



A wideband 2.4 GHz signal analyser and generator. Specifically designed for PHY Layer Testing. The **moreph** SDR at the core enables a full bandwidth, high dynamic range transmitter and receiver, that can simultaneously RX/TX over the entire 2.4GHz ISM band. An integrated CW signal generator covering 25MHz to 6GHz ensures that you will not require any other test equipment! Upgrade moreph30 with any of our test and measurement options, evolve it into a protocol analyser with blueSPY, or get them all – the choice is yours.

KEY FEATURES:

SUPPORTS ALL BT 5.4 PHY TEST CASES

- Extensive coverage with no additional test equipment, USB, and Ethernet host interfaces.
 - C/I, blocking & intermodulation signals generated internally.
 - Accurate power control to -115dBm for coded PHY tests.
 - Full support for in-band emissions.

ADVANCED FEATURES

- Channel Sounding RF-PHY (Early Adopter).
- Ultra-linear receiver and transmitter.
- Built-in 6GHz CW source.
- Simultaneous monitoring of all WIFI channels.
- Options for BR/EDR, BLE, QBHSL, IEEE 802.15.4 Channel Sounding (BETA) and customized PHY's.

VERY FAST, REDUCES TOTAL TEST TIME

- 2 second boot time.
- In-band emissions test completes in 2.5ms.
- Rapid connection to device under test:
 - Inquiry and page packets TX on multiple channels simultaneously.
 - RX listens on all channels simultaneously.

APPLICATION BASED GUI AND API

- Dedicated RF-PHY Applications.
- WIFI Traffic Generator.
- Record and Playback Application.
- Development and Production Test Options.
- blueSPY Protocol Analyser (Sniffer).
 - Channel Sounding (CS) capture.
 - 16 Channel Logic Analysis.



OVERVIEW:

The moreph30 can perform all of the tests set out in the Bluetooth Radio Frequency Physical Layer test specification for both BR/EDR and BLE without the need for external test equipment, with the exception of out-of-band blocking. The application can act as a signalling tester, with full control of the device under test (DUT) over-the-air. It can also be used in a non-signalling mode, analysing packets transmitted by the DUT, as well as generating both wanted and interfering signals simultaneously for reception by the DUT.

For BLE the moreph30 can utilise advertise and scan packets to provoke a response from the device and perform both transmitter and receiver testing. It can also analyse packets on a live link as well as acting as a signal generator capable of producing both wanted and interfering signals simultaneously.

Please see the morephCS Product Brief for details of the Channel Sounding PHY layer tester.

USE CASES:

- Pre-Compliance tester. Allows the developer to "pre-test" with confidence before committing to a formal 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 potential issues.

BR/EDR AND BLE RF-PHY OPERATING MODES:

- Loop back testing. Scripted support for all RF-PHY test cases.
- Signal Generation. Create complex composite test signals.
- Signal Analysis. Off-air or conducted detailed waveform and BER analysis. Permits interactive control of DUT, dirty transmitter, and interferers.
- DUT control. Debug LMP traffic between Zircon and the device under test.
- Packet sniffer. Combine with Wireshark to form an elementary packet sniffer.
- Scan/Advertise. Provoke and test device without serial interface.

SUPPORTED APPLICATIONS

PHY Layer Testers	Bluetooth 5.4 LE RF Tester with AoA/AoD extension
	Bluetooth 5.4 BR/EDR RF Tester
	'Channel Sounding' RF Tester (Early Adopter Version)
	802.15.4 RF Tester
Protocol Analysers	QBHSL RF Tester
	Bluetooth® LE
	Bluetooth® BR/EDR
	BT Channel Sounding.
	802.15.4
Traffic Generator	QBHSL
	WIFI b/g/n
RF record and playback - 90MHz bandwidth up to 4 hours - physical upgrade required.	



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 TEST CASES:

BR/EDR APPLICATION ONLY:

The BR/EDR RF-PHY Application for the moreph30 supports the following BR/EDR PHY level tests with no additional test equipment. The BR/EDR application can be run in either a signalling or non-signalling mode.

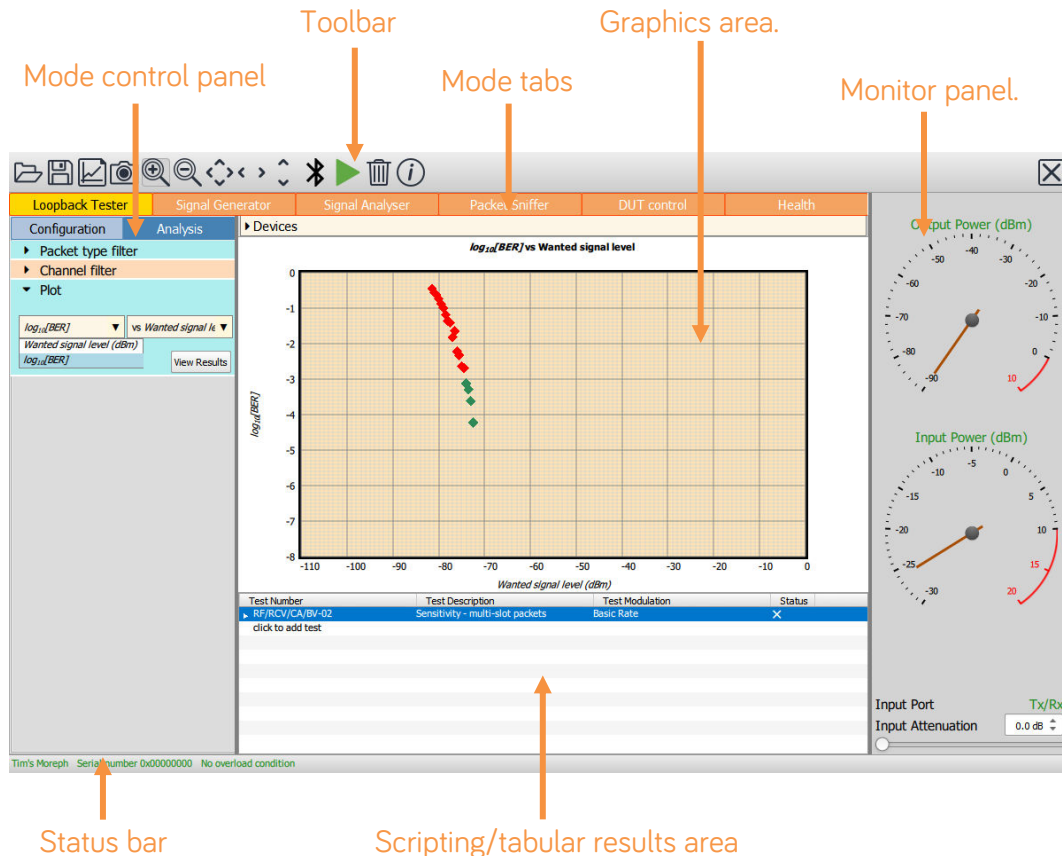
TEST NUMBER	TEST DESCRIPTION	PHY	LIMITATIONS
RF/TRM/CA/BV-01-C	Output power	BR	
RF/TRM/CA/BV-02-C	Power density	BR	See (a)
RF/TRM/CA/BV-03-C	Power control	BR	
RF/TRM/CA/BV-04-C	Tx output spectrum – frequency range	BR	
RF/TRM/CA/BV-05-C	Tx output spectrum – 20dB bandwidth	BR	
RF/TRM/CA/BV-06-C	Tx output spectrum – adjacent channel power	BR	
RF/TRM/CA/BV-7-C	Modulation characteristics	BR	
RF/TRM/CA/BV-8-C	Initial carrier frequency tolerance	BR	
RF/TRM/CA/BV-9-C	Carrier frequency drift	BR	
RF/TRM/CA/BV-10-C	EDR relative transmit power	2-EDR/3-EDR	
RF/TRM/CA/BV-11-C	EDR carrier frequency stability & modulation accuracy	2-EDR/3-EDR	
RF/TRM/CA/BV-12-C	EDR differential phase encoding	2-EDR/3-EDR	
RF/TRM/CA/BV-13-C	EDR in-and spurious emissions	2-EDR/3-EDR	
RF/TRM/CA/BV-14-C	Enhanced power control	2-EDR/3-EDR	
RF/TRM/CA/BV-15-C	EDR guard time	2-EDR/3-EDR	
RF/TRM/CA/BV-16-C	EDR synchronization sequence & trailer	2-EDR/3-EDR	
RF/RCV/CA/BV-01-C	Sensitivity – single slot packets	2-EDR/3-EDR	
RF/RCV/CA/BV-02-C	Sensitivity – multi slot packets	BR	
RF/RCV/CA/BV-03-C	C/I performance	BR	
RF/RCV/CA/BV-04-C	Blocking performance	BR	See (b)
RF/RCV/CA/BV-05-C	Intermodulation performance	BR	See (c)
RF/RCV/CA/BV-06-C	Maximum input level	BR	
RF/RCV/CA/BV-07-C	EDR sensitivity	2 Mbps	
RF/RCV/CA/BV-08-C	EDR BER floor performance	2-EDR/3-EDR	
RF/RCV/CA/BV-09-C	EDR C/I performance	2-EDR/3-EDR	
RF/RCV/CA/BV-10-C	EDR maximum input level	2-EDR/3-EDR	



LIMITATIONS:

- The initial sweep for the power density is performed over 90MHz and not 240MHz as per the specification. Unless the device under test has severe issues, this should return the correct frequency for the second scan and hence the correct value for the power density.
- Blocking tests are limited to the range 25 MHz to 6 GHz and to blocking levels of approximately -30dBm or less. This is substantially less coverage than dictated by the specification. It should be possible to perform blocking tests in the range 2GHz to 3GHz without additional test equipment. However additional test equipment will be required to evaluate the blocking performance outside this range. The unit contains a high-performance F-BAR filter at its input and possesses an extremely high dynamic range. This ensures that the DUT will always be blocked before the tester. The unit can also provide a gating signal for the blocker to ensure it is off when the DUT is attempting to transmit.
- The intermodulation test can be performed provided both the CW and continuous interferers lie within the range 2395MHz to 2485MHz. This can always be arranged by choosing whether they are placed above or below the wanted signal.

BR/EDR APPLICATION GUI



BLE APPLICATION ONLY:

The LE RF-PHY Application for the moreph30 supports the following LE PHY level tests with no additional test equipment:

TEST NUMBER	TEST DESCRIPTION	SWITCHING	PHY	NOTES
RF-PHY/TRM/BV-01-C	Output power		Uncoded, 1 Mbps	
RF-PHY/TRM/BV-03-C	In-band emissions		Uncoded, 1 Mbps	
RF-PHY/TRM/BV-05-C	Modulation characteristics		Uncoded, 1 Mbps	
RF-PHY/TRM/BV-06-C	Carrier frequency offset & drift		Uncoded, 1 Mbps	
RF-PHY/TRM/BV-08-C	In-band emissions		2Mbps	
RF-PHY/TRM/BV-09-C	Modulation characteristics		Stable, uncoded, 1 Mbps	
RF-PHY/TRM/BV-10-C	Modulation characteristics		2 Mbps	
RF-PHY/TRM/BV-11-C	Modulation characteristics		Stable, 2 Mbps	
RF-PHY/TRM/BV-12-C	Carrier frequency offset & drift		2 Mbps	
RF-PHY/TRM/BV-13-C	Modulation characteristics		LE Coded, S=8	
RF-PHY/TRM/BV-14-C	Carrier frequency offset & drift		LE Coded, S=8	
RF-PHY/TRM/BV-15-C	Output power, with CTE		Uncoded, 1Mbps	
RF-PHY/TRM/BV-16-C	Carrier frequency offset & drift, CTE		Uncoded, 1Mbps	
RF-PHY/TRM/BV-17-C	Carrier frequency offset & drift, CTE		Uncoded, 2Mbps	
RF-PHY/TRM/PS/BV-01-C	Tx power stability, AoD	2µs	Uncoded, 1Mbps	
RF-PHY/TRM/PS/BV-02-C	Tx power stability, AoD	1µs	Uncoded, 1Mbps	
RF-PHY/TRM/PS/BV-03-C	Tx power stability, AoD	2µs	Uncoded, 2Mbps	
RF-PHY/TRM/PS/BV-04-C	Tx power stability, AoD	1µs	Uncoded, 2Mbps	
RF-PHY/TRM/ASI/BV-01-C	Antenna switching integrity AoD	2µs	Uncoded, 1Mbps	
RF-PHY/TRM/ASI/BV-02-C	Antenna switching integrity AoD	1µs	Uncoded, 1Mbps	
RF-PHY/TRM/ASI/BV-03-C	Antenna switching integrity AoD	2µs	Uncoded, 2Mbps	
RF-PHY/TRM/ASI/BV-04-C	Antenna switching integrity AoD	1µs	Uncoded, 2Mbps	
RF-PHY/RCV/BV-01-C	Receiver sensitivity		Uncoded, 1 Mbps	
RF-PHY/RCV /BV-03-C	C/I & receiver selectivity		Uncoded, 1 Mbps	
RF-PHY/RCV /BV-04-C	Blocking		Uncoded, 1 Mbps	See (a)
RF-PHY/RCV /BV-05-C	Intermodulation		Uncoded, 1 Mbps	See (b)
RF-PHY/RCV /BV-06-C	Maximum input signal		Uncoded, 1 Mbps	
RF-PHY/RCV /BV-07-C	PER report integrity		Uncoded, 1 Mbps	
RF-PHY/RCV /BV-08-C	Receiver sensitivity		2 Mbps	
RF-PHY/RCV /BV-09-C	C/I & receiver selectivity		2 Mbps	



RF-PHY/RCV /BV-10-C	Blocking		2 Mbps	See (a)
RF-PHY/RCV /BV-11-C	Intermodulation		2 Mbps	See (b)
RF-PHY/RCV /BV-12-C	Maximum input signal		2 Mbps	
RF-PHY/RCV /BV-13-C	PER report integrity		2 Mbps	
RF-PHY/RCV /BV-14-C	Receiver sensitivity		Stable, uncoded, 1 Mbps	
RF-PHY/RCV /BV-15-C	C/I & receiver selectivity		Stable, uncoded, 1 Mbps	
RF-PHY/RCV /BV-16-C	Blocking		Stable, uncoded, 1 Mbps	See (a)
RF-PHY/RCV /BV-17-C	Intermodulation		Stable, uncoded, 1 Mbps	See (b)
RF-PHY/RCV /BV-18-C	Maximum input signal		Stable, uncoded, 1 Mbps	
RF-PHY/RCV /BV-19-C	PER report integrity		Stable, uncoded, 1 Mbps	
RF-PHY/RCV /BV-20-C	Receiver sensitivity		Stable, 2 Mbps	
RF-PHY/RCV /BV-21-C	C/I & receiver selectivity		Stable, 2 Mbps	
RF-PHY/RCV /BV-22-C	Blocking		Stable, 2 Mbps	See (a)
RF-PHY/RCV /BV-23-C	Intermodulation		Stable, 2 Mbps	See (b)
RF-PHY/RCV /BV-24-C	Maximum input signal		Stable, 2 Mbps	
RF-PHY/RCV /BV-25-C	PER report integrity		Stable, 2 Mbps	
RF-PHY/RCV /BV-26-C	Receiver sensitivity		LE coded, S=2	
RF-PHY/RCV /BV-27-C	Receiver sensitivity		LE coded, S=8	
RF-PHY/RCV /BV-28-C	C/I & receiver selectivity		LE coded, S=2	
RF-PHY/RCV /BV-29-C	C/I & receiver selectivity		LE coded, S=8	
RF-PHY/RCV /BV-30-C	PER report integrity		LE coded, S=2	
RF-PHY/RCV /BV-31-C	PER report integrity		LE coded, S=8	
RF-PHY/RCV /BV-32-C	Receiver sensitivity		Stable, LE coded, S=2	
RF-PHY/RCV /BV-33-C	Receiver sensitivity		Stable, LE coded, S=8	
RF-PHY/RCV /BV-34-C	C/I & receiver selectivity		Stable, LE coded, S=2	
RF-PHY/RCV /BV-35-C	C/I & receiver selectivity		Stable, LE coded, S=8	
RF-PHY/RCV /BV-36-C	PER report integrity		Stable, LE coded, S=2	
RF-PHY/RCV /BV-37-C	PER report integrity		Stable, LE coded, S=8	
RF-PHY/RCV /IQC/BV-01-C	IQ sample coherency, AoD receiver	2µs	Uncoded, 1Mbps	
RF-PHY/RCV /IQC/BV-02-C	IQ sample coherency, AoD receiver	1µs	Uncoded, 1Mbps	
RF-PHY/RCV /IQC/BV-03-C	IQ sample coherency, AoD receiver	2µs	Uncoded, 2Mbps	
RF-PHY/RCV /IQC/BV-04-C	IQ sample coherency, AoD receiver	1µs	Uncoded, 2Mbps	
RF-PHY/RCV /IQC/BV-05-C	IQ sample coherency, AoA receiver	2µs	Uncoded, 1Mbps	



RF-PHY/RCV /IQC/BV-06-C	IQ sample coherency, AoA receiver	2 μ s	Uncoded, 2Mbps	
RF-PHY/RCV /IQDR/BV-01-C	IQ samples dynamic range, AoD rx	2 μ s	Uncoded, 1Mbps	
RF-PHY/RCV /IQDR/BV-02-C	IQ samples dynamic range, AoD rx	1 μ s	Uncoded, 1Mbps	
RF-PHY/RCV /IQDR/BV-03-C	IQ samples dynamic range, AoD rx	2 μ s	Uncoded, 2Mbps	
RF-PHY/RCV /IQDR/BV-04-C	IQ samples dynamic range, AoD rx	1 μ s	Uncoded, 2Mbps	
RF-PHY/RCV /IQDR/BV-05-C	IQ samples dynamic range, AoA rx	2 μ s	Uncoded, 1Mbps	
RF-PHY/RCV /IQDR/BV-06-C	IQ samples dynamic range, AoA rx	2 μ s	Uncoded, 2Mbps	

LIMITATIONS:

- a. Blocking tests are limited to the range 25 MHz to 6 GHz. The Bluetooth test specification has an upper limit of 12.75 GHz. The supported range does include the 2nd harmonic of the 2.4 GHz band. If the blocking test passes at the 2nd harmonic, then it is highly likely to pass for higher test frequencies. The blocking source used in the Moreph30 has significant harmonic content. Some internal filtering of the source is applied to attenuate harmonics falling within the 2.4 GHz band. If blocking failures do occur, then further testing may be required to ascertain whether these are due to the fundamental of the blocker or one of its harmonics.
- b. The specification states that the intermodulation tests should be performed with the interfering signals both on the low side and the high side of the wanted signal. Under some circumstances, when the wanted signal is close to the band edge, this can lead to the interfering signals being placed outside the Moreph30 signal generator bandwidth of 2395MHz to 2485MHz. When these circumstances arise, the test will only be performed with the interfering signals positioned closer to the band centre. The requirement to perform intermodulation tests with the signals both above and below the wanted signal is somewhat perverse. If the wanted signal is at the band edge and the interfering signals are positioned outside the band, then the interfering signals will be attenuated by frontend filtering and the intermodulation performance of the device improved. Hence the inability of Moreph30 to test this scenario is considered somewhat academic.

NOTES:

The DUT may be controlled from the BLE application using Direct Test Mode, H4, H5 or BCSP. The application can also be run in a signalling mode using advertise and scan packets.

The BLE Application can also be used as a stand-alone signal generator or signal analyser.



BLE APPLICATION GUI

Mode control panel

Toolbar

Mode tabs

Graphics area.

Monitor panel.

Status bar

Scripting/tabular results area

Signal Analyser Mode

Quantity	#Packets	Min	Max	Avg	Curr	> Limit	< Limit
P_{avg}	2464	-4.3 dBm	4.3 dBm	-4.3 dBm	4.3 dBm	-20dBm	20dBm
P_{p}	2464	-29.0 MHz	-12.3 MHz	-21.0 MHz	-	-150kHz	150kHz

Programming the in-band CW interferer signal



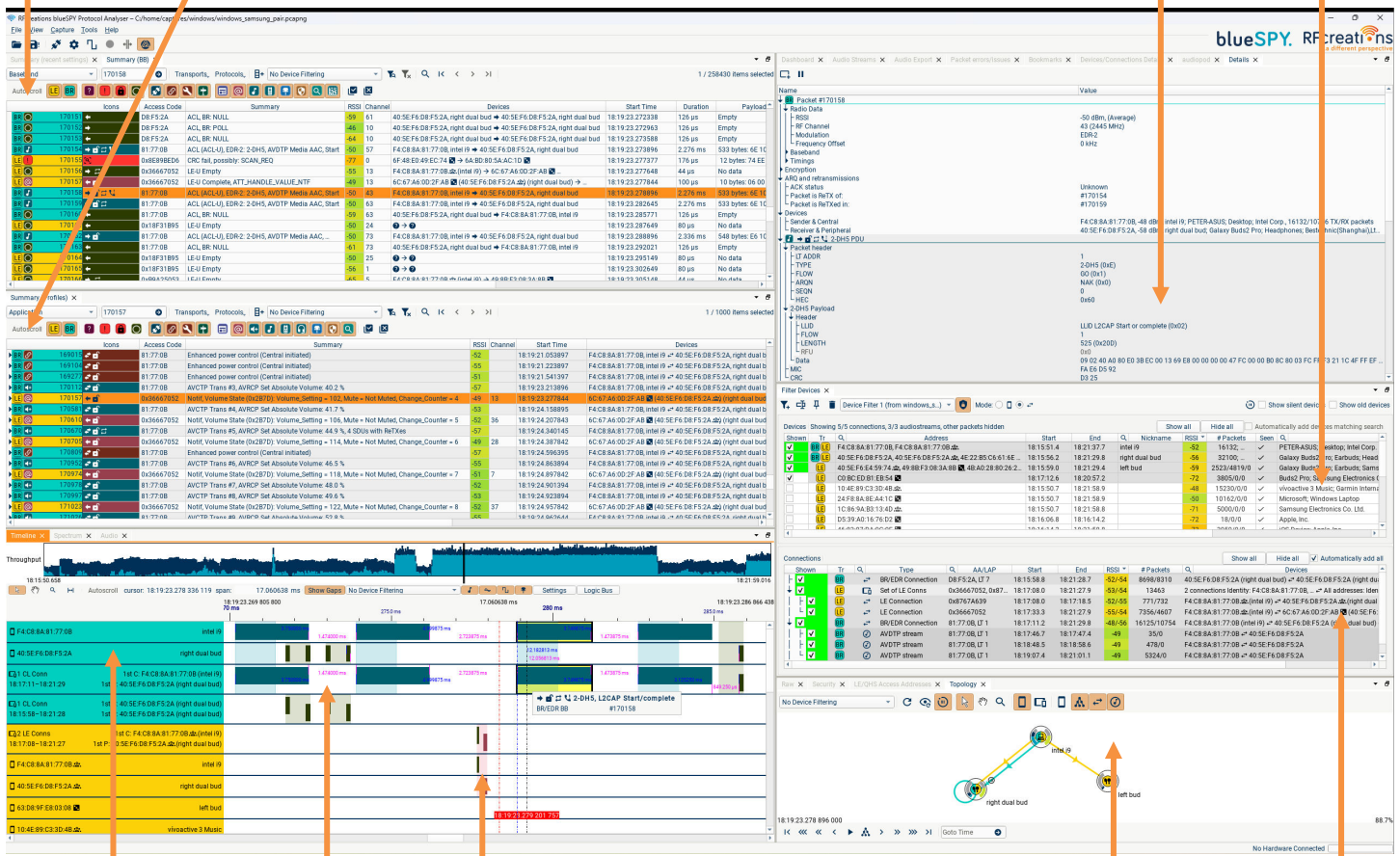
blueSPY PROTOCOL ANALYSER APPLICATION:

The blueSPY Protocol analysis application offers multiple configuration options, it can perform wideband capture of the entire 2.4GHz ISM band, simultaneously capturing and decoding multiple wireless technologies. It has full PHY support for classic Bluetooth™ (BR/EDR), Bluetooth Low Energy, LE Audio, Qualcomm® High Speed Link, (QHS), MediaTek mHDT V2.0 and 802.15.4 the flexibility to offer customized PHY options on request. Built-in spectrum analysis, up to 16 logic analyser channels and the ability to monitor all 13 WIFI channels simultaneously, full of advanced features as standard.

Select which PHYs, packet types and profiles to display.

Show BB packets and profile-level traffic in parallel tabs., integrating LE, Classic and other PHYs.

Details of packet contents & RF + Link Layer properties (ACKs, ReTXEs, etc)



The screenshot displays the blueSPY Protocol Analyser interface. The main window shows a list of captured packets with columns for Access Code, Summary, RSSI, Channel, Start Time, Devices, Duration, and Payload. A detailed view of a selected packet is shown on the right, displaying RF and Link Layer properties such as Modulation, Baseband, Encryption, ACK status, and Packet ID. Below the packet list, a real-time device/connection topology diagram is visible, showing connections between various devices like 'F4CB8A1770B' and '40SEF608F52A'.

Packets organised by connection/stream in the Timeline.

LE packets

Investigate timing collisions between connections.

Real-time device/connection topology.

Filter to a subset of the connections between those devices.



WHAT'S IN THE BOX:

- 1 moreph30 Test Instrument.
- 1 soft dust bag.
- 1 USB-A to USB-C cable, grey, 1m
- 1 Antenna, black
- 1 12V PSU



If a blueSPY PRO option has been purchased:

- 1 Logic Probe Pod
- 1 Hirose to Hirose cable, black, 300mm
- 1 Logic Cable, MK18
- 1 Set of EZ Clips (16 grey, 1 red & 1 black)

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