MBNL

Commissioning & Testing of Cellular Antenna Systems

RD10011

GSDD054
LEE003

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2.00	8th Feb 2013	Colin Johnson	Note that this is a complete refresh: R2.00 with COC and RICC Forms New sweep test limits ***Standard Sweep Testing*** and ***Additional Sweep Testing*** RICC Full Schematic requirement clarified. Digital inclinometer photos for all antennas. Extensive Appendices: MHA powering details Testing schematics Plot examples

Continued

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Updates - Continued

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3.00	13/12/2013	Colin Johnson	Published as RD10011 3.2 Additional note on consideration of 13dB limit added as per RPF requirement.
Next Revision			The SRL limits of 13dB are being reviewed. Document will be upgraded in the near future for new frequencies.

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1 Introduction

Commissioning of MBNL Cellular Antenna Systems has been significantly revised.

The philosophy being that documentation has been rationalised and RF tests are carried out to confirm the Cellular Antenna System is operating to a standard that should not negatively affect the performance of the site.

Focus is to enable the SWC to complete their sweep testing **on the day of BAU work**, and to provide **COC handover packs** with enough information to confirm the system either: operational or provide justification for the non conformances identified. Antenna line sweep tests must be carried out correctly, or it is worthless to attempt to interpret them, to deduce what may be causing a non conformance.

The majority of rigging works since 2010 are not new installations and will include the re-working of legacy networks from H3G / TMobile / Orange that could be up to 15 years old, and may already have been modified several times.

Wherever there is a material / physical change to any component or part of the antenna line system, from the BTS / Node B ports to the Antenna ports, including the antenna, is shall be tested and a COC / RICC completed.

Summary of main changes:

1. Introducing the concept of ***Standard Sweep Testing*** and ***Additional Sweep Testing***, that will be used to prove the antenna line operational or identify the area of non conformance.
2. Limit levels (SRL / RLL / RL) have been relaxed in this GSDD to reflect the effect of multiple reflections adding together, in phase, and falsely indicating a non conformance.
3. New Rigging Installation and Commissioning Certificate ***(RICC) Revision*** that includes recording of DTFL and RLL results as part of the ***Standard Sweep Testing*** and a new page for ***Additional Sweep Testing***. Also updated COC issued.
4. Appendices extensively added to providing notes and schematics on sweep testing and MHAs.
5. GPS antenna alignment as standard (this change applicable to EE - Orange UK)

Out of Scope: EE Orange SAP bar code asset management.

Definitions / Acronyms at end of document.

1.1 Retrospective Application of RD10011_GSDD054 / RICC / COC

To retrospectively apply RD10011_GSDD054 R2.00 (or later) to antenna line commissioning and testing done under a previous regime:

1) RD10011_GSDD054 / RICC / COC shall be fully applied and handover documentation re-worked and re-submitted, on a site by site basis. Additionally:
    a. State **"Retrospective Application of RD10011_GSDD054"** in the following sections:
        i. *COC - 1.4 Comments / Non Conformance / Additional Testing*
        ii. *RICC – Additional Notes / Comments / TT & PR*
    b. If any part is not complying / faulty, then this still requires attention per procedure, *Reporting a Testing Non Conformance*.
    c. requires main feeder DTFL and RLL results; if previously these have not been done it should be clearly highlighted to the Cell Planner for their consideration.
2) Any genuine faults or service affecting issues identified under previous testing are STILL VALID, even if all passing under point (1) above.
3) Shall Not - cherry pick bits, or single lines, from different specifications.
4) Shall Not - resubmit previous versions of handover packs with statements retrospectively applying. See point (1) above.

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1.2 Radio Frequencies

This covers full band and operator sub bands. Sub bands are important when dealing with combiners. Operator's sub bands are also sub divided into carriers, not covered here.

1.2.1 MBNL Radio Frequencies for Testing Markers – Table

MBNL Base Station Frequencies (MHz) Testing Markers		
800 (LTE)	**TX (F1)**	**RX (F2)**
Full Band (UK)	791 - 821	832 - 862
Hutchison 3G UK (H3G)	**791 - 796**	**832 - 837**
Everything Everywhere (Orange and T-Mobile)	**796 - 801**	**837 - 842**

Note: TX and RX reversal is not a typo

MBNL Base Station Frequencies (MHz) Testing Markers		
1800 (GSM & LTE)	**RX (F1)**	**TX (F2)**
Full Band (UK)	1711 - 1781	1806 - 1876
Hutchison 3G UK (H3G) - LTE	**1722 - 1736**	**1817 - 1831**
Everything Everywhere – GSM & LTE (Orange and T-Mobile)	**1722 - 1781**	**1817 - 1876**
Everything Everywhere (T-Mobile) - Legacy	1722 - 1751	1817 - 1846
Everything Everywhere (Orange) - Legacy	1752 - 1781	1847 - 1876

2100 3G (UMTS)	**RX (F1)**	**TX (F2)**
Full Band (UK)	1921 - 1979	2111 - 2169
Hutchison 3G UK (H3G)	**1921 - 1934**	**2111 - 2124**
Everything Everywhere (Orange and T-Mobile)	**1960 - 1979**	**2150 - 2169**
Everything Everywhere (T-Mobile) - Legacy	1960 - 1969	2150 - 2159
Everything Everywhere (Orange) - Legacy	1970 - 1979	2160 - 2169

2600 (LTE)	**RX (F1)**	**TX (F2)**
Full Band (UK)	2500 - 2570	2620 - 2690
Hutchison 3G UK (H3G)	**N/A**	**N/A**
Everything Everywhere (Orange and T-Mobile)	**2535 - 2570**	**2655 - 2690**

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1.2.2 MBNL Radio Frequencies for Selected Equipment and Test Markers - Table

1710.1	UK 1800 Rx	1781.7	Mid Band	1805.1	UK 1800 Tx	1876.7
1711 for test	Receive Band (Uplink)	for test 1781	Full Band Test Fx	1806 for test	Transmit Band (Downlink)	for test 1876
OLO 1711 1721	1722 T Mobile 1751	1752 Orange 1781	Sub Band Test Fx	OLO 1806 1816	1817 T Mobile 1846	1847 Orange 1876
	1722 EE - Everything Everywhere - EE 1781				1817 EE - Everything Everywhere - EE 1876	
1710	MHA - Full Band	MHA - Full Band	MHA - Full / Wide Band	1805	MHA - Full Band	MHA - Full Band 1880
	1721.7 RD313	RD313	UCU RD313 - Blue		RD313	RD313 1876.7
	1721.7 RD250-01	RD250-01	UCU RD250-01 - Yellow		RD250-01 1846.7	NOT COVERED !
	1720 Triasx MHA 1760	NOT COVERED !	MHA TRIASX Wide		1815 Triasx MHA 1855	NOT COVERED !
	NOT COVERED !	1751 MHA - OuK Sub Band 1781	MHA - OuK 2G Sub Band		NOT COVERED !	1846 MHA - OuK Sub Band 1876
1710	Diplexor - Full Band	Diplexor - Full Band	Diplexor - Full Band		Diplexor - Full Band	Diplexor - Full Band 1880
	1722 1736 H3G LTE		Sub Band Test Fx		1817 1831 H3G LTE	

1920	UK 2100 Rx	1980	Mid Band	2110	UK 2100 Tx	2170
1921 test	Receive Band (Uplink)	test 1979	Full Band Test Fx	2111 test	Transmit Band (Downlink)	test 2169
H3G 1921 1934	OLO - Bands 1935 1959	1960 1969 T Mobile 1970 1979 Orange	Sub Band Test Fx	H3G 2111 2124	OLO - Bands 2125 2149	2150 2159 T Mobile 2160 2169 Orange
		1960 EE 1979				2150 EE 2169
1920 MHA	MHA	MHA 1980	MHA - Full / Wide Band	2110 MHA	MHA	MHA 2170
1920.3 LO 1934.9	Blocked by Filters	1959.7 RD313 Hi 1979.7	UCU RD313 - Blue	2110.3 LO 2124.9	Blocked by Filters	2149.7 RD313 Hi 2169.7
1920.3 LO 1934.9	Blocked by Filters	1959.7 Hi 1969.7 ! NO !	UCU RD250-01 - Yellow	2110.3 LO 2124.9	Blocked by Filters	2149.7 Hi 2159.7 ! NO !
1920	Triasx MHA	1980	MHA TRIASX Wide	2110	Triasx MHA	2170
1920	Diplexor - Full Band		Diplexor - Full Band		Diplexor - Full Band	2170

Test frequencies rounded up or down to nearest Meg to bring within band to avoid any tight filtering causing unnecessary fails.
Note: New Wideband MHAs are Full Band 1800 and 2100. Radio Design (341 / 376 / 448) and "Kaelus"

The tables above show how the 1800 and 2100 UK band and operator sub bands are covered by some of the equipment that is MBNL uses. Not all equipment will cover all sub bands. Also where more than one piece of equipment is installed in the Antenna Line then only the lesser of the available bands will work. For example: if using a UCU RD313 (Mk2 with blue band) and an old style Triasx Wideband MHA, the 1800 sub bands available will not allow a large part of the EE 1800 band to work, this primarily affects the legacy OuK sub bands above 1752 and 1847MHz.
See the **'NOT COVERED !'** and **'! NO !'** in the tables below.

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2 Antenna Installation

2.1 Antenna Height

Above Ground Level (AGL) is antenna height from ground level to the mid point of the antenna.

2.2 Antenna Alignment

Per instruction (RDS), use a GPS antenna alignment device to align antennas to UK Grid North. Must use UK Grid North - Datum OSGB36. Tolerance is:

+/- 1 degree to UK Grid North

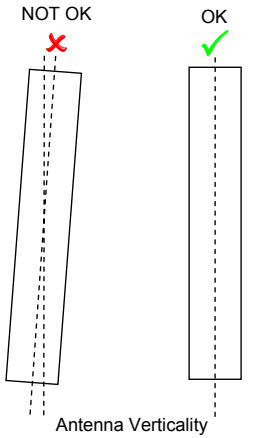
Enter site, cell and antenna data into the device and record on proprietary software.

Use a digital inclinometer to confirm antenna tilts to:

+/- 0.5 deg to mechanical tilt and to vertical

Place on rear of antenna and mark position with indelible black marker, writing sector ID above mark, to confirm the mechanical tilt.

Photo shall be taken on antenna tilt digital inclinometer setting, on the rear of the antenna.



Antenna Verticality
Skew antennas not allowed
As viewed from behind antenna

Antenna verticality (to confirm it is not skew) will also be confirmed but there is no need to mark this position on the antenna.

Under written (e-mail) concession from MBNL, in cases where GPS device is obstructed, a gun sight (using RIS form) or other alignment method may be used.

Details on antenna beam crossing, horizontal and vertical clearances etc are covered in ***RD10012_GSDD004A***.

2.3 Remote Electrical Tilt (RET)

Details covered in other documents, ***S2029 GSDDTBC***, detailing how to commission VET / RET systems. As required save screen dumps / commissioning files and insert these to the *COC*. Also record in the *RICC* the:

- RET Motor / RTA serial number
- Where full remote control systems are provided they should be confirmed commissioned by remote testing before leaving site.
- The final electrical tilt must be confirmed and recorded when installing antennas.

RET device 'Sector ID' should be entered on site.

At time or writing EE – Orange RET installation detailed in ***Proc 9*** and ***ERN 463338*** should still be followed for legacy OuK sites.

2.4 Passive Intermodulation (PIM) Testing

Under consideration, but not currently done as standard on MBNL sites.

General principles are that testing with a 20W unit will have a pass / fail at around -90 to -95dBm.

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3 Sweep Testing

3.1 General

Standard Sweep Testing – DTFL / RLL / SRL as required by the works being carried out. If any non conformances cannot be justified from information on the DTFL / RLL plots then *Additional Sweep Testing* will be carried out, as permitted by accessibility of test points.

Additional Sweep Testing – Breaking down the antenna line into parts until either:

1. *divide into 2 with a 50 Ohm load, 2 halves can be shown to pass SRL / RLL limits or*
2. individually all piece of equipment can be proven to pass SRL / RLL limits separately or
3. a faulty piece of equipment or legacy components are identified.

Sweep Test Limit levels have been relaxed in this GSDD in recognition of:

- the effect of multiple reflections coming from multiple sources, and adding together if in phase, to provide a result that is unnecessarily poor (MHA, UCU and Antenna, multiple jumpers etc. And to reduce wasted time and confusion when testing sites
- The importance of the actual & correct site antenna line plots being submitted to the SWC and Cell Planner. Incorrect testing is misleading, will result in wasted time and effort, and will be rejected.
- Majority of work carried out on MBNL network is on legacy sites, may be up to 15 years old.

The emphasis now it to provide accurate sweep tests for a site, so that Cell Planner plot analysis, in conjunction with site performance data, can make an informed decision on whether the site's Antenna Line performance is acceptable or not.

Single component tests that fail their data sheet specification return loss levels, are normally faulty and should be replaced, either as part of the business as usual or as a fault on the site.

System Testing (SRL) that does not meet the limits set out, are not necessarily a straight fail as the addition of multiple reflections can result in occasional peaks of very low performance. In these cases, additional testing should be carried out on:

- Main feeder to confirm overall DTFL and RLL
- split system into two (by using a load) or
- testing of each individual component

If each individual sub system or all the components can be proved to be operating within specification / limits then the system is operational, not faulty. If the Cell Planner still feels that the overall system performance will cause site performance issues then the site Antenna Line may need to be re-designed or some components swapped to remove the unwanted addition of reflections.

Sweep testing regime is detailed below and additional information / Schematics etc are in the Appendices:

- Appendix - MHA DC Power for Testing
- Appendix - Sweep Test Equipment Setup
- Appendix - SRL Test Circuit Schematics
- Appendix - Plot Analysis – Notes key points of interpretation

Also covered at the end of this section are:

- Trouble tickets / PRs should be raised for testing non conformances

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3.1.1 Plot Formats

Sweep tests will be submitted in the COC attached as a PDF. The electronic files (DAT, MDB, other) are to be kept by the SWC for a period of 12 months in case the site plots require further investigation.

PDF reports are either by 'printing' the desired plots to a .PDF or the proprietary software may produce a .PDF report. A useful PDF Converter is:

http://www.cutepdf.com/

3.1.1.1 Anritsu SiteMaster

Select the .MDB or .DAT data file option on your SiteMasters. More modern SiteMasters have the option of a .VNA file format that produces PDF, of plots, that are almost illegible. Electronic plot data files are accessible using Anritsu Handheld Software available as download from:

http://www.anritsu.com/en-gb/downloads/software/drivers-software-downloads/dwl2242.aspx

3.1.1.2 Rohde Schwarz ZVH

Uses a .SET file format for each plot. These are saved individually in a folder, and will need zipped together, if emailing to others. Electronic plot data files are accessible using Rohde&Schwarz software (*ZVH View*) available as download from:

http://www.rohde-schwarz.com/en/software/zvh/

Print to .PDF in *ZVH View* by selecting *Tools / Report Generator / select files to report* and PDF print options, save file as.... This will create a black on white file which is legible. Preference if for 2 plots per page. Do NOT open plots and then *File / Print* (to a PDF generator) as this will produce, almost illegible, colour plot with a black background.

3.1.2 Plot Layouts

Use Return Loss Mode unless stated otherwise.

- Y - Axis - Return Loss range 0 to -54 dB
- X- Axis - **Frequency** range full band or **Distance** to far end connector plus 5m.

Markers and limit lines as described in testing table.

Unit shall be calibrated to as necessary for temperature and to include test leads.

Date and time accurate, prefer UK date format dd/mm/yyyy

3.1.3 Plot Naming - Table

Cell ID	Feeder Label / Identifier	TX / RX	Type of Test
Normally a 5 digit number	As detailed in RD10012_GSDD004A : C1A1, TC3A2, uA1, HuA1 Use legacy convention if applicable	Omit unless: testing has been separate on TX or RX, legacy 2G. Plots in only the TX or RX range required	DTFL, RLL, SRL, PRESRL RL Ant, SRL to Load, SRL ex UCU, RLL UCU +Jump
12345	uA1 / TuA1		SRL
12345 uA1 DTFL **12345 uA1 RLL** **12345 EuA1 SRL** **12345 HuA1 SRL** **12345 C1A1 DTFL** **12345 C1A1 RLL** **12345 C1A1 SRL** **12345 uB2 RL Ant** **12345 HuB2 SRL to Load** **12345 uB2 SRL ex UCU** **12345 HuB2 RLL UCU + Jump** **12345 EuB2 RLL UCU** See Test Limit Tables for more test / plot names			

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3.2 Standard Sweep Testing

**** Note in preparation to next revision and 13dB SRL limit ****

The following details specify the testing regime required and acceptable limits for each system. Currently the SRL test limits within the following tables takes into account possible issues with combined antenna line reflections and hence a theoretical value of 13dB has been identified as a possible limit. Although this is theoretically possible, it is not deemed to be acceptable and is therefore under review. Should actual site SRLs be approaching this value (but not less than 13dB):

Record in COC and RICC Comments, as: summarise, save all PRE SRL plots, submit in COC and attach e-mail from MBNL, and log results in the Additional Testing tab section 5 of the RICC.

Note: Acceptable testing limits for the new 4G frequencies will be confirmed in an imminent update of this document.

3.2.1 Pre Test SRL

Before commencing changes to any system, SRL (system return loss) of existing equipment. Test should be done per final SRL, on equipment present, with MHAs powered. If:

1) ALL PASS
   Record on in RICC Comments that "*PRE SRL ALL PASS*".
   However it is recommended that the PRE SRL plots should always be saved, PDFed and submitted, in case needed for later reference.

2) Anything fails
   Report to MBNL by phone (confirmed by return e-mail) and clarify further actions if necessary. E.g. Log fault number (MBNL Trouble Ticket / PR from NOC, EE Orange STK Trouble Ticket), additional testing if there is time, etc.
   Record in *COC* and *RICC Comments*, as non conformance: summarise, save all PRE SRL plots, submit in COC and attach e-mail from MBNL, and **log results in the *Additional Testing* tab section 5 of the RICC**.

3.2.2 MHA DC Power Bias T

Whenever testing MHA they should be powered. Schematics of how to power MHA and typical MHA CWA operating modes are detailed in the

- Appendix - MHA DC Power for Testing
- Appendix - Sweep Test Equipment Setup
- Appendix - SRL Test Circuit Schematics

It is required to configure the antenna line to take DC power from its normal operational source and to use 2No bias T (external) to power a sector's MHA for all subsequent SRL testing. MHA DC power consumption is measured in mA and is recorded for each MHA (in total, for both sides) on the *RICC* form.

If you get an MHA CWA mA draw operational non conformance, the unit should be tested for current draw at ground level and if not compliant, it is faulty and should be returned via the appropriate DOA or Returns procedure.

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3.2.3 Standard Sweep Testing

Standard Sweep Testing – DTFL / RLL / SRL as required by the works being carried out. If any non conformances cannot be justified from information on the Main Feeder DTFL / RLL plots then *Additional Sweep Testing* will be carried out, as permitted by accessibility of test points.

DTFL – Distance to Fault Load (Main Feeder&Jumpers) – as per DTF but a 50 Ohm load is put on the far end of the test circuit. When used on the main feeder circuit this provides information on feeder / jumper and connector component performance. Good for fault finding. See also **DTF in appendix**.

RLL – Return Loss Load (Main Feeder&Jumpers) – as per RL but a 50 Ohm load is put on the far end of the test circuit / component. This allows for the testing of components or sub divided system and will exclude any external interference as the parts tested will be in a closed system.

SRL – System Return Loss – a frequency plot showing how a component or sub system's reflections are adding together at a given frequency. '*System*' means for the full Antenna Line including all components from BTS connector and the **antenna**. This test may suffer from the addition of reflections from multiple components or from external interference picked up by the antenna.

3.2.4 Standard Testing – New Site Made / Factory Made Jumper

3.2.4.1 Factory Made Jumper

It is understood that the SWC will test and Factory Made Jumpers on site prior to installation, confirming manufacturer / RD10011_GSDD054 specifications, and **NO** faulty units will be installed.

DTFL and RLL limits for Factory Made Jumpers are detailed in the sweep test limits tables; they are different from main feeder DTFL / RLL.

3.2.4.2 Site Made Jumpers (Man made connector ends or run into ducts)

Typically these will interconnect between two components or equipment where factory made jumpers cannot be supplied / installed because of excessive length or ducting etc. E.g. from a UCU to a BTS position and may be ducted on streetworks sites.

These jumper assemblies, include any factory made jumpers at either the ends (UCU / BTS etc), will be tested to Main Feeder DTFL / RLL specification, detailed in the sweep test limits tables.

Save plots, submit into COC and record results in *RICC Additional Testing Section 5*.

If these jumpers form part of the main feeder / jumpers there is no need to test separately as they will be tested as part of the *Standard Testing* main feeder DTFL / RLL.

Plots should be clearly identifiable: DTFL BTS Jump / RLL BTS Jump etc also see Sweep Testing Schematic diagram in the Appendices.

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3.2.5 Standard Sweep Test - Details - Table

Test		Circuit	Frequencies / Markers / Limits	Results
1	**DTFL*** (Distance to Fault Load)	Main Feeder and associated jumpers (MHA / UCU / Diplexor) * Also necessary for Site Made Jumpers if not forming part of the main feeders & jumpers *	Test full band frequency. Length to end connector plus 5m or 10m. Limit line for cable: -40 / -33dB Markers to peak at 0m, far end connector and all other connectors, and any feeder limit line fails.	Use DTFL results to record lengths Record cable and connector RL values in the RICC
2	**RLL*** (Return Loss Load)		Plot shows Full band Limit line of: -25dB or -20dB Marker to peak	Record RL value in the RICC
3	**SRL** (System Return Loss)	System fully connected from antenna. Test from final equipment connection, or furthest end (e.g. input to a combiner if Node B / BTS jumpers not installed)	Plots shows Full Band Markers (1-4) to show RX and TX band, depending on equipment installed. Limit line of: -13dB or -12dB Results: Marker (5&6) to peak in each RX and TX bands marked.	Use SRL for each feeder / frequency to input RL value into RICC

* - For DTFL and RLL tests because the circuit is "wide band" it is acceptable to do one test across both 1800 and 2100 or from 800 to 2600 if necessary on one plot. Plots must be clearly named to confirm the frequencies used, particularly on the DTFL. If no suffix / description to plot title (BTS Jump etc…) added will assume these to be Main Feeder.

3.2.6 Standard Sweep Tests – When Required? - Table

It is not always necessary to do all commissioning sweep tests; this is dependent on the work carried out.

Description of Works	Pre SRL	DTFL	RLL	SRL	MHA Current
Antenna Pan / Tilt	No	No	No	No	No
Antenna Swap	Yes	No	No	Yes	Yes
UCU / Diplexor Swap (Including re-jumpering on BTS side)	Yes	Recommended	Recommended	Yes	Yes
MHA Swap - like for like (No changes to jumpers / technologies)	Yes	Yes	Yes	Yes	Yes
MHA Swap – Other (changes to jumpers / technologies)	Yes	Yes	Yes	Yes	Yes
UCU / Diplexor Install (normally includes MHA / jumper changes)	Yes	Yes	Yes	Yes	Yes
Additional of Frequency Use (800/1800/2100/2600) onto existing	Yes	Yes	Yes	Yes	Yes
Main Feeder Changes (Including any jumper changes)	Yes	Yes	Yes	Yes	Yes
New Site / New Antenna System	No	Yes	Yes	Yes	Yes

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3.2.7 Sweep Test Limits - Table

Test / Plot	Description	Frequency Limit (-dB)			
		800	1800	2100	2600
DTFL	ALL New cable	TBC	40		
	Existing / Legacy cables	TBC	33		
	Connectors	TBC	28		24
RLL	Main Feeder Only	TBC	25		
	Main Feeder plus Jumpers	TBC	20		
SRL	No UCU / Diplexor	TBC	13		
	With UCU / Diplexor	TBC	12		

Divided in Two (with 50 Ohm Load) BOTH halves must be tested						
Test / Plot	Description		Frequency Limit (-dB)			
			800	1800	2100	2600
Load replacing Antenna						
RL Ant	RL Antenna Only		TBC	14 or 15.6		
SRL to Load	RL from BTS	With UCU / Diplexor	TBC	13		
		No UCU / Diplexor	TBC	14		
Load onto UCU antenna port						
SRL ex UCU	SRL – No UCU / Diplexor		TBC	13		
RLL UCU + Jump	RLL from BTS to load on UCU antenna port (including BTS & bulkhead jumper)		N/A	16		N/A

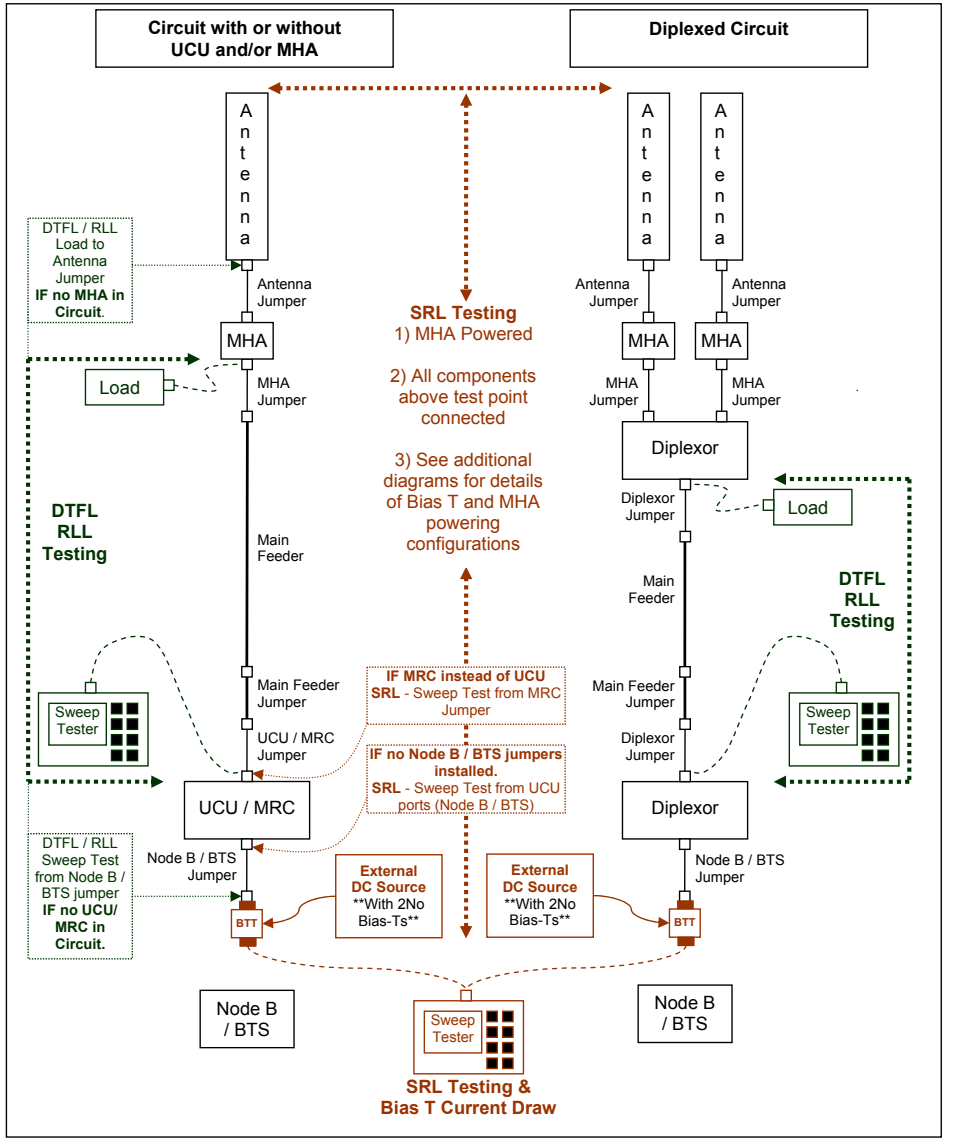
Sub Divided / Component – Return Loss (RL and RLL)					
Test / Plot	Description	Frequency Limit (-dB)			
		800	1800 RX / TX	2100 RX / TX	2600
RL Ant + Jump	Antenna and Antenna Jumper	TBC	13		
RLL UCU	UCU to Load (no jumper)	N/A	18		N/A
RL MHA + Ant	MHA and Antenna (no MHA jumper)	TBC	16 / 13		TBC
RLL Dip	Diplexor to Load (no jumpers)	21			
RLL Jump	Factory Made Jumper to Load	TBC	28		26
Mast Head Amplifiers to Load (Requires to be powered)					
RLL MHA	RD341 - Wideband 2-2 Port	N/A	18 / 20	18 / 20	N/A
RLL MHA	RD376 - Wideband 2-4 Port	N/A	18 / 20	18 / 20	N/A
RLL MHA	RD448 - Mini Wideband 2-2 Port	N/A	16 / 18	16 / 18	N/A
RLL MHA	Kaelus Wideband (New Triasx)	N/A	18 / 18	18 / 18	N/A
RLL MHA	Triasx Wideband (Old Version)	N/A	18 / 18	18 / 18	N/A
RLL MHA	LGP18521 - Powerwave 2G	N/A	18 / 19.5	N/A	N/A
RLL MHA	Commscope (Andrews) 2G	N/A	18 / 18	N/A	N/A
RLL MHA	Nokia - WMHD	N/A	N/A	16 / 18	N/A
RLL MHA	Katherine 3G	N/A	N/A	18 / 18	N/A

All tests with MHA DC powered.

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3.2.8 Standard Sweep Test Schematic - Generic

Below are typical diagrams providing schematic representation of Antenna Line configurations and where commissioning sweep tests should be carried out from. Specific testing schematics are provided in the appendices; ***MHA DC Power for Testing, Sweep test Equipment Setup, SRL Test Circuit Schematics***



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3.3 Standard Sweep Test - Non-Conformance

Sweep tests can be Non-Conforming / Failing if:

1. Do not achieve a design limit (this should be black or white)
2. Trace shows an anomaly (unexpected spike / patter, in the wrong place) that indicates a fault on the system or faulty testing. It may pass limits but is still Non-Conforming.

When looking a sweep test plots, first thing to consider is the quality of the plots received. If the sweep tests have not been carried out correctly there will be little value in trying to analyse them. Incorrectly set up test equipment or incorrectly named plots will invalidate a lot of the information on the plots. Additional guidance is provided in the Appendices.

Where ***Standard Sweep Test*** DTFL, RLL and SRL tests pass limits, record on the RICC and complete handover pack. Where one or more of the ***Standard Sweep Tests*** are non-conforming, then these may be attributed to poor performance of a legacy system, as detailed below, or some ***Additional Sweep Testing*** may be needed as outlined in following section.

3.3.1 Standard Sweep Test – DTFL – Non Conformance

Where these indicate that the main feeder is damaged or a connector is not operating up to specification this may cause subsequent RLL and SRL results to fail as well. New feeder / connectors should pass limits but legacy components may be been damaged, deteriorated over time or even to an older / lower specification.

- Faulty Connectors should be clearly identifiable.
- Faulty cable may be because of physical damage and cable should be inspected at that distance.

3.3.2 Standard Sweep Test - RLL – Non Conformance

RLLs non-conformance may be attributed to issues highlighted in the DTFL results.

RLLs non-conformance may also occur where there is no single point indicating a fail on the DTFL. This should not occur on new installations. This may occur on legacy sites because of the addition of multiple reflections from connectors / jumpers / feeder on a circuit. In this case the main issue is what is the final SRL for the circuit?

3.3.3 Standard Sweep Test - SRL – System Return Loss – Non Conformance

SRL non-conformance can cause a deterioration of the overall performance of the site and may also cause the equipment to issue a VSWR alarm (if below -11dB). SRL non-conformance may be caused by DTFL and RLL issues already identified or may be cause by the reflection addition effects where there are multiple components in the system with significant reflections. Circuits with UCU / MHA / Antenna in them are more likely to suffer from reflection addition effect.

When testing with the MHA powered the RX path stops at the MHA, as it will be filtered toward the output side of an amplifier. Only the TX circuit will pass the MHA and include reflections from the Antenna.

SRL non-conformance may be justified if the DTFL / RLL clearly show that issues with a legacy main feeder system. Otherwise ***Additional Sweep Testing*** is necessary, see next section.

- Are limits correct for circuit / component being tested? See Sweep Test Limits table.
- Are markers in the correct positions for the components in the circuits? See MBNL Radio Frequencies for Testing / Markers tables.

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3.3.4 Standard Sweep Testing Non-Conformance Considerations - Table

DTFL		RLL	SRL		Check For / Possible Cause
Feeder	Connector		RX	TX	
Fail	Pass / Fail	Pass / Fail	Pass / Fail	Pass / Fail	Likely damage to the main feeder / jumper at a given distance and may need repaired. May be exhibited over a length and will probably require the replacement of the feeder or replacing a jumper. Will affect RLL and SRL
Pass	**Fail**	Pass or Fail	Pass or Fail	Pass / Fail	Likely faulty connector at a given distance, will need replaced. May not be a factory made jumper? Will affect RLL and SRL
Pass	Pass	**Fail**	Pass / Fail	Pass / Fail	More likely to happen on main feeder with many connectors / jumpers or old / legacy feeder systems that are being re-used. Should not happen on new installations. May affect SRL if failing RLL limit. If following SRL pass then it is at the Cell Planner's discretion the course of action to take, depending on cell performance.
Pass	Pass	Pass	**Fail**	**Fail**	Could be any jumper / component up to and including the MHA. Although not the antenna unless there are multiple issues on the antenna line. ***Additional Sweep Testing Required***
Pass	Pass	Pass	**Fail**	Pass	Could be any jumper / component up to and including the MHA. Will not be caused by external interference. Is the MHA powered? MHA RX bypass circuits have very poor SRL. If this happens across many circuits it suggests that the MHA were NOT powered. ***Additional Sweep Testing Required***
Pass	Pass	Pass	Pass	**Fail**	Could be any jumper / component up to and including the Antenna or even external interference. Is the MHA powering should not be an issue as the MHA TX circuit remains the same powered or un powered. If this is common to both cables in a sector it suggests that there may be a problem with the MHA or Antenna. ***Additional Sweep Testing Required***

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3.4 Additional Sweep Testing – Divided in Two / to 50 Ohm Load / Component

Where an SRL non-conformance cannot be explained from the DTFL / RLL results then it is necessary to divide the antenna line in two, using a 50Ohm load, and test the two parts separately. It is the SWC decision as to whether to split the system, at the antenna or UCU or other position.

**** BOTH halves must be tested ****

If both halves pass their respective limits independently, then record the results in the RICC and the antenna line is now considered passing.

If one of the halves still is non-conformant then this should be further sub divided, or eventually, split down into its components, access permitting. Eventually either:

- all the halves / sub-systems / components will pass – antenna line Passes
- a faulty component / jumper / connector will be identified as non-conformant

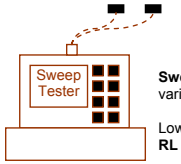
This will consist of SRL / RLL and DTFL sweep tests as described before and:

RL – Return Loss – same as SRL, but for part of the antenna line, using the antenna as the end load.

3.4.1 Schematic Diagram Key

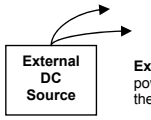
Not every configuration has its own schematic in detail. It is possible that there are combinations of the schematic diagrams in the Appendix. If any SWC field technician is in any doubt about DC circuits for testing or operation then they should refer to their SWC rigging technical lead.

Schematic Diagram Key

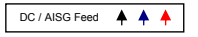


Sweep Tester and Test Connections – shows the test connection points for the various tests that may be required.

Lower box details the example **Test / Plot Name**. In this case its:
RL MHA + Ant = MHA and Antenna (no MHA jumper)



External DC Source – 12V dc power source. This may be mains / battery powered or may be possible to power from the sweep test equipment (ZVH) with the appropriate leads.



DC Current Indicator Arrows

Black – Test / Mixed **Blue – 3G 2100** **Red – 2G 1800**



BTO - Bias T Operational – Needs to remain in the circuit to power the MHA.



BTO / BTT - Bias T Operational / Test – Will be needed for testing. Although, if also an Operational bias T it will need to be left in the circuit. Most legacy E/// 2G equipment will have operational Bias-Ts installed. These may be used to inject MHA DC power for testing by connection with an SMA / M8 Nano-Change (PITA) Lead.



BTT - Bias T Test – Used for testing ONLY. Will need removed from circuit after testing.

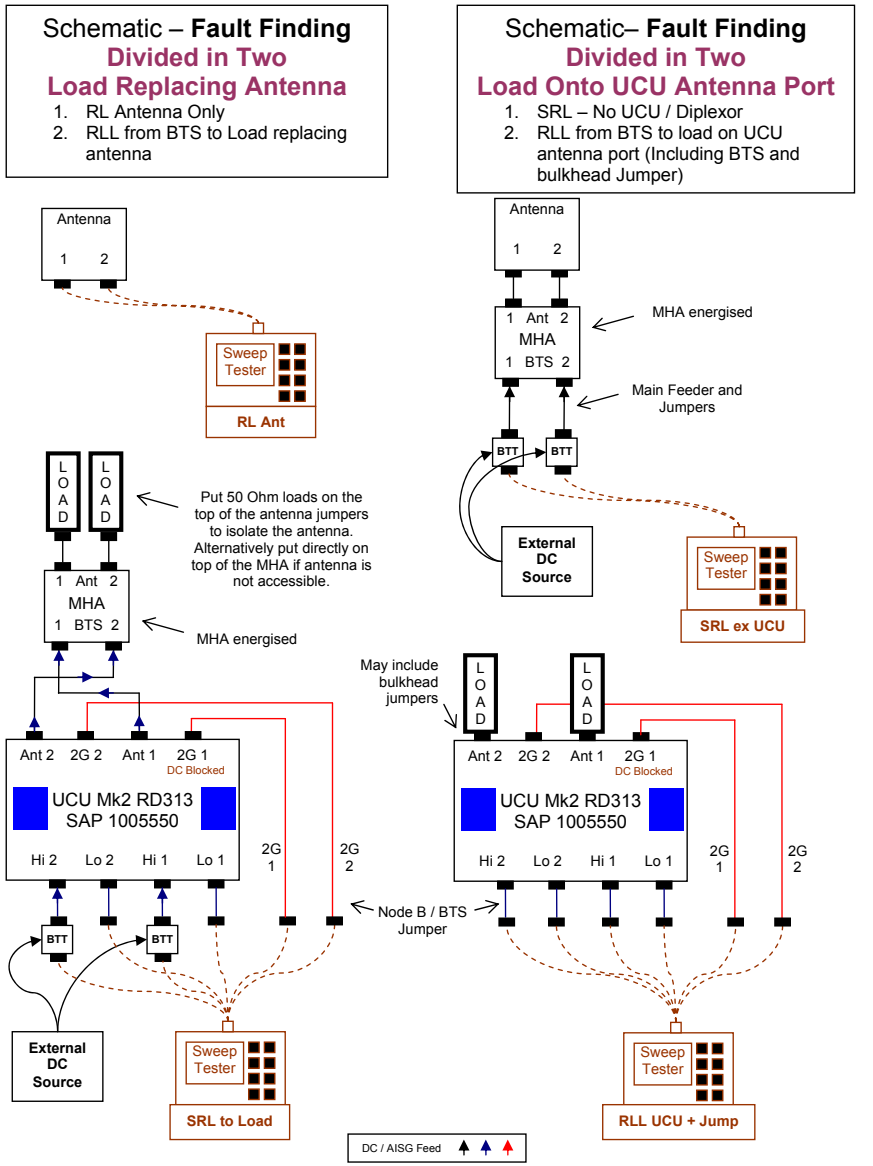


BTB - Bias T Block – Operational Bias T used for DC blocking, needs to remain in the circuit

Connector / Connector Pair – normally DIN 7/16

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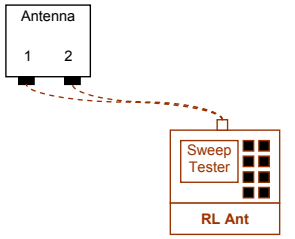
3.4.2 Additional Sweep Testing Schematics - Fault Finding – Divided in Two



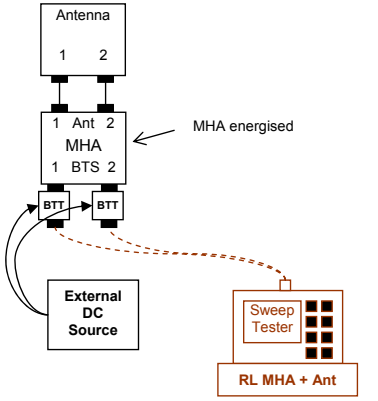
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3.4.3 Additional Sweep Testing Schematics - Fault Finding – Sub Divided / Component Testing

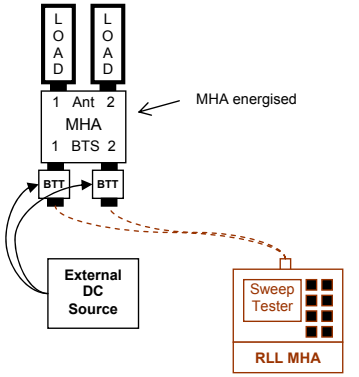
Schematic – **Fault Finding**
Component Testing
RL Antenna Only



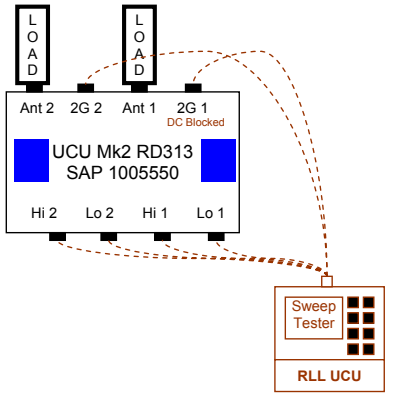
Schematic – **Fault Finding**
MHA and Antenna
(NO MHA Jumper)



Schematic – **Fault Finding**
Component Testing
RL MHA Only



Schematic – **Fault Finding**
Component Testing
UCU to Load (NO Jumpers)



DC / AISG Feed

Divided in Two / Sub Divided SRL / RL / RLL Limits - see sweep test limit table.
UCU Switches and DC Blocking - As described in other schematics

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3.5 Reporting a Testing Non Conformance

This may be because of faulty equipment provided free issue or for legacy equipment issues. If it is due to SWC installation SWC should be returning ASAP to put right before completion of the works and handover. Faulty free issue equipment should be tested and returned via DOA or returns process.

Justify on RICC and log on COC. Contact Cell Planner of Implementation Manager for their advice / direction.

Raise a Trouble Ticket / PR, this can be direct with the NOC / GNOC or via the Cell Planner / Implementation Manager. Record the reference on the COC or RICC.

NOC Front Office- Ericsson	GNOC - NSN
Phone 01189 024222 Option 1 option 1 for 2G sites Option 1 option 2 for 3G sites	Phone 020 3318 6361

Record trouble ticket or PR number on COC / RICC. If not raised you will need an E-mail confirming arrangements made with the relevant Cell Planner / MSP Implementation Manager.

3.5.1 Reporting an Antenna Line Design Non Conformance

This is detailed in ***RD10012_GSDD004A*** and ***Q1007***.

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4 Rigging Handover Documentation

To be uploaded onto *ADCBuild / SiteNet* under relevant Project and categorization, in accordance with *S1010 Handover Pack Requirements*.

1) **RD10011_GSDD054 / LEE003 Form – Certificate of Conformance (COC) - Form,** Word file. With inserted files:
   a. RD10011_GSDD054 / LEE003 – Rigging Installation and Commissioning Certificate (RICC) – form
   b. Sweep Test Plots
   c. Antenna Alignment file
   d. RET Report files
   e. Concessions / Non Conformance files
   f. Other files
      i. The only serial number logged in ***RD10011_GSDD054 Forms*** is the RET motor serial numbers and these are to be recorded on the ***RICC Form***. ***S1016*** **Equipment & serial number schedule** – has its own existence and must be loaded independently to ADC build, it may be required in accordance with:
         a) ***S1010 MBNL Handover Pack Requirements***, or
         b) S1016 may be use for transfer to asset logging systems (Legacy OuK sites).
      ii. Emails – confirming actions taken, especially from Cell Planner
2) **Photo File** – Excel File
3) **RDS**

Out of scope: CAD drawings / ICNIRP / SRF / Other files are uploaded separately in accordance with *S1010 Handover Pack Requirements*.

4.1 SWC Archive Files – Additional Recommendation

In case further interrogation / justification is needed, as only PDF required for some COC attachments, it is recommended the SWC keeps archive electronic copies, for 12 months of:

1. RICC Excel 2003 file
2. Plots actual data file (.mdb or equivalent)
3. GPS data file

4.2 File Naming Convention

Save files as detailed below.

4.2.1.1 Table – File Naming Table

Cell ID	Document	FX Band / Tech	Project
5 digit number or similar	Type	Detail which FX / Tech is covered IF not all of them	What is the main project under which works being done
12345	RICC / COC / Plots / GPS Align / RET / Emails	2G / 3G / LTE / 08LTE / 18LTE / 26LTE etc	2G Refresh / 2G Onto 3G / JBP500 / 3rd Carrier / Diamond
Examples: 12345_COC_2G onto 3G			
12345_RICC_3G_2G onto 3G		12345_RICC_2G_2G onto 3G	
12345_Plots_3G_2G onto 3G		12345_ Plots _2G_2G onto 3G	
12345_GPS Align_2G onto 3G		12345_RET_2G onto 3G	

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4.3 RD10011_GSDD054 / LEE003 – Certificate of Conformance (COC) – Form R2.00

Word document used to record on-site rigging activities. General site information is inserted to the document and other documents are to be 'inserted' in the relevant sections. Attached file sizes are to be adjusted accordingly to keep size reasonable (below 5Mb). Provides one document compiling the: rigging instructions, results, concessions and non-conformities.

4.3.1 COC Screen Shot – Section 1 – Installation Information

Most should be self explanatory. Example screenshot below:

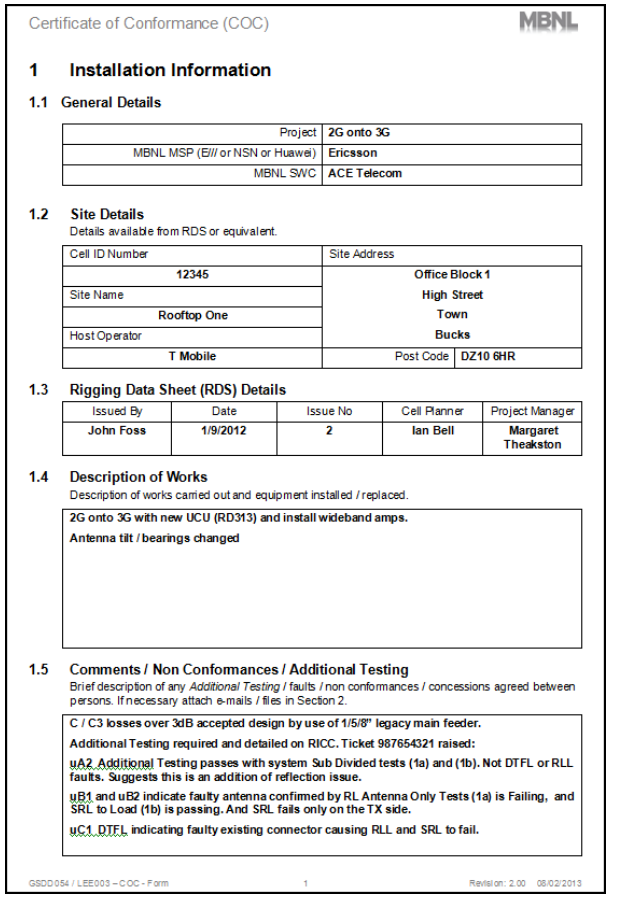
1.1) General Details

1.2) Site Details – all details available on the RDS

1.3) Rigging Data Sheet (RDS) Details – all details available on the RDS

1.4) Description of Works – brief

1.5) Comments and Non Conformances – brief, add details as necessary



Certificate of Conformance (COC) MBNL

1 Installation Information

1.1 General Details

Project	2G onto 3G
MBNL MSP (E/// or NSN or Huawei)	Ericsson
MBNL SWC	ACE Telecom

1.2 Site Details

Details available from RDS or equivalent.

Cell ID Number	Site Address
12345	Office Block 1
Site Name	High Street
Rooftop One	Town
Host Operator	Bucks
T Mobile	Post Code DZ10 6HR

1.3 Rigging Data Sheet (RDS) Details

Issued By	Date	Issue No	Cell Planner	Project Manager
John Foss	1/9/2012	2	Ian Bell	Margaret Theakston

1.4 Description of Works

Description of works carried out and equipment installed / replaced.

2G onto 3G with new UCU (RD313) and install wideband amps.
Antenna tilt / bearings changed

1.5 Comments / Non Conformances / Additional Testing

Brief description of any *Additional Testing* / faults / non conformances / concessions agreed between persons. If necessary attach e-mails / files in Section 2.

C / C3 losses over 3dB accepted design by use of 1/5/8" legacy main feeder.
Additional Testing required and detailed on RICC. Ticket 987654321 raised:
uA2 Additional Testing passes with system Sub Divided tests (1a) and (1b). Not DTFL or RLL faults. Suggests this is an addition of reflection issue.
uB1 and uB2 indicate faulty antenna confirmed by RL Antenna Only Tests (1a) is Failing, and SRL to Load (1b) is passing. And SRL fails only on the TX side.
uC1 DTFL indicating faulty existing connector causing RLL and SRL to fail.

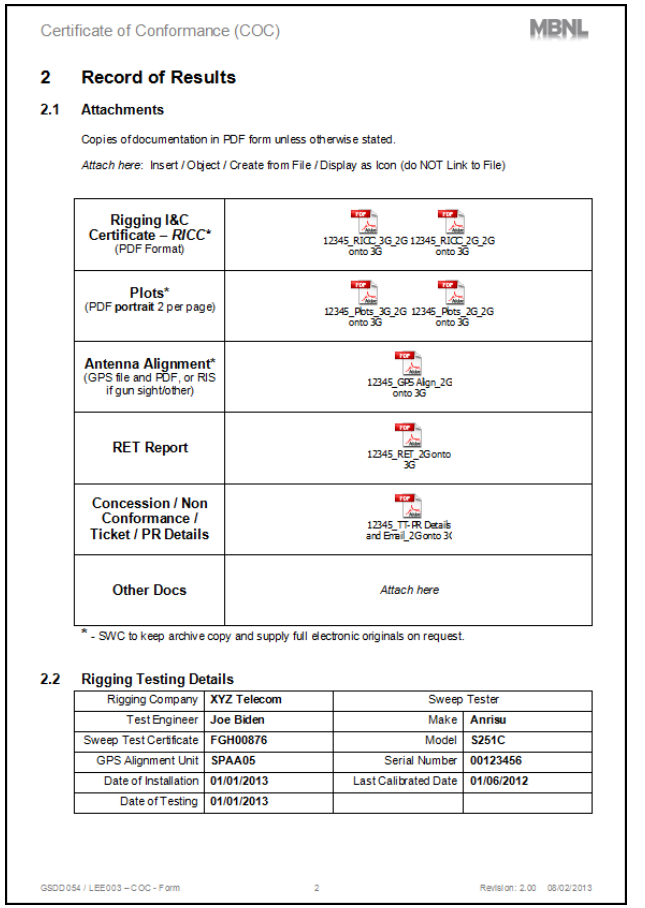
GSDD054 / LEE003 – COC - Form 1 Revision: 2.00 08/02/2013

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COC Screen Shot – Section 2 – Record of Results
Page to insert support documents (as files) as required covering the work carried out. Example screen shot below.

2.1) Attachments

2.2) Rigging Testing Details - Confirm the details of the rigging contract company, site test engineer and the details of the test equipment used to carry out the testing. Test engineers must have attended the Anritsu SiteMaster Training course or equivalent. Test Equipment last calibration date will be entered and should be within the last 12 months.



Certificate of Conformance (COC) MBNL

2 Record of Results

2.1 Attachments

Copies of documentation in PDF form unless otherwise stated.

Attach here: Insert / Object / Create from File / Display as Icon (do NOT Link to File)

Rigging I&C Certificate – *RICC** (PDF Format)	12345_RICC_3G_2G onto 3G 12345_RICC_2G_2G onto 3G
Plots* (PDF **portrait** 2 per page)	12345_Plots_3G_2G onto 3G 12345_Plots_2G_2G onto 3G
Antenna Alignment* (GPS file and PDF, or RIS if gun sight/other)	12345_GPS Align_2G onto 3G
RET Report	12345_RET_2Gonto 3G
Concession / Non Conformance / Ticket / PR Details	12345_TT-PR Details and Email_2Gonto 3(
Other Docs	*Attach here*

* - SWC to keep archive copy and supply full electronic originals on request.

2.2 Rigging Testing Details

Rigging Company	**XYZ Telecom**	Sweep Tester	
Test Engineer	**Joe Biden**	Make	**Anrisu**
Sweep Test Certificate	**FGH00876**	Model	**S251C**
GPS Alignment Unit	**SPAA05**	Serial Number	**00123456**
Date of Installation	**01/01/2013**	Last Calibrated Date	**01/06/2012**
Date of Testing	**01/01/2013**		

GSDD054 / LEE003 – COC - Form 2 Revision: 2.00 08/02/2013

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4.4 GSDD0054 / LEE003 - Rigging I&C Certificate (RICC) – Form R2.00

***** *Need to enable Macros. May need to reduce Excel security level in Developer / Options* *****

Excel document (Version 2003). Only coloured cells will accept entry. Several entry boxes use drop downs. If you don't know the SAP code from the drop down for an MHA or combiner, and it is not on the RDS, use the 'SAP Number Lookup' tab.

Each RICC covers one frequency 1800 or 2100 etc. Recommended way to save time is to build the schematic and do one of the frequencies (say 2100) then, using 'save as' and then changing the Primary SRL frequency, to 1800 and amend the components.

The RICC should be completed while on site by the SWC field operative. The users of the RICC are the SWC Implementation team and the MBNL Cell Planner. The **MBNL Cell Planner uses the RICC** as a single sheet summary to:

1) Decide if antenna line is operating to levels that will not negatively affect performance
2) To confirm the circuit Total IL, for Node B / BTS parameters.
3) **Confirm Circuit and Schematic**: the equipment, jumpers and feeders installed on site, and their configuration. This information is used in Nemesis where a digital model of each Antenna Line is stored. Antenna line components (MHA, UCU, Diplexor) types should be detailed wherever possible, as this will affect the sweep test marker bands that are operational.
   A **complete rigging schematic** is required whenever rigging works are carried out, with the exceptions of:
   a. Antenna tilt / bearing change – no schematic is required.
   b. Single component like for like swap, with no changes to jumpering / main feeder and no climbing undertaken. Schematic required only detailing the new component installed. It is acceptable to record unchanged legacy jumpers and feeders as 'existing'. Only required to enter lengths if a DTFL is required or new cables inserted.
      i. excludes MHA swaps as this involved climbing, DTFL and RLL should be done, and schematics detailed.

4.4.1 RICC Worksheets Tabs



Worksheet tabs should not be copied and pasted. They should be kept in this order.

4.4.1.1 *Standard Testing* Worksheet

This is where site information, circuit schematic and Standard Sweep Tests are recorded. This sheet should always be PDF printed along with the Additional Testing Worksheet.

4.4.1.2 *Additional Testing* Worksheet

Most information in this sheet is imported for the Standard Testing worksheet. Confirm test limits for *Additional Testing* and record results. This sheet should always be PDF printed along with the Standard Testing Worksheet.

4.4.1.3 *SAP Number Lookup* Worksheet

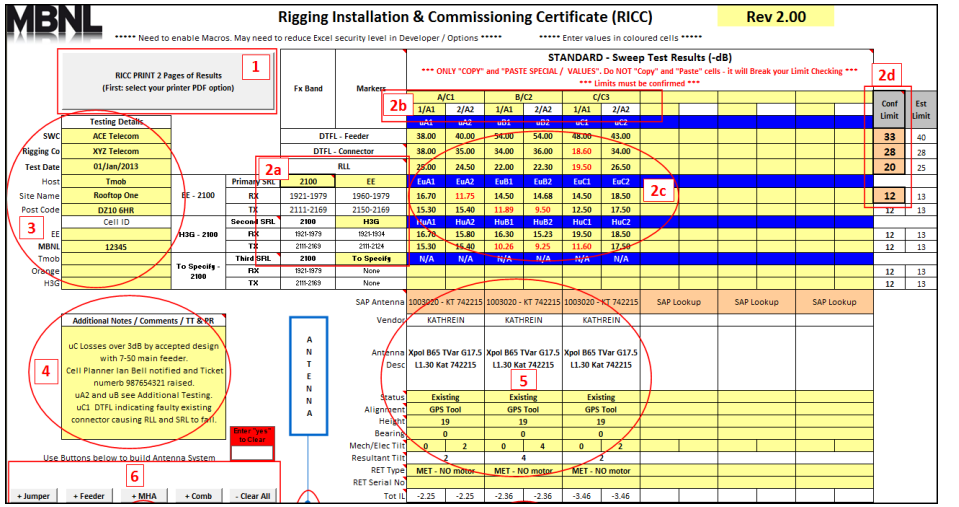
You can lookup MHA, antennas, combiners and diplexors here to get additional information on their specifications. You can also add MHA, Antennas or Combiners that are not available in the drop down lists. So non standard, test or trial equipment, can be input.

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4.4.2 RICC 3G Standard Testing Tab - Top Half

Guidance is highlighted in diagram below. Red Numbers provide cross reference.

1) Print button will automatically print the Standard and Additional Testing sheet to the selected printer. You will need to select your PDF file print option before hitting this button.
2) Select Frequency / Markers / Limits / Sector ID and enter results.
    a. Selecting the *Fx Band* (say 2100) will automatically set the frequency and sector labels. One frequency per RICC. To make this sheet for 1800 of a wideband job, first save your work then 'Save As' new filename and change the *FX Band* to 1800. Markers drop down allowing up to 3 operator sub band tests for the *Fx Band* selected. In example below there are EE and H3G sub bands on the 2100.
    b. Select Sectors and Antenna references from drop downs. Delete unwanted sectors.
    c. Record results. RICC will turn these **RED** if they fail minimum limit. Example below show some fails and there is an explanation in part 4 and there would be Additional Sweep Testing carried out and recorded in the *Additional Testing* tab.
    d. You need to enter the limits against which you are testing or all results will turn **RED**. A limit estimate is provided and there it table to the right.
3) Enter the general details on the top left.
4) Free text field. Record note / comments / non conformance / Trouble Ticket References etc.
5) Enter antenna and RET information
6) Build the circuit below the antenna using the buttons. This can be cleared by using the Clear All after inputting 'yes' into the red box. It's built from the top down and will add the next component underneath.



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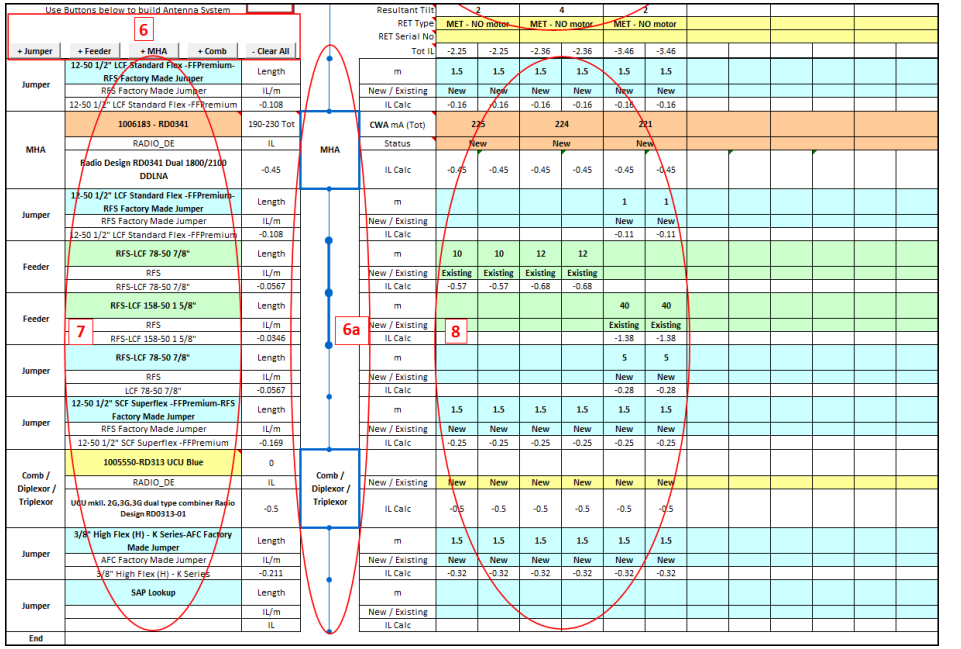
4.4.3 RICC 3G Standard Testing Tab - Building the Circuit

6) Build the circuit below the antenna using the buttons. This can be cleared by using the Clear All after inputting 'yes' into the red box. It's built from the top down and will add the next component underneath.

   a. The circuit diagram will build itself

7) Select the feeder / MHA / Combiner type from the drop downs. This will do most of the work for you. Below you can see that all the new jumpers are 'Factory Made Jumpers'.

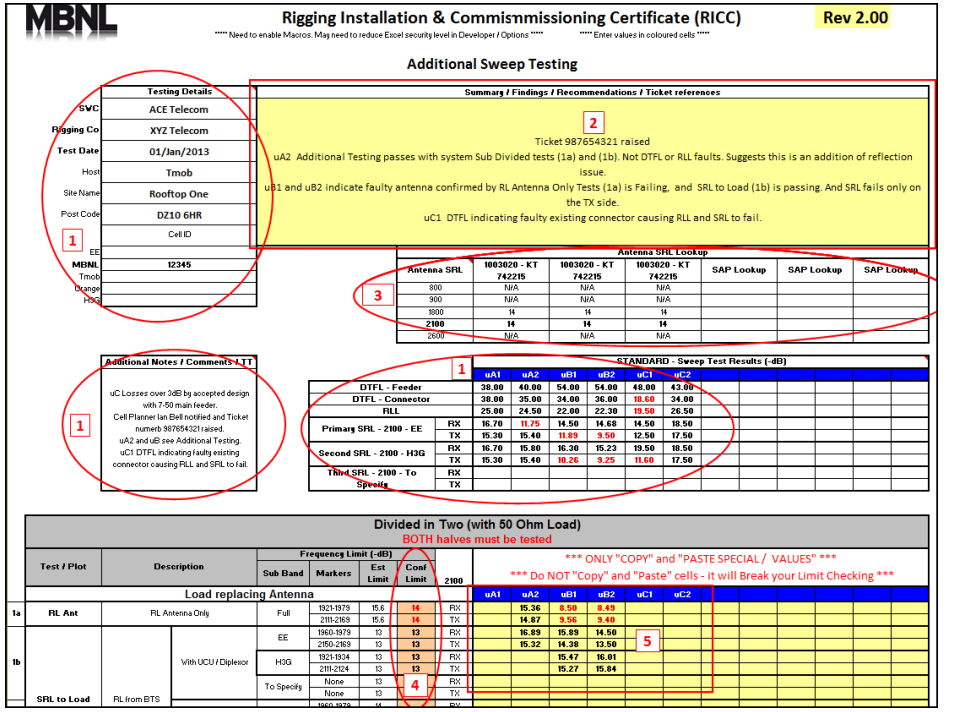
8) Enter lengths / currents and if a component is New / Existing / etc. In example below sectors C has different feeder types. This is catered for by entering additional feeder types when building the circuit then leaving blank or selecting 'None' or entering zero value.



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4.4.4 RICC 3G Additional Testing Tab

1) Information and results are brought across automatically from the *Standard Testing* sheet.
2) Record explanation of *Additional Testing* results
3) Reference table providing the SRL values for antennas used and applicable frequency.
4) Enter the 'Confirmed Limits' for each test in these boxes. If you do not enter a value here all the results will remain **RED**.
5) Record *Additional Testing* results in this section.



Further down in the *Additional Testing* tab there are places for:

- other component testing
- MHA drop downs (need to be selected)
- Free text fields for other tests.

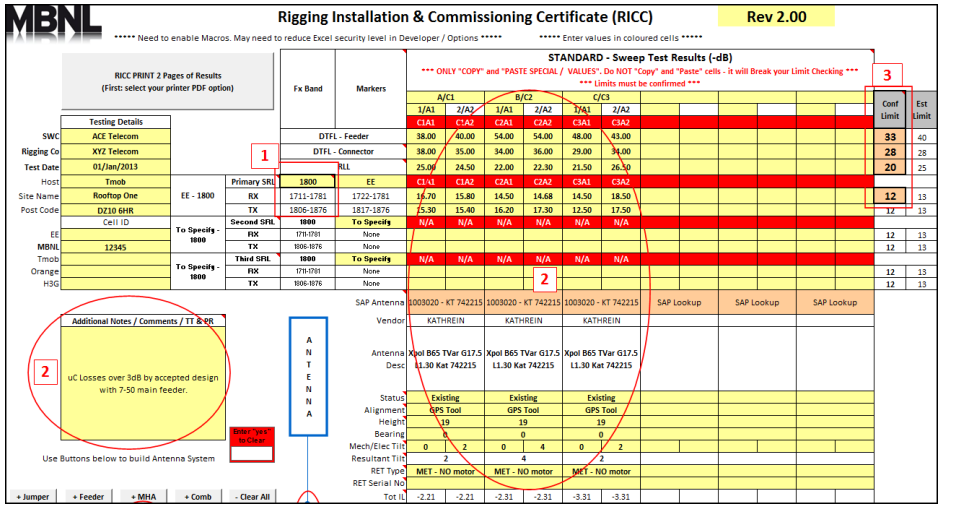
And there are some further examples of issues / resolution in the Appendices.

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4.4.5 RICC 2G Standard Testing Tab

For example: once the 3G RICC has been completed and 'saved' do a 'save as' changing the file name. Then select the *Fx Band* to 1800, amend and record the 2G results as per 3G. Example below shows all *Standard Testing* is PASSING so there is no need for any *Additional Testing*.

1) Select 1800. This will automatically change the sector antenna IDs.
2) Amend and record the 2G results
3) Limits may differ when you change frequencies or if the circuits are different. I.e. a separate 2G system will not go through a UCU and the SRL limit will be high.



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5 Appendix – Approved Test Equipment

Use	Manufacturer / Supplier	Model	Description	Website
Cable and Antenna Analyser	**Anritsu**	Site Master S332E or S331E Replacement for S251C S251C Manufacture Discontinued but many still available via lease companies. S331E	RF spectrum analyzer for Mobile Telecommunications Can come with integral Bias T and DC power. Handheld Software Tools V6.61 or later Select .MDB or .DAT plot format. .VNA format is undesirable.	www.anritsu.com/en-GB/
	Rohde& Schwarz	ZVH Cable and Antenna Analyser	RF spectrum analyzer for Mobile Telecommunications Can come with integral Bias T and DC power.	www.rohde-schwarz.co.uk
GPS Alignment Tool	**SPAA05**	10580-00065	Must use UK Grid North - Datum OSGB36 Securely mount to antenna	www.spaa05.com
	Thales			
	MulitWave Sensors			
	Associated Antennas LTD			
	PPM GmbH	4011 GPS Compass System		info@ppmgmbh.com Michael Singer m.singer@ppmgmbh.com
Antenna mechanical inclination and verticality	**Digital Inclinometer / Clinometer**	Various	Accurate to 0.2deg	
PIM	**Not specified**	Not specified		Not specified
electromagnetic field strength monitoring equipment	**NARDA**	As appropriate	Narda Alert	www.narda-sts.de/home.html

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6 Appendix – MHA DC Power for Testing

6.1 MHA Bias T Powering for Testing

Key aspects / requirement of SRL testing are:

1. DC powers the circuit from the normal ***'Operational Source'***. External DC power source and 2No Testing Bias-Ts will be required.
2. Node Bs / BTS are correctly configured to power the installed MHA. This may require remote **(SOG)** support for configuration. Especially where MHA are being changed.
3. DC Blocking is used against unwanted DC propagation, but may also need changed, if changing MHAs.
    a. ***UCU DC selector switches*** are correctly depressed.
    b. ***DC blockers (Bias Ts)*** are applied / removed as necessary to operational circuits.

MHA must be powered for SRL testing or they will fail in the RX range(s) because of low performance of the RX bypass circuits. TX circuits are the same powered, or not. It is unacceptable to state that and SRL fail is because the MHA were not powered. This applies to both pre and post SRL tests.

This section refers to MHA ports 1&2, some MHA may be numbered 0&1, or A&B, but 1&2 are referred to generically.

When testing MHAs from a simple DC power source they will operate in Current Window Alarm (CWA) mode. This may differ from when AISG capable MHAs detect an AISG signal, e.g. when being powered from the BTS or Node B. Legacy AISG MHA such as the NSN WMHD will always have AISG on Port 1 and DC on Port 2. However more modern AISG MHA have built in intelligence, that will select the AISG and DC power port(s) depending on whether they detect an AISG signal or not. In some instances AISG MHA require DC on both ports in CWA mode, when no AISG is detected, for testing purposes.

Self selecting AISG MHA can take several minutes to settle down if they detect any AISG signal, or if they have their DC constantly switched around.

For SRL testing an MHA's DC power can come from several (but never multiple) sources:

1. **Requires** - External DC source with 2No Testing Bias-Ts to confirm operational DC circuit from equipment end.
2. Equipment (BTS / Node B) – when working on the 2G side, BTS jumper side only, of a UCU where the wideband MHA is powered form the 3G Node B (which is still operational), the MHA will remain powered for the SRL testing.

As a last resort SiteMasters / ZVH can provide DC on the test circuit via internal Bias-Ts, but this will only power a single side of the circuit, and will only work in some instances (will not work when testing via a UCU). Also AISG signals from the sweep tester may cause the modern self selecting AISG MHAs to go into auto selection mode, rather than CWA. This can take several minutes to complete:

An external DC power source is REQUIRED.

6.1.1 MHA Testing Principles

External DC power source will be required for testing via UCU. The principle of the guidance is to get the Antenna Line operationally configured and tested:

1. UCU switches in an operational configuration proving the normal operation DC paths are powering the MHA. No need to be switching UCU switches during commissioning testing, thus reducing the risk of them being incorrectly set.
2. Ensuring the Antenna Line circuit is in its complete operational configuration when being SRL tested. With no further requirement to make / unmake Antenna Line connectors for the addition / removal of testing Bias-T(s) or testing jumpers.

Testing Bias-T(s) should **not** be inserted above the UCU to power the MHA as this will defeat points (1) and (2) above. Testing Bias-T(s) should be removed from the end of the circuit on completion of testing and only operational Bias-T(s) should be left in an antenna line.

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DC current is critical as all MHAs have an operational DC current range (mA). If the DC current draw is too low (circuit problem) or too high (MHA alarm) then the MHA is not functioning.

When changing MHAs and the operational source DC power feed, it will normally be necessary to remove / reposition DC blocks. This can be done via UCU switches or may require the physical removal / repositioning of DC blocking bias-ts.

When DC power is provided via the BTS / Node B then the MHA type must be confirmed within the telecoms equipment. This is of particular importance when changing / upgrading MHA types and will normally require a change of BTS / Node B parameters either remotely (via **SOG** support) or locally. This will set DC power provision and AISG communications, where applicable.

Always use 12V unless particular MHA requires a different voltage.

When using a Triasx MHA with a PDU, the three green lights will be sufficient, but must be photographed.

6.2 UCU DC Selector Switches

GSDD050 2g / 3g UCU – (Universal Combiner Unit) provided additional UCU details. Table below describes the UCU selector switch selection combinations. Selection for testing should be the same as the operational settings, depending on which BTS or Parent Node B is powering the MHA, in normal service.

UCU switches select when it's depressed / pushed in.

6.2.1.1 Table – UCU DC Selector Switch Settings

UCU Selector Switch (Depress to select)			**DC Port Pass Active**					
			**GSM**		**Hi** 3G EE		**Lo** 3G H3G	
ANT2 DC		ANT1						
3G / GSM 1800	Hi / Lo		**2**	**1**	**2**	**1**	**2**	**1**
GSM 1800	Out of Circuit	**N/A** Node Bs to be set to No AISG and No Power MHA Other	**DC**	**X**	X	N/A	X	N/A
3G	HI-BAND	DC HI	X	X	**DC**	**DC**	X	X
3G	LO-BAND	DC LO	X	X	X	X	**DC**	**DC**
Below combinations **Do Not Used**								
3G **(Do Not Use)**	HI-BAND	DC LO	X	X	DC	X	X	DC
3G **(Do Not Use)**	LO-BAND	DC HI	X	X	X	DC	DC	X

X = DC Blocked

GSM 1800 Port 1 is ALWAYS DC Blocked

ANT 1 "AISG" is ignored as this only relates to the AISG port on the back of the UCU and is dependent on the ANT 1 DC selection.

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6.2.2 MRC (Multi Radio Combiner) DC Bypass

The NSN supplied MRC (Multi Radio Combiner) combines 3G only, and does not include for 2G (1800). MRC combines the 3G from BTS1 and BTS2 in a different way than a UCU. MRC has no DC selector switches and is hard wired, the Schematic in Appendix:

MRC BTS 1 – Child Node B – DC Blocked

MRC BTS 2 – Parent Node B – DC Bypass

MRC Operational Testing
!! Exception !!
SRL – disconnect the MRC Jumper from the MRC and SRL test antenna line without the MRC in circuit. This will be full band 3G and all 3G frequencies are visible on one plot.
Fault Investigation
SRL test MRC by itself and MRC Node B jumpers separately.

EXCEPTION: The way the MRC RX band works the RX SRL results would be of limited value. Therefore for operational commissioning purposes SRL testing on MRC sites will be done from the MRC jumpers.

For MRC legacy installations the Wideband MHA should only be Triasx type and may only be powered from the 2G side of diplexors using PDU, and putting DC blocks on the Diplexor 2100 side.

MRC should be swapped out for the current UCU version (Mk2 RD313 blue band at present) and the associated Triasx wideband MHA also swapped for a Wideband Full Band variant (presently a Kaelus, RD341, RD 376, etc)

6.2.3 Testing Bias-Ts and 12V External DC Supply

Bias-Ts shown below will block the DC from the BTS (Male) connector and feed DC via the ANT / RF DC (Female) connector. A male / male adaptor will be needed if connecting direct to UCU ports.

6.2.3.1 NSN – Bias-T [w/out VSWR] (CS7299613) SAP 601803 Nokia Stock item

NSN Bias-T used as DC Blocker. DC connection is via an M8 Nano-Change (PITA) lead.



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6.2.3.2 ETL – KRY101-1587/1 Diplex Bias-T Unit800 SAP S002087 Ericsson Stock item

ETL Bias-T may also be used as a DC Blocker. DC connection is via an SMA lead.



6.2.3.3 Image – External DC Supply with 2No Bias Ts (available from ICD)

Portable units also available. Polarity of 4mm banana plugs must be correct.



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6.3 MHA – Additional information on CURRENT MHAs

MBNL 2G / 1800 MHA - CURRENT							
MHA	Dual?	2G	3G	AISG	DC Power	Recommendation for testing external DC Power	
						Port 1	Port 2
Commscope / Andrew E15S09P75 SAP 1006246	Dual Unit	Full	N/A	(TBC)	CWA if no AISG detected	100-120mA for MHA. When CWA powered up both sides unit will take all power from one side and also apply a 100mA dummy load to the other port 200-220mA total	
PowerWave LGP18521 SAP 1006170	Dual Unit	Full	N/A	2.0 – Fixed to Port 1 (BTS0)	CWA if no AISG detected (TBC)	90-130mA each (TBC)	90-130mA each (TBC)
						Requires feed to both ports in CWA 180-260mA total (TBC)	

MBNL 3G / 2100 MHA - CURRENT							
MHA	Dual?	2G	3G	AISG	DC Power	Recommendation for testing external DC Power	
						Port 1	Port 2
Kathrein 782 11120 SAP 1006180	Dual Unit	N/A	Full	2.0 – self selecting	CWA if no AISG detected	80-120mA each	80-120mA each
						Requires feed to both ports in CWA 160-240mA total	
NSN WMHD SAP 606492	Dual	N/A	Full	Fixed to Port 1	Port 2 only	AISG only	100-190mA via Port 2
						Recommend feed to both ports for testing but will work from Port 2 only. 100-190mA total	

MBNL WIDEBAND MHA - CURRENT							
MHA	Dual?	2G	3G	AISG	DC Power	Recommendation for testing external DC Power	
						Port 1	Port 2
"Kaelus" TMA2053F01V2-1 SAP 1006509	Dual Unit	Full	Full	2.0 – self selecting	CWA if no AISG detected	Requires feed to either port in CWA, will draw from Port 1 (BTS1) only if presented to both. Total the same: 235-275mA total Increased top end by 10mA as site readings close to top end.	
Radio Design 341 - 1006183 376 - 1006185 448 - 1006810	Dual Unit	Full	Full	2.0 – self selecting	CWA if no AISG detected	95-115mA each	95-115mA each
						Requires feed to both ports in CWA 190-230mA total	

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6.4 MHA – Additional information on LEGACY MHAs – P1

MBNL 2G / 1800 MHA - LEGACY							
MHA	**Dual?**	**2G**	**3G**	**AISG**	**DC Power**	**Recommendation for testing external DC Power**	
						Port 1	**Port 2**
PowerWave DDLNA (TBC) SAP 606455	TBC	TBC	TBC	TBC	TBC	TBC	TBC
						TBC	
Ericsson KRY 112 88/1 SAP 1003791 KRY 112 88/2 SAP 607327	Dual Unit	Full	N/A	No	CWA	90-110mA each	90-110mA each
						Recommend feed to both ports in CWA 180-220mA total	
Ericsson P000530					Duplex DLNA (ETL)	TBC	TBC
Ericsson P000531 RTN 501 18/01					LNA	TBC	TBC
P002349 **May Not be in SAP**					Dual Duplex LNA	2 Port Unit	
Ericsson ddTMA SAP S002082 KRY 112 20/11	Single	** Sub **	N/A	No	CWA ddTMA	2 Port Unit so 2No units needed per Xpolar sector +12.8 to +29.5V DC 90+-50mA (alarm >180) each Total 180 – 202mA (2No units) For Testing 160 – 220mA (2No units)	
Ericsson ddTMA SAP S001766 KRY 112 61/2 for RBS 2x06	Single	Full	N/A	No	CWA **May Not be in Spectrum**	2 Port Unit so 2No units needed per Xpolar sector +12.8 to +29.5V DC 96+-5mA (alarm >180) each Total 180 – 202mA (2No units) For Testing 160 – 220mA (2No units)	
ALNA (LGP) SAP P000292 or P000296	Single	TBC	N/A	No	CWA – Separate Units	TX (TBC) DC Blocked	RX (TBC) XXX-YYYmA
						Recommend feed both A1 and A2 RX side at same time to energise both MHA on sector. (TBC)	
FOREM DLNA SAP P001068	TBC	TBC	N/A	No	CWA	TX (TBC) DC Blocked	RX (TBC) XXX-YYYmA
						Recommend ??	
FOREM LNA SAP P001069	Single	TBC	N/A	No	CWA – Separate Units	TX (TBC) DC Blocked	RX (TBC) XXX-YYYmA
						Recommend feed both A1 and A2 RX side at same time to energise both MHA on sector. XXX-YYYmA (TBC)	

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6.5 MHA – Additional information on LEGACY MHAs – Cont'd

MBNL 3G / 2100 MHA - LEGACY							
MHA	**Dual?**	**2G**	**3G**	**AISG**	**DC Power**	**Recommendation for testing external DC Power**	
						Port 1	**Port 2**
NSN WMHC SAP 603736	Dual	N/A	Full	No	Port 2 only	N/A	100-190mA via Port 2
						Recommend feed to both ports for testing but will work from Port 2 only. 100-190mA total	
NSN WMHB SAP 600651	Single	N/A	Full	No	CWA – Separate units	50-95mA each (TBC)	50-95mA each (TBC)
						Requires feed to both ports in CWA 100-190mA total (TBC)	
NSN WMHA SAP D-MSTH02	Single	N/A	Full	No	CWA – Separate units	50-95mA each (TBC)	50-95mA each (TBC)
						Requires feed to both ports in CWA 100-190mA total (TBC)	

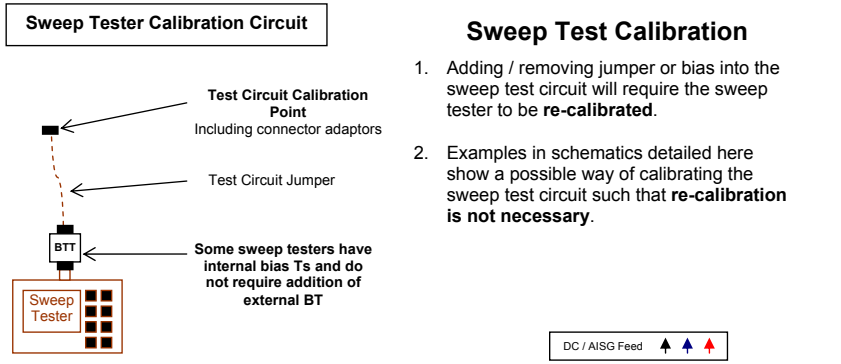
MBNL WIDEBAND MHA - LEGACY							
MHA	**Dual?**	**2G**	**3G**	**AISG**	**DC Power**	**Recommendation for testing external DC Power**	
						Port 1*	**Port 2**
"Triasx" TMA0002F1V1 SAP 607716	Dual Unit	Sub	Full	No	CWA only	Requires feed to either port in CWA, can draw from Port 2 (BTS2) only when powered from 2G side via PDU. Power on both ports if from 3G equipment side. Total the same: 430-565mA total	

* - if 'Port 1' DC power required then it cannot be supplied via the 2G 1800 side of the UCU as there is a DC block on 2G Port 1. Must be dual fed from the UCU 3G side, and Node B(s) should be configured appropriately by **SOG**.

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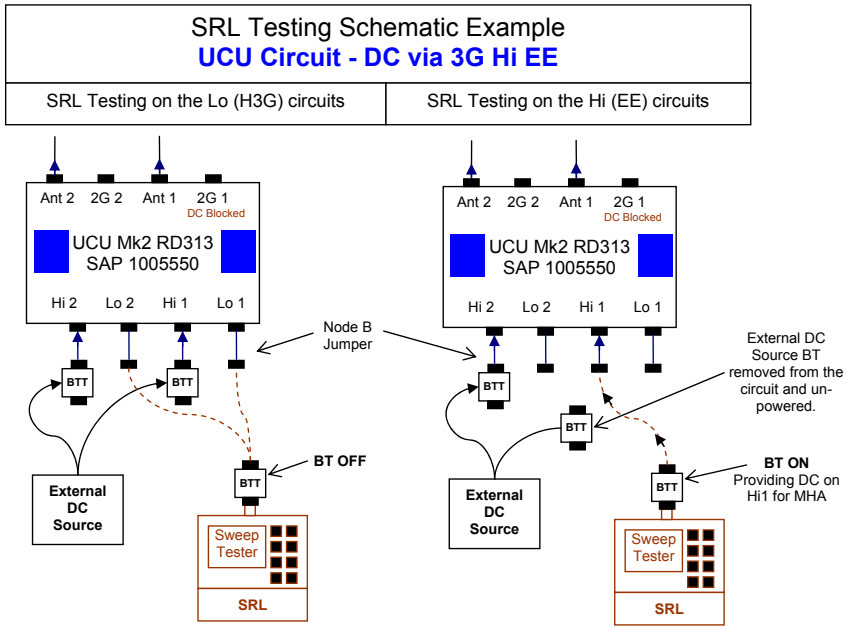
7 Appendix – Sweep Test Equipment Setup

7.1.1 Sweep Test Calibration Schematics



Sweep Test Calibration

1. Adding / removing jumper or bias into the sweep test circuit will require the sweep tester to be **re-calibrated**.
2. Examples in schematics detailed here show a possible way of calibrating the sweep test circuit such that **re-calibration is not necessary**.



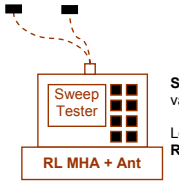
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8 Appendix – Sweep Test Circuit Schematics

8.1.1 Schematic Diagram Key

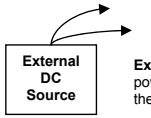
Not every configuration has its own schematic in detail. It is possible that there are combinations of the schematic diagrams below. If any SWC field technician is in any doubt about DC circuits for testing or operation then they should refer to their SWC rigging technical lead.

Schematic Diagram Key

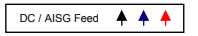


Sweep Tester and Test Connections – shows the test connection points for the various tests that may be required.

Lower box details the example **Test / Plot Name**. In this case its:
RL MHA + Ant = MHA and Antenna (no MHA jumper)



External DC Source – 12V dc power source. This may be mains / battery powered or may be possible to power from the sweep test equipment (ZVH) with the appropriate leads.



DC Current route indicators. Colour represents from which source:

Black Test/Wideband - Blue 3G/2100 – Red 2G/1800



BTO - Bias T Operational – Needs to remain in the circuit to power the MHA.



BTO / BTT - Bias T Operational / Test – Will be needed for testing. Although, if also an Operational bias T it will need to be left in the circuit. Most legacy E/// 2G equipment will have operational Bias-Ts installed. These may be used to inject MHA DC power for testing by connection with an SMA / M8 Nano-Change (PITA) Lead.



BTT - Bias T Test – Used for testing ONLY. Will need removed from circuit after testing.



BTB - Bias T Block – Operational Bias T used for DC blocking, needs to remain in the circuit



Connector / Connector Pair – normally DIN 7/16

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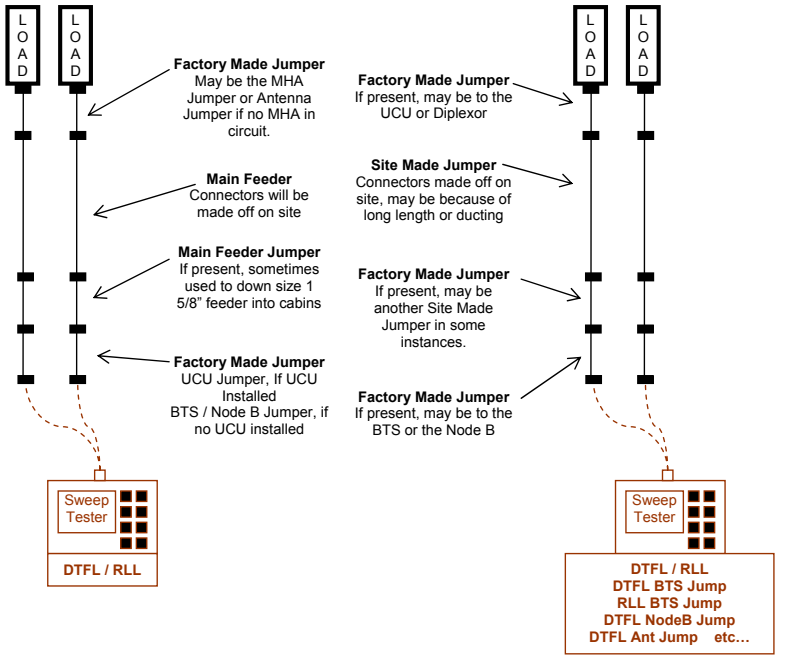
8.1.2 DTFL / RLL Schematic – Main Feeder / Site Made Jumper

DTFL / RLL Schematic
Main Feeder
Antenna/MHA &
UCU/BTS/Node B Jumper

NO UCU / MRC / Diplexors
No DC

DTFL / RLL Schematic
Site Made Jumper
Antenna & BTS/Node B
Jumper

NO UCU / MRC / Diplexors
No DC



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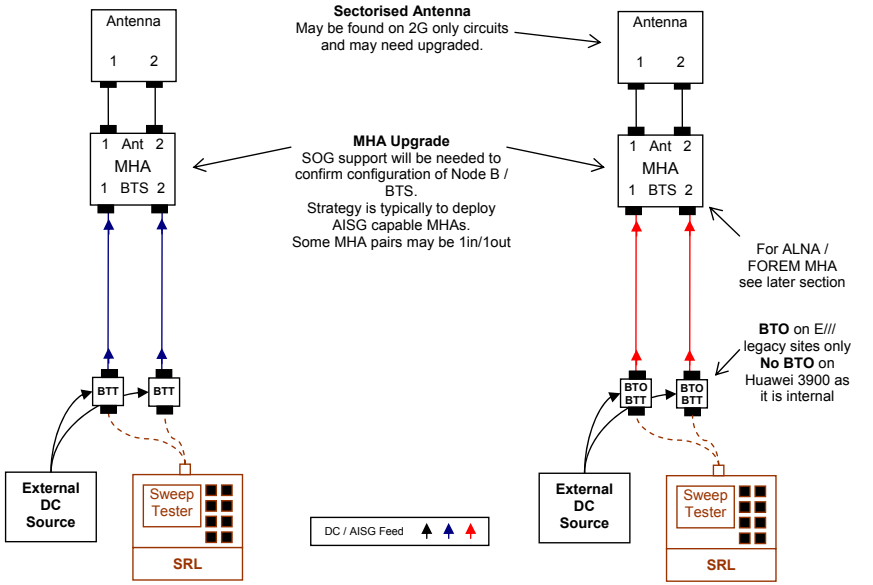
8.1.3 SRL Schematic – 3G & 2G Separate Circuits – NO UCU / MRC / Diplexors

SRL Schematic
Separate 3G ONLY
NO UCU / MRC / Diplexors

DC via 3G

SRL Schematic
Separate 2G ONLY
NO UCU / MRC / Diplexors

DC via 2G / 1800



Flexi MHA control setting will normally need changed to suite new / change to MHA, and will require **SOG** support.
Bias T Key at start of section for guidance if they should remain in the operational circuit: **BTT, BTO/BTT, BTB, BTO**

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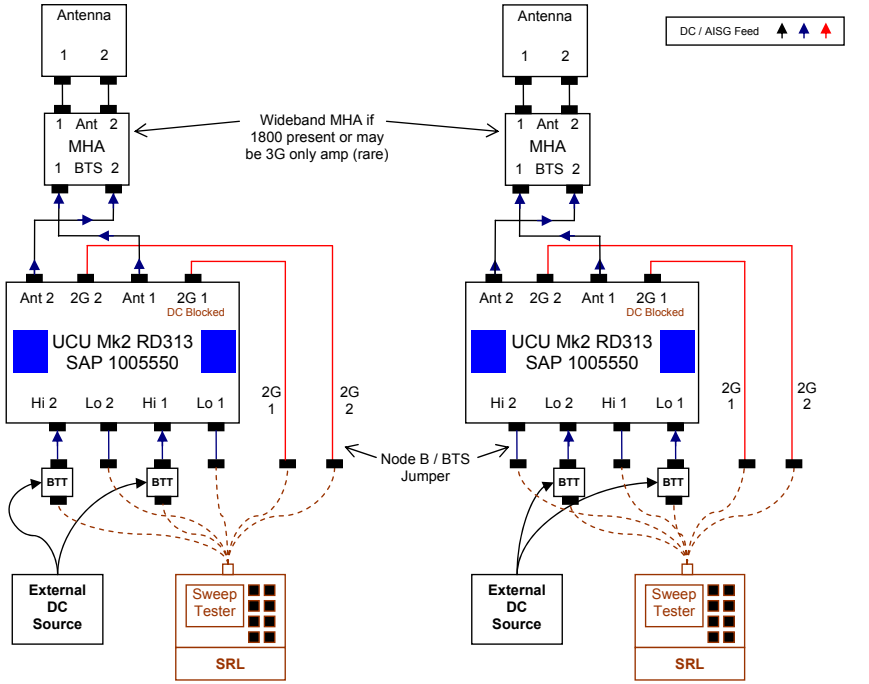
8.1.4 SRL Schematic – UCU Wideband – DC from Node B 2100

SRL Schematic
UCU Circuit
DC via 3G Hi EE
Node B Parent EE/Tmob

UCU Switches to Depress
3G/2G – 3G
Ant1 DC – Hi Band
Ant2 – DC Hi

SRL Schematic
UCU Circuit
DC via 3G Lo H3G
Node B Parent H3G

UCU Switches to Depress
3G/2G – 3G
Ant1 DC – Lo Band
Ant2 – DC Lo



Flexi MHA control setting will normally need changed to suite new / change to MHA, and will require **SOG** support.
Bias T Key at start of section for guidance if they should remain in the operational circuit: **BTT, BTO/BTT, BTB, BTO**

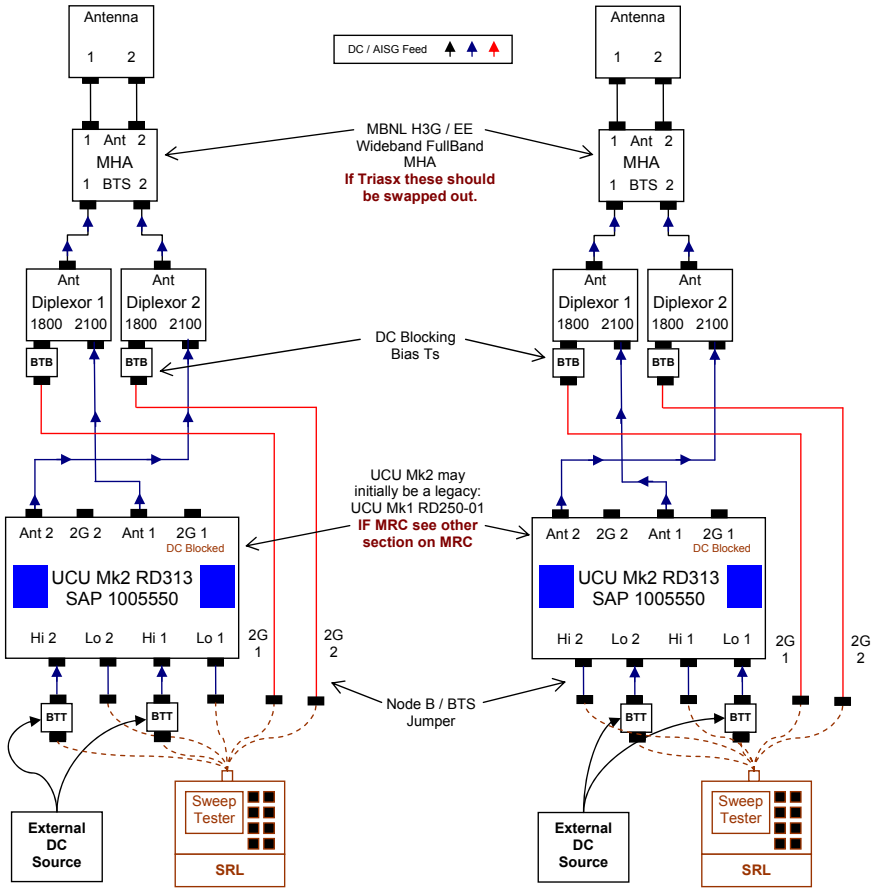
8.1.5 SRL Schematic – UCU with Diplexor – DC from Node B 2100

SRL Schematic
UCU and Diplexor Circuit
DC via 3G Hi EE
Node B Parent EE/Tmob

UCU Switches to Depress
3G/2G – 3G
Ant1 DC – Hi Band
Ant2 – DC Hi
DC Blockers
Required

SRL Schematic
UCU and Diplexor Circuit
DC via 3G Lo H3G
Node B Parent H3G

UCU Switches to Depress
3G/2G – 3G
Ant1 DC – Lo Band
Ant2 – DC Lo
DC Blockers
Required



Flexi MHA control setting will normally need changed to suite new / change to MHA, and will require **SOG** support.

Bias T Key at start of section for guidance if they should remain in the operational circuit: **BTT, BTO/BTT, BTB, BTO**

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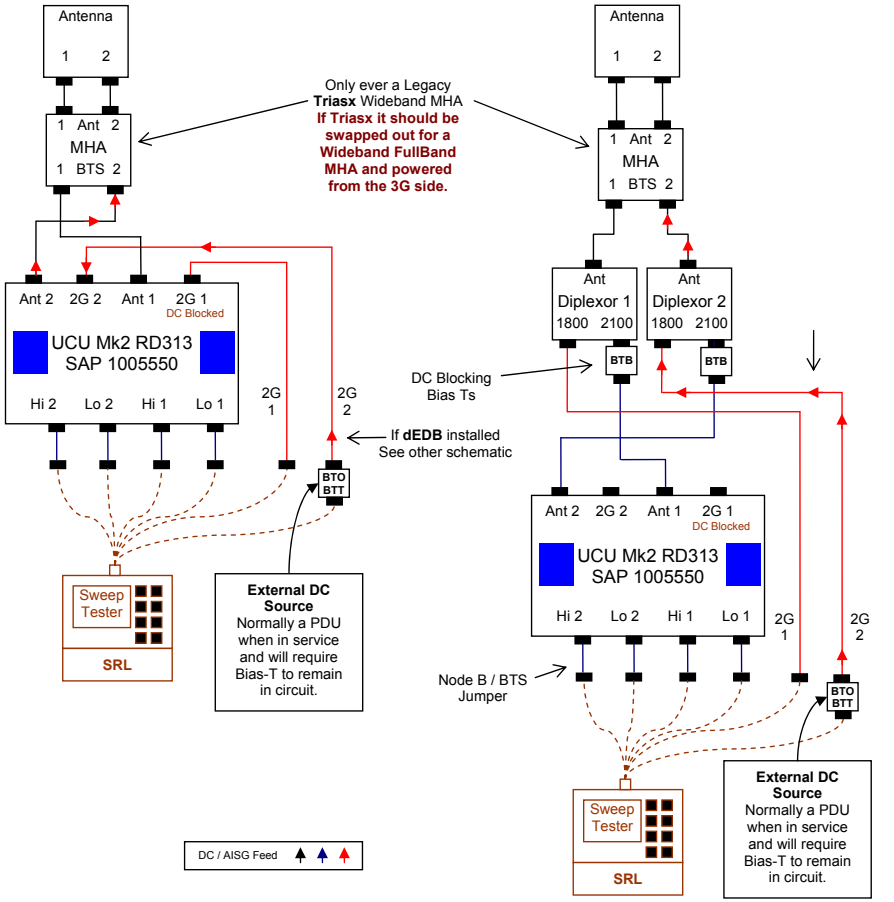
8.1.6 SRL Schematic – UCU Wideband / Diplexed – DC from 1800

SRL Schematic
UCU Circuit
DC via 2G / 1800
Huawei BTS 1800 (not currently used)
PDU Power (Legacy E/// 2G, phasing out)

UCU Switches to Depress
3G/2G – GSM 1800
Ant1 DC – Out of Circuit
Ant2 – **N/A** Node Bs to be set to No AISG and No Power, MHA Other
DC Blockers
None Required

SRL Schematic
UCU and Diplexor Circuit
DC via 2G / 1800
Huawei BTS 1800 (not currently used)
PDU Power (Legacy E/// 2G, phasing out)

UCU Switches to Depress
3G/2G – GSM 1800
Ant1 DC – Out of Circuit
Ant2 – **N/A** Node Bs to be set to No AISG and No Power, MHA Other
DC Blockers
Required



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8.1.7 SRL Schematic – MRC - DC from Node B 2100

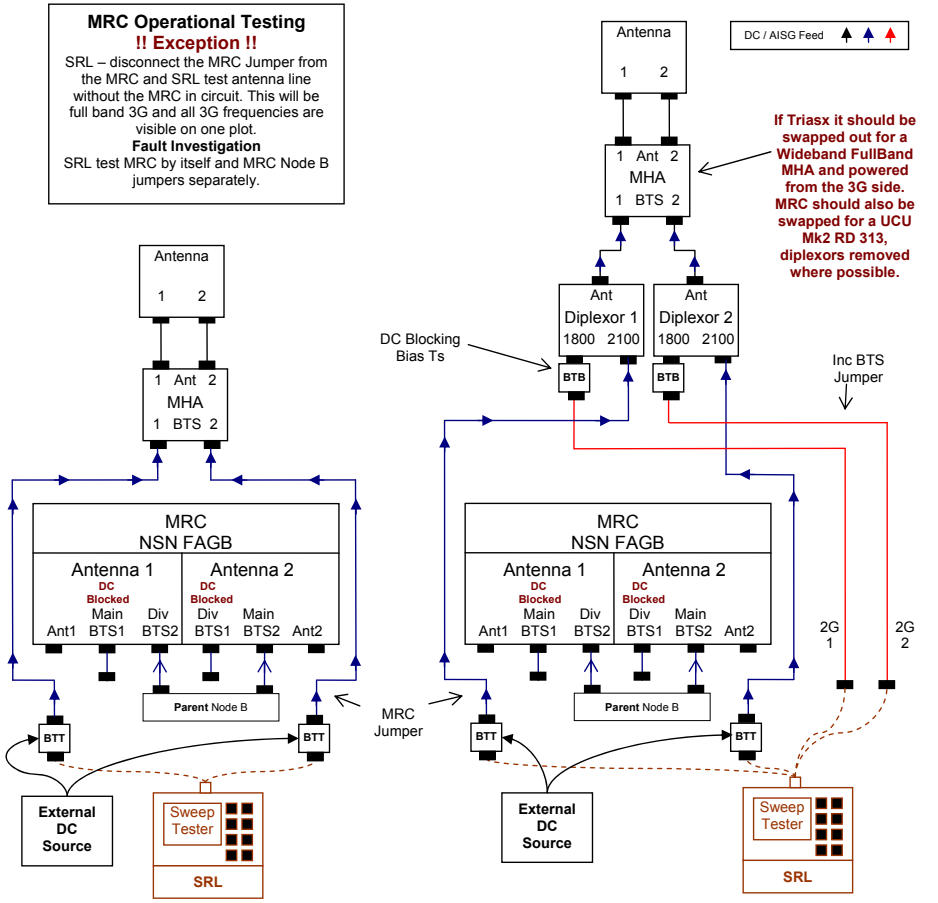
SRL Schematic
MRC Only
DC via 3G BTS 2
Node B Parent EE/Tmob OR H3G

MRC is BTS 1 DC Blocked
DC Blockers
None Required

SRL Schematic
MRC and Diplexor Circuit
DC via 3G BTS 2
Node B Parent EE/Tmob OR H3G

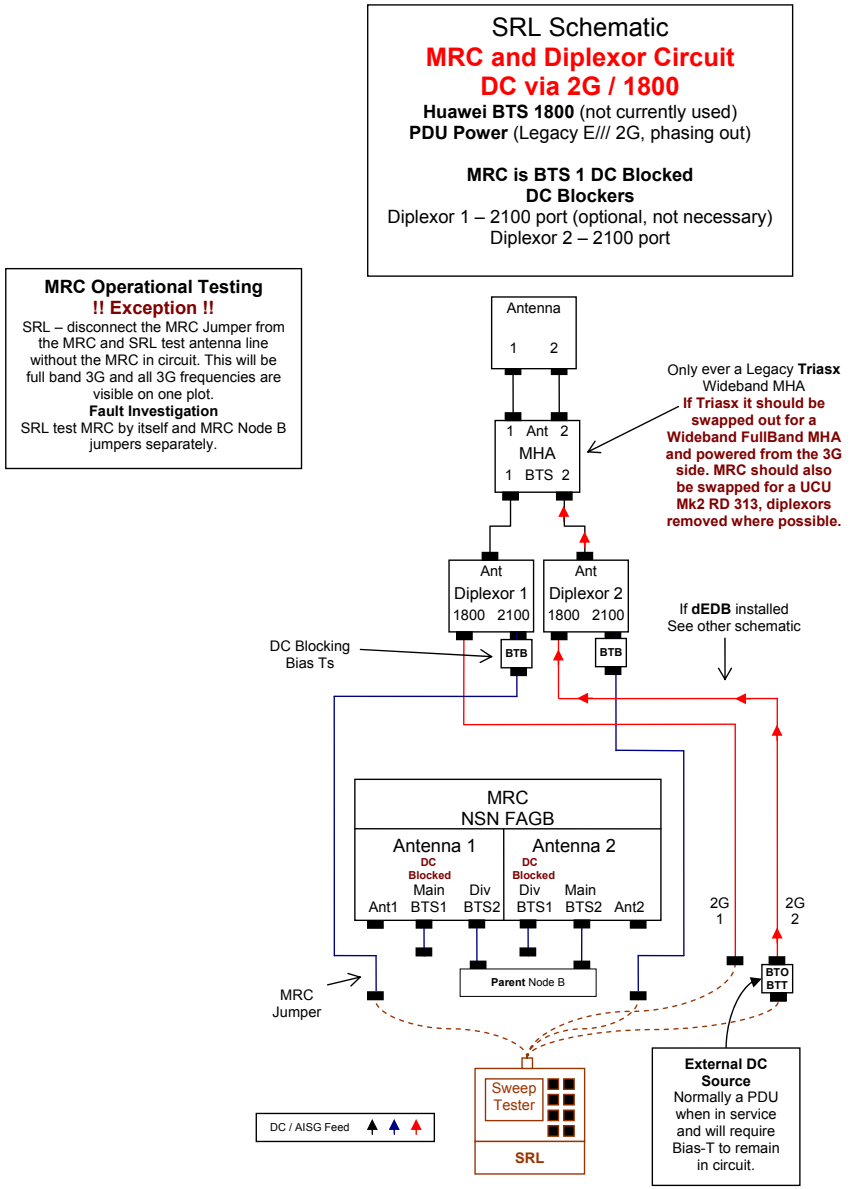
MRC is BTS 1 DC Blocked
DC Blockers
Diplexor 1 – 1800 port
Diplexor 2 – 1800 port

MRC Operational Testing
!! Exception !!
SRL – disconnect the MRC Jumper from the MRC and SRL test antenna line without the MRC in circuit. This will be full band 3G and all 3G frequencies are visible on one plot.
Fault Investigation
SRL test MRC by itself and MRC Node B jumpers separately.



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8.1.8 SRL Schematic – MRC Diplexed - DC from BTS 1800



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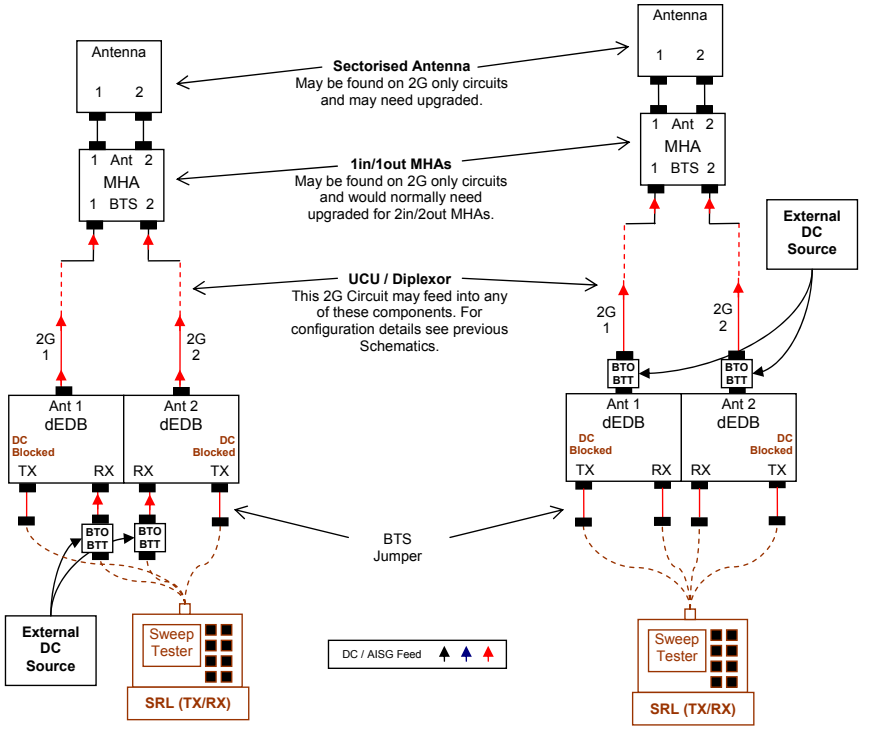
8.1.9 SRL Schematic – dEDB Legacy Ericsson BTS - DC from BTS 1800

SRL Schematic
dEDB Circuit 1
DC via 2G / 1800
Only with Legacy Ericsson BTS

UCU Switches to Depress DC Blockers
See previous schematics if applicable.

SRL Schematic
dEDB Circuit 2
DC via 2G / 1800
Only with Legacy Ericsson BTS

UCU Switches to Depress DC Blockers
See previous schematics if applicable.



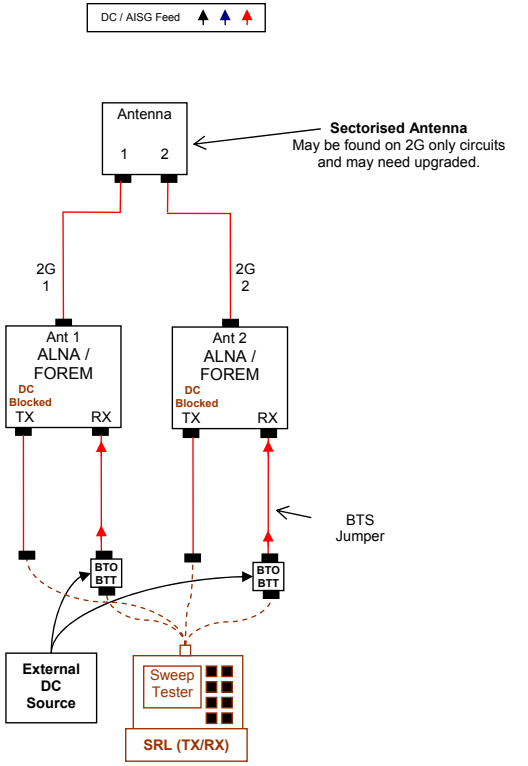
Bias T Key at start of section for guidance if they should remain in the operational circuit: **BTT, BTO/BTT, BTB, BTO**

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8.1.10 SRL Schematic – ALNA / FOREM - DC from BTS 1800

SRL Schematic
ALNA / FOREM Circuit
DC via 2G / 1800
Only with Legacy Ericsson BTS

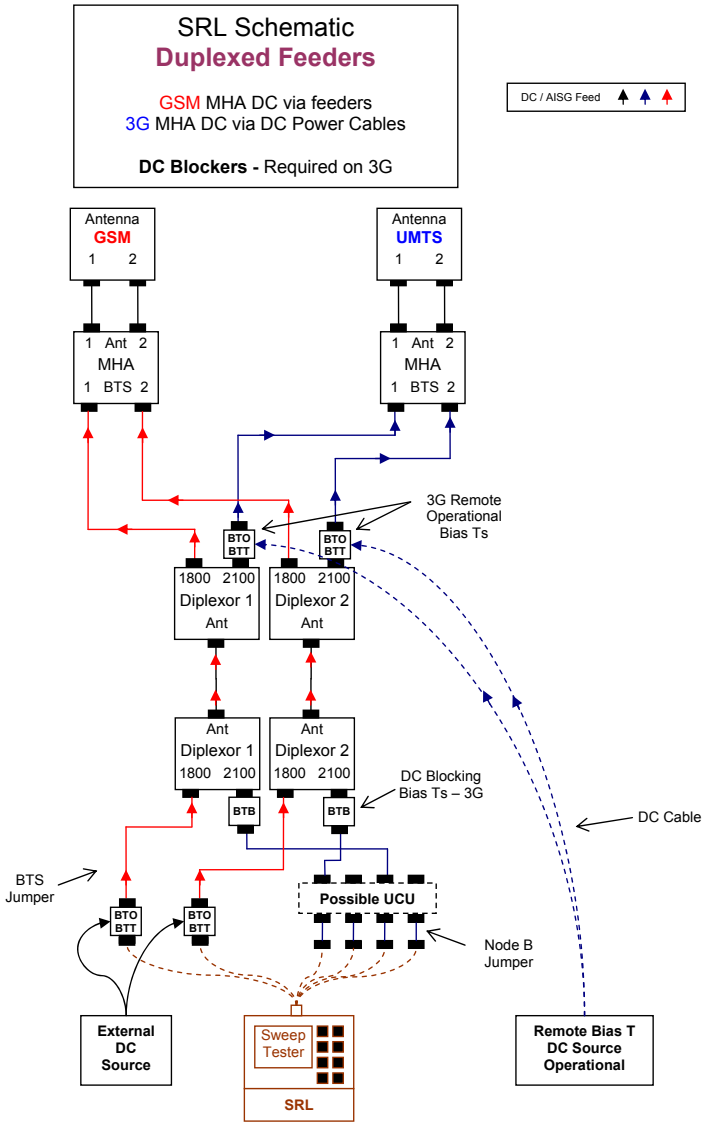
UCU Switches to Depress
DC Blockers
See previous schematics if applicable.



Bias T Key at start of section for guidance if they should remain in the operational circuit: **BTT, BTO/BTT, BTB, BTO**

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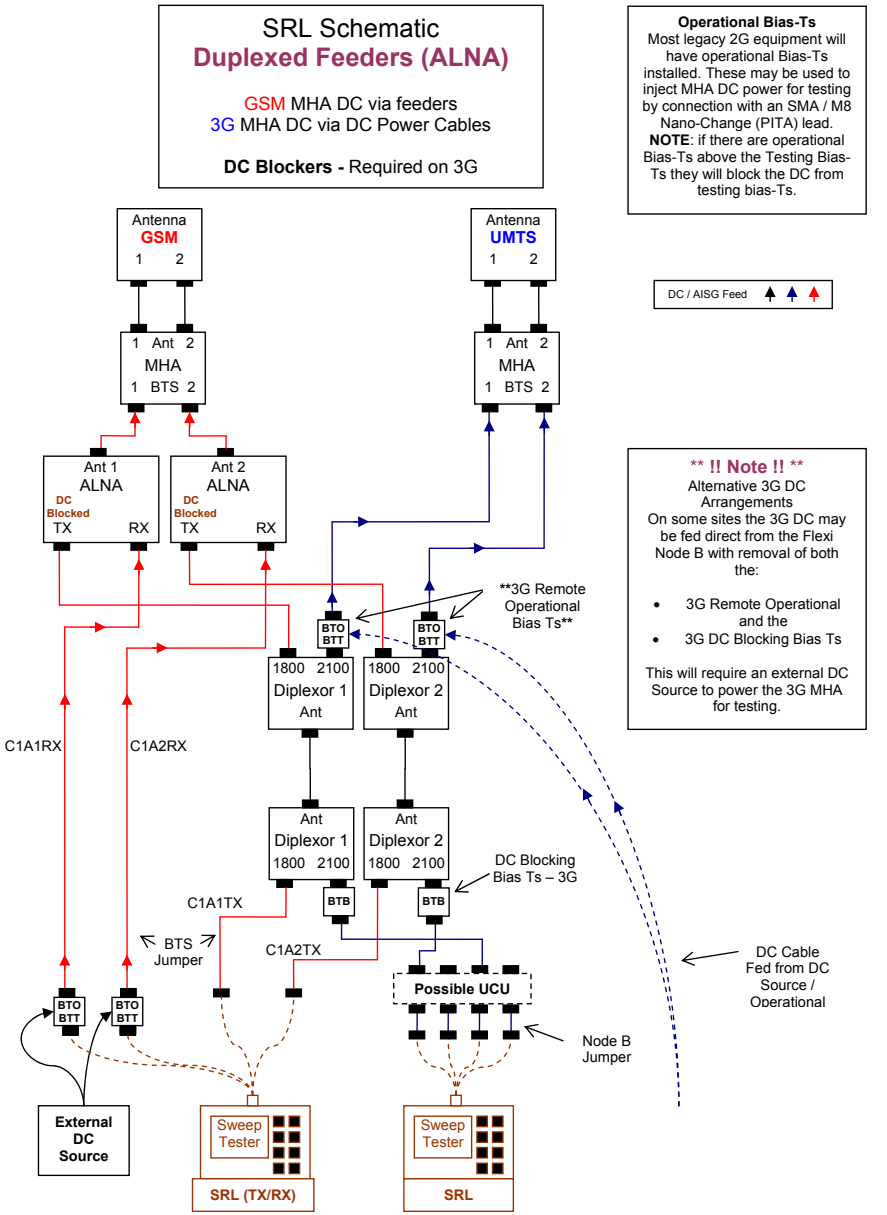
8.1.11 SRL Schematic – Wideband Duplexed Feeders – Legacy TMobile



Bias T Key at start of section for guidance if they should remain in the operational circuit: **BTT, BTO/BTT, BTB, BTO**

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8.1.12 SRL Schematic – Wideband Duplexed Feeders with 2G ALNA – Legacy TMobile

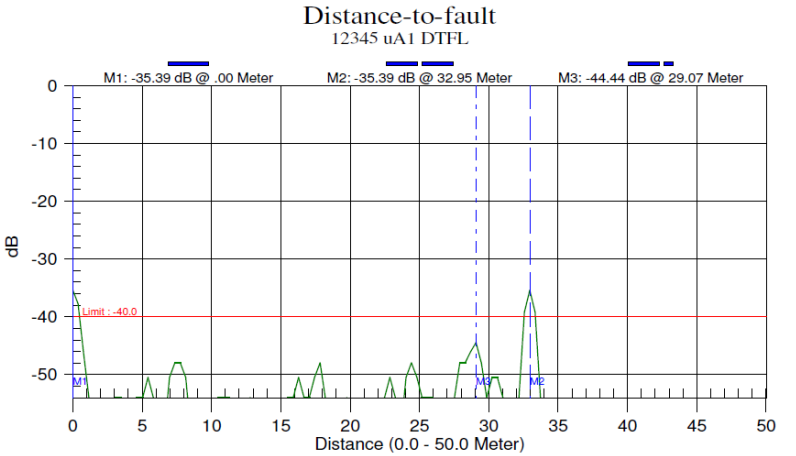


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9 Appendix - Example Sweep Test Plots

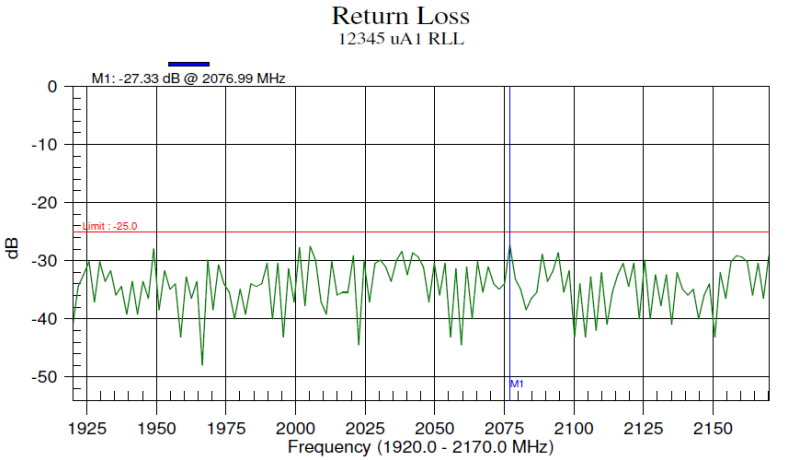
9.1 Example Plot DTFL – Distance to Fault Load

Feeder limit set to -40dB for new feeder. Connectors near end and far end are only traces above -40dB and are still passing, better than -28dB for connectors. Far end connector marker is the main feeder length, no jumpers. There is at least 5m beyond the end connector, but not too much. Note: DTFL plots under 10m can be problematic.



9.2 Example Plot RLL – Return Loss Load

This is across the entire bandwidth from 1920-2170 inclusive, as with the DTFL it only contains cable and connector component (no filters). Only one marker to peak and this is below the limit line.

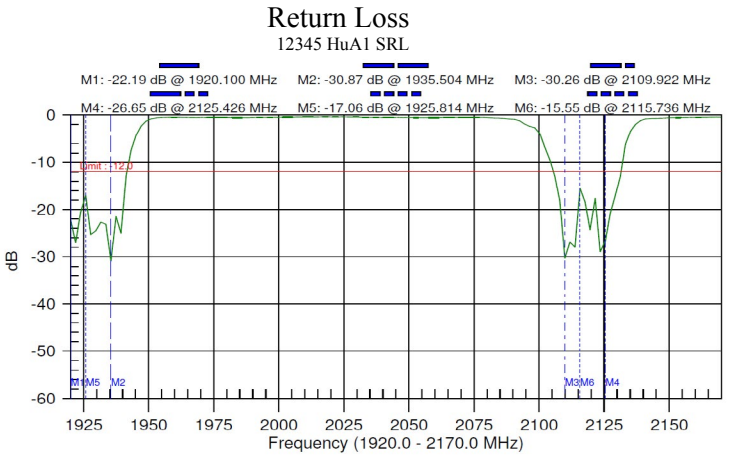


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9.3 Example Plot SRL – System Return Loss

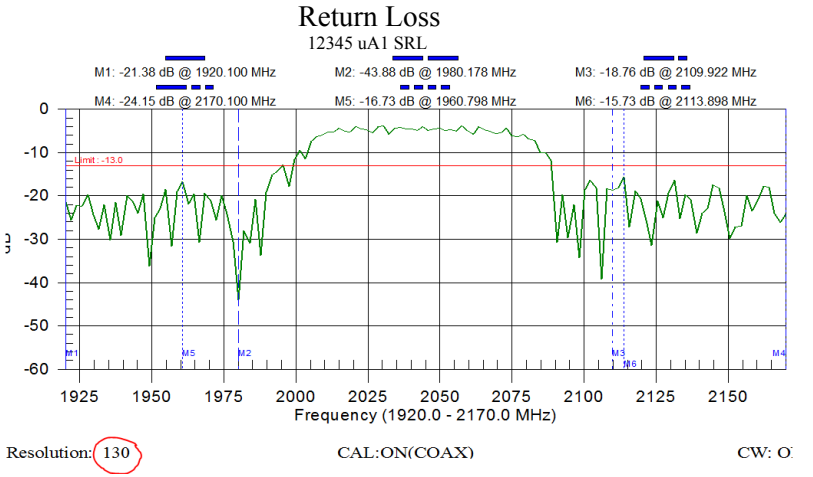
9.3.1 3G EE Band SRL Example Plot

SRL from a UCU in the H3G sub bands (denoted by the 'H' in the Feeder Identifier, HuA1). Markers 1/2/3/4 mark H3G sub band and M5/6 are to peak. Note (1) how the filters in the UCU restrict the operational range much further than just a normal 3G MHA (2) Also the sub band is very close to zero indicating that the Node B jumper was not included in the test circuit.



9.3.2 3G Full Band SRL Example Plot

SRL from UCU jumper (no UCU installed) markers to the 3G full band as all component in the circuit are 3G full band. Markers 1/2/3/4 mark 3G full band and M5/6 are to peak. Note how the filters in the MHA restrict the operational range much less than via the UCU. Note the M4 marker, in the example below, is at 2170.10, this is because the resolution (130) of the plot is so low that this is the first available data point that includes the 2169 position, 2168.16 would not be acceptable. Similarly for M1/M2/M3 markers.



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10 Appendix - Plot Analysis – Notes key points of interpretation

10.1 General

Plot date and times should be consisted for a set of results. This is also indicative of how long some works may have taken and at what time of day. It is not unusual for the time setting on a sweep tester to be incorrectly set and the date format is sometimes in US (mm/dd/yyyy) format instead of UK (dd/mm/yyyy) format.

Each sweep tester has a serial number and this is shown on each plot. These will normally be the same for all plots.

Duplicated plots by copying a plot and re-naming it. This invalidates all the plots supplied as you cannot be sure what you are looking at. This is easier to pick up if the plots are printed out and you will find the traces to be identical although the plot name may have changed.

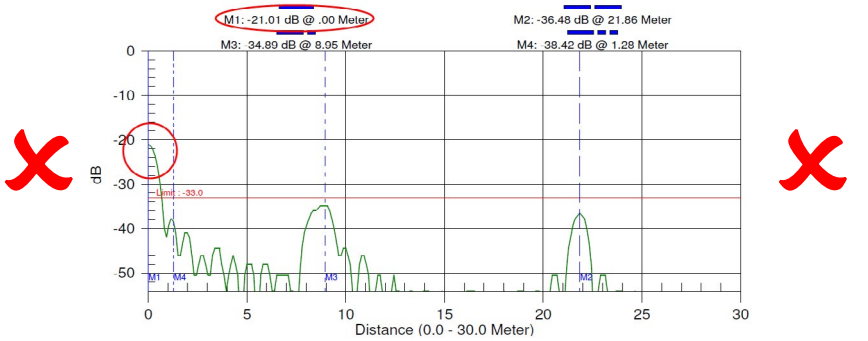
10.1.1 DTFL – Incorrect Testing

These should show the first connector of the test circuit at the 0 (Zero) distance mark.

If first connector peak is not shown there is an issue with the calibration of the test circuit.

If the first connector peak is out of spec <-28dB (say -22dB) then this will prevent accurate readings on the DTFL and will most likely make the RLL results worse (across all frequencies). This can happen if a testing adaptor plug / testing bias t is worn out or not mating properly.

Many reflections around a connector peak may also indicate an issue and may mask feeder faults. The connector peak should only have a few side lobes.



10.1.2 DTFL – Crossed Feeders

DTFL plots for antenna 1 and 2 for a given sector should show very similar lengths, assuming the feeder goes from the equipment position to the same antenna. However different sectors A/B/C lengths may differ considerably on rooftop sites and tower sites with larger headframes, where there are separate antennas at slightly different positions.

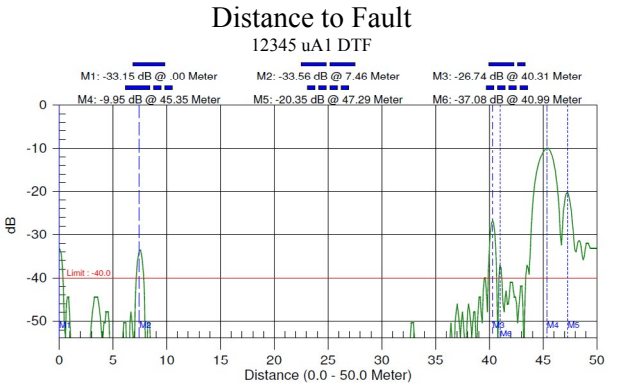
A visual inspection / comparison between the plots will highlight possible crossed feeders where for example plots for uB1 ~ uC1 and uB2 ~ uC2. You may also be able to pinpoint main feeder jumper connectors for comparison. It's also necessary to take account of the site layout and possible sectorised antenna on the 2G.

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10.1.3 DTF – Distance to Fault (No 50 Ohm Test Load)

A distance plot showing the reflections of individual components and the distance that they are from the test point. Normally up to an including the antenna as no 50 Ohm load applied. Can indicate feeder and jumper lengths but is not a substitute for a DTFL. Often used by field techs for initial fault finding when investigating a problematic site. However this test cannot see 'through' components very well (as tends to be done wide band and all components are not wide band) as large reflections and attenuation in the test circuit will tend to mask further other large reflections. In example below:

M1 – Near connector direct onto main feeder jumper. (BTS jumper excluded from test)	M3 – this is main feeder connection to the MHA Jumper. Possibly distorted by M4 and reflections	M5 – the antenna. But as this is behind a larger spike (M4) and may be affected by side lobes, this resultant reflection is unreliable.
M2 – Main feeder connector to the main feeder jumper connector @ 7.5m	M4 – this is the MHA and looks poor because test is not limited to the operational TX band. MHA Bandpass filters make this look very poor.	M6 – this would indicate a feeder fail but may be made unreliable because of large M3 before it and M3 / M4 side lobes.

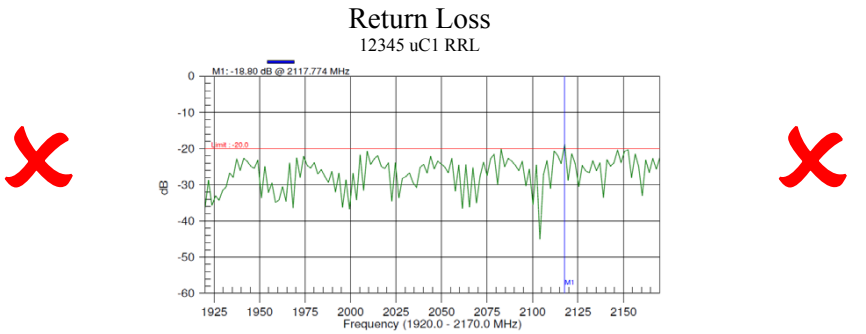


10.1.4 RLL – Failing Limit

The wider the band these tests are done over the better the plots will look.

Problems with test connectors / connectors / feeder / jumpers highlighted in DTFL test can cause this test to fail.

Example below is of a 7-50 long feeder site with 5-50 tails out of the cabin and ½" tails onto the UCU and MHA. Although the limit for this configuration is reduced to -20dB it still fails and there were faulty connectors and damaged feeder. Nothing is wrong with the plot itself, it is failing limit specification.

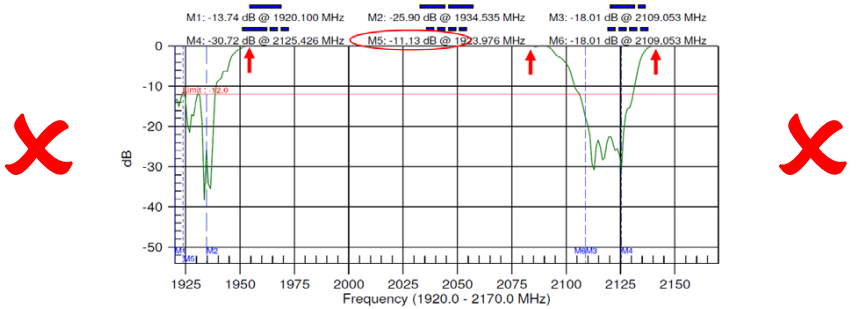


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10.1.5 SRL – Incorrect Testing

Currently we marker to peak in the operational sub bands. When testing a circuit with more than one reflective source this could be slightly misleading if the reflections come back to the test point in phase, and produce a worse result. An average line, not more than 3dB below repetitive peaks, is also an accurate assessment of actual SRL, but this is open to interpretation. Also genuine issues can either appear as a single peak, so these cannot be discounted.

Note: Marginal SRL non-conformances can be cause by the removal of a BiasT from a calibrated test circuit. Tell tale sign for this is when any of the plot rises above 0 (zero) see example plot below.



Plot is SRL though a UCU. Filter bands are going above zero, see the red arrows. This indicated there is a calibration problem with the test circuit, which has in effect shifted the trace up and brings all the test results from this site into question. Other observations on this plot:

1. the RX SRL is failing, but this could be because of the calibration offset.
2. The RX SRL is around 7dB worse (-11.13 to -18.01) that the TX. This difference would suggest that both the MHA is not powered, and MHA RX is working in bypass mode. This could indicate incorrect testing.

10.1.6 VSWR Alarm from BTS / Node B – Intermittent Fault

In some instances the BTS or Node B may indicate a VSWR alarm. However when arriving on site the alarm is not present and a low SRL cannot be measured. This indicates an intermittent fault that is, most likely, caused by wind vibration or heating affect on external components, this could be the jumpers, connectors, MHA or antenna. Passive sweep testing will not normally identify this fault. It's recommended that:

1. Visual intrusive testing of the external connectors is undertaken or ideally:
2. Specialist Dynamic PIM testing is undertaken to check this system.

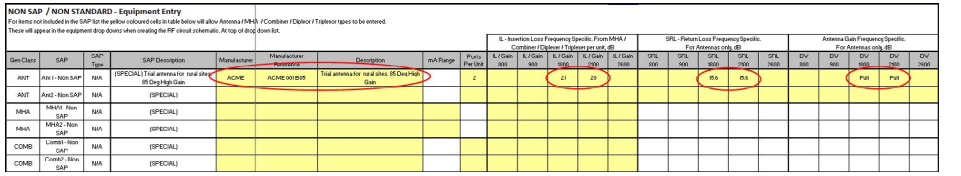
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11 Appendix - Rigging I&C Certificate (RICC) – Examples / Issue / Common Errors

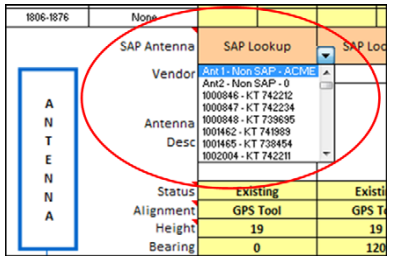
11.1.1 Trial / New Component Not in Drop Down Lists

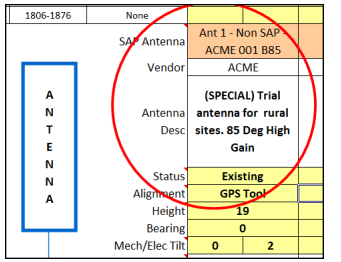
This can be added in the *SAP Lookup* worksheet. Add the information and SAP number, if known, and SRL / IL values. This will then appear at the top of the Antenna / MHA / Combiner drop down lists.

Entered details for a trial ACME 001 B85 antenna in *SAP Lookup* worksheet



demo of selection in the *Standard Testing* worksheet.



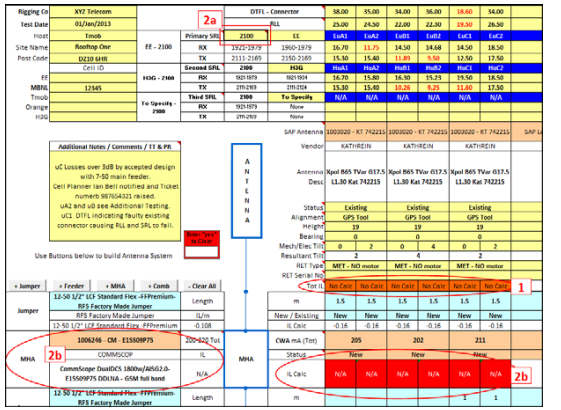


11.1.2 Tot IL "*No Calc*" of "*FX Error*"



In example below there is a 2G 1800 only MHA selected for an *FX Band* of 2100 (2a). The sheet will return an N/A error for the *MHA IL* (2b) and the *Tot IL* will show "No Calc" (1).

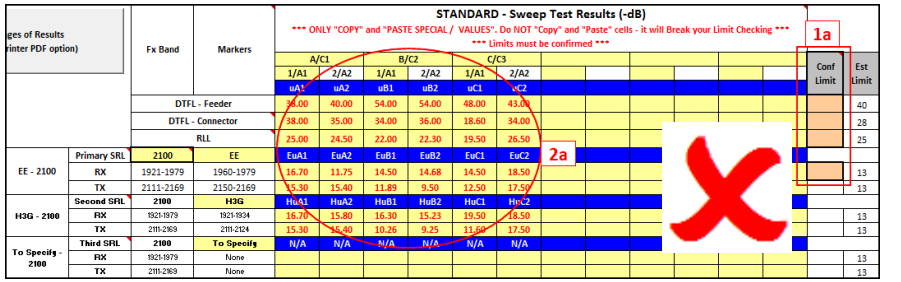
All components and *FX Band* must be compatible.



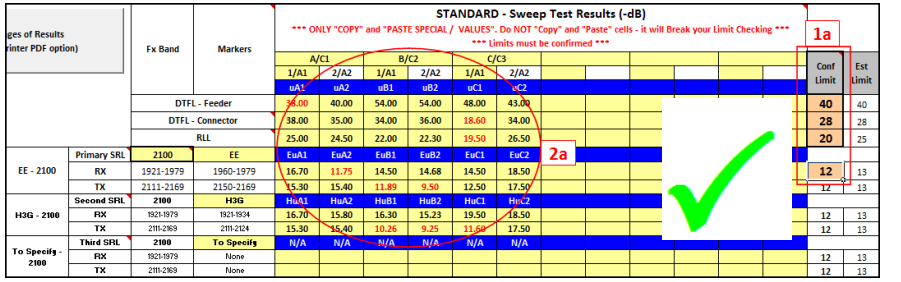
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11.1.3 *Standard Testing* all coming up RED

Need to enter values in the Conf Limit boxes (1a)

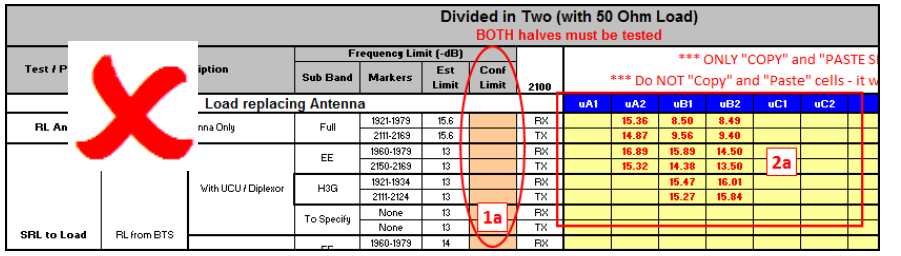


With Confirmed Limit values entered (1a) only the failing entries will turn **RED** (2a).

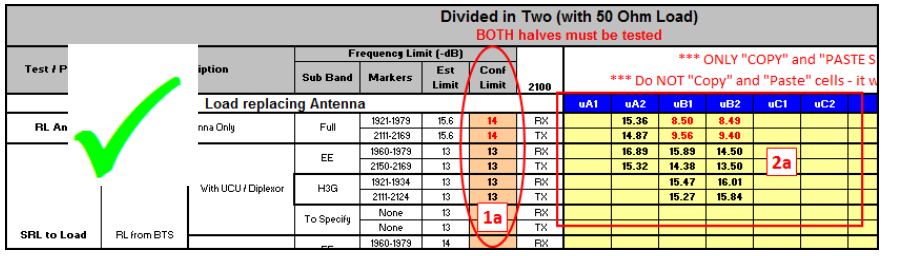


11.1.4 *Additional Testing* all coming up RED

Need to enter values in the Conf Limit boxes (1a)



With Confirmed Limit values entered (1a) only the failing entries will turn **RED** (2a).



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11.1.5 Pre SRL Failing – Recording Results in *Additional Testing*

This can be recorded at the bottom of the *Additional Testing* worksheet in the free text entry section:

1. Detail test (in this case Pre SRL)
2. Detail Frequencies
3. Input limit. You may need to look this up from table.
4. Input results.

	Other / Component – Return Loss (RL and RLL)													
	Test / Plot Specify	Description Specify	Frequency Limit (-dB) Detail Sub Band	Detail Markers	N/A	Conf Limit	2100		*** ONLY "CO *** Do NOT "Copy" and					
	Other Component - Free Text Fields								uA1	uA2	uB1	uB2		
5a	PRE SRL	Legacy circuit via UCU RD 250 was failing	Tmobile	1960-1969	TBC	12	RX		13.47	12.69				
				2150-2159	TBC	12	TX		11.89	11.32				
5b	RLL ??	Specify	Full	eck Spec	TBC		RX							
				eck Spec	TBC		TX							
5c	RLL ??	Specify	Full	Check Spec	TBC		RX							
				Check Spec	TBC		TX							

1 2 3 4

11.1.6 MHA Component Testing – Recording Results in *Additional Testing*

MHA type should be selected from drop down. In example below a Nokia – WMHD has been selected

1. and the appropriate limits are automatically indicated.
2. These still need to be manually confirmed or all results will show RED.

	Mast Head Amplifiers to Load (Requires to be powered)							uA1	uA2	uB1	uB2
4a	RLL MHA	Nokia - WMHD	Full Available	Check Spec	16	16	RX		16.50		
				Check Spec	18	18	TX		19.23		
4b	RLL MHA	Other MHA	Full Available	Check Sp	TBC		RX				
				Check Sp	TBC		TX				

1 2

11.1.7 Site Made Jumper – DTFL / RLL Testing – Recording Results in *Additional Testing*

Section 5 of Additional Testing Tab has free text entry fields. It is accepted that any newly installed site made jumpers (and associated factory made jumpers) will pass specification. However for Site Made Jumpers it is required to record these results and submit the Plots. Example below: all passing, for a BTS 2G onto 3G type job, where BTS jumpers had to be run into ducts to the new 2G location.

	Other / Component – Return Loss (RL and RLL)													
	Test / Plot Specify	Description Specify	Frequency Limit (-dB) Detail Sub Band	Detail Markers	N/A	Conf Limit	1800		*** ONLY "COPY" and "PAS *** Do NOT "Copy" and "Paste" cells					
	Other Component - Free Text Fields								C1A1	C1A2	C2A1	C2A2	C3A1	C3A2
5a	DTFL BTS Jump	Site made BTS Jumper and factory made jumpers installed	Full	Feeder	TBC	40	RX		54.00	47.00	42.00	54.00	48.00	54.00
				Connector	TBC	28	TX		33.00	34.00	32.00	32.50	33.60	33.40
5b	RLL BTS Jump	Site made BTS Jumper and factory made jumpers installed	Full	Check Spec	TBC	20	RX		24.35	22.65	25.89	24.89	25.07	26.39
				Check Spec	TBC		TX							

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12 Appendix – Reference Information

12.1 Table – Typical antenna VSWR / SRL Lookup

VSWR	SRL
<1.25	19.1dB
<1.29	18.0dB
<1.4	**15.6dB**

VSWR	SRL
<1.5	14.0dB
<1.6	12.7dB
<1.7	11.7dB

12.2 Table: Flexi Port Lookup - Example

Flexi FRGF / FRGP ports	6	5	4	3	2	1
MBNL	uC2	uC1	uB2	uB1	uA2	uA1
OuK Legacy	C4	C3	B4	B3	A4	A3
EE Jumpers	EuC2	EuC1	EuB2	EuB1	EuA2	EuA1
	Hi2	Hi1	Hi2	Hi1	Hi2	Hi1
H3G Jumpers	HuC2	HuC1	HuB2	HuB1	HuA2	HuA1
	Lo2	Lo1	Lo2	Lo1	Lo2	Lo1

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12.3 MRC FAGB – Schematic and Performance

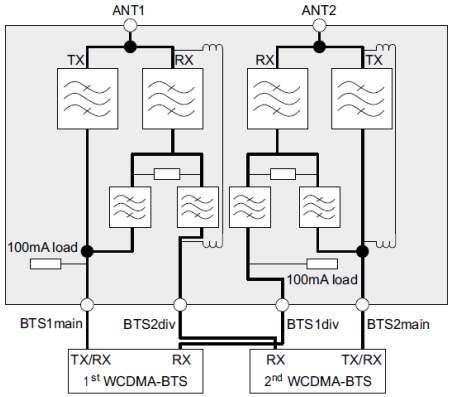


Figure 2 Block diagram of FAGB

3.3.2 Electrical specifications for FAGB

Electrical characteristics		Values
Nominal impedence (for all RF ports)		50 Ω
Operating frequency bandwidths		
	Rx band (GSM & WCDMA)	1920–1980 MHz
	Tx band (GSM & WCDMA)	2110–2170 MHz
	AISG/3GPP carrier	2.176 MHz ±100 ppm
Antenna port return loss		
	Rx bands	min. 18 dB (VSWR max. 1.29:1)
	Tx bands	min. 18 dB (VSWR max. 1.29:1)
	AISG/3GPP band (2.176 MHz)	min. 10 dB (VSWR max. 1.95:1)
BTS port return loss		
	Rx bands	min. 18 dB (VSWR max. 1.29:1)
	Tx bands	min. 18 dB (VSWR max. 1.29:1)
	AISG/3GPP band (2.176 MHz)	min. 10 dB (VSWR max. 1.95:1)
Tx path insertion loss		
	general	max. 0.3 dB
	in room temperature	0.2 dB
Group delay distortion		
	Tx path, Tx band	max. 15 ns / 5MHz
	Rx paths, Rx band	max. 20 ns / 5MHz
Rx path insertion loss (general)		
	Insertion loss (including ripple)	max. 4.5 dB

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13 References and Related Documents

MBNL documentation covers current Projects and legacy information for the MBNL radio access network. These have a variety of reference numbers and can be downloaded from:

MBNL Intranet - mbnl.co.uk

ADC Build Extranet - adcbuild.com

13.1 MBNL Documents (In Particular)

RD10012_GSDD004A *- Rigging – Feeder Systems*

RD10011_GSDD054 / LEE003 *– Certificate of Conformance (COC) – Form*

RD10011_GSDD054 / LEE003 *- Rigging I&C Certificate (RICC) – Form*

13.1.1.1 MBNL WLI and BLI

WLI001 *- 2G REFRESH Triasx wideband MHA WLI*

WLI002 *- 2G MHA WLI1 (2)*

WLI003 *- Rules to implement regarding the number of sectors and types of antenna to implement*

WLI004 *- 2G REFRESH ALNA TMA SWAPS WLI*

WLI006 *- 2G Refresh Feeder Preparation*

BLI013 *- Configuration requirements for RD0341 & RD0376*

BLI015 *- 2G Refresh RBS2000 Multiple Cabinets*

BLI016 *- Configuration requirements for Kaelus MHA*

BLI018 *- BLI on how to deploy MHAs on space diversity sites with large special separation*

BLI023 *- Diplexor 2G DC Blocking on Wideband Sites*

BLI024 *- Enabling Works for 1800 Network Integration 2G and 4G*

BLI027 *- Splitters for Omni to Trisector*

BLI029 *- 2G Refresh – Huawei 3900 Tail Connection Point*

BLI031 *- Addition of EE 2G onto 3G 4 sector sites using split sectors*

Temporary Guidance on MHA usage V1.0

13.1.1.2 MBNL LEC and LED

LECB003 *– RF Design Guidelines for RAN Cell Sites*

LECB012 *- MBNL Radio Planning Guidelines*

LECB023 *– MBNL Antenna System Planning, Deployment and Upgrades Project Godiva*

LECB027 *– Network Design - Antenna Subsystem Strategy*

LED017 *- MBNL Node B Configurations 3UK*

LED017 *- MBNL Node B Configurations EE*

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13.1.1.3 MBNL GSDD

RD10012_GSDD004A *- Rigging – Feeder Systems*

GSDD007 *- Health & Safety Signage*

GSDD008 *- ICNIRP Compliance Certification*

GSDD011 *- POW/FREDO Cabinets*

GSDD021 *- WREA to WREB Installation Requirements*

GSDD022 *- Flexi BTS Installation Guidelines for Stacked Option (Without Enclosure)*

GSDD023 *- Parasitic Conversion of Nokia WIN B to House a Flexi-BTS*

GSDD024 *- VRC to Flexi Stack*

GSDD025 *- IBBU Back to Back*

GSDD026 *- Flexi BTS Installation Guidelines for (Existing) VRE Cabinet*

GSDD028 *- Flexi Site Deployment within Equipment Rooms and Cabins*

GSDD035 *- Triasx WBTMA (Wideband Tower Mounted Amplifier)*

GSDD036 *- Jumper Schedule*

GSDD037 *- IBBU Upgrade with Flexi Stack*

GSDD039 *- H3G Streetworks & Macro Structure Upgrade Solutions*

GSDD040 *- Drawing Standards*

GSDD050 *- 2g / 3g UCU – (Universal Combiner Unit)*

GSDD051 *- Pre-Construction HSE Document Requirements and Checks*

RD10011_GSDD054 / LEE003 *– Commissioning & Testing of Cellular Antenna System*

GSDD059 *- Current Product List*

GSDD060 *- Secure Flexi BTS Cabinet – Guidelines for Detailed Design of Streetworks Sites including upgrades*

GSDD061 *- Parasitic Conversion of IBBU cabinet – Overview DRAFT*

GSDD062 *- Ordering and Installing UCUs*

GSDD063 *- NEC RAN-Swap Infrastructure Guidelines (Cabins and Internal Rooms)*

GSDD070 *- Cabin and Equipment Room Cooling Assessment and Solution*

GSDD072 *- Summary of Parasitic Conversions*

GSDD082 *- Antennas*

GSDD083 *- Universal Combiner Unit (UCU) within the Phoenix Cabinet*

GSDD091 *- 3G >3 Sector Deployment*

GSDD093 *- Mast Head Amplifiers*

GSDD097 *- Flexi Site Deployment in Indoor and Outdoor Racks with UCU*

GSDD098 *- 2g Refresh-GSDD098 Huawei BTS 3900A Adapter Plates*

GSDD099 *- 2G Refresh - deDbs Recycling Process*

GSDD100 *- Ex OUK Roadside Upgrade Guidelines - Strategy and High Level Power*

GSDD102 *- 2G Refresh Small Cabin Site Strategy*

TAN001 *Flexi Plinth Detail*

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13.1.1.4 MBNL Active Legacy Documents

Mxxx Mechanical & Electrical series documentation

Qxxx Quality series documentation

Rxxx Rigging series documentation

Sxxxx Structural series documentation

M3006 *Lighting Protection and Earthing*

Q1007 *How to create a 'Fixit'*

R3002 *Streetworks Sites*

R3005 *Outdoor Equipment Connections*

R3006 *Nortel S8000 Feeder Connection Details*

R3007 *Ericsson RBS2202 Feeder Connection Details*

R3008 *Diplexing Feeders for GSM/UMTS Sites (Feeder Sharing)*

R3009 *Ericsson RBS2106 and RBS2106i Rigging Connections*

R3010 *Ericsson RBS2206 Rigging Connections*

S1010 *Handover Documentation, Audit and Quality*

S1016 *Handover Documents*

S1020 *FIXIT Process and Requirements*

S2015 *SRF*

S2029 *RET (Remote Electrical Tilt)*

S3011 *3G (UMTS) Site Upgrade for existing T-Mobile Cell Sites*

S3001 *Macro Site Design*

ESL001 *Operations Site Access & Outages Procedure*

13.1.1.5 MBNL Superseded Legacy Documents

~~***R2003*** *Alan Dick WBTMA (Wideband Tower Mounted Amplifier)*~~ **– Superseded with *GSDD035***

~~***R3001*** *Rigging Design and Construction for Macro Sites (GSM & UMTS)*~~ **- Superseded with *RD10012_GSDD004A***

~~***R4001*** *Macro Sites – Rigging / Feeder Design Principles*~~ **Superseded with *RD10012_GSDD004A***

~~***S2010*** *Health & Safety Signage*~~ **– Superseded with GSDD007**

~~***CDOC2012 –*** *Commissioning / Testing of Cellular Antenna Systems*~~ **- Superseded with RD10011_GSDD054**

~~***PROC7*** *Implementation Antenna Alignment Procedure*~~ **- Superseded with RD10011_GSDD054**

~~***PROC9*** *Everything Everywhere PCN Antenna and Feeder Installation Procedure*~~ **- Superseded with RD10012_GSDD004A**

~~***PROC51*** *Implementation Testing and Commissioning of GSM and UMTS Antenna and Feeder Systems Procedure*~~ **- Superseded with RD10011_GSDD054**

PROC2573 Base Station Shutdown Procedure

13.2 Other

"Antenna spacings Between GSM & UMTS Operators", ref. Spec *261Inter-Operator Antenna Forum* (IOAF) document

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14 Appendix - Definitions / Acronyms

Term	Definition / Description
ACU	Antenna Control Unit
ADC	Acquisition Design and Construction contractor. Contract company with overall responsibility for the delivery of a project.
ADCBuild	ADC Build Extranet - adcbuild.com
AGL	Above Ground Level is antenna height from ground level to the mid point of the antenna.
AISG	Antenna Interface Standards Group http://www.aisg.org.uk/
Antenna Jumper	Final jumper connecting onto an antenna.
Antenna Line	All the jumpers / feeders / MHA / combiner / diplexors / splitters / connectors from the equipment RF ports up to an including the antenna.
Broadband	A unit covering 2G and 3G, also see Wideband
BTS	Base Transceiver Station, the 2G radio equipment at a RAN site
BTS Jumper	Initial jumper connecting onto an BTS/NodeB towards the main feeder cable, diplexor, MRC, UCU etc
Carrier	A frequency range covering a single UK operator's sub division of their sub band. E.g. UMTS is divided into 5MHz carriers.
Cell Planner	Engineer responsible for the RAN design and site requirements. Documented in the RDS.
Cellular Antenna System	Includes all feeders, connections, grounding, MHA, combiners, antennas from the antenna to the final radio equipment (BTS / NodeB) connection.
COC	Certificate of Conformance – Cellular Antenna System handover document bringing together the various commissioning results.
Contractor	Company undertaking cellular antenna system rigging works.
Consolidation	MBNL process of converting T-Mobile and H3G RAN sites to MORAN configuration.
Combiner	Generic term for a sub band diplexor / triplexor. Example an MRC or a UCU.
Combiner Jumper	Jumper connecting onto a Combiner towards the main feeder cable.
Connector Pair	Normally DIN 7-16 (may be N-Type) pair, one male and one female making the connection of 2No components. Sometimes the 'male' connector is a right angle.
DAS	Distributed Antenna System
Diplexor	A combiner unit designed to combine 2G and 3G Tx and Rx signals onto a common feeder /antenna system
Dorset	Orange street cabinet
EE	Everything Everywhere joint venture between Deutsche Telecom (T-Mobile UK) and France Telecom (Orange UK)
Flexi	NSN 3G Node B modular system used by MBNL
Fredo	MBNL street cabinet
Full Band	A frequency range covering all UK operators for given technology 900 / 1800 / 2100
Godiva	MBNL project under which T-mobile and H3G RAN sites were consolidated to MORAN configuration. Project phase one end date 10/10/10.

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Term	Definition / Description
H3G	Hutchison 3G (Three), 3UK
Legacy	Generic term used for antenna line components that are existing on site or re-used. Should be logged in schematics as 'existing'.
Main Feeder	Main feeder connecting BTS / Node B to the antenna / MHA.
MET	Manual Electrical Tilt is where the antennas electrical tilt can be manually adjusted at the antenna. May be with or without motors.
MBNL	Mobile Broadband Network Limited
MEAS	The BT Ethernet used by MBNL
MHA	Mast Head Amplifier - For ease "MHA" will be used when refereeing generically to all LNA (Low Noise Amplifiers) also referred to as TMA, ASC etc. This active DC powered device amplifies the uplink / receive signal as near as possible to the antenna.
MHA Jumper	Feeder cable between MHA towards the main feeder
MORAN	Multiple-Operator Radio Access Network configuration
MRC	Multi Radio Combiner - combines the 3G H3G and T-Mobile sub bands onto a common feeder / antenna system. (supplied by Nokia)
MRC Jumper	Jumper running from the MRC toward the main feeder or 2G/3G diplexor
Node B	Industry name for the 3G radio equipment at a RAN site
Node B Jumper	Initial jumper connecting onto an BTS/NodeB towards the main feeder cable, diplexor, MRC, UCU etc
Optimisation	The process which follows a drive test of a given Cluster and which is intended to make adjustments to the performance of a site or sites to improve the corresponding cluster coverage and/or capacity.
Orange	Orange UK a partner of EE
Project	Generic term referring to scope and requirements under a specific Project or Contractual arrangements.
RAMS	Risk Assessment and Method Statements
RAN	Radio Access Network - consist of the RF and transmission systems of mobile telecommunications system providing the interface between the user device (Ue) and the core network (CN).
RCE	Remote Control Unit
RCU	RealTilt Control Unit providing RET AISG interface to Node B.
RCUA	NSN RCU
RDS	Rigging Data Sheet – details the existing and required radio requirements for a cell site. Owned by the Cell Planner.
RET	Remote Electrical Tilt is the addition of AISG control system to enabling tilting of the antennas from a Remote location, other than the site itself.
RET Cable	Generic term for AISG cable assemblies.
RET Motor	Motorised device that adjust electrical tilt of an antenna.
RICC	Rigging Installation and Commissioning Certificate, an Excel document recording antenna installation, sweep test results and schematic.
Rigging Contractor	See Contractor / Small Works Contractor

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Term	Definition / Description
SiteNet	Site and project document repository on ADCBuild.
Small Works Contractor	Contractor to MBNL for works as contracted, varying from acquisition, design, civils, rigging, integration and maintenance.
Splice	Normally refers to main feeder: addition to, extension of or combination of 2No legacy feeders to complete a feeder run a new position. Splices are not acceptable in new main feeder installations.
Splitter	Generic term for a passive device that splits one RF transmission path into two, normally full band (3dB loss)
SRF	Supply Request Form – details the required free issue equipment / materials.
Sub Band	A frequency range covering a single UK operator's frequency allocation for given technology 900 / 1800 / 2100. Operators Sub Band
T-Mobile	T mobile UK a partner of EE
TMA	Tower Mounted Amplifier - generically referred to as an **MHA** TMA-D: Duplexed Tower Mount Amplifier that combines Tx and Rx ports from the radio system and connects to a single antenna. TMA-S: A receive only Tower Mount Amplifier is installed between the receiving antenna and the radio to boost weak signals. TMA-DD: A dual duplex tower mount amplifier used for radio systems with a single transmission line connection for transmit and receive.
UCU	Universal Combiner Unit. A 3G combiner unit with 2G/3G diplexor in the same case. The combiner is designed to combine the 3G Tx and Rx bands RF outputs of T-Mobile& H3G onto a common feeder / antenna system while the diplexor unit takes the 3G single and combines 2G and 3G Tx and Rx signals onto a common feeder /antenna system
UCU Jumper	Jumper connecting onto a UCU towards the main feeder cable.
VET	Variable Electrical Tilt is the addition of AISG control system to enabling tilting of the antennas from a safe location on the site.
Wideband	A unit covering 2G and 3G, also see Broadband
2 Port System	A '2 Port System' refers to the number of antennas (connectors) used by either a 2G or 3G system in a particular sector e.g. a X-Polarised Antenna (i.e. x2 connectors) is a x2 Port System (i.e. x2 antennas)

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