TITLE **2.5GHZ 12W PWR AMPLIFIER (STRATA OB HPU)**

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TEST PROCEDURE SPECIFICATION

1.0 SCOPE:

This procedure describes the testing to be performed on a 12W power amplifier used in the Strata Outdoor Broadcast HPU. Tests to be done include small signal gain, input return loss, detector voltage and saturated power output. Refer to product specification PS-1453 during tests. Place amplifier on heat-sink (P/N 907502) at all times with a small bench fan blowing through heat-sink fins. Case temperature is not to exceed +75 degree C.

Amplifier P/N 907344-1 covers 1.99-2.5GHz and P/N 907344-2 covers 2.3-2.7GHz.

2.0 TEST EQUIPMENT REQUIRED:

HP8757A	Network Analyzer
HP8350B	Sweeper mainframe
HP83492B	.01-20GHz plug-in
HP85025B	Detector
HP85027B	Bridge .01 to 26.5GHz
HP436A	Power Meter (2)
HP8481B	Power Sensor (25W) and HP8481A Power Sensor up to 20 dBm.
Fluke 8010A	D.M.M.

(POWER DESIGNS) 0-40V, 0-5A Power supply (5A min. capacity) (2)

ATT-0303-10-SMA-07	10dB, 10 Watt SMA attenuator (Midwest Microwave)
ATT-0303-03-SMA-07	3dB, 10 Watt SMA attenuator
ATT-0303-20-SMA-07	20dB, 10 Watt SMA attenuator

Microscope

HP7470A	Plotter
3292	Narda broadband Coupler

MRC P/N 907282-1, -2 2W IF/RF Strata Up-Converter
Static station and operator test strap
907502-Heat Sink & Small bench fan HP8348A Microwave Power Amp.
(DC) Power Harness & Test Cover or MRC 906816-1, or –2 see freq.
H.P. Cal. Kit plus Heat Sink for 906816-1,-2 if needed

Equiv. Equip. may be substituted.

REVISION HISTORY BLOCK

Revision	ECO#	DATE
A	2154-4	12/09/02

3.0 SPECIFICATIONS:

3.1 DC INPUT +11.0V ±0.5V @ < 5A MAX

3.2 SMALL SIGNAL GAIN 14 dB preferred, Otherwise 13 dB for each band @ +10 dBm input

3.3 INPUT RETURN LOSS 8 dB min., 10 dB preferred from 1.99-2.5 GHz(-1) or 2.3-2.7 GHz(-2).

3.4 V(drain) Vd = =10V ±0.2V & V(gate) Vg = -5V ±0.3V

3.5 CURRENT < 50ma when PA-EN is grounded.

3.6 V-Det. = +0.8 to +1.3 Volts into a 10K ohm load across RF Band.

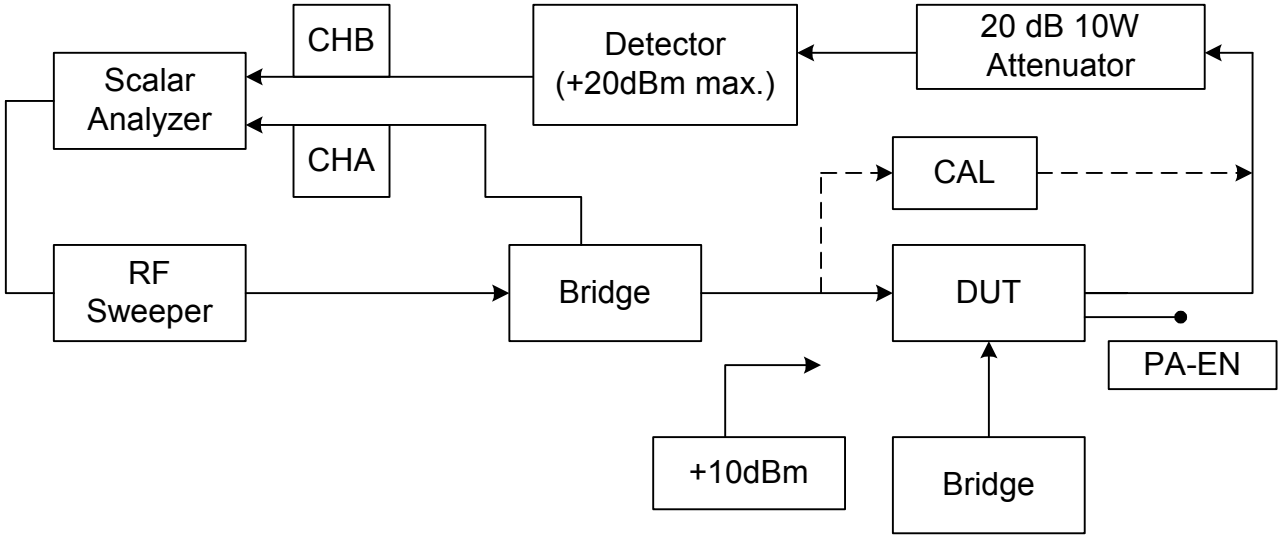
3.7 SPURIOUS OUTPUT <-54 dBc

3.8 FREQUENCY 1.99-2.5 GHz (907344-1), 2.3-2.7 GHz (907344-2)

3.9 11.5W min., 12W OUTPUT POWER preferred with +30 dBm INPUT

4.0 SET-UP

TEST BLOCK DIAGRAM 1



NOTES: 1. Do not overdrive HP8502B detector (Pmax =+20dBm)
2. DUT to have it's top cover attached for all RF measurements
3. DUT to be mounted on heat sink with fan blowing on it. Tcase not to exceed +75 degree C.

Set up equipment as shown in TEST BLOCK DIAGRAM 1.

4.1 RF SWEEPER:

Start/Stop:	1.99-2.5GHz (P/N 907344-1; 2.3-2.7GHz (P/N 907344-2)
Power Output:	+10dBm typ. At RF input of amp
Modulation	ON
Sweep Time:	.5 second

4.2 SCALER ANALYZER

CH-A (Input return loss):	10dB/Div
Detection:	AC
Mode:	A-mem
Ref:	0 dB
CH-B (Gain)	2dB/Div
Mode:	B-mem and Ref: 14dB

5.0 DC-BIAS SETTINGS FOR FETS

5.1 Mount the UUT to the heat sink with all the main mounting screws and leaving the top cover off. Set the Power Supply to + 11.0V but don't connect the DC Power until the following initial settings are done. See figure 1 below.

5.2 Before applying DC power to the amplifier, adjust R29 (1K pot), R2 (100 ohm pot) and R21 (100 ohm pot) as shown below. CW = fully clockwise. CCW = fully counterclockwise. Measure all the Gate resistances to ground, they should be > 600 Ohms to ground.

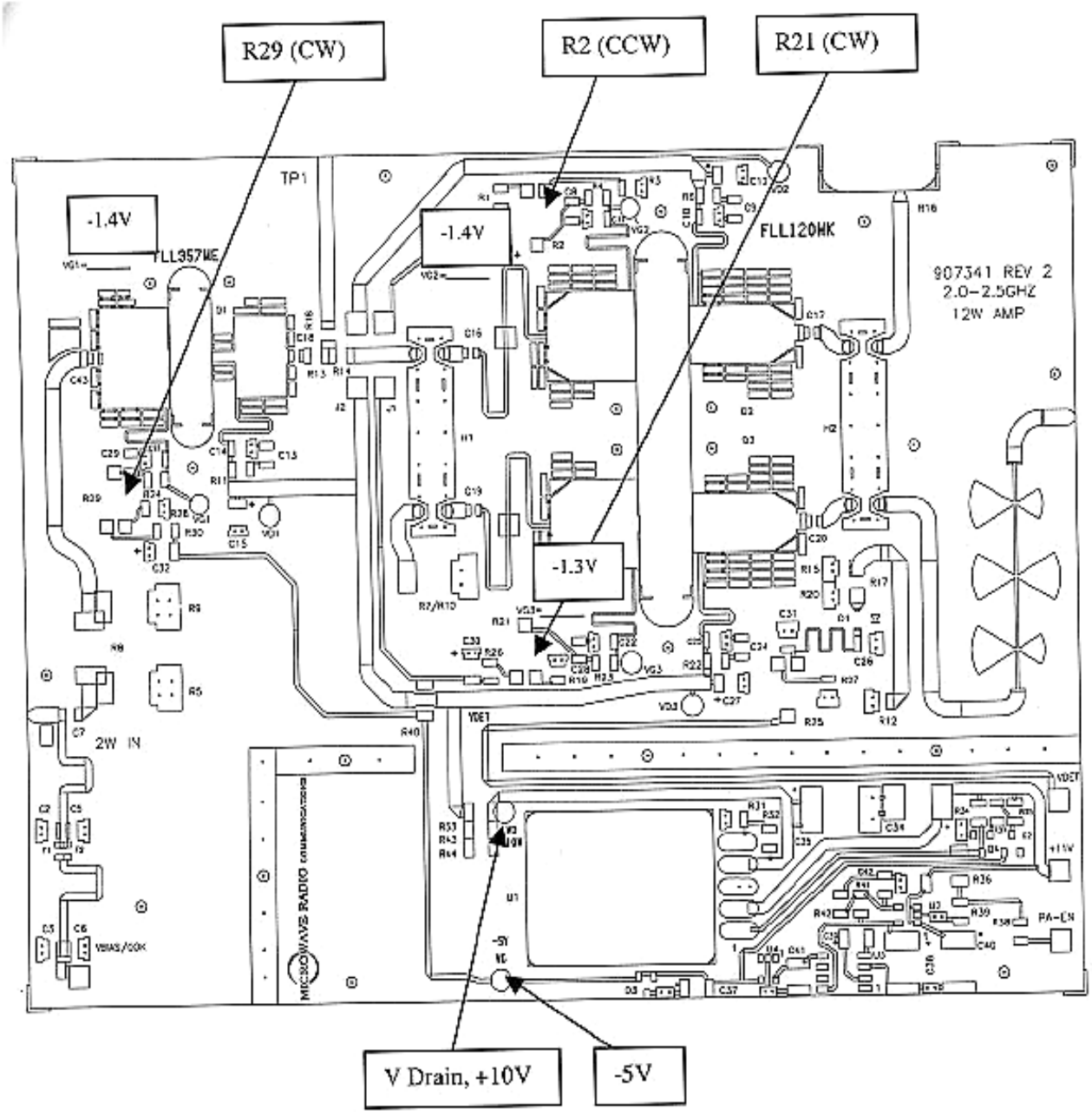

R29 (CW)
R2 (CCW)
R21 (CW)
-1.4V
-1.4V
-1.3V
TP1
FLL357ME
FLL120HK
907341 REV 2
2.0-2.5GHZ
12W AMP
2W IN
V Drain, +10V
-5V

FIGURE 1

5.3 These pot adjustments yield a more negative voltage applied to the gates of the FETs upon initial turn-on. This voltage approaches Vpinch-off thus reducing drain current when the amp is first powered up. Make a hard copy of data shown on the FLL357ME and FLL120MK (X2) storage cases. Apply +11V to the amplifier. Vdrain (Vd) should be +10V+/-.2V and Vgate (Vg) should be –5V+/-.3V. Vary amplifier's input voltage +/-.5V around +11V and monitor Vd. Vdrain should be regulated and not change. Apply DC power to DUT but leave RF input power off. We will be adjusting R29 (VG1), R2 (VG2) and R21 (VG3) for proper gate voltages. Proper gate voltage for Vg1 is the voltage shown on the FLL357ME container. After adjusting R29 for correct gate voltage write in the gate voltage in the space provided on the MSA board, for example: VG1= -1.4V. **Note: Only Q2 & Q3 have their gate voltages backed off -.2Volts.** Proper voltage for VG2 and VG3 is the gate voltage shown on it's storage container *minus* .2V. For example, Q2's (FLL120MK) container reads a gate voltage of –1.2V so adjust R2 for VG2= -1.2V-.2V = -1.4V. Also for example Q3's (FLL120MK) container reads a gate voltage of –1.1V so adjust R21 for VG3= -1.1V-.2V = -1.3V. By backing off gate voltage by -.2V we are slightly throttling back the drain current consumption but still maintaining proper RF power performance. Write in gate voltages in the space provided on the MSA board; i.e. VG2 = -1.4V and VG3 = -1.3V for example. See Diagram 3 for typical voltages.

6.0 SMALL SIGNAL GAIN AND RETURN LOSS TESTS

6.1 Apply RF input power and make sure top cover (w/ attached absorber) is fastened securely with all cover screws. Small signal gain should be 13 dB min. 14 dB preferred and input return loss is – 8dB min. 10 dB preferred from 1.99-2.5 GHz(-1) or 2.3-2.7GHz(-2).See plots 1 & 2 for typical performance. The –2 amp.s should measure the same as the –1 amp.s.
For troubleshooting purposes only, we can test the line-up of the 6dB pi-pad (R5,8,9) and FLL357MK (Q1) using test port #1 (TP1). Remove R14 (0 ohm) and place it in the R18 spot. Small signal gain should be +4dB typical and return loss –10dB typical. We can also test the balanced output FLL120MK stage. Use TP1 and remove R13 and install 0 ohm jumper at the R18 location. Small signal gain should be about 10dB typical and input return loss to be –10dB typical. Note: If the output power is low by approx. 3 dB check the output of the hybrid couplers for balanced outputs from H1 or the input powers to H2 are equal. Do this test at low input power and use a dc blocked RF/Microwave probe if troubleshooting is required.

7.0 POWER OUTPUT AND DETECTED VOLTAGE MEASUREMENT:

7.1 To measure saturated power output we must drive power amp with +30dBm (1W) typical. The Strata 2W IF/RF upconverter (MRC P/N 907282) can be used to supply this 1W input drive level or any other high power RF source. Refer to set-up shown in Diagram 2. Remember power pad for input to spectrum analyzer. Keep input power to S/A below it's 1W limit. See plots 3 & 4 for typical power out versus frequency. Pout should be +12W typical, 11.5W minimum.

7.2 Adjust R25 (1K pot) through top hole in cover for .8-1.3V detected voltage across the RF band.

Set R25 to 1.0V or greater at the highest det. Voltage so the lower voltages are in spec.

7.3 Current draw from +11V line to be <5 amps. Verify current on cal'd DMM.

7.4 Ground out PA-Enable feedthru and this should disable power FET's and cause current draw to be less than 50mA.

8.0 CONTINUITY TEST

8.1 Turn off the DC and Microwave power. Remove the unit from the heat sink and cables. Do a resistance test between RF-IN center pin and the PS/OOK feedthru pin. The res. S/B < 0.5 ohms. Typical is less than 0.1 ohms.

For reference only….The 12W amp will be used in the Strata HPU (High Power Unit). It will be driven by the standard 2W TXU. The RF attenuator on the 2W IF/RF upconverter in the TXU is to be set to 7dB so as to reduce it's power output from 2W to about 1W. This yields better spurious performance out of the IF/RF upconverter. This in turn allows us to meet the spurious spec of <-54dBc out of the 12W HPU in the analog mode. For the digital mode the RF attenutor will be adjusted accordingly across the band for each modulation scheme at final test. The attenuator settings will be saved by the on-board microcontroller in the 2W IF/RF module (MRC P/N 907282).

TEST BLOCK DIAGRAM 2

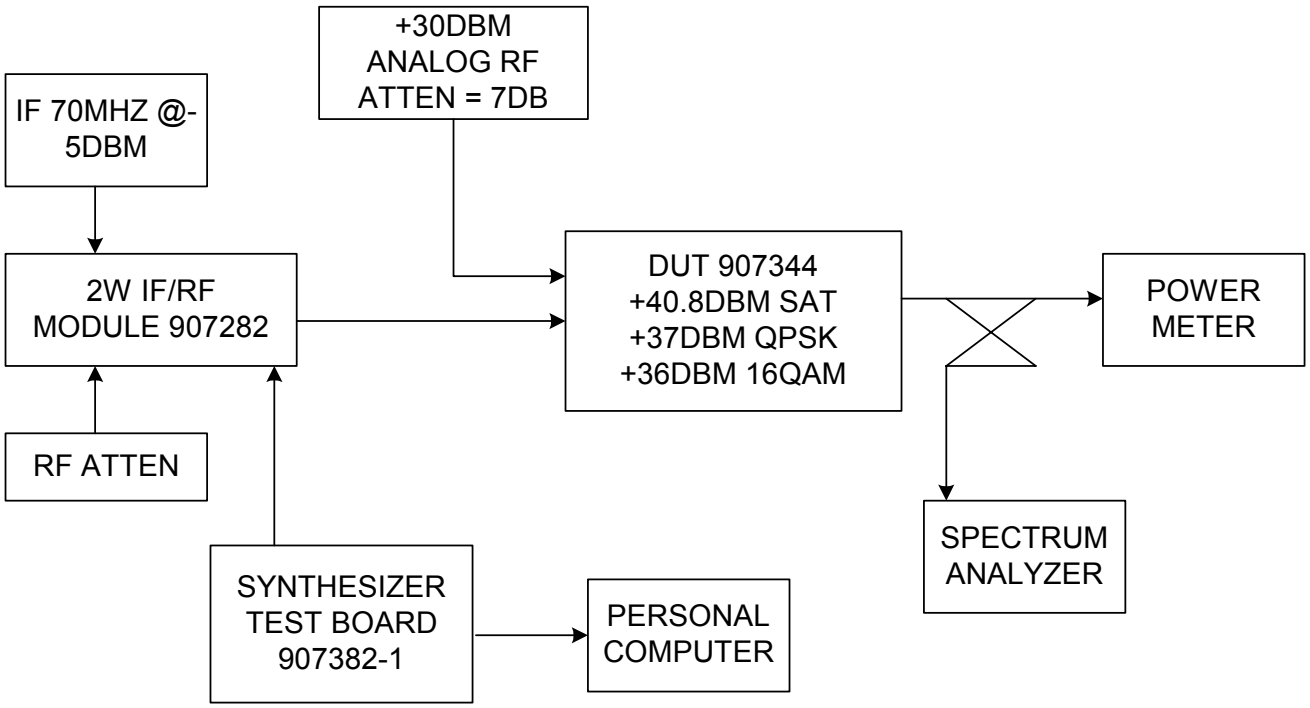
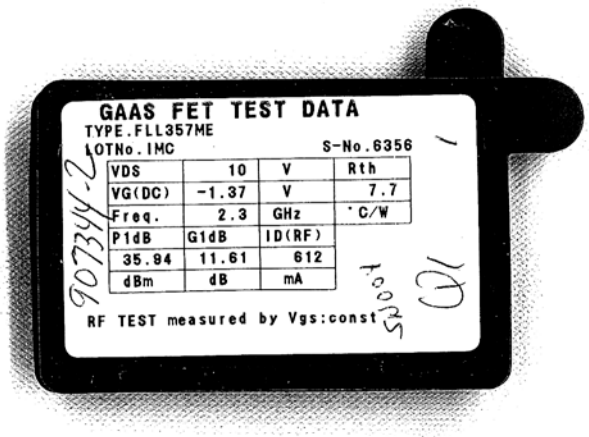


DIAGRAM 3



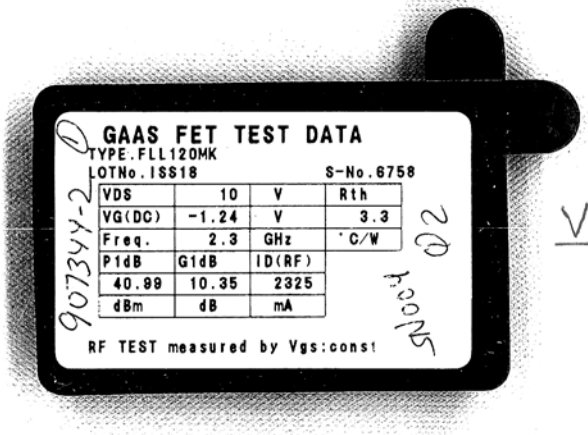
GAAS FET TEST DATA
TYPE.FLL357ME
LOTNo.1MC S-No.6356

VDS	10	V	Rth
VG(DC)	-1.37	V	7.7
Freq.	2.3	GHz	°C/W
P1dB	G1dB	ID(RF)	
35.94	11.61	612	
dBm	dB	mA	

RF TEST measured by Vgs:const

907344-2 01 Sanyo

VG1 = -1.37V



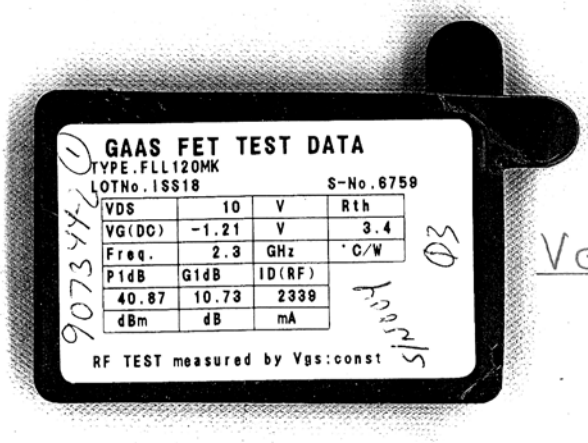
GAAS FET TEST DATA
TYPE.FLL120MK
LOTNo.1SS18 S-No.6758

VDS	10	V	Rth
VG(DC)	-1.24	V	3.3
Freq.	2.3	GHz	°C/W
P1dB	G1dB	ID(RF)	
40.99	10.35	2325	
dBm	dB	mA	

RF TEST measured by Vgs:const

907344-2 02 Sanyo

VG2 = -1.24V-.2V = -1.44V



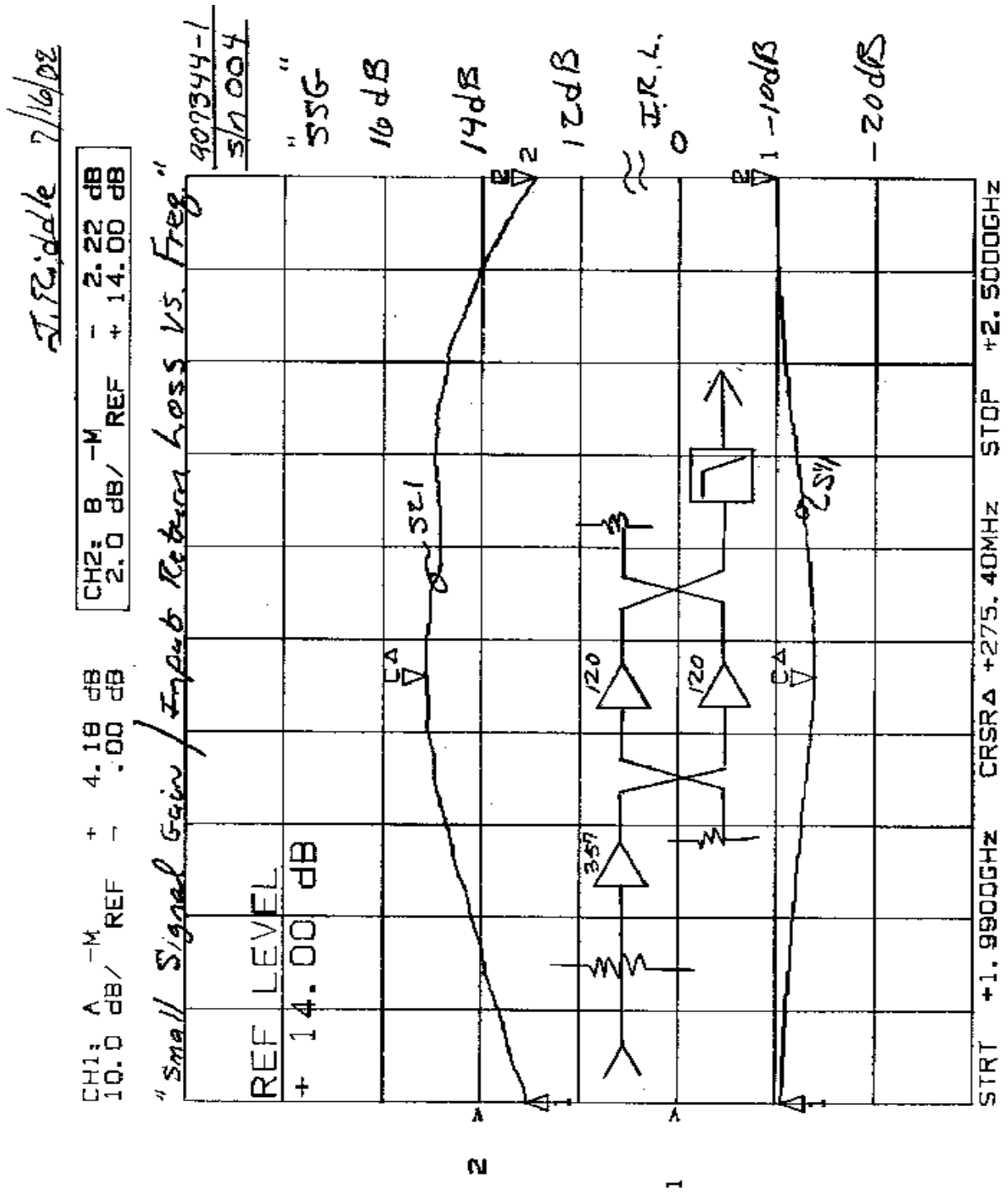
GAAS FET TEST DATA
TYPE.FLL120MK
LOTNo.1SS18 S-No.6759

VDS	10	V	Rth
VG(DC)	-1.21	V	3.4
Freq.	2.3	GHz	°C/W
P1dB	G1dB	ID(RF)	
40.87	10.73	2339	
dBm	dB	mA	

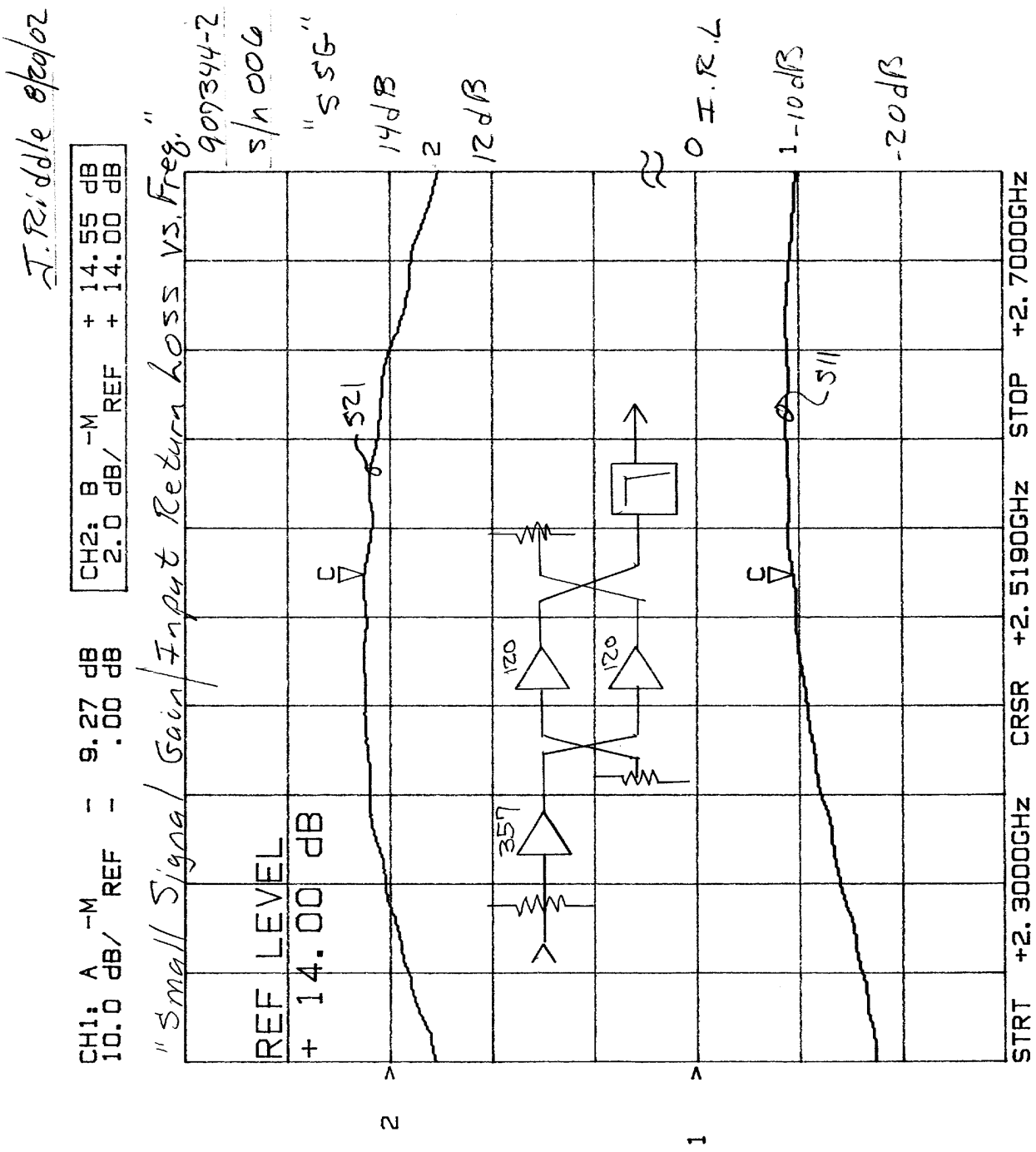
RF TEST measured by Vgs:const

907344-2 03 Sanyo

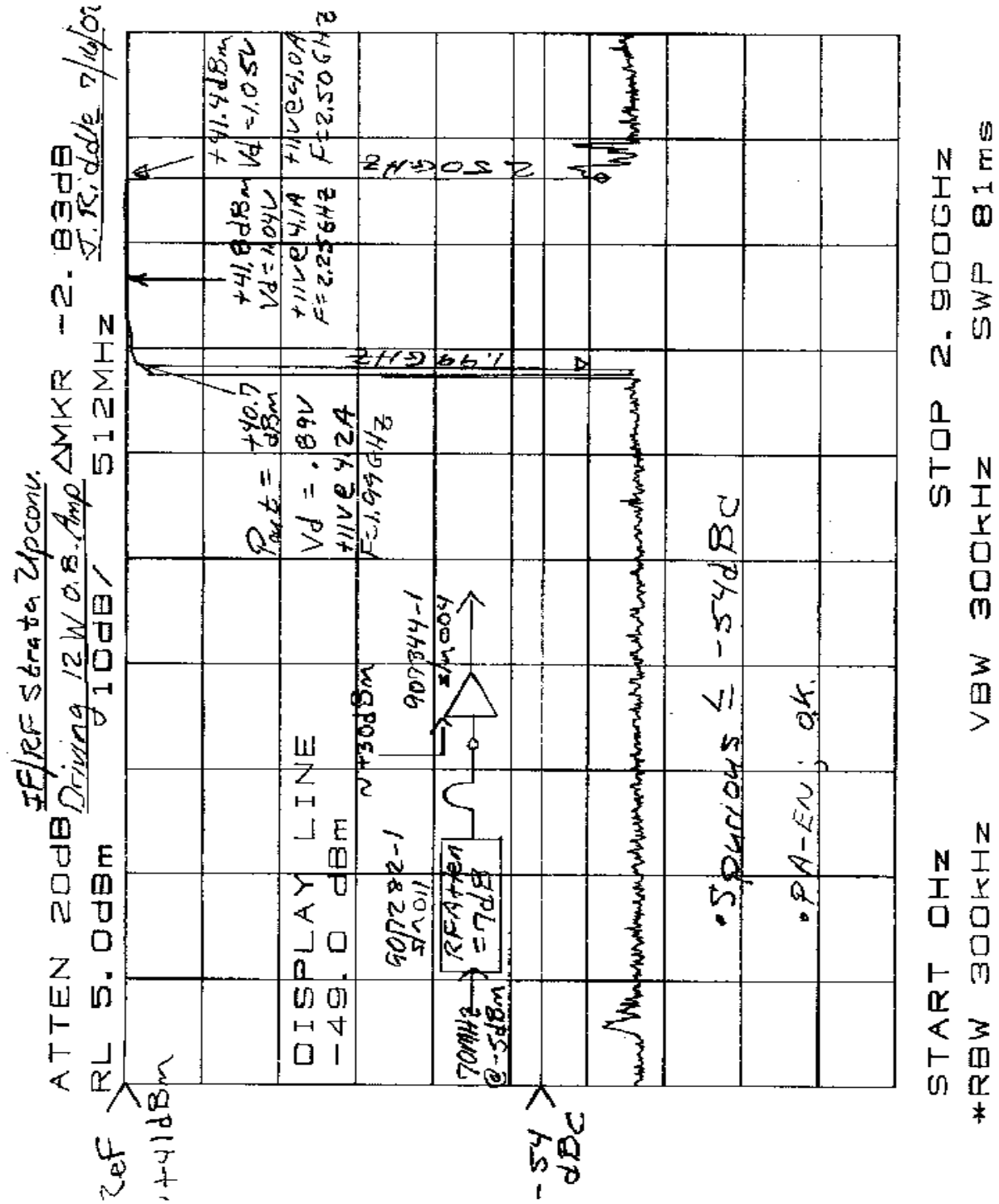
VG3 = -1.21V-.2V = -1.41V


"Small Signal Gain / Input Return Loss vs. Freq"
907344-1
s/n 004
"SSG"
16 dB
14dB
12dB
I.R.L.
0
-10dB
-20dB
CH1: A -M
10.0 dB/ REF + 4.18 dB
- .00 dB
CH2: B -M
2.0 dB/ REF - 2.22 dB
+ 14.00 dB
REF LEVEL
+ 14.00 dB
S21
S11
120
120
35Ω
STRT +1.9900GHz
CRSR Δ +275.40MHz
STOP +2.5000GHz
2
1

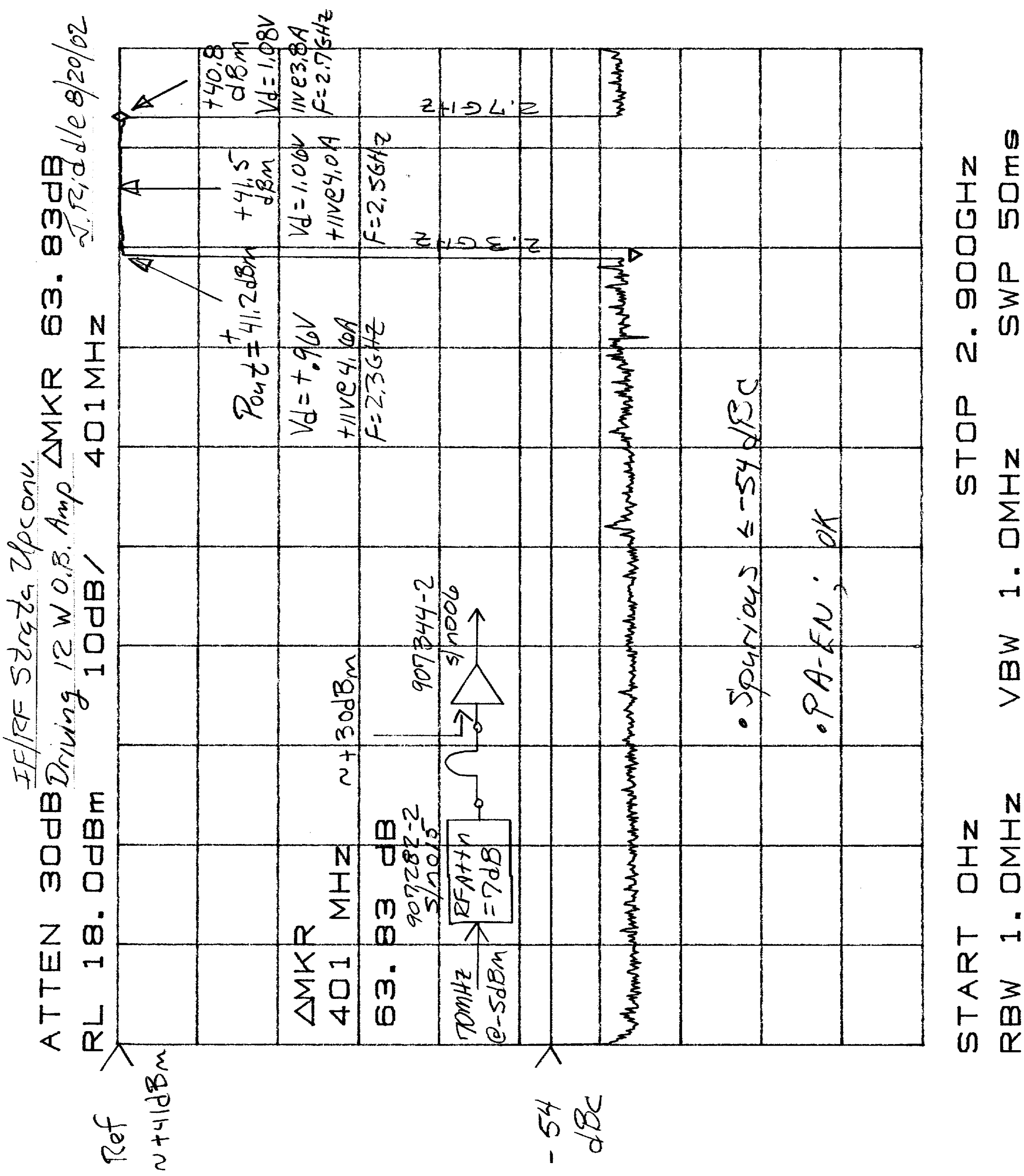
PLOT 1 (-1)


T. Riddle 8/20/02
"Small Signal Gain/Input Return Loss vs. Freq."
909344-2
s/n 006
"SSG"
CH2: B -M + 14.55 dB
2.0 dB/ REF + 14.00 dB
CH1: A -M - 9.27 dB
10.0 dB/ REF - .00 dB
REF LEVEL
+ 14.00 dB
14dB
12dB
0 I.R.L
1-10dB
-20dB
S21
S11
120
120
357
STRT +2.3000GHz
CRSR +2.5190GHz
STOP +2.7000GHz
2
1

PLOT 2 (-2)


IF/RF Strata Upconv.
Driving 12W O.B. Amp
ATTEN 20dB
RL 5.0dBm
10dB/
512MHz
-2.83dB
DISPLAY LINE
-49.0 dBm
STOP 2.900GHz
*RBW 300kHz
VBW 300kHz
SWP 81ms
START 0Hz
-54 dBc
Ref +41dBm
*SPURIOUS ≤ -54dBc
*PA-ENV. OK.

PLOT 3 (-1)


ATTEN 30dB ΔMKR 63.83dB
RL 18.0dBm 10dB/ 401MHz
ΔMKR
401 MHz
63.83 dB
START 0Hz STOP 2.900GHz
RBW 1.0MHz VBW 1.0MHz SWP 50ms

PLOT 4 (-2)

(-1)

TECH	OPTIONAL TEST DATA SHEET					TP907344
S/N	FREQ. GHz	OUTPUT POWER (W)	DETECTOR VOLTAGE	S. SIGNAL GAIN	INPUT R. L.	RF-IN to OOK RES.
	1.99					
	2.25					
	2.50					
	1.99					
	2.25					
	2.50					
	1.99					
	2.25					
	2.50					
	1.99					
	2.25					
	2.50					
	1.99					
	2.25					
	2.50					
	1.99					
	2.25					
	2.50					
	1.99					
	2.25					
	2.50					
	1.99					
	2.25					
	2.50					
	1.99					
	2.25					
	2.50					

(-2)

TECH	OPTIONAL TEST DATA SHEET					TP907344
S/N	FREQ. GHz	OUTPUT POWER (W)	DETECTOR VOLTAGE	S. SIGNAL GAIN	INPUT R. L.	RF-IN to OOK RES.
	2.30					
	2.50					
	2.70					
	2.30					
	2.50					
	2.70					
	2.30					
	2.50					
	2.70					
	2.30					
	2.50					
	2.70					
	2.30					
	2.50					
	2.70					
	2.30					
	2.50					
	2.70					
	2.30					
	2.50					
	2.70					
	2.30					
	2.50					
	2.70					
	2.30					
	2.50					
	2.70					