Troubleshooting - RF

Contents

RF Troubleshooting

RH-3/RH-3P General Troubleshooting Notes

When troubleshooting the receiver, first check the RX_AGC PDM value. The AGC value should be close to the typical values in the tables. Since the RX AGC will try to keep a constant amplitude at the output of the receiver chain, if the AGC value indicates an AGC gain that is substantially higher than normal, then the AGC is compensating for extra loss in another component. If the AGC PDM values are normal, but there is still a problem, check the actual AGC voltages. RF probing at specific locations in the chain can then help to pinpoint the source of the problem.

Likewise, when troubleshooting the transmitter, first check the measured output power and AGC values, which will give an indication of where to start probing.

Although the tables list power levels for many combinations of AGC values, it is generally only necessary to check one combination. The extra information is provided in case it may be useful in an unexpected situation. Likewise, although probing points and signal-level information are given for each point in the receiver and transmitter chains, the troubleshooter is not expected to probe each point on every phone — only the suspected trouble spots.

Absolute power measurements were made with an Agilent (HP) 85024A active high-impedance probe. Other probes can be used (but should be high-impedance so that the measurement does not load the circuit) but may very well have a different gain; therefore, adjust the absolute measurements accordingly. Also, adjust if using a probe attenuator.

Where a range is given for loss, typically the higher loss occurs at the band edges. Probing is not a very accurate method to measure absolute power; therefore, you cannot expect measured results to exactly match the numbers listed here.

Power depends on the impedance of the circuit. For example, if a filter has a nominal loss of 5 dB, then straightforward probing on the input and output, then subtracting, might not result in 5 dB because the input impedance might be different from the output impedance. Most components in the RF section have the same input and output impedance (50 ohms), but where this is not the case, absolute power is noted in the tables in dBm, rather than loss or gain in dB.

When testing the CDMA receiver, it is easier to inject a CW tone into the receiver. The gains and losses will be the same for a CW signal as for CDMA.

Note: After opening the shield lids, allways replace them with new lids.

Conditions of Phone

TX Power Low

If TX power is low, turn on transmitter in local mode using Phoenix. Check:

1 Current (0.7 - 1 A for max power, mode, and channel dependent).

2 Perform visual inspection of PWB under microscope to check proper placement, rotation, and soldering of components.

3 Look for presence of TX signal on spectrum analyser at the correct frequency. If signal is not on frequency, check in 100 MHz span. If signal is present but off-frequency, check synthesizer. If signal is not present, or present but low in amplitude, use probing tables to determine where in the chain the fault occurs, with AGC PDMs set for known transmit power as listed in the tables.

4 Check that AGC PDMs are set for desired TX power and ensure AGC voltages are correct.

5 Check the LOs for proper frequency and amplitude.

6 Ensure power supplies to transmitter have correct voltage.

Receiver Not Working Properly

If Receiver is not working properly, turn on receiver in local mode and check:

1 Turn on receiver with Phoenix, inject a signal into the receiver.

2 Check the AGC PDM.

3 Perform a visual inspection of the PWB under a microscope to check proper placement, rotation, and soldering of components.

4 Measure signal levels at various points in the chain and determine where in the chain the fault lies.

5 Check the LOs for proper frequency and amplitude.

6 Ensure power supplies to receiver have correct voltage.

Phone Cannot Make a Call

If phone won't make a call:

1 Ensure phone is in normal mode (*i.e.*, ensure the phone is searching for a signal, net server is on).

2 Ensure Preferred Roaming List (PRL) is loaded into phone.

3 Ensure phone is tuned (read tuning parameters using Batch Tune component in Phoenix, an untuned phone will have all zeros in tuning file), and has passed tuning.

4 Ensure call box channel is set for a channel in PRL, and ensure SID is correct.

5 Ensure MIN, MDN, and SID are entered into the phone.

6 Ensure VCTCXO is centered, as described in VCTCXO tuning description.

7 Ensure transmitter and receiver are working properly by checking them in local mode.

Transmitter Troubleshooting

Cell Transmitter

Cell Transmitter Path

The following table indicates the test points to probe when troubleshooting the cell transmitter path. The steps shown are the recommended but do not have to be followed in that order. Refer to the Appendix for a reference diagram that illustrates the test points on the circuit board. An HP high frequency probe is used to make the frequency and output power measurements.

Constant Reference Values CELL Oscillator and IF:	
VHF Tx Lo 457.2	Tx IF 228.6
VHF Rx Lo 367.2	Rx IF 183.6

Setup: Mode	**Tx**	**Rx**	**Band**	**CW or CDMA**	**BB GenIO**	**PDM**	**Rho**
Local	On	On	PCS/CELL	CDMA	GenIO 8 = H	TxIF and RF AGC = 0	On
	Chnn	Tx Freq	Rx Freq	UHF	GenIO 12 = L		
	384	836.52	881.52	1065.12	GenIO 13 = L		
	600	1880	1960	2143.6			

Step #	Part	Part Ref	Label	Test Point	Typical Value	Units	Comments
1	Jedi	Pin 7	I+	J601	0.1 to 0.9, 1.7	VAC, VDC	Test Point on BB side
2	Jedi	Pin 8	I-	J602	0.1 to 0.9, 1.8	VAC, VDC	
3	Jedi	Pin 4	Q+	J603	0.1 to 0.9, 1.9	VAC, VDC	
4	Jedi	Pin 5	Q-	J604	0.1 to 0.9, 1.10	VAC, VDC	
5	Jedi	Pin 45	IF CELL-	top-C603	-45, 228.6	dBm/30kHz, MHz	
6	Jedi	Pin 46	IF CELL+	bottom-C603	-45, 228.6	dBm/30kHz, MHz	
7	Jedi	Pin 31	CELL_DRVout	pin 1-Z601	-38	dBm/30kHz	
8	Z601	Pin 3	SAW out	pin 3	-40	dBm/30kHz	
9	Orca	Pin 2	RF in	pin 3-Z601	-40	dBm/30kHz	
10	Orca	Pin 8	PA out	left-R814	-17.5	dBm/30kHz	
11	Z802	Pin 1	Iso Out=Dup In	pin 11-Z803		dBm/30kHz	This test point is inaccessible
12	Z803	Pin 8	Dup-Ant	pin 8	-19	dBm/30kHz	This point is only accessi-ble if the CELL duplexer can shield is removed
13	Z800	Pin 3	Diplexer	left-L802	-19		

Cell Power Amplifier

The table above is the path that one would take to determine where the problem is in the transmitter path. There are other circuits that affect the operation of the transmitter path; for example, the power amplifier (PA) has the DC/DC converter (PMIC device) which controls it. The following tables illustrate the circuits that have an effect on the transmitter path and how to troubleshoot them.

The following table illustrates the PA troubleshooting information.

PA Power and Gain Measurements	
Power Amplifier Input Test Point	Power Amplifier Output Test Point
pin3-Z601	right-R814

PA Power and Gain Specifications					
Mode	**Name**	**Power Output Range**	**Nominal Gain**	**Vcc Range**	**Vcc Test Point**
Gain mode 0	V0	up to 9	23.8	0.75- 0.88	C806
Gain mode 1	V1	9 to 13	25.2	1.125- 1.375	C806
Gain mode 3	V2	Not used	Not used	2 - 2.5	C806
Gain mode 2	Bypass	13 up	29	3 - 4	C806
Overall Gain	V0 to Bypass	9	3.5 to 7.3 +/- 0.5		
unit	N/A	dBm	dB	VDC	N/A

PA Gain Step Gen IO 12	GenIO13	PA Vcc volt (v)	Spec Name
L	L	0.8	V0
H	L	1.2	V1
L	H	2.2	V2
H	H	3.7	Bypass

** Depends on VBATT*

Cell PMIC

The following table illustrates the PMIC troubleshooting information.

Setup: Mode	Tx	Rx	Band
Local	On	On	PCS/CELL

Measurements:					
Pin	**Label**	**Test Point**	**Units**	**Depends on**	**Comments**
1	EP	Pin 1	1.8	UPP	IC enable = GenIO 10
2	M0	Pin 2	1.8	UPP	Control 0 = GenIO 12
3	M1	Pin 3	1.8	UPP	Control 1 = GenIO 13
4	NC	NC	NC	NC	NC
5	FB	Pin 5	0.75 - 4	M0, M1	See PA worksheet. Output to fly-back inductor
6	FB	Pin 6	0.75 - 4	M0, M1	Shares PWB pad with pin 5
7	BYPVout	bottom-C808	0.75 - 4	M0, M1	PMIC bypass output used at Pout > 12 dBm
8	VDD	right-L810	VBATT	VBATT	Digital DC supply, shared with pin 12, 14, 15
9	VSS	GND	GND	GND	Digital GND, shared gnd with pin 13
10	NC	NC	NC	NC	NC
11	Vbgap	NC	NC	NC	Bandgap voltage output
12	VDD	right-L810	VBATT	VBATT	Digital DC supply
13	Vss	GND	GND	GND	Digital GND, shared gnd with pin 9
14	Vsw	right-L810	VBATT	VBATT	Switcher supply
15	Vsw	right-L810	VBATT	VBATT	Switcher supply
16	Gsw	GND	GND	GND	Switcher GND, does not share with pin 9 and pin 13

Good phone PMIC Resistances	
Pin	**Resistance**
1	60k
2	75k
3	80k
4	1.59M
5	1.6M

Good phone PMIC Resistances	
Pin	**Resistance**
6	2M
7	2M
8	2M
9	0.1
10	100
11	115k
12	60k
13	0.2
14	1.3M
15	1.18M
16	0.1

Cell IF and RF AGC and PA Control

The following table illustrates the PDM values and their typical values for the IF AGC, RF AGC Jedi Pout, Gain steps, and the PA VCC levels. It also shows the typical power output at the RF connector.

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Cell CDMA Chnn 384														
TX RF AGC			TX IF AGC			Jedi Po		PA Gain Step		PA Vcc			Con n RF Pout
PDM	Typical Value	Test Point	PDM	Typical Value	Test Point	Typical Value	Test Point	Gen IO 12	Gen IO 13	Typical Value	Test Point	PA Gain	
-324	0.41	Bottom C606	-324	0.41	Top C605	-17	pin 1 Z601	H	H	3.47	C806	DM	25
-226	0.56		-226	0.56		-21		H	H	3.61		28	20
-146	0.68		-146	0.68		-21		H	H	3.67		28	15.1
-146	0.68		-146	0.68		-27		H	L	1.2		26	13
-111	0.74		-111	0.74		-28		H	L	1.2		25.8	10.3
-111	0.74		-111	0.74		-28		L	L	0.82		24.5	9
-6	0.9		-6	0.9		-35		L	L	0.82			0
52	1		52	1		-45		L	L	0.82			-10
105	1.09		105	1.09		-54		L	L	0.82			-20
180	1.09		180	1.21		-64		L	L	0.82			-30
266	1.36		266	1.36		-74		L	L	0.82			-40
353	1.5		353	1.49		-83		L	L	0.82			-50

Cell Power Detector

The following tables illustrate the measurements required for troubleshooting the Cell power detector.

Setup:					
Mode	**Tx**	**Rx**	**Band**	**Chnn**	**Rho**
Local	On	On	PCS/CELL	600/384	On
	Input Chnn	Tx Freq	Rx Freq		
	384	836.52	881.52		
	600	1880	1960		

Measurements:									
CELL, Channel 384									
TX ADC	PA Gain Step		Conn RF Pout	Power Detector					Comments
RF/IF pdm	GIO 12	GIO 13		Pout at detector	Test Point	Det Out	Test Point	mA	Det=Detector Po=Power
353	L	L	-50	-86.3	right R814	2	left C807	235	CELL band and detector cou-pling is about 22 dB
140	L	L	-25	-63		2		235	
-5	L	L	0	-41		1.998		235	
-105	L	L	9	-30		1.967		250	
-105	H	L	10	-29		1.957		268	
-143	H	L	13	-26		1.93		286	
-143	H	H	14.9	-23.5		1.9		435	
-175	H	H	17	-21.5		1.86		486	
-210	H	H	19	-19		1.812		550	
-246	H	H	21	-17		1.745		630	
-286	H	H	23	-15		1.667		730	
-330	H	H	25	-12		1.547		860	
-352	H	H	26	-11.5		1.485		950	
-365	H	H	26.5	-11		1.44		1000	
-387	H	H	27.5	-10		1.36		1095	
none			dBm	dBm/ 30kHz		VDC			dBm only refers to total power meas-ured

Detector Reference and DC Supply		
Label	Test Point	Typical Value
Det Ref	left-C803	2
Det Supply	bottom-C257	2.8

Detector Reference and DC Supply		
Label	Test Point	Typical Value
		VDC

PCS Transmitter

PCS Transmitter Path

The following table indicates the test points to probe when troubleshooting the PCS transmitter path. The steps shown are the recommended but do not have to be followed in order. Refer to the Appendix for a reference diagram that illustrates the test points on the circuit board. An HP high-frequency probe is used to make the frequency and output power measurements.

Constant Reference Values	
PCS Oscillator and IF:	
VHF Tx Lo 527.2	Tx IF 263.6
VHF Rx Lo 367.2	Rx IF 183.6

Setup:							
Mode	Tx	Rx	Band	CW or CDMA	BB GenIO	PDM	Rho
Local	On	On	PCS/CELL	CDMA	GenIO 8 = H	Tx IF and RF AGC = 0	On
	Chnn	Tx Freq	Rx Freq	UHF	GenIO 12 = L		
	384	836.52	881.52	1065.12	GenIO 13 = L		
	600	1880	1960	2143.6			

PCS TX							
Step #	Part	Part Ref	Label	Test Point	Typical Value	Units	Comments
1	Jedi	Pin 7	I+	J601	0.1 to 0.9, 1.7	VAC, VDC	

PCS TX							
Step #	**Part**	**Part Ref**	**Label**	**Test Point**	**Typical Value**	**Units**	**Comments**
2	Jedi	Pin 8	I-	J602	0.1 to 0.9, 1.8	VAC, VDC	
3	Jedi	Pin 4	Q+	J603	0.1 to 0.9, 1.9	VAC, VDC	
4	Jedi	Pin 5	Q-	J604	0.1 to 0.9, 1.10	VAC, VDC	
5	Jedi	Pin 45	If PCS-	top C604	-44, 263.6	dBm/30kHz, MHz	
6	Jedi	Pin 46	IF PCS+	bottom C605	-44, 263.6	dBm/30kHz, MHz	
7	Jedi	Pin 31	PCS_DRVout_A	bottom L604	-51, 1880	dBm/30kHz, MHz	A output is for chnns 25 to 599. This measured power is leakage.
8	Jedi	Pin 31	PCS_DRVout_B	right L605	-30, 1880	dBm/30kHz, MHz	B output is for channs 600 to 1175
9	Z602	Pin 1	SAW out A	pin3 N602	-56	dBm/30kHz	The outputs of Z602 and the inputs to N602 are difficult to reach
10	Z602	Pin 3	SAW out B	pin 1 N602	-32	dBM/30kHz	If not necessary, skip to the PA input measure-ment
11	Shamu	Pin 4	RF in	left C640	-32	dBm/30kHz	
12	Shamu	Pin 8	PA out	left R803	-9	dBm/30kHz	Accessible only if Isolator shield can is removed
13	Z801	Pin 6	Iso Out=Dup In	none	none	dBm/30kHz	Accessible only if PCS duplexor shield can is removed
14	Z804	Pin Rx	ant	none	none	dBm/30kHz	Accessible only if PCS duplexor shield can is removed
15	Z800	P3	Diplexer	left L802	-14	dBm/30kHz	

PCS Power Amplifier

The preceding table is the path that one would take to determine where the problem is in the transmitter path. There are other circuits that affect the operation of the transmitter path; for example, the power amplifier (PA) has the DC/DC converter (PMIC device) that controls it. The following tables illustrate the circuits that have an affect on the transmitter path and how to troubleshoot them.

The table below illustrates the PA troubleshooting information.

PA Power and Gain Measurements		
Power Amplifier Input Test Point	**Power Amplifier Output Test Point 1**	**Power Amplifier Output Test Point 2**
right C640	* left R803	** right C804
** inaccessible unless shield can is removed (no lid) ** This is the coupled power. You must 30 dB to get correct value*		

PCS PA Power and Gain Specifications					
Mode	**Name**	**Power Output Range**	**Nominal Gain**	**Vcc Range**	**Vcc Test Point**
Gain mode 0	V0	up to 8	22.4	0.75 - 0.88	C806
Gain mode 1	V1	8 to 12	24.4	1.125 - 1.375	C806
Gain mode 3	V2	Not Used	Not Used	2 - 2.5	C806
Gain mode 2	Bypass	12 up	28	3 - 4	C806
Overall gain	V0 to bypass	8	3.6 to 7.6 +/- 0.5		
unit		dBm	dB	VDC	N/A

Phoenix Control and Example Values			
PA Gain Step		**PA Vcc**	**Spec Name**
GenIO 12	**GenIO 13**	**volt (v)**	
L	L	0.8	V0
H	L	1.2	V1
L	H	2.2	V2
H	H	3.7	Bypass

PCS PMIC

The following table illustrates the PMIC troubleshooting information.

Setup:			
Mode	**Tx**	**Rx**	**Band**
Local	On	On	PCS/CELL

Measurements:					
Pin	**Label**	**Test Point**	**Units**	**Depends on**	**Comment**
1	EP	Pin 1	1.8	UPP	IC enable = GenIO 10
2	M0	Pin 2	1.8	UPP	Control 0 = GenIO 12
3	M1	Pin 3	1.8	UPP	Control 1 = GenIO 13
4	NC	NC	NC	NC	NC
5	FB	Pin 5	0.75 - 4	M0, M1	See PA worksheet. Output to fly-back inductor
6	FB	Pin 6	0.75 - 4	M0, M1	Shares PWB pad with pin 5
7	BYPVout	bottom C808	0.75 - 4	M0, M1	PMIC bypass output used at Pout > 12 dBm
8	VDD	right L810	VBATT	VBATT	Digital DC supply, shared with pin 12, 14, 15
9	VSS	GND	GND	GND	Digital GND, shared gnd with pin 13
10	NC	NC	NC	NC	NC
11	Vbgap	NC	NC	NC	Bandgap voltage output
12	VDD	right L810	VBATT	VBATT	Digital DC supply
13	Vss	GND	GND	GND	Digital GND, shared gnd with pin 9
14	Vsw	right L810	VBATT	VBATT	Switcher supply
15	Vsw	right L810	VBATT	VBATT	Switcher supply
16	Gsw	GND	GND	GND	Switcher GND, does not share with pin 9 and pin 13

Good phone PMIC Resistances	
Pin	**Resistance**
1	60k
2	75k
3	80k
4	1.59M
5	1.6M
6	2M
7	2M
8	2M
9	0.1
10	100
11	115k
12	60k
13	0.2
14	1.3M
15	1.18M
16	0.1

PCS IF and RF AGC and PA Control

The following table illustrates the PDM values and their typical values for the IF AGC, RF AGC Jedi Pout, Gain steps, and the PA VCC levels. It also shows the typical power output at the RF connector.

PCS CDMA Chnn 600														
TX RF AGC			TX IF AGC			Jedi Po		PA Gain Step		PA Vcc			Con n RF Pout
PDM	Typical Value	Test Point	PDM	Typical Value	Test Point	Typical Value	Test Point	Gen IO 12	Gen IO 13	Typical Value	Test Point	PA Gain	
-133	0.71	Bottom C606	-133	0.71	Top C605	-17	right L605	H	H	3.55	C806	DM	23
-96	0.77		-96	0.77		-19		H	H	3.65		30	20
-52	0.83		-52	0.83		-25		H	H	3.65		30	16.3
-52	0.83		-52	0.83		-25		H	L	1.2		26	12
-31	0.86		-31	0.86		-28		H	L	1.2		26	10.3
-31	0.86		-31	0.86		-28		L	L	0.81		25	8
39	0.98		39	0.98		-36		L	L	0.81		25	0
91	1.07		91	1.07		-46		L	L	0.82		25	-10
159	1.18		159	1.18		-58		L	L	0.82		27	-20
244	1.32		244	1.32		-69		L	L	0.82		25	-30
331	1.46		331	1.46		-80		L	L	0.82		25	-40
418	1.6		418	1.6		-89		L	L	0.82		25	-50

PCS Power Detector

The following tables illustrate the measurements required for troubleshooting the PCS power detector.

Setup:					
Mode	Tx	Rx	Band	Chnn	Rho
Local	On	On	PCS/CELL	600/384	On
	Input	Tx Freq	Rx Freq		
	384	836.52	881.52		
	600	1880	1960		

PCS, Chnn 600									
TX AGC	PA Gain Step			Pout at Detector	Power Detector				Comments
RF/IF pdm	GIO 12	GIO 13	Conn RF Pout		Test Point	Det Out	Test Point	mA	**Det = Detector Po = Power
418	L	L	-50	-87	right R814	2	left C807	250	PCS band detector coupling is about 30 dB
201	L	L	-25	-68	right R814	2	left C807	250	
39	L	L	0	-41.5	right R814	2	left C807	255	RF amplifier has the most gain increase near 0 dBm
-30	L	L	8	-33	right R814	1.986	left C807	263	
-30	H	L	10.2	-31	right R814	1.984	left C807	278	
-51	H	L	12	-29	right R814	1.979	left C807	285	
-72	H	H	18	-21.5	right R814	1.93	left C807	473	
-85	H	H	19	-21	right R814	1.914	left C807	500	
-108	H	H	21	-19	right R814	1.882	left C807	557	
-133	H	H	23	-17	right R814	1.84	left C807	634	
-148	H	H	24	-16.5	right R814	1.81	left C807	685	
-162	H	H	25	-16	right R814	1.778	left C807	740	

Detector Reference and DC Supply		
Label	Test Point	Typical Value
Det Ref	left C803	2
Det Supply	bottom C257	2.8
		VDC

Receiver Troubleshooting

Cell Receiver

Receiver Path (Cell mode)

Setup:	
Input power	**-50 dBm**
Input Freq	881.52 MHz
Rx AGC PDM	225 PDM

CDMA Generator Code Domain Setup		
Channel	**Power**	**Walsh code**
Pilot	-7 dB	0
Paging	-12 dB	1
Traffic	-15.6 dB	10
Sync	-16 dB	32

Measurements							
Step	**Part**	**Part Ref**	**Label**	**Test Point**	**Typical Value**	**Units**	**Comments**
1	Diplexer	none	RF Conn	Diplexer Pin 3	*-73	dBm/30kHz	
2	Alfred	Pin 11	CELL LNA input	Alfred Pin 11	-68	dBm/30kHz	expected LNA gain = 12 to 14 dB
3	Alfred	Pin 13	CELL LNA output	bottom L901	-59	dBm/30kHz	Yoda register 6. Defaults to high gain mode
4	Alfred	Pin 16	CELL Mixer input	Alfred Pin 16	-53	dBm/30kHz	Note that this is a passive device but impedances cause power level to appear higher
5	Alfred	Pin 17	Mixer output (183.6 MHz)	right L903	-54	dBm/30kHz	Mixer is passive and typical conversion gain is -5 dB

Measurements							
Step	**Part**	**Part Ref**	**Label**	**Test Point**	**Typical Value**	**Units**	**Comments**
6	Alfred	Pin 18	IF Amp input	right C906	-56	dBm/30kHz	
7	Alfred	Pin 22	IF output (565 ohms)	left L909	-33	dBm/30kHz	IF amp gain typically 15 to 19
8	Z701	Pin 5	IF filter input	top L702	-42	dBm/30kHz	impedance change creates -10 dB delta
9	Yoda	Pin 31	VGA input 1	right C702	-56	dBm/30kHz	see TS picts 2, doc #2
10	Yoda	Pin 32	VGA input 2	right C707	-56	dBm/30kHz	both look same and look distorted
11	Yoda	Pin 8	Qb out	J704	0 to 0.6, 1.3	VAC, VDC	see TS picts 2.doc #3,4,5 SA view of BB I or Q
12	Yoda	Pin 7	Q out	J703	0 to 0.6, 1.3	VAC, VDC	see TS picts 2.doc #3,4,5 SA view of BB I or Q
13	Yoda	Pin 8	Ib out	J702	0 to 0.6, 1.3	VAC, VDC	see TS picts 2.doc #3,4,5 SA view of BB I or Q
14	Yoda	Pin 9	1 out	J701	0 to 0.6, 1.3	VAC, VDC	see TS picts 2.doc #3,4,5 SA view of BB I or Q

Alfred (Cell mode)

Constant Reference Values: CELL Iscillator and IF	
VHF Tx Lo 457.2	**Tx IF 228.6**
VHF RX Lo 367.2	Rx IF 183.6

Setup							
Mode	**Tx**	**Rx**	**Band**	**CW or CDMA**	**Pin**	**Default PDM**	**LNA Gain Mode**
Local	Off	On	PCS/CELL	CW	-80 dBm	RX IF AGC = 0	High

Setup							
Mode	Tx	Rx	Band	CW or CDMA	Pin	Default PDM	LNA Gain Mode
	Input Chnn	Tx Freq	Rx Freq	UHF			
	384	836.52	881.52	1065.12			
	600	1880	1960	2143.6			

Measurements							
Pin	Label	Test Point	CELL Typical Value	PCS Typical Value	Units	Depends on	Comments
1	LO_VDD_P	bottom L908	2.63, 13.4, 1065.12	2.48,-15.6, 2143.6	VDC, dBm, MHz	VR4, band	Only an inductor separates pin 1 and 2
2	LO_VDD_C	top L908	2.3, -15, 1065.12	2.45, 11, 2143.6	VDC, dBm, MHz	VR4, band	measured is off-set by the LO power
3	BAND	left C911	O	2.63	VDC	Yoda	
4	P_MIX_IN	left L911	NA	-72, 1960	dBm, MHz	band	PCS band
5	P_RFA_VDD	top R910	2.7	2.7	VDC	VR4	PCA band
6	GND	NA	NA	NA	NA	NA	
7	GAIN_CTL	left C909	2.7	2.7	VDC	Yoda	LNA gain switch
8	P_LNA_OUT	bottom C902	NA	-69, 1960	dBm, MHz	band	PCS band
9	GND	NA	NA	NA	NA	NA	
10	P_LNA_IN	Pin 10	NA	-83, 1960	dBm	band	PCS band
11	C_LNA_IN	Pin 11	-80, 881.52	NA	dBm, MHz	band	CELL band
12	GND	NA	NA	NA	NA	NA	
13	C_LNA_OUT	bottom L901	-69, 881.52	NA	dBm, MHz	band	CELL band
14	VDD	top R910	2.7	2.7	VDC	VR4	closer MPs are blocked by shield
15	RFA_VDD_C	top R910	2.7	2.7	VDC	VR4	same as pin 5
16	C_MIX_IN	Pin 16	-75, 881.52	NA	dBm, MHz	band	CELL band

Measurements							
Pin	**Label**	**Test Point**	**CELL Typical Value**	**PCS Typical Value**	**Units**	**Depends on**	**Comments**
17	MIX_OUT	right L903	-66, 183.6	-67, 183.6	dBm, MHz	UHF LO	UHF = 1055.12 (CELL), 2143.6 (PCS)
18	IFA_IN	right C905	-63, 183.6	-65, 183.6	dBm, MHz		
19	IFA_SRC	right L910	-63, 183.6	-65, 183.6	dBm, MHz		
20	AMPS_OUT	NC	NC	NC	NC	NC	No AMPS in this application
21	GND	NA	NA	NA	NA	NA	
22	CDMA_OUT	left L909	-42, 183.6	-44	dBm, MHz		Alfred provides about 40 dBm of overall
23	IF_SEL	Pin 23	0	0	VDC		Always gnded for this frequency plan
24	LO_IN	top L 904	1, 1065.12	2.4, 2143.6	dBm, MHz	UHF LO	

Yoda (Cell mode)

Constant Reference Values	
Cell Oscillator and IF	
VHF Tx Lo 457.2	Tx IF 228.6
VHF Rx Lo 367.2	Rx IF 183.6

Setup							
Mode	**Tx**	**Rx**	**Band**	**CW or CDMA**	**Pin**	**Default PDM**	**LNA Gain Mode**
Local	Off	On	PCS/CELL	CW	-80dBm	RX IF AGC = 0	High
	Input Chnn	Tx Freq	Rx Freq	UHF			
	384	836.52	881.52	1065.12			
	600	1880	1960	2143.6			

Measurements							
Pin	**Label**	**Test Point**	**CELL Typical Value**	**PCS Typical Value**	**Units**	**Depends on**	**Comments**
1	AGC_CON	right C703	0.916	0.916	VDC	UPP	RX_IF_AGC = GenIO 09, Equals 0.918 VDC when 0
2	AGC_REF	right C725	1.8	1.8	VDC	VIO	PDM = 0
3	VREF	right C731	1.36	1.36	VDC	UEM pin H13	same as RF_CONV0(9) at UEM
4	RBIAS	right R706	1.21	1.2	VDC	UEM	sets internal bias current
5	AVDD_RX	right C742	2.8	2.8	VDC	VR6	analog DC supply
6	Qb	J704	1.25, 0.2	1.25, 0.2	VDC, VAC		
7	Q	J703	1.25, 0.2	1.25, 0.2	VDC, VAC		
8	Ib	J702	1.25, 0.2	1.25, 0.2	VDC, VAC		
9	I	J701	1.25, 0.2	1.25, 0.2	VDC, VAC		
10	OFFI	right C735	1.65	1.65	VDC		I signal DAC. Off-set high freq tx
11	OFFQ	left C736	1.65	1.65	VDC		Q signal DAC. Off-set high freq tx
12	CLK	BB J450	2.2, 9.6	2.2.9.6	VAC, MHz	UPP	RF_CLK = VCTCXO 2 bursts
13	DATA	BB J451	2.2	2.2	VAC	UPP	Digital control data for Yoda
14	LE	BB J452	2.2	2.2	VAC	UPP	Enable pin for Yoda
15	DVDD	right C710	1.8	1.8	VDC	VIO	Digital DC supply
16	19.2OUT/ LD(1.8)	right C711	5, 19.2	5, 19.2	dBm, MHz	VCTCXO	Amplified output of DC TCXO
17	AVDD_TCXO	left C734	2.8	2.8	VDC	VR3	VCTCXO buffer amplifier DC sup-ply
18	TCXO_IN	right C728	5, 19.2	5, 19.2	dBm, MHz	VCTCXO	VCTCXO input to Yoda
19	DVDD_SYNTH	left C704	1.8	1.8	VDC	VIO	Digital Yoda syn-thesizer DC supply

Measurements							
Pin	**Label**	**Test Point**	**CELL Typical Value**	**PCS Typical Value**	**Units**	**Depends on**	**Comments**
20	AVSS_SYNTH	GND	GND	GND	GND	GND	GND
21	AVDD_SYNTH	left R703	2.75	2.75	VDC	VR7	Analog Yoda synthesizer DC supply
22	CP	right C754	-7.5, 367.2	-7,367.2	dBm, MHz		Charge pump output
23	VCO_TANKb	left C754	1,367.2	1,367.2	dBm, MHz	pin 22, VR7	VCO external varactor control
24	AVDD_VCO2	bottom C720	2.7	2.7	VDC	VR7	Analog VCO DC supply
25	OUT4_CTRL_TEST_1b	NC	NC	NC	NC	NC	NC
26	OUT3_CTRL_TEST_1	Pin 7(TL)	2.7	0	VDC		G501 synthesizer band select
27	OUT2_CTRL_TEST_Qb	bottom R904	0	2.7	VDC		Alfred RF band select
28	OUT1_CTRL_TEST_Q	bottom R902	27.0	27.0	VDC-H, VDC-L		Alfred LNA gain state control
29	AVDD_MIX	bottom C712	2.7	2.7	VDC	VR6	Mixer analog DC voltage supply
30	AVDD_if	bottom C744	2.7	2.7	VDC	VR6	Mixer analog DC voltage supply
31	VGA_IN	right C707	-70, 183.6	-73, 183.6	dBm, MHz	Alfred output	Yoda RF input A from Alfred
32	VGA_INB	right C702	-70, 183.6	-73, 183.6	dBm, MHz	Alfred output	Yoda RF input B from Alfred

RX AGC (Cell mode)

RX RF AGC PDM vs AGC Voltage			
RX RF AGC			
PDM	**Typical Value**	**Test Point**	**Comments**
-512	0.1	right C703	
-400	0.279		
-300	0.436		
-200	0.597		
-100	0.753		
0	0.913		
100	1.076		
200	1.24		
300	1.403		
350	1.484		
400	1.565		
500	1.727		
511	1.745		
UNITS	**VDC**		

Rx AGC vs RF Pin for CELL and PCS Bands			
Conn RF Pin	**CELL RF AGC**	**PCS RF AGC**	**Comments**
-25	1.485	1.512	
-35	1.298	1.336	
-45	1.159	1.18	In Normal mode, the phone will adjust RF RX AGC
-55	1.019	1.039	Rx power is coming in, the I and Q will be about 0.5 Vpp and 1.3 V
-65	0.861	0.896	
-75	0.728	0.747	Approximately 1 pdm per 1 mV
-85	0.563	0.596	

Rx AGC vs RF Pin for CELL and PCS Bands			
Conn RF Pin	**CELL RF AGC**	**PCS RF AGC**	**Comments**
-94	0.441	0.46	
-95	0.431	0.66	Note the reduced delta because the LNA is switched on
-96	0.651	0.646	LNA switch hysteresis: -94 on the way down, -89 on the way up
-100	0.594	0.59	
-105	0.524	0.59	
-107	0.493	0.485	
UNITS	**VDC**	**VDC**	

PCS Receiver

Receiver Path (PCS mode)

PCS CDMA Rx Test	
Setup:	
Input power:	-50 dBm
Input Freq:	1960 MHz
Rx AGC PDM:	225 PDM

CDMA Generator Code Domain Setup		
Channel	**Power**	**Walsh code**
Pilot	-7 dB	0
Paging	-12 dB	1
Traffic	-15.6 dB	10
Sync	-16 dB	32

Measurements						
Step	**Part**	**Part Ref**	**Label**	**Test Point**	**Typical Value**	**Units**
1	Diplexer	none	RF Conn	Diplexer Pin 1	-67	dBm/30kHz
2	Alfred	Pin 10	PCS LNA input	Alfred Pin 10	-70	dBm/30kHz
3	Alfred	Pin 8	PCS LNA output	bottom C902	-57	dBm/30kHz
4	Alfred	Pin 4	PCS Mixer input	left C911	-59	dBm/30kHz
5	Alfred	Pin 17	Mixer output (183.6 MHz)	right L903	-53	dBm/30kHz
6	Alfred	Pin 18	IF AMP input	right C906	-50	dBm/30kHz
7	Alfred	Pin 22	IF output (565 ohms)	left L909	-31	dBm/30kHz
8	Z701	Pin 5	IF filter input	top L702	-39	dBm/30kHz
9	Yoda	Pin 31	VGA input 1	right C702	-56	dBm/30kHz
10	Yoda	Pin 32	VGA input 2	right C707	-58	dBm/30kHz
11	Yoda	Pin 6	Qb out	J704	0 to 0.6, 1.3	VAC, VDC
12	Yoda	Pin 7	Q out	J703	0 to 0.6, 1.3	VAC, VDC
13	Yoda	Pin 8	Ib out	J702	0 to 0.6, 1.3	VAC, VDC
14	Yoda	Pin 9	I out	J701	0 to 0.6, 1.3	VAC, VDC

Alfred (PCS mode)

Constant Reference Value	
PCS Oscillator and IF:	
VHF TxLo 527.2	Tx IF 263.6
VHF Rx Lo 367.2	Rx IF 183.6

Setup:							
Mode	**Tx**	**Rx**	**Band**	**CW or CDMA**	**Pin**	**Default PDM**	**LNA Gain Mode**
Local	Off	On	PCS/CELL	CW	-80 dBm	RX IF AGC = 0	High
	Input Chnn	Tx Freq	Rx Freq	UHF			

Setup:							
Mode	**Tx**	**Rx**	**Band**	**CW or CDMA**	**Pin**	**Default PDM**	**LNA Gain Mode**
	384	836.52	881.52	1065.12			
	600	1880	1960	2143.6			

Measurements							
Pin	**Label**	**Test Point**	**CELL Typical Value**	**PCS Typical Value**	**Units**	**Depends on**	**Comments**
1	LO_VDD_P	bottom L908	2.63, 13.4, 1065.12	2.48,-15.6, 2143.6	VDC, dBm, MHz	VR4, band	Only an inductor separates pin 1 and 2
2	LO_VDD_C	top L908	2.3, -15, 1065.12	2.45, 11, 2143.6	VDC, dBm, MHz	VR4, band	measured is off-set by LO power
3	BAND	left C911	0	2.63	VDC	Yoda	
4	P_MIX_IN	left L911	NA	-72, 1960	dBm, MHz	band	PCS band
5	P_RFA_VDD	top R910	2.7	2.7	VDC	VR4	PCS band
6	GND	NA	NA	NA	NA	NA	
7	GAIN_CTL	left C909	2.7	2.7	VDC	Yoda	LNA gain switch
8	P_LNA_OUT	bottom C902	NA	-69, 1960	dBm, MHz	band	PCS band
9	GND	NA	NA	NA	NA	NA	
10	P_LNA_IN	Pin 10	NA	-83, 1960	dBm	band	PCS band
11	C_LNA_IN	Pin 11	-80, 881.52	NA	dBm, MHz	band	CELL band
12	GND	NA	NA	NA	NA	NA	
13	C_LNA_OUT	bottom L901	-69, 881.52	NA	dBm, MHz	band	CELL band
14	VDD	top R910	2.7	2.7	VDC	VR4	closer MPs are blocked by shield
15	RFA_VDD_C	top R910	2.7	2.7	VDC	VR4	same as pin 5
16	C_MIX_IN	Pin 16	-75, 881.52	NA	dBm, MHz	band	CELL band
17	MIX_OUT	right R903	-66, 183.6	-67, 183.6	dBm, MHz	UHF LO	UHF = 1065.2 (CELL), 2143.6 (PCS)
18	IFA_IN	right C906	-63, 183.6	-65, 183.6	dBm, MHz		

Measurements							
Pin	**Label**	**Test Point**	**CELL Typical Value**	**PCS Typical Value**	**Units**	**Depends on**	**Comments**
19	IFA_SRC	right L910	-63, 183.6	-65, 183.6	dBm, MHz		
20	AMPS_OUT	NC	NC	NC	NC	NC	no AMPS in this application
21	GND	NA	NA	NA	NA	NA	
22	CDMA_OUT	left L909	-42, 183.6	-44	dBm, MHz		Alfred provides about 40 dBm overall
23	IF_SEL	pin 23	0	0	VDC		always gnded for this frequency plan
24	LO_IN	top L904	1, 1065.2	2.4, 2143.6	dBm, MHz	UHF LO	

Yoda (PCS mode)

Constant Reference Values:	
PCS Oscillator and IF:	
VHF Tx Lo 527.2	Tx IF 263.6
VHF Rx Lo 367.2	Rx IF 183.6

Setup:							
Mode	Tx	Rx	Band	CW or CDMA	Pin	Default PDM	LNA Gain Mode
Local	Off	On	PCS/CELL	CW	-80 dBm	RX IF AGC = 0	High
	Input Chnn	Tx Freq	Rx Freq	UHF			
	384	836.52	881.52	1065.12			
	600	1880	1960	2143.6			

Measurements							
Pin	Label	Test Point	CELL Typical Value	PCS Typical Value	Units	Depends on	Comments
1	AGC_CON	right C703	0.916	0.916	VDC	UPP	RX_IF_AGC = GenIO 09, Equals 0.918 VDC when 0
2	AGC_REF	right C725	1.8	1.8	VDC	VIO	PDM = 0
3	VREF	right C731	1.36	1.36	VDC	UEM pin H13	same as RF_CONV0(9) at UEM
4	RBIAS	right R706	1.21	1.2	VDC	UEM	sets internal bias current
5	AVDD_RX	right C742	2.8	2.8	VDC	VR6	analog DC supply
6	Qb	J704	1.25, 0.2	1.25, 0.2	VDC, VAC		
7	Q	J703	1.25, 0.2	1.25, 0.2	VDC, VAC		
8	Ib	J702	1.25, 0.2	1.25, 0.2	VDC, VAC		
9	I	J701	1.25, 0.2	1.25, 0.2	VDC, VAC		

Measurements							
Pin	Label	Test Point	CELL Typical Value	PCS Typical Value	Units	Depends on	Comments
10	OFFI	right C735	1.65	1.65	VDC		I signal DAC. Off-set high freq tx
11	OFFQ	left C736	1.65	1.65	VDC		Q signal DAC. Off-set high freq tx
12	CLK	BB J450	2.2, 9.6	2.2.9.6	VAC, MHz	UPP	RF_CLK = VCTCXO 2 bursts
13	DATA	BB J451	2.2	2.2	VAC	UPP	Digital control data for Yoda
14	LE	BB J452	2.2	2.2	VAC	UPP	Enable pin for Yoda
15	DVDD	right C710	1.8	1.8	VDC	VIO	Digital DC supply
16	19.2OUT/ LD(1.8)	right C711	5, 19.2	5, 19.2	dBm, MHz	VCTCXO	Amplified output of DC TCXO
17	AVDD_TCX O	left C734	2.8	2.8	VDC	VR3	VCTCXO buffer amplifier DC sup-ply
18	TCXO_IN	right C728	5, 19.2	5, 19.2	dBm, MHz	VCTCXO	VCTCXO input to Yoda
19	DVDD_SYN TH	left C704	1.8	1.8	VDC	VIO	Digital Yoda syn-thesizer DC supply
20	AVSS_SYN TH	GND	GND	GND	GND	GND	GND
21	AVDD_SYN TH	left R703	2.75	2.75	VDC	VR7	Analog Yoda syn-thesizer DC supply
22	CP	right C754	-7.5, 367.2	-7,367.2	dBm, MHz		Charge pump out-put
23	VCO_TANK b	left C754	1,367.2	1,367.2	dBm, MHz	pin 22, VR7	VCO external var-actor control
24	AVDD_VCO 2	bottom C720	2.7	2.7	VDC	VR7	Analog VCO DC supply
25	OUT4_CTR L_TEST_1b	NC	NC	NC	NC	NC	NC
26	OUT3_CTR L_TEST_1	Pin 7(TL)	2.7	0	VDC		G501 synthesizer band select
27	OUT2_CTR L_TEST_Qb	bottom R904	0	2.7	VDC		Alfred RF band select
28	OUT1_CTR L_TEST_Q	bottom R902	27.0	27.0	VDC-H, VDC-L		Alfred LNA gain state control

Measurements							
Pin	**Label**	**Test Point**	**CELL Typical Value**	**PCS Typical Value**	**Units**	**Depends on**	**Comments**
29	AVDD_MIX	bottom C712	2.7	2.7	VDC	VR6	Mixer analog DC voltage supply
30	AVDD_if	bottom C744	2.7	2.7	VDC	VR6	Mixer analog DC voltage supply
31	VGA_IN	right C707	-70, 183.6	-73, 183.6	dBm, MHz	Alfred output	Yoda RF input A from Alfred
32	VGA_INB	right C702	-70, 183.6	-73, 183.6	dBm, MHz	Alfred output	Yoda RF input B from Alfred

RX AGC (PCS mode)

RX RF AGC PDM vs AGC Voltage			
RX RF AGC			
PDM	Typical Value	Test Point	Comments
-512	0.1	right C703	
-400	0.279		
-300	0.436		
-200	0.597		
-100	0.753		
0	0.913		
100	1.076		
200	1.24		
300	1.403		
350	1.484		
400	1.565		
500	1.727		
511	1.745		
UNITS	**VDC**		

Rx AGC vs RF Pin for CELL and PCS Bands			
Conn RF Pin	CELL RF AGC	PCS RF AGC	Comments
-25	1.485	1.512	
-35	1.298	1.336	
-45	1.159	1.18	In Normal mode, the phone will adjust RF RX AGC
-55	1.019	1.039	Rx power is coming in, the I and Q will be about 0.5 Vpp and 1.3 V
-65	0.861	0.896	
-75	0.728	0.747	Approximately 1 pdm per 1 mV
-85	0.563	0.596	
-94	0.441	0.46	

Rx AGC vs RF Pin for CELL and PCS Bands			
Conn RF Pin	**CELL RF AGC**	**PCS RF AGC**	**Comments**
-95	0.431	0.66	Note the reduced delta because the LNA is switched on
-96	0.651	0.646	LNA switch hysteresis: -94 on the way down, -89 on the way up
-100	0.594	0.59	
-105	0.524	0.59	
-107	0.493	0.485	
UNITS	**VDC**	**VDC**	

GPS Troubleshooting

Measurements should be done using High-Frequency Probe with spectrum analyzer in order to measure local and reference frequencies and RF-power levels in intermediate stages of chain. Oscilloscope is used to measure DC-voltages and low frequency signals.

Digital multimeter is also useful measurement equipment in faultfinding. Also cellular tester is needed in order to perform tests mentioned in this document.

External RF connector is implemented for improving reliability of the measurements and should be used when reasonable.

GPS RF section is mainly build around of TRF5101 PG2.1 IC (N001). The GPS RF block has a separate front end filter, inter stage filter, LNA, TCXO, and down converter circuitry.

In this RF troubleshooting document, tolerances are specified for critical GPS RF signals and voltages.

Before changing a single ASIC or component, please check the following:

1. The soldering and alignment marks of the GPS ASICs
2. Supply voltages and control signals are OK

The RF ASIC module is static-discharge sensitive! So it is recommended to wear EDS-protected clothes and shoes and to use grounded soldering irons.

The shield lid must be always replaced with new one after it is opened. Check that there are no short circuits on PWB caused by plate ends.

GPS Receiver

Receiver troubleshooting is divided into four sections:

1 GPS RF general checking

2 GPS reference clock checking

3 GPS RF and GPS BB interface checking

4 GPS RX chain checking

Fastest way to troubleshoot GPS RF is to follow the faultfinding chart.

Please note that before changing ASICs or filters, soldering and missing components must be checked visually. There are no parameters in GPS RF, which should be tuned externally. Accurate signal levels are not shown in the flowcharts below because of the figures apply with specific measurement probes. It is useful to compare the results against reference phones.

Test Equipment

1 Signal generator up to 2 GHz

2 Oscilloscope with 10:1 passive probe

3 High Frequency Probe for Spectrum Analyzer (Please note that the signal levels mentioned in the RX troubleshooting have been measured with an active probe.)

4 Spectrum analyzer up to 6.7 GHz

5 PC with Phoenix SW and GPS option

Path of the Received Signal

Functional block diagram of the GPS RF:

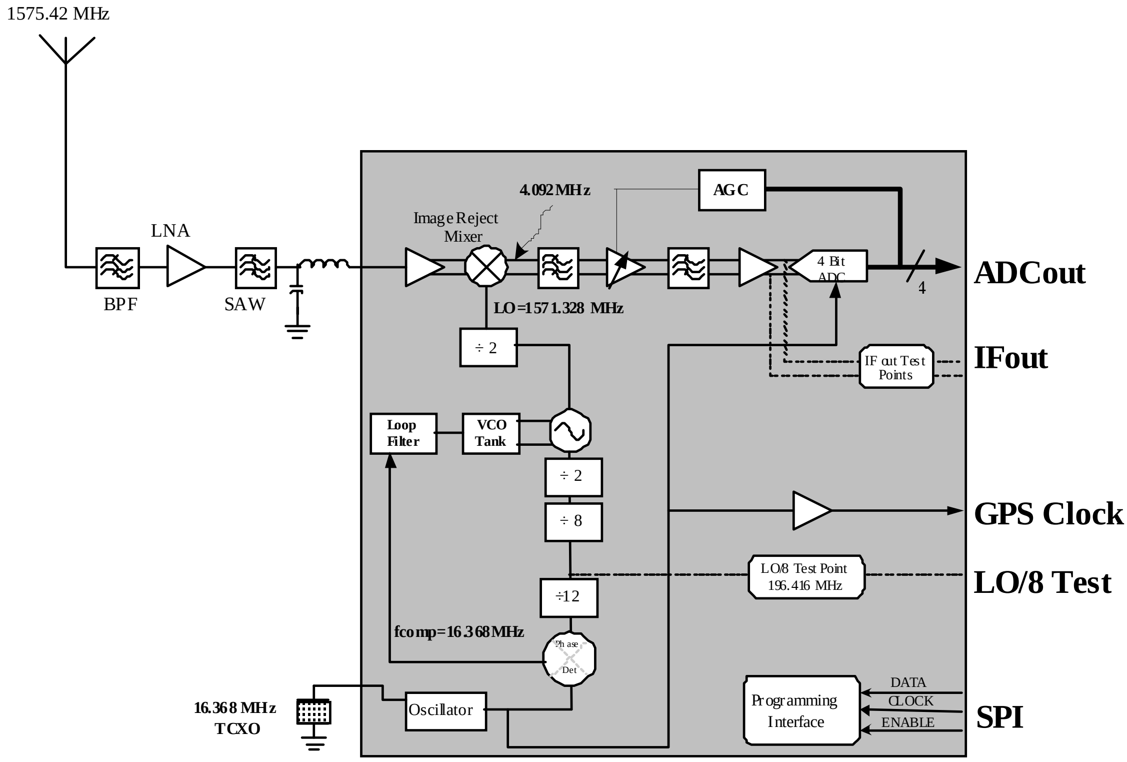

Figure 1: GPS RF Functional Diagram

GPS RF Quick Fault-finding Chart

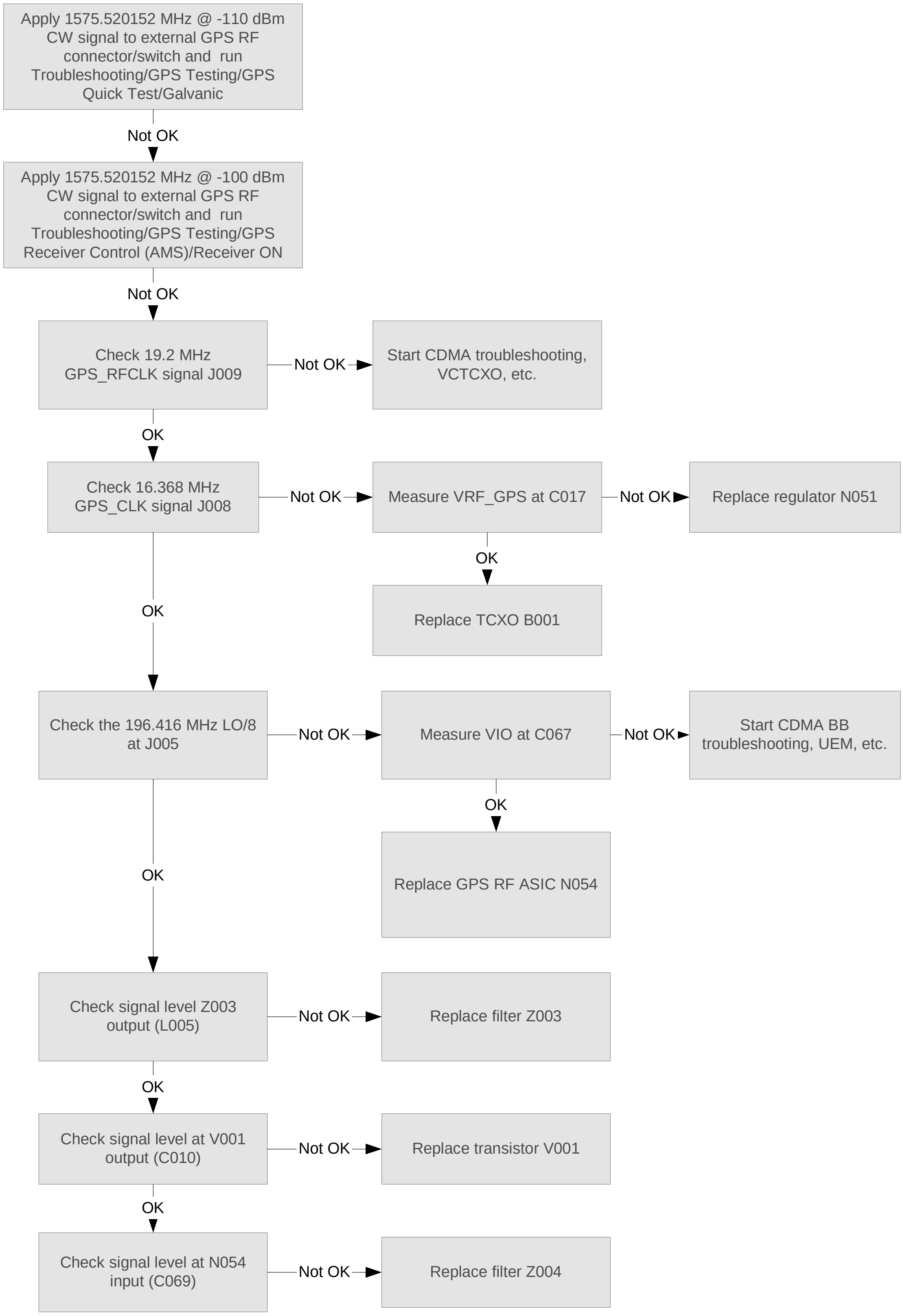

Figure 2: GPS RF Fault-finding chart (Quick reference)

Block Diagrams

Transmitter

The following figure illustrates a simplified block diagram of the transmitter. It illustrates every major component from I and Q baseband all the way to the antenna port.

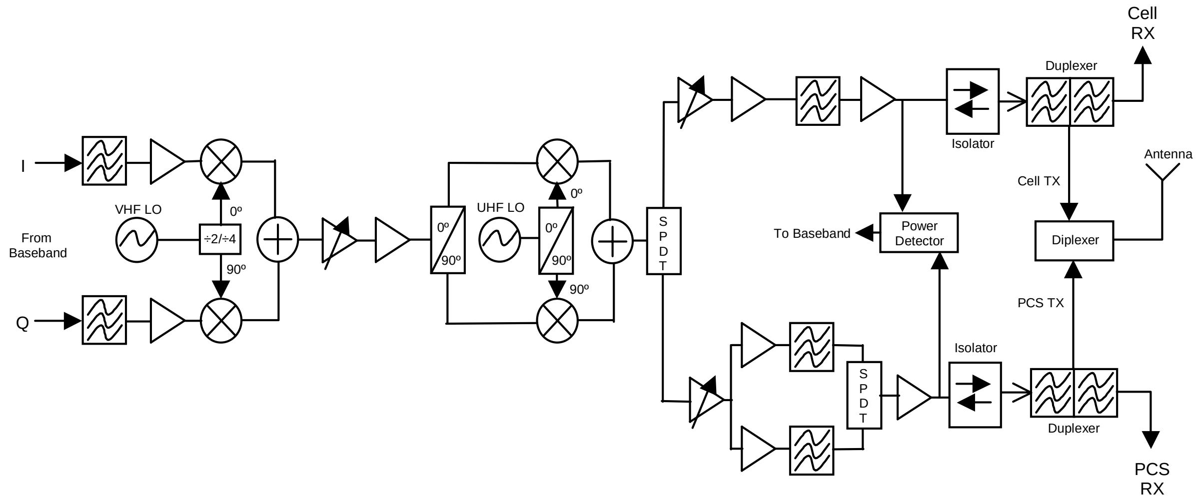

Figure 3: Transmitter Block Diagram

Receiver

The following figure illustrates a simplified block diagram of the receiver. It illustrates every major component from the antenna port all the way to I and Q baseband

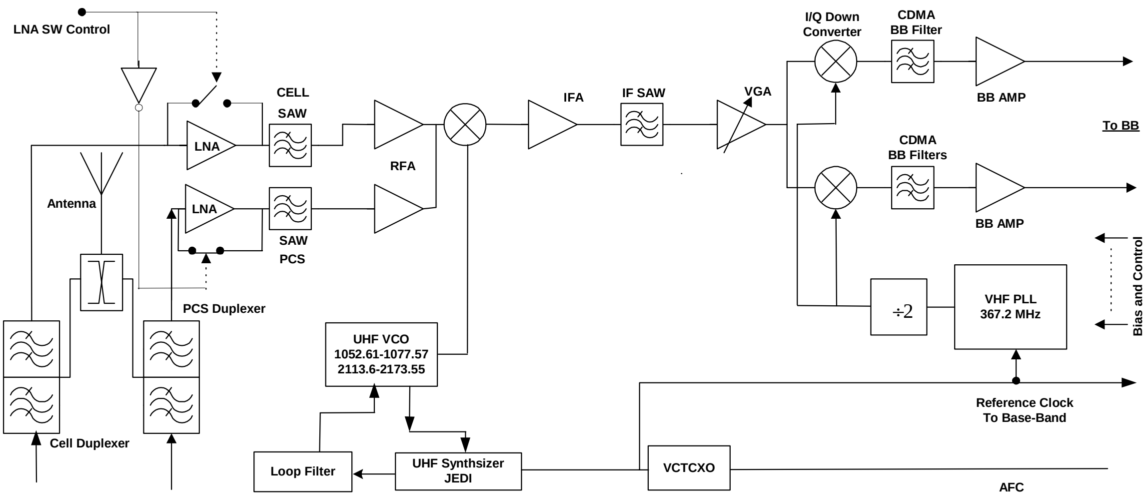

Figure 4: Receiver Block Diagram

Synthesizer

The following figure illustrates a block diagram of the synthesizers.

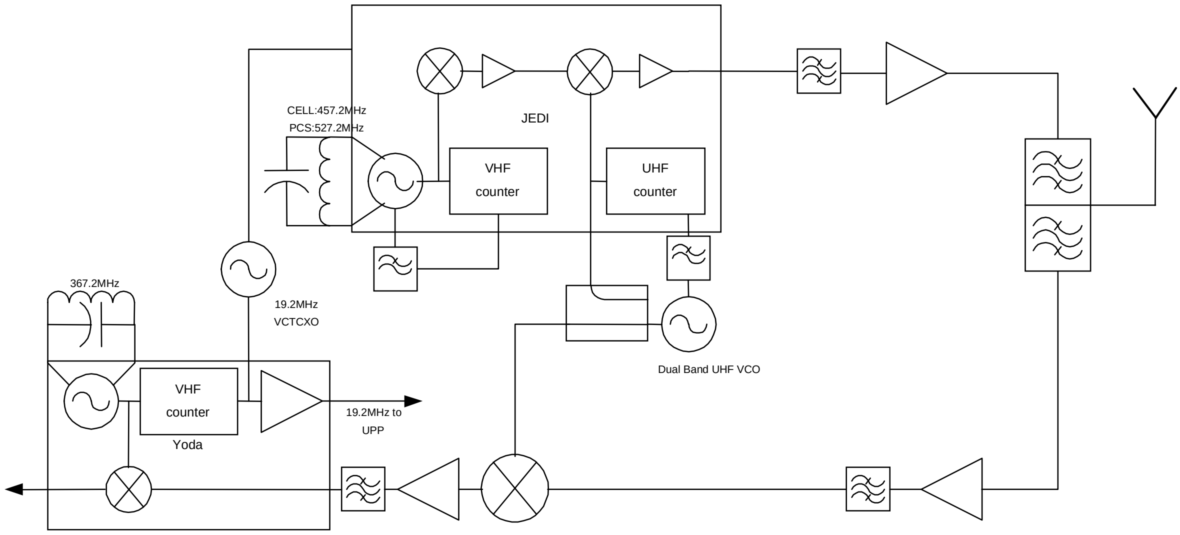

Figure 5: Synthesizers Block Diagram

GPS

The following figure illustrates a simplified block diagram of the GPS RF.

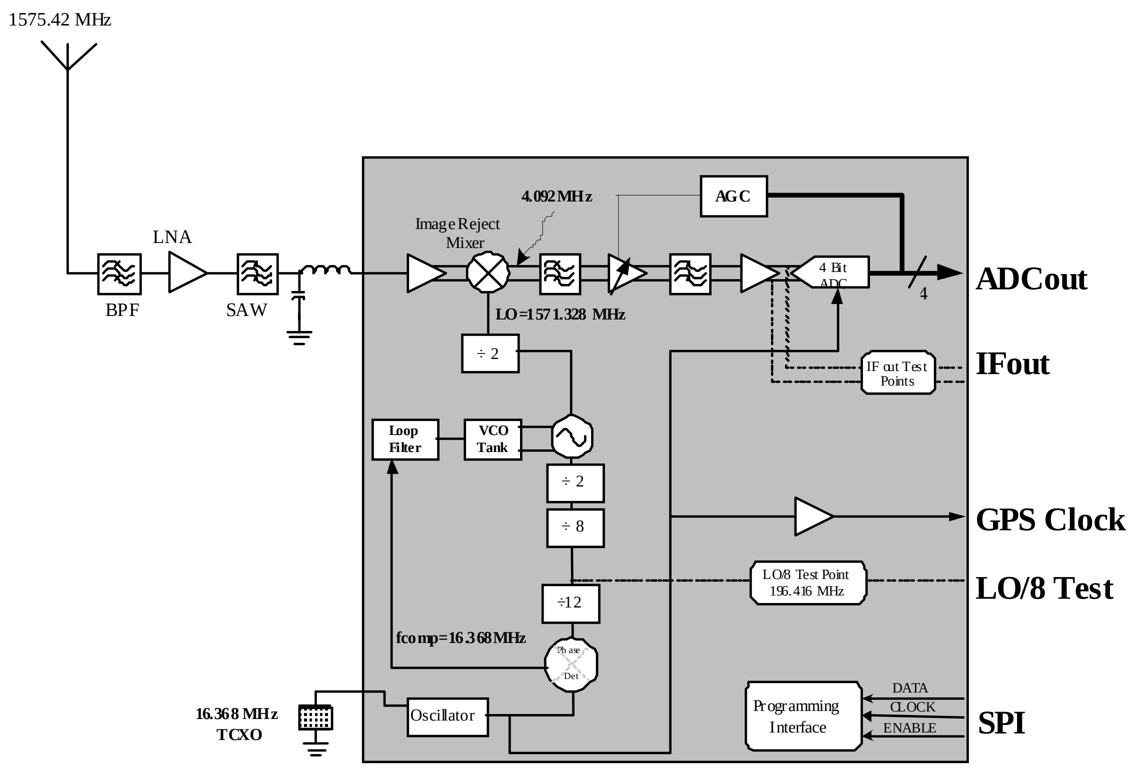

Figure 6: GPS RF Block Diagram

Frequency Plan

The following figure illustrates a simplified block diagram of the frequency plan.

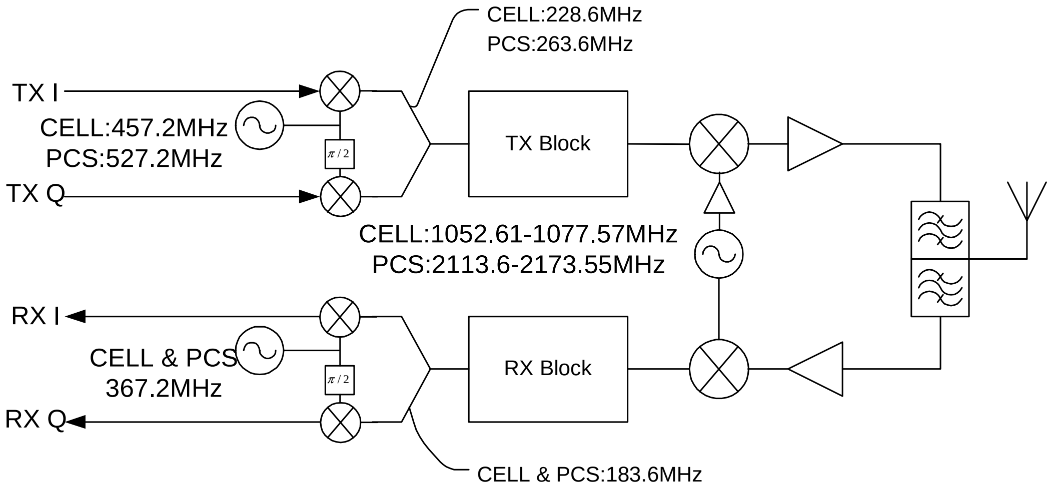

Figure 7: Frequency Plan Block Diagram

Jedi

The following figure illustrates a detailed block diagram of the Jedi TX chip.

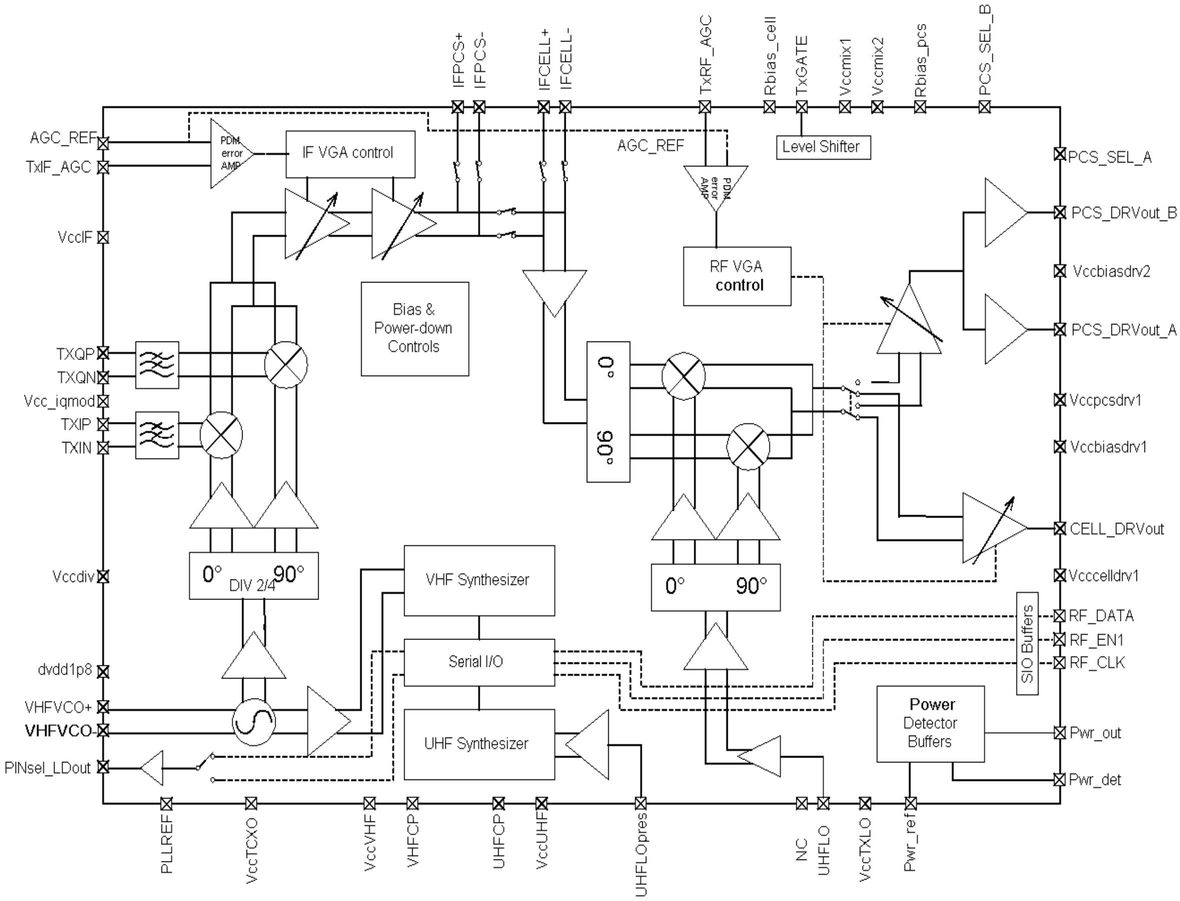

Figure 8: Jedi Block Diagram

Yoda

The following figure illustrates a detailed block diagram of the Yoda RX chip.

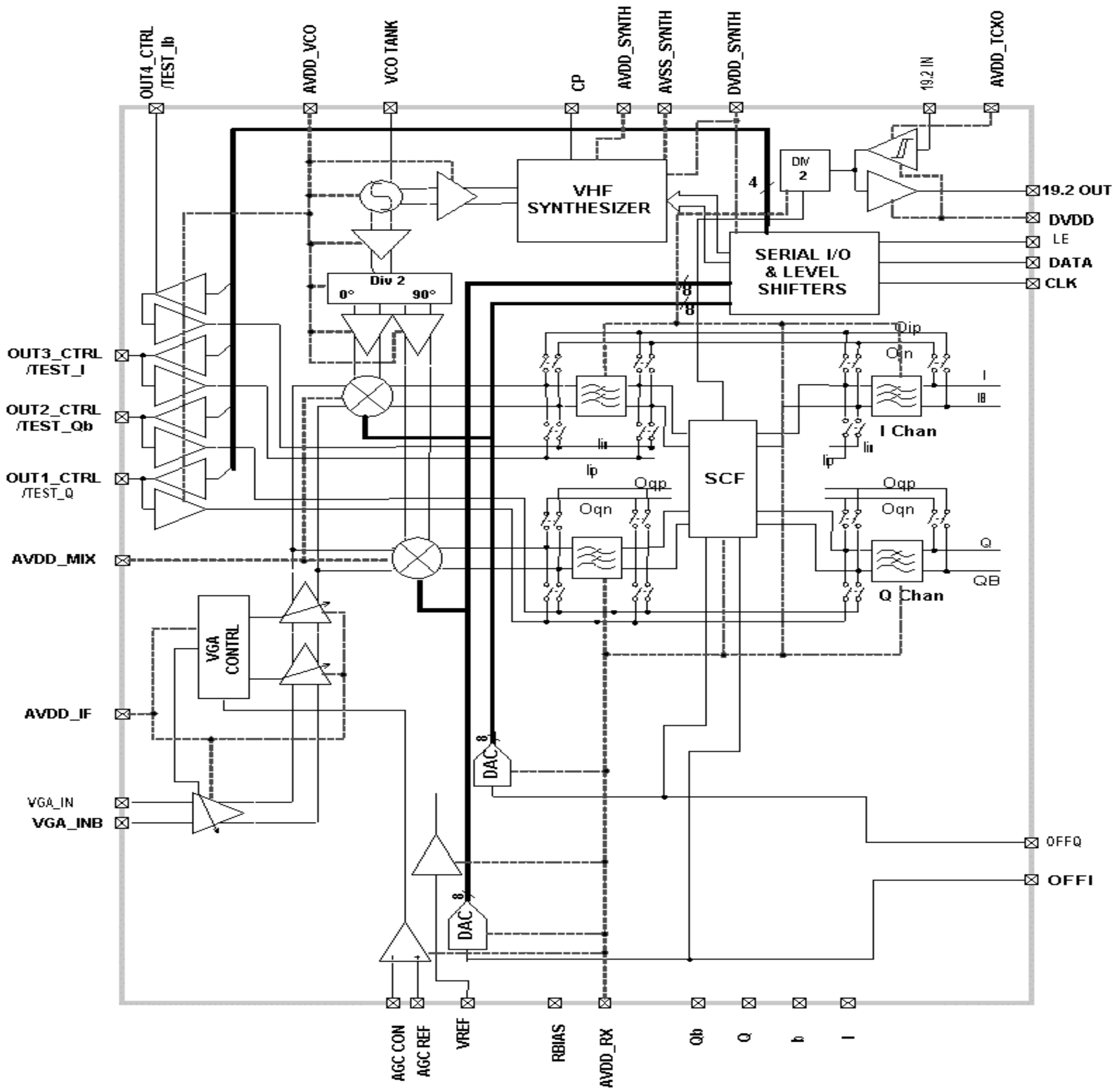

Figure 9: Yoda Block Diagram

Description of RF ASICs

Jedi (N601)

In this dual-mode transmitter, the BB I and Q signal input buffer, modulator, IF VGA, up-converter, RF VGA, and the PA driver will be integrated on a single IC called Jedi. This Tx IC, Jedi, includes VHF synthesizers with external tanks and the UHF PLL circuitry excluding VCOs. This Tx IC plus Cell and PCS band power amplifiers, SAW filters, power detectors, isolators, and duplexers form the transmitter. Therefore, it is a highly integrated transmitter.

Yoda (N700)

In this dual-mode RF receiver, two highly integrated chips, an RF IC named Alfred and an IF-BB IC called Yoda, are used to cover overall dual-mode receiver function, and therefore the external parts count of the receiver is significantly reduced.

Alfred (N901)

In this dual-mode RF receiver, two highly integrated chips, an RF IC named Alfred and an IF-BB IC called Yoda, are used to cover overall dual-mode receiver function, and therefore the external parts count of the receiver is significantly reduced.

Orca (N803)

The Orca power amplifier is designed for the CELL frequency band.

Shamu (N802)

The Shamu power amplifier is designed for the PCS frequency band.

GPS ASIC (N054)

The GPS ASIC is a highly integrated IC which contains all the RF circuitry for the GPS receiver (except the LNA which is a discrete design) with the exception of some passive components.

Probing Diagrams

The following figure is an assembly drawing of the top of the board.

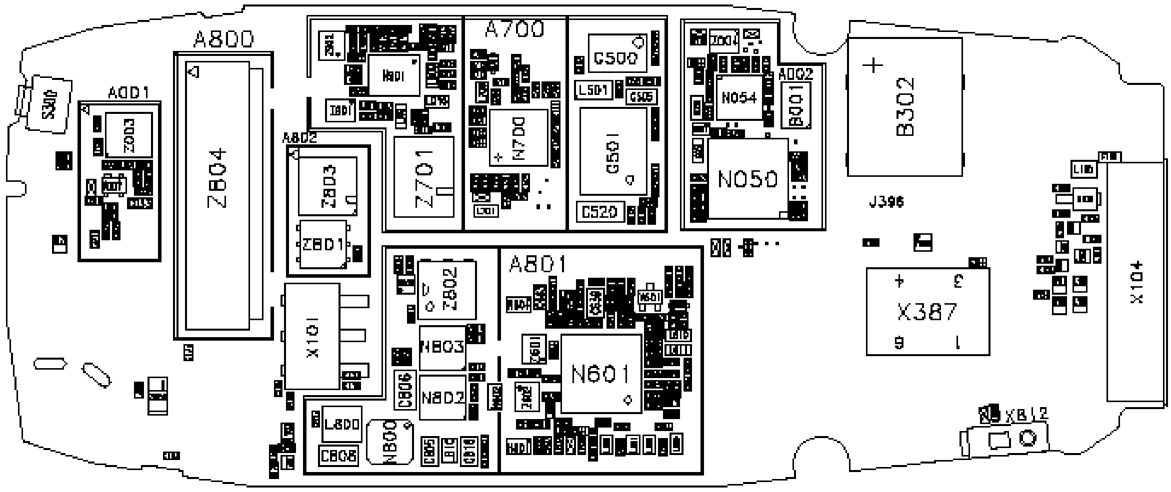

Figure 10: PWB Top View

The following figure is the assembly drawing of the bottom of the board.

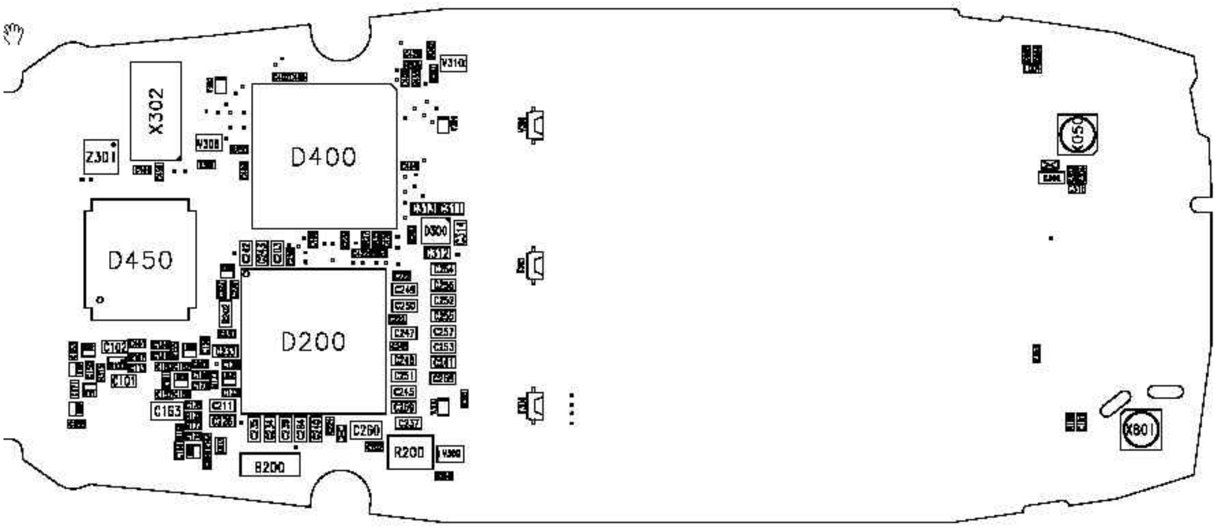

Figure 11: PWB Bottom View

Power Amplifier (PA) Module test points:

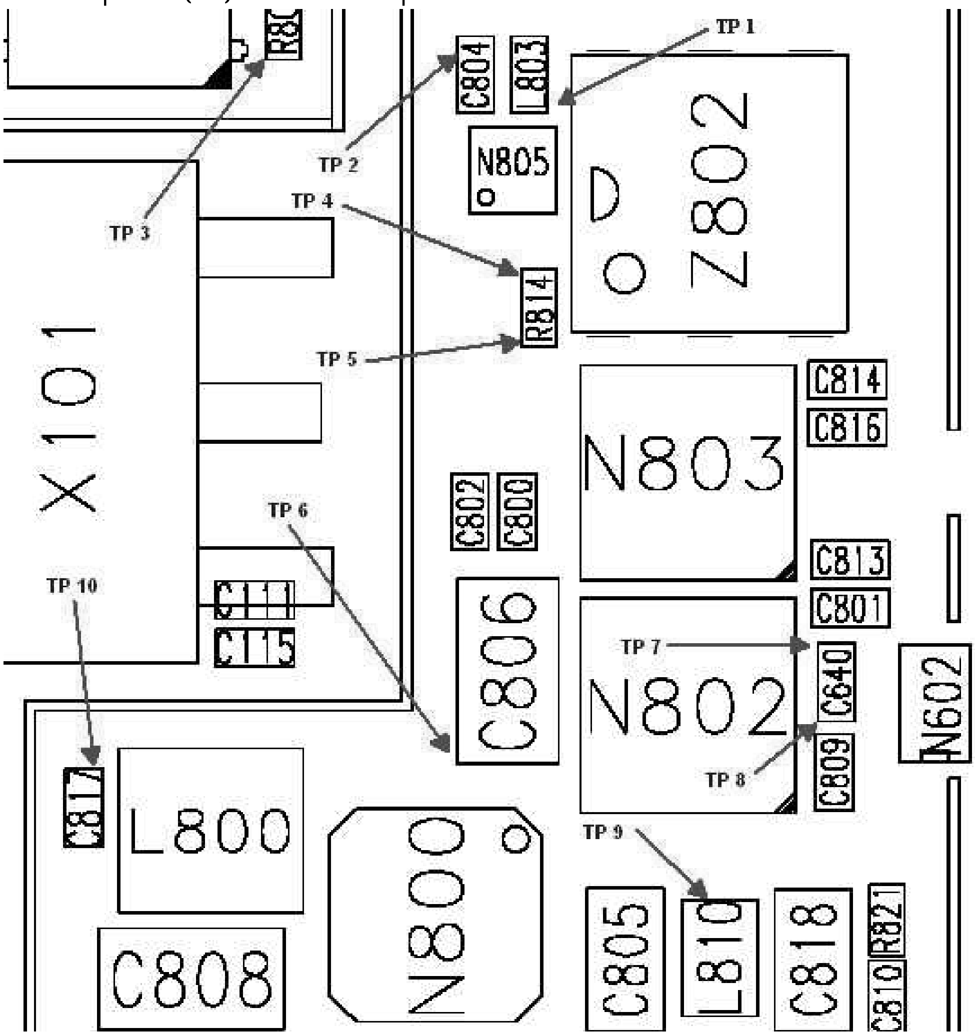

Figure 12: PA Module test points

The following figure is the close-up view of the transmitter section of the board.

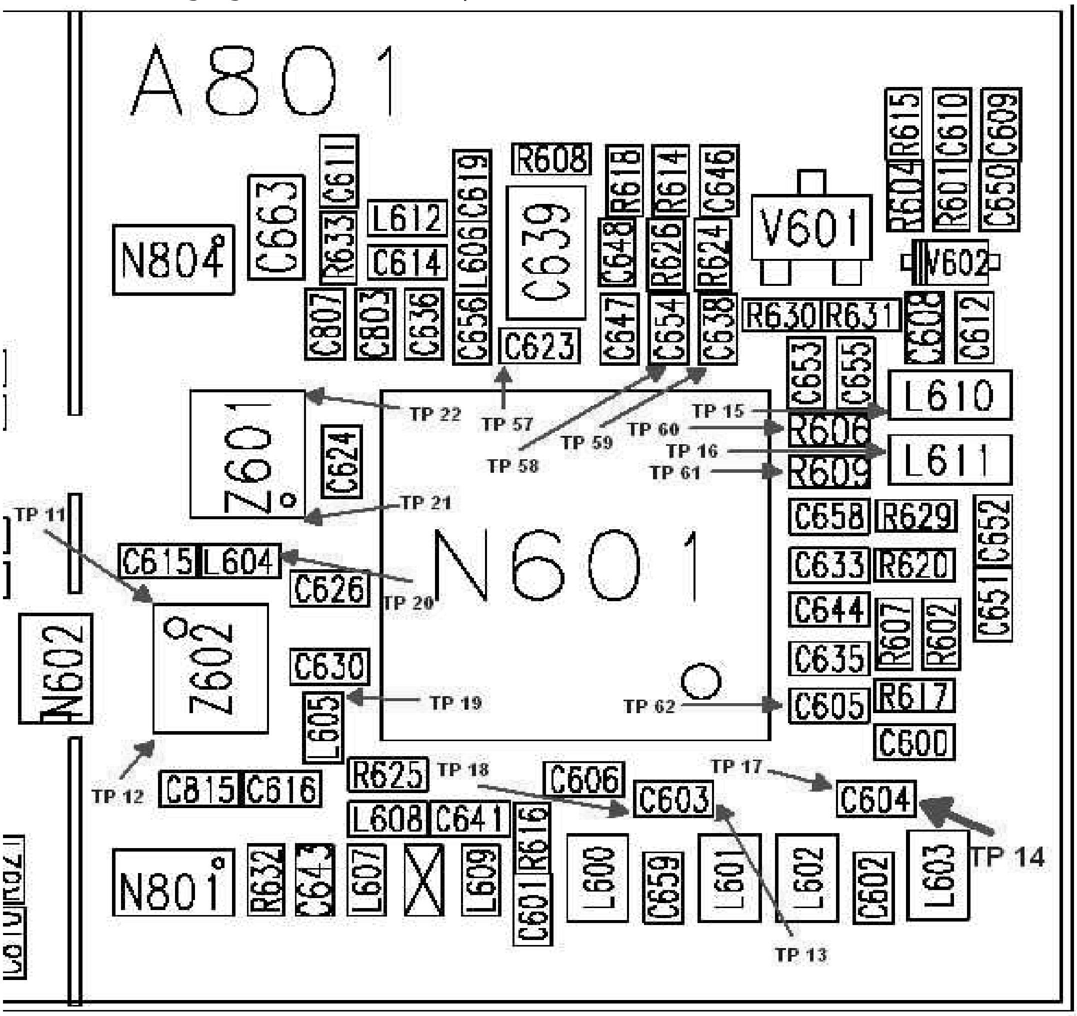

Figure 13: Transmitter view

The following diagram indicates the TX Module test point:

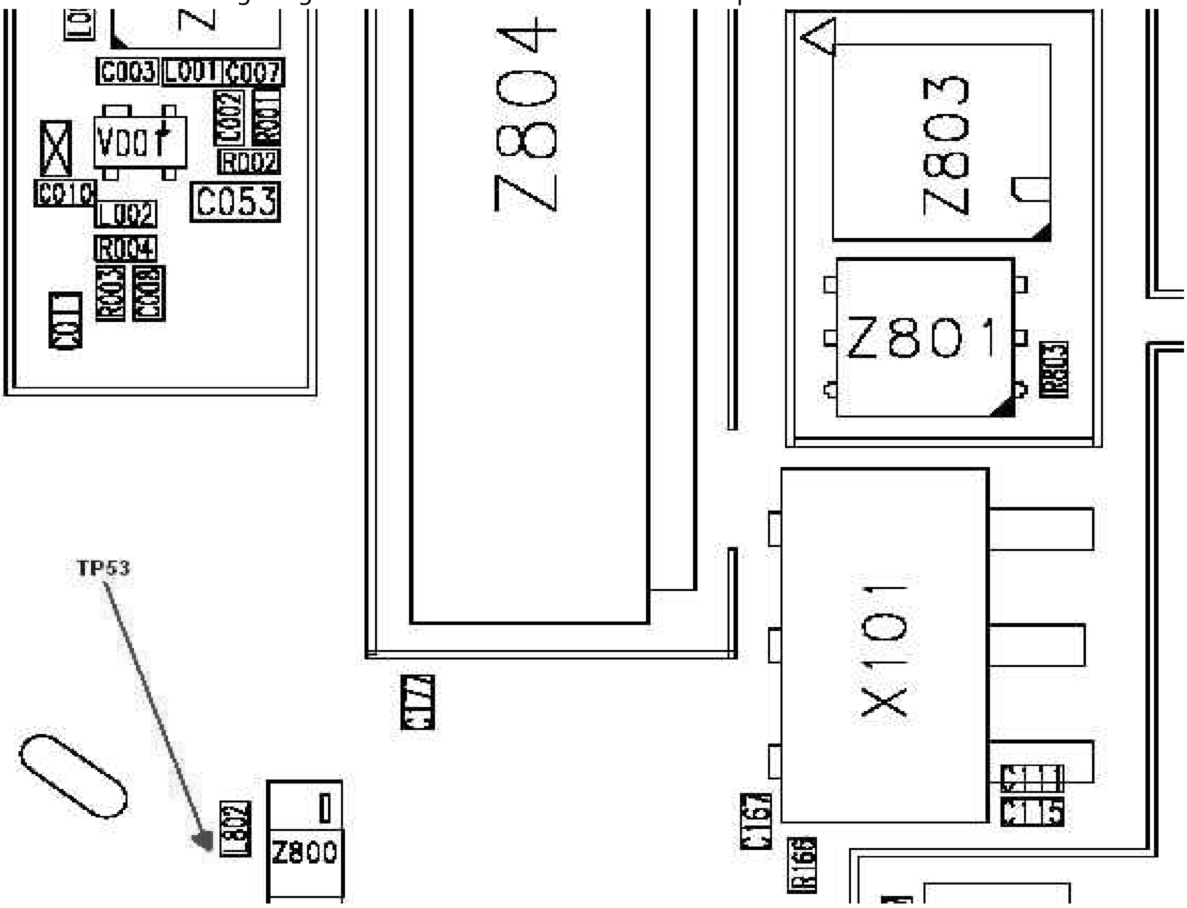

Figure 14: TX Module test point

The following figure is the close-up view of the receiver section of the board.

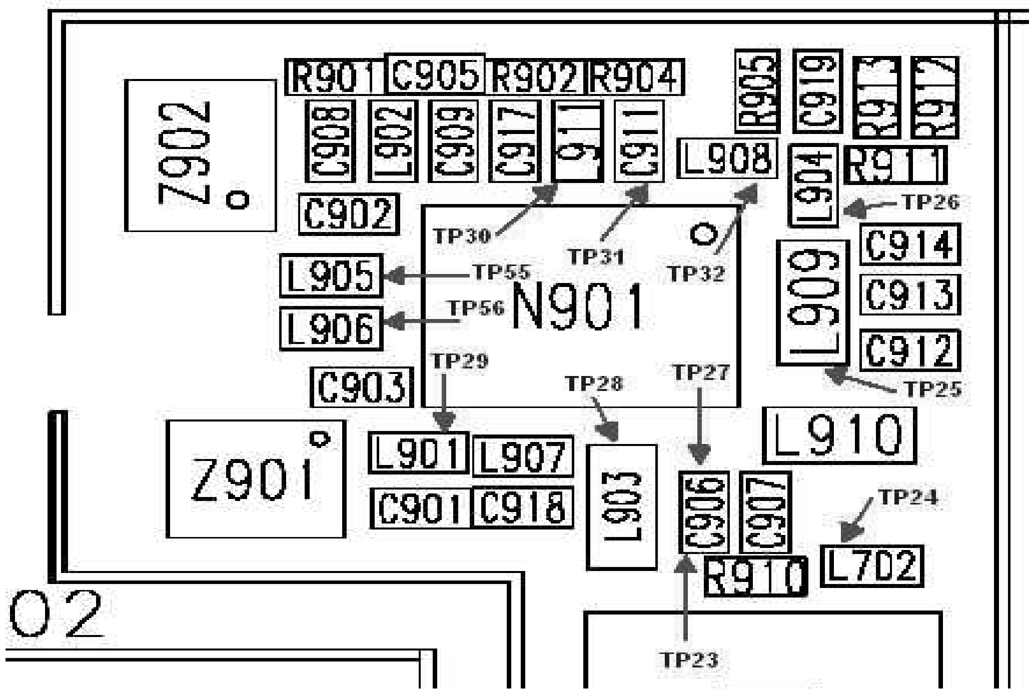

Figure 15: Receiver view

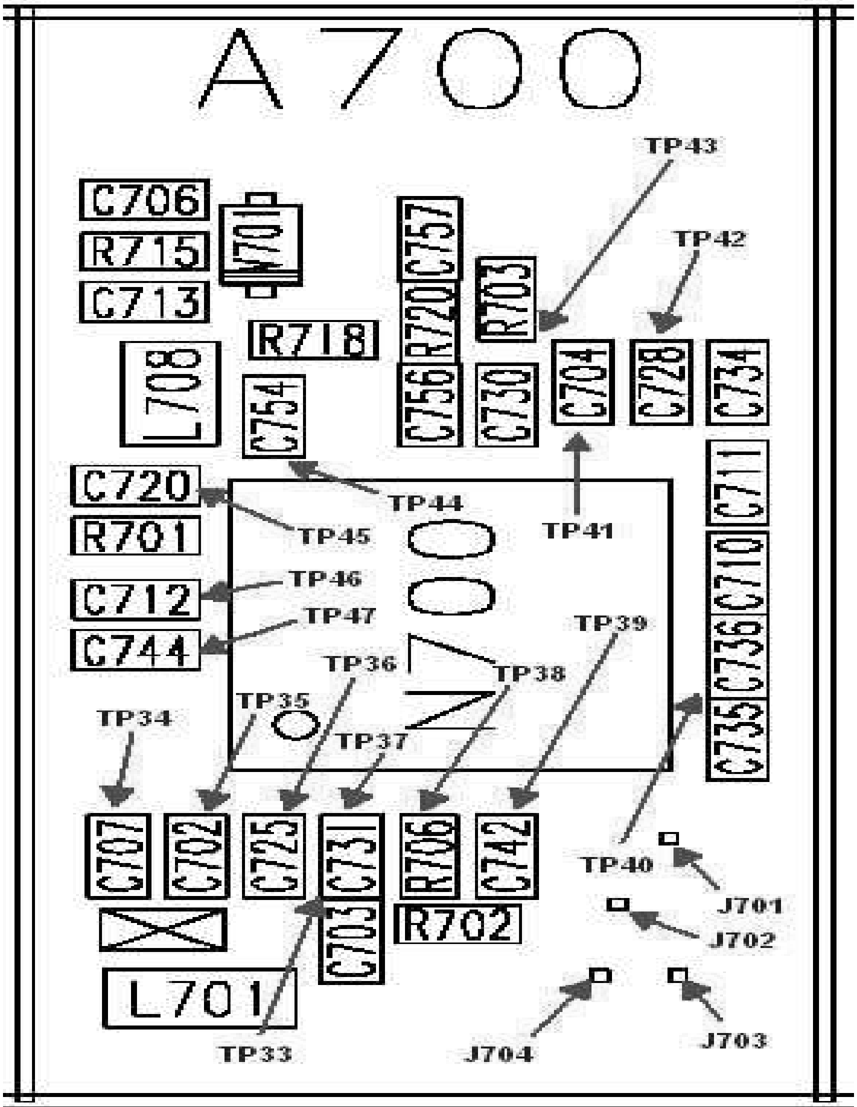

Figure 16: Receiver (Yoda) test points

The following figure is the close-up view of the synthesizer section of the board.

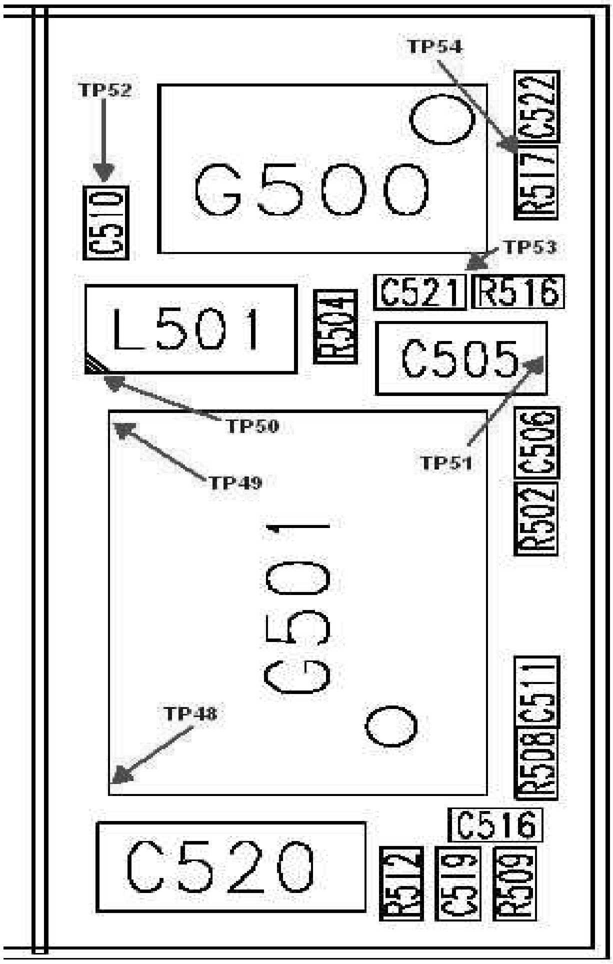

Figure 17: Synthesizer Module test points

Test Point	Component	Measure
48	G501	2.7 VDC
49	G501	-3 dBm @ 1065.12 MHz (Cell) -3 dBm @ 2146.3 MHz (PCS)
50	L501	1065.12 MHz (Cell) 2146.3 MHz (PCS)
51	C505	2.72 VDC
52	C510	5 dBm @ 19.2 MHz
53	C521	2.8 VDC
54	R517	1.26 VDC

Tuning Descriptions

Tuning Title	Description	Troubleshooting
Yoda VHF PLL	This is one of the phone's self-tests which gives either a *pass* or *fail* result only. The RX VHF PLL is inside the Yoda IC. The phone checks the VHF PLL's lock-detect bit. If this bit indicates that the PLL is unlocked, the test will fail.	Check C706, R715, C713, L708, C754, R718, V701, R720, C757, C756. Also check power supplies to Yoda, particularly check for 2.7v on VR5, and on VR7 at C720, check for 1.8v on VIO at C704. If no fault is found, replace Yoda (N701).
Jedi VHF PLL	This is one of the phone's self-tests which gives either a *pass* or *fail* result only. The TX VHF PLL is inside the Jedi IC. The phone checks the VHF PLL's lock-detect bit. If this bit indicates that the PLL is unlocked, the test will fail.	Check C651, R629, C650, L610, C646, R624, V601, C653, C655, R630, R631, L611, C652, R626, C648, C647, C608, R604, V602, R601, C612, R615, C609, C610. Check power supplies to Jedi (N601), particularly ensure 2.7v on VR5 at C651 and 1.8v on VIO at C608. If no problems are found, replace Jedi.
TX Detector (Cell)	This is one of the phone's self-tests which gives either a *pass* or *fail* result only. The phone transmits at several power levels and checks the ADC value of the power detector. The ADC value is measured first for a set of AGC values, then each AGC value is changed one at a time to make sure that the ADC changes as each AGC is changed individually.	Check the AGC voltages and components of the associated PDMs. For problems with the IF or RF AGC, also check Jedi and supporting components. For PA AGC problems, also check the PA and supporting components. If all of the above cases fail, troubleshoot the TX chain. If all the output powers are passing, then perhaps the test is failing because the ADC voltage is wrong (which at this point we cannot read, so we are measuring the actual output power). If the voltages are wrong, then check the power detector at R814, L803, N805, C803, C807, and also Jedi. If the voltages are correct and it still fails, check the UEM (D200).
TX Detector (PCS)	This is one of the phone's self-tests which gives either a *pass* or *fail* result only. The phone transmits at several power levels and checks the ADC value of the power detector. The ADC value is measured first for a set of AGC values, then each AGC value is changed one at a time to make sure that the ADC changes as each AGC is changed individually.	Check the AGC voltages and components of the associated PDMs. For problems with the IF or RF AGC, also check Jedi and supporting components. For PA AGC problems, also check the PA and supporting components. If all of the above cases fail, troubleshoot the TX chain. If all the output powers are passing, then perhaps the test is failing because the ADC voltage is wrong (which at this point we cannot read, so we are measuring the actual output power). If the voltages are wrong, then check the power detector at R803, C804, L803, N805, C803, C807, and also Jedi. If the voltages are correct and it still fails, check the UEM (D200).

Tuning Title	Description	Troubleshooting
Cell PA Temp	This is one of the phone's self tunings, which reads the ADC voltage of a thermistor R808, and checks to make sure the phone is at room temperature. The reason for this is that a phone should not be tuned while it is hot or cold.	If the phone was recently transmitting in Cell band at full power for an extended period of time, it is probably hot for that reason. Let it cool down for a few minutes, then try again. If it still fails, there may either be a short on the board or else a problem with the PA Temp circuitry. To check PA Temp circuitry, check R808, C232, R202, and D200. If a short is suspected, check the cell PA first. If an infrared camera is available, this is one of the easiest methods to detect a short.
Cell RX DC Offset I (or Q)	This is one of the phone's self tunings, which measures and adjusts the cell band CDMA receiver DC offsets until they are within the limits.	Check Yoda (N701) and supporting components.
TX Start-up Current	This test turns on the transmitter (PCS transmitter for PCS-only phones) and measures current of the whole phone, which can detect some assembly errors.	If current is very high, there may be a short circuit on the phone caused by a solder bridge, a failed component that is internally shorted, a component placed with the wrong rotation which shorts two nodes that shouldn't be, or some other reason. A visual inspection can find solder bridges or wrong component rotations. A failed component can be found by functional tests of the phone's sub-blocks.
TX Start-up Amplitude	This test turns on the transmitter (PCS transmitter in PCS-only phones) and checks for the presence of a TX signal with an amplitude within a specified range. A wide range is allowed since the transmitter is not yet tuned.	Check proper placement, rotation and soldering of the components in the TX chain. Check for the presence of LO tones. Check for presence of a TX signal at each point in the TX chain.

Tuning Title	**Description**	**Troubleshooting**
VCTCXO Frequency	The purpose of this tuning is to determine what the AFC DAC value needs to be in order to center the VCTCXO frequency. The PCS transmitter is turned on and no TX baseband modulation is provided. The carrier is then centered in frequency. This is done to the carrier after it has been mixed up to 1880 MHz, since it's easier to measure the tolerance of 1 ppm at 1880 MHz than it is at 19.2 MHz. Additionally, the tone at 1880 MHz can be measured without taking the phone apart.	1) If there is no tone, probe pin 3 of G500 for a tone at 19.2 MHz. If this is not present, check power supplies, particularly ensure 2.7v on VCTCXO Vcc pin, pin 4 of G500. Also check the control pin, pin 1 of G500, for a voltage between 0.4 and 2.7v. If the voltages are correct, and soldering of all G500 terminals is correct, replace G500. If 19.2 MHz tone is present but tone at 836.52 MHz is not, troubleshoot cell TX chain. 2) If the carrier is present but the PDM needed to center it is outside of the +/- 150 range, or if it cannot be centered, there is a hardware problem. 3) In the following procedure, performing frequency centering on the RF carrier at 1880 MHz will detect frequency errors due to the VCTCXO and supporting hardware, which will be the majority of the problems, but will not detect frequency errors due to the hardware that mixes the VCTCXO tone at 19.2 MHz up to 1880 MHz. In order to troubleshoot this hardware also, frequency centering should be performed on the 19.2 MHz tone to +/- 19.2 Hz on pin 3 of G501 using a frequency counter, then the VHF and UHF LOs should be checked. Since this will be time-consuming and will probably only account for a small percentage of the failures, it is not recommended unless the situation justifies the time spent. The VHF LO is inside the Jedi IC (N601) and troubleshooting of the cell UHF LO is required. 4) If the carrier can be centered but the PDM is out of range, check the control voltage on pin 1 of G500. If it is 2.2v, (and pin 4 is at 2.7v, and pin 2 at 0v), then the VCTCXO (G500) is working correctly but the circuit that delivers the control voltage is not. Check soldering of all G500 terminals, also check R516, C521, R517, C522, C510, and D200. If the control voltage on pin 1 of G501 is not 2.2v, but the carrier is centered, then there is a problem with the VCTCXO G501. If there is 2.7v on pin 4 and the soldering is correct, then replace G500.

Tuning Title	Description	Troubleshooting
		5) If the carrier cannot be centered, check to see if you can adjust to 2.2v on pin 1 of G500. If you can, within the PDM range of +/- 150, then the circuitry that delivers the voltage is working correctly, and the VCTCXO has a problem. Troubleshoot it as described in the previous section. If you cannot adjust to 2.2v within the accepted range, then the AFC circuitry has a problem. Troubleshoot it as described in the previous section. 6) In the case that there is a fault with both the AFC circuitry and the VCTCXO, then several combinations of the previously described conditions are possible. Start by ensuring 2.2v on pin 1 of G500 using a PDM within the range +/- 150, then center the tone.
TX IF AGC Cell Po	The IF gain curve is characterized by varying the TX_IF_AGC and measuring the transmit power. This is only done once (in cell CDMA mode) since the same circuitry is used for both Cell and PCS.	Check Robin (N801) and supporting components. Also check D400, which generates the PDM signals. Check AGC PDM voltages. Troubleshoot the rest of the transmitter chain if necessary.
PA Gain Cell Po	These tunings model the cell PA gain curve by setting the PA AGC PDM to several values and measuring output power. First, the TX PA AGC and the TX RF AGC are set to (approximately) their maximum used values (not the maximum possible values, but the maximum of the range over which they are used). Then the TX IF AGC is set so that the transmit power on the antenna connector is approximately +11 dBm (this power is reported in the next tuning). Then, six PDM values are written to the PA AGC and the output power is measured for each. These values are reported in this tuning.	If the power readings are low, check the AGC voltages. You can also probe on the PA input to find out if the power level is low going into the PA, or if the power level is correct going into the PA but the PA gain is too low. If the power level going into the PA is too low, probe the TX chain at all the other points prior to the PA listed in the table to see where the gain is lacking. When that point is identified, check the soldering of all related components, and replace components until the fault is found. If the power on the PA input is not low and the PA AGC voltage is correct, similarly probe the power at all points after the PA to find the fault, being extremely careful not to short the probing point to ground because this will instantly destroy the PA. Visually check soldering first, and probe on PA output as a last resort.
TX IF AGC (Cell)	This is the part of the previous tuning when the TX IF AGC is adjusted so that the output power is +11 dBm.	Check Jedi (N601). Also check D400, which generates the PDM signals. Check AGC PDM voltages. Troubleshoot the rest of the cell transmitter if needed.

Tuning Title	Description	Troubleshooting
TX RF AGC (Cell)	This tuning characterizes the RF AGC curve by entering PDM values to the RF AGC and measuring the output power.	Check Jedi (N601). Also check D400, which generates the PDM signals. Check AGC PDM voltages. Troubleshoot the rest of the cell transmitter if needed.
TX Gain Comp (Cell)	This tuning ensures that the value of TxdBCtr correctly corresponds to the absolute TX output power. On the mid channel, with TxdBCtr set to a specified value, G_Offset is adjusted so that the output power is -8 dBm, and that value of G-Offset is recorded (which is an absolute value) in the next tuning. The output power in dBm is recorded in this tuning. After this is done on the mid channel, the channel is changed to each of the other channels, and output power is reported. (G_offset is not adjusted on the other channels as it was on the center channel, just the output power is recorded).	Set the phone to local mode and program it to Cellular (or PCS) CDMA RX/TX mode on channel 384 (or 600 for PCS) using the Main Mode window. Using the Phoenix RF Tuning window, choose *mode* = RF Tuning, and choose this test. Adjust G_Offset in the "Values" dialog box line until the TX output power (measured on the RF connector with a spectrum analyzer) is equal to -8.0 dBm +/- 0.5 dB. Use the G_Offset limit range as a guide to which values to enter.Once this is done on the center channel, change to each of the other channels, and record the power. Do not adjust G_Offset on the other channels, just record the power. It should be within the limits listed in the tuning results file. **Channel** / **Cell** / **PCS** Low 991 25 LowMid 107 200 MidLow 245 400 Mid 384 600 MidHigh 512 800 HighMid 660 1000 High 799 1199* * *1199 not a voice channel, but used in tuning.*
TN G_Offset (Cell)	See description of previous tuning. This step reports G_Offset.	If G_Offset is not within the limits, troubleshoot the Cell TX.
TN PA Gain Cal (PCS)	This tuning characterizes the PCS PA gain curve.	If the power readings are low, check the AGC voltages. You can also probe on the PA input to find out if the power level is low going into the PA, or if the power level is correct going into the PA but the PA gain is too low. If the power level going into the PA is too low, probe the TX chain at all the other points prior to the PA. When that point is identified, check the soldering of all related components, and replace components until the fault is found. If the power on the PA input is not low and the PA AGC voltage is correct, similarly probe the power at all points after the PA to find the fault, being extremely careful not to short the probing point to ground because this will instantly destroy the PA. Visually check soldering first, and probe on PA output as a last resort.

Tuning Title	Description	Troubleshooting
TX IF AGC (PCS)	The TX IF AGC is adjusted so that the output power is +11 dBm.	Check Jedi (N601) and supporting components. Also check D400, which generates the PDM signals. Check AGC PDM voltages. Troubleshoot the rest of the transmitter chain if necessary.
TX RF AGC (PCS)	This tuning characterizes the PCS TX_RF_AGC.	Check Jedi (N601). Also check D400, which generates the PDM signals.
TX Limiting (Cell)	This tuning provides an upper limit on the transmit power while in Cell (or PCS) IS95 mode. The reason for this is to ensure that the phone never goes above the maximum transmit power level.	If the maximum cannot be reached, either a component in the transmitter has too much loss, or not enough gain. Troubleshoot the Cell (PCS) transmitter, with the phone set to the same channel as the failed channel.
TX Limiting (PCS)	This tuning provides an upper limit on the transmit power while in Cell (or PCS) IS95 mode. The reason for this is to ensure that the phone never goes above the maximum transmit power level.	If the maximum cannot be reached, either a component in the transmitter has too much loss, or not enough gain. Troubleshoot the Cell (PCS) transmitter, with the phone set to the same channel as the failed channel.
TS ACPR (Cell or PCS)	Adjacent Channel Power Ratio (ACPR) is a measure of band power in the adjacent channel as compared to the tuned channel, so it is a power delta in dB. Band power is measured at the center tuned frequency and also at an offset lower (higher) than the center frequency, and the difference is ACPR. For this test, the offset is - 1.25 MHz (+ 1.25 MHz).	If one or more of the AGC values needs a value much higher than normal to achieve maximum power, then that would indicate that a component in the chain has less gain (or more loss) than it should, and another component that is compensating for that could be saturating. Check all decoupling capacitors (C614, C615, C605, C603, C602, C624, C621, C651, C611, C604, C610, C608, C650, C841, C817, C808, C840, C809, C803).
PA Detector (PCS)	This tuning determines the output voltage of the TX power detector as a function of transmitted RF power.	If transmitted power levels cannot be attained, check PCS TX.
ACPR (Cell)	Tunes for adjacent channel power rejection.	Troubleshoot the Cell TX and also look at the Cell band TX decoupling capacitors.
RX IF AGC RX dB Ctr	This tuning calibrates the RX IF AGC curve. The tuner injects three known signal power levels into the phone's receiver, and for each one the phone's AGC algorithms, adjusts the RX_IF_AGC to get the same amplitude at the output of Yoda, although different amplitudes are going in.	While injecting a signal into the receiver, check the values of RX_IF_AGC PDM value and, if needed, voltage. RSSI should be within +/- 2 dB of the actual power in dBm on the RF connector. The AGC will try to keep the same amplitude on Yoda output; therefore, if the AGC value is larger than normal, then the AGC is compensating for loss in the chain prior to the variable gain amplifier.

Tuning Title	Description	Troubleshooting
LNA Gain	This tuning records RxdBCtr (which is automatically adjusted to produce the same amplitude on the receiver output no matter what the input is) for the receiver with the LNA in high gain mode, and again with the LNA in low gain mode. For Cell and PCS, it is done over several channels.	Check Alfred and supporting components.