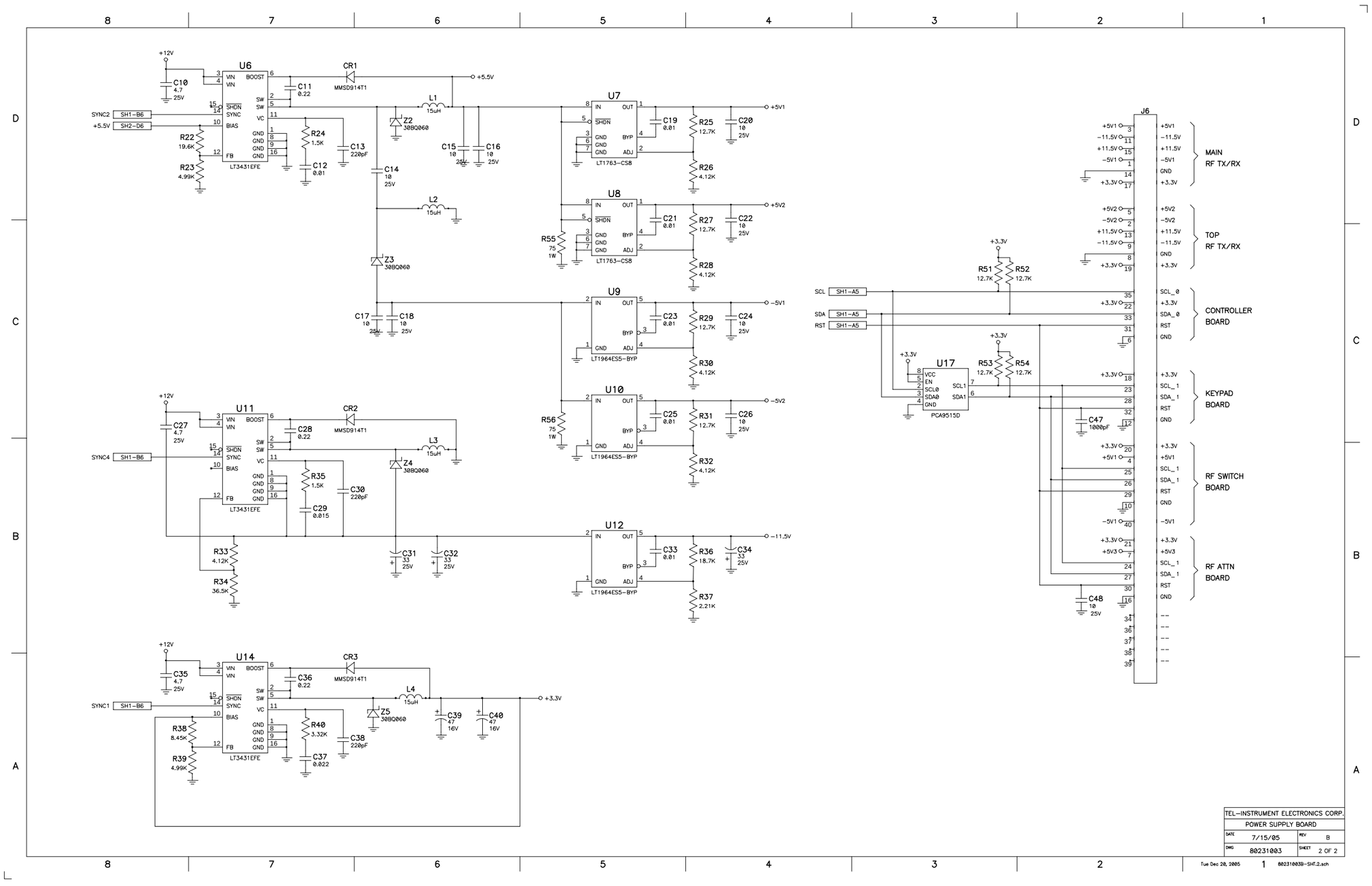
U15 LT1372CS8 (VIN, VSW, S/S, FB, GND_S, GND, VC) · SYNC3 SH1-B6 · R42 1.82K · R43 4.99K · R44 28.7K · R41 4.99K · C42 0.022 · C43 0.0022 · C44 6.8 50V · C45 6.8 50V · R45 499 · R46 499 · R48 10K · Q4 BSS84 · R49 10K · J8 SUPPR · CR4 BAS70-04 · C46 270pF · R47 499 · J7 PULSE · Q3 MMBT3904LT1 · R50 3.32K

U16 AD5301BRM (A0, A1, SCL, SCA, VDD, PD, OUT, GND) · +3.3V · C41 0.01

U13 PCA9557 (SCL, SDA, RST, A0, A1, A2, VSS, I/O7–I/O0, VDD) · SCL SH2-C3 · SDA SH2-C3 · RST SH2-C3 · +3.3V · R57 95.3K · R58 95.3K · R60 1.00K · C49 1000pF · C50 10 25V · SH1-C6 Q7-D · SH1-D6 VRMT · SH1-C8 Q6-G

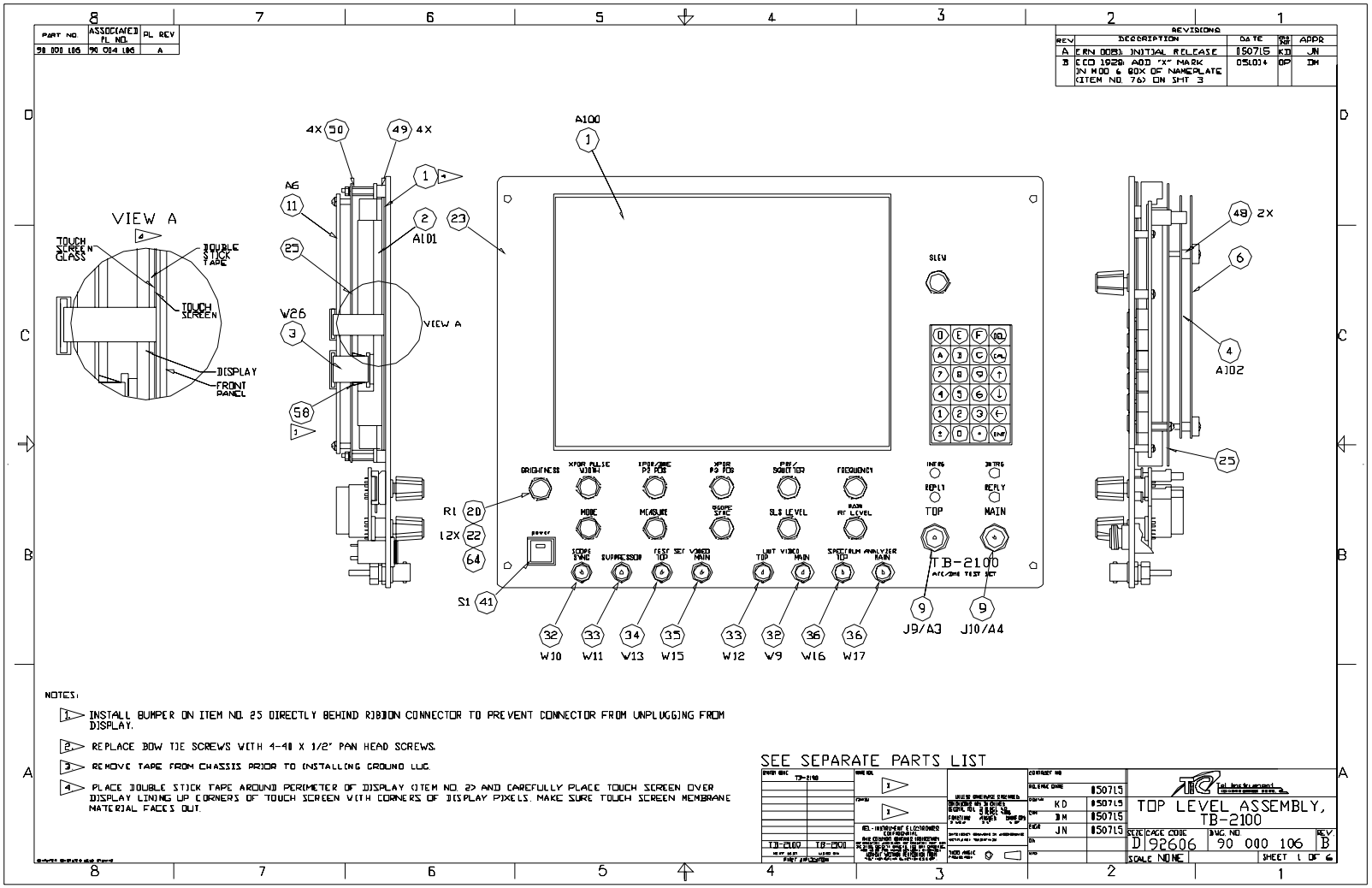
TEL—INSTRUMENT ELECTRONICS CORP.	
POWER SUPPLY BOARD	
DATE 7/15/05	REV B
DWG 80231003	SHEET 1 OF 2

Tue Dec 20, 2005 1 80231003B-SH1.1.sch


U6
LT3431EFE
U7
LT1763-CS8
U8
LT1763-CS8
U9
LT1964ES5-BYP
U10
LT1964ES5-BYP
U11
LT3431EFE
U12
LT1964ES5-BYP
U14
LT3431EFE
U17
PCA9515D
J6
CR1
CR2
CR3
MMSD914T1
Z2
Z3
Z4
Z5
30BQ060
L1
L2
L3
L4
15uH
+12V
+5.5V
+5V1
+5V2
-5V1
-5V2
-11.5V
+3.3V
SYNC2
SYNC4
SYNC1
SH1-B6
SH2-D6
SH1-A5
SCL
SDA
RST
MAIN
RF TX/RX
TOP
RF TX/RX
CONTROLLER
BOARD
KEYPAD
BOARD
RF SWITCH
BOARD
RF ATTN
BOARD
TEL-INSTRUMENT ELECTRONICS CORP.
POWER SUPPLY BOARD
DATE 7/15/05
REV B
DWG 80231003
SHEET 2 OF 2
Tue Dec 28, 2005
80231003B-SHT.2.sch

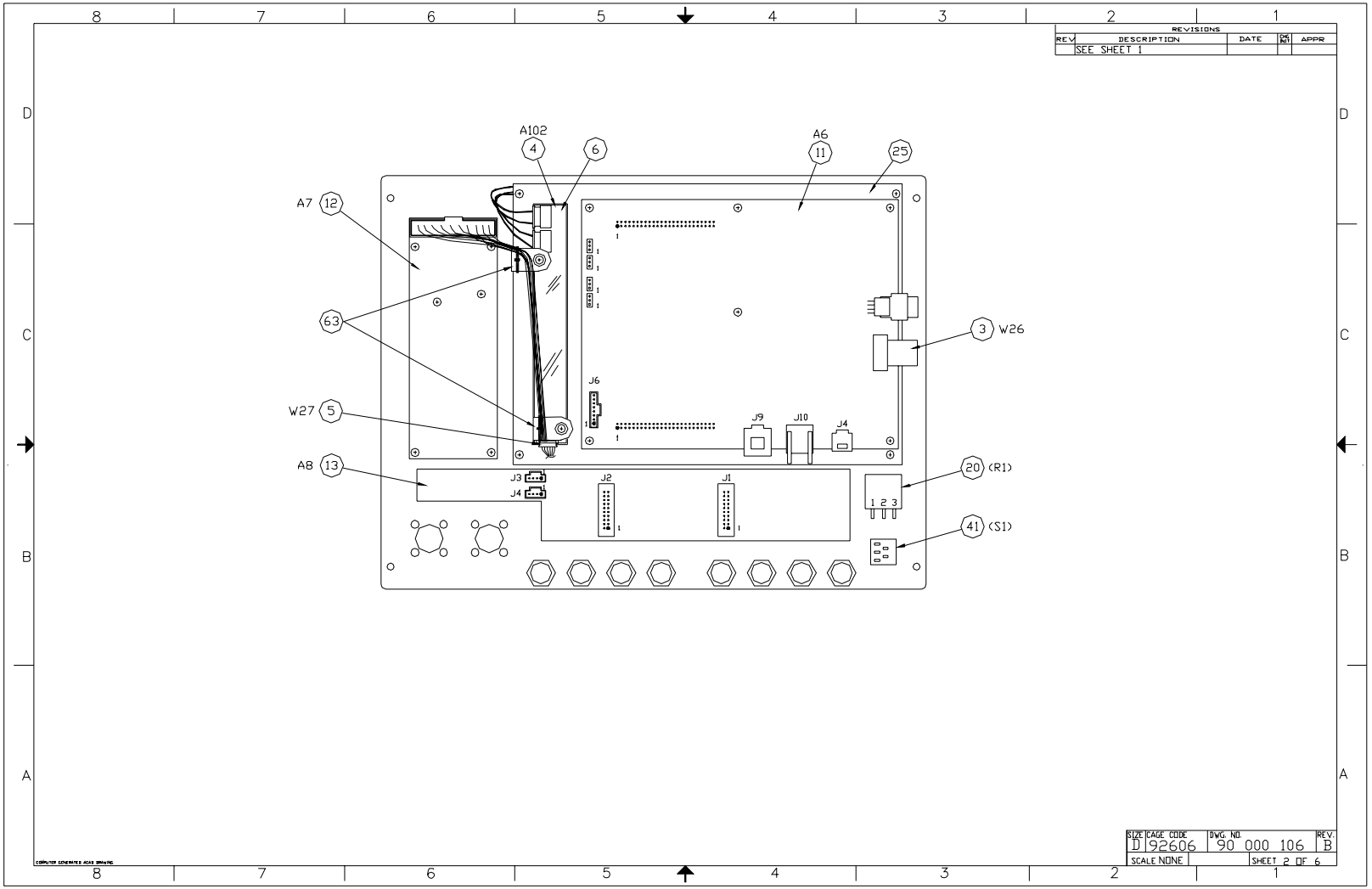
CHAPTER VI

ILLUSTRATED PART LIST AND DRAWINGS



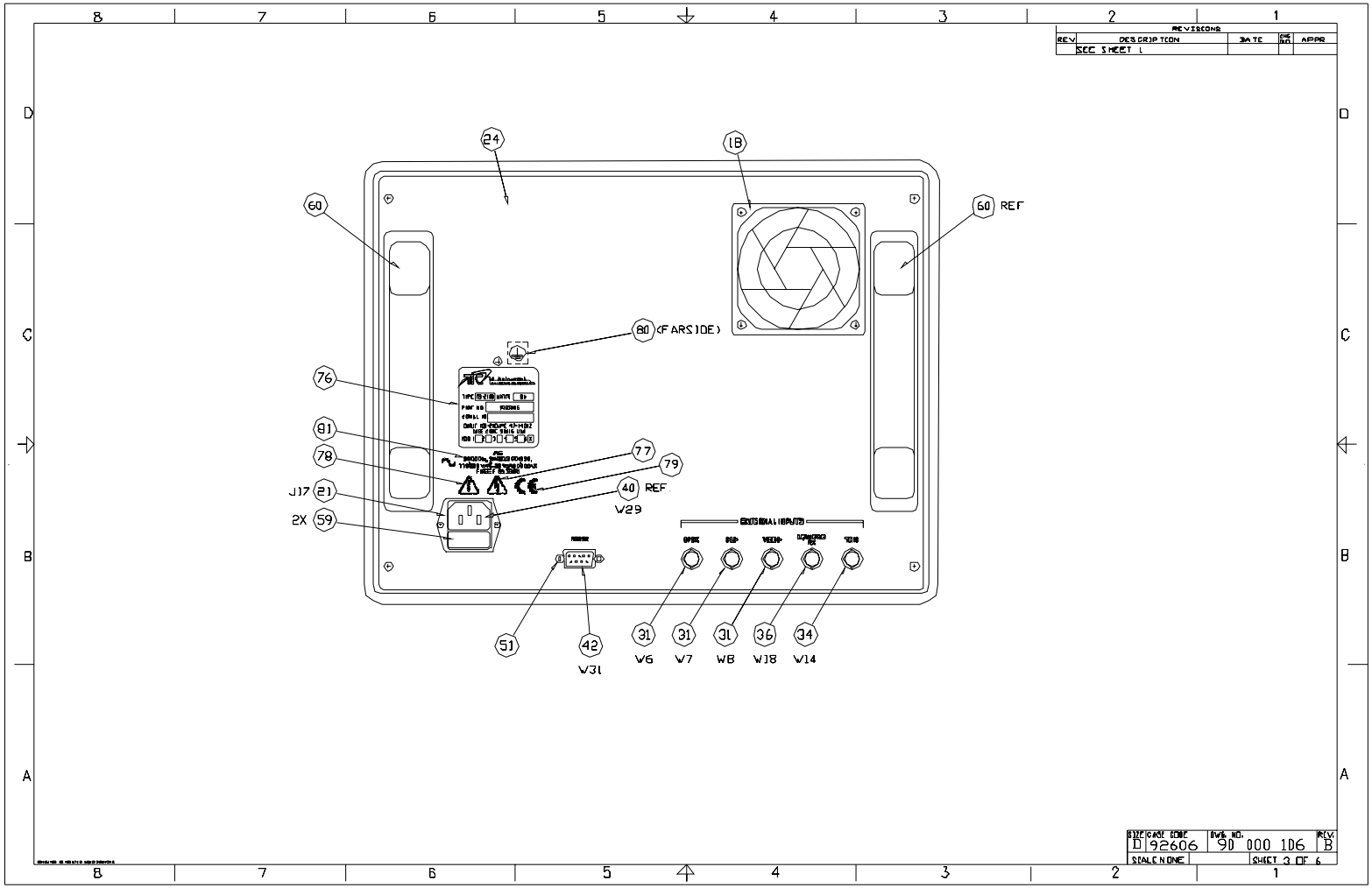
TB-2100 Top Level Assembly

Figure 6-1(a)



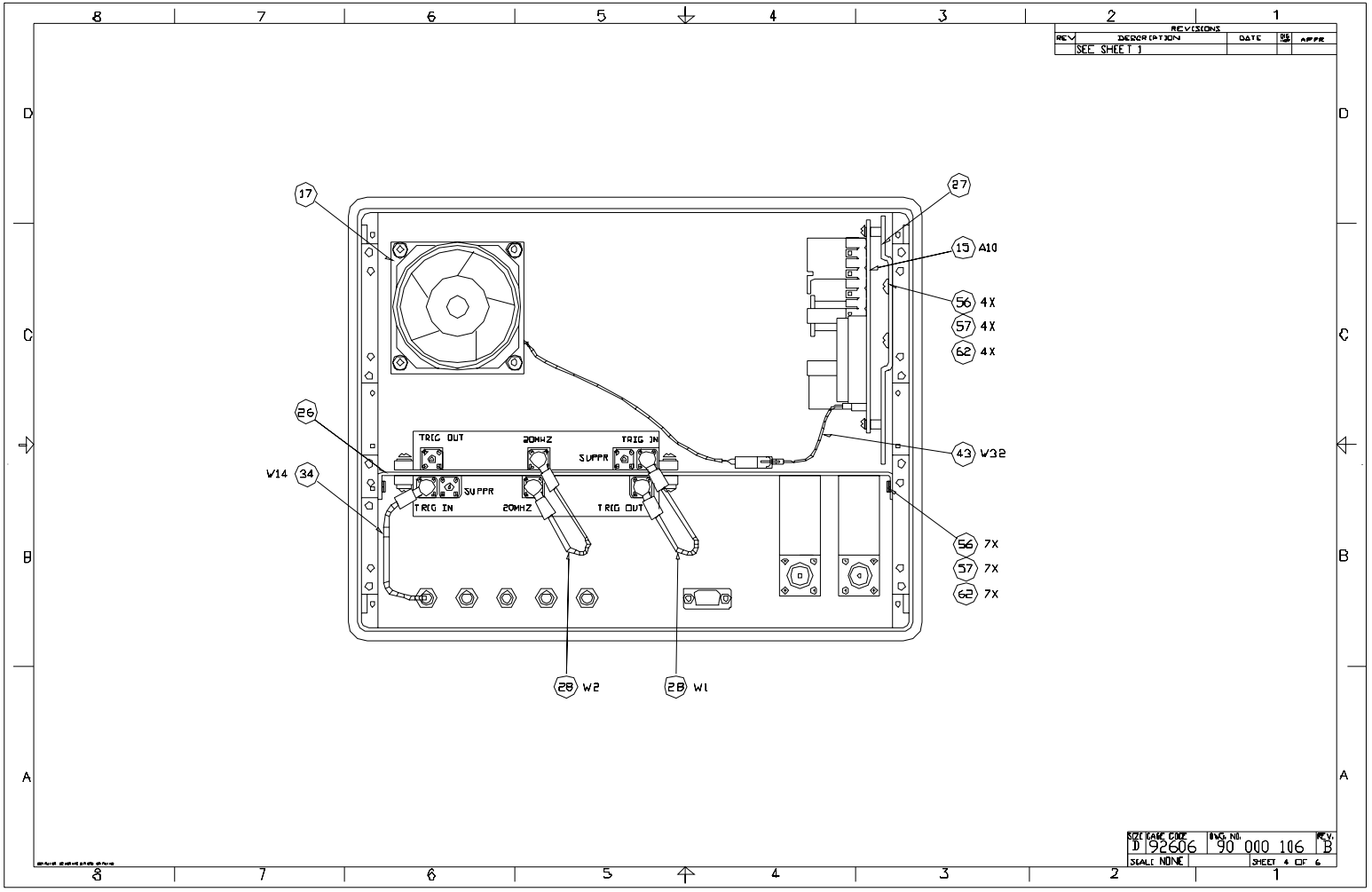
TB-2100 Top Level Assembly

Figure 6-1(b)



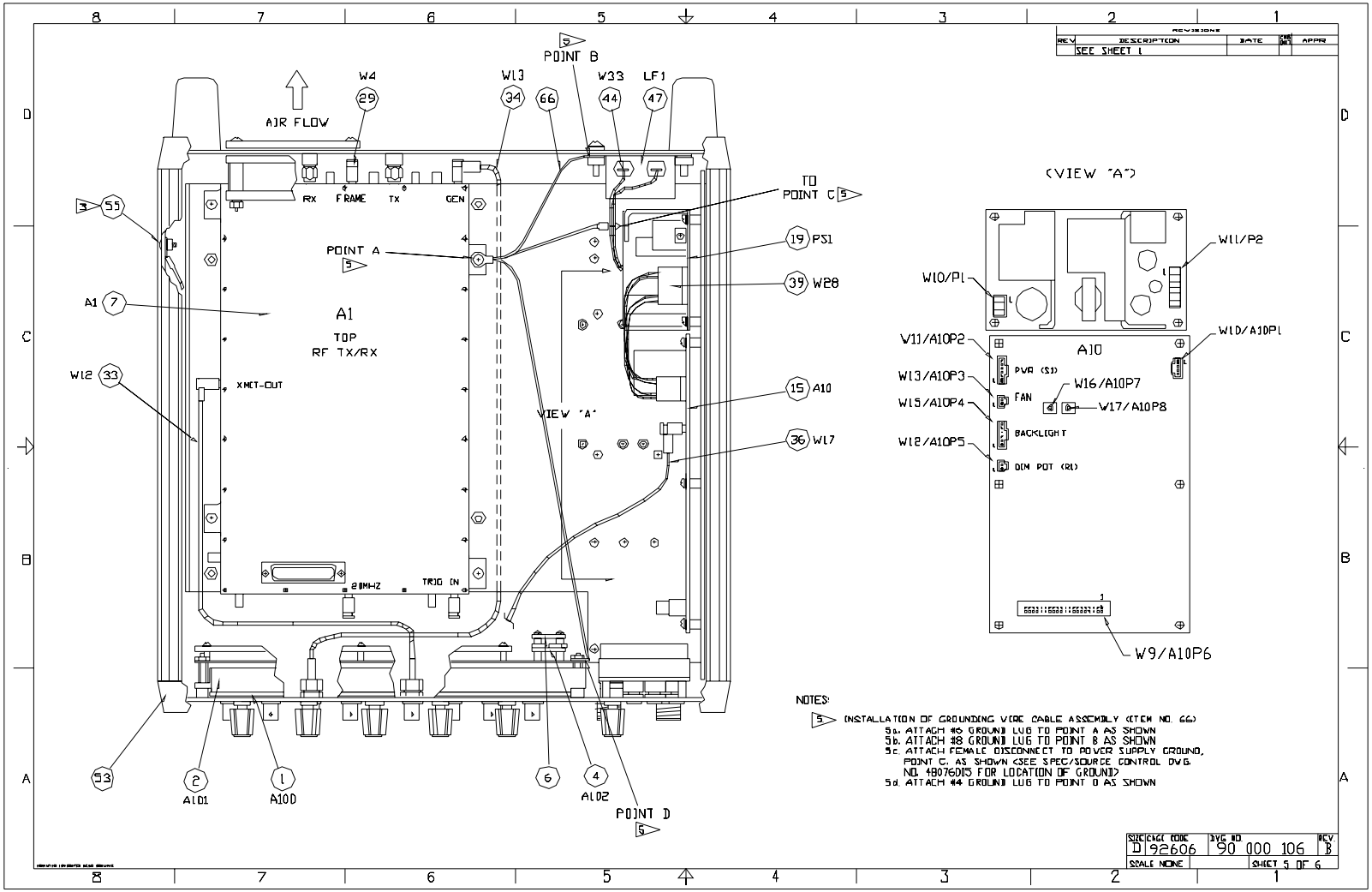
TB-2100 Top Level Assembly

Figure 6-1(c)



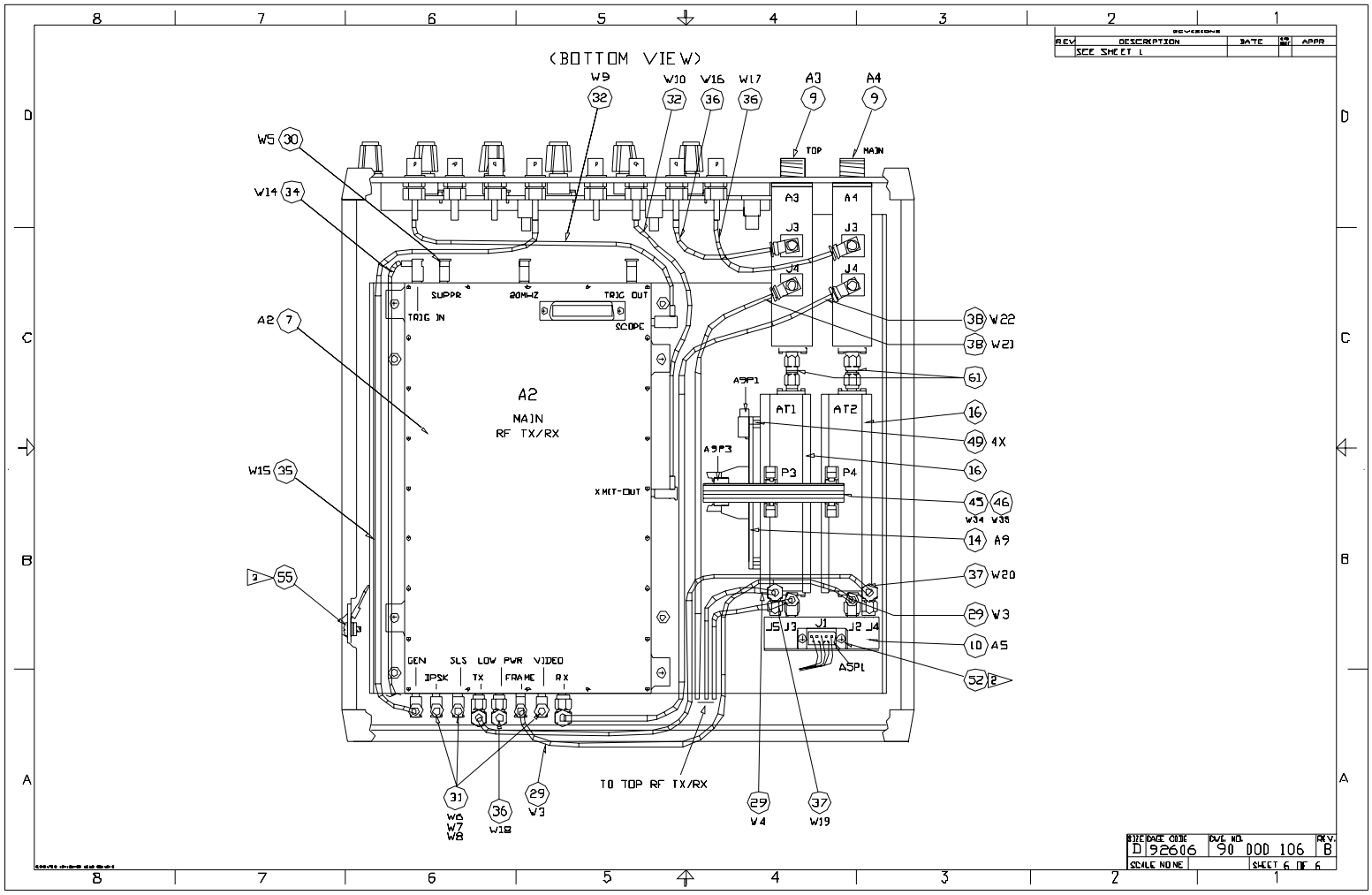
TB-2100 Top Level Assembly

Figure 6-1(d)



TB-2100 Top Level Assembly

Figure 6-1(e)



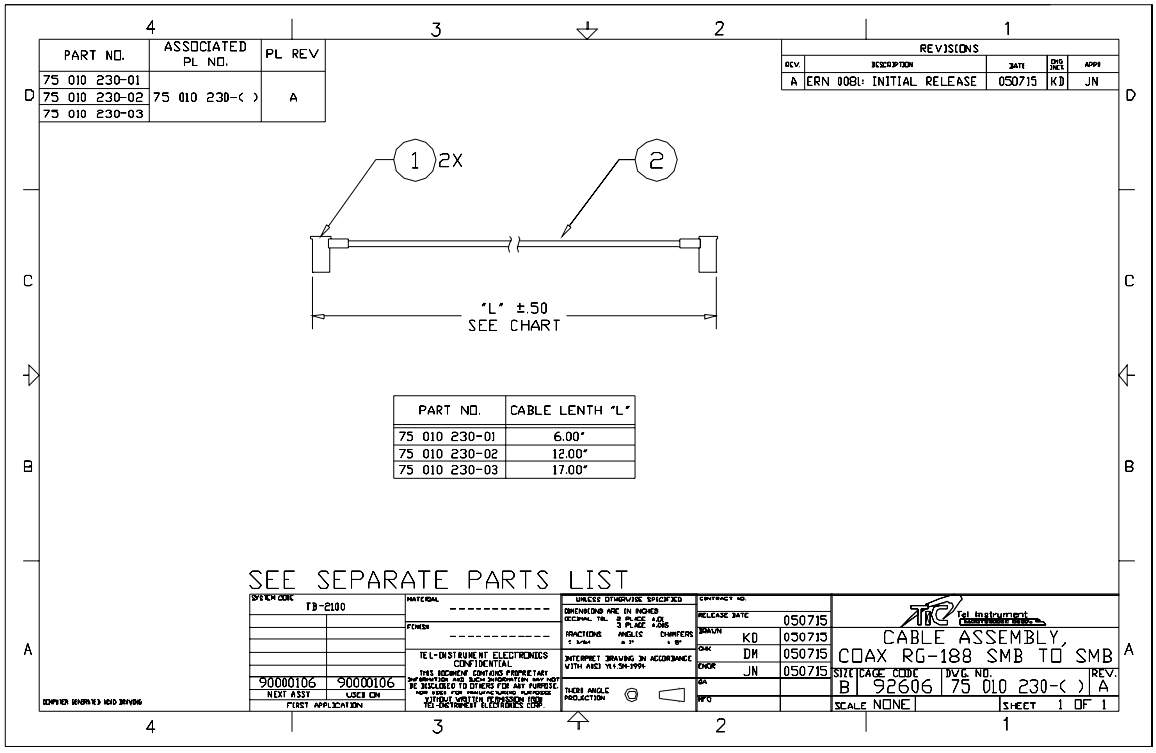
TB-2100 Top Level Assembly

Figure 6-1(f)

Front Panel Assembly				90 000 106		
#	QTY	Tel Desig.	Nomenclature	Ref Designator	Resource	Vendor P/N
1	1	62080001	Touch screen	A100	3M	RES-10.4-PL4
2	1	45010007	10.4" VGA TFT LCD	A101	Sharp	LQ104V1DG51
3	1	75010108	Cable Assy, LCD	W26	Axon	FDC31/0076BFF10
4	1	43026011	PCB Assy, Backlight Inverter	A102	TDK	CXA-P1212B-WJL
5	1	75010222	Cable Assy, Backlight Inverter	W27	KLJ	55-0103-0001
6	1	62040069	Backlight Bd Cover		KLJ	76-0103-0024
7	2	88000047	RF TX/RX Top Assy, RF TX/RX Main Assy	A1, A2	KLJ	01-0103-0010
8						
9	2	88000045	RF I/O Assy	A3, A4	KLJ	01-0103-0020
10	1	88000046	RF Switch Assy	A5	KLJ	01-0103-0030
11	1	80224001	PCB Assy,Controller	A6	KLJ	20-5104-0000
12	1	80225001	PCB Assy, Keypad	A7	KLJ	20-5105-0000
13	1	80226001	PCB Assy, Encoder	A8	KLJ	20-5106-0000
14	1	80229001	PCB Assy, RF Attn Control	A9	KLJ	20-5109-0000
15	1	80231001	PCB Assy, Power Supply	A10	KLJ	20-5111-0000
16	2	44002012	Solid State Programmable Attenuator	AT1, AT2	JFW	50P-1595-SMA
17	1		Fan	BL1	Panasonic	FBA08A12L1AZ
18	1	31004017	Fan Guard		QualTek	09080-G
19	1	48076005	Power Supply	PS1	Astec	LPS63
20	1	41700025	Pot,Panel Mt,50k	R1	Clarostat	575SX1A48F503SS
21	1	48000141	Connector, AC Pwr Line w/Fuse Holder, Flange Mount	J17	Schurter	6200.2200
22	12	57025026	Knob		Rogan	PT-3
23	1	61060056	Front Panel		KLJ	47-0103-0000
24	1	61060057	Rear Panel		KLJ	47-0103-0010
25	1	62070061	Controller Bd Mtg Plate		KLJ	47-0103-0020
26	1	65000038	Shelf		KLJ	47-0103-0030
27	1	62070062	Power Supply Mtg Plate		KLJ	47-0103-0031
28	2	75010230-01	Cable Assy, Coax RG-188 SMB to SMB 6"	W1,W2	KLJ	55-0010-0060
29	2	75010230-02	Cable Assy, Coax RG-188 SMB to SMB 12"	W3,W4	KLJ	55-0010-0120
30	1	75010230-03	Cable Assy, Coax RG-188 SMB to SMB 17"	W5	KLJ	55-0010-0170
31	3	75010231-01	Cable Assy, Coax RG-188 SMB to BNC 7"	W6,W7,W8	KLJ	55-0020-0070
32	2	75010231-02	Cable Assy, Coax RG-188 SMB to BNC 12"	W9,W10	KLJ	55-0020-0120
33	2	75010231-03	Cable Assy, Coax RG-188 SMB to BNC 17"	W11,W12	KLJ	55-0020-0170
34	2	75010231-04	Cable Assy, Coax RG-188 SMB to BNC 20"	W13,W14	KLJ	55-0020-0200
35	1	75010231-05	Cable Assy, Coax RG-188 SMB to BNC 24"	W15	KLJ	55-0020-0240
36	3	75010232	Cable Assy, Coax RG-188 SMA to BNC 8"	W16,W17,W18	KLJ	55-0030-0080

Front Panel Assembly				90 000 106		
#	QTY	Tel Desig.	Nomenclature	Ref Designator	Resource	Vendor P/N
37	2	75010233-01	Cable Assy, Semi-Flex Coax SMA to SMA, 12"	W19, W20	KLJ	55-0040-0120
38	2	75010233-02	Cable Assy, Semi-Flex Coax SMA to SMA, 20"	W21, W22	KLJ	55-0040-0200
39	1	75010223	Cable Assy, Power Supply	W28	KLJ	55-0103-0002
40	1	75010224	Cable Assy, Line Filter to AC Input	W29	KLJ	55-0103-0003
41	1	75010225	Cable Assy, Pwr Switch to PS Brd	W30 (Ref. S1)	KLJ	55-0103-0004
42	1	75010226	Cable Assy, RS232 to Contr	W31	KLJ	55-0103-0005
43	1	75010227	Cable Assy, Fan to PS	W32	KLJ	55-0103-0006
44	1	75010228	Cable Assy, Line Filter to PS	W33	KLJ	55-0103-0007
45	1	75010229-01	Cable Assy, Ribbon 10 Pin 2.3"	W34	KLJ	55-1000-0023
46	1	75010229-02	Cable Assy, Ribbon 10 Pin 5"	W35	KLJ	55-1000-0050
47	1	43020015	Filter, Line 115/220 VAC	LF1	Schaffner	FN2010-12-06
48	2	52100016	Spacer, Nylon Unthreaded Round 1/4" OD, 5/16" L, #4		McMaster	94639 A104
49	8	52100017	Spacer, Alum Unthreaded Round 1/4" OD, 7/32" L, #4		McMaster	92510 A034
50	4	52400045	Standoff, Hex Alum Female Threaded, 1/4" OD, 1/2" L, #4		McMaster	91780 A735
51	1	48055001	Short Female Screwlock Kit		Amp	207952-3
52	1	56012007	Bow Tie Clip		Keystone	2060
53	1	64030055	Case		Schroff	10823-454 (6UX63HPX362)
54	1	64031002	Plastic Feet, Kit (Case Accessory)		Schroff	21100-813
55	1	64031001	Grounding Kit (Case Accessory)		Schroff	21100-815
56	11	50110036	Screws, M4 X 8mm		McMaster	92000A218
57	11	52020007	Washer, Split Lock M4		McMaster	92148A160
58	1	31010012	Bumper, Adhesive 0.4 X 0.88		Amerlok	2598
59	2	45100033	Fuse, 5 X 20 MM 250VAC 2A Fast-Acting		LittelFuse	216002
60	1	31016012	Bumper, Rubber (Pair)		Schroff	20823-669
61	2	48000140	Adapter, SMA-Male to SMA-Male		Delta	1327-000-K000-002
62	11	64031003	Hardware, Square Nut & Retainer (Case Accessory)		Schroff	21100 087 (Pkg of 100)
63	2	56000011	Clamp Cable, 0.125", 0.140 Nylon		Keystone	7620
64	1	53000007	Mounting Nut		Clarostat	1051301
65	1	75001702	Harness Assy	W40		
66	1	75010281	Cable Assy, Grounding Wire	W41		
67	REF	04-0103-CL00	Calibration Procedure			
68	REF	01-0103-0000	Factory Test Procedure			
69	REF	90003106	Schematic Diagram, System Interconnect			
70						
71	1	48078009-01	CPLD, Programmable			
72	1	40201303	CMOS Flash Memory			
73	1	48077035-01	Memory, Programmed			

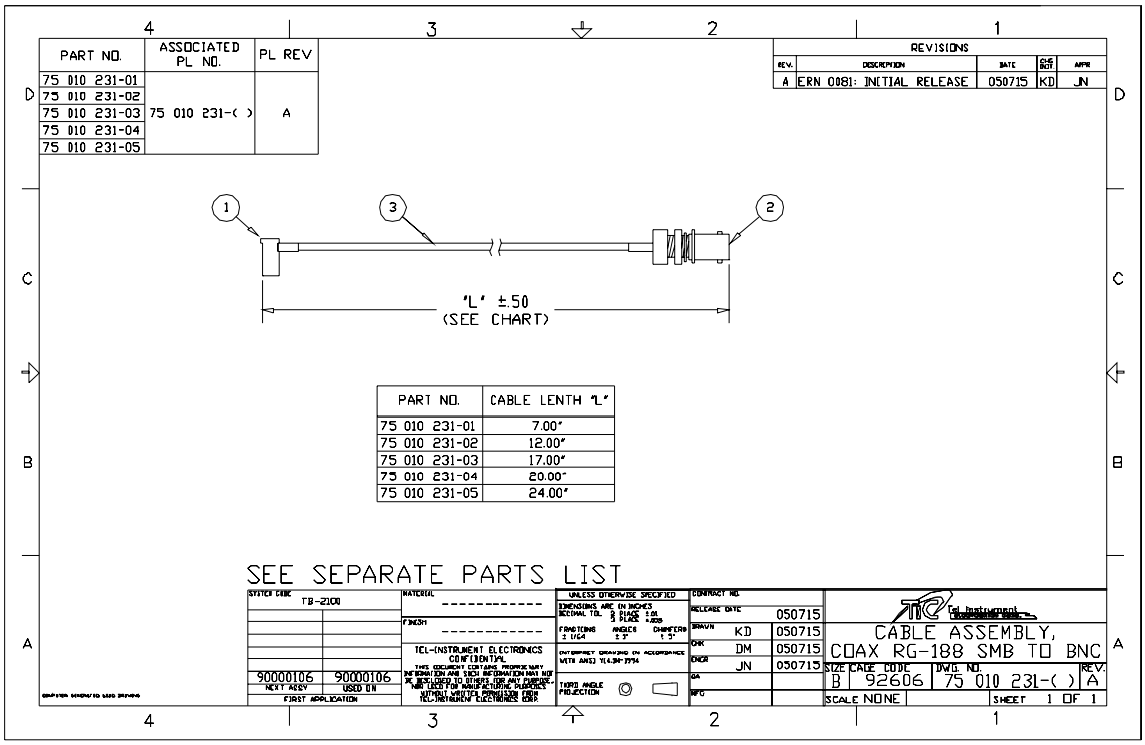
Front Panel Assembly				90 000 106		
#	QTY	Tel Desig.	Nomenclature	Ref Designator	Resource	Vendor P/N
74						
75						
76	1	57030017	Nameplate, Generic			
77	1	57031008	Label, Dangerous Voltage		PANDUIT	PESW-A-1
78	1	57031009	Label, Hazardous Area		PANDUIT	PESW-A-9
79	1	57031010	Label, "CE" Symbol		SETON	50790
80	1	57031011	Label, Safety Function		PANDUIT	PESC-H-EC
81	1	57031026	Label, AC Power 110V/220V			



Cable Assembly SMB to SMB

Figure 6-2

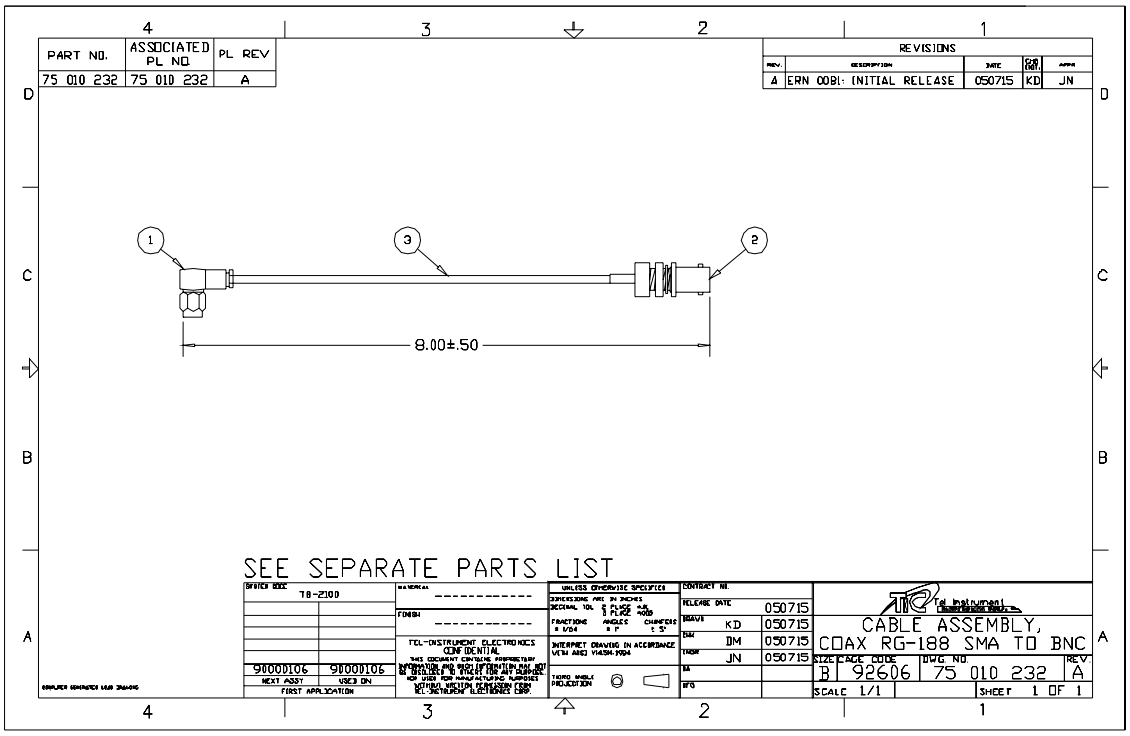
Coax RG-188 Cable Assembly SMB to SMB				75 010 230-01, 02, 03		
#	QTY	Tel Desig.	Nomenclature	Ref Designator	Resource	Vendor P/N
1	2	48040082	Connector, SMB Rt. Angle		Amphenol	903-367P-51A2
2	AR	71110008	Cable, Coax		Various	RG-188A/U
			NOTES:			
			1. 75010230-01 CABLE ASSY LENGTH IS 6"			
			(REF. W1, W2).			
			75010230-02 CABLE ASSY LENGTH IS 12"			
			(REF. W3, W4).			
			75010230-03 CABLE ASSY LENGTH IS 17"			
			(REF. W5).			



Cable Assembly SMB to BNC

Figure 6-3

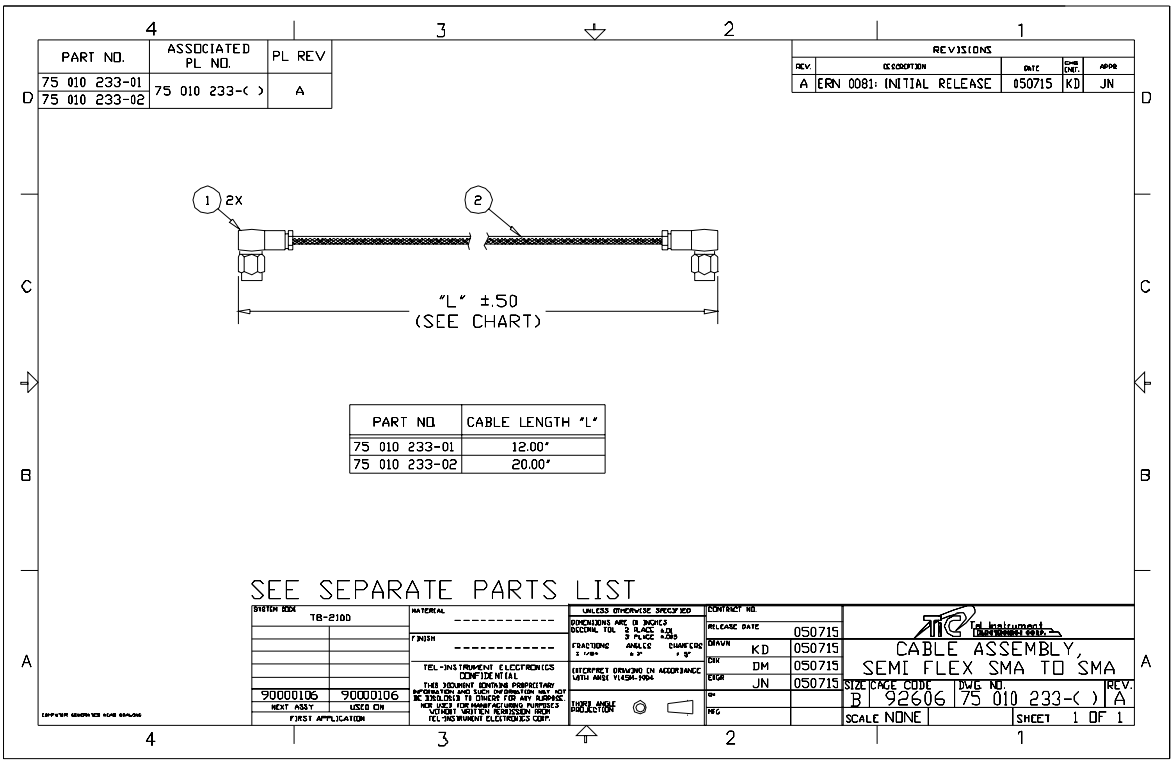
Coax RG-188 Cable Assembly SMB to BNC				75 010 231-01, 02, 03, 04, 05		
#	QTY	Tel Desig.	Nomenclature	Ref Designator	Resource	Vendor P/N
1	1	48040082	Connector, SMB Rt. Angle		Amphenol	903-367P-51A2
2	1	48040084	Connector, BNC Bulkhead Jack		Kings	KC-19-152
3	AR	71110008	Cable, Coax		Various	RG-188A/U
			NOTES:			
			1. 75010231-01 CABLE ASSY LENGTH IS 7"			
			(REF. W6, W7, W8).			
			75010231-02 CABLE ASSY LENGTH IS 12"			
			(REF. W9, W10).			
			75010231-03 CABLE ASSY LENGTH IS 17"			
			(REF. W11, W12).			
			75010231-04 CABLE ASSY LENGTH IS 20"			
			(REF. W13, W14).			
			75010231-05 CABLE ASSY LENGTH IS 24"			
			(REF. W15).			



Cable Assembly SMB to BNC

Figure 6-4

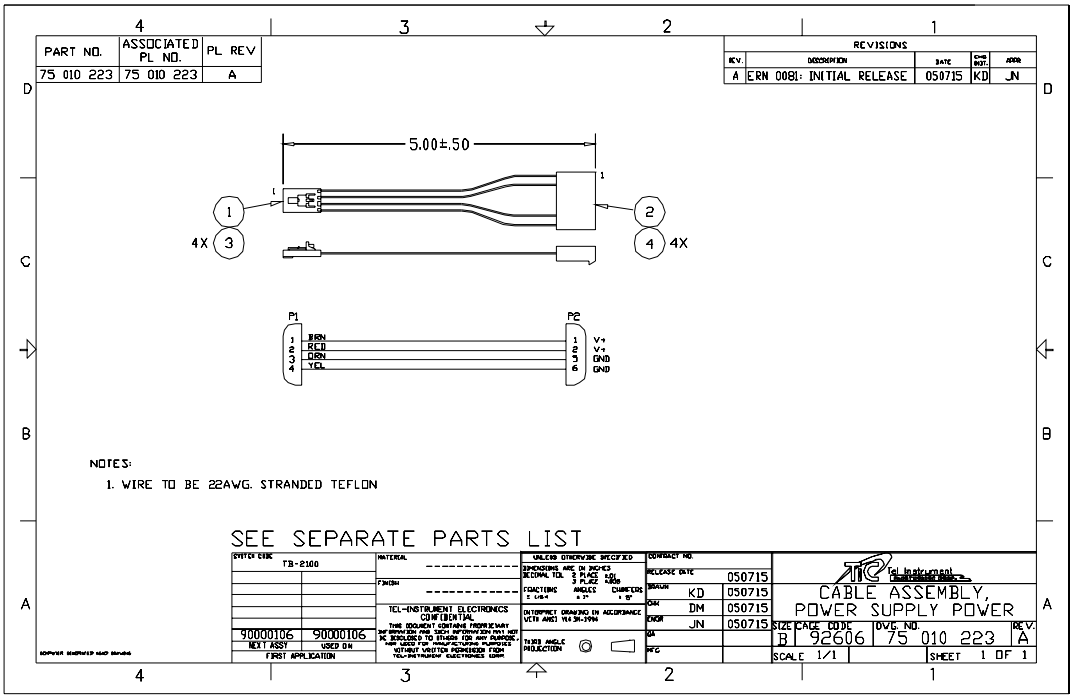
Coax RG-188 Cable Assembly SMB to BNC				75 010 232-01, 02		
#	QTY	Tel Desig.	Nomenclature	Ref Designator	Resource	Vendor P/N
1	1	48040016	Connector, SMA Rt. Angle		Amphenol	901-9531-3
2	1	48040082	Connector, BNC Bulkhead Jack		Kings	KC-19-152
3	AR	71110008	Cable Coax		Various	RG-188A/U



Cable Assembly SMB to BNC

Figure 6-5

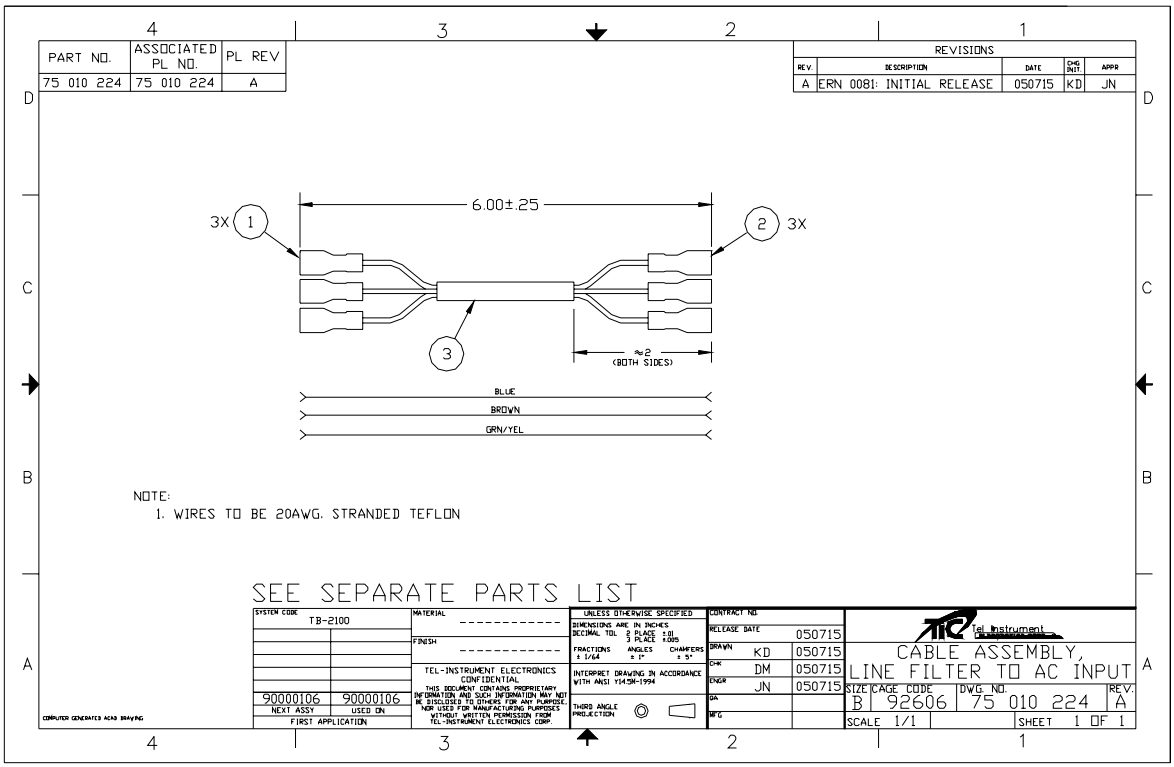
Coax RG-188 Cable Assembly SMB to BNC				75 010 233-01, 02		
#	QTY	Tel Desig.	Nomenclature	Ref Designator	Resource	Vendor P/N
1	2	48040016	Connector, SMA Rt. Angle		Amphenol	901-9531-3
2	AR	71111002	Cable, Semi-Flex 0.086 O.D.		EZ FORM	EZFLEX86
			NOTES:			
			1. 75010233-01 CABLE ASSY LENGTH IS 12".			
			(REF. W19, W20)			
			75010233-02 CABLE ASSY LENGTH IS 20".			
			(REF. W21, W22)			



Cable Assembly SMB to BNC

Figure 6-6

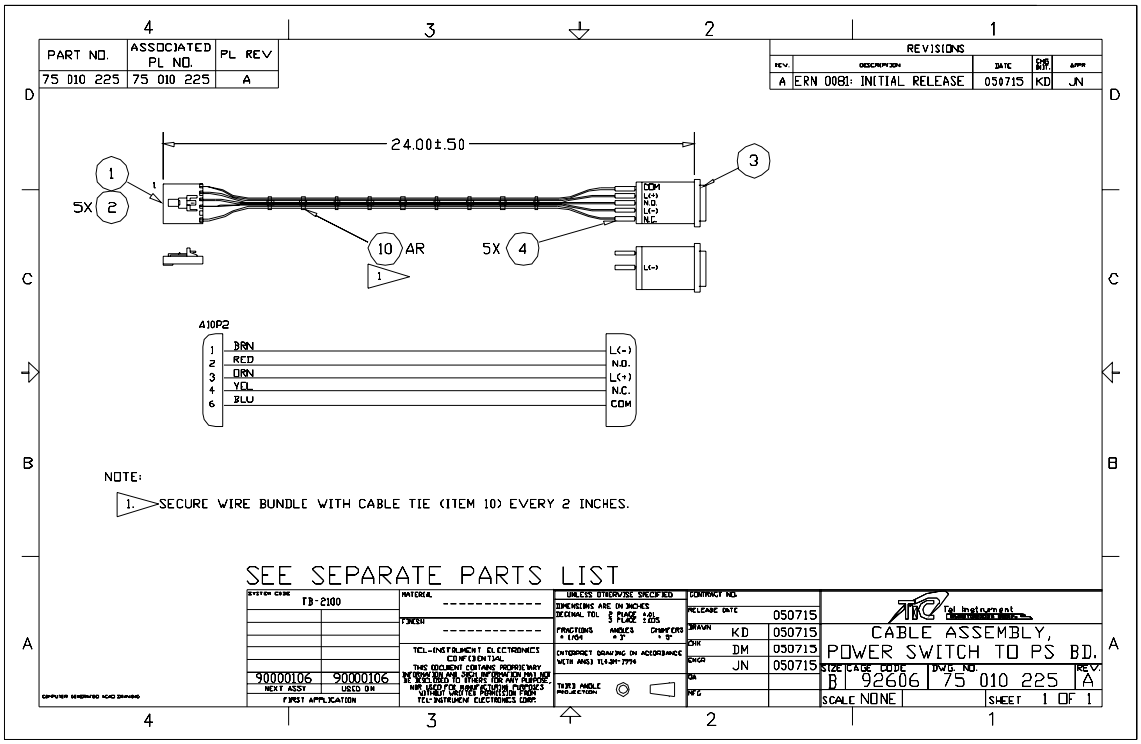
Cable Assembly SMB to BNC				75 010 223		
#	QTY	Tel Desig.	Nomenclature	Ref Designator	Resource	Vendor P/N
1	1	48054013	Connector, Crimp Housing 4 Pin		Molex	50-57-9404
2	1	48054014	Connector, Housing w/lock		Molex	09-50-3061
3	4	46053016	Crimp Terminal, 22-24 Awg		Molex	16-02-0103
4	4	46053017	Crimp Terminal, 22-30 Awg		Molex	08-55-0102
5	AR	72722021-02	Wire, Teflon Insul., 24AWG, Brn		Olympic	305-1
6	AR	72722021-03	Wire, Teflon Insul., 24AWG, Red		Olympic	305-2
7	AR	72722021-04	Wire, Teflon Insul., 24AWG, Orn		Olympic	305-3
8	AR	72722021-05	Wire, Teflon Insul., 24AWG, Yel		Olympic	305-4



Cable Assembly Line Filter to AC Input

Figure 6-7

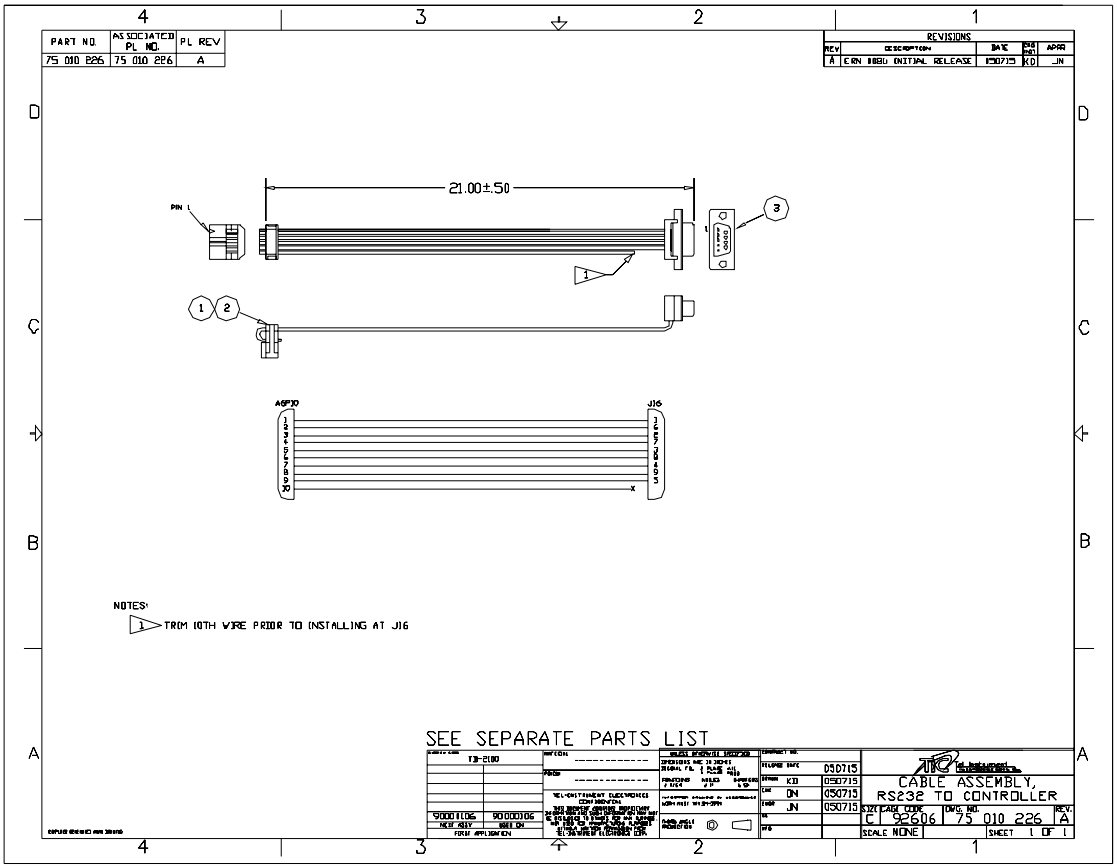
Cable Assembly Line Filter to AC Input				75 010 224		
#	QTY	Tel Desig.	Nomenclature	Ref Designator	Resource	Vendor P/N
1	3	55006012	Fem Disconnect, Insul., 0.187		Sta-Kon	18RAD-18377
2	3	55006011	Fem Disconnect, Insul., 0.25		Sta-Kon	RA2573
3	AR	73000006	Sleeving, Black 0.25 O.D.		Alpha	FIT-221-1/4
4	AR	72720007	Wire, Teflon Insul., 20AWG, Blu		Olympic	309-6
5	AR	72720002	Wire, Teflon Insul., 20AWG, Brn		Olympic	309-1
6	AR	72720006	Wire, Teflon Insul., 20AWG, Grn/Yel		Olympic	309-54



Cable Assembly Power Switch to PS Board

Figure 6-8

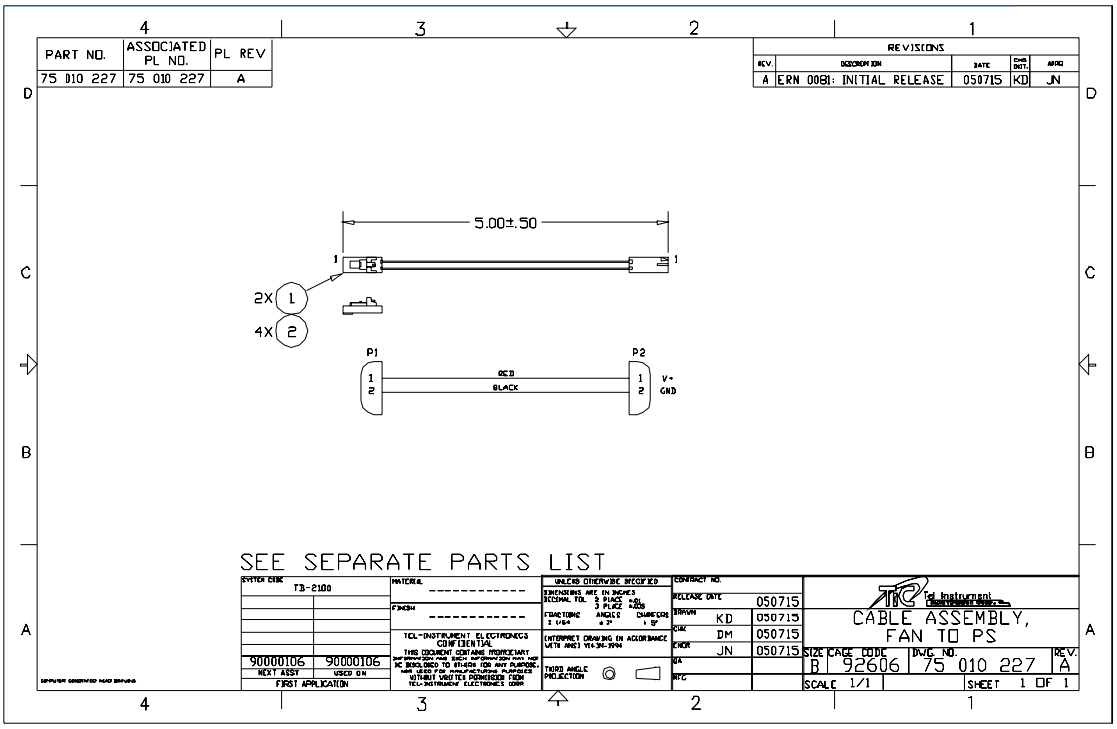
Cable Assembly PWR Switch to PS Board			75 010 225			
#	QTY	Tel Desig.	Nomenclature	Ref Designator	Resource	Vendor P/N
1	3	55006012	Fem Disconnect, Insul., 0.187		Sta-Kon	18RAD-18377
2	3	55006011	Fem Disconnect, Insul., 0.25		Sta-Kon	RA2573
3	AR	73000006	Sleeving, Black 0.25 O.D.		Alpha	FIT-221-1/4
4	AR	72720007	Wire, Teflon Insul., 20AWG, Blu		Olympic	309-6
5	AR	72720002	Wire, Teflon Insul., 20AWG, Brn		Olympic	309-1
6	AR	72720006	Wire, Teflon Insul., 20AWG, Grn/Yel		Olympic	309-54



Cable Assembly RS-232 to Controller

Figure 6-9

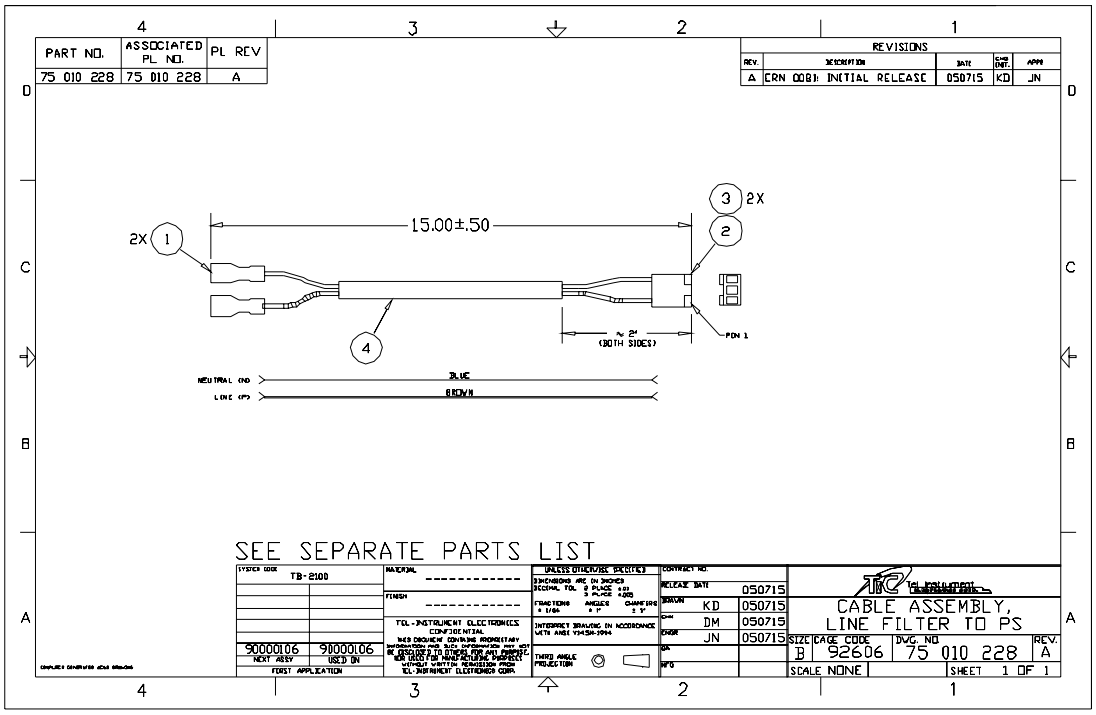
Cable Assembly RS-232 to CONTR				75 010 226		
#	QTY	Tel Desig.	Nomenclature	Ref Designator	Resource	Vendor P/N
1	1	48000157	Connector, 10 Pin Hdr Socket		3M	3473-6600
2	1	55001011	Strain Relief 10 Pin Hdr		3M	3448-3010
3	1	48000014	Connector, 9 Pin "D" Socket		AMP	747052-4
4	AR	75000037	Ribbon Cable, 10 Conductor		3M	3365/10



Cable Assembly Fan to Power Supply

Figure 6-10

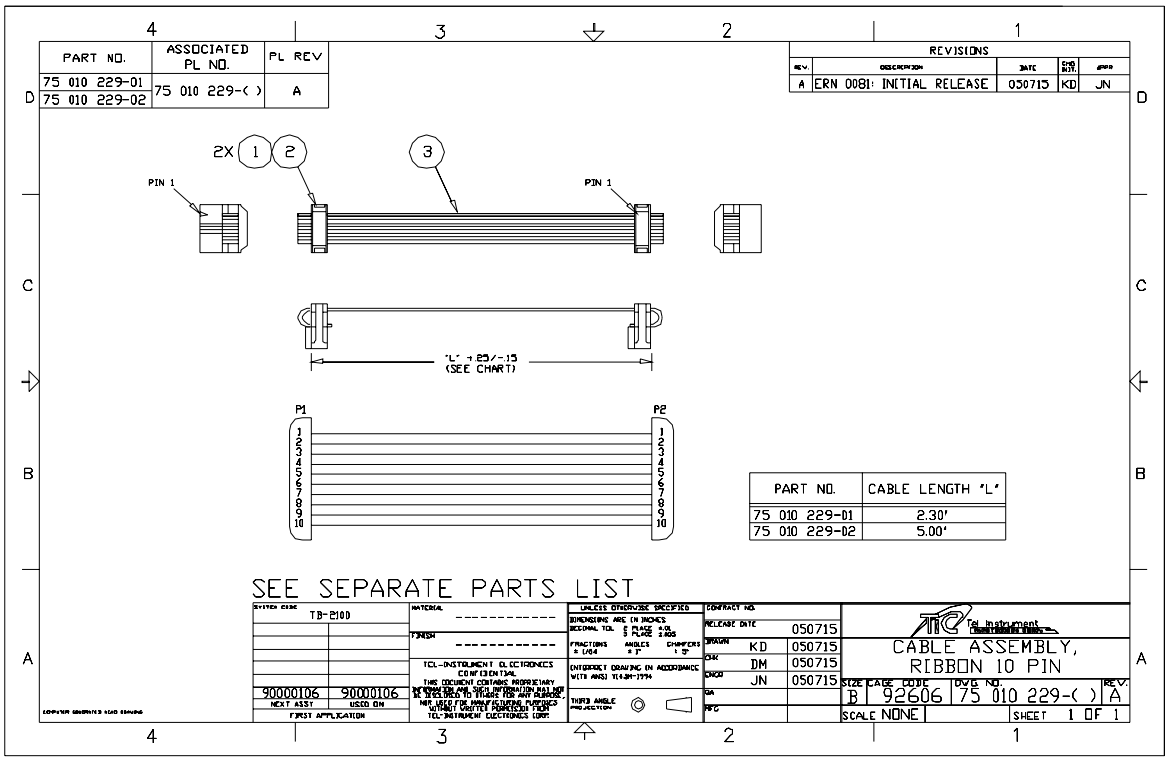
Cable Assembly Fan to PS				75 010 227		
#	QTY	Tel Desig.	Nomenclature	Ref Designator	Resource	Vendor P/N
1	2	48054012	Connector, 2 Pin		Molex	50-57-9402
2	4	46053016	Recept, Crimp 22-24 AWG		Molex	16-02-0103
3	AR	72722021-03	Wire, Teflon Insul., 24AWG, Red		Olympic	305-3
4	AR	72722021-01	Wire, Teflon Insul., 24AWG, Blk		Olympic	305-1



Cable Assembly Line Filter to Power Supply

Figure 6-11

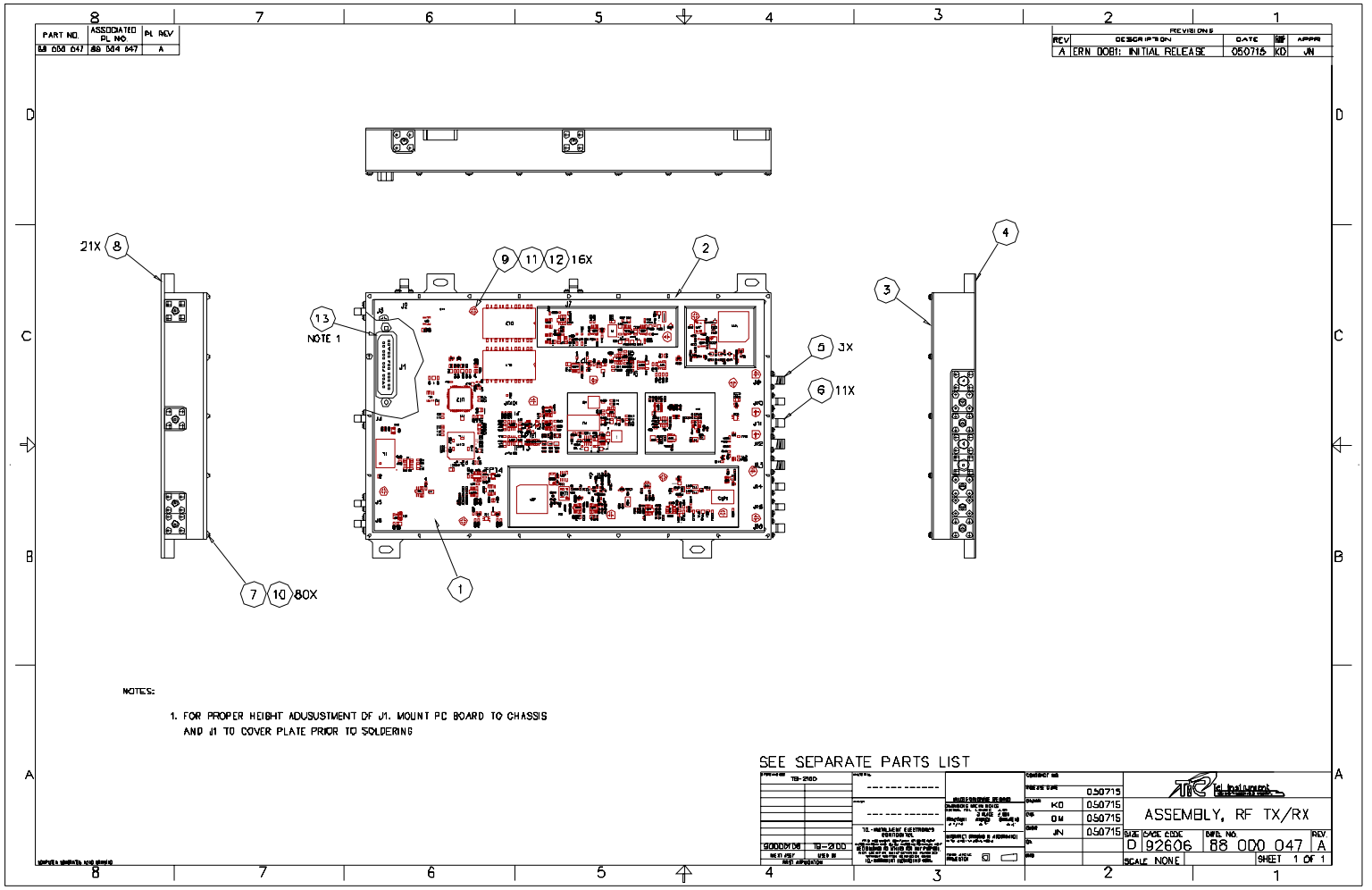
Cable Assembly Line Filter to PS				75 010 228		
#	QTY	Tel Desig.	Nomenclature	Ref Designator	Resource	Vendor P/N
1	2	55006011	Fem Disconnect, Insul. 0.25		Sta-Kon	RA2573
2	1	48054008	Connector, Housing 3 Pos.		Molex	09-50-3031
3	2	46052007	Connector, Term Fem 18-24AWG		Molex	08-52-0072
4	AR	73000006	Sleeving, Black 0.25 O.D.		Alpha	FIT-221-1/4
5	AR	72722021-07	Wire, Teflon Insul., 20AWG, Blu		Olympic	305-6
6	AR	72722021-02	Wire, Teflon Insul., 20AWG, Brn		Olympic	305-1



Cable Assembly Ribbon w/ 10 Pins

Figure 6-12

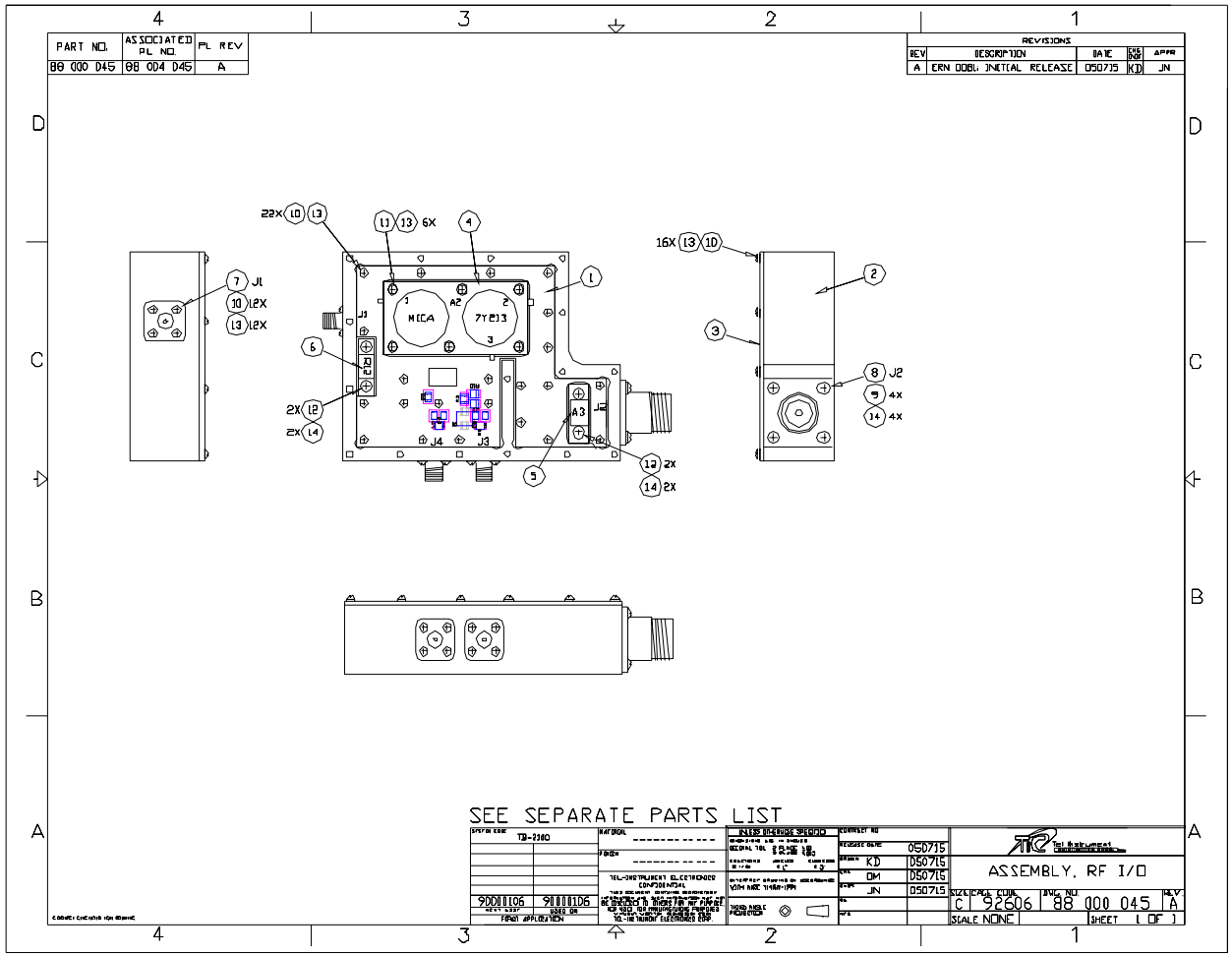
Cable Assembly Ribbon, 10 Pin			75 010 229-01, 02			
#	QTY	Tel Desig.	Nomenclature	Ref Designator	Resource	Vendor P/N
1	2	48000157	Connector, 10 Pin Hdr Socket		3M	3473-6600
2	2	55001011	Strain Relief 10 Pin Hdr		3M	3448-3010
3	AR	75000037	Ribbon Cable, 10 Conductor		3M	3365/10
			NOTES:			
			1. 75010229-01 CABLE ASSY LENGTH IS 2.3".			
			(REF. W34).			
			75010229-02 CABLE ASSY LENGTH IS 5".			
			(REF. W35).			



RF TX/RX Assembly

Figure 6-13

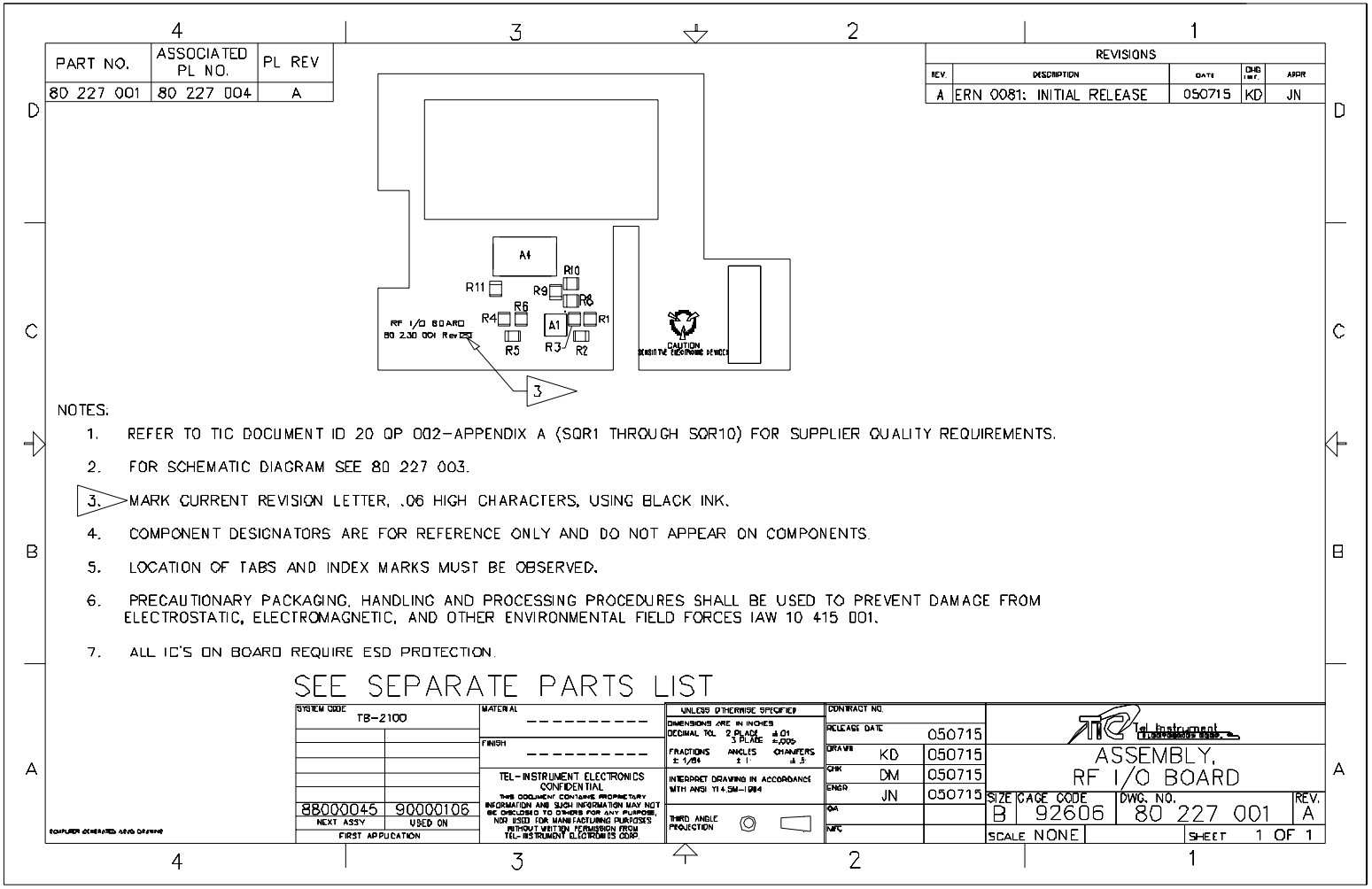
Top RF TX/RX Assy. Main RF TX/RF Assy				80 230 001		
#	QTY	Tel Desig.	Nomenclature	Ref Designator	Resource	Vendor P/N
1	1	80230001	RF TX/RX PC Brd. Assy.	A14, A15	KLJ	
2	1	62000050	Chassis, RF TX/RX		KLJ	
3	1	62040070	Top Cover, RF TX/RX		KLJ	
4	1	62040071	Bottom Cover, RF TX/RX		KLJ	
5	3	48040075	Connector, SMA Panel Mt	J9,J12,J13	AEP	
6	11	48040076	Connector, SMB,Panel Mt	J2-J7,J10,J11, J14,J15,J16	AEP	
7	80	50110038	Screw, Pan Hd 2-56 X 3/16Lg.			
8	21	50120010	Screw, Flat Hd., 100 Deg 2-56 X 3/16Lg.		Tower	
9	16	50110007	Screw, Pan Hd 4-40 X 1/4Lg.			
10	80	52020005	Washer, Lock #2			
11	16	52020002	Washer, Lock #4			
12	16	52010002	Washer, Flat #4			
13	1	52400071	Jack Screw, Connector D-Sub Female		AMP	
14	1	48078010-01	CPLD, Programmable			
			NOTES:			
			1. USE FOR PROGRAMMING 48078010.			
			2. THIS PARTS LIST IS UTILIZED FOR BOTH TOP			
			AND MAIN RF TX/RX ASSEMBLY'S. ITEM 1 REF.			
			DESIG. A14 IS USED ON TOP RF TX/RX ASSY			
			AND REF. DESIG. A15 IS USED ON MAIN RF			
			TX/RX ASSY.			



Assembly RF Input / Output

Figure 6-14

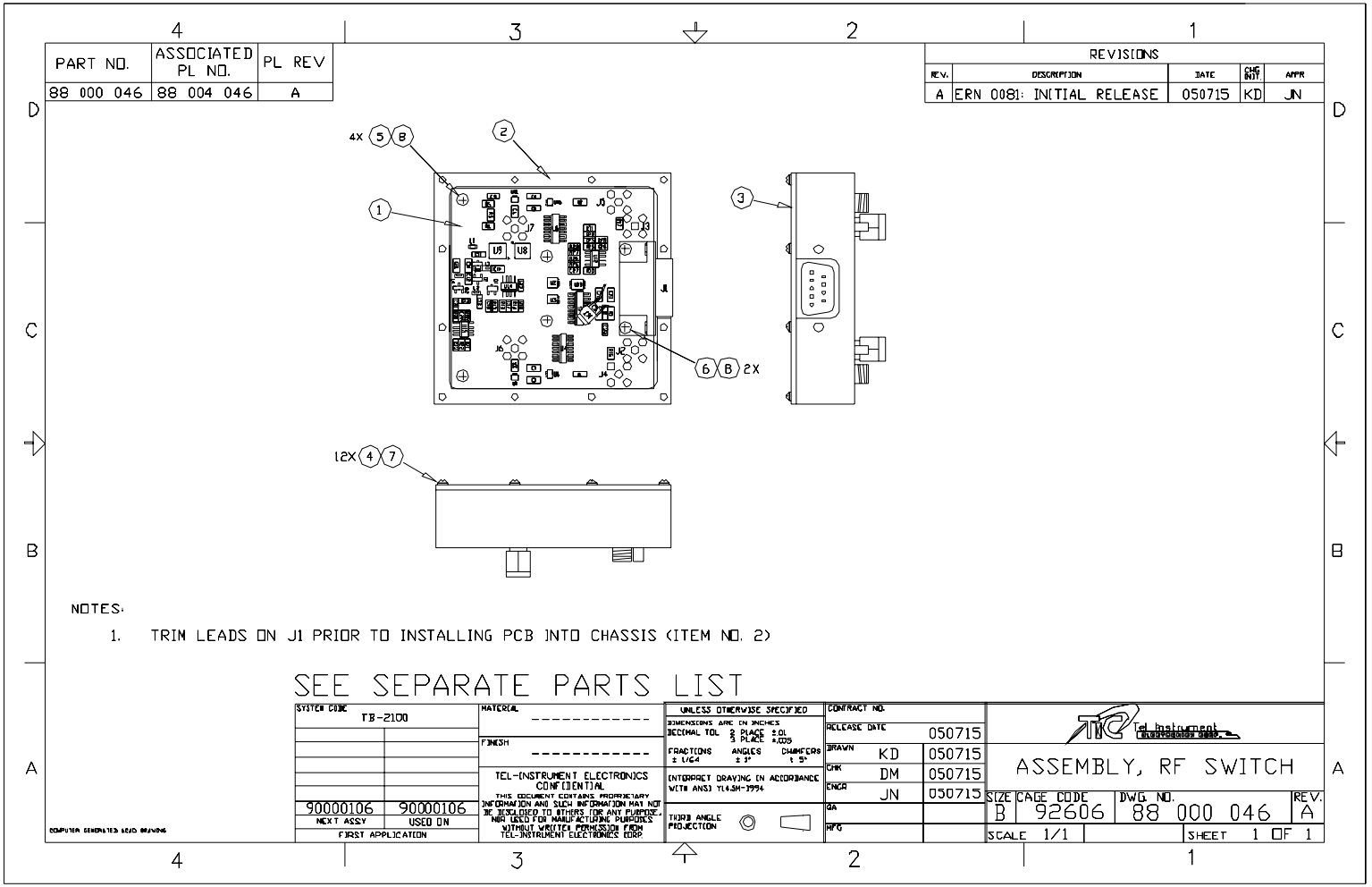
Top RF IO Assy. Main RF IO Assy.				80 000 045		
#	QTY	Tel Desig.	Nomenclature	Ref Designator	Resource	Vendor P/N
1	1	80227001	RF I/O PC Brd. Assy.	A16, A17	KLJ	
2	1	62000051	Chassis, RF I/O		KLJ	
3	1	62040074	Cover, RF I/O		KLJ	
4	1	40050005	Circulator		MICA	
5	1	44002013	Attenuator		Anaren	
6	1	41130019	Resistor	R12	Anaren	
7	3	48040075	Connector, SMA Female Panel Mt	J1,J3,J4	AEP	
8	1	48040078	Connector, N Panel Jack Receptacle	J2	Delta	
9	8	50130001	Screw, Fillister 4-40 x 1/4Lg.		Tower	
10	50	50110038	Screw, Pan Hd 2-56 x 3/16Lg.			
11	6	50110032	Screw, Pan Hd 2-56 X 7/16Lg.			
12	56	52020005	Washer, Lock #2			
13	4	52020002	Washer, Lock #4			
14	6	52010003	Washer, Flat #2			
			NOTES:			
			THIS PARTS LIST IS UTILIZED FOR BOTH			
			TOP AND MAIN RF I/O ASSEMBLY'S. ITEM 1			
			REF. DESIG. A16 IS USED ON TOP RF I/O			
			ASSEMBLY AND A17 IS USED ON MAIN RF			
			I/O ASSEMBLY.			



Assembly RF Input / Output

Figure 6-15

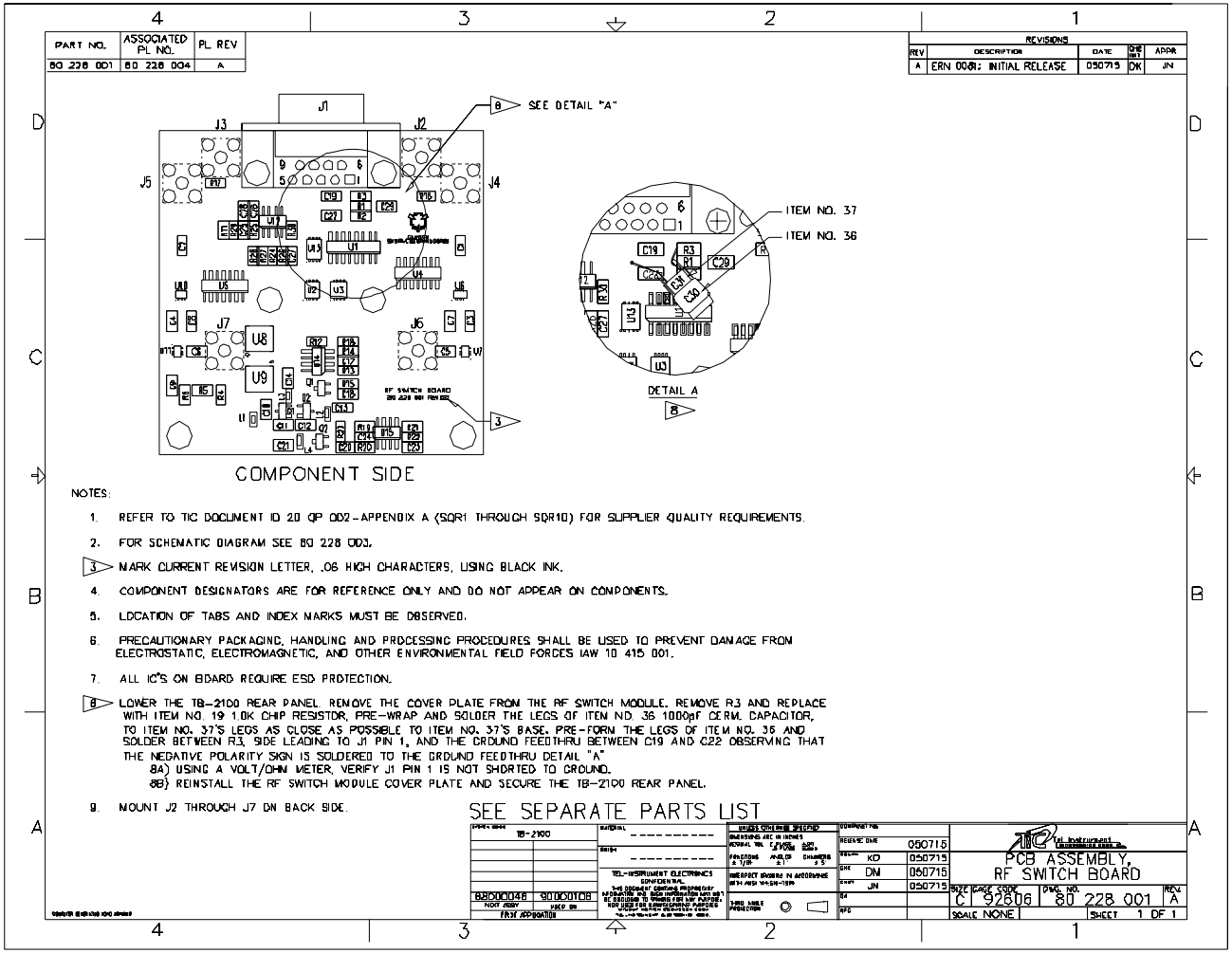
PCB Assy. RF IO				80 227 001		
#	QTY	Tel Desig.	Nomenclature	Ref Designator	Resource	Vendor P/N
1	1	80227002	PCB Drill and Fabrication, RF I/O (Rev C)		KLJ	09-0107-0000
2	4	41164001-94	Res. Chip 1% RC1210; 93.1 Ohm	R4,R6,R8,R10	Panasonic	ERJ-14NF93R1U
3	2	41164001-85	Res. Chip 1% RC1210; 75.0 Ohm	R5,R9	Panasonic	ERJ-14NF75R0U
4	2	41164001-77	Res. Chip 1% RC1210; 61.9 Ohm	R1,R3	Panasonic	ERJ-14NF61R9U
5	1	41164001-132	Res. Chip 1% RC1210; 232 Ohm	R2	Panasonic	ERJ-14NF2320U
6	1	41161009-68	Res. Chip 1% RC0805; 49.9 Ohm	R11	Panasonic	ERJ-6ENF49R9V
7	1	40050004	2-Way, 0 Deg Power Splitter	A1	Mini-Circuits	SBB-2-13
8	1	40201220	Directional Coupler, 20 dB	A4	Anaren	1D1304-20



Assembly RF Switch

Figure 6-16

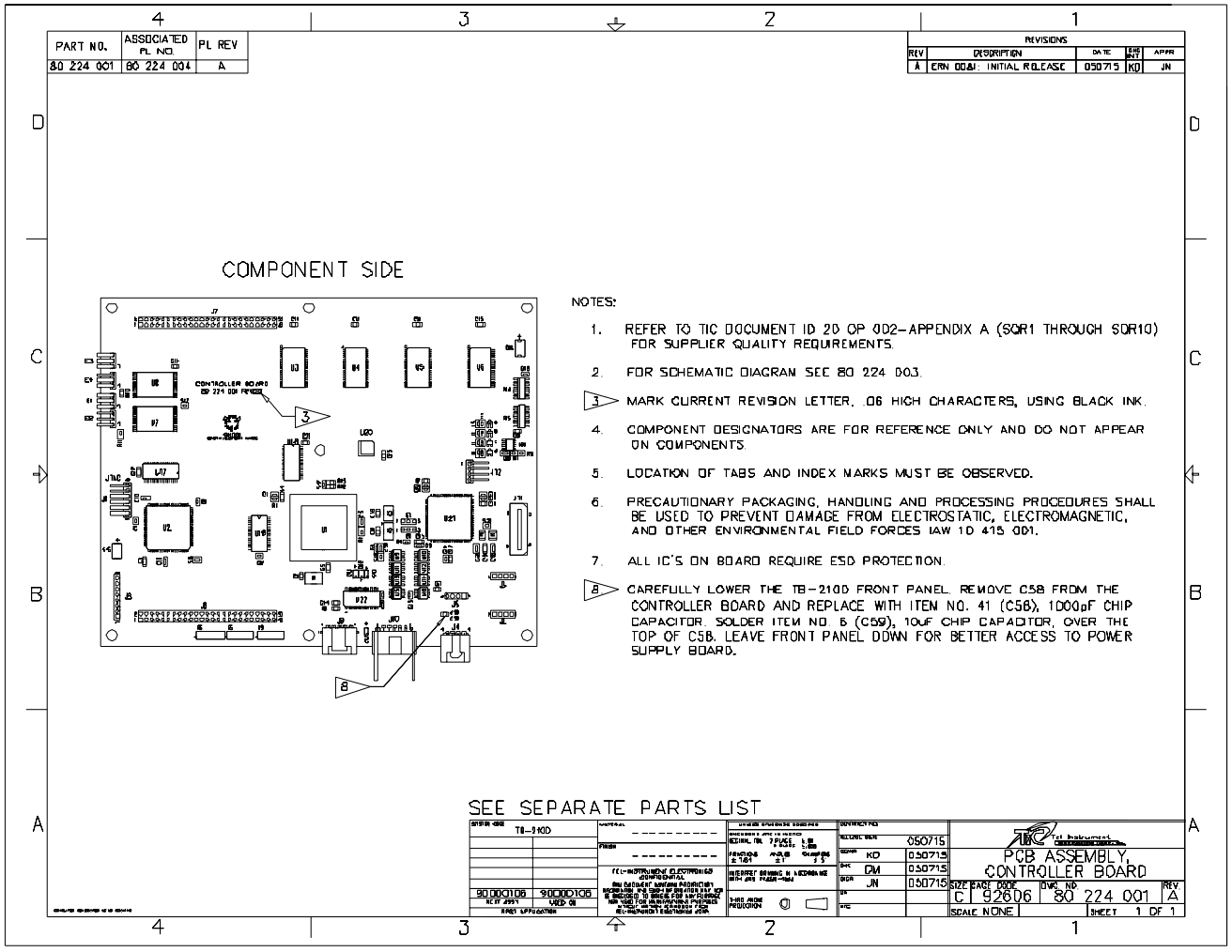
RF Switch Assembly				88 000 046		
#	QTY	Tel Desig.	Nomenclature	Ref Designator	Resource	Vendor P/N
1	1	80228001	RF Switch PC Brd. Assy.	A18	KLJ	
2	1	62000052	Chassis, RF Switch		KLJ	
3	1	62040075	Top Cover, RF Switch		KLJ	
4	12	50110038	Screw, Pan Hd 2-56 x 3/16Lg.			
5	4	50110007	Screw, Pan Hd 4-40 x ¼Lg.			
6	2	50110006	Screw, Pan Hd 4-40 x 3/8Lg.			
7	12	52020005	Washer, Lock #2			
8	6	52020002	Washer, Lock #4			



Assembly RF Switch Board

Figure 6-17

PCB Assembly RF Switch Board				80 228 001		
#	QTY	Tel Desig.	Nomenclature	Ref Designator	Resource	Vendor P/N
1	1	80228002	PCB Drill and Fabrication, RF Switch Bd. (Rev. C)			09-0108-0000
2	1	40201265	8 bit SMBus I/O Port:	U1	Philips	PCA9557D
3	1	40201263	Dual,2 Input OR;8-SSOP	U2	TI	SN74LVC2G32DCTR
4	1	40201264	Dual,2 Input AND;8-SSOP	U3	TI	SN74LVC2G08DCTR
5	2	40201228	Quad,2 Input AND;14-SOIC	U4,U5	TI	SN74LVC00AD
6	4	40201266	RF Switch	U6,U7,U10,U11	Skyworks	AS179-92
7	2	40050004	2-Way, 0 Deg Power Splitter	U8,U9	Mini-Circuits	SBB-2-13
8	3	40201267	Op Amp	U12,U14,U15	Linear Technology	LT1219LCS8
9	1	40201268	DAC,8 bit,I2C;8-uSOIC	U13	Analog Devices	AD5301BRM
10	2	40001040	Transistor, PNP, MMBT3906LT1,SOT-23	Q1,Q2		MMBT3906LT1
11	1	41163003	Thermistor; 0805; 4.7k, 5%,3560k (NTC)	RT1	BC Components	2322 61553472
12	2	40010053	Diode,Dual,PIN;SOT-23	D1,D2	Agilent	HSMP-3864
13	4	43011098	Inductor-SM;120 nH	L1,L2,L3,L4	Panasonic	ELJ-NJR12JF2
14	8	42029002-06	Cap Chip X7R 25V 0805; 0.1 uF 10%	C17,C22-C27,C29	Panasonic	ECJ-2VB1E104K
15	4	42029001-45	Cap Chip X7R 10V 0805; 1 uF	C18,C19,C20,C28	Kemet	C0805C105K8RACTU
16	15	42028004-24	Cap Chip NP0 50V 0805; 100 pF 5%	C1-C14, C21	Panasonic	ECJ-2VC1H101J
17			NOT ASSIGNED	C15,C16		
18	4	41161009-289	Res SMT 1% 0805;10k	R1,R2,R16,R17	Panasonic	ERJ-6ENF1002V
19	1	41161009-193	Res SMT 1% 0805;1.0K	R3	Panasonic	ERJ-6ENF1001V
20	2	41161009-142	Res SMT 1% 0805; 294	R4,R6		ERJ-6ENF2940V
21	1	41161009-24	Res SMT 1% 0805; 17.4	R5		ERJ-6ENF17R4V
22	7	41161009-385	Res SMT 1% 0805; 100k	R12,R13,R18,R19, R21,R26, R30		ERJ-6ENF1003V
23	1	41161009-187	Res SMT 1% 0805; 866	R15		ERJ-6ENF8660V
24	1	41161009-390	Res SMT 1% 0805; 113k	R20		ERJ-6ENF1133V
25	1	41161009-338	Res SMT 1% 0805; 32.4k	R22		ERJ-6ENF3242V
26	1	41161009-326	Res SMT 1% 0805; 24.3k	R23		ERJ-6ENF2432V
27	3	41161009-421	Res SMT 1% 0805; 237k	R24,R25,R27		ERJ-6ENF2373V
28	1	41161009-243	Res SMT 1% 0805; 3.32k	R28		ERJ-6ENF3321V
29	1	41161009-277	Res SMT 1% 0805; 7.50k	R29		ERJ-6ENF7501V
30			NOT INSTALLED	R14		
31			NOT USED	R7,R8,R9,R10,R11		
32	1	48000148	Conn, D-Sub, 9 pin Rt Angl Plug	J1	AMP	747250-4
33	2	48040079	Conn, SMA, PCB Straight Plug Receptacle	J6,J7	AEP	9649-1113-000
34	2	48040080	Conn, SMB, PCB Straight Male Jack Receptacle	J2,J3	AEP	2009-7511-000
35	2	48040081	Conn, SMA, PCB Straight Jack Receptacle	J4,J5	AEP	9650-1113-000
36	1	42100006	Cap., Mono, Cerm 1000pF, 100V, X7R, 10%	C30	Panasonic	ECU-S2A102KBA
37	1	42190029	Cap., Min Alum Elect. 10uF, 25V, 20%	C31	Panasonic	ECE-A1EKA100

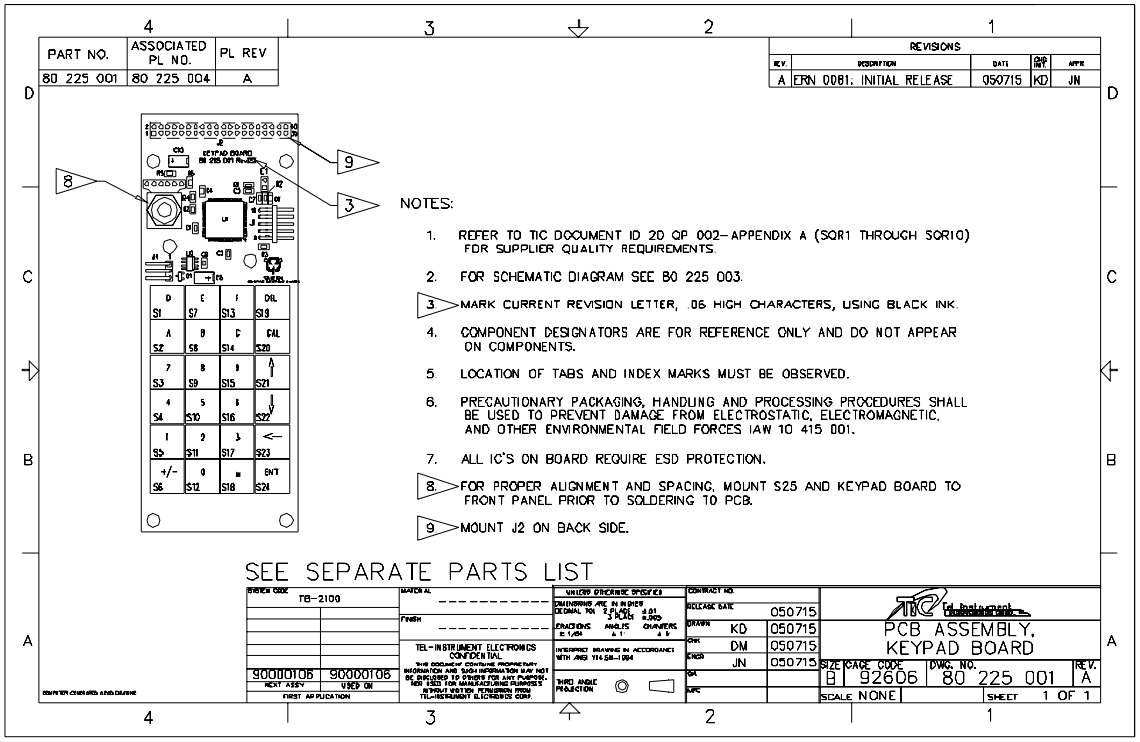


PCB Assembly Controller Board

Figure 6-18

PCB Assembly Controller				80 224 001		
#	QTY	Tel Desig.	Nomenclature	Ref Designator	Resource	Vendor P/N
1	1	80224002	PCB Drill and Fabrication, Controller Bd. (Rev. C)			09-0104-0000
2	1	42029001-45	Cap Chip X7R 10V, 1uF;0805	C1	Kemet	C0805C105K8RACTU
3	48	42029002-06	Cap Chip X7R 25V 0805; 0.1 uF 10%	C2,C3,C4,C5,C6,C7,C8,C9, C10,C11,C12,C13, C14,C15 C16,C17,C18,C19, C20, C21,C22,C23,C24, C25,C26 C27,C28,C29,C30, C31, C32,C33,C34,C35, C36,C37 C38,C39,C44,C47, C48, C49,C50,C52,C53, C54,C55,C57	Panasonic	ECJ-2VB1E104K
4	4	42480024	Cap SMT Tant 35V EIA A;0.22uF 20%	C40,C41,C42,C43	Panasonic	ECS-H1VY224R
5	2	42480021	Cap SMT Tant 16V EIA D;47uF 20%	C45,C46	AVX	TPSD476M016R0150
6	2	42028021-08	Cap SMT X5R 6.3V 0805; 10 uF 20%	C51, C59	Panasonic	ECJ-2FB0J106M
7	1	42028004-16	Cap SMT NP0 50V 0805; 22 pF 5%	C56	Panasonic	ECJ-2VC1H220J
8	4	40010054	Dual Diode, SOT-23	D1,D2,D3,D4	Diodes, Inc	BAS70-04-7
9	2	55050047	Connector 3 pin 0.1" SIL header	E6,E7	Molex	22-03-2031
10	4	55050048	Connector 3 pin 0.1" SIL header, Rt. Angle	E1,E2,E3,E4	Molex	22-12-2031
11	1	55050049	Connector 6 pin 0.1" SIL header, Rt Angle	J1	Molex	22-12-2061
12	1	55050044	Connector 4 pin 0.1" SIL header, Rt Angle	J4	Molex	70553-0003
13	1	55050046	Connector 4 pin 0.1" SIL Rt Angle header	J12	Molex	22-05-2041
14	1	55050045	Connector 8 pin 0.1" SIL header	J6	Molex	70563-0007
15	2	48000151	Connector 2 X 25 0.1" DIL header	J7,J8	Samtec	SSQ-125-01-G-D
16	1	55050050	Connector 2 X 5 0.1" DIL header, Rt Angle	J9	Molex	15-29-7210
17	1	55050051	Connector, 2 X 5 0.1" DIL header Rt Angle w/latches	J10	AMP	104130-1
18	1	55050052	Connector, Recept 31 pin 1mm	J11	Hirose	DF9-31P-1V(20)
19	2	48065012	Ferrite Bead SMT 1812;1.5A	L1,L2	Steward	MI1812K121R
20	4	48065011	Ferrite Bead SMT	L3,L4,L5,L6	Murata	BLM21AG601SN1D
21	4	41161009-383	Res SMT 1% 0805;95.3k	R1,R8,R10,R11	Panasonic	ERJ-6ENF9532V
22	2	41161009-289	Res SMT 1% 0805;10.0k	R2,R7	Panasonic	ERJ-6ENF1002V
23	2	41161009-239	Res SMT 1% 0805;3.01k	R3,R4	Panasonic	ERJ-6ENF3011V
24	3	41150005-44	Res SMT 2% 9 pin SIL;10k	R5,R6,R9	CTS	752091103GB
25	2	41161009-193	Res SMT 1% 0805;1.00k	R12,R13	Panasonic	ERJ-6ENF1001V

PCB Assembly Controller				80 224 001		
#	QTY	Tel Desig.	Nomenclature	Ref Designator	Resource	Vendor P/N
26	2	41150006	Res SMT 2% 16 pin DIL;220/330	R14,R15	CTS	766165131A
27	1	41161009-339	Res SMT 1% 0805;33.2k	R16	Panasonic	ERJ-6ENF3322V
28	1	40201305	Microcontroller PLCC68	U1	Philips	PXAS30KBA
29	1	40201306	FPGA, CPLD TQ144	U2	Xilinx	XC95144XL-7TQ144C
30	4	40201304	SRAM 44-TSOPII;256k X 16	U3,U4,U5,U6	Cypress	CY7C1041CV33-12ZC
31	1	40201303	Flash 48-TSOP 3.3V Bottom Boot 70ns;4M X 16	U8	Toshiba	TC58FVB160AFT-70
32	1		Programmed Memory	U7		
33	8	40201278	I2C Serial EEPROM 3.3V 8-SOIC; 32k X 8	U9-U16	Microchip	24LC256-I/SN
34	2	40201297	Buffer/Driver 48-SSOP;16bit	U17,U18	TI	SN74LVTH16244 ADL
35	1	40201298	Transceiver 48-SSOP;16bit	U19	TI	SN74LVTH16245 ADL
36	1	40201302	UART 48-TQFP	U20	EXAR	ST16C1550CQ48
37	1	40201296	LCD Controller 144-QFP20	U21	Epson	S1D13806F
38	1	40201299	RS232 3.3V 48-SSOP	U22	TI	SN75C23243DLR
39	1	40201300	Touchscreen Controller 16-TSSOP	U23	TI	TSC2003IPW
40	1	40201301	Xtal Osc SMT 50ppm;29.49120 MHz	X1	CTS	CB3LV-3C-29.49120-T
41	1	42029003-01	Cap, Cerm Chip 0805 1000pF/50V X7R 10%	C58	Panasonic	ECJ-2VB1H102K

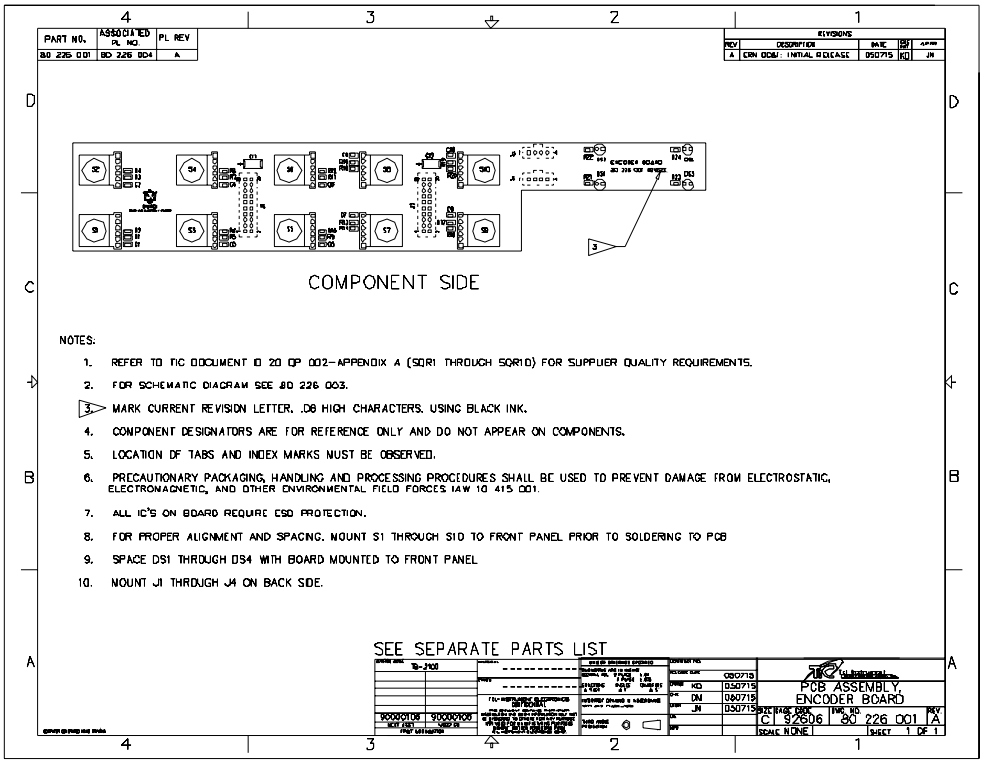


PCB Assembly, Keypad Board

Figure 6-19

PCB Assembly, KeyPad				80 225 001		
#	QTY	Tel Desig.	Nomenclature	Ref Designator	Resource	Vendor P/N
1	1	80225002	PCB Drill and Fabrication RF Board (Rev C)			09-0105-0000
2	1	48077037-01	Memory, Programmed	U1	Cygnal	C8051F020
3	1	40201295	RS232,1X1;8-SOIC	U2	Maxim	DS276S
4	1	55050041	Connector 3 pin 0.1" SIL Rt Angle header	J4	Molex	22-28-8032
5	1	55040042	Connector 2 X 5 0.1" DIL Rt Angle header	J1	Sullins	PZC05DBBN
6	1	55050043	Connector 2 X 20 0.1" DIL header	J2	Molex	15-29-6240
7	6	42029002-06	Cap Chip X7R 25V 0805; 0.1 uF 10%	C1,C2,C3,C4,C7,C9	Panasonic	ECJ-2VB1E104K
8	1	42480021	Cap SMT Tant 16V EIA D;47uF 20%	C10	AVX	TPSD476M016R0150
9	1	42028020-07	Cap Chip Y5V 16V 0805; 1 uF	C6	Panasonic	ECJ-2VF1C105Z
10	1	42480023	Cap Chip Tant 22 uF, 20V, 20%;EIA D (7343)	C8	Kemet	T491D226M020AS
11	1	41161009-383	Res SMT 1% 0805;95.3k	R1	Panasonic	ERJ-6ENF9532V
12	1	41161009-193	Res SMT 1% 0805;1.00k	R2	Panasonic	ERJ-6ENF1001V
13	1	41161009-258	Res SMT 1% 0805;4.75k	R3	Panasonic	ERJ-6ENF4751V
14	1	41161009-62	Res SMT 1% 0805;43.2	R4	Panasonic	ERJ-6ENF43R2V
15	2	41161009-226	Res SMT 1% 0805;2.21k	R5,R6	Panasonic	ERJ-6ENF2211V

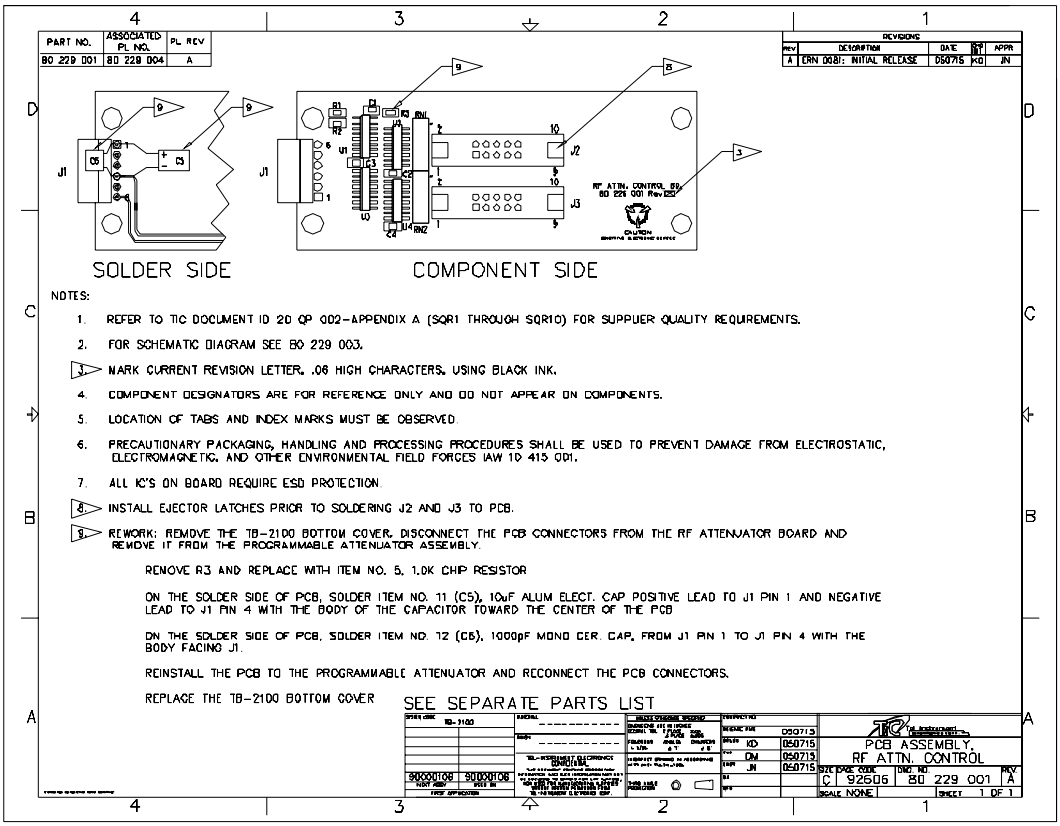
PCB Assembly, KeyPad				80 225 001		
#	QTY	Tel Desig.	Nomenclature	Ref Designator	Resource	Vendor P/N
16	1	40010059	Diode, Schottky, 30V; SOT-23	D1	Diodes Inc	BAT54-7
17	1	45001018	LED, Green, SMT;0805	D2	Lumex	SML-LXT0805GW-TR
18	1	46020028	Optical Encoder,18deg,panel mount	S25	Grayhill	62SY18003
19	24	57024001	Keyswitch	S1,S2,S3,S4,S5,S6,S7,S8,S9, S10,S11,S12,S13, S14,S15,S16 S17,S18,S19,S20, S21,S22, S23,S24	EAO	81.10101.00
20	18	57027001	Square Key, Lt Grey		EAO	80.11011.09
21	1	57027003	Square Cap, Lt Grey, Blk text;0		EAO	82.01036.09
22	1	57027004	Square Cap, Lt Grey, Blk text;1		EAO	82.01027.09
23	1	57027005	Square Cap, Lt Grey, Blk text;2		EAO	82.01028.09
24	1	57027006	Square Cap, Lt Grey, Blk text;3		EAO	82.01029.09
25	1	57027007	Square Cap, Lt Grey, Blk text;4		EAO	82.01030.09
26	1	57027008	Square Cap, Lt Grey, Blk text;5		EAO	82.01031.09
27	1	57027009	Square Cap, Lt Grey, Blk text;6		EAO	82.01032.09
28	1	57027010	Square Cap, Lt Grey, Blk text;7		EAO	82.01033.09
29	1	57027011	Square Cap, Lt Grey, Blk text;8		EAO	82.01034.09
30	1	57027012	Square Cap, Lt Grey, Blk text;9		EAO	82.01035.09
31	1	57027013	Square Cap, Lt Grey, Blk text;A		EAO	82.01001.09
32	1	57027014	Square Cap, Lt Grey, Blk text;B		EAO	82.01002.09
33	1	57027015	Square Cap, Lt Grey, Blk text;C		EAO	82.01003.09
34	1	57027016	Square Cap, Lt Grey, Blk text;D		EAO	82.01004.09
35	1	57027017	Square Cap, Lt Grey, Blk text;E		EAO	82.01005.09
36	1	57027018	Square Cap, Lt Grey, Blk text;F		EAO	82.01006.09
37	1	57027019	Square Cap, Lt Grey, Blk text;.		EAO	82.01076.09
38	1	57027020	Square Cap, Lt Grey, Blk text;+/-		EAO	82.01087.09
39	1	57027021	Square Cap, Lt Blue, Wht text;DEL		EAO	82.01086.05
40	1	57027022	Square Cap, Lt Blue, Wht text;CAL		EAO	82.01085.05
41	3	57027023	Square Cap, Lt Blue, Wht text;->		EAO	82.01077.05
42	1	57027024	Square Cap, Lt Blue, Wht text;ENT		EAO	82.01169.05
43	6	57027002	Square Key, Lt Blue		EAO	80.11011.05



PCB Assembly, Encoder

Figure 6-20

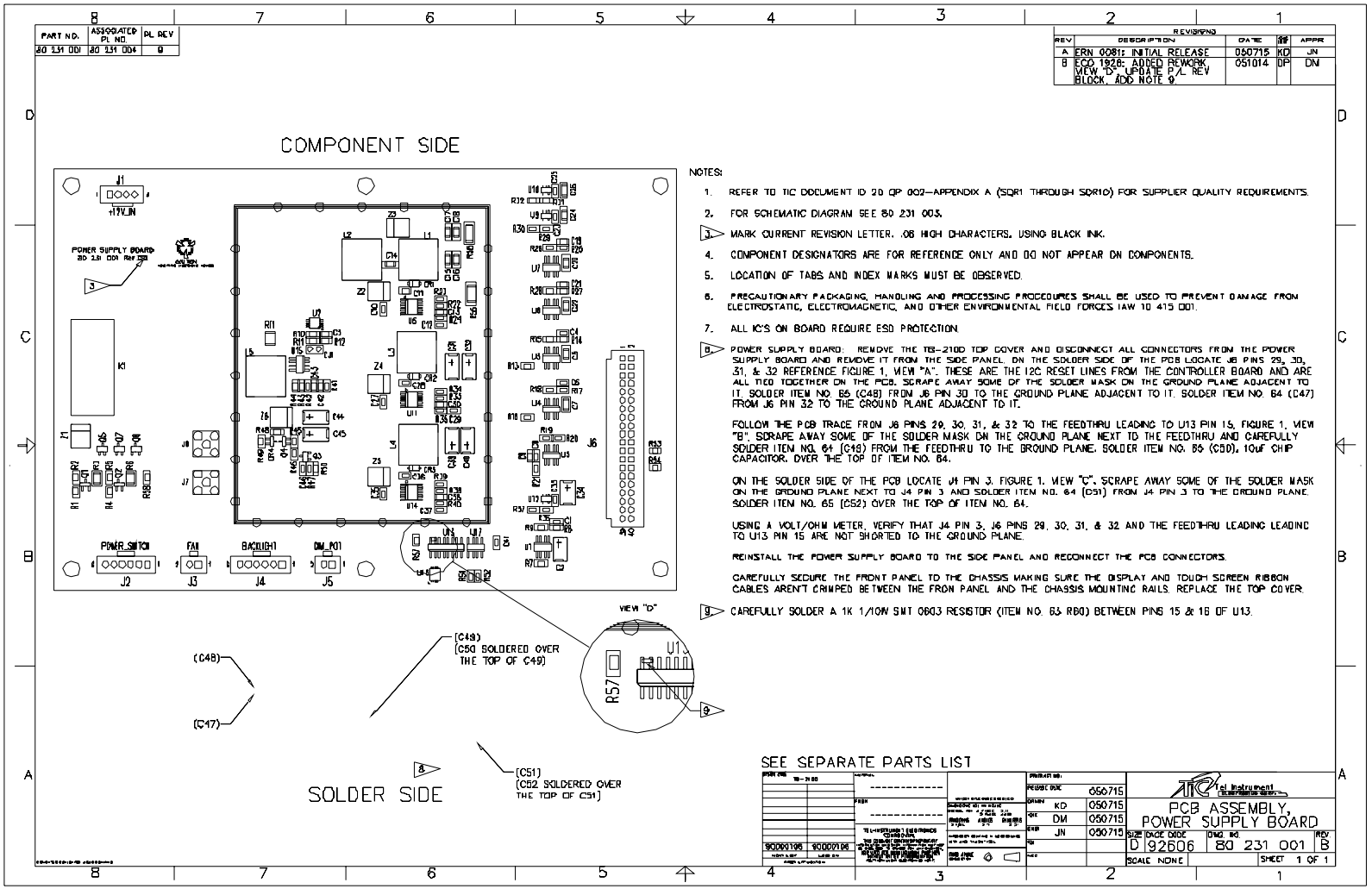
PCB Assembly, Encoder				80 226 001		
#	QTY	Tel Desig.	Nomenclature	Ref Designator	Resource	Vendor P/N
1	1	80226002	PCB Drill and Fabrication, Encoder Bd. (Rev B)			09-0106-0000
2	2	55050037	Connector 2 X 10 0.1" DIL straight header	J1,J2	Molex	15-42-6220
3	10	42029002-06	Cap Chip X7R 25V 0805; 0.1 uF 10%	C1-C10	Panasonic	ECJ-2VB1E104K
4	2	42480021	Cap SMT Tant 16V EIA D;47uF 20%	C11,C12	AVX	TPSD476M016R0 150
5	4	41161009-114	Res SMT 1% 0805;150	R21-R24	Panasonic	ERJ-6ENF1500V
6	20	41161009-226	Res SMT 1% 0805;2.21k	R1-R20	Panasonic	ERJ-6ENF2211V
7	10	46020028	Optical Encoder,18deg,panel mount		Grayhill	62SY18003
8	4	45001025	LED, T-1 3/4, Green, 0.1" thru hole	DS1-DS4	Chicago Miniature	4304H5
9	2	55050036	Connector 1 X 4, 0.1" SIL Straight Header	J3, J4	Molex	70543-0003



PCB Assembly, RF Attenuator Control

Figure 6-21

PCB Assembly, RF ATTN Control				80 229 001		
#	QTY	Tel Desig.	Nomenclature	Ref Designator	Resource	Vendor P/N
1	1	80229002	PCB Drill and Fabrication, RF Attn. Control Bd. (Rev. B)			09-0109-0000
2	2	40201265	8 bit SMBus I/O Port:	U1,U3	Philips	PCA9557D
3	2	40001042	Transistor Array:16-SOIC	U2,U4	TI	ULN2003AD
4	4	42029002-06	Cap Chip X7R 25V 0805; 0.1 uF 10%	C1-C4	Panasonic	ECJ-2VB1E104K
5	1	41161009-193	Res SMT 1% 0805;1.0k	R3	Panasonic	ERJ-6ENF1001V
6	2	41161009-289	Res SMT 1% 0805;10k	R1,R2	Panasonic	ERJ-6ENF1002V
7	2	41150005-44	Res SMT 2% 9 pin SIL;10k	RN1,RN2	CTS	752091103GB
8	1	48000150	Conn, 1X6, rt angle, friction lock	J1	Molex	70553-0005
9	2	55050035	Conn, 2X5, straight, latch/eject	J2,J3	3M	3793-6002
10	4	55077007	Pin, Ejector latch, long		3M	3505-3
11	1	42190029	Cap, Min. Alum Elect., 10uf/25V, 20%	C5	Panasonic	ECE-A1EKA100
12	1	42100006	Cap, Mono Cerm., 1000pF/100V X7R 10%	C6	Panasonic	ECU-S2A102KBA

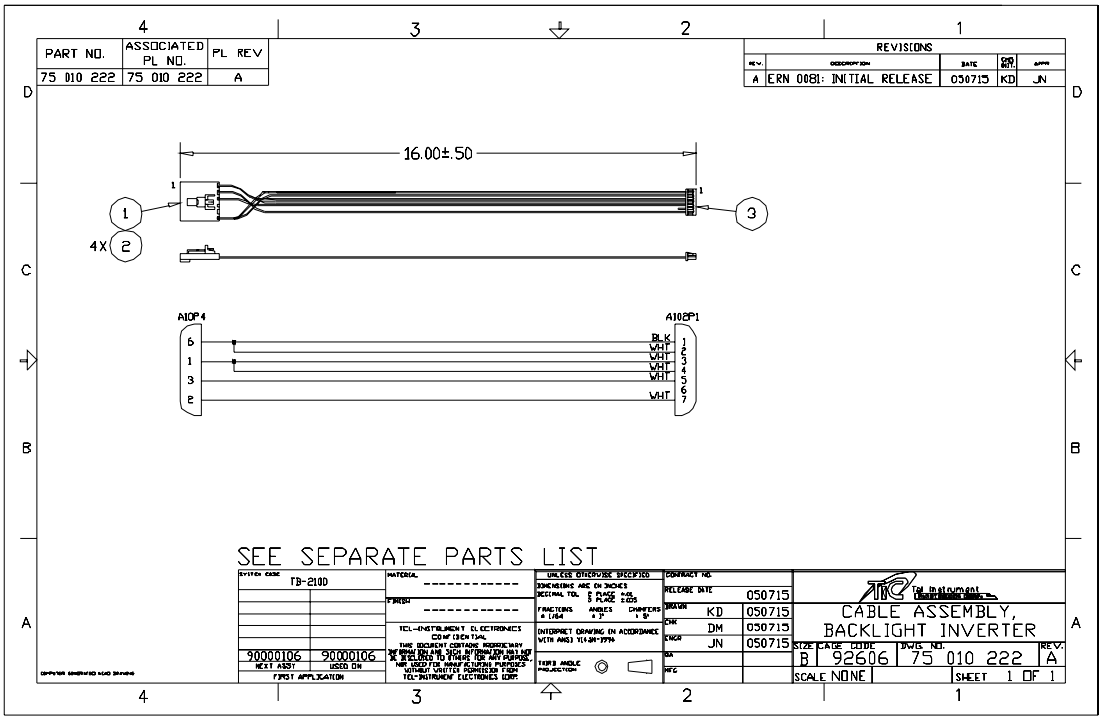


PCB Assembly, Power Supply Board

Figure 6-22

PCB Assembly, Power Supply				80 231 001		
#	QTY	Tel Desig.	Nomenclature	Ref Designator	Resource	Vendor P/N
1	1	80231002	PCB Drill and Fabrication, Pwr Supply Bd. (Rev B)			09-0111-0000
2	3	40201291	Switching Regulator, TSSOP-16	U6,U11,U14	Linear Technology	LT3431EFE
3	3	40201292	Negative LDO, ThinSOT	U9,U10,U12	Linear Technology	LT1964ES5-BYP
4	1	40201293	Switching Regulator, SO-8	U15	Linear Technology	LT1372CS8
5	5	40201285	Positive LDO, SO-8	U1,U3,U4,U7,U8	Linear Technology	LT1763CS8
6	1	40201265	8 bit SMBus I/O Port:	U13	Philips	PCA9557D
7	1	40201268	DAC,8 bit,I2C;8-uSOIC	U16	Analog Devices	AD5301BRM
8	0		Oscillator, MSOP-10 (NOT INSTALLED)	U2		
9	1	40201267	Op Amp	U5	Linear Technology	LT1219LCS8
10	1	40201294	SMBus Expander	U17	Philips	PCA9515D
11	1	40001019	Transistor, NPN, MMBT3904LT1, SOT-23	Q3	Infineon Tech.	MMBT3904LT1
12	2	40001043	Transistor, MOSFET,P Channel;SOT-23	Q4,Q5	Fairchild	BSS84
13	4	40001041	Transistor, N Channel MOSFET, SOT-23	Q1,Q2,Q6,Q7	Zetex	VN10LFTA
14	1	40010054	Dual Diode;SOT-23	CR4	Diodes Inc.	BAS70-04-7
15	3	40010057	Diode, Switching, SOD-123	CR1,CR2,CR3	ON Semi	MMSD914T1
16	6	40010058	Diode, Schottky, SMC	Z1,Z2,Z3,Z4,Z5,Z6	IR	30BQ060
17	11	42029006-05	Cap Chip X5R 25V 1206; 10 uF 20%	C5,C7,C14,C15,C16,C17, C18,C20,C22,C24, C26	Panasonic	ECJ-3YB1E106M
18	0		Cap Chip; (NOT INSTALLED)	C3		
19	3	42028004-28	Cap Chip NP0 50V 0805; 220 pF 5%	C13,C30,C38	Panasonic	ECJ-2VC1H221J
20	1	42029003-15	Cap Chip X7R 50V 0805; 0.015 uF 10%	C29	Panasonic	ECJ-2VB1H153K
21	3	42029002-10	Cap Chip X7R 25V 0805; 0.22 uF 10%	C11,C28,C36	Panasonic	ECJ-2YB1E224K
22	11	42029003-13	Cap Chip X7R 50V 0805; 0.01 uF 10%	C1,C4,C6,C8,C12, C19, C21,C23,C25,C33, C41	Panasonic	ECJ-2VB1H103K
23	4	42480016-04	Cap SMT Tant 25V EIA D;33uF 20%	C2,C31,C32,C34	Panasonic	EEJ-L1ED336R
24	3	42029005-03	Cap Chip X5R 25V 0805;4.7 uF 20%	C10,C27,C35	Panasonic	ECJ-2FB1E475M
25	2	42480021	Cap SMT Tant 16V EIA D;47uF 20%	C39,C40	AVX	TPSD476M016R0150

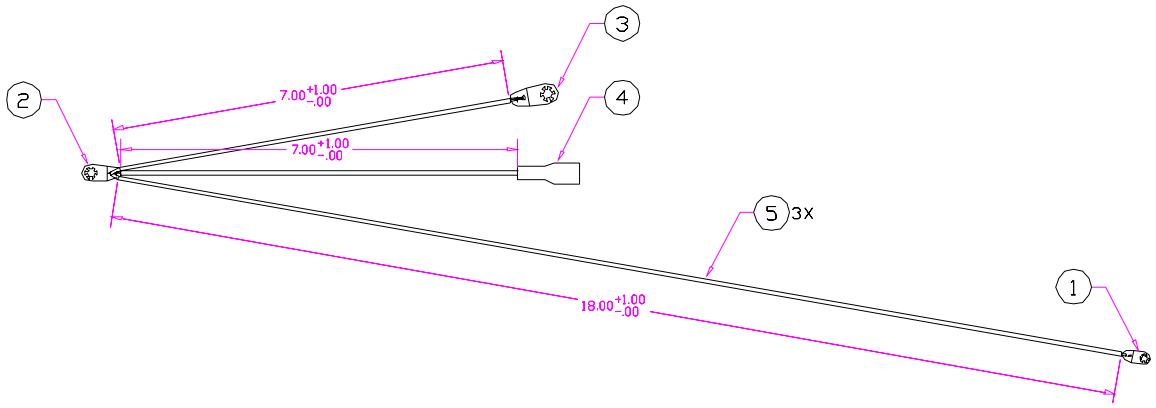
PCB Assembly, Power Supply				80 231 001		
#	QTY	Tel Desig.	Nomenclature	Ref Designator	Resource	Vendor P/N
26	2	42029003-17	Cap Chip X7R 50V 0805; 0.022 uF 10%	C37,C42	Panasonic	ECJ-2VB1H223K
27	2	42480022	Cap SMT Tant 50V, 6.8uF;7343	C44,C45	Kemet	T491D685M050AS
28	1	42029003-05	Cap Chip X7R 50V 0805; 0.0022 uF 10%	C43	Panasonic	ECJ-2VB1H222K
29	1	42029001-45	Cap Chip X7R 10V, 1uF;0805	C9	Kemet	C0805C105K8RACTU
30	1	42028004-29	Cap Chip NPO 50V 0805; 270pF	C46	Panasonic	ECJ-2VC1H271J
31	0		Res, SMT; (NOT INSTALLED)	R12		
32	7	41161009-252	Res. SMT 1% 0805; 4.12k	R15,R18,R26,R28, R30, R32,R33	Panasonic	ERJ-6ENF4121V
33	1	41161009-343	Res. SMT 1% 0805; 36.5k	R34	Panasonic	ERJ-6ENF3652V
34	2	41161009-210	Res. SMT 1% 0805; 1.5k	R24,R35	Panasonic	ERJ-6ENF1501V
35	3	41161009-383	Res SMT 1% 0805;95.3k	R7,R57,R58	Panasonic	ERJ-6ENF9532V
36	0		Res SMT; (NOT INSTALLED)	R10		
37	0		Res SMT; (NOT INSTALLED)	R11		
38	1	41161009-282	Res SMT 1% 0805;8.45k	R38	Panasonic	ERJ-6ENF8451V
39	4	41161009-260	Res SMT 1% 0805;4.99k	R23,R39,R41,R43	Panasonic	ERJ-6ENF4991V
40	1	41161009-317	Res SMT 1% 0805;19.6k	R22	Panasonic	ERJ-6ENF1962V
41	4	41161009-226	Res SMT; 1% 0805;2.21k	R9,R19,R20,R37	Panasonic	ERJ-6ENF2211V
42	1	41161009-347	Res SMT; 1% 0805;40.2k	R21	Panasonic	ERJ-6ENF4022V
43	2	41161009-243	Res SMT 1% 0805;3.32k	R40,R50	Panasonic	ERJ-6ENF3321V
44	2	41161009-268	Res SMT 1% 0805;6.04k	R2,R5	Panasonic	ERJ-6ENF6041V
45	2	41161009-77	Res SMT 1% 0805;61.9	R1,R4	Panasonic	ERJ-6ENF61R9V
46	2	41164001-172	Res SMT 1% 1210;604	R3,R6	Panasonic	ERJ-14NF6040U
47	2	41161009-315	Res SMT 1% 0805;18.7k	R8,R36	Panasonic	ERJ-6ENF1872V
48	1	41161009-333	Res SMT 1% 0805;28.7k	R44	Panasonic	ERJ-6ENF2872V
49	3	41161009-164	Res SMT 1% 0805;499	R45,R46,R47	Panasonic	ERJ-6ENF4990V
50	1	41161009-218	Res SMT 1% 0805;1.82k	R42	Panasonic	ERJ-6ENF1821V
51	2	41161009-289	Res SMT 1% 0805;10.0k	R48,R49	Panasonic	ERJ-6ENF1002V
52	10	41161009-299	Res SMT 1% 0805;12.7k	R14,R17,R25,R27, R29, R31,R51,R52,R53, R54	Panasonic	ERJ-6ENF1272V
53	2	41161028	Res SMT 1% 0805;0.1	R13,R16	Panasonic	ERJ-L06KJ10CV
54	2	41130021	Res SMD 5% 2512; 75 1W	R55,R56	Panasonic	ERJ-1TYJ750U
55	5	43011103	Power Inductor SMT 15 uH	L1,L2.L3,L4,L5	Sumida	CDRH125-150MC
56	1	55050036	1X4 Connector (Ref. 12VDC Input)	J1	Molex	70543-0003
57	2	55050039	1X6 Connector (Ref. Power Switch)	J2,J4	Molex	70543-0005
58	2	48040083	Connector SMB Jack Recept Straight (Ref. Pulse_A3)	J7,J8	Johnson Comp.	131-1701-216
59	2	55050038	1X2 Connector (Ref. Fan)	J3,J5	Molex	70543-0001
60	1	55050043	Conn.Header Dual Row Vert. 40Pin 0.1" Ctr (Ref.Output)	J6	Molex	15-42-6240
61	1	45100035	Resettable Fuse	RT1	PolySwitch	MINISMDC014-2
62	1	46005008	Relay SPDT;12Vdc	K1	Omron	G2RL-1A-DC12
63	1	41161029	Res SMT 1% 0603; 1.00K	R60	Yageo	9C06031A1001FKHFT
64	3	42029003-01	Cap, Cerm., Chip 0805, 1000pF/50V X7R 10%	C47, C49, C51	Panasonic	ECJ-2VB1H102K
65	3	42028021-08	Cap, Cerm., Chip 0805, 10uF/6.3V X5R 20%	C48, C50, C52	Panasonic	ECJ-2FB0J106M



Cable Assembly, Backlight Inverter

Figure 6-23

Cable Assy. Backlight Inverter				75 010 222		
#	QTY	Tel Desig.	Nomenclature	Ref Designator	Resource	Vendor P/N
1	1	48054011	Connector, 6 Pin		Molex	50-57-9406
2	4	46053016	Recept, Crimp 22-24 AWG		Molex	16-02-0103
3	1		Cable Assembly		All American	RTX-7P1
4	AR	72722021-01	Wire, Teflon Insul., 24AWG, Blk		Olympic	305-0
5	AR	72722021-10	Wire, Teflon Insul., 24AWG, Wht		Olympic	305-9



Cable Assembly, Grounding Wire

Figure 6-24

Cable Assembly Grounding Wire				75 010 281		
#	QTY	Tel Desig.	Nomenclature	Ref Designator	Resource	Vendor P/N
1	1	55010001	LUG, GROUND #4		KEYSTONE	7311
2	1	55010002	LUG, GROUND #6		KEYSTONE	7312
3	1	55010003	LUG, GROUND #8		KEYSTONE	7313
4	1	55006011	FEMALE DISCONNECT, INSULATED .25		STA-CON	RA2573
5	AR	72418020	WIRE, TEFLON INSUL. 18AWG. GREEN/YELLOW		OLYMPIC	311-54

Appendix A - Remote Control Operation

1.0 Remote Operation

The TB-2100 provides two methods of remote control

- **ATC-1400A/S-1403DL Emulation** (Sect. 1.1) - Uses the RS-232 and General Purpose Interface Bus (GPIB) commands used in the IFR ATC-1400A ATC/DME Test Set and S-1403DL Mode S Accessory unit
- **TB-2100 RS-232 Remote Control** (Sect. 1.2) - Uses RS-232 commands for emulation of all TB-2100 functions and front-panel controls

1.1 ATC-1400A/S-1403DL Emulation

The TB-2100 commands shown in Table 1 emulate the remote control commands used by the IFR ATC-1400A ATC/DME Test Set and S-1403DL Mode S Accessory Unit (refer to appropriate IFR manuals for detailed programming instructions). The commands were implemented in this fashion to facilitate inter-changeability of the TB-2100 with the IFR products.

For the commands shown in Table 1, all commands are in ASCII code. Table 2 contains SCPI Commands List. Information shown under Data column reflects input/output of TB-2100. Data shown in parentheses is input data, data not enclosed in parentheses is output data. If the Data column is blank, there are no input/output data associated with the command.

Table 1

DME Command	Data	Description
A	XXX	Set Acceleration value
DMEX		Set DME Function to X Channel
DMEY		Set DME Function to Y Channel
DV2=	X.X	Set DME P2 Pulse Spacing (-7.9 to +7.9 in 0.1 us steps)
DV20		Set DME P2 to Cal
DV2+		Deviate DME P2 Positive (-12 to +3 dB)
DV2-		Deviate DME P2 Negative
EQ0		Disable Equalizer Pulses
EQ1		Enable Equalizer Pulses
E0		Disable Echo Pulses
E1		Enable Echo Pulses
E%	XXX	Set DME Reply Efficiency
ID0		Disable IDENT Tone
ID1		Enable IDENT Tone
ID2		Enable Code Message
ID3=	XXXXXX	Set Code Message
IDP=	XXX	Set Number of Dot Times for Period (1 to 999)
IDS=	XXX	Set CODE Dot Time in ms (100, 125, or 160)
NM0		Disable –1 nmi Range
NM1		Enable –1 nmi Range

DME Command	Data	Description
R	XXX.XX	Set DME Range Delay (0 to 399.00 nmi)
R?	(#XXX.XX)	Get DME Range Delay
RI		Set Range Delay Inbound
RO		Set Range Delay Outbound
SQ0		Disable DME Squitter
SQ1		Enable DME Squitter
TC0		Disable TACAN Modulation
TC1		Enable TACAN Modulation
UP?	(#XXXX)	Get UUT DME PRF
V	XXX0	Set DME Velocity (0 to 9990 kts)
V?	($XXX0)	Get DME Velocity

General Command	Data	Description
!		Go to Local Mode
CM0		Select 1.45 us Cal Marks
CM1		Select 1.0 us Cal Marks
DCL		Device Clear (Return to Front Panel Setup)
DF=	X.XX	Set Delta Frequency Value (0.00 to 9.99 MHz)
DF0		Cancel Delta Frequency
DF+		Add Delta Frequency
DF-		Subtract Delta Frequency
ES=	+/-XX	Set Echo/SLS Pulse Amplitude (-12 to +3 dBm)
F	XXXX	Set RF Output Frequency (962 to 1213 MHz)
F?	(#XXXX.XX)	Get RF Output Frequency (962 to 1213 MHz + DF)
FP1		Sample and measure UUT 1st pulse
FP2		Sample and measure UUT 2nd pulse
P?	(#XXXX)	Get PRF
PS=	XXXX	Set XPDR PRF or DME Squitter rate
RF	XXX	Set RF Output Level (0 to –127 dBm)
RT0		Set RF Output to Normal
RT1		Set RF Output to Off
RT2		Set RF Output to CW
SP0		Disable Suppressor Pulse
SP1		Enable Suppressor Pulse
SRM=	XXXXXX	Set SRQ Mask for Desired SRQ Signal
T0		Set SYNC to Interrogation
TD		Set SYNC to Reply
UF?	(#XXXX.XX)	Get UUT Frequency (1020 to 1155 MHz)
UW?	(#XXXX)	Get UUT Power in Watts
WN		Set Narrow Tolerance Window
WW		Set Wide Tolerance Window
S-1403DL		

General Command	Data	Description
Format	ASCii/BINary/ HEXadecimal/OCTal	Sets format for numerical data returns
S1403c		Switches to old-style command interpreter
SCPI		Switches to new SCPI-style command interpreter
SYSTem:LANGuage S1403C		Switches to old-style command interpreter

XPDR Command	Data	Description
C?	(#XXXXXX)	Get XPDR Code/Altitude
DI=	XXX.X	Double Interrogation P1 to P1 spacing (20.5+Mode Spacing to 399.0 us)
IP=	+/-XXX.X	Enable and Deviate INTRF Pulse (-17.5 to 399.9 us)
IP0		Disable INTRF Pulse and Double INTERR Pulse
P0		Disable XPDR PRF
P1		Enable XPDR PRF
S0		Disable SLS Pulse
S1		Enable SLS Pulse
U%?	(#XXXX)	Get UUT XPDR % Reply (0% to 159%)
XA		Set XPDR Mode A
XC		Set XPDR Mode C
XA1		Set XPDR Mode AC1
XA2		Set XPDR Mode AC2
XP=	X.XX	Set XPDR Pulse Width (0.10 to 1.95 us)
XP0		Set XPDR Pulse Width to Cal
XP1		Set XPDR Pulse Width to Variable Value
XV=	X.XX	Set P2/P3 Deviation (0.00 to 1.95 us in 0.05 us steps)
XV20		Set P2 Pulse Spacing to CAL
XV2+		Increases P2 Pulse Spacing by Value set in XV=
XV2-		Decreases P2 Pulse Spacing by Value set in XV=
XV30		Set P3 Pulse Spacing to CAL
XV3+		Increases P3 Pulse Spacing by Value set in XV=
XV3-		Decreases P3 Pulse Spacing by Value set in XV=

XPDR Command	Data	Description
SCPI-Style: INTerrogation:TRIGger:BURST Old-Style: BURST.		Same as pressing BURST key
SCPI-Style: GENerator[:STATe] Old-Style:	ANTA/ANTB (0/1), ON/OFF (1/0) OFF or –1.95 to 1.95 in 0.05	Enable/Disables interrogation for specified antenna

XPDR Command	Data	Description
ANTB=		
SCPI-Style: GENerator:TIME:OFFSet <n> Old-Style: ANTB=	-0.95 to 0.95 OFF or –1.95 to 1.95 in 0.05	Sets ANTB interrogation position in us, relative to ANTA
SCPI-Style: GENerator[:STATe]<ant>? Old-Style: ANTB?		Returns interrogation status for specified antenna
SCPI-Style: GENerator:TIME:OFFSet ? Old-Style: ANTB?		Returns the ATNB interrogation position in us, relative to ANTA
SCPI_Style: GENerator:LEVel <ant>,<coarse> Old-Style: BRF=	ANTB (1), -20 to –83 -20 to -83	Sets ANTB level in dBm
SCPI_Style: GENerator:LEVel:OFFset <ant>,<fine> Old-Style: BRFLV= or RFLV=	ANTA/ANTB (0/1), -3.0 to 3.0 -3.0 to 3.0	Sets ANTB vernier in dB
GENerator:LEVel?<ant>	ANTB (1)	Returns ANTB level setting in dBm
GENerator:LEVel:OFFSet?		Returns ANTB vernier setting in dB
SCPI-Style: INTerrogation:FUNCtion:ATCrbs ~~&~~ ~~ATC1400a:ATCRBS "A"~~ ~~(stand alone only)~~ Old-Style: ATC		Starts ATC Function
SCPI-Style: INTerrogation:FUNCtion? Old-Style:		Returns active interrogation function with parameters

XPDR Command	Data	Description
MODE?		
SCPI-Style: INTerrogation:FUNCtion:INTerlace <n> Old-Style: INTLCE=<n>	1 to 999	Starts Interlace / sets ATCRBS to Mode S interrogations ratio
SCPI-Style: INTerrogation:FUNCtion:INTerlace? Old-Style: none		Returns ATCRBS to Mode S interrogation ratio setting
SCPI-Style: INTerrogation:FUNCtion:DI <f1>,<f2> & ~~ATC1400a:MODE "DI", 50~~ Old-Style: DI=	"ATC"/"SEQ"/"ACS"/"ACL" "ATC"/"SEQ"/"ACS"/"ACL"	Starts DI / sets both interrogation types
SCPI-Style: INTerrogation:FUNCtion:DI? Old-Style: Mode?		Returns DI interrogation types
SCPI-Style: INTerrogation:FUNCtion:BURST<f1>,<BN> Old-Style: BURST=	"ATC"/"SEQ"/"ACS"/"ACL" 1 to 9999	Starts Burst/ sets interrogation type and number
SCPI-Style: INTerrogation:FUNCtion:BURST? (No Old-Style)		Returns the BURST interrogation type and number setting
SCPI_Style: INTerrogation:P3 <level>	"CAL"/"VAR"/"OFF"	Sets P3 pulse level
SCPI_Style: INTerrogation:P3?		Returns P3 pulse level setting
SCPI_Style: INTerrogation:P6 <level>[,<width>[,<dev>]]	"CAL"/"OFF","CAL"/-1.50 to +1.50, "CAL"/-1.95 to +1.95	Sets P6 pulse level, width and position.
SCPI_Style: INTerrogation:P6?		Returns P6 pulse level, width and position setting.

XPDR Command	Data	Description
SCPI_Style: INTerrogation:P2 <level>	“CAL” / ”VAR” / ”OFF”	Sets P2 pulse level
SCPI_Style: INTerrogation:P2?		Returns P2 pulse level
SCPI_Style: INTerrogation:P6:SPR <on/off>[,<dev>]		ON/OFF,”CAL”/-1.00 to 1.00
SCPI_Style: INTerrogation:P6:SPR?		Returns SPR control and position setting
SCPI_Style: INTerrogation:P4 <level>[,<width>[,<dev>]]	“CAL”/”VAR”/”OFF”,”CAL”/0.20 to 3.55, “CAL”/-1.95 to +1.95	Sets P4 pulse level, width and position.
SCPI_Style: INTerrogation:P4?		Returns P4 pulse level, width and position setting.
SCPI_Style: REPLy:ATCRbs? Old-Style: none		Returns Mode C reply altitude or Mode A reply identification
SCPI_Style: REPLy:DELay[<type?]? Old-Style: RPDLY?	“ATC” / ”MODES”	Returns reply delay in us
SCPI_Style: REPLy:DELay:FIRSt? Old-Style: none		Returns reply delay for the current function
SCPI Style: REPLy:DELay:CLEar Old-Style: none		Clears the percent reply readings
SCPI_Style: REPLy:PERCent?[<ant>[,<rtype>]] Old-Style: PRPLY? or APER? or BPER? or SPER? (antenna A only)	ANTA/ANTB,”TOTAL”/”ATC”/”MODES”/”BAD”/”NOREPLY”	Sets percent reply through selected antenna for set type
SCPI Style:		Clears percent reply readings.

XPDR Command	Data	Description
REPly:PERCent:CLEar Old-Style: none		
SCPI-Style: SQTR:ADDRess? Old-Style: SQADD? (returns Mode S address in latest squitter, doesn't set the source)		Returns squitter address
SCPI-Style: SQTR:TAIL?		Returns squitter tail number and country
SCPI-Style: SQTR:COUNt:PERiod <t>	10 to 300	Sets period in seconds for counting squitters
SCPI-Style: SQTR:COUNt:PERiod?		Returns period sett99ing in seconds for counting squitters
SCPI-Style: SQTR:COUNt? [<type>]	"DF11"/"DF17"/"DF17A"/"DF17I"/"DF17O"/"DF17P"/"DF17S"/"DF17T"	Returns squitter count during set period for selected type
SCPI-Style: SQTR:COUNt:CLEar		Clears squitter count readings
SCPI-Style: SQTR:TIMe? <type>[,<format>] Old-Style: SQTR? SQTRDF11? SQTRDF17A? SQTRDF17I? SQTRDF17O? SQTRDF17P? SQTRDF17S? SQTRDF17T?	"DF11"/"DF17"/"DF17A"/"DF17I"/"DF17O"/"DF17P"/"DF17S"/"DF17T", "A"/"N"	Returns squitter time intervals in seconds and data in selected format.
SCPI-Style: SQTR:TIMe:CLEar Old-Style: SQTRDFCLEAR		Clears squitter time readings
SCPI-Style: SQTR:CAPTure[:STATe]<on/off> Old-Style: SQTRBUFCAPTURE=	ON/OFF (1/0)	Enables/disables squitter capture
SCPI-Style:		Clears all buffer entries

XPDR Command	Data	Description
SQTR:CAPTure:CLEar Old-Style: SQTRBUFCLEAR		
SCPI-Style: SQTR:CAPTure:COUNt? Old-Style: SQTRBUFCOUNT?		Returns number of entries in capture buffer and capacity
SCPI-Style: SQTR:CAPTure:FILTer <filter> Old-Style: SQTRBUFFILTER=	OR mask of: 1 = ATCRBS Fruit 2 = Non-DF11/DF17/Mode S Fruit 4 = DF11 Squitter 8 = DF17I Squitter 16 = DF17S Squitter 32 = DF17A Squitter 64 = DF17T Squitter 128 = DF17P Squitter 256 = DF17O Squitter	Sets squitter capture filter
SCPI-Style: SQTR:CAPTure:FILTer? Old-Style: none		Returns squitter capture filter setting
SCPI_Style: SQTR:CAPTure:GET?<format> Old-Style: SQTRBUFGET? (returns entire squitter & interval)	“A”/”N”	Returns squitter capture buffer data. “A” is all bits and “N” is data with downlink format and address broken out. Data format is set by the INT:SMEN:FORM command
SCPI-Style: INTerrogation:TRIGger:SOURce <src> (No Old-Style)	“SELFint”/”SYNC”/”TRIGgen”/”BURSt”	Sets interrogation trigger source
SCPI-Style: INTerrogation:TRIGger:SOURce? (No Old-Style)		Returns interrogation trigger source setting
SCPI-Style: INTerrogation:TRIGger:GENerator <num><hz|sec> (No Old-Style)	0.004 to 99.999 SEC or 1 to 2500 Hz	Sets internal trigger generator
SCPI-Style:		Returns internal trigger generator setting

XPDR Command	Data	Description
INTerrogation:TRIGger:GENerator? (No Old-Style)		
SCPI-Style: INTerrogation:SCOPe<type>,<on/off>[,<dev>] (No Old-Style)	"ATC"/"MODES"/"ACS"/"ACL",ON/OFF (1/0), 0 to 255 or "CAL" ATC: 0 to 35 us MODES: 0 to 255 us ACS: 0 to 255 us ACL: 0 to 255 us	Sets SCOPE TRIG OUT
SCPI-Style: INTerrogation:SCOPe? (No Old-Style)		Returns SCOPE TRIG OUT settings
SCPI-Style: INTerrogation:SYNC:OUT<type>,<on/off> Old-Style EXSYN=	"ATC"/"MODES"/"ACS"/"ACL",ON/OFF (1/0)	Sets EXT SYNC OUT connector output
SCPI-Style: INTerrogation:SYNC:OUT? Old-Style EXSYN?		Returns EXT SYNC OUT connector output
SCPI-Style: INTerrogation:SYNC:OUT:DEViation<value> Old-Style (none)	-9.95 to 9.95	Sets EXT SYNC OUT connector pulse position in us from P1.
SCPI-Style: INTerrogation:SYNC:OUT:DEViation? Old-Style (none)		Returns EXT SYNC OUT connector pulse position in us from P1.
SCPI-Style: INTerrogation:PPMG<type>,<on/off>[,<pulse#>] Old-Style PPMG=	"ATC"/"MODES"/"DELM",ON/OFF (1/0), pulse#: ATC: "F1", "F2", "A1", "A2", "A4", "B1", "B2", "B4", "C1", "C2", "C4", "D1", "D2", "D4", "X", "SPI" MODES: 1 to 116 DELM: 1 to 16	Sets Pulse Power Measurement Gate control for specified pulse
SCPI-Style: INTerrogation:PPMG?<type> Old-Style PPMG?	"ATC"/"MODES"/"DELM"	Returns Pulse Power Measurement Gate control for specified type
SCPI-Style: INTerrogation:MODulation<ant>,<on/off>	ANTA/ANTB (0/1), INT/EXT/INTExt	Specifies Mode S modulation for the selected antenna

XPDR Command	Data	Description
Old-Style EXMOD=		
SCPI-Style: INTerrogation:MODulation?<ant> Old-Style EXMOD?	ANTA/ANTB (0/1)	Returns Mode S modulation for the selected antenna
SCPI-Style: INTerrogation:PPULse<on/off>[,<dev>] Old-Style none	ON/OFF (1/0), 0 to 260	Sets PREPULSE OUT status and position
SCPI-Style: INTerrogation:PPULse? Old-Style none		Returns PREPULSE OUT status and position
SCPI-Style: INTerrogation:SMENu:FORMat <f> Old-Style none	HEXadecimal/OCTal	Sets numerical format for sequence menu data
SCPI-Style: INTerrogation:SMENu:FORMat? Old-Style none		Returns numerical format for sequence menu data
SCPI-Style: INTerrogation:SMENu:SET:ALL<x> Old-Style none	“OFF”/”XPDR”/”USER”/”ZERO”/”DEFault”	Modifies the ADDR interrogation field in all sequence menus
SCPI-Style: INTerrogation:SMENu:GLOBal:ADDRess <gtype>,<addr> Old-Style none	“USER”, 0 to 8388608	Sets global transponder address
SCPI-Style: INTerrogation:SMENu:GLOBal:ADDRess? <gtype> Old-Style none	“XPDR”/”USER”	Returns global transponder address
SCPI-Style:	“XPDR”/“USER”, 0 to 8388608	Sets global XOR mask

XPDR Command	Data	Description
INTerrogation:SMENu:GLOBal:APXor<gtype>,<xor> Old-Style none		
SCPI-Style: INTerrogation:SMENu:GLOBal:APXor?<gtype> Old-Style none	“XPDR”/“USER”	Returns global XOR mask
SCPI-Style: SYSTem:COMMunicate:SERial:RCI<on/off> Old-Style none	ON/OFF (1/0)	Enables/disables control through RS232 connector
SCPI-Style: SYSTem:COMMunicate:SERial:RCI? Old-Style none		Returns control status through RS232 connector
SCPI-Style: SYSTem:COMMunicate:SERial:ECHO<on/off> Old-Style none	ON/OFF (1/0)	Enables/disables RS232 remote command echo
SCPI-Style: SYSTem:COMMunicate:SERial:ECHO? Old-Style none		Returns RS232 remote command echo status
SCPI-Style: SYSTem:COMMunicate:SERial:DUMP<on/off>[,<bdr>,<eol>] Old-Style none	ON/OFF (1/0),8/7/0,”CRLF”/”LF”/”CR”/”NUL”	Sets RS232 screen dump parameters
SCPI-Style: SYSTem:COMMunicate:SERial:DUMP? Old-Style none		Returns RS232 screen dump parameters
SCPI-Style: SYSTem:COMMunicate:SERial:BAUD<rate> Old-Style	110/150/300/600/1200/2400/4800/9600/19200/38400/57600	Sets RS232 baud rate

XPDR Command	Data	Description
none		
SCPI-Style: SYSTem:COMMunicate:SERial:BAUD? Old-Style none		Returns RS232 baud rate
SCPI-Style: SYSTem:COMMunicate:SERial:BITS<b> Old-Style none	7/8	Sets RS232 bits per word
SCPI-Style: SYSTem:COMMunicate:SERial:BITS? Old-Style none		Returns RS232 bits per word
SCPI-Style: SYSTem:COMMunicate:SERial:SBITS<b> Old-Style none	1/2	Sets RS232 stop bits per word
SCPI-Style: SYSTem:COMMunicate:SERial:SBITS? Old-Style none		Returns RS232 stop bits per word
SCPI-Style: SYSTem:COMMunicate:SERial:PARity<p> Old-Style none	NONE/ODD/EVEN	Sets RS232 parity check mode
SCPI-Style: SYSTem:COMMunicate:SERial:PARity? Old-Style none		Returns RS232 parity check mode
SCPI-Style: SYSTem:COMMunicate:SERial:PACE<hndshk> Old-Style none	NONE/XON	Sets RS232 software handshaking mode
SCPI-Style: SYSTem:COMMunicate:SERial:PACE? Old-Style		Returns RS232 software handshaking mode

XPDR Command	Data	Description
none		
SCPI-Style: SYSTem:COMMunicate:SERial:CONTrol:RTS<hndshk> Old-Style none	ON/STANdard/RFR	Sets RS232 hardware handshaking mode
SCPI-Style: SYSTem:COMMunicate:SERial:CONTrol:RTS? Old-Style none		Returns RS232 hardware handshaking mode
SCPI-Style: SYSTem:COMMunicate:GPIB:RCI<on/off> Old-Style none	ON/OFF (1/0)	Enables/disables control through GPIB connector
SCPI-Style: SYSTem:COMMunicate:GPIB:RCI? Old-Style none		Returns control status through GPIB connector
SCPI-Style: SYSTem:COMMunicate:GPIB:ADDRess<af> Old-Style none	0 to 31	Sets S-1403DL GPIB address
SCPI-Style: SYSTem:COMMunicate:GPIB:ADDRess? Old-Style none		Returns S-1403DL GPIB address
SCPI-Style: SYSTem:COMMunicate:ATC1400:CONTrol<c> Old-Style none	“MASTer”/”SLAVe”/”ALONe”	Sets S-1403DL control relationship with ATC-1400A
SCPI-Style: SYSTem:COMMunicate:ATC1400:CONTrol? Old-Style none		Returns S-1403DL control relationship with ATC-1400A
SCPI-Style: SYSTem:COMMunicate:ATC1400:S1403c:ADDRess<a>	2 to 7	Sets S-1403DL IFR bus address

XPDR Command	Data	Description
Old-Style none		
SCPI-Style: SYSTem:COMMunicate:ATC1400:S1403c:ADDRess? Old-Style none		Returns S-1403DL IFR bus address
SCPI-Style: SYSTem:DATE<y>,<m>,<d> Old-Style none	0000 to 9999, 1 to 12, 1 to 31	Sets current date
SCPI-Style: SYSTem:DATE? Old-Style none		Returns current date
SCPI-Style: SYSTem:TIME<h>,<m>,<s> Old-Style none	0 to 23, 0 to 59, 0 to 59	Sets current time
SCPI-Style: SYSTem:TIME? Old-Style none		Returns current time
*IDN?		Returns identification, serial number and firmware versions
*OPT?		
SCPI-Style: INTerrogation:SMENu<smenu#>,<on/off>[,<iformat>,<data>] Old-Style none	0 to 999, ON/OFF (1/0), “A”/”N”/”S”/”L”, (<data> varies with <iformat>)	Sets interrogation data for specific sequence menu
SCPI-Style: INTerrogation:SMENu?<smenu#>[,<iformat>] Old-Style none	0 to 999, “A”/”N”/”S”/”L”	Returns interrogation data for specific sequence menu
SCPI-Style: INTerrogation:SMENu:BITS<smenu#>,<startbit#>,<bitlen>,<data>	0 to 999, 1 to 112, 1 to 32, (value for up to 32 bits of data)	Sets selected interrogation data bits of selected sequence menu

XPDR Command	Data	Description
Old-Style none		
SCPI-Style: INTerrogation:SMENu:BITS?<smenu#>,<startbit#>,<bitlen> Old-Style none	0 to 999, 1 to 112, 1 to 32	Returns selected interrogation data bits of selected sequence menu
SCPI-Style: INTerrogation:SCOPe:SMENu<smenu#>,<on/off> Old-Style none	0 to 999, ON/OFF (1/0)	Activates/deactivates SCOPE TRIG OUT connector pulse for selected sequence menu
SCPI-Style: INTerrogation:SCOPe:SMENu?<smenu#> Old-Style none	0 to 999	Returns SCOPE TRIG OUT connector pulse for selected sequence menu
SCPI_Style: REPLy:SMENu?<smenu#>[,<rformat>] Old-Style: DFSQ?	0 to 999, “A”/”N”	Returns selected sequence menu reply data in set format
SCPI_Style: REPLy:SMENu:BITS?<smenu#>,<startbit#>,<bitlen> Old-Style: DFSQ?	0 to 999, 1 to 112, 1 to 32	Returns selected sequence menu reply data

TABLE 2

SPCI Commands

Command	Parameters	Definition	Return Value
GEN <ant>,<on/off>	**<ant>** = ANTA or 0 (i.e. MAIN), ANTB or 1 (i.e. TOP) **<on/off>** = OFF or 0, ON or 1	Turn ON/OFF the specified RF output.	
GEN:STAT <ant>,<on/off>	**<ant>** = ANTA or 0 (i.e. MAIN), ANTB or 1 (i.e. TOP) **<on/off>** = OFF or 0, ON or 1	Turn ON/OFF the specified antenna.	
GEN? <ant>	**<ant>** = ANTA or 0 (i.e. MAIN), ANTB or 1 (i.e. TOP)	Request the on/off status of the specified RF output.	0 = OFF 1 = ON
GEN:STAT? <ant>	**<ant>** = ANTA or 0 (i.e. MAIN), ANTB or 1 (i.e. TOP)	Request the on/off status of the specified RF output.	0 = OFF 1 = ON
GEN:LEV <ant>,<coarse>	**<ant>** ANTB or 1 (i.e. TOP) **<coarse>** = -83 to -20 (dBm in 1 dBm steps)	Set the RF level of the specified RF output.	
GEN:LEV? <ant>	**<ant>** = ANTA or 0 (i.e. MAIN), ANTB or 1 (i.e. TOP)	Request the RF level of the specified RF output.	**<level>** = -83 to -20 (dBm in 1 dBm steps)
GEN:LEV:OFFS <ant>,<fine>	**<ant>** = ANTA or 0 (i.e. MAIN), ANTB or 1 (i.e. TOP) **<fine>** = -3.0 to 3.0 (dB in 0.1 dB steps)	Adjust the RF level of the specified RF output.	
GEN:LEV:OFFS? <ant>	**<ant>** = ANTA or 0 (i.e. MAIN), ANTB or 1 (i.e. TOP)	Request the RF level adjustment for the specified RF output.	**< level >** = -3.0 to 3.0 (dB in 0.1 dB steps)
GEN:TIME:OFFS <value>	**<value> =** -0.95 to 0.95 (µs in 0.05 µs steps)	Set the timing offset for the TOP RF board.	
INT:FUNC?		Request mode setting.	**<f>** = ATC, SEQ, ACL, ACS, INT, DI, BURS, or ATCM
INT:FUNC:ACL		Set mode to ACL. If the XA command was received prior to this command the mode will be set to AACL. If the XC command was received prior to this command the mode will be set to CACL. If neither XA or XC command was received prior to this command the mode will be set to AACL.	
INT:FUNC:ACS		Set mode to ACS. If the XA command was received prior to this command the mode will be set to AACS. If the XC	

INT:FUNC:ACS (Continued)		command was received prior to this command the mode will be set to CACS. If neither XA or XC command was received prior to this command the mode will be set to AACS.	
INT:FUNC:ATC		Set mode to ATCRBS. If the XA command was received prior to this command the mode will be set to A. If the XC command was received prior to this command the mode will be set to C. If neither XA or XC command was received prior to this command the mode will be set to A.	
INT:FUNC:BURST [<f1>,<n1>]	**<f1>** = "ATC", "SEQ", "ACS" or "ACL" (quotes are required) **<n1>** = 1 to 9999	Set mode to BURST mode. If this command received previously no parameters are necessary. The <f1> parameter is the interrogation type that will be burst. The <n1> is the number of interrogations to burst.	
INT:FUNC:BURST?		Request BURST type and BURST count.	<f1>,<n1> **<f1>** = ATC, SEQ, ACS or ACL **<n1>** = 1 to 9999
INT:FUNC:DI [<f1>,<f2>]	**<f1>** = "ATC", "SEQ", "ACS" or "ACL" (quotes are required) **<f2>** = "ATC", "SEQ", "ACS" or "ACL" (quotes are required)	Set mode to DOUBLE mode. If this command received previously no parameters are necessary. Both interrogations defined by <f1> and <f2> come out each PRF. The spacing between <f1> and <f2> is defined by the DI command.	
INT:FUNC:DI?		Request the two Double mode interrogation types.	<f1>,<f2> **<f1>** = ATC, SEQ, ACS or ACL **<f2>** = ATC, SEQ, ACS or ACL
INT:FUNC:INT <n>	**<n>** = 1 to 999	Set mode to INTERLACE mode. The number of ATCRBS interrogations transmitted for each Mode S interrogation is defined by <n>. If the XA command was received prior to this command the ATCRBS interrogation will be set to A. If the XC command was received prior to this command the ATCRBS interrogation will be set to C. If neither XA or XC command was received prior to this command the ATCRBS interrogation will	

		be set to A.	
INT:FUNC:INT?		Request the interlace ratio.	**<n>** = 1 to 999
INT:FUNC:SEQ		Set mode to SEQUENCE mode. The SEQUENCE interrogations should be setup prior to issuing this command.	
INT:MOD <ant>,<src>	**<ant>** = ANTA or 0 (i.e. MAIN), ANTB or 1 (i.e. TOP) **<src>** = “INT”, “EXT”, “INTE” (quotes are required)	Set the modulation source for the specified antenna.	
INT:MOD? <ant>	**<ant>** = ANTA or 0 (i.e. MAIN), ANTB or 1 (i.e. TOP)	Request the modulation source for the specified antenna.	**<src>** = INT, EXT, INTE
INT:P2 <level>	**<level>** = “CAL”, “VAR” or “OFF” (quotes are required)	Set P2 level. CAL: set to P1 level VAR: set to level defined with the ES command OFF: turn P2 off	
INT:P2?		Request the P2 level setting.	**<level>** = CAL, VAR or OFF
INT:P3 <level>	**<level>** = “CAL”, “VAR” or “OFF” (quotes are required)	Set P3 level. CAL: set to P1 level VAR: set to level defined with the ES command OFF: turn P3 off	
INT:P3?		Request the P3 level setting.	**<level>** = CAL, VAR or OFF
INT:P4 <level>[,<width>[,<dev>]	**<level>** = “CAL”, “VAR” or “OFF” (quotes are required) **<width>** = “CAL” or 0.20 to 3.55 (µs in 0.0125 µs steps) (quotes are required as shown) **<dev>** = “CAL” or -1.95 to 1.95 (µs in 0.025 µs steps) (quotes are required as shown)	Define P4 pulse level, width (optional) and position (optional). for level: CAL: set to P1 level VAR: set to level defined with the ES command OFF: turn P4 off	
INT:P4?		Request the P4 level, pulse width and pulse position.	<level>,<width>,<dev> **<level>** = CAL, VAR or OFF **<width>** = CAL or 0.20 to 3.55 (µs in 0.0125 µs steps) **<dev>** = CAL or -1.95 to 1.95 (µs in 0.025 µs steps)

INT:P6 <level>[,<width>[,<dev>]	**<level>** = “CAL” or “OFF” (quotes are required) **<width>** = “CAL” or –1.50 to 1.50 (µs in 0.25 µs steps from CAL) (quotes are required as shown) **<dev>** = “CAL” or -1.95 to 1.95 (µs in 0.025 µs steps from CAL) (quotes are required as shown)	Define P6 pulse level, width (optional) and position (optional). for level: CAL: set to P1 level OFF: turn P6 off	
INT:P6?		Request the P6 level, pulse width and pulse position.	<level>,<width>,<dev> **<level>** = CAL or OFF **<width>** = CAL or –1.50 to 1.50 (µs in 0.25 µs steps from CAL) **<dev>** = CAL or -1.95 to 1.95 (µs in 0.025 µs steps from CAL)
INT:P6:SPR <on/off>[,<dev>]	**<on/off>** = OFF or 0, ON or 1 **<dev>** = “CAL” or -1.00 to 1.00 (µs in 0.025 µs steps from CAL) (quotes are required as shown)	Enable/Disable SPR and set it’s position <optional>.	
INT:P6:SPR?		return the P6 on/off status (1/0) and position	<on/off>,<dev> **<on/off>** = 0 or 1 **<dev>** = CAL or -1.00 to 1.00 (µs in 0.025 µs steps from CAL)

INT:PPMG <type>,<on/off>[,<pulse#>]	**<type>** = “ATC”, “DELM” or “MODES” (quotes are required)
	
	<on/off> = OFF or 0, ON or 1
	
	if <type> = “ATC”:
	<pulse#> = “F1”, “F2”, “A1”, “A2”, “A4”, “B1”, “B2”, “B4”, “C1”, “C2”, “C4”, “D1”, “D2”, “D4”, “X” or “SPI” (quotes are required)
	
	if <type> = “MODES”:
	<pulse#> = 1 to 116
	
	if <type> = “DELM”:
		Define which pulse should be used to measure power and frequency. (Pulse selection is optional)	

	<pulse#> = 1 to 16		

INT:PPMG? <type>	**<type>** = “ATC”, “DELM” or “MODES” (quotes are required)	Request the on/off status and selected pulse to be used for power and frequency measurements for the specified type.	<on/off>,<pulse#>
			
			<on/off> = 0 or 1
			
			if <type> = “ATC”:
			<pulse#> = F1, F2, A1, A2, A4, B1, B2, B4, C1, C2, C4, D1, D2, D4, X or SPI
			
			if <type> = “MODES”:
			<pulse#> = 1 to 116
			
			if <type> = “DELM”:
			<pulse#> = 1 to 16

INT:PPUL <on/off>[,<dev>]	**<on/off>** = OFF or 0, ON or 1 **<dev>** = 0 to 260 (µs in 1 µs steps)	Enable/Disable the prepules and set the position prior to P1. Position is optional.	
INT:PPUL?		Request the on/off status and position of the prepulse.	<on/off>,<dev> **<on/off>** = 0 or 1 **<dev>** = 0 to 260 (µs in 1 µs steps)

INT:SCOP <type>,<on/off>[,<dev>]	**<type>** = “ATC”, “MODES”, “ACS” or “ACL” (quotes are required)
	
	<on/off> = OFF or 0, ON or 1
	
	if <type> = “ATC”:
	<dev> = 0 to 35 (µs in 1 µs steps)
	
	else:
	<dev> = 0 to 255 (µs in 1 µs steps)
		Enable/Disable the scope sync for the specified interrogation type and set it’s position (optional).	

INT:SCOP? <type>	**<type>** = “ATC”, “MODES”, “ACS” or “ACL” (quotes are required)	Request the on/off status and position of the scope trigger for the specified type.	<on/off>,<dev>
			
			<on/off> = OFF or 0, ON or 1
			
			if <type> = “ATC”:
			<dev> = 0 to 35 (µs in 1 µs steps)
			
			else:
			<dev> = 0 to 255 (µs in 1 µs steps)

INT:SMEN <smenu#>,<on/off>[,<iformat>,<data>]	**<smenu#>** = 0 to 999 **<on/off>** = OFF or 0, ON or 1 **<iformat>** = “A”, “N”, “S” or “L” (quotes	Enable/Disable the specified sequence number. Optional: define the mode S data for the specified sequence number in the	

INT:SMEN (Continued)	are required)
	
	if <iformat> = “A”:
	<data> = 56 or 112 bits preceded by #H if specified radix is hex, #Q if specified radix is octal. The prefix and the data bits must be enclosed in quotes.
	
	else:
	<data> = <uf#>,<data>,<addr>
	where <uf#> is in decimal. <data> is 27 or 83 bits preceded by #H if specified radix is hex, #Q if specified radix is octal. The prefix and the data bits must be enclosed in quotes. <addr> is the 24 bit address preceded by #H if specified radix is hex, #Q if specified radix is octal.
		specified format.	

INT:SMEN? <smenu#>,<iformat>	**<smenu#>** = 0 to 999
	
	<iformat> = “A”, “N”, “S” or “L” (quotes are required)
		Request the status and data for the specified sequence number.	<on/off>,<iformat>,<data>
			
			<on/off> = OFF or 0, ON or 1
			
			<iformat> = “A”, “N”, “S” or “L”
			
			if <iformat> = “A”:
			<data> = 56 or 112 bits preceded by #H if specified radix is hex, #Q if specified radix is octal.
			
			else:
			<data> = <uf#>,<data>,<addr>
			where <uf#> is in decimal. <data> is 27 or 83 bits preceded by #H if specified radix is hex, #Q if specified radix is octal. <addr> is the 24 bit address preceded by #H if specified radix is hex, #Q if specified radix is octal.

INT:SYNC:OUT <type>,<on/off>	**<type>** = “ATC”, “MODES”, “ACS” or “ACL” (quotes are required) **<on/off>** = OFF or 0, ON or 1	Enable/Disable the external sync pulse for the specified interrogation type.	
INT:SYNC:OUT? <type>	**<type>** = “ATC”, “MODES”, “ACS” or “ACL” (quotes are required)	Request the on/off status of the sync pulse for the specified type.	0 = OFF 1 = ON
INT:SYNC:OUT:DEV <dev>	**<dev>** = -9.95 to 9.95 (µs in .0125 µs steps)	Set the position for the external sync pulse.	
INT:SYNC:OUT:DEV?		Request the position of the sync pulse.	**<dev>** = -9.95 to 9.95 (µs in .0125 µs steps)
INT:TRIG:BURS		In BURST mode trigger the burst. If not in BURST mode single shot the selected	

		interrogation.	
INT:TRIG:GEN <num> <hz/sec>	**<num>** = 1 to 2500 if <hz/sec> = HZ **<num>** = 0.0004 to 99.9999 if <hz/sec> = SEC **<hz/sec>** = HZ or SEC (note that there is not a comma between the two parameters in this singular case)	Set the PRF rate.	
INT:TRIG:GEN?		Request the PRF rate.	<num> <hz/sec> **<num>** = 1 to 2500 if <hz/sec> = HZ **<num>** = 0.0004 to 99.9999 if <hz/sec> = SEC **<hz/sec>** = Hz or sec (note that there is not a comma between the two parameters in this singular case)
INT:TRIG:SOUR <src>	**<src>** = “SELF”, “SYNC”, “TRIG” or “BURS” (quotes are required)	Set the interrogation trigger source. “SELF” – wrap interrogation around to reply. “SYNC” – use the external source. “TRIG” – use the PRF provide by the INT:TRIG:GEN command. “BURS” – trigger controlled by the INT:TRIG:BURS command.	
INT:TRIG:SOUR?		Request the interrogation trigger source.	**<src>** = SELF, SYNC, TRIG or BURS
REPL:ATCR?		Request ATCRBS reply data.	<atype>, <value>, <X>, <IP/EM> **<atype>** = ID for a mode A reply, ALT for a mode C reply **<value>** = four octal numbers of the ident code (preceded by ID if the SPI is present) for a mode A reply, altitude in feet for a mode C reply **<X>** = is X if the X pulse is present, blank otherwise

REPL:ATCR? (Continued)			**<IP/EM>** = IP if SPI present, EM for an emergency identification reply
REPL:DEL? <rtype>	**<rtype>** = “ATC” or “MODES”	Request reply delay data for the specified type.	<delay>,<min>,<max> **<delay>** = current reply delay measurement **<min>** = minimum reply delay measurement **<max>** = maximum reply delay measurement All returned values are float and represent µs.
REPL:DEL:CLE		Initialize the min and max reply delays.	
REPL:DEL:FIRS?		Request reply delay only for the current type.	<delay> The returned value is float and represents µs.

REPL:MODES? [<rformat>]	**<rformat>** = “A”, “N”, “S” or “L” (quotes are required)	Request the mode S reply data in the specified format.	<rformat>,<data>
			
			<rformat> = “A”, “N”, “S” or “L”
			
			if <rformat> = “A”:
			<data> = 56 or 112 bits preceded by #H if specified radix is hex, #Q if specified radix is octal.
			
			else:
			<data> = <uf#>,<data>,<addr>
			where <uf#> is in decimal. <data> is 27 or 83 bits preceded by #H if specified radix is hex, #Q if specified radix is octal. <addr> is the 24 bit address preceded by #H if specified radix is hex, #Q if specified radix is octal.

REPL:PERC? [<ant>[,<rtype>]]	**<ant>** = ANTA or 0 (i.e. MAIN), ANTB or 1 (i.e. TOP) **<rtype>** = “TOTAL”, “ATC”, “MODES”, “BAD” or “NOREPLY”	Request reply percentage for the specified antenna and the specified type.	**<percent>** = 0 to 100 Not specifying <ant> and <rtype> results in all percentages for ANTA being returned in the order of the rtype parameter list followed by all percentages for ANTB. Specifying <ant> but not <rtype> results in all percentages for the specified antenna being returned in the order of the rtype parameter list.

REPL:PERC:CLE		Initialize the reply percent measurements.	

REPL:SMEN? <smenu#>[,<rformat>]	**<smenu#>** = 0 to 999
	
	<rformat> = “A”, “N”, “S” or “L” (quotes are required)
	
	if <rformat> = “A”:
	<data> = 56 or 112 bits preceded by #H if specified radix is hex, #Q if specified radix is octal. The prefix and the data bits must be enclosed in quotes.
	
	else:
	<data> = <uf#>,<data>,<addr>
	where <uf#> is in decimal. <data> is 27 or 83 bits preceded by #H if specified radix is hex, #Q if specified radix is octal. The prefix and the data bits must be enclosed in quotes. <addr> is the 24 bit address preceded by #H if specified radix is hex, #Q if specified radix is octal.
		Request the reply data for the specified sequence number in the specified format. If <rformat> is not provided data will be returned in N format.	<rformat>,<data>
			
			<rformat> = “A”, “N”, “S” or “L”
			
			if <rformat> = “A”:
			<data> = 56 or 112 bits preceded by #H if specified radix is hex, #Q if specified radix is octal.
			
			else:
			<data> = <uf#>,<data>,<addr>
			where <uf#> is in decimal. <data> is 27 or 83 bits preceded by #H if specified radix is hex, #Q if specified radix is octal. <addr> is the 24 bit address preceded by #H if specified radix is hex, #Q if specified radix is octal. If the number of bits requested is not a multiple of 8 the data will be left justified.

REPL:SMEN:BITS? <smenu#>,<startbit#>,<bitlen>	**<smenu#>** = 0 to 999 **<startbit#>** = 1 to 112 **<bitlen>** = 1 to 32	Request the specified bits of the reply data for the specified sequence number.	**<data>** = the requested reply data bits preceded by #H if specified radix is hex, #Q if specified radix is octal.
REPL:SPAC? <rtype>	**<rtype>** = “ATC” (quotes are required)	Request the F1 to F2 reply pulse spacing.	<spacing> The returned value is float and represents µs.
REPL:JITT? <rtype>	**<rtype>** = “ATC” or “MODES” (quotes are required)	Request the reply delay jitter for the selected type.	<jitter> The returned value is float and represents µs.
REPL:WIDT? <rtype>	**<rtype>** = “ATC” or “MODES” (quotes are required)	Request the width of the reply pulses for the selected type.	if <rtype> = “ATC”: **<F1width>,<F2 width>** if <rtype> = “MODES” **<P1 width>** The returned value(s) is/are float and represent µs.
REPL:TIM <time>	**<time>** = 1.000 to 65.535 (in seconds)	Set the reply delay time limit.	
SQTR:ADDR?		Request squitter address.	**<addr>** = the 24 bit address extracted from the DF11 squitter preceded by #H if specified radix is hex, #Q if specified radix is octal.

SQTR:CAPT <on/off>	**<on/off>** = OFF or 0, ON or 1	Enable/Disable squitter capturing.	
SQTR:CAPT:STAT <on/off>	**<on/off>** = OFF or 0, ON or 1	Enable/Disable squitter capturing.	
SQTR:CAPT?		Request squitter capturing status.	0 = OFF 1 = ON
SQTR:CAPT:STAT?		Request squitter capturing status.	0 = OFF 1 = ON
SQTR:CAPT:CLE		Clear all squitter capture buffers.	
SQTR:CAPT:COUN?		Request the number of squitters in the buffer and the number of squitters the buffer is capable of storing.	<count>,<max count>
SQTR:CAPT:FILT <filter>	<filter> A set bit indicates that the associated squitter type should be buffered bit 0: ATCRBS FRUIT bit 1: MODES FRUIT bit 2: DF11 squitters bit 3: DF17I squitters bit 4: DF17S squitters bit 5: DF17A squitters bit 6: DF17T squitters bit 7: DF17P squitters bit 8: DF17O squitters	Set which squitters to capture.	
SQTR:CAPT:FILT?		Request the squitter buffer filter setting.	<filter> A set bit indicates that the associated squitter type should be buffered bit 0: ATCRBS FRUIT bit 1: MODES FRUIT bit 2: DF11 squitters bit 3: DF17I squitters bit 4: DF17S squitters bit 5: DF17A squitters bit 6: DF17T squitters bit 7: DF17P squitters bit 8: DF17O squitters
SQTR:CAPT:GET? <format>	**<format>** = “A” or “N” (quotes are required)	Request the next entry in the squitter buffer.	<time>,<ant>,<format>,<data> **<time>** = time since previous squitter in seconds as a float value **<ant>** = 0 (ANTA) or 1 (ANTB) **<format>** = A or N depending on the format

SQTR:CAPT:GET? <format> (Continued)			requested. If no format is specified use N.
			
			if <format> = "A":
			<data> = 56 or 112 bits preceded by #H if specified radix is hex, #Q if specified radix is octal.
			
			else:
			<data> = <uf#>,<data>,<addr>
			where <uf#> is in decimal. <data> is 27 or 83 bits preceded by #H if specified radix is hex, #Q if specified radix is octal. <addr> is the 24 bit address preceded by #H if specified radix is hex, #Q if specified radix is octal. If the number of bits requested is not a multiple of 8 the data will be left justified.

SQTR:CAPT:MODE <mode>	**<mode>** = CONT or SING	Set the squitter buffer mode of operation.	
SQTR:CAPT:MODE?		Set the squitter buffer mode of operation.	**<mode>** = CONTINUOUS or SINGLESHOT
SQTR:COUN? [<type>]	**<type>** = "DF11", "DF17", "DF17A", "DF17I", "DF17O", "DF17P", "DF17S" or "DF17T" (quotes are required)	Request the number of squitters received during the squitter period.	**<count>** = the number of squitters of the specified type received during the last squitter period. **<df11 count>,<df17 count>, <df17a count>,<df17i count>, <df17o count>,<df17p count>, <df17s count>,<df17t count>** = if no type is specified the counts for each of the squitter types will be returned.
SQTR:COUN:CLE		Initialize the squitter counters to zero.	
SQTR:COUN:PER <t>	**<t>** = 10 to 300 (in seconds)	Set the time period during which to count squitters.	
SQTR:COUN:PER?		Request the squitter period.	**<t>** = 10 to 300 (in seconds)
SQTR:TAIL?		Request the tail number and country code extracted from the DF11 squitter.	<tail>,<country> **<tail>** = tail number (ascii string) **<country>** = country name (ascii string)
SQTR:TIM? <type>[,<format>]	**<type>** = "DF11", "DF17", "DF17A", "DF17I", "DF17O", "DF17P", "DF17S" or "DF17T" (quotes are required) **<format>** = "A" or "N" (quotes are required)	Return squitter information for a specified squitter type.	<time>,<min>,<max>,<ant>,<format>,<data> **<time>** = current squitter interval for the specified type (in seconds as a float value) **<min>** = minimum squitter interval for the specified type (in seconds as a float value) **<max>** = maximum squitter interval for the

SQTR:TIM? <type>[,<format>] (Continued)			specified type (in seconds as a float value)
			<ant> = 0 (ANTA) or 1 (ANTB)
			
			<format> = A or N depending on the format requested. If no format is specified use N.
			
			if <format> = "A":
			<data> = 56 or 112 bits preceded by #H if specified radix is hex, #Q if specified radix is octal.
			
			else:
			<data> = <uf#>,<data>,<addr>
			where <uf#> is in decimal. <data> is 27 or 83 bits preceded by #H if specified radix is hex, #Q if specified radix is octal. <addr> is the 24 bit address preceded by #H if specified radix is hex, #Q if specified radix is octal. If the number of bits requested is not a multiple of 8 the data will be left justified.

SQTR:TIM:CLE		Initialize the squitter time measurements counters.	
SQTR:TIM:TIM <type>,<time>	**<type>** = "DF11", "DF17", "DF17A", "DF17I", "DF17O", "DF17P", "DF17S" or "DF17T" (quotes are required) **<time>** = 1.000 to 65.535 (in seconds)	Set the time limit for looking at time between squitters.	
SYST:COMM:ATC:CONT <c>	**<c>** = "MAST", "SLAV" or "ALON"	Set the SI-1404 control relationship with ATC-1400A. This command is accepted but is not needed.	
SYST:COMM:ATC:CONT?		Request the SI-1404 control setting.	**<c>** = "MAST", "SLAV" or "ALON"
SYST:COMM:ATC:S:ADDR <a>	**<a>** = 2 to 7	Set IFR bus address for SI-1404 commands. This command is accepted but is not needed.	
SYST:COMM:ATC:S:ADDR?		Request the IFR bus address setting for SI-1404 commands.	**<a>** = 2 to 7
SYST:COMM:GPIB:ADDR <a>	**<a>** = 0 to 31	Set the GPIB address.	
SYST:COMM:GPIB:ADDR?		Request the GPIB address setting.	**<a>** = 0 to 31
SYST:COMM:GPIB:RCI <on/off>	**<on/off>** = OFF or 0, ON or 1	Enable/Disable remote control via GPIB.	
SYST:COMM:GPIB:RCI?		Request remote control via GPIB status.	0 = OFF 1 = ON

		(Why would you ever reply OFF to this?)	
SYST:COMM:SER:BAUD <rate>	**<rate>** = 110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400 or 57600 (bits per second)	Set the rs232 baud rate.	
SYST:COMM:SER:BAUD?		Request the rs232 baud rate setting.	**<rate>** = 110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400 or 57600 (bits per second)
SYST:COMM:SER:BITS <bits>	**<bits>** = 7 or 8	Set the rs232 bits per word.	
SYST:COMM:SER: BITS?		Request the rs232 bits per word setting.	**<bits>** = 7 or 8
SYST:COMM:SER:CONT:RTS <hndshk>	**<hndshk>** = ON, STAN or RFR	Set the rs232 hardware handshaking mode.	
SYST:COMM:SER: CONT:RTS?		Request the rs232 hardware handshaking mode setting.	**<hndshk>** = ON, STAN or RFR
SYST:COMM:SER:ECHO <on/off>	**<on/off>** = OFF or 0, ON or 1	Enable/Disable rs232 echo.	
SYST:COMM:SER:ECHO?		Request the rs232 echo setting.	0 = OFF 1 = ON
SYST:COMM:SER:PACE <hndshk>	**<hndshk>** = NONE or XON	Set the rs232 software handshaking mode.	
SYST:COMM:SER:PACE?		Request the rs232 software handshaking mode setting.	**<hndshk>** = NONE or XON
SYST:COMM:SER:PAR <p>	**<p>** = NONE, ODD or EVEN	Set the rs232 parity.	
SYST:COMM:SER:PAR?		Request the rs232 parity setting.	**<p>** = NONE, ODD or EVEN
SYST:COMM:SER:RCI <on/off>	**<on/off>** = OFF or 0, ON or 1	Enable/Disable remote control via rs232.	
SYST:COMM:SER:RCI?		Request remote control via rs232 status. (Why would you ever reply OFF to this?)	0 = OFF 1 = ON
SYST:COMM:SER:SBIT <b>	**<b>** = 1 or 2	Set the rs232 number of stop bits.	
SYST:COMM:SER:SBIT?		Request the rs232 number of stop bits.	**<b>** = 1 or 2
SYST:DATE <y>,<m>,<d>	**<y>** = 0000 to 9999 **<m>** = 1 to 12 **<d>** = 1 to 31	Set the current date.	
SYST:DATE?		Request the current date.	<y>,<m>,<d> **<y>** = 0000 to 9999 **<m>** = 1 to 12 **<d>** = 1 to 31
SYST:KEY:REP <delay>,<rate>	**<delay>** = 0.1 to 2.0 (seconds in 0.1 second steps) **<rate>** = 0.1 to 2.0 (seconds in 0.1	Set the SI-1404 keyboard control parameters. This command is accepted but is not	

	second steps)	needed.	
SYST:KEY:REP?		Request the SI-1404 keyboard control parameter settings.	**<delay>** = 0.1 to 2.0 (seconds in 0.1 second steps) **<rate>** = 0.1 to 2.0 (seconds in 0.1 second steps)
SYST:TIME <h>,<m>,<s>	**<h>** = 0 to 23 **<m>** = 0 to 59 **<s>** = 0 to 59	Set the current time.	
SYST:TIME?		Request the current time.	**<h>** = 0 to 23 **<m>** = 0 to 59 **<s>** = 0 to 59

1.2 TB-2100 RS-232 Remote Control

The TB-2100 allows remote control of all functions using RS-232 commands. An RS-232 terminal emulation program such as Terra Term Pro (freeware available at http://hp.vector.co.jp/authors/VA002416/teraterm.html) can be used for control of the TB-2100. The Terra Term Pro terminal emulation program (or equivalent program) should be setup as follows:

Setup/Terminal:

- Uncheck "Local echo"
- Uncheck "Auto switch"
- New-line Receive: CR+LF
- New-line Transmit: CR
- Terminal ID: VT100

Setup/Serial Port: Port: (COM1)
Baud rate: 115200
Data: 8 bit
Parity: none
Stop: 1 bit
Flow control: hardware
Transmit delay: 0/0

The RS-232 commands are shown in Tables 3 and 4.

Table 3

Controller Board Commands

Command	Format	Definition
A	A<accel>, 0 to 399 ft/sec2	Set DME acceleration
ABS	ABS0 – main RF Board, diversity mode ABS1 – top RF Board, diversity mode ABS2 – main RF Board, non-diversity mode ABS3 – top RF Board, non-diversity mode	Set the absolute power cal constants for diversity and non-diversity mode
AX		Axn commands
B	B0 – main RF Board B1 – top RF Board	Select which RF board to send pass through commands to
C?	in A mode return data is AANNNN where the first two characters - AA - are: F0 if F2 is missing ID if SPI is present FD if SPI is present and F2 is missing 00 if F2 is present and SPI is missing and the last 4 characters - NNNN - are the 4 digit octal code. in C mode return data is -AANNNN where the first character - the negative sign - is only present when the BCD altitude is below sea level other wise the return string begins with the next two characters - AA - which is as defined above for mode A and the last five characters are decimal numbers representing the altitude in feet (divided by 1000) with the second to last character being	Request ATCRBS data.

Command	Format	Definition
	a decimal point. The range is -1.0 to 126.5 thousand feet.	
CRX	for the main Board: CRX00<float> – coeff 0 CRX10<float> – coeff 1 CRX20<float> – coeff 2 CRX30<float> – coeff 3 CRX40<float> – coeff 4 CRX50<float> – coeff 5 CRX60<float> – coeff 6 for the top Board: CRX01<float> – coeff 0 CRX11<float> – coeff 1 CRX21<float> – coeff 2 CRX31<float> – coeff 3 CRX41<float> – coeff 4 CRX51<float> – coeff 5 CRX61<float> – coeff 6	Set the 6th order polynomial coefficients describing the RX Power adjustment with RX frequency. CRX00 and CRX01 cause all seven coefficients to be stored in EEPROM on the controller board.
CTX	for the main Board: CTX00<float> – coeff 0 CTX10<float> – coeff 1 CTX20<float> – coeff 2 CTX30<float> – coeff 3 CTX40<float> – coeff 4 CTX50<float> – coeff 5 CTX60<float> – coeff 6 for the top Board: CTX01<float> – coeff 0 CTX11<float> – coeff 1 CTX21<float> – coeff 2 CTX31<float> – coeff 3 CTX41<float> – coeff 4 CTX51<float> – coeff 5 CTX61<float> – coeff 6	Set the 6th order polynomial coefficients describing the TX Power adjustment with TX frequency. CTX00 and CTX01 cause all seven coefficients to be stored in EEPROM on the controller board.
DCL		Return to power up default settings
DF	DF=<float>, 0.00 to 9.99 DF0, remove delta from xmit frequency DF+, add delta to xmit frequency DF-, subtract delta from xmit frequency	Delta transmit frequency in MHz. Transmit frequency is set with the F<float> command
DI	DI=0, disable double mode DI=<float>, maximum is 399.9. The minimum is 40.0 us if the first interrogation is Mode S. If not then the minimum is 20.5 + the P1 to P3 spacing of the first interrogation.	Set the spacing for IFR double mode

Command	Format	Definition
	(Interference pulses are turned off for DI mode.)	
DLD	DLD0 – main RF Board DLD1 – top RF Board	Download RF Board microprocessor code
DMEX		Turn on DME mode
DMEY		Turn on DME mode
DV	DV2=<float>, set the deviation, 0-7.9us DV20, set the spacing to normal DV2+, add the deviation DV2-, subtract the deviation	DME P2 pulse spacing deviation
E	E0 – disable E1 – enable	Control Echo pulses
E%	E%<percent>, 0 to 100	Set the DME reply efficiency
EQ	EQ0 – disable EQ1 – enable	Control Equalizer pulses
ES	ES=<amp>, +3 to –12 (IFR limits were +9 to –19)	Set amplitude of echo/sls pulse
F	F<freq>, 962 to 1213	Set the transmit frequency in MHz
F?		Return the transmit frequency
FP	FP1, F1(xpdr)/P1(dme) FP2, F2(xpdr)/P2(dme)	Select F1/F2 (xpdr) or P1/P2 (dme) for power and frequency measurements
GEN		SCPI commands
GEN?		SCPI commands
GENE		SCPI commands
I2C	I2C.<addr>.<data> addr: 18 – mutual suppression DAC 1C – RF Switch DAC 30 – RF Switch parallel I/O 32 – Top attenuator control 34 – Main attenuator control 36 – Power Supply Board control data: 0xy0 – hex DAC data 0xy0 – hex DAC data 01xx – CC for non-diversity, 30 for diversity 01xx – attenuator setting, 0-ff 01xx – attenuator setting, 0-ff 01xx – bit 7 = power supply status bit 4-6, power supply shutdowns bit 3, backlight control: 0=off, 1=on bit 2, TB-2100 power control bit 0-1, unused	Passes an I2C command to the specified module within the TB-2100
IDN?		SCPI commands

Command	Format	Definition
INT		SCPI commands
INTE		SCPI commands
IP	IP=<float>, -17.5 to 399.9us, enable IP0, disable interference pulse	Control interference pulse. IP= command both sets the timing of the interference pulse wrt to P1 of the interrogation and turns it on
MSI	MSI.<14xh | 28xh>	Set a Mode S interrogation (For use with Mode S 'S' display mode only)
NM	NM0 – disable NNM mode NM1 – enable NNM mode	Control NNM (negative nautical mile) mode
P	P0 – turn off PRF P1 – turn on PRF P? – return PRF	TB2100 PRF
PGM	PGM0 – main RF Board PGM1 – top RF Board	Download RF Board FPGA code
PS	PS=<rate>	Set the interrogation rate in xpdr mode (1 to 2500), the squitter rate in DME mode (1 to 5000), (IFR limits were 0 to 7999)
PWSC	PWSC0<float> – main RF Board PWSC1<float> – top RF Board	Set the measured power cal constants for scaling
R	R<float>, 0 to 399.99	Set the DME range delay in Nmi
R?		Return the DME range delay as a space followed by 5 decimal ASCII characters including a decimal point between the third and fourth digits.
REPL		SCPI commands
RF	RF<level>, 0 to -127	Set the RF output level in dBm
RFSW	RFSW0<char>	Set the RF Switch DAC cal constant
RI		Set DME velocity to inbound
RO		Set DME velocity to outbound
RT	RT0 – turn RF output on RT1 – turn RF output off RT2 – set RF output to CW	Control RF output
S	S0 – turn SLS pulse off S1 – turn SLS pulse on	Control SLS pulse
S1403c		Switch to S1403C command interpreter (we accept but ignore this command, we will interpret all commands at all times no matter the format)
SCPI		Switch to SCPI command interpreter (we accept but ignore this command, we will interpret all commands at all times no matter the format)
SP	SP0 – disable suppression SP1 – enable suppression	Control suppression
SQ	SQ0 – disable SQ1 – enable	Control DME squitter
SQTR		SCPI commands
SYST		SCPI commands
T	TO – scope sync on interrogation TD – scope sync on reply	DME scope sync
TAMB	TAMB0 – main RF Board, diversity mode TAMB1 – top RF Board, diversity mode TAMB2 – main RF Board, non-diversity mode	Set the TAM cal constants for diversity and non-diversity mode

Command	Format	Definition
	TAMB3 – top RF Board, non-diversity mode	
TC	TC0 – disable TC1 – enable	Control TACAN modulation
U%?		Return UUT percent reply
UF?		Request the UUT frequency
UP?		Request the DME interrogation rate
UW?		Request the UUT power
V	V<velocity>, 0 to 9990, lsdigit must be 0	Set DME velocity in knots
V?		Return current DME velocity
WN		Narrow window command. In DME mode send the XNAR or YNAR. In XPDR mode pass the command to the RF board.
WW		Wide window command. In DME mode send the XWID or YWID. In XPDR mode pass the command to the RF board.
XA		Set ATCRBS type to A
XC		Set ATCRBS type to C
XP	XP=<float>, 0.10 to 1.95us XP0, set pulse widths to nominal XP1, set pulse widths as defined by XP=	Control pulse width for ATCRBS pulses
XV	XV=<float>, 0.0 to 1.95 in us XV20, Set P2 pulse position to nominal XV2+, Add deviation to the P2 position XV2-, Subtract deviation from the P2 position XV30, Set P3 pulse position to nominal XV3+, Add deviation to the P3 position XV3-, Subtract deviation from the P3 position	Control pulse position for ATCRBS pulses P2 and P3

Table 4
RF Board Commands

The controller board command “B” selects which RF board these commands are sent to if they are sent via the controller board.

Command	Format	Definition
A		Set up a nominal Mode A interrogation.
AACL		Set up a nominal Mode A/Mode S All-Call interrogation (long P4).
AACS		Set up a nominal Mode A-Only All-Call interrogation (short P4).
BSPC	BSPC<float>, 0.1 to 1000.0 ms	Set the spacing between interrogations in a burst sequence. The burst sequence is repeated at the set PRF rate.
BSQ	BSQ.<sequence>, a sequence of up to 50 interrogations of up to 16 types (0 – F), X means none. For example, BSQ.03AX98, would result in a burst starting with the interrogation in slot 0, followed by the interrogations in slot 3 and slot 0xA, followed by	Set the sequence of interrogations to be used in a burst interrogation. The burst sequence is repeated at the set PRF rate.
BTR?		Request the BOOT code revision string.
C		Set up a nominal Mode C interrogation.
CACL		Set up a nominal Mode C/Mode S All-call interrogation (long P4).
CACS		Set up a nominal Mode C-Only All-Call interrogation (short P4).
CLK	CLK0 – disable the clock output CLK1 – enable the clock output	Enable/Disable a 20MHz clock output to be used by the other RF board.
CLR		Clear contents of the current slot.
CM	CM0 – 1.45us period CM1 – 1.0us period	Set the “cal mark” output period.
CMD	CMD<delay>, 1 to 255, *6.25ns	Set the "cal mark" delay. (NOTE: this command replaces an analog adjustment that was used to line up the cal marks).
CR?	Return <float>	Request the current range in the DME range counter in the FPGA.
CRF	CRF0<float> – coeff 0 CRF1<float> – coeff 1 CRF2<float> – coeff 2 CRF3<float> – coeff 3 CRF4<float> – coeff 4 CRF5<float> – coeff 5 CRF6<float> – coeff 6	Set the 6th order polynomial coefficients describing the RX Power adjustment with RX frequency. CRF0 causes all seven coefficients to be stored in EEPROM on the RF board.

Command	Format	Definition
CRF?	Return: < coeff 0>CRLF < coeff 1>CRLF < coeff 2>CRLF < coeff 3>CRLF < coeff 4>CRLF < coeff 5>CRLF < coeff 6>CRLF (data is returned in scientific notation)	Request the 6th order polynomial coefficients describing the RX Power adjustment with RX frequency .
CSS	CSS0<float> – coeff 0 CSS1<float> – coeff 1 CSS2<float> – coeff 2 CSS3<float> – coeff 3 CSS4<float> – coeff 4 CSS5<float> – coeff 5 CSS6<float> – coeff 6	Set the 6th order polynomial coefficients that define the equation that gives the SLS level DAC setting (wrt P1) as a function of Db. CSS0 causes all seven coefficients to be stored in EEPROM on the RF board.
CSS?	Return: < coeff 0>CRLF < coeff 1>CRLF < coeff 2>CRLF < coeff 3>CRLF < coeff 4>CRLF < coeff 5>CRLF < coeff 6>CRLF (data is returned in scientific notation)	Request the 6th order polynomial coefficients that define the equation that gives the SLS level DAC setting (wrt P1) as a function of Db.
CTF	CTF0<float> – coeff 0 CTF1<float> – coeff 1 CTF2<float> – coeff 2 CTF3<float> – coeff 3 CTF4<float> – coeff 4 CTF5<float> – coeff 5 CTF6<float> – coeff 6	Set the 6th order polynomial coefficients describing the TX Power adjustment with TX frequency. CTF0 causes all seven coefficients to be stored in EEPROM on the RF board.
CTF?	Return: < coeff 0>CRLF < coeff 1>CRLF < coeff 2>CRLF < coeff 3>CRLF < coeff 4>CRLF < coeff 5>CRLF < coeff 6>CRLF (data is returned in scientific notation)	Request the 6th order polynomial coefficients describing the TX Power adjustment with TX frequency.
CTL	CTL0<float> – coeff 0	Set the 6th order polynomial coefficients that

Command	Format	Definition
	CTL1<float> – coeff 1 CTL2<float> – coeff 2 CTL3<float> – coeff 3 CTL4<float> – coeff 4 CTL5<float> – coeff 5 CTL6<float> – coeff 6	define the equation that gives the TX level DAC setting as a function of dB. CTL0 causes all seven coefficients to be stored in EEPROM on the RF board.
CTL?	Return: < coeff 0>CRLF < coeff 1>CRLF < coeff 2>CRLF < coeff 3>CRLF < coeff 4>CRLF < coeff 5>CRLF < coeff 6>CRLF (data is returned in scientific notation)	Request the 6th order polynomial coefficients that define the equation that gives the TX level DAC setting as a function of dB.
CW	CW10 – disable CW on ch. 1 CW11 – enable CW on ch. 1 CW20 – disable CW on ch. 2 CW21 – enable CW on ch. 2	Enable/disable CW (Continuous RF) on channel 1 or 2.
DACA	DACA0.<hex>, 2 hex characters, set DAC A0 DACA1.<hex>, 2 hex characters, set DAC A1	Set DAC A0 (spare) or DAC A1 (mod bias). Range: 2.4 V Resolution: 0.00938 V The setting will be stored in EEPROM to allow the DAC to be initialized to the set value on power up.
DACA0?		Request the DAC A0 (spare) setting. Range: 2.4 V Resolution: 0.00938 V
DACA1?		Request the DAC A1 (mod bias) setting. Range: 2.4 V Resolution: 0.00938 V
DACB	DACB0.<hex>, 2 hex characters, set DAC B0 DACB1.<hex>, 2 hex characters, set DAC B1	Set DAC B0 (video gain) or DAC B1 (dpsk level). Range: 2.4 V Resolution: 0.00938 V The setting will be stored in EEPROM to allow the DAC to be initialized to the set value on power up.

Command	Format	Definition
DACB0?		Request the DAC B0 (video gain) setting. Range: 2.4 V Resolution: 0.00938 V
DACB1?		Request the DAC B1 (dpsk level) setting. Range: 2.4 V Resolution: 0.00938 V
DACC	DACC0.<hex>, 2 hex characters, set DAC C0 DACC1.<hex>, 2 hex characters, set DAC C1	Set DAC C0 (log scale) or DAC C1 (p1 level). Range: 2.4 V Resolution: 0.00938 V The setting will be stored in EEPROM to allow the DAC to be initialized to the set value on power up.
DACC0?		Request the DAC C0 (log scale) setting. Range: 2.4 V Resolution: 0.00938 V
DACC1?		Request the DAC C1 (p1 level) setting. Range: 2.4 V Resolution: 0.00938 V
DACD	DACD0.<hex>, 2 hex characters, set DAC D0 DACD1.<hex>, 2 hex characters, set DAC D1	Set DAC D0 (log int) or DAC D1 (TCXO tune). Range: 2.4 V Resolution: 0.00938 V The setting will be stored in EEPROM to allow the DAC to be initialized to the set value on power up.
DACD0?		Request the DAC D0 (log int) setting. Range: 2.4 V Resolution: 0.00938 V
DACD1?		Request the DAC D1 (TCXO tune) setting. Range: 2.4 V Resolution: 0.00938 V
DACS	DACS.<hex>, 3 hex characters	Set the internal microprocessor DAC1 (sls level). Range: 2.4 V Resolution: 0.00059 V

Command	Format	Definition
DACT	DACT.<hex>, 3 hex characters	Set the internal microprocessor DAC0 (TX level). Range: 2.4 V Resolution: 0.00059 V
DDC	DDC<float>	Set the DME distance calibration constant. The setting will be stored in EEPROM to allow the DAC to be initialized to the set value on power up.
DDC?	Return <float>	Request the DME distance calibration constant.
DEL	DEL<float>, -20.0 to +3.0 dB	Set the DME echo reply RF level relative to the primary DME reply RF level. (This command will also set the SLS level without turning off or on any pulses.)
DI	DI=0, disable double mode DI=<float>, maximum is 399.9. The minimum is 40.0 us if the first interrogation is Mode S. If not then the minimum is 20.5 + the P1 to P3 spacing of the first interrogation. (Interference pulses are turned off for DI mode.)	Set the spacing for IFR double mode.
DID	DID0 – turn off Ident Code and Ident Tone DID1 – turn on Ident Code	Enable/Disable DME Ident Code. (This command only accepted when in DME mode)
DIST	DIST<float>, 0 –500 nm	Set the DME range. Range: 0 - 500 nm Resolution: ~.001 nm
DLD	DLD0 – main RF Board DLD1 – top RF Board	Download the RF Board microprocessor code.
DLY	DLY<float>, 1.0 – 1000.0 us	Set the delay of interrogation in current slot from the end of the interrogation in the previously used slot number. Range: 1.00 – 1000.00 µs Resolution: .05 µs
DMAX	DMAX<float>, 0 –500 nm	Set the DME maximum range. No error checking is performed. DMIN must be less than DMAX. Range: 0 - 500 nm Resolution: ~.001 nm

Command	Format	Definition
DMEA	DMEA<accel>, 0 to 399 ft/sec2	Set DME acceleration. (This command is only available when issuing commands directly to the RF board. When sending commands through the controller board use the controller board A command)
DMIN	DMIN<float>, 0 –500 nm	Set the DME minimum range. (Note: No error checking is performed. DMIN must be less than DMAX.) Range: 0 - 500 nm Resolution: ~.001 nm
DOB		Not available.
DR?		Request the DME interrogation rate. Interrogation is returned in Hz.
DTN	DTN0 – turn off Ident Tone and Ident Code DTN1 – turn on Ident Tone	Enable/Disable DME Ident Tone. (This command only accepted when in DME mode)
ECHO	ECHO0 – disable echo ECHO1 – enable echo	Enable/Disable the DME echo reply. The echo reply is at a fixed 30 nm distance.
EQL	EQL0 – disable equalization EQL1 – enable equalization	Enable/Disable DME ident tone equalization. The tone is generated by transmitting pulse pairs (X or Y) at a 1350 Hz PRF. If equalization is on, a second pulse pair is transmitted 100 us after each of the original (1350 Hz) pairs.
EXS	EXS<float>, -9.95 to 9.95 us EXS<10.0>, turn on external sync EXS<-10.0>, turn off external sync	Enable/Disable and set the timing of the external sync.
FRQ?	Return <float> in MHz	Request the measured UUT frequency.
GAR?		Request the FPGA revision string.
ID	ID0, Disable Ident Code and Ident Tone ID1, Enable Ident Tone ID2, Enable Ident Code	Enable/Disable the DME Ident Code and Ident Tone.
ID3	ID3<string>	Define the Ident Code word for modulating the RF output.
IDP	IDP<period>, 1 – 999	Set the Ident Code period (or rep rate) in dot times.
IDS	IDS<dot>, 100 – 160	Set the Ident Code dot time (dash time is 3 x dot time, dash-dot spacing is dot time, letter spacing is dash time).
IFP	IFP0 – interference pulse 0 IFP1 – interference pulse 1	Select which interference pulse to which subsequent interference pulse commands will

Command	Format	Definition
		apply.
INT	INT<ratio>, 1 – 999 ATCRBS interrogations for every mode S interrogation	Put the RF Board into IFR interlace mode. (This command is only available when issuing commands directly to the RF board. When sending commands through the controller board use the controller board INT:FUNC:INT command)
IPL	IPL<float>, less than -20.0, turn off the interference pulse IPL<float>, -20.0 to 3.0 dB, turn on the interference pulse	Turn on/off and set the Interference Pulse RF level relative to P1.
IPP	IPP<float>, -260.0 – 500.0 µs	Set Interference Pulse position. Resolution: .025 µs
IPW	IPW<float>, 0.1 to 3.1875 µs	Set Interference Pulse width. Resolution: .0125 µs
IQ?		Request the current Mode S Squitter time interval – the time in seconds between the latest squitter and the previous squitter.
IQH?		Request the longest Mode S Squitter time interval recorded since the last IQH? command.
IQL?		Request the shortest Mode S Squitter time interval recorded since the last IQH? command.
LAG	LAG<int>	Set the log amp gain calibration constant. The setting will be stored in EEPROM to allow the DAC to be initialized to the set value on power up.
LAG?		Request the log amp gain calibration constant.
LAO		Set the log amp offset calibration constant. The setting will be stored in EEPROM to allow the DAC to be initialized to the set value on power up.
LAO?		Request the log amp offset calibration constant.
LKUP		Not available.
MA	MA1 – measure pulse A1 MA2 – measure pulse A2 MA4 – measure pulse A4	Designate ATCRBS reply pulse for measurement.
MB	MB1 – measure pulse B1 MB2 – measure pulse B2 MB4 – measure pulse B4	Designate ATCRBS reply pulse for measurement.
MC	MC1 – measure pulse C1	Designate ATCRBS reply pulse for

Command	Format	Definition
	MC2 – measure pulse C2 MC4 – measure pulse C4	measurement.
MD	MD1 – measure pulse D1 MD2 – measure pulse D2 MD4 – measure pulse D4	Designate ATCRBS reply pulse for measurement.
MDX	MDX1 – measure pulse P1 MDX2 – measure pulse P2	Designate DME X channel interrogation pulse for measurement.
MDY	MDY1 – measure pulse P1 MDY2 – measure pulse P2	Designate DME Y channel interrogation pulse for measurement.
MF	MF1 – measure pulse F1 MF2 – measure pulse F2	Designate ATCRBS reply pulse for measurement.
MID		Designate ATCRBS reply SPI pulse for measurement.
MS	MS<pulse>, 1-112	Designate Mode S reply pulse for measurement.
MSP	MSP<pramble pulse>, 1-4	Designate Mode S reply preamble pulse for measurement.
MX		Designate ATCRBS reply X pulse for measurement.
NNM	NNM0 – disable NNM mode NNM1 – enable NNM mode	Enable and disable NNM mode. Offset the reply range by -1 nm in DME mode when enabled (reduce latency time by 12.3545 µs).
OFFP	OFFP4 – turn off P4 OFFP6 – turn off P6	Turn off ATCRBS P4 or Mode S P6.
ONP	ONP4 – turn on P4 ONP6 – turn on P6	Turn on ATCRBS P4 or Mode S P6.
P1W	P1W<float>, -0.7 – 2.3875 µs	Set P1 pulse width deviation from nominal.
P2	P2.i=0, i = 0 to 7, set bit i of port 2 to 0 P2.i=1, i = 0 to 7, set bit i of port 2 to 1	Sets the value of bit i of port 2 to 0 or 1 in accordance with the value of the command parameter.
P2L	P2L<float>, less than -20.0, turn off the P2 pulse P2L<float>, -20.0 to 3.0 dB, turn on the P2 pulse	Turn on/off and set the P2 Pulse RF level relative to P1.
P2P	P2P<float>, -7.9 to 7.9 us	Set P2 pulse position deviation from nominal. Resolution: .025 µs
P2W	P2W<float>, -0.7 – 2.3875 µs	Set P2 pulse width deviation from nominal.
P3L	P3L<float>, less than -20.0, turn on fixed level P3 P3L<float>, -20.0 to 3.0 dB, turn on variable level P3	Turn on/off variable level P3 and set its RF level relative to P1.
P3P	P3P<float>, -7.9 to 7.9 us	Set P3 pulse position deviation from nominal. Resolution: .025 µs
P3W	P3W<float>, -0.7 – 2.3875 µs	Set P3 pulse width deviation from nominal
P4	P4.i=0, i = 0 to 7, set bit i of port 2 to 0	Sets the value of bit i of port 4 to 0 or 1 in

Command	Format	Definition
	P4.i=1, i = 0 to 7, set bit i of port 2 to 1	accordance with the value of the command parameter.
P4L	P4L<float>, less than -20.0, turn on fixed level P4 IPL<float>, -20.0 to 3.0 dB, turn on variable level P4	Turn on/off variable level P4 and set its RF level relative to P1.
P4P	P4P<float>, -7.9 to 7.9 us	Set P4 pulse position deviation from nominal. Resolution: .025 µs
P4W	P4W<float>, -0.7 – 2.3875 µs	Set P4 pulse width deviation from nominal.
P5L	P5L<float>, less than -20.0, turn off the P5 pulse P5L<float>, -20.0 to 3.0 dB, turn on the P5 pulse	Turn on/off and set the P5 Pulse RF level relative to P1.
P5P	P5P<float>, -7.9 to 7.9 us	Set P5 pulse position deviation from nominal. Resolution: .025 µs
P5W	P5W<float>, -0.7 – 2.3875 µs	Set P5 pulse width deviation from nominal.
P6P	P6P<float>, -0.5 to 7.9 us	Set P6 pulse position deviation from nominal. Resolution: .025 µs
P6W	P6W<float>, -3.0 – 3.0 µs	Set P6 pulse width deviation from nominal.
PB?		Not available.
PGM	**If issuing the command directly to the RF board:** PGM – Programs the FPGA directly from the downloaded file. PGM0 – Programs the onboard EEPROM with the FPGA image PGM1 – Programs the FPGA with the image contained in the onboard EEPROM **If sending the command through the controller board:** PGM0 – Program the onboard EEPROM and the FPGA on the main RF board with the FPGA image PGM1 – Program the onboard EEPROM and the FPGA on the top RF board with the FPGA image	Download RF Board FPGA code.
PLS		Set up an interrogation as a single interference pulse.
PLSW	PLSW<float>, 0.1 to 3.1875 µs	Set Interference Pulse width. Resolution: .0125 µs
PP	PP0,<float>, 0 to 260 us, turn off prepulse PP1,<float>, 0 to 260 us, turn on prepulse	Enable/Disable and set the timing of the prepulse. The timing parameter defines how far ahead of P1 the prepulse appears. The timing parameter is optional.
PP?	Return <stat>,<position> stat = 0 (off), 1 (on)	Request the status and position of the prepulse.

Command	Format	Definition
	position = how far ahead of P1 the prepulse appears in us	
PR?		Request the UUT percent reply.
PRF	PRF<float>, 0 to 1Hz by 0.1Hz, 1 to 10000 Hz by 1 Hz	Set the PRF for sending out the programmed interrogations/pulses.
PW1?		Request the pulse width of an ATCRBS reply F1 pulse in 12.5ns resolution. (This command is only available when issuing commands directly to the RF board. When sending commands through the controller board use the controller board REPL:WIDT? “ATC” command)
PW2?		Request the pulse width of an ATCRBS reply F2 pulse in 12.5ns resolution. (This command is only available when issuing commands directly to the RF board. When sending commands through the controller board use the controller board REPL:WIDT? “ATC” command)
PWS1?		Request the pulse width of a Mode S reply P1 pulse in 12.5ns resolution. (This command is only available when issuing commands directly to the RF board. When sending commands through the controller board use the controller board REPL:WIDT? “MODES” command)
PWR?	Return <float> in Watts	Request the measured power of the unit under test.
QC?	Return: 0xhhhhhhhhhhhhhh **or** 0xhhhhhhhhhhhhhhhhhhhhhhhhhh MSB is bit 1	Request the current Mode S squitter data in hex format.
QN	QN0 = DF11 QN1 = DF17I (Aircraft ID) (type code 1,2,3,4) QN2 = DF17S (Surface Position) (type code 5,6,7,8) QN3 = DF17A (Airborne Position) (type code 9-18, 20, 21, 22) QN4 = DF17T (Airborne Velocity) (type code 19, subtype 1,2) QN5 = DF17P (Airborne Velocity)	Set the squitter type to which any subsequent squitter commands will apply.

Command	Format	Definition
	(type code 19, subtype 3,4) QN6 = DF17O (Other) (type code 0 and 23-31) QN7 = undefined	
RATT	RATT<float>	Set the receive attenuator calibration constant. The setting will be stored in EEPROM to allow the DAC to be initialized to the set value on power up.
RATT?	Return <float>	Request the receive attenuator calibration constant.
RC?	If ATCRBS reply, return: 0xhh If MODE S reply, return: 0xhhhhhhhhhhhhhh **or** 0xhhhhhhhhhhhhhhhhhhhhhhhhhh (MSB is bit 1**)**	Request the current reply data in hex format.
RD?	Return <float> in us	Request the current reply delay.
RDC	RDC<float>	Set the reply delay calibration constant. The setting will be stored in EEPROM to allow the DAC to be initialized to the set value on power up.
RDC?	Return <float>	Request the reply delay calibration constant.
RDH?	Return <float> in us	Request the longest reply delay since the last RDH? command.
RDL?	Return <float> in us	Request the shortest reply delay since the last RDH? command.
RE	RE<eff>, 0 – 100	Set the DME reply efficiency.
RFR?		Request the RF board revision string
RST		Reset the RF Board to its power-up state.
RXF	RXF<float>, 952.00 – 1223.00 MHz	Set the Receive synthesizer frequency.
SL	SL.hhhhhhhhhhhhhhhhhhhhhhhhhh (MSB is bit 1**)**	Set up a long Mode S interrogation with the specified data content.
SLS	SLS<float>, less than -20.0, turn off the P2 pulse SLS<float>, -20.0 to 3.0 dB, turn on the P2 pulse	Turn on/off and set the P2 Pulse RF level relative to P1.
SN	SN<slot>, 0 – 15	Set the current slot number.
SPC?		Return the spacing between an ATCRBS reply F1 and F2 pulse in 12.5ns resolution. (This command is only available when issuing commands directly to the RF board. When sending commands through the controller board use the controller board REPL:SPAC? “ATC”

Command	Format	Definition
		command)
SPR	SPR<float>, = -99.00, turn off SPR SPR<float>, -1.0 – 1.0 us, turn on SPR	Set the Sync Phase Reversal deviation from nominal.
SQF?	Return <float> in MHz	Request the measured UUT frequency.
SQP?	Return <float> in Watts	Request the measured power of the unit under test.
SQX	SQX<rate>, 0 - 10000	Transmit random channel-X DME squitter pulse pairs with the specified average PRF.
SQY	SQY<rate>, 0 - 10000	Transmit random channel-Y DME squitter pulse pairs with the specified average PRF.
SS	SS.hhhhhhhhhhhhhh (MSB is bit 1**)**	Set up a short Mode S interrogation with the specified data content.
STD	STD-99.00, turn off scope syncs STD<float>, -5.0 – 1000.0 us	Set scope sync delay with respect to the leading edge of P1.
SUP	SUP0 – disable SUP1 – enable	Enable/Disable the mutual suppression pulse.
TACM	TACM0 – disable TACM1 – enable	Enable/Disable TACAN modulation of the DME squitter pulses.
TAM	TAM<float>	Set the internal microprocessor DAC0, used for TX_AM. (Note: for calibration use)
TAMD	TAMD<float>	Set the DME transmit power calibration constant in dB. The setting will be stored in EEPROM to allow the DAC to be initialized to the set value on power up.
TAMD?		Request the DME transmit power calibration constant in dB.
TXF	TXF<float>, 952.00 – 1223.00 MHz	Set the Transmit synthesizer frequency.
VEL	VEL<float>, 0 - 9990 knots	Set the DME velocity.
WN		Select the narrow tolerance window
WW		Select the wide tolerance window
XCO	XCO0 – disable XCO1 - enable	Enable/Disable the external 20MHz clock from the other RF board
XNAR		Set the DME interrogation acceptance window to narrow for X channels.
XTR		Enable/Disable External triggering of ATCRBS and Mode S interrogations.
XWID		Set the DME interrogation acceptance window to wide for X channels.
YNAR		Set the DME interrogation acceptance window

Command	Format	Definition
		to narrow for Y channels.
YWID		Set the DME interrogation acceptance window to wide for Y channels.

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