KT-RFCT 2400A
Radio Frequency Communications Tester Datasheet

Version: 2.0

Introduction

The Konrad Technologies Radio Frequencies Communication Tester (KT-RFCT 2400A) provides a low-cost test solution for wireless devices. Both RF parametric test and network throughput performance testing are possible within the same instrument covering key communication standards such as Bluetooth and Wi-Fi.

The inclusion of two independent sub-systems for signaling and non-signaling test gives test engineers maximum test flexibility and makes this instrument ideal for the functional test of IoT devices including:

- smart home devices & smart meters
- mobile phones & accessories
- automotive telematic units
- remote keyless entry (RKE)
- car infotainment systems

Non-Signaling

Figure 1: KT-RFCT 2400A Non-Signaling Sub-System

The non-signaling sub-system can generate RF signals at the Tx/Rx port using an arbitrary waveform generator and can capture RF signals in the form of IQ data for analysis on an external PC. Within the non-signaling subsystem, a calibrated software defined radio (SDR) provides wide frequency coverage from 70 MHz to 6 GHz which allows flexible test coverage for a range of power and spectrum transmitter measurements. Similarly, an arbitrary waveform generator allows receiver testing, including the capability to test GPS devices. Support for generic modulations such as amplitude-shift keying (ASK) and frequency-shift keying (FSK) extends test coverage for automotive applications such as remote keyless entry and tyre pressure monitoring in popular sub 1 GHz ISM bands.

Signaling

Figure 2: KT-RFCT 2400A Signaling Sub-System

The signaling sub-system is specifically designed for Bluetooth and Wi-Fi test. It can functionally test devices by establishing a connection with the device-under-test (DUT) and perform received signal strength (RSSI) or throughput measurements in the case of Wi-Fi and read and write to device registers.

For Wi-Fi, the instrument can operate as a client or access point (AP). The KT-RFCT 2400A allows RF parametric test and throughput testing test of a final packaged product loaded with production firmware without the need of a specific engineering test mode.

Use Cases

This mix of test methodology, SDR concept, RF parametric test and network performance verification test within a small footprint makes the KT-RFCT 2400A ideal for use cases such as:

- Automated end-of-line (EOL) manufacturing test
- Product lifecycle regression test
- Repair & service test

For end-of-line testing signaling tests the KT-RFCT 2400A provides functional verification of operation with minimal effort or complexity. Such testing can be executed unobtrusively over the air (OTA) to reduce or eliminate complexity of RF fixturing and cabling. Furthermore, non-signaling power and spectrum measurements can also validate the success of the manufacturing process, such as the correct soldering and attachment of antennas. The addition of network test within the KT-RFCT 2400A reduces the need for multiple pieces of test equipment for RF and throughput test, emulating end-user real-world behavior and operation of the wireless device.

For product lifecycle testing the instrument can test devices continuously with custom OTA communications within specific environment conditions. For example, reading and writing registers using BT to test associated device functions such as LEDs, file transfers, internet sharing, accelerometers and BT profiles.

Within repair and service use cases the ability to pair with BT and connect with devices as part of a Wi-Fi network provides basic test functionality. This can then be extended to meet the requirements for detecting failures such as using BT profiles to share files (which are then run through a checksum) or to perform basic RSSI measurements over Wi-Fi.

System Integration & Test Automation

The tester can be easily integrated into existing test systems through comprehensive software tools including support for LabVIEW and text-based programming languages like C, C++ & Python. An Ethernet communications interface provides the communication between the PC client and the tester. For device bring-up and benchtop debug a Soft Front Panel program provides basic test coverage.

Further Test Capabilities

The instrument includes a physical port extension interface for optional hardware addons or upgrades. It also enables customers to implement custom controls such as triggering, controlling of switches & attenuators, DUT control through UART or simple DIO. For example, for BT this allows use of the BT LE Direct Test Mode (DTM) plugin for sending BT commands over UART to enable non-signaling tests.

Specifications

Unless otherwise stated all specifications apply for a period of at least 12 months following receipt or following unit calibration and following 10 minutes after power up and when used in an operating temperature of +23° ±3°C.

Tx/Rx & Rx Ports (Non-Signaling Test Ports)

Input Specifications

Parameter	Units	Typical	Min	Max
Connector Type		SMA(f)		
Port Impedance	Ohms	50		
Return Loss (nominal)	dB		10	
Frequency Range	GHz		0.07	5.99
Frequency Resolution (LO Tuning)	Hz		2.4	
Frequency Accuracy	ppm	2		
Maximum Instantaneous Bandwidth	MHz	20		
Input Level	dBm			-10
DC Input level	V			0
Input Level Accuracy above -70 dBm	dB	±1[1]		
ADC Resolution	bits			12
Sample Rate	MS/s		0.0625	20[2]
Sample Length	MS		0.001	20

Tx/Rx Port (Non-Signaling Test Port)

Output Specifications

Parameter	Units	Typical	Min	Max
Connector Type		SMA(f)		
Port Impedance	Ohms	50		
Return Loss (nominal)	dB		10	
Frequency Range	GHz		0.07	5.99
Frequency Resolution (LO Tuning)	Hz		2.4	
Frequency Accuracy	ppm	2		
Maximum Instantaneous Bandwidth	MHz	20		
Output Level (Peak/rms)	dBm		-100	-5
Output Level Accuracy above -70 dBm	dB	±1[1]		
DAC Resolution	bits			12
Sample Rate	MS/s		0.0625	20[3]
Sample Length	MS		0.001	20

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[1] Measurement Conditions: Sample rate 20 MS/s, flat top window over the 20k samples

[2] Useable to 40 MS/s with output disabled

[3] Useable to 40 MS/s with input disabled

Wi-Fi/BT Port Specifications (Signaling Test Port)

Wi-Fi Signaling Mode

Parameter	Units	Value
Connector Type		SMA(f)
Modem		Connection as Access Point or Client
WiFi Standards		IEEE 802.11 a/b/g/n/ac
Bandwidths	MHz	20, 40, 80
Bands	GHz	2.4 and 5
DUT reports		RSSI, SSID, Throughput[4]
Impedance	Ohms	50 (typical)
Output Level Range (Avg Burst power)	dBm	-5 to -45 in 0.25 dB steps
Output Level Accuracy	dB	±2 (typical)
Input Level Accuracy	dB	Unspecified
Repeatability	±dB	1.0 (2 sigma)
Linearity	±dB	1.0 (2 sigma)

BT Signaling Mode

Parameter	Units	Value
Connector Type		SMA(f)
Modem		Bluetooth Classic (BR/EDR) Bluetooth Smart (BT LE Central) (optional) Bluetooth LE DTM (optional)
Supported BT Profiles		PAN, PANU (client), PAN-NAP (server)
DUT reports		RSSI, MAC, Supported Profiles
Impedance	Ohms	50 (typical)
Output Level (Avg. Burst power)	dBm	-6 to +5[5] with no attenuation
Input / Output Attenuation Range	dB	0 to 40 step 0.25
Repeatability	dB	±1.0 (2 sigma)
Linearity	dB	±1.0 (2 sigma)

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[4] When used with optional iPERF plugin
[5] Nominal with 0 dB attenuation selected

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Ref Port Specifications

Parameter	Units	Value
Connector Type		SMA (f)
Port Impedance	Ohms	50
Input Frequency	MHz	10
Max Input Level	dBm	15
	Vrms	1.25

Extension Interface

Connector Type	
D-SUB(37) female	UART – TTL GPIO (0-4) 3.3 VDC 5 VDC
USB 2.0	5 VDC available Reserved for future use

Rear Panel Connectors

Port	Connector Type	Rating
DC Power In[6]	Jack type RAPC722X 2.0 mm center pin diameter with +ve polarity	12VDC 3A
	Phoenix	12VDC 3A
Ethernet	RJ45 (CAT-6)	1GB

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[6] DC Power can be applied to either connector but should not be applied simultaneously to both.

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Software Drivers and APIs

KT-RFCT 2400A Drivers	C/C++ 7	LabVIEW	Python
Non Signaling	√	√	√
WiFi Signaling	√	√	√
BT Signaling	√	√	√
BT LE Central Signaling (optional)	√	√	×
BT LE DTM Signaling (optional)	√	√	×
iPerf (optional)	√	√	×

Non-Signaling Parameters

Rx Mode - RF Port Selection (Input on Tx/Rx or Rx), Frequency, Reference Level, Sample Rate, Fetch IQ Samples, Capture Trigger Source (immediate/hardware trigger from GPIO or IQ)

Tx Mode - Frequency, Power (In/Out), ARB File load / Play / Trigger Source (immediate/hardware trigger from GPIO)

Wi-Fi Signaling Parameters

AP Mode - AP SSID, AP Password, TX Power, Wi-Fi Channel, Wi-Fi Standard, List connected Wi-Fi Client MAC addresses, Wi-Fi Client reported RSSI, Ping

Client Mode - Scan for AP SSIDs, MAC address for connected AP, TX Power, AP Reported RSSI, Ping

BT Signaling Mode Parameters

Scan for BT devices (MAC addresses & names), List device profiles, Report RSSI, Ping

BT LE Central Signaling Parameters

Scan for BT LE devices (MAC addresses & names), Connect/Disconnect, Read, Write, Notify, Advertisement info, Report RSSI, Ping

BT LE DTM Signaling Parameters

DTM Tx start / stop, DTM Rx start / stop

iPERF Signaling Parameters

iPerf start / stop

Custom Plugins can be provided upon request. For further details contact Konrad Customer Support.

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[7] Supplied for both Windows and Linux operating systems

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Soft Front Panel

Manual user control is supported with an intuitive soft front panel application to allow users to control all hardware settings and view and manipulate acquired data in each of the operating modes.
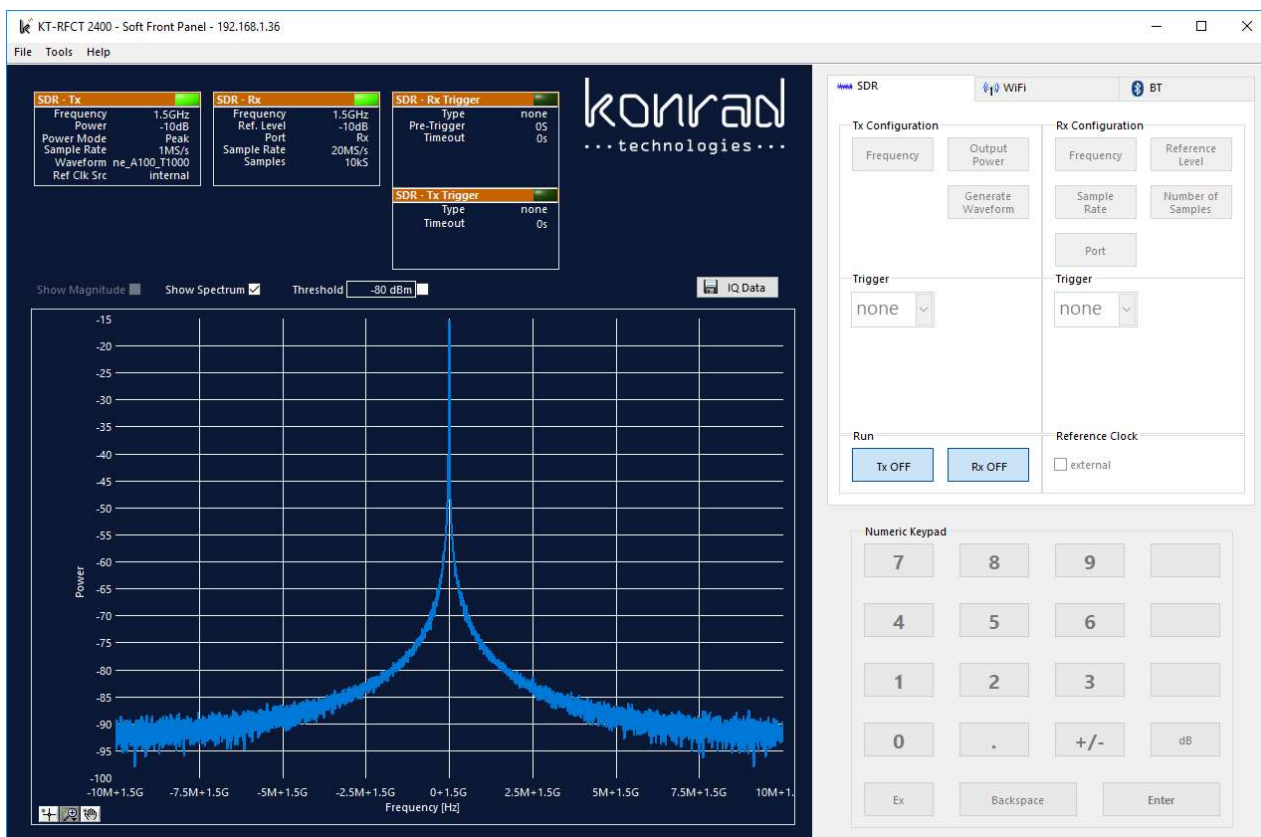

Figure 5. RFCT Soft Front Panel

Measurement Toolkits (Optional)

To enhance the capability of the non-signaling sub-system the KT-RFCT 2400A test set has additional modulation toolkits are available for purchase. These are provided by both Konrad and National Instruments (NI).

Measurement Toolkits	Programming Interfaces			
	C	**C++**	**Python**	**LabVIEW**
KT-RFCT Modulation Toolkit				√
KT-RFCT Keyless Entry Toolkit[8]				√
NI Modulation Toolkit				√
NI WLAN Toolkit	√			√
NI BT Toolkit	√			√
NI GNSS Toolkit	√			√

Konrad Modulation Toolkit provides generic ASK & FSK modulation generation and analysis capabilities. National Instruments (NI) Modulation Toolkit provides generic modulation VI examples for use in LabVIEW.

NI WLAN, BT and GNSS toolkits provide enhanced coverage for non-signaling test.
Further details of NI Toolkits can be found on their specific data sheets.

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[8] Requires KT-RFCT Modulation Toolkit

Physical Dimensions

Parameter	Units	Value
Width	mm	221.45
Depth	mm	220.89
Height (1U)	mm	43.65
Weight	kg	1.620

Client PC Interface and Requirements

The tester can be controlled from a remote client PC through an Ethernet interface using either a customer application with KT APIs or the soft front panel utilities (provided with the KT-RFCT 2400 Tools Installer package). The client PC requirements are as below:

PC Feature	Minimum Requirement
OS	Windows 7 or later, Linux
Processor	Intel i3 or better
RAM	4GB is recommended
Ethernet	1GB is recommended

Conformance

The instrument complies with the following essential requirements

EMC directive 2014/30/EU
Low Voltage directive 2014/35/EU
RoHS directive 2011/65/EU.

Warranty

12 months

Recommended Calibration Interval

12 months

Supplied With

KT-RFCT 2400A can be supplied standalone or complete with DC power converter, ethernet cable and quick start guide containing information how to download user documentation and software.

Serial number specific license keys for any optional software will be supplied for user activation.

Ordering Information

Model Number	Description	Konrad Part Number
KT-RFCT 2400A	Radio Frequency Communications Tester	G170120
KT-RFCT 2400A	Radio Frequency Communications Tester starter kit including AC/DC power adapter, 1m ethernet cable and quick start guide	G170125
Software Options:		
KT-RFCT 2400A iPerf	iPerf Server Plugin for RFCT	SW800053
KT-RFCT 2400A BT LE Central	BT LE Central Plugin for RFCT	SW800054
KT-RFCT 2400A BT LE DTM	BT LE Test Mode Plugin for RFCT	SW800055
Hardware Accessories:		
Rack Mount Kit	Brackets for 19-inch rack assembly	G170123
Software Accessories:		
KT-RFCT 2400A Keyless Entry Toolkit	Software library for testing remote keyless entry devices	Contact Konrad Sales
Konrad Modulation Toolkit	Software library for ASK and FSK modulation and demodulation	Contact Konrad Sales