Appendix 5. System Check

Prior to the assessment, the system was verified in the flat region of the phantom, 900 MHz, 1900 MHz, 2450 MHz and 5.0 GHz dipoles were used. A forward power of 250 mW was applied to the 900 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: 02/04/2013
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	20.6 ºC	ε_r	41.50	41.11	-0.94	5.00
				σ	0.97	0.97	-0.31	5.00
				1g SAR	10.50	10.12	-3.62	5.00
				10g SAR	6.74	6.52	-3.26	5.00

Date: 03/04/2013
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	20.6 ºC	ε_r	41.50	41.11	-0.94	5.00
				σ	0.97	0.97	-0.31	5.00
				1g SAR	10.50	10.16	-3.24	5.00
				10g SAR	6.74	6.56	-2.67	5.00

System Check 900 Body
Date: 05/04/2013
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	23.5 ºC	ε_r	55.00	52.37	-4.78	5.00
				σ	1.05	1.08	2.48	5.00
				1g SAR	10.80	10.44	-3.33	5.00
				10g SAR	6.96	6.72	-3.45	5.00

Date: 08/04/2013
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	23.9 ºC	ε_r	55.00	52.39	-4.75	5.00
				σ	1.05	1.04	-0.86	5.00
				1g SAR	10.80	10.56	-2.22	5.00
				10g SAR	6.96	6.80	-2.30	5.00

System Check 1900 Head
Date: 28/03/2013
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	39.00	-2.50	5.00
				σ	1.40	1.44	3.14	5.00
				1g SAR	39.40	40.80	3.55	5.00
				10g SAR	20.70	21.00	1.45	5.00

System Check 1900 Body
Date: 09/04/2013
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	23.2 ºC	ε_r	53.30	51.05	-4.22	5.00
				σ	1.52	1.55	2.15	5.00
				1g SAR	40.50	41.20	1.73	5.00
				10g SAR	21.40	21.48	0.37	5.00

Date: 10/04/2013
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	23.2 ºC	ε_r	53.30	51.05	-4.22	5.00
				σ	1.52	1.55	2.15	5.00
				1g SAR	40.50	42.00	3.70	5.00
				10g SAR	21.40	21.84	2.06	5.00

System Check 2450 Head
Date: 10/04/2013
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	23.9 ºC	ε_r	39.20	38.27	-2.37	5.00
				σ	1.80	1.77	-1.85	5.00
				1g SAR	52.30	53.20	1.72	5.00
				10g SAR	24.20	24.60	1.65	5.00

Date: 11/04/2013
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	23.9 ºC	ε_r	39.20	38.27	-2.37	5.00
				σ	1.80	1.77	-1.85	5.00
				1g SAR	52.30	54.40	4.02	5.00
				10g SAR	24.20	24.80	2.48	5.00

System Check 2450 Body
Date: 11/04/2013
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	23.1 ºC	ε_r	52.70	51.15	-2.94	5.00
				σ	1.95	1.99	2.26	5.00
				1g SAR	52.00	54.00	3.85	5.00
				10g SAR	24.10	24.12	0.08	5.00

Date: 12/04/2013
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	23.1 ºC	ε_r	52.70	51.15	-2.94	5.00
				σ	1.95	1.99	2.26	5.00
				1g SAR	52.00	53.60	3.08	5.00
				10g SAR	24.10	24.52	1.74	5.00

System Check 5200/5500/5800 Head
Date: 15/04/2013
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	21.9 ºC	ε_r	36.00	35.39	-1.69	10.00
				σ	4.66	4.59	-1.55	5.00
				1g SAR	78.10	80.30	2.82	5.00
				10g SAR	22.30	22.80	2.24	5.00

Date: 15/04/2013
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	21.9 ºC	ε_r	36.00	35.39	-1.69	10.00
				σ	4.66	4.59	-1.55	5.00
				1g SAR	78.10	77.60	-0.64	5.00
				10g SAR	22.30	22.30	0.00	5.00

Date: 16/04/2013
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	21.9 ºC	ε_r	35.60	34.93	-1.88	10.00
				σ	4.96	4.86	-2.05	5.00
				1g SAR	82.50	83.50	1.21	5.00
				10g SAR	23.50	23.30	-0.85	5.00

Date: 16/04/2013
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	21.9 ºC	ε_r	35.30	34.55	-2.12	10.00
				σ	5.27	5.17	-1.87	5.00
				1g SAR	77.00	77.30	0.39	5.00
				10g SAR	21.90	21.90	0.00	5.00

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
De-Ionized Water	52.87
Polysorbate 20	46.10
Salt	1.03

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

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

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

Ingredient (% by weight)	**Frequency**
	2450 MHz Head
De-Ionized Water	55.75[1]
Polysorbate 20	45.25[1]

Ingredient (% by weight)	**Frequency**
	2450 MHz Body
De-Ionized Water	71.70
Polysorbate 20	28.00
Salt	0.30

Simulated Tissues (Continued)

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 recipe 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+
Data Acquisition Electronic (DAE) System	
Serial Number:	DAE3 SN:431
PC Controller	
PC:	Dell Precision 340
Operating System:	Windows 2000
Data Card:	DASY4 Measurement Server
Serial Number:	1080
Data Converter	
Features:	Signal Amplifier, multiplexer, A/D converted and control logic.
Software:	DASY4 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.

DASY4 SAR System Specifications (Continued)	
E-Field Probe	
Model:	EX3DV4
Serial No:	3871
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
Phantom	
Phantom:	SAM 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.

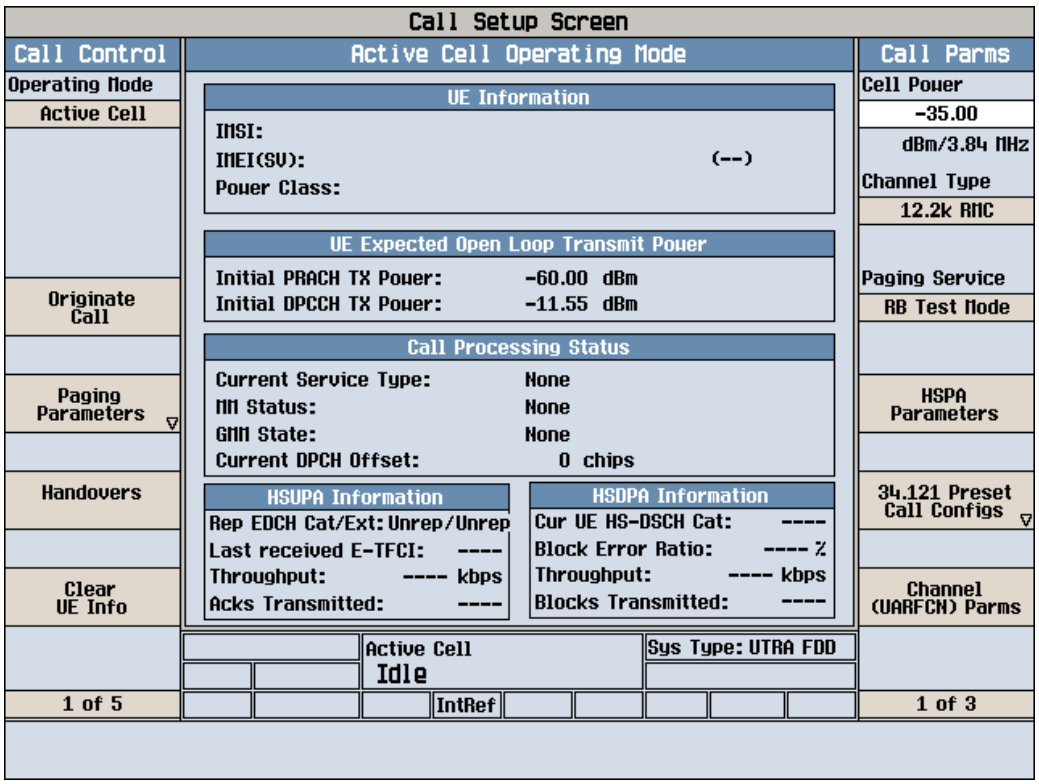


Figure 1: 3G Call Setup Screen

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.

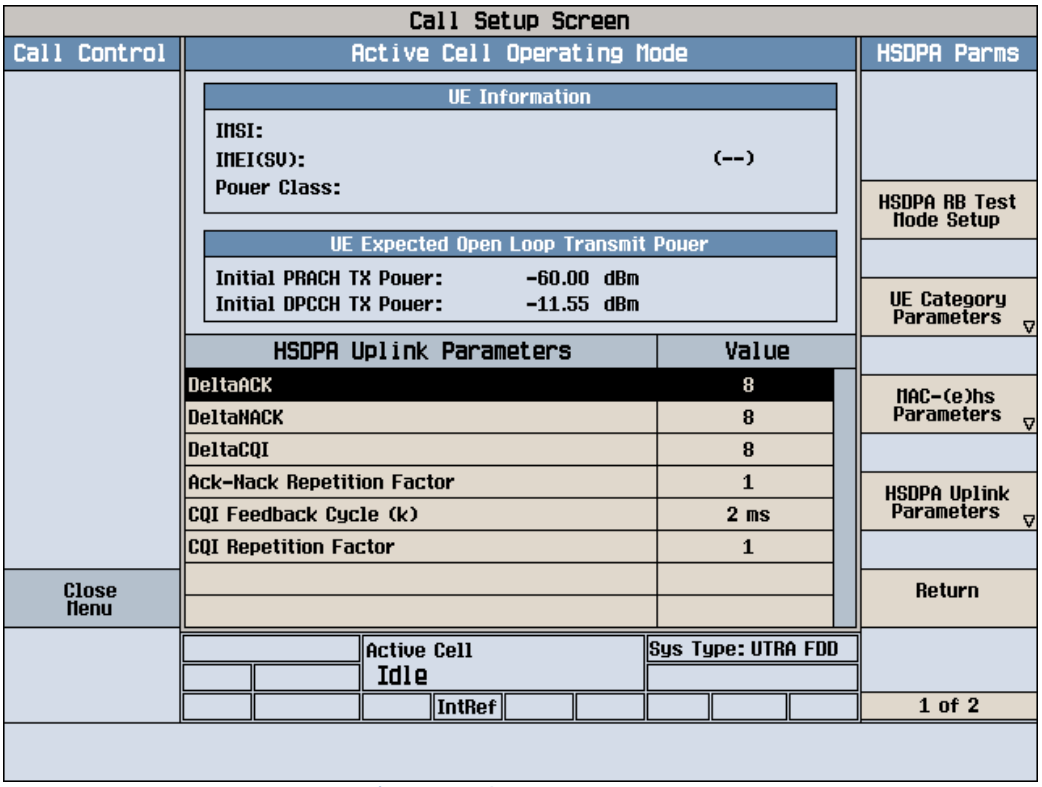


Figure 2: HSDPA Parameters

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.

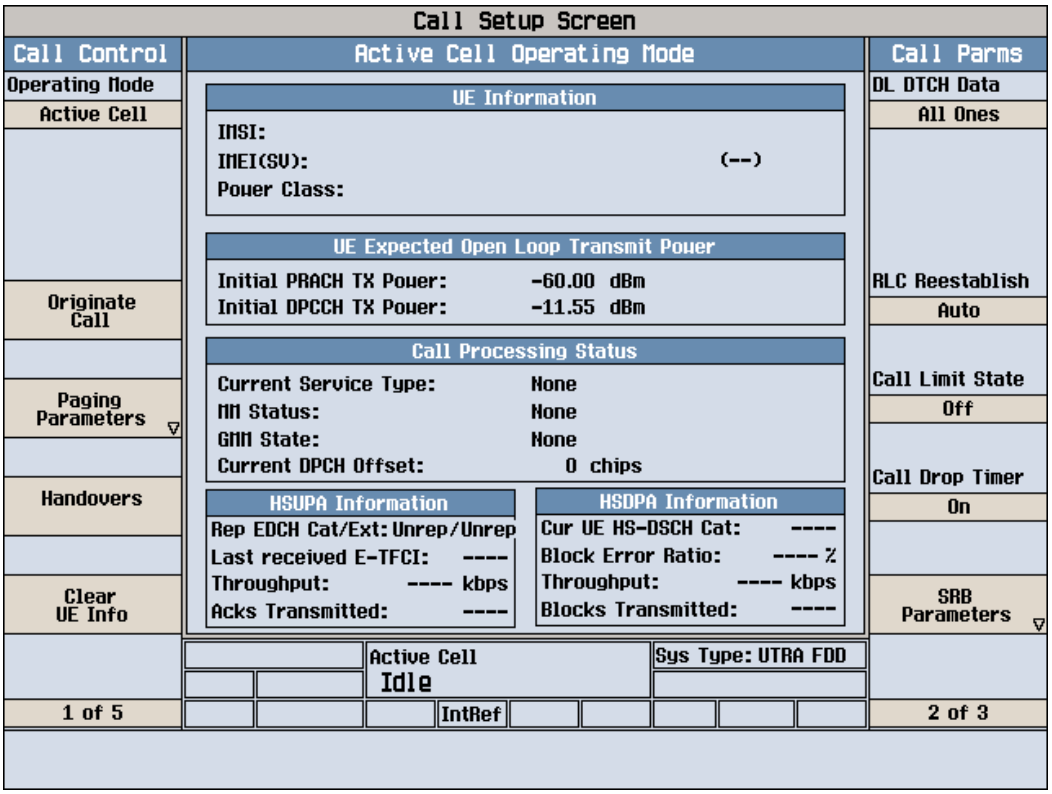


Figure 3: DL DTCH Data Parms

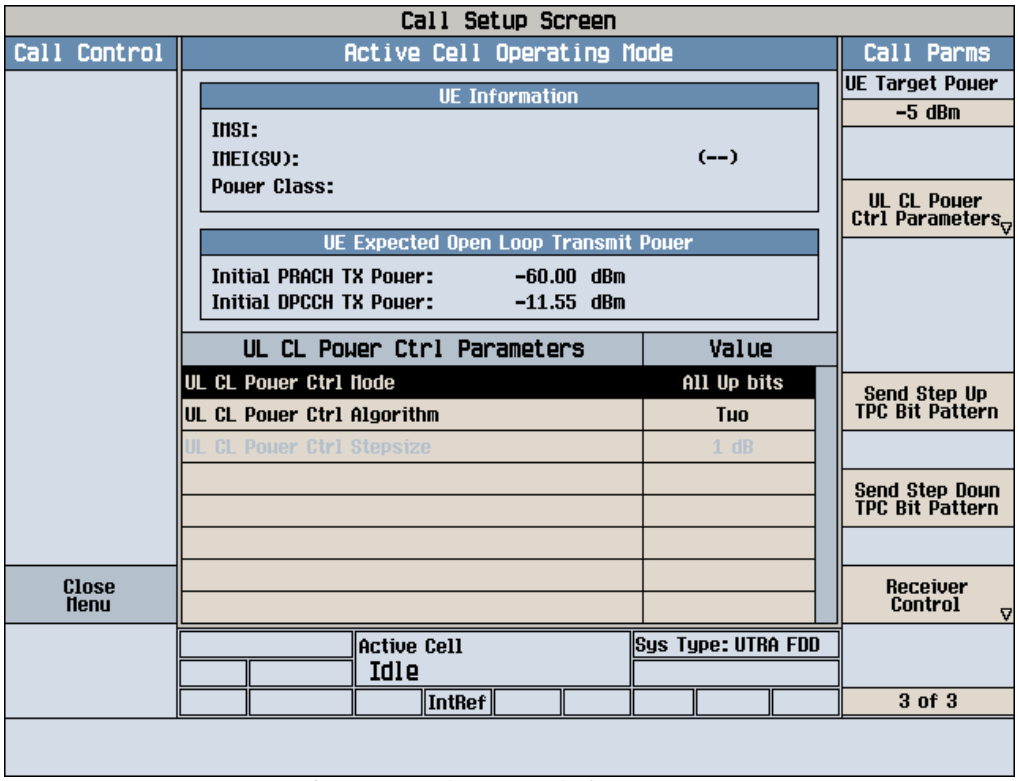


Figure 4: UL CL Power Ctrl Parameters

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.

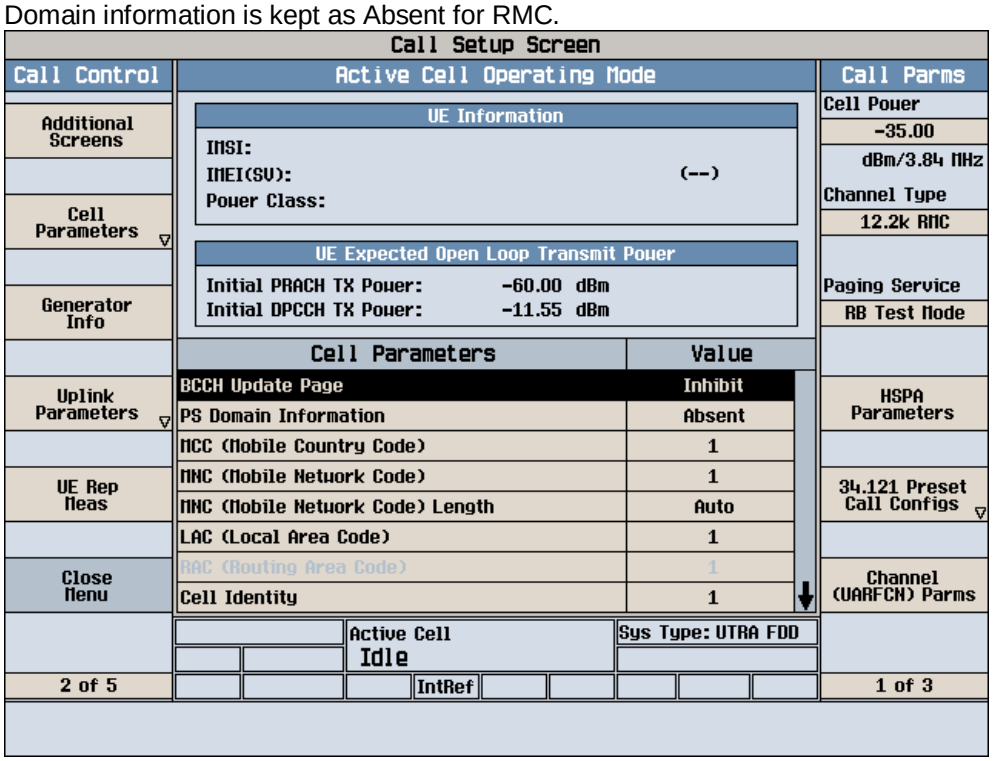


Figure 5: Cell Parameters

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.

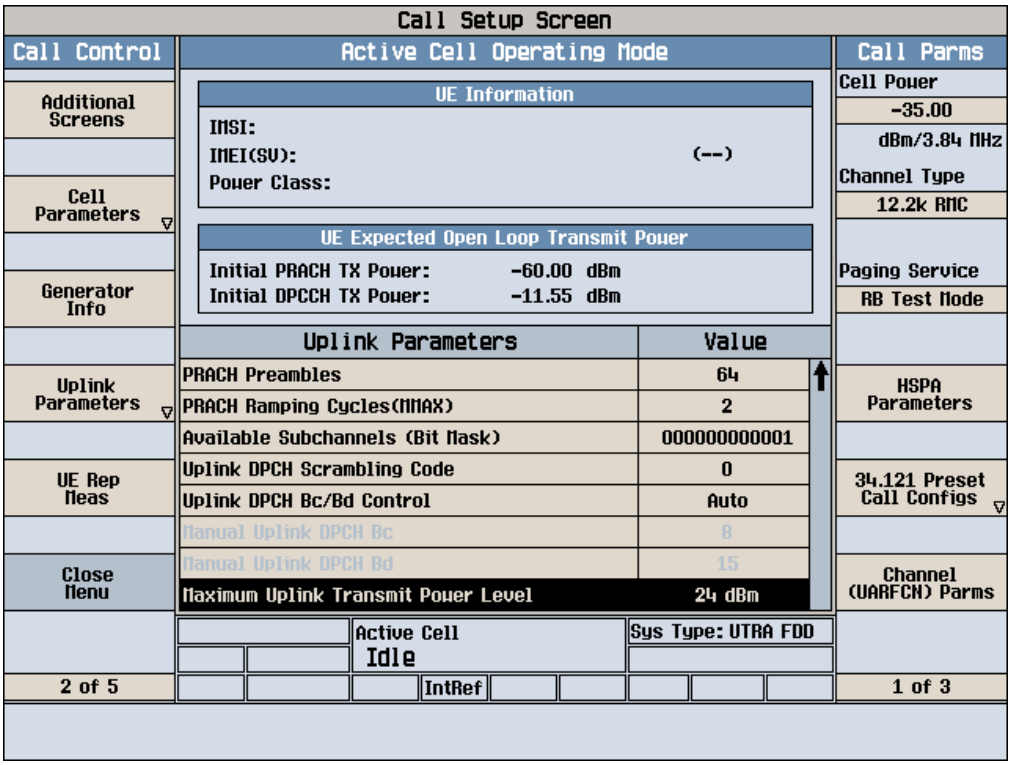


Figure 6: Uplink Parameters

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.

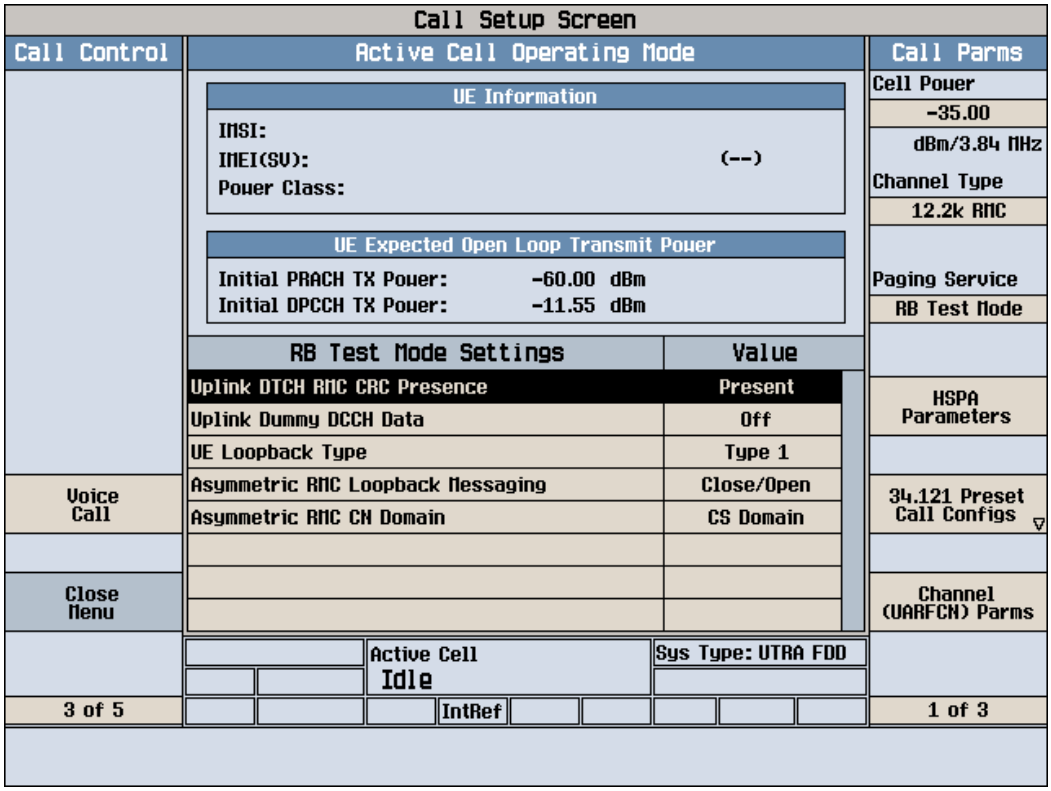


Figure 7: RB Test Mode Settings

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 $\beta_c/\beta_d = 12/15$, $B_{hs}/\beta_c = 24/15$

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 $\beta_c = 11/15$ and $\beta_d = 15/15$

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 $\Delta_{CQI} = 8 \Leftrightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15 \Leftrightarrow \beta_{hs} = 30/15 * \beta_c$

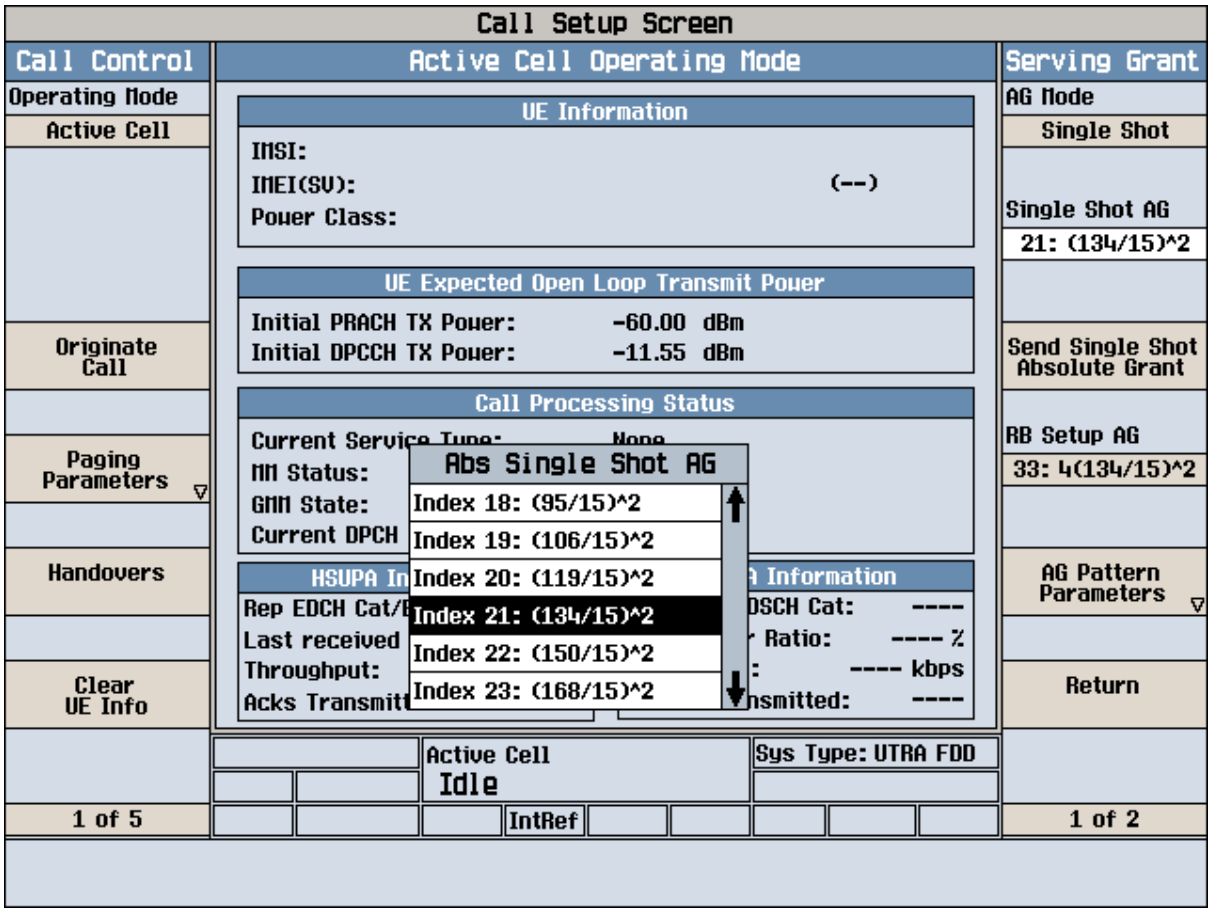
Note 2: CM = 1 for $\beta_c/\beta_d = 12/15$, $B_{hs}/\beta_c = 24/15$. For all other combinations of DPDCH, DPCCH, HS-DPCCH, E-DPDCH AND E-DPCCH for the MPR is based on the relative CM difference.

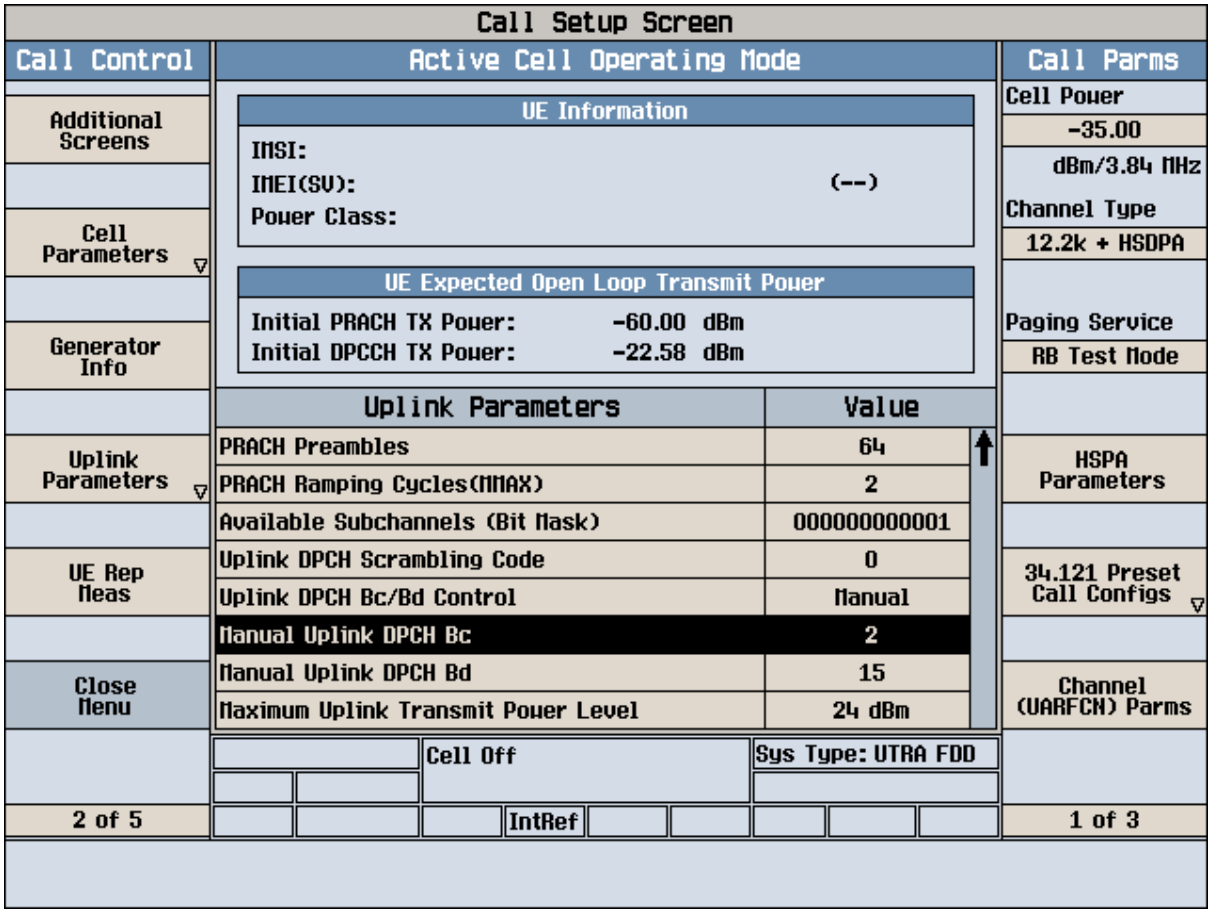
Note 3: For subtest 1 the β_c/β_d ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 10/15$ and $\beta_d = 15/15$.

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 $\beta_c = 14/15$ and $\beta_d = 15/15$.

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

Note 6: B_{od} cannot 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
Current Service Type: None
MM Status:
GMM State:
Current DPCH
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
Paging Parameters
RB Setup AG
33: 4(134/15)^2
Handovers
AG Pattern Parameters
Rep EDCH Cat/
Last received
Throughput:
Acks Transmitt
DSCH Cat: ----
Ratio: ---- %
---- kbps
nsmitted: ----
Clear UE Info
Return
Active Cell
Idle
Sys Type: UTRA FDD
IntRef
1 of 5
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
Paging Service
RB Test Mode
Generator Info
Uplink Parameters
Value
PRACH Preambles 64
PRACH Ramping Cycles(NMAX) 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
Uplink Parameters
HSPA Parameters
UE Rep Meas
34.121 Preset Call Configs
Close Menu
Channel (UARFCN) Parms
Cell Off
Sys Type: UTRA FDD
IntRef
2 of 5
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.

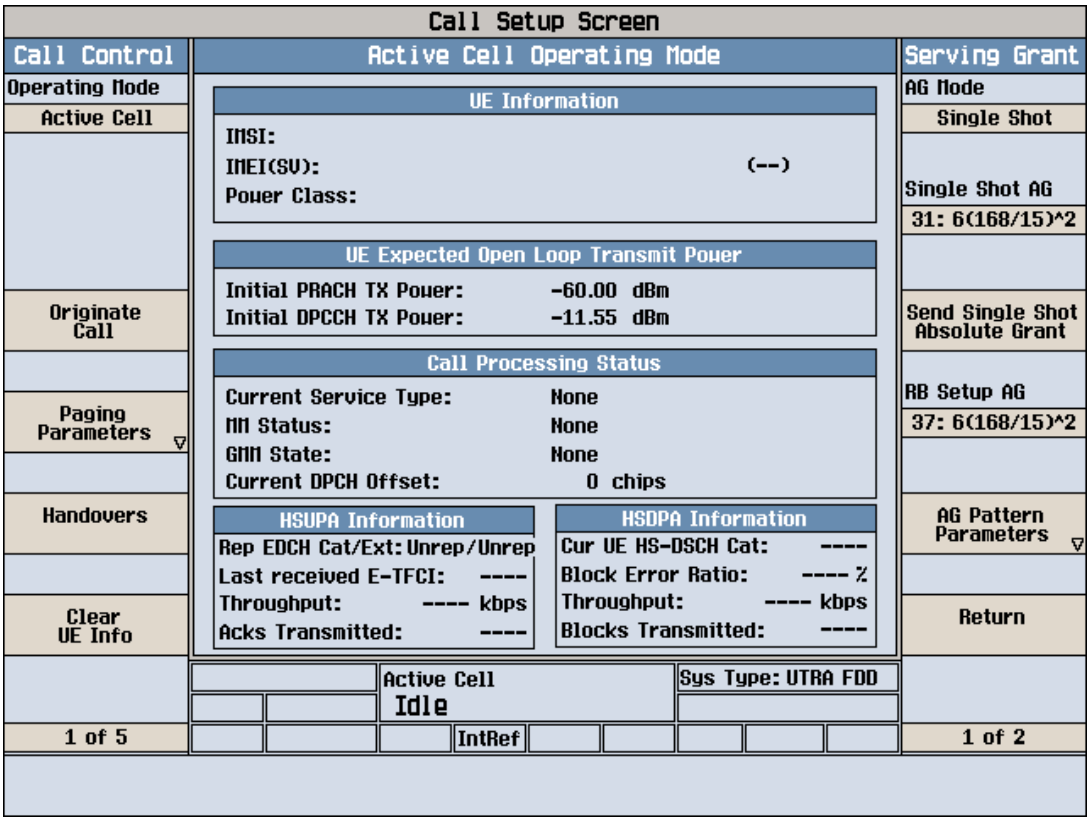


Figure 8: Serving Grant Example