Application Note

DVB-S2 & DVB-S2X SIGNAL GENERATION IN K-BAND AND ANALYSIS

Products:

- R&S®BTC
- R&S®SLG
- R&S®SMW200A
- R&S®SGS100A
- R&S®SGU100A
- R&S®FSW

M.Naseef, F.Ramian, Y.Shavit | 1MA273 | Version 3e | 11.2021

Note:

Please find up to date document on our homepage
http://www.rohde-schwarz.com/appnote/1MA273
Analysis software can be downloaded from
http://www.rohde-schwarz.com/appnote/1EF93

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1 Overview

The Application Note (AN) addresses test and measurement possibilities for DVB-S2 and DVB-S2X signals in the K_u & K_a -band. This AN includes detailed description of measurement setups, signal generation and in some cases signal up-conversion. Signal quality (Error Vector Magnitude (EVM) and Modulation Error Ratio (MER)) analysis in the K_u & K_a-band is shown using Rohde & Schwarz instruments.

This paper is intended towards satellite equipment manufacturers, network operators, government & authorities, CE receiver chip set manufacturers, car manufacturers and automotive infotainment system manufactures.

2 Abstract

The Digital Video Broadcasting (DVB) suite of various standards provide methods of communicating data and video signals through different medium including cable, terrestrial, mobile, and satellite. The first DVB system for satellite communication (DVB-S) was adopted in 1994, using QPSK modulated signal.

A second-generation DVB system intended for satellite communication (data, broadcasting and unicasting) named DVB-S2 was published in 2005 and since then the satellite communication industry has undergone many changes. Emerging technologies such as high efficiency video coding (HEVC), ultra-high definition TV (UHDTV) and high throughput satellite (HTS) require higher data rates. Migration from DVB-S to DVB-S2 meant achieving significantly better performance using the same satellite transponder bandwidth and emitted signal power. The measured DVB-S2 performance gain over DVB-S is around 30% for both, single-carrier and multiple-carrier-per-transponder configurations [1]. This capacity enhancement is a direct result of the higher order modulation (16-APSK, 32-APSK) used in DVB-S2 transmission [2].

In 2014, DVB-S2X an extension to DVB-S2 was released. The new standard offers a gain in throughput of up to 20 percent in Direct-To-Home (DTH) networks and 51 percent for other professional applications (such as contribution links or IP-trunking) compared to DVB-S2 [3].

The first generation of satellites operated in the C-band (4-6 GHz) [4]. As satellite applications kept growing, so did the requirement of higher data throughput. The push for higher data rates meant engineering satellite payloads designed to operate in K_u band (10-14 GHz) [4]. Further evolution of satellite applications resulted in exploding demand for HD television and higher speed internet and pushed the capacity of K_u -band operation to the limit. To keep in sync with mainstream economics of scale, communication satellites are evolving towards higher frequency in the K_a-band (18-30 GHz) and “spot-beams” in K_u -band enabled by higher gain antenna on the satellite [4]. Another reason for the industry to adapt to the K_a-band for High Throughput Satellites (HTS) is the exhaustion of orbital slots for the incumbent bands [4].

This application note is intended to address test and measurement possibilities for DVB-S2 and DVB-S2X signals in the K_u & K_a -band. It includes detailed description of measurement setups; DVB-S2 and DVB-S2X signal generation, up-conversion and signal quality (Error Vector Magnitude (EVM) and Modulation Error Ratio (MER)) analysis in the K_u & K_a -band using Rohde & Schwarz instruments.

This paper is intended towards satellite component manufacturers, broadcast receiver manufacturers, SatCom terminal receiver manufacturers, network operators, government & authorities, CE receiver chip set manufacturers, car manufacturer, Military satellite or UAV receiver and component manufacturers and automotive infotainment system manufactures.

Abbreviations

The following abbreviations are used in this application note for Rohde & Schwarz products:

- The R&S®BTC Broadcast Test Center is referred to as **BTC**
- The R&S®SMW200A Vector Signal Generator is referred to as **SMW**
- The R&S®SLG Satellite Load Generator is referred to as **SLG**
- The R&S®FSW Signal and Spectrum Analyzer is referred to as **FSW**
- The R&S®SGS100A SGMA RF Source is referred to as **SGS**
- The R&S®SGU100A SGMA Upconverter is referred to as **SGU**
- Digital Video Broadcasting - Satellite - Second Generation is referred to as **DVB-S2**
- Extension to Digital Video Broadcasting - Satellite - Second Generation is referred to as **DVB-S2X**
- Amplitude Phase Shift Keying is referred to as **APSK**
- Very Small Aperture Terminal is referred to as **VSAT**
- Digital Satellite News Gathering is referred to as **DSNG**
- Direct to Home is referred to as **DTH**

3 Evolution of DVB-S2 to DVB-S2X

The DVB-S2 specification was introduced in 2005 to address mainly DTH applications. The technical specification of the standard can be found as part 1 of the ESTI EN 302307. Modulation schemes such as 8PSK, 16-Amplitude Phase Shift Keying (APSK) and 32APSK were included in the DVB-S2 standard. Since then multiple new application requirements have generated a buzz in the industry. The core market segments demanding enhancement in performance are Direct to Home (DTH), contribution, VSAT and DSNG [5]. Emerging markets such as Mobile (air, sea and rail) have their eye set on increasing the range of applications [5]. DVB-S2X was introduced as an evolution of the existing DVB-S2 standard to make way for rapid market deployment [5].

The DVB-S2 (EN 302307 [2]) document has been split into two parts. Part 1 describes the original DVB-S2 standard and Part 2 addresses the DVB-S2X extensions [5]. According to definitions, "any DVB-S2X receiver is backwards compatible with the DVB-S2 specifications as the part 1 implementation is mandatory, but legacy DVB-S2 receivers are not forward compatible with the DVB-S2X extensions. Accordingly, the legacy DVB-S2 receivers will not decode transmissions using the new DVB-S2X features, while the new DVB-S2X receivers will decode both DVB-S2X and DVB-S2 transmissions" [5].

DVB-S2X improvements include (i) smaller Roll-Offs (RO), (ii) advanced filtering technologies for improved Carrier Spacing, (iii) support of Different Network Configuration, (iv) increased MODCOD (Modulation and coding) granularity, (v) higher order Modulation Schemes (64/128/256-APSK), (vi) very low SNR for Mobile Applications, (vii) different classes for linear and non-linear MODCODs, (viii) support of Wideband Signals (up to 72Mbaud), (ix) support of Channel Bonding, (x) additional Standard Scrambling Sequence [3].

A detailed technical description of the DVB-S2X feature extensions can be found in [6]. However, a quick overview of the benefits introduced to the market through the implementation of the DVB-S2X standard are listed below.

► DTH (Direct to Home) applications: A combined implementation of the features offered by DVB-S2X standard signifies an improvement over the pre-existing DVB-S2 standard, in terms efficiency and flexibility. This paves the way for next generation services such as UHDTV [5].

► VSAT applications: Implementation of the Super-Framing structure as specified in Annex E of the DVB-S2X document, make it possible to support Intra-system Interference Mitigation, Beam-Hopping as well as Multi-format Transmission. This opens up the door for greater advancements in the field of interactive broadband networks [5].

► Professional and DSNG (Digital Satellite News Gathering) applications: DVB-S2X introduces a number of higher efficiency modulation schemes (64APSK, 128APSK & 256APSK) in addition to the previous 16APSK and 32APSK. This enables a much optimized satellite capacity usage with spectral efficiency reaching up to 6bps/Hz [5].

4 Signal Generation and Up-conversion

The BTC alone can generate RF signals up to 6 GHz. For frequencies higher than 6 GHz up to 40 GHz, the SGMA (SGU and SGS) instruments are required to up convert the signal. The BTC can also support third party up-converters if desired.

The SMW signal generator is capable of generating RF vector signals up to 40 GHz without the requirement of any external up-converters.

The SLG can generate signals from 250 MHz to 3000 MHz by itself. For test requirements in the Ku or Ka-band, an external block up-converter is need. For this purpose, a third party up-converter is used in this application note. The block upconverter VSBU from WORK MICROWAVE can up-convert signals to K_u and K_a band.

The next three sub-sections would explain how DVB-S2 and DVB-S2X signals are generated up to Ka-band using BTC, SMW and SLG.

4.1 Signal Generation Setup using BTC + SGMA Instrument

In order to up-convert the DVB-S2 and DVB-S2X signals to the K-band, a combination of the BTC and SGMA (SGS and SGU) equipment is used.

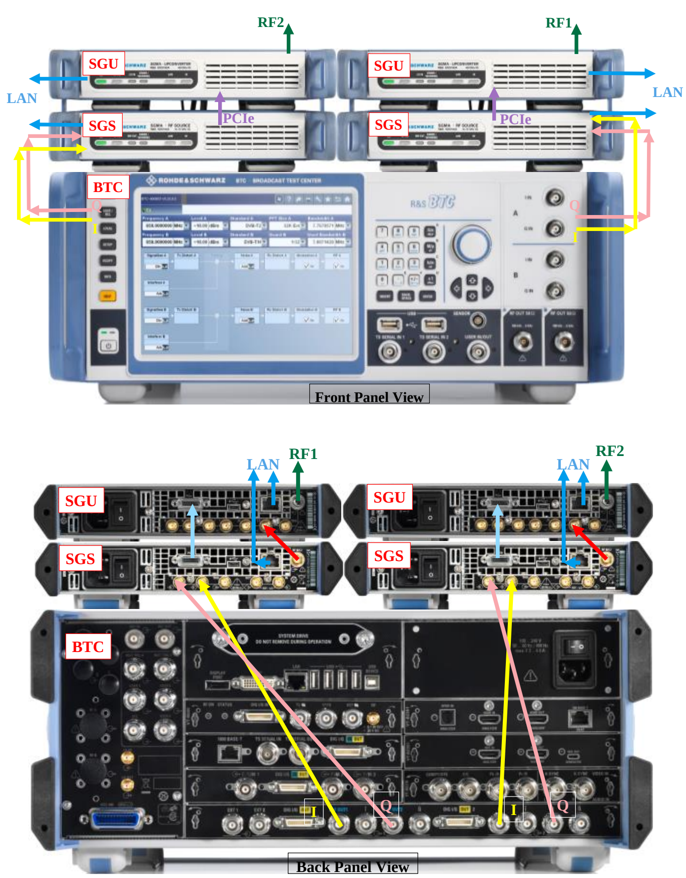


Figure 1: Front & Back Panel View of Equipment Connection

Figure 1 shows the front panel view and back panel view for the instrumental connection between BTC and SGMA instruments.

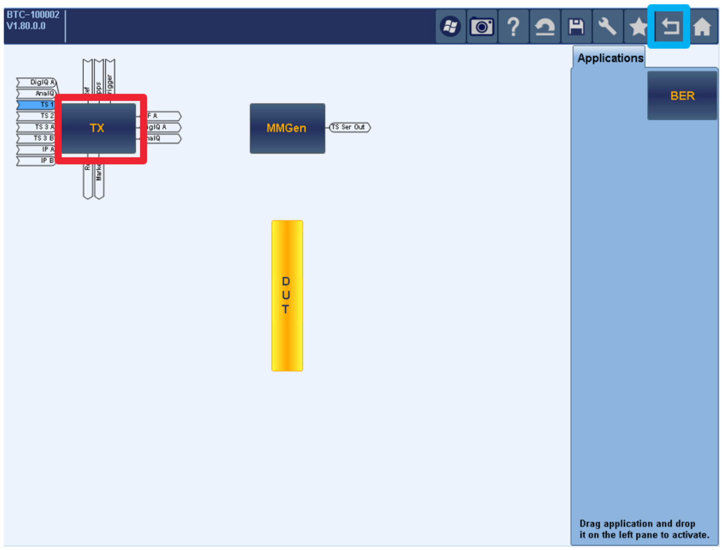
4.1.1 DVB-S2 Signal Generation in K-band (Parametric Configuration on BTC-GUI)

This section explains how to generate DVB-S2 Signals and the parametric configuration on the BTC Graphical User Interface (GUI).

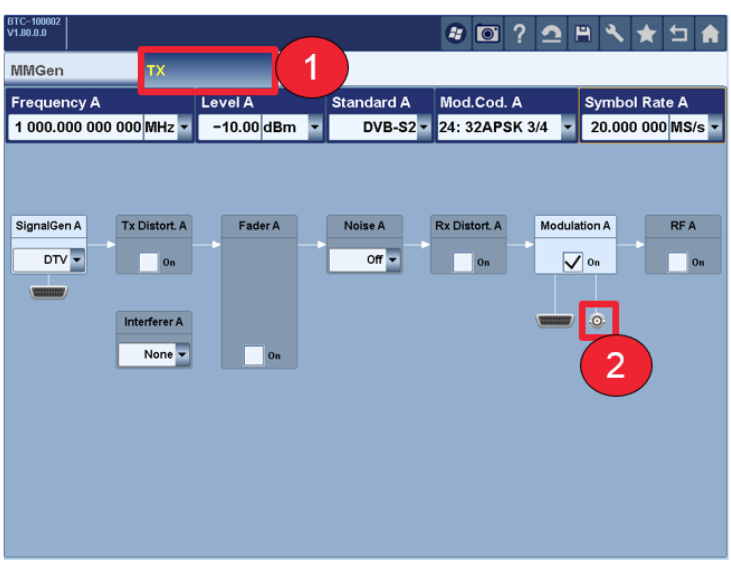
► Preset the BTC

► Click on the TX settings box

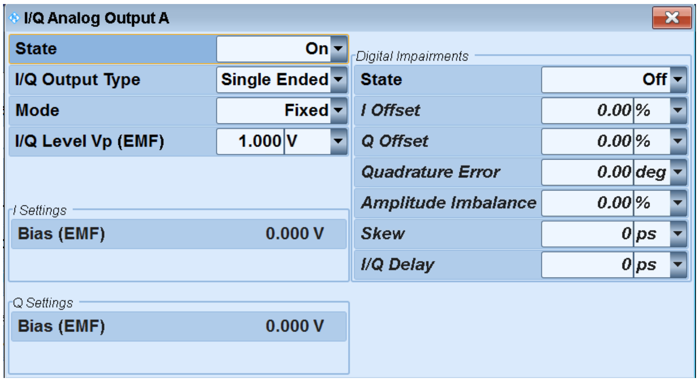
NOTE: The back button (marked in Blue) on the top right corner is used to go back to home screen



► To switch on I/Q Analog Output A, click on TX tab (#1) and then the BNC icon (#2)

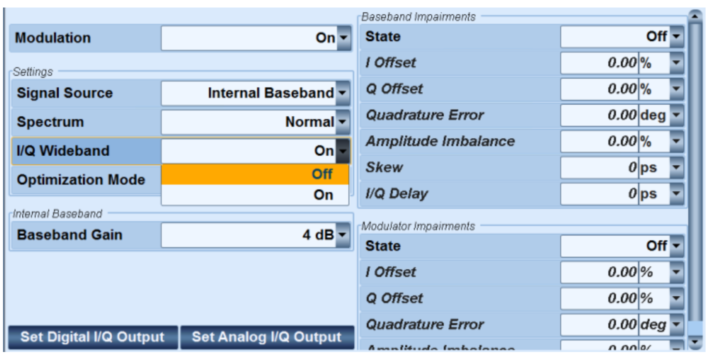


► Switch *On* the I/Q Analog Output A as shown in the figure below



► Click on the back button

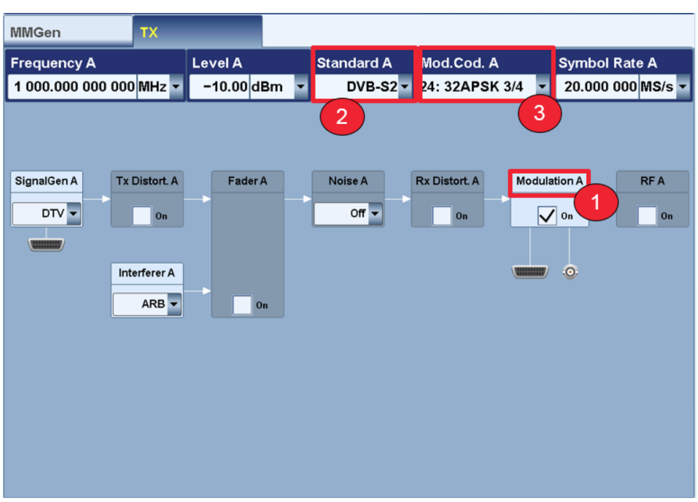
► Click on Modulation and switch *On* the Modulation



► Click on the back button

► Click on Modulation A (#1)

► Select the DVB-S2 Mode (#2) and select the desired Mod.Cod scheme (#3)

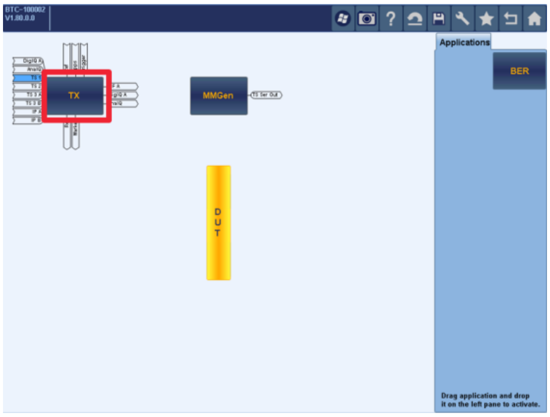


4.1.2 DVB-S2X Signal Generation in K-band (Parametric Configuration on BTC-GUI)

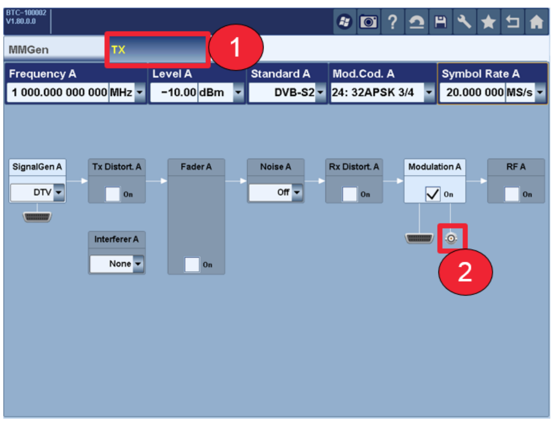
This section explains how to generate DVB-S2X Signals and the parametric configuration on the BTC Graphical User Interface (GUI).

► *Preset* the BTC

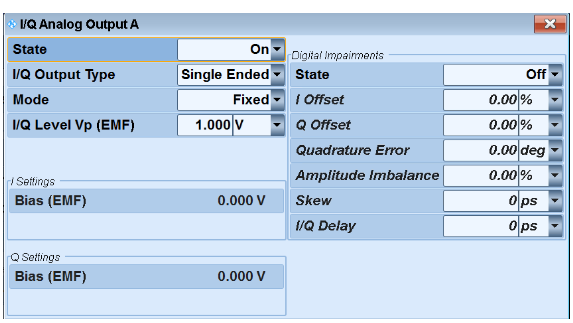
► Click on the TX settings box



► To switch on I/Q Analog Output A, click on TX tab (#1) and then the BNC icon (#2)

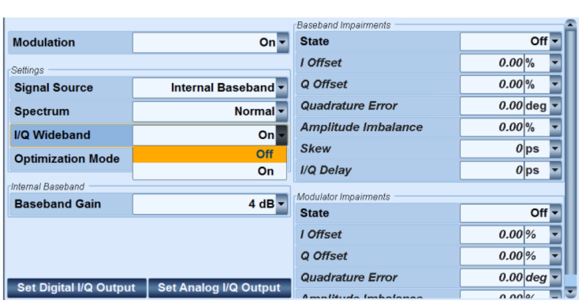


► Switch *On* the I/Q Analog Output A as shown in the figure below



► Click on the back button

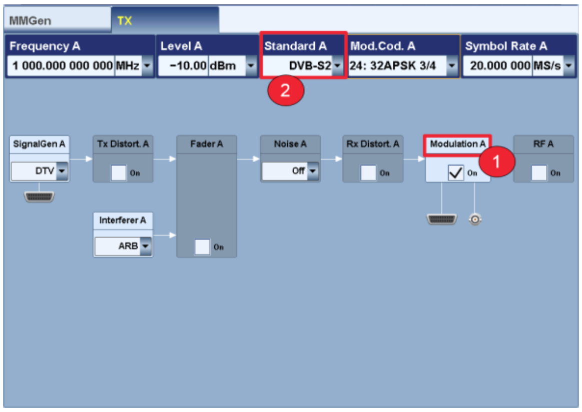
► Click on Modulation and switch *On* the Modulation



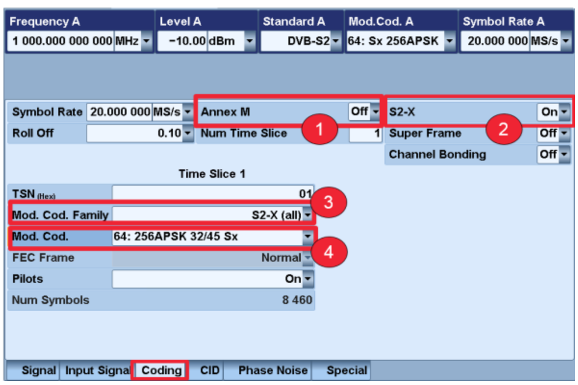
► Click on the back button

► Click on Modulation A (#1)

► Select the DVB-S2 Mode (#2)

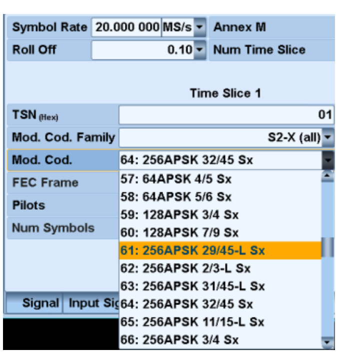


► From the *SignalGen* A menu, select Coding and configure the parameters as shown in the figure below in the following order

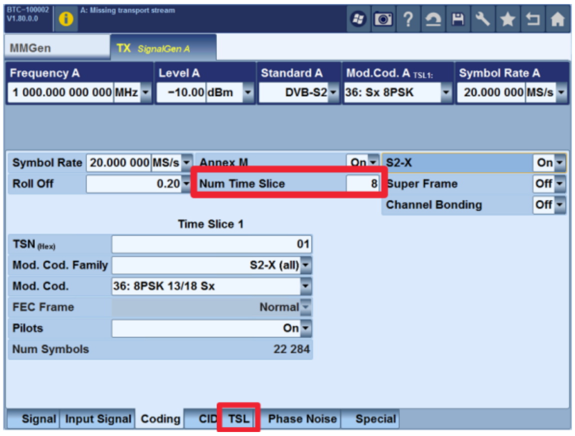


– Pilots can be ON or OFF (Depends on user need). Depending on the state of the pilot settings on the BTC, the FSW analysis must be properly configured for performing DVB-S2 payload measurements. (Explained in Section 5)

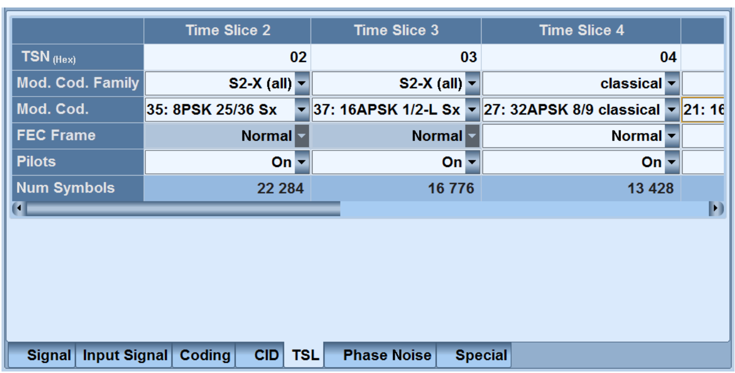
► Select the desired DVB-S2X Mod.Cod from the drop down box



► If Annex is Switched ON, number of Time Slice can be adjusted from 1 to 8



► Time Slice configurations can be performed from the TSL menu



4.1.2.1 SGMA (SGU+SGS) Instruments GUI Configuration for Signal Up-conversion

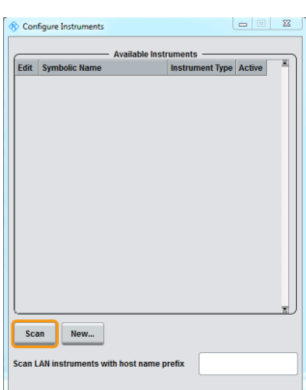
The SGMA instruments do not have on board displays and thus require to be remotely controlled using the Graphical User Interface (GUI) from a computer via LAN.

The Software can be downloaded free from the Rohde & Schwarz website.

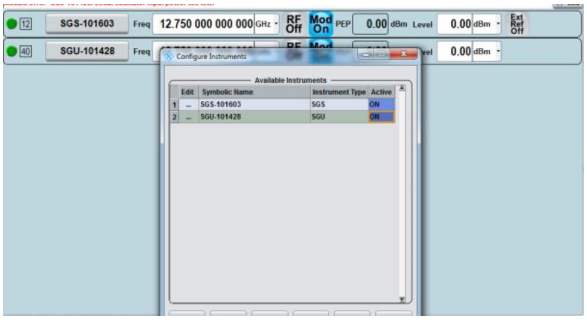
http://www.rohde-schwarz.com/en/software/sgu100a/

► Open SGMA-GUI

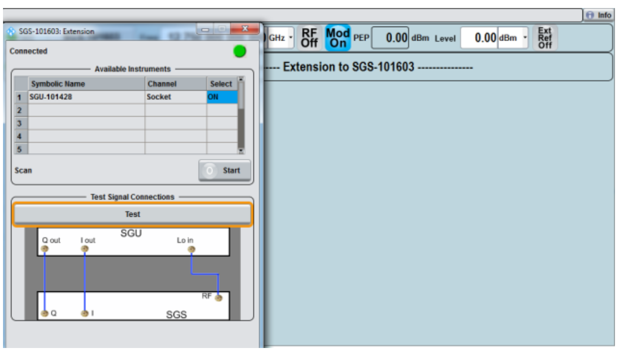
► Setup > Instrument > Scan



► Select SGS and SGU and press ON



► Select SGS-*xxxxxx* > *Extension* > *ON* > Test



4.1.3 Additional Features of the BTC

Satellite communication links are subject to, amongst other impairments, noise (AWGN) and fading. However, the noise contribution on the uplink and downlink signals are different. The BTC offers the possibility to simulate the complete satellite link and works fully independently for up- and downlink.

Satellite transmission links are not immune to fading effects (i.e. rain fade and multipath). The fading effect depends on the location of transmitting earth station and the receiving earth station. The BTC also add the capability to simulate complex fading scenarios, with a choice of multiple fading profiles and up to 40 independent fading paths.

According to ETSI TS 103129, DVB-CID (Carrier Identity) technology is described as a mechanism to trace and avoid interference on satellite uplinks. DVB-CID is a Global Unique Identifier (GUI) with GPS coordinates and contact details. The BTC can generate DVB-CID signals with only a few button clicks.

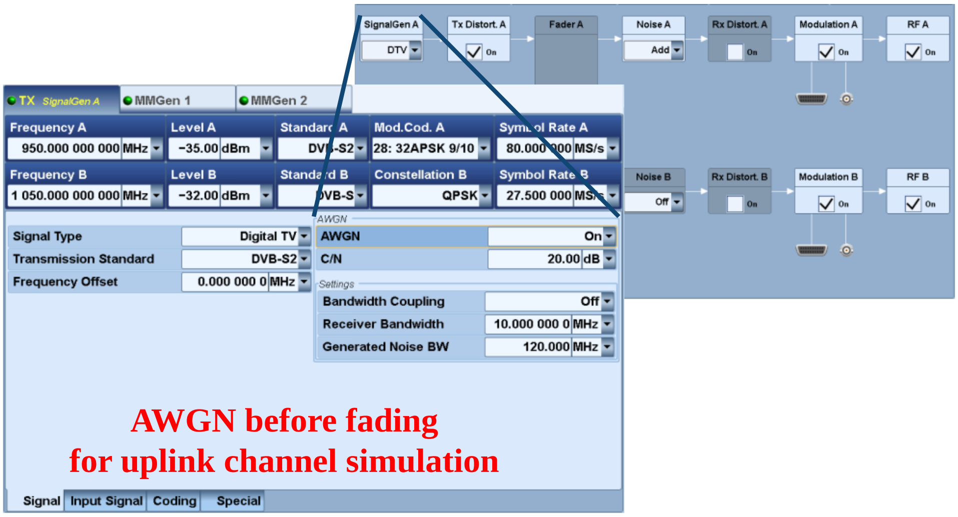
In order to simulate downlink interface signals, up to eight interferers can emulated with the BTC. Eight different waveforms of up to 160 MHz bandwidth can be loaded on to the internal arbitrary waveform generator (ARB). Predefined signals are also available as waveform libraries.

4.1.3.1 AWGN Simulation on Up- and Downlink

Simulating AWGN noise on the uplink signal

► Click *SignalGen A*

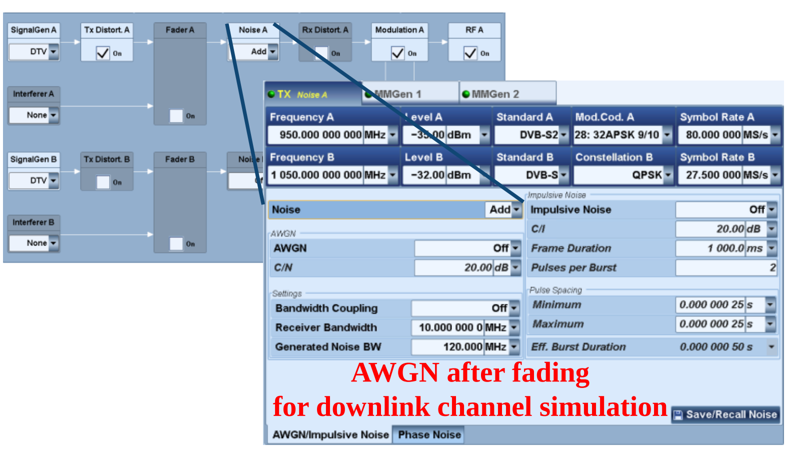
► Switch *AWGN* option *ON*



Simulating AWGN noise on the downlink signal

► Select *Add* Noise (After Fader A on the home screen)

► Switch *On AWGN*

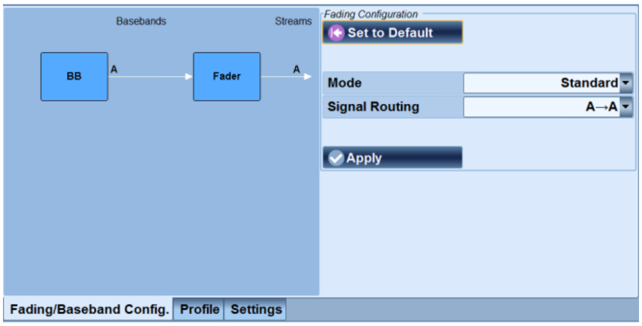


4.1.3.2 Signal Fading Simulation

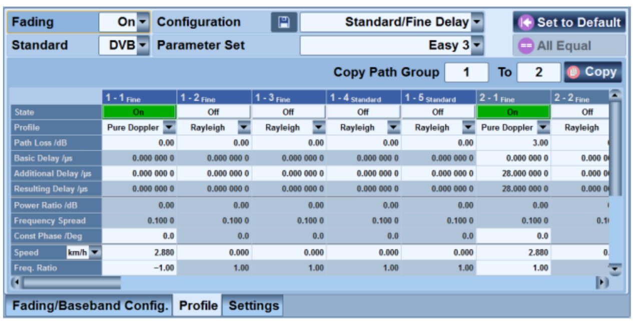
To configure the Baseband Fader of the BTC

► Select the Fader on the home screen

► Configure the *Fading/Baseband Config.* as shown in the figure below



► Configure the *Profile* according to use case

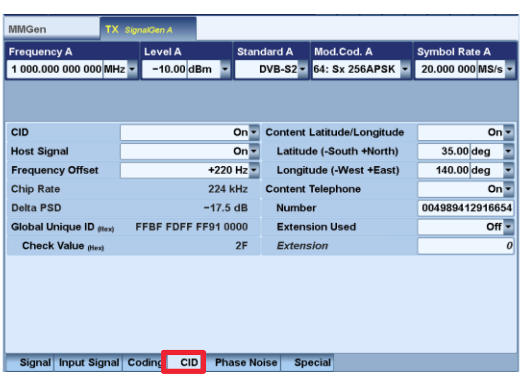


4.1.3.3 DVB-CID Waveform Generation

► Select the *SignalGen A* Mode on the BTC

► Select the *CID* Menu

► Switch *On* the CID and configure the parameter according to application requirement

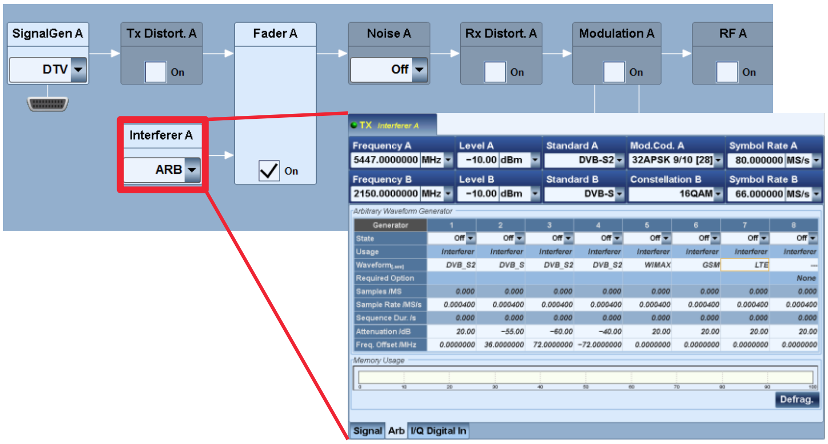


4.1.3.4 Satellite Interference Signals

► Configure the *Interferer A* in *ARB Mode*

► Select or load the required signal files in *Waveform* tab

► Switch *State* On


SignalGen A
DTV
Tx Distort. A
On
Fader A
On
Noise A
Off
Rx Distort. A
On
Modulation A
On
RF A
On
Interferer A
ARB
TX Interferer A
Frequency A 5447.0000000 MHz
Level A −10.00 dBm
Standard A DVB-S2
Mod.Cod. A 32APSK 9/10 [28]
Symbol Rate A 80.000000 MS/s
Frequency B 2150.0000000 MHz
Level B −10.00 dBm
Standard B DVB-S
Constellation B 16QAM
Symbol Rate B 66.000000 MS/s
Arbitrary Waveform Generator
Generator 1 2 3 4 5 6 7 8
State Off Off Off Off Off Off Off Off
Usage Interferer Interferer Interferer Interferer Interferer Interferer Interferer Interferer
Waveform DVB_S2 DVB_S DVB_S2 DVB_S2 WIMAX GSM LTE ---
Required Option None
Samples /MS 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
Sample Rate /MS/s 0.000400 0.000400 0.000400 0.000400 0.000400 0.000400 0.000400 0.000400
Sequence Dur. /s 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
Attenuation /dB 20.00 −55.00 −60.00 −40.00 20.00 20.00 20.00 20.00
Freq. Offset /MHz 0.0000000 36.0000000 72.0000000 −72.0000000 0.0000000 0.0000000 0.0000000 0.0000000
Memory Usage
Defrag.
Signal
Arb
I/Q Digital In

4.2 Signal Generation Setup using SMW

The SMW is capable of generating RF vector signals up to 40 GHz without the requirement of any external up-converters.

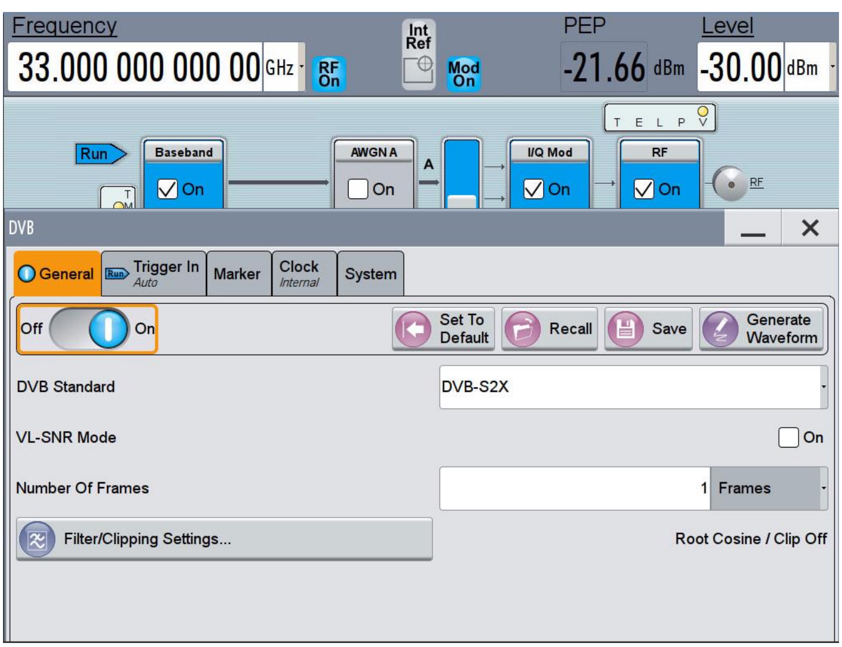
Figure 2: SMW can generate DVB-S2 and DVB-S2X signals up to 40 GHz without any external up conversion

4.2.1 DVB-S2X Signal Generation in K-band (Parametric Configuration on SMW)

This section explains how to generate DVB-S2X Signals and the parametric configuration on the SMW.

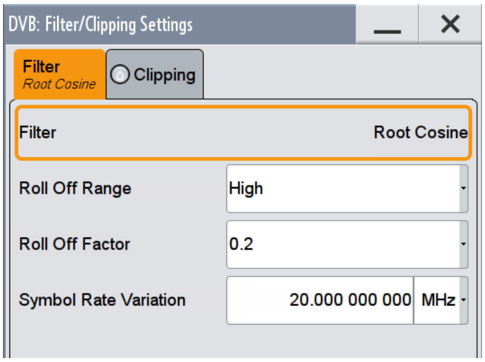
► *Preset* the SMW

► Click on the *Baseband* and select DVB

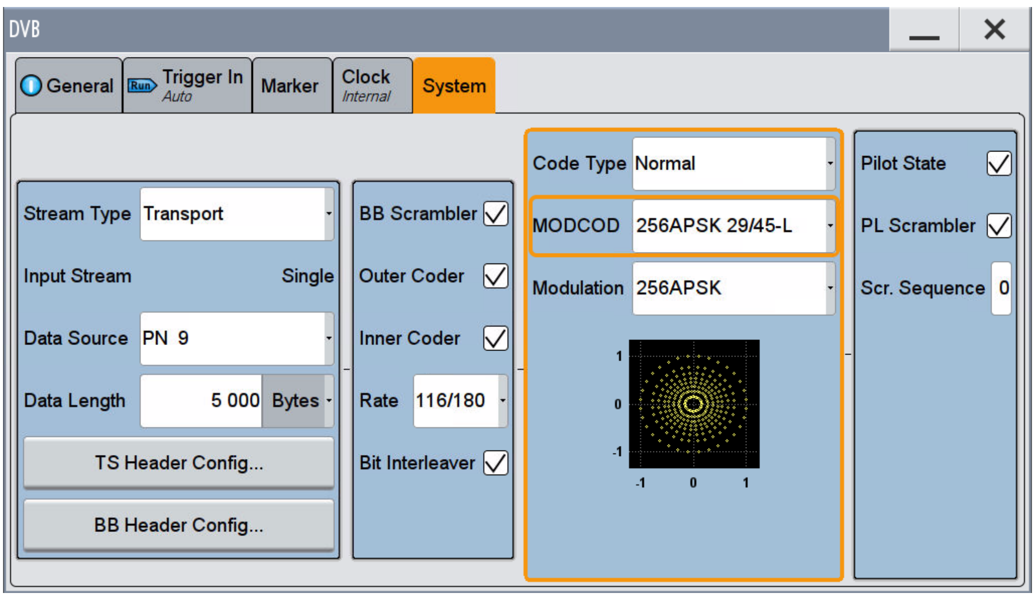


► Select DVB-S2X or DVB-S2 as the signaling standard

► Click Filter/Clipping Settings and define the required parameters



► Now go into the System menu and select the preferred MODCOD



► At this point, set the signal frequency. (for this example it is set at 33 GHz)

► Next turn on I/Q mod

► Finally, switch on RF

4.3 DVB-S2X Signal Generation using SLG + Third Party Up-converter

The SLG is primarily suited for performing RF tests on satellite TV components. Its interfaces, which are commonly used in consumer electronics and professional satellite electronics, make the generator ideal for testing tuners and set-top boxes as well as up-converters, amplifiers and satellite payloads.

In order to up-convert the DVB-S2X signals from the SLG to the K-band, a combination of the SLG and VSBU equipment (from Work Microwave) is used.

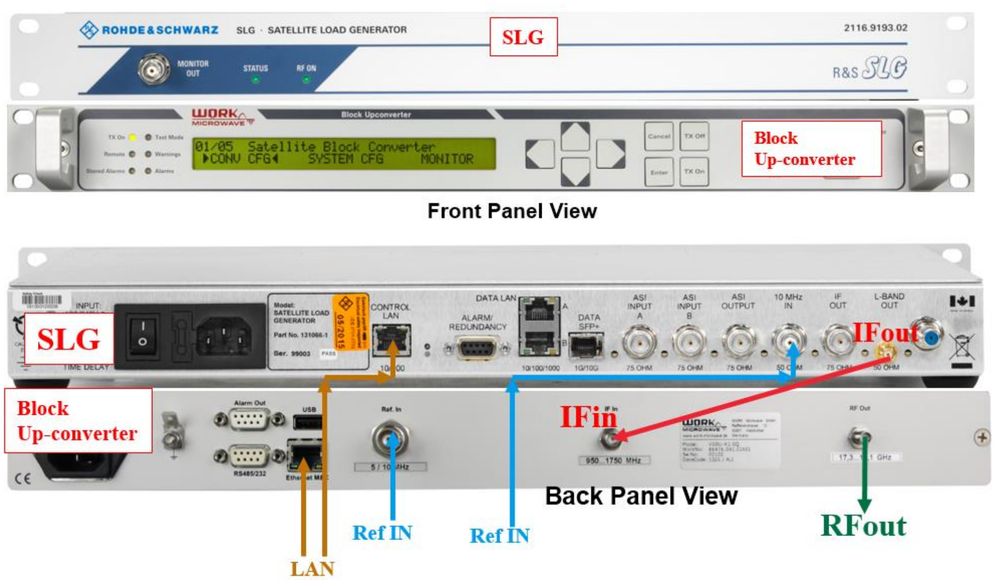


Figure 3: Front & Back Panel View of Equipment Connection

Figure 3 shows the front panel view and back panel view for the instrumental connection between SLG and VSBU equipment (from Work Microwave) instruments.

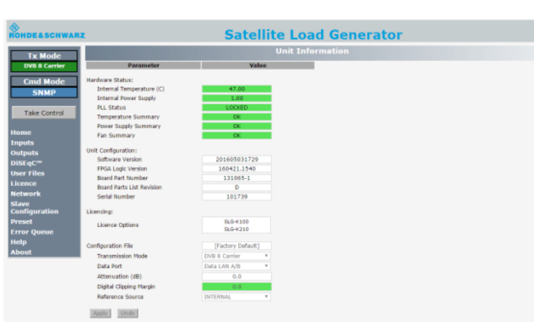
4.3.1 DVB-S2X Signal Generation in K-band (Parametric Configuration on SLG web interface)

This section explains an example on how to generate DVB-S2X signals and the parametric configuration on the SLG web interface.

► From Any web browser type the IP address of the SLG

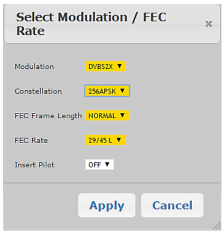
– To find the IP address, go to the Command Prompt of the control computer and type in *ping -4 rsslg-xxxxxx.local* (where xxxxxx is the serial number)

► Click on *Take Control* on left column panel

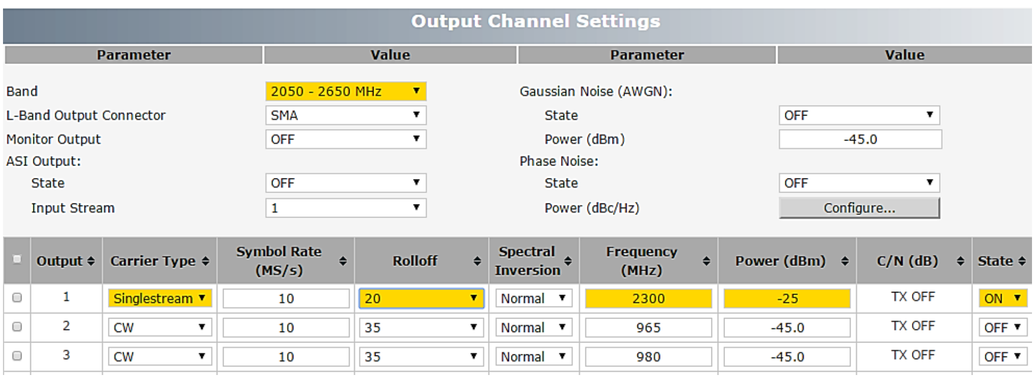


► Select Reference source as *EXTERNAL* and click *Apply*

- Click on *Inputs* and configure as follows
  - *Input Source*: PN23 SYNC Insert
  - Modulation / FEC Rate



  - Click on *Apply* to save the settings
- Click on *Outputs* and configure as follows
  - Band: 2050 - 2650 MHz



  - Click on *Apply* to save settings
- Switch on Tx ON (on the VSBU Work Microwave)

5 Signal Analysis using the FSW

5.1.1 Installation of the Analysis Software

The analysis can be performed using a software tool that automates the configuration and provides the variety of different constellations that are used within DVB-S2(X).
The software can be downloaded free of charge from http://www.rohde-schwarz.com/appnote/1EF93.

The software does not require any installation. Simply double click on the executable, either on a PC that has a connection to the instrument (GPIB or LAN) or directly on the instrument. When the software runs directly on the instrument, the VISA Analyzer address can be left in its default "`TCPIP::localhost`", otherwise the VISA resource string specifies the connection and address of the instrument. (Then the VISA address of the analyzer just has to be set to `TCPIP::localhost`)

5.1.2 Installing the User Modulation files on the FSW

Since the DVB-S2(X) standard uses a variety of dedicated mappings, it is necessary to supply each constellation as a user modulation file (".vam") to the FSW. The software package comes with all mappings defined in the DVB-S2 and DVB-S2X standards. The "Copy Constellations" button copies all constellation files onto the instrument. All constellation files need to be located on the instrument before the software can run the first measurement.

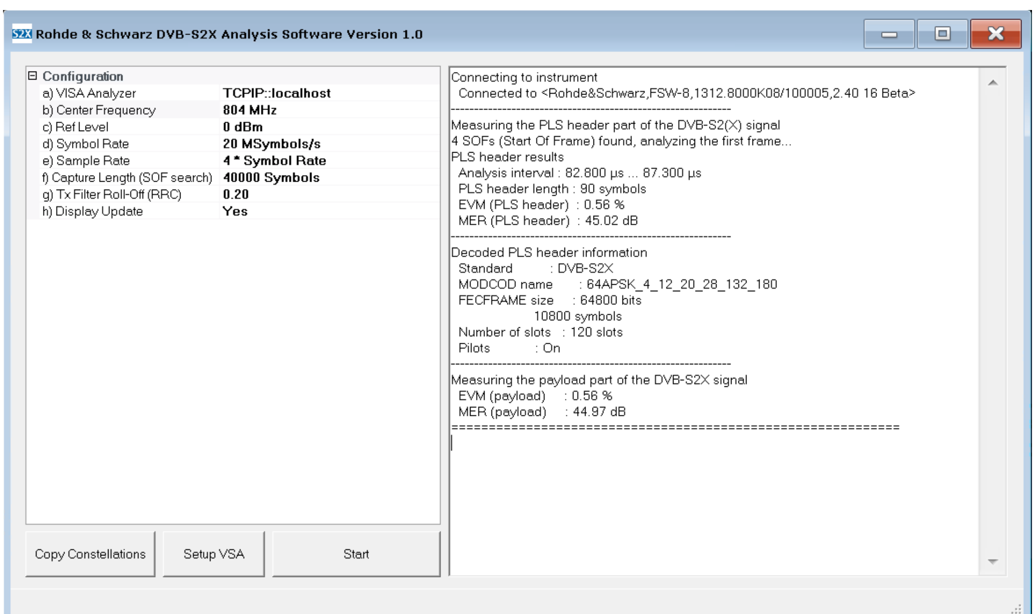


Figure 4: Screenshot of the DVB-S2X Analysis software running on an R&S FSW. A onetime "Copy Constellations" is required. "Setup VSA" sets up the MSRA and VSA channels. "Start" initiates the measurement.

5.1.3 Configuring the FSW

The instrument is configured automatically by pressing "Setup VSA". The configuration section on the left side of the software specifies all parameters that are not predefined in the standard. The symbol rate is completely open, i.e. it can be adapted to the data throughput needs and the available bandwidth. The transmit filter roll-off coefficient determines the signal's bandwidth at a given symbol rate. [1] specifies coefficients of .20, .25, and .30, whereas [2] adds .05, .10, and .15.

The Capture Length for the header channel defines the search range for the SOF pattern and is given in symbols. This parameter significantly influences the measurement speed. The default setting of 40,000 symbols ensures that the header channel will always find the SOF pattern. 64800 bit per frame result in 32400 symbols with QPSK modulation. Adding 180 symbols for two header sections results in the minimum length that guarantees a successful pattern search. If your signal uses a higher order modulation and you need to increase measurement speed, you may decrease this number.

The Sampling Rate is derived from the symbol rate with an oversampling factor. A factor of 4 is sufficient.

When you have adapted the above settings to your signal, the software configures the instrument as soon as you hit "Setup VSA".

"Start" finally initiates the measurement on the preconfigured instrument and displays the results in the window on the right hand side.

Attention
For a more detailed discussion on DVB-S2X signal analysis, as well as, how to analyze signals with two different modulation schemes using the FSW in the Multi-Standard-Radio-Analyzer (MSRA) and Vector Signal Analysis personality, please read the application note **1EF93**. **https://www.rohde-schwarz.com/appnote/1EF93**

6 Measurement Setup and Results

6.1 Measurement Setup

6.1.1 Measurement setup using BTC

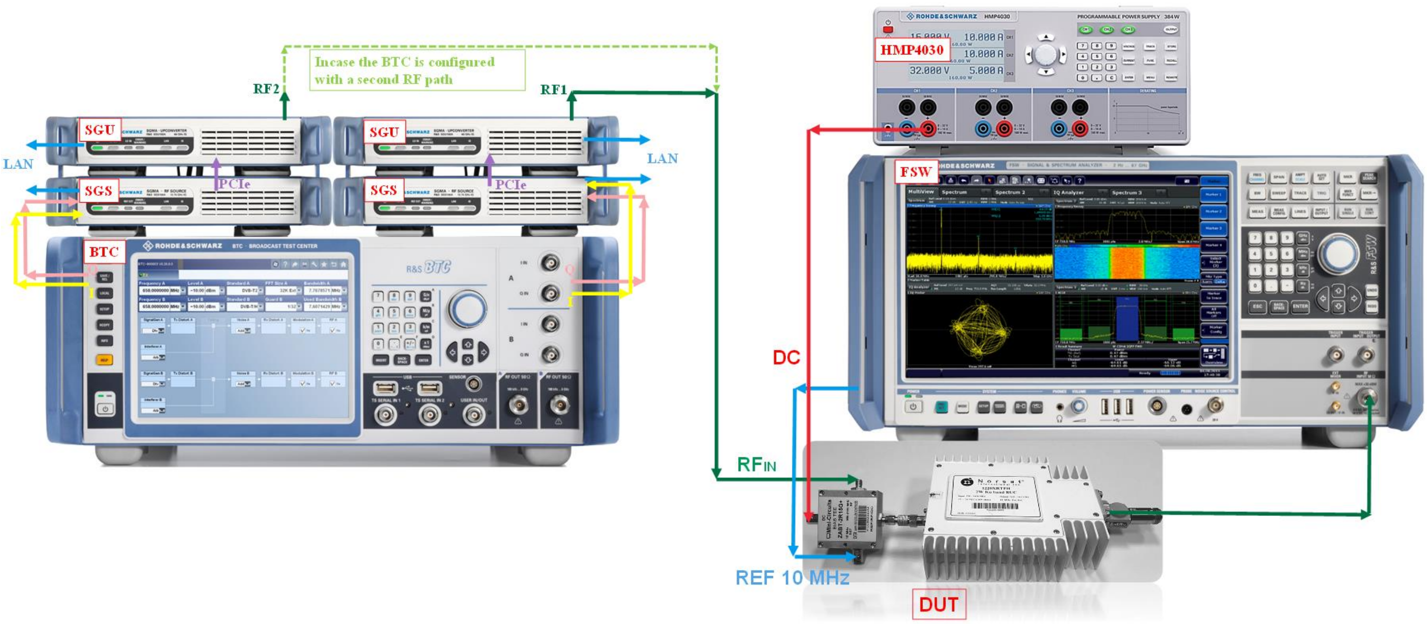


Figure 5: Generated DVB-S2 & DVB-S2X Test Signal Quality Analysis using FSW

Figure 5 shows the measurement setup for generating a DVB-S2 or DVB-S2X test signal and characterizing the performance (in terms of EVM and MER) of a DUT using the FSW. However, this application note is intended at providing the reader with a clear idea of the quality of the generated K-band DVB-S2 and DVB-S2X signal. With that in mind, a direct connection is setup from the signal generator to the signal and spectrum analyzer. The quality of the test signal is then measured.

6.1.2 Measurement setup using SMW

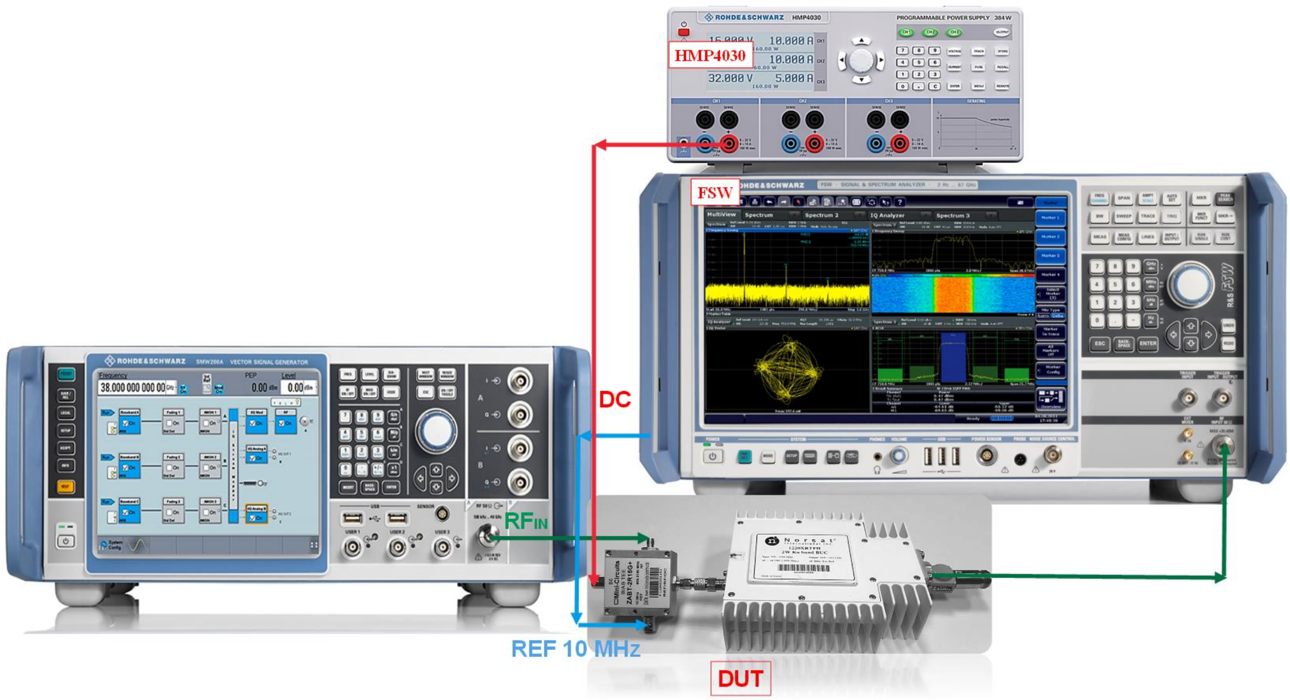


Figure 6: DVB-S2 & DVB-S2X Signal Generated using SMW and Signal Quality Analysis using FSW

Figure 6 shows the measurement setup for generating a DVB-S2 or DVB-S2X test signal using the SMW and characterizing the performance (in terms of EVM and MER) of a DUT using the FSW. However, this application note is intended at providing the reader with a clear idea of the quality of the generated K-band DVB-S2 and DVB-S2X signal. With that in mind, a direct connection is setup from the signal generator to the signal and spectrum analyzer. The quality of the test signal is then measured.

6.1.3 Measurement Setup using SLG

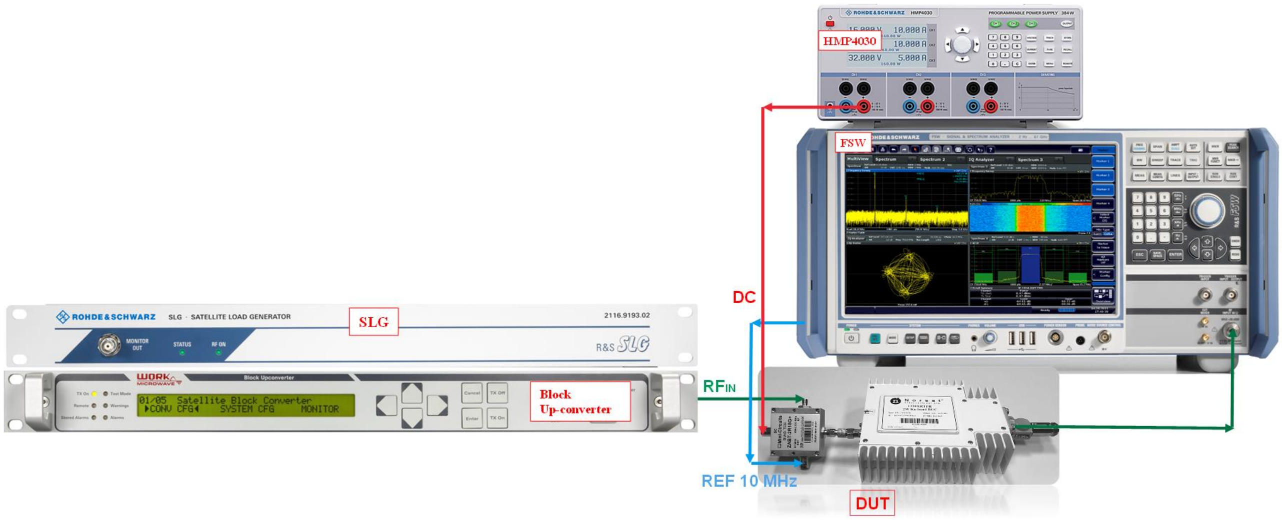


Figure 7: Generated DVB-S2X Test Signal Quality Analysis using FSW

Figure 7 shows the measurement setup for generating a DVB-S2 or DVB-S2X test signal and characterizing the performance (in terms of EVM and MER) of a DUT using the FSW. However, this application note is intended at providing the reader with a clear idea of the quality of the generated K-band DVB-S2 and DVB-S2X signal. With that in mind, a direct connection is setup from the signal generator to the signal and spectrum analyzer. The quality of the test signal is then measured.

6.2 Measurement Results

6.2.1 DVB-S2X 256APSK signal generated using BTC

Signal Type:

► 256APSK 32/45 Sx (Mod.Cod 64 on BTC)

► Symbol Rate: 20 MS/s, Roll Off : 0.2

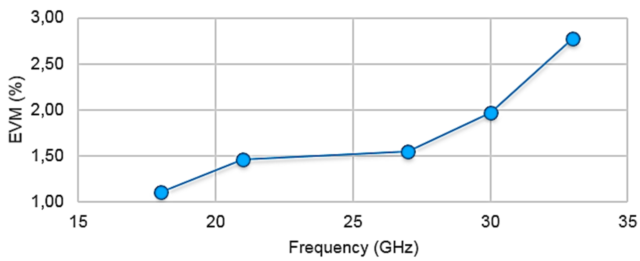


Figure 8: EVM measurement on DVB-S2X 256APSK signal generated using BTC and analyzed using FSW at different frequencies

Figure 8 shows the EVM measurements on DVB-S2X signals. The FSW is capable of analyzing RF signal up to 85 GHz without the need of external down conversion.

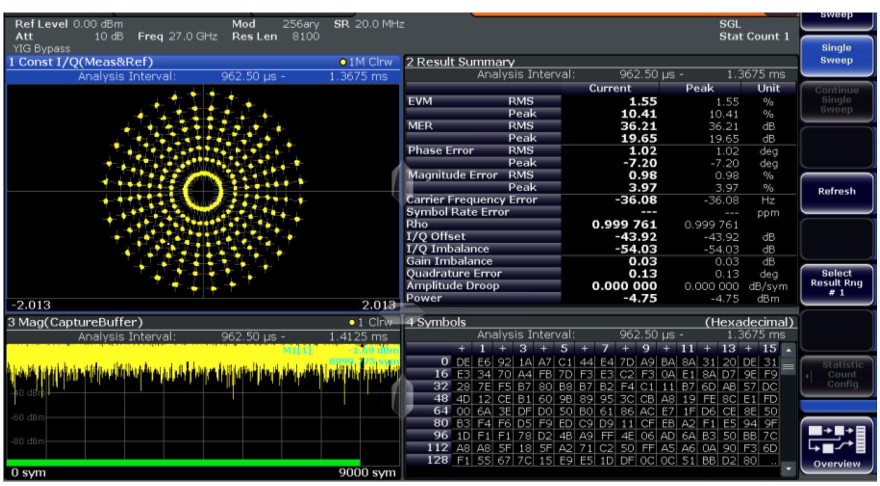


Figure 9: 256APSK modulated DVB-S2X signal measurement on the FSW at 27 GHz

Figure 9 shows the DVB-S2X signal with 256APSK modulation from the BTC being analyzed at 27 GHz.

6.2.2 DVB-S2 32APSK signal generated using BTC

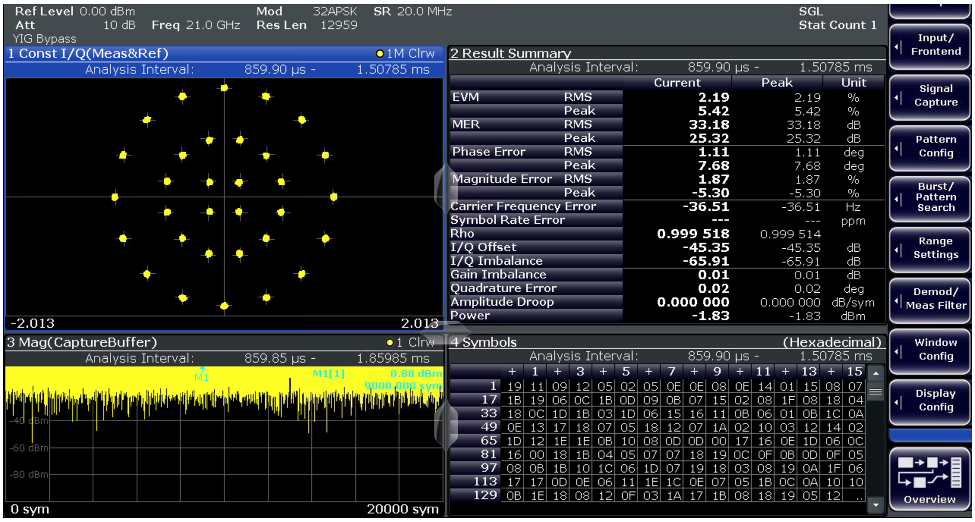


Figure 10: DVB-S2 Signal Analysis using FSW-K70 at 21 GHz

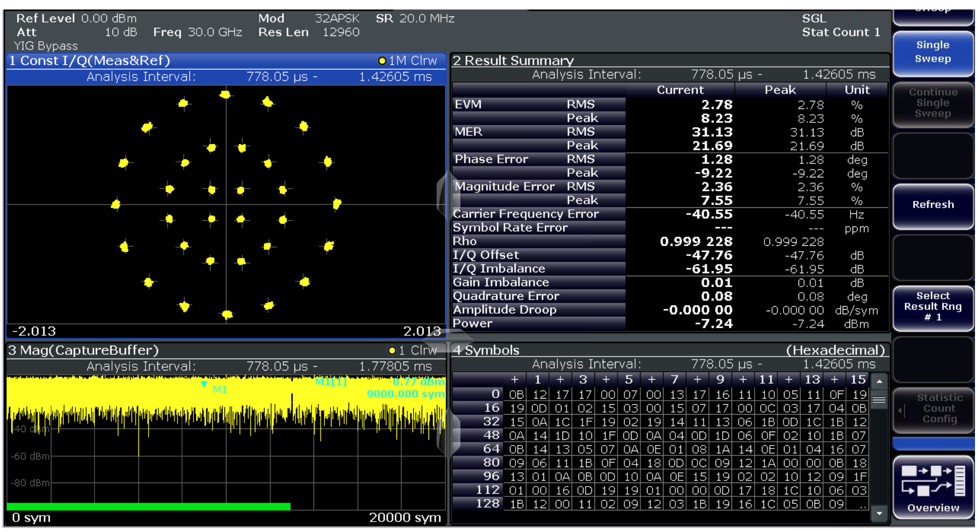


Figure 11: DVB-S2 Signal Analysis using FSW-K70 at 30 GHz

Figure 10 and Figure 11 shows the DVB-S2 signal with 32APSK modulation (Roll-off = 0.25, Symbol Rate = 20 MS/s and code rate 4/5) from the BTC being analyzed at 21 GHz and 30 GHz.

6.2.3 DVB-S2X 256APSK signal generated using SMW

Signal Type:

- 256APSK 29/45-L MODCOD
- Symbol Rate: 20 MS/s, Roll Off: 0.2

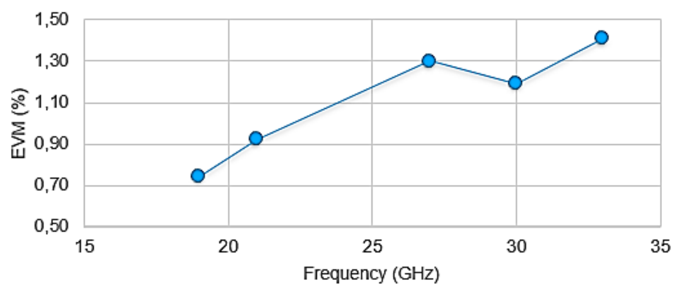


Figure 12: EVM measurement on DVB-S2X 256APSK signal generated using SMW and analyzed using FSW at different frequencies

Figure 12 shows the EVM measurements on DVB-S2X signals. The FSW is capable of analyzing RF signal up to 85 GHz without the need of external down conversion.

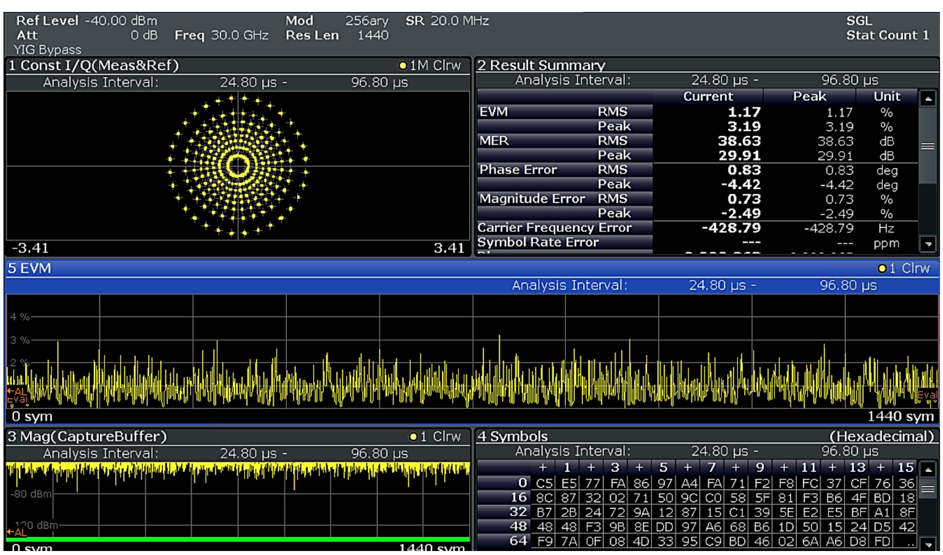


Figure 13: 256APSK modulated DVB-S2X signal measurement on the FSW at 30 GHz

Figure 13 shows the DVB-S2X signal with 256APSK modulation from the SMW being analyzed at 30 GHz.

6.2.4 DVB-S2 32APSK signal generated using SMW

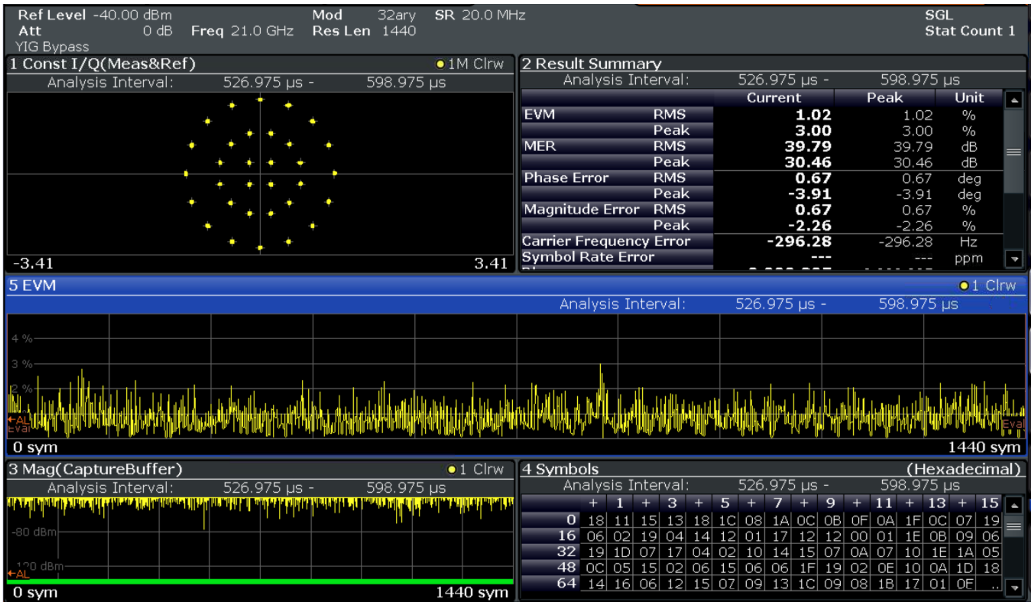


Figure 14: DVB-S2 Signal Analysis using FSW-K70 at 21 GHz

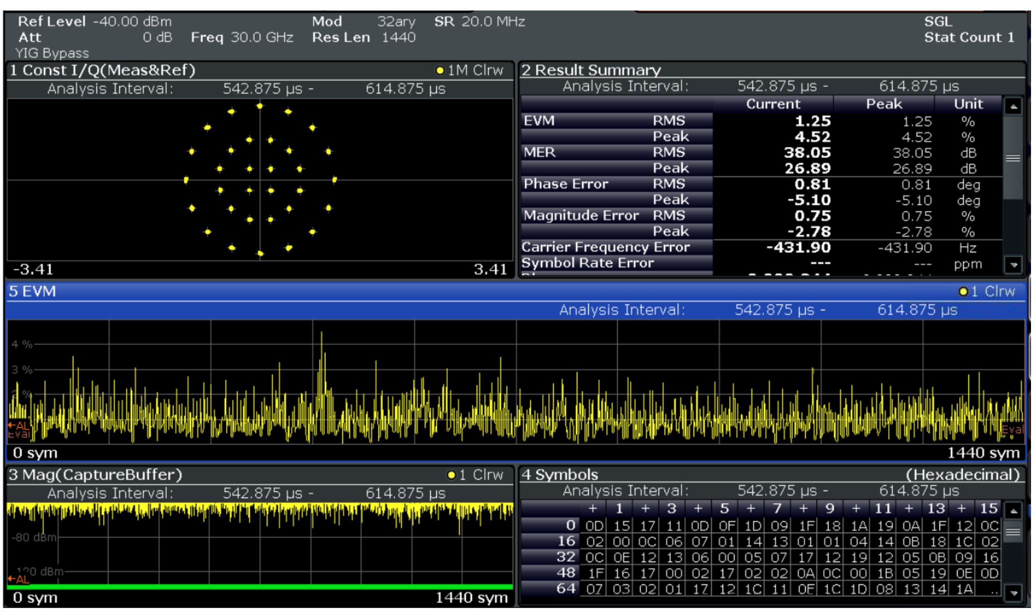


Figure 15: DVB-S2 Signal Analysis using FSW-K70 at 30 GHz

Figure 14 and Figure 15 shows the DVB-S2 signal with 32APSK modulation (Roll-off = 0.25, Symbol Rate = 20 MS/s and code rate 4/5) from the SMW being analyzed at 21 GHz and 30 GHz.

6.2.5 DVB-S2X 256APSK signal generated using SLG

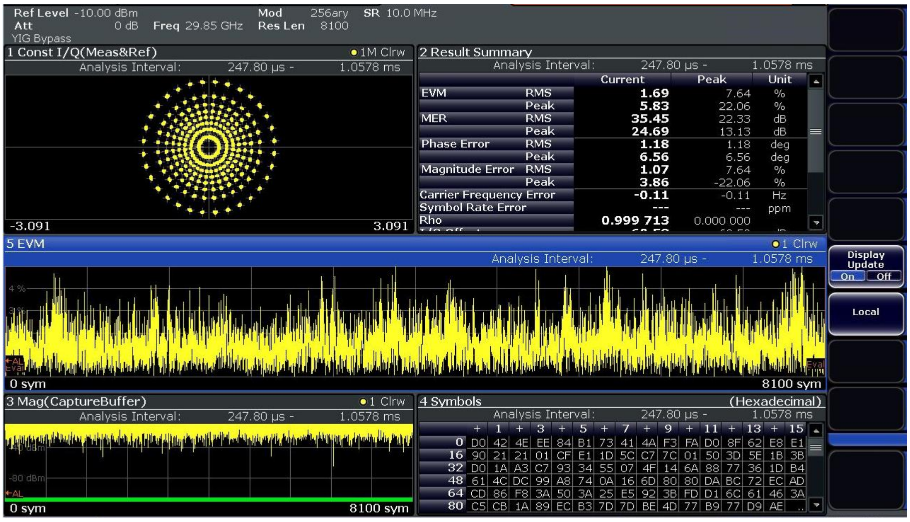


Figure 16: DVB-S2X Signal Analysis using FSW-K70 at 29.85 GHz (Ka-band)

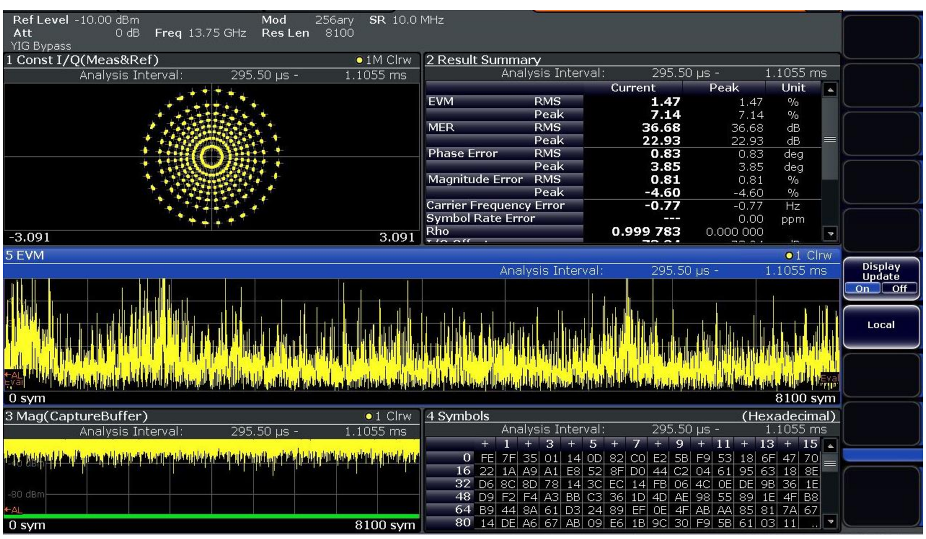


Figure 17: DVB-S2X Signal Analysis using FSW-K70 at 13.75 GHz (Ku-band)

Figure 16 and Figure 17 shows the DVB-S2X signal with 256APSK modulation (Roll-off = 0.2, Symbol Rate = 10 MS/s) from the SLG being analyzed at 13.75 GHz and 29.85GHz.

7 Literature

[1] V. M. B. S. M. T. A. Bertella, *Laboratory evaluation of DVB-S2 state-of-the-art equipment,* RAI-CRIT.

[2] European Standard (Telecommunications series), *ETSI EN 302 307 V1.2.1 (2009-08).*

[3] K. Willems, *DVB-S2X Demystified (White Paper),* Newtec.

[4] HUGHES, *The view from JUPITER: High-Throughput Satellite Systems (White Paper),* 2013.

[5] TM-S ad-hoc group, *White Paper on the use of DVB-S2X for DTH applications, DSNG & Professional Services, Broadband Interactive Services and VL-SNR applications,* DVB Document A172.

[6] European Standard (Telecommunications series), *ETSI EN 302 307-2 V1.1.1 (20014-10).*

8 Ordering Information

Broadcast Test Center*

Designation	Type	Order No.
Broadcast Test Center	R&S®BTC	2114.3000.02
Frequency range 100 kHz up to 6 GHz, RF Path A	R&S®BTC-B3106	2114.3200.02
100 kHz to 6 GHz, RF path B	R&S®BTC-B3206	2114.3400.02
Baseband Generator 1st channel	R&S®BTC-B1	2114.3500.02
Baseband Generator 2nd channel	R&S®BTC-B2	2114.3600.02
Extended I/Q Interfaces Analog and digital IQ-Inputs and Outputs Enables installed hardware interfaces	R&S®BTC-K2500	2114.7293
Baseband Main Module, one I/Q path to RF	R&S®BTC-B11	2114.6500.02
Baseband Main Module, two I/Q paths to RF	R&S®BTC-B12	2114.6600.02
100 kHz to 6 GHz, RF path B	R&S®BTC-B3206	
Low Phase Noise	R&S®BTC-B3100	2114.6000.02
Arbitrary Waveform Generator, 1GSample	R&S®BTC-K35	2114.6974.02
DVB-S/S2, real-time coder	R&S®BTC-K508	2114.7093.02
DVB-S2X, real-time coder S2-/S2X-/S2X VL-SNR MODCODs	R&S®BTC-K510	2114.7170.02
Path A Fading Simulator	R&S®BTC-B1031	2114.3700.02
Path B Fading Simulator, (HW opt.)	R&S®BTC-B1032	2114.3800.02
Dynamic Fading Additional fading profiles Birth Death, Moving propagation and more	R&S®BTC-K1031	2114.7158
AWGN Generator Package up to 160 MHz bandwidth, additive white gaussian noise, option package (2 paths)	R&S®BTC-K1040	2114.7770.02
Extended AWGN Generator, option package (SL) Additive White Gaussian Noise Generator, phase noise, impulsive noise, option package (2 paths)	R&S®BTC-K1043	2114.7787.02
DVB-CID Waveforms	R&S®WV-K810	
Satellite Interferers	R&S®WV-K1123	2116.9970.02

Satellite Load Generator*

Designation	Type	Order No.
Multichannel digital satellite TV modulator	R&S®SLG	2116.9193.02
SLG Master Upgrade	R&S®SLG-K100	2116.9341.02

SGMA RF Source and Upconverter*

Designation	Type	Order No.
SGMA RF Source	R&S®SGS100A	1416.0505.02
1 MHz to 6 GHz, I/Q (with vector modulation)	R&S®R&S-B106V	1416.2350.02
Frequency Extension to 12.75 GHz, IQ	R&S®SGS-B112V	1416.1576.02
Reference Oscillator OCXO	R&S®SGS-B1	1416.2408.02
Electronic Step Attenuator	R&S®SGS-B26	1416.1353.02
SGMA Upconverter	R&S®SGU100A	1416.0808.02
10 MHz to 20 GHz, I/Q (with vector modulation)	R&S®SGU-B120V	1418.2657.02
Frequency extension to 40 GHz, I/Q	R&S®SGU-B140V	1418.2928.02
Mechanical Step Attenuator	R&S®SGU-B26	1418.3401.02
Connection Kit SGU100A to SGS100A	R&S®SGU-Z4	1418.3701.02

SMW200A Vector Signal Generator *

Designation	Type	Order No.
Vector Signal Generator	R&S®SMW200A	1412.0000.02
100 KHz to 40 GHz	R&S®SMW-B140	1413.0604.02
Signal routing and baseband main module, one I/Q path to RF	R&S®SMW-B13	1413.2807.02
Fading Simulator	R&S®SMW-B14	1413.1500.02
Dynamic Fading	R&S®SMW-K71	1413.3532.02
DVB-S2/DVB-S2X	R&S®SMW-K116	1414.3259.02

Signal and Spectrum Analyzer*

Designation	Type	Order No.
Signal und spectrum analyzer 2 Hz to 43.5 GHz	R&S®FSW43	1312.8000.43
RF preamplifier, 100 kHz to 43 GHz	R&S®FSW-B24	1313.0832.43
Resolution bandwidth > 10 MHz	R&S®FSW-B8	1313.2464.02
160 MHz Analysis Bandwidth,	R&S®FSW-B160	1313.1668.02
Vector Signal Analysis	R&S®FSW-K70	1313.1416.02
500 MHz Analysis Bandwidth	R&S®FSW-B500	1313.4296.02
OCXO Precision Reference Frequency	R&S®FSW-B4	1313.0703.02
Electronic Attenuator, 1 dB steps	R&S®FSW-B25	1313.0990.02

*Other ZVA, FSW, RTO, vector signal generator (SMW, SGU, SGS, SGT), BTC, Power Sensor, Power Meter are available as well. More Options are available. The instrument's minimum configuration for this application is shown in the table. Please ask your local representative for a suitable configuration according to your needs.

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1MA273 | Version 3e | 11.2021
Application Note | DVB-S2 & DVB-S2X Signal Generation in K-band and Analysis
Data without tolerance limits is not binding | Subject to change