





FCC PART 15.407(H)  
 DYNAMIC FREQUENCY SELECTION  
 TEST AND MEASUREMENT REPORT

For

**Sensity Systems, Inc.**

480 Oakmead Parkway, Sunnyvale, CA 94085, USA

**FCC ID: SXNLSNM-0001-A**

<b>Report Type:</b> Original Report	<b>Equipment Type:</b> Light Sensory Module
<b>Prepared By:</b> Ning Ma 	
<b>Report Number:</b> R1304307-FCC DFS	
<b>Report Date:</b> 2013-08-26	
Victor Zhang 	
<b>Reviewed By:</b> EMC/RF Lead	
Bay Area Compliance Laboratories Corporation (BACL) 1274 Anvilwood Avenue, Sunnyvale, CA 94089, USA Tel: (408) 732-9162 Fax: (408) 732-9164	

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\* This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "\*" (Rev. 11)

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**DOCUMENT REVISION HISTORY**

<b>Revision Number</b>	<b>Report Number</b>	<b>Description of Revision</b>	<b>Date of Revision</b>
0	R1304307-FCC DFS	Original Report	2013-08-26

## **1 GENERAL DESCRIPTION**

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### **1.1 Product Description for Equipment under Test (EUT)**

This test and measurement report was prepared on behalf of *Sensity Systems, Inc.*, and their product model: *LSNM-0001-A* with *FCC ID: SXNLSNM-0001-A* or the “EUT” as referred to in this report. The EUT is a light sensory module operating in the 2.4 GHz, 5.2 GHz, 5.3 GHz and 5.6 GHz bands.

### **1.2 Mechanical Description of EUT**

The EUT measures approximately 15 cm (L) x 15 cm (W) x 12 cm (H) and weighs 620g.

*The test data gathered are from typical production sample, serial number: 0102713A0000C250 provided by the manufacturer.*

### **1.3 Objective**

This report is prepared on behalf of *Sensity Systems, Inc.* in accordance with FCC CFR47 §15.407 (h) and FCC 06-96 Appendix.

The objective is to determine compliance with FCC rules for DFS Detection Threshold, Channel Availability Check Time, Uniform Spreading U-NII Detection Bandwidth, Channel Closing Transmission Time, and Channel Move time

### **1.4 Related Submittal(s)/Grant(s)**

N/A

### **1.5 Test Methodology**

FCC CFR 47 Part2, Part15.407 (h)

FCC 06-96 Appendix “COMPLIANCE MEASUREMENT PROCEDURES FOR UNLICENSED NATIONAL INFORMATION INFRASTRUCTURE DEVICES OPERATING IN THE 5250-5350 MHz AND 5470-5725 MHz BANDS INCORPORATING DYNAMIC FREQUENCY SELECTION”

## 1.6 Test Facility

Bay Area Compliance Laboratories Corp. (BACL) is:

1- An independent Commercial Test Laboratory accredited to **ISO 17025:2005** by **A2LA**, in the fields of: Electromagnetic Compatibility & Telecommunications covering Emissions, Immunity, Radio, RF Exposure, Safety and Telecom. This includes NEBS (Network Equipment Building System), Wireless RF, Telecommunications Terminal Equipment (TTE); Network Equipment; Information Technology Equipment (ITE); Medical Electrical Equipment; Industrial, Commercial, and Medical Test Equipment; Professional Audio and Video Equipment; Electronic (Digital) Products; Industrial and Scientific Instruments; Cabled Distribution Systems and Energy Efficiency Lighting.

2- An ENERGY STAR Recognized Laboratory, for the LM80 Testing, a wide variety of Luminaires and Computers.

3- A NIST Designated Phase-I and Phase-II CAB including: ACMA (Australian Communication and Media Authority), BSMI (Bureau of Standards, Metrology and Inspection of Taiwan), IDA (Infocomm Development Authority of Singapore), IC (Industry Canada), Korea (Ministry of Communications Radio Research Laboratory), NCC (Formerly DGT; Directorate General of Telecommunication of Chinese Taipei) OFTA (Office of the Telecommunications Authority of Hong Kong), Vietnam, VCCI - Voluntary Control Council for Interference of Japan and a designated EU CAB (Conformity Assessment Body) (Notified Body) for the EMC and R&TTE Directives.

4 - A Product Certification Body accredited to **ISO Guide 65:1996** by **A2LA** to certify:

1- Unlicensed, Licensed radio frequency devices and Telephone Terminal Equipment for the FCC. Scope A1, A2, A3, A4, B1, B2, B3, B4 & C.

2. Radio Standards Specifications (RSS) in the Category I Equipment Standards List and All Broadcasting Technical Standards (BETS) in Category I Equipment Standards List for Industry Canada.

3. Radio Communication Equipment for Singapore.

4. Radio Equipment Specifications, GMDSS Marine Radio Equipment Specifications, and Fixed Network Equipment Specifications for Hong Kong.

5. Japan MIC Telecommunication Business Law (A1, A2) and Radio Law (B1, B2 and B3).

6. Audio/Video, Battery Charging Systems, Computers, Displays, Enterprise Servers, Imaging Equipment, Set-Top Boxes, Telephony, Televisions, Ceiling Fans, CFLs (including GU24s), Decorative Light Strings, Integral LED Lamps, Luminaires, Residential Ventilating Fans.

The test site used by BACL Corp. to collect radiated and conducted emissions measurement data is located at its facility in Sunnyvale, California, USA.

The test site at BACL Corp. has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997, and Article 8 of the VCCI regulations on December 25, 1997. The test site also complies with the test methods and procedures set forth in CISPR 22:2008 §10.4 for measurements below 1 GHz and §10.6 for measurements above 1 GHz, as well as ANSI C63.4-2009, ANSI C63.4-2009, TIA/EIA-603 & CISPR 24:2010.

The Federal Communications Commission and Voluntary Control Council for Interference have the reports on file and they are listed under FCC registration number: 90464 and VCCI Registration No.: A-0027. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL Corp. is an American Association for Laboratory Accreditation (A2LA) accredited laboratory (Lab Code 3297-02). The current scope of accreditations can be found at

<http://www.a2la.org/scopepdf/3297-02.pdf?CFID=1132286&CFTOKEN=e42a3240dac3f6ba-6DE17DCB-1851-9E57-477422F667031258&jsessionId=8430d44f1f47cf2996124343c704b367816b>

## 2 EUT TEST CONFIGURATION

### 2.1 Justification

The EUT was configured for testing according to FCC Part 15.407(H) Standard.

### 2.2 EUT Exercise Software

N/A

### 2.3 EUT Internal Configuration

Manufacturer	Description	Model	Serial Number
Sensity Systems	Main Board	U-Node V2	40313260134
Sensity Systems	Power Board	PMAC V2	40313260176
Sensity Systems	Sensor Board	D055	6MT064462-0089

### 2.4 External I/O Cabling List and AC Cord

Cable Description	Length (M)	From	To
RS45 x 2	< 1.0	Laptop	Router

### 2.5 Local Support Equipment

Manufacturer	Describe	Model	FCC ID
Ruckus Wireless	Router	ZF7321	S9GZF7321
SONY	Laptop	VAIO	282748313005507

### 3 SUMMARY OF TEST RESULTS

The following result table represents the list of measurements required under the CFR47 §47 Part15.407 (h) and FCC 06-96.

Items	Description of Test	Results
Detection Bandwidth	UNII Detection Bandwidth	N/A
Performance Requirements Check	Initial Channel Availability Check Time (CAC)	N/A
	Radar Burst at the Beginning of the CAC	N/A
	Radar Burst at the End of the CAC	N/A
In-Service Monitoring	Channel Move Time	Compliant
	Channel Closing Transmission Time	Compliant
	Non-Occupancy Period	Compliant
Radar Detection	Statistical Performance Check	N/A

Note: N/A EUT is a client device without the radar detection function.



## 4 APPLICABLE STANDARDS

### 4.1 DFS Requirements

FCC CFR47 §15.407 (h) and FCC 06-96 Appendix.

**Table 1: Applicability of DFS requirements prior to use of a channel**

Requirement	Operational Mode		
	Master	Client (Without radar detection)	Client (With radar detection)
Non-Occupancy Period	Yes	Not Required	Yes
DFS Detection Threshold	Yes	Not Required	Yes
Channel Availability Check Time	Yes	Not Required	Not Required
Uniform Spreading	Yes	Not Required	Not Required
U-NII Detection Bandwidth	Yes	Not Required	Yes

**Table 2: Applicability of DFS requirements during normal operation**

Requirement	Operational Mode		
	Master	Client (Without DFS)	Client (With DFS)
DFS Detection Threshold	Yes	Not Required	Yes
Channel Closing Transmission Time	Yes	Yes	Yes
Channel Move Time	Yes	Yes	Yes

**Table 3: Interference Threshold values, Master or Client incorporating In-Service Monitoring**

Maximum Transmit Power	Value (See Notes 1 and 2)
$\geq 200$ milliwatt	-64 dBm
$< 200$ milliwatt	-62 dBm

**Note 1:** This is the level at the input of the receiver assuming a 0 dBi receive antenna.  
**Note 2:** Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response.

**Table 4: DFS Response requirement values**

Parameter	Value
Non-occupancy period	Minimum 30 minutes
Channel Availability Check Time	60 seconds
Channel Move Time	10 seconds See Note 1.
Channel Closing Transmission Time	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period. See Notes 1 and 2.
U-NII Detection Bandwidth	Minimum 80% of the UNII 99% transmission power bandwidth. See Note 3.

**Note 1:** The instant that the *Channel Move Time* and the *Channel Closing Transmission Time* begins is as follows:

- For the Short Pulse Radar Test Signals this instant is the end of the *Burst*.
- For the Frequency Hopping radar Test Signal, this instant is the end of the last radar *Burst* generated.
- For the Long Pulse Radar Test Signal this instant is the end of the 12 second period defining the *Radar Waveform*.

**Note 2:** The *Channel Closing Transmission Time* is comprised of 200 milliseconds starting at the beginning of the *Channel Move Time* plus any additional intermittent control signals required to facilitate a *Channel* move (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions.

**Note 3:** During the *U-NII Detection Bandwidth* detection test, radar type 1 is used and for each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.

**Table 5: Short Pulse Radar Test Waveforms**

Radar Type	Pulse Width (Microseconds)	PRI (Microseconds)	Pulses	Minimum Percentage of Successful Detection	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 6: Long Pulse Radar Test Signal**

Radar Type	Bursts	Chirp Width (MHz)	PRI (usec)	Number of Pulses per Burst	Number of Bursts	Minimum Percentage of Successful Detection	Minimum Number of Trials
5	50-100	5-20	1000-2000	1-3	8-20	80%	30

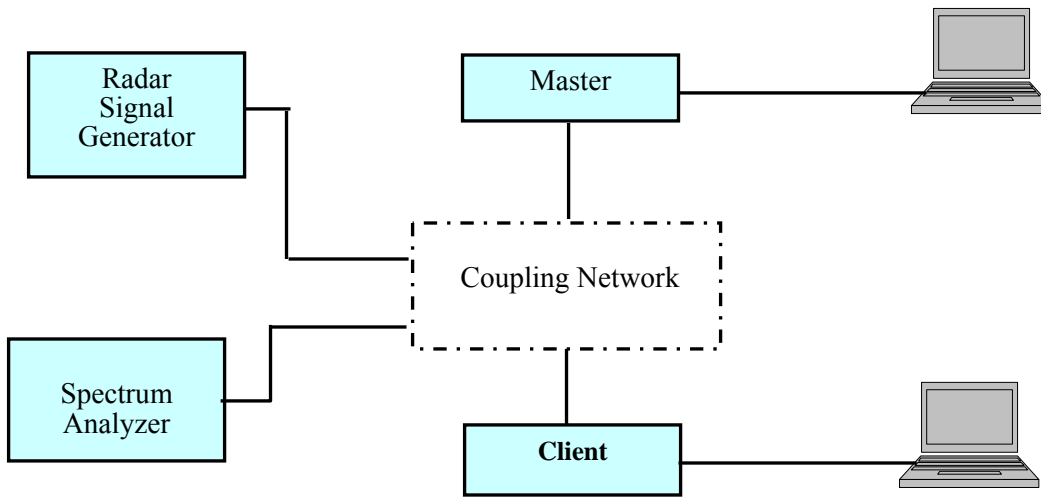
**Table 7: Frequency Hopping Radar Test Signal**

Radar Type	Pulse Width (usec)	PRI (usec)	Pulses per Hop	Hopping Rate (kHz)	Hopping Sequence Length (msec)	Minimum Percentage of Successful Detection	Minimum Number of Trials
6	1	333	9	0.333	300	70%	30

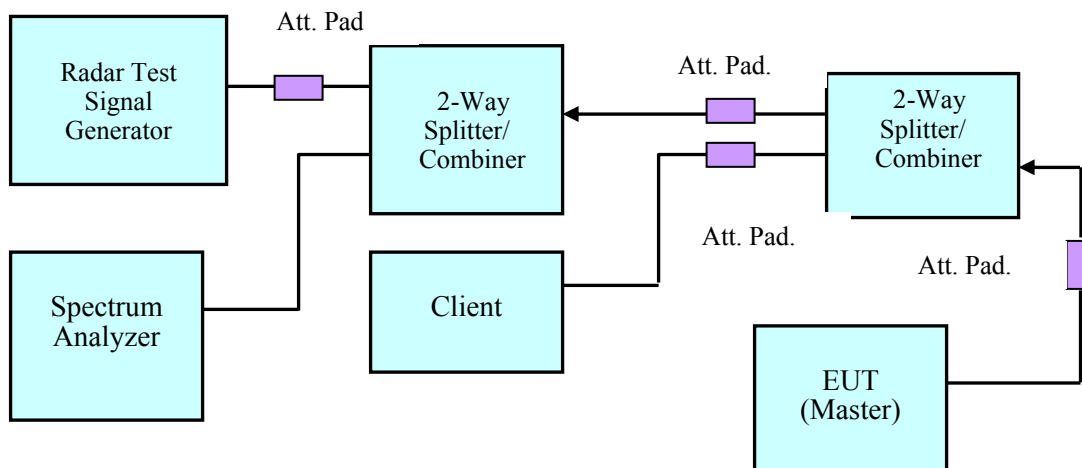
## 4.2 DFS Measurement System

BACL DFS measurement system consists of two subsystems: (1) The radar signal generating subsystem and (2) the traffic monitoring subsystem.

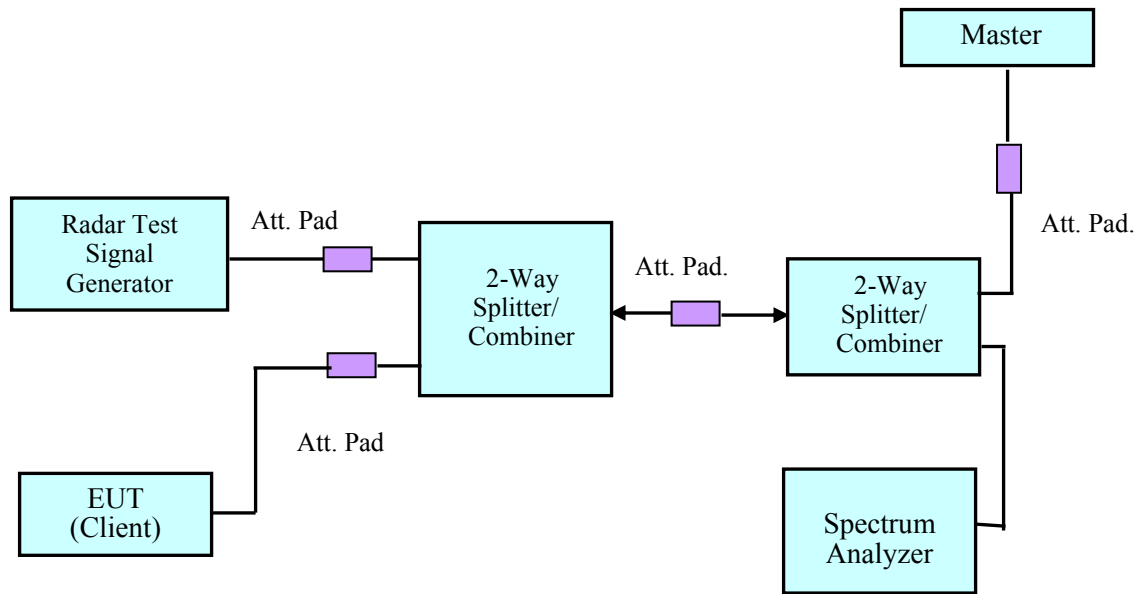
### 4.3 System Block Diagram



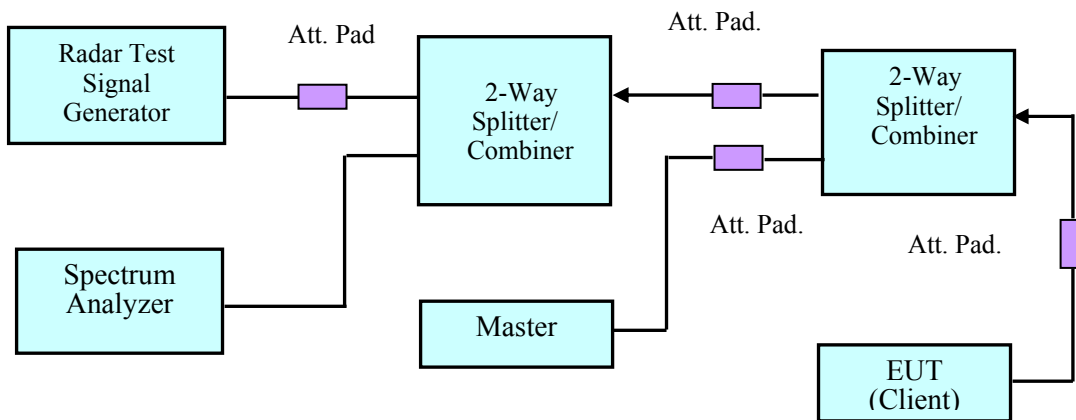
### 4.4 Conducted Method



**Setup for Master with injection at the Master**

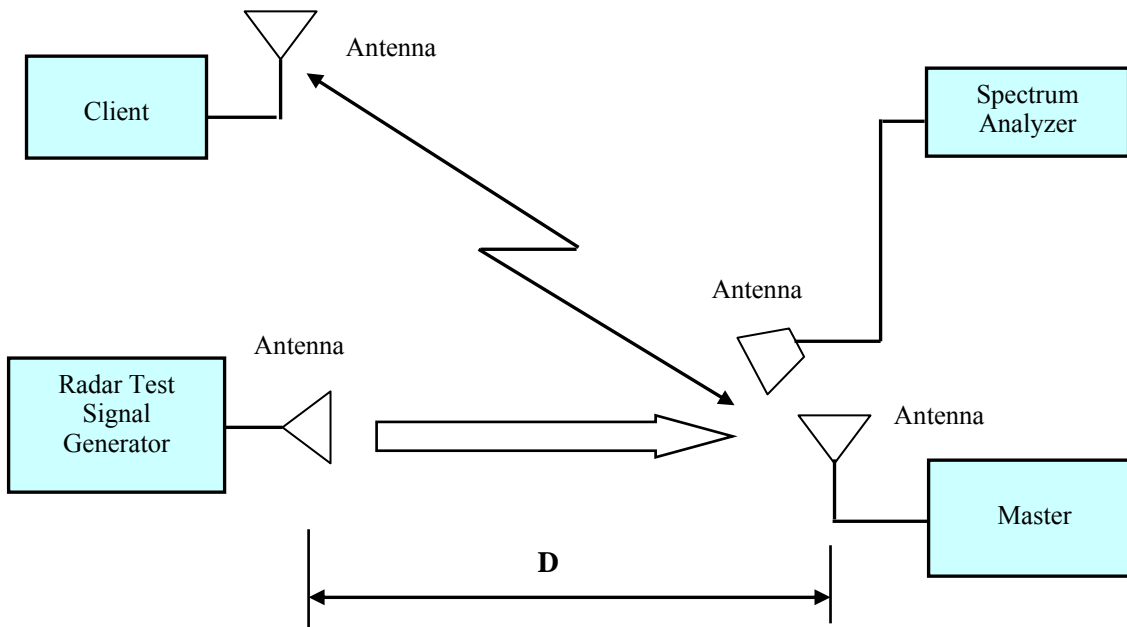


**Setup for Client with injection at the Master**



**Setup for Client with injection at the Client**

#### 4.5 Radiated Method



#### 4.6 Test Procedure

A spectrum analyzer is used as a monitor verifies that the EUT status including Channel Closing Transmission Time and Channel Move Time, and does not transmit on a Channel during the Non-Occupancy Period after the diction and Channel move. It is also used to monitor EUT transmissions during the Channel Availability Check Time.

## 5 TEST RESULTS

### 5.1 Description of EUT

The EUT operates in 5230-5350 MHz and 5470-5725 MHz range.

The rated output power of EUT is <23 dBm (EIRP), Therefore the required interference threshold level is -62 dBm, the required radiated threshold at antenna port is -62dBm.

The calibrated radiated DFS detection threshold level is set to -62 dBm.

WLAN traffic is generated by streaming the video file TestFile.mpg, this file is used by IP and Frame based systems for loading the test channel during the In-service compliance testing of the U-NII device. The file is streamed from the Access Point to the Client in full motion video mode using the media player with the V2.61 Codec package.

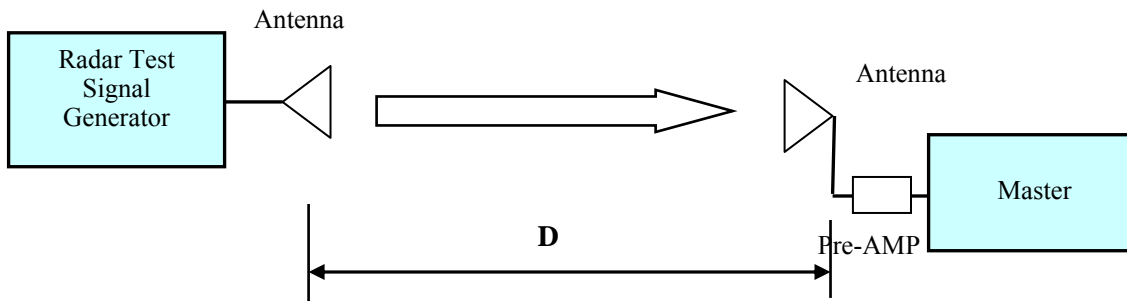
The EUT will not work on 5600-5650MHz band.

### 5.2 Test Equipment List and Details

Manufacturer	Equipment Description	Model Number	S/N	Calibration Date
National Instruments	NI PXI-1042 8-Slot chassis	PXI-1042	V08X01EE1	N/A
National Instruments	Arbitrary Waveform Generator	PXI-5421	N/A	N/A
National Instruments	RF Upconverter	PXI-5610	N/A	N/A
ASCOR	Upconverter	AS-7206	N/A	N/A
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-10-16
A.R.A.	Antenna Horn	DRG-118/A	1132	2013-01-29
EMCO	Antenna Horn	3115	9511-4627	2012-10-17
Mini-Circuits	Splitter/Combiner	2FSC-2-10G	0349	N/A
Narda	Splitter/Combiner	4326B-2	03514	N/A
Midwest	Attenuator	290-30	N/A	N/A
Mini-Circuits	Attenuator	BW-S30W2	N/A	N/A
HP	Pre-Amplifier	8449B	3147A00400	2013-02-04

**Statement of Traceability:** **BACL Corp.** attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

### 5.3 Radar Waveform Calibration



**Radiated Calibration Setup Block Diagram**

### 5.4 Test Environmental Conditions

<b>Temperature:</b>	23 °C
<b>Relative Humidity:</b>	42 %
<b>ATM Pressure:</b>	101.5 kpa

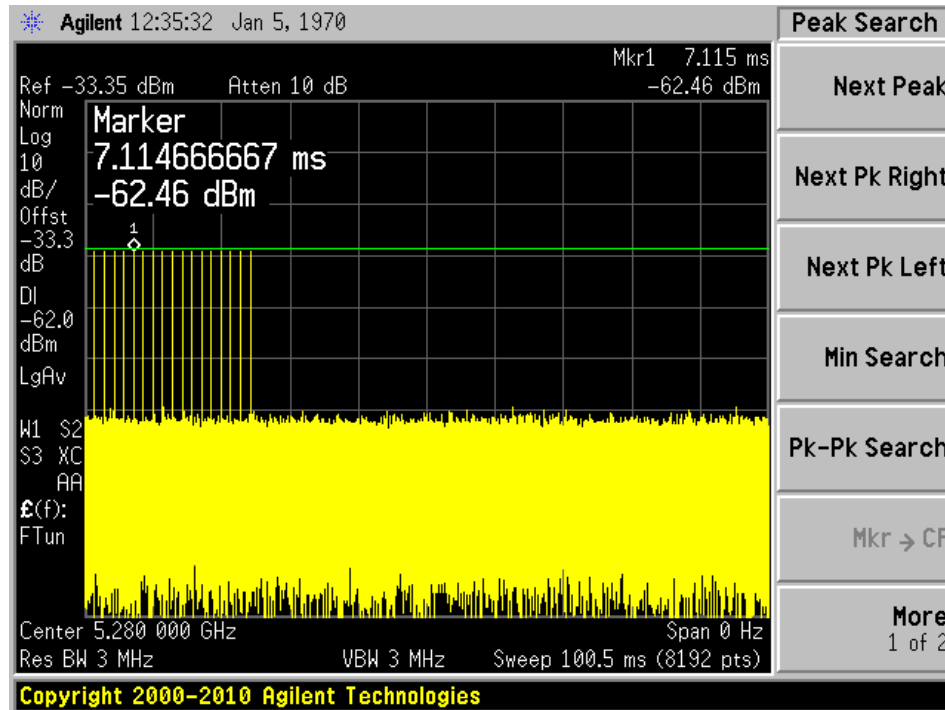
*Testing performed by Ning Ma on 2013-05-29 at DFS testing site.*



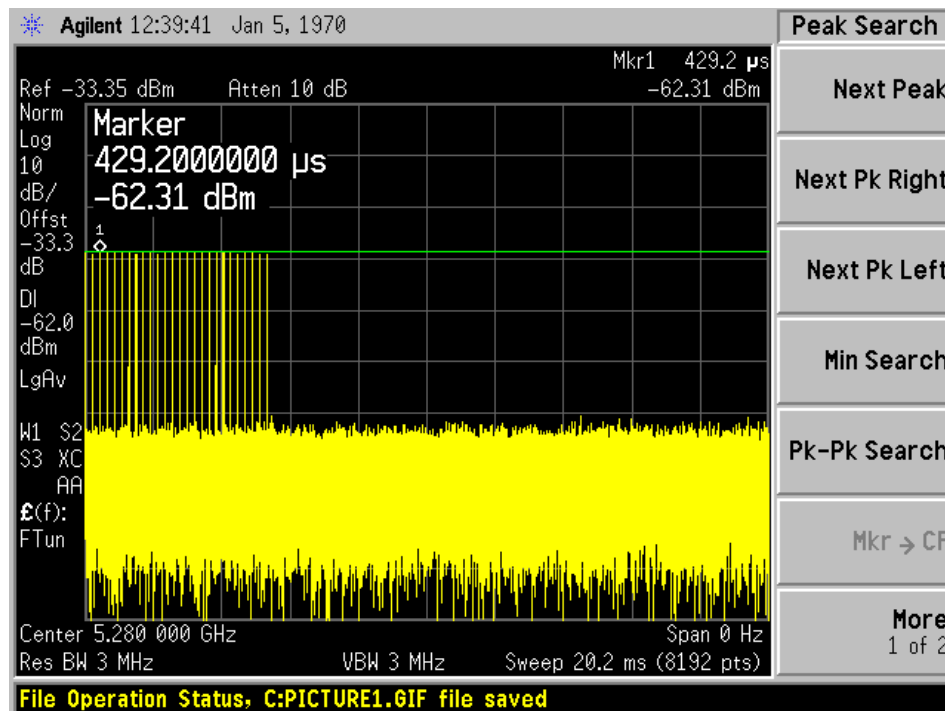
**Plots of Radar Waveforms**

**5280 MHz**

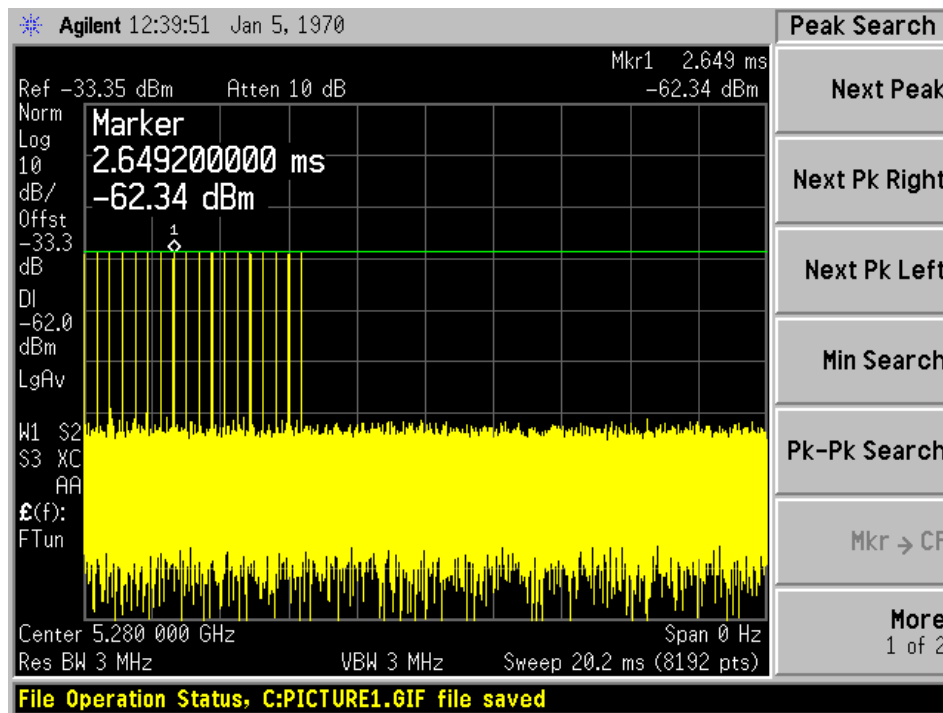
Radar Type 1



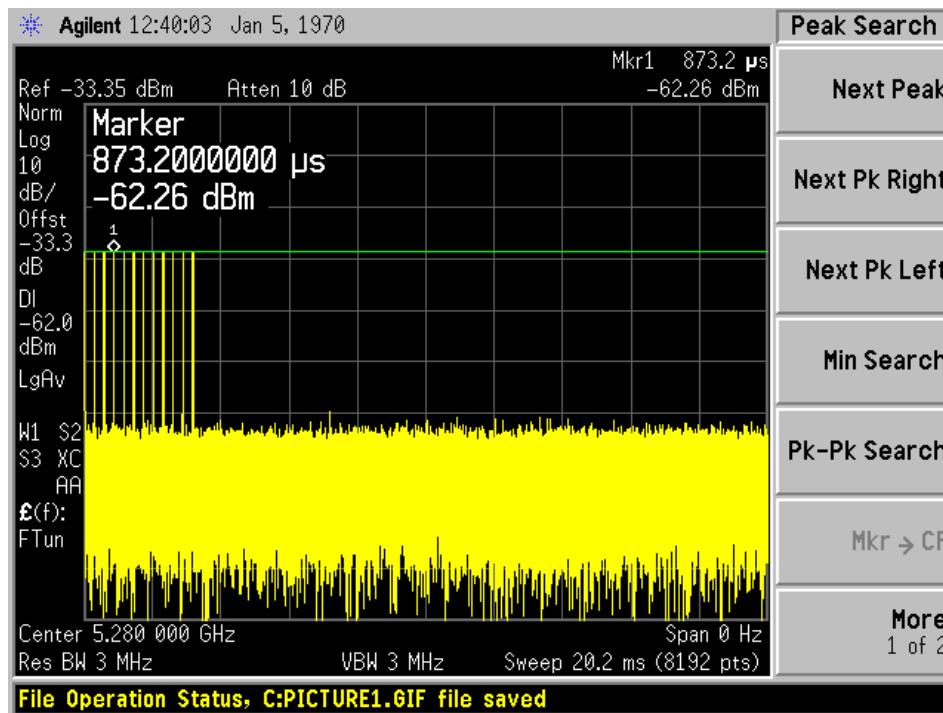
Radar Type 2



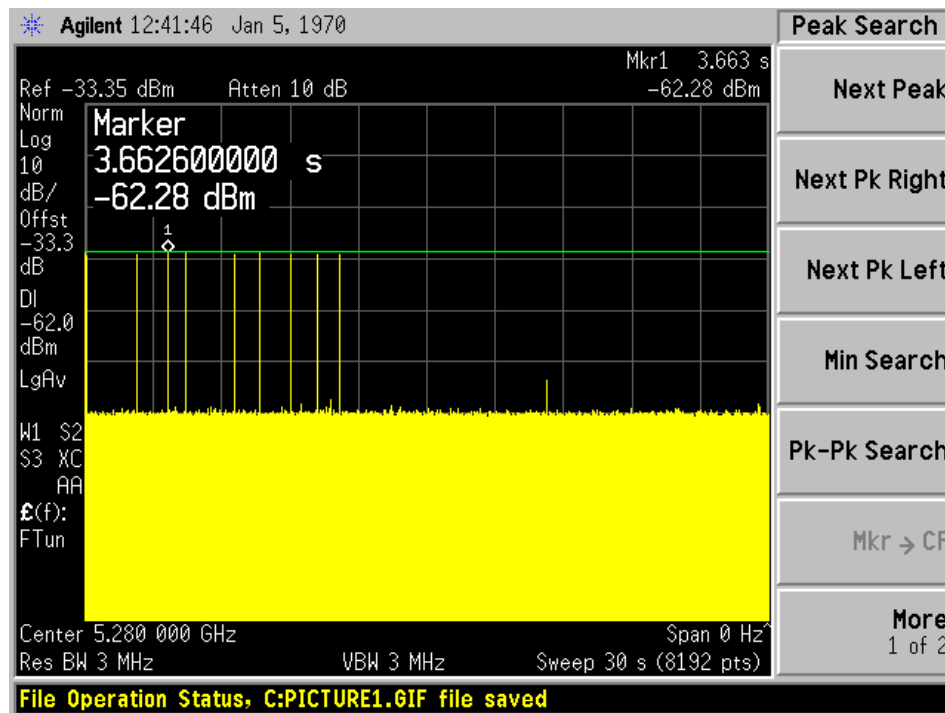
Radar Type 3



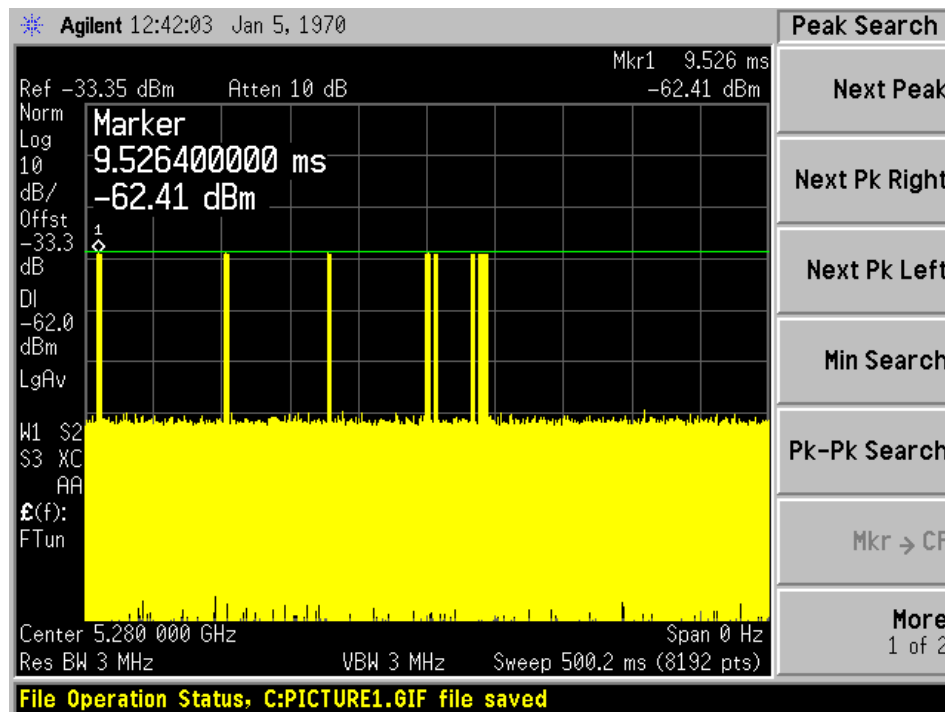
Radar Type 4



Radar Type 5

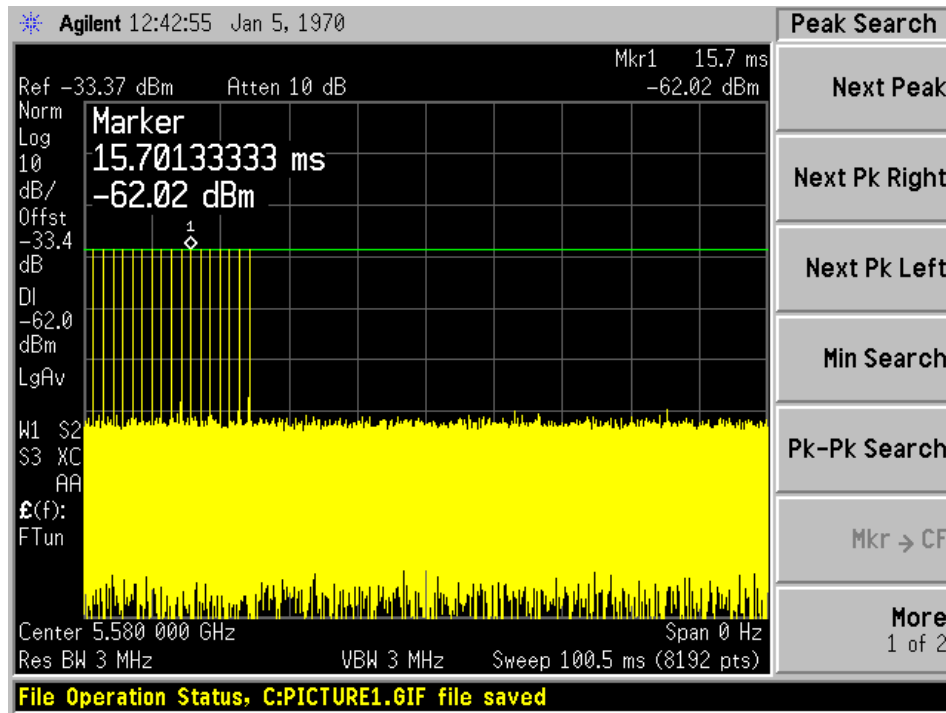


Radar Type 6

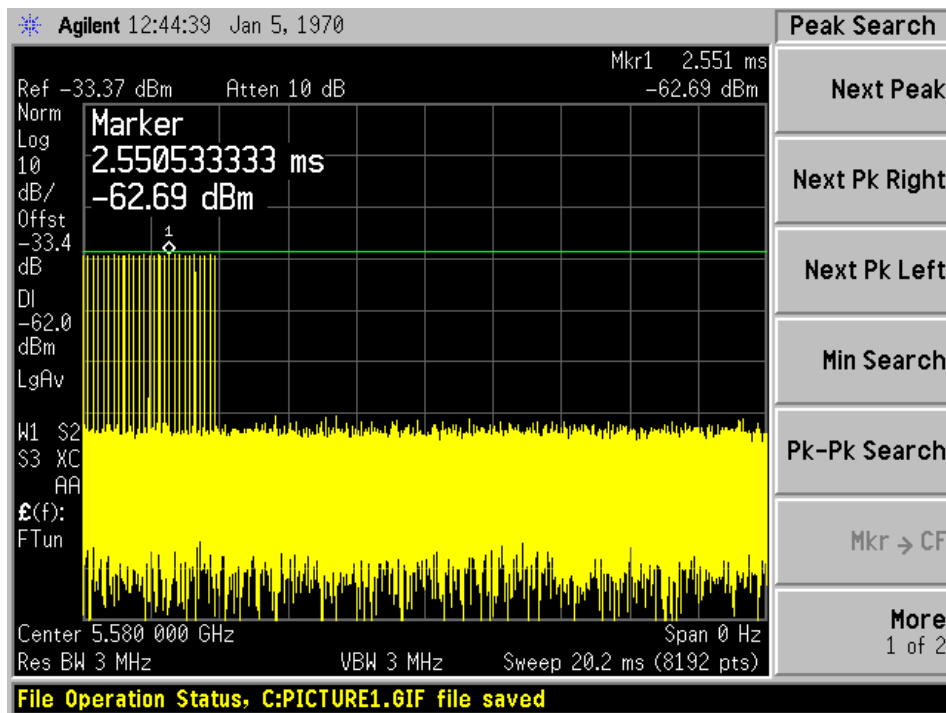


5580 MHz

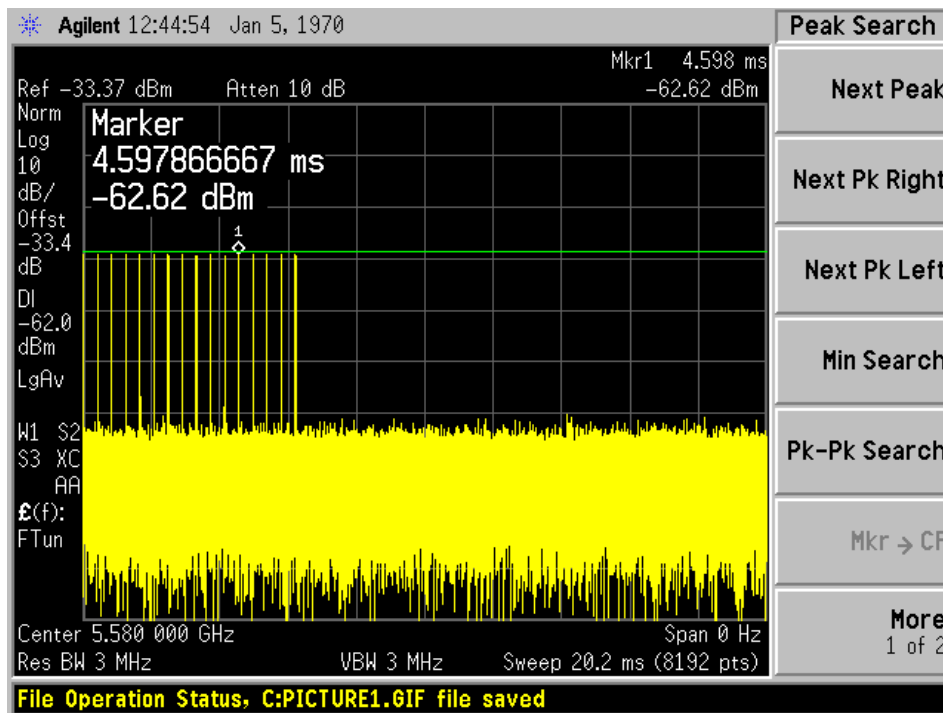
Radar Type 1



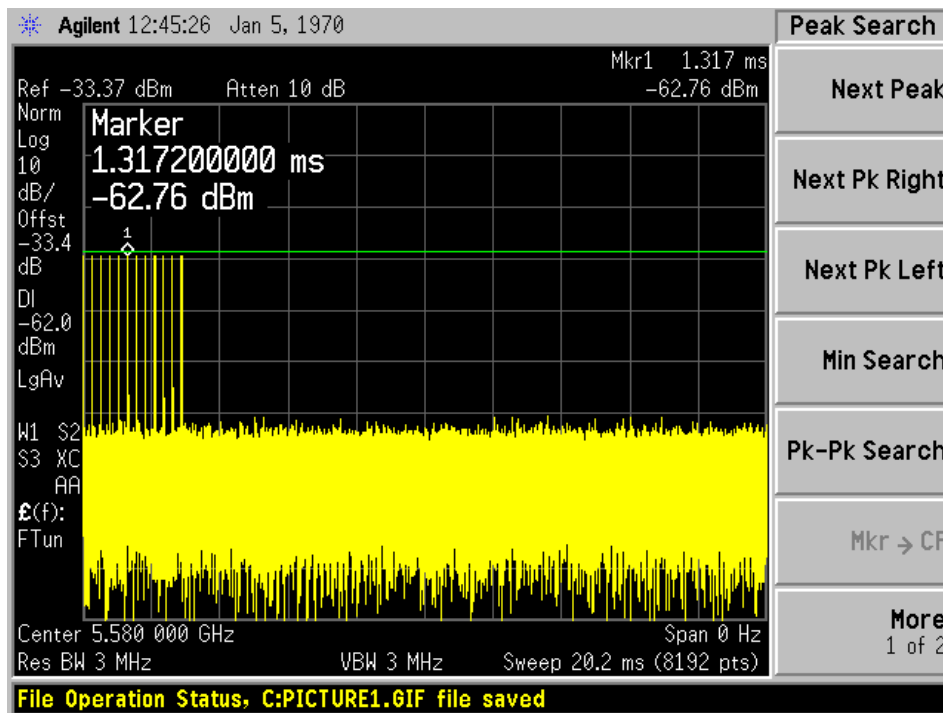
Radar Type 2



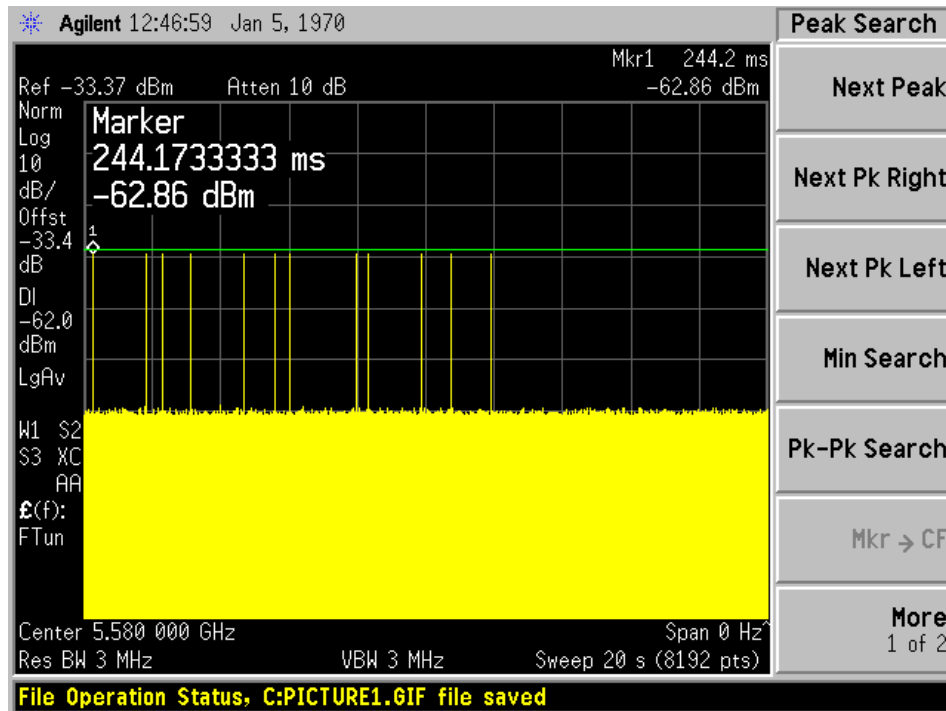
### Radar Type 3



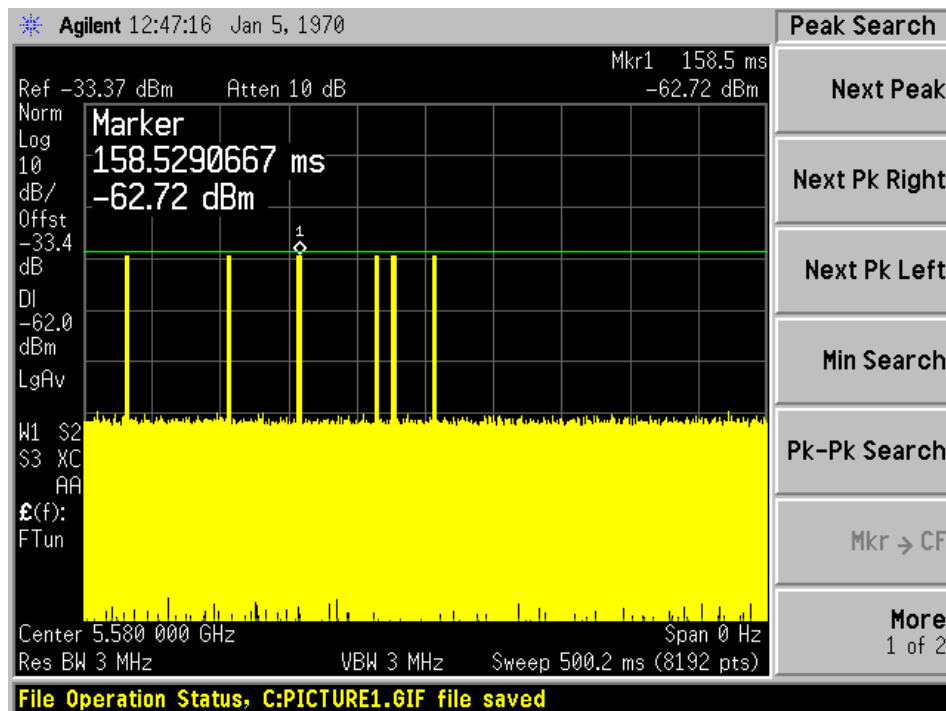
### Radar Type 4



### Radar Type 5



### Radar Type 6



## **6 CHANNEL MOVE TIME & CHANNEL CLOSING TRANSMISSION TIME**

### **6.1 Test Procedure**

Perform one of the type1 to type 4 short pulse radar waveform, BAACL use type 1 radar signal, repeat using a long pulse radar type5 waveform.

The aggregate channel closing transmission time is calculated as follows:

Aggregate Transmission Time = N \* Dwell Time

N is the number of spectrum analyzer bins showing a device transmission

Dwell Time is the dwell time per bin (i.e. Dwell Time = S/B, S is the sweep time and B is the number of bin, i.e. 8192)

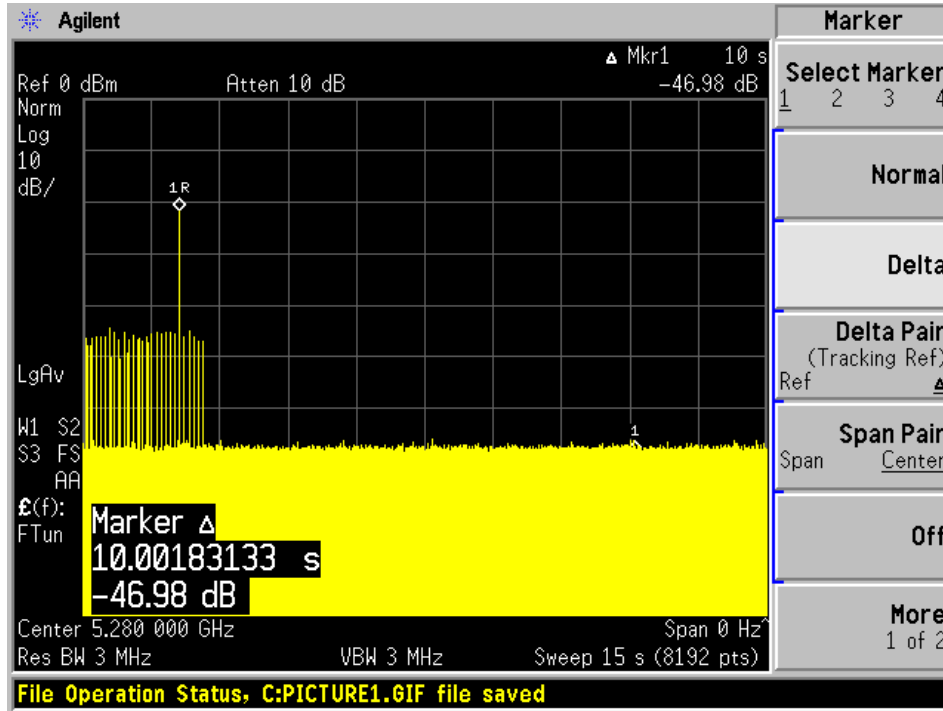
### **6.2 Test Results**

<b>Frequency (MHz)</b>	<b>Bandwidth (MHz)</b>	<b>Radar Type</b>	<b>Results</b>
5280	20	Type 1	Compliant
		Type 5	Compliant
5580	20	Type 1	Compliant
		Type 5	Compliant
5270	40	Type 1	Compliant
		Type 5	Compliant
5550	40	Type 1	Compliant
		Type 5	Compliant

Please refer to the following tables and plots.

### 5280 MHz, 20 MHz Bandwidth

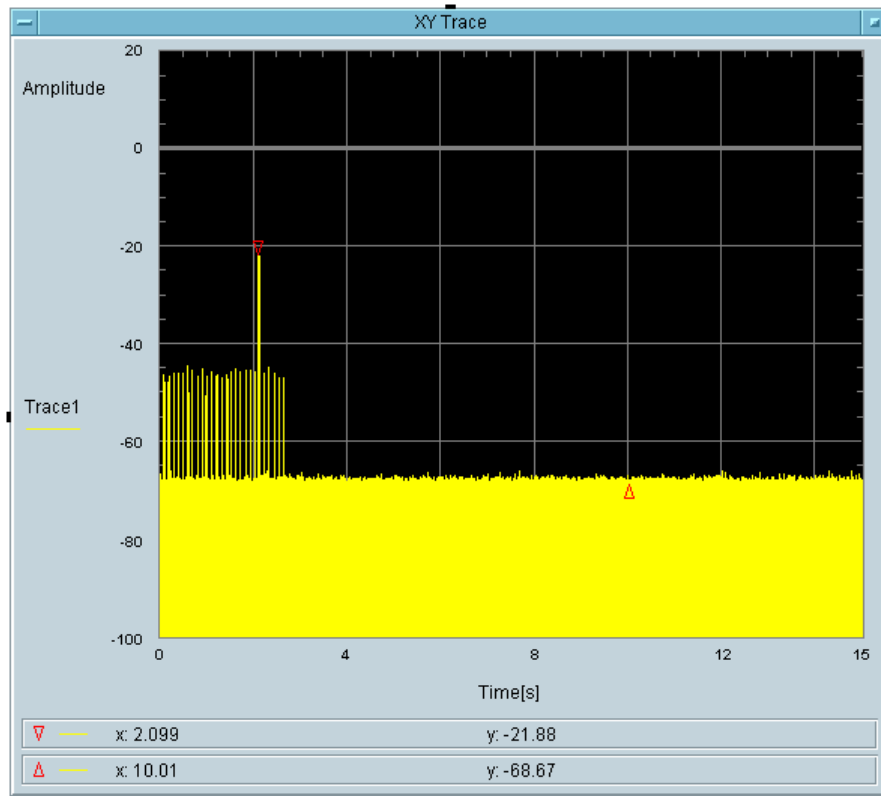
Type 1 radar channel move time result:





Type3 radar channel closing transmission time result:

Aggregate Transmission Time (ms)	Limit (ms)	Margin (ms)
43.95	60	16.05

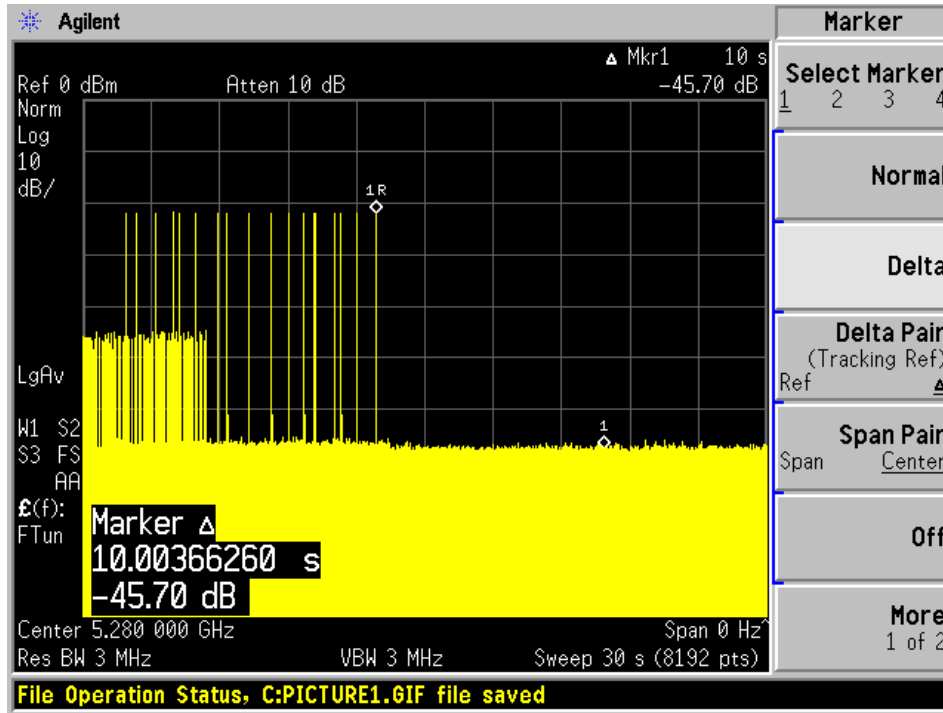


Total On Time [s]  
43.95m

Total On Time After Delay [s]  
43.95m

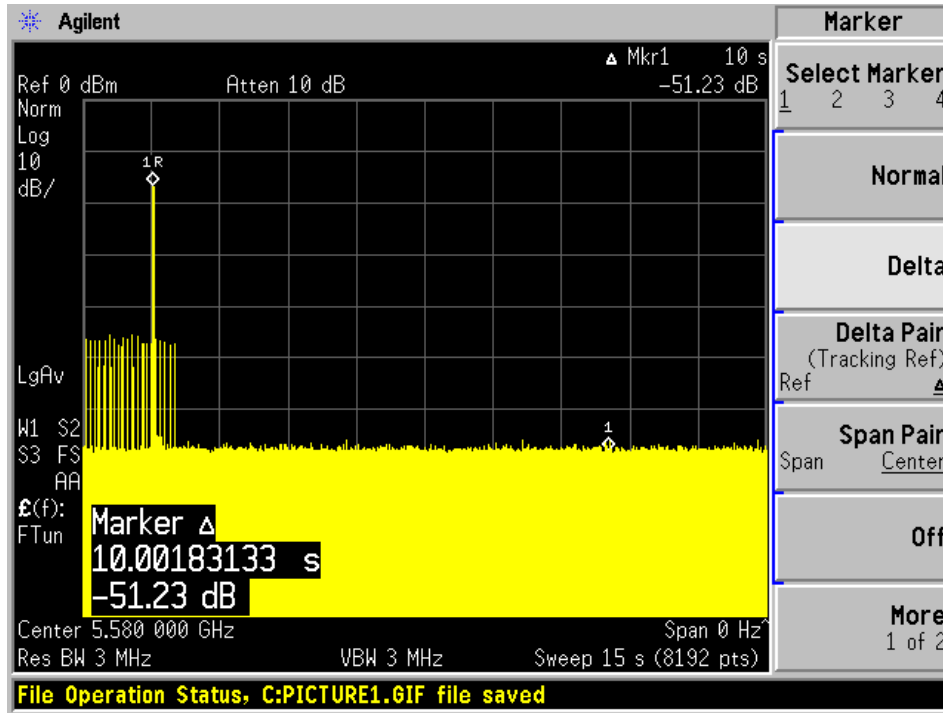
Type 5 radar channel move time result:

The traffic ceases at the end of the radar waveform, therefore it complies with the Channel move time as 10 seconds after the end of the radar waveform



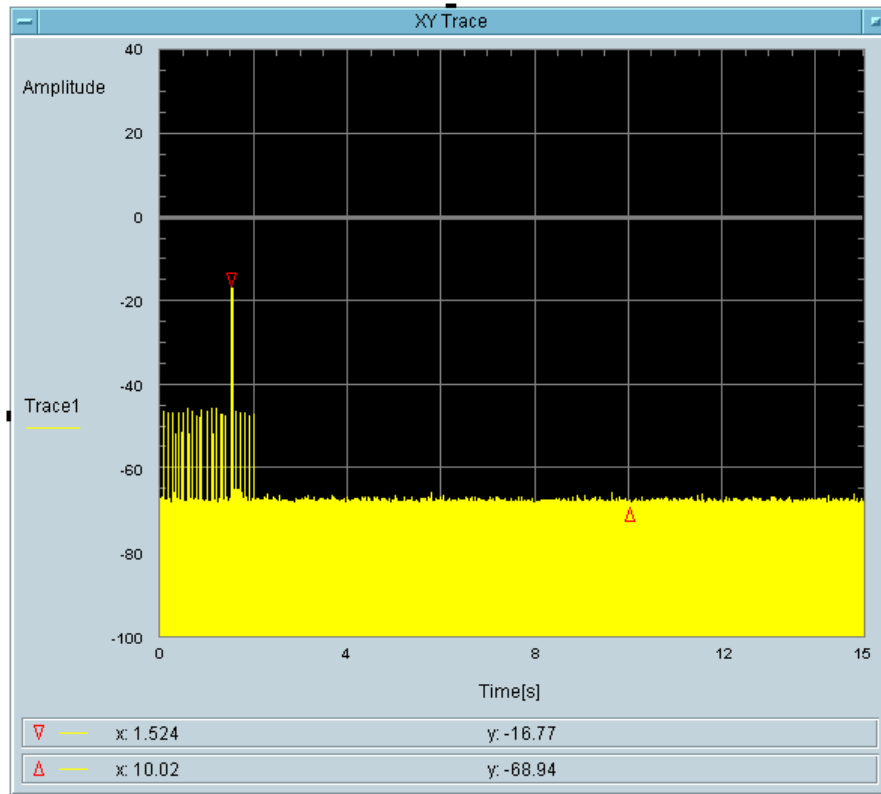
### 5580 MHz Bandwidth 20 MHz

Type 1 radar channel move time result:



Type 1 radar channel closing transmission time result:

Aggregate Transmission Time (ms)	Limit (ms)	Margin (ms)
5.493	60	54.507

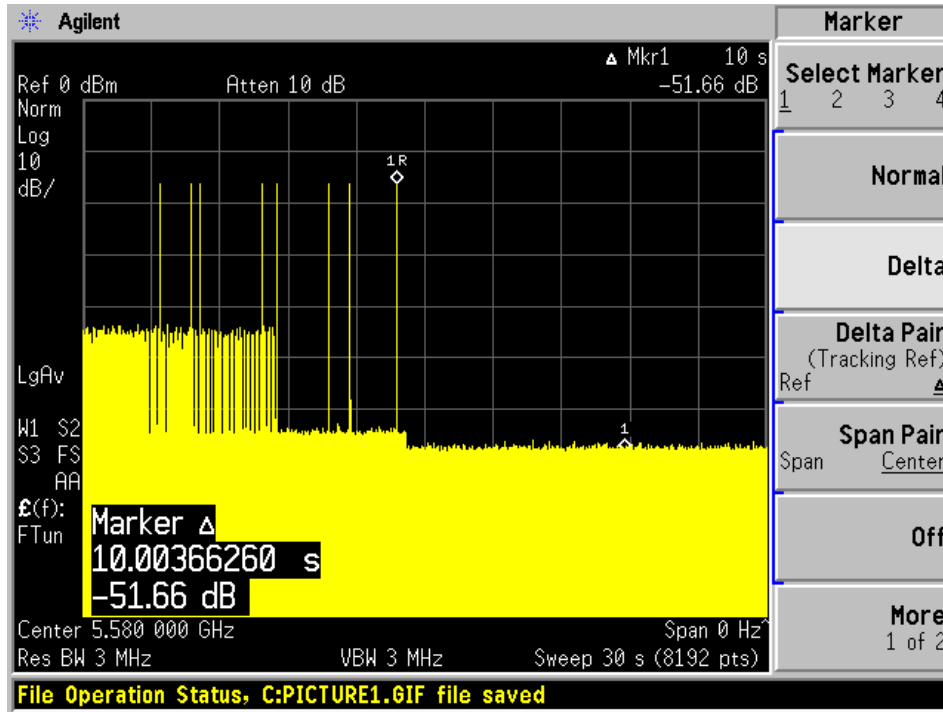


Total On Time [s]  
10.99m

Total On Time After Delay [s]  
5.493m

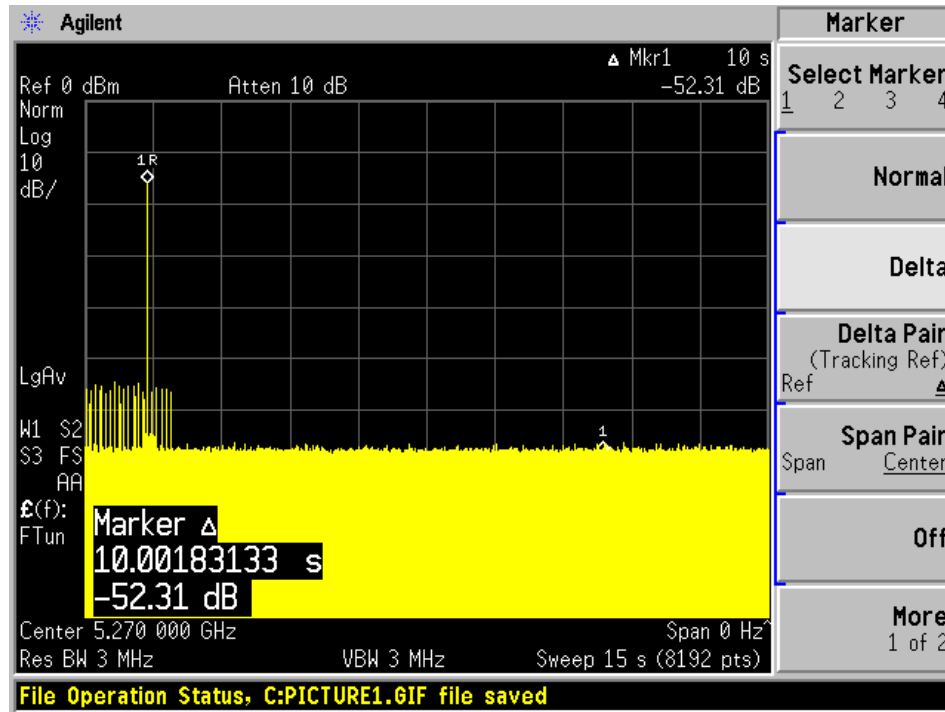
Type 5 radar channel move time result:

The traffic ceases at the end of the radar waveform, therefore it complies with the Channel move time as 10 seconds after the end of the radar waveform



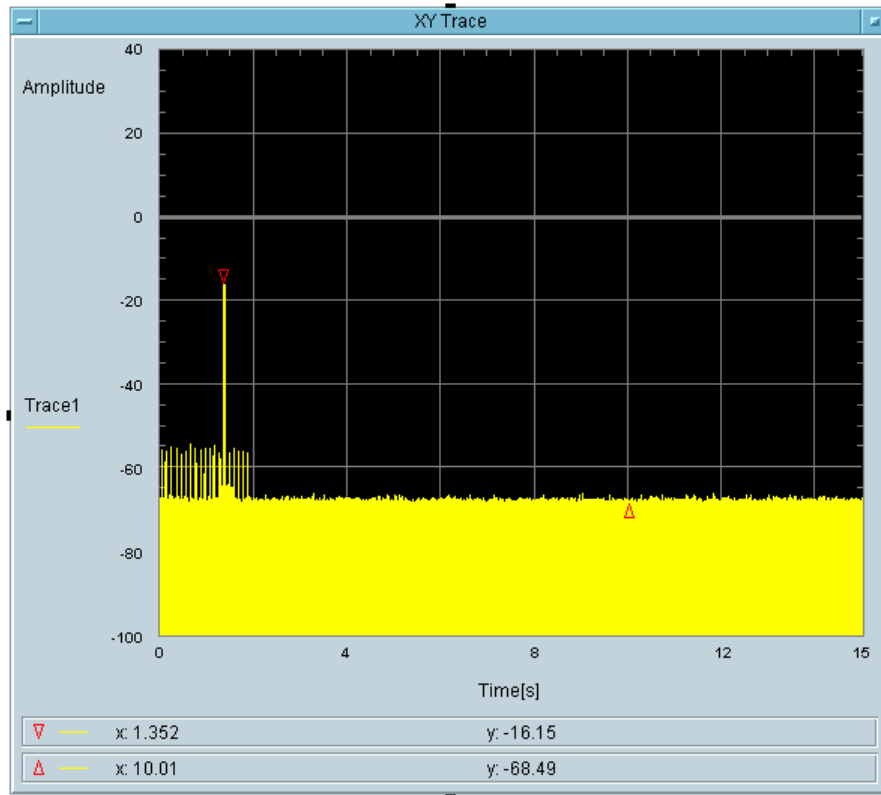
### 5270 MHz, 40 MHz Bandwidth

Type 1 radar channel move time result:



Type1 radar channel closing transmission time result:

Aggregate Transmission Time (ms)	Limit (ms)	Margin (ms)
7.324	60	52.676

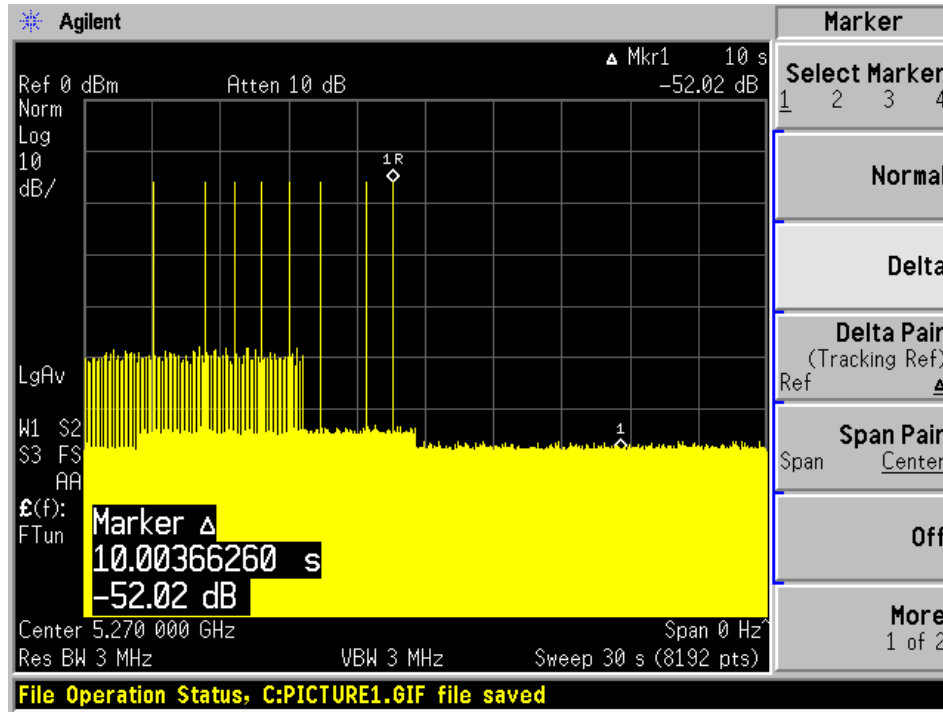


Total On Time [s]  
12.82m

Total On Time After Delay [s]  
7.324m

Type 5 radar channel move time result:

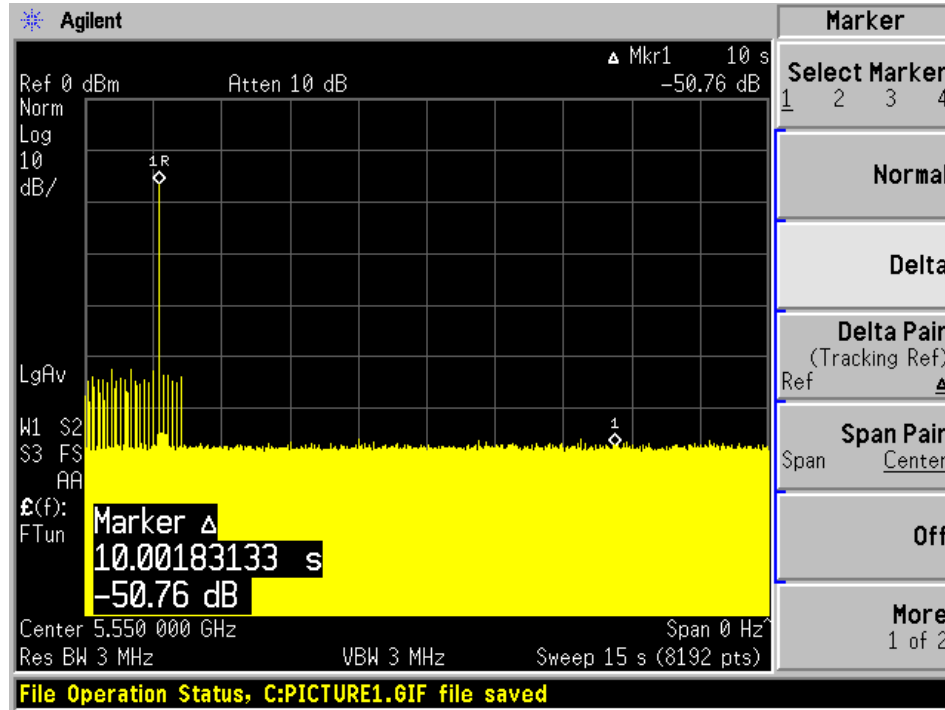
The traffic ceases at the end of the radar waveform, therefore it compliance with the Channel move time as 10 seconds after the end of the radar waveform





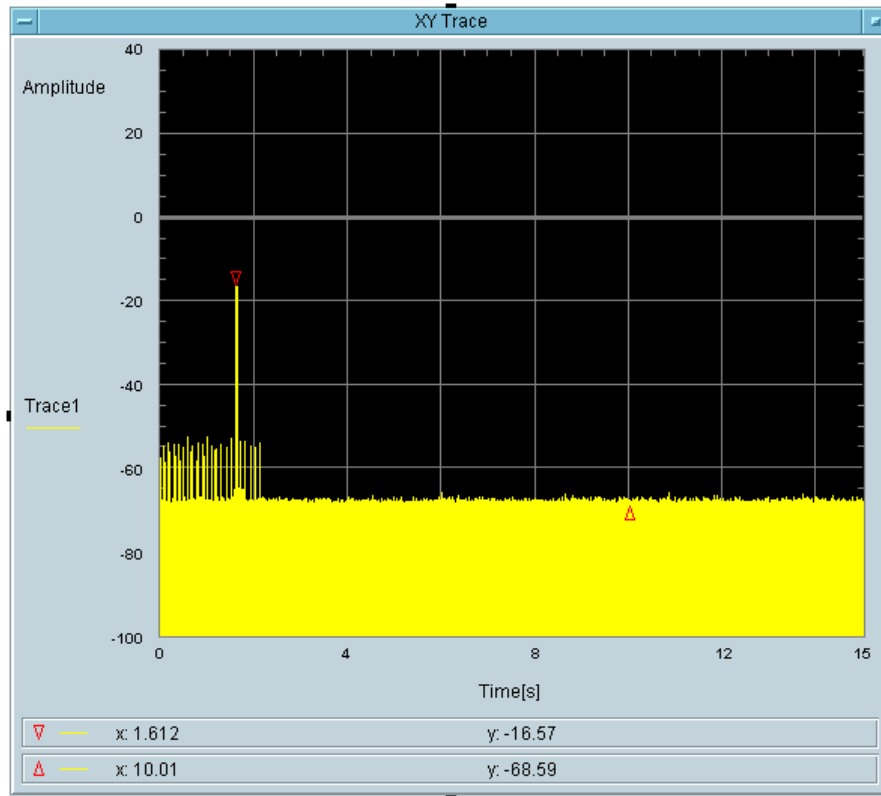
### 5550 MHz, 40 MHz Bandwidth

Type 1 radar channel move time result:



Type1 radar channel closing transmission time result:

Aggregate Transmission Time (ms)	Limit (ms)	Margin (ms)
5.493	60	54.507

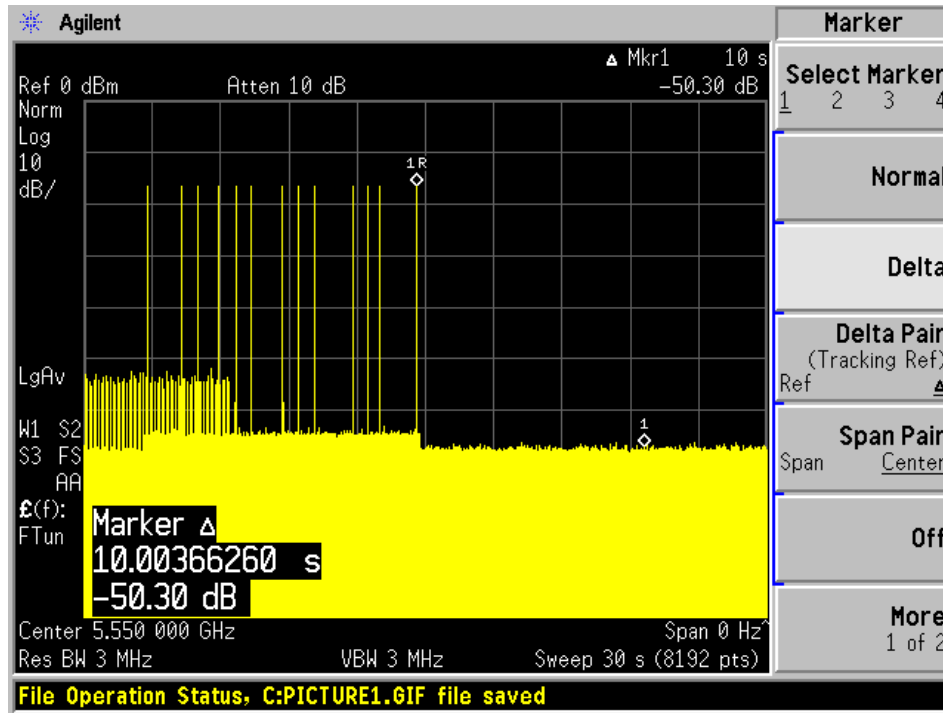


Total On Time [s]  
10.99m

Total On Time After Delay [s]  
5.493m

Type 5 radar channel move time result:

The traffic ceases at the end of the radar waveform, therefore it complies with the Channel move time as 10 seconds after the end of the radar waveform



## 7 Non-Occupancy Period

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### 7.1 Test Procedure

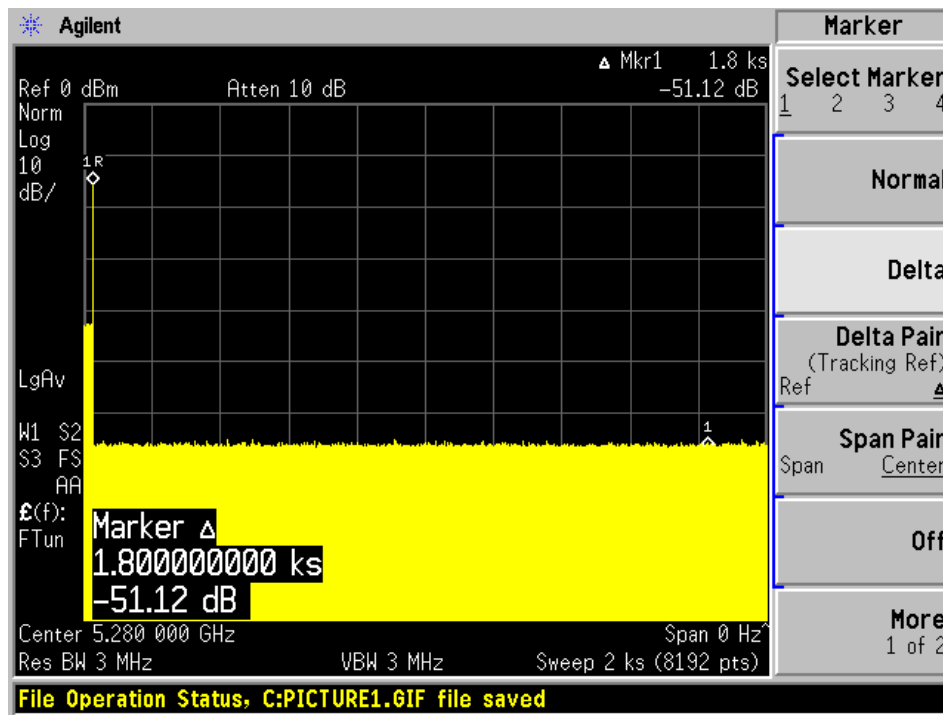
Measure the EUT for more than 30 minutes following the channel close/move time to verify that the EUT does not resume any transmissions on this channel. Provide one plot to demonstrate no transmission on the channel for the non-occupancy period (30 minutes observation time)

### 7.2 Test Results

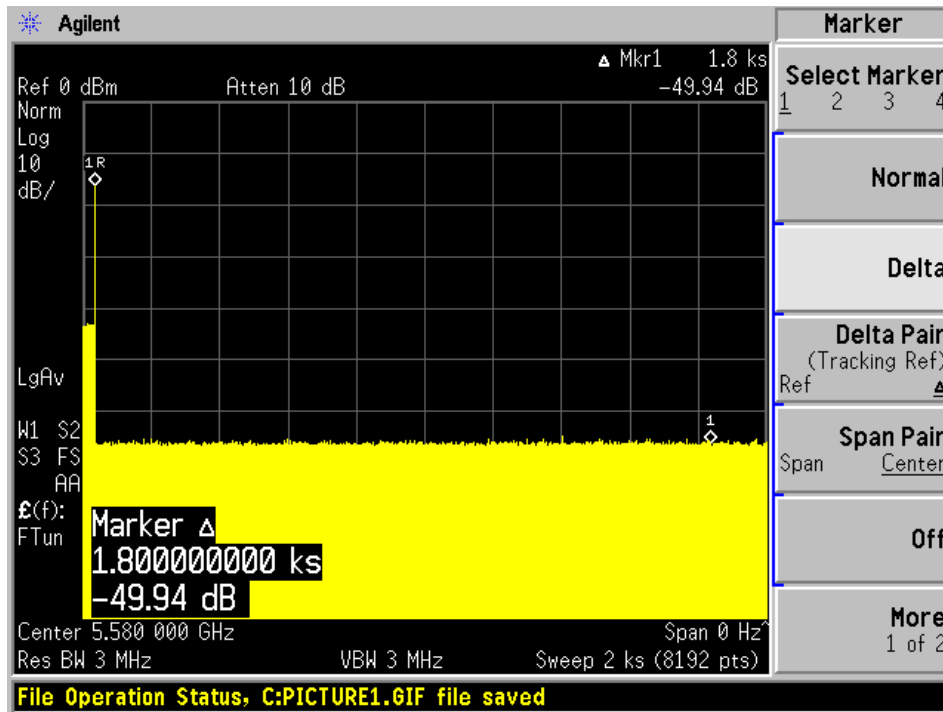
Frequency (MHz)	Bandwidth (MHz)	Spectrum Analyzer Display
5280	20	No transmission within 30 minutes
5580	20	No transmission within 30 minutes
5270	40	No transmission within 30 minutes
5550	40	No transmission within 30 minutes

Please refer to the following plots.

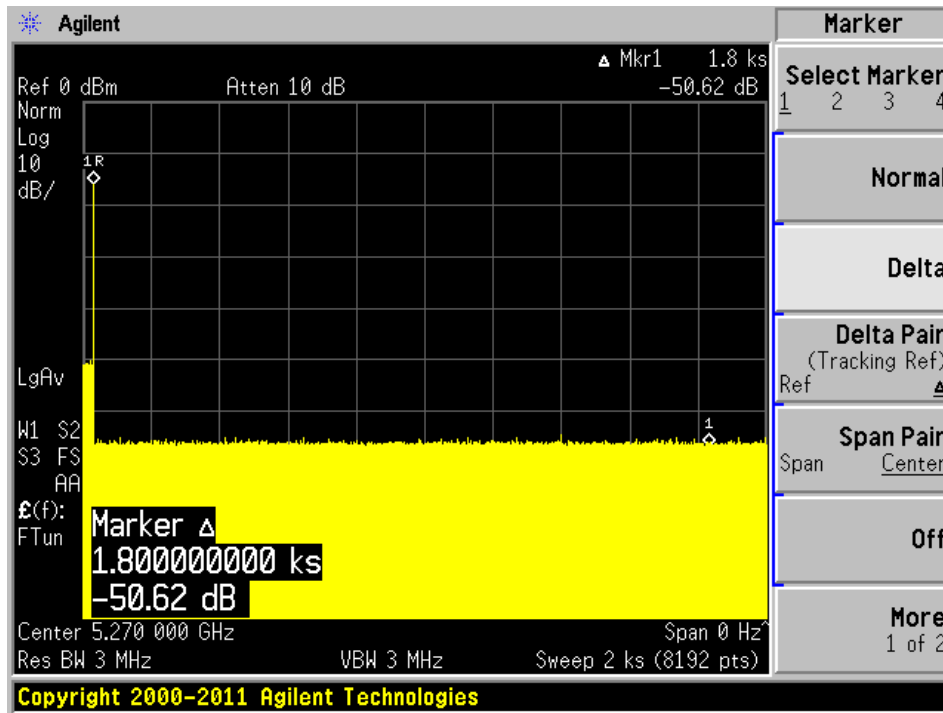
### 5280 MHz, 20 MHz Bandwidth



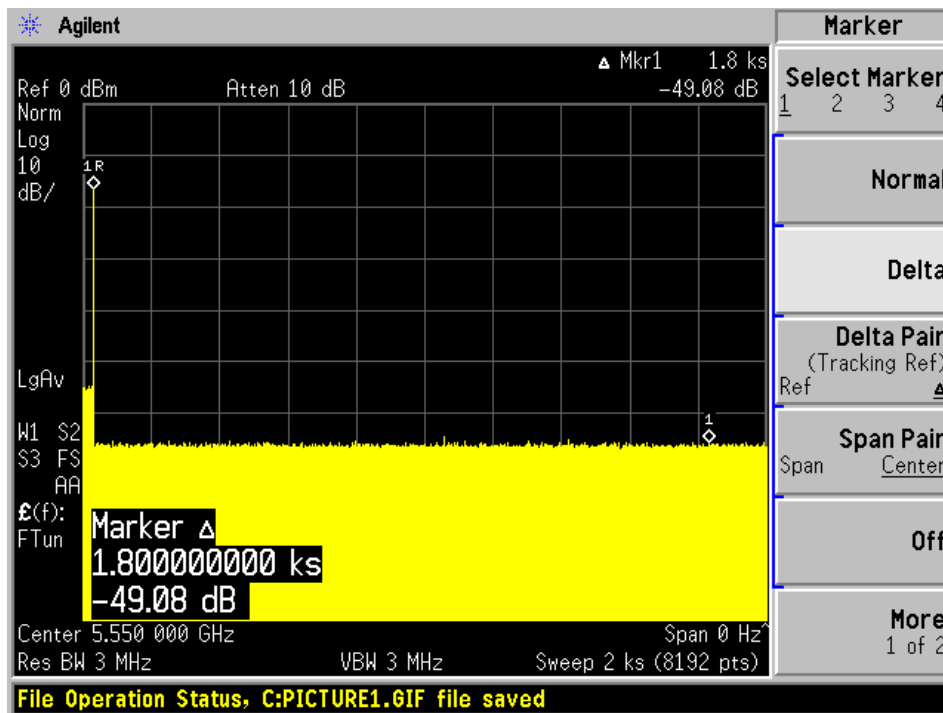
### 5580 MHz, 20 MHz Bandwidth



5270 MHz, 40 MHz Bandwidth

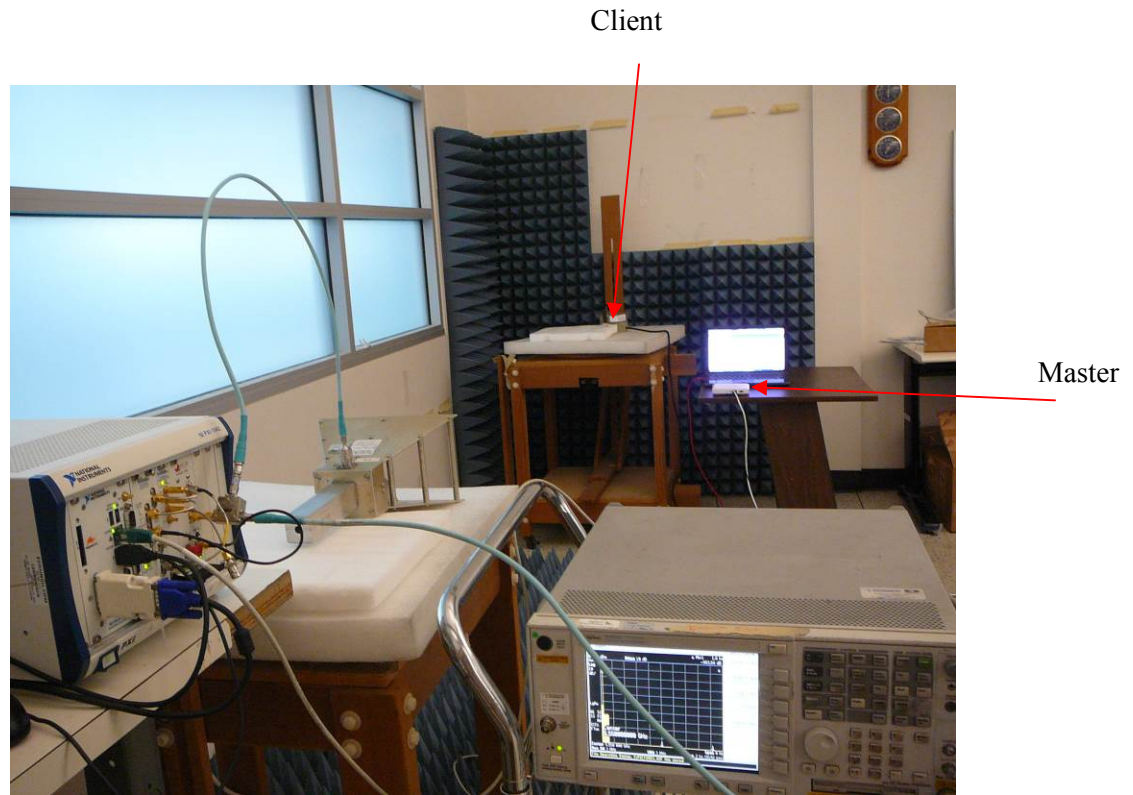


5550 MHz, 40 MHz Bandwidth



## 8 EXHIBIT A – TEST SETUP PHOTOGRAPHS

### 8.1 Setup View



## 9 EXHIBIT B – EUT PHOTOGRAPHS

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### 9.1 Module with Enclosure and the External Antenna View



### 9.2 Module with Enclosure Top View





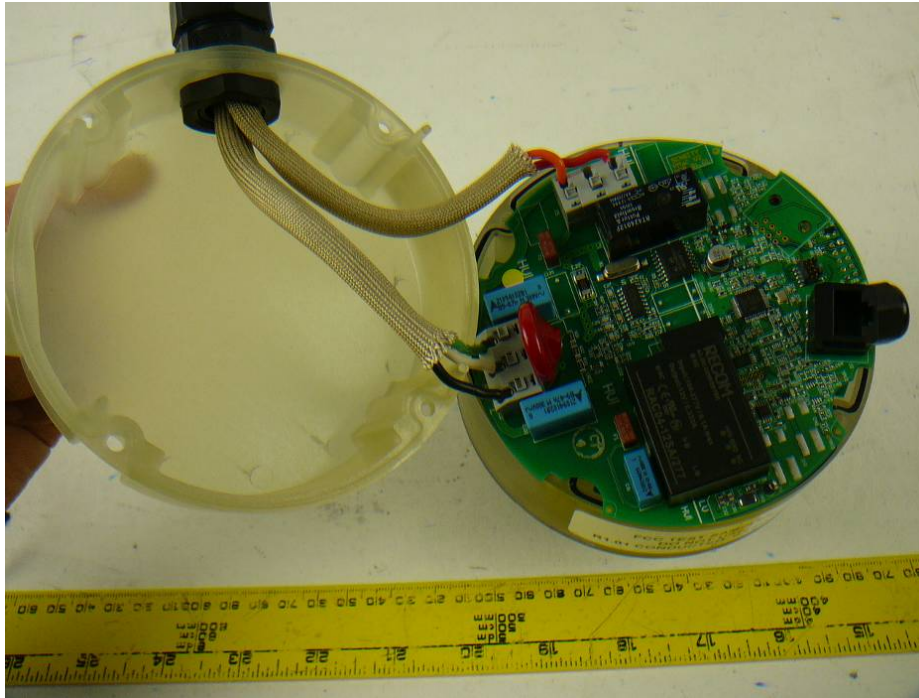
### 9.3 Module with Enclosure Bottom View



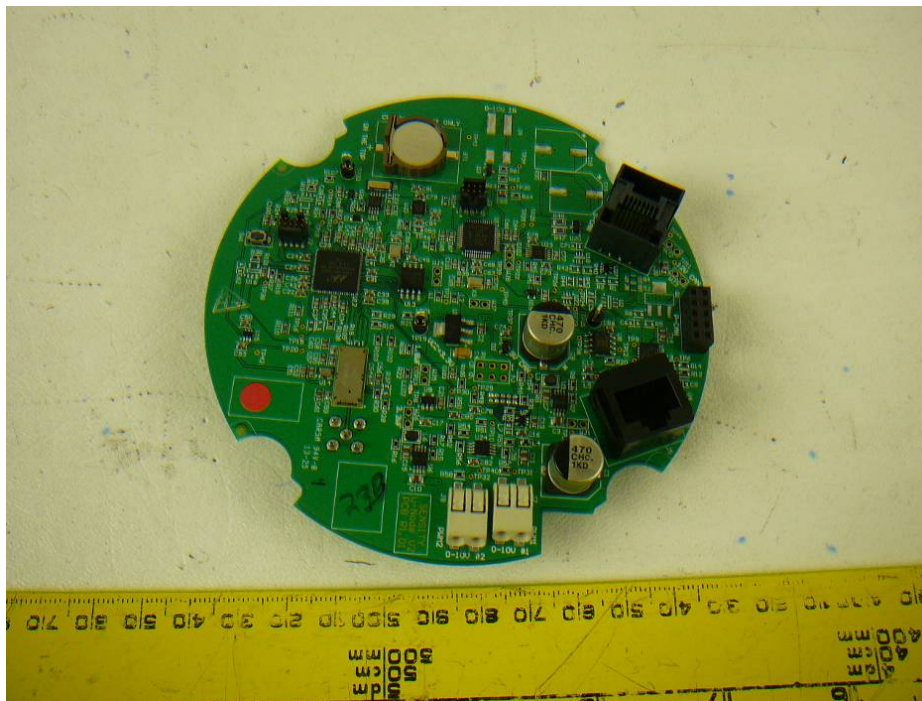
### 9.4 Module with Enclosure Side View



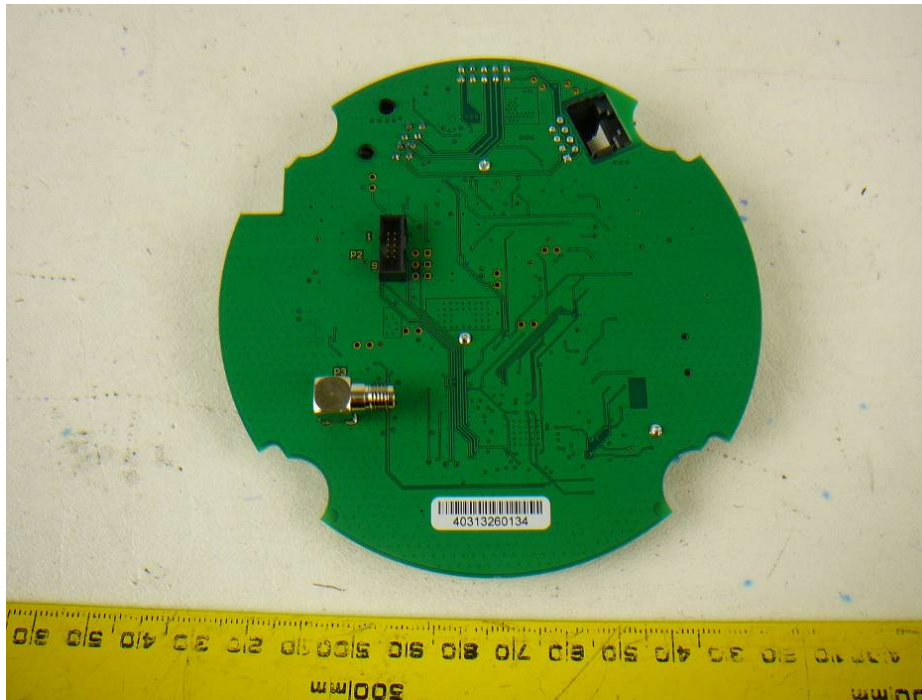
### 9.5 Open View



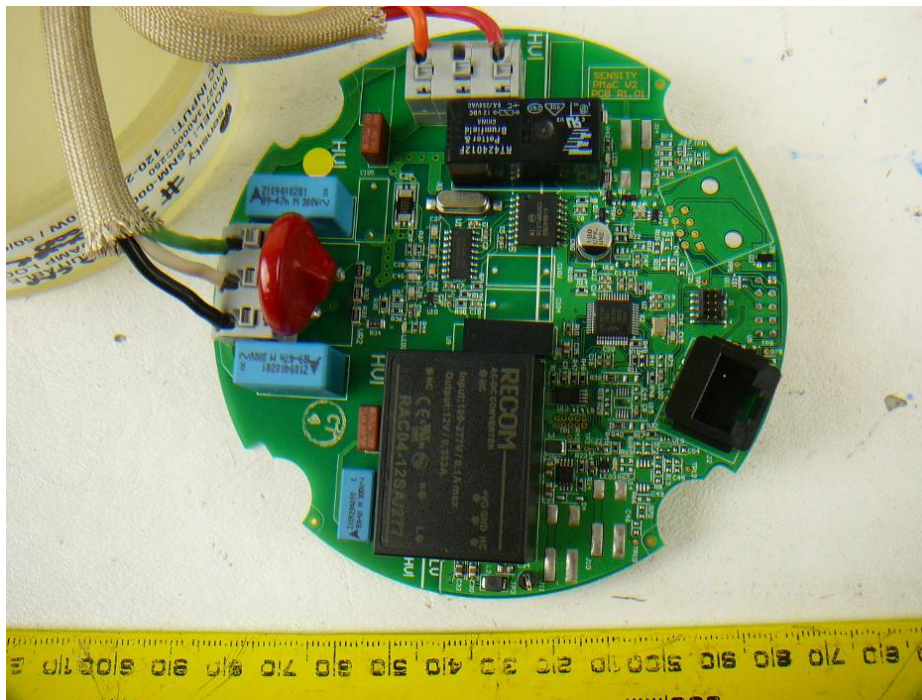
### 9.6 Main Board Component View



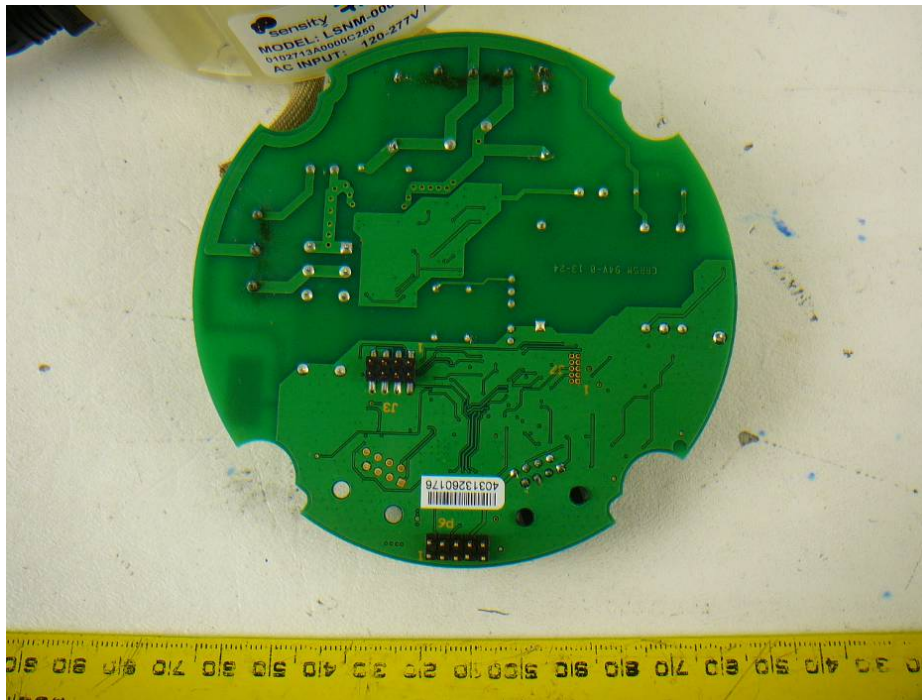
### 9.7 Main Board Solder View



### 9.8 Power Board Component View



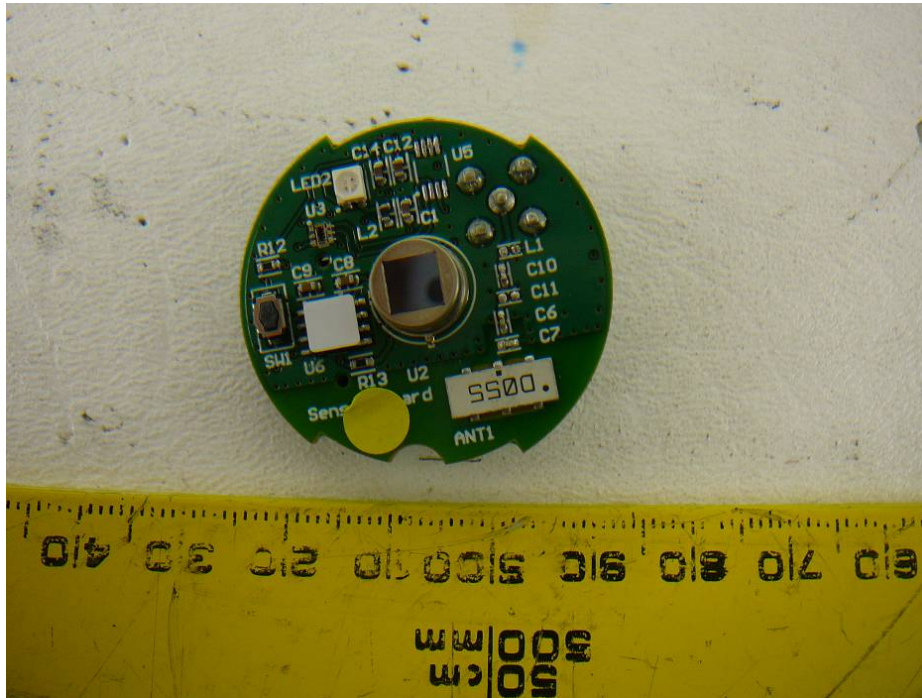
### 9.9 Power Board Solder View



### 9.10 Sensor Board Component View



### 9.11 Sensor Board Solder View



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