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# *TEST REPORT*

## *DYNAMIC FREQUENCY SELECTION REQUIREMENTS*

## *OF*

## *FCC Part 15 Subpart E (UNII)*

## *Symbol Technologies*
## *Model(s): CB3000*

| | |
|---|---|
| MANUFACTURER: | Symbol Technologies<br>648 West Maude Ave.<br>Sunnyvale, CA |
| TEST SITE: | Elliott Laboratories, Inc.<br>684 W. Maude Ave<br>Sunnyvale, CA 94086 |
| REPORT DATE: | November 3, 2006 |
| FINAL TEST DATE: | November 3, 2006 |
| AUTHORIZED SIGNATORY: | Juan Martinez<br>Sr. EMC Engineer |

ACCREDITED
2016-01

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## *SCOPE*

The Federal Communications Comission and the European Telecommunications Standards Institute (ETSI) publish standards regarding ElectroMagnetic Compatibility and Radio spectrum Matters for radio-communications devices. Tests have been performed on the Symbol Technology model CB3000 in accordance with these standards.

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

- FCC Part 15 SubPart E Unlicensed National Information Infrastructure (U-NII) 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 Symbol Technologies model CB3000 and therefore apply only to the tested sample. The sample was selected and prepared by Alan Parrish of Symbol Technologies.

## *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 are covered through a manufacturer statement or through observation of the device.

## *STATEMENT OF COMPLIANCE*

The tested sample of Symbol Technologies model CB3000 complied with the DFS requirements of:

FCC Part 15.407

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 Symbol Technologies model CB3000 is a Wireless Bridge Adaptor is a Wireless bridge router that is designed to provide wireless Internet and network service

The sample was received on Novembe 30, 2006 and tested on Novembe 30, 2006. The EUT consisted of the following component(s):

| Manufacturer | Model | Description | Serial Number |
|---|---|---|---|
| Symbol Technologies | CB3000 | Wireless Bridge | 6146529900788 |

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

**Operating Modes**

☐ Master Device

☐ Client Device

☒ Client Device with In-Service Monitoring

**Antenna Gains / EIRP**

| | 5250 – 5350 MHz | 5470 – 5725 MHz |
|---|---|---|
| Lowest Antenna Gain (dBi) | 4 | 4 |
| Highest Antenna Gain (dBi) | 13 | 13 |
| Output Power (dBm) | 19.7 | 19.7 |

☒ Power can exceed 200mW eirp

**Channel Protocol**

☒ IP Based

☐ Frame Based

☐ OTHER _____

### *ENCLOSURE*

The EUT enclosure is primarily constructed of plastic . It measures approximately 17.5 cm wide by 10 cm deep by 3 cm high.

### *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 |
|---|---|---|---|---|
| *Cisco* | *AIR-AP1131AG-A-K9* | *Master AP* | *FTX1040T17J* | *LDK102054E* |
| Dell | POP1L | Laptop | 01014 | DoC |

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) |
| Ethernet | Laptop | Cat5 | Unshielded | 1 |

***EUT OPERATION***

The EUT was operating with the following software.

Client Device: DFS_CB3000

During the in-service monitoring detection probability and channel moving tests the system was configured with a streaming video file from the master device (sourced by the PC connected to the master device via an ethernet interface) to the client device.

The streamed file was the “FCC” test file and the client device was using Windows Media Player Classic as required by FCC Part 15 Subpart E

## *TEST RESULTS*

### *TEST RESULTS SUMMARY – FCC Part 15, CLIENT DEVICE*

| Description | Radar Type | Radar Frequency | Measured Value | Requirement | Test Data | Status |
|---|---|---|---|---|---|---|
| Channel closing transmission time | Type 1<br>Type 5 | 5500 MHz<br>5320 MHz | 2.8ms<br>0ms | <60ms | Appendix C | Pass |
| Channel move time | Type 1<br>Type 5 | 5500 MHz<br>5320 MHz | .466s<br>0s | <10s | Appendix C | Pass |
| Transmit Power Control | | | | | | Client to Provide |

**Table 1 FCC Part 15 Subpart E Client Device Test Result Summary**

Notes:
1) Channel availability check, detection threshold and non-occupancy period are not applicable to client devices.

### *MEASUREMENT UNCERTAINTIES*

ISO Guide 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 (based on a coverage factor (k=2) and were calculated in accordance with NAMAS document NIS 81 and M3003.

| Measurement | Measurement Unit | Expanded Uncertainty |
|---|---|---|
| Timing<br>(Channel move time, aggregate transmission time) | ms | Timing resolution<br>+/- |
| Timing<br>(non occupancy period) | seconds | 5 seconds |
| DFS Threshold (radiated) | dBm | |
| DFS Threshold (conducted) | dBm | |

## *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.

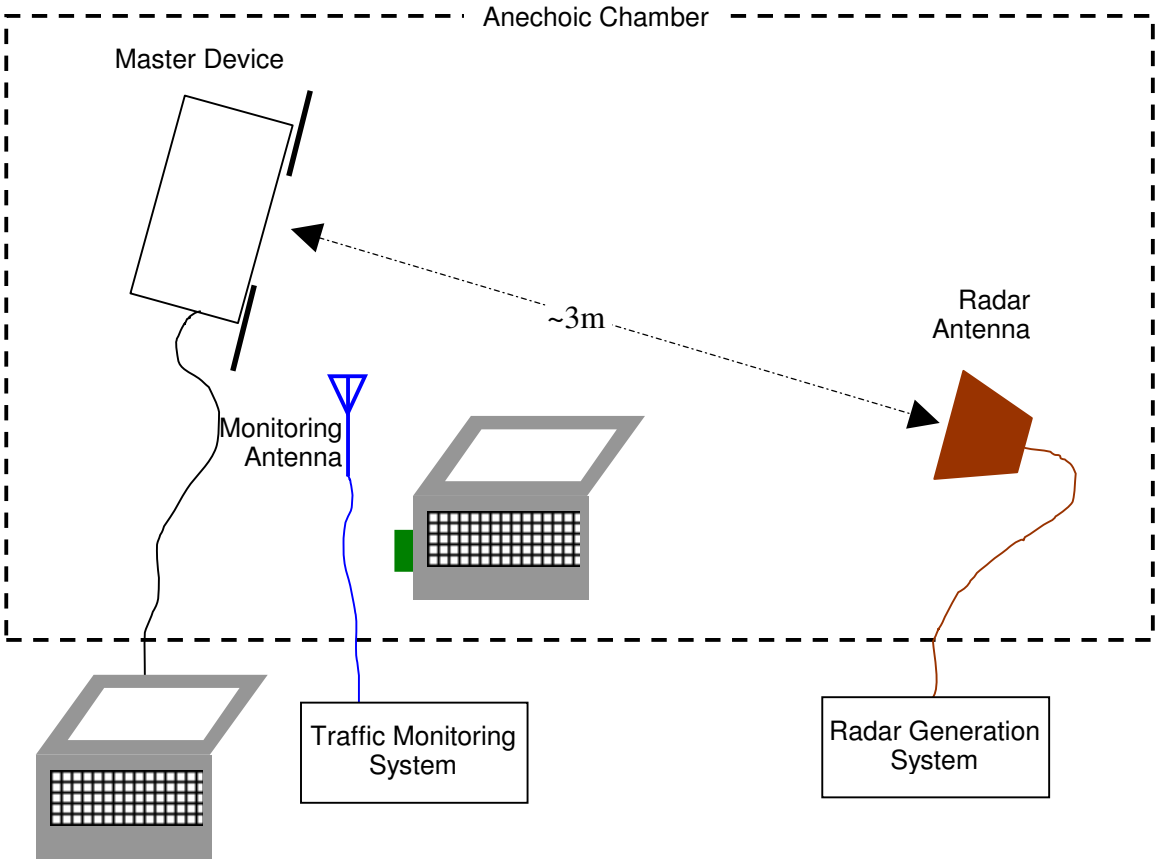



**Figure 1 Test Configuration for radiated Measurement Method**

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 (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:

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

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 noth 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.

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 radar burst 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 two ways:

FCC – 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.

### *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.

In the case of the FCC requirements, for radar waveform types 1 through 4 an additional calculation is made to determine the average detection probability over all four radar waveform types. This calculation is the arithmetic mean of the four individual probabilities.

### *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 | 787 | 10-Jan-07 |
| EMCO | Antenna, Horn, 1-18 GHz (SA40, 30 Hz) | 3115 | 1142 | 07-Jun-07 |
| Tektronix | 1 GHz Oscilloscope | TDS5104 | 1435 | 10-Apr-07 |
| EMCO | Antenna, Horn, 1-18 GHz | 3117 | 1662 | 07-Apr-07 |
| Agilent | Vector Signal Generator (250kHz - 20GHz) | E8267C | 1877 | 23-Nov-07 |

## *Appendix B Test Data Tables for Radar Detection Probability*

Not applicable device is a client with no radar detection.

## *Appendix C Test Data Tables and Plots for Channel Closing*

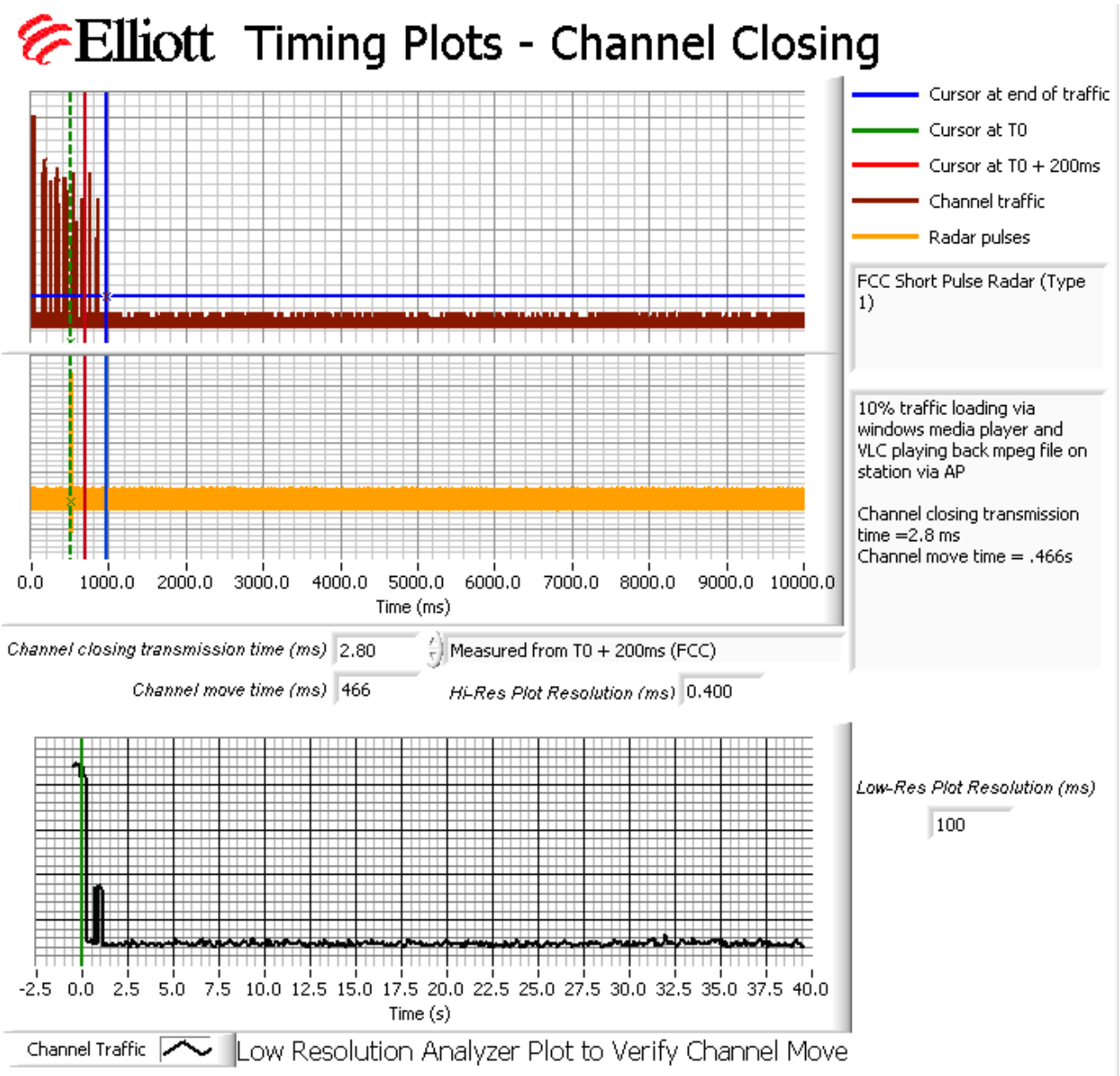
### *FCC PART 15 SUBPART E DATA*

| Waveform Type | Channel Closing Transmission Time [1] | | Channel Move Time | | Result |
|---|---|---|---|---|---|
| | Measured | Limit | Measured | Limit | |
| Radar Type 1 | 2.8ms | 60 ms | .466s | 10s | Pass |
| Radar Type 5 | 0ms | 60 ms | 0s | 10s | Pass |

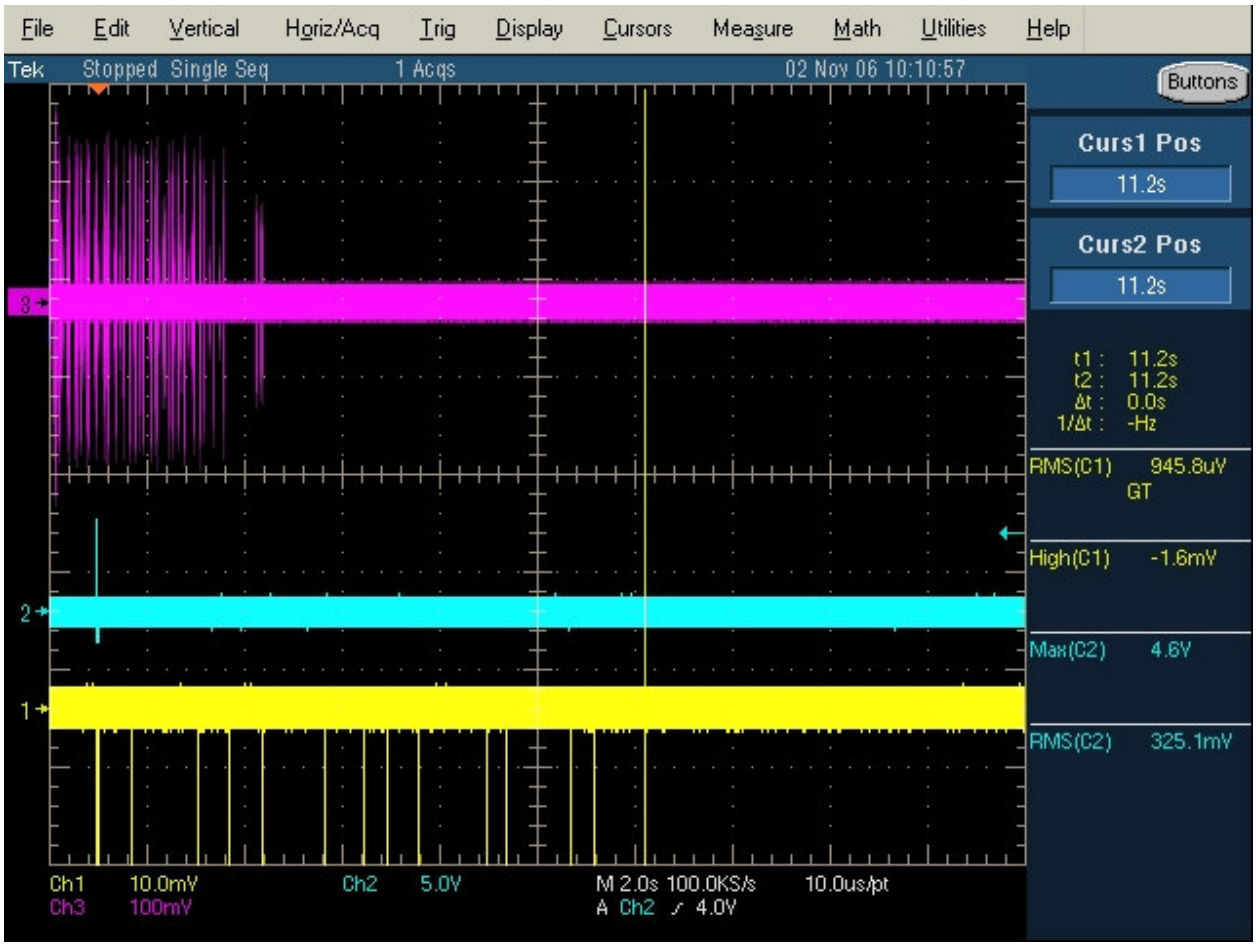
**Table 2 FCC Part 15 Subpart E Channel Closing Test Results**

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

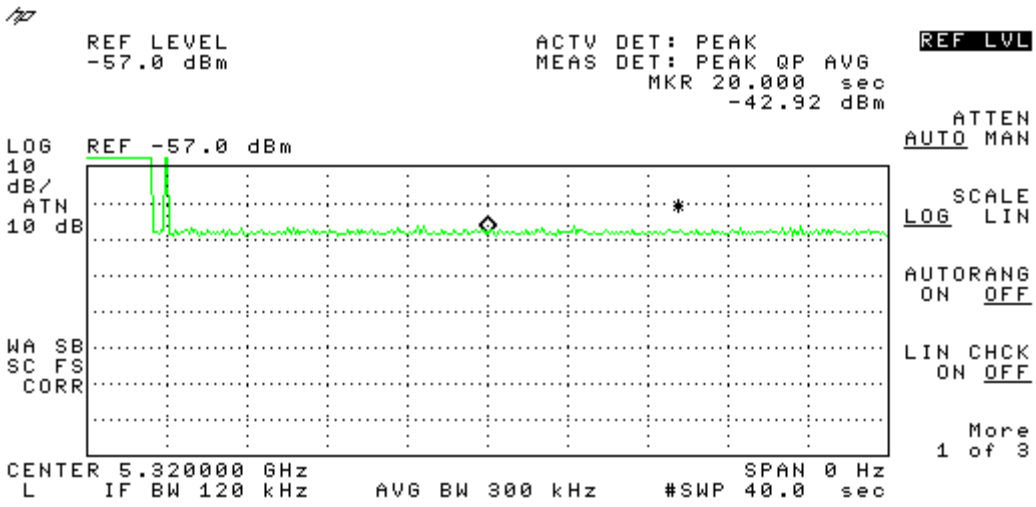
[1] Channel closing time for FCC measurements is the aggregate transmission time starting from 200ms after the end of the radar signal to the completion of the channel move.




**Radar Type 1 FCC Closing and Moving time plot**




**Radar Type 5 FCC Closing and Moving time plot (Channel Moved before radar pulse completed)**



## *Appendix D Test Data – Channel Availability Check*

Not applicable device is a client with no radar detection.

## *Appendix E Test Data – Uniform Loading*

Not applicable device is a client with no radar detection.

## *Appendix F Antenna Specification Sheet*

Client to provide separately

## *Appendix G Test Configuration Photographs*