TEST REPORT

Covering the
DYNAMIC FREQUENCY SELECTION (DFS)
REQUIREMENTS
OF

FCC Part 15 Subpart E (UNII) / RSS-210 Annex A9

Summit Data Communications
Model(s): SDC-MSD40NBT

COMPANY:	Summit Data Communications 526 South Main St. Suite 805 Akron, OH, 44311
TEST SITE:	Elliott Laboratories 41039 Boyce Road Fremont, CA 94538
REPORT DATE:	February 29, 2012
FINAL TEST DATE:	January 3, 2012
TEST ENGINEER:	Mark Hill

PROGRAM MGR /
TECHNICAL REVIEWER:

Mark Hill
Staff Engineer

QUALITY ASSURANCE DELEGATE /
FINAL REPORT PREPARER:

David Guidotti
Senior Technical Writer

ACCREDITED
Testing Cert #0214.26

Elliott Laboratories is accredited by the A2LA, certificate number 0214.26, to perform the test(s) listed in this report, except where noted otherwise. This report and the information contained herein represent the results of testing test articles identified and selected by the client performed to specifications and/or procedures selected by the client. National Technical Systems (NTS) makes no representations, expressed or implied, that such testing is adequate (or inadequate) to demonstrate efficiency, performance, reliability, or any other characteristic of the articles being tested, or similar products. This report should not be relied upon as an endorsement or certification by NTS of the equipment tested, nor does it represent any statement **whatsoever** as to its merchantability or fitness of the test article, or similar products, for a particular purpose. This report shall not be reproduced except in full

REVISION HISTORY

Rev #	Date	Comments	Modified By
1.0	2-29-2012	First Release	-

TABLE OF CONTENTS

REVISION HISTORY **2**
TABLE OF CONTENTS **3**
LIST OF TABLES **3**
LIST OF FIGURES **3**
SCOPE **4**
OBJECTIVE **4**
STATEMENT OF COMPLIANCE **4**
DEVIATIONS FROM THE STANDARD **4**
EQUIPMENT UNDER TEST (EUT) DETAILS **5**
GENERAL 5
ENCLOSURE 5
MODIFICATIONS 5
SUPPORT EQUIPMENT 6
EUT INTERFACE PORTS 6
EUT OPERATION 6
RADAR WAVEFORMS **7**
TEST RESULTS **8**
TEST RESULTS SUMMARY – FCC PART 15, CLIENT DEVICE 8
MEASUREMENT UNCERTAINTIES 8
DFS TEST METHODS **9**
RADIATED TEST METHOD 9
DFS MEASUREMENT INSTRUMENTATION **11**
RADAR GENERATION SYSTEM 11
CHANNEL MONITORING SYSTEM 12
DFS MEASUREMENT METHODS **13**
DFS – CHANNEL CLOSING TRANSMISSION TIME AND CHANNEL MOVE TIME 13
DFS – CHANNEL NON-OCCUPANCY AND VERIFICATION OF PASSIVE SCANNING 13
DFS CHANNEL AVAILABILITY CHECK TIME 14
TRANSMIT POWER CONTROL (TPC) 14
SAMPLE CALCULATIONS **15**
DETECTION PROBABILITY / SUCCESS RATE 15
THRESHOLD LEVEL 15
APPENDIX A TEST EQUIPMENT CALIBRATION DATA **16**
APPENDIX B TEST DATA TABLES AND PLOTS FOR CHANNEL CLOSING **17**
FCC PART 15 SUBPART E CHANNEL CLOSING MEASUREMENTS 17

LIST OF TABLES

Table 1 FCC Short Pulse Radar Test Waveforms 7
Table 2 FCC Long Pulse Radar Test Waveforms 7
Table 3 FCC Frequency Hopping Radar Test Waveforms 7
Table 4 FCC Part 15 Subpart E Client Device Test Result Summary 8
Table 5 FCC Part 15 Subpart E Channel Closing Test Results 17

LIST OF FIGURES

Figure 1 Test Configuration for radiated Measurement Method 9
Figure 2 Channel Closing Time and Channel Move Time – 40 second plot 18
Figure 3 Close-Up of Transmissions Occurring More Than 200ms After The End of Radar 19
Figure 4 Radar Channel Non-Occupancy Plot 20

SCOPE

Test data has been taken pursuant to the relevant DFS requirements of the following standard(s):

- FCC Part 15 Subpart E Unlicensed National Information Infrastructure (U-NII) Devices.
- RSS-210 Annex 9 Local Area Network Devices.

Tests were performed in accordance with these standards together with the current published versions of the basic standards referenced therein as outlined in Elliott Laboratories test procedures. The test results recorded herein are based on a single type test of the Summit Data Communications model SDC-MSD40NBT and therefore apply only to the tested sample. The sample was selected and prepared by Ron Seide of Summit Data Communications.

OBJECTIVE

The objective of the manufacturer is to comply with the standards identified in the previous section. In order to demonstrate compliance, the manufacturer or a contracted laboratory makes measurements and takes the necessary steps to ensure that the equipment complies with the appropriate technical standards. Compliance with some DFS features is covered through a manufacturer statement or through observation of the device.

STATEMENT OF COMPLIANCE

The tested sample of the Summit Data Communications model SDC-MSD40NBT complied with the DFS requirements of FCC Part 15.407(h)(2) and RSS-210 Annex A9.3.

Maintenance of compliance is the responsibility of the manufacturer. Any modifications to the product should be assessed to determine their potential impact on the compliance status of the device with respect to the standards detailed in this test report.

DEVIATIONS FROM THE STANDARD

No deviations were made from the test methods and requirements covered by the scope of this report.

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Summit Data Communications model SDC-MSD40NBT is a 802.11abgn module.

The sample was received on January 3, 2012 and tested on January 3, 2012. The EUT consisted of the following component(s):

Manufacturer	Model	Description	Serial Number
Summit Data Communications	SDC-MSD40NBT	802.11abg module	Prototype

The manufacturer declared values for the EUT operational characteristics that affect DFS are as follows:

Operating Modes (5250 – 5350 MHz, 5470 – 5725 MHz)

☒ Client Device (no In Service Monitoring, no Ad-Hoc mode)

☐ Client Device with In-Service Monitoring

Antenna Gains / EIRP (5250 – 5350 MHz, 5470 – 5725 MHz)

	5250 – 5350 MHz	5470 – 5725 MHz
Lowest Antenna Gain (dBi)	5	5
Highest Antenna Gain (dBi)	5	5
EIRP Output Power (dBm)	20.7	21.5

☐ Power can exceed 200mW eirp

Channel Protocol

☒ IP Based

☐ Frame Based

☐ OTHER _____

ENCLOSURE

The EUT has no enclosure. It is designed to be installed within the enclosure of a host computer.

MODIFICATIONS

The EUT did not require modifications during testing in order to comply with the requirements of the standard(s) referenced in this test report.

SUPPORT EQUIPMENT

The following equipment was used as local support equipment for testing:

Manufacturer	Model	Description	Serial Number	FCC ID
Dell	Inspirion 8600	Laptop Computer	42707742661	DoC
HP	iPaq	Handheld PDA	N/A	N/A
Cisco	*AIR-AP1252AG-A-K9*	*802.11 Access Point*	*FTX1209906V*	*LDK102062*
Linksys	AirLink 100	4 port switch and DHCP server	030008256167	RRK-AR430W

The italicized device was the master device.

EUT INTERFACE PORTS

The I/O cabling configuration during testing was as follows:

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length (m)
Cisco AP	Switch	CAT 5	Unshielded	10.0
Switch	Laptop Computer (FTP Server)	CAT 5	Unshielded	10.0

EUT OPERATION

The EUT was operating with the following software.

Client Device: Summit Client Utility v3.03.14, Driver v3.03.11

As the host device does not support playback of the FCC movie, file, the network was exercised by an FTP transfer of the movie from the FTP server connected to the master device to the client. Refer to KDB 594163 for the FCC's approval of the alternate test method.

RADAR WAVEFORMS

Table 1 FCC Short Pulse Radar Test Waveforms					
Radar Type	Pulse Width (µsec)	PRI (µsec)	Pulses / burst	Minimum Detection Percentage	Minimum Number of Trials
1	1	1428	18	60%	30
2	1-5	150-230	23-29	60%	30
3	6-10	200-500	16-18	60%	30
4	11-20	200-500	12-16	60%	30
Aggregate (Radar Types 1-4)				80%	120

Table 2 FCC Long Pulse Radar Test Waveforms							
Radar Type	Pulse Width (µsec)	Chirp Width (MHz)	PRI (µsec)	Pulses / burst	Number of *Bursts*	Minimum Detection Percentage	Minimum Number of Trials
5	50-100	5-20	1000-2000	1-3	8-20	80%	30

Table 3 FCC Frequency Hopping Radar Test Waveforms							
Radar Type	Pulse Width (µsec)	PRI (µsec)	Pulses / hop	Hopping Rate (kHz)	Hopping Sequence Length (msec)	Minimum Detection Percentage	Minimum Number of Trials
6	1	333	9	0.333	300	70%	30

TEST RESULTS

TEST RESULTS SUMMARY – FCC Part 15, CLIENT DEVICE

Table 4 FCC Part 15 Subpart E Client Device Test Result Summary

Description	Radar Type	EUT Frequency	Measured Value	Requirement	Test Data	Status
Channel closing transmission time	Type 1	5500 MHz	7.2ms	60ms	Appendix B	Pass
Channel move time	Type 1	5500 MHz	582ms	10s	Appendix B	Pass
Non-occupancy period - associated	Type 1	5300 MHz	> 30 minutes	> 30 minutes	Appendix B	Pass
Passive Scanning	N/A	N/A	Refer to manufacturer attestation			

1) Tests were performed using the radiated test method.
2) Channel availability check, detection threshold and non-occupancy period are not applicable to client devices.

MEASUREMENT UNCERTAINTIES

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level, with a coverage factor (k=2) and were calculated in accordance with UKAS document LAB 34.

Measurement	Measurement Unit	Expanded Uncertainty
Timing (Channel move time, aggregate transmission time)	ms	Timing resolution +/- 0.24%
Timing (non occupancy period)	seconds	5 seconds
DFS Threshold (radiated)	dBm	1.6
DFS Threshold (conducted)	dBm	1.2

DFS TEST METHODS

RADIATED TEST METHOD

The combination of master and slave devices is located in an anechoic chamber. The simulated radar waveform is transmitted from a directional horn antenna (typically an EMCO 3115) toward the unit performing the radar detection (radar detection device, RDD). Every effort is made to ensure that the main beam of the EUT's antenna is aligned with the radar-generating antenna.

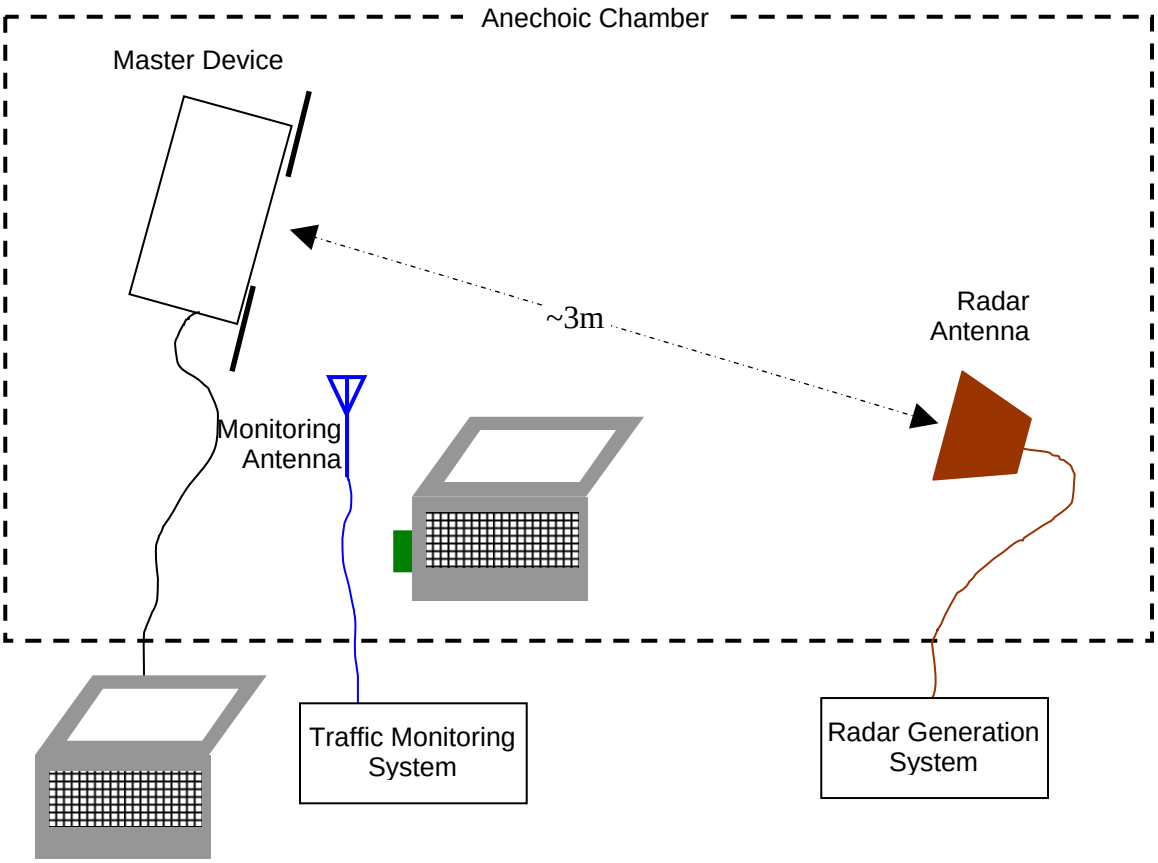

Figure 1 Test Configuration for radiated Measurement Method

The signal level of the simulated waveform is set to a reference level equal to the threshold level (plus 1dB if testing against FCC requirements). Lower levels may also be applied on request of the manufacturer. The level reported is the level at the RDD antenna and so it is not corrected for the RDD's antenna gain. The RDD is configured with the lowest gain antenna assembly intended for use with the device.

The signal level is verified by measuring the CW signal level from the radar generation system using a reference antenna of gain G_{REF} (dBi). The radar signal level is calculated from the measured level, R (dBm), and any cable loss, L (dB), between the reference antenna and the measuring instrument:

$$\text{Applied level (dBm)} = R - G_{REF} + L$$

If both master and client devices have radar detection capability then the device not under test is positioned with absorbing material between its antenna and the radar generating antenna, and the radar level at the non RDD is verified to be at least 20dB below the threshold level to ensure that any responses are due to the RDD detecting radar.

The antenna connected to the channel monitoring subsystem is positioned to allow both master and client transmissions to be observed, with the level of the EUT's transmissions between 6 and 10dB higher than those from the other device.

DFS MEASUREMENT INSTRUMENTATION

RADAR GENERATION SYSTEM

An Agilent PSG is used as the radar-generating source. The integral arbitrary waveform generators are programmed using Agilent's "Pulse Building" software and Elliott custom software to produce the required waveforms, with the capability to produce both un-modulated and modulated (FM Chirp) pulses. Where there are multiple values for a specific radar parameter then the software selects a value at random and, for FCC tests, the software verifies that the resulting waveform is truly unique.

With the exception of the hopping waveforms required by the FCC's rules (see below), the radar generator is set to a single frequency within the radar detection bandwidth of the EUT. The frequency is varied from trial to trial by stepping in 5MHz steps.

Frequency hopping radar waveforms are simulated using a time domain model. A randomly hopping sequence algorithm (which uses each channel in the hopping radar's range once in a hopping sequence) generates a hop sequence. A segment of the first 100 elements of the hop sequence are then examined to determine if it contains one or more frequencies within the radar detection bandwidth of the EUT. If it does not then the first element of the segment is discarded and the next frequency in the sequence is added. The process repeats until a valid segment is produced. The radar system is then programmed to produce bursts at time slots coincident with the frequencies within the segment that fall in the detection bandwidth. The frequency of the generator is stepped in 1 MHz increments across the EUT's detection range.

The radar signal level is verified during testing using a CW signal with the AGC function switched on. Correction factors to account for the fact that pulses are generated with the AGC functions switched off are measured annually and an offset is used to account for this in the software.

The generator output is connected to the coupling port of the conducted set-up or to the radar-generating antenna.

CHANNEL MONITORING SYSTEM

Channel monitoring is achieved using a spectrum analyzer and digital storage oscilloscope. The analyzer is configured in a zero-span mode, center frequency set to the radar waveform's frequency or the center frequency of the EUT's operating channel. The IF output of the analyzer is connected to one input of the oscilloscope.

A signal generator output is set to send either the modulating signal directly or a pulse gate with an output pulse co-incident with each radar pulse. This output is connected to a second input on the oscilloscope and the oscilloscope displays both the channel traffic (via the if input) and the radar pulses on its display.

For in service monitoring tests the analyzer sweep time is set to > 20 seconds and the oscilloscope is configured with a data record length of 10 seconds for the short duration and frequency hopping waveforms, 20 seconds for the long duration waveforms. Both instruments are set for a single acquisition sequence. The analyzer is triggered 500ms before the start of the waveform and the oscilloscope is triggered directly by the modulating pulse train. Timing measurements for aggregate channel transmission time and channel move time are made from the oscilloscope data, with the end of the waveform clearly identified by the pulse train on one trace. The analyzer trace data is used to confirm that the last transmission occurred within the 10-second record of the oscilloscope. If necessary the record length of the oscilloscope is expanded to capture the last transmission on the channel prior to the channel move.

Channel availability check time timing plots are made using the analyzer. The analyzer is triggered at start of the EUT's channel availability check and used to verify that the EUT does not transmit when radar is applied during the check time.

The analyzer detector and oscilloscope sampling mode is set to peak detect for all plots.

DFS MEASUREMENT METHODS

DFS – CHANNEL CLOSING TRANSMISSION TIME AND CHANNEL MOVE TIME

Channel clearing and closing times are measured by applying a burst of radar with the device configured to change channel and by observing the channel for transmissions. The time between the end of the applied radar waveform and the final transmission on the channel is the channel move time.

The aggregate transmission closing time is measured in one of two ways:

FCC/KCC Notice No. 2010-48 – the total time of all individual transmissions from the EUT that are observed starting 200ms at the end of the last radar pulse in the waveform. This value is required to be less than 60ms.

ETSI – the total time of all individual transmissions from the EUT that are observed from the end of the last radar pulse in the waveform. This value is required to be less than 260ms.

DFS – CHANNEL NON-OCCUPANCY AND VERIFICATION OF PASSIVE SCANNING

The channel that was in use prior to radar detection by the master is additionally monitored for 30 minutes to ensure no transmissions on the vacated channel over the required non-occupancy period. This is achieved by tuning the spectrum analyzer to the vacated channel in zero-span mode and connecting the IF output to an oscilloscope. The oscilloscope is triggered by the radar pulse and set to provide a single sweep (in peak detect mode) that lasts for at least 30 minutes after the end of the channel move time.

For devices with a client-mode that are being evaluated against FCC rules the manufacturer must supply an attestation letter stating that the client device does not employ any active scanning techniques (i.e. does not transmit in the DFS bands without authorization from a Master device).

DFS CHANNEL AVAILABILITY CHECK TIME

It is preferred that the EUT report when it starts the radar channel availability check. If the EUT does not report the start of the check time, then the time to start transmitting on a channel after switching the device on is measured to approximate the time from power-on to the end of the channel availability check. The start of the channel availability check is assumed to be 60 seconds prior to the first transmission on the channel.

To evaluate the channel availability check, a single burst of one radar type is applied within the first 2 seconds of the start of the channel availability check and it is verified that the device does not use the channel by continuing to monitor the channel for a period of at least 60 seconds. The test is repeated by applying a burst of radar in the last 2 seconds (i.e. between 58 and 60 seconds after the start of CAC when evaluating a 60-second CAC) of the channel availability check.

Compliance with the EN 301 893 channel loading requirement, where appropriate (i.e. when channel selection is not determined under control of the network), is demonstrated by power cycling the product multiple times and recording the channel selected for use. The distribution of channels is compared against a probabilistic channel selection to verify that the distribution falls within the expected random distribution (i.e. 1/n probability for each channel, given n channels) for the number of trials performed.

TRANSMIT POWER CONTROL (TPC)

Compliance with the transmit power control requirements for devices is demonstrated through measurements showing multiple power levels and manufacturer statements explaining how the power control is implemented.

SAMPLE CALCULATIONS

DETECTION PROBABILITY / SUCCESS RATE

The detection probability, or success rate, for any one radar waveform equals the number of successful trials divided by the total number of trials for that waveform.

THRESHOLD LEVEL

The threshold level is the level of the simulated radar waveform at the EUT's antenna. If the test is performed in a conducted fashion then the level at the rf input equals the level at the antenna plus the gain of the antenna assembly, in dBi. The gain of the antenna assembly equals the gain of the antenna minus the loss of the cabling between the rf input and the antenna. The lowest gain value for all antenna assemblies intended for use with the device is used when making this calculation.

If the test is performed using the radiated method then the threshold level is the level at the antenna.

Appendix A Test Equipment Calibration Data

Manufacturer	Description	Model #	Asset #	Cal Due
Hewlett Packard	EMC Spectrum Analyzer, 9 kHz - 6.5 GHz	8595EM	780	28-Jan-12
EMCO	Antenna, Horn, 1-18 GHz	3115	1561	22-Jun-12
EMCO	Antenna, Horn, 1-18 GHz	3117	1662	04-May-12
Agilent	PSG Vector Signal Generator (250kHz - 20GHz)	E8267C	1877	30-Mar-12
Tektronix	500MHz, 2CH, 5GS/s Scope	TDS5052B	2118	07-Oct-12

Appendix B Test Data Tables and Plots for Channel Closing

FCC PART 15 SUBPART E Channel Closing Measurements

Table 5 FCC Part 15 Subpart E Channel Closing Test Results

Waveform Type	Channel Closing Transmission Time [1]		Channel Move Time		Result
	Measured	Limit	Measured	Limit	
Radar Type 1	7.2ms	60ms	582	10s	Pass

After the final channel closing test the channel was monitored for a further 30 minutes. No transmissions occurred on the channel.

[1] Channel closing time for FCC measurements is the aggregate transmission time starting from 200ms after the end of the radar signal to the completion of the channel move.

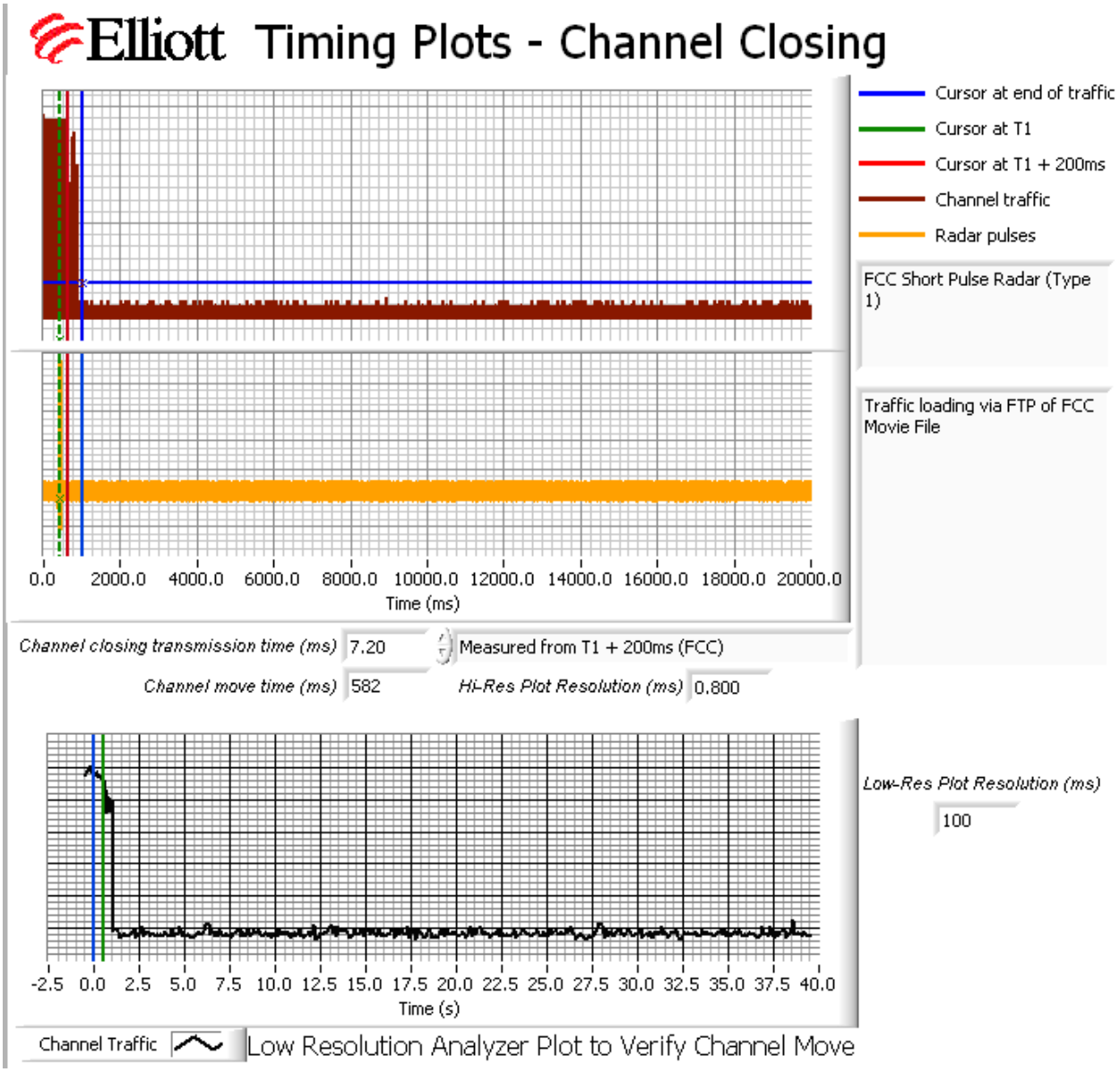

Figure 2 Channel Closing Time and Channel Move Time – 40 second plot

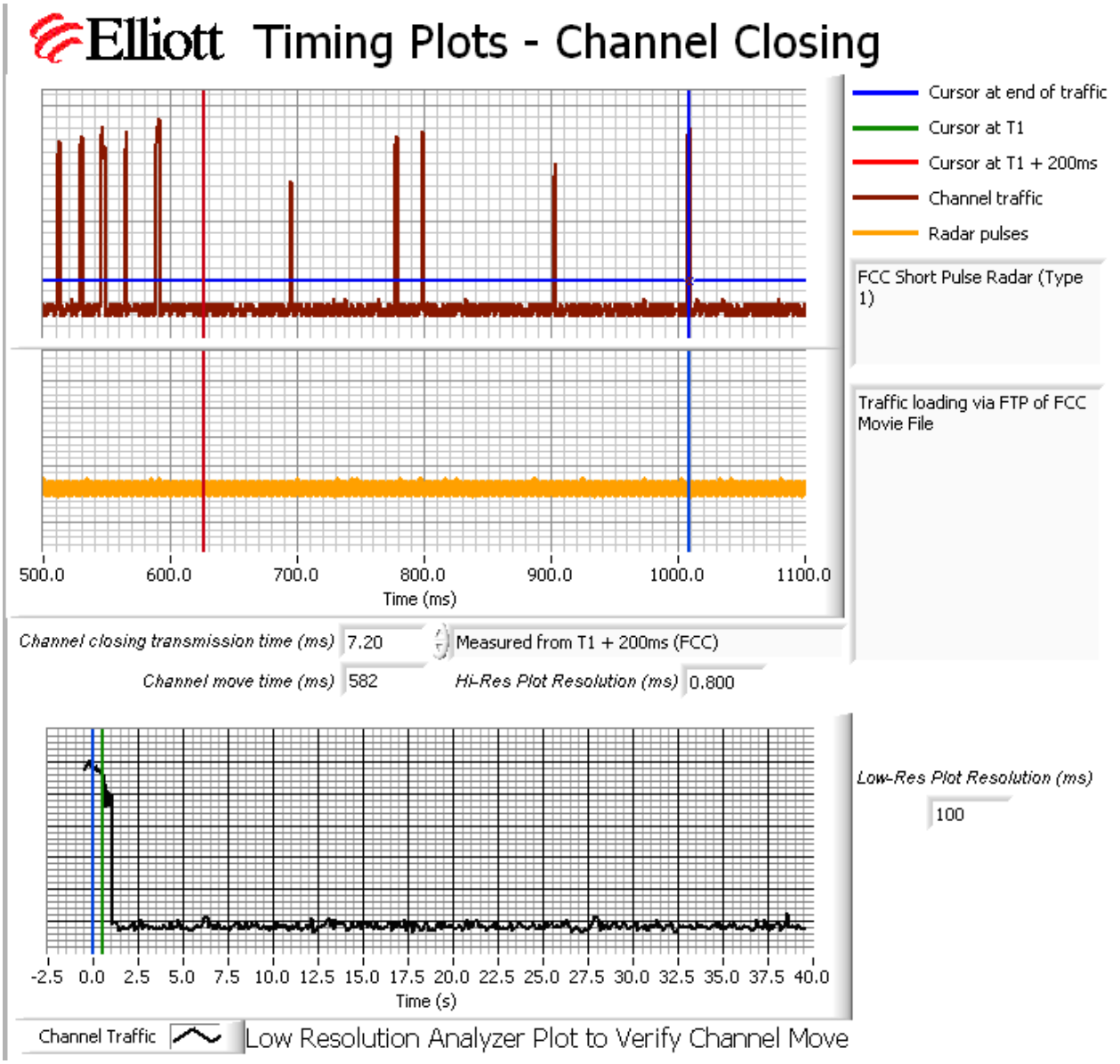

Figure 3 Close-Up of Transmissions Occurring More Than 200ms After The End of Radar

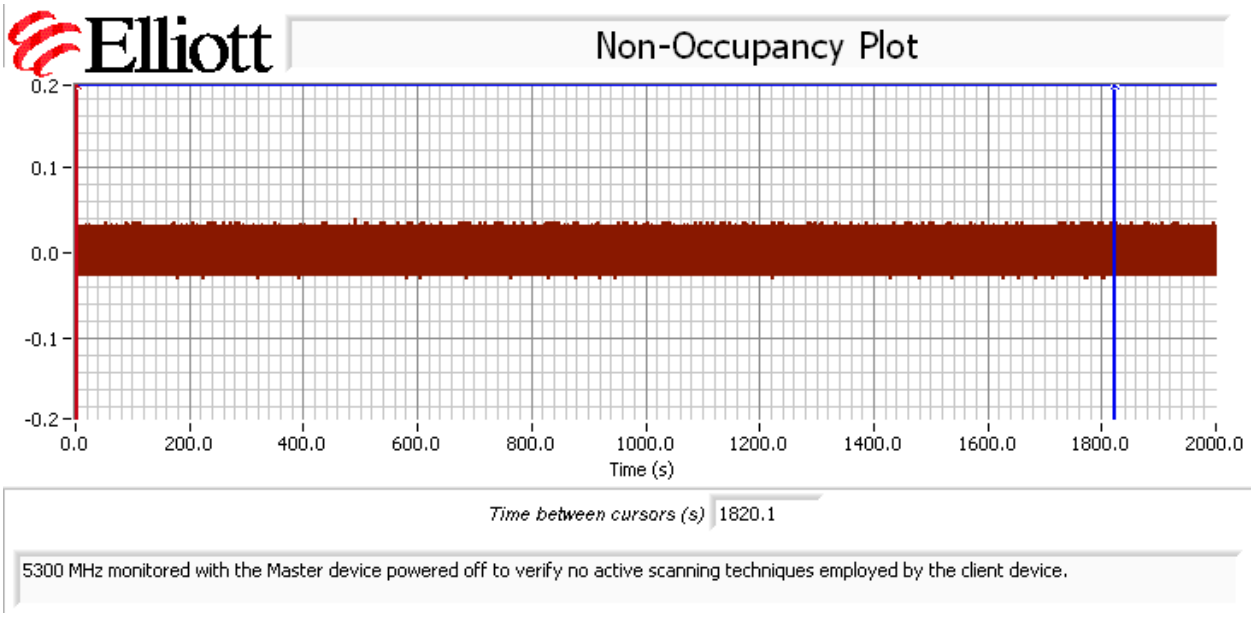

Figure 4 Radar Channel Non-Occupancy Plot

The non-occupancy plot was made over a 30-minute time period following the channel move time with the analyzer IF output connected to the scope and tuned to the vacated channel. No transmissions were observed after the channel move had been completed.