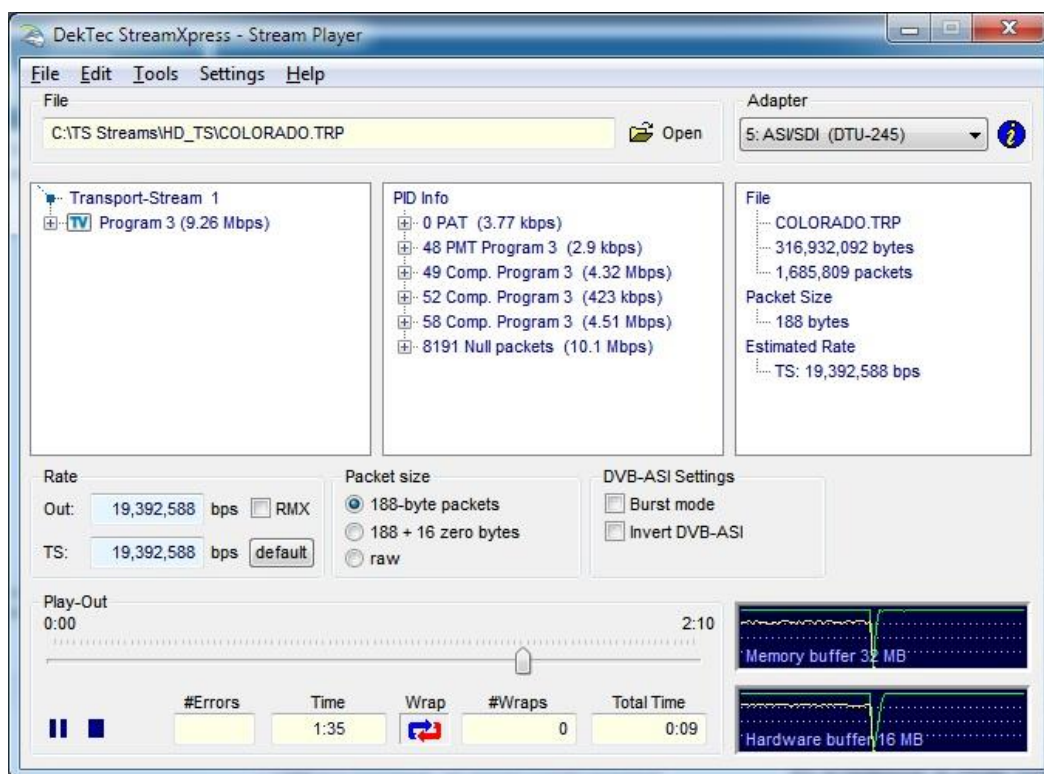


DekTec StreamXpress®

Stream Player Software



USER MANUAL

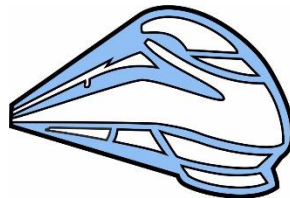
Nov 2024



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1. Introduction

1.1. General Description

The StreamXpress is an easy-to-use PC software package for real-time playback of files to DekTec output adapters or local network ports ("local NICs").

StreamXpress supports playback to a large range of streaming formats:

- DVB-ASI
- IP: SMPTE 2110, TS-over-IP, SRT
- RF modulated signals, e.g. ATSC 3.0, DVB-T2
- RF intermediate file formats, e.g. STLTP, T2-MI
- SDI

Features of the StreamXpress include:

- File contents viewer (decoded from PSI/SI information).
- Automatic file rate computation/estimation.
- Remultiplexing to a different rate with PCR correction.
- Endless play with optional automatic correction of continuity-counter, PCR/PTS/DTS and TDT/TOT fields.
- Test-signal generation.
- Error injection.
- Saving and loading settings from XML files.
- Remote control.

Special modulator features include:

- Controlling modulation parameters.
- DVB-T2 parameter sets.
- Integrated channel simulator.
- ISDB-T multiplexer.

The StreamXpress can be bundled with DekTec hardware, e.g. the DTA-2174B-SP is a DekTec DTA-2174B unit with on-board StreamXpress license. A tiny USB dongle is available for licensing StreamXpress to play out TS-over-IP streams via the network port of your PC or laptop. This dongle is not required when a DekTec output adapter is available. Then an extra StreamXpress NIC license (DTC-300-NIC) can be programmed on the DekTec adapter to play out TS-over-IP streams via the network port.

1.2. StreamXpress Licensing

The StreamXpress can be freely downloaded from the DekTec website, but to run the software, a license is required, which is the **-SP** option. This option is available in two forms:

- Stored on a DekTec output adapter. For example, the **DTA-2174B-SP** is a DekTec DTA-2174B unit with on-board StreamXpress license. Only one StreamXpress license is required per DekTec hardware device. When multiple output ports are available on a single hardware device, multiple independent versions of StreamXpress can be running at the same time.
- Stored on a small USB dongle. The order code is **DTC-300-DGL**.

Separate StreamXpress licenses can be ordered with the order code **DTC-300-SP**. In this case, the serial number of the output adapter must be specified.

The remote control option (-RC) is available separately with ordering code DTC-302-RC. See the DTC-302-RC API document for further details.

1.3. Applications

The table below shows some typical applications of StreamXpress.

Application	Description
Stream DVB-ASI with a laptop.	Stream an MPEG-2 transport stream to an ASI output port on a DekTec USB device, e.g. the DTU-245.
Stream DVB-ASI on a multi-port PCIe device.	Stream an MPEG-2 transport stream to one of the ASI output ports on a DekTec PCIe device, e.g. the DTA-2174B. Most DekTec adapters have bidirectional ports, use DtInfo for changing input ports into output ports.
Stream TS-over-IP.	Using a PCIe DekTec device supporting an Ethernet connection, stream one or multiple transport streams over the DekTec Ethernet port. Note that StreamXpress does not have a limit on how many streams can be streamed over the Ethernet port, it is only limited by the PC resources. StreamXpress can also stream over a standard NIC card. You need a DTC-300-NIC or DTC-300-DGL license for this option to be available.
Generate a modulated RF signal.	Using a USB or PCIe DekTec device supporting RF outputs, StreamXpress can generate an RF modulated signal that can be connected directly to the antenna input of digital TV equipment. StreamXpress allows changing the modulation standard, the modulation-specific parameters, and the RF settings.
Stream SDI.	Stream an SDI stream to one of the ASI/SDI output ports on a DekTec PCIe device, e.g. the DTA-2174B. Note: The SDI file format used by StreamXpress is proprietary to DekTec.

1.4. DekTec Hardware Compatible with StreamXpress

Refer to the [Supported Adapters](#) section on the StreamXpress web page.

1.5. PC Requirements

Refer to the [StreamXpress PC Requirements](#) section on the StreamXpress web page.

1.6. Installation and Licensing

Refer to the [StreamXpress Installation](#) document.

1.7. Limitations

The structure of the software and hardware brings with it a few limitations. The main limitations are listed below.

Scrambling	No real time scrambling or encryption is supported. If a file is encrypted, StreamXpress can stream the encrypted file.
SDI	The SDI streams needs to be compliant to the DekTec SDI file format and needs to be recorded by DekTec software and/or hardware.
VBR	Only CBR Transport Streams are supported.

1.8. List of abbreviations

8PSK	8 Levels Phase Shifting
ACE	Active Constellation Extension
ADTB-T	Advanced Digital Television Broadcast-Terrestrial
ATSC	Advanced Television System Committee
ASI	Asynchronous Serial Interface
CATV	Cable Television
CBR	Constant Bit Rate
CDSD	Cable Delivery System Descriptor
CMMB	China Mobile Multimedia Broadcasting
COFDM	Coded Orthogonal Frequency Division Multiplexing
DAB	Digital Audio Broadcasting
DMB	Digital Multimedia Broadcasting
DQPSK	Differential Quadrature Phase Shift Keying
DSNG	Digital Satellite News Gathering
DTMB-T/H	Digital Terrestrial Multimedia Broadcast-Terrestrial/Handheld
DTS	Decoding Time Stamp
DVB	Digital Video Broadcasting
DVB-C	DVB standard for modulation appropriate for in Cable networks
DVB-H	DVB standard for modulation appropriate for Terrestrial Handheld networks
DVB-T	DVB standard for modulation appropriate for Terrestrial networks
DVB-T2	DVB standard for second generation modulation appropriate for Terrestrial networks
EPG	Electronic Program Guide
FEC	Forward Error Correction

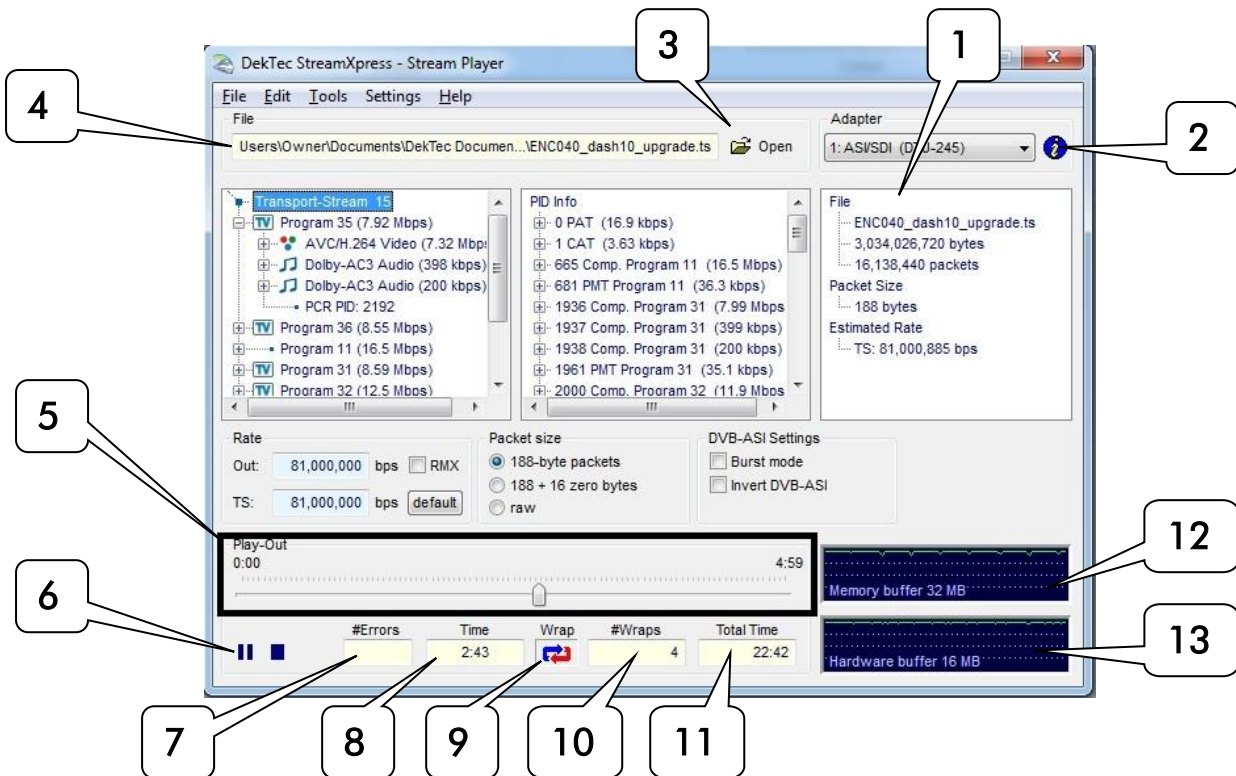
FEF	Future Extension Frame
FFT	Fast Fourier Transfer
GOP	Group Of Picture
HEM	High-Efficiency Mode
IIP	ISDB-T Information Packet
IP	Internet Protocol
IQ	In phase and Quadrature phase modulation components
ISDB-T	Integrated Services Digital Broadcasting- Terrestrial
ISSY	Input Stream SYNchronizer
LCD	Liquid Crystal Display
LDPC	Low-Density Parity-Check
MAC	Media Access Controller
MBd	Megabaud. Number of symbols per second.
Mbps	Megabit per second
MFN	Multiple Frequency Network
MISO	Multiple Input Single Output mode
MPTS	Multi-Program Transport Stream
NA	Not Applicable
NIT	Network Information Table
OFDM	Orthogonal Frequency Division Multiplexing
PAPR	Peak to Average Power Ratio
PCR	Program Clock Reference
PID	Packet ID
PLP	Physical Layer Pipe
ppm	Parts per million
PRBS	Pseudo Random Binary Sequence
PTS	Presentation Time Stamp
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency
RO	Read Only
R/W	Read / Write
SDI	Serial Digital Interface
SFN	Single Frequency Network
SMPTE	Society of Motion Picture and Television Engineers

SNMP	Simple Network Management Protocol
SRT	Secure Reliable Transport
RTP	Real-time Transport Protocol
T2-MI	DVB standard that defines the communication protocol used between the T2 Gateway and the DVB-T2 modulator.
TDSD	Terrestrial Delivery System Descriptor
TDT	Time and Date Table
TMCC	Transmission and Multiplexing Configuration Control
TOT	Time Offset Table
TPS	Transmission Parameters Signaling
TR	Tone Reservation
TS	Transport Stream
TS-over-IP	Transport Stream over IP
TTL	Time To Live
UDP	User Datagram Protocol
UHF	Ultra High Frequency band, officially ranging from 300MHz to 3GHz, but in the context of cable and terrestrial television from 300MHz to 1GHz.
URL	Uniform Resource Locator
VBR	Variable Bit Rate
VHF	Very High Frequency band, ranging from 30 to 300MHz

2. The StreamXpress User Interface

2.1. General Settings

The settings and fields shown in the image below apply to all DekTec devices.



#	Name	Description
1	Adapter	Selects the hardware adapter and port to playout
2	Info	Shows information about the selected hardware adapter and selected port. Also provides the serial number of the selected adapter.
3	Open file	Selects the file to open for playout.
4	File	Displays the filename and full path of the opened file.
5	Playout status	The cursor can be dragged to select a different playback position in the file.
6	Start/stop/pause	Control buttons to start, stop or pause playback.
7	#Errors	Counts errors when the hardware adapter drops packets because StreamXpress cannot fill the internal buffers fast enough.
8	Time	Playing time since the beginning of the file.
9	Wrap	If selected, the file will be repeated over and over. If not selected, the file will be played once.
10	#Wraps	Shows the number of loops since the playback was started.
11	Total time	Total playing time since start or since the last time the stop button was pressed.

12	Memory buffer	Shows the fullness of the software memory buffer used for playback. If the fullness line drops to zero, software underflow occurs and playback may stutter.
13	Hardware buffer	Shows the fullness of the hardware buffer located on the adapter. If the fullness line drops to zero, hardware underflow occurs and playback may stutter.

2.2. General Menu

This section describes the general menus at the top of the StreamXpress interface. Following this table, a more detailed section offers some additional information on the menus.

Menu	Sub Menu	Description	Details
File	Open	To open a TS file, an SDI file, an IQ file, an ETI file or an XML configuration file	#1
File	Save Settings	To save a configuration file that will include all of the settings. The format is XML. The XML file can be modified with an external XML editor	#2
File	Capture Stream	To capture the output stream to a file. Note that you do not require an adaptor with an input to capture the streaming file	#3
File	Exit	To close StreamXpress	
Edit	Sub Loop	Allow creating a sub loop that will be smaller than the complete file length	#4
Tools	Error Injection	Allows injecting calibrated TS errors.	#5
Tools	Loop and TDT/TOT Adaptation	Allows changing the loop functions when using a TS playout. Also allow to change the setting for TDT/TOT when looping the stream.	#6
Tools	Test Signal generator	Allow to use Pseudo Random Polynomial playout 0151 PRBS or use a pseudo random file. This is used for error rate measurement	#7
Settings	RF Output Control	When using a modulator device, this menu allows to change the RF output level	#8
Settings	Use NIT...	Allow to use the NIT to derive playout parameters	#9
Help	About	Provides version and build number for StreamXpress	

This section provides additional details regarding the general menus.

#1 File/Open:

Opening an MPEG-2 TS:

The default file extension is .TS and .TRP for MPEG-2 Transport Streams. If the file extension is not .TS or .TRP, it may not show up in the list of available files. In that case just select the *.* filter and you'll be able to see the file. As long as the file is an MPEG-2 TS, StreamXpress will be able to open the file no matter what its extension is. If the file is not a valid MPEG-2 TS, it will open the file and indicate it is not a valid transport stream. StreamXpress can accept 188 and 204 byte packets MPEG-2 TS.

NOTE: StreamXpress plays standard MPEG-2 TS that can come from any source.

Opening an .XML configuration file:

Use the File/Open function to load an .XML configuration file. See #2 Save Settings for more information.

Opening a .dtsdi file:

StreamXpress can play out SDI files from the hard disk using an adaptor that supports SDI playback. See the section of this manual about playing SDI files.

Opening an IQ file:

StreamXpress can be used to play files with IQ samples. See the section about IQ modulation options for more information.

Opening an ETI file:

ETI files contain a multiplexed stream for DAB/DAB+/DMB. StreamXpress only supports the ETI(NI) file format.

#2 File/Save Settings:

When playing out a file with StreamXpress, the user can change many of the settings including bitrate, RF channels, RF power levels etc... In some case when StreamXpress is used for regular testing (like QC applications) it does make sense to save all the playout settings into a file for future recall.

The Save Settings will save into an .XML file the current settings including the filename and path. To reload the settings use the open button and select the proper .XML file.

Note

- The user can edit and create StreamXpress XML configuration files using a standard text or XML editor. You can use File / Save Settings to obtain a configuration file that corresponds to the current StreamXpress settings and then update the settings to the desired values. The format of the configuration file speaks for itself.

#3 File/Capture Stream:

StreamXpress allows modifying the original recorded file when playing back out. For example, the user can modify the total rate, change 188 byte packet into 204 byte packets or loop the file several times to increase its total playout time. StreamXpress has an internal recorder that allows writing the modified playout file to the hard disk. The Capture Stream menu allows selecting a filename and location to record the output file. When the Capture Stream file is selected, the file will be recorded to the hard disk when playing out the stream.

NOTE: As soon as the stop button is pressed, the recorded file will be closed and won't be overwritten even if the start button is pressed again.

NOTE: This feature is available even if your DekTec device is a playout device only.

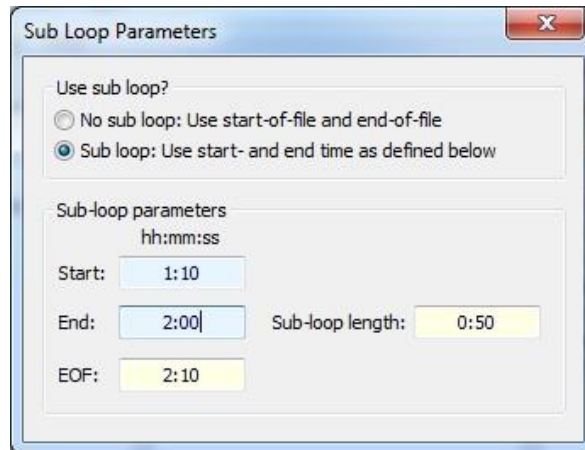
NOTE: This feature is only available for MPEG-2 TS files.

#4 Edit/Sub Loop:

Sometimes recorded files can be long and only part of the stream can be of interest for testing

purposes. StreamXpress allows playing a part of the stream. This is setup using the Sub Loop function. When using the Sub Loop, select the start time (from the start of the file) and the end time or the duration of the sub loop.

NOTE : When sub loop is selected a ****Sub Loop Selected**** message will appears in the playout window and the Sub loop Parameters windows will remain open.



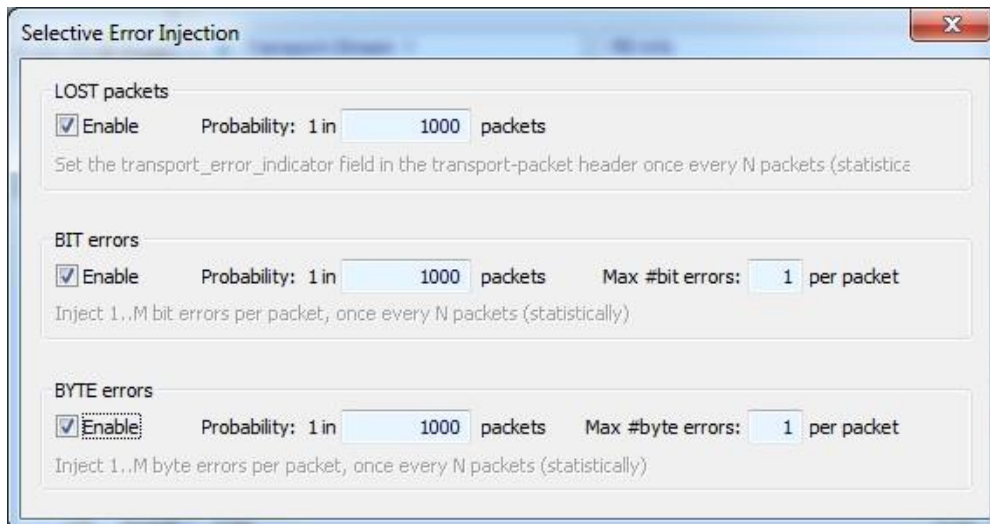
#5 Tools/Error Injection:

StreamXpress will play a recorded file from the hard disk. Assuming the file on the hard disk is perfect, StreamXpress will play without any TS errors. Sometimes it's interesting to add calibrated errors to the playout to simulate bad transmission or to test a receiving device's capability to recover from errors. The Tools/Error Injection menu allows to inject calibrated errors into the output TS.

NOTE: This menu is only available when playing an MPEG-2 TS.

There are 3 types of errors that can be injected:

- Lost Packets
- Bit errors
- Byte Errors



Lost Packets: When selecting this type of error insertion, StreamXpress will set the `transport_error_indicator` field in the TS packet header once every N packets. The frequency of the error insertion can be changed using the probability window.

Bit Errors: When selecting this type of error insertion, StreamXpress will modify (from 1 to 0 or from 0 to 1) 1 to M bits per modified packet. The frequency of the error insertion can be changed using the probability window. The bit error distribution is random.

BYTE Errors: When selecting this type of error insertion, StreamXpress will modify 1 to M bytes per modified packet. The frequency of the error insertion can be changed using the probability window. The byte error distribution is random.

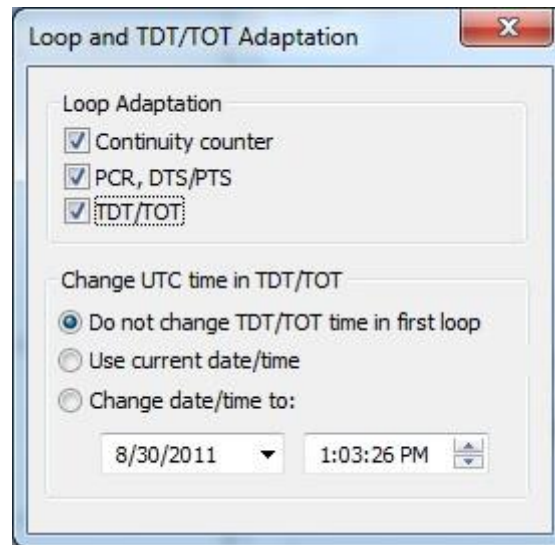
NOTE: The probability of error insertion can vary by few packets. For exact bit error measurement use the Test-Signal generator function.

NOTE: When injecting errors, the Selective Error Injection window will remain open until all error injection options are turned off.

#6 Tools/ Loop and TDT/TOT Adaptation:

StreamXpress offers the capability to loop a recorded transport stream for continuous playback. An operation encoder is designed to run continuously and when looping a pre-recorded TS there will be some discontinuity that can affect the receiver and decoder downstream.

StreamXpress offers some looping options that can help minimize the effect of the discontinuity at the looping point. It allows adapting the Continuity Counter, PCR and DTS/PTS, TDT/TOT after the first loop. These adaption functions are only available when playing transport-stream files.



Loop adaption for the Continuity Counter:

When selecting Continuity Counter StreamXpress will modify, in real time, after the 1st loop, the Continuity Counter of each PID in the stream to ensure that there is no discontinuity in the count that may result in decoder error or reset. As a result after the 1st loop, the continuity count of the original file will not be maintained when that option is enabled.

Loop adaption for the PCR and DTS/PTS:

When selecting PCR, DTS/PTS StreamXpress will modify, in real time, after the 1st loop, the PCR and DTS/PTS of each program/component in the stream to ensure that there is no discontinuity in the PCR that may result in decoder error or reset. As a result after the 1st loop, the PCR and PTS/DTS of the original file will not be maintained when this option is enabled.

NOTE: This option should be not used when testing time sensitive element like interactive data triggered by PCR value or add insertion trigger with SCTE35 flags. As the PCR and PTS/DTS are re-stamped, the trigger will be lost in these applications after the first loop.

Loop adaption for the TDT/TOT:

When selecting TDT/TOT StreamXpress will modify, in real time, after the 1st loop, the TDT and TOT according to the setting below. It will re-stamp each packet with a TOT/TDT packet updating the timetable so it appears to be continuous in time. There are 3 options for updating the TDT/TOT.

Do Not change the TDT/TOT time in first loop: In this case StreamXpress will use the TDT/TOT from the original stream as reference and when looping will increment the TDT/TOT accordingly.

Use current date/time: In this case StreamXpress will discard the TDT/TOT from the stream and replace it with the current time and date of the PC.

Change date/time to: In this case StreamXpress will use the specified date/time and replace the TDT/TOT. Upon looping, the date and time will be updated accordingly.

Note on Stream Looping: StreamXpress can improve the looping performance by “tricking” the receiver that it is receiving a real time continuous stream. However, StreamXpress cannot make a

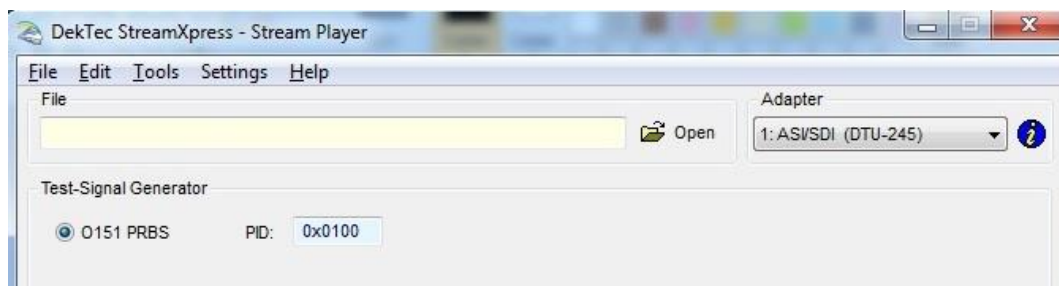
100% seamless looping and elements such as buffer integrity, GOP boundary etc... will not be respected at looping point. In order to minimize the visual effect of the looping, it is advised to use a single program TS file with black video and audio silence at the start and the end of the clip.

#7 Tools/Test-Signal Generator:

StreamXpress offers the capability to playout a PRBS test signal for accurate bit rate measurements. A PRBS (Pseudo Random Binary Sequence) is a binary PN (Pseudo-Noise) signal. The sequence of binary 1's and 0's exhibits certain randomness and autocorrelation properties.

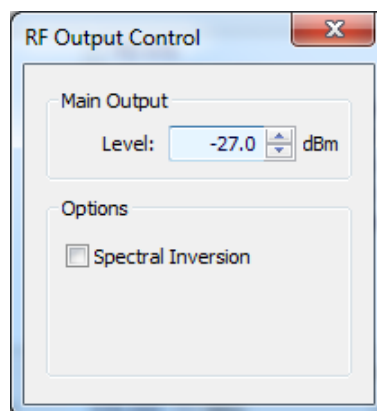
Bit-sequences like PRBS are used for testing transmission lines and transmission equipment because of their randomness properties. StreamXpress implements ITU-T standard O.151 (See Appendix B. for more information on how the PRBS sequence is generated)

StreamXpress is capable of encapsulating the O.151 PRBS data into an MPEG-2 TS where the user specifies the PID where the PRBS data will be carried. The user can also specify the total bitrate of the transport stream. The total PRBS sequence is 64Mbits so the duration of the sequence will depend on the bitrate played out.



#8 Settings/RF Output Control:

StreamXpress offers the capability to change the RF output level when using an RF modulator with a variable RF output. The user can choose to adjust the RF output level and also to invert the spectrum.



#9 Settings/Use NIT for Deriving Parameters:

StreamXpress offers the capability to read the NIT if present in the stream and derive the Streaming parameters. This is relevant for streams with a DVB "Cable Delivery System Descriptor (CDSD)" or "Terrestrial Delivery System Descriptor (TDSD)".

If "Deriving parameters from NIT" is set:

- For DVB-C: the RF frequency, symbol rate and QAM constellation are set to the values found in the CDSD
- For DVB-T: the RF frequency and DVB-T parameters are set to the values found in the TDSD

2.3. Display Transport Stream Information

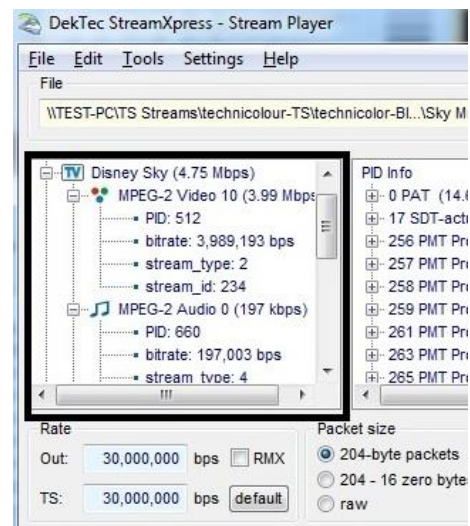
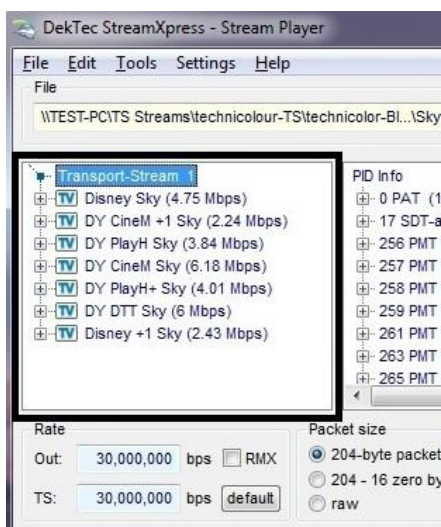
Upon opening an MPEG-2 TS StreamXpress will read the data from the opened TS file and display some valuable information for the user. There are 3 main areas of display:

- Transport Stream Info
- PID Info
- File Info

2.3.1. Transport Stream Info

The first window from the left represents the Transport Stream Info. It will display the following information if it's available in the stream:

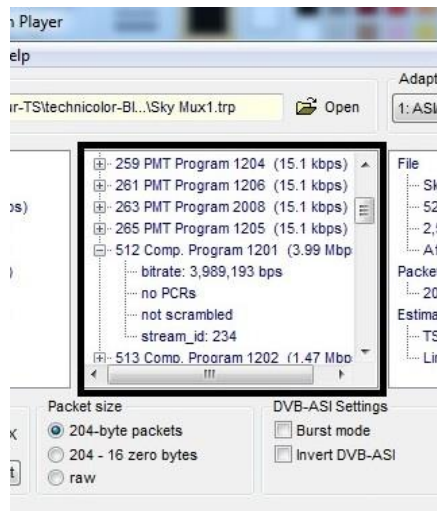
- Transport Stream ID.
- Each program detected into the stream.
- Program name and total bitrate for the program.
- Under each program: PID#, Stream_type, Stream_ID and bitrate of each component.



2.3.2. PID Info

The second window from the left represents the PID Info. It will display the following information if it's available in the stream:

- Each PID and its association with a program number.
- Bitrate of the PID.
- PCR presence.
- Whether or not the stream is scrambled.
- Stream_ID.



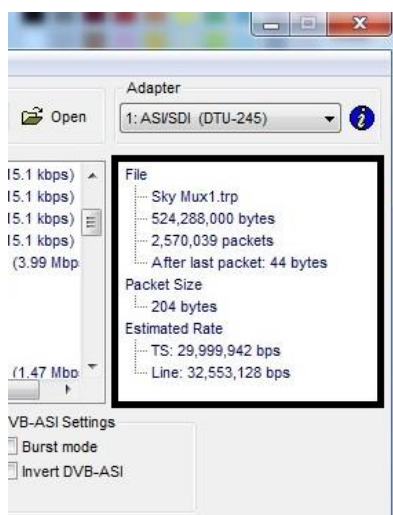
2.3.3. File Info

The third window from the left represents the File Info. It will display from the file:

- File name.
- File size in bytes.
- Number of full packets in the file.
- Packet Size.
- Estimated Rate for the TS and for the Line.
- How many bytes are trailing and not part of a full MPEG TS packet.

Notes

- The line rate includes Reed-Solomon 16 bytes extra information, if present.
- Some players can have issues with trailing bytes that are not part of any TS packet. StreamXpress will discard these trailing bytes during playback.



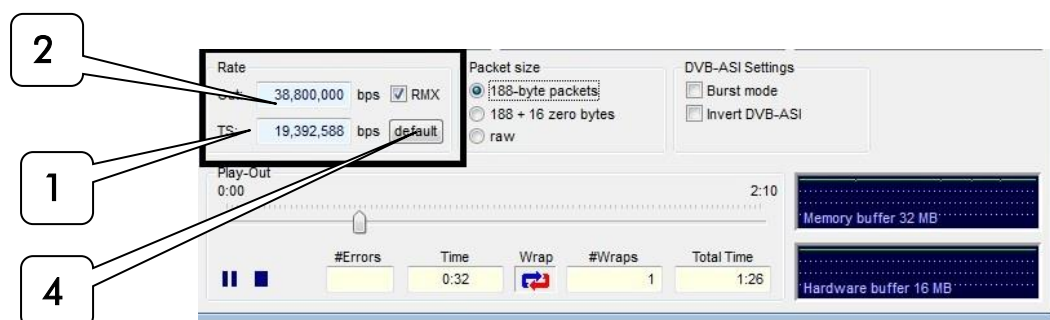
3. Playing a Transport Stream over ASI

StreamXpress supports the playout of CBR transport streams over different interfaces. One of the most common interfaces is ASI. This section describes settings specific to playing a transport stream over ASI.

3.1.1. ASI Rate Control

StreamXpress offers some powerful capabilities with regards to setting the output rate of the playback.

Variable	Type	Description	Details	Diag.
TS Rate	Display/Field	Display the TS rate of the file derived from PCR in the file	#1	1
Out Rate	Field	Allow to set the output rate for the playback	#2	2
RMX	Button	Select to remux the TS to match the output rate of the channel	#3	3
Default	Button	Use this to restore the default output rate (based on PCRs) in the TS rate window		4



#1 TS Rate:

The native TS rate is derived by reading the PCR values in the first 12MB of the file, counting the number of bytes between PCR values and correlating with the PCR values.

NOTE: If the file has bad PCR values or there are no PCRs detected, the TS rate will be wrong. The same will happen if the stream is VBR. In this case the user can type in its own value for the TS rate. If the TS rate is different than the calculated bitrate, the TS rate will turn red. If the StreamXpress plays a file at the non-native rate, it may result in bad timing of the A/V which may result in picture breaking up and pixelating.

#2 Out Rate:

The output rate will follow the native TS rate by default but represent the actual playout rate. The output rate can be set independent of the native rate. Note that without remultiplexing (RMX button) the stream won't be able to be decoded properly if played at a different rate than the native rate as the PCR values will not be correct.

#3 RMX:

StreamXpress offers the capability to remultiplex the open TS by adding in real time Null Packets (stuffing) and recalculating PCR and PTS/DTS on the fly.

This is desirable when trying to play to a modulator that requires a fixed input bitrate.

NOTE: StreamXpress can only add Null Packets and cannot play properly at a rate lower than the native rate (even if the original stream contains null packets).

NOTE: If the output rate is set lower than the native TS rate, the Out display will turn orange.

3.1.2. Packet Size

StreamXpress supports the playback of multiple TS formats. It supports 188 byte packets, 204 byte packets (188 + 16 zero bytes) and raw playback.

If the original file contains 188 byte packets, the user can choose to playout 188 byte packets (Native) or 204 byte packets (188+ 16 zero byte) or can play a file in raw format.

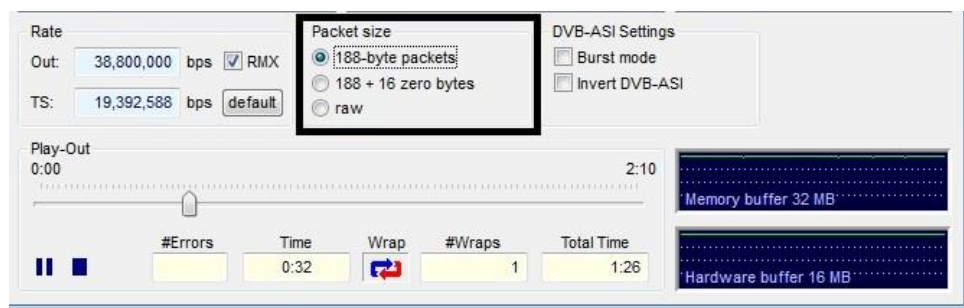
NOTE: StreamXpress cannot calculate valid Reed-Solomon bytes so therefore the 16 additional bytes will be zero bytes.

If the original file contains 204 byte packets, The user can choose to playout 204 byte packets (Native) or 188 byte packets (188- 16 zero byte) or can play a file in raw format.

NOTE: StreamXpress will play valid Reed-Solomon if present in the original file.

NOTE: The TS rate will be different than the line rate as the 16 extra bytes are not used to calculate the playout rate. The actual output rate will include the 16 Reed-Solomon bytes per packet if playing 204 bytes packets.

If the file is not formatted with either 188 or 204 byte TS packets, StreamXpress can play Raw. Raw means that StreamXpress doesn't care about packet size: anything can be transmitted. This works for ASI or SPI, but not for modulators because these devices expect a packet structure. This is the only way to playout ETI files over an ASI interface.



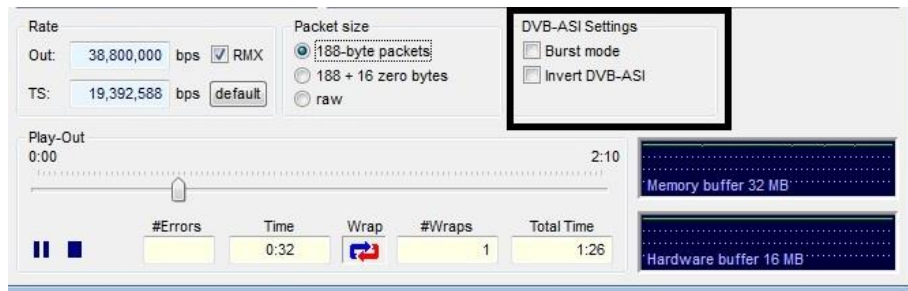
3.1.3. DVB-ASI Settings

StreamXpress with playback over ASI using byte mode meaning that each byte is spread across the 270Mbps/s ASI interface. This mode is the safest mode as it spreads the data evenly without any burst. Data bursts can create near instantaneous data rate hikes that may be difficult for ASI receiver to handle.

StreamXpress allows to playback ASI in burst mode. In this case the interface will be sending complete 188 bytes packets at a time. Click on the Burst mode tick box to select this mode.

ASI is very similar to SDI as it is a 270Mbps/s serial signal. One of the major differences between ASI and SDI is that ASI is polarized, meaning that it has to be in a certain polarization for the data to be received. Some older Distribution Amplifier (DA) will invert the polarization of the ASI data when receiving and regenerating an ASI signal, causing the receiver not to be able to handle that inverted ASI.

The StreamXpress software allows to playback inverted ASI which can be used to test a device capability to handle inverted ASI or to feed an inverting DA (Creating a proper ASI on the output side). Click on invert DVB-ASI tick box to select this mode.



4. Playing a Transport Stream over IP

StreamXpress supports playback of CBR transport streams over IP via different protocols:

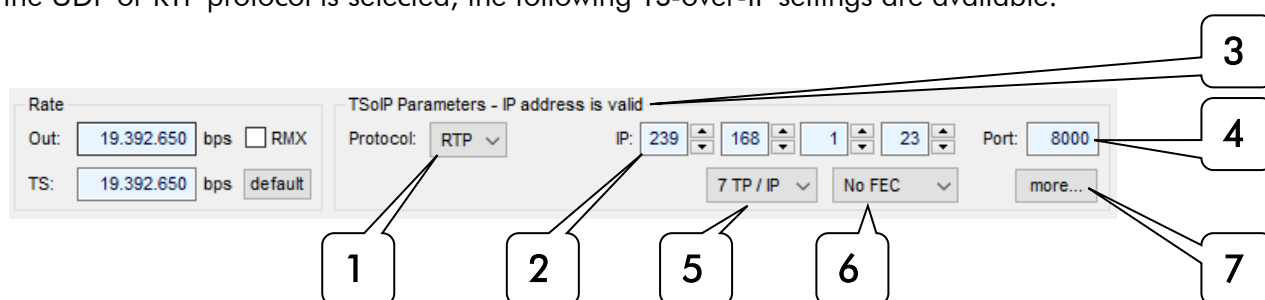
- UDP
- RTP
- SRT

Note

- If you want to play a stream over IP through a standard NIC you will need a DTC-300-NIC or DTC-300-DGL license.

4.1. UDP and RTP

When the UDP or RTP protocol is selected, the following TS-over-IP settings are available:

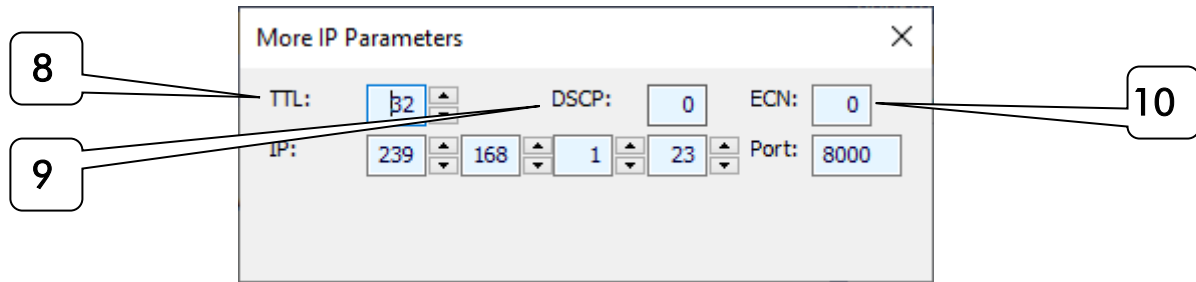


Variable	Type	Description	Details	Diag.
Protocol	Drop down	Select between UDP, RTP or SRT transmission	#1	1
IP address	Selection	Enter the destination IP address (Unicast or Multicast)	#2	2
IP address messaging	Display	Display information about the entered destination IP address	#3	3
Port number	Selection	Enter the destination Port number	#4	4
Number of TS packets per IP	Drop down	Select the number of TS packets per IP packets	#5	5
FEC	Drop down	If in RTP mode, select the type of FEC applied	#6	6
More	Button	Open the 'More IP Parameters' dialog		7

The following additional fields are available in the 'More IP Parameters' dialog:

Variable	Type	Description	Details	Diag.
TTL	Selection	Enter the Time to Live (TTL) value	#8	8
DSCP	Selection	Enter the Differentiated Services Code Point (DSCP) value	#9	9
ECN	Selection	Enter the Explicit Congestion Notification (ECN) value	#10	10

#1 Protocol:



#1 Protocol:

This field allow the selection of SRT (See next section), UDP only or UDP/RTP packet

This field allow the selection of SRT (See next section), UDP only or UDP/RTP packets. The RTP (real Time protocol) header is an extension of the UDP header and allows adjusting of the network in order to improve the quality of service delivery of media.

The RTP adds mostly 2 elements to the UDP header. A UDP packet counter and a time stamp. The StreamXpress does increase the RTP counter for every packet sent and includes a packet time stamp.

NOTE: RTP is required for the use of FEC.

#2 IP address:

This field allow setting the destination IP address of the TSolP. There are 3 types of IP address: Unicast targeting a single device on a network, Multicast targeting multiple devices on the network and Broadcast targeting all devices on the network.

NOTE: If a network is not multicast aware, all multicast streams will be handled like broadcast.

NOTE: DekTec devices only support IPv4 addressing at this time.

Unicast address range is from 0.0.0.0 to 223.255.255.255, but not all of the addresses are unicast (See broadcast address).

Multicast address range is from 224.0.0.0 to 239.255.255.255

Address range 240.0.0.0 to 255.255.254 are reserved and should not be used (However, they can be used by StreamXpress).

Broadcast address depends on the subnet and is typically the last address in a subnet. 255.255.255.255 is also a local broadcast address.

#3 IP address messaging:

This field display the status of the IP address entered. In order to playout the stream, the IP address entered needs to be valid.

The following displays are possible:

-Address is valid (Display of the address will be blue). Streaming is possible

-Validation IP address (Display of the address will be yellow). The StreamXpress is requesting the switch to verify if the unicast IP address is found in the network. Streaming during that time is not possible.

-IP address not found (Display of the address will be orange). The StreamXpress indicates that the switch responded that the destination IP address is not on the network. Streaming is not possible.

-Link is down (Display of the address will be red). The StreamXpress indicates that the Ethernet link is down. Streaming is not possible.

#4 Port :

This field allow the selection of the destination UDP port number. The UDP port number range from 0 to 65535. Note most of the common used ports are below 1000 (Like FTP-Port 21 or HTTP-Port 80). It is advised to use port greater than 1000 to avoid potential confusion with other applications.

NOTE: Knowing the port number is required for the receiving end of the unicast or multicast.

#5 Number of TS packets per IP :

This field allow the selection of the number of TS packets per Ethernet packets (1 to 7). The standard size of an Ethernet packet is 1500 bytes. With the Ethernet, IP, UDP and RTP header, there is 1446 Bytes available for data. As each TS packet is 188bytes, the maximum number of TS packets that an Ethernet frame can carry at once is 7x188 packets. Less packets can be encapsulated into an Ethernet packet (1 to 7) but 7 is the most common and efficient way of encapsulating MPEG-2 TS.

#6 FEC :

If the Ethernet link is lossy, it may be useful to use FEC in order to improve the quality of the delivery by adding redundant information to the main TSolP streaming.

The FEC scheme for DVB-IP is defined in SMPTE 2022. FEC works by sending extra packets of information along with the original payload. The FEC packets can be used at the receive end to recreate data packets that have been lost during transport. The amount of data that can be recovered is directly related to the amount of FEC data sent. There are 2 dimensions for the SMPTE2022: Row and Columns.

The Column FEC stream is sent with the same destination IP address but the port is incremented by 2 from the main TSolP port.

The Row FEC stream is sent with the same destination IP address but the port is incremented by 4 from the main TSolP port.

Depending on the combination of Rows and Columns, more or less lost IP packets can be recovered.

D represents the number of Row and L the number of Columns.

#8 TTL:

This field allows setting the TTL (Time to Live value) in the Ethernet header.

TTL is an 8-bit field. The maximum TTL value is 255. The time-to-live value can be thought of as an upper bound on the time that an IP datagram can exist in an Internet system. The TTL field is set by the sender of the datagram, and reduced by every router on the route to its destination. If the TTL field reaches zero before the datagram arrives at its destination, then the datagram is discarded. The purpose of the TTL field is to avoid a situation in which an undeliverable datagram keeps

circulating on an Internet system. In theory, under IPv4, time to live is measured in seconds, although every host that passes the datagram must reduce the TTL by at least one unit. In practice, the TTL field is reduced by one on every hop.

#9 DSCP:

Differentiated services code point. The possible values are:

0 = Standard	32 = Interactive
8 = Low-priority data	40 = Signaling
16 = Management	48 = Network control
24 = Video	

#10 ECN:

Explicit congestion notification. The possible values are:

0 = Non ECN capable	2 = ECN capable (0)
1 = ECN capable (1)	3 = Congestion encountered

4.2. SRT

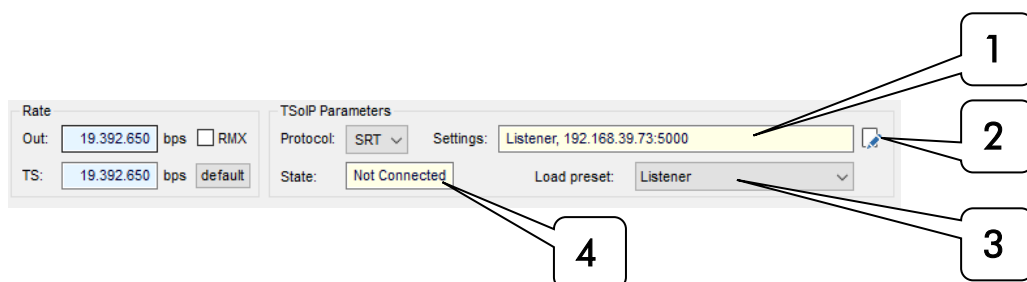
StreamXpress supports stream playback via the [Secure Reliable Protocol](#) (SRT).

StreamXpress enables users to setup SRT connections, debug the connection process, and play streams. SRT ([Secure Reliable Protocol](#)) is an open-source video transport protocol that is designed to provide reliable transmission over unpredictable networks. It supports packet re-transmission while maintaining low latency. Encryption and forward error correction are supported as well.

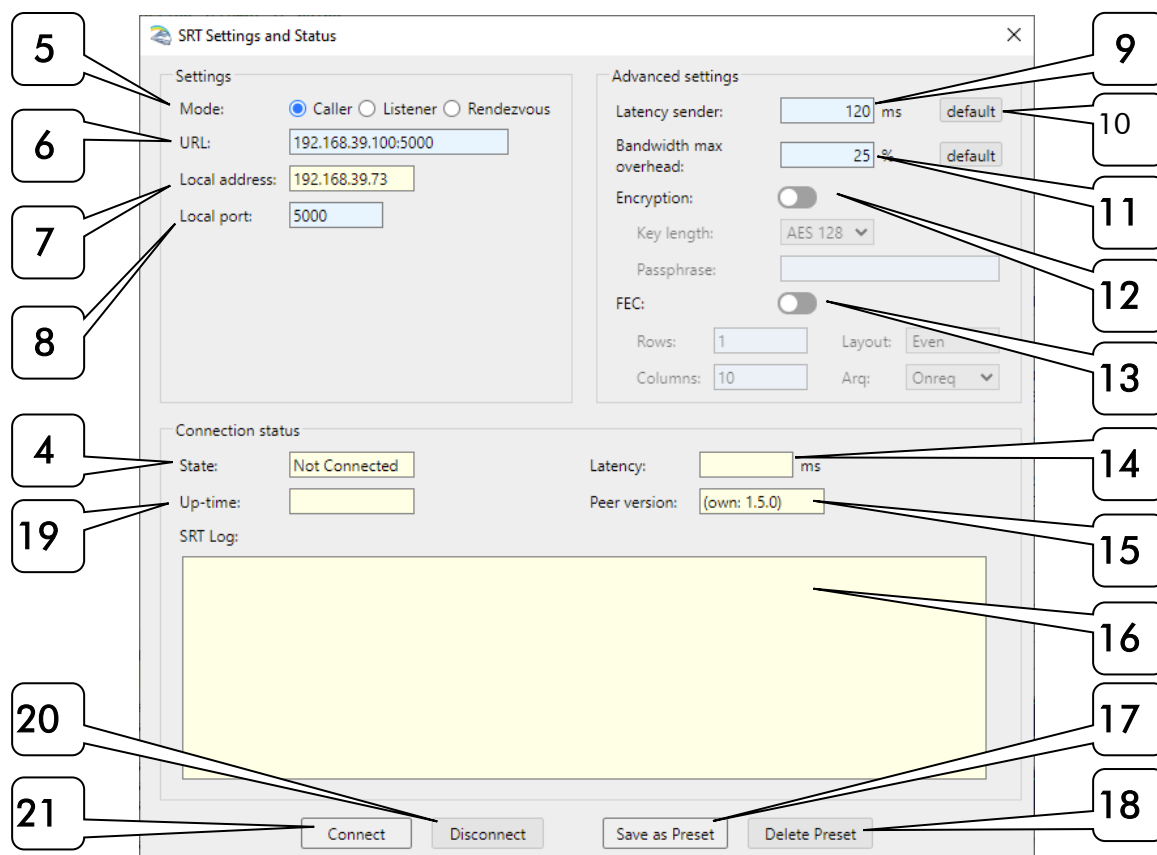
Note

- For more information and guidelines on how to set-up an SRT connection it is advised to refer to additional resources, such as the SRT Deployment Guide that is available through <https://www.srtalliance.org>.

For playing streams with the SRT protocol the following controls are available on the main screen:



Additionally, the SRT Settings and Status window provides the following controls for setting-up and monitoring SRT connections:



4.2.1. SRT Controls – Summary Description

#	Name	Description
1	Settings	Shows a summary of the main SRT settings.
2	Edit	Opens the <i>SRT Settings and Status</i> dialog.
3	Load Preset	Loads settings that were previously saved in a so-called <i>Preset</i> .
4	State	Shows the state of the SRT connection.
5	Mode	Sets the SRT mode to Caller , Listener or Rendezvous .
6	URL	Sets the destination IP and port.
7	Local address	Shows the local ethernet adapter used by SRT.
8	Local port	Specifies the local port used by SRT.
9	Latency sender	Specifies the SRT latency configured by StreamXpress.
10	Default (2x)	Sets <i>Latency sender</i> resp. <i>Bandwidth max overhead</i> to their default value.
11	Bandwidth max overhead	Specifies the recovery bandwidth overhead.
12	Encryption	Allows to setup the Encryption settings.

13	FEC	Allows to setup the FEC settings.
14	Latency	Shows the negotiated SRT latency.
15	Peer version	Shows the SRT version of the peer.
16	Log	Shows the SRT log messages and errors.
17	Save as Preset	Opens the <i>Save Preset</i> dialog.
18	Delete Preset	Opens the <i>Delete Preset</i> dialog.
19	Uptime	Shows the time since the last successful connection.
20	Connect	Starts the SRT connection process.
21	Disconnect	Terminates the SRT connection or cancels the pending connection attempt.

4.2.2. SRT Controls – Extended Description

#	Name	Description
1	Settings	This field shows a summary of the current SRT settings.
2	Edit	Press this button to open the <i>SRT Settings and Status</i> dialog and edit the SRT settings and view information on the connection status.
3	Load Preset	A set of SRT settings can be quickly loaded from the main window of StreamXpress by selecting a so-called <i>Preset</i> . Saving or deleting a Preset is possible through the <i>SRT Settings and Status</i> window. Presets are saved in an XML file. This file can also be edited manually, see C:\UserName\AppData\Roaming\DekTec\StreamXpress\SrtPresets.xml .
4	State	This field shows the SRT connection status in the main window of StreamXpress. Possible states are Not Connected , Connecting , Connected and Disconnecting .
5	Mode	Sets the connection mode used by SRT to perform the handshake procedure with the peer. The possible modes are: Caller Sets StreamXpress as the initiator of an SRT streaming session. To establish a connection, the peer must be using Listener mode. The caller must know the listener's public IP address and port number and supply this information through the URL field. Listener Sets StreamXpress to wait for a request to start an SRT streaming session. The listener device only needs to know to listen for an SRT stream on a certain port. Rendezvous Allows two devices to negotiate an SRT session over a mutually agreed upon port number. Both source and destination must be in Rendezvous mode.
6	URL	Sets the IP address and port number of the peer in Listener or Rendezvous mode, for example: <i>127.0.0.1:5000</i> .
7	Local address	Shows the local ethernet adapter used by SRT.
8	Local port	Specifies the local port used in case of Listener or Caller mode. In Rendezvous mode, the local port will be equal to the port number of the peer that is entered in the URL field.
9	Latency sender	Specifies the latency proposed by StreamXpress in the SRT connection

		negotiations. This is not necessarily equal to the final negotiated latency that will be visible in the <i>Latency</i> field after a successful connection attempt.
10	Default (2x)	Sets <i>Latency sender resp. Bandwidth max overhead</i> to their defaults.
11	Bandwidth max overhead	Specifies the recovery bandwidth overhead, this is the additional bandwidth available for retransmission as percentage of the input rate.
12	Encryption	<p>The encryption settings consist of the following fields:</p> <p>Encryption On/Off – Determines whether encryption is used and enforced, meaning that both StreamXpress and the receiver must use the same password and key length if encryption is enabled.</p> <p>Key Length Encryption key length. Possible values are Default, AES-128, AES-192 and AES-256. Value Default means that the "effective value" for the key length is AES-128, but this applies only when neither party has set the value explicitly.</p> <p>Passphrase The passphrase for encryption. The password must be minimum 10 and maximum 79 characters long.</p>
13	FEC	<p>Specifies the settings for forward error correction (FEC). StreamXpress currently only supports the full FEC configuration, consisting of the following fields: Rows, Columns, Layout and Arq.</p> <p>For more information on how to configure the FEC filter, please refer to the SRT Packet Filtering & FEC section in the Haivision manual.</p>
14	Latency	Shows the negotiated SRT latency.
15	Peer version	Shows the SRT version of the peer.
16	Log	Shows the SRT log messages and errors.
17	Save as Preset	Opens the <i>Save Preset</i> dialog.
18	Delete Preset	Opens the <i>Delete Preset</i> dialog.
19	Uptime	Shows the time since the last successful connection.
20	Connect	Starts the SRT connection process.
21	Disconnect	Terminates the SRT connection or cancels the pending connection attempt.

5. Using StreamXpress as an RF Modulator

5.1. DekTec Modulators

DekTec offers a complete line of PCIe and USB modulators that cover virtually all digital TV modulation standards used around the world. For an overview of DekTec modulators and the modulation standards they support, refer to the [DekTec Modulators](#) section on the DekTec website.

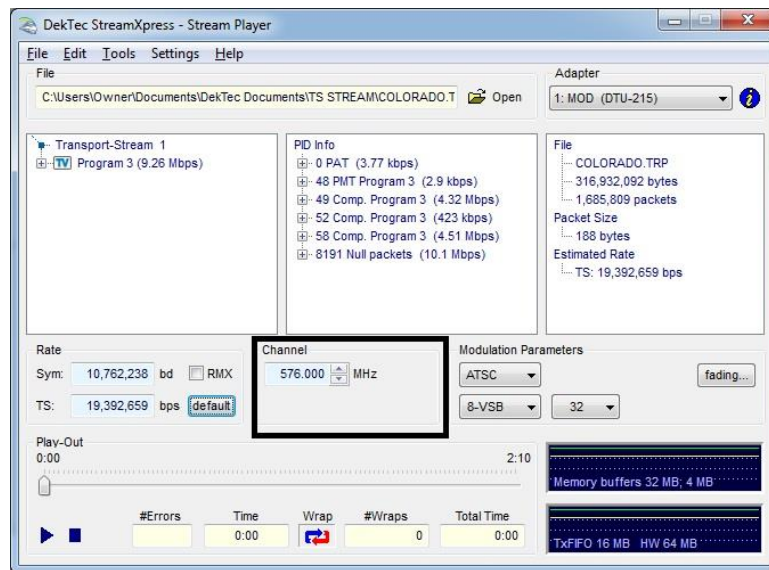
StreamXpress can play streams on any DekTec modulator. Settings specific to the selected modulation standard can be specified via the StreamXpress user interface. Each modulation type offers different settings that will be discussed by modulation type in the sections below.

Note

- Please verify that your DekTec hardware device is [capable](#) and licensed for the modulation standard you want to use. If your DekTec device does not support a standard, or is not licensed for a standard, the option will not show up in the list of modulation standards.

5.2. General RF Settings

The user can select in which part of the RF spectrum to send the modulated signal. Enter the **center** frequency of the modulated signal.



For example, if the modulated signal is 6 MHz wide and the selected RF channel frequency is 576MHz, the RF signal will span from 573MHz to 579MHz.

Note

- The StreamXpress can play at any channel frequency but depending on the modulation standard and the world region, a fixed grid of channel frequencies may be in use. Commercial receivers may only be able to tune to frequencies that are on-grid.
For example, in the US, terrestrial channel 7 is allocated from 174MHz to 180MHz. To feed channel 7 to a TV, set the channel frequency to 177MHz.

5.3. Symbol Rate Settings

In a digitally modulated signal, [symbol rate](#) is an important concept. It indicates the number of symbols generated per second. Each symbol encodes a certain number of bits.

The symbol rate is dictated by the modulation type and settings such as bandwidth, constellation etc. The data rate actually used to play the stream must be very close to the theoretical data rate to function properly.

When setting the modulation parameters, the StreamXpress will calculate and display the required output bit rate ("Out") or symbol rate ("Sym").

The image displays two screenshots of the StreamXpress modulation settings interface. The top screenshot shows the DVB-T2 configuration. Under the 'Rate' section, 'Out' is set to 35,782,930 bps with the 'RMX' checkbox checked, and 'TS' is set to 19,392,588 bps with the 'default' button. The 'Channel' is set to 474.000 MHz. The 'Modulation Parameters' section shows 'DVB-T2' selected, with 'fading...' and 'params...' buttons. The bottom screenshot shows the ATSC configuration. Under the 'Rate' section, 'Sym' is set to 10,762,238 bd with the 'RMX' checkbox checked, and 'TS' is set to 10,000,000 bps with the 'default' button. The 'Channel' is set to 577.500 MHz. The 'Modulation Parameters' section shows 'ATSC' selected, with '8-VSB' and '32' also selected, and a 'fading...' button.

- If the file rate ("TS" for transport stream files) is **equal** to the required output / symbol rate, all is well. The RMX box needs not be ticked.
- If the file rate is **lower** than the required output / symbol rate, the user can tick the RMX box to let StreamXpress remultiplex the file in real-time to adapt to the required output rate.
Note: If the RMX box is not ticked, the file may not play properly.
- If the file rate is **higher** than the required output / symbol rate, the modulation capacity is insufficient and the file cannot be played out properly: the TS rate display will turn red, or the Out rate will turn orange if the RMX box is ticked.

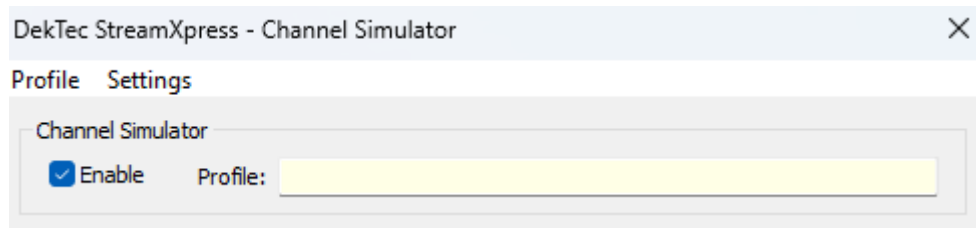
5.3.1. Channel Simulation (Fading)

StreamXpress incorporates the XpressSim channel simulation software as part of its GUI. If the XpressSim software is licensed on the DekTec device, the *fading* button will be enabled.

XpressSim allows insertion of white noise and addition of multi-path fading echoes.

5.3.1.1 Channel Simulator Enable

The Channel-Simulator group contains the overall enable box.

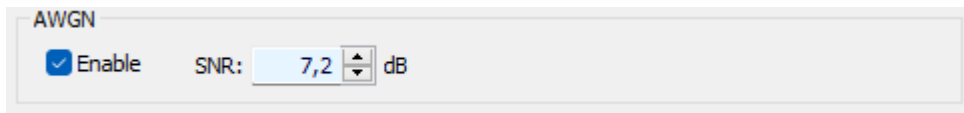


If checked, channel simulation is enabled, and noise and fading-path parameters can be specified. If unchecked, no channel simulation is applied.

In the Profile menu, the Open File... button enables you to load a previously saved set of channel-simulation settings. The Save... button allows you to save the current settings.

5.3.1.2 AWGN

The AWGN group enables you to specify parameters for the addition of Gaussian-distributed noise to the RF-signal. If the Enable box is checked, the Signal-To-Noise ratio relative to the original signal can be specified.



5.3.1.3 Multiple Transmission Paths Simulation

This group allows you to specify up to 32 transmission paths.

Multiple Transmission Paths Simulation

☒ Enable #Paths: Total path power: dB

#	Type	Atten (dB)	Delay (us)	Phase (deg)	Speed (km/h)	Doppler (Hz)
1	CONSTANT_DELAY	0,05	0,00	0		
2	CONSTANT_DELAY	20,0	10,0	0		
3	CONSTANT_DELAY	30,0	20,0	0		

The following parameters can be specified per fading path:

Fading parameter	Description
Type	Echo Type: Constant Delay, Constant Doppler, Rayleigh fading with Gaussian spectrum or Rayleigh fading with Jakes spectrum
Atten (dB)	Attenuation of the path in dB
Delay (us)	Delay of the path in microseconds
Phase (deg)	Phase shift of the path in degrees. Only for Constant Delay and Constant Doppler path types
Speed (km/h) Doppler(Hz)	Speed of the simulated moving receiver in km per hour. The resulting Doppler frequency in Hz is displayed. Only for Constant Doppler, Rayleigh Jakes and Rayleigh Gaussian path types.

If the Multiple Transmission Paths Simulation is disabled, it acts as a single path without attenuation and without delay. If the Multiple Transmission Paths Simulation is enabled and no paths are defined, it acts as a pure noise generator.

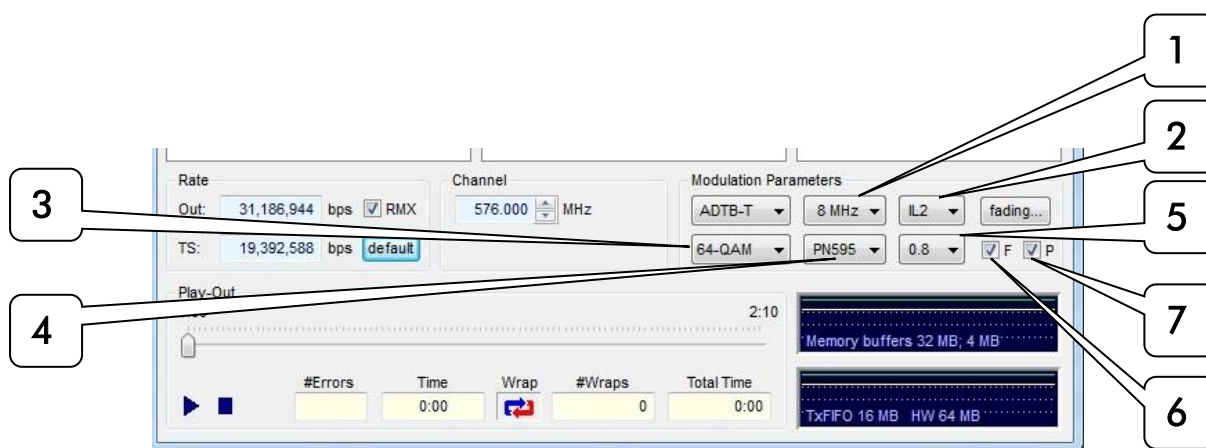
The sum of path power is displayed. The normalize button allows you to normalize the attenuation of the paths such that the total power is 0dB again.

5.4. Settings per Modulation Type

5.4.1. ADTB-T

This section shows how to specify the modulation parameters for ADTB-T in StreamXpress.

ADTB-T modulation can be configured in the *parameters* part of the main StreamXpress window.



#	Name	Description
1	Bandwidth	Selects the bandwidth of the modulated signal: 5, 6, 7 or 8 MHz.
2	Interleaver mode	Selects the time interleaver mode: IL1=short 240 symbols; IL2=long 720 symbols.
3	Constellation	Selects the constellation type: 4NR-QAM, 4-QAM, 16-QAM, 32-QAM or 64-QAM.
4	Guard interval	Selects the guard interval noise code: PN420, PN595 and PN945. ADTB-T modulation uses a pseudo-random noise code in the guard interval to allow for faster synchronization and more accurate channel estimation.
5	Code rate	Selects the code rate used for error correction: 0.4, 0.6 and 0.8.
6	Frame numbering	When selected, each ADTB-T RF frame is sequentially numbered for missing frame and reordering tracking.
7	Pilots	When selected, inserts a pilot. Inserting a pilot is optional and allows faster locking of the receiver to the ADTB-T signal.

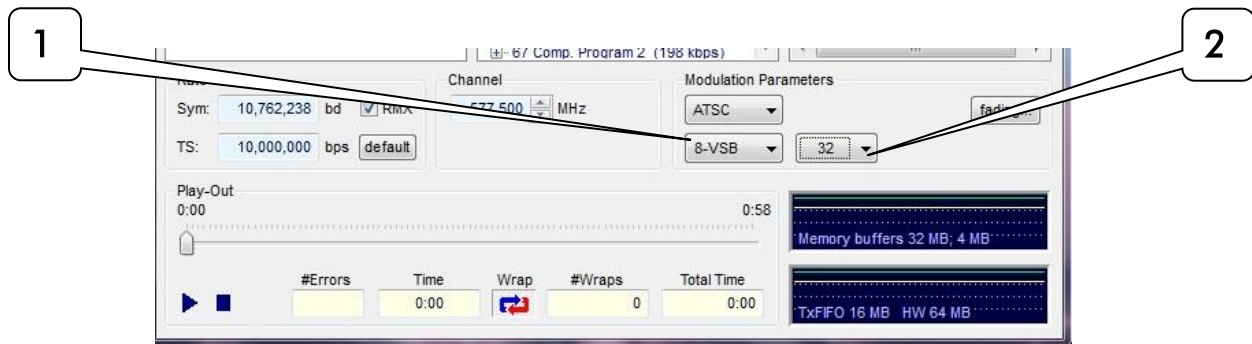
5.4.2. ATSC 1.0

This section shows how to specify the modulation parameters for ATSC 1.0 in StreamXpress.

Note

- “ATSC” refers to the old single-carrier ATSC 1.0 standard.
- ATSC 3.0 streams can be played via the STLTP format.

ATSC 1.0 modulation can be configured in the *parameters* part of the main StreamXpress window.



#	Name	Description
1	Modulation	Selects the modulation mode: 8-VSB or 16-VSB. 8-VSB should normally be used. 16-VSB was intended for ATSC digital cable, but instead, QAM has been chosen as the standard for the cable industry.
2	Sideband filter	Selects the number of taps used for implementing the sideband filter. The default value is 32 taps. Changing the sideband filters changes the shape of the RF envelope. Note that settings above 32 should be avoided as it will cost an excessive amount of CPU cycles to the PC with no real gain in the modulation quality.

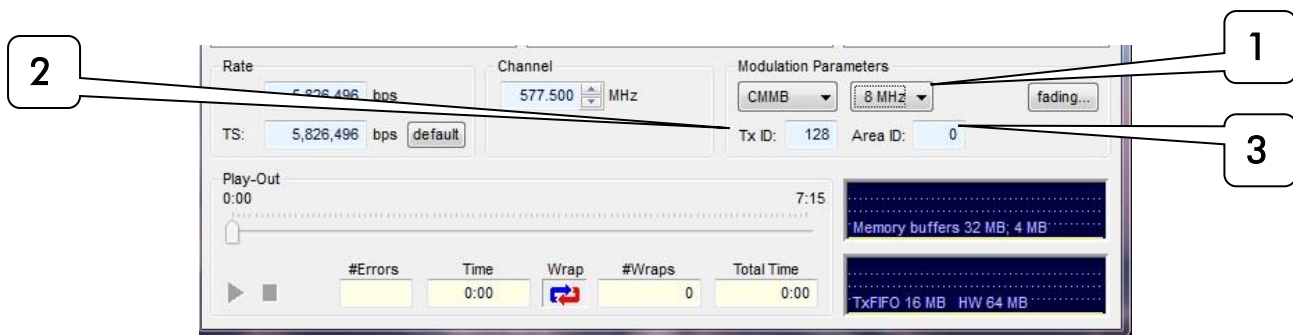
5.4.3. CMMB

This section shows how to specify the modulation parameters for CMMB in StreamXpress.

Notes

- CMMB modulation does not use transport streams. It requires files multiplexed in a special CMMB format.
- CMMB modulation is used both in the satellite- and the VHF/UHF band. StreamXpress only supports CMMB in the VHF/UHF band.

ATSC 1.0 modulation can be configured in the *parameters* part of the main StreamXpress window.



#	Name	Description
1	Bandwidth	Selects the modulation bandwidth: 2MHz or 8MHz. CMMB uses 4K OFDM for 8 MHz channels and 1K for 2 MHz channels.
2	Tx ID	Selects the Transmitter Identity: 128 .. 256. Represents the transmitter identity in a Single Frequency Network.
3	Area ID	Selects the Area Identity: 0 .. 127. Used to identify an application or region.

5.4.4. DAB(+)

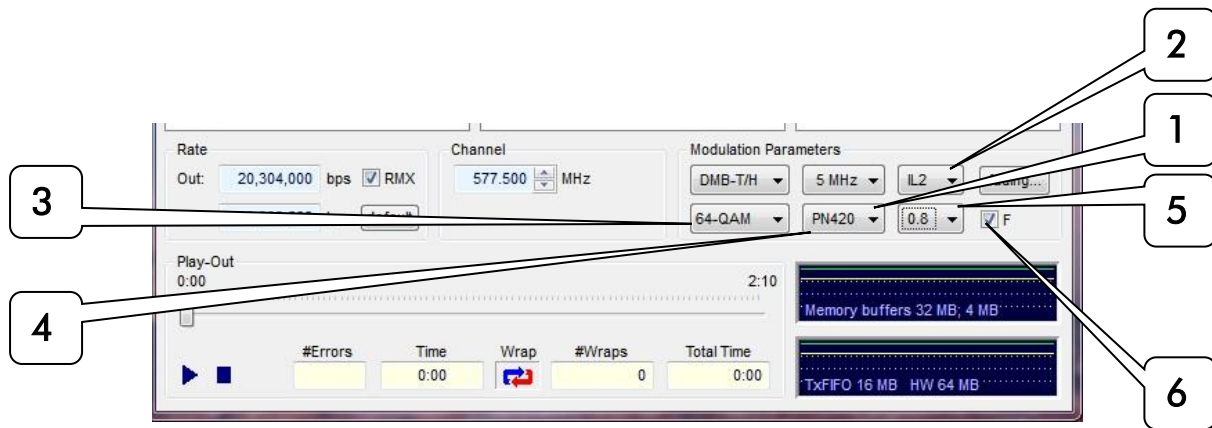
DAB does not use standard transport streams but uses ETI files. An ETI files can contain multiple audio streams. StreamXpress can playout ETI files.

DekTec offers a command line utility to create an ETI file: **DabMux.exe**. This utility can be found in the same directory where StreamXpress is installed. Documentation is included in this same directory, in **DabMux.pdf**.

5.4.5. DMB-T/H

This section shows how to specify the modulation parameters for DMB-T/H in StreamXpress.

DMB-T/H modulation can be configured in the *parameters* part of the main StreamXpress window.



#	Name	Description
1	Bandwidth	Selects the bandwidth of the modulated signal: 5, 6, 7 or 8 MHz.
2	Interleaver mode	Selects the time interleaver mode: IL1=short 240 symbols; IL2=long 720 symbols.
3	Constellation	Selects the constellation type: 4NR-QAM, 4-QAM, 16-QAM, 32-QAM or 64-QAM.
4	Guard interval	Selects the guard interval noise code: PN420, PN595 and PN945. DMB-T/H modulation uses a pseudo-random noise code in the guard interval to allow for faster synchronization and more accurate channel estimation.
5	Code rate	Selects the code rate used for error correction: 0.4, 0.6 and 0.8.
6	Frame numbering	When selected, each DMB-T/H RF frame is sequentially numbered for missing frame and reordering tracking.

5.4.6. DVB-C

This section shows how to specify the modulation parameters for DVB-C in StreamXpress.

Note

- DVB-C is also known as J.83 Annex A.

DVB-C modulation can be configured in the *parameters* part of the main StreamXpress window.



#	Name	Description
1	Constellation	Selects the QAM constellation to be used: 16-QAM, 32-QAM, 64-QAM, 128-QAM or 256-QAM. Note: 64-QAM and 256-QAM are the most popular modes.

5.4.7. DVB-S

This section shows how to specify the modulation parameters for DVB-S in StreamXpress.

DVB-S modulation can be configured in the *parameters* part of the main StreamXpress window.



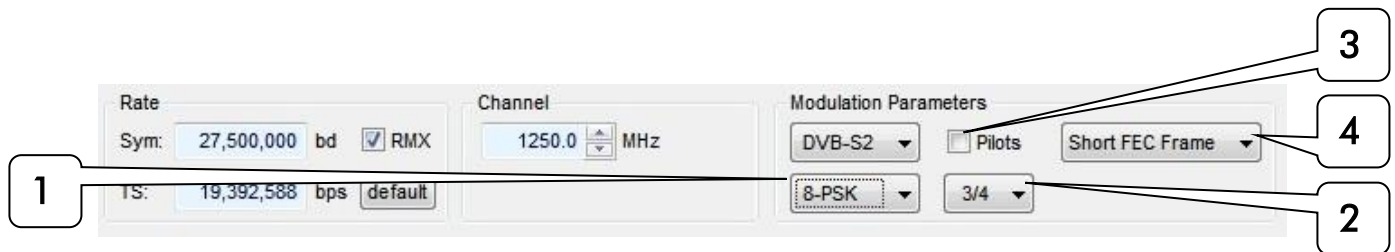
#	Name	Description
1	Constellation	Selects the constellation mode to be used: Only QPSK6 is available.
2	FEC code rate	Selects the FEC code rate: 1/2, 2/3, 3/4, 5/6 or 7/8.

The output frequency range is the L band: 950-2150MHz.

5.4.8. DVB-S2

This section shows how to specify the modulation parameters for DVB-S2 in StreamXpress.

DVB-S2 modulation can be configured in the *parameters* part of the main StreamXpress window.



#	Name	Description
1	Constellation	Selects the constellation mode: QPSK, 8-PSK, 16-APSK, 32-APSK
2	FEC code rate	Selects the FEC code rate. For QPSK: 1/4, 1/3, 2/5, 1/2, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9, 9/10 For 8-PSK: 3/5, 2/3, 3/4, 4/5, 5/6, 8/9, 9/10
3	Pilots	When selected, inserts pilot signals. Pilots are symbols that are inserted at regular intervals to aid in carrier synchronization. They are especially useful at lower FEC code rates to maintain synchronization.
4	FEC frame length	Selects short (16,200 bits) or long (64,800) FEC frames.

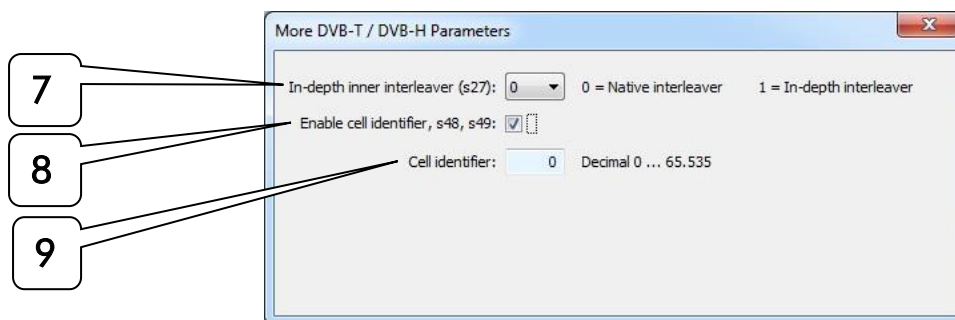
5.4.9. DVB-T

This section shows the modulation parameters that can be set in the main StreamXpress window when the DVB-T modulation standard is selected.

DVB-T modulation can be configured in the *parameters* part of the main StreamXpress window.



#	Name	Description
1	Bandwidth	Selects the bandwidth of the modulated signal: 5, 6, 7 or 8 MHz.
2	FFT mode	Selects the approximate number of OFDM carriers: 2K, 4K or 8K. Exact number of carriers: 1705 (2K), 3409 (4K), 6817 (8K).
3	Constellation	Selects the constellation used per carrier: QPSK, 16-QAM, 64-QAM.
4	Guard interval	Selects the guard interval: 1/32, 1/16, 1/8 or 1/4. DVB-T uses a guard interval to avoid that echoes interfere with the next OFDM symbol. The guard fraction represents the ratio between the number of empty symbols and symbols in use.
5	FEC code rate	Selects the FEC code rate: 1/2, 2/3, 3/4, 5/6 or 7/8.
6	More	Opens a second window with more DVB-T settings.



#	Name	Description
7	Inner interleaver	Should be set to 0 for DVB-T.
8	Enable cell identifier	When checked, enables TPS bits s40 .. s47 as cell identifier.
9	Cell identifier	Selects the value of the cell identifier: 0 .. 65535. Identifies the transmitter cell from which a signal is transmitted.

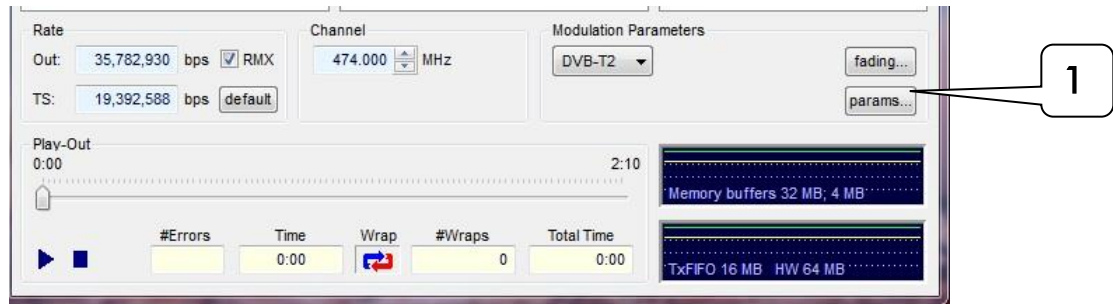
5.4.10. DVB-T2 – Single PLP

StreamXpress provides single-PLP DVB-T2 modulation.

Note

- To generate multi-PLP DVB-T2, use the [T2Xpress](#) application, which is enabled on modulators with the DTC-378-T2 or GOLD option.

DVB-T2 modulation can be configured in the *parameters* part of the main StreamXpress window.



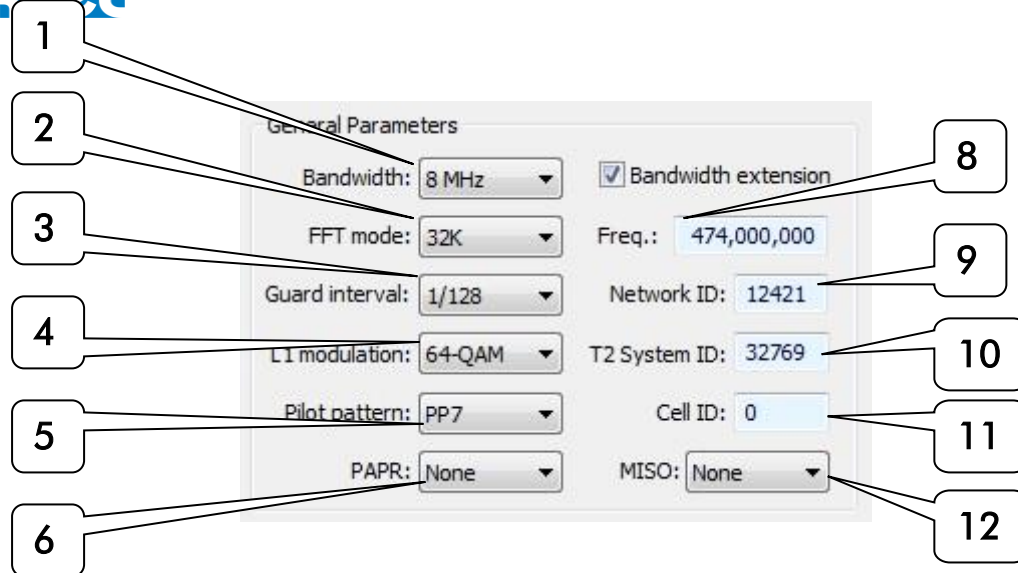
#	Name	Description
1	Params	Opens a second window with the DVB-T2 modulation settings.

#	Name	Description
1	General parameters	General DVB-T2 parameters independent of the PLP.
2	PLP #0 parameters	PLP-specific modulation parameters for the first (and only) PLP.
3	Frame structure	Provides details about the structure of a DVB-T2 frame.
4	FEF	Controls the Future Extension Frame.
5	Messages and presets	Message center and preset configurations.

5.4.10.1 DVB-T2 – General Parameters

This part of the DVB-T2 parameters dialog shows the general DVB-T2 modulation parameters. These parameters are highly technical in nature. Please refer to the DVB-T2 specification (ETSI EN 302 755) for more information on these parameters.

7

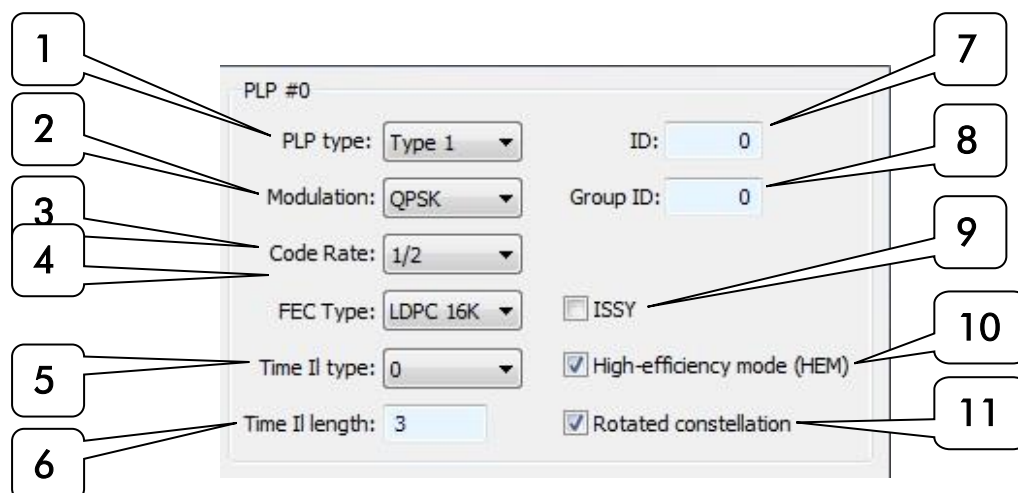


#	Name	Description
1	Bandwidth	Selects the bandwidth of the modulated signal: 1.7, 5, 6, 7, 8, 10MHz. Note: 1.7MHz is typically used for radio transmission via DAB.
2	FFT mode	Selects the FFT mode: 1K, 2K, 4K, 8K, 16K , 32K. These modes represent the approximate number of active OFDM carriers. Note that DVB-T only offers 2K, 4K and 8K. Exact number of carriers: 853 (1K), 1705 (2K), 3409 (4K), 6817 (8K), 6913 (8K extended), 13633 (16K), 13921 (16K extended), 27265 (32K), 27841 (32K extended).
3	Guard interval	Selects the guard interval: 1/128, 1/32, 1/16, 1/8, 1/4, 19/128, 19/256. DVB-T2 uses a guard interval to avoid that echoes interfere with the next OFDM symbol. The guard fraction represents the ratio between the number of empty symbols and the number of symbols in use.
4	L1 modulation	Selects the constellation used for modulating the L1-post signaling data. Options are BPSK, QPSK, 16-QAM, 64-QAM. The L1 data indicates which auxiliary stream is used as transmitter signature as well as the exact location of the stream; it also carries the transmitter-signature related information. Note: the main modulation mode is set in the PLP area.
5	Pilot pattern	Selects the pilot pattern: PP1, PP2, PP3, PP4, PP5, PP6, PP7 or PP8. The scattered pilot patterns are used by receivers to compensate for changes in channels in the time and frequency domain.
6	PAPR	Selects whether Peak to Average Power Ratio (PAPR) reduction is used. This is intended to increase the efficiency of the RF power amplifier. DVB-T2 offers two techniques for PAPR reduction PAPR: Active Constellation Extension (ACE), Tone Reservation (TR) or both (ACE+TR).
7	Bandwidth extension	Selects whether Extended Carrier Mode must be used, in which mode the number of used carriers is extended while at the same time keeping the bandwidth limits of the RF channel. This mode is only available for FFT modes 8K, 16K and 32K. If it is setup when the FFT mode is different than the available modes, the frame structure will be disabled and the TS rate will show -1 for error.
8	Frequency	Sets the center frequency of the modulated RF signal in Hz.
9	Network ID	Sets the <i>Network ID</i> : 0 .. 65535 The Network ID uniquely identifies a DVB-T2 network.

10	T2 system ID	Sets the <i>T2 system ID</i> : 0 .. 65535 The T2 system ID uniquely identifies a DVB-T2 channel (= "T2 system" in DVB-T2 speak) within a DVB-T2 network.
11	Cell ID	Sets the <i>Cell ID</i> : 0 .. 65536 The Cell ID uniquely identifies a geographic cell in a DVB-T2 network. If cell IDs are not used, this field shall be set to '0'.
12	MISO	Sets the Multiple Input Single Output (MISO) mode, None if not used. In MISO mode, multiple transmitting antennas are used, but only one receiving antenna. MISO processing consists of taking the input data cells and producing two similar sets of data cells at the output, each of which will be directed to a separate group of transmitters. StreamXpress can output the first group of cells (Tx1), the second group of cells (Tx2) or can output the sum of both Tx1 and Tx2 .

5.4.10.2 DVB-T2 – PLP #0 Parameters

This part of the DVB-T2 parameters dialog shows modulation parameters specific to PLP #0 (the only PLP as StreamXpress only supports single-PLP modulation). These parameters are highly technical in nature. Please refer to the DVB-T2 specification (ETSI EN 302 755) for more information on these parameters.



#	Name	Description
1	PLP type	Selects the type of PLP: Type 1 , Type 2 , Common . Type 1 : One slice per T2 frame, transmitted before any Type 2 PLPs. Type 2 : Two or more sub-slices per T2 frame, transmitted after Type 1 PLPs. Common : One slice per T2 frame, transmitted just after L1 signaling. The L1 field may contain data shared by multiple PLPs.
2	Modulation	Selects the constellation used for modulating the PLP data: QPSK , 16-QAM , 64-QAM , 256-QAM .
3	Code rate	Selects the FEC code rate: 1/2 , 2/3 , 3/4 , 4/5 , 5/6 , 7/8 .
4	FEC type	Selects the type of FEC: LDPC 16K , LDPC 64K . LDPC stands for Low Density Parity Check.
5	Time interleaving type	Selects the type of time interleaving. A value of '0' indicates that one interleaving frame corresponds to one T2 frame and contains one or more TI blocks. A value of '1' indicates that one interleaving frame is carried in more than one T2-frame and contains only one TI block.
6	Time interleaving length	If the type of time-interleaving is '1', this field sets the number of T2 frames to which each interleaving frame is mapped. If the type of time-interleaving is '0', this field sets the number of time-interleaver blocks per interleaving frame.
7	ID	Sets the <i>PLP ID</i> : 0 .. 255 The PLP ID uniquely identifies a PLP within a DVB-T2 channel.
8	Group ID	Sets the PLP's <i>Group ID</i> : 0 .. 255. A DVB-T2 channel can contain multiple PLP groups, each identified by a unique Group ID. This can be used by a receiver to link the data PLP to its associated common PLP, which will have the same PLP Group ID.

9	ISSY	Selects whether <i>ISSY</i> is being used. ISSY (Input Stream Synchronizer) ensures Constant-Bit-Rate (CBR) and constant end-to-end transmission delay for any input data format.
10	HEM mode	Selects whether <i>High-Efficiency Mode</i> is used.
11	Rotated constellation	Selects whether a rotated constellation is used. The use of constellation rotation allows for improvements in power transmission requirements, achieving the required BER at a lower SNR.

5.4.10.3 DVB-T2 – Frame Structure

This part of the DVB-T2 parameters dialog is mainly informative in nature. It shows, given the specified general and PLP#0 specific parameters, the exact format of the modulated T2 frame. The fields shown in this dialog section are highly technical in nature. Please refer to the DVB-T2 specification (ETSI EN 302 755) for more explanation.

The screenshot shows the 'Frame Structure' dialog box. The fields are as follows:

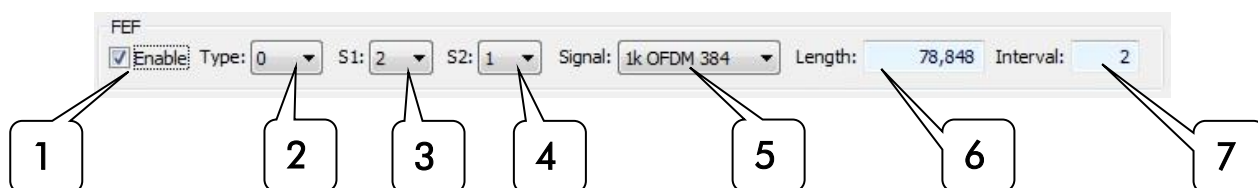
- 1**: #Frames per superframe: 2
- 2**: Frame size: 1,282,017 cells
- 3**: #L1-pre/post: 1840 + 250 = 2090 cells
- 4**: Data cells: 1,279,800 cells
- 5**: NUM_DATA_SYMBOLS: Valid range 7 .. 103, Current 103
- 6**: PLP#0 NUM_BLOCKS: Valid range 1 .. 632, Current 632
- 7**: Optimum1 checkbox (checked)
- 8**: Optimum2 checkbox (unchecked)
- 9**: #Dummy cells: 127
- 10**: Bitrate: 18,942,807

#	Name	Description
1	#Frames per superframe	Shows the number of T2 frames per superframe: 1 to 255.
2	Frame size	Shows the total number of cells per T2 frame.
3	#L1-pre/post	Shows the number of cells used for L1-pre and L1-post signaling.
4	Data cells	Shows the number of data cells per T2 frame.
5	NUM_DATA_SYMBOLS	Shows the valid range and the current value for the number of data OFDM symbols per T2 frame, excluding P1 and P2 preamble symbols. This field refers to NUM_DATA_SYMBOLS in ETSI EN 302 755.
6	PLP#0 NUM_BLOCKS	Shows the valid range and the current value for the number of FEC blocks contained in the interleaving frame for PLP#0. This field refers to PLP_NUM_BLOCKS in ETSI EN 302 755.
7	Optimum1	Selects whether to use the "Optimum1" values, which are the best values for NUM_DATA_SYMBOLS and PLP_NUM_BLOCKS, as shown below the Optimum1 check box. When unchecked, the user can change the values of NUM_DATA_SYMBOLS and PLP_NUM_BLOCKS using an up and down arrow.
8	Optimum2	Selects whether to use the "Optimum2" values, which are the user-defined optimum values for NUM_DATA_SYMBOLS and PLP_NUM_BLOCKS, as shown below the Optimum2 check box. These values may be equal to the Optimum1 values.
9	#Dummy cells	Shows the number of dummy cells inserted in the T2 frame. If the data PLP and auxiliary streams do not exactly fill the data cells, dummy cells are inserted into the remaining cells of the T2 frame.
10	Bitrate	Shows the resulting TS bitrate given the modulation parameters specified in the dialog window.

5.4.10.4 DVB-T2 – FEF Parameters

This part of the DVB-T2 parameters dialog shows the FEF specific parameters. These parameters are highly technical in nature. Please refer to the DVB-T2 specification (ETSI EN 302 755) for more information on FEF parameters.

Future Extension Frame (FEF) insertion enables carriage of frames defined in a future extension of the DVB-T2 standard in the same multiplex as regular T2-frames. The use of future extension frames is optional. A FEF can use a new type of modulation independent of DVB-T2. The “FEF part” is defined as the part of the DVB-T2 signal between two regular T2 frames which contains the FEFs.



#	Name	Description
1	Enable	Selects whether FEF frames are inserted.
2	Type	Selects the type of FEF. At this time all values are undefined and reserved for future use.
3	S1	Selects the value of the S1 signaling field that would be used for FEF.
4	S2	Selects the value of the S2 signaling field that would be used for FEF.
5	Signal	Selects the test signal inserted in the FEF part of the DVB-T2 signal: Zero, 1k OFDM 852, 1k OFDM 384. StreamXpress can insert a test signal during the FEF period to see if FEFs are interfering with the main transmission of DVB-T2.
6	Length	Selects the length of the FEF part in number elementary periods T, from the start of the P1 symbol of the FEF part, to the start of the P1 symbol of the next T2 frame.
7	Interval	Selects the number of T2 frames between two FEF parts. For example, if Interval is 4, a FEF is inserted every 4 DVB-T2 frames.

5.4.10.5 DVB-T2 – Messages and Presets

This part of the DVB-T2 parameters dialog:

- Shows whether all manually entered configuration settings are compatible with each other and displays any error messages.
- Allows users to select preset values based on industry standard use-case test sets.



#	Name	Description
1	Message center	Displays messages indicating whether the selected parameters are compatible with each other. If there is an error, a message will indicate the reason for the error and what settings may need to be changed. Note: In case of an error, streaming will be disabled and the output rate of the main StreamXpress window will show -1 in orange.
2	Group	Selects the 'group' of test cases to use. The StreamXpress comes with preset configurations to help users select practical DVB-T2 transmission parameters. Each group represents an organization or group of parameters defined for a specific application.
3	Ref	Selects a test stream from the selected group above. Note: StreamXpress offers hundreds of possible configurations. The user should refer to online documentation for more information on how to use the test streams in each group.

5.4.11. DVB-T2 - T2MI

T2-MI (T2 Modulator Interface) is a stream format that contains the contents to be modulated, the DVB-T2 modulation parameters, and the low-level decisions on cell allocation and scheduling. A T2-MI stream uniquely defines the transmitted DVB-T2 stream, so that each modulator in a Single Frequency Network (SFN) can unambiguously create an identical on-air signal.

StreamXpress can open a T2-MI stream encapsulated in an MPEG-2 TS file and use it to generate a DVB-T2 signal on a DekTec modulator.

Notes

- The T2-MI stream format and the encapsulation of T2-MI packets in an MPEG-2 TS are defined in ETSI TS 102 773.
- Playing a T2-MI stream to a DekTec modulator requires the DTC-378-T2 or the GOLD option.

When T2-MI modulation is selected in the main StreamXpress window, the only parameter the user can change is the RF carrier frequency.

The image shows a software interface with three main sections: Rate, Channel, and Modulation Parameters. The Rate section has an 'Out:' label, a text box containing '40,000,000', and the unit 'bps'. Below this is a 'default' button. The Channel section has a text box containing '666.000' and the unit 'MHz'. The Modulation Parameters section has a dropdown menu currently set to 'T2-MI' and a 'fading...' button.

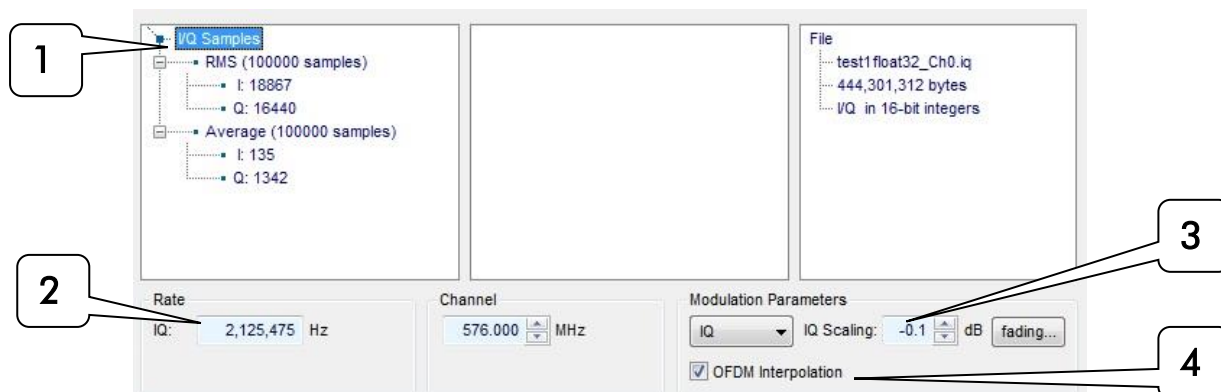
5.4.12. I/Q Sample Playout

A special modulation mode is “I/Q”: In this mode, StreamXpress can play “raw” I/Q samples from an I/Q file, after upconverting the I/Q samples to the specified channel frequency.

Note

- To create an I/Q file, please refer to *Appendix B I/Q File Format*.

I/Q playout can be configured in the *parameters* part of the main StreamXpress window.



#	Name	Description
1	I/Q samples	Shows the number of I/Q samples, the amplitude (root mean square of I resp. Q samples) and the average value (DC unbalance).
2	I/Q rate	Sets the rate at which I/Q samples will be played.
3	Scaling	Sets the amplitude of the output signal.
4	OFDM interpolation	Selects whether OFDM interpolation (checked) or QAM interpolation with a channel filter should be used. By default, you should select OFDM interpolation. QAM interpolation is only useful if the I/Q signal represents a QAM signal with a sample rate equal to the symbol rate, and a Root Raised Cosine (RRC) channel filter is required as with standard QAM modulation. The key characteristic of a channel filter is that some energy folds in the spectrum outside the symbol rate.

5.4.13. ISDB-S

This section shows how to specify the modulation parameters for ISDB-S in StreamXpress.

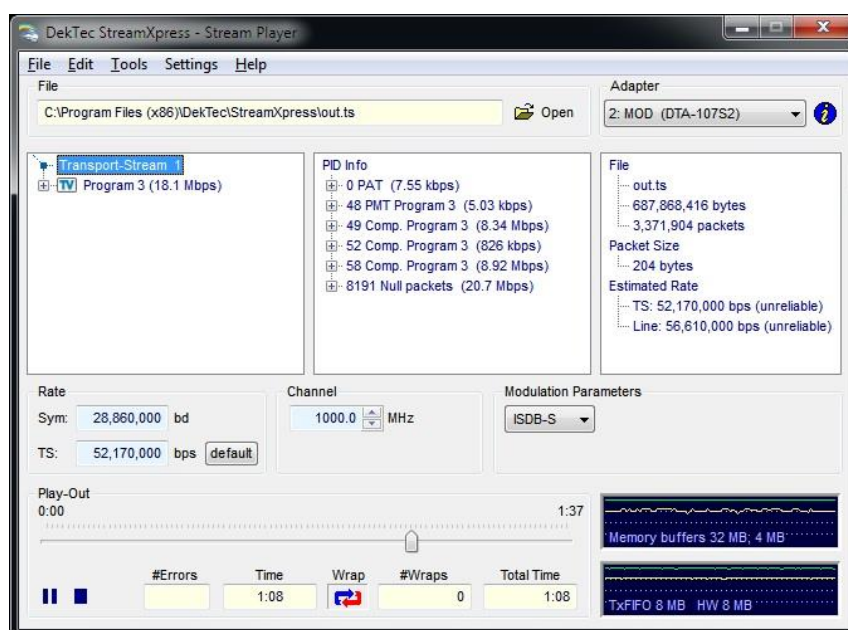
ISDB-S is a satellite modulation standard used in Japan and some South American countries. It uses a special file format consisting of a multiplex of one or more transport streams, and a *TMCC* (Transmission and Multiplexing Configuration Control) signal that describes the configuration of the multiplex and the ISDB-S modulation parameters.

StreamXpress can playout pre-multiplexed ISDB-S files. DekTec also offers a command line utility, **IsdbsMux**, to create a multiplexed ISDB-S file from one or more transport streams. **IsdbsMux.exe** can be found in the same directory where StreamXpress is installed. Please refer to the IsdbsMux Man Page for the command line options that can be specified.

Note

- StreamXpress does not include a real-time ISDB-S multiplexer as for ISDB-T. Only pre-multiplexed ISDB-S files can be used.

To playback ISDB-S, open a valid multiplexed ISDB-S file and select **ISDB-S** modulation. The playout rate should be left at 52.17Mbps.



5.4.14. ISDB-T

5.4.14.1 ISDB-T – Introduction

ISDB-T is a terrestrial modulation format used in Japan, Brazil and other South American countries. It allows up to three *layers* in a single RF channel, e.g. HDTV, SDTV and mobile, with different modulations settings per layer. The spectrum is divided into 13 *segments* in the frequency domain.

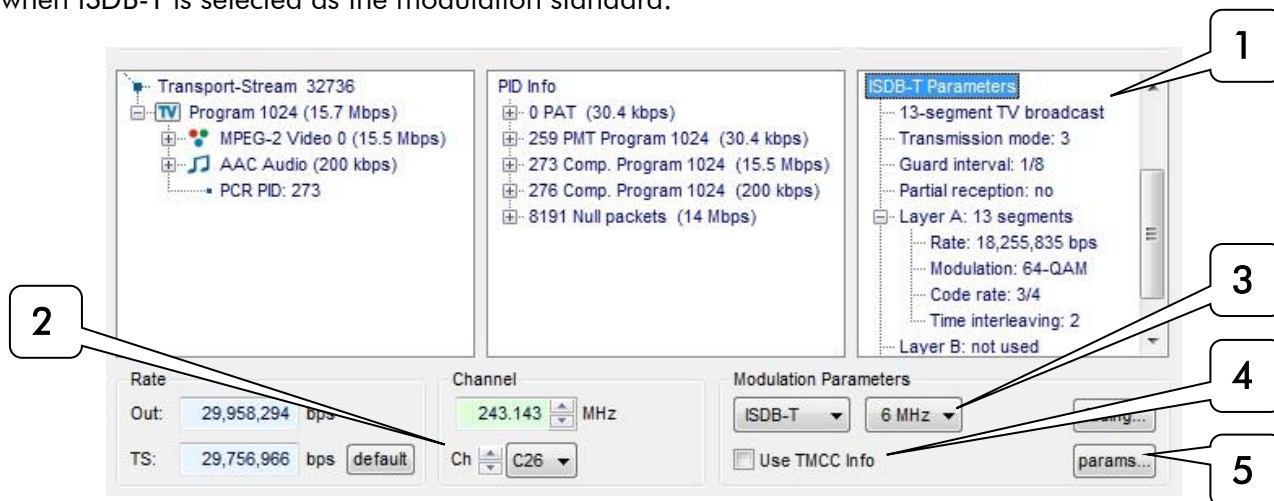
StreamXpress accepts two types of ISDB-T input:

- A standard 188-byte transport stream. An embedded ISDB-T multiplexer maps elementary streams to the different ISDB-T layers (A, B, C).

- A 204-byte TS with TMCC (Transmission and Multiplexing Configuration Control) info in the 16 additional bytes of each transport packet. The StreamXpress can extract the TMCC data and use it to configure the ISDB-T multiplexer and the ISDB-T modulation parameters.

5.4.14.2 ISDB-T – Settings in Main StreamXpress Window

This section shows the modulation parameters that can be set in the main StreamXpress window when ISDB-T is selected as the modulation standard.



#	Name	Description
1	Parameter view	Shows ISDB-T modulation information if the selected file is a .tmcc file. Note: The “use TMCC Info” checkbox must be checked to actually use these parameters for transmission.
2	Channel	Selects the RF channel number for playout. Channel 1 to 62 is the standard channel plan for ISDB-T over-the-air, C31 to C62 for ISDB over cable.
3	Bandwidth	Sets the modulation bandwidth: 6MHz or 8MHz. Note: 6MHz bandwidth is prevalent for ISDB-T.
4	Use TMCC info	Selects whether to derive the modulation parameters from the TMCC file.
5	Params...	Opens a second window with detailed ISDB-T modulation settings.

5.4.14.3 ISDB-T – Modulation Parameters

In the ISDB-T parameters window, you can view and change the ISDB-T modulation parameters.

The screenshot shows the 'ISDB-T Parameters' window. Callout 1 points to the PID table. Callout 2 points to the 'Map other PIDs to layer' dropdown and 'Allow PID in multiple layers' checkbox. Callout 3 points to the 'Layer Parameters' section. Callout 4 points to the 'Valid ISDB-T Settings' status bar and 'Revert to' buttons.

PID	Svc/Comp	Rate	A	B	C
0x0000	PAT	4,034	A	-	-
	HD Full Res	7,087,257			
0x0033	MPEG-1 Audio	198,287	A	-	-
0x0034	MPEG-1 Audio	198,437	A	-	-
0x0031	AVC/H.264 Video	6,690,532	A	-	-
	SD Full Resolution	2,519,614			
0x0043	MPEG-1 Audio	198,437	-	B	-
0x0044	MPEG-1 Audio	198,437	-	B	-
0x004b	Private data	44,977	-	B	-
0x0041	AVC/H.264 Video	2,077,763	-	B	-
0x0011	SDT actual	747	A	B	C

Map other PIDs to layer: -- ☒ Allow PID in multiple layers

ISDB-T Parameters
Broadcast Type: Television Mode: 3 Guard: 1/8 IIP PID: 0x1FF0
☐ Partial Reception ☐ Emergency Broadcasting

Layer Parameters

	#Segments	Modulation	Code Rate	Time Intlv	Rate (bps)	Selected (bps)
A	6	64QAM	3/4	I = 2	8,425,770	7,099,956
B	6	16QAM	3/4	I = 1	5,617,180	2,520,361
C	1	64QAM	3/4	I = 2	1,404,295	2,241
Total	13				15,447,245	9,622,558

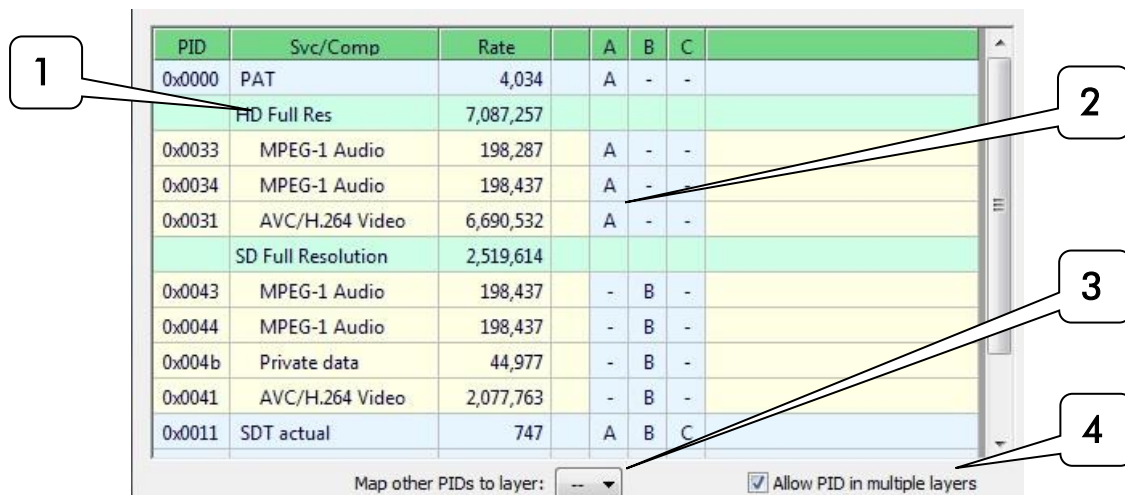
Valid ISDB-T Settings
Revert to: TMCC Parameters Initial Settings

The settings in this window are described in four sections.

#	Name	Description
1	Stream mapping	Mapping from TS components to ISDB-T layers (A, B or C).
2	Main parameters	Main ISDB-T modulation parameters.
3	Layer parameter	Modulation parameters per ISDB-T layer.
4	Message center	Shows status and error messages and allows reverting settings.

5.4.14.4 ISDB-T – Stream Mapping

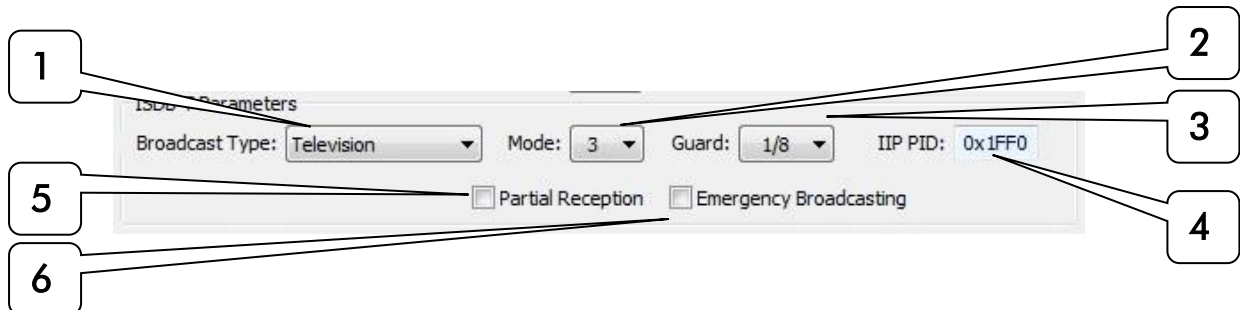
In this part of the ISDB-T2 parameters dialog you can select which elementary streams ('PIDs') are carried in which layer (A, B or C). Typically, a service is carried in a single layer.



#	Name	Description
1	Grid	Shows PID, component type and bitrate per elementary stream.
2	Layer	Selects the layer (A, B and/or C) to which an elementary stream is assigned. Select by clicking in the A, B, or C column. Unless "Allow PID in multiple layers" is checked, each component can only go in 1 layer.
3	Map other PIDs	Selects whether unassigned elementary streams are mapped to a default layer.
4	Allow PID in multiple layers	If checked, you can duplicate the same elementary stream in multiple layers.

5.4.14.5 ISDB-T – General Parameters

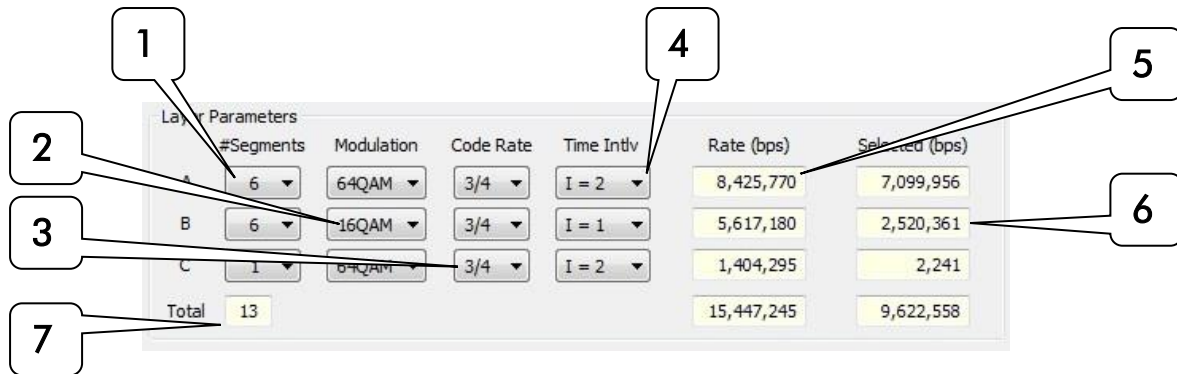
This part of the ISDB-T2 parameters dialog shows the general ISDB-T2 modulation parameters.



#	Name	Description
1	Broadcast type	Selects between 13-segment television, 1-segment radio and 3-segment radio.
2	OFDM mode	Selects the OFDM mode: 1, 2 or 3. Mode 1 uses 108 carriers, mode 2 uses 216 carriers and mode 3 uses 432 carriers per segment.
3	Guard interval	Selects the guard interval: 1/32, 1/16, 1/8, 1/4. ISDB-T uses a guard interval to avoid that echoes interfere with the next OFDM symbol. The guard fraction represents the ratio between the number of guard symbols and the number of symbols in use.
4	IIP PID	Sets the PID for carrying the IIP, which stands for ISDB-T Information Packet. IIPs contain the TMCC data that is sent to the modulator to control it: <ul style="list-style-type: none"> Precise timing parameters to enable modulators to accurately synchronize with each other in a Single Frequency Network (SFN). Modulation parameters for each hierarchical layer (A, B, C).
5	Partial reception	Selects whether the central ISDB-T segment is created in such a way that it can be received by a 1-segment receiver. If partial reception is used, the 1-segment signal must use layer A.
6	Emergency broadcasting	Selects whether the alarm broadcasting flag (a single bit) in the TMCC data must be asserted.

5.4.14.6 ISDB-T – Parameters per Layer

This part of the ISDB-T parameters dialog shows the modulation parameters per layer (A, B, C).



#	Name	Description
1	#Segments	Selects the number of segments per layer.
2	Modulation	Selects the modulation applied per layer: DQPSK, QPSK, 16QAM, 64QAM . Each layer can use a different modulation.
3	Code rate	Selects the FEC code rate per layer: 1/2, 2/3, 3/4, 5/6, 7/8 . Each layer can use a different code rate.
4	Time interleaving mode	Selects the type of time interleaving. The valid settings for the time interleaving mode depend on the OFDM mode. For OFDM mode 1, valid settings are 0, 4, 8, 16. For OFDM mode 2, valid settings are 0, 2, 4, 8. For OFDM Mode 3, valid settings are 0, 1, 2, 4.
5	Rate	Shows the total available bitrate per layer, given the modulation parameters.
6	Selected	Shows the bitrate used by the selected elementary streams. If the selected rate is higher than the available rate, the Selected bitrate box turns red and an error message is displayed.
7	Total	Shows the total number of segments, the total available bitrate and the total selected bitrate.

5.4.14.7 ISDB-T – Message Center

This part of the ISDB-T modulation parameters dialog:

- Shows whether the entered configuration settings are compatible with each other and displays any error messages.
- Allows users to revert settings.



#	Name	Description
1	Message center	Displays messages indicating whether the selected parameters are compatible with each other. If there is an error, a message will indicate the reason for the error and what settings may need to be changed. Note: In case of an error, streaming will be disabled and the output rate of the main StreamXpress window will show -1 in orange.
2	TMCC parameters	Loads the modulation parameters from the TMCC data contained in the 204-byte packet TS file.
3	Initial settings	Reverts the settings to the original modulation settings that were active before any manual changes were made.

5.4.15. QAM-B

This section shows how to specify the modulation parameters for QAM-B in StreamXpress. QAM-B uses a channel bandwidth of 6MHz.

Note

- QAM-B is also known as J.83 Annex B.

QAM-B modulation can be configured in the *parameters* part of the main StreamXpress window.



#	Name	Description
1	Constellation	Selects the QAM constellation to be used: 64-QAM or 256-QAM .
2	Interleaver mode	Selects the interleaver mode. CW is the 4-bit control word, l is the number of taps of the interleaver and J is the increment. StreamXpress supports all 13 interleaver modes defined in the specification.

5.4.16. QAM-C

This section shows how to specify the modulation parameters for QAM-C in StreamXpress.

QAM-C is the digital cable standard in Japan and some other Asian countries. QAM-C uses a channel bandwidth of 6MHz.

Note

- QAM-C is also known as J.83 Annex C.

QAM-C modulation can be configured in the *parameters* part of the main StreamXpress window.



#	Name	Description
1	Constellation	Selects the QAM constellation to be used: 16-QAM, 32-QAM, 64-QAM, 128-QAM or 256-QAM. Note: 64-QAM and 256-QAM are the most popular modes.

6. StreamXpress Command-Line Options

StreamXpress can be configured at startup with parameters specified in command-line options. This can be used in Windows shortcuts, from the command line and in batch files. For example, "StreamXpress64.exe -play "TV_tuner_settings.xml" -t 315 -n 2" will start StreamXpress with a specified file and adapter selected.

Option	Description
"filename"	Starts StreamXpress with a specific settings-file or playout-file selected. An option flag is not required.
-dte	Starts the StreamXpress with DTE-3100 support. StreamXpress will search the network for DTE-3100s that are licensed and enabled for use with StreamXpress.
-hide	Starts the StreamXpress as a process without launching the GUI.
-play	Starts playing the selected file immediately.
-once	Plays the selected file once (not in a loop).
-port <i>portno</i>	Selects a specific port number to use on a device.
-rc <i>tcp_portno</i>	Starts StreamXpress in remote-control mode. <i>tcp_portno</i> is the TCP port number on which StreamXpress starts listening for remote-control commands.
-t <i>typeno</i>	Selects the DekTec adapter with the specified type number. For example, <i>typeno</i> =2172 selects the DTA-2172.
-t <i>typeno</i> -n <i>deviceno</i>	If multiple devices of the same type are present, the -n option can be used in conjunction with the -t option to select the n th device in the system. For example, "-t 315 -n 2" will select the second DTU-315 in the adapter list.

7. Using StreamXpress with the DTE-3100

The DTE-3100 is a standalone IP to ASI converter that can be used as a “networked” port. StreamXpress can be used with a DTE-3100 to remotely stream a file stored on the PC to the ASI port of the DTE-3100.

The DTE-3100 supports two modes:

Mode	Description
SMPTE mode	Standalone mode where a SMPTE 2022 TS-over-IP stream is converted to ASI.
DTAPI mode	The DTE-3100 can be connected to an application running on a PC, e.g. to the StreamXpress.

To use StreamXpress with a DTE-3100:

- the DTE-3100 must be set to **DTAPI mode**;
- the DTE-3100 must be licensed for StreamXpress.

To stream to the DTE-3100, the StreamXpress must be started from the DOS command prompt with the `-dte` command-line option.

7.1. Selecting DTAPI Mode on the DTE-3100

The DTE-3100 must be in DTAPI mode to operate from the StreamXpress. To achieve this, select the DTAPI application from the *Application Switcher* tab in the DTE-3100 web interface:



Appendix A. PRBS Generation According to ITU O.151

StreamXpress offers the possibility to play a PRBS test signal according to the ITU O.151 standard. The definition of this PRBS is as follows:

A 23-bit register (PRBS_REG) is initialized to all 1's. Then, for each bit of output:

- Output bit = $\sim(\text{PRBS_REG_bit17} \text{ xor } \text{PRBS_REG_bit22})$.
That is, bits 17 and 22 (zero-indexed) are exclusive OR-ed and the result of that is negated. The result of this computation is the next output bit.
- $\text{PRBS_REG} = ((\text{PRBS_REG} \ll 1) | (((\text{PRBS_REG} \gg 22) \text{ xor } (\text{PRBS_REG} \gg 17)) \& 1)) \& 0x7FFFFFFF$
Bits 17 and 22 are exclusive OR-ed. Then all bits in PRBS_REG are shifted to the left and the result of the exclusive OR of the previous bits 17 and 22 is stored as new bit 0.

Appendix B. I/Q File Format

To play I/Q samples with StreamXpress via a DekTec modulator card, the user must provide a valid I/Q file. DekTec supports multiple I/Q file formats.

Format	Description
I/Q Float32	I/Q pairs of 32-bit IEEE 754 floats in little Endian format.
I/Q Int16	<p>I/Q pairs of signed 16-bit integers in little Endian format.</p> <p>Example:</p> <p>Byte #0: Least-significant byte I</p> <p>Byte #1: Most-significant byte I</p> <p>Byte #2: Least-significant byte Q</p> <p>Byte #3: Most-significant byte Q</p> <p>etc.</p>
I/Q Text	<p>Text-based format (ASCII) containing one I/Q sample pair per line.</p> <p>Each line contains an I value followed by a Q value, separated by a TAB character ('\08'). I/Q values should be formatted as "0x" followed by a four-character hexadecimal value. Lines are separated by a linefeed ('\0A').</p> <p>Example:</p> <p>0x2b45<TAB>0x1c3f<LF></p> <p>0xfeA9<TAB>0x0073<LF></p>

The I/Q file can be generated by DekTec T2Xpress or C2Xpress for example or be created by the user.