

Quick-Link for Testing the ULE Device RF Link

Abstract

The need to check the RF link functionality of an assembled (“in-casing”) ULE Device often arises in the production (Final Test) and QA (debug) settings. This is certainly the case if the RF link functionality has not been tested prior to assembly/casing of the Device. However, even if the ULE Device embeds a previously tested DHX91-based module (such as the DHAN or DHAN-S), this module has experienced shipping, handling and assembly leaving some doubt as to whether the final ULE Device is still fully functional from a RF link standpoint. Of course, it is possible to register the ULE Device (the DUT) to a ULE Controller and send Keep Alives, Alerts or other relevant data over the link and thereby check link integrity. This is probably an acceptable approach if a specific ULE Controller is bundled together with a specific ULE Device and together they are sold as a system. However, in most cases the ULE Device is sold separately and registered to a ULE Controller in the field. In this case the 20 to 30 seconds required to register the Device in the production line (to a Golden Unit Controller) is prohibitively long.

Effective and quick (on the order of “seconds”) testing of the RF link in a ULE device in the production or quality/debug) setting poses a number of challenges:

- ULE Devices in their casings typically do not expose any interface for accessing the EEPROM or SW running on the DUT. Thus, configuring special RF test modes (like TBR6 or other “primitives” like continuous transmit or TDD - toggling between Tx and Rx) is impractical
- Most production and QA environments suffer from multiple ULE entities competing for the bandwidth. In order for the DUT RF link to be evaluated, it needs to link with a specific ULE Controller so that its performance can be monitored

This Application Note describes the “Quick-Link” test mode for the ULE Device (DUT) which enables it to loop-back (in “TBR6” fashion) data to a “Golden Unit Controller” (GUC) which has also been configured in a special test mode. The Test Station is depicted below:

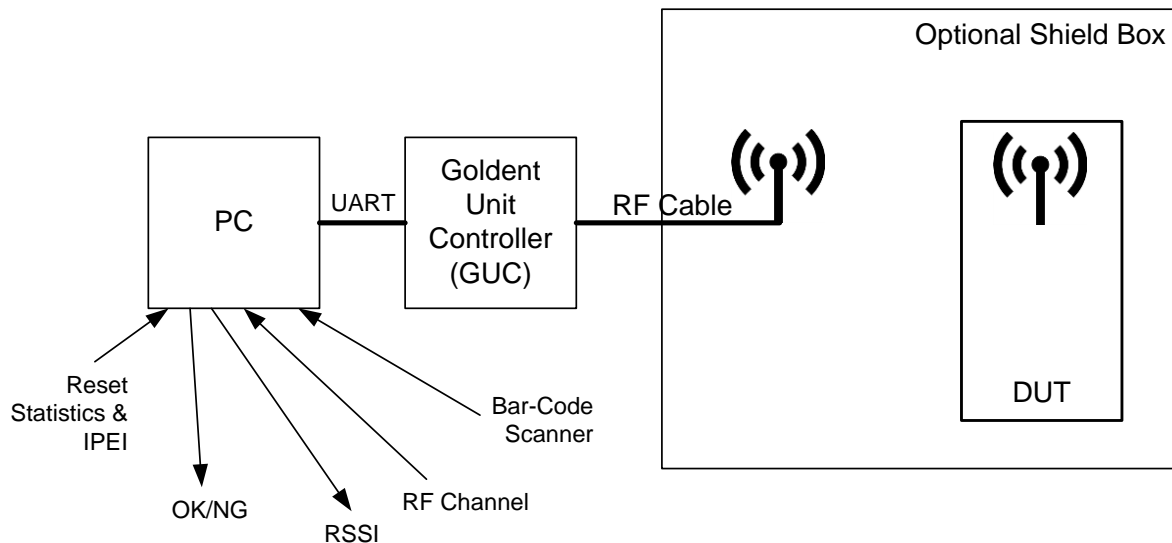


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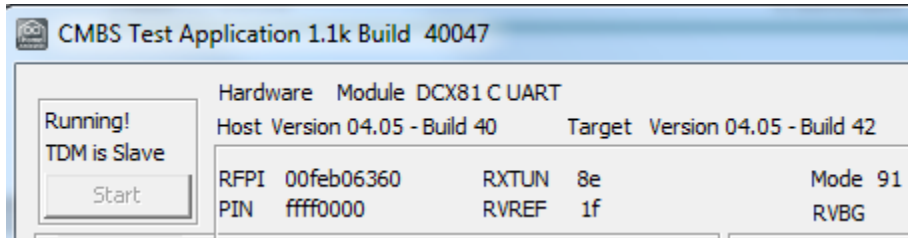
Change Log

Table 0-1: List of Changes

| REVISION | DATE | DESCRIPTION |
|----------|-------------------|--|
| 2.0 | May 2016 | Baseline release |
| 3.0 | June 8, 2016 | <ul style="list-style-type: none"> *Support for QuickLink in Device SDK is from Version 3.17 (not 30.3) *Support for QuickLink in CMBS Target is from Version 4.05 Build 42 *Support for Quicklink in CMBS Host is from Version 4.05 Build 40 *Minimum loopback interval is now 150 frames or 1.5s (was 50 frames) *Add clarification of GUC diagnostic report *Add Summary of Instructions *Add Appendix to highlight loopback functionality on Device side |
| 4.0 | January 4, 2017 | <ul style="list-style-type: none"> *Clarify that the RFPI = = 0x0A AA AA AA A0 is the default setting of the GUC when it is in QuickLink Test Mode – User does not need to enter anything *Add instruction to register a ULE Device to the GUC *Note that the SD02_MIN_ULE_TBR6_LOCKING_RSSI referred to in QuickLink Mode 0x15, is NOT available in ULE Devices with SDKs preceding 32.04 release *Add instructions for automating QuickLink using the cmbs_tcx Host *Add instructions how to reduce Tx Power in the GUC |
| 5.0 | January 23, 2018 | *Note that for SW versions 33.xx, the EEPROM Offset for enabling QuickLink is now 0x7CA instead of 0x792 |
| 6.0 | November 27, 2019 | <ul style="list-style-type: none"> *Note EEPROM setting alternative to registering a ULE Device to the GUC *Note 100mS packet interval setting to avoid entering hibernation |

In which SW Versions is Quick-Link supported?

All ULE Device versions above 30.17 support Quick-Link. A GUC (ie ULE Base/Controller) outfitted with Target and Host SW indicated below will support Quick-Link.



Note: See Appendix below for guidelines for automating the GUC (using the cmbs_tcx host) described in this document.

How does Loopback Mode work?

The GUC is transmitting a special “beacon” which informs the DUT at what interval it should wake up from hibernation and send a packet with a random data payload (and the GUC “knows” what this payload should be). The GUC collects these packets, checks their amplitude and makes sure all the CRC and PRBS data is clean and retrieves the RSSI reading (at the DUT side) from the previous ACK (the DUT embeds this info in the loopback packet as well!). The GUC will use this information to report whether or not the DUT transceiver is OK.

How does a ULE Device “know” it is in Loopback Test Mode

As mentioned above, the typical ULE Device will have no input keyboard or diagnostic/configuration interface available in production. When powering up the ULE Device, how does it know to enable Loopback mode and not enter normal application mode? In the ULE Device DECT EEPROM domain, there is a parameter called SD02_QUICKLINK_MODE (Offset 0x792 or 0x7CA for SW version 33.x). When set to 0x00 (this is the default), Quick-Link is disabled. If parameter is Set to 0x11, 13 or 15 (prior to casing, when customizing the DUTs EEPROM with its IPEI and other unique ULE or Regional parameters), the ULE Device will enable Loopback Test Mode for 1s **only if the ULE Device is not yet registered**. If the GUC is NOT detected within 1s, the DUT will either:

- *open for Registration (if auto-registration has been configured)
- *enter hibernate and wait for the Application to configure it for Registration
- *open for TBR6 (if TBR6 Test Mode has been configured in SD02_TEST_MODE)

How does the ULE Device “know” to lock on to the “desired” GUC?

In a production setting, it is likely that there are multiple GUCs (transmitting the special loopback beacon) in range of the DUT. How do we insure that the DUT will sync and loopback with the correct GUC? There are 3 options:

- 1) **The DUT SD02_QUICKLINK_MODE parameter is set to 0x11.** The DUT locks to any GUC with an RFPI = 0x0A AA AA AA A0 (Note: this is the default RFPI of the GUC. Thus, the RFPI does not need to be modified on the GUC side). This mode is appropriate when only one loopback test station is operational (or sufficient shielding of the GUC-DUT link is provided) such that there is no concern for “spurious lock” to an adjacent GUC. Furthermore, care must be taken to power-down the DUT prior to powering up the next DUT. In this mode, the GUC cannot distinguish between the DUTs and erroneous data will be reported!

- 2) **The DUT SD02_QUICKLINK_MODE parameter is set to 0x15.** As with setting of 0x11, The DUT locks to any GUC with an RFPI = 0x0A AA AA AA A0. However, here the DUT can configure their EEPROM parameter **SD02_MIN_ULE_TBR6_LOCKING_RSSI** (offset 0x794 - in SDK version 32.04 and later only - default setting for this parameter is -60dBm) such that they do not sync to any incoming GUC beacon with a signal level below this threshold. GUCs adjacent to each other in the production line can be distanced to guarantee that the desired GUC arrives at a level 30dB or more above the interfering GUCs
- 3) **The DUT SD02_QUICKLINK_MODE parameter is set to 0x13.** Prior to the loopback test, each DUT must be assigned a unique ID number called the IPEI – this IPEI is stored in the DUT’s EEPROM (Note: this must be done regardless of whether the loopback test is conducted or not). The programmed IPEI of the DUT is typically stored in a database and associated with the (scan-able) serial # appended to the DHAN or DHAN-S module. Prior to powering up the DUT, its IPEI is entered (either manually or via scan of the serial #) into the GUC test station. The GUC will utilize the DUT’s IPEI to identify its special loopback beacon transmissions – and the DUT will know to look for this specific beacon and no other

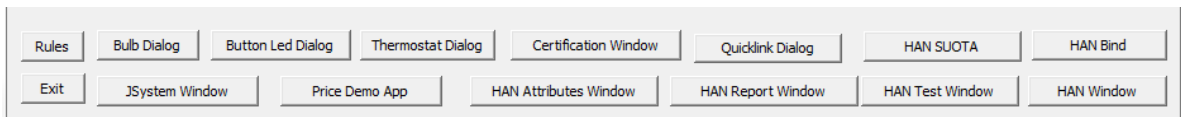
Additional measures should be employed to assure adjacent test stations to not interfere with each other:

1. shielding of the radiated path between the GUC antenna and the DUT
2. Beacon transmission frequencies (configurable – see description in subsequent section) of adjacent GUCs should be distanced from each other

How to Configure the GUC for Loopback Test?

The source code of the QuickLink portion of the Test Application can be supplied to the customer to facilitate automation of this final test station.

On the GUC Main Menu at the bottom there is a button called “QuickLink Dialog”.



Once this button is pressed the QuickLink submenu will appear – as shown below. It will show 0x00. Do the following steps:

- a) Prior to configuring the ULE Base as a GUC (next steps), register one ULE Device to the ULE Base. **Alternatively, one may also set the GUC EEPROM [SD02_TEST_MODE=0x14] to 0x80**
- b) Enter 0x91 in the SET TBR6 Field and hit this button. Then Reset the Target (on Main Menu, upper right)
- c) Optional (recommended): Enter DUT IPEI and hit SET IPEI (DUT 0x792 or 0x7CA for SW version 33.x offset must be configured with 0x13 setting – as mentioned above)
- d) Hit Set PM Button. The GUC will now be in Loopback Mode and ready to loopback with a DUT

Assuming the DUT SD02_QUICKLINK_MODE parameter has already been set, once the DUT is powered up it will automatically sync with the GUC and the loopback data will begin to stream.

The GUC default settings for loopback are shown below:

- Loopback request is being transmitted on an arbitrary RF channel (Carrier = 0xFF is the default)
- It is requesting the DUT to send a packet every 2s (Period = 200 frames). **This value should be altered to 100 frames if one wants to prevent the DUT from hibernating between packets**
- If no IPEI has been SET, any DUT with the 0x11 setting in the QUICKLINK_MODE EEPROM offset (0x792 or 0x7CA for SW version 33.x) and now waking up from reset, will sync to this bearer and start sending packets ever

- GUC is transmitting at Max Power
- Acceptable minimum RSSI reading for the incoming packet from DUT is 0xA0 (~-51dBm)
- Acceptable minimum RSSI reading reported by the DUT is 0xA0 (~-51dBm)

Result shown below is typical for GUC and DUT in close proximity to each other, with GUC transmitting full power. Here is a description of the Fields displayed at the GUC side:

Counter: Counts the number of packets sent by the DUT

Status: 2 indicates that all packets (starting from 1) have arrived when expected (Period = expected +/- 1 frame), all RSSI readings are above threshold, all BER/FER/BCRC are correct. 0 indicates that at least one of the packets is in error.

Period Error: Indicates how many of the packets have arrived late (more than 1 frame greater than expected)

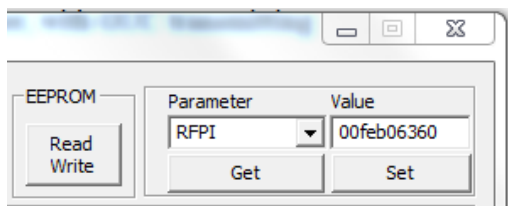
Last Rx Frame and Sync Frame: Indicates the interval between packets sent by the DUT. Should be equal to the "Period", eg 200 (frames = 2seconds)

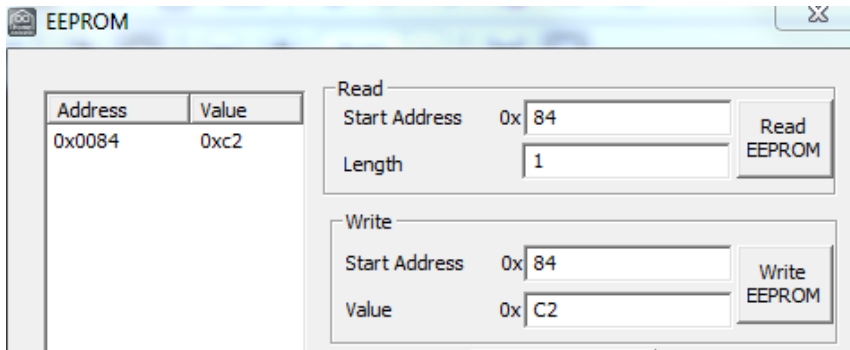
Local RSSI: the signal level measured by the GUC

RSSI: the signal level measured by the DUT (and looped back to the GUC)

| Counter | Status | Last Rx Fr | Period Error | RSSI Local | RSSI | BER | FER | BCRC | Sync Frmae | First Rx Fr | Period MIN | Period MAX | RSSI Local Min | RSSI Local Max |
|---------|--------|------------|--------------|--------------|--------------|-----|-----|------|------------|-------------|------------|------------|----------------|----------------|
| 17 | 2 | 10967 | 0 | 0x1b(-30dBm) | 0x1b(-30dBm) | 0 | 0 | 0 | 10965 | 7767 | 199 | 201 | 0x1b(-30dBm) | 0x1b(-30dBm) |
| 16 | 2 | 10767 | 0 | 0x1b(-30dBm) | 0x1b(-30dBm) | 0 | 0 | 0 | 10765 | 7767 | 199 | 201 | 0x1b(-30dBm) | 0x1b(-30dBm) |
| 15 | 2 | 10567 | 0 | 0x1b(-30dBm) | 0x1b(-30dBm) | 0 | 0 | 0 | 10565 | 7767 | 199 | 201 | 0x1b(-30dBm) | 0x1b(-30dBm) |
| 14 | 2 | 10367 | 0 | 0x1b(-30dBm) | 0x1b(-30dBm) | 0 | 0 | 0 | 10365 | 7767 | 199 | 201 | 0x1b(-30dBm) | 0x1b(-30dBm) |
| 13 | 2 | 10168 | 0 | 0x1b(-30dBm) | 0x1b(-30dBm) | 0 | 0 | 0 | 10166 | 7767 | 200 | 201 | 0x1b(-30dBm) | 0x1b(-30dBm) |
| 12 | 2 | 9967 | 0 | 0x1b(-30dBm) | 0x1b(-30dBm) | 0 | 0 | 0 | 9965 | 7767 | 200 | 200 | 0x1b(-30dBm) | 0x1b(-30dBm) |
| 11 | 2 | 9767 | 0 | 0x1b(-30dBm) | 0x1b(-30dBm) | 0 | 0 | 0 | 9765 | 7767 | 200 | 200 | 0x1b(-30dBm) | 0x1b(-30dBm) |
| 10 | 2 | 9567 | 0 | 0x1b(-30dBm) | 0x1b(-30dBm) | 0 | 0 | 0 | 9565 | 7767 | 200 | 200 | 0x1b(-30dBm) | 0x1b(-30dBm) |
| 9 | 2 | 9367 | 0 | 0x1b(-30dBm) | 0x1b(-30dBm) | 0 | 0 | 0 | 9365 | 7767 | 200 | 200 | 0x1b(-30dBm) | 0x1b(-30dBm) |
| 8 | 2 | 9167 | 0 | 0x1b(-30dBm) | 0x1b(-30dBm) | 0 | 0 | 0 | 9165 | 7767 | 200 | 200 | 0x1b(-30dBm) | 0x1b(-30dBm) |
| 7 | 2 | 8967 | 0 | 0x1b(-30dBm) | 0x1b(-30dBm) | 0 | 0 | 0 | 8965 | 7767 | 200 | 200 | 0x1b(-30dBm) | 0x1b(-30dBm) |
| 6 | 2 | 8767 | 0 | 0x1b(-30dBm) | 0x1b(-30dBm) | 0 | 0 | 0 | 8765 | 7767 | 200 | 200 | 0x1b(-30dBm) | 0x1b(-30dBm) |
| 5 | 2 | 8567 | 0 | 0x1b(-30dBm) | 0x1b(-30dBm) | 0 | 0 | 0 | 8565 | 7767 | 200 | 200 | 0x1b(-30dBm) | 0x1b(-30dBm) |
| 4 | 2 | 8367 | 0 | 0x1b(-30dBm) | 0x1b(-30dBm) | 0 | 0 | 0 | 8365 | 7767 | 200 | 200 | 0x1b(-30dBm) | 0x1b(-30dBm) |
| 3 | 2 | 8167 | 0 | 0x1b(-30dBm) | 0x1b(-30dBm) | 0 | 0 | 0 | 8165 | 7767 | 200 | 200 | 0x1b(-30dBm) | 0x1b(-30dBm) |
| 2 | 2 | 7967 | 0 | 0x1b(-30dBm) | 0x1b(-30dBm) | 0 | 0 | 0 | 7965 | 7767 | 200 | 200 | 0x1b(-30dBm) | 0x1b(-30dBm) |
| 1 | 2 | 7767 | 0 | 0x1b(-30dBm) | 0x00(0 dBm) | 0 | 0 | 0 | 7541 | 7767 | 0 | 0 | 0x1b(-30dBm) | 0x1b(-30dBm) |

In the above example, both GUC and DUT receivers are in compression and reporting RSSI of -30dBm. In order to test the DUT Rx under more realistic conditions, it is recommended to reduce the GUC transmission to a minimum, roughly 0dBm. This is done as by clicking the "EEPROM" button at the top right of the GUC Main Menu. The submenu shown below will pop up. Write Value 0xC2 to Start Address 0x84.





Note now the RSSI reported by the DUT has dropped to ~-35dBm.

| Counter | Status | Last Rx Fr | Period Error | RSSI Local | RSSI |
|---------|--------|------------|--------------|--------------|--------------|
| 7 | 2 | 3591 | 0 | 0x1b(-30dBm) | 0x18(-37dBm) |
| 6 | 2 | 3391 | 0 | 0x1b(-30dBm) | 0x19(-35dBm) |
| 5 | 2 | 3191 | 0 | 0x1b(-30dBm) | 0x19(-35dBm) |

If the DUT is now further isolated from the GUC and the RSSI reading at the DUT drops below -50dBm, the Status bit which indicated “2”, now indicates “0” – a fail!

| | | | | | |
|----|---|-------|---|--------------|--------------|
| 16 | 0 | 40967 | 0 | 0x1b(-30dBm) | 0x0f(-65dBm) |
| 15 | 0 | 40767 | 0 | 0x1b(-30dBm) | 0x11(-57dBm) |
| 14 | 0 | 40567 | 0 | 0x1b(-30dBm) | 0x13(-51dBm) |
| 13 | 2 | 40367 | 0 | 0x1b(-30dBm) | 0x14(-48dBm) |
| 12 | 2 | 40167 | 0 | 0x1b(-30dBm) | 0x14(-48dBm) |
| 11 | 2 | 39967 | 0 | 0x1b(-30dBm) | 0x14(-48dBm) |

In the case shown below, the period between subsequent frames jumped from 200 (expected) to 480 (missed one loopback packet). Note the “Status” change from 2 to 0 – a fail!!

| Counter | Status | Last Rx Fr | Period Error | RSSI Local | RSSI | BER | FER | BCRC | Sync Frmae | First Rx Fr | Period MIN | Period MAX |
|---------|--------|------------|--------------|--------------|--------------|-----|-----|------|------------|-------------|------------|------------|
| 10 | 0 | 227703 | 1 | 0x1b(-30dBm) | 0x19(-35dBm) | 0 | 0 | 0 | 31093 | 225623 | 200 | 480 |
| 9 | 0 | 227503 | 1 | 0x1b(-30dBm) | 0x18(-37dBm) | 0 | 0 | 0 | 30893 | 225623 | 200 | 480 |
| 8 | 0 | 227303 | 1 | 0x1b(-30dBm) | 0x00(0 dBm) | 0 | 0 | 0 | 30466 | 225623 | 200 | 480 |
| 7 | 2 | 226823 | 0 | 0x1b(-30dBm) | 0x18(-37dBm) | 0 | 0 | 0 | 30213 | 225623 | 200 | 200 |
| 6 | 2 | 226623 | 0 | 0x1b(-30dBm) | 0x19(-35dBm) | 0 | 0 | 0 | 30013 | 225623 | 200 | 200 |

Notice the “Clear Statistics” Button at the upper right. This button is used to reset the Counter and the Status fields. Example below

| | | | | | | | | |
|----|---|--------|---|--------------|--------------|---|---|---|
| 2 | 2 | 225823 | 0 | 0x1b(-30dBm) | 0x18(-37dBm) | 0 | 0 | 0 |
| 1 | 2 | 225623 | 0 | 0x1b(-30dBm) | 0x00(0 dBm) | 0 | 0 | 0 |
| 47 | 0 | 138399 | 2 | 0x1b(-30dBm) | 0x1a(-33dBm) | 0 | 0 | 0 |
| 46 | 0 | 138199 | 2 | 0x1b(-30dBm) | 0x1a(-33dBm) | 0 | 0 | 0 |

Fields are supplied to alter these defaults:

- Transmission can be fixed to any of the channels (Valid Entries are: 0, 1, 2 etc....as in TBR6)
- the IPEI of the DUT can be entered, ie only the DUT with correct IPEI (with **SD02_QUICKLINK_MODE** parameter is set to **0x13**– see above) will be able to loopback with the GUC
- DUT packet interval can be set to 100, 200, 250, 300 frames. See appendix for a description of how the DUT enters/exits hibernation while in 200 frame QuickLink. The 100 frame setting should be used if one wants to prevent the device from entering hibernation in between loopback transmissions

- RSSI Threshold for incoming DUT Packet (RSSI Local): Refer to the table in the appendix. This parameter (called) SD02_PRODUCTION_TEST_RSSI_THRESH_UPLINK) is found at offset 0xFA
- RSSI Threshold for incoming DUT Packet (RSSI Local): Refer to the table in the appendix. This parameter (called) SD02_PRODUCTION_TEST_RSSI_THRESH_Downlink) is found at offset 0xF9

Modified settings will be enforced immediately in the GUC loopback beacon, ie no need to power cycle the GUC. Just need to re-hit the “SET PM” button.

Summary of Instructions:

Overall Test Setup: Arrange ~50 of loss between GUC and DUT. This can be accomplished either by distancing the two or adding an SMA coaxial attenuator between the GUC and the rubber antenna supplied.

GUC Initial Setup: Power On the GUC and run the DSPG Application Test SW (or some commandline version of this) and:

- Make sure that a single ULE Device is already registered to the ULE Base/Controller. **Alternatively, one may also set the GUC EEPROM [SD02_TEST_MODE=0x14] to 0x80**
- configure for QuickLink Mode (0x91) in the Quicklink bar.
- Lower the Tx Power to 0dBm via EEPROM R/W. (See Appendix below). This is useful to somewhat isolate (RF-wise) the GUC from the DUT
- Program the “PRODUCTION_TEST_RSSI_THRESH_UPLINK” EEPROM setting to give ~5dB lower than the reading you get with a “known good device”, say “0xC0” (eg, for a link with 50dB loss you should get approximately -30dBm reading).
- Program the “PRODUCTION_TEST_RSSI_THRESH_Downlink” EEPROM setting to give ~5dB lower than the reading you get with a “known good device”, say “0x88” (eg, for a link with 50dB loss you should get approximately -55dBm reading with the Tx Power set for 0dBm

DUT Initial Setup: Offset 0x792 or 0x7CA for SW version 33.x should be set for QuickLink with IPEI, ie 0x13. Customer should have a tabulation of Serial# (shown on the label for the DHAN-S module and scannable) vs IPEI. This Serial# should be scanned in to the GUC (and IPEI recovered) prior to power up of the DUT in the presence of the GUC. Or, simply manually enter this IPEI into the GUI

Running the GUC: Now hit SET IPEI and SET PM buttons. The GUC is now transmitting beacon targeting the DUT with this IPEI

Power Up DUT1: Collect 2,3 or more “Counts” on the Quicklink table “Counter”. Status should remain 2. If not, DUT fails. Power down the DUT and click the “Clear Statistics” button on upper right corner.

Next DUT: Enter new IPEI (or scan it in) and hit SET IPEI and SET PM buttons. Now Power Up DUT#2 and repeat!!

NOTE: see Appendix for a log of the “conversation” at the CMBS API for this GUC Initial Setup and setup from one DUT to the next. Customer can automate QuickLink for efficient Production line testing by referring to the “cmbs_tcx” sample code (downloaded via GPG key from the DSPG FTP) and calling upon the same CMBS API functions!

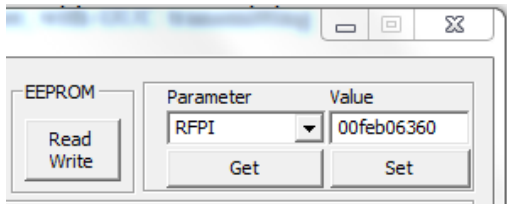
Conclusion

ULE Device manufacturers looking for a quick check of the RF Link at the final test station can enable the Quick-Link functionality in the device EEPROM. The unregistered DUT is placed 30 to 90dB of attenuation within the range of a specially programmed Golden Unit Controller (the GUC can be purchased from DSP

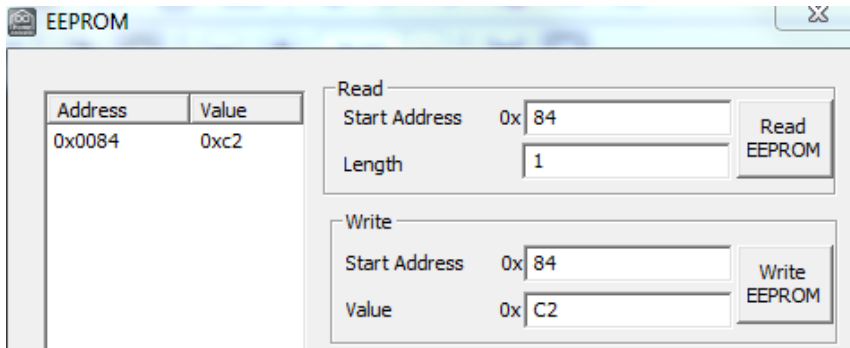
Group LTD) and within seconds, the Link functionality can be validated. There is no need to register the DUT to the GUC. There is no need to access the EEPROM or JTAG I/F before or after the test. Just apply power to the DUT and the test will run.

Appendix: Reducing Tx Power to ~0dBm in the GUC

Select EEPROM R/W at the upper-right corner of the GUC main screen



Write 0xC2 setting to Offset 0x84 as shown below



Appendix: RSSI Threshold Tabulations

These settings are relevant to SD02_PRODUCTION_TEST_RSSI_THRESH_UPLINK & DOWNLINK and SD02_MIN_ULE_TBR6_LOCKING_RSSI.

| PIN [DBM] | 8-BIT RSSIO HEX | PIN [DBM] | 8-BIT RSSIO HEX | PIN [DBM] | 8-BIT RSSIO HEX | PIN [DBM] | 8-BIT RSSIO HEX |
|-----------|-----------------|-----------|-----------------|-----------|-----------------|-----------|-----------------|
| -95 | 30 | -74 | 60 | -53 | 98 | -32 | D0 |
| -94 | 30 | -73 | 68 | -52 | A0 | -31 | D8 |
| -93 | 30 | -72 | 68 | -51 | A0 | -30 | D8 |
| -92 | 30 | -71 | 70 | -50 | A0 | -29 | D8 |
| -91 | 38 | -70 | 70 | -49 | A8 | -28 | D8 |
| -90 | 38 | -69 | 70 | -48 | A8 | -27 | D8 |
| -89 | 38 | -68 | 78 | -47 | A8 | -26 | D8 |
| -88 | 40 | -67 | 78 | -46 | B0 | -25 | D8 |
| -87 | 40 | -66 | 78 | -45 | B0 | -24 | D8 |
| -86 | 40 | -65 | 78 | -44 | B0 | -23 | D8 |
| -85 | 40 | -64 | 80 | -43 | B8 | -22 | D8 |
| -84 | 48 | -63 | 80 | -42 | B8 | -21 | D8 |
| -83 | 48 | -62 | 80 | -41 | B8 | -20 | D8 |
| -82 | 50 | -61 | 88 | -40 | C0 | -19 | D8 |
| -81 | 50 | -60 | 88 | -39 | C0 | -18 | D8 |
| -80 | 50 | -59 | 88 | -38 | C0 | -17 | D8 |
| -79 | 50 | -58 | 90 | -37 | C8 | -16 | D8 |
| -78 | 58 | -57 | 90 | -36 | C8 | -15 | D8 |
| -77 | 58 | -56 | 90 | -35 | D0 | -14 | D8 |
| -76 | 60 | -55 | 98 | -34 | D0 | -13 | D8 |

Appendix: Automating the GUC for QuickLink

Customers typically wish to automate the GUC production line activity. This must be done by writing a “production-line Application” which accesses the CMBS API library that resides in the GUC. DSP Group LTD supplies a sample application called “cmbs_tcx” which can serve as a baseline for such an application.

The screenshot shows the Quicklink application window. At the top, there are several control buttons: "Set tbr6" (with a dropdown showing "0x 91"), "Get tbr6", "Set IPEI" (with a text field showing "00feb54800"), "Set PM", "Carrier 0x" (with a dropdown showing "FF"), and "Period" (with a text field showing "200"). Below these buttons is a table with 13 columns: Counter, Status, Last Rx Fr, Period Error, RSSI Local, RSSI, BER, FER, BCRC, Sync Frmae, First Rx Fr, Period MIN, and Period M. The table contains 6 rows of data.

| Counter | Status | Last Rx Fr | Period Error | RSSI Local | RSSI | BER | FER | BCRC | Sync Frmae | First Rx Fr | Period MIN | Period M |
|---------|--------|------------|--------------|--------------|--------------|-----|-----|------|------------|-------------|------------|----------|
| 6 | 2 | 3033 | 0 | 0x1b(-30dBm) | 0x16(-42dBm) | 0 | 0 | 0 | 3031 | 2033 | 199 | 201 |
| 5 | 2 | 2834 | 0 | 0x1b(-30dBm) | 0x16(-42dBm) | 0 | 0 | 0 | 2832 | 2033 | 199 | 201 |
| 4 | 2 | 2633 | 0 | 0x1b(-30dBm) | 0x16(-42dBm) | 0 | 0 | 0 | 2631 | 2033 | 199 | 201 |
| 3 | 2 | 2434 | 0 | 0x1b(-30dBm) | 0x15(-45dBm) | 0 | 0 | 0 | 2432 | 2033 | 200 | 201 |
| 2 | 2 | 2234 | 0 | 0x1b(-30dBm) | 0x15(-45dBm) | 0 | 0 | 0 | 2232 | 2033 | 201 | 201 |
| 1 | 2 | 2033 | 0 | 0x1b(-30dBm) | 0x00(0 dBm) | 0 | 0 | 0 | 1840 | 2033 | 0 | 0 |

02-01-2017 12:37:20:288 (1483353440288)

Host ---> Target: 10 00 05 00 09 00 01 00 91

{CMBS_EV_DSR_PARAM_SET(15)}

<CMBS_IE_PARAMETER(16)>:

TEST_MODE : 91

Set to GUC to Loopback Mode

02-01-2017 12:37:20:320 (1483353440320)

Target ---> Host: 1B 00 00 00 10 00 13 00 10 00 04 00 09 00 00 00 16 00 01 00 00 00 0F 02 00 0C BF

{CMBS_EV_DSR_PARAM_SET_RES(16)}

<CMBS_IE_PARAMETER(16)>:

TEST_MODE

<CMBS_IE_RESPONSE(22)>:

Response: OK

02-01-2017 12:37:29:273 (1483353449273)

Host ---> Target: 1A 00 08 00 00 84 00 00 00 01 00 C2

{CMBS_EV_DSR_PARAM_AREA_SET(78)}

<CMBS_IE_PARAMETER_AREA(26)>:

Param_Area=0, Offset=132, Length=1

, Data: C2

Set Tx Power (offset 0x84) to ~0dBm

02-01-2017 12:37:29:304 (1483353449304)

Target ---> Host: 13 00 00 00 4F 00 0B 00 16 00 01 00 00 00 0F 02 00 77 71

{CMBS_EV_DSR_PARAM_AREA_SET_RES(79)}

<CMBS_IE_RESPONSE(22)>:

Response: OK

02-01-2017 12:37:38:714 (1483353458714)

Host ---> Target: 1A 00 08 00 00 FA 00 00 00 01 00 D8

{CMBS_EV_DSR_PARAM_AREA_SET(78)}

<CMBS_IE_PARAMETER_AREA(26)>:

Param_Area=0, Offset=250, Length=1

, Data: D8



Set Uplink RSSI Threshold to ~-30dBm

02-01-2017 12:37:38:745 (1483353458745)

Target ---> Host: 13 00 00 00 4F 00 0B 00 16 00 01 00 00 0F 02 00 77 71

{CMBS_EV_DSR_PARAM_AREA_SET_RES(79)}

<CMBS_IE_RESPONSE(22)>:

Response: OK

02-01-2017 12:37:46:217 (1483353466217)

Host ---> Target: 1A 00 08 00 00 F9 00 00 00 01 00 A8

{CMBS_EV_DSR_PARAM_AREA_SET(78)}

<CMBS_IE_PARAMETER_AREA(26)>:

Param_Area=0, Offset=249, Length=1

, Data: A8



Set Downlink RSSI Threshold to ~-48dBm

02-01-2017 12:37:46:247 (1483353466247)

Target ---> Host: 13 00 00 00 4F 00 0B 00 16 00 01 00 00 0F 02 00 77 71

{CMBS_EV_DSR_PARAM_AREA_SET_RES(79)}

<CMBS_IE_RESPONSE(22)>:

Response: OK

02-01-2017 12:37:52:080 (148335347280)

Host ---> Target:

{CMBS_EV_DSR_SYS_RESET(31)}



Reset the ULE Controller

02-01-2017 12:37:53:709 (1483353473709)

Target ---> Host: 08 00 00 00 7D 00 00 00

{CMBS_EV_DSR_TARGET_UP(125)}

02-01-2017 12:38:08:179 (1483353488179)

Host ---> Target: 27 30 05 00 00 FE B5 48 00

{CMBS_EV_DSR_HAN_TBR6_SET_GUCI(12359)}

<CMBS_IE_HAN_ULE_DEVICE_IPUI(12327)>:

ULE Device TBR 6 IPUE[5]: {0,FE,B5,48,0}



Enter the DUT IPEI

02-01-2017 12:38:08:183 (1483353488183)

Target ---> Host: 13 00 00 00 48 30 0B 00 16 00 01 00 00 0F 02 00 77 71

RSSI Local Max: 0xD8
RSSI: 0xA8
RSSI Min: 0xA8
RSSI Max: 0xA8
Missed Acks: 0x00
Sync Attempts: 0x00
Sync Frames: 0x980



02-01-2017 17:10:17:466 (1483369817466)
Host ---> Target:
{CMBS_EV_DSR_HAN_TBR6_RESET_STATISTICS(12361)}

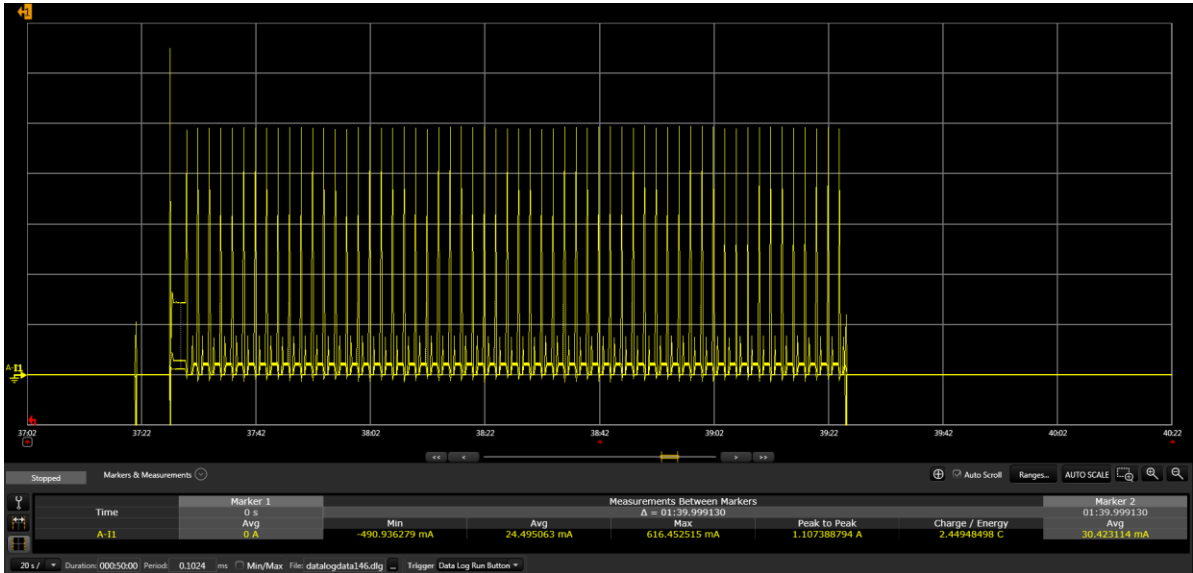


02-01-2017 17:10:17:471 (1483369817471)
Target ---> Host: 13 00 00 00 4A 30 0B 00 16 00 01 00 00 00 0F 02 00 77 71
{CMBS_EV_DSR_HAN_TBR6_RESET_STATISTICS_RES(12362)}
<CMBS_IE_RESPONSE(22)>:
Response: OK

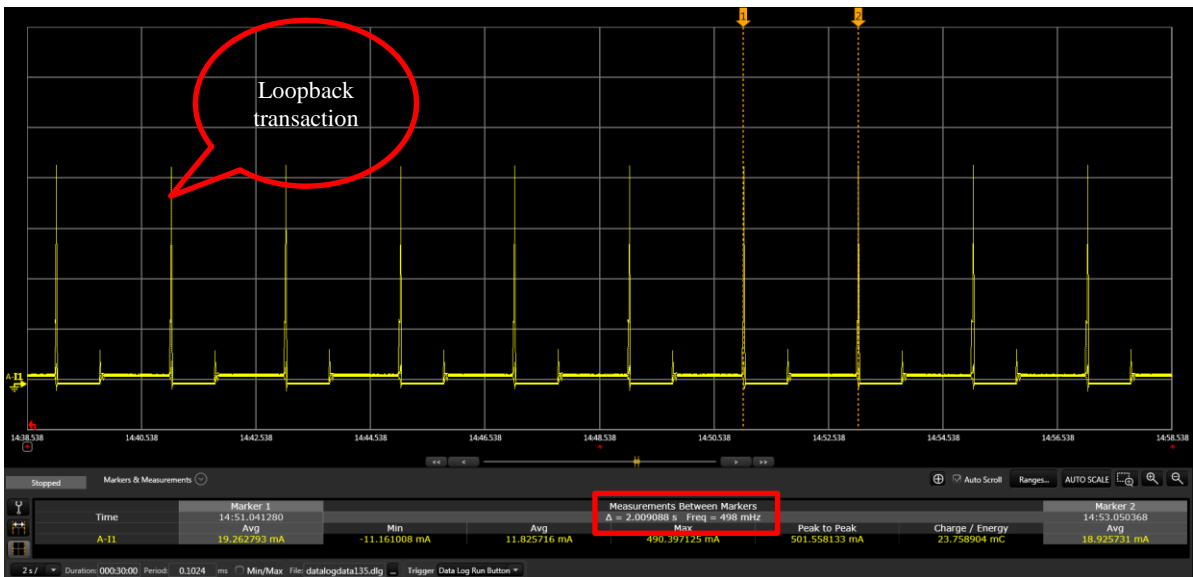


Appendix: Current (=Activity) vs Time for QuickLink

Interval for this Device was set at 200 frames. The “big picture is show below.



Note: Transaction every 2s, followed by short period of hibernation then wakeup for next loopback transaction



Plot below is with the GUC turned OFF

