

morephcs.

channel sounding



A Bluetooth® LE Channel Sounding Application for the moreph30 hardware platform. When used in conjunction with RFcreations programmable switch box it can perform all of the tests set out in the Bluetooth LE Channel Sounding RFPHY test specification and the Channel Sounding Layer test specification. Channel Sounding captures, including raw IQ data, can be exported, and shared with other users. Validate your implementation now, used at the SIG IOP Sessions.

KEY FEATURES:

CS TEST CASE SUPPORT

- Support for all RF-PHY test cases, including BT=2.0 modulation index.
- Support for all Channel Sounding Layer test cases. using the HCI test command and not via an over-the-air link.

CONTROL AND ANALYSIS TOOLS

- Simple control via comprehensive GUI or Python/C dll.
- Log of all HCI traffic and key events.
- Export of raw IQ data, spectrogram or entire capture to share.
- Capture of GPIO time aligned with IQ data

EXTENSIVE GRAPHICS INCLUDING

- 1MHz x 1µs spectrogram of the entire Channel Sounding procedure
- IQ and demodulated waveforms of wanted and companion signals
- Gated spectra of initiator or reflector
- ToF vs channel sounding step
- Linear phase regression

COMPREHENSIVE SIGNAL DISTORTIONS:

- Programmable clock timing error
- MITM attacks
- Additive white gaussian noise
- Maximum phase in exclusion zone
- Sinusoidal frequency fluctuations



USE CASES:

- **PRE-COMPLIANCE TESTER:** Allows the developer to "pre-test" with confidence before committing to test house.
- **SILICON EVALUATION:** Capture corrupt waveforms for detailed analysis and perform RF-PHY testing on live links.
- **SILICON CHARACTERISATION:** Eliminates the need for additional test equipment, dramatically reducing test time and increasing throughput.
- **RMA ANALYSIS:** Simple to use GUI rapidly identifies faults.

OPERATING MODES:

- **SCRIPTED:** Scripted support for all RFPHY test cases and Channel Sounding Layer test cases. Test parameters can be edited to form custom scripts.
- **MANUAL:** The unit can act either as an initiator or reflector performing an arbitrary Channel Sounding procedure as defined by the user. If a IUT is attached, then HCI event reports are captured and analysed. All key parameters such as ToF, linear phase regression and spectra are calculated. IQ and spectrum data are available for viewing or export.
- **CALIBRATE:** Permits the amplitude and phase response of the moreph30 to be calibrated.



SUPPORTED TEST CASES:

The morephCS. application supports all of the tests listed below when used with an RFcreations programmable switch box. The IUT must be connected via a serial HCI interface. All Channel Sounding Layer tests are conducted using the HCI test command and are not performed using an over-the-air link.

TEST NUMBER	TEST DESCRIPTION
RFPHY/TRM/CS/BV-900-C	Stable Phase, 1 Ms/s, CS_Tone
RFPHY/TRM/CS/BV-901-C	Stable Phase, 2 Ms/s, CS_Tone
RFPHY/TRM/CS/BV-930-C	Modulation Spectrum, 1 Ms/s, Mode-1
RFPHY/TRM/CS/BV-931-C	Modulation Spectrum, 2 Ms/s, Mode-1
RFPHY/TRM/CS/BV-932-C	Modulation Spectrum, 2 Ms/s, BT = 2.0, Mode-1
RFPHY/TRM/CS/BV-950-C	Modulation Characteristics, 2 Ms/s, BT = 2.0, Mode-1
RFPHY/TRM/CS/BV-951-C	Modulation Characteristics, 2 Ms/s, BT = 2.0, Mode-3
RFPHY/TRM/CS/BV-1000-C	TX SNR Output Control, 1 Ms/s, SNRmin, Mode-1
RFPHY/TRM/CS/BV-1001-C	TX SNR Output Control, 1 Ms/s, SNRmin, Mode-3
RFPHY/TRM/CS/BV-1002-C	TX SNR Output Control, 2 Ms/s, SNRmin, Mode-1
RFPHY/TRM/CS/BV-1003-C	TX SNR Output Control, 2 Ms/s, SNRmin, Mode-3
RFPHY/TRM/CS/BV-1004-C	TX SNR Output Control, 2 Ms/s, SNRmin, Mode-1, BT = 2.0
RFPHY/TRM/CS/BV-1005-C	TX SNR Output Control, 2 Ms/s, SNRmin, Mode-3, BT = 2.0
RFPHY/TRM/CS/BV-1006-C	TX SNR Output Control, 1 Ms/s, SNRmax, Mode-1
RFPHY/TRM/CS/BV-1007-C	TX SNR Output Control, 1 Ms/s, SNRmax, Mode-3
RFPHY/TRM/CS/BV-1008-C	TX SNR Output Control, 2 Ms/s, SNRmax, Mode-1
RFPHY/TRM/CS/BV-1009-C	TX SNR Output Control, 2 Ms/s, SNRmax, Mode-3
RFPHY/TRM/CS/BV-1010-C	TX SNR Output Control, 2 Ms/s, SNRmax, Mode-1, BT = 2.0
RFPHY/TRM/CS/BV-1011-C	TX SNR Output Control, 2 Ms/s, SNRmax, Mode-3, BT = 2.0
RFPHY/TRM-RCV/CS/BV-960-C	Step Mode-0, Frequency Verification, 1 Ms/s
RFPHY/TRM-RCV /CS/BV-961-C	Step Mode-0, Frequency Verification, 2 Ms/s
RFPHY/TRM-RCV /CS/BV-962-C	Step Mode-0, Frequency Verification, 2 Ms/s, BT = 2.0
RFPHY/TRM-RCV /CS/BV-970-C	Step Main Mode, Frequency Verification, 1 Ms/s, Mode-1
RFPHY/TRM-RCV /CS/BV-971-C	Step Main Mode, Frequency Verification, 1 Ms/s, Mode-2
RFPHY/TRM-RCV /CS/BV-972-C	Step Main Mode, Frequency Verification, 1 Ms/s, Mode-3
RFPHY/TRM-RCV /CS/BV-973-C	Step Main Mode, Frequency Verification, 2 Ms/s, Mode-1
RFPHY/TRM-RCV /CS/BV-974-C	Step Main Mode, Frequency Verification, 2 Ms/s, Mode-3
RFPHY/TRM-RCV /CS/BV-975-C	Step Main Mode, Frequency Verification, 2 Ms/s, BT = 2.0, Mode-1
RFPHY/TRM-RCV /CS/BV-976-C	Step Main Mode, Frequency Verification, 2 Ms/s, BT = 2.0, Mode-3
RFPHY/TRM-RCV/CS/BV-990-C	Phase Measurement Accuracy, 1 Ms/s, Mode-2, Reflector
RFPHY/TRM-RCV/CS/BV-991-C	Phase Measurement Accuracy, 1 Ms/s, Mode-3, Reflector
RFPHY/TRM-RCV/CS/BV-992-C	Phase Measurement Accuracy, 2 Ms/s, Mode-3, Reflector
RFPHY/TRM-RCV/CS/BV-993-C	Phase Measurement Accuracy, 2 Ms/s, BT = 2.0, Mode-3, Reflector
RFPHY/TRM-RCV/CS/BV-994-C	Phase Measurement Accuracy, 1 Ms/s, Mode-2, Initiator
RFPHY/TRM-RCV/CS/BV-995-C	Phase Measurement Accuracy, 1 Ms/s, Mode-3, Initiator
RFPHY/TRM-RCV/CS/BV-996-C	Phase Measurement Accuracy, 2 Ms/s, Mode-3, Initiator



	Phase Measurement Accuracy, 2 Ms/s, BT = 2.0, Mode-3, Initiator
CS/NAD/REF/BV-01-C	Normalized Attack Detector Metric, Mode-1, Random Sequence 32-bits, Reflector LE 1M PHY
CS/NAD/REF/BV-02-C	Normalized Attack Detector Metric, Mode-1, Random Sequence 64-bits, Reflector LE 1M PHY
CS/NAD/REF/BV-03-C	Normalized Attack Detector Metric, Mode-1, Random Sequence 96-bits, Reflector LE 1M PHY
CS/NAD/REF/BV-04-C	Normalized Attack Detector Metric, Mode-1, Random Sequence 128-bits, Reflector LE 1M PHY
CS/NAD/REF/BV-05-C	Normalized Attack Detector Metric, Mode-1, Sounding Sequence 32-bits, Reflector LE 1M PHY
CS/NAD/REF/BV-06-C	Normalized Attack Detector Metric, Mode-1, Sounding Sequence 96-bits, Reflector LE 1M PHY
CS/NAD/REF/BV-07-C	Normalized Attack Detector Metric, Mode-3, Random Sequence 32-bits, Reflector LE 1M PHY
CS/NAD/REF/BV-08-C	Normalized Attack Detector Metric, Mode-3, Random Sequence 64-bits, Reflector LE 1M PHY
CS/NAD/REF/BV-09-C	Normalized Attack Detector Metric, Mode-3, Random Sequence 96-bits, Reflector LE 1M PHY
CS/NAD/REF/BV-10-C	Normalized Attack Detector Metric, Mode-3, Random Sequence 128-bits, Reflector LE 1M PHY
CS/NAD/REF/BV-11-C	Normalized Attack Detector Metric, Mode-3, Sounding Sequence 32-bits, Reflector LE 1M PHY
CS/NAD/REF/BV-12-C	Normalized Attack Detector Metric, Mode-3, Sounding Sequence 96-bits, Reflector LE 1M PHY
CS/NAD/INI/BV-01-C	Normalized Attack Detector Metric, Mode-1, Random Sequence 32-bits, Initiator LE 1M PHY
CS/NAD/INI/BV-02-C	Normalized Attack Detector Metric, Mode-1, Random Sequence 64-bits, Initiator LE 1M PHY
CS/NAD/INI/BV-03-C	Normalized Attack Detector Metric, Mode-1, Random Sequence 96-bits, Initiator LE 1M PHY
CS/NAD/INI/BV-04-C	Normalized Attack Detector Metric, Mode-1, Random Sequence 128-bits, Initiator LE 1M PHY
CS/NAD/INI/BV-05-C	Normalized Attack Detector Metric, Mode-1, Sounding Sequence 32-bits, Initiator LE 1M PHY
CS/NAD/INI/BV-06-C	Normalized Attack Detector Metric, Mode-1, Sounding Sequence 96-bits, Initiator LE 1M PHY
CS/NAD/INI/BV-07-C	Normalized Attack Detector Metric, Mode-3, Random Sequence 32-bits, Initiator LE 1M PHY
CS/NAD/INI/BV-08-C	Normalized Attack Detector Metric, Mode-3, Random Sequence 64-bits, Initiator LE 1M PHY
CS/NAD/INI/BV-09-C	Normalized Attack Detector Metric, Mode-3, Random Sequence 96-bits, Initiator LE 1M PHY



CS/NAD/INI/BV-10-C	Normalized Attack Detector Metric, Mode-3, Random Sequence 128-bits, Initiator LE 1M PHY
CS/NAD/INI/BV-11-C	Normalized Attack Detector Metric, Mode-3, Sounding Sequence 32-bits, Initiator LE 1M PHY
CS/NAD/INI/BV-12-C	Normalized Attack Detector Metric, Mode-3, Sounding Sequence 96-bits, Initiator LE 1M PHY
CS/NAD/REF/BV-13-C	Normalized Attack Detector Metric, Mode-1, Random Sequence 32-bits, Reflector LE 2M PHY
CS/NAD/REF/BV-14-C	Normalized Attack Detector Metric, Mode-1, Random Sequence 64-bits, Reflector LE 2M PHY
CS/NAD/REF/BV-15-C	Normalized Attack Detector Metric, Mode-1, Random Sequence 96-bits, Reflector LE 2M PHY
CS/NAD/REF/BV-16-C	Normalized Attack Detector Metric, Mode-1, Random Sequence 128-bits, Reflector LE 2M PHY
CS/NAD/REF/BV-17-C	Normalized Attack Detector Metric, Mode-1, Sounding Sequence 32-bits, Reflector LE 2M PHY
CS/NAD/REF/BV-18-C	Normalized Attack Detector Metric, Mode-1, Sounding Sequence 96-bits, Reflector LE 2M PHY
CS/NAD/REF/BV-19-C	Normalized Attack Detector Metric, Mode-3, Random Sequence 32-bits, Reflector LE 2M PHY
CS/NAD/REF/BV-20-C	Normalized Attack Detector Metric, Mode-3, Random Sequence 64-bits, Reflector LE 2M PHY
CS/NAD/REF/BV-21-C	Normalized Attack Detector Metric, Mode-3, Random Sequence 96-bits, Reflector LE 2M PHY
CS/NAD/REF/BV-22-C	Normalized Attack Detector Metric, Mode-3, Random Sequence 128-bits, Reflector LE 2M PHY
CS/NAD/REF/BV-23-C	Normalized Attack Detector Metric, Mode-3, Sounding Sequence 32-bits, Reflector LE 2M PHY
CS/NAD/REF/BV-24-C	Normalized Attack Detector Metric, Mode-3, Sounding Sequence 96-bits, Reflector LE 2M PHY
CS/NAD/INI/BV-13-C	Normalized Attack Detector Metric, Mode-1, Random Sequence 32-bits, Initiator LE 2M PHY
CS/NAD/INI/BV-14-C	Normalized Attack Detector Metric, Mode-1, Random Sequence 64-bits, Initiator LE 2M PHY
CS/NAD/INI/BV-15-C	Normalized Attack Detector Metric, Mode-1, Random Sequence 96-bits, Initiator LE 2M PHY
CS/NAD/INI/BV-16-C	Normalized Attack Detector Metric, Mode-1, Random Sequence 128-bits, Initiator LE 2M PHY
CS/NAD/INI/BV-17-C	Normalized Attack Detector Metric, Mode-1, Sounding Sequence 32-bits, Initiator LE 2M PHY
CS/NAD/INI/BV-18-C	Normalized Attack Detector Metric, Mode-1, Sounding Sequence 96-bits, Initiator LE 2M PHY
CS/NAD/INI/BV-19-C	Normalized Attack Detector Metric, Mode-3, Random Sequence 32-bits, Initiator LE 2M PHY



CS/NAD/INI/BV-20-C	Normalized Attack Detector Metric, Mode-3, Random Sequence 64-bits, Initiator LE 2M PHY
CS/NAD/INI/BV-21-C	Normalized Attack Detector Metric, Mode-3, Random Sequence 96-bits, Initiator LE 2M PHY
CS/NAD/INI/BV-22-C	Normalized Attack Detector Metric, Mode-3, Random Sequence 128-bits, Initiator LE 2M PHY
CS/NAD/INI/BV-23-C	Normalized Attack Detector Metric, Mode-3, Sounding Sequence 32-bits, Initiator LE 2M PHY
CS/NAD/INI/BV-24-C	Normalized Attack Detector Metric, Mode-3, Sounding Sequence 96-bits, Initiator LE 2M PHY
CS/NAD/REF/BV-25-C	Normalized Attack Detector Metric, Mode-1, Random Sequence 32-bits, Reflector LE 2M 2BT PHY
CS/NAD/REF/BV-26-C	Normalized Attack Detector Metric, Mode-1, Random Sequence 64-bits, Reflector LE 2M 2BT PHY
CS/NAD/REF/BV-27-C	Normalized Attack Detector Metric, Mode-1, Random Sequence 96-bits, Reflector LE 2M 2BT PHY
CS/NAD/REF/BV-28-C	Normalized Attack Detector Metric, Mode-1, Random Sequence 128-bits, Reflector LE 2M 2BT PHY
CS/NAD/REF/BV-29-C	Normalized Attack Detector Metric, Mode-1, Sounding Sequence 32-bits, Reflector LE 2M 2BT PHY
CS/NAD/REF/BV-30-C	Normalized Attack Detector Metric, Mode-1, Sounding Sequence 96-bits, Reflector LE 2M 2BT PHY
CS/NAD/REF/BV-31-C	Normalized Attack Detector Metric, Mode-3, Random Sequence 32-bits, Reflector LE 2M 2BT PHY
CS/NAD/REF/BV-32-C	Normalized Attack Detector Metric, Mode-3, Random Sequence 64-bits, Reflector LE 2M 2BT PHY
CS/NAD/REF/BV-33-C	Normalized Attack Detector Metric, Mode-3, Random Sequence 96-bits, Reflector LE 2M 2BT PHY
CS/NAD/REF/BV-34-C	Normalized Attack Detector Metric, Mode-3, Random Sequence 128-bits, Reflector LE 2M 2BT PHY
CS/NAD/REF/BV-35-C	Normalized Attack Detector Metric, Mode-3, Sounding Sequence 32-bits, Reflector LE 2M 2BT PHY
CS/NAD/REF/BV-36-C	Normalized Attack Detector Metric, Mode-3, Sounding Sequence 96-bits, Reflector LE 2M 2BT PHY
CS/NAD/INI/BV-25-C	Normalized Attack Detector Metric, Mode-1, Random Sequence 32-bits, Initiator LE 2M 2BT PHY
CS/NAD/INI/BV-26-C	Normalized Attack Detector Metric, Mode-1, Random Sequence 64-bits, Initiator LE 2M 2BT PHY
CS/NAD/INI/BV-27-C	Normalized Attack Detector Metric, Mode-1, Random Sequence 96-bits, Initiator LE 2M 2BT PHY
CS/NAD/INI/BV-28-C	Normalized Attack Detector Metric, Mode-1, Random Sequence 128-bits, Initiator LE 2M 2BT PHY
CS/NAD/INI/BV-29-C	Normalized Attack Detector Metric, Mode-1, Sounding Sequence 32-bits, Initiator LE 2M 2BT PHY
CS/NAD/INI/BV-30-C	Normalized Attack Detector Metric, Mode-1, Sounding Sequence 96-bits, Initiator LE 2M 2BT PHY



CS/NAD/INI/BV-31-C	Normalized Attack Detector Metric, Mode-3, Random Sequence 32-bits, Initiator LE 2M 2BT PHY
CS/NAD/INI/BV-32-C	Normalized Attack Detector Metric, Mode-3, Random Sequence 64-bits, Initiator LE 2M 2BT PHY
CS/NAD/INI/BV-33-C	Normalized Attack Detector Metric, Mode-3, Random Sequence 96-bits, Initiator LE 2M 2BT PHY
CS/NAD/INI/BV-34-C	Normalized Attack Detector Metric, Mode-3, Random Sequence 128-bits, Initiator LE 2M 2BT PHY
CS/NAD/INI/BV-35-C	Normalized Attack Detector Metric, Mode-3, Sounding Sequence 32-bits, Initiator LE 2M 2BT PHY
CS/NAD/INI/BV-36-C	Normalized Attack Detector Metric, Mode-3, Sounding Sequence 96-bits, Initiator LE 2M 2BT PHY
CS/PAC/REF/BV-01-C*	Sounding Sequence, Marker Signals, Reflector, LE 1M, Mode-1 32-bit
CS/PAC/REF/BV-02-C*	Sounding Sequence, Marker Signals, Reflector, LE 2M, Mode-1 32-bit
CS/PAC/INI/BV-01-C*	Sounding Sequence, Marker Signals, Initiator, LE 1M, Mode-1 32-bit
CS/PAC/INI/BV-02-C*	Sounding Sequence, Marker Signals, Initiator, LE 2M, Mode-1 32-bit
CS/PAC/REF/BV-03-C*	Sounding Sequence, Marker Signals, Reflector, LE 1M, Mode-1 96-bit
CS/PAC/REF/BV-04-C*	Sounding Sequence, Marker Signals, Reflector, LE 1M, Mode-1 96-bit
CS/PAC/INI/BV-03-C*	Sounding Sequence, Marker Signals, Initiator, LE 1M, Mode-1 96-bit
CS/PAC/INI/BV-04-C*	Sounding Sequence, Marker Signals, Initiator, LE 2M, Mode-1 96-bit
CS/PAC/REF/BV-05-C*	Sounding Sequence, Marker Signals, Reflector, LE 1M, Mode-3 32-bit
CS/PAC/REF/BV-06-C*	Sounding Sequence, Marker Signals, Reflector, LE 2M, Mode-3 32-bit
CS/PAC/INI/BV-05-C*	Sounding Sequence, Marker Signals, Initiator, LE 1M, Mode-3 32-bit
CS/PAC/INI/BV-06-C*	Sounding Sequence, Marker Signals, Initiator, LE 2M, Mode-3 32-bit
CS/PAC/REF/BV-07-C*	Sounding Sequence, Marker Signals, Reflector, LE 1M, Mode-3 96-bit
CS/PAC/REF/BV-08-C*	Sounding Sequence, Marker Signals, Reflector, LE 2M, Mode-3 96-bit
CS/PAC/INI/BV-07-C*	Sounding Sequence, Marker Signals, Initiator, LE 1M, Mode-3 96-bit
CS/PAC/INI/BV-08-C*	Sounding Sequence, Marker Signals, Initiator, LE 2M, Mode-3 96-bit
CS/PAC/INI/BV-09-C*	Random Sequence, LE 1M, Mode 1, 32-bit, Initiator
CS/PAC/REF/BV-09-C*	Random Sequence, LE 1M, Mode 1, 32-bit, Reflector
CS/PAC/INI/BV-10-C*	Random Sequence, LE 1M, Mode 1, 64-bit, Initiator
CS/PAC/REF/BV-10-C*	Random Sequence, LE 1M, Mode 1, 64-bit, Reflector
CS/PAC/INI/BV-11-C*	Random Sequence, LE 1M, Mode 1, 96-bit, Initiator
CS/PAC/REF/BV-11-C*	Random Sequence, LE 1M, Mode 1, 96-bit, Reflector
CS/PAC/INI/BV-12-C*	Random Sequence, LE 1M, Mode 1, 128-bit, Initiator
CS/PAC/REF/BV-12-C*	Random Sequence, LE 1M, Mode 1, 128-bit, Reflector
CS/PAC/INI/BV-13-C*	Random Sequence, LE 2M, Mode 1, 32-bit, Initiator
CS/PAC/REF/BV-13-C*	Random Sequence, LE 2M, Mode 1, 32-bit, Reflector
CS/PAC/INI/BV-14-C*	Random Sequence, LE 2M, Mode 1, 64-bit, Initiator
CS/PAC/REF/BV-14-C*	Random Sequence, LE 2M, Mode 1, 64-bit, Reflector
CS/PAC/INI/BV-15-C*	Random Sequence, LE 2M, Mode 1, 96-bit, Initiator
CS/PAC/REF/BV-15-C*	Random Sequence, LE 2M, Mode 1, 96-bit, Reflector
CS/PAC/INI/BV-16-C*	Random Sequence, LE 2M, Mode 1, 128-bit, Initiator
CS/PAC/REF/BV-16-C*	Random Sequence, LE 2M, Mode 1, 128-bit, Reflector



CS/PAC/INI/BV-17-C*	Random Sequence, LE 1M, Mode 3, 32-bit, Initiator
CS/PAC/REF/BV-17-C*	Random Sequence, LE 1M, Mode 3, 32-bit, Reflector
CS/PAC/INI/BV-18-C*	Random Sequence, LE 1M, Mode 3, 64-bit, Initiator
CS/PAC/REF/BV-18-C*	Random Sequence, LE 1M, Mode 3, 64-bit, Reflector
CS/PAC/INI/BV-19-C*	Random Sequence, LE 1M, Mode 3, 96-bit, Initiator
CS/PAC/REF/BV-19-C*	Random Sequence, LE 1M, Mode 3, 96-bit, Reflector
CS/PAC/INI/BV-20-C*	Random Sequence, LE 1M, Mode 3, 128-bit, Initiator
CS/PAC/REF/BV-20-C*	Random Sequence, LE 1M, Mode 3, 128-bit, Reflector
CS/PAC/INI/BV-21-C*	Random Sequence, LE 2M, Mode 3, 32-bit, Initiator
CS/PAC/REF/BV-21-C*	Random Sequence, LE 2M, Mode 3, 32-bit, Reflector
CS/PAC/INI/BV-22-C*	Random Sequence, LE 2M, Mode 3, 64-bit, Initiator
CS/PAC/REF/BV-22-C*	Random Sequence, LE 2M, Mode 3, 64-bit, Reflector
CS/PAC/INI/BV-23-C*	Random Sequence, LE 2M, Mode 3, 96-bit, Initiator
CS/PAC/REF/BV-23-C*	Random Sequence, LE 2M, Mode 3, 96-bit, Reflector
CS/PAC/INI/BV-24-C*	Random Sequence, LE 2M, Mode 3, 128-bit, Initiator
CS/PAC/REF/BV-24-C*	Random Sequence, LE 2M, Mode 3, 128-bit, Reflector
CS/PAC/REF/BV-25-C*	CS Sync with Invalid Access Address, LE 1M
CS/PAC/REF/BV-26-C*	CS Sync with Invalid Access Address, LE 2M
CS/PAC/INI/BV-27-C*	Sounding Sequence, 32-bit with invalid marker, Initiator
CS/PAC/REF/BV-27-C*	Sounding Sequence, 32-bit with invalid marker, Reflector
CS/PAC/INI/BV-28-C*	Sounding Sequence, 96-bit with invalid marker, Initiator
CS/PAC/REF/BV-28-C*	Sounding Sequence, 96-bit with invalid marker, Reflector
CS/PAC/REF/BV-29-C*	Channel Index Selection Algorithm #3b, Reflector
CS/PAC/INI/BV-29-C*	Channel Index Selection Algorithm #3b, Initiator
CS/PAC/REF/BV-30-C*	Channel Index Selection Algorithm #3c, Reflector, Hat
CS/PAC/INI/BV-30-C*	Channel Index Selection Algorithm #3c, Initiator, Hat
CS/PAC/REF/BV-31-C	Channel Index Selection Algorithm #3c, Reflector, X Shape
CS/PAC/INI/BV-31-C	Channel Index Selection Algorithm #3c, Initiator, X Shape
CS/RTT/INI/BV-01-C	Channel Sounding – RTT, Initiator, LE 1M, Mode 1, RTT AA-Only
CS/RTT/INI/BV-02-C	Channel Sounding – RTT, Initiator, LE 1M, Mode 3, RTT AA-Only
CS/RTT/INI/BV-03-C	Channel Sounding – RTT, Initiator, LE 2M, Mode 1, RTT AA-Only
CS/RTT/INI/BV-04-C	Channel Sounding – RTT, Initiator, LE 2M, Mode 3, RTT AA-Only
CS/RTT/INI/BV-13-C	Channel Sounding – RTT, Initiator, LE 1M, Mode 1, RTT 32-bit Sounding Sequence
CS/RTT/INI/BV-14-C	Channel Sounding – RTT, Initiator, LE 1M, Mode 3, RTT 32-bit Sounding Sequence
CS/RTT/INI/BV-15-C	Channel Sounding – RTT, Initiator, LE 2M, Mode 1, RTT 32-bit Sounding Sequence
CS/RTT/INI/BV-16-C	Channel Sounding – RTT, Initiator, LE 2M, Mode 3, RTT 32-bit Sounding Sequence
CS/RTT/INI/BV-17-C	Channel Sounding – RTT, Initiator, LE 1M, Mode 1, RTT 96-bit Sounding Sequence
CS/RTT/INI/BV-18-C	Channel Sounding – RTT, Initiator, LE 1M, Mode 3, RTT 96-bit Sounding Sequence



CS/RTT/INI/BV-19-C	Channel Sounding – RTT, Initiator, LE 2M, Mode 1, RTT 96-bit Sounding Sequence
CS/RTT/INI/BV-20-C	Channel Sounding – RTT, Initiator, LE 2M, Mode 3, RTT 96-bit Sounding Sequence
CS/RTT/INI/BV-21-C	Channel Sounding – RTT, Initiator, LE 1M, Mode 1, RTT 32-bit Random Sequence
CS/RTT/INI/BV-22-C	Channel Sounding – RTT, Initiator, LE 1M, Mode 3, RTT 32-bit Random Sequence
CS/RTT/INI/BV-23-C	Channel Sounding – RTT, Initiator, LE 2M, Mode 1, RTT 32-bit Random Sequence
CS/RTT/INI/BV-24-C	Channel Sounding – RTT, Initiator, LE 2M, Mode 3, RTT 32-bit Random Sequence
CS/RTT/INI/BV-25-C	Channel Sounding – RTT, Initiator, LE 1M, Mode 1, RTT 64-bit Random Sequence
CS/RTT/INI/BV-29-C	Channel Sounding – RTT, Initiator, LE 1M, Mode 3, RTT 64-bit Random Sequence
CS/RTT/INI/BV-27-C	Channel Sounding – RTT, Initiator, LE 2M, Mode 1, RTT 64-bit Random Sequence
CS/RTT/INI/BV-28-C	Channel Sounding – RTT, Initiator, LE 2M, Mode 3, RTT 64-bit Random Sequence
CS/RTT/INI/BV-29-C	Channel Sounding – RTT, Initiator, LE 1M, Mode 1, RTT 96-bit Random Sequence
CS/RTT/INI/BV-30-C	Channel Sounding – RTT, Initiator, LE 1M, Mode 3, RTT 96-bit Random Sequence
CS/RTT/INI/BV-31-C	Channel Sounding – RTT, Initiator, LE 2M, Mode 1, RTT 96-bit Random Sequence
CS/RTT/INI/BV-32-C	Channel Sounding – RTT, Initiator, LE 2M, Mode 3, RTT 96-bit Random Sequence
CS/RTT/INI/BV-33-C	Channel Sounding – RTT, Initiator, LE 1M, Mode 1, RTT 128-bit Random Sequence
CS/RTT/INI/BV-34-C	Channel Sounding – RTT, Initiator, LE 1M, Mode 3, RTT 128-bit Random Sequence
CS/RTT/INI/BV-35-C	Channel Sounding – RTT, Initiator, LE 2M, Mode 1, RTT 128-bit Random Sequence
CS/RTT/INI/BV-36-C	Channel Sounding – RTT, Initiator, LE 2M, Mode 3, RTT 128-bit Random Sequence
CS/RTT/INI/BV-05-C	Sounding Sequence Linear Regression Accuracy, Initiator, LE 1M, Mode-1, 32-bit
CS/RTT/INI/BV-06-C	Sounding Sequence Linear Regression Accuracy, Initiator, LE 2M, Mode-1, 32-bit
CS/RTT/INI/BV-07-C	Sounding Sequence Linear Regression Accuracy, Initiator, LE 1M, Mode-1, 96-bit
CS/RTT/INI/BV-08-C	Sounding Sequence Linear Regression Accuracy, Initiator, LE 2M, Mode-1, 96-bit



CS/RTT/INI/BV-09-C	Sounding Sequence Linear Regression Accuracy, Initiator, LE 1M, Mode-3, 32-bit
CS/RTT/INI/BV-10-C	Sounding Sequence Linear Regression Accuracy, Initiator, LE 2M, Mode-3, 32-bit
CS/RTT/INI/BV-11-C	Sounding Sequence Linear Regression Accuracy, Initiator, LE 1M, Mode-3, 96-bit
CS/RTT/INI/BV-12-C	Sounding Sequence Linear Regression Accuracy, Initiator, LE 2M, Mode-3, 96-bit
CS/RTT/REF/BV-01-C	Channel Sounding – RTT, Reflector, LE 1M, Mode 1, RTT AA-Only
CS/RTT/REF/BV-02-C	Channel Sounding – RTT, Reflector, LE 1M, Mode 3, RTT AA-Only
CS/RTT/REF/BV-03-C	Channel Sounding – RTT, Reflector, LE 2M, Mode 1, RTT AA-Only
CS/RTT/REF/BV-04-C	Channel Sounding – RTT, Reflector, LE 2M, Mode 3, RTT AA-Only
CS/RTT/REF/BV-13-C	Channel Sounding – RTT, Reflector, LE 1M, Mode 1, RTT 32-bit Sounding Sequence
CS/RTT/REF/BV-14-C	Channel Sounding – RTT, Reflector, LE 1M, Mode 3, RTT 32-bit Sounding Sequence
CS/RTT/REF/BV-15-C	Channel Sounding – RTT, Reflector, LE 2M, Mode 1, RTT 32-bit Sounding Sequence
CS/RTT/REF/BV-16-C	Channel Sounding – RTT, Reflector, LE 2M, Mode 3, RTT 32-bit Sounding Sequence
CS/RTT/REF/BV-17-C	Channel Sounding – RTT, Reflector, LE 1M, Mode 1, RTT 96-bit Sounding Sequence
CS/RTT/REF/BV-18-C	Channel Sounding – RTT, Reflector, LE 1M, Mode 3, RTT 96-bit Sounding Sequence
CS/RTT/REF/BV-19-C	Channel Sounding – RTT, Reflector, LE 2M, Mode 1, RTT 96-bit Sounding Sequence
CS/RTT/REF/BV-20-C	Channel Sounding – RTT, Reflector, LE 2M, Mode 3, RTT 96-bit Sounding Sequence
CS/RTT/REF/BV-21-C	Channel Sounding – RTT, Reflector, LE 1M, Mode 1, RTT 32-bit Random Sequence
CS/RTT/REF/BV-22-C	Channel Sounding – RTT, Reflector, LE 1M, Mode 3, RTT 32-bit Random Sequence
CS/RTT/REF/BV-23-C	Channel Sounding – RTT, Reflector, LE 2M, Mode 1, RTT 32-bit Random Sequence
CS/RTT/REF/BV-24-C	Channel Sounding – RTT, Reflector, LE 2M, Mode 3, RTT 32-bit Random Sequence
CS/RTT/REF/BV-25-C	Channel Sounding – RTT, Reflector, LE 1M, Mode 1, RTT 64-bit Random Sequence
CS/RTT/REF/BV-26-C	Channel Sounding – RTT, Reflector, LE 1M, Mode 3, RTT 64-bit Random Sequence
CS/RTT/REF/BV-27-C	Channel Sounding – RTT, Reflector, LE 2M, Mode 1, RTT 64-bit Random Sequence
CS/RTT/REF/BV-28-C	Channel Sounding – RTT, Reflector, LE 2M, Mode 3, RTT 64-bit Random Sequence



CS/RTT/REF/BV-29-C	Channel Sounding – RTT, Reflector, LE 1M, Mode 1, RTT 96-bit Random Sequence
CS/RTT/REF/BV-30-C	Channel Sounding – RTT, Reflector, LE 1M, Mode 3, RTT 96-bit Random Sequence
CS/RTT/REF/BV-31-C	Channel Sounding – RTT, Reflector, LE 2M, Mode 1, RTT 96-bit Random Sequence
CS/RTT/REF/BV-32-C	Channel Sounding – RTT, Reflector, LE 2M, Mode 3, RTT 96-bit Random Sequence
CS/RTT/REF/BV-33-C	Channel Sounding – RTT, Reflector, LE 1M, Mode 1, RTT 128-bit Random Sequence
CS/RTT/REF/BV-34-C	Channel Sounding – RTT, Reflector, LE 1M, Mode 3, RTT 128-bit Random Sequence
CS/RTT/REF/BV-35-C	Channel Sounding – RTT, Reflector, LE 2M, Mode 1, RTT 128-bit Random Sequence
CS/RTT/REF/BV-36-C	Channel Sounding – RTT, Reflector, LE 2M, Mode 3, RTT 128-bit Random Sequence
CS/RTT/REF/BV-05-C	Sounding Sequence Linear Regression Accuracy, Reflector, LE 1M, Mode-1, 32-bit
CS/RTT/REF/BV-06-C	Sounding Sequence Linear Regression Accuracy, Reflector, LE 2M, Mode-1, 32-bit
CS/RTT/REF/BV-07-C	Sounding Sequence Linear Regression Accuracy, Reflector, LE 1M, Mode-1, 96-bit
CS/RTT/REF/BV-08-C	Sounding Sequence Linear Regression Accuracy, Reflector, LE 2M, Mode-1, 96-bit
CS/RTT/REF/BV-09-C	Sounding Sequence Linear Regression Accuracy, Reflector, LE 1M, Mode-3, 32-bit
CS/RTT/REF/BV-10-C	Sounding Sequence Linear Regression Accuracy, Reflector, LE 2M, Mode-3, 32-bit
CS/RTT/REF/BV-11-C	Sounding Sequence Linear Regression Accuracy, Reflector, LE 1M, Mode-3, 96-bit
CS/RTT/REF/BV-12-C	Sounding Sequence Linear Regression Accuracy, Reflector, LE 2M, Mode-3, 96-bit
CS/TIM/INI/BV-01-C	Channel Sounding – Timing, Initiator, No Sub_Mode, Mode-1
CS/TIM/INI/BV-02-C	Channel Sounding – Timing, Initiator, No Sub_Mode, Mode-2
CS/TIM/INI/BV-03-C	Channel Sounding – Timing, Initiator, No Sub_Mode, Mode-3
CS/TIM/INI/BV-04-C	Channel Sounding – Timing, Initiator, Mode-2, Sub_Mode-1
CS/TIM/INI/BV-05-C	Channel Sounding – Timing, Initiator, Mode-2, Sub_Mode-3
CS/TIM/INI/BV-06-C	Channel Sounding – Timing, Initiator, Mode-3, Sub_Mode-2
CS/TIM/INI/BV-07-C	Power Ramp Profile, Ramp-down, Initiator, Step Mode-1
CS/TIM/INI/BV-08-C	Power Ramp Profile, Ramp-down, Initiator, Step Mode-2
CS/TIM/INI/BV-09-C	Power Ramp Profile, Ramp-down, Initiator, Step Mode-3
CS/TIM/REF/BV-01-C	Channel Sounding – Timing, Reflector, Mode-1
CS/TIM/REF/BV-02-C	Channel Sounding – Timing, Reflector, Mode-2
CS/TIM/REF/BV-03-C	Channel Sounding – Timing, Reflector, Mode-3



CS/TIM/REF/BV-04-C	Channel Sounding – Timing, Reflector, Mode-2, Sub_Mode-1
CS/TIM/REF/BV-05-C	Channel Sounding – Timing, Reflector, Mode-2, Sub_Mode-3
CS/TIM/REF/BV-06-C	Channel Sounding – Timing, Reflector, Mode-3, Sub_Mode-2
CS/TIM/REF/BV-07-C	Reflector Transmission Timing Reference, Timing
CS/TIM/REF/BV-08-C	Power Ramp Profile, Ramp-down, Reflector, Step Mode-1
CS/TIM/REF/BV-09-C	Power Ramp Profile, Ramp-down, Reflector, Step Mode-2
CS/TIM/REF/BV-10-C	Power Ramp Profile, Ramp-down, Reflector, Step Mode-3
CS/PM/INI/BV-03-C	Initiator Transmit Antenna Switching Integrity, LE 1M, Mode-2, N_AP:1
CS/PM/INI/BV-04-C	Initiator Transmit Antenna Switching Integrity, LE 1M, Mode-3, N_AP:1
CS/PM/INI/BV-07-C	Initiator Transmit Antenna Switching Integrity, LE 1M, Mode-2, 2:2
CS/PM/INI/BV-08-C	Initiator Transmit Antenna Switching Integrity, LE 1M, Mode-3, 2:2
CS/PM/INI/BV-17-C	Initiator Transmit Antenna Switching Integrity, LE 2M, Mode-3, N_AP:1
CS/PM/INI/BV-18-C	Initiator Transmit Antenna Switching Integrity, LE 2M, Mode-3, 2:2
CS/PM/REF/BV-06-C	Reflector Receive Antenna Switching Integrity, LE 1M, Mode-2, 1:N_AP
CS/PM/REF/BV-08-C	Reflector Receive Antenna Switching Integrity, LE 1M, Mode-2, 2:2
CS/PM/REF/BV-09-C	Reflector Receive Antenna Switching Integrity, LE 1M, Mode-3, 2:2
CS/PM/REF/BV-07-C	Reflector Receive Antenna Switching Integrity, LE 1M, Mode-3, 1:N_AP
CS/PM/REF/BV-18-C	Reflector Receive Antenna Switching Integrity, LE 2M, Mode-3, 1:N_AP
CS/PM/REF/BV-19-C	Reflector Receive Antenna Switching Integrity, LE 2M, Mode-3, 2:2
CS/PM/INI/BV-01-C	Phase Measurements during T_PM, Initiator, Mode-2
CS/PM/REF/BV-01-C	Phase Measurements during T_PM, Reflector, Mode-2
CS/PM/REF/BV-02-C	Phase Measurements during T_PM, Reflector, Mode-2, SubMode-1
CS/PM/INI/BV-02-C	Phase Measurements during T_PM, Initiator, Mode-3
CS/PM/REF/BV-03-C	Phase Measurements during T_PM, Reflector, Mode-3
CS/PM/INI/BV-09-C	Phase Based Distance Estimate, Sounding Sequence, Initiator, Mode-1, 32-bit Sounding Sequence
CS/PM/REF/BV-10-C	Phase Based Distance Estimate, Sounding Sequence, Reflector, Mode-1, 32-bit Sounding Sequence
CS/PM/INI/BV-10-C	Phase Based Distance Estimate, Sounding Sequence, Initiator, Mode-1, 96-bit Sounding Sequence
CS/PM/REF/BV-11-C	Phase Based Distance Estimate, Sounding Sequence, Reflector, Mode-1, 96-bit Sounding Sequence
CS/PM/INI/BV-11-C	Phase Based Distance Estimate, Sounding Sequence, Initiator, Mode-3, 32-bit Sounding Sequence
CS/PM/REF/BV-12-C	Phase Based Distance Estimate, Sounding Sequence, Reflector, Mode-3, 32-bit Sounding Sequence
CS/PM/INI/BV-12-C	Phase Based Distance Estimate, Sounding Sequence, Initiator, Mode-3, 96-bit Sounding Sequence



CS/PM/REF/BV-13-C	Phase Based Distance Estimate, Sounding Sequence, Reflector, Mode-3, 96-bit Sounding Sequence
CS/PM/INI/BV-13-C	Phase Based Distance Estimate, Sounding Sequence, LE 2M, Initiator, Mode-1, 32-bit Sounding Sequence
CS/PM/REF/BV-14-C	Phase Based Distance Estimate, Sounding Sequence, LE 2M, Reflector, Mode-1, 32-bit Sounding Sequence
CS/PM/INI/BV-14-C	Phase Based Distance Estimate, Sounding Sequence, LE 2M, Initiator, Mode-1, 96-bit Sounding Sequence
CS/PM/REF/BV-15-C	Phase Based Distance Estimate, Sounding Sequence, LE 2M, Reflector, Mode-1, 96-bit Sounding Sequence
CS/PM/INI/BV-15-C	Phase Based Distance Estimate, Sounding Sequence, LE 2M, Initiator, Mode-3, 32-bit Sounding Sequence
CS/PM/REF/BV-16-C	Phase Based Distance Estimate, Sounding Sequence, LE 2M, Reflector, Mode-3, 32-bit Sounding Sequence
CS/PM/INI/BV-16-C	Phase Based Distance Estimate, Sounding Sequence, LE 2M, Initiator, Mode-3, 96-bit Sounding Sequence
CS/PM/REF/BV-17-C	Phase Based Distance Estimate, Sounding Sequence, LE 2M, Reflector, Mode-3, 96-bit Sounding Sequence

NOTE: All tests that have an * after their name are tests that are performed using HCI test commands not an ACL link, as per the test specification.

TECHNICAL SPECIFICATION:

RX INPUT: HIGH SENSITIVITY

Connector type	SMA
Noise figure	6dB
IP3 @ max sensitivity	+7dBm
SNR in 1MHz bandwidth	80dB
Maximum input signal	+27dBm
Maximum usable signal	-10dBm
Instantaneous bandwidth	2401 - 2481 MHz
Impedance	50Ω
Coupling	AC
Maximum DC voltage	50V

RX INPUT: LOW SENSITIVITY:

Connector type	SMA
Noise figure	46dB
IP3 @ max sensitivity	+47dBm
SNR in 1MHz bandwidth	80dB
Maximum input signal	+27dBm
Maximum usable signal	+27dBm
Instantaneous bandwidth	2401 - 2481 MHz
Impedance	50Ω
Coupling	AC
Maximum DC voltage	50V



TX OUTPUT:

Connector type	SMA
Instantaneous dynamic range	>80dB typ
Maximum output signal	+3dBm
Minimum output signal	-130dBm
Instantaneous bandwidth	2401 – 2481 MHz
Impedance	50Ω
Coupling	AC
Maximum DC voltage	50V

CW SOURCE

Minimum frequency	23.5MHz
Maximum frequency	6GHz
Minimum power	-50 dBm
Maximum power	-28 dBm

EXTERNAL CLOCK INPUT

Connector type	SMA
Maximum input signal	-10dBm
Minimum input signal	+20dBm
Frequency	10 MHz
Impedance	50Ω
Coupling	AC
Maximum DC voltage	50V

DIGITAL IO

Connector type	20pin IDC
Number of inputs	8
Logic input high	2.4V (min)
Logic input low	0.9V (max)
Number of outputs	8
Logic output high	3.2V (min)
Logic output low	0.1V (max)
Output current	±6mA

USB:

Connector type	Type-C
Speed	High speed
VBUS load	2.2μF, > 10kΩ

ETHERNET:

Connector type	RJ-45
Speed	10/100/1000

POWER:

Connector type	1.7mm jack
Input voltage	9V
Power	15W (application dependent)
Reverse polarity protection	Yes
Over voltage protection	Yes
Under voltage protection	Yes



REGULATORY APPROVALS:

Europe (CE)	EN61326-1:2013 EN55011:2009 EN55032:2012
US (FCC)	CFR 47 Pt 15 B

SUPPORTED HOSTS:

Supported hosts	Windows 7 or higher Linux on request macOS on request
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PRELIMINARY

