

Sx4000 DVB Interoperability Test Declaration

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Content

Confidential Proprietary Notice	3
Document Convention	3
Content	4
Table of Figures	5
Table of Tables	5
Revision History Table	6
Reference Documentation	6
Acronyms, Abbreviations, and Symbols	7
1 Introduction	8
1.1 Interoperability Declarations	8
1.2 DVB-S2/X Standards Compatibility	8
1.3 DVB-RCS2 Standards Compatibility	10
2 Transmission Tests	15
2.1 Transmission Test Setup	15
2.2 Continuous S2/S2X Waveforms	17
2.3 DVB-RCS2 MER/EVM Test	15
3 Reception Tests	12
3.1 Test Setup	12
3.2 DVB-S2\X Continuous Streams	12
3.3 Burst waveform, Annex E, Superframe Format 6	13
3.4 DVB-RCS2 QEF Test	14
4 Multiple Transmission and Reception Tests	19
4.1 Test Setup	19
4.2 DVB-S2X Annex E	19
4.3 DVB-RCS2	20

Table of Figures

Figure 4-1 – Test Setup	19
Figure 4-2 - Time-Frequency Diagram	20

Table of Tables

Table 0-1 - Revision History Table	6
Table 0-2 – Document Approval	Error! Bookmark not defined.
Table 0-3 – Document Approval	Error! Bookmark not defined.
Table 0-1 - Acronyms, Abbreviations, and Symbols	7
Table 1-1 - Interoperability Declarations.....	8
Table 1-2 - DVB-RCS2 Terminal Features Capability.....	10
Table 1-3 - Terminal Profiles Description- Physical Layer.....	11
Table 2-1 - TX MER/EVM Test Results	17
Table 3-1 - QEF Test Results	12
Table 3-2 - SF6 QEF Test Results	13
Table 3-3 – RCS2 QEF Test Results.....	14

Revision History Table

Table 0-1 - Revision History Table

Revision	Name	Date	Description
1.0	Avi Freedman	26/6/2025	Release

Reference Documentation

The following references contain useful information concerning standard compatibility and other supportive documentation:

- [1] ETSI EN 302 307-1: “Digital Video Broadcasting (DVB); Second generation framing structure, channel coding, and modulation systems for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications; Part 1: DVB-S2”.
- [2] ETSI EN 302 307-2: “Digital Video Broadcasting (DVB); Second generation framing structure, channel coding and modulation systems for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications; Part 2: DVB-S2 Extensions (DVB-S2X)”.
- [3] DVB BlueBook A115-1r3: (draftETSI EN 301 545-1 (V1.4.1)): “Digital Video Broadcasting (DVB); Second Generation DVB Interactive Satellite System (DVB-RCS2); Part 1: Overview and System Level specification”.
- [4] DVB BlueBook A115-2r4: (draftETSI EN 301 545-2 (V1.5.1)): “Digital Video Broadcasting (DVB); Second Generation DVB Interactive Satellite System (DVB-RCS2); Part 2: Lower Layers for Satellite standard”.
- [5] TM-S0585r6: “V&V Hardware Interoperability Tests”

Acronyms, Abbreviations, and Symbols

The table below lists and describes all Acronyms, Abbreviations, and Symbols that appear in this document.

Table 0-1 - Acronyms, Abbreviations, and Symbols

Acronym	Description
CB	Carrier Board
dB	Decibel
EVM	Error Vector Magnitude
FER	Frame Error Rate
MER	Modulation Error Rate
MODCOD	MODulatio&CODing
Msp/s	Mega Symbols Per Second
PC	Personal Computer
PLS	Physical Layer Signaling
QEF	Quasi Error Free
RX	Receive
SF	SuperFrame
SFH	SuperFrame header
SNR	Signal To Noise Ratio
SNRE	Signal To Noise Ratio Estimation
TX	Transmit

1 Introduction

This document describes the tests conducted according to DVB document [5] to comply with the interoperability declaration below. The DUT is the Sx4000 ASIC, which is a digital modem ASIC that can be integrated within a RCST, Hub or payload. All tests were conducted using an Evaluation board (EVB).

1.1 Interoperability Declarations

DUT

Mfr. Satixfy (Now part of MDA Space)

Model: Sx4000 ASIC

Type: RCST, GW, OBP RCST Profile: As per section 1.3

Table 1-1 - Interoperability Test Declarations

Tests Performed:	Section
Reception of continuous S2/S2X Waveforms	2.1
Reception of continuous S2X/Annex E Waveforms	2.2
Reception of Burst S2X/Annex E	2.3
Reception of RCS2 LM bursts	2.4
Reception of multiple transmissions S2/S2X/Annex E	4.2
Reception of multiple transmissions RCS2 (LM, CPM, LM-SS)	2.4, 4.2
Transmission of RCS2 waveforms (LM, CPM, LM-SS)	3.3
Transmission of continuous S2/S2X/Annex E Waveforms	3.2
Transmission of Burst S2/S2X/Annex E waveforms	4.2
Doppler Compensation on Tx	
Doppler Compensation on Rx	

1.2 DVB-S2/X Standards Compatibility

Table 1-2 below denotes all the system configurations supported by Sx4000 ASIC according to Table 1 of [2].

Table 1-2 – DVB-S2/X System Configurations

System configurations		Satixfy	Comments
FECFRAME (normal)	64 800 (bits)		
QPSK	1/4, 1/3, 2/5 (S2-MODCODs)	Y	
	1/2, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9, 9/10 (S2-MODCODs)	Y	
	13/45	Y	
	9/20; 11/20	Y	
8PSK	3/5, 2/3, 3/4, 5/6, 8/9, 9/10 (S2-MODCODs)	Y	
	23/36; 25/36; 13/18	Y	
8APSK-L	5/9; 26/45	Y	
16APSK	2/3, 3/4, 4/5, 5/6, 8/9, 9/10 (S2-MODCODs)	Y	

System configurations		Satixfy	Comments
	26/45; 3/5; 28/45; 23/36; 25/36; 13/18; 7/9; 77/90	Y	
16APSK-L	5/9; 8/15; 1/2; 3/5; 2/3	Y	
32APSK	3/4, 4/5, 5/6, 8/9, 9/10 (S2-MODCODs)	Y	
	32/45; 11/15; 7/9	Y	
32APSK-L	2/3	Y	
64APSK	11/15; 7/9; 4/5; 5/6	Y	
64APSK-L	32/45	Y	
128APSK	3/4; 7/9	Y	
256APSK	32/45; 3/4	Y	
256APSK-L	29/45; 2/3; 31/45; 11/15	Y	
FECFRAME (short)	16 200 (bits)		
QPSK	1/4, 1/3, 2/5 (S2-MODCODs)	Y	
	1/2, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9 (S2-MODCODs)	Y	
	11/45; 4/15; 14/45; 7/15 8/15; 32/45	Y	
8PSK	3/5, 2/3, 3/4, 5/6, 8/9 (S2-MODCODs)	Y	
	7/15; 8/15; 26/45; 32/45	Y	
16APSK	2/3, 3/4, 4/5, 5/6, 8/9 (S2-MODCODs)	Y	
	7/15; 8/15; 26/45; 3/5; 32/45	Y	
32APSK	3/4, 4/5, 5/6, 8/9 (S2-MODCODs)	Y	
	2/3; 32/45	Y	
VL-SNR Header		Y	
QPSK	2/9 (normal)	Y	
BPSK	1/5; 4/15; 1/3 (short)	Y	
	1/5; 11/45; 1/3 (medium)		
BPSK-S (Spreading Factor 2)	1/5; 11/45 (short)	Y	
Fixed Size Super-frame formats 0-3		N	
Fixed Size Super-frame format 4		Y	
Part 2 PLHEADER	8-bits	Y	
Extended PLHEADER For Wide-band mode	8+8 bits (time slicing)	Y	
GSE-High Efficiency Mode	For GSE/GSE-Lite	N	
Rolloff 0,35, 0,25, 0,20, 0,15; 0,10 and 0,05		Y	
Channel bonding		N	

System configurations		Satixfy	Comments
CCM		Y	
VCM		Y	
ACM		Y	
Single Transport Stream		N	No support for TS
Multiple Transport Streams		N	No support for TS
Single Generic Streams		Y	GSE
Multiple Generic Streams		Y	
Input Stream Synchronizer		N	No support for TS
Null Packet Deletion		N	No support for TS
Dummy Frame Insertion		Y	
Beam Hopping Periodic BH, VLSNR (Superframe Format 5)		Y	
Traffic driven BH VLSNR) (Superframe Format 6)		Y	
Traffic driven BH, no VL-SNR (Superframe Format 7)		Y	
Y = Supported N = Not supported			

1.3 DVB-RCS2 Standards Compatibility

[Table 1-3](#) and [Table 1-4](#) below denote all the terminal features supported by the Sx4000 ASIC according to Table 1 and Table 2 of [3].

Table 1-3 - DVB-RCS2 Terminal Features Capability

Terminal feature	Satixfy	Comment
PHYSICAL LAYER		
QPSK/8PSK support on the return link	Y	
CPM support on the return link	N	
Reference waveforms	Y	
Custom waveforms	Y	
Continuous Carrier mode operation	N	
BPSK transmission on the return link	Y	
Direct Sequence spread spectrum on the return link	Y	
Waveform bound permanently to timeslot	Y	
Waveform allocated to timeslots at the time of assignment	Y	
EIRP power control	Y	
Constant Power Density control	Y	
Forward link DVB-S2 CCM, S2 ACM	Y	
Forward link DVB-S2X ACM	Y	
Forward link DVB-S2X Annex E	Y	Superframes formats 5, 6, 7
Forward Link Single Continuous Generic Stream	Y	

Terminal feature	Satixfy	Comment
Forward link Single TS Packet Stream	N	
Forward link Multiple Streams (TS or GS)	Y	GSE streams only
GSE in BBframe CRC32	Y	
NCRv2 support in DVB-S2X	Y	
MAC LAYER		
DAMA for traffic (supporting all capacity categories)	Y	
Unsolicited DA for traffic	Y	
Slotted Aloha logon	Y	
Random Access combined with DAMA	Y	
Random access with replicas	N	Constant or variable rate replication ratio
In-band signalling in traffic timeslots	Y	
Signalling in DA signalling timeslots	Y	
Protection for non-line-of-sight interruptions on the forward link	N	Either Reed-Solomon or Raptor codes
Y = Supported N = Not supported		

Table 1-4 - Terminal Profiles Description- Physical Layer

Terminal profiles	Satixfy	Comments
PHYSICAL LAYER		
16 QAM return link modulation	Y	
32APSK Forward Link modulation	Y	
Essential waveform flexibility	Y	
Fast carrier switching	Y	
Lowest carrier switching class	Y	Class 4
Y = Supported N = Not supported		

2 Reception Tests

2.1 Test Setup

Figure 2-1 below depicts the test set up used for transmission tests. The signal generator is connected to the Sx4000 via a 6bit ADC.

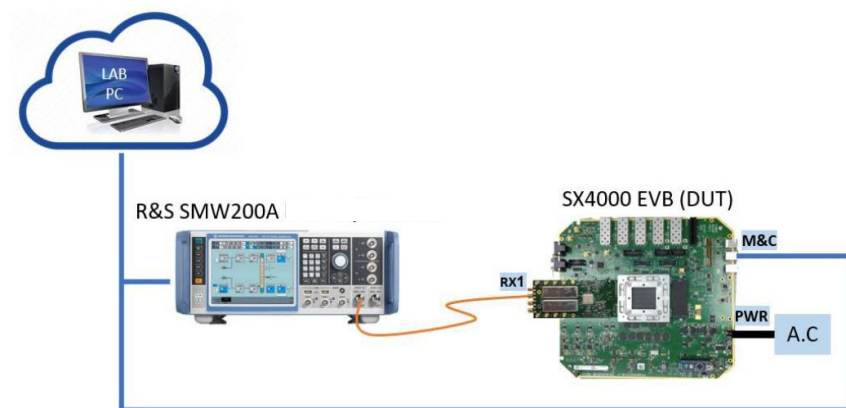


Figure 2-1 - DVB-S2/S2X/RCS2 Reception Test Setup

The interoperability tests were performed against a standard compliant signal generator. Interoperability is demonstrated either by QEF tests, where the implementation degradation is close to the ideal E_s/N_0 as defined in [1] and [2], or by test where a high signal level was used and a correct decoding of known symbols (PLS, preamble and postamble) is declared by the demodulator.

2.2 DVB-S2\X Continuous Streams

Table 2-1 below summarizes the QEF Test Results for the 2E5 frame count.

Table 2-1 - QEF Test Results

PLS	Modulation	Code Rate	S2/S2X	Symbol Rate [Mps]	Standard QEF [dB]	SNRE [dB]	Measured QEF [dB]	Delta vs. Standard [dB]
5	QPSK	1/4	S2	475	-2.35	-2.62	-2.40	-0.05
9	QPSK	1/3	S2	475	-1.25	-1.28	-1.15	0.10
13	QPSK	2/5	S2	475	-0.30	-0.12	-0.15	0.15
17	QPSK	1/2	S2	475	1.00	1.09	1.20	0.20
21	QPSK	3/5	S2	475	2.25	2.39	2.45	0.20
25	QPSK	2/3	S2	475	3.10	3.14	3.30	0.20
29	QPSK	3/4	S2	475	4.05	4.11	4.20	0.15
33	QPSK	4/5	S2	475	4.70	4.81	4.85	0.15
37	QPSK	5/6	S2	475	5.20	5.25	5.35	0.15
77	16-APSK	3/4	S2	475	10.20	10.26	10.40	0.20
97	32-APSK	3/4	S2	475	12.75	12.92	13.00	0.25
133	QPSK	13/45	S2X	475	-2.05	-1.89	-1.80	0.25
135	QPSK	9/20	S2X	475	0.20	0.24	0.40	0.20
137	QPSK	11/20	S2X	475	1.45	1.58	1.65	0.20

PLS	Modulation	Code Rate	S2/S2X	Symbol Rate [Mps]	Standard QEF [dB]	SNRE [dB]	Measured QEF [dB]	Delta vs. Standard [dB]
149	16-APSK	1/2-L	S2X	475	5.95	6.00	6.15	0.20
153	16-APSK	5/9-L	S2X	475	6.85	6.93	7.05	0.20
159	16-APSK	3/5-L	S2X	475	7.40	7.61	7.65	0.25
161	16-APSK	28/45	S2X	475	8.10	8.30	8.35	0.25
165	16-APSK	2/3-L	S2X	475	8.45	8.51	8.70	0.25
167	16-APSK	25/36	S2X	475	9.25	9.36	9.45	0.20
175	32-APSK	2/3-L	S2X	475	11.10	11.29	11.40	0.30
179	32-APSK	32/45	S2X	475	11.75	11.96	12.05	0.30
183	32-APSK	7/9	S2X	475	13.05	13.23	13.35	0.30
185	64-APSK	32/45-L	S2X	475	14.00	14.21	14.25	0.25
191	64-APSK	7/9	S2X	475	15.45	15.76	15.90	0.45
199	64-APSK	5/6	S2X	475	16.55	16.64	16.90	0.35

Table 2 2 below lists the DVB-S2/X VLSNR QEF Test Results for the 2E5 frame count.

Table 2-2 - DVB-S2/X VLSNR QEF Test Results

PLS	Modulation	Code Rate	Symbol Rate [Mps]	Standard QEF [dB]	SNRE [dB]	Measured QEF [dB]	Delta vs. Standard [dB]
129/1	BPSK	1/5	475	-6.85	-42.14	-7.05	-0.20
129/2	BPSK	11/45	475	-5.50	-5.42	-5.35	0.15
129/3	BPSK	1/3	475	-4.00	-4.24	-4.00	-0.00
129/5	BPSK-S	11/45	475	-8.30	-8.36	-8.10	0.20
131/0	BPSK	1/5	475	-6.00	-5.97	-5.95	0.05
131/1	BPSK	4/15	475	-4.60	-4.64	-4.65	-0.05
131/2	BPSK	1/3	475	-3.50	-3.56	-3.60	-0.10

2.3 Burst waveform, Annex E, Superframe Format 6

Table 2-3 below summarizes the QEF Test Results for the 2E5 frame count. The test was performed with SuperFrame format 6, with variable SuperFrame size. Within each SuperFrame the same modcod is used for all the frames. The signal is transmitted in bursts at different rates.

Table 2-3 - SF6 QEF Test Results

PLS	Modulation	Code Rate	Symbol Rate [Mps]	Superframe Size [symbols]	Burst Rate [1/sec]	Standard QEF [dB]	Measured QEF [dB]	Delta vs. Standard [dB]
4	QPSK	1/4	475	201816	2340	-2.35	-2.30	0.05
8	QPSK	1/3		201816	2340	-1.24	-1.14	0.10
20	QPSK	3/5		201816	2340	2.23	2.53	0.30
28	QPSK	3/4		201816	2340	4.03	4.33	0.30

PLS	Modulation	Code Rate	Symbol Rate [Mps]	Superframe Size [symbols]	Burst Rate [1/sec]	Standard QEF [dB]	Measured QEF [dB]	Delta vs. Standard [dB]
36	QPSK	5/6		201816	2340	5.18	5.48	0.30
96	32-APSK	3/4		82260	5696	12.73	14.78	2.05
134	QPSK	9/20		201816	2340	0.22	0.57	0.35
148	16-APSK	1/2-L		102204	4596	5.97	6.47	0.50
158	16-APSK	3/5-L		102204	4596	7.41	7.91	0.50
166	16-APSK	25/36		102204	4596	9.27	9.97	0.70
174	32-APSK	2/3		82260	5696	11.10	12.60	1.50
184	64-APSK	32/45-L		68976	6775	13.98	17.33	3.35

2.4 DVB-RCS2 QEF Test

Table 2-4 below summarizes the QEF Test Results for the 2E5 frame count, at different symbol rates. The signal is transmitted in bursts at different rates.

Table 2-4 – RCS2 QEF Test Results

Waveform ID	Modulation	Code Rate	Burst Length [Symbol]	Burst Rate [1/sec]	Symbol Rate [Mps]	Standard QEF [dB]	SNRE [db]	Measured QEF [dB]	Delta vs. Standard [dB]
1	QPSK	1/3	664	2647	112.5	0.20	0.84	0.35	0.15
2	QPSK	1/3	262	6709	112.5	1.30	1.98	1.35	0.05
3	QPSK	1/3	536	3279	112.5	0.20	1.80	0.55	0.35
4	QPSK	1/2	536	3279	112.5	2.35	4.53	2.75	0.40
5	QPSK	2/3	536	3279	112.5	4.30	4.88	4.70	0.40
6	QPSK	3/4	536	3279	112.5	5.35	5.92	5.40	0.05
7	QPSK	5/6	536	3279	112.5	6.70	6.64	6.65	-0.05
8	8PSK	2/3	536	3279	112.5	8.10	8.72	8.35	0.25
9	8PSK	3/4	536	3279	112.5	9.30	10.14	9.55	0.25
10	8PSK	5/6	536	3279	112.5	10.85	10.51	11.05	0.20
11	16QAM	3/4	536	3279	112.5	11.15	11.56	11.50	0.35
12	16QAM	5/6	536	3279	112.5	12.55	12.04	12.70	0.15
13	QPSK	1/3	1616	1087	112.5	-0.50	-0.21	-0.45	0.05
14	QPSK	1/2	1616	1087	112.5	1.70	2.38	1.80	0.10
15	QPSK	2/3	1616	1087	112.5	3.70	4.09	3.65	-0.05
16	QPSK	3/4	1616	1087	112.5	4.75	4.59	4.70	-0.05
17	QPSK	5/6	1616	1087	112.5	5.95	6.32	6.15	0.20
18	8PSK	2/3	1616	1087	112.5	7.50	7.65	7.60	0.10
19	8PSK	3/4	1616	1087	112.5	8.75	8.97	8.80	0.05
20	8PSK	5/6	1616	1087	112.5	10.25	9.72	10.30	0.05
21	16QAM	3/4	1616	1087	112.5	10.70	11.05	11.00	0.30
22	16QAM	5/6	1616	1087	112.5	12.05	12.28	12.15	0.10
32	QPSK	1/2	832	2112	112.5	1.95	2.59	2.85	0.90

Waveform ID	Modulation	Code Rate	Burst Length [Symbol]	Burst Rate [1/sec]	Symbol Rate [Mps]	Standard QEF [dB]	SNRE [db]	Measured QEF [dB]	Delta vs. Standard [dB]
33	QPSK	3/4	566	3105	112.5	6.05	5.62	5.95	-0.10
34	QPSK	1/2	1392	1262	112.5	1.75	2.28	2.00	0.25
35	QPSK	3/4	938	1874	112.5	4.95	5.48	5.00	0.05
36	QPSK	7/8	810	2170	112.5	7.35	7.50	7.45	0.10
37	QPSK	2/3	2660	660	112.5	3.55	3.69	3.50	-0.05
38	QPSK	4/5	2222	791	112.5	5.30	4.94	5.25	-0.05
39	QPSK	6/7	2076	846	112.5	6.30	6.38	6.25	-0.05
40	BPSK	1/3	1868	941	112.5	-3.20	-3.41	-3.05	0.15
41	BPSK	1/3	1612	1090	112.5	-3.00	-4.00	-2.85	0.15
42	BPSK	1/3	3236	543	112.5	-3.50	-3.67	-3.35	0.15
43	BPSK	1/2	3236	543	112.5	-1.30	-1.63	-1.25	0.05
44	QPSK	5/6	266	6608	112.5	7.30	7.67	7.40	0.10
45	8PSK	2/3	266	6608	112.5	8.70	8.48	9.10	0.40
46	8PSK	3/4	266	6608	112.5	10.05	9.60	10.45	0.40
47	8PSK	5/6	266	6608	112.5	11.60	11.78	11.95	0.35
48	16QAM	3/4	266	6608	112.5	11.75	12.62	12.10	0.35
49	16QAM	5/6	266	6608	112.5	13.20	13.23	13.60	0.40

3 Transmission Tests

3.1 Transmission Test Setup

Figure 3-1 below depicts the test set up used for transmission tests. The EVB is connected to the signal analyzer via a 6bit DAC.

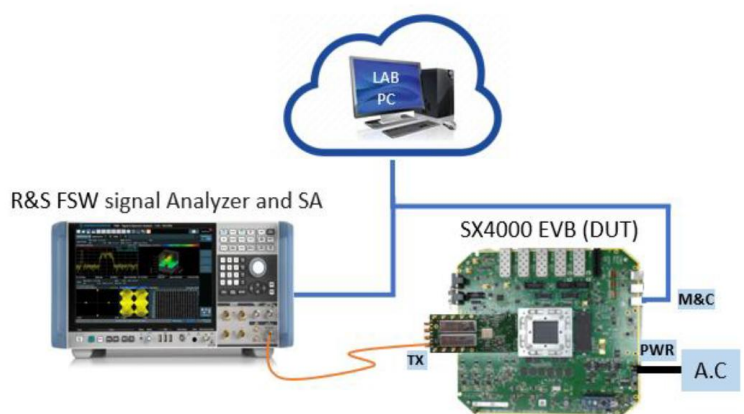


Figure 3-1 – Transmission Setup

3.2 DVB-RCS2 MER/EVM Test

Table 3-1 and Table 3-2 below list the Tx RCS2 EVM test results. The RCS2 bursts are transmitted at a rate as indicated in the burst rate column. The test included all the linear

modulation waveforms as indicated in Tables A-1 and A-2 of [5]. The Error Vector Magnitude (EVM) measurements of less than 1%, as measured by the signal analyzer, indicate that the modulated waveforms are close to the modulation defined in the standard.

For all waveforms the Preamble and Postamble were identified correctly by the Signal Analyzer.

Table 3-2 lists Linear Modulation (LM) waveforms, Table 3-2 lists Linear Modulation Spread Spectrum (LM-SS) waveforms.

Table 3-1 - TX RCS2 EVM Test Results – LM Waveforms

Waveform ID	Modulation	Code Rate	Burst Length [Symbol]	Burst Rate [1/sec]	Symbol Rate [Msps]	MER [dB]	EVM [%]
1	QPSK	1/3	664	2794	118.75	32.20	2.45
2	QPSK	1/3	262	7081	118.75	32.21	2.45
3	QPSK	1/3	536	3461	118.75	32.48	2.38
4	QPSK	1/2	536	3461	118.75	32.61	2.35
5	QPSK	2/3	536	3461	118.75	32.54	2.37
6	QPSK	3/4	536	3461	118.75	32.57	2.36
7	QPSK	5/6	536	3461	118.75	32.56	2.35
8	8QPSK	2/3	536	3461	118.75	32.60	2.35
9	8QPSK	3/4	536	3461	118.75	32.48	2.38
10	8QPSK	5/6	536	3461	118.75	32.55	2.36
11	16QAM	3/4	536	3461	118.75	32.20	2.45
12	16QAM	5/6	536	3461	118.75	32.15	2.47
13	QPSK	1/3	1616	1148	118.75	32.47	2.38
14	QPSK	1/2	1616	1148	118.75	32.53	2.36
15	QPSK	2/3	1616	1148	118.75	32.46	2.38
16	QPSK	3/4	1616	1148	118.75	32.51	2.37
17	QPSK	5/6	1616	1148	118.75	32.45	2.39
18	8QPSK	2/3	1616	1148	118.75	32.50	2.37
19	8QPSK	3/4	1616	1148	118.75	32.45	2.39
20	8QPSK	5/6	1616	1148	118.75	32.52	2.37
21	16QAM	3/4	1616	1148	118.75	32.15	2.47
22	16QAM	5/6	1616	1148	118.75	32.16	2.47
32	QPSK	1/2	832	2230	118.75	32.49	2.37
33	QPSK	3/4	566	3278	118.75	32.49	2.38
34	QPSK	1/2	1392	1332	118.75	32.46	2.38
35	QPSK	3/4	938	1978	118.75	32.45	2.39
36	QPSK	7/8	810	2290	118.75	32.47	2.38
37	QPSK	2/3	2660	697	118.75	32.45	2.38
38	QPSK	4/5	2222	835	118.75	32.51	2.37
39	QPSK	6/7	2076	893	118.75	32.44	2.39
40	BPSK	1/3	1868	993	118.75	32.74	2.31
41	BPSK	1/3	1612	1151	118.75	32.75	2.30
42	BPSK	1/3	3236	573	118.75	32.70	2.32
43	BPSK	1/2	3236	573	118.75	32.75	2.30
44	QPSK	5/6	266	6975	118.75	32.71	2.32

Waveform ID	Modulation	Code Rate	Burst Length [Symbol]	Burst Rate [1/sec]	Symbol Rate [Msps]	MER [dB]	EVM [%]
45	8PSK	2/3	266	6975	118.75	32.67	2.33
46	8PSK	3/4	266	6975	118.75	32.63	2.34
47	8PSK	5/6	266	6975	118.75	32.62	2.33
48	16QAM	3/4	266	6975	118.75	32.38	2.41
49	16QAM	5/6	266	6975	118.75	32.34	2.41

Table 3-2 - TX RCS2 EVM Test Results- LM-SS Waveforms

Waveform ID	Modulation	Code Rate	Burst Length [Symbol]	Burst Rate [1/sec]	Symbol Rate [Msps]	MER [dB]	EVM [%]
1	BPSK	1/2	1792	4141	475	31.98	2.53
2	BPSK	2/3	1344	5522	475	31.56	2.66
3	BPSK	1/2	3047	2435	475	32.07	2.50
4	BPSK	2/3	2198	3376	475	31.86	2.56
5	BPSK	1/2	7548	983	475	31.47	2.67
7	BPSK	1/2	1792	4141	475	32.09	2.49
8	BPSK	2/3	1344	5522	475	32.52	2.37
9	BPSK	1/2	3047	2435	475	31.47	2.67
10	BPSK	2/3	2198	3376	475	31.93	2.53
12	BPSK	2/3	5662	1310	475	29.15	3.49
13	BPSK	1/2	1792	4141	475	30.86	2.86
14	BPSK	2/3	1344	5522	475	31.55	2.65
15	BPSK	1/2	3047	2435	475	29.22	3.46
16	BPSK	2/3	2198	3376	475	31.01	2.81
17	BPSK	1/2	7548	983	475	23.02	7.07
18	BPSK	2/3	5662	1310	475	24.83	5.73
19	BPSK	1/2	1419	5230	475	29.02	3.54

3.3 Continuous S2/S2X Waveforms

3.3.1 TX EVM

Error! Reference source not found.3 and Table 3-4 below describe the Tx DVB-S2\X test results, for a set of waveforms and symbol rates. The Error Vector Magnitude (EVM) measurements of less than 3%, as measured by the signal analyzer, indicate that the modulated waveforms are close to the modulation defined in the standard.

For all waveforms the Physical Layer Signaling (PLS) code was identified correctly by the Signal Analyzer. Only a single modcod per modulation is listed below.

Table 3-3 lists S2/S2X normal frames. Table 3-4 lists VLSNR frames.

Table 3-3 - TX MER/EVM Test Results

PLS	Modulation [Canonical]	Code Rate	Symbol Rate [Msps]	MER [db]	EVM [%]
45	QPSK	9/10	475	31.99	2.51
69	8-PSK	9/10	475	31.60	2.63
93	16-APSK	9/10	475	31.37	2.70
113	32-APSK	9/10	475	31.89	2.54
136	QPSK	11/20	475	31.04	2.81
147	8-PSK	13/18	475	31.13	2.78
173	16-APSK	77/90	475	30.97	2.83
183	32-APSK	7/9	475	31.03	2.81
194	64-APSK	4/5	475	31.16	2.77
202	128-APSK	7/9	475	30.00	3.16
215	256-APSK	3/4	475	31.32	2.72
227	QPSK	32/45	475	31.90	2.54
235	8-PSK	32/45	475	31.91	2.54
245	16-APSK	32/45	475	31.75	2.59
249	32-APSK	32/45	475	31.13	2.77

Table 3-4 –VLSNR TX MER/EVM Test Results

PLS	Modulation [Canonical]	Code Rate	Frame Length [bits]	Symbol Rate [Msps]	MER [db]	EVM [%]
129/0	QPSK	2/9	64800	475	30.43	3.01
129/2	BPSK	11/45	32400		30.78	2.89
129/3	BPSK	1/3	32400		30.74	2.90
129/4	BPSK-S	1/5	16200		30.73	2.91
129/5	BPSK-S	11/45	16200		30.83	2.87
131/0	BPSK	1/5	16200		30.75	2.90
131/1	BPSK	4/15	16200		30.76	2.90
131/2	BPSK	1/3	16200		30.53	2.97

3.3.2 TX Spectral Mask Test

Figure 3-2 below depicts the Mask test Results performed for some Normal frames of DVB-S2/S2X waveforms, with roll-off 5%.

The signal spectrum is compared to the masks as defined in [2], Annex A. The green line is the lower mask, and the orange one is the higher mask.

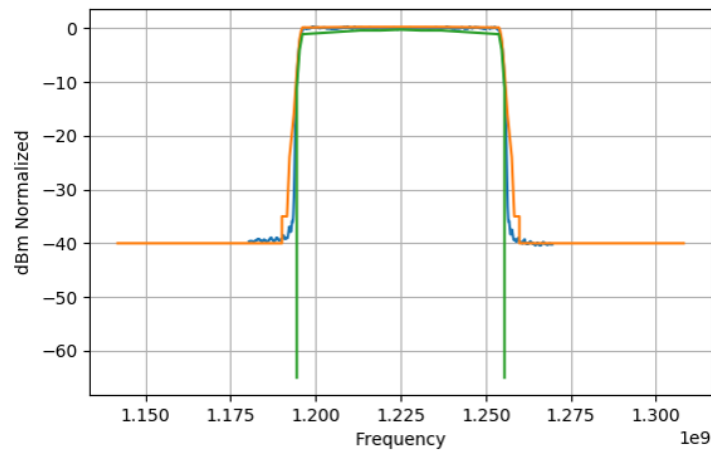


Figure 3-2 - TX Mask Test Results

4 Multiple Transmission and Reception Tests

4.1 Test Setup

The following tests were performed in a loop-back mode connecting the 4-channel modulator within the ASIC to the 4-channel demodulator. The test setup is depicted in [Figure 4-1](#), where the modulator output, which is a SerDes is connected internally to the demodulator SerDes input. Thus, these tests demonstrate the ASIC capability to support multiple transmissions and reception.

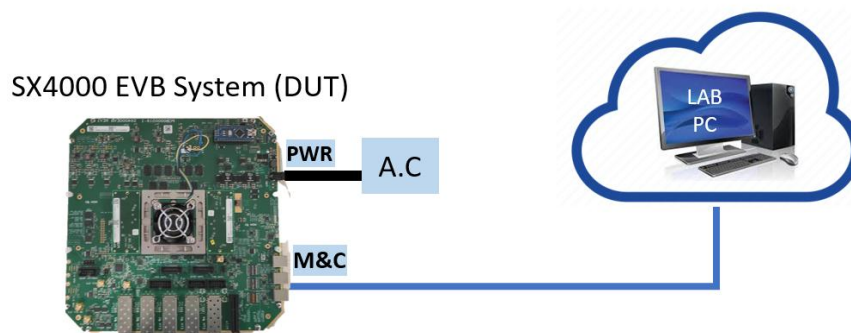


Figure 4-1 – Test Setup

4.2 DVB-S2X Annex E

This test Dynamically configures the Modulator and the Demodulator with bursts of Superframes over 4 channels. The dwell cycle contains 32 dwells. The following parameters are changing between even to odd dwells:

- Dwell times are 5ms in even dwells and 730 μ s in odd dwells.
- 4 Superframes format 6 in even dwells, 1 SF format 6 in odd dwells.
- Symbol rate of each Channel varies:
 - 120Msps for each channel in even dwells
 - Two 50Msps channels and two 180Msps in odd dwells.

The PLFRAMES payload contains PRBS data with a variety of modcods.

Figure 4-2 depicts the time frequency allocation in this test.



Figure 4-2 - Time-Frequency Diagram

All frames were received with no errors.

4.3 DVB-RCS2

The test dynamically configures the Modulator and the Demodulator with different RCS2 frames over 8 50Mbps channels. The RCS2 SuperFrame contains 64 MFTDMA frames. Each frame is 730 usec long and contains 96 time slots. The waveform IDs within each frequency channel is the same, but different between channels. The payload contains PRBS data, and all bursts are of type “traffic”. Figure 4-3 depicts the time frequency allocation in this test.

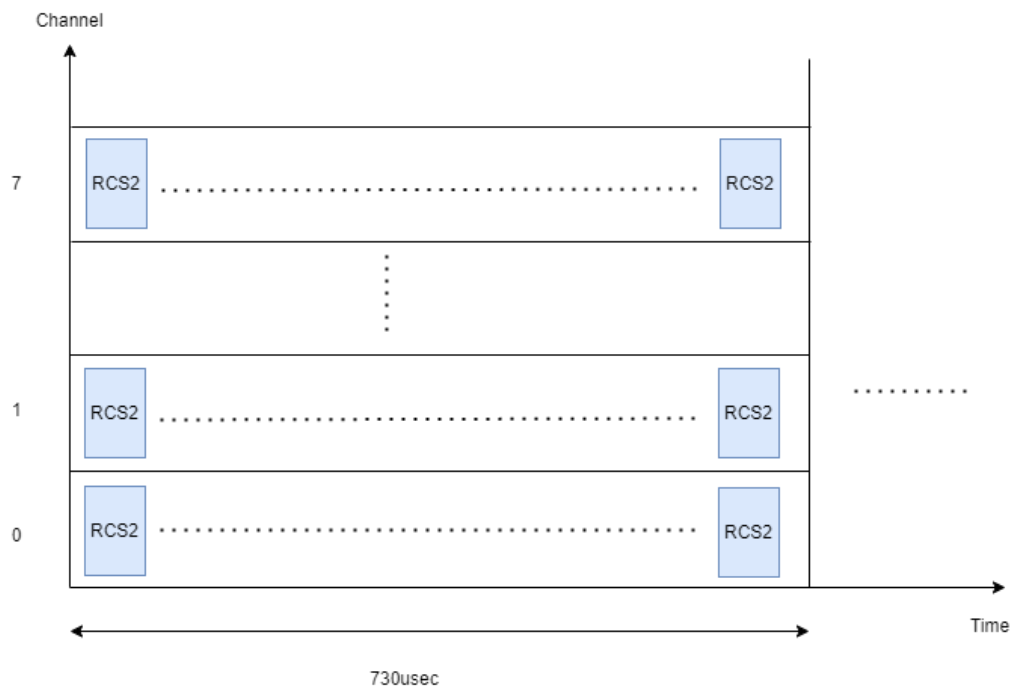


Figure 4-3- Time-Frequency Diagram

All bursts were received with no errors.

5 Doppler Tests

5.1 Doppler compensation

Figure 5-1 below depicts the test setup.

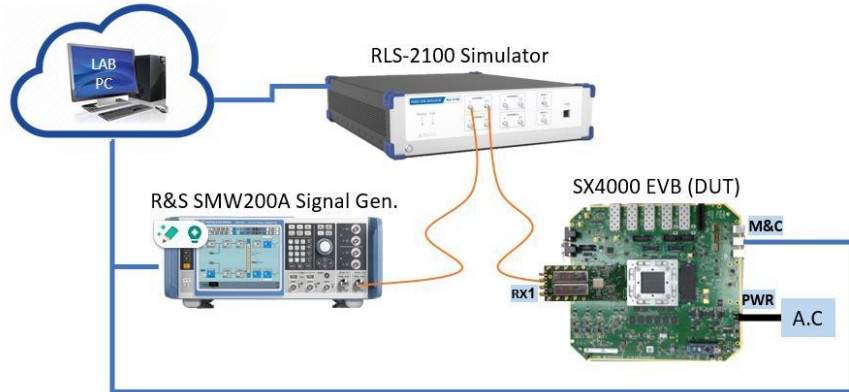


Figure 5-1- Doppler Compensation RX Setup

The tests use the radio link simulator RLS-2100, by SquarePeg, to induce a Doppler shift according to a required profile.

Figure 5-2 shows a Doppler shift profile, ranging between +650kHz shift and -650kHz shift.

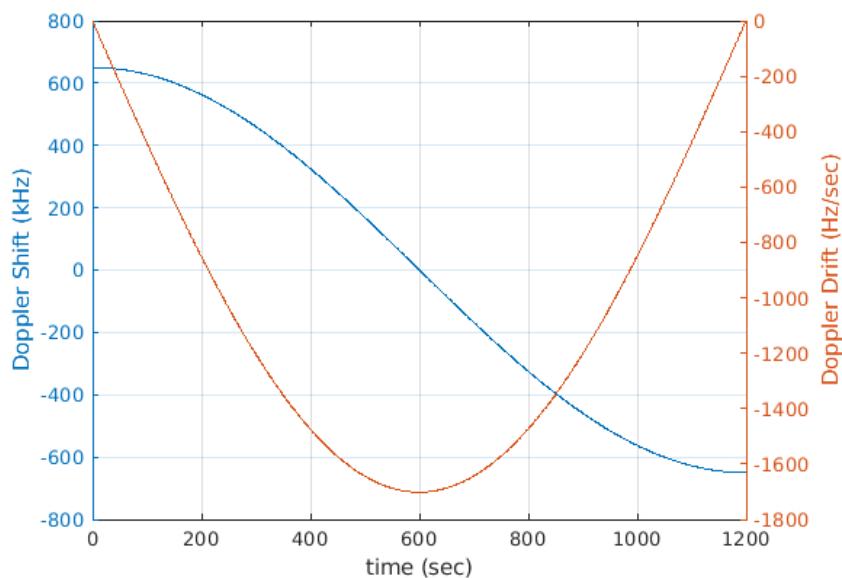


Figure 5-2- Doppler Shift Profile

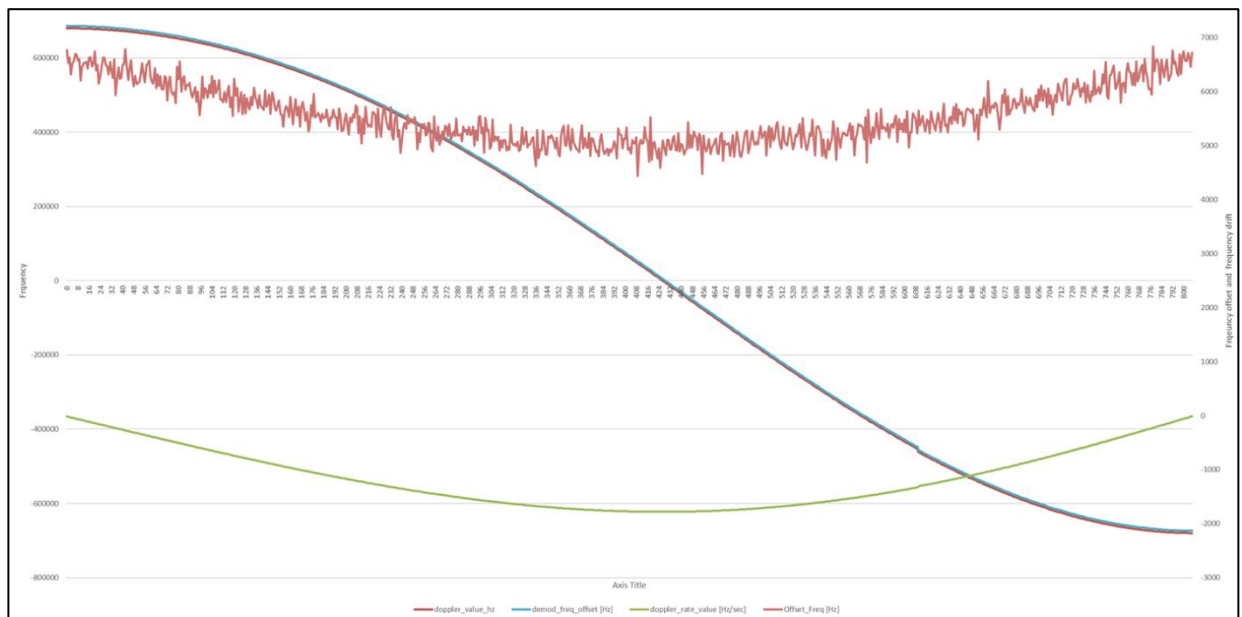
The profile was applied to the Sx4000 EVB with the transmission parameters specified in Table 5-1

Table 5-2 –Doppler Compensation Test Parameters

Parameter	Value	Comments
Modcod (PLS)	165	16APSK 2/3-L
Symbol Rate	475	MHz
Roll-off	0.05	
SNR	8.83	dB (QEF+0.4)

No error was detected during the operation. The modem provides, per frame, a frequency deviation report. Fig 5-3 depicts:

- Red solid line: the Doppler shift value (Hz)
- Green line: The Doppler drift (Hz/sec).
- Blue line: Doppler compensation applied to the modem (identical to the applied Doppler with a small timing error).
- Orange line: The residual frequency error reported by the modem after compensation (Hz).


Figure 5-3- Frequency Shift Measurement Results

The residual error ranges between 4kHz to 7 kHz, resulting from the timing deviation of the compensation signal.

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