



# **SDR-1000**

## **iMX6 based Dual DSRC Module with Antenna Diversity**

### **User Guide**

**Release 1.1**  
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This device complies with Part 15 of the FCC Rules.

Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) This device must accept any interference received, including interference that may cause undesired operation.

#### [OEM Warning statement](#)

If using a permanently affixed label, the modular transmitter must be labeled with its own FCC identification number, and, if the FCC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains Transmitter Module FCC ID: 2AADT-SDR1000," or "Contains FCC ID: 2AADT-SDR1000" Any similar wording that expresses the same meaning may be used. The Grantee may either provide such a label, an example of which must be included in the application for equipment authorization, or, must provide adequate instructions along with the module which explain this requirement. In the latter case, a copy of these instructions must be included in the application for equipment authorization

# Regulatory Compliance

## FCC Class B Information

### **IMPORTANT NOTE: FCC Compliance statement**

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

### **IMPORTANT NOTE: FCC Operation Guide**

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

### **IMPORTANT NOTE: FCC Caution Statement**

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

### **IMPORTANT NOTE: FCC RF exposure statement**

The antenna(s) used for this device must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

## **IMPORTANT NOTE: FCC Shielded cable statement**

This unit was tested with shielded cables on the peripheral devices. Shielded cables must be used with the unit to insure compliance.

## 1. Introduction

This user guide describes the use of the Savari iMX6 Based Dual DSRC Module - SDR1000 as the communication device for onboard and roadside system for V2X communication. Covering the V2V and V2I communication using the predefined 5.9 GHz frequency band. The module is based the ARM based iMX6 and the QCA6485 DSRC communication device. The Module RF transceivers are based on the Qualcomm QCA6485, local area network (WLAN) support two spatial streams 801.11p IEEE standard.

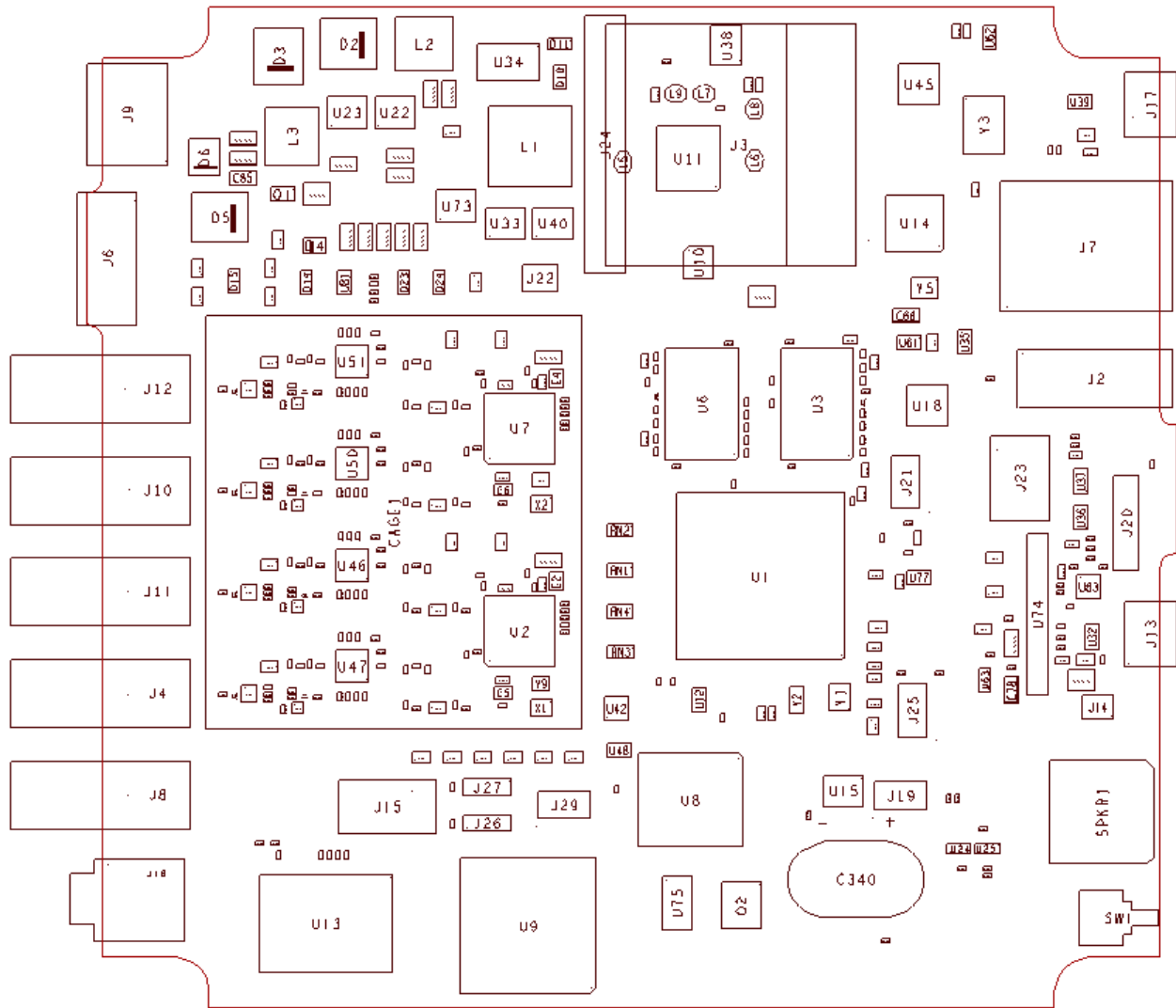
## 2. Module

The SDR-1000 is a 10-layer double sided PCB. It has multiple IO and peripheral for implementing on-board and roadside systems using DSRC communication. Specifically, for development purposes, the module includes

- USB based UART port which communicates to a PC PuTTY, or similar terminal.
- 100base-T Ethernet port.
- USB host port
- 4 input/output digital I/O port
- CAN BUS interface for connecting to in-car devices
- µSD card interface for bootup and external memory
- 3 LED for status and debugging
- Speaker output
- Onboard microphone
- Onboard speaker
- Mini PCIe connector
- USB OTG (not populated)
- LCD I2C connection (not populated)
- SDIO (not populated)

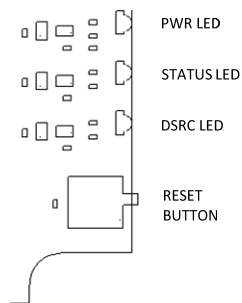
The default boot source is the eMMC memory but, pressing the reset button for more than four seconds, during power-up or otherwise, will cause the boot device to change to the microSD drive, if an SD is inserted.

### 3. Interfaces



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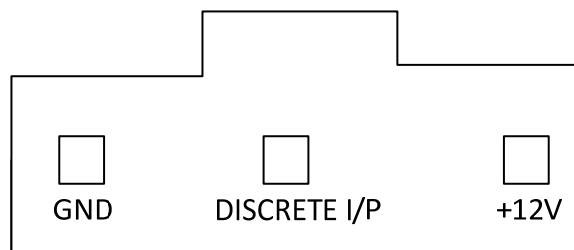
Position of LEDs and reset button



The IO interfaces are described in the following table.

Function	Ref.	Connector type	MNF part #
Audio	J16	3.5mm jack	CUI Inc. SJ-43514
GPS	J8	FAKRA C polarity	Rosenberger 59S2AQ-40MTS-C
DSRC 2 Chan #2	J4	FAKRA no polarity	Rosenberger 59S2AQ-40MTS-Z
DSRC 2 Chan #1	J11	FAKRA no polarity	Rosenberger 59S2AQ-40MTS-Z
DSRC 1 Chan #2	J10	FAKRA no polarity	Rosenberger 59S2AQ-40MTS-Z
DSRC 1 Chan #1	J12	FAKRA no polarity	Rosenberger 59S2AQ-40MTS-Z
3.3V GPIO	J6	9 pin 1.5mm male	Molex 503175-0900
Car power	J9	3 pin Micro-Fit male	Molex 43650-0302
UART	J17	USB micro A/B receptacle	Molex 47589-0001
100 base-T ethernet	J7	10/100base-T RJ45	Abracon ARJ-101D
USB	J2	USB type A	Molex 48204-0001
LCD connector	J20	12 pin FPC ZIF	Molex 52559-1233
USB OTG	J13	USB micro A/B receptacle	Molex 47589-0001
SD card reader	J1	Micro SD push-push	Amphenol 101-00660-68-6
Reset switch	J14	SPST Push-to-make	C & K FP11SPA1B1TP00
FPGA program header	J19	0.05 pitch 2x5 pin header	Samtec FTSH-105-01-F-DV-P
Back-up battery	J22	1.25mm 1x3 pin header	Molex 53047-0210
Sirius XM header	J25	0.05 pitch 2x5 pin header	Samtec FTSH-105-01-F-DV-P
Mini PCIe	J3	Mini PCIe RA 7mm	Tyco 179547-1
Processor JTAG	J21	0.05 pitch 2x5 pin header	Samtec FTSH-105-01-F-DV-P
USB header	J23	1.5mm 4 pin header	Molex 502584_0460
CAN bus IF	J15	2mm 1 x 4 pin header shrouded	Molex 55932-0410
BOOT1 configuration	J26	2mm 1x3 pin header	Samtec MTMM-103-07
Configuration bit 1-6	J27	2mm 1x3 pin header	Samtec MTMM-103-07
Security program header	J29	0.05 pitch 2x5 pin header	Samtec FTSH-105-01-F-DV-P

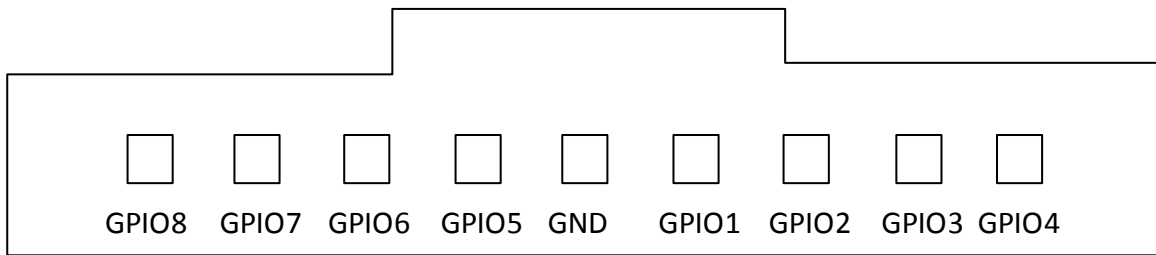
#### a. Car power CONNECTOR





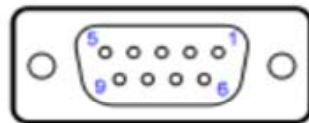
The discrete I/P is intended to be connected to the ignition switch. It provides a wake-up signal in low-power mode and controls the power supplies in continuous micro-power mode, see pages **Error! Bookmark not defined.** & **Error! Bookmark not defined.**

**b. GPIO CONNECTOR**



See page **Error! Bookmark not defined.** for a description of the signals.

**c. CAN bus connector**



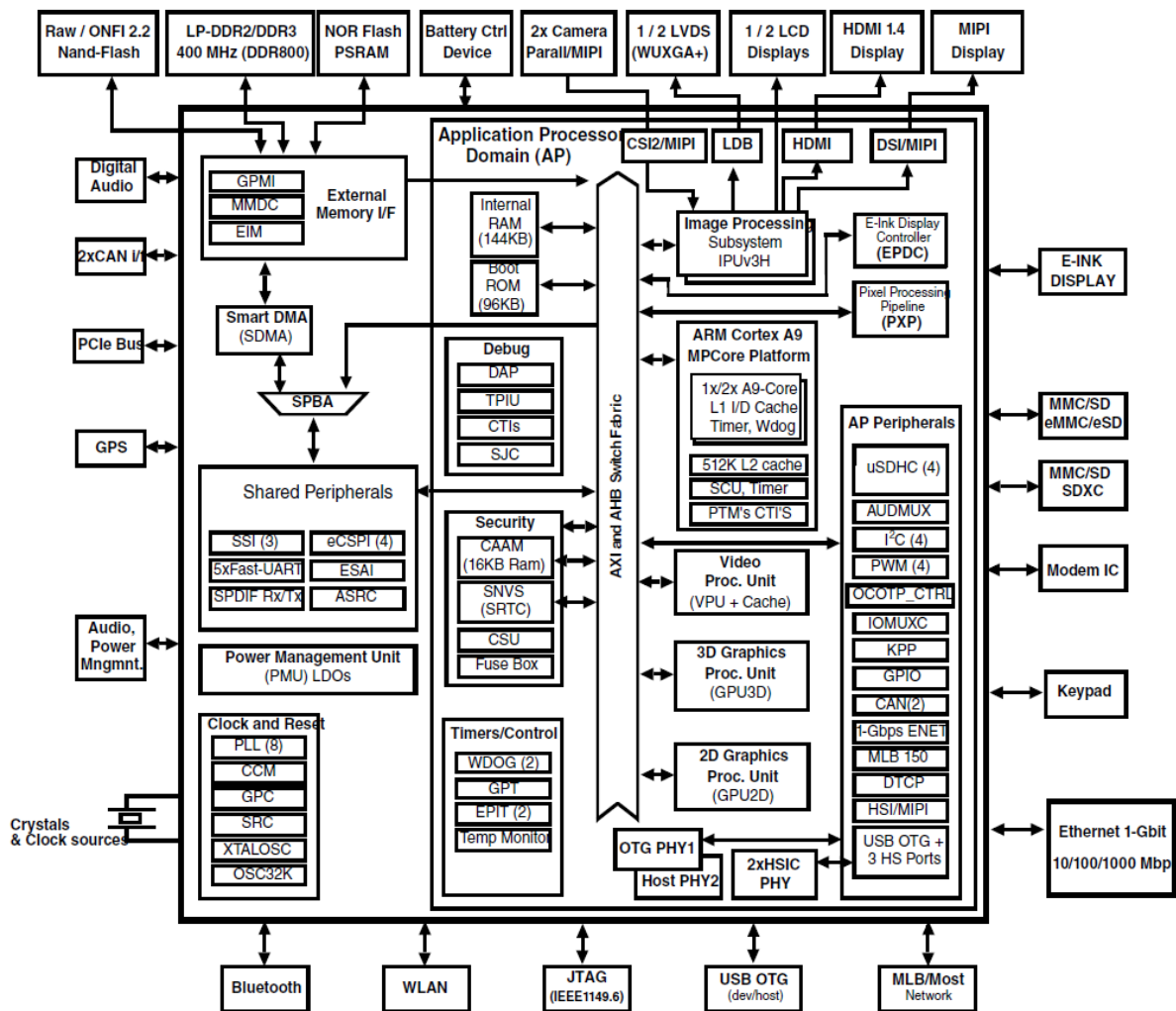
**9 Pin (male) D-Sub CAN Bus PinOut**

Pin #	Signal names	Signal Description
1	Reserved	Upgrade Path
2	CAN_L	Dominant Low
3	CAN_GND	Ground
4	Reserved	Upgrade Path
5	CAN_SHLD	Shield, Optional
6	GND	Ground, Optional
7	CAN_H	Dominant High
8	Reserved	Upgrade Path
9	CAN_V+	Power, Optional

As seen on the rear panel

## 4. iMX6 Processor

The processor is an iMX6 Dual Lite processor with up to 64-bit wide memory composed of 4 DDR3L DRAMs. The recommendations of Freescale application note [AN4397](#) have been followed to allow exchange of different variants of the iMX6.



### a. PROCESSOR SPEED

The processor speed can be configured to 396MHz with the DDR3 interface operating at 352MHz; or 792MHz. Provision is made to run a 1GHz variant of the processor.

The speed can be changed in Linux. In root mode go to the directory

```
/sys/devices/system/cpu/cpu0/cpufreq/
```

To determine current speed setting

```
cat cpuinfo_cur_freq
```

 will tell you the current speed

To enable speed setting

```
echo userspace > scaling_governor
```

To set the speed to 792MHz

```
echo 792000 > scaling_setspeed
```

To set the speed to 396MHz

```
echo 396000 > scaling_setspeed
```

## b. PROCESSOR IO

The processor IO modules are utilized thusly:

Module	Attached devices	Notes
AUD4	Cirrus WM8962 stereo CODEC	Tx and Rx slave mode. The MCLK is generated in the iMX6 and supplied to the CODEC via a GPIO
AUD5	Sirius XM module header	Only slave Rx mode with BCLK, Frame strobe and Rx data
ECSPI2	Infineon security device	Infineon SLI97
ECSPI3	Security FPGA	SS0 not equipped
	Security FLASH	SS1 SST25V10
FLEXCAN2	CAN bus driver	High speed
GPIOs	Indicator LEDs	
	Discrete IO connector	
	Power control	
	Miscellaneous functions	
I2C1	Mini PCIe connector	
I2C2	64kb serial EEPROM	Device ID 0x50
	PMIC	Device ID 0x08
I2C3	RTC	Device ID 0x6F
	Cirrus WM8962 stereo CODEC	Device ID 0x1A Note Test functionality at 0x4A
	Invensense ICM20602 6-axis motion detector	Device ID 0x69
JTAG		This header is for an ARM Cortex-9 debugger
RMII	10/100base-T ethernet	
UART1	Security device programming	Smart card interface to Infineon SLI97
UART2	uBlox NEO-M8 GPS module	
UART3	Sirius XM module header	
UART4	RS232 console	Via USB requires an FT232 driver on the host

USB H1	Microchip USB84604 hub	Downstream ports are: dual USB header; USB 2.0 Type A connector; mini PCIe connector.
USDHC1	DSRC 1	4-bit interface
USDHC2	Micro SD drive connector	4-bit interface
USDHC3	eMMC 4G FLASH memory	8-bit DDR interface expandable to 8G.
USDHC4	DSRC 2	4-bit interface shared with an SDIO memory card connector

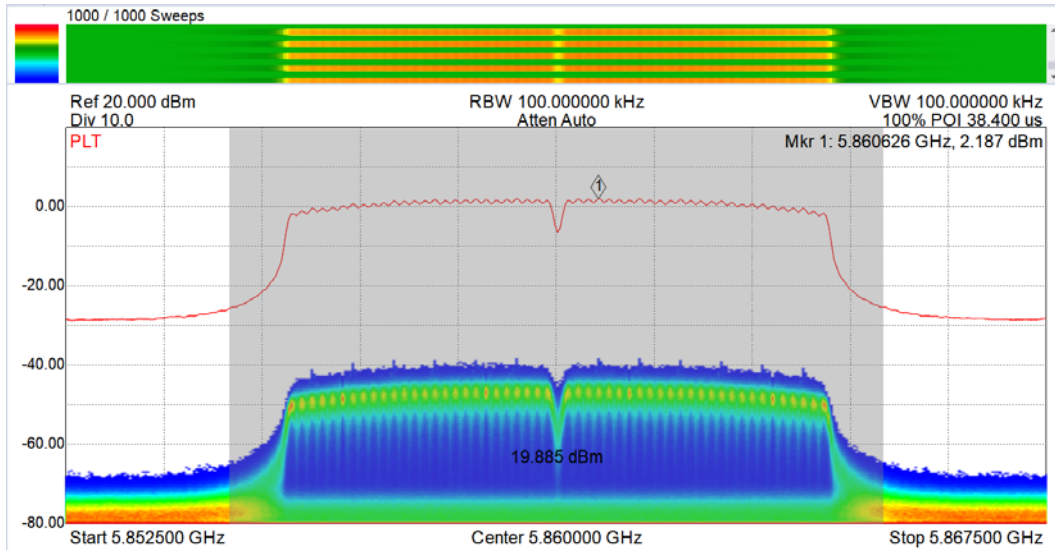
## 5. RF Performances

### a. Operation parameters for RF output

SDR1000 Module RF Operating Parameters		
Function	Transceiver	---
Frequencies (MHz)	5855 - 5920 (CH 172 - 184) (10MHz bandwidth)	5875 (20MHz bandwidth) 5905 (20MHz bandwidth)
Modulation	BPSK, QPSK, 16-QAM/64-QAM	---
Max Tx Power (dBm)	33	---
Date Rate (Mbps)	6-54	---
Operating Voltage Range (V)	Chipset: 3.14 – 3.46	Amplifier: 3.15 – 5.25
RX sensitivity (dBm)	-95	---
Operating Temperature Range	-40°C to +85°C	Humidity < 95%
Applications	DSRC/V2X/Automotive	---

### b. Mechanical Description

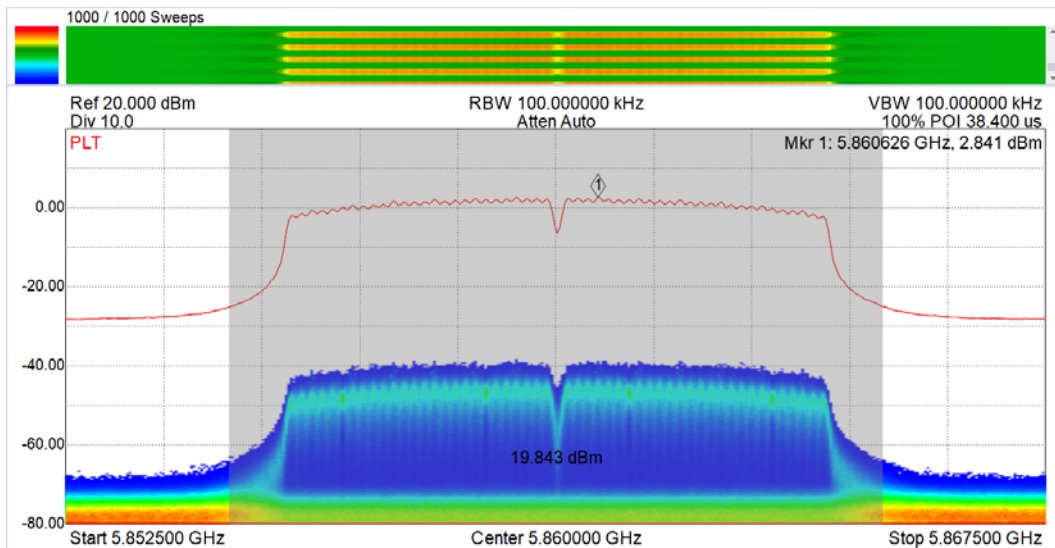
SDR1000 RF Module Mechanical Description		
Size (mm)	47.71 x 52.18	---
Shield Description	RF Shield is used over the entire RF section of the module.	This shield prevents excessive RF radiation.
Connectors (Recommended)	FAKRA type connectors	



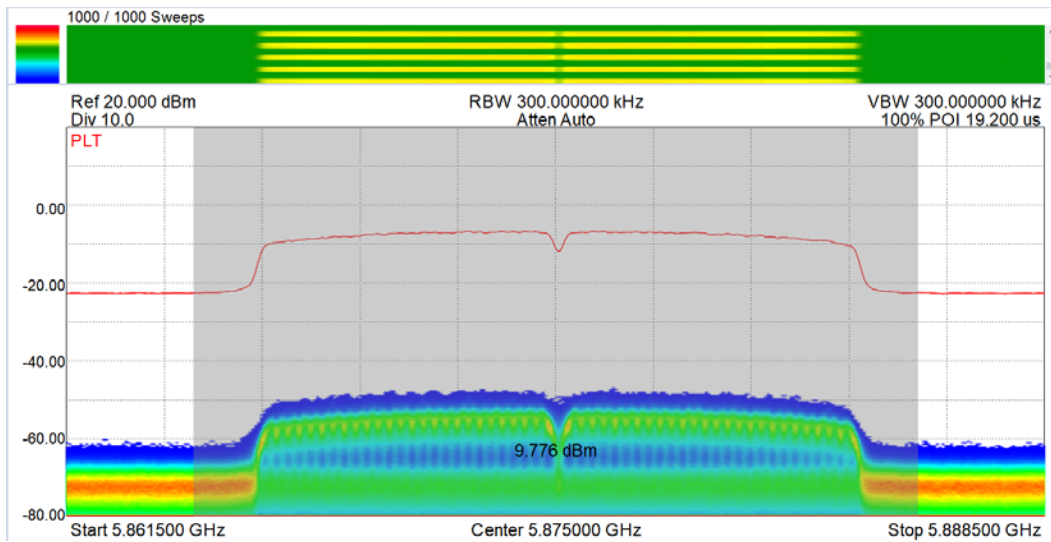
### c. Modular output

#### i. Output based on BPSK Modulation

Module Output (20dBm)	
Modulation/Data Rate (Mbps)	BPSK/6
Bandwidth (MHz)	10
Frequency (MHz) / Channel	5860/172



Module Output (20dBm)	
Modulation/Data Rate (Mbps)	BPSK/12
Bandwidth (MHz)	10
Frequency (MHz) / Channel	5860/172



Module Output (10dBm)	
Modulation/Data Rate (Mbps)	BPSK/6
Bandwidth (MHz)	20
Frequency (MHz) / Channel	5875/175

### 1.1.1. Output based on QPSK Modulation

Module Output (10dBm)	
Modulation/Data Rate (Mbps)	QPSK/12
Bandwidth (MHz)	20
Frequency (MHz) / Channel	5875/175

