

# Certification Test Instructions

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## 1. Physical Setup

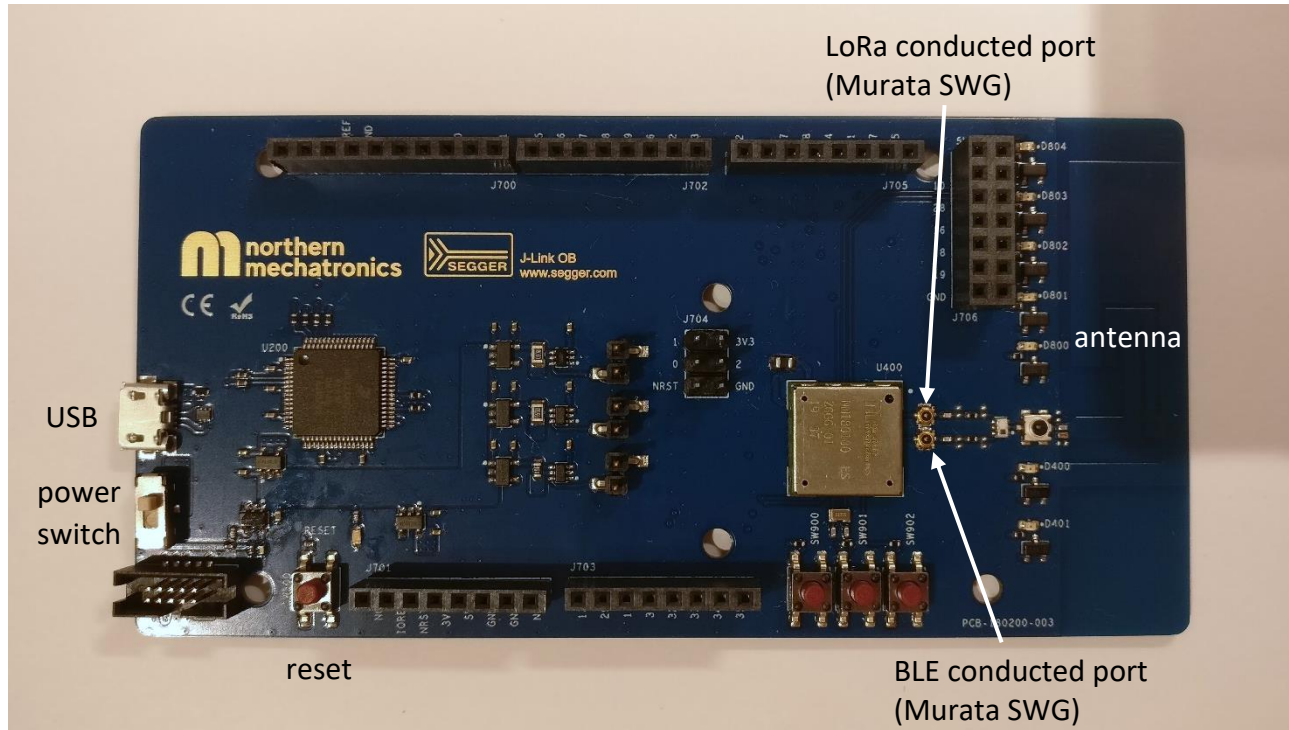


Figure 1 Certification EUT test setup.

### 1.1. Measurement Setup

1. Attach the USB cable to the EUT.
2. Attach the USB cable to the laptop.
3. Attach the SWG cable to the conducted port (LoRa or BLE)
4. Turn on the power switch

### 1.2. Command Console

Once the EUT is powered on, the command console can be accessed over the serial port using a terminal program such as PuTTY. Once the serial port is attached, press reset and the user will be greeted by a prompt as shown in Figure 2. Type help to see all the supported commands.

For certification testing, the relevant command is cert. To see a list of detailed subcommands of each radio, type

```
cert help [radio]
```

where radio can be lora or ble.

```
COM8 - PuTTY
Northern Mechatronics
NM180100 Command Console
Type 'help' for a list of supported commands.
Built on: Dec 15 2019 16:39:08
>
```

Figure 2 Command console.

```
COM8 - PuTTY
Northern Mechatronics
NM180100 Command Console
Type 'help' for a list of supported commands.
Built on: Dec 15 2019 16:39:08
> cert help
usage: cert [radio] [command] [<args>]
Supported radios are:
  lora
  ble
See 'cert help [radio] for cert command details of each radio.
>
```

Figure 3 Certification commands.

## 2. LoRa

The sample output in the following sections were performed with a 30dB attenuator inline to prevent self-mixing in the spectrum analyzer. Please ensure the appropriate attenuation is in place to avoid self-mixing caused by the fundamental power level.

### 2.1. Conducted Spurious Emissions

Test Case	Instrument Settings	Test Condition		Command Sequence
15.247(d)	30 MHz – 25 GHz RBW = 100 kHz VBW = 300 kHz	125 kHz Channel Bandwidth	902.3 MHz	cert lora load 125 cert lora dts 902.3 cert lora stop
			908.5 MHz	cert lora load 125 cert lora dts 908.5 cert lora stop
			914.9 MHz	cert lora load 125 cert lora dts 914.9 cert lora stop
		500 kHz Channel Bandwidth	903 MHz	cert lora load 500 cert lora dts 903 cert lora stop
			907.8 MHz	cert lora load 500 cert lora dts 907.8 cert lora stop
			914.2 MHz	cert lora load 500 cert lora dts 914.2 cert lora stop

## 2.2. Radiated Spurious Emissions

Test Case	Instrument Settings	Test Condition	Command Sequence	
15.205 15.209 15.247(d)	30 MHz – 1 GHz RBW = 100 kHz VBW = 300 kHz	125 kHz Channel Bandwidth	902.3 MHz	cert lora load 125 cert lora dts 902.3 cert lora stop
			908.5 MHz	cert lora load 125 cert lora dts 908.5 cert lora stop
			914.9 MHz	cert lora load 125 cert lora dts 914.9 cert lora stop
	> 1 GHz RBW = 1 MHz VBW = 3 MHz	500 kHz Channel Bandwidth	903 MHz	cert lora load 500 cert lora dts 903 cert lora stop
			907.8 MHz	cert lora load 500 cert lora dts 907.8 cert lora stop
			914.2 MHz	cert lora load 500 cert lora dts 914.2 cert lora stop

### 2.3. Channel Spacing

Test Case	Instrument Settings	Test Condition		Command Sequence
15.247(a)(1)	Span = 2.50BW RBW = 1% of Span VBW >= 3x RBW	125 kHz Channel Bandwidth	902.3 MHz	cert lora load 125  cert lora dts 902.3 cert lora stop  cert lora dts 902.5 cert lora stop

Sample Output

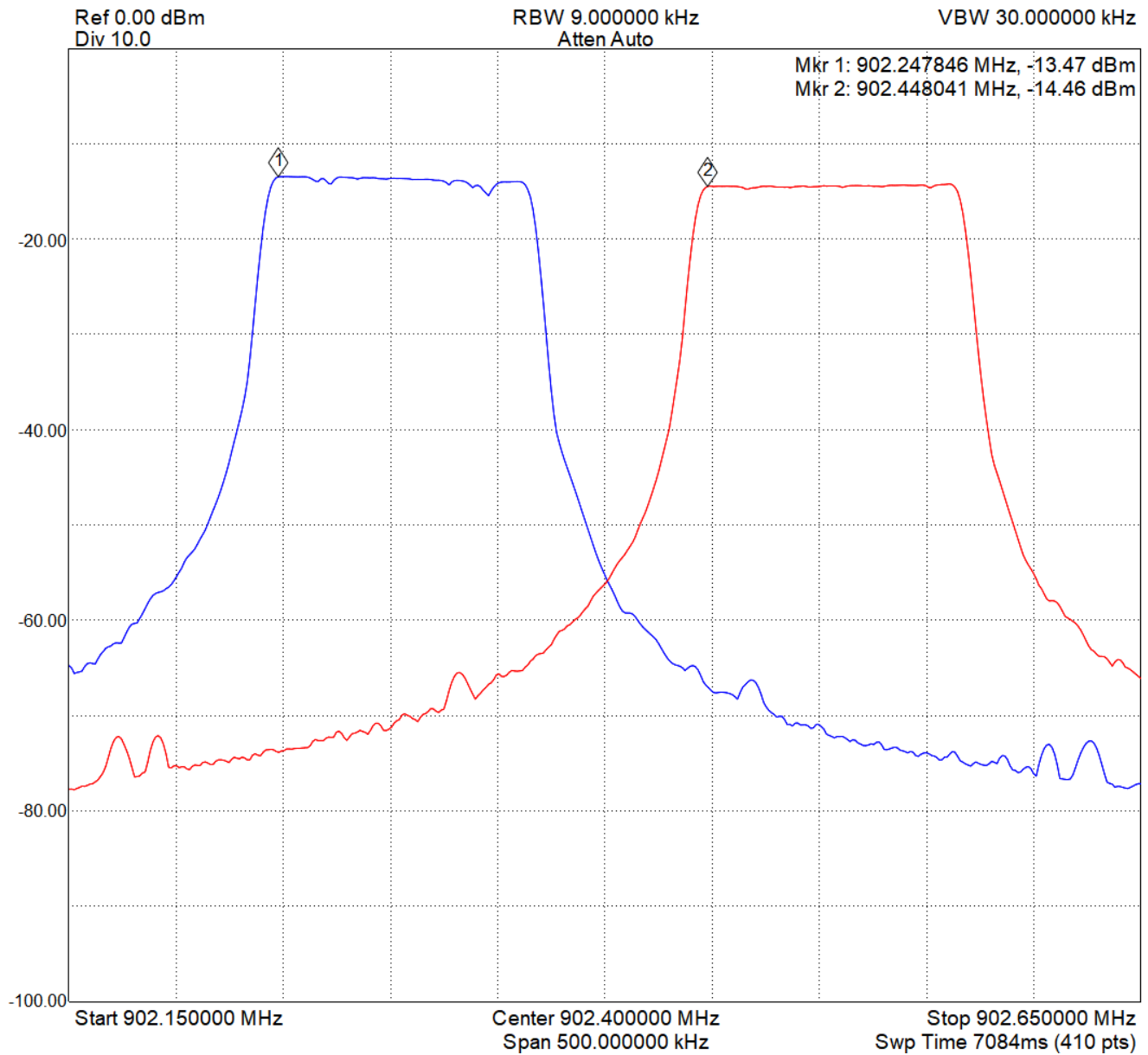


Figure 4 LoRa 125kHz channel bandwidth channel spacing.



## 2.4. 20dB Bandwidth

Test Case	Instrument Settings	Test Condition	Command Sequence	
15.247(a)(1)	Span = 1.5OBW RBW = 1% to 5% of OBW VBW >= 3x RBW	125 kHz Channel Bandwidth	902.3 MHz	cert lora load 125 cert lora dts 902.3 cert lora stop
			908.5 MHz	cert lora load 125 cert lora dts 908.5 cert lora stop
			914.9 MHz	cert lora load 125 cert lora dts 914.9 cert lora stop

Sample Output

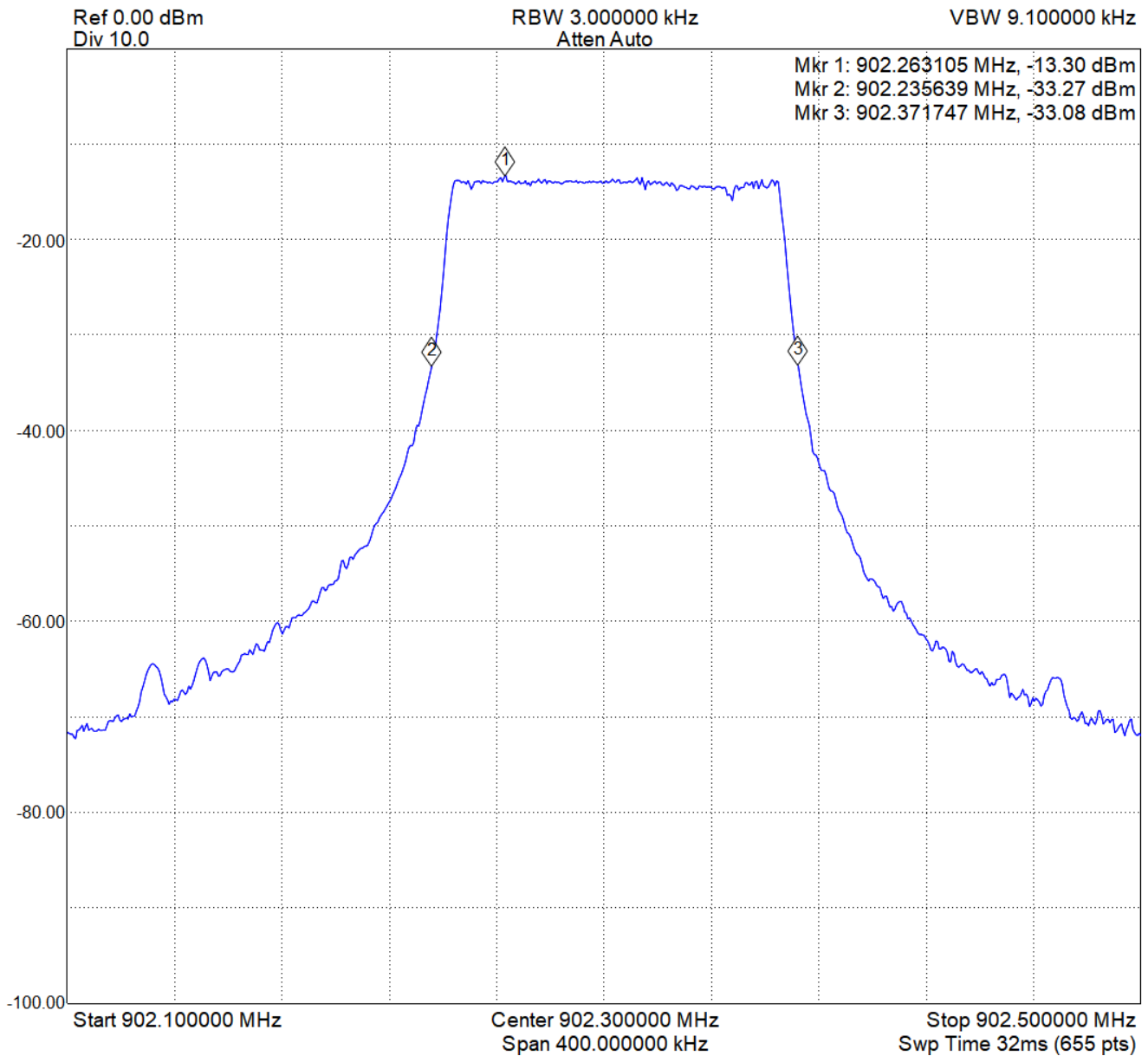


Figure 5 LoRa 125kHz channel bandwidth 20dB bandwidth.

## 2.5. 6dB Bandwidth

Test Case	Instrument Settings	Test Condition	Command Sequence	
15.247(a)(2)	Span = 1.50BW RBW = 100 kHz VBW >= 3x RBW	500 kHz Channel Bandwidth	903 MHz	cert lora load 500 cert lora dts 903 cert lora stop
			907.8 MHz	cert lora load 500 cert lora dts 907.8 cert lora stop
			914.2 MHz	cert lora load 500 cert lora dts 914.2 cert lora stop

Sample Output

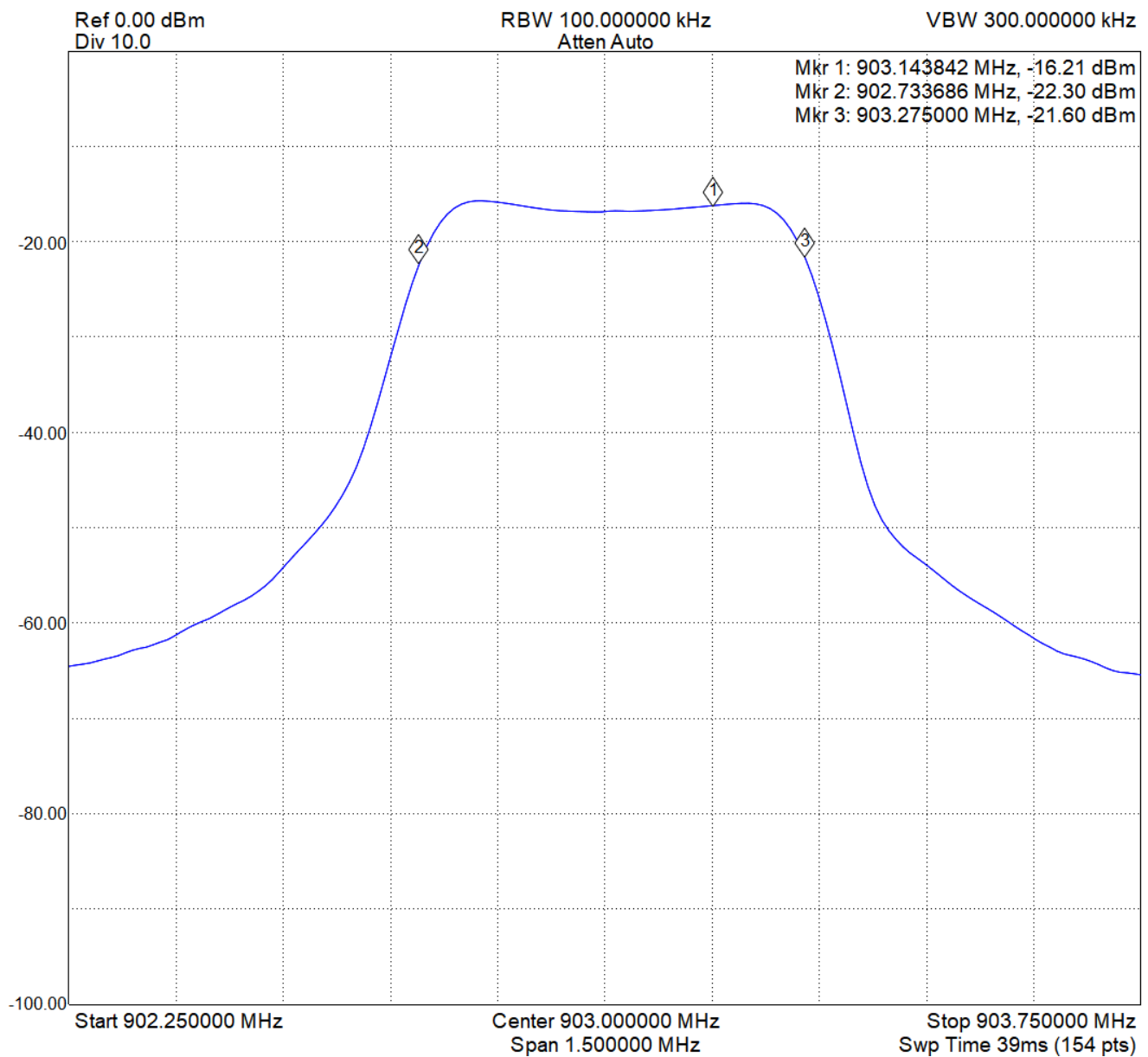


Figure 6 LoRa 500kHz channel bandwidth 6dB bandwidth.

## 2.6. Hybrid Mode Dwell Time

Test Case	Instrument Settings	Test Condition	Command Sequence
15.247(a)(1)(iii)	Sweep Time = 26s RBW = 100kHz VBW = 300kHz Span = 0Hz	125 kHz Channel Bandwidth	cert lora load 125 cert lora dts 902.3 (or any other FHSS channel) cert lora stop

### Sample Output

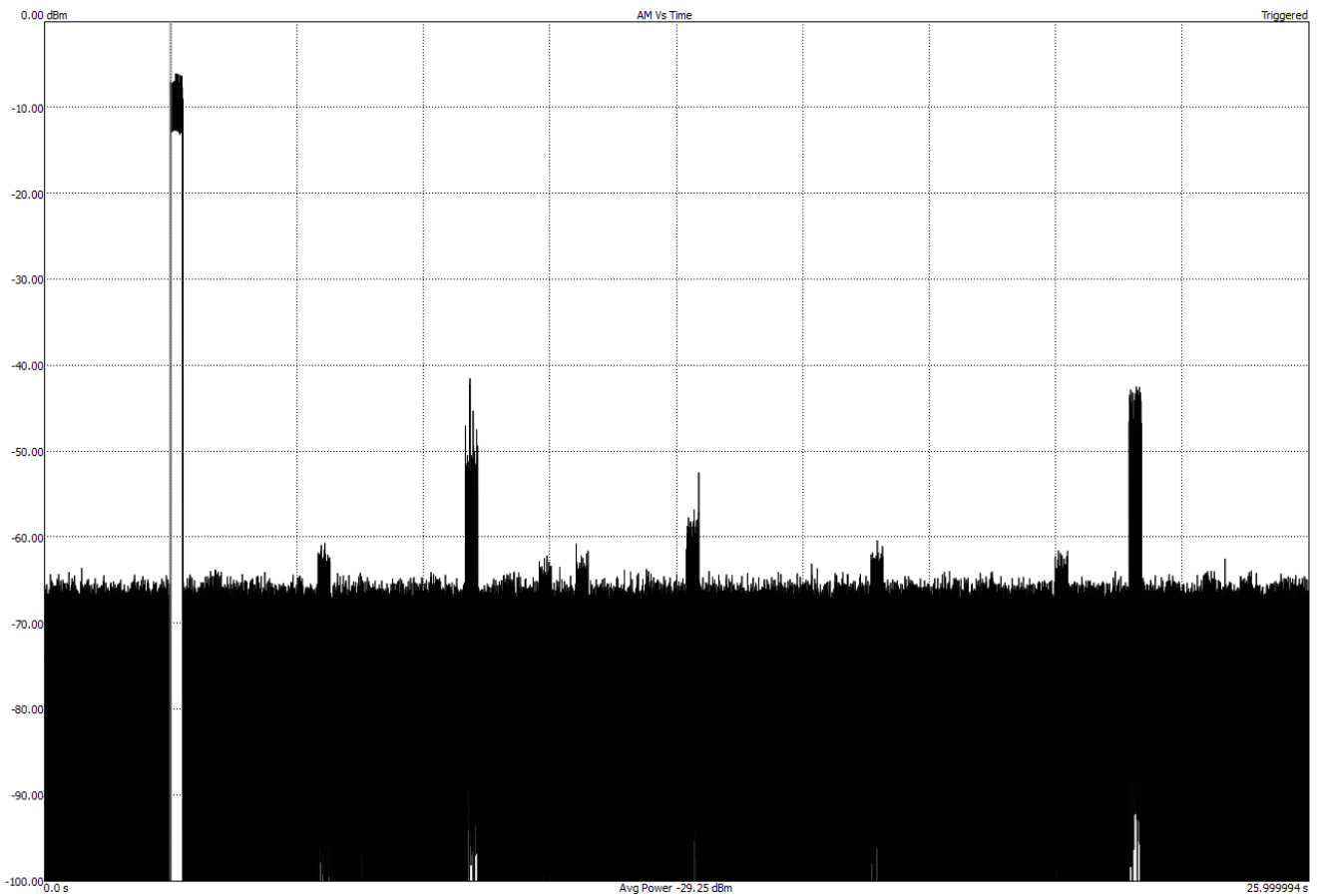


Figure 7 LoRa hybrid mode FHSS dwell time.

## 2.7. Number of Hopping Channels

Test Case	Instrument Settings	Test Condition	Command Sequence
15.247(a)(1)(iii)	RBW = 30 kHz VBW = 100 kHz	125 kHz Channel Bandwidth	cert lora load 125 cert lora fhss cert lora stop

Sample Output

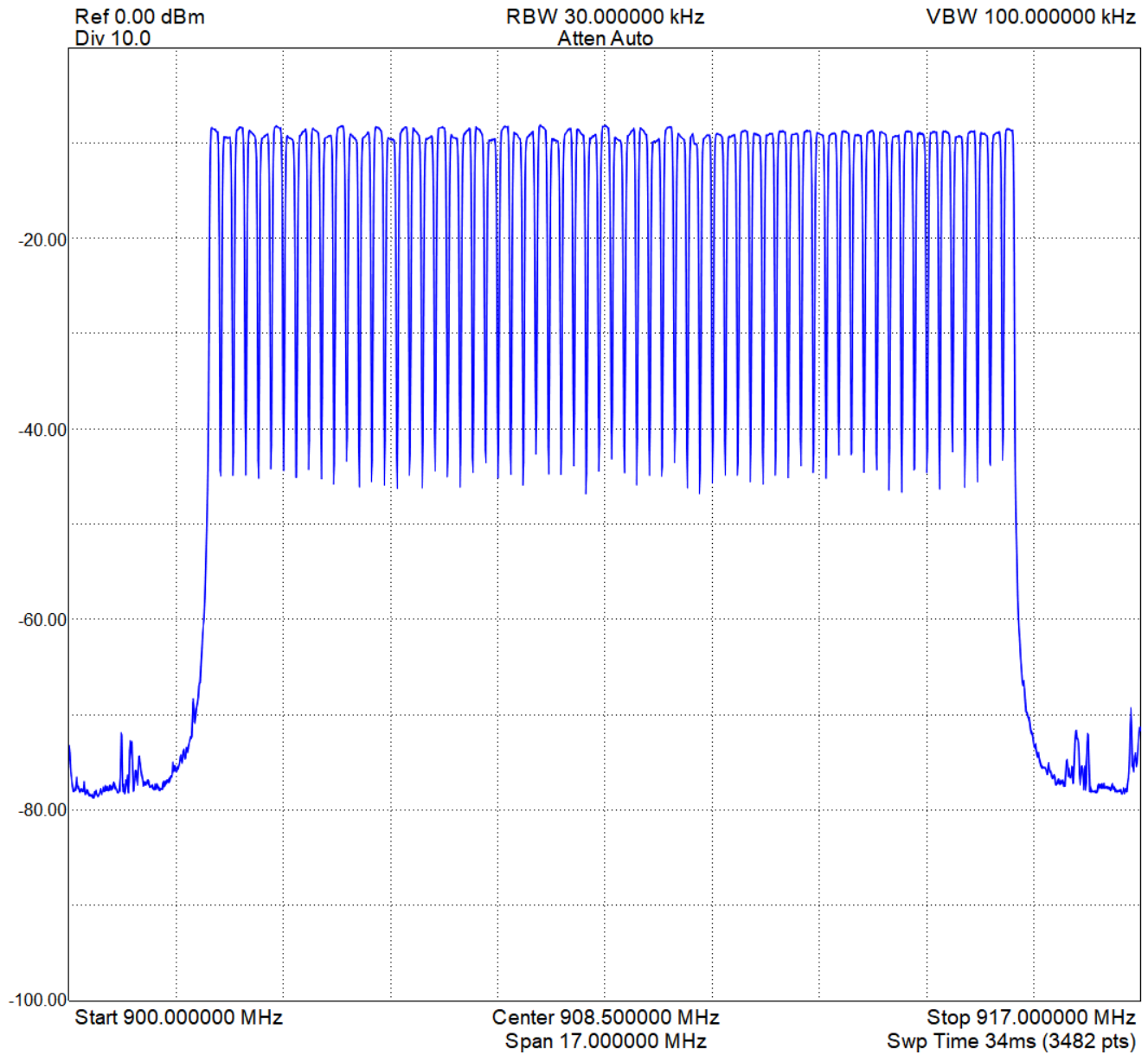


Figure 8 LoRa 125kHz channel bandwidth hopping channels.

## 2.8. Maximum Conducted Output Power

Test Case	Instrument Settings	Test Condition		Command Sequence
15.247(b)(3)	Span = 1.5 x OBW RBW = 1% to 5% of OBW VBW = 3x RBW	125 kHz Channel Bandwidth	902.3 MHz	cert lora load 125 cert lora dts 902.3 cert lora stop
			908.5 MHz	cert lora load 125 cert lora dts 908.5 cert lora stop
			914.9 MHz	cert lora load 125 cert lora dts 914.9 cert lora stop
		500 kHz Channel Bandwidth	903 MHz	cert lora load 500 cert lora dts 903 cert lora stop
			907.8 MHz	cert lora load 500 cert lora dts 907.8 cert lora stop
			914.2 MHz	cert lora load 500 cert lora dts 914.2 cert lora stop

Sample Output

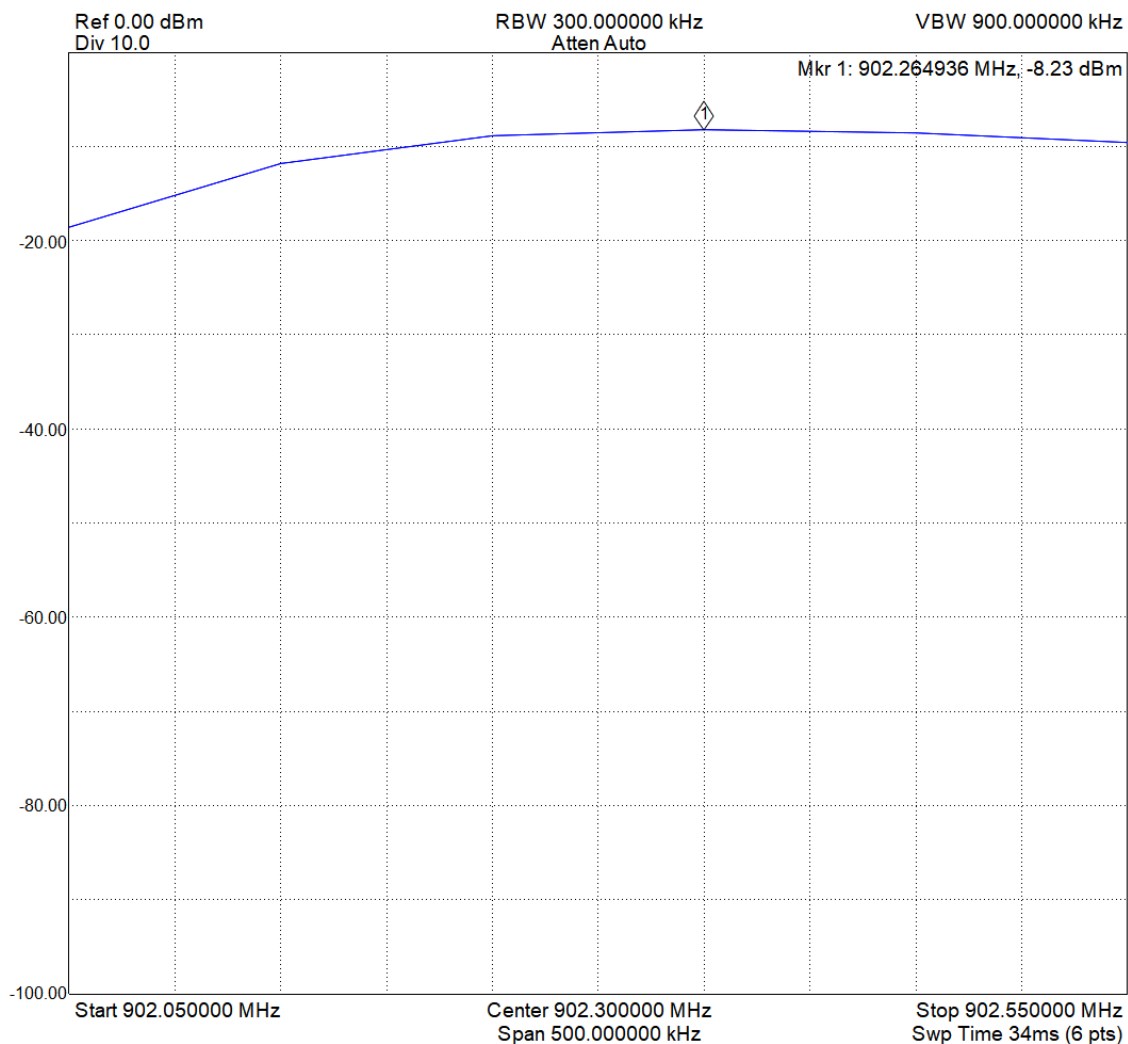


Figure 9 LoRa maximum conducted output power.

## 2.9. Band Edge

Test Case	Instrument Settings	Test Condition		Command Sequence
15.247(a)(1)	Span = 1.5OBW RBW = 1% to 5% of OBW VBW >= 3x RBW	125 kHz Channel Bandwidth	902.3 MHz	cert lora load 125 cert lora dts 902.3 cert lora stop
			914.9 MHz	cert lora load 125 cert lora dts 914.9 cert lora stop

Sample Output

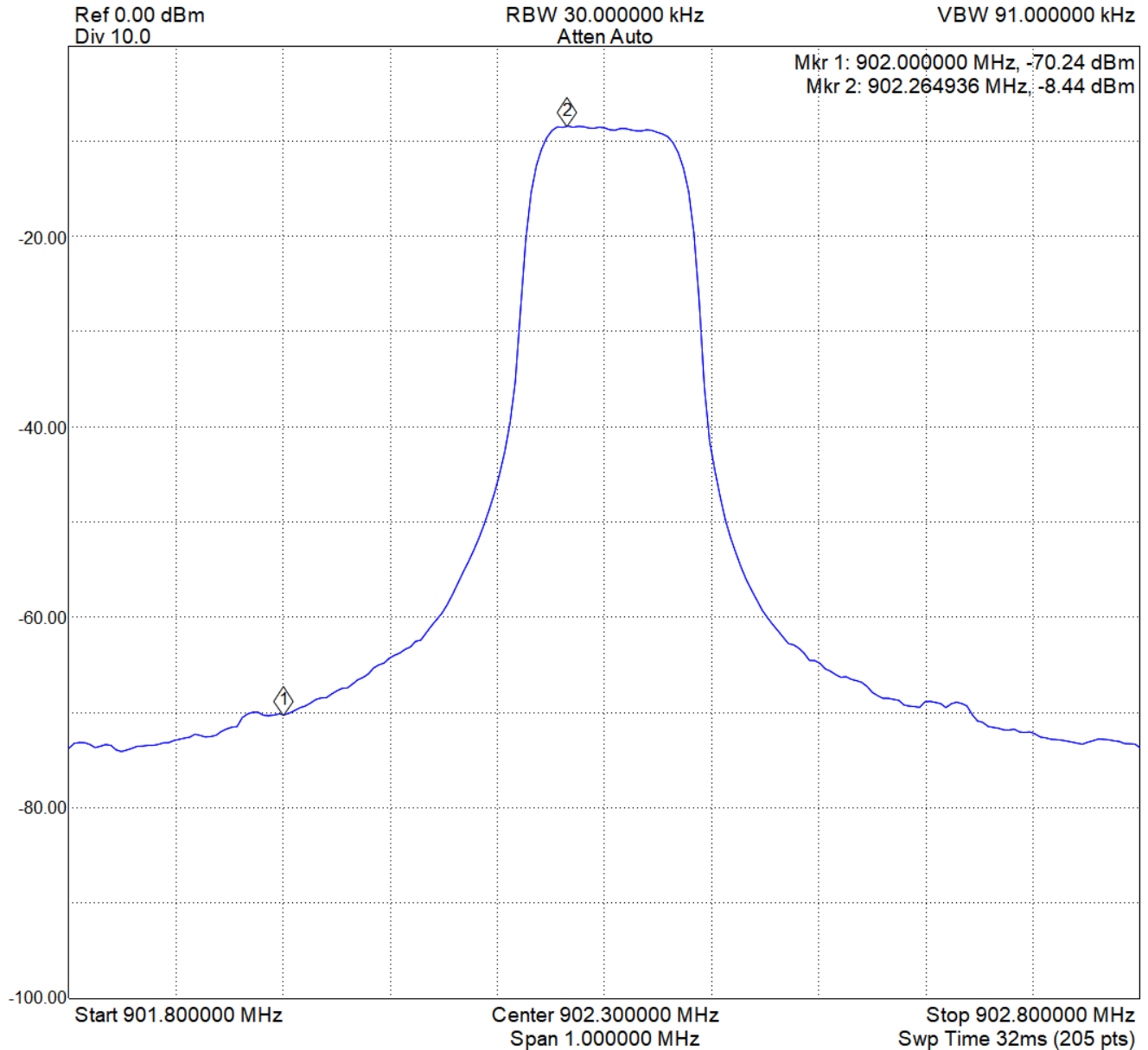


Figure 10 LoRa lower band edge out-of-band emission level.

## 2.10. Power Spectral Density

Test Case	Instrument Settings	Test Condition	Command Sequence	
15.247(e) 15.247(f)	Span = 1.5 x OBW RBW = 3 kHz VBW = 10 kHz	125 kHz Channel Bandwidth	902.3 MHz	cert lora load 125 cert lora dts 902.3 cert lora stop
			908.5 MHz	cert lora load 125 cert lora dts 908.5 cert lora stop
			914.9 MHz	cert lora load 125 cert lora dts 914.9 cert lora stop
		500 kHz Channel Bandwidth	903 MHz	cert lora load 500 cert lora dts 903 cert lora stop
			907.8 MHz	cert lora load 500 cert lora dts 907.8 cert lora stop
			914.2 MHz	cert lora load 500 cert lora dts 914.2 cert lora stop

Sample Output

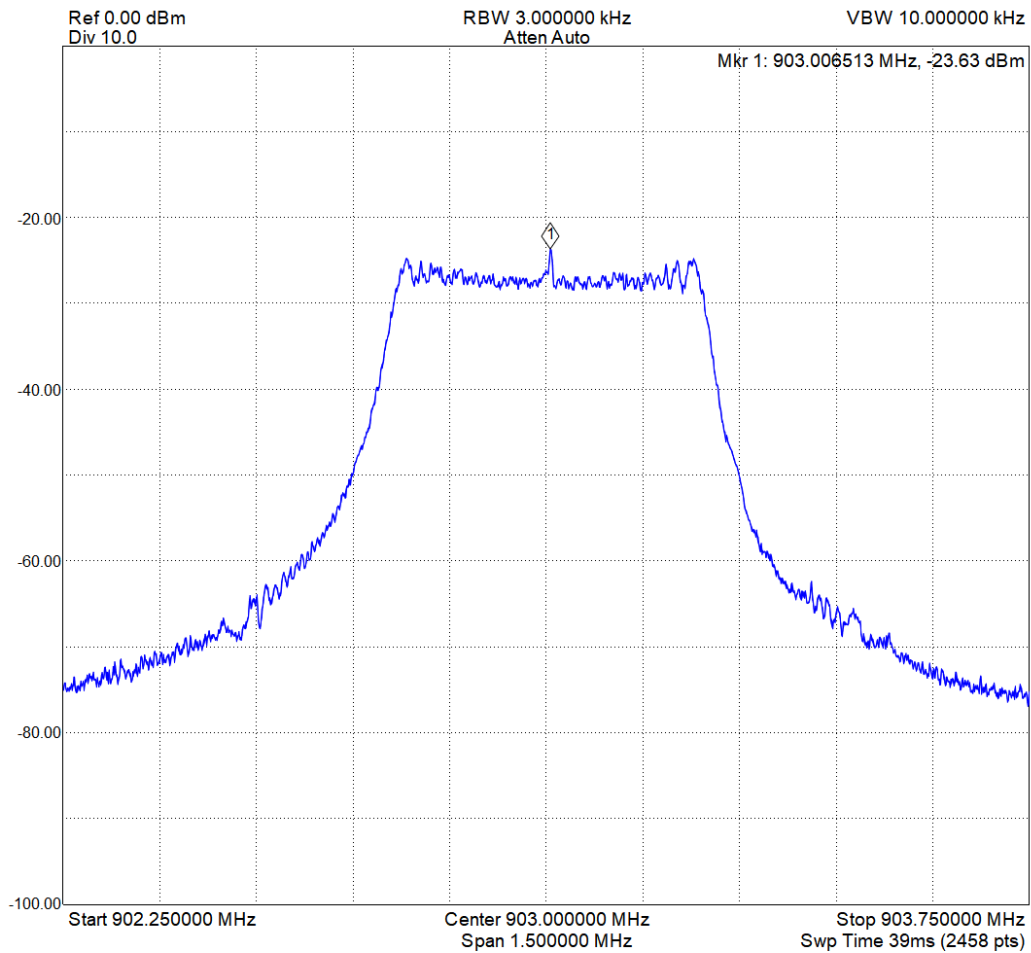


Figure 11 LoRa power spectral density.

### 3. BLE

#### 3.1. Conducted Spurious Emissions

Test Case	Instrument Settings	Test Condition	Command Sequence
15.247(d)	30 MHz – 25 GHz RBW = 100 kHz VBW = 300 kHz	2402 MHz	cert ble dts 0 cert ble stop
		2440 MHz	cert ble dts 19 cert ble stop
		2480 MHz	cert ble dts 39 cert ble stop



### 3.2. Radiated Spurious Emissions

Test Case	Instrument Settings	Test Condition	Command Sequence
15.205 15.209 15.247(d)	30 MHz – 1 GHz RBW = 100 kHz VBW = 300 kHz	2402 MHz	cert ble dts 0 cert ble stop
		2440 MHz	cert ble dts 19 cert ble stop
	> 1 GHz RBW = 1 MHz VBW = 3 MHz	2480 MHz	cert ble dts 39 cert ble stop

### 3.3. Occupied Bandwidth

Test Case	Instrument Settings	Test Condition	Command Sequence
15.247(a)(2)	Span = 1.50BW RBW = 100 kHz VBW >= 3x RBW	2402 MHz	cert ble dts 0 cert ble stop
		2440 MHz	cert ble dts 19 cert ble stop
		2480 MHz	cert ble dts 39 cert ble stop

Sample Output

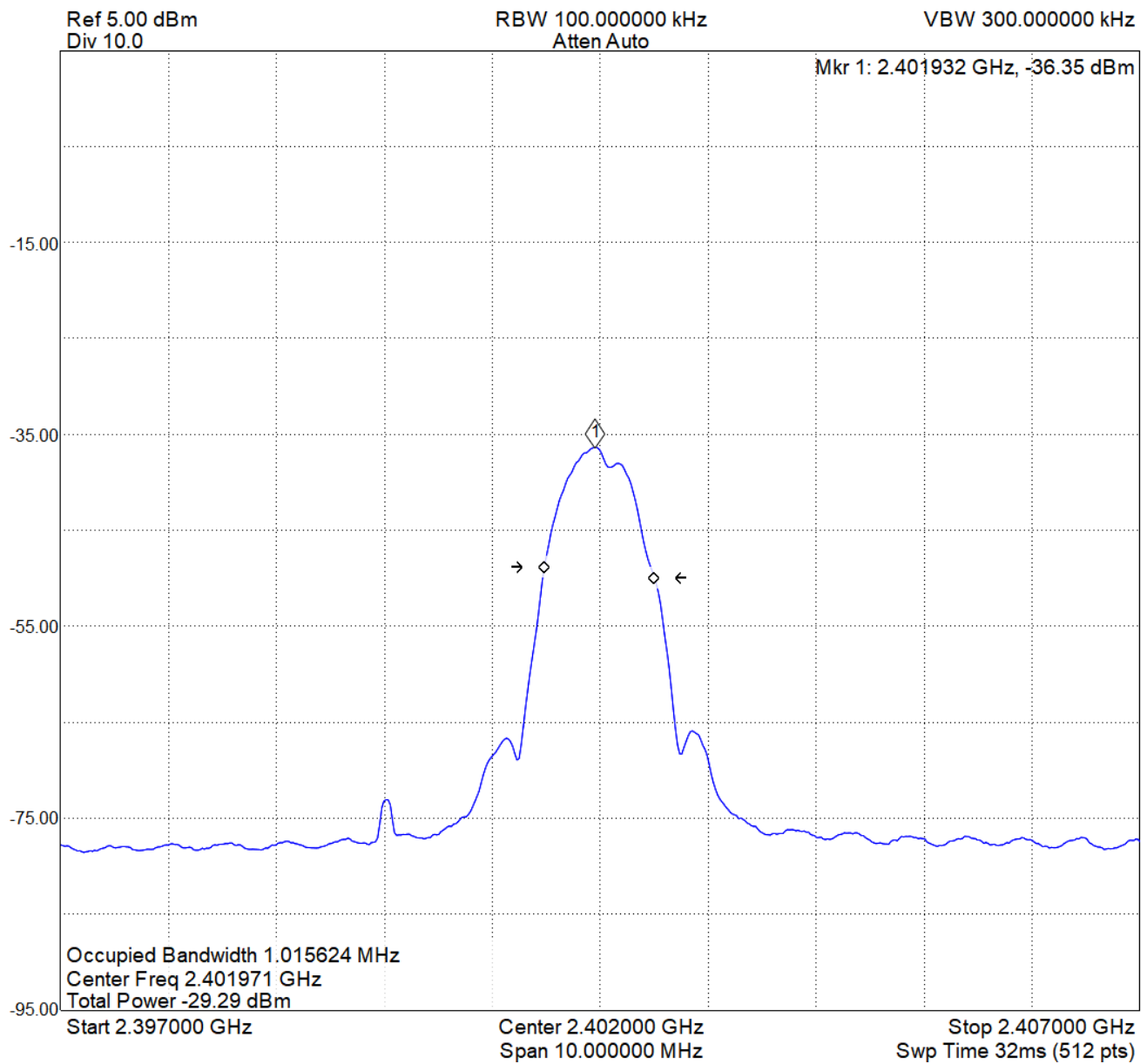


Figure 12 BLE occupied bandwidth.

### 3.4. Maximum Conducted Output Power

Test Case	Instrument Settings	Test Condition	Command Sequence
15.247(b)(3)	Span = 1.5 x OBW RBW = 1% to 5% of OBW VBW = 3x RBW	2402 MHz	cert ble dts 0 cert ble stop
		2440 MHz	cert ble dts 19 cert ble stop
		2480 MHz	cert ble dts 39 cert ble stop

Sample Output

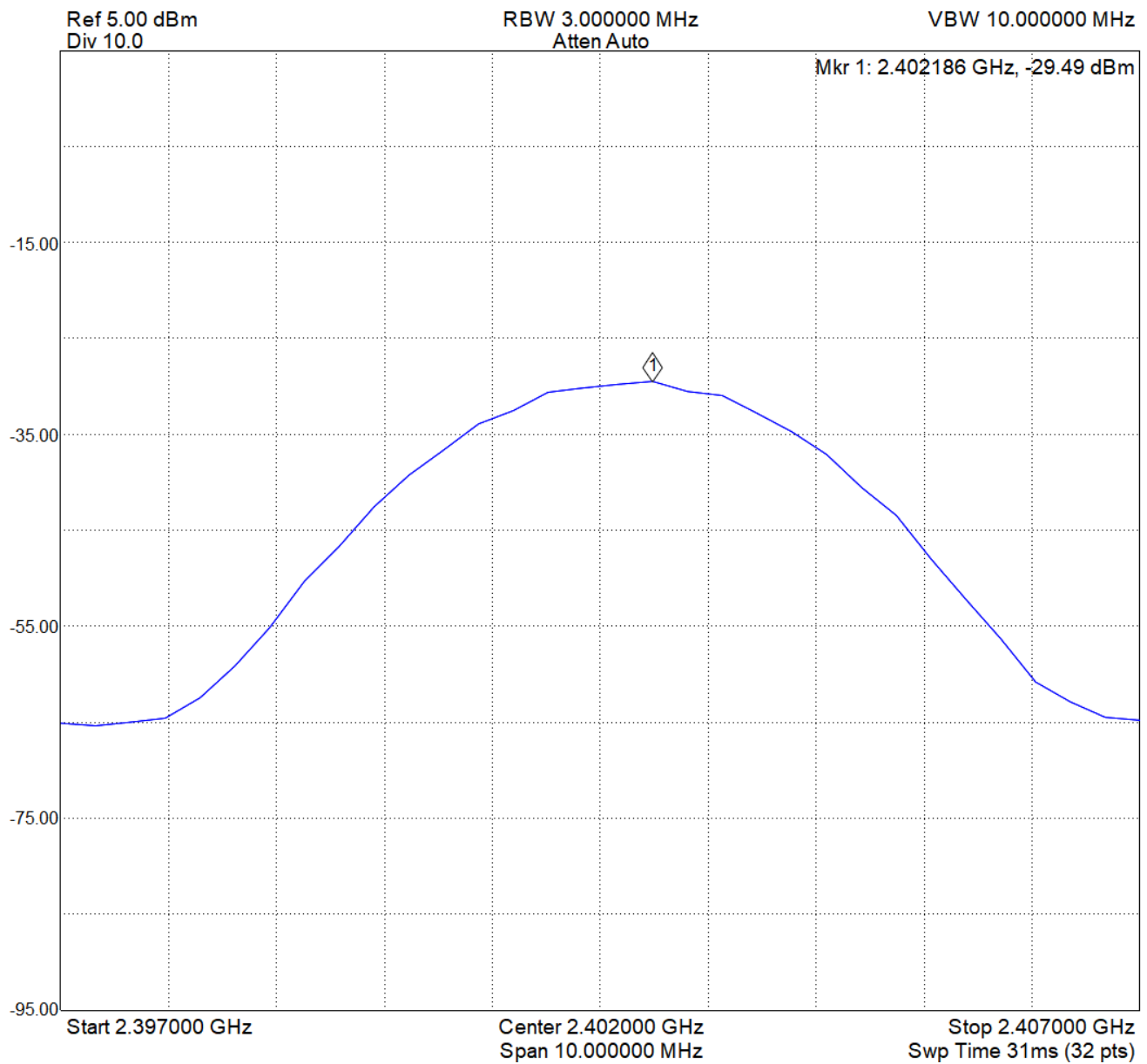


Figure 13 BLE maximum conducted power.

### 3.5. Band Edge

Test Case	Instrument Settings	Test Condition	Command Sequence
	Span = 1.5 x OBW 100 kHz >= RBW >= 3 kHz VBW >= 3 x RBW	2402 MHz	cert ble dts 0 cert ble stop
		2480 MHz	cert ble dts 39 cert ble stop

Sample Output

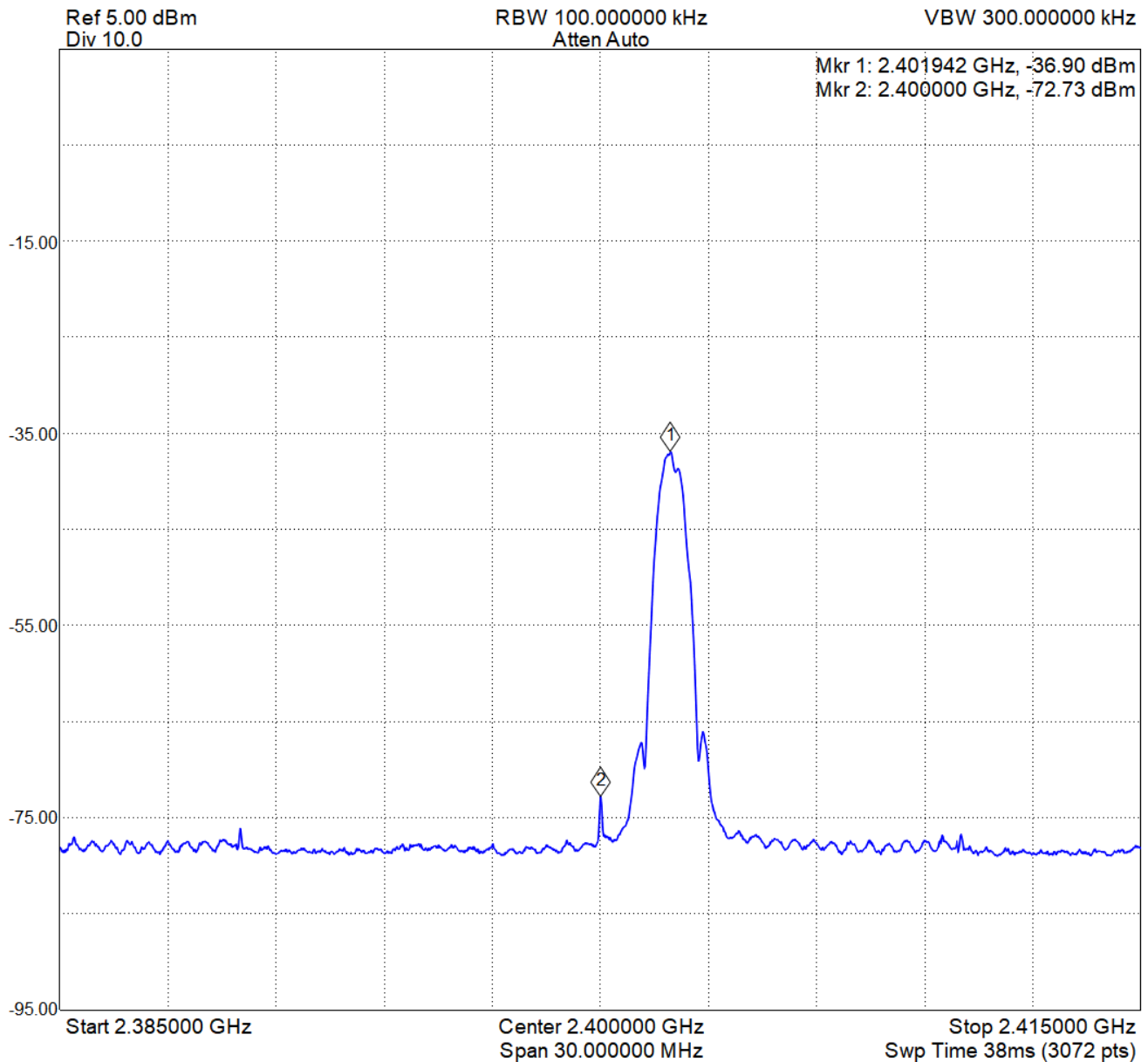


Figure 14 BLE lower band edge out-of-band emissions.

### 3.6. Power Spectral Density

Test Case	Instrument Settings	Test Condition	Command Sequence
15.247(e) 15.247(f)	Span = 1.5 x OBW 100 kHz >= RBW >= 3 kHz VBW >= 3 x RBW	2402 MHz	cert ble dts 0 cert ble stop
		2440 MHz	cert ble dts 19 cert ble stop
		2480 MHz	cert ble dts 39 cert ble stop

Sample Output

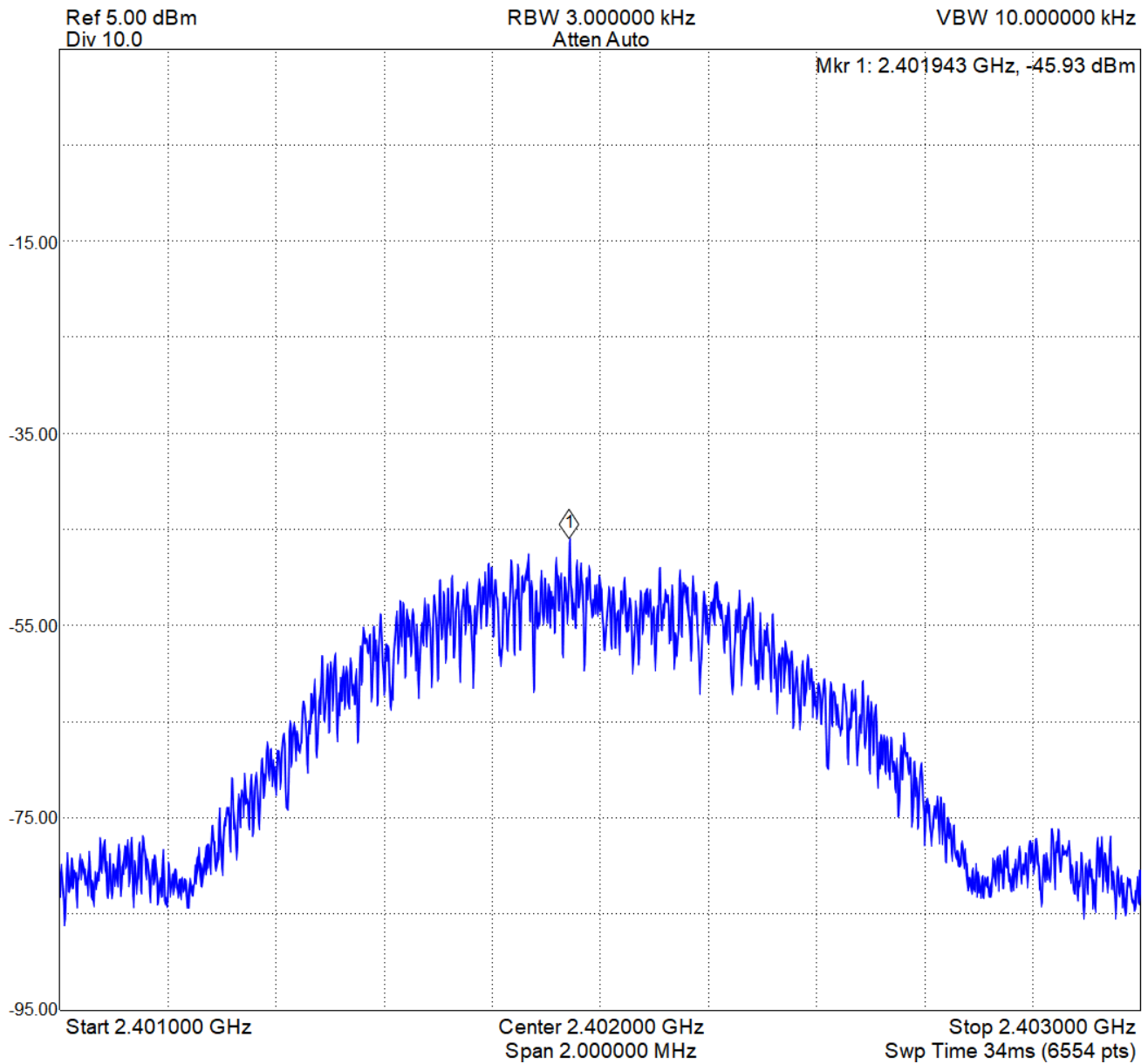


Figure 15 BLE power spectral density.

#### 4. Co-Existence

Channel Combinations		Command Sequence
LoRa	BLE	
903 MHz	2402 MHz	cert lora load 500 cert lora dts 903 cert ble dts 0 cert ble stop cert lora stop
	2440 MHz	cert lora load 500 cert lora dts 903 cert ble dts 19 cert ble stop cert lora stop
	2480 MHz	cert lora load 500 cert lora dts 903 cert ble dts 39 cert ble stop cert lora stop
907.8 MHz	2402 MHz	cert lora load 500 cert lora dts 907.8 cert ble dts 0 cert ble stop cert lora stop
	2440 MHz	cert lora load 500 cert lora dts 907.8 cert ble dts 19 cert ble stop cert lora stop
	2480 MHz	cert lora load 500 cert lora dts 907.8 cert ble dts 39 cert ble stop cert lora stop
914.2 MHz	2402 MHz	cert lora load 500 cert lora dts 914.2 cert ble dts 0 cert ble stop cert lora stop
	2440 MHz	cert lora load 500 cert lora dts 914.2 cert ble dts 19 cert ble stop cert lora stop
	2480 MHz	cert lora load 500 cert lora dts 914.2 cert ble dts 39 cert ble stop cert lora stop