Supplemental Procedure for Operation of the Telecommunications Development Laboratory (TDL)

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TDL Equipment

List of TDL equipment including: Item Name, Manufacturer, Model No. Serial No., and Status which can be one of the following:

CBU:	Calibrate Before Use (CBU)
SYS CBU:	System Calibration Before Use
IND:	Indication Only
CAL:	Calibrated

Item Name	Manufacturer	Model No.	Serial No.	Tag No.	Status
COMN-DECODER	LINKABIT INC M/A-COM	LV-7035	0034	370721	SYS CBU
COMN-DECODER	LINKABIT INC M/A-COM	LV-7035	0025	379243	SYS CBU
I/LE-ANALYZER-SPECTRUM	HEWLETT-PACKARD CO	8564E	3517A00343	1467988	8-21-1999
BENCH CLEAN	PURE AIRE CORP	720C	000	389658	IND
I/LE-METER-POWER	HEWLETT-PACKARD CO	436A	2604A24285	346792	CBU
I/LE-COUNTER	STANFORD RESEARCH SYSTEMS INC	SR620	0824	000415	CBU
TRANSMITTER	FIBER OPTIC	ORTEL CORP	10341A-E08	001912	IND
I/H9-RECEIVER-FIBER OPTIC	ORTEL CORP	10455A-E06	005371	001913	IND
OFF MACH-CALCULATOR	HEWLETT-PACKARD CO	45A	1350A32878	027808	IND
OFF MACH-CALCULATOR	HEWLETT-PACKARD CO	25	1601A03329	027825	IND
I/LE-SYNTHESIZER-FREQUENCY	HEWLETT-PACKARD CO	3325B	2847A05874	1046951	CBU
I/LE-GENERATOR-SIGNAL	HEWLETT-PACKARD CO	8663A	3017A01751	1048912	CBU
CARD CAGE SYSTEM	ZOLTECH	VCV11/28JL	1188	1053556	SYS CBU
TELEMETRY SUBSYST	MOTOROLA INC	01-25246E01	2	115093	SYS CBU
RECEIVER TEST	MOTOROLA INC	01-25247E01	2	115094	SYS CBU
I/LE-TRANSLATOR-TIME CODE	TRAK MICROWAVE CORP	8397-4	215	118088	IND
I/LE-SYNTHESIZER-FREQUENCY	RACAL INSTRUMENTS INC	7010-S-241	401994	118430	IND
COMN-DECODER	LINKABIT INC M/A-COM	LV-7035	0033	118505	SYS CBU
I/LE-ATTENTUATOR	MICROLAB/FXR F-FXR DV AMPHENOL	U164BF	TDL	1198735	SYS CBU

Item Name	Manufacturer	Model No.	Serial No.	Tag No.	Status
I/LE-METER-POWER	HEWLETT-PACKARD CO	437B	A776729	1200467	CBU
I/LE-PLOTTER	HEWLETT-PACKARD CO	7475A	3005L40594	1204168	IND
ANALYZER FREQUENCY	HEWLETT-PACKARD CO	5371A	2828A00594	1211692	CBU
I/LE-SYNTHESIZER-FREQUENCY	HEWLETT-PACKARD CO	3325A	2652A25117	122243	CBU
PRINTER	EPSON AMERICA INC	FX-86E	08037101	125326	IND
I/LE-GENERATOR-SIGNAL	HEWLETT-PACKARD CO	8663A	3310A02117	1306068	CBU
I/LE-POWER SUPPLY	ACT GRAPHICS	TRPS02-10-G-RO	4340	1309618	IND
CMPTR-CHASSIS	MUPAC CORP OF MUTRON CORP	539ASSPBPFC	25932	1314938	IND
GENERATOR	TIME CODE"	TRAK SYSTEMS DIV OF TRAK MICRO	784	1315555	IND
CMPTR-WORKSTATION	SUN MICROSYSTEMS INC	144	425E0502	1317382	IND
MONITOR	IBI SYSTEMS INC	SM4120EF	01186	1318348	IND
STORAGE UNIT	ANDATACO	RM40	00001368	1318676	IND
I/LE-ANALYZER-SIGNAL	HEWLETT-PACKARD CO	35670A	3431A00993	1458601	CBU
I/LE-SYNTHESIZER-FREQUENCY	HEWLETT-PACKARD CO	3325B	2847A10965	1459525	CBU
I/LE-SYNTHESIZER-FREQUENCY	HEWLETT-PACKARD CO	3325B	2847A10967	1459526	CBU
I/LE-CHAMBER-TEMP	SIGMA SYSTEMS INC	M600MC-3	5474	1472055	CBU
I/LE-GENERATOR-FUNCTION	HEWLETT-PACKARD CO	3325B	2847A12132	1702112	CBU
I/LE-GENERATOR-FUNCTION	HEWLETT-PACKARD CO	3325B	2847A12126	1702113	CBU
I/LE-OSCILLOSCOPE	TEKTRONIX INC F-PENTRIX CORP	TDS420A	B021940	1702212	CBU

Item Name	Manufacturer	Model No.	Serial No.	Tag No.	Status
I/LE-GENERATOR-SIGNAL	HEWLETT-PACKARD CO	8644B	3546A00830	1707366	CBU
COMN-REPEATER-ETHERNET-FIBER	TEKTRONIX INC F-PENTRIX CORP	PB200	9608020	1707996	SYS CBU
I/LE-ATTENTUATOR	WEINSCHEL ENGINEERING CO	5892	121	1719453	IND
COMN-ATTENUATOR	WEINSCHEL ENGINEERING CO	5892	122	1719454	IND
I/LE-AMPLIFIER-DIST	HEWLETT-PACKARD CO	5087A	2208A02938	333617	IND
I/LE-STANDARD-FREQUENCY	FREQUENCY AND TIME SYSTEMS INC	1050A	211	334904	IND
COMPUTER	MICRO"	INTERNATIONAL BUSINESS MACHINE	7076193	345495	IND
CMPTR-MONITOR-COLOR	INTERNATIONAL BUSINESS MACHINE	339	65001	345496	IND
DISPLAY	HEWLETT-PACKARD CO	85662A	2542A12372	345622	CBU
I/LE-ANALYZER-SPECTRUM	HEWLETT-PACKARD CO	8566B	2627A03107	345623	CBU
I/LE-SYNTHESIZER	HEWLETT-PACKARD CO	3326A	2519A00827	345783	CBU
I/LE-POWER SUPPLY	HEWLETT-PACKARD CO	0-40 VOLT 0-1.5	2410A08166	346575	IND
I/LE-POWER SUPPLY	HEWLETT-PACKARD CO	0-40 VOLT 0-1.5	2410A08279	346576	IND
I/LE-POWER SUPPLY	HEWLETT-PACKARD CO	0-40 VOLT 0-1.5	2410A08263	346578	IND
I/LE-POWER SUPPLY	HEWLETT-PACKARD CO	0-20	2412A08164	346750	IND
I/LE-METER-POWER	HEWLETT-PACKARD CO	438A	2625A02701	346793	CBU
I/LE-POWER SUPPLY	HEWLETT-PACKARD CO	0-20	2412A08154	346960	IND

Item Name	Manufacturer	Model No.	Serial No.	Tag No.	Status
I/LE-POWER SUPPLY	HEWLETT-PACKARD CO	0-20	2412A08160	346961	IND
I/LE-OSCILLOSCOPE	TEKTRONIX INC F-PENTRIX CORP	2235	B026778	347609	CBU
I/LE-OSCILLOSCOPE	TEKTRONIX INC F-PENTRIX CORP	2235	B026763	347611	CBU
I/LE-OSCILLOSCOPE	TEKTRONIX INC F-PENTRIX CORP	2465ACT	B010194	347918	CBU
I/LE-SYNTHESIZER-FREQUENCY	RACAL INSTRUMENTS INC	7010S179	400371	364419	IND
I/LE-OSCILLATOR	RESDEL ENGINEERING CORP	9457005	402	371170	IND
I/LE-AMPLIFIER	HEWLETT-PACKARD CO	5087A	2208A02229	384037	IND
RECEIVER TEST	MOTOROLA INC	AGC/MGC	000	389736	SYS CBU
COMN-TRANSMITTER	MOTOROLA INC	01-25252E01	2	389887	SYS CBU
I/LE-POWER SUPPLY	SORENSON INDUSTRIES INC	QB12-8	205	389897	IND
RECEIVER TEST	MOTOROLA INC	01-25248E01	2	389899	SYS CBU
RECEIVER TEST	MOTOROLA INC	01-25250E01	2	389900	SYS CBU
OSCILLATOR QUARTZ	HEWLETT-PACKARD CO	106B	612-00172	389919	IND
BENCH CLEAN	AGNEW-HIGGINS INC	182	2422	389966	CBU
I/LE-SYNCHRONIZER	JET PROPULSION LABORATORY	94883974	EL-87-0004	889267	SYS CBU
I/LE-POWER SUPPLY	LAMBDA ELECTRONICS	94983541	001	889430	IND
MULTIPROGRAMMER	HEWLETT-PACKARD CO	6954A	2747A00184	894373	IND
FLOPPY DRIVE	HEWLETT-PACKARD CO	9127A	2639A04171	894558	IND
I/LE-ANALYZER-SIGNAL	HEWLETT-PACKARD CO	3562A	2904A04160	G03220	CBU
I/LE-SYNTHESIZER-FREQUENCY	HEWLETT-PACKARD CO	3335A	2843A04873	G03867	CBU

Item Name	Manufacturer	Model No.	Serial No.	Tag No.	Status
ANALYZER FREQUENCY	HEWLETT-PACKARD CO	5371A	2842A00965	G03886	CBU
I/LE-VOLTMETER	VECTOR ELECTRONICS CO	8508A	2919U00515	G04707	CBU
I/LE-GENERATOR-SIGNAL	HEWLETT-PACKARD CO	8665A	2914A00154	G05715	CBU
I/LE-RECEIVER-FIBER OPTIC	GRASS VALLEY GROUP INC THE	NONE	NONE	G08718	IND
I/LE-COUNTER	HEWLETT-PACKARD CO	5245L	335-00844	389656	IND
CMPTR-TERMINAL-DATA PROCESS	DIGITAL EQUIPMENT CORPORATION	VT220	TA704E6334	120500	IND
I/LE-DETECTOR	FEMTOSECOND SYSTEMS	FSS1000E	NONE	1706954	SYS CBU
PRINTER	ADP"	ITOH CO LTD IND ELECT DIV	300793	389341	IND
PRINTER	EPSON AMERICA INC	SX-80	345827	389505	IND
CMPTR-PRINTER	EPSON AMERICA INC	FX-80	388026	394601	IND
I/LE-SYNTHESIZER	HEWLETT-PACKARD CO	8770A	2812A00557	897647	CBU
TELEMETRY SUBSYST	MOTOROLA INC	01-25245E01	2	389743	SYS CBU
MICROWAVE SOURCE	HEWLETT-PACKARD CO	11975A	2517A01003	121964	SYS CBU
I/LE-COUNTER-FREQUENCY	HEWLETT-PACKARD CO	5334B	2937A11378	1474635	CBU
EW/P-GENERATOR	HEWLETT-PACKARD CO	33120A	US34016183	1474763	CBU
EW/P-GENERATOR	HEWLETT-PACKARD CO	33120A	US34016190	1474764	CBU
I/LE-AMPLIFIER	HEWLETT-PACKARD CO	11975A	2738A02048	1702119	SYS CBU
I/LE-COUNTER-FREQUENCY	HEWLETT-PACKARD CO	5386A	3206A04211	1702206	CBU

Item Name	Manufacturer	Model No.	Serial No.	Tag No.	Status
I/LE-GENERATOR-SIGNAL	HEWLETT-PACKARD CO	203A	621-50982	389953	CBU
MULTIMETER	DIGITAL"	HEWLETT-PACKARD CO	2823A082436	1207564	CBU
MULTIMETER	DIGITAL"	HEWLETT-PACKARD CO	2823A08243	1207565	CBU
I/LE-SYNTHESIZER	DANA CONTROLS DIV-SECO ELECTRO	9457039-B	404719	377997	SYS CBU
I/LE-SYNTHESIZER-FREQUENCY	RACAL INSTRUMENTS INC	7010S179	400329	379009	SYS CBU
I/LE-SYNTHESIZER	RACAL INSTRUMENTS INC	7010-S-241	403122	385059	SYS CBU
I/LE-GENERATOR-TIME CODE	TRAK MICROWAVE CORP	8390-24M (BCD)	525	893435	IND
COMN-DECODER	LINKABIT INC M/A-COM	LV-7035	0019	898053	SYS CBU
I/LE-GENERATOR-TIME CODE	TRAK MICROWAVE CORP	8390-23	679	G11445	IND
I/LE-VOLTMETER	HEWLETT-PACKARD CO	8405A	725-01025	389490	CBU
I/LE-AMPLIFIER-POWER	HEWLETT-PACKARD CO	467A	444-00448	389847	CBU
PRINTER	EPSON AMERICA INC	FX286E	03004467	890976	IND
AMPLIFIER	DC	DYNAMICS CORP OF AMERICA	6122-0110	027827	CBU
I/LE-POWER SUPPLY	SORENSON INDUSTRIES INC	QB12-8	442	115096	IND
I/LE-POWER SUPPLY	HEWLETT-PACKARD CO	0-40 VOLT 0-1.5	2410A08161	346577	IND
I/LE-POWER SUPPLY	HEWLETT-PACKARD CO	0-20	2412A08165	346749	IND
CMPTR-PRINTER	EPSON AMERICA INC	FX-85	08025662	342520	IND

Item Name	Manufacturer	Model No.	Serial No.	Tag No.	Status
COMN-DECODER	LINKABIT INC M/A-COM	LV-7035	0002	357086	SYS CBU
TERMINAL	QUME CORP	103A	B0016610	383120	IND
TRANSPONDER TEST	MOTOROLA INC	1750953	002	389730	SYS CBU
TRANSPONDER	RCA CORP GVMT & COMMERCIAL SYS	1750953	003	389731	SYS CBU
CMPTR-MONITOR-COLOR	NEC ELECTRONICS USA INC	MULTISYNC	77D09914J	899546	IND
I/LE-OSCILLOSCOPE	TEKTRONIX INC F-PENTRIX CORP	2235	B026796	347610	IND
I/LE-OSCILLATOR	RESDEL ENGINEERING CORP	9457005	413	371169	SYS CBU
I/LE-EXTENDER	HEWLETT-PACKARD CO	6944A	2726A01159	894546	IND
PRINTER	HEWLETT-PACKARD CO	2227B	2730S02390	894675	IND
CMPTR-PRINTER-LASER	HEWLETT-PACKARD CO	33471A	3049J02DRR	1207626	IND
CMPTR-WORKSTATION	SUN MICROSYSTEMS INC	144	303F0384	1302056	IND
CMPTR-MONITOR	SONY CORP	GDM1962B	9306DX0988	1302057	IND
I/LE-GENERATOR-FREQUENCY	HEWLETT-PACKARD CO	8662A	3117A04226	1208637	CBU
I/LE-COUNTER	HEWLETT-PACKARD CO	5334B	2937A10931	1472071	CBU
COMN-TRANSMITTER	GRASS VALLEY GROUP INC THE	3291TX-411	NONE	G08717	IND
I/LE-STANDARD-FREQUENCY	FTS SYSTEMS INC	1050/004/015/S17 /S20	337	896806	IND
I/LE-OSCILLOSCOPE	TEKTRONIX INC F-PENTRIX CORP	TDS684A	B010202	1318239	IND

ENGINERING TEST PROCEDURES AND DATA SHEETS

1. INTRODUCTION

1.1. Purpose

This standard set of procedures and data sheets are to be used in combination with the the Engineering Testing and Preliminary Evaluation (ETPE) Handbook for typical engineering testing and evaluation. TDL'S standard test procedures can be modified to accommodate the customer's needs or special tests can be negotiated if needed.

1.2 Scope

This standard series of tests in combination with the ETPE Handbook addresses the process of testing performed by TDL for the purpose of establishing or verifying telecommunications performance for flight or other projects.

2. REQUIREMENTS

2.1. Safety

Listed in the ETPE Handbook.

2.2. Reference Documentation

Listed in the ETPE Handbook.

2.3. Quality Records

Engineering data sheets.

2.4. Equipment

No additional requirements.

2.5. Supplies

No additional requirements.

3. **TDL STANDARD TEST PROCEDURES and Data Sheet**

3.1 Radio Frequency Tests

3.1.1 RF1: Uplink Receiver Threshold and AGC Calibration

3.1.1.1 Objectives

The objectives of this test are to verify

(1) the capability of the uplink receiver to maintain RF phase lock to a minimum power level specified by the radio requirements document.

(2) receiver AGC calibration vs. uplink carrier power.

3.1.1.2 Rationale

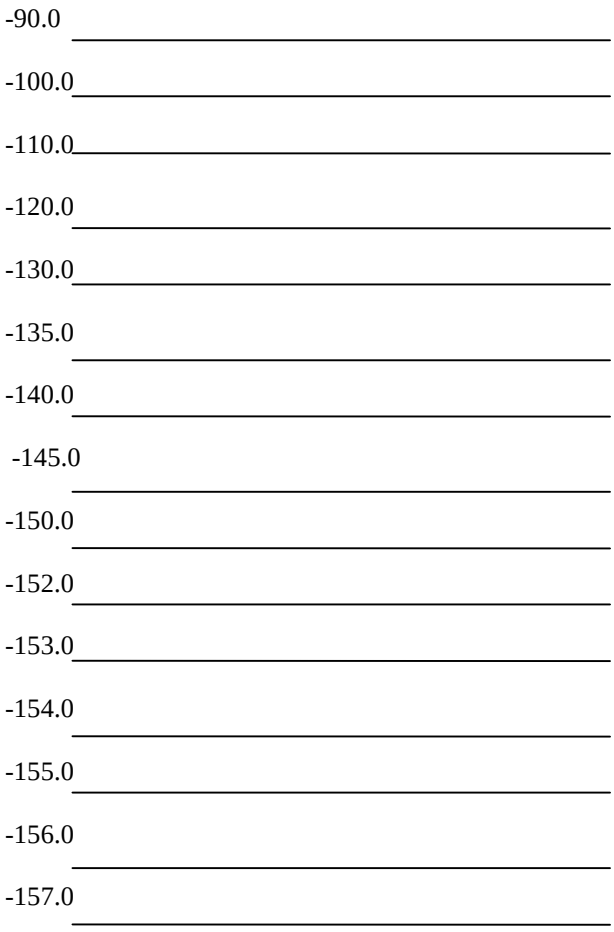
Proper receiver carrier threshold and AGC values verify predicted radio performance specified by the radio requirements document.

3.1.1.3 Description

Standard operating procedure is used to acquire uplink receiver phase lock to a specified carrier frequency (usually radio best lock frequency). The uplink carrier power level is incrementally reduced and AGC values are recorded until receiver carrier threshold is indicated by loss of carrier lock.

3.1.1.4 Standard Data Sheet

Uplink Signal Level (dBm)	AGC (volts)
-70.0	_____
-80.0	_____



3.1.2 RF2: Uplink Receiver Maximum and Minimum acquisition Rates

3.1.2.1 Objectives

The objectives of this test are to verify that the uplink receiver will acquire RF phase lock when the uplink carrier is initially offset from the nominal rest frequency and then swept at specified rates to specified offsets as defined by the radio requirements document. The ability of the uplink receiver to acquire the swept uplink carrier vs signal level will be consistent with the radio requirements document or mission requirements.

3.1.2.2 Rationale

This test verifies uplink acquisition performance and provides data for DSN mission uplink acquisition procedures.

3.1.2.3 Description

The TDL up link transmitter output is adjusted to provide a specified carrier power and frequency offset at the uplink receiver input. The uplink transmitter is enabled, and is sweept (linearly ramped) in frequency at a at a specified rate through the uplink receiver lock frequency to the opposite offset frequency, and is then swept in the opposite direction back to the uplink receiver best lock frequency. Failure of the receiver to acquire lock indicates a sweep rate limit. Continue procedure with using various combinations of sweep rates and signal levels to establish the minimum and maximum bounds of the uplink receiver.

3.1.2.4 RF2 Uplink Receiver Maximum and Minimum Sweep Rate Data Sheet

Uplink carrier	Maximum rate	Minimum rate
-70.0 dBm		
-90.0 dBm		
-110.0 dBm		
-120.0 dBm		
-130.0 dBm		
-135.0 dBm		
-140.0 dBm		
-145.0 dBm		
-150.0 DBm		
-152.0 dBm		
-154.0 dBm		

3.1.3 RF3: Up Link Tracking Range

3.1.3.1. Objective

The objectives of this test is to verify

(1) that the uplink receiver will remain phase locked to the carrier when the carrier is swept to the maximum specified frequency offset from the receiver nominal frequency at a specified rate and specified carrier power.

(2) the receiver Static Phase Error (SPE) curve.

3.1.3.2 Rationale

This test will confirm uplink tracking performance and provides data for DSN mission uplink acquisition and tracking procedures.

3.1.3.3 Description

After receiver lock is acquired, the uplink carrier is set to specified levels and swept at specified rates to specified offset frequencies from center frequency. Receiver lock and SPE are monitored, and SPE values are recorded at specified frequencies.

3.1.3.4 Criteria

Maximum and minimum acquisition sweep rates shall be provided by the project.

3.1.3.5 RF3 Uplink Tracking Range Data Sheet

Offset Frequency	Static Phase Error
-500k	
-400k	
-300k	
-200k	
-100k	
0	
+100k	
+200k	
+300k	
+400k	
+500k	

3.1.4 RF3A: Uplink Receiver Pull in Range

3.1.4.1 Objective

The objective of this test is to calibrate maximum pull in range vs time from a specified static frequency offset and at a specified uplink signal level.

3.1.4.2 Rationale

This test will calibrate the maximum frequency offset from best lock that the radio system requires to pull automatically into lock.

3.1.4.3 Description

with the uplink receiver at best lock frequency and the uplink signal level set at the specified level, turn off the uplink transmitter and set the transmitter frequency to the offset specified by the radio requirements. Turn on the uplink transmitter and record the time required for the uplink receiver to acquire phase lock. If the uplink receiver fails to acquire, verify uplink receiver is at best lock and repeat test with a reduced offset. If the uplink receiver acquires phase lock, increase the frequency offset and repeat test to find maximum offset that does not achieve phase lock. Repeat for all cases on the data sheet.

3.1.4.4 RF3A Uplink Receiver Pull in Range Data Sheet

Signal Level	Frequency Offset	Time
-90.0 dBm	+	
-90.0dBm	-	
-100.0 dBm	+	
-100.0 dBm	-	
-110.0 dBm	+	
-110.0 dBm	-	
-120.0 dBm	+	
-120.0 dBm	-	
-130.0 dBm	+	
-130.0 dBm	-	
-140.0 dBm	+	
-140.0 dBm	-	
-145.0 dBm	+	
-145.0 dBm	-	

3.1.5 Downlink Transmitter Tests

3.1.5.1 RF4: Downlink Transmitter RF Power Output

3.1.5.2 Objective

The objective of this test is to measure and monitor the downlink transmitter power output .

3.1.5.3 Rationale

The RF path attenuation is selected based on path loss measurements and the power output assumptions. The actual power out should be measured and monitored at a calibrated point in the RF test path to verify the power and any change of output power during testing.

3.1.5.4 Description

The transmitter output power level is measured at the specified reference interface point with a calibrated power meter.

3.1.5.5 Criteria

The transmitter power specification will be supplied by the project for system level testing and by the radio requirements document for subsystem level testing.

3.1.5.6 Downlink Transmitter RF Power Output Data Sheet

RF power output Monitor point loss Total power out
at Monitor point dB

dBm + Monitor point loss = dBm

3.1.6 RF5: Downlink Carrier Phase Noise

3.1.6.1 Objective

The objective of the this test is to verify that the phase noise associated with the downlink carrier is within the specified allowable range.

3.1.6.2 Rationale

Excessive phase noise in the downlink system could significantly degrade overall link performance. This test identifies excessive phase noise as a possible impediment to acceptable downlink performance.

3.1.6.3 Description

The X or Ka band downlink is down converted to a 100 to 500 MHz IF signal and then routed to the Block V Receiver. The Block V Receiver in a 10 HZ bandwidth is phase locked to the IF at strong signal > -90 dBm.
Record the Block V tracking loop spec.

3.1.6.4 Criteria

Downlink noise (jitter) shall be specified by the project or the radio specifications.

3.1.7 RF6: Downlink RF Spectrum

3.1.7.1 Objective

The objective of this test is to verify that the downlink residual amplitudes do not exceed the signal -amplitude specifications and that the spurious (unexplained) spectral components do not exceed the specified limits.

3.1.7.2 Rationale

This test verifies that the downlink transmitter linearity and modulation bandwidths are compatible with the ground receiver.

3.1.7.3 Description

A spectrum analyzer is used to observe and record downlink spectra at specified frequencies, frequency spans and resolution bandwidths.

3.1.7.4 Criteria

Downlink spectrum limits shall be specified by the project.

3.1.8 RF7: Downlink Receiver Threshold

3.1.8.1 Objective

The objective of this test is to verify the capability of the downlink receiver to maintain RF carrier phase lock to the minimum specified signal level.

3.1.8.2 Rationale

This test verifies proper DSN receiver performance and establish confidence in the downlink RF configuration integrity.

3.1.8.3 Description

A RF link is configured as specified, and the DSN receiver is locked to a specified strong downlink. The signal level is then incrementally decreased until the receiver no longer maintains phase lock with the carrier.

3.1.8.4 Criteria

The DSN receiver threshold should occur at the point predicted for the test configuration. The calculation for the DSN Receiver is -198.6 + 10 log of 2Blo tracking bandwidth + 10 log of the DSN receiver front end noise temperature.

3.1.9 RF8: DOR Characteristics

3.1.9.1 Objective

Verify the frequency stability and coherence of the DOR tones.

3.1.9.2 Rationale

Frequency instability or lack of coherence could degrade downlink only ranging performance.

3.1.10 Telemetry Tests

3.1.10.1 TLM1: Telemetry Spectrum

3.1.10.2 Objective

The objective of this test is to verify that downlink telemetry sideband amplitudes are consistent with specified modulation indices, modulation bandwidths, and waveform specifications for telemetry-composite modulation signals.

3.1.10.3 Rationale

Spectrum plots illustrate telemetry data power distribution, modulation characteristics, and subsystem frequency response.

3.1.10.4 Description

Specified telemetry configurations are applied to the downlink. A spectrum analyzer is configured as specified to display the data spectrum, and spectrum plots are recorded. The spectrum analysis may occur at

RF,IF, or baseband frequencies.

3.1.10.5 Criteria

Telemetry characteristics shall be provided by the project prior to the test.

3.1.11 TLM2: Telemetry Performance

3.1.11.1 Objective

The objective of this test is to verify downlink signal quality by observing telemetry subsystems losses.

3.3.11.2 Rationale

Telemetry performance is one of the best indicators of telecommunications system status, since idt is sensitive to RF interference, frequency and phase noise, receiving, demodulation, decoding losses and waveform distortion. Proper telemetry performance provides practical assurance of overall telecommunication system health.

3.3.11.3 Test Description

A telecommunications link is configured as specified by the project a accurate SNR is set by using a Y-factor device to establish a precision SNR (+ or - 0.2 dB). Telemetry is then processed by using a Bit Error Rate Checker (bit by bit comparison with reference data) and plotted on a standard graph with a theoretical reference to determine the system loss from theory. If telemetry reference data is not available, the performance can be derived from the Block V Receiver Symbol Loop Estimator.

3.3.11.4 Criteria

Telemetry performance criteria are derived from Reference Documents (1) 810-5, (2) 821-series, and mission-support requirements. Test results are also compared to the pretest baseline.

3.3.12 TLM3: Subcarrier Frequency versus Temperature

3.3.12.1 Objective

Calibrate subcarrier frequency change versus projected flight temperature variation.

3.3.12.2 Rationale

Calibration will aid the flight project mission operations team's subcarrier frequency prediction for the tracking station operations.

3.3.12.3 Description

Install telemetry system in the temperature chamber, turn on the telemetry and radio system. Establish a strong signal (-100 dBm) RF link to Block V Receiver and acquire RF,Subcarrier, and Symbol lock. Turn on the dry nitrogen purge for 10 minutes before starting the temperature sweep from 30 deg C to minus _____ deg C at _____ deg C per hour ,record subcarrier frequency continuously during the temperature sweep. Dwell at the low temperature until the subcarrier frequency stabilizes, then sweep to the positive ____ deg C at _____ deg C per hour and dwell until the temperature stabilizes continuously recording the subcarrier frequency change.

3.3.12.4 Criteria

The instructions for the temperature sweep, recording rates and dwell times are to be furnished by the project.

3.3.13 PH1: Stability Performance

3.3.13.1 Objective

Calibrate the stability of the radio subsystem.

3.3.13.2 Rationale

Excessive frequency instability would compromise the mission.

3.3.13.3 Description

Configure TDL's system for a strong uplink signal (-90 dBm) to the radio under test. Configure the radio's downlink signal (-10 dBm to the Radio Science downconverter. Configure the Radio Science equipment to output a 20 kHz signal at +14 dBm, patch this signal to the Video Offset Mixer input in Rack 16. Patch the output of the Zero Crossing Detector to channel 2 of the HP 5371 Frequency and Time Interval Analyzer. Connect a HP3325 Frequency Source to the LO input of the Video Offset Mixer , set HP3325 to 20001.0 HZ and 0 dBm. Connect a second HP3325 Frequency source set to 4Hz and 4 volts p-p to channel 1 of the HP 5371. Load the ALLANV program into the HP310 computer and record data for 8 hours. Process and plot the Allan Variance data and compare it to the Radio Requirements Document. Plot the Phase Drift data for cycle slips and plot the results. If cycle slips occurred the Allan Variance results will be out of specifications.

3.3.13.4 Criteria

The Allan Variance data should equal or surpass the specification in the Radio Requirements Document and the Mission Requirements Document.

3.3.14 PH2: Phase Noise Spectral Density

3.3.14.1 Objective

Calibrate Radio subsystem phase noise

3.3.14.2 Rationale

Excessive phase noise translates into excessive frequency instability in a spacecraft radio.

3.3.14.3 Description

Configure the Radio Science open loop receiver to down convert the radio subsystem under test to a 20 kHz IF. Connect the IF to a HP3562A or 35670A low frequency fft analyzer. Set analyzer to display from 20 kHz ,span =100 HZ, record spectrum.
Set analyzer span to 10 kHz and record spectrum. Reconfigure system and repeat test if system under test has more than one downlink signal.

3.3.14.4 Criteria

Follow the radio requirements document for the specifications for phase noise for each downlink tested.

3.3.15 PH3: Phase Delay versus Temperature

3.3.15.1 Objective

Calibrate RF carrier phase change versus radio temperature profile.

3.3.15.2 Rationale

Unknown phase changes vs temperature could bias valuable Radio Science data if the changes are not well understood.

3.3.15.3 Description

Configure the 20kHZ from the Radio Science down convertor to channel 1 of the 5371A that is part of the Allan Variance measuring equipment connect the output from a 3325a function generator that is referenced to the TDL's reference timing system to channel 2. Load the phase drift program into the HP 310 computer that is part of the data acquisition

computer. Run the drift program during the temperature sweep and plot the result at the end of test.

3.3.15.4 Criteria

Compare the phase drift plot to project predictions and report results.

3.3.16 RM1: Ranging Polarity and Zero Delay Calibration

3.3.16.1 Objective

To calibrate the round trip delay to the device under test with a non inverting zero delay device which determines the normal phase of the Sequential Ranging Assembly (SRA). To determine whether the turn around ranging channel inverts the ranging signal.

3.3.16.2 Rationale

The zero delay calibration is needed to subtract from the final delay test through the radio to arrive at the absolute radio delay. The ranging polarity test is needed for project mission predictions for the tracking stations.

3.3.16.3 Description

Configure the Zero Delay Device at the end of the RF cables that attach to the radio under test. Set the modulation index to 3 dB carrier suppression on the uplink transmitter and start the SRA acquisition sequence and record range numbers, if the ranging numbers are too large, then invert the ranging code and repeat test. Note whether the final transmitted ranging code was inverted or not. Connect the radio in place of the Zero Delay Device and range. If the transmitted ranging code did not need a inversion from the previous test then the ranging channel is not inverted.

3.3.16.4 Criteria

Ranging delay is compared to radio requirements document.

3.3.17 RM2: Ranging Delay

3.3.17.1 Objective

The objectives of this test is to measure the delay of the radio under test and to determine the effects of uplink signal level and range modulation index on range delay.

3.3.17.2 Rationale

Radio range delay must be known for all configurations of the radio including signal level for proper mission evaluation of distance from earth to the spacecraft.

3.3.17.3 Description

A ranging link is configured according to project plans and ranging is performed to provide radio unique range information in support of mission ranging operations.

3.3.17.4 Criteria

Range performance criteria is derived from project/mission requirements and 810-5.

3.3.18 RM3: Ranging Delay versus Temperature

3.3.18.1 Objective

Calibrate range delay versus temperature.

3.3.18.2 Rationale

Delay variations could cause errors in evaluating ranging during the mission.

3.3.18.3 Description

Lock radio system to a strong signal uplink and apply ranging modulation as predetermined by the project. Start a temperature sweep that was approved by the project and record ranging delay during the temperature sweep. Compare the recorded with the radio requirements document.

3.3.18.4 Criteria

Follow the radio requirements document as a guide for sitting up the ranging test and evaluating the recorded data.

ETPEH-1

ENGINEERING TESTING AND PRELIMINARY EVALUATION (ETPE) HANDBOOK

1. INTRODUCTION

1.1. Purpose

This handbook is to be used as a set of instructions to govern any engineering testing and preliminary evaluation (ETPE) at the Telecommunication Development Laboratory (TDL) located in Building 161, Room 114. This handbook will aid managers, system engineers and test engineers to develop an appropriate test plan for the device under test (DUT) following ETPE process.

1.2. Scope

This handbook addresses the process of testing performed by TDL for the purpose of establishing or verifying telecommunications performance for flight or other projects. This handbook outlines standard tests, and provides guidelines for procedures. The ETPE process is not limited to the tests described hereon, special tests can be negotiated on a case by case basis.

2. REQUIREMENTS

2.1. Safety

No additional requirements.

2.2. Reference Documentation

810-8, Compatibility Test Design Handbook.

TDL Standard Test Procedure and Data Sheet

2.3. Quality Records

870/872 - Series, Compatibility Test Program.

2.4. Equipment

see “Division 33 Procedure for Operation of the TDL Laboratory” resources

2.5. Supplies

No additional requirements.

3. INSTRUCTIONS

3.1.

Perform initial planning of the test in accordance with Sections 1 & 3 of the 810-8, DSN Compatibility Test Design Handbook.

3.2.

Define type of test in accordance with Sections 1 & 2 of the 810-8, DSN Compatibility Test Design Handbook.

3.3.

Negotiate additional tests to be conducted at TDL in accordance with the TDL Standard Test Procedure and Data Sheet.

3.4.

Prepare Section 1 of Engineering Testing and Preliminary Evaluation (ETPE) plan in accordance with work instruction EN-01.01-002, paragraph 3.2.

3.5.

Prepare Section 2 of Engineering Testing and Preliminary Evaluation (ETPE) plan in accordance with work instruction EN-01.01-002, paragraph 3.3.

3.6.

Prepare Test Procedures in accordance with EN-01.01-002.

3.7.

Prepare Section 3 of Engineering Testing and Preliminary Evaluation (ETPE) plan in accordance with work instruction EN-01.01-002, paragraph 3.5.

3.8.

Prepare detailed results appendix of Engineering Testing and Preliminary Evaluation (ETPE) plan in accordance with work instruction EN-01.01-002, paragraph 3.6.

3.9.

Prepare additional Sections or Appendixes of the Engineering Testing and Preliminary Evaluation (ETPE) plan in accordance with work instruction EN-01.01-002, paragraph 3.7.

ETPEP-1

ENGINEERING TESTING AND PRELIMINARY EVALUATION (ETPE) PROCESS

1. INTRODUCTION

1.1. Purpose

This document is to be used as a set of instructions to govern the Engineering Testing and Preliminary Evaluation (ETPE) process at the Telecommunication Development Laboratory (TDL) located in Building 161, Room 114. This will aid managers, system engineers and test engineers to develop an appropriate test plan for the device under test (DUT) following ETPE process.

1.2. Scope

This work instruction addresses all aspects of ETPE. The ETPE is the vehicle by which information regarding performance testing is conveyed to customers.

The ETPE contains sections regarding planning, results, and detailed test data. Furthermore, the ETPE is a living document and is by nature modular to allow for additional sections as testing needs change.

The ETPE is used by operations personnel in their support of projects. The ETPE is created based on years of experience on ETPE for different flight hardware since 1969 and put forth by the ETPE author.

2. REQUIREMENTS

2.1. Certification (mission critical DUT only; otherwise no additional requirements)

Facility Safety Survey - Systems Safety Office	4-6370
Operation Safety Survey - Operation Safety Review	4-5667
Electrostatic Discharge Control - ESD Survey	4-7081
Clean Room Certification – Contamination Control	4-4031

2.2. Reference Documentation

DSN 810-8, DSN/Flight project Interface Compatibility Test Design Handbook.

DSN 810-5, DSN/Flight project Interface Design Handbook.
http://deepspace1/dsndocs/810-5/810-5.html

DSN 810-3, TDA Standard Practice - Glossary of DSN terms and Abbreviations.

TDL Standard Test Procedure and Data Sheet

Project specific radio frequency subsystem engineering data.

2.3. Quality Records

870/872 - Series, Compatibility Test Program.

Control Environment - Contamination Control Service.

2.4. Equipment

Oxygen Monitor required for temperature chamber operations only. No additional requirements.

2.5. Supplies

No additional requirements.

2.6. Emergency

TDL Emergency procedure

3. INSTRUCTIONS

3.1. Preparation

Obtain a list to whom the document of ETPE should be distributed, from the cognizant System Engineer of the DUT.

3.2. Prepare Section 1 of ETPE document, Introduction.

3.2.1. Purpose

Explain the purpose of the ETPE document. Begin with
"This document provides a description of <#tests> that will be performed in the Telecommunication Development Laboratory (TDL) for <#project> <#system; #subsystem>."

3.2.2. Scope

Explain the scope of the ETPE document. Begin with
"The scope of TDL testing is to provide <#test result> for <#activity> using TDL supplied <#equipment>."

3.2.3 Procedures

Explain the nature of the procedures and their usefulness to the readers of this document.

3.2.4. Acronyms and Abbreviations

List and define the acronyms and abbreviations that will be used in the ETPE.

3.2.5. Reference Documents

List titles and document numbers (if applicable) of other papers that are directly relevant to the ETPE.

3.2.6. Document Changes

3.2.6.1.Change Control

State who has control of changes to the ETPE document.

3.2.6.2.Change Requests

State how users of the ETPE may initiate changes to its contents.

3.2.6.3. Change Releases

State how changes to the ETPE are released to all of its readers.

3.3. Prepare Section 2 of the ETPE document, TDL Test Plan.

3.3.1. Introduction

3.3.1.1. Purpose

Explain the purpose of the upcoming test. Begin with "This document describes <#tests> at TDL for <#project> <#system; #subsystem>."

3.3.1.2. Scope

Explain the scope of the upcoming test. Begin with "The scope is to provide <#test result> for <#activity> using TDL supplied <#equipment>."

3.3.2. General Test Information

3.3.2.1 Test Configuration

Provide a short written description of the test configuration at TDL. Also provide a drawing of the planned test equipment.

3.3.2.2. Other facility and support

Provide a short written description of the test facilities outside TDL. Also provide a drawing of the planned lab-wide test configuration.

3.3.2.3. Calibration Requirement

Provide a short written description of the calibration requirement at TDL. Also provide a drawing of the planned calibration configuration.

3.3.2.4. ETPE test changes

The ETPE test conductor reserves the right to make changes to the procedures deemed necessary while conducting the test. An explanation of these changes will be noted in the test procedures and included in the detailed results (appendix).

3.3.3. Test Documentation

3.3.3.1. Detailed Procedures

Explain the nature of the procedures and their usefulness to the readers of this document. State how readers of the ETPE may obtain copies of the detailed procedures.

3.3.3.2. Test Report

Provide a short statement regarding the test reporting process, i.e. what items are deliverable, when they are delivered, and who receives them.

3.3.3.3. Test Schedule

Provide a forecast of the testing activities stating the test name and its approximate duration. It is most convenient to layout the day, test title and duration as three columns in a tabular format.

3.3.4. Mechanical and Electrical Compatibility Tests.

3.3.5. Uplink Receiver Tests

3.3.5.1. RF1 Uplink Receiver Threshold and AGC Calibration.

3.3.5.1.1.Objective

Follow DSN 810-8, par. 4.1.1.1.

3.3.5.1.2. Rationale

Follow DSN 810-8, par. 4.1.1.2.

3.3.5.1.3. Description

Follow DSN 810-8, par. 4.1.1.3.

3.3.5.1.4. Conditions

Call out the DSN/flight project configurations in tabular format for this test.

3.3.5.1.5. Criteria

Follow DSN 810-8, par. 4.1.1.4.

3.3.5.2. RF2 Uplink Receiver Maximum and Minimum Acquisition Rates.

3.3.5.2.1. Objective

Follow DSN 810-8, par. 4.1.2.1.

3.3.5.2.2. Rationale

Follow DSN 810-8, par. 4.1.2.2.

3.3.5.2.3. Description

Follow DSN 810-8, par. 4.1.2.3.

3.3.5.2.4. Conditions

Call out the DSN/flight project configurations in tabular format for this test.

3.3.5.2.5. Criteria

Follow DSN 810-8, par. 4.1.2.4.

3.3.5.3. RF3 Uplink Receiver Tracking Range

3.3.5.3.1. Objective

Follow DSN 810-8, par. 4.1.3.1.

3.3.5.3.2.Rationale

Follow DSN 810-8, par. 4.1.3.2.

3.3.5.3.3. Description

Follow DSN 810-8, par. 4.1.3.3.

3.3.5.3.4. Conditions

Call out the DSN/flight project configurations in tabular format for this test.

3.3.5.3.5. Criteria

Follow DSN 810-8, par. 4.1.3.4.

3.3.5.4. RF3A Uplink Receiver Pull in Range

3.3.5.4.1. Objective

Calibrate maximum range versus time.

3.3.5.4.2. Rationale

Measurements provide spacecraft offset frequency uncertainties.

3.3.5.4.3. Description

Follow TDL Procedure RF-3A.

3.3.5.4.4. Conditions

Call out the DSN/flight project configurations in tabular format for this test.

3.3.5.4.5. Criteria

Follow radio requirements document.

3.3.6. Downlink Transmitter Tests.

3.3.6.1. RF4 Downlink Transmitter RF Power Output

3.3.6.1.1. Objective

Follow DSN 810-8, par. 4.1.4.1.

3.3.6.1.2. Rationale

Follow DSN 810-8, par. 4.1.4.2.

3.3.6.1.3. Description

Follow DSN 810-8, par. 4.1.4.3.

3.3.6.1.4. Conditions

Call out the DSN/flight project configurations in tabular format for this test.

3.3.6.1.5. Criteria

Follow DSN 810-8, par. 4.1.4.4.

3.3.6.2. RF5 Downlink Carrier Phase Noise

3.3.6.2.1. Objective

Follow DSN 810-8, par. 4.1.5.1.

3.3.6.2.2. Rationale

Follow DSN 810-8, par. 4.1.5.2.

3.3.6.2.3. Description

Follow DSN 810-8, par. 4.1.5.3.

3.3.6.2.4. Conditions

Call out the DSN/flight project configurations in tabular format for this test.

3.3.6.2.5. Criteria

Follow DSN 810-8, par. 4.1.5.4.

3.3.6.3. RF6 Downlink RF Spectrum

3.3.6.3.1. Objective

Follow DSN 810-8, par. 4.1.6.1.

3.3.6.3.2. Rationale

Follow DSN 810-8, par. 4.1.6.2.

3.3.6.3.3. Description

Follow DSN 810-8, par. 4.1.6.3.

3.3.6.3.4. Conditions

Call out the DSN/flight project configurations in tabular format for this test.

3.3.6.3.5. Criteria

Follow DSN 810-8, par. 4.1.6.4.

3.3.6.4. RF7 Downlink Receiver Threshold

3.3.6.4.1. Objective

Follow DSN 810-8, par. 4.1.7.1.

3.3.6.4.2. Rationale

Follow DSN 810-8, par. 4.1.7.2.

3.3.6.4.3. Description

Follow DSN 810-8, par. 4.1.7.3.

3.3.6.4.4. Conditions

Call out the DSN/flight project configurations in tabular format for this test.

3.3.6.4.5 Criteria

Follow DSN 810-8, par. 4.1.7.4.

3.3.6.5. RF8 DOR Characteristics

3.3.6.5.1. Objective

Verify frequency stability and coherence of the DOR tones.

3.3.6.5.2. Rationale

Frequency instability or lack of coherence could degrade downlink only ranging.

3.3.6.5.3. Description

Follow TDL Procedure RF-8.

3.3.6.5.4. Conditions

Call out the DSN/flight project configurations in tabular format for this test.

3.3.6.5.5. Criteria

Follow radio requirements document.

3.3.7.Telemetry Tests

3.3.7.1. TLM1 Telemetry Spectrum

3.3.7.1.1. Objective

Follow DSN 810-8, par. 4.3.1.1.

3.3.7.1.2. Rationale

Follow DSN 810-8, par. 4.3.1.2.

3.3.7.1.3. Description

Follow DSN 810-8, par. 4.3.1.3.

3.3.7.1.4. Conditions

Call out the DSN/flight project configurations in tabular format for this test.

3.3.7.1.5. Criteria

Follow DSN 810-8, par. 4.3.1.4.

3.3.7.2. TLM2 Telemetry Performance

3.3.7.2.1. Objective

Follow DSN 810-8, par. 4.3.2.1.

3.3.7.2.2 Rationale

Follow DSN 810-8, par. 4.3.2.2.

3.3.7.2.3. Description

Follow DSN 810-8, par. 4.3.2.3.

3.3.7.2.4. Conditions

Call out the DSN/flight project configurations in tabular format for this test.

3.3.7.2.5. Criteria

Follow DSN 810-8, par. 4.3.2.4.

3.3.7.3. TLM3 Subcarrier Frequency versus Temperature

3.3.7.3.1. Objective

Calibrate subcarrier frequency versus temperature.

3.3.7.3.2. Rationale

Calibration will aid mission operations subcarrier frequency prediction.

3.3.7.3.3 Description

Follow TDL Procedure TLM-3.

3.3.7.3.4. Conditions

Call out the DSN/flight project configurations in tabular format for this test.

3.3.7.3.5. Criteria

Follow radio requirements document.

3.3.8. Frequency Stability Tests

3.3.8.1. PH1 Stability Performance

3.3.8.1.1. Objective

Calibrate the stability of radio subsystem.

3.3.8.1.2. Rationale

Excessive frequency instability could compromise the mission.

3.3.8.1.3. Description

Follow TDL Procedure PH-1.

3.3.8.1.4. Conditions

Generate a strong signal.

3.3.8.1.5. Criteria

Follow radio requirements document.

3.3.8.2. PH2 Phase Noise Spectral Density

3.3.8.2.1. Objective

Calibrate subsystem phase noise.

3.3.8.2.2. Rationale

Excessive frequency instability could compromise the mission.

3.3.8.2.3. Description

Follow TDL Procedure PH-2.

3.3.8.2.4. Conditions

Generate a strong signal.

3.3.8.2.5. Criteria

Follow radio requirements document.

3.3.8.3. PH3 Phase Delay versus Temperature

3.3.8.3.1. Objective

Calibrate phase changes versus spacecraft temperature profile.

3.3.8.3.2. Rationale

Phase changes could bias valuable data if not understood.

3.3.8.3.3. Description

Follow TDL Procedure PH-3.

3.3.8.3.4. Conditions

Generate a Strong signal.

3.3.8.3.5. Criteria

Follow radio requirements document.

3.3.9. Ranging Tests

3.3.9.1. RM1 Ranging Polarity

3.3.9.1.1. Objective

Follow DSN 810-8, par. 4.2.1.1.

3.3.9.1.2. Rationale

Follow DSN 810-8, par. 4.2.1.2.

3.3.9.1.3. Description

Follow DSN 810-8, par. 4.2.1.3.

3.3.9.1.4. Conditions

Call out the DSN/flight project configurations in tabular format for this test.

3.3.9.1.5. Criteria

Follow radio requirements document.

3.3.9.2. RM2 Ranging Delay

3.3.9.2.1. Objective

Follow DSN 810-8, par. 4.2.2.1.

3.3.9.2.2. Rationale

Follow DSN 810-8, par. 4.2.2.2.

3.3.9. 2.3. Description

Follow DSN 810-8, par. 4.2.2.3.

3.3.9.2.4. Conditions

Call out the DSN/flight project configurations in tabular format for this test.

3.3.9.2.5. Criteria

Follow DSN 810-8, par. 4.2.2.4.

3.3.9.3. RM3 Ranging Delay versus Temperature

3.3.9.3.1. Objective

Calibrate range versus temperature.

3.3.9.3.2. Rationale

Delay change could cause errors in evaluating ranging during the mission.

3.3.9.3.3. Description

Follow TDL Procedure RM-3.

3.3.9.3.4. Conditions

Generate a Strong signal.

3.3.9.3.6. Criteria

Follow radio requirements document.

3.4. Test Plan

Obtain cognizance, resource allocation, and approval for ETPE Sections 1 and 2 from the TDL supervisor. At this point, the ETPE is ready to release the TDL Test Plan to all test personnel.

3.5. Prepare Section 3 of the ETPE document, TDL Test Summary

3.5.1. Purpose

Explain the purpose of the test summary section.

3.5.2. Objectives

Explain the objectives of the TDL test.

3.5.3. Configuration

Provide a short written description of the test configuration that was used at TDL. Also provide a drawing of the actual test configuration. Explain any changes in the test configurations and refer the detailed changes to the appendix with the detailed results.

3.5.4. Results

3.5.4.1. General

Make a concluding statement regarding the performance of DUT based upon the results of the above tests. Put forth explanations of any changes to the original test configuration and possible actions pertinent to enhance the performance characteristics of the DUT.

3.5.4.2. RF1 Uplink Receiver Threshold and AGC Calibration

Make a concluding statement of this test, based upon the test criteria.

3.5.4.3. RF2 Uplink Receiver Maximum and Minimum Acquisition Rates

Make a concluding statement of this test, based upon the test criteria.

3.5.4.4. RF3 Uplink Receiver Tracking Range

Make a concluding statement of this test, based upon the test criteria.

3.5.4.5 RF3A Uplink Receiver Pull In Range

Make a concluding statement of this test, based upon the test criteria.

3.5.4.6. RF4 Downlink Transmitter Power Output

Make a concluding statement of this test, based upon the test criteria.

3.5.4.7. RF5 Downlink Carrier Phase Noise

Make a concluding statement of this test, based upon the test criteria.

3.5.4. 8. RF6 Downlink RF Spectrum

Make a concluding statement of this test, based upon the test criteria.

3.5.4.9. RF7 Downlink Receiver Threshold

Make a concluding statement of this test, based upon the test criteria.

3.5.4.10. RF8 DOR Characteristics

Make a concluding statement of this test, based upon the test criteria.

3.5.4.11. TLM1 Telemetry Spectrum

Make a concluding statement of this test, based upon the test criteria.

3.5.4.12. TLM2 Telemetry Performance

Make a concluding statement of this test, based upon the test criteria.

3.5.4.13. TLM3 Subcarrier Frequency versus Temperature

Make a concluding statement of this test, based upon the test criteria.

3.5.4.14. PH1 Stability Performance

Make a concluding statement of this test, based upon the test criteria.

3.5.5.15. PH2 Phase Noise Spectral Density

Make a concluding statement of this test, based upon the test criteria.

3.5.4.16. PH3 Phase Delay versus Temperature

Make a concluding statement of this test, based upon the test criteria.

3.5.4.17. RM1 Ranging Polarity

Make a concluding statement of this test, based upon the test criteria.

3.5.4.18. RM2 Ranging Delay

Make a concluding statement of this test, based upon the test criteria.

3.5.4.19. RM3 Ranging Delay versus Temperature

Make a concluding statement of this test, based upon the test criteria.

3.6. Prepare Appendix of the ETPE, TDL Test Detail.

3.6.1. Purpose

Explain the nature of the contents for this Appendix.

3.6.2. Test Results

Test results generated will be delivered to the requesting organization. Records will be kept for reference and archival purpose only.

3.6.2.1. RF1 Uplink Receiver Threshold and AGC Calibration

Include the configuration table that described the conditions for this test with the appropriate results added in the table. Include a plot of the AGC voltage vs. Input power to the spacecraft receiver.

3.6.2.2. RF2 Uplink Receiver Maximum and Minimum Acquisition Rates

Include the configuration table that described the conditions for this test with the appropriate results added in the table.

3.6.2.3. RF3 Uplink Receiver Tracking Range

Include the configuration table that described the conditions for this test with the appropriate results added in the table. Include a spectrum plot of the uplink receiver tracking range.

3.6.2.4. RF3A Uplink Receiver Pull IN Range

Include the configuration table that described the conditions for this test with the appropriate results added in the table.

3.6.2.5. RF4 Downlink Transmitter Power Output

Include the configuration table that described the conditions for this test with the appropriate results added in the table.

3.6.2.6. RF5 Downlink Carrier Phase Noise

Include the configuration table that described the conditions for this test with the appropriate results added in the table. Also include the spectrum plots.

3.6.2.7. RF6 Downlink RF Spectrum

Include the configuration table that described the conditions for this test with the appropriate results added in the table.

3.6.2.8. RF7 Downlink Receiver Threshold

Include the configuration table that described the conditions for this test with the appropriate results added in the table.

3.6.2.9. RF8 DOR Characteristics

Include the configuration table that described the conditions for this test with the appropriate results added in the table. Also include the spectrum plots.

3.6.2.10. TLM1 Telemetry Spectrum

Include the configuration table that described the conditions for this test with the appropriate results added in the table. Also include the spectrum plots.

3.6.2.11. TLM2 Telemetry Performance

Include the configuration table that described the conditions for this test with the appropriate results added in the table. If a bit error rate was measured, include a plot of the resulting bit error rate vs. The input E_b/N_o.

3.6.2.12. TLM3 Subcarrier Frequency

Include the configuration table that described the conditions for this test with the appropriate results added in the table. Also include the spectrum plots.

3.6.2.13. PH1 Stability Performance

Include the configuration table that described the conditions for this test with the appropriate results added in the table.

3.6.2.14. PH2 Phase Noise Spectral Density

Include the configuration table that described the conditions for this test with the appropriate results added in the table.

3.6.2.15. PH3 Phase Delay

Include the configuration table that described the conditions for this test with the appropriate results added in the table.

3.6.2.16. RM1 Ranging Polarity

Include the configuration table that described the conditions for this test with the appropriate results.

3.6.2.17. RM2 Ranging Delay

Include the configuration table that described the conditions for this test with the appropriate results added in the table.

3.6.2.18. RM3 Ranging Delay versus Temperature

Include the configuration table that described the conditions for this test with the appropriate results added in the table.

3.7. Additional sections

Prepare additional Sections or Appendices of the ETPE document such that the contents of the ETPE reflect all stages of testing that have been done. Any additional test requires a plan, summary, and detail entered into the ETPE as two Sections and an Appendix. Follow paragraph 3.3 for the test plan, paragraph 3.5 for the test summary and paragraph 3.6 for the test detail.

3.8. Publishing

Publish draft copy of the completed ETPE document.

3.9. ETPE Distribution

Obtain approval of the completed ETPE contents from the cognizant system engineer of the DUT. At this point, the ETPE document is ready to be released to users on the distribution list.

3.10. Archival

Archive a copy of the released ETPE document in TDL project files. Keep on file for at least one year.

PPCP-T-1

TELECOMMUNICATIONS DEVELOPMENT LABORATORY (TDL)
PROJECT PRETEST CALIBRATION PROCEDURE 1
TELEMETRY

Configure TDL to conform to the Telemetry Calibration Block Diagram attached to the Calibration Procedure.
Configure Telemetry Simulator for 100.0 KBPS convolutional encoded K=7, R=1/2 on a 2 KHz SUBCARRIER.
Configure (using the Telemetry Calibration Block Diagram) the Y-factor SNR measuring device to measure the Block v Receiver signal to noise ratio. Calculate the y-factor for a Eb/No = 3.0dB using the Y-factor instructions attached to the Telemetry Calibration Procedure.

Set the SNR at the input to the Block V Receiver using the Y-factor SNR measuring device according to the Y-factor procedure attached to the Telemetry Calibration Procedure.
Run the telemetry test equipment and record the 3.0 dB results on the data sheet. Change the down link variable attenuator by .5 dB to achieve a 2.5 dB Eb/No and record the 2.5 dB results. Repeat for the 2.0 dB case.
Plot results on the Telemetry Data Sheet and verify that the loss from theory is less than 1 dB from the theoretical reference curve. File the calibration data in TDL'S Telemetry Calibration file as a calibration reference for each project.

Repeat test for 100 bps.

Repeat test for 10 bps.

Y-Factor calculation:

$$\text{Y-factor (dB)} = 10 * LOG\left(\frac{\left(\frac{10^{EB/No}}{10} \right) * br}{11330.5 * \sin^2(\text{mod}\,\theta)} + 1 \right)$$

DATA SHEET

bit rate	mode	code	mod index	Subcarrier freq.	Carrier freq.	Subcarrier BW/win	sym BW/win
100K							
100K							
100K							
100bps							
100bps							
100bps							
10bps							
10bps							
10bps							

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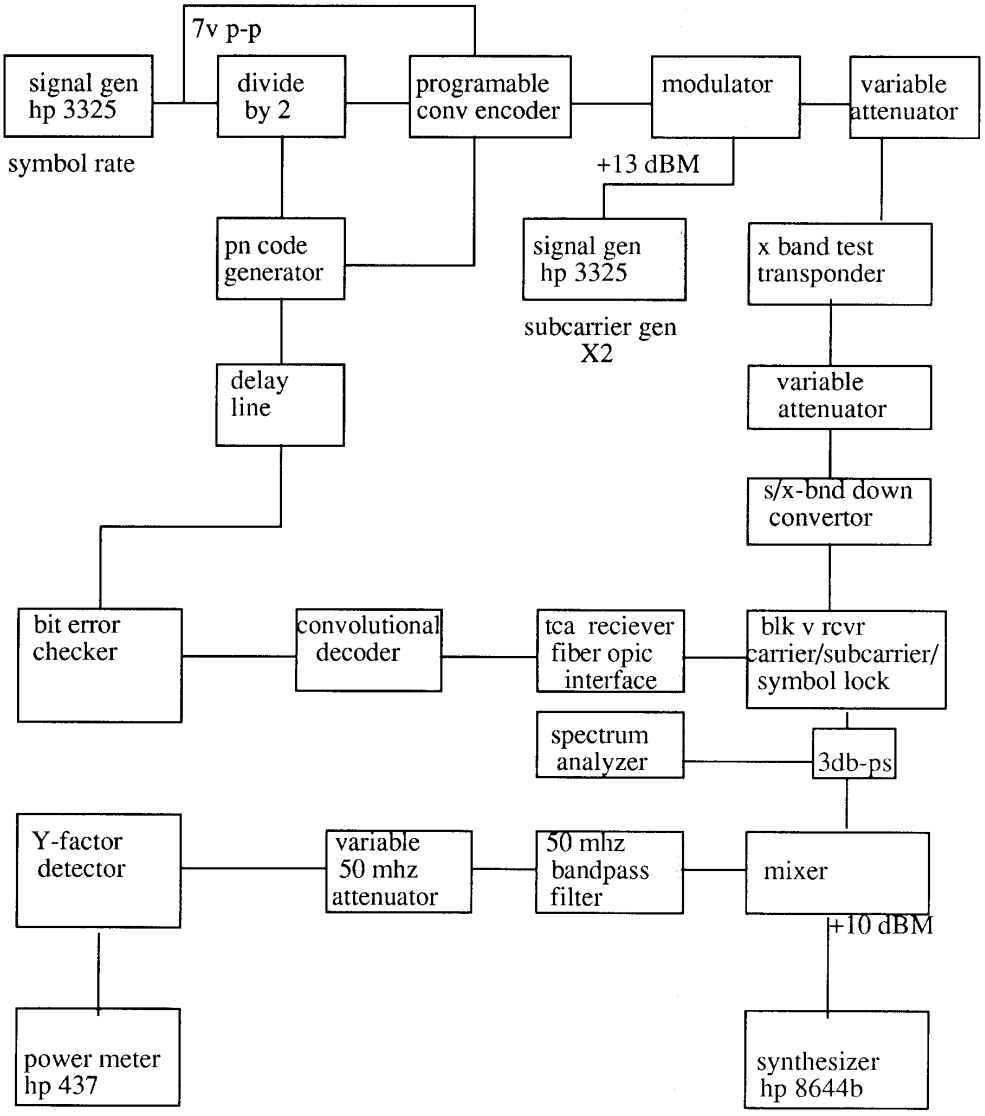
TELEMETRY CALIBRATION BLOCK DIAGRAM



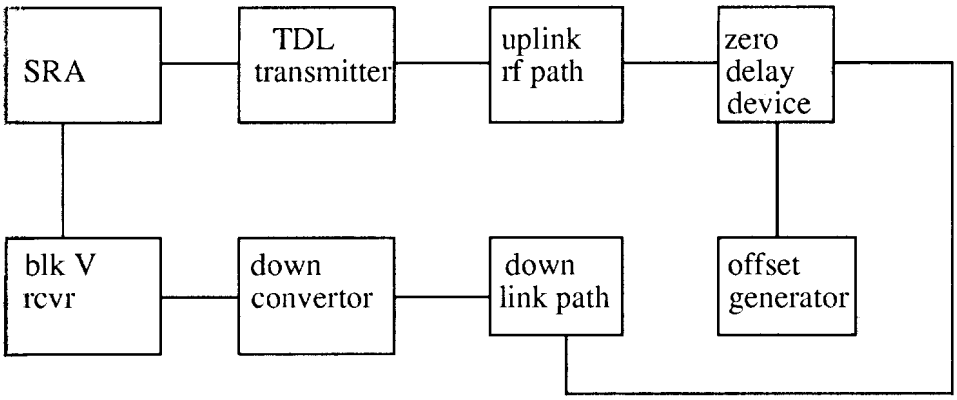
PPCP-R-2

TELECOMMUNICATIONS DEVELOPMENT LABORATORY (IDL)
PROJECT PRETEST CALIBRATION PROCEDURE 2
RANGING

Configure TDL to conform to the Ranging Calibration Block diagram attached to the Ranging Calibration Procedure.
Configure the Sequential Ranging Assembly (SRA) for a 35 degree modulation angle on the X-Band and downlink, 1 MHz clock and T 1 =5 s, T2=2s integration time. Set the SRA IF SNR to +5.0 dB. Configure the Block V Receiver to acquire the downlink carrier and output ranging on the fiber optic link to the SRA. Acquire the X-band down link signal at a +20dB ranging SNR.
Average 5 ranging acquisitions and record the average on the Ranging Calibration Data Sheet for the +20dB SNR, then reduce SRA,s ranging signal in 5 dB steps by increasing the X Band variable attenuator by 5 dB and record each average of 5 Ranging delay numbers on the Ranging data sheet. Continue to reduce the ranging signal and if set SNR as specified on the data sheet and record each set of data to a -5 dB ranging signal SNR, increase T1 and T2 as necessary to reduce variations in the ranging data.

RANGING DATA SHEET

		SRA					BLK V				
SET SNR	IF SET SNR	SRA RANGE NUMBER			T1	T2	PT/NO	PC/NO	CAR SNR	RF ATTN DIAL	
+20	+5										
+15	+5										
+10	+5										
+5	+5										
0	0										
-5	-5										



PPCP-PN-3

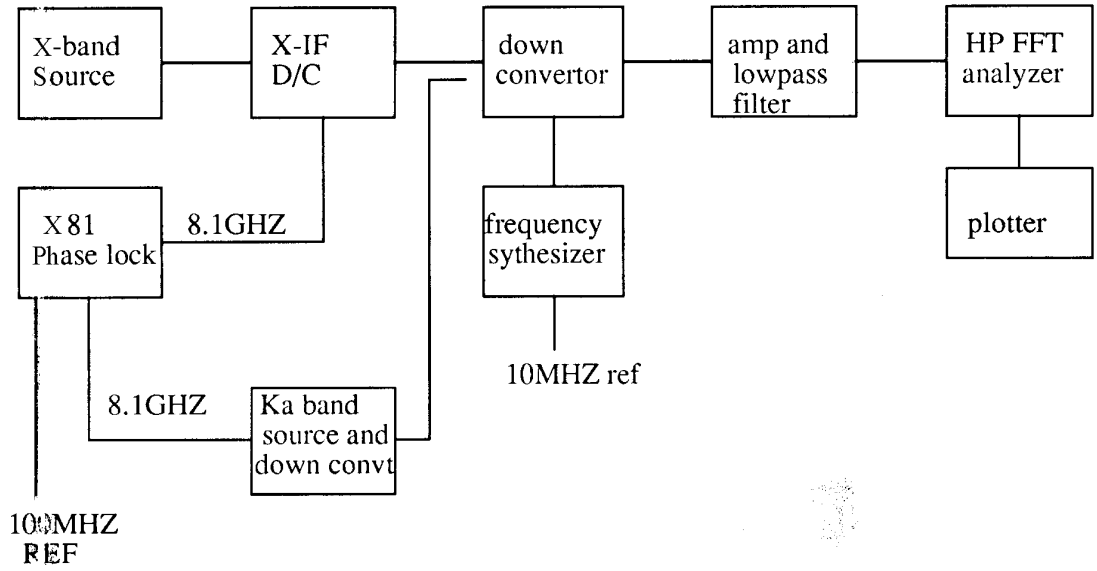
TELECOMMUNICATIONS DEVELOPMENT LABORATORY (TDL)
PROJECT PRETEST CALIBRATION PROCEDURE 3
PHASE NOISE

Configure TDL to conform to the Phase Noise Calibration Block Diagram attached to the Phase Noise Calibration procedure.

Calculate the IF frequency after the first down conversion. For X-band, X-band - 8100 MHZ= X-band IF. For Ka Band, Ka Band - 32400MHz = Ka Band IF. Select if under test and set second down convertor frequency to IF - 20kHz this establishes the output IF to be 20KHZ to the Hewlet Packard 3562A or 35670A low frequency FFT analyzer.

Set the FFT analyzer for a 0 to 100Hz span with the IF frequency as the frequency on and make a plot of the down converted Spectrum.

Set the FFT analyzer for a 0 to 10000Hz span and make a plot of the down converted Spectrum.

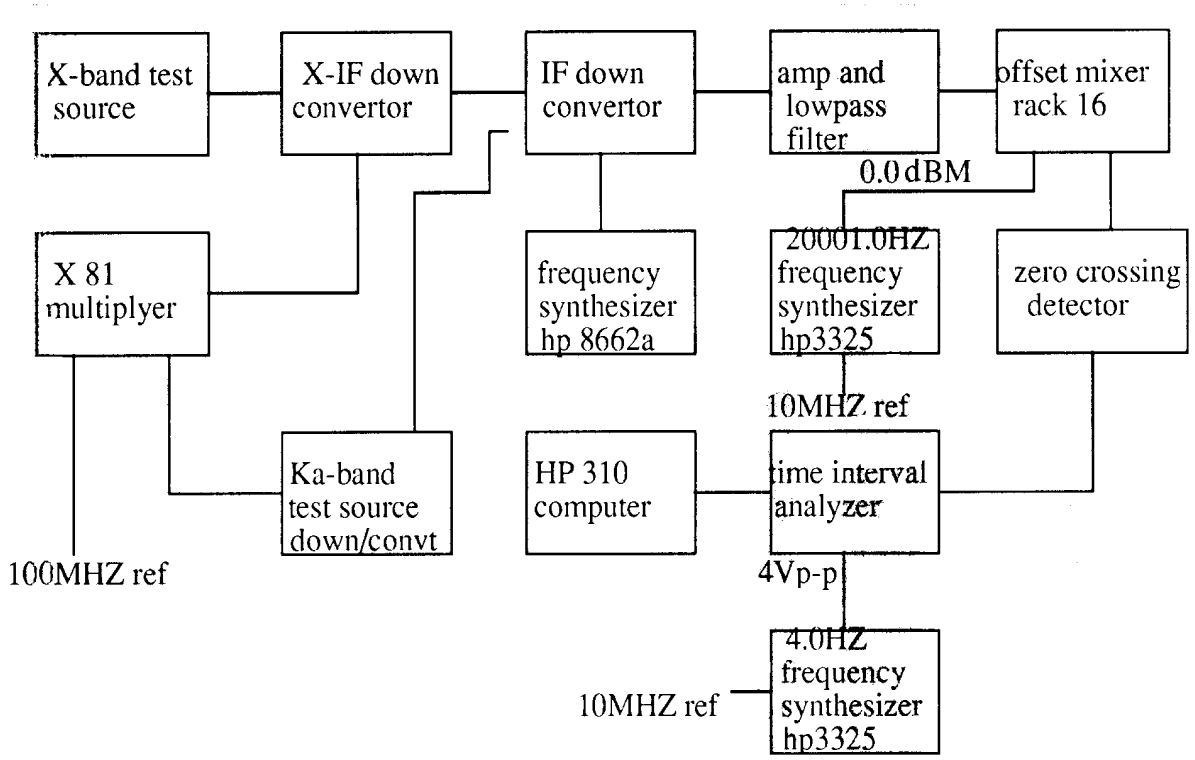


PPCP-AV-4

TELECOMMUNICATIONS DEVELOPMENT LABORATORY (FDL)
PROJECT PRETEST CALIBRATION PROCEDURE 4
ALLAN VARIANCE

Configure TDL to conform to the Allan Variance Calibration Block-Diagram attached to the Allan Variance Test Procedure.

Load the ALLANV program from the HP310 rack mount computer memory located in rack16. Adjust the 20 KHz signal from the Radio Science rack to _14dB as read on the spectrum analyzer and connect the signal to the offset mixer located in the rack 16. Run the Allan Variance program and enter the highest downlink signal from the Device Under Test (DUT) in number 1. If the downlink signal is coherent enter "yes" in number 2. Enter test notes in number 4, and start test. Stop test when enough data is collected or it will stop recording in approximate 50 hours. Plot Allan Variance curve and process data for the phase change curve plot.



PPCP-CS-5

TELECOMMUNICATIONS DEVELOPMENT LABORAT9,RY,(TDL)
PROJECT PRETEST CALIBRATION PROCEDURE 5'
CYCLE SLIP

Configure TDL to conform to the Cycle Slip Calibration Block Diagram attached to Cycle Slip Test Procedure.
Load the Phase Drift program from the HP 3 10 rack mount computer located in rack 16. Commands MSI "DRIFIF",CAT, LOAD, PHIDRIF. Run program for 8 hours, and process data for cycle slips and plot.