DOCSIS ATP 2.0

PHY-20.2

JUPITER 200 PHY-20.2 TEST SCRIPT DATA SHEET

Cable Modem Pre-equalizer Test

DAQTron, Inc.

Innovative Test Solutions, Broadband & Beyond

A DOCSIS 2.0 ATP TEST SCRIPT DATA SHEET

Jupiter 200 PHY-20.2

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DOCSIS ATP 2.0

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Introduction

"This test measures the ability of the transmit equalizer in the CM to produce the required fidelity, as indicated by the modulation error ratio (MER), in the presence of specified microreflections. It also tests for proper management of the pre-equalizer taps." - ***DOCSIS 2.0 ATP***

Test Requirements

"This test describes the use of a vector analyzer to measure MER at the input to the CMTS and a multipath delay generator to impair the upstream transmission. Other equivalent equipment may be used to generate multipath. For detailed MER measurement procedures for TDMA and S-CDMA, see MER section of ATP." - ***DOCSIS 2.0 ATP***

The DAQTron RF-PHY-20 Test Script uses the HP 89441A Vector Signal Analyzer to measure MER and the DAQTron 2525 Microreflection Impairment Unit to impair the upstream transmission. The DAQTron 2525 Microreflection Impairment Unit simulates microreflections or "ghosts" present in the upstream signal. Various delayed versions of the incident signal are summed with the incident signal to achieve microreflections over the range of 0 to 2.5 microseconds in 0.25 microsecond increments. Further descriptions of the DAQTron 2525 Microreflection Impairment Unit are available in the **Jupiter 110/200 PHY Hardware Setup Data Sheet** document.

Setup

The Jupiter 200 PHY-20.2 Test Script utilizes Jupiter hardware as shown in Figure 1 of the **Jupiter 200 PHY Hardware Setup Data Sheet** document.

PHY-20.2, Measurement of MER

There are three test procedures as indicated by DOCSIS 2.0 ATP: Equalized Test, Pre-equalized Test, and Measurement of MER with Echo Channels. DAQTron's PHY-20.2 Test script approach combines the Pre-equalized and Measurement of MER with Echo Channels tests into one single procedure named: Measurement of MER. In addition, PHY-20.2 test script can be run in two different test modes:

1. Load Mode: CM will use the latest equalization coefficients sent by the CMTS without using its current equalization coefficients to compensate echo channel impairments.

2. Convolve Mode: CM will convolve the latest equalization coefficients sent by the CMTS with its current equalization coefficients to compensate echo channel impairments.

As Stated by DOCSIS 2.0 ATP:	**As Performed by Jupiter 200:**	**Deviation**
N/A	DAQTron 2525 Microreflection Impairment Unit Calibration There are 4 programmable (enable/disable) switches in the DAQTron 2525 Microreflection Impairment Unit that are used to enable or disable Echo channels: - PHY-20 **SW1**: Enables/Disables Path 1 in PHY-20 RF interface. 0 dB Attn. 0 µsec Delay. - PHY-20 **SW2**: Enables/Disables Path 2 in PHY-20 RF interface. -10 dB Attn. 0.5 µsec Delay. - PHY-20 **SW3**: Enables/Disables Path 3 in PHY-20 RF interface. -20 dB Attn. 1.0 µsec Delay. - PHY-20 **SW3**: Enables/Disables Path 3 in PHY-20 RF interface. -20 dB Attn. 1.0 µsec Delay. - PHY-20 **SW4**: Enables/Disables Path 4 in PHY-20 RF interface. -30 dB Attn. 1.5 µsec Delay.	DAQTron Specific to PHY-20 RF Interface

As Stated by DOCSIS 2.0 ATP:	As Performed by Jupiter 200:	Deviation
	The PHY-20 RF Interface is controlled via Control Path 2. 1.0) Set upstream power level at the CM to 20 dBmV by adjusting cable plant's upstream attenuators. Enable PHY-20 SW2, and disable PHY-20 SW1, PHY-20 SW3, and PHY-20 SW4. Set upstream power level at the CM to 30 dBmV by adjusting PHY-20 AT1 attenuator. 2.0) Enable PHY-20 SW3, and disable PHY-20 SW1, PHY-20 SW2, and PHY-20 SW4. Set upstream power level at the CM to 40 dBmV by adjusting PHY-20 AT2 attenuator. 3.0) Enable PHY-20 SW4, and disable PHY-20 SW1, PHY-20 SW2, and PHY-20 SW3. Set upstream power level at the CM to 50 dBmV by adjusting PHY-20 AT3 attenuator. 4.0) Enable PHY-20 SW1, and disable PHY-20 SW2, PHY-20 SW3, and PHY-20 SW4. Check for CM online. 5.0) Set upstream power level at the CM to **UpstreamPower** specified in the environment file.	
1.0) Place CMTS in "coefficient pass-through" test mode.	N/A	None
2.0) Ghost Generator Reference Channel 1 enabled (0 delay, 0 attenuation).	The PHY-20 RF Interface is controlled via Control Path 2. There are 4 programmable (enable/disable) switches in the DAQTron 2525 Microreflection Impairment Unit that are used to enable or disable Echo channels: SW1 is enabled via Control Path 2 to select the 0 delay and 0 attenuation Path	None

As Stated by DOCSIS 2.0 ATP:	As Performed by Jupiter 200:	Deviation
	1 of the PHY-20 RF Interface.	
3.0) Using Packet Source, send upstream packets.	The Test Script uses the Packet Generator over Control Path 1. The Packet Generator is commanded to send traffic at on the US path	None
4.0) Enable Vector Analyzer adaptive equalizer with 24 symbol-spaced taps.	VSA adaptive equalizer is configured via Control Path 3	Yes
5.0) Using Vector Analyzer, demodulate data packets.	Demodulate the carrier frequency error (FERR) and tune symbol rate for phase error.	None
	1.0) Disable CM pre-equalizer (Equalizer is disabled by sending to the CM all zero coefficients except main tap = 1 + j0, in load mode). 2.0) Setup PHY-20 RF Interface for Echo test 1.	Yes
6.0) Set Vector Analyzer frequency and symbol rate for best recovered MER (VSA equalizer on).	1.0) Enable Equalizer on VSA. 2.0) Wait until a reasonable MER is measured for the test case. 3.0) Hold VSA Equalizer	None
7.0) Transfer VSA equalizer taps to CM pre-equalizer via CMTS.	Transfer normalized VSA Equalizer taps to CMTS via Control Path 1	None
8.0) Use Downstream Sniffer to analyze the equalization information is present in RNG-RSP message.	Wait for CM to download Equalization coefficients.	None
9.0) Disable VSA equalizer.	Disable VSA Equalizer.	None
10.0) Record MER with no echoes. Verify that it meets 33 dB.	Measure the best recovered MER on VSA via Control Path 3 and determine pass and fail criteria.	None

As Stated by DOCSIS 2.0 ATP:	As Performed by Jupiter 200:	Deviation
	Repeat the above steps 1 through 10 until all combinations of channels (Echo Test 2 thru Echo test 7) have been tested.	None
	Repeat steps 1 thru 10 at 24 MHz and 38.8 MHz of upstream channel frequency.	None

Echo Case	Path 2 Echo Magnitude (dB)/ Delay (us)	Path 3 Echo Magnitude (dB)/ Delay (us)	Path 4 Echo Magnitude (dB)/ Delay (us)	Required MER (dB)
1	-10/0.5			33
2		-20/1.0		33
3			-30/1.5	33
4	-10/0.5	-20/1.0		29
5	-10/0.5		-30/1.5	29
6		-20/1.0	-30/1.5	29
7	-10/0.5	-20/1.0	-30/1.5	29

PHY-20.2 Echo Test Cases

Known Issues: ATP Deviations, Assumptions and Caveats

The following list contains all the current issues. The issues can be with the ATP, 3rd Party Hardware, or DAQTron's implementation.

1. This test was written to the TEP Version: 2.0 - ATP - RFI – 020531.
2. DAQTron Inc. currently cannot support the test with an SCDMA channel type due to CMTS limitations.

3. 63 equalizer taps is used on the VSA for Echo test cases 4 and 7. However, a subset of 24 taps is extracted and used by the CM to proceed with the test. VSA will not converge with 23 taps.

Expected Test Times

PHY-20.2 Test Script time is approximately 2.5 to 3 hours to run (ATDMA modulation profile, 3 US frequencies, 7 Echo tests per frequency).

Environment File Details

Using this file as shown below with all items set to TRUE will conduct the test in its entirety as described above in the **Procedure** section. Some comments have been added and denoted with "//**" preceding the comments. Any test sections set to FALSE will be skipped when the test is executed. The environment file shown below sets up one test case (modulations, channel widths, frequencies). DAQTron's Test Sequencer, described in the **DAQTron Jupiter 110/200 Operator's Guide**, is used to cycle through various test cases.

PHY-20.2.env

```
[Procedures]
Unequalized Test=FALSE
Pre-equalized Test=FALSE
Measurement of MER with echo channels=TRUE

[UNEQUALIZED TEST]
Frequencies(MHz)=8.2,,24,,38.8
UpstreamPower(dBmV)=50

[PRE-EQUALIZED TEST]
Frequencies(MHz)=8.2,,24,,38.8
UpstreamPower(dBmV)=50

[MEASUREMENT OF MER WITH ECHO CHANNELS]
Tune Freq & Sym?=TRUE                    //** Only applicable when running in Load Mode
Skip Cal? (T)=TRUE
Test Mode=Load Mode                      //** Load Mode or Convolve Mode
Max # Interations=3                      //** Only applicable when running in Convolve Mode
Frequencies (MHz)=38.8                   //** ATP Specifies 8.2, 24, and 38.8 MHz
VSA Training max duration (min)=5        //** Maximun of 2 min is recommended for when running in Convolve
                                         //** mode to optimize time
Convergence Gain=5.00E-6
UpstreamPower (dBmV)=50

[Pre-Test Setup (ATDMA)]
Tune Freq & Sym?=TRUE
Skip Cal?=TRUE
Frequencies (MHz)=8.2                    //** ATP Specifies 8.2, 24, and 38.8 MHz
VSA Training max duration (min)=4        //** Minimum of 5 min is recommended
Convergence Gain=5.00E-5
UpstreamPower (dBmV)=50

[ATDMA Modulation Profile]
Modulation Type.1=QPSK
Preamble Length.1=32
Differential Encoding?.1=FALSE
FEC "T" Bytes.1=5
FEC Codeword Size ("K").1=16
Scrambler Seed.1=38
Max Burst Size.1=0
Guard Time.1=12
```

Last Codeword Shortened?.1=TRUE
Scrambler?.1=TRUE
Byte Interleaver Depth.1=1
Byte Interleaver Block Size.1=2048
Preamble Type.1="qpsk0 (1)"
TCM Error Correction?.1=FALSE
S-CDMA Interleaver Step Size.1=0
S-CDMA Spreader On?.1=FALSE
S-CDMA Subframe Codes.1=0
Channel Type.1="atdma (2)"
Modulation Type.3=QPSK
Preamble Length.3=128
Differential Encoding?.3=FALSE
FEC "T" Bytes.3=5
FEC Codeword Size ("K").3=34
Scrambler Seed.3=38
Max Burst Size.3=0
Guard Time.3=12
Last Codeword Shortened?.3=FALSE
Scrambler?.3=TRUE
Byte Interleaver Depth.3=1
Byte Interleaver Block Size.3=2048
Preamble Type.3="qpsk0 (1)"
TCM Error Correction?.3=FALSE
S-CDMA Interleaver Step Size.3=0
S-CDMA Spreader On?.3=FALSE
S-CDMA Subframe Codes.3=0
Channel Type.3="atdma (2)"
Modulation Type.4=QPSK
Preamble Length.4=128
Differential Encoding?.4=FALSE
FEC "T" Bytes.4=5
FEC Codeword Size ("K").4=34
Scrambler Seed.4=38
Max Burst Size.4=0
Guard Time.4=12
Last Codeword Shortened?.4=TRUE
Scrambler?.4=TRUE
Byte Interleaver Depth.4=0
Byte Interleaver Block Size.4=2048
Preamble Type.4="qpsk0 (1)"
TCM Error Correction?.4=FALSE
S-CDMA Interleaver Step Size.4=0
S-CDMA Spreader On?.4=FALSE
S-CDMA Subframe Codes.4=0
Channel Type.4="atdma (2)"
Modulation Type.9=64-QAM
Preamble Length.9=64
Differential Encoding?.9=FALSE
FEC "T" Bytes.9=5
FEC Codeword Size ("K").9=78
Scrambler Seed.9=38
Max Burst Size.9=8
Guard Time.9=12
Last Codeword Shortened?.9=TRUE
Scrambler?.9=TRUE
Byte Interleaver Depth.9=0
Byte Interleaver Block Size.9=2048
Preamble Type.9="qpsk0 (1)"
TCM Error Correction?.9=FALSE
S-CDMA Interleaver Step Size.9=0
S-CDMA Spreader On?.9=FALSE
S-CDMA Subframe Codes.9=0

Channel Type.9="atdma (2)"
Modulation Type.10=64-QAM
Preamble Length.10=128
Differential Encoding?.10=FALSE
FEC "T" Bytes.10=16
FEC Codeword Size ("K").10=220
Scrambler Seed.10=38
Max Burst Size.10=0
Guard Time.10=12
Last Codeword Shortened?.10=TRUE
Scrambler?.10=TRUE
Byte Interleaver Depth.10=0
Byte Interleaver Block Size.10=2048
Preamble Type.10="qpsk0 (1)"
TCM Error Correction?.10=FALSE
S-CDMA Interleaver Step Size.10=0
S-CDMA Spreader On?.10=FALSE
S-CDMA Subframe Codes.10=0
Channel Type.10="atdma (2)"
Modulation Type.11=64-QAM
Preamble Length.11=32
Differential Encoding?.11=FALSE
FEC "T" Bytes.11=6
FEC Codeword Size ("K").11=78
Scrambler Seed.11=38
Max Burst Size.11=0
Guard Time.11=12
Last Codeword Shortened?.11=TRUE
Scrambler?.11=TRUE
Byte Interleaver Depth.11=0
Byte Interleaver Block Size.11=2048
Preamble Type.11="qpsk0 (1)"
TCM Error Correction?.11=FALSE
S-CDMA Interleaver Step Size.11=0
S-CDMA Spreader On?.11=FALSE
S-CDMA Subframe Codes.11=0
Channel Type.11="atdma (2)"

[SCDMA Modulation Profile]
Modulation Type.1=128-QAM
Preamble Length.1=32
Differential Encoding?.1=FALSE
FEC "T" Bytes.1=0
FEC Codeword Size ("K").1=16
Scrambler Seed.1=38
Max Burst Size.1=0
Guard Time.1=1
Last Codeword Shortened?.1=TRUE
Scrambler?.1=TRUE
Byte Interleaver Depth.1=1
Byte Interleaver Block Size.1=0
Preamble Type.1="qpsk0 (1)"
TCM Error Correction?.1=TRUE
S-CDMA Interleaver Step Size.1=5
S-CDMA Spreader On?.1=TRUE
S-CDMA Subframe Codes.1=10
Channel Type.1="scdma (3)"
Modulation Type.3=QPSK
Preamble Length.3=320
Differential Encoding?.3=FALSE
FEC "T" Bytes.3=5
FEC Codeword Size ("K").3=34

Scrambler Seed.3=38
Max Burst Size.3=0
Guard Time.3=1
Last Codeword Shortened?.3=FALSE
Scrambler?.3=TRUE
Byte Interleaver Depth.3=1
Byte Interleaver Block Size.3=0
Preamble Type.3="qpsk0 (1)"
TCM Error Correction?.3=TRUE
S-CDMA Interleaver Step Size.3=1
S-CDMA Spreader On?.3=FALSE
S-CDMA Subframe Codes.3=10
Channel Type.3="scdma (3)"
Modulation Type.4=QPSK
Preamble Length.4=128
Differential Encoding?.4=FALSE
FEC "T" Bytes.4=5
FEC Codeword Size ("K").4=34
Scrambler Seed.4=38
Max Burst Size.4=0
Guard Time.4=1
Last Codeword Shortened?.4=TRUE
Scrambler?.4=TRUE
Byte Interleaver Depth.4=1
Byte Interleaver Block Size.4=0
Preamble Type.4="qpsk0 (1)"
TCM Error Correction?.4=TRUE
S-CDMA Interleaver Step Size.4=1
S-CDMA Spreader On?.4=FALSE
S-CDMA Subframe Codes.4=10
Channel Type.4="scdma (3)"
Modulation Type.9=128-QAM
Preamble Length.9=32
Differential Encoding?.9=FALSE
FEC "T" Bytes.9=5
FEC Codeword Size ("K").9=78
Scrambler Seed.9=38
Max Burst Size.9=8
Guard Time.9=1
Last Codeword Shortened?.9=TRUE
Scrambler?.9=TRUE
Byte Interleaver Depth.9=1
Byte Interleaver Block Size.9=0
Preamble Type.9="qpsk0 (1)"
TCM Error Correction?.9=TRUE
S-CDMA Interleaver Step Size.9=5
S-CDMA Spreader On?.9=TRUE
S-CDMA Subframe Codes.9=10
Channel Type.9="scdma (3)"
Modulation Type.10=128-QAM
Preamble Length.10=64
Differential Encoding?.10=FALSE
FEC "T" Bytes.10=10
FEC Codeword Size ("K").10=220
Scrambler Seed.10=38
Max Burst Size.10=0
Guard Time.10=1
Last Codeword Shortened?.10=TRUE
Scrambler?.10=TRUE
Byte Interleaver Depth.10=1
Byte Interleaver Block Size.10=0
Preamble Type.10="qpsk0 (1)"
TCM Error Correction?.10=TRUE

S-CDMA Interleaver Step Size.10=5
S-CDMA Spreader On?.10=TRUE
S-CDMA Subframe Codes.10=10
Channel Type.10="scdma (3)"
Modulation Type.11=128-QAM
Preamble Length.11=32
Differential Encoding?.11=FALSE
FEC "T" Bytes.11=6
FEC Codeword Size ("K").11=78
Scrambler Seed.11=38
Max Burst Size.11=0
Guard Time.11=1
Last Codeword Shortened?.11=TRUE
Scrambler?.11=TRUE
Byte Interleaver Depth.11=1
Byte Interleaver Block Size.11=0
Preamble Type.11="qpsk0 (1)"
TCM Error Correction?.11=TRUE
S-CDMA Interleaver Step Size.11=5
S-CDMA Spreader On?.11=TRUE
S-CDMA Subframe Codes.11=10
Channel Type.11="scdma (3)"

Limit File Details

The limit file shown below for PHY-20.2 allows user control of test pass/fail criteria without requiring access to the actual test script. One application of this limit file would be to set up 'marginal' criteria for passing, or in other words to allow for a comfort margin in modem performance before submission for certification testing. Acronyms for data format and conditions are as specified in the **DAQTron Jupiter 110/200 Operator's Guide**.

PHY-20.2.lmt

pre-eq_test_MER,C0%s%r,GE,27
Required_MER,c1%P,GE,c2

Test Results

The Data Viewer displays a tab for the Progress report and another tab for Test Results.

Figure 2. Progress Tab for Jupiter 200 PHY-20.2.

Tabular Report

The Tabular report lists the **PICS**, **Measurement**, **Comment**, **Pass/Fail** and **Limit** applied to the measurement. Also, there are filter and Print buttons. The filter button allows you to view all data, only the data that passed the test or only the data that failed the test.

PICS Coverage

ID	PICS Item	ATP	Requirement	Quality	Quantity
4096	CmPhTx.54	PHY-20.2	A transmit pre-equalizer of a linear equalizer structure, as shown in Figure 4-5, MUST be configured by the CM in response to the Ranging Response (RNG-RSP) message transmitted by the CMTS	Indirect	Total
4098	CmPhTx.55	PHY-20.2	The pre-equalizer MUST support a symbol (T)-spaced equalizer structure with 8 taps	Direct	Total
4100	CmPhTx.56	PHY-20.2	The pre-equalizer MAY have 1, 2, or 4 samples per symbol, with a tap length longer than 8 symbols.	Indirect	Partial
4105	CmtsPhRx.3	PHY-20.2	In response to an initial ranging request and periodic ranging requests prior to CM registration, when the CMTS sends the pre-equalizer coefficients, the CMTS MUST compute and send them with an equalizer length of 8 and in symbol-spaced format	Direct	Total
4108	CmtsPhRx.5	PHY-20.2	The CMTS MUST not move the main tap location [of the pre-equalizer coefficients] during periodic station maintenance	Direct	Total
4109	CmPhTx.58	PHY-20.2	During initial ranging, the CM, not the CMTS, MUST compensate for the delay (ranging offset) due to a shift from the first tap to a new main tap location of the equalizer coefficients sent by the CMTS	Indirect	Total
4110	CmPhTx.59	PHY-20.2	Prior to an initial ranging request and whenever the US channel frequency or symbol rate changes, the CM MUST initialize the pre-equalizer coefficients to a default setting in which all coefficients are zero except the real coefficient of the first tap	Direct	Total
4111	CmtsPhRx.6	PHY-20.2	Equalizer coefficients may be included in every RNG-RSP message, but typically they only occur when the CMTS determines the channel response has significantly changed	Direct	Total

ID	PICS Item	ATP	Requirement	Quality	Quantity
4177	CmtsPhRx.100	PHY-20.2	NOTE: The CM MUST be capable of achieving a cluster SNR of at least 27 dB in the presence of the channel micro-reflections defined in Table 2-2	Direct	Total
4522	CmtsMaMsg.42	PHY-20.2	Ranging Response messages contain a CM Transmitter Equalization Information TLV tuple	Direct	Total
4527	CmtsMaMsg.46	PHY-20.2	Generalized Equalizer: The number of forward taps per symbol MUST be either 1, 2, or 4	Direct	Partial
4528	CmtsMaMsg.47	PHY-20.2	Generalized Equalizer: For a symbol-spaced equalizer, the number of forward taps per symbol field MUST be set to "1"	Direct	Total
4529	CmtsMaMsg.48	PHY-20.2	Generalized Equalizer: The number of reverse taps (M) field MUST be set to "0" for a linear equalizer	Direct	Total
4530	CmtsMaMsg.49	PHY-20.2	Generalized Equalizer: The total number of taps MAY range up to 64, with each tap consisting of a real and imaginary coefficient entry in the table.	Indirect	Partial
5711	CmMaCfg.185	PHY-20.2	The CM MUST support Transmit Equalizer Taps per Symbol configuration setting	Direct	Total
5712	CmMaCfg.186	PHY-20.2	All CMs MUST support symbol-spaced equalizer coefficients	Direct	Total
5713	CmMaCfg.187	PHY-20.2	The CM MUST support Number of Transmit Equalizer Taps configuration setting	Direct	Total
5714	CmMaCfg.188	PHY-20.2	All CMs MUST support an equalizer length of at least 8 symbols	Direct	Total
4102	CmPhTx.57	PHY-20.2	The CM MUST convolve the coefficients sent by the CMTS with the existing coefficients to get the new coefficients	Indirect	Total
4113	CmPhTx.61	PHY-20.2	The CM MUST also compensate for the change in transmit power due to the gain (or loss) of the new coefficients	Indirect	Total

PICS Items to be Covered by Vendor specific ATPs

ID	PICS Item	ATP	Requirement	Quality	Quantity
4107	CmtsPhRx.4		After registration, the CMTS MAY use a fractionally spaced equalizer format (T/2- or T/4-spaced) with a longer tap length to match the CM pre-equalizer capabilities that the CMTS learned from the REG-REQ message modem capabilities field		
4112	CmPhTx.60		The CM MUST normalize the pre-equalizer coefficients in order to guarantee proper operation (such as not to overflow or clip)		
4115	CmPhTx.63		If the CM equalizer structure implements the same number of coefficients as assigned in the RNG-RSP message, then the CM MUST not change the location of the main tap in the RNG-RSP message		
4116	CmPhTx.64		If the CM equalizer structure implements a different number of coefficients than defined in the RNG-RSP message, the CM MAY shift the location of the main tap value		
4531	CmtsMaMsg .50		Generalized Equalizer: Data MUST be treated as if byte-concatenated, that is, the first byte after the length field of the second type-4 element is treated as if it immediately followed the last byte of the first type-4 element		
4533	CmtsMaMsg .51		Generalized Equalizer: If more than 255 bytes are needed to represent equalization information, then several type-4 elements MAY be used		
5337	CmtsMaInit. 7		If opportunities are offered prior to the pending-till-complete expiry, the "good-enough" test which follows receipt of a RNG-RSP MUST NOT judge the CM's transmit equalization until pending-till-complete expires		

DOCSIS Test Result Tables

Procedure 3

Upstream Frequency	Test #	Measured MER (dB)	Criteria (dB)	Pass/Fail
27.0 MHz	1		27	
	2		27	
	3		27	
	4		27	
	5		27	
	6		27	
	7		27	
33.5 MHz	1		27	
	2		27	
	3		27	
	4		27	
	5		27	
	6		27	
	7		27	
40.0 MHz	1		27	
	2		27	
	3		27	
	4		27	
	5		27	
	6		27	
	7		27	