Appendix 5. System Check

Prior to the assessment, the system was verified in the flat region of the phantom, 900 MHz, 1800 MHz, 1900 MHz, 2450 MHz and 5.0 GHz dipoles were used. A forward power of 250 mW was applied to the 900 MHz, 1800 MHz, 1900 MHz, 2450 MHz dipoles and 100 mW was applied to 5.0 GHz dipole and the system was verified to a tolerance of ±5% for the 900MHz, 1800MHz, 1900MHz, 2450 MHz and 5.0 GHz dipoles.

The applicable verification normalised to 1 Watt.

System Check 900 Head
Date: 25/06/2013
Validation Dipole and Serial Number: D900V2; SN: 035

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	900	23.0ºC	22.5ºC	ε_r	41.50	40.49	-2.43	5.00
				σ	0.97	0.95	-2.01	5.00
				1g SAR	10.50	10.24	-2.48	5.00
				10g SAR	6.74	6.68	-0.89	5.00

Channel Number	Channel Description	Frequency (MHz)	Parameters	
4132	Low	826.4	ε_r	40.98
			σ	0.90
4183	Middle	836.6	ε_r	40.90
			σ	0.91
4233	High	846.6	ε_r	40.87
			σ	0.92

Date: 01/07/2013
Validation Dipole and Serial Number: D900V2; SN: 035

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	900	24.0 ºC	22.2 ºC	ε_r	41.50	40.64	-2.07	5.00
				σ	0.97	0.96	-1.13	5.00
				1g SAR	10.50	10.60	0.95	5.00
				10g SAR	6.74	6.88	2.08	5.00

Channel Number	Channel Description	Frequency (MHz)	Parameters	
128	Low	824.2	ε_r	41.10
			σ	0.91
190	Middle	836.6	ε_r	41.10
			σ	0.92
251	High	848.8	ε_r	41.00
			σ	0.93

System Check 900 Body
Date: 27/06/2013
Validation Dipole and Serial Number: D900V2; SN: 035

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	900	24.0ºC	22.5ºC	ε_r	55.00	53.80	-2.18	5.00
				σ	1.05	1.04	-1.10	5.00
				1g SAR	10.80	10.52	--2.59	5.00
				10g SAR	6.96	6.92	-0.57	5.00

Channel Number	Channel Description	Frequency (MHz)	Parameters	
128	Low	824.2	ε_r	53.69
			σ	1.01
190	Middle	836.6	ε_r	53.65
			σ	1.02
251	High	848.8	ε_r	53.61
			σ	1.03

Date: 28/06/2013
Validation Dipole and Serial Number: D900V2; SN: 035

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	900	24.0 ºC	21.0 ºC	ε_r	55.00	52.93	-3.76	5.00
				σ	1.05	1.04	-0.95	5.00
				1g SAR	10.80	11.16	3.33	5.00
				10g SAR	6.96	7.28	4.60	5.00

Channel Number	Channel Description	Frequency (MHz)	Parameters	
128	Low	824.2	ε_r	53.69
			σ	1.01
190	Middle	836.6	ε_r	53.65
			σ	1.02
251	High	848.8	ε_r	53.61
			σ	1.03

System Check 900 Body (Continued):
Date: 01/07/2013
Validation Dipole and Serial Number: D900V2; SN: 035

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	900	24.0ºC	22.7ºC	ε_r	55.00	52.91	-3.80	5.00
				σ	1.05	1.05	0.19	5.00
				1g SAR	10.80	11.00	1.85	5.00
				10g SAR	6.96	7.20	3.45	5.00

Channel Number	Channel Description	Frequency (MHz)	Parameters	
4132	Low	826.4	ε_r	53.28
			σ	1.01
4183	Middle	836.6	ε_r	53.23
			σ	1.02
4233	High	846.6	ε_r	53.19
			σ	1.02

System Check 1800 Head
Date: 25/06/2013
Validation Dipole and Serial Number: D1800V2; SN: 264

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	1800	24.0ºC	21.1ºC	ε_r	40.00	40.17	0.43	5.00
				σ	1.40	1.37	-1.86	5.00
				1g SAR	37.20	35.40	-4.84	5.00
				10g SAR	19.60	19.36	-1.22	5.00

Channel Number	Channel Description	Frequency (MHz)	Parameters	
1312	Low	1712.4	ε_r	40.50
			σ	1.30
1412	Middle	1732.4	ε_r	40.40
			σ	1.31
1513	High	1752.6	ε_r	40.33
			σ	1.33

System Check 1800 Body
Date: 11/07/2013
Validation Dipole and Serial Number: D1800V2; SN: 264

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	1800	24.0 ºC	23.7 ºC	ε_r	53.30	50.91	-4.48	5.00
				σ	1.52	1.56	2.83	5.00
				1g SAR	37.80	37.60	-0.53	5.00
				10g SAR	20.10	20.64	2.69	5.00

Channel Number	Channel Description	Frequency (MHz)	Parameters	
1312	Low	1712.4	ε_r	51.20
			σ	1.49
1412	Middle	1732.4	ε_r	51.20
			σ	1.51
1513	High	1752.6	ε_r	51.20
			σ	1.52

Date: 12/07/2013
Validation Dipole and Serial Number: D1800V2; SN: 264

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	1800	24.0 ºC	23.7 ºC	ε_r	53.30	50.91	-4.48	5.00
				σ	1.52	1.56	2.83	5.00
				1g SAR	37.80	37.56	-0.63	5.00
				10g SAR	20.10	20.44	1.69	5.00

Channel Number	Channel Description	Frequency (MHz)	Parameters	
1312	Low	1712.4	ε_r	51.20
			σ	1.49
1412	Middle	1732.4	ε_r	51.20
			σ	1.51
1513	High	1752.6	ε_r	51.20
			σ	1.52

System Check 1900 Head
Date: 25/06/2013
Validation Dipole and Serial Number: D1900V2; SN: 537

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	1900	24.0 ºC	23.0 ºC	ε_r	40.00	38.82	-2.95	5.00
				σ	1.40	1.41	0.43	5.00
				1g SAR	39.40	40.40	2.54	5.00
				10g SAR	20.70	21.52	3.96	5.00

Channel Number	Channel Description	Frequency (MHz)	Parameters	
9262	Low	1852.4	ε_r	39.15
			σ	1.36
9400	Middle	1880	ε_r	38.96
			σ	1.39
9538	High	1907.6	ε_r	38.81
			σ	1.42

Date: 01/07/20130
Validation Dipole and Serial Number: D1900V2; SN: 537

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	1900	24.0ºC	23.0ºC	ε_r	40.00	39.23	-1.93	5.00
				σ	1.40	1.42	1.56	5.00
				1g SAR	39.40	39.20	-0.51	5.00
				10g SAR	20.70	20.24	-2.22	5.00

Channel Number	Channel Description	Frequency (MHz)	Parameters	
512	Low	1850.2	ε_r	39.40
			σ	1.37
661	Middle	1880	ε_r	39.30
			σ	1.40
810	High	1909.8	ε_r	39.19
			σ	1.43

System Check 1900 Body
Date: 28/06/2013
Validation Dipole and Serial Number: D1900V2; SN: 537

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	1900	24.0 ºC	23.5 ºC	ε_r	53.30	51.93	-2.57	5.00
				σ	1.52	1.52	-0.28	5.00
				1g SAR	40.50	41.60	2.72	5.00
				10g SAR	21.40	22.00	2.80	5.00

Channel Number	Channel Description	Frequency (MHz)	Parameters	
9262	Low	1852.4	ε_r	52.00
			σ	1.47
9400	Middle	1880	ε_r	52.00
			σ	1.50
9538	High	1907.6	ε_r	51.90
			σ	1.52

Date: 29/06/2013
Validation Dipole and Serial Number: D1900V2; SN: 537

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	1900	24.0 ºC	23.5 ºC	ε_r	53.30	51.93	-2.57	5.00
				σ	1.52	1.52	-0.28	5.00
				1g SAR	40.50	38.80	-4.20	5.00
				10g SAR	21.40	20.56	-3.93	5.00

Channel Number	Channel Description	Frequency (MHz)	Parameters	
9262	Low	1852.4	ε_r	52.00
			σ	1.47
9400	Middle	1880	ε_r	52.00
			σ	1.50
9538	High	1907.6	ε_r	51.90
			σ	1.52

System Check 1900 Body (Continued):
Date: 11/07/2013
Validation Dipole and Serial Number: D1900V2; SN: 537

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	1900	24.0 ºC	23.5 ºC	ε_r	53.30	52.69	-1.14	5.00
				σ	1.52	1.56	-1.39	5.00
				1g SAR	40.50	38.80	-4.20	5.00
				10g SAR	21.40	20.56	-3.93	5.00

Channel Number	Channel Description	Frequency (MHz)	Parameters	
512	Low	1850.2	ε_r	52.80
			σ	1.50
661	Middle	1880	ε_r	52.70
			σ	1.54
810	High	1909.8	ε_r	52.70
			σ	1.57

System Check 2450 Head

Date: 09/07/2013
Validation Dipole and Serial Number: D2440V2; SN: 701

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	2450	24.0 ºC	23.7 ºC	ε_r	39.20	38.47	-1.86	5.00
				σ	1.80	1.81	0.65	5.00
				1g SAR	52.30	53.60	2.49	5.00
				10g SAR	24.20	24.04	-0.66	5.00

Channel Number	Channel Description	Frequency (MHz)	Parameters	
1	Low	2412	ε_r	40.48
			σ	1.75
6	Middle	2437	ε_r	38.52
			σ	1.80
11	High	2462	ε_r	40.29
			σ	1.80

Date: 10/07/2013
Validation Dipole and Serial Number: D2440V2; SN: 701

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	2450	24.0 ºC	23.7 ºC	ε_r	39.20	38.47	-1.86	5.00
				σ	1.80	1.81	0.65	5.00
				1g SAR	52.30	52.30	-0.57	5.00
				10g SAR	24.20	23.60	-2.48	5.00

Channel Number	Channel Description	Frequency (MHz)	Parameters	
1	Low	2412	ε_r	40.48
			σ	1.75
6	Middle	2437	ε_r	38.52
			σ	1.80
11	High	2462	ε_r	40.29
			σ	1.80

System Check 2450 Body

Date: 08/07/2013
Validation Dipole and Serial Number: D2440V2; SN: 701

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	2450	24.0 ºC	22.1 ºC	ε_r	52.70	51.51	-2.26	5.00
				σ	1.95	2.00	2.82	5.00
				1g SAR	52.00	53.60	3.08	5.00
				10g SAR	24.10	24.20	0.41	5.00

Channel Number	Channel Description	Frequency (MHz)	Parameters	
1	Low	2412	ε_r	51.62
			σ	1.97
6	Middle	2437	ε_r	51.55
			σ	1.99
11	High	2462	ε_r	51.62
			σ	1.97

System Check 5200/5500/5800 Head

Date: 12/07/2013
Validation Dipole and Serial Number: D5GHzV2; SN: 1016

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	5200	24.0 ºC	23.5 ºC	ε_r	36.00	35.05	-2.69	5.00
				σ	4.66	4.69	0.74	5.00
				1g SAR	78.10	79.90	2.30	5.00
				10g SAR	23.00	22.90	2.69	5.00

Channel Number	Channel Description	Frequency (MHz)	Parameters	
48	Middle	5240	ε_r	34.96
			σ	4.76

Date: 13/07/2013
Validation Dipole and Serial Number: D5GHzV2; SN: 1016

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	5200	24.0 ºC	23.5 ºC	ε_r	36.00	35.05	-2.69	5.00
				σ	4.66	4.69	0.74	5.00
				1g SAR	78.10	76.90	-1.54	5.00
				10g SAR	23.00	23.00	0.00	5.00

Channel Number	Channel Description	Frequency (MHz)	Parameters	
48	Middle	5240	ε_r	34.96
			σ	4.76

Date: 15/07/2013
Validation Dipole and Serial Number: D5GHzV2; SN: 1016

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	5200	24.0 ºC	23.5 ºC	ε_r	36.00	36.07	0.19	5.00
				σ	4.66	4.73	1.48	5.00
				1g SAR	78.10	78.00	-0.13	5.00
				10g SAR	23.00	22.60	1.35	5.00

Channel Number	Channel Description	Frequency (MHz)	Parameters	
52	Middle	5260	ε_r	35.88
			σ	4.80

System Check 5200/5500/5800 Head (Continued):
Date: 15/07/2013
Validation Dipole and Serial Number: D5GHzV2; SN: 1016

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	5500	24.0 ºC	23.5 ºC	ε_r	35.60	35.43	-0.48	5.00
				σ	4.96	5.01	7.60	5.00
				1g SAR	82.50	86.50	4.85	5.00
				10g SAR	23.50	24.50	4.26	5.00

Channel Number	Channel Description	Frequency (MHz)	Parameters	
136	Middle	5680	ε_r	35.17
			σ	5.18

Date: 15/07/2013
Validation Dipole and Serial Number: D5GHzV2; SN: 1016

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	5800	24.0 ºC	23.5 ºC	ε_r	35.30	35.00	-0.85	5.00
				σ	5.27	5.31	0.76	5.00
				1g SAR	77.00	80.70	4.81	5.00
				10g SAR	21.90	22.80	4.11	5.00

Channel Number	Channel Description	Frequency (MHz)	Parameters	
157	Middle	5785	ε_r	35.03
			σ	5.30

System Check 5200/5500/5800 Body

Date: 13/07/2013
Validation Dipole and Serial Number: D5GHzV2; SN: 1016

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	5200	24.0 ºC	23.0 ºC	ε_r	49.00	48.10	-1.84	5.00
				σ	5.30	5.43	2.53	5.00
				1g SAR	75.10	75.00	-0.13	5.00
				10g SAR	21.10	20.90	-0.95	5.00

Channel Number	Channel Description	Frequency (MHz)	Parameters	
48	Middle	5240	ε_r	47.67
			σ	5.41

Date: 16/07/2013
Validation Dipole and Serial Number: D5GHzV2; SN: 1016

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	5200	24.0 ºC	23.0 ºC	ε_r	49.00	48.84	-0.33	5.00
				σ	5.30	5.39	1.71	5.00
				1g SAR	75.10	73.10	-2.66	5.00
				10g SAR	21.10	20.30	-3.79	5.00

Channel Number	Channel Description	Frequency (MHz)	Parameters	
38	Middle	5190	ε_r	48.83
			σ	5.39
42	Middle	5190	ε_r	48.80
			σ	5.41
52	Middle	5260	ε_r	48.65
			σ	5.48
54	Middle	5270	ε_r	48.63
			σ	5.49
58	Middle	5290	ε_r	48.58
			σ	5.53

System Check 5200/5500/5800 Body (Continued):

Date: 16/07/2013
Validation Dipole and Serial Number: D5GHzV2; SN: 1016

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	5500	24.0 ºC	23.0 ºC	ε_r	48.60	48.21	-0.80	5.00
				σ	5.65	5.77	2.16	5.00
				1g SAR	79.00	81.40	3.04	5.00
				10g SAR	22.00	22.50	2.27	5.00

Channel Number	Channel Description	Frequency (MHz)	Parameters	
106	Middle	5530	ε_r	48.21
			σ	5.81
134	Middle	5670	ε_r	48.03
			σ	5.98
136	Middle	5680	ε_r	47.99
			σ	5.99

Date: 16/07/2013
Validation Dipole and Serial Number: D5GHzV2; SN: 1016

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	5800	24.0 ºC	23.0 ºC	ε_r	48.20	47.81	-0.81	5.00
				σ	6.00	6.14	2.41	5.00
				1g SAR	74.40	74.60	0.27	5.00
				10g SAR	20.60	20.50	-0.49	5.00

Channel Number	Channel Description	Frequency (MHz)	Parameters	
155	Middle	5775	ε_r	47.88
			σ	6.14
157	Middle	5785	ε_r	47.85
			σ	6.14
159	Middle	5795	ε_r	47.83
			σ	6.15

Appendix 6. Simulated Tissues

The body mixture consists of water, Polysorbate (Tween 20) and salt. Visual inspection is made to ensure air bubbles are not trapped during the mixing process. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the tissue.

Ingredient (% by weight)	Frequency 750/835/850/900 MHz	
	Head	Body
De-Ionized Water	52.87	71.30
Polysorbate 20	46.10	28.00
Salt	1.03	0.70

Ingredient (% by weight)	Frequency 1800/1900 MHz	
	Head	Body
De-Ionized Water	55.40	71.50
Polysorbate 20	44.22	28.00
Salt	0.38	0.50

Ingredient (% by weight)	Frequency 2450/2600 MHz	
	Head	Body
De-Ionized Water	55.75(1)	71.70
Polysorbate 20	45.25(1)	28.00
Salt	0.00	0.30

Stimulating Liquid for 3700 MHz to 5800 MHz are supplied and manufactured by SPEAG

Ingredient (% by weight)	Frequency
	3700 - 5800 MHz Head / Body
De-Ionized Water	~78.00
Mineral Oil	~11.00
Emulsifiers	~9.00
Additives and Salt	~2.00

Note(s):

1. As per the recipe provided by National Physical Laboratory, the 2450 MHz Head Fluid reciepe is mixed to the total percentage of weight is by 101.0 %.

Appendix 7. DASY4 System Details

A.7.1. DASY4 SAR Measurement System

UL, SAR measurement facility utilises the Dosimetric Assessment System (DASY™) manufactured by Schmid & Partner Engineering AG (SPEAG™) of Zurich, Switzerland. The DASY4 system is comprised of the robot controller, computer, near-field probe, probe alignment sensor, and the SAM phantom containing brain or muscle equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF). A cell controller system contains the power supply, robot controller; teach pendant (Joystick), and remote control. This is used to drive the robot motors. The Staubli robot is connected to the cell controller to allow software manipulation of the robot. The data acquisition electronics (DAE) performs signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection etc. The DAE is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card. The DAE3 utilises a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching mulitplexer, a fast 16-bit AD-converter and a command decoder and control logic unit. Transmission to the PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe-mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer.

A.7.2. DASY4 SAR System Specifications

Robot System	
Positioner:	Stäubli Unimation Corp. Robot Model: RX90L
Repeatability:	0.025 mm
No. of Axis:	6
Serial Number:	F00/SD89A1/A/01
Reach:	1185 mm
Payload:	3.5 kg
Control Unit:	CS7
Programming Language:	V+
Robot System	
Positioner:	Stäubli Unimation Corp. Robot Model: RX90L
Repeatability:	0.025 mm
No. of Axis:	6
Serial Number:	F01/5J86A1/A/01
Reach:	1185 mm
Payload:	3.5 kg
Control Unit:	CS7
Programming Language:	V+
Robot System	
Positioner:	Stäubli Unimation Corp. Robot Model: TX60L
Repeatability:	±0.030 mm
No. of Axis:	6
Serial Number:	F12/5MZ7A1/A/01
Reach:	920 mm
Payload:	2.0 kg
Control Unit:	CS8C
Programming Language:	V+
Data Acquisition Electronic (DAE) System	
Serial Number:	DAE3 SN:417
Serial Number:	DAE3 SN:431
Serial Number:	DAE3 SN:450

DASY4 SAR System Specifications (Continued) PC Controller	
PC:	Dell Precision 340
Operating System:	Windows 2000
Data Card:	DASY Measurement Server
Serial Number:	1080
Data Converter	
Features:	Signal Amplifier, multiplexer, A/D converted and control logic.
Software:	DASY Software
Connecting Lines:	Optical downlink for data and status info. Optical uplink for commands and clock.
PC Interface Card	
Function:	24 bit (64 MHz) DSP for real time processing Link to DAE3 16 nit A/D converter for surface detection system serial link to robot direct emergency stop output for robot.
E-Field Probe	
Model:	EX3DV4
Serial No:	3814
Construction:	Triangular core
Frequency:	10 MHz to >6 GHz
Linearity:	±0.2 dB (30 MHz to 6 GHz)
Probe Length (mm):	337
Probe Diameter (mm):	10
Tip Length (mm):	9
Tip Diameter (mm):	2.5
Sensor X Offset (mm):	1
Sensor Y Offset (mm):	1
Sensor Z Offset (mm):	1
E-Field Probe	
Model:	ES3DV3
Serial No:	3304
Construction:	Triangular core
Frequency:	10 MHz to >4 GHz
Linearity:	±0.2 dB (30 MHz to 4 GHz)
Probe Length (mm):	337
Probe Diameter (mm):	10
Tip Length (mm):	10
Tip Diameter (mm):	4
Sensor X Offset (mm):	2
Sensor Y Offset (mm):	2
Sensor Z Offset (mm):	2

DASY4 SAR System Specifications (Continued)	
E-Field Probe	
Model:	ET3DV6
Serial No:	1528;1529
Construction:	Triangular core
Frequency:	10 MHz to 2.55GHz
Linearity:	±0.2 dB (30 MHz to 2.55GHz)
Probe Length (mm):	337
Probe Diameter (mm):	10
Tip Length (mm):	10
Tip Diameter (mm):	6.8
Sensor X Offset (mm):	2.7
Sensor Y Offset (mm):	2.7
Sensor Z Offset (mm):	2.7
Phantom	
Phantom:	SAM Phantom, Eli Phantom
Shell Material:	Fibreglass
Thickness:	2.0 ±0.1 mm

Appendix 8. 3G Test set-up

3G (12.K RMC / HSDPA / HSUPA) setup

To switch from 2G to 3G, on the system config screen choose Format Switch and select WCDMA. The Call Setup Screen as shown in figure 1 pops up.

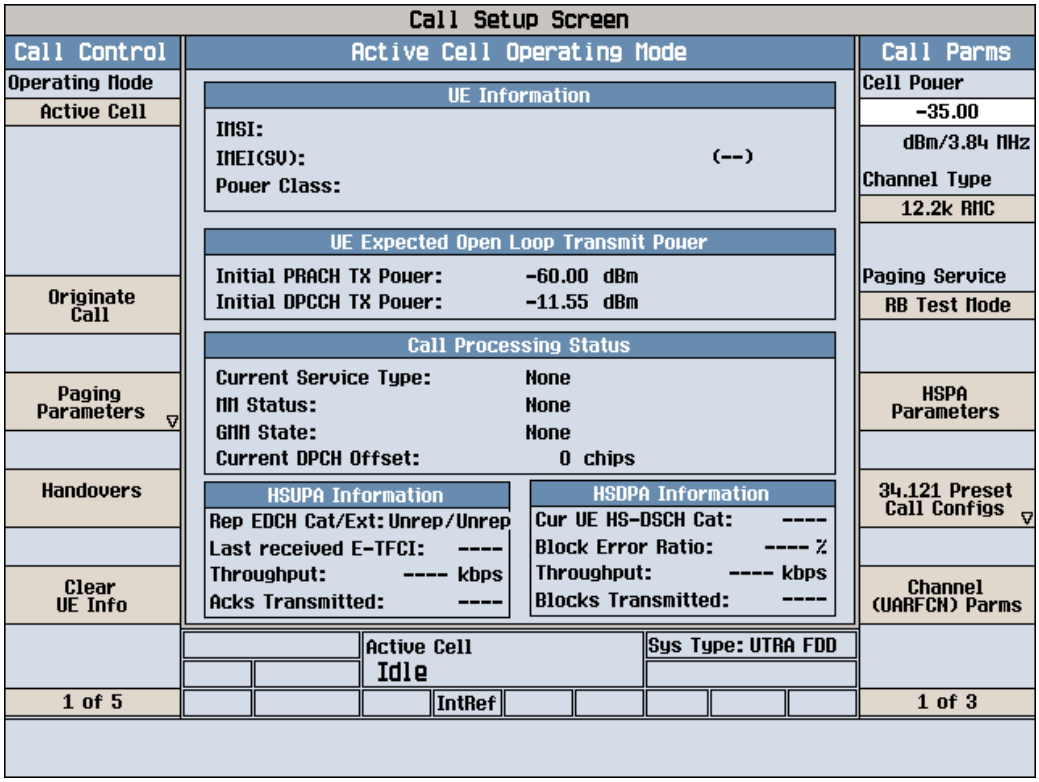


Figure 1: 3G Call Setup Screen

For a 12.2k RMC call follow the steps below.

8.1. Steps for 12.2k RMC

1. Ensure that the Operating Mode of the cell is off before setting up the instrument.
2. On the Call Setup Screen, under Call Parameters, press the button against Cell Power. The Cell Power value is set to about -35dBm to account for all the losses and ensure sufficient signal strength to the EUT.
3. The Channel Type is selected to 12.2k RMC. Press button against Channel (VARFCN) Parms select the correct Downlink Channel for the required UMTS FDD Band.
4. On the Call Setup Screen, under Call Parameters, press the button against HSPA Parameters. Under HSDPA Parameters on page 1, press HSDPA Uplink parameters and set the Delta ACK, Delta NACK, Delta CQI values to 8. Under HSDPA Parms itself, press HSDPA RB Test Mode Setup button and then the HSDPA RB Test Mode Settings and change HS-DSCH Data Pattern to All Ones.

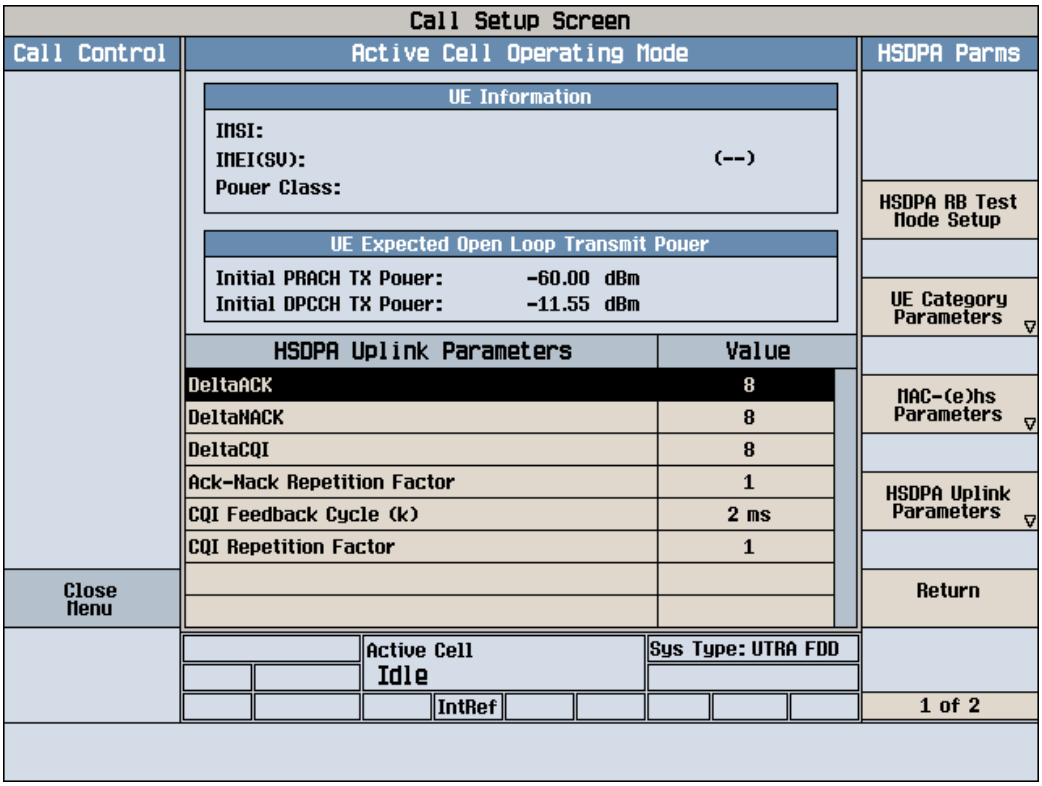


Figure 2: HSDPA Parameters

5. On the Call Setup Screen, under Call Parameters, on page 2, check if the DL DTCH Data is set to All Ones. On page 3, ensure that the Receiver is set to Manual. On page 3 itself, under UL CL Power Ctrl Parameters, UL CL Power Ctrl Mode is set to All Up Bits.

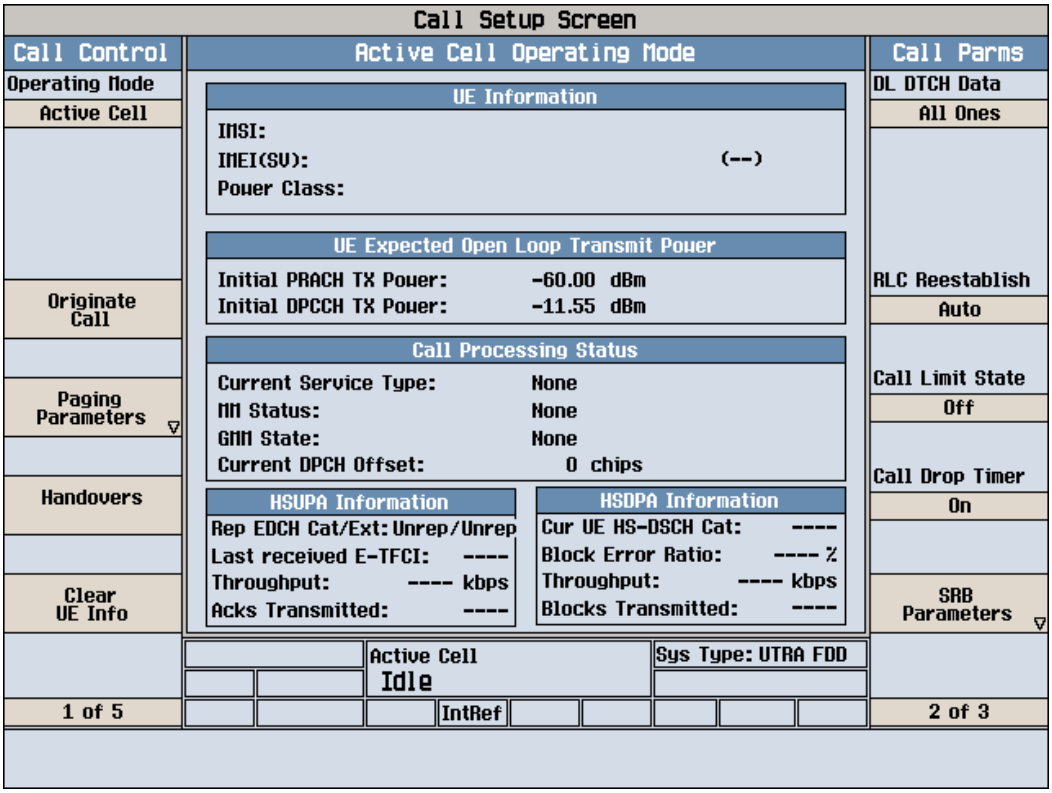


Figure 3: DL DTCH Data Parms

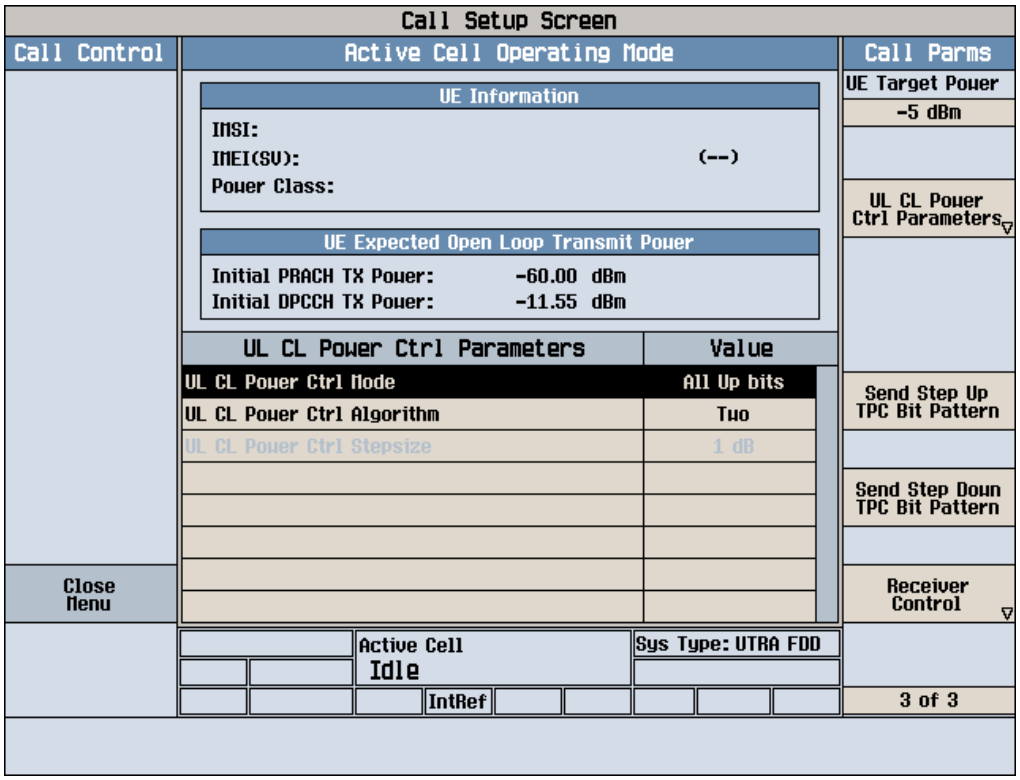


Figure 4: UL CL Power Ctrl Parameters

6. On the Call Setup Screen, under Call Control, page 2, Cell Parameters, it is ensured that PS Domain information is kept as Absent for RMC.

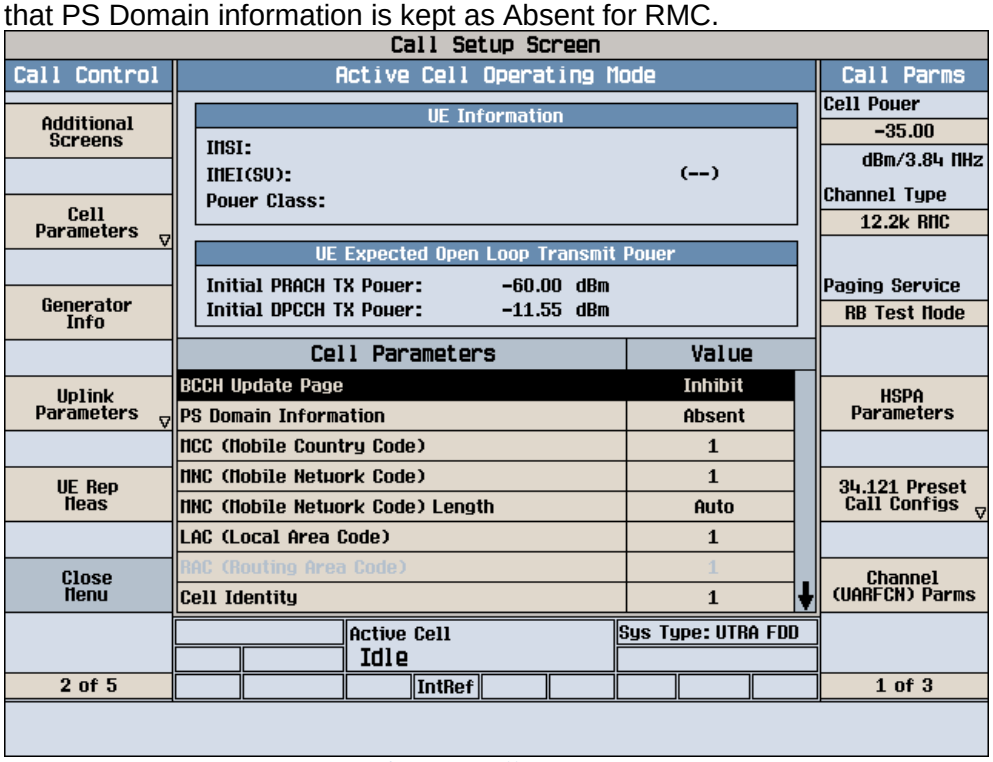


Figure 5: Cell Parameters

7. On the same page under Uplink Parameters the maximum Uplink Transmit Power is made 24dBm. Uplink DPCH Bc/Bd Control Settings are kept at Auto for RMC. These vary according for HSDPA and HSUPA as per the values given in KDB 941225 D01 SAR test for 3G devices v02.

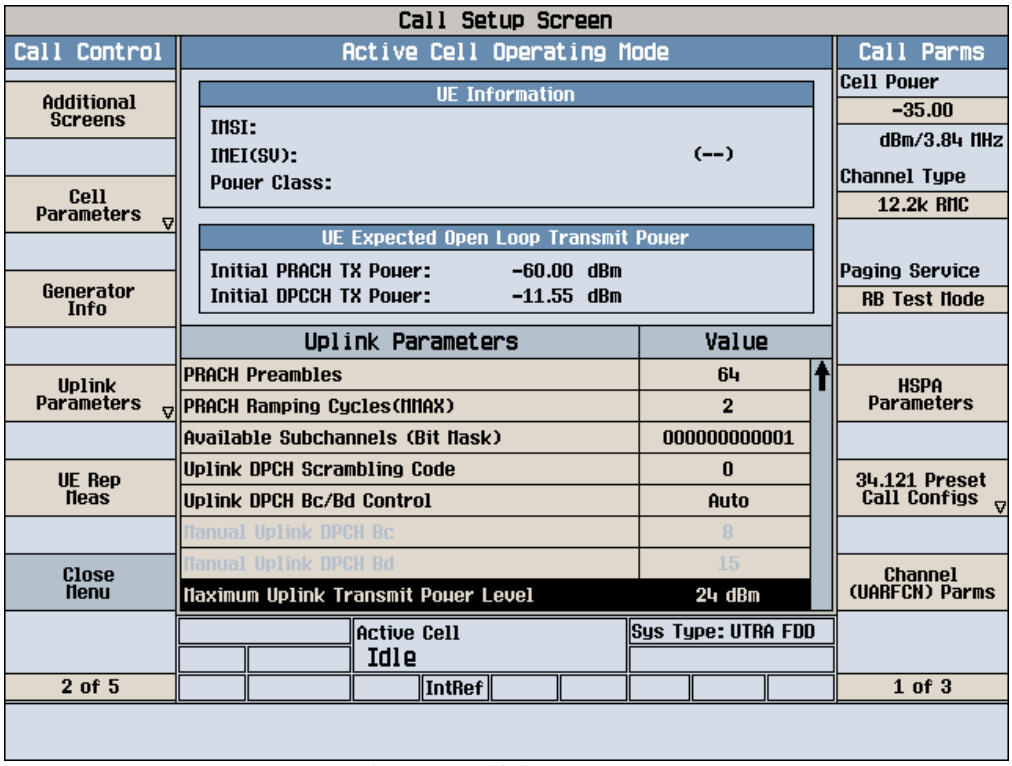


Figure 6: Uplink Parameters

8. On page 3 under Call Control, for the RB Test Mode setup, Asymmetric RMC CN Domain is ensured to be in CS Domain for RMC call.

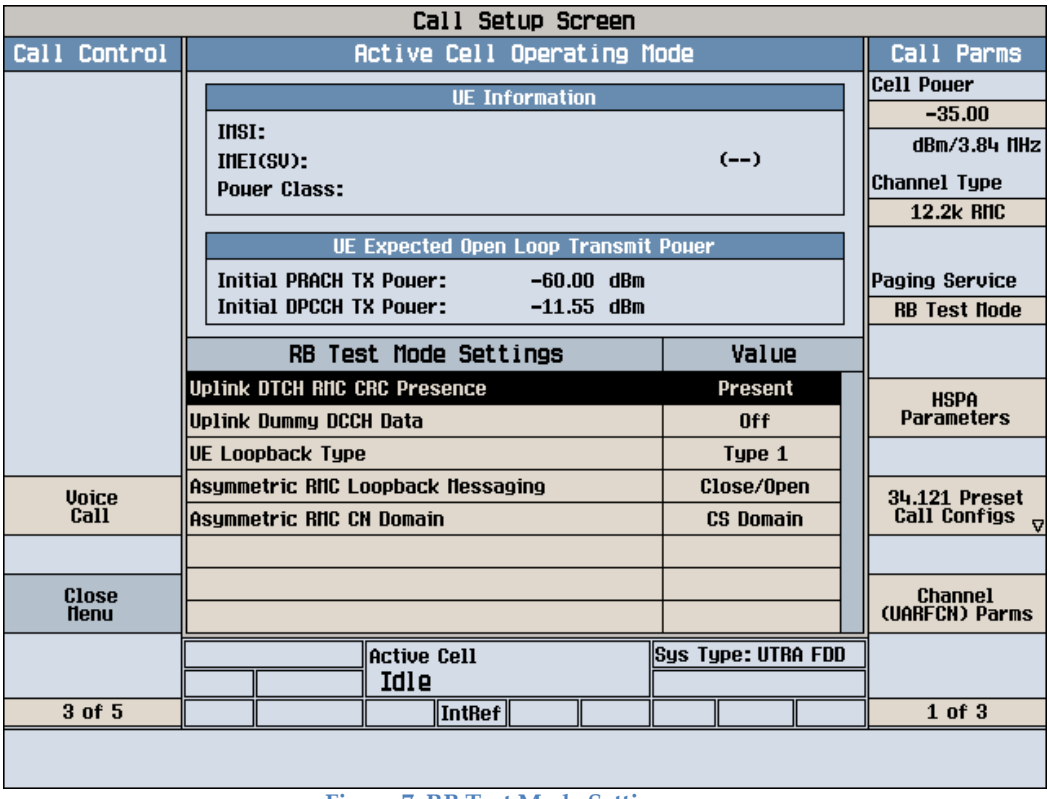


Figure 7: RB Test Mode Settings

9. After the test set has been set up, change the cell Operating Mode to Active Cell and originate a call.

8.2. Steps for 12.2k RMC + HSDPA/HSUPA

1. Most of the steps to be followed are as in the case of 12.2k RMC however, some of the settings need to be changed. The Channel Type is changed to 12.2k RMC+HSDPA or 12.2k RMC+HSUPA as required.
2. For HSDPA and HSUPA, the settings remain same as the case for RMC but the PS Domain is made Present for Cell Parameters (Figure 5) and RB Test Mode Setup (Figure 7).
3. The following tables taken from FCC 3G SAR procedures (KDB 941225 D01 SAR test for 3G devices v02) below were applied to the Agilent 8960 series 10 wireless communications test set which supports 3G / HSDPA release 5 / HSUPA release 6.

Sub-test 1 Setup for Release 5 HSDPA

Sub-test	β_c	β_d	B_d *(SF)*	β_c/β_d	β_{hs} (1)	SM (dB) (2)
1	2/15	15/15	64	2/15	4/15	0.0
2	12/15 (3)	15/15 (3)	64	12/15 (3)	24/15	1.0
3	15/15	8/15	64	15/8	30/15	1.5
4	15/15	4/15	64	15/4	30/15	1.5

Note 1: Δ_{ACK}, Δ_{NACK} and $\Delta_{CQI} = 8 \Leftrightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15 \Leftrightarrow \beta_{hs} = 30/15 * \beta_c$

Note 2: CM = 1 for β_c/β_d = 12/15, B_{hs}/β_c = 24/15

Note 3: For subtest 2 the β_c/β_d ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to β_c = 11/15 and β_d = 15/15

Sub-test 5 Setup for Release 6 HSUPA

Sub-test	β_c	β_d	B_d *(SF)*	β_c/β_d	β_{hs} (1)	B_{oc}	B_{od}	B_{od} *(SF)*	B_{od} *(codes)*	CM (2) (dB)	MPR (dB)	AG (4) Index	E-TFCI
1	11/15 (3)	15/15 (3)	64	11/15 (3)	22/15	209/225	1039/225	4	1	1.0	0.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	31/15	B_{al1}: 47/15 B_{al2}: 47/15	4	1	2.0	1.0	15	92
4	2/15	15/15	64	2/15	2/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15 (4)	15/15 (4)	64	15/15 (4)	24/15	24/15	134/15	4	1	1.0	0.0	21	81

Note 1: Δ_{ACK}, Δ_{NACK} and $\Delta_{CQI} = 8 \Leftrightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15 \Leftrightarrow \beta_{hs} = 30/15 * \beta_c$

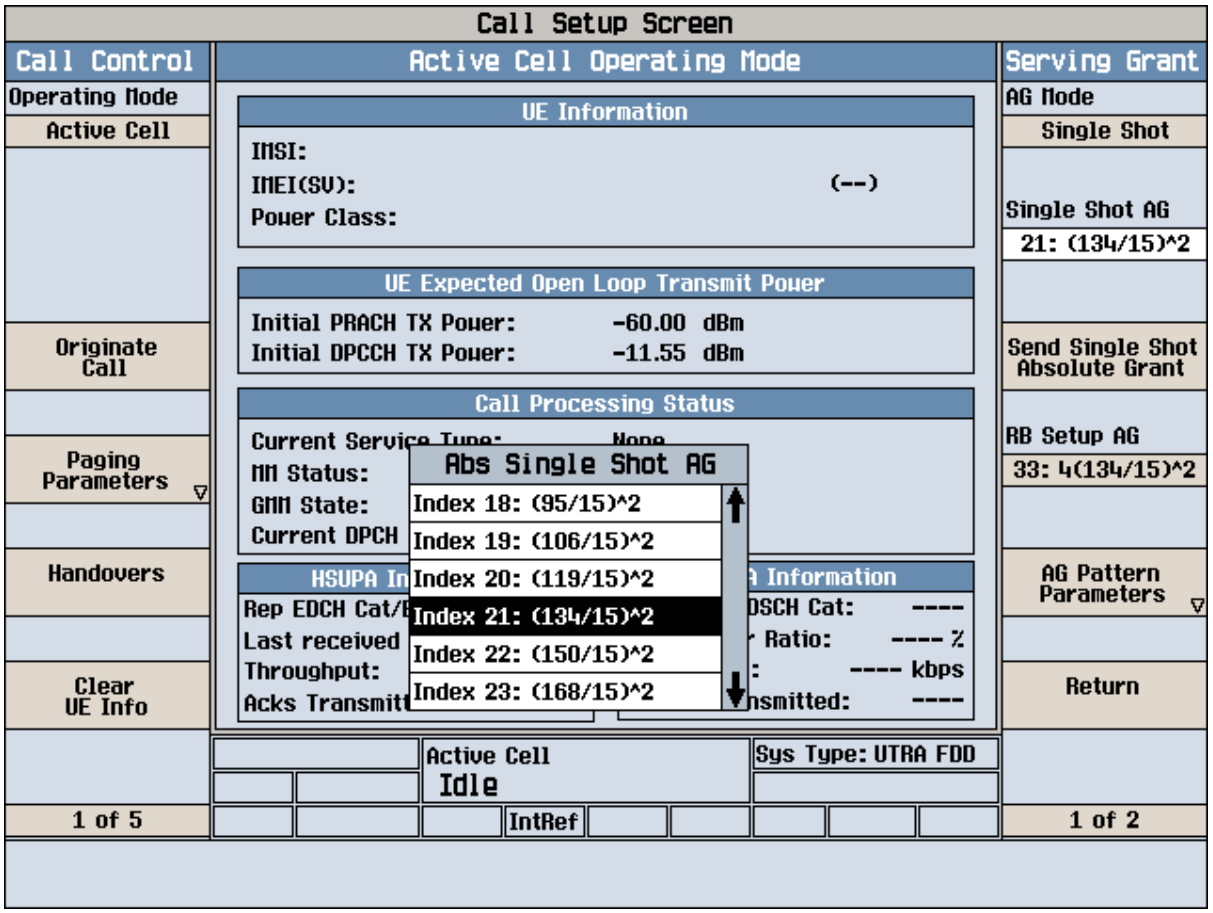
Note 2: CM = 1 for β_c/β_d = 12/15, B_{hs}/β_c = 24/15. For all other combinations of DPDCH, DPCCH, HS-DPCCH, E-DPDCH AND E-DPCCH for the MPR is based on the relative CM difference.

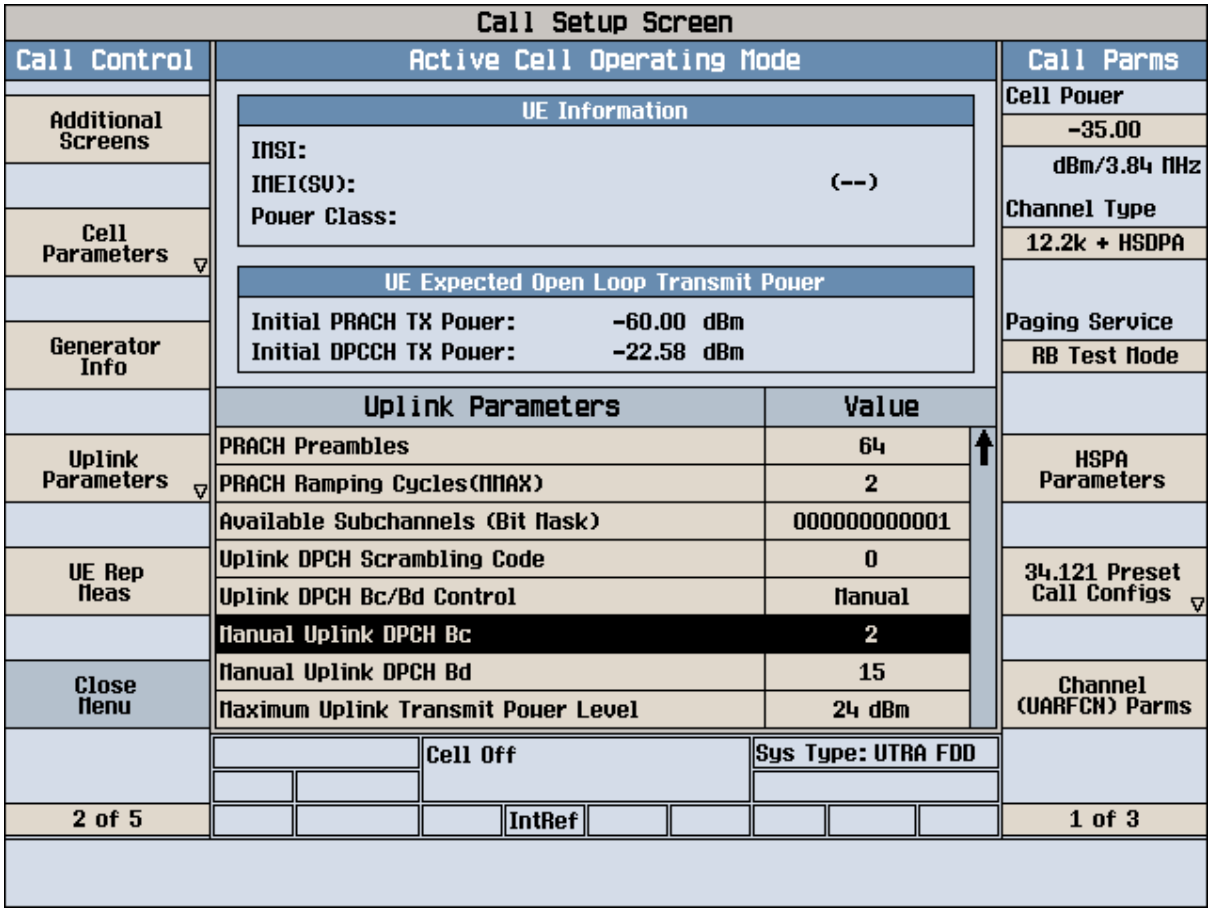
Note 3: For subtest 1 the β_c/β_d ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to β_c = 10/15 and β_d = 15/15.

Note 4: For subtest 5 the β_c/β_d ratio of 15/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to β_c = 14/15 and β_d = 15/15.

Note 5: Testing UE using E-DPDCH Physical Layer category 1 Sub-test 3 is not required according to TS 25.306 Tavle 5.1g.

Note 6: B_{od} can not be set directly; it is set by Absolute Grant Value.


Call Setup Screen
Call Control
Active Cell Operating Mode
Serving Grant
Operating Mode
Active Cell
UE Information
IMSI:
IMEI(SV): (--)
Power Class:
AG Mode
Single Shot
Single Shot AG
21: (134/15)^2
UE Expected Open Loop Transmit Power
Initial PRACH TX Power: -60.00 dBm
Initial DPCCH TX Power: -11.55 dBm
Originate Call
Send Single Shot Absolute Grant
Call Processing Status
Paging Parameters
RB Setup AG
33: 4(134/15)^2
Abs Single Shot AG
Index 18: (95/15)^2
Index 19: (106/15)^2
Index 20: (119/15)^2
Index 21: (134/15)^2
Index 22: (150/15)^2
Index 23: (168/15)^2
Handovers
AG Pattern Parameters
Clear UE Info
Return
Active Cell
Idle
Sys Type: UTRA FDD
1 of 5
IntRef
1 of 2


Call Setup Screen
Call Control
Active Cell Operating Mode
Call Parms
Additional Screens
UE Information
IMSI:
IMEI(SV): (--)
Power Class:
Cell Power
-35.00
dBm/3.84 MHz
Channel Type
12.2k + HSDPA
Cell Parameters
UE Expected Open Loop Transmit Power
Initial PRACH TX Power: -60.00 dBm
Initial DPCCH TX Power: -22.58 dBm
Generator Info
Paging Service
RB Test Mode
Uplink Parameters
Value
PRACH Preambles 64
PRACH Ramping Cycles(MMAX) 2
Available Subchannels (Bit Mask) 000000000001
Uplink DPCH Scrambling Code 0
Uplink DPCH Bc/Bd Control Manual
Manual Uplink DPCH Bc 2
Manual Uplink DPCH Bd 15
Maximum Uplink Transmit Power Level 24 dBm
HSPA Parameters
UE Rep Meas
34.121 Preset Call Configs
Close Menu
Channel (UARFCN) Parms
Cell Off
Sys Type: UTRA FDD
2 of 5
IntRef
1 of 3

4. For HSUPA the Serving Grant Parameter needs to be set. On the Call Setup Screen, under Call Parameters, press the button against HSPA Parameters. On the new screen that pops up, press HSUPA and Serving Grant. The Serving Grant is set according to the table for HSPA in the KDB (AG Index). The correct AG is chosen from the Single Shot AG. Consecutively, the RG Setup AG is set as per the ratio set on Single Shot AG.

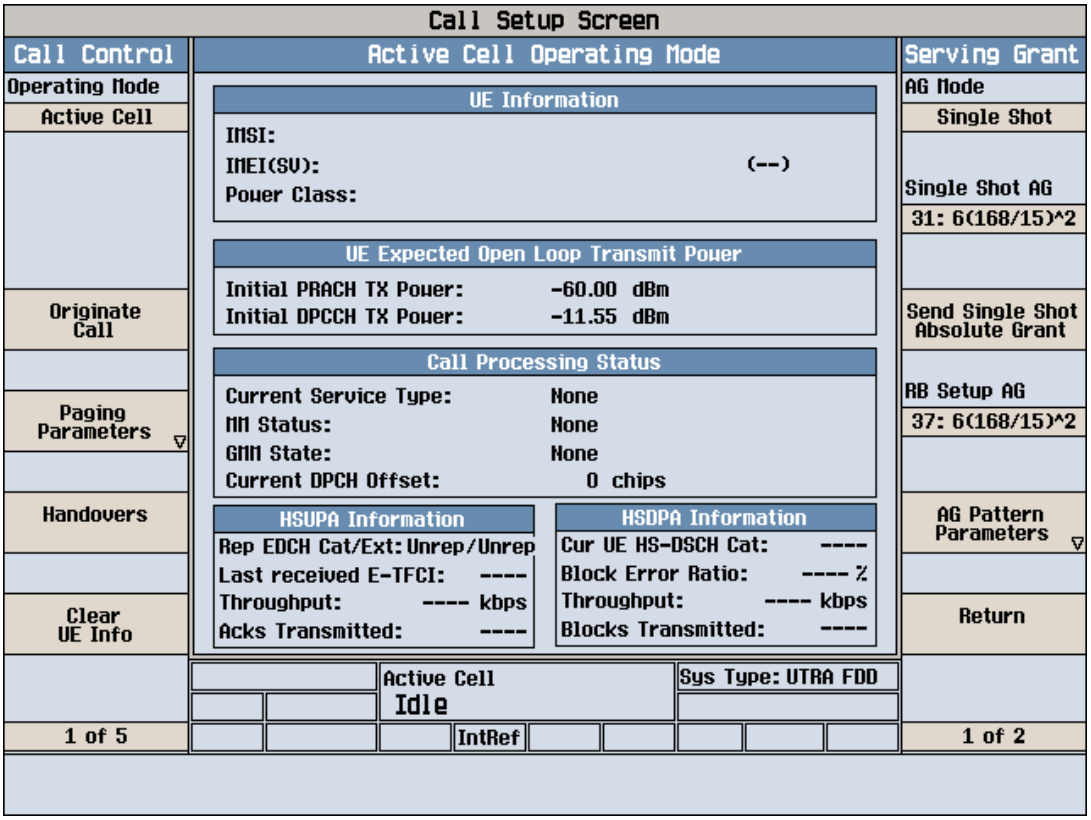


Figure 8: Serving Grant Example

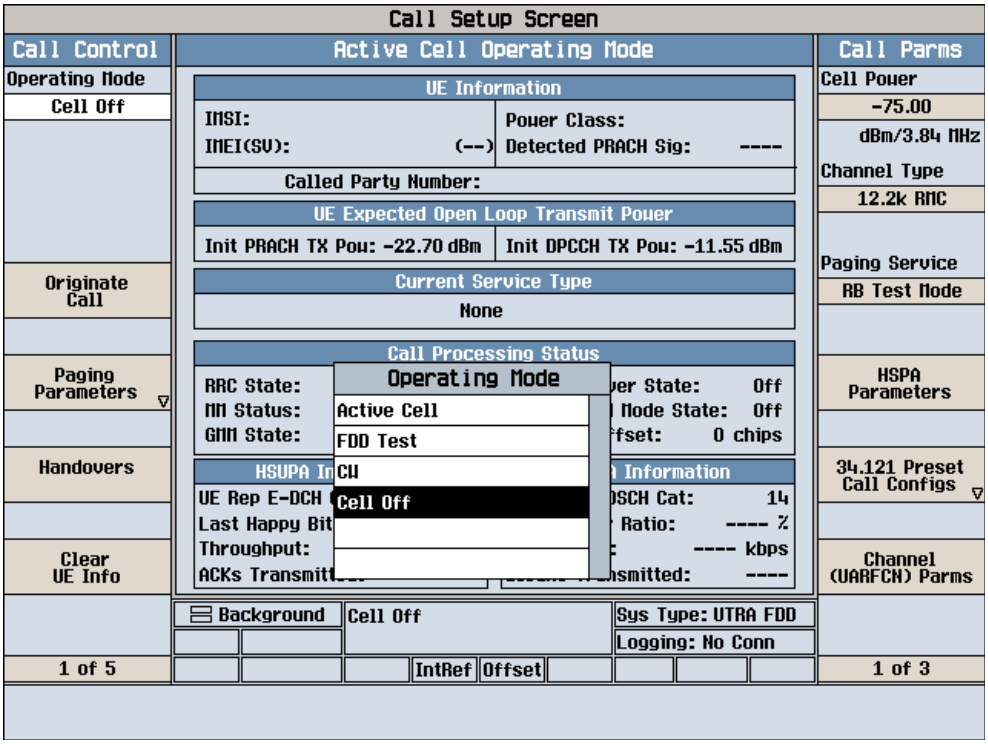
Appendix 9. CAT24 Test set-up

A.9.1. Establish a DC-HSDPA RB Test Mode Connection with DL 42Mbps

RB (radio bearer) test mode is a special, defined-channel configuration designed to simplify the testing environment. Since W-CDMA is an incredibly flexible system, defined radio bearers, called RMCs (reference measurement channels) simplify which configurations need to be tested for RF performance.
RB test mode provides the ability to set up a standalone channel configuration originating from the 8960 via call-processing. The direction of the call setup is always from the 8960 to the UE. This is the typical RF test that is used throughout the lifecycle of a device's design process. Using RB test mode is attractive to device manufacturers because it does not require extra software to control the UE. In this type of call connection, the radio bearer (within the 8960) essentially controls the UE during test.

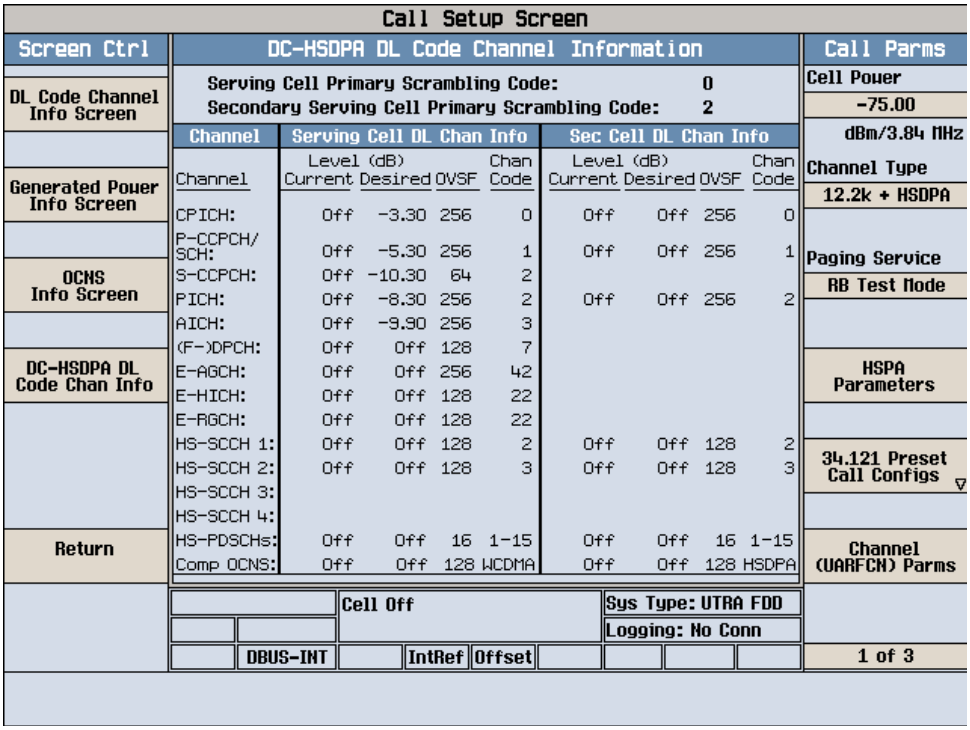
A.9.1.1 Configure 8960

1. Press **Operating Mode** (**F1**), select **Cell Off** operating mode.



2. Set the **Channel type** to **12.2k + HSDPA**.

3. Set the downlink channel code. In order to achieve the 42 Mbps maximum downlink throughput, you have to set up 15 HS-PDSCHs which will possibly cause a code collision.
To easily configure the downlink 15 HS-PDSCH for a maximum throughput, use the code preset to configure the code channels for both the serving cell and the secondary serving cell.
Select **Call Control 2 of 6**-> **Generator Info (F3)** -> **Downlink Channel Configs (F4)** -> **DL Chan code Preset Configs (F5)**, choose **34.121 Tables E.6.2.3,4 (HSDPA 15 HS-PDSCHs).**
Set the **Conn S-CCPCH Cfg** to **Off** to avoid the code collision.
To see the channel code allocation for the serving cell and the secondary serving cell, select **Additional Gen Info Screens (F1) -> DC-HSDPA DL Code Chan Info (F4).**



4. Configure DC-HSDPA parameters to achieve the Maximum Downlink Data Rate:
First of all, you must know the maximum data rate of the device under test according to its category and the key factors to achieve the maximum date rate. In this lab, you use a category 24 device whose maximum data rate is 42 Mbps when DC-HSDPA is configured.
a) Set up the HSDPA RB Test Mode Parameters

*Path: Call Parms 1 of 3 -> HSPA Parameters (**F10**) -> HSDPA Parameters (**F10**) -> HSDPA RB Test Mode Setup (**F8**) -> HSDPA RB Test Mode Settings (**F8**).*

- **RB Test HS-DSCH Configuration Type** = **User Defined**
- **RB Test User Defined HS-DSCH MAC entity** = **MAC-ehs** (Note 1)
- **RB Test User Defined HARQ Processes** = **6** (Note 2)
- **RB Test User Defined UE IR Buffer Allocation** = **Implicit**
- **RB Test User Defined DC-HSDPA State** = **On**
- **RB Test Mode DC-HSDPA DPCH Loopback State** = **On**

Note 1: DC-HSDPA requires MAC-ehs. You must set the MAC entity to MAC-ehs before setting the DC-HSDPA state)
Note 2: To restrict the amount of soft memory that can be allocated to a single HARQ process (and thus limit the amount of data that has to be transferred across the UE"s internal data buses) the specifications require that when setting up a DC-HSDPA call with the implicit HARQ memory partitioning the network must configure 6, 7, or 8 HARQ processes per cell. For the explicit HARQ memory partitioning case, the number of HARQ processes can be 1 through 8, but the memory size for each HARQ process cannot be greater than the number of soft channel bits for an implicit memory partitioning with 6 processes per HS-DSCH channel.
b) Set up the Serving Cell Parameters

Path: **F10**

- **RB Test User Defined 64QAM State** =**On**
- **RB Test User Defined Active HS-PDSCHs** =**15**
- **RB Test User Def Transport Block Size Index** =**62**
- **RB Test User Defined Modulation Type** =**64QAM**
- **RB Test User Defined Inter-TTI Interval** =**1**

c) Set up the Secondary Serving Cell Parameters
Path: **F11**

- **RB Test User Def Secondary Cell 64QAM State** =**On**
- **RBTM User Def Sec Cell Active HS-PDSCHs** = **15**
- **RBTM User Def Sec Cell TB Size Index** = **62**
- **RBTM User Def Sec Cell Modulation Type** =**64QAM**
- **RBTM User Def Sec Cell Inter-TTI Interval** = **1**

d) Set the **Secondary Serving Cell Power (dBm/3.84 MHz)** to **-25 dBm/3.84 MHz**

*Path: Return (**F12**) -> HSDPA Parms 2 of 2 -> Secondary Serv Cell Parms (**F10**)*
e) Set the **Cell power** to **-25 dBm/3.84 MHz**

*Path: CALL SETUP -> **F7***
f) Set the HSDPA Conn DL Channel Levels

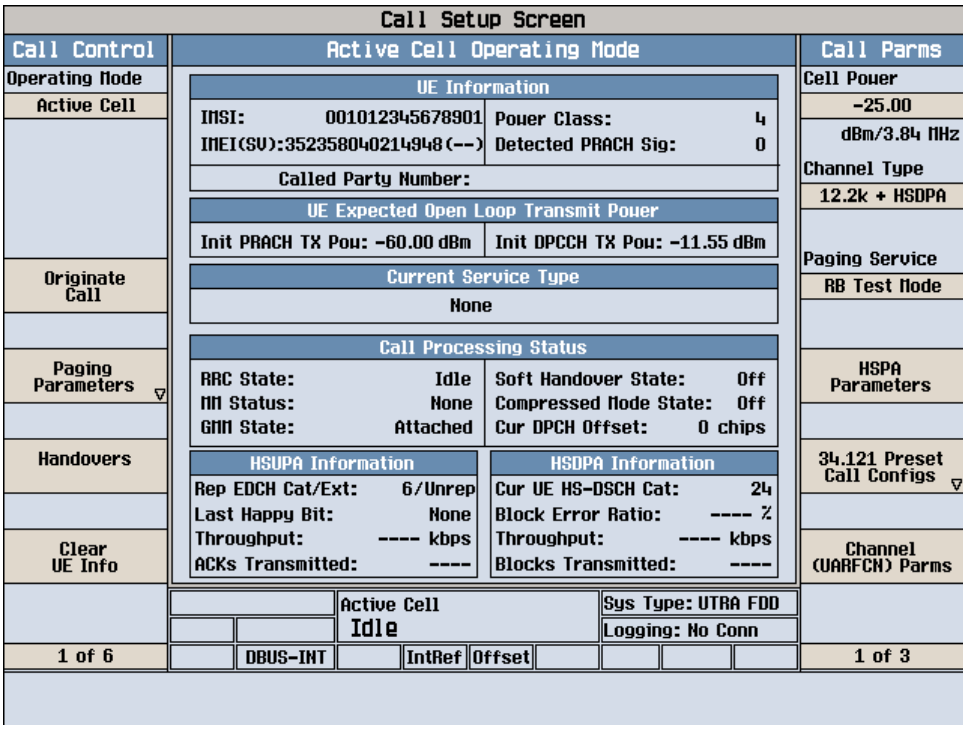
*Path: CALL SETUP -> Call Control 2 of 6 -> Generator Info (**F3**) ->Downlink Channel Levels (**F3**) -> Connected DL Channel Levels (**F3**) -> **F3***

- **HSDPA Cell 1 Connected CPICH Level** = **-8**
- **HSDPA Cell 1 Connected P-CCPCH/SCH Level** = **-20**
- **HSDPA Cell 1 Connected PICH Level** = **off**
- **HSDPA Cell 1 Connected DPCH Level** = **-30**
- **HSDPA Cell 1 Connected HS-PDSCH Level (Sum)** = **-1 dBm**
- **HSDPA Cell 1 Connected HS-SCCH 1 to 4 Level** = **-20,-20,off,off**
- **Secondary Cell HSDPA Conn CPICH Level** = **-8**
- **Secondary Cell HSDPA Conn PCCPCH/SCH Level** = **-20**
- **Secondary Cell HSDPA Conn PICH Level** = **off**
- **Secondary Cell HSDPA Conn HS-PDSCHs Lvl (Sum)** = **-1 dBm**
- **Secondary Cell HSDPA Conn HS-SCCH 1 to 4 Level** = **-20,-20,off,off**

5. Set the **Operating Mode** (**F1**) to **Active Cell**.

A.9.1.2. Power on the UE and Set up the Connection

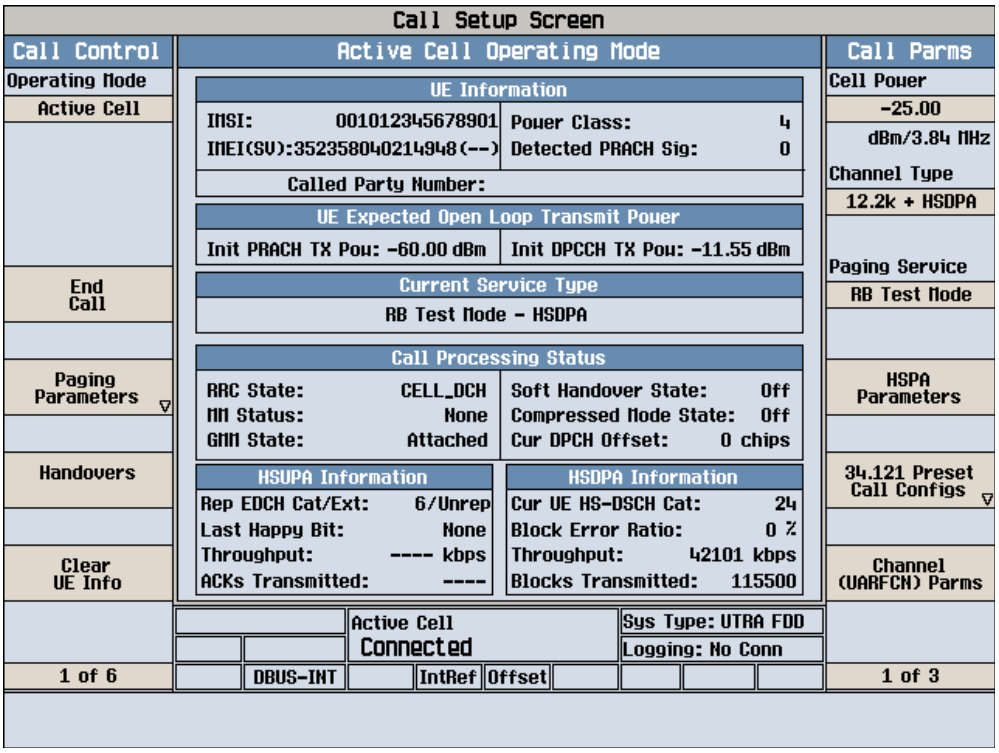
Power on the device, and then wait for it to camp on 8960. You should be able to see the following screen.



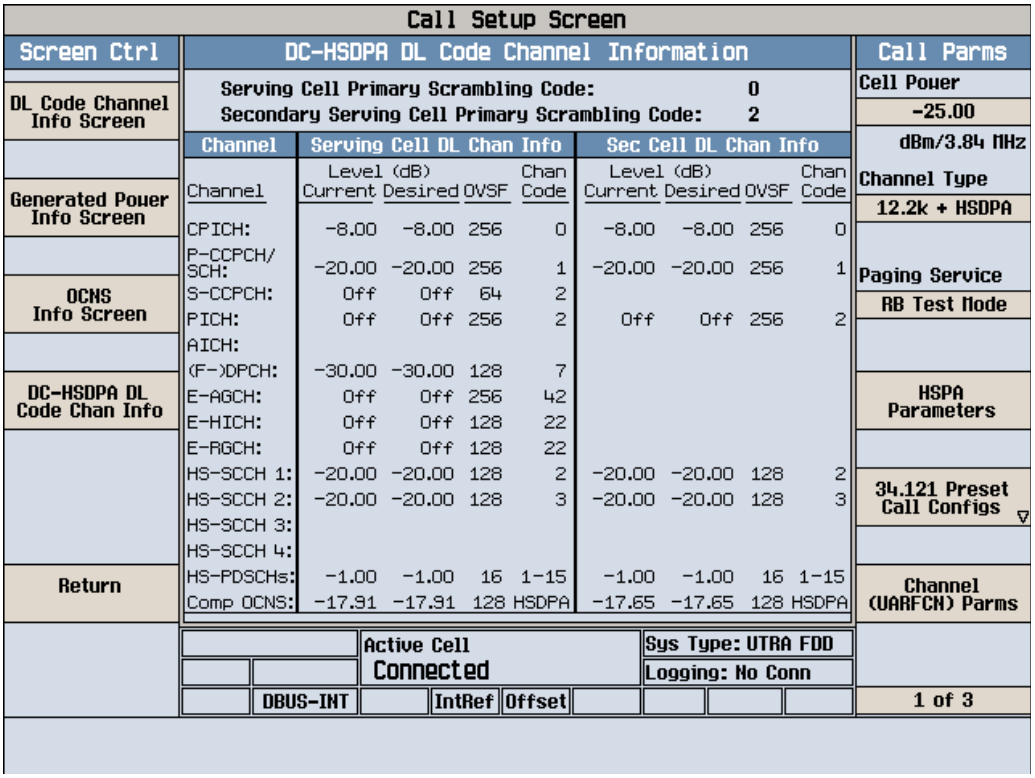
The UE reports HSDPA categories to 8960, which represents its maximum data rate capability. DC-HSDPA requires UE categories 21 to 24.
The GMM state must be **Attached**, otherwise you cannot establish a HSDPA connection.
2. Originate the Connection

a) Now, Originate an RB Test call with DC-HSDPA by pressing „**F3**" from the main Call Setup screen.

b) After a connection is set up, you will be able to see the throughput from the HSDPA Information window. Press the **Measurement Reset** key to reset the calculation.



Now you can also check the connected DC-HSDPA downlink channel levels.
*Path: CALL SETUP->Call Control 2 of 6 -> Generator Info (**F3**) -> Additional Gen Info Screens (**F1**) ->DC-HSDPA DL Code Chan Info (**F4**).*



A.9.2. Activate/ Deactivate the Secondary Serving Cell

Once a DC-HSDPA connection is established, 8960 can control the UE to start or stop monitoring the secondary serving cell using HS-SCCH orders. The HS-SCCH orders can be sent on either the serving or secondary serving cell.

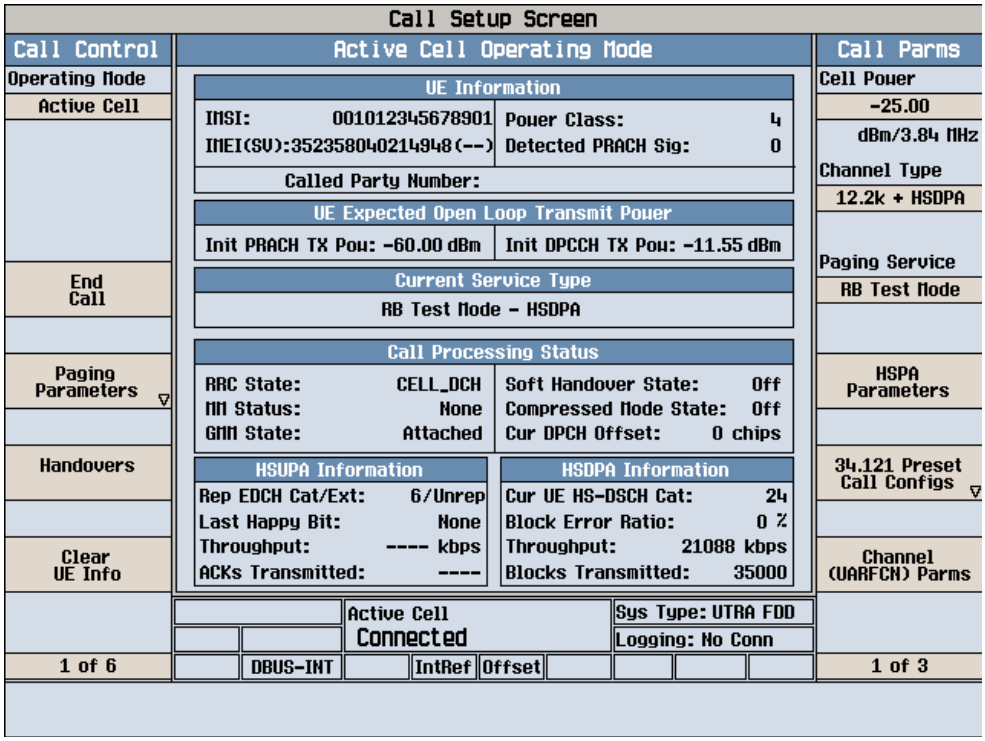
A.9.2.1 Deactivate the Secondary Serving Cell

1. Setup the Deactivate Secondary Cell Parameter

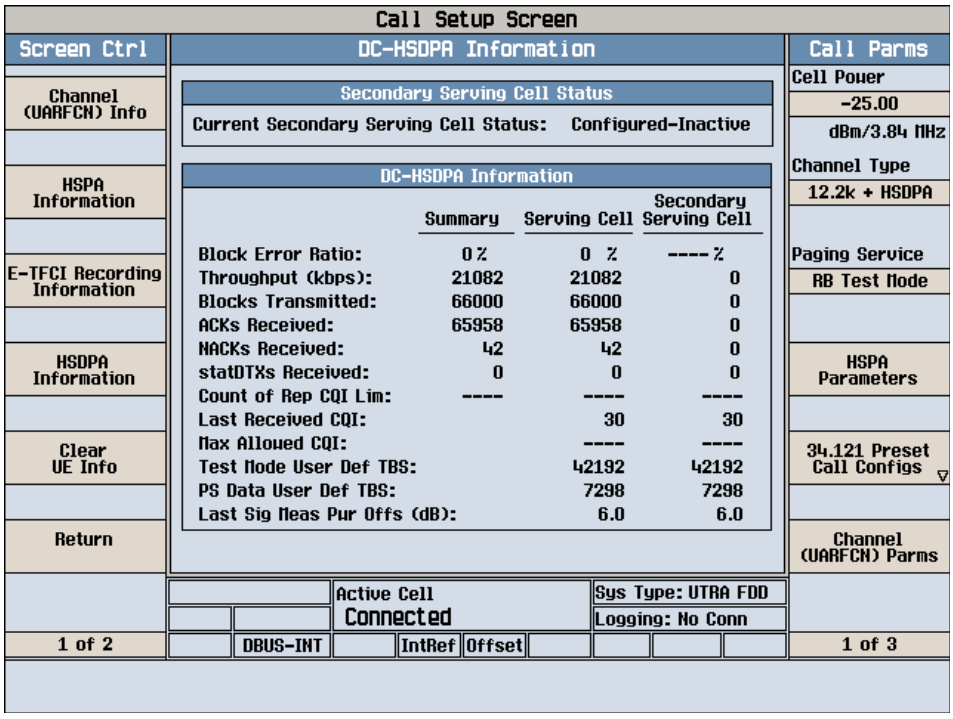
*Path: CALL SETUP->Call Control 6 of 6 -> HS-SCCH Order (**F3**) -> Deactivate Secondary Cell (**F2**)*
In this lab you set it to deactivate the secondary serving cell from the serving cell.

- **Deactivate Secondary Cell HS-SCCH Order From** = **Serving Cell**

Press **Send Deactivate Secondary Cell** (**F5**)
Press Measurement Reset key and see the throughput has dropped to 21 Mbps or so, like the figure below:

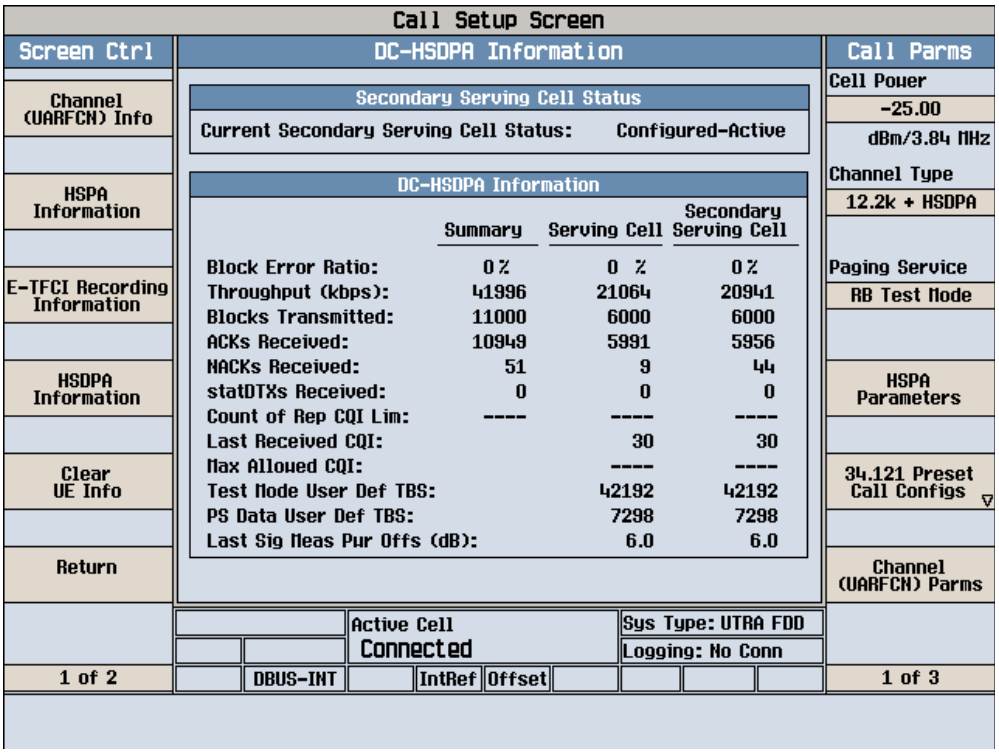


You can see more on the DC-HSDPA Information screen.
Path: *CALL SETUP->Call Control 2 of 6 -> Additional Screens (**F1**) -> HSDPA Information (**F4**) -> DC-HSDPA Information (**F4**).*



A.9.2.2 Re-activate the Secondary Serving Cell

Now you can activate the secondary serving cell by pressing back to the HS-SCCH Order menu.
*Path: CALL SETUP->Call Control 6 of 6 -> HS-SCCH Order (**F3**)*
Press **Send Activate Secondary Cell** (**F1**).
Press the Measurement Reset key and see the throughput has increased to 42 Mbps. When you look at the DC-HSDPA Information screen, you can see the secondary serving cell is set up again.



When DC-HSDPA is active, the HBLER measurement can also be used to perform receiver testing. 3GPP TS 34.121-1 sections 6.3C and 6.3D are supported and can be set up and tested as described in an appendix in another document, DC-HSDPA User Guide.