

DTU-331

0-3GHz RF Probe for USB-3



DATASHEET

July 2023

DekTec

Table of Contents

1. Introduction	3
1.1. Overview.....	3
1.2. Software Defined Radio (SDR).....	3
1.3. Features	3
1.4. Applications	4
1.5. Operating the DTU-331	4
1.6. Standard Applications for the DTU-331 Provided by DekTec	5
1.7. Developing Custom Applications for the DTU-331	5
2. Options Available for the DTU-331	6
3. Operating the DTU-331	7
3.1. Summary.....	7
3.2. USB-3 Port	7
3.3. USB-3 Cable	7
3.4. USB-3 Host Controller.....	8
3.5. Host CPU	8
3.6. Operating System	8
3.7. Resolving USB-Related Issues.....	9
4. Overview of DTU-331 Operation	10
4.1. System Diagram	10
5. Specifications	11
5.1. Ports	11
5.2. RF Input.....	11
5.3. Reception and Demodulation	12
5.4. Measurements	13
5.5. Miscellaneous Specifications.....	14
5.6. Compliancy.....	14
6. Modulation Standards	15
6.1. ATSC 1.0	15
6.2. ATSC 3.0	16
6.3. DAB/DAB+/T-DMB.....	17
6.4. DVB-C2	17
6.5. DVB-CID	18
6.6. DVB-S	18
6.7. DVB-T	19
6.8. DVB-T2	19
6.9. I/Q Samples.....	20
6.10. ISDB-T / ISDB-T _{SB}	20
6.11. QAM-A (DVB-C)	21
6.12. QAM-B	21
6.13. QAM-C (ISDB-C)	22

1. Introduction

1.1. Overview

The DTU-331 is a portable RF probe designed to receive and demodulate digital radio and TV signals. The device incorporates a convenient USB 3.0 type C interface for easy connectivity with a laptop or desktop computer. Its power is drawn from the USB bus, eliminating the need for a separate power supply.



Figure 1. Analyzing arbitrary RF signals with the DTU-331 RF Probe.

Equipped with two tuners, the device can receive cable/terrestrial signals with a bandwidth of up to 8MHz and satellite signals with a bandwidth of up to 60MHz. The integrated RF mixer enables a broadened tuning range for both tuners, allowing a frequency coverage from 42 to 3220MHz.

Weighing only 500 grams, this versatile device is well-suited for portable applications with a notebook or as an easily installable receiver for standard PCs. It can be used for field measurements with a laptop, as a portable measurement receiver in the lab, or as a receiver front end for SDR experiments.

1.2. Software Defined Radio (SDR)

A standout feature of the DTU-331 is its utilization of software-defined radio (SDR) technology. This provides flexibility and capabilities beyond those of traditional hardware-based demodulators.

The power of SDR is rooted in its software-centric approach to demodulation. With all I/Q samples accessible to the analyzing software, the probe enables precise and unique RF measurements not achievable with any chip-based demodulator solution. The SDR architecture allows the RF probe to adapt to changes in existing standards and to accommodate emerging ones, ensuring the device maintains its future relevance and efficacy.

Overall, the DTU-331 represents a blend of advanced technology, user-centric design, and versatility, presenting a great solution for those seeking reliable, precise, and portable RF analysis.

In conclusion, the utilization of SDR in the DTU-331 not only allows for advanced RF measurements beyond the capabilities of traditional methods, but it also enables the reception and analysis of non-DTV signals. Furthermore, the inherent flexibility of SDR accommodates new standards, ensuring the device remains pertinent and effective amidst evolving RF communication norms.

1.3. Features

Key RF features of the DTU-331 include:

- RF input: micro-BNC, 42 – 3220MHz.
- 8-MHz tuner equipped with a 16-bit ADC capable of receiving cable, terrestrial, and satellite standards with a bandwidth up to 8MHz.
- 60-MHz tuner with 12-bit ADC for receiving satellite or other wide-band standards.
- RF mixer to expand the RF input range of the tuners:
 - 8-MHz tuner: 42 – 3220MHz. The mixer is employed for the range 1002 – 3220MHz.
 - 60-MHz tuner: 925 – 3220MHz. The mixer is employed for the range 2175 – 3220MHz.
- Facilitates digital processing of any RF signal in I/Q passthrough mode by end users.

- The user can select the analog bandwidth and digital sample rate. Keep in mind that the chosen digital sample rate should be at least twice the maximum frequency of the input signal, per the Nyquist criterion, to ensure accurate signal representation. The available ranges are:
 - 8-MHz tuner: 1 to 40Msps.
 - 60-MHz tuner: 5 to 80Msps.
- A wide range of modulation standards can be demodulated and analyzed, including ATSC 3.0 and DVB-T2, refer to §2 for a complete list.
- The DTU-331 can also serve as an I/Q sampler for any RF signal with a bandwidth up to 60MHz in the 42 to 3.22GHz range.

1.4. Applications

The DTU-331 RF probe's versatility makes it a potent tool for a variety of RF signal monitoring and analysis applications. The following list illustrates some possible uses, though its potential applications are only limited by user creativity.

- Comprehensive analysis of modulated Digital Television (DTV) signals at all layers, spanning from the RF layer to audio/video and metadata streams.
- Long-term monitoring of DTV signals.
- Field measurements of terrestrial DTV signals. DekTec provides in-depth RF analysis software tailored for ATSC 3.0, DVB-T2 and DVB-CID.
- Recording of I/Q samples in the field, with the capability to playback these samples in a lab environment using a DekTec modulator device, such as the [DTU-315](#).
- Verification of the output from RF equipment, such as in a production environment.
- Decoding and analyzing of DVB-CID signals for satellite carrier identification, a unique and advanced feature of the DTU-331 included as standard.
- Conducting SDR experiments, with the DTU-331 providing the source of I/Q samples.
- In educational contexts, the DTU-331 can be a valuable tool for learning about and experimenting with various DTV standards.

1.5. Operating the DTU-331

Operating the DTU-331 involves the use of the DtBb2 driver, the DTAPI library, and an application that is linked to DTAPI. DekTec offers a variety of standard applications that support the DTU-331 (refer to §1.6), or users can develop their own application for analyzing or monitoring modulated RF streams (refer to §1.7).

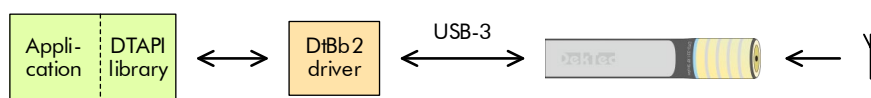


Figure 2. The DTAPI library and DtBb2 driver enable applications to control the DTU-331.

1.6. Standard Applications for the DTU-331 Provided by DekTec

DekTec provides several standard Windows applications for the DTU-331. To run these applications, a specific option (license) must be present in the non-volatile memory of the unit. Refer to §2 for a description of options and the corresponding ordering codes. The following table lists the available applications and their descriptions:

Application	Options required	Description
<i>StreamXpert</i>	-SX	DekTec's well-known stream analyzer. Please refer to §6 for a list of supported analysis functions per modulation standard.
<i>Atsc3Xpert</i>	-XPRT	ATSC 3.0 receiver and analyzer with advanced RF measurements and decoding of all signaling information. Features recording of PLP data in PCAP files and real-time ALP and ROUTE/MMT output over IP.
<i>C2Xpert</i>	-XPRT	Real-time DVB-C2 analyzer software. DVB-C2 has not been the commercial success what was hoped for, but this analyzer is still available.
<i>T2Xpert</i>	-XPRT	Real-time DVB-T2 analyzer software with advanced RF measurements in detailed graphs and displaying of all T2 signaling information. Features single-PLP and multi-PLP reception, T2-Lite and T2-MI output over IP.

The following table lists the order codes required to purchase applications from DekTec.

Option	Order code	Note
-SX	DTC-320-SX	The DTU-331 with this option included can be ordered as DTU-331-SX.
-RC	DTC-344-XPRT	Enables advanced RF measurements with <i>Atsc3Xpert</i> , <i>T2Xpert</i> and <i>C2Xpert</i>

1.7. Developing Custom Applications for the DTU-331

Developers are provided the opportunity to create custom applications for the DTU-331 using the free Software Development Kit (SDK) for DekTec devices. Currently, the SDK is exclusively available for the Windows platform. It includes the DtBb2 device driver and the DTAPI library. The user installs the DtBb2 device driver and links the custom application against DTAPI.

The device driver is responsible for low-level operations that require access to the DTU-331 hardware. This includes the initiation and management of USB transfers, control of tuners, sample-rate converters and other RF processing hardware functions, and the reading and writing of Vital Product Data (VPD). However, developers need not delve be aware of these driver functions as they are effectively abstracted by the DTAPI library.

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2. Options Available for the DTU-331

The DTU-331 supports a wide range of modulation standards, listed in the table below. The probe supports demodulation and basic RF measurements for all standards in the table. Please note that the "Included" remark means that the option is already included in the base product and no additional license is required.

Feature	Option	Order code	Remark
ATSC 1.0		<i>Included*</i>	
ATSC 3.0		<i>Included*</i>	
DAB		<i>Included*</i>	Also enables DRM(+)
DVB-C2		<i>Included*</i>	
DVB-CID		<i>Included*</i>	
DVB-S		<i>Included*</i>	
DVB-T		<i>Included*</i>	
DVB-T2		<i>Included*</i>	
I/Q samples		<i>Included*</i>	
ISDB-T		<i>Included*</i>	
QAM-A		<i>Included*</i>	ITU J.83 Annex A, also known as DVB-C
QAM-B		<i>Included*</i>	ITU J.83 Annex B
QAM-C		<i>Included*</i>	ITU J.83 Annex C
Base measurements		<i>Included*</i>	Pre/Post BER, error correction statistics, signaling/modulation parameters.
Advanced RF measurements <i>Atsc3Xpert</i> <i>C2Xpert</i> <i>T2Xpert</i> <i>StreamXpert</i>	-XPRT -SX	DTC-344-XPRT DTC-320-SX	Enables the Advanced Demodulator API: constellation diagram, spectrum, impulse response, transfer function, and the listed applications. Real-time stream analysis.

* The term "Included" indicates that the feature is part of the base product, requiring no special license.

The DTU-331 includes all supported modulation standards within its base product, along with the flexibility to obtain raw I/Q samples, thereby offering users the ability to accommodate any applicable modulation standard without the need for additional options.

If you are considering running one of DekTec's RF analyzer tools or writing a custom application with the Advanced Demodulator API, the -XPRT option is necessary.

3. Operating the DTU-331

3.1. Summary

The DTU-331 is a high-performance device that requires specific considerations on the USB-3 bus connection and the host system for optimal operation. To ensure the best performance, please observe the recommendations outlined below.

Section	Aspect	Recommendation
§3.2	USB-3 port	Use a 'true' USB-3 port, as operation via a USB-2 port is not supported.
§3.3	USB-3 cable	Use a reliable USB-3 cable. The DTU-331 box includes cables suitable for different ports (USB-C or USB-A).
§3.4	Host Controller	Connect via an integrated USB-3 host controller. Avoid using USB-3 add-on cards.
§3.5	Host CPU	A modern Core i7 CPU (or AMD equivalent) is recommended. The DTU-331 package includes cables suitable for different ports (USB-C or USB-A).
§3.6	Operating System	Windows 10 or 11 is recommended. Linux and macOS are not supported.

3.2. USB-3 Port

To ensure proper operation of the DTU-331, your host system must have one or more available USB-3 ports. It is important to note that the DTU-331 cannot be operated via a USB-2 port due to its high-speed requirements.

3.3. USB-3 Cable

The DTU-331 is equipped with a USB type-C connector. The DTU-331 comes with different USB-3 cables to accommodate various types of host ports. The box includes:

Cable	Remarks
50cm USB-3 type-C to type-C cable	Laptops and PCs with USB-C ports.
100cm USB-3 type-C to type-C cable	
100cm USB-3 type-A to type-C cable	Laptops and PCs with USB-A ports only.

Please use these supplied cables, or a high-quality USB-3 cable, for proper connectivity.

Note:

- The DTU-331 does not require USB Power Delivery (USB-PD) or Thunderbolt for correct operation.

3.4. USB-3 Host Controller

The USB-3 host controller manages the data transfers between your host system (PC) and the DTU-331. For optimal compatibility, it is recommended to connect the DTU-331 to an integrated USB-3 host controller. Most laptops already have an integrated host controller, ensuring proper functionality. However, when using a desktop PC, it is advisable to avoid USB-3 add-on cards.

The following USB-3 host controllers have been successfully tested with the DTU-331:

USB-3 Host Controller	Remarks
Etron USB-3 Extensible Host Controller	Used on motherboards.
Intel USB-3 eXtensible Host Controller	Used on motherboards.
AS Media eXtensible Host Controller	Used on motherboards.
Renesas/NEC D720200	Used on motherboards.
Renesas/NEC D720202	Used on PC add-on cards with 2 external USB-3 ports.

Please note that the following USB-3 host controllers are not supported by the DTU-331:

USB-3 Host Controller	Remarks
AS Media ASM1022	Used on PC add-on cards with 2 external USB-3 ports.
AS Media ASM1042 1144A/1144B	Used on PC add-on cards with 4/2 external USB-3 ports.
Texas Instruments TUSB7340	Used on PC add-on cards with 4 external USB-3 ports.
VIA/VLI VL810/VL811	Used on PC add-on cards with 4/5 external USB-3 ports.

3.5. Host CPU

To utilize the DTU-331 at its full capacity, your host system should have sufficient computing power. The minimum requirements for the host CPU depend on the modulation type used:

Modulation Type	Required Minimum CPU
DVB-S at 27.5MBd	Core i7-4xxx or better (or AMD equivalent) with processor base frequency ≥ 2.8 GHz.
Other modulation types	Core i7-4xxx or better (or AMD equivalent); no requirement on processor base frequency.

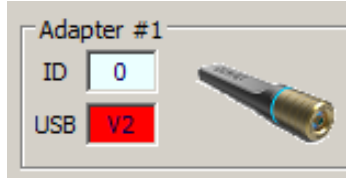
3.6. Operating System

The DTU-331 is supported by the following operating systems:

Operating System	Remarks
Windows 10 and 11 (64 bits)	These operating systems natively support USB 3. Please do <u>not</u> install the driver supplied with the USB-3 host controller.
Other Windows versions (older, server), Linux, macOS	Not supported.

3.7. Resolving USB-Related Issues

Occasionally, the proper functioning of the DTU-331 may be hindered due to the USB connection operating in USB-2 instead of the required USB-3 mode. You can confirm the operating mode by employing the DtInfo tool, which will display the USB version in its graphical user interface (GUI).



In USB-2 mode, DtInfo will still detect the DTU-331, as it can read the Volatile Programmable Data (VPD) under this mode. However, in this mode, the DTU-331 is incapable of transmitting a data stream to the host.

If your DTU-331 operates in USB-2 mode, you can try to fully disconnect the USB-3 connector from both ends of the cable, then reconnect.

Should the problem persist, it may be due to the quality of the USB cable. Ensure that you are using a high-quality and preferably short USB-3 cable. If the DTU-331 continues to start up in USB-2 mode, it might point towards a compatibility issue, please refer to the preceding sections in this manual.

4. Overview of DTU-331 Operation

4.1. System Diagram

The DTU-331 is a versatile I/Q receiver, designed with two distinct receive paths, each catering to different bandwidth requirements. The first is an 8MHz path, optimized for receiving cable and terrestrial Digital TV (DTV) standards, accommodating a maximum bandwidth of 8MHz. The second is a 60MHz path, specifically tuned for satellite standards, capable of handling a maximum bandwidth of 60MHz. Users can select the appropriate path according to their specific reception needs.

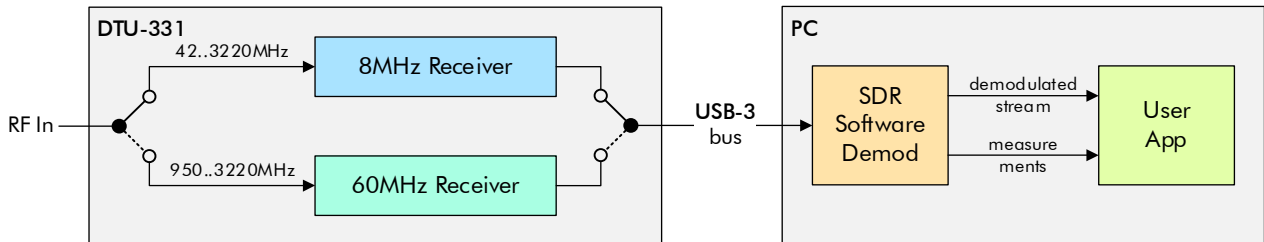


Figure 3. System diagram.

As depicted in Figure 2Figure 3, the received samples are transferred to the host through a high-speed USB-3 bus. The demodulation process is predominantly software-based, leveraging Software Defined Radio (SDR) techniques. This processing is executed within the framework of DekTec's supporting library, DTAPI.

The user application, in turn, receives the demodulated stream and measurements from DTAPI, enabling users to manipulate and analyze the data as required.

5. Specifications

5.1. Ports

The DTU-331 features the following connections.

Port	Connector	Impedance	Description
1	Micro-BNC female	75Ω	RF input.
USB	USB Type-C (USB-C) female	-	USB 3.2 Gen 1 connection.

Note

- The USB Type-C connector on the DTU-331 is a female port, providing a USB 3.2 Gen 1 interface (5 Gbps) for connecting to a laptop or PC. The USB-C cable connector is reversible, allowing for easy insertion in either orientation.

5.2. RF Input

The characteristics of the input and demodulation characteristics are specified in the table below.

Parameter	Qualification	Min	Typ	Max	Unit
RF INPUT					
Connector type		Micro-BNC, female			
Impedance		75			Ω
RETURN LOSS					
Not powered		Not specified			dB
If 8MHz tuner is used	0 - 1GHz	-5 (optimized for sensitivity)			dB
	1 - 3GHz	-5	-15		dBm
If 60MHz tuner is used	1 - 2GHz			-9	dBm
	2 - 3GHz	-5	-12		dBm
LEVEL					
Total input power	Band filled with channels			-9	dBm
Sensitivity	Typical	-80		-20	dBm
Required channel level	Typical for Terrestrial using a robust mode	-80		-20	dBm
	Terrestrial, worst case	-75			dBm
	Cable, worst case	-70			dBm
	Satellite, worst case	-65			dBm
RF Fequency					
8MHz tuner		42		3220	MHz
60MHz tuner		925		3220	MHz
Initial accuracy	25°C	-0.5		+0.5	ppm
Aging in first year				1	ppm
Stability	0 to 45°C ambient	-0.5		+0.5	ppm

5.3. Reception and Demodulation

The following table provides an overview of the reception and demodulation characteristics for both the 8MHz and 60MHz tuners of the DTU-331 RF Probe, specifying their respective minimum, typical, and maximum parameter values where applicable.

Parameter	Qualification	Min	Typ	Max	Unit
8MHZ TUNER					
Bandwidth		0.85, 1.7, 5, 6, 7, 8			MHz
Sample rate		1		40	Msp/s
ADC bit depth		16			bits
I/Q samples bit depth		16-bit I + 16-bit Q			bits
MER	DVB-T2, 8MHz			45	dB
I/Q constellation	42 - 1002MHz	Up to 64k QAM			
	1002 - 3220MHz	Up to 1k QAM			
60MHZ TUNER					
Bandwidth		9, 10, 11, ..., 58, 59, 60			MHz
Sample rate		5		80	Msp/s
ADC bit depth		12			bits
I/Q samples bit depth	5 - 50Msp/s	16-bit I + 16-bit Q			bits
	50 - 66Msp/s	12-bit I + 12-bit Q			bits
	66 - 80Msp/s	10-bit I + 10-bit Q			bits
MER	DVB-S, 27.5MBd			35	dB
I/Q constellation	925 - 2,200MHz	Up to 256-APSK			
	2,200 - 3220MHz	Up to 32-APSK			

5.4. Measurements

The table below outlines the range and accuracy of measurements that can be conducted with the 8MHz and 60MHz tuners of the DTU-331 RF Probe: power level and Modulation Error Ratio (MER).

Parameter	Qualification	Min	Typ	Max	Unit
8MHZ TUNER					
Power level range	42 - 2,300MHz	-20 to -80			dBm
	2,300 - 3220MHz	-20 to -70			
Power level accuracy	42 - 2,300MHz	±1.0	±2.0	dBm	
	2,300 - 3220MHz	±1.0	±3.0		
MER range		10 to 45			dB
MER accuracy		±0.5	±2.0		
60MHZ TUNER					
Power level range	925 - 2,200MHz	-20 to -80			dBm
	2,200 - 3220MHz	-20 to -70			
Power level accuracy	925 - 2,200MHz	±1.0	±2.0	dBm	
	2,200 - 3220MHz, -20 to -50dBm	±1.0	±3.0		
	2,200 - 3220MHz, -50 to -70dBm	±1.0	±5.0		
MER range		10 to 45			dB
MER accuracy		±0.5	±2.0		

5.5. Miscellaneous Specifications

The table below presents miscellaneous specifications for the DTU-331 RF Probe for USB-3, delineating key attributes related to its USB connection, power parameters, mechanical dimensions, and environmental operating conditions.

Parameter	Qualification	Min	Typ	Max	Unit
USB					
Connector type		USB Type-C (USB-C) female			
Generation		USB 3.2 Gen 1			
Link speed		5			Gbit/s
POWER					
Voltage	At USB-C connector	4.5	5	5.25	W
Power consumption	Overall range	0.5		6.5	W
	Device is idle		0.5		W
	8MHz, 42 - 1.002MHz		4.75	4.9	W
	8MHz, 1002 - 3220MHz		5.3	5.5	W
	60MHz, 925 - 2,200MHz		5.4	5.5	W
60MHz, 2,200 - 3220MHz		6.1	6.5	W	
MECHANICAL					
Dimensions	W x H x D	154 x 30 x 30			mm
Weight		144			g
ENVIRONMENTAL					
Operating temperature		0		+40	°C

5.6. Compliancy

The table below lists the key EMC, ESD immunity, and safety standards with which the DTU-331 RF Probe complies.

Parameter	Qualification	Min	Typ	Max	Unit
COMPLIANCY					
EMC Emission		EN 55022			
		FCC CFR 47 Part 15 Class A			
EMC Immunity		EN 55024			
		EN 61000-4-3/4/5/6/8			
ESD Immunity		8kV (EN 61000-4-2)			
Safety		IEC 60065			
		UL1419			

6. Modulation Standards

This section provides features, specifications and software support per modulation standard.

6.1. ATSC 1.0

Parameter / Feature	Value / Comment
STANDARD	ATSC A/53E, nowadays also known as ATSC 1.0
DEMODULATION	
Modulation type	8-VSB
Symbol rate	10.762MBd
FEATURES	
Output format	MPEG-2 Transport Stream
Measurements (using DTAPI)	Level, MER, pre-RS BER, packet errors, Reed-Solomon statistics.
Advanced RF measurements (using DTAPI with -XPRT option)	Constellation diagram, spectrum.
SOFTWARE SUPPORT	
<i>StreamXpert</i>	Analyzes ATSC 1.0 transport streams; shows signal level and MER.
DTAPI	DTAPI is a C++ API for custom application development with DekTec devices. Provides access to all measurements listed above as well as a direct interface to the demodulated Transport Stream.

6.2. ATSC 3.0

Parameter / Feature	Value / Comment
STANDARD	ATSC 3.0
DEMODULATION	
Bandwidth	6, 7, 8MHz
Modulation type	QPSK, 16, 32, 64, 128, 256, 1024, 4096-QAM
FFT	8K, 16K, 32K
Multi PLP	Up to 64 PLPs
PLP multiplexing	LDM, FDM, TDM, TFDM
FEATURES	
Output format	ALP packets BB frames IP, as offline capture file or live IP output
Measurements (using DTAPI)	All ATSC 3.0 modulation parameters. Level, MER, pre-LDPC BER, pre-BCH BER, LDPC statistics, frame errors, bootstrap info, Layer1 signaling info, Tx ID info.
Advanced RF measurements (using DTAPI with -XPRT option)	Constellation diagram, spectrum, impulse response (echoes), transfer function.
SOFTWARE SUPPORT	
Atsc3Xpert	DekTec's specialized ATSC 3.0 RF analysis software for Windows. It is designed to effectively interpret and visualize RF signal data through detailed visualizations of constellation diagram, transfer function, impulse response and LDPC statistics, along with L1 signaling information, subframe- and PLP parameters, all in an intuitive GUI. Additionally, Atsc3Xpert features recording of PLP data in PCAP files and supports real-time ALP and ROUTE/MMT output over IP. The decoded stream can be automatically forwarded to StreamXpert for decoding and visualization of the upper AV layers and metadata.
StreamXpert	DekTec's stream analyzer software for Windows. For ATSC 3.0 streams, StreamXpert features metadata analysis and audio/video decoding of ATSC 3.0 streams.
DTAPI	DTAPI is a C++ API for custom application development with DekTec devices. Provides access to all measurements listed above as well as an interface to the IP packets decoded from the ATSC 3.0 stream.

6.3. DAB/DAB+/T-DMB

Parameter / Feature	Value / Comment
STANDARD	EN 300 401, TS 102 563, TS 102 427
DEMODULATION	
Modes	I, II, III, IV
FEATURES	
Output format	ETI(NI) stream according to EN 300 799 Raw DAB data AAC audio MPEG-2 Transport Stream (T-DMB)
Measurements (using DTAPI)	Level, MER, pre-Viterbi/pre-RS BER, packet errors. Viterbi statistics, Reed-Solomon statistics, ensemble info, Tx ID info.
Advanced RF measurements (using DTAPI with -XPRT option)	Constellation diagram, spectrum, impulse response (echoes), transfer function.
SOFTWARE SUPPORT	
<i>StreamXpert</i>	Decodes DAB(+) streams.
SDK (DTAPI)	Enables custom application development for processing of DAB(+) or T-DMB streams (analysis, monitoring, and more).

6.4. DVB-C2

	Value / Comment
STANDARD	EN 302 769
DEMODULATION	
Bandwidth	6MHz, 8MHz
Modulation type	16, 32, 64, 128, 256, 1024, 4096-QAM
Multi PLP	Up to 256 PLPs
FEATURES	
Output format	MPEG-2 Transport Stream GSE packets MPEG-2 Transport Stream
Measurements (using DTAPI)	All DVB-C2.0 modulation parameters. Level, MER, pre-LDPC BER, pre-BCH BER, LDPC statistics, packet errors.
Advanced RF measurements (using DTAPI with -XPRT option)	Constellation diagram, spectrum, impulse response (echoes), transfer function.
SOFTWARE SUPPORT	
<i>C2Xpert</i>	DekTec's dedicated DVB-C2 RF analyzer for Windows. C2Xpert receives and analyzes DVB-C2 RF streams and presents both basic and advanced RF measurements in a GUI. Additionally, it displays all DVB-C2 modulation parameters.
<i>StreamXpert</i>	DekTec's stream analyzer software for Windows. For DVB-C2 signals, StreamXpert shows input RF level and MER in the GUI, and it decodes audio, video, PSI and SI data in the Transport Stream.
DTAPI	DTAPI is a C++ API for custom application development with DekTec devices. Provides access to all measurements listed above as well as a direct interface to the demodulated Transport Stream.

6.5. DVB-CID

Parameter / Feature	Value / Comment
STANDARD	ETSI TS 103 129 v1.1.2
DEMODULATION	
Modulation type	BPSK
FEATURES	
Output format	CID frame data
Measurements (using DTAPI)	Level, SNR
SOFTWARE SUPPORT	
<i>StreamXpert</i>	DekTec's stream analyzer software for Windows. For DVB-CID, StreamXpert has a dedicated window tab specifically designed for showing the CID decoding status, and offering a comprehensive view of the decoded DVB-CID data.
SDK (DTAPI)	DTAPI is DekTec's C++ API for custom application development. The SDK contains a number of classes specifically designed for demodulating and decoding CID.

6.6. DVB-S

Parameter / Feature	Value / Comment
STANDARD	EN 300 421
DEMODULATION	
Modulation type	QPSK
Symbol rate	1 to 40MBd
FEATURES	
Output format	MPEG-2 Transport Stream
Measurements (using DTAPI)	Level, MER, pre-Viterbi/pre-RS BER, packet errors. Viterbi statistics, Reed-Solomon statistics.
Advanced RF measurements (using DTAPI with -XPRT option)	Constellation diagram, spectrum, impulse response (echoes), transfer function.
SOFTWARE SUPPORT	
<i>StreamXpert</i>	DekTec's stream analyzer software for Windows. For DVB-S signals, StreamXpert shows RF level and MER in the GUI, and it decodes audio, video, PSI and SI data in the Transport Stream.
DTAPI	DTAPI is a C++ API for custom application development with DekTec devices. Provides access to all measurements listed above as well as a direct interface to the demodulated Transport Stream.

6.7. DVB-T

Parameter / Feature	Value / Comment
STANDARD	EN 300 744
DEMODULATION	
Bandwidth	5, 6, 7, 8MHz
Modulation type	QPSK, 16-QAM, 64-QAM
FEATURES	
Output format	MPEG-2 Transport Stream
Measurements (using DTAPI)	Level, MER, pre-Viterbi/pre-RS BER, packet errors. Viterbi statistics, Reed-Solomon statistics, TPS info.
Advanced RF measurements (using DTAPI with -XPRT option)	Constellation diagram, spectrum, impulse response (echoes), transfer function.
SOFTWARE SUPPORT	
StreamXpert	DekTec's stream analyzer software for Windows. For DVB-T signals, StreamXpert shows input RF level and MER in the GUI, and it decodes audio, video, PSI and SI data in the Transport Stream.
DTAPI	DTAPI is a C++ API for custom application development with DekTec devices. Provides access to all measurements listed above as well as a direct interface to the demodulated Transport Stream.

6.8. DVB-T2

Parameter / Feature	Value / Comment
STANDARD	EN 302 755 v1.1.1, v1.2.1, v1.3.1
DEMODULATION	
Bandwidth	1.7, 5, 6, 7, 8MHz
Modulation type	QPSK, 16-QAM, 64-QAM
Profile	Base, Lite
Multi PLP	Up to 256 PLPs
FEATURES	
Output format	MPEG-2 Transport Stream T2-MI GSE packets BB frames
Measurements (using DTAPI)	Level, MER, pre-LDPC/pre-BCH BER, LDPC statistics, packet errors. Recovers all modulation parameters.
Advanced RF measurements (using DTAPI with -XPRT option)	Constellation diagram, spectrum, impulse response (echoes), transfer function, MER per subcarrier.
SOFTWARE SUPPORT	
T2Xpert	DekTec's specialized DVB-T2 RF analysis software for Windows. It is designed to effectively interpret and visualize RF signal data through detailed visualizations of constellation diagram, transfer function, MER per subcarrier, impulse response and LDPC statistics, along with T2 signaling information, PLP parameters and more, all in an intuitive GUI.
StreamXpert	DekTec's stream analyzer software for Windows. For DVB-T2 signals, StreamXpert shows input RF level and MER in the GUI, and it decodes audio, video, PSI and SI data in the Transport Stream.
DTAPI	DTAPI is a C++ API for custom application development with DekTec devices. Provides access to all measurements listed above as well as a direct interface to the demodulated Transport Stream.

6.9. I/Q Samples

Parameter / Feature	Value / Comment
STANDARD	DekTec proprietary
DEMODULATION	
Sample rate	1 to 80Msps
Modulation type	QPSK, 16-QAM, 64-QAM
Profile	Base, Lite
Bandwidth	0.85, 1.7, 5, 6, 7, 8 9 to 60MHz in 1MHz steps.
FEATURES	
Output format	I/Q samples as pairs of 16-bit signed integers in I, Q order.
Measurements	Level
SOFTWARE SUPPORT	
<i>DtRecord</i>	Command line tool for recording streams, compatible with Windows and Linux. Can be used for recording I/Q sample files.
<i>StreamXpert</i>	No support for I/Q samples.
DTAPI	DTAPI is a C++ API for custom application development with DekTec devices. Provides access to all measurements listed above as well as a direct interface to the demodulated Transport Stream.

6.10. ISDB-T / ISDB-T_{SB}

Parameter / Feature	Value / Comment
STANDARD	ARIB STD-B31, ARIB STD-B29
DEMODULATION	
Bandwidth	6, 8MHz
Number of segments	ISDB-T: 13 ISDB-T _{SB} : 1, 3
FEATURES	
Output format	MPEG-2 Transport Stream MPEG-2 Transport Stream + TMCC
Measurements (using DTAPI)	Level, MER, pre-Viterbi/pre-RS BER, packet errors, Reed-Solomon statistics. Recovers all modulation parameters per layer.
Advanced RF measurements (using DTAPI with -XPRT option)	Constellation diagram, spectrum, impulse response (echoes), transfer function.
SOFTWARE SUPPORT	
<i>StreamXpert</i>	DekTec's stream analyzer software for Windows.
DTAPI	DTAPI is a C++ API for custom application development with DekTec devices. Provides access to all measurements listed above as well as a direct interface to the demodulated Transport Stream.

6.11. QAM-A (DVB-C)

Parameter / Feature	Value / Comment
STANDARD	ITU-T J.83 Annex A, EN 300 429
DEMODULATION	
Bandwidth	8MHz
Modulation	16, 32, 64, 128, 256-QAM
Symbol rate	1 to 7MBd
FEATURES	
Output format	MPEG-2 Transport Stream
Measurements (using DTAPI)	Level, MER, pre-Viterbi/pre-RS BER, packet errors, Reed-Solomon statistics. Recovers all modulation parameters per layer.
Advanced RF measurements (using DTAPI with -XPRT option)	Constellation diagram, spectrum.
SOFTWARE SUPPORT	
<i>StreamXpert</i>	DekTec's stream analyzer software for Windows. For DVB-C signals, StreamXpert shows RF level and MER in the GUI, and it decodes audio, video, PSI and SI data in the Transport Stream.
DTAPI	DTAPI is a C++ API for custom application development with DekTec devices. Provides access to all measurements listed above as well as a direct interface to the demodulated Transport Stream.

6.12. QAM-B

Parameter / Feature	Value / Comment
STANDARD	ITU-T J.83 Annex B
DEMODULATION	
Bandwidth	6MHz
Modulation	64, 256-QAM
Symbol rate	5.057, 5.361MBd
Interleaving	All ITU-T J.83.B defined interleaving modes
FEATURES	
Output format	MPEG-2 Transport Stream
Measurements (using DTAPI)	Level, MER, pre-RS BER, packet errors, Reed-Solomon statistics. Recovers all modulation parameters per layer.
Advanced RF measurements (using DTAPI with -XPRT option)	Constellation diagram, spectrum.
SOFTWARE SUPPORT	
<i>StreamXpert</i>	DekTec's stream analyzer software for Windows. For QAM-B signals, StreamXpert shows RF level and MER in the GUI, and it decodes audio, video, PSI and SI data in the Transport Stream.
DTAPI	DTAPI is a C++ API for custom application development with DekTec devices. Provides access to all measurements listed above as well as a direct interface to the demodulated Transport Stream.

6.13. QAM-C (ISDB-C)

Parameter / Feature	Value / Comment
STANDARD	ITU-T J.83 Annex C
DEMODULATION	
Bandwidth	6MHz
Modulation	16, 32, 64, 128, 256-QAM
Symbol rate	5.274MBd
FEATURES	
Output format	MPEG-2 Transport Stream
Measurements (using DTAPI)	Level, MER, pre-RS BER, packet errors, Reed-Solomon statistics. Recovers all modulation parameters per layer.
Advanced RF measurements (using DTAPI with -XPRT option)	Constellation diagram, spectrum.
SOFTWARE SUPPORT	
StreamXpert	DekTec's stream analyzer software for Windows. For QAM-B signals, StreamXpert shows RF level and MER in the GUI, and it decodes audio, video, PSI and SI data in the Transport Stream.
DTAPI	DTAPI is a C++ API for custom application development with DekTec devices. Provides access to all measurements listed above as well as a direct interface to the demodulated Transport Stream.