

MaxEye Digital Video Signal Analysis Toolkit

DVB-T2

Version 1.0.6.2

Getting Started Guide



Contents

1. Introduction	
2. InstalledFile Location	
3. ProgrammingExamples	ì
3.1. Measure Modulation Accuracy4	
3.1.1 MaxEye DVBT2 RFSA Measure Modulation Accuracy4	
3.1.2 MaxEye DVB-T2 USRP Measure Modulation Accuracy12	
3.1.3 MaxEye DVB-T2 USRP Measure Modulation Accuracy – External Wfm Acqtn 14	
3.2. Spectral Measurements	•
3.2.1 MaxEye DVB-T2 RFSA Spectral Measurements14	
3.2.2 MaxEye DVB-T2 USRP Spectral Measurements17	
4. Tips for searching examples in NI Example Finder 19	I



1. Introduction

The MaxEye DVB-T2 Signal analysis toolkit contains LabVIEW VIs to perform measurements on DVB-T2 signals that confirm ETSI standard EN 302755 version 1.3.1. Refer to the ETSI EN 302755 standard for the signal specifications and this document assumes that the user is familiar with the DVB-T2 standard specification. Thisguideexplainshowto use theDVB-T2SignalAnalysistoolkitusingtheprogramming examples.

2. InstalledFile Location

The toolkit help file is installed in, <LabVIEW>\help\MaxEye\Digital Video Toolkits\DVB-T2 Signal Analysis Help.chm

 $The other documentation files are installed in < LabVIEW > \vi.lib\addons\MaxEye\Digital Video Toolkits\DVB-T2 Analysis\Analysis\Documentation$

ThetoolkitAPIfilesareinstalledin,<LabVIEW>\vi.lib\addons\MaxEye\DigitalVideoToolkits\DVB-T2Analysis\Analysis\API.in

You can also findashortcut to the abovelocation from thewindows startmenu.

Start->AllPrograms->MaxEye->Digital VideoToolkits->DVB-T2

3. ProgrammingExamples

TheDVB-T2 SignalAnalysis toolkitcontains examples forperforming the following

- i. Modulation Accuracy of the DVB-T2 transmitter can be analyzed based on the signal acquired from the NI RFSA or NI USRP.
- ii. Perform the Spectral Measurements of the signal acquired from the NI RFSA or NI USRP.



Theprogrammingexamplesarecreatedusing theLabVIEWAPI VIs.Formoreinformationabout theAPI VIusedintheexampleVIsrefertotheMaxEyeDVB-T2Signal AnalysisHelp.chm document, accessible atStart->AllPrograms->MaxEye->DigitalVideoToolkits->DVB-T2->\<LabVIEW>\Analysis ->Documentation.

3.1. Measure Modulation Accuracy

DVB-T2Signal Analysis toolkit measures the performance of the RF front end of the DVB-T2 transmitter. The DVB-T2Signal Analysis toolkit has an example to measure the modulation accuracy of the transmitter by performing the measurements on the signal acquired from the NI RFSA or NI USRP.

3.1.1 MaxEye DVBT2 RFSA Measure Modulation Accuracy

This Example is used to measure the modulation accuracy of the DVB-T2 transmitter. The measurements are performed on the signal acquired from the hardware. The Figure 1below shows the front panel of the Example VI.

The user configurations are divided in to four categories

- 1. Hardware Settings
- 2. Measurement Settings
- 3. Measurement Plots1
- 4. Measurement Plots2
- 5. L1 Signaling Parameters
- 6. L1 Post Signaling Parameters
- 7. Measurement Results



nfiguration	Measurement Plots1	Measurement Plots1 2	L1 PreSignaling Params	L1 Post Signaling Params	L1 Post Data Measurement Results			
_			, , ,			RMS EVM dB	weasurem	Dook EVM dP
Hardware	Configuration	1	Measurement Configura	tion		0		0
	Resource Name	RESA 💌	Bandwidth			RMS EVM, %		Peak EVM, %
Ca	rrier Frequency (Hz) (474.000M	Minz"			0		0
	Auto Level	False	20.7			Data MER, dB		Peak MER, dB
Maximum	Input Power (dBm)	0.00	Number of Averages			Data Magnitu	de Error, dB	Peak EVM Symbol Position
Exter	nal Attenuation (dB)	0.00	1			0		0
Frequency	Reference		PLP Index			Data Phase Er	ror, deg	
	Peference Source	PXI CIL	V ⁰			10	EET Size	
	Eronuon cu (Hz)	10.0005.6					111 3120	
	riequency (Hz)	10.000E+0					Average	Power, dBm
rigger							0	
	Trigger En	abled 💽					Peak Pov	ver, dBm
	Edge 쉬	Rising Slope					0	
P	reTrigger Delay, sec 🕴	0					Frequenc	ry offset, Hz
	Trigger Level (dBm) 🗐	-20.00					Clock Off	fset (PPM)
N	Ain Quiet Time (sec) 🗍	0.000E+0					0	
							IQ gain ir	mbalance, dB
							0.00	
							IQ Offset	, dB
							Ouadrate	raskov doa
							0.00	ne skew, deg

Figure 1



3.1.1.1 Hardware Settings

Resource Name 7	RFSA
Carrier Frequency (Hz) $\frac{7}{7}$	474.000M
Auto Level	False
Maximum Input Power (dBm)	10.00
External Attenuation (dB) $\frac{7}{7}$	0.00
Frequency Reference	
Reference Source	PXI_Clk
Frequency (Hz) +	10.000E+6
gger	abled 🔵 🗩
Trigger En	The second secon
Trigger En Edge 쉬	Rising Slope
Trigger En Edge 7 PreTrigger Delay, sec 7	Rising Slope
Trigger En Edge () PreTrigger Delay, sec () Trigger Level (dBm) ()	Rising Slope 0 -20.00



RFSA Resource– Configure the resource name used in NI Measurement and Automation explorer for the RFSA.

Carrier Frequency(Hz)–Center Frequency of theDVB-T2signal in Hz.

Auto Level (TRUE/FALSE) – Sets the best reference level for the instrument based on the peak power of the measured signal.

Maximum Input Power Level (dBm)– Maximum expected power of an input RF signal.

External Attenuation(dB), Reference Source, Frequency(Hz), Trigger settings– Refer NI RFSA Signal Analyzer help file.



3.1.1.2 Measurement Settings

The Measurement Settings for DVB-T2 Signal Analysis contains Measurement Mode property which specifies the type of measurement performed on the acquired signal. Two measurement modes are supported Demodulation Measurements or Spectral Measurements. The help for each of the properties is availableinDVB-T2 Signal Analysis Help.chm file.

Bandwidth	
"8Mhz"	
Acquisition L	ength, sec
0.7	
Number of A	verages
1	
PLP Index	
0	

Figure 3

PLP Index – the EVM measurements are performed based on the value specified by this property.

Acquisition Length – Configure the Acquisition Length in seconds. The toolkit performs the measurements using one Time Interleaver block. So the minimum acquisition length should be twice the Interleaving Frame duration for the selected PLP Index.

Note: The duration of Interleaving Frame depends on the following parameters,

- → Frame Interval
- → TIME_IL_Length
- \rightarrow TIME_IL_TYPE
- → T2 Frame duration





Figure4

Suncarriers -->

Subcarriers -->



3.1.1.3 Measurement Plots

The DVB-T2 Signal Analysis Toolkit returns several plots to analyze the measurement results. Among them important ones are shown in the Figure 4.

- i. Data PLP Constellation Graph
- ii. L1 Post Signaling Data Constellation Graph
- iii. Channel Impulse Response (Magnitude)
- iv. EVM Vs Symbols
- v. Channel Frequency Response (Magnitude)
- vi. Channel Frequency Response (Phase)

Refer to the DVB-T2 Signal Analysis Help.chm file for more information about the measurement traces.

3.1.1.4 L1 Signaling Parameters

nput Stream Type	L1 FEC	No. Data Symbols
TS	LDPC 16K	0
3W Extension	L1 POST Size	Regen Flag
Normal Mode	0	0
51	L1 Post Info SIze	L1 Post Ext
0	0	Disable
52	Pilot Pattern	Num RF
0	PP1	0
1 Repetition	TX ID	Current RF Index
Disabled	0	0
Guard interval	Cell ID	T2 Version
1/32	0	1.1.1
APR Enabled	PAPR ACE Enabled	PAPR TR Enabled
Disabled	Disabled *	Disabled
Nework ID	T2 System ID	L1 Post Scrambled
0	0	FALSE
.1 Mod	No. T2 Frames	T2 Base Lite
BPSK	0	FALSE
.1 Cod		
1/2		



~	PLP Params			L1 Post Data Params	
 	PLP Index 0	PLP Group ID 0	Frame Interval	Sub slices per frame	RX Idx 0
	PLP ID	PLP COD	Time IL Length	Number of PLPs	Frequency 0
	PLP Type Comm	PLP Mod QPSK	Time IL Type	0 Aux_Config_RFU	FEF Length MSB
	PLP Payload Type GFPS	PLP Rotation	InBand A Flag	0 FEF Type	0 Auxillary Stream Loop
	FF Flag 0	PLP FEC Type 16K	InBand B Flag	0 FEF Length	Aux Stream Type TX_SIG
	First RF IDX	PLP Num Blocks Max	PLP Mode <0>	0 FEF Interval	Aux Private CONF
	First Frame Index	Static Flag	Static Padding Flag	Frame Index	Frame Index Next Frame
	PLP Start	PLP Num Blocks Next	Frame	Sub Slice Interval	Sub Slice Interval Next Frame
	PLP Num Blocks	PLP Start Next Frame		Type 2 Start	0
	,			L1 Change Counter	0 Start RF Idx Next Frame
				0 Aux Private Dvn	0 Aux Private Dyn Next Frame
				0	0

Figure 6

3.1.1.4 Measurement Results

The most important measurement results are shown separately as shown in the Figure7. The toolkit averages these measurement results over the number of acquisitions specified by the Number of Averages value.



Me	easurement Results	
RMS EVM, dB	L1 Post Data EVM, dB	
0	0	
RMS EVM, %	L1 Post Data EVM, %	
0	0	
Data MER, dB	L1 Post Data MER, dB	
0	0	
Data Magnitude Error, dB	L1 Post Data Magnitude Error, dB	
0	0	
Data Phase Error, deg	L1 Post Data Phase Error, deg	
0	0	
Peak EVM, dB	L1 Post Data Peak EVM, dB	
0	0	
Peak EVM, %	L1 Post Data Peak EVM, %	
0	0	
Peak MER, dB	L1 Post Data Peak MER, dB	
0	0	
Peak EVM Symbol Position	L1 Post Data Peak EVM Symbol Position	
0	0	
Frequency of	ffset, Hz	
0		
Clock Offset	(PPM)	
0		
IQ gain imba	alance, dB	
0.00		
IQ Offset, dB		
0		
Quadrature	skew, deg	

Figure 7



3.1.2 MaxEye DVB-T2 USRP Measure Modulation Accuracy

This Example is used to measure the modulation accuracy of the DVB-T2 transmitter. The measurements are performed on the signal acquired from the USRP. The Figure 8 shows the front panel of the Example VI.

The user configurations are divided in to three categories

- 1. Hardware Settings
- 2. Measurement Settings
- 3. Measurement Plots1
- 4. Measurement Plots2
- 5. L1 Pre Signaling Parameters
- 6. L2 Post Signaling Parameters
- 7. Measurement Results

			27		🔹 Search
uration Measurement Plots1 Measurement	Plots1 2 L1 Pre-Signalling Params	L1 Post-Signalling Params	L1 Data Measurement Results	Me	asurement Results
rdware Configuration	Measurement Configuration			RMS EVM, dB	Peak EVM, dB
ice name	Bandwidth			0	0
92.168.10.2	A "8Mhz"			RMS EVM, %	Peak EVM, %
Rate Coerced IQ Rate	Acquisition Length sec				D LAKED ID
DM 100k	- 0.5			Data MER, dB	
arrier Frequency Coerced Carrier Frequency	Number of Averages			Data Magnitude	Fror dB Peak FVM Symbol Position
74M 100k				0	0
in Coerced Gain	PLP Index			Data Phase Error,	deg
]0	- 0			0	
mple Width	1				
b-bit tive Antenna					FFT Size
2					Average Dower dBm
					Average Power, doni
					Peak Power, dBm
					0
					Frequency offset, Hz
					0
					Clock Offset (PPM)
					0
					IQ gain imbalance, dB
					0.00
					IQ Offset, dB
					10
					Quadrature skew, deg
					10.00

Figure 8



3.1.2.1 Hardware Settings

Device name	
¹ / ₀ 192.168.10.2	•
IQ rate	coerced IQ rate
/ 10M	0
Carrier Frequency	Coerced Carrier Frequency
474M	0
Active antenna	Coerced Gain
RX2	0
Gain	
(T) 0	
Sample Width	
() 16-bit	

Figure 9

Device Name – specifies the IP address of the NI USRP device.

IQ Rate – sampling rate of the signal to be acquired. Configure this value based on the signal bandwidth of the transmitted DVB-T2 signal.

Carrier Frequency – Center Frequency of the DVB-T2 signal in Hz.

Sample Width, Active Antenna, Gain, Expected Peak, coerced IQ rare, coerced carrier frequency, and coerced gain – Refer NI USRP help file.

Note: The rest of the front panel controls are similar to the example **MaxEye DVBT2 RFSA Measure Modulation Accuracy**.



3.1.3 MaxEye DVB-T2 USRP Measure Modulation Accuracy - External Wfm Acqtn

This Example is used to measure the modulation accuracy of the DVB-T2 transmitter. **The measurements are performed on the single acquisition of the signal from the USRP**. Hence the measurements cannot be averaged. The front panel is identical to the example mentioned in the Section 3.1.2.

Edit View Project Operate Tools Window H	lp		(****	
A A A A A A A A A A A A A A A A A A A			► S	earch 🔍 🦻 🖽
figuration Measurement Plots 1 Measurement Plot	ts 2 L1 PreSignalling Results L1 Post Signalling Resul	s L1 Measurement Results	Measure	ment Summary
Hardware Configuration		RM	S EVM, dB	Peak EVM, dB
Device name	Bandwidth	0 Ph4	CEVAA OV	0 Desk EV/M 9/
I 192.168.10.2	# "8Mhz"	0	5 2 4 141, 70	
IQ rate coerced IQ rate	Acquisition Length, sec	Dat	a MER, dB	Peak MER, dB
/ 10M 0	()0.3	0		0
Carrier Frequency Coerced Carrier Frequency	PLP Index	Dat	a Magnitude Error, dB	Peak EVM Symbol Position
T 474M 0	0	0		0
	Path Detection Threshold, dB	Dat	a Phase Error, deg	
Sample Width	J ⁻³⁵	0		
			FFT Si	ze
Active antenna			JIK	
RX2			Avera	ge Power, dBm
			Death	Name dBas
			Peak	ower, abm
			Frequ	ency offset Hz
			0	citey onset, the
			Clock	Offset (PPM)
			0	
			IQ gai	n imbalance, dB
			0.00	
			IQ Off	set, dB
			0	
			Quad	rature skew, deg
			0.00	



3.2. Spectral Measurements

3.2.1 MaxEye DVB-T2 RFSA Spectral Measurements

This example is used to perform the spectral measurements of the signal received from the RFSA. The front panel of the Example VI is shown in the Figure 11.

$\bigcirc \bigcirc$	MAXEYE
$\bigcirc \bigcirc \bigcirc$	TECHNOLOGIES

Hardware Configuration	Spectral Measurement Configuration	Spectral Emission Mask Trace	Plot 0
Resource Name PXIIISlot6 Carrier Frequency (H2) 474.000E+6 Auto Level False Maximum Input Power (dBm) -30.00 External Attenuation (dB) 0.00 Frequency Reference Reference Source OnboardClock Frequency (H2) D0.000E+6	Bandwidth Averaging Mode (1.7Mhz") Vector Span Number of Averages (25M) (10) FFT Window Type Acquisition Length, sec (1.14) (0.001) Resolution Bandwidth Type (0.001) Resolution Bandwidth (Hz) (10) (1.14) (1.14)	-40 - -50 - -60 - -70 - -80 - 99 - 99 - 410 - -110 - -120 -	
ACP Configuration Center Channel Bandwidth (Hz) BM ACP Frequency Offsets (Hz) ACP Bandwidths (H	SEM Configuration SEM Reference Level Type SEM Reference Power Level User Defined 0 SEM Frequency Offsets (Hz) SEM Power Offsets (dB)	-140 - -150 - -160 - 4.6E+8 4.65E+8 4.7E+8 4.75E+8 4.8E+8 Time	4.85E+8 4.9E+8
0 -8E+6 0 -3E+6 3E+6 0 8E+6 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 -1.2E+7 0 -120 -6E+6 -60 -60 -60 -4E+6 0 -60 -60 6E+6 -60 -120 -120 12E+7 -120 -120 -120	Spectral Mask Margin,dB Channel Power (dBm) 0 Adjacent Channel Powers (dBm) 0 0	

Figure11

The user configurations are divided in to four categories

- 1. Hardware Configuration
- 2. Spectral Measurement Configuration
- 3. ACP/SEM Configuration
- 4. Spectral Measurement Results

3.2.1.1 Hardware Settings

Resource Name ¹ ⁄ ₈	PXI1Slot6		
Carrier Frequency (Hz)	474.000M		
Auto Level	False		
Maximum Input Power (dBm) 7	0.00		
External Attenuation (dB)	0.00		
Frequency Reference			
Reference Source	nboardClock		
Frequency (Hz)	10.000E+6		

Figure 12



RFSA Resource – Configure the resource name used in NI Measurement and Automation explorer for the RFSA.

Carrier Frequency (Hz) – Center Frequency of the DVB-T2 signal in Hz.

Auto Level (TRUE/FALSE) – Sets the best reference level for the instrument based on the peak power of the measured signal.

Maximum Input Power Level (dBm) –Maximum expected power of an input RF signal.

External Attenuation (dB), Reference Source, Frequency (Hz), – Refer NI RFSA Signal Analyzer help file.

3.2.1.2 ACP/SEM Configuration

The ACP/SEM configurations for DVB-T2 Signal Analysis are shown in the Figure 13. Thehelpforeachofthe properties is available in DVB-T2 SignalAnalysis Help.chm file.

ACP Co	onfiguration			SEM C	onfiguration		
Center Channel Bandwidth (Hz)				SEM Reference Level Type SEM Reference Power Level			
	ACP Frequency	Offsets (Hz)	ACP Bandwidths (Hz)	SEM F	requency Offsets	(Hz) SEM Po	ower Offsets (dB)
0	/ -8E+6	÷)0	* 8E+6	0	(/ ⊤) -12M	()0	-120
	(r) 8E+6		2 8E+6		-6M		/ -95
	· · 0		() () ()		-4.2M		-83
	(T) 0		0		-3.8M		-32.8
	/ T) 0		0		3.8M		-32.8
	/ T) 0		0		4.2M		-83



3.2.1.3 Spectral Measurement Results

DVB-T2 Signal Analysis tool kit returns the following results

1. Spectral Mask Trace



- 2. Spectral Mask Margin
- 3. Channel Power (dBm)
- 4. Adjacent Channel Powers (dBm)

The help for each of the spectral measurement results is available in DVB-T2 Signal Analysis Help.chm file.



Figure 14

3.2.2 MaxEye DVB-T2 USRP Spectral Measurements

This example is used to perform the spectral measurements of the signal received from the USRP. The front panel of the Example VI is shown in the Figure 15





3.2.2.1 Hardware Settings

The hardware settings of the USRP is similar to the example MaxEye DVBT2 USRP Measure Modulation Accuracy explained in the Section <u>3.1.2.1</u>

Note: Apart from the hardware setting the front panel of the Example VI is similar to the example MaxEye DVB-T2 RFSA Spectral Measurements. For each of the properties please refer the DVB-T2 Signal Analysis help file.

4. Tips for searching examples in NI Example Finder

Use any of the following keywords to search DVB-T2 Signal Analysis examples in the NI Example Finder,

Keywords: dvb-t2, spectral, measurements, modulation, accuracy