



# AP2 RF Transceiver Module

## FEATURES

- 2.4GHz worldwide ISM band
- 78 selectable RF channels (2403 to 2480MHz)
- 20mm x 20mm drop-in module
- Ultra low power operation
- Simple sync/async serial interface
- Integrated F antenna
- On board 32.768 kHz crystal oscillator
- Broadcast, acknowledged, or burst data transmissions
- ANT channel combined message rate up to 190Hz (8byte data payload)
- Minimum message rate per ANT channel 0.5Hz
- Burst transfer rate up to 20Kbps (true data throughput)
- Up to 8 ANT channels
- Up to 3 public, managed and/or private network keys
- 1 Mbps RF data rate, GFSK modulation
- 1.9V to 3.6V supply voltage range
- -40°C to +85°C operating temperature
- Pin compatible with ANT AP1 and AT3 modules
- Radio regulatory approval for major markets
- RoHS compliant

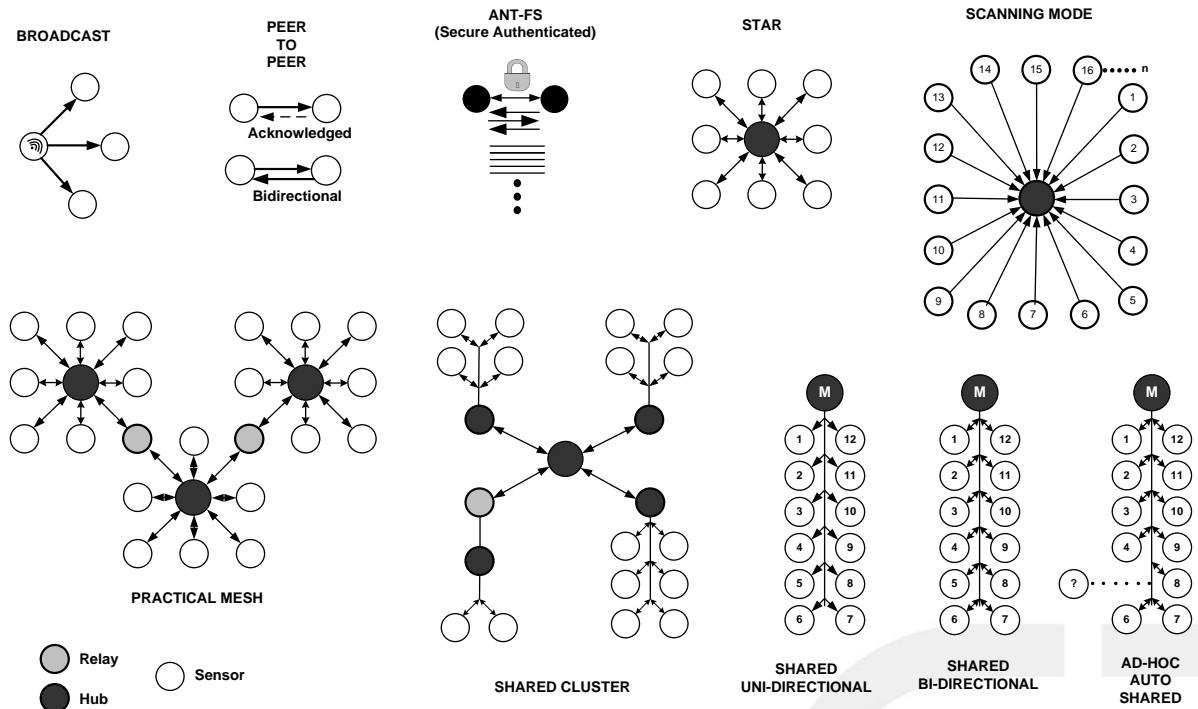


## FAMILY MEMBERS

ANTAP281M4IB – 8 ANT channels; surface mount

ANTAP281M5IB – 8 ANT channels; Molex connector

## ANT NETWORK CONFIGURATIONS



D00001266 Rev1.8

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## Notices and Restricted Use Information

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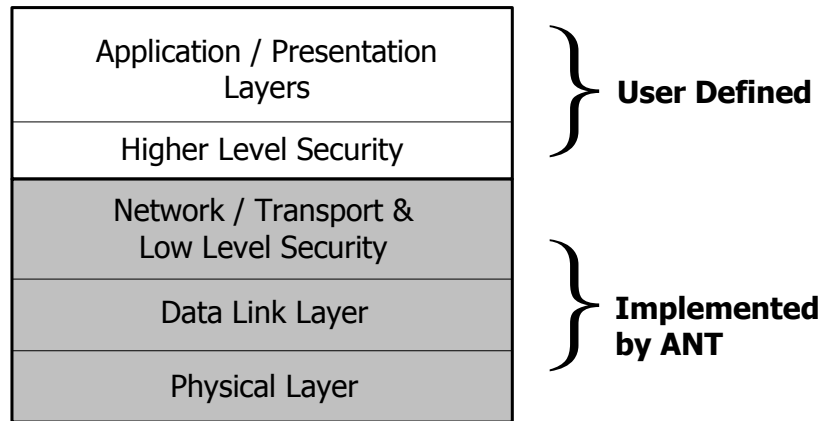
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## ANT™ Overview

ANT™ is a practical wireless sensor network protocol running on 2.4 GHz ISM band. Designed for ultra low power, ease of use, efficiency and scalability, ANT easily handles peer-to-peer, star, tree and practical mesh topologies. ANT provides reliable data communications, flexible and adaptive network operation and cross-talk immunity. The protocol stack of ANT is extremely compact, requiring minimal microcontroller resources and considerably reducing system costs.

ANT provides carefree handling of the Physical, Network, and Transport OSI layers. In addition, it incorporates key low-level security features that form the foundation for user-defined, sophisticated, network-security implementations. ANT ensures adequate user control while considerably lightening computational burden in providing a simple yet effective wireless networking solution.



ANT supports public, managed and private network architectures with  $2^{32}$  uniquely addressable devices possible, ensuring that each device can be uniquely identified from each other in the same network.

ANT is proven with an installed base of multimillion nodes in ultra low power sensor network applications in sport, fitness, home and industrial automation. The ANT solutions are available in chips, chipsets and modules to suit a wide variety of application needs.

### **Incorporated in AP2 product family are several ANT core stack enhancements:**

- Background scanning
- Continuous scanning mode
- High density node support
- Improved channel search
- Channel ID management
- Improved transmission power control
- Frequency agility
- Proximity acquisition

The complete description of ANT message protocol is found in the document "ANT Message Protocol and Usage". The serial interface details are provided in the document "Interfacing with ANT General Purpose Chipsets and Modules". Both documents are available on [www.thisisant.com](http://www.thisisant.com).

ANT+ and ANT+ Alliance

ANT+ is the open application layer on the top of the ANT stack. It standardizes communications and facilitates interoperability between a wide array of personal sports, wellness and lifestyle monitoring devices. ANT+ defines device profiles that specify access, data formats, and channel parameters.

The ANT+ Alliance is comprised of companies who have adopted the ANT+ promise of interoperability. The Alliance ensures standardized communication through optimized brand value and partnerships with other top tier companies and products.

## 1 ANT AP2 Module

The ANT AP2 module is a drop-in module based on the reference design of nRF24AP2, a new generation of ANT system on chip family from Nordic Semiconductor. An F antenna is integrated on the small-sized 20mm by 20mm board. The module has been certified to comply with radio regulation or standards covering global markets include North America, Europe, Japan and Australia. The integrated module eases the burden for application and system developers from extensive RF and antenna design, and regulatory compliance testing, allowing quicker time to market. Able to support 8 ANT channels, the module is ideal to build control or hub nodes of a wireless sensor network.

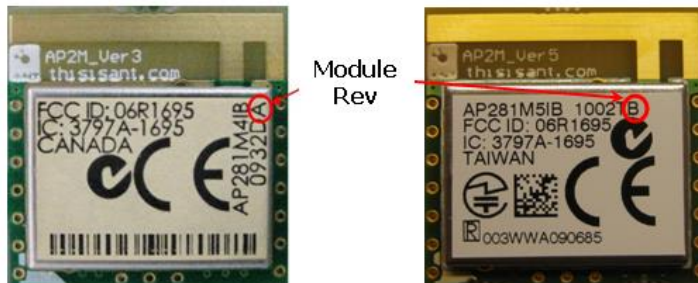
AP2 modules are currently available in the following varieties.

Module	ANT chip Used	Description	Packaging Option
ANTAP281M4IB	nRF24AP2-8CHQ32	Surface mountable, 8 ANT channels, 20x20mm, industrial temperature range	- Tray: 20 modules on a tray - Reel: 500 modules taped on a 13" reel
ANTAP281M5IB	nRF24AP2-8CHQ32	With Molex connector, 8 ANT channels, 20x20mm, industrial temperature range	

### 1.1 Module version

AP2 modules have gone through many versions to incorporate new features and correct known issues. Data consumption specification in this datasheet only applies to module version F and above. Please check the "AP2 module Revision History" for the feature upgrades, known issues with fixes or workarounds, as well as the current consumption data.

AP281MxIB module revision is identified by the last character of a 6 character tracking code as indicated on the pictures below:



### 1.2 Interface

The module may be connected to the user's host controller using the 17 pin-out assignment (surface mount) style or the 20-pin Molex header connection style provided below:

Surface Mount Pin	Molex Header Pin	Pin Name	Async Mode	Sync Mode	Description
1	6	TEST	TEST (Tie to GND)	TEST (Tie to GND)	Tie to Ground
2	10	$\overline{\text{RST}}$	$\overline{\text{RST}}$	$\overline{\text{RST}}$	Reset the device
3	1	Vcc	Vcc	Vcc	Power supply source
4	19	GND	GND	GND	Power supply ground

5	8	NC	NC	NC	No connection
6	17	$\overline{\text{SUSPEND}}$ / $\overline{\text{SRDY}}$	$\overline{\text{SUSPEND}}$	$\overline{\text{SRDY}}$	Async -> Suspend control Sync -> Serial port ready
7	15	SLEEP/ $\overline{\text{MRDY}}$	SLEEP	$\overline{\text{MRDY}}$	Async -> Sleep mode enable Sync -> Message ready indication
8	13	NC	NC	NC	No connection
9	11	PORTSEL	PORTSEL (Tie to GND)	PORTSEL (Tie to V <sub>cc</sub> )	Asynchronous or synchronous port select
10	7	BR2/SCLK	BR2	SCLK	Async -> Baud rate selection Sync -> Clock output signal
11	4	TXD0/SOUT	TXD0	SOUT	Async -> transmit data signal Sync -> Data output
12	3	RXD0/SIN	RXD0	SIN	Async -> Receive data signal Sync -> Data input
13	5	BR1/SFLOW	BR1	SFLOW	Async -> Baud rate selection Sync -> Bit or byte flow control select
14	9	BR3	BR3	Tie to GND	Async -> Baud rate selection Sync -> Not used, tie to ground
15	14	RESERVERD2	Tie to GND	Tie to GND	Reserved Pin, Tie to ground
16	12	RESERVERD1	Tie to GND	Tie to GND	Reserved Pin, Tie to ground
17	2	RTS/SEN	RTS	SEN	Async -> Request to send Sync -> Serial enable signal
	16,18,20	NC	NC	NC	No connection

The baud rate of the asynchronous communication is controlled by the speed select signals BR1, BR2 and BR3. The table below shows the relationship between the states of the speed select signals and the corresponding baud rates.

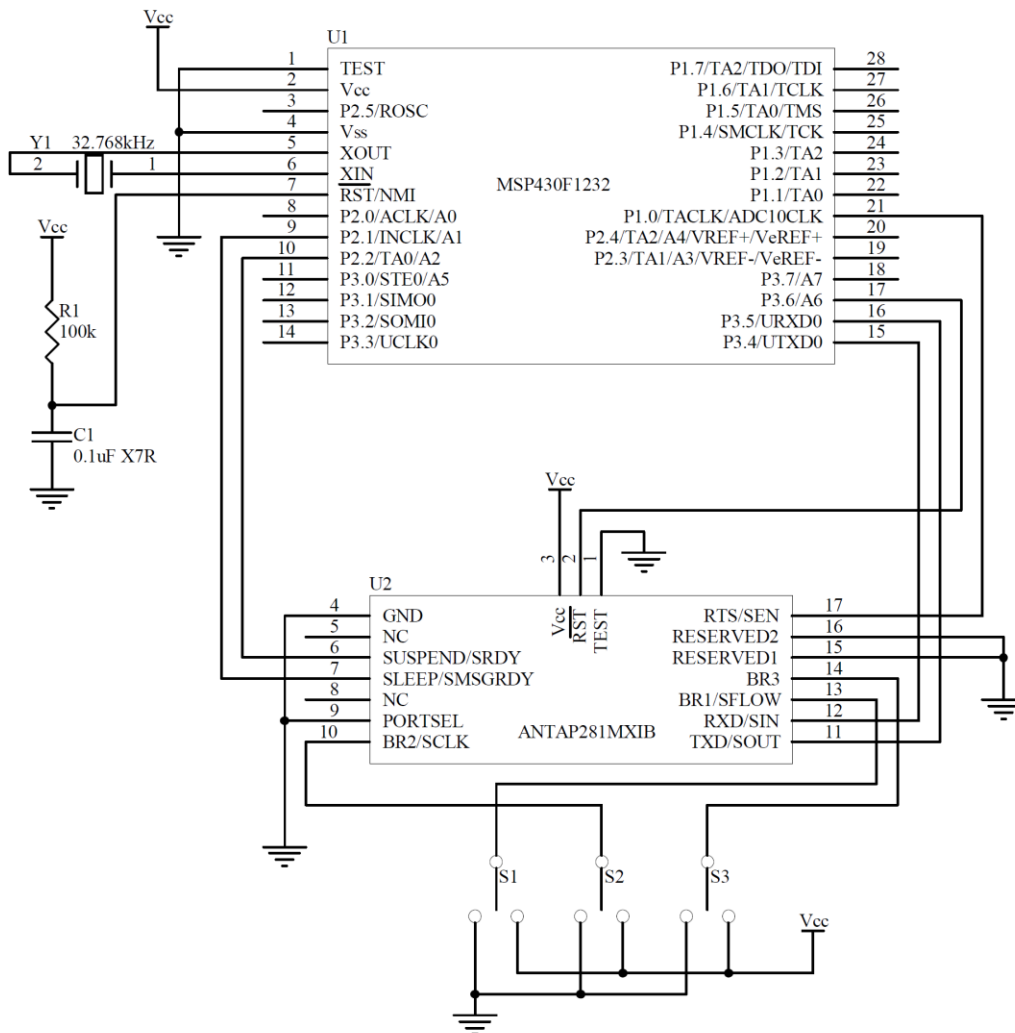
BR3	BR2	BR1	Baud Rate
0	0	0	4800
0	1	0	19200
0	0	1	38400
0	1	1	50000
1	0	0	1200

1	1	0	2400
1	0	1	9600
1	1	1	57600

### 1.3 Application MCU connection

Please refer to “Interfacing with ANT General Purpose Chipsets and Modules” and “nRF24AP2 Product Specification” section 5 “Host Interface”. The following sample designs show the proper electrical connectivity of an ANT AP2 module to an application microcontroller, using TI MSP430F1232 as example.

#### 1.3.1 Async Mode

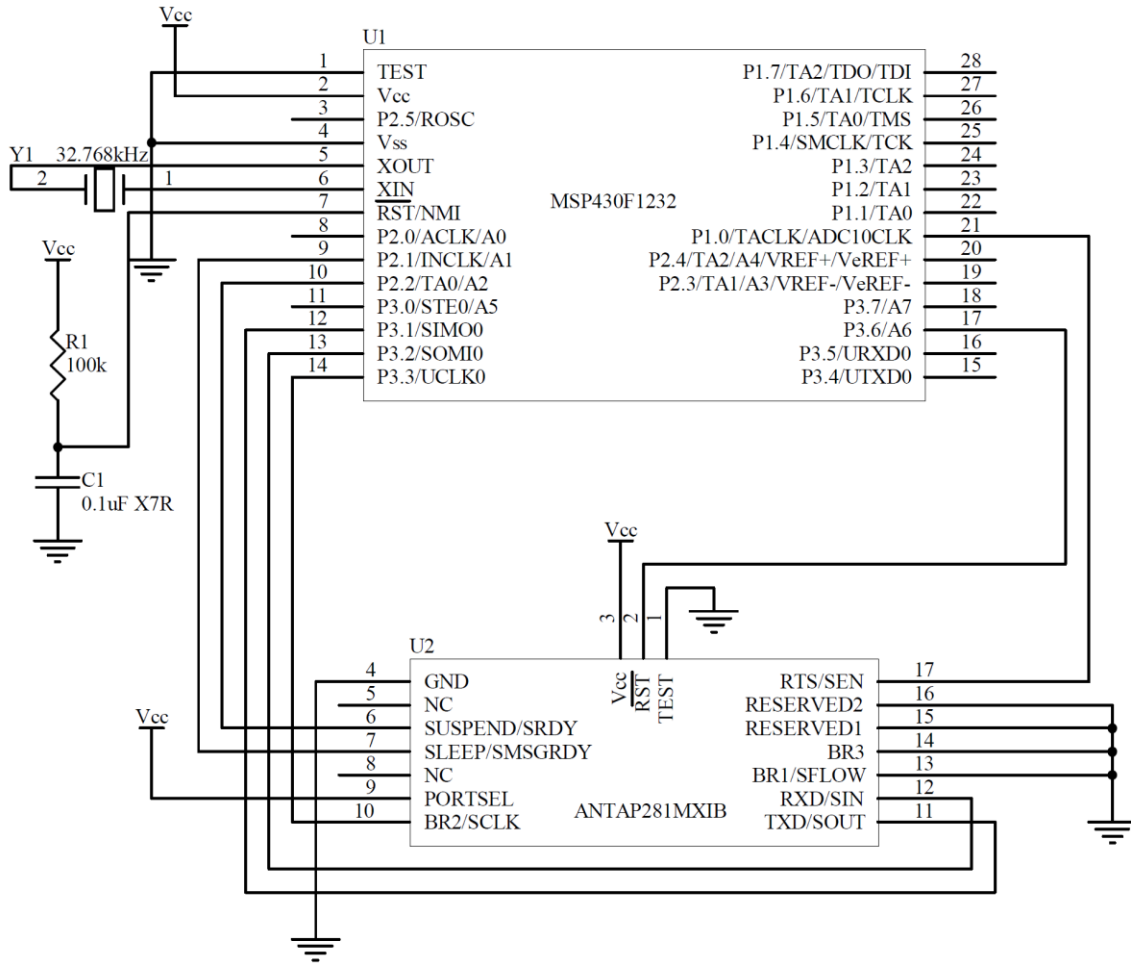


**Notes:**

- Module RXD and TXD connected directly to hardware USART of microcontroller.
- Switches on baud rate selection pins (BR1, BR2 and BR3) are for ease of use only. They can be connected directly to the logic level of interest.
- RTS can be connected to an interrupt pin for convenience in some applications. (Interrupt pins located on Port 1&2 on the MSP430F1232)



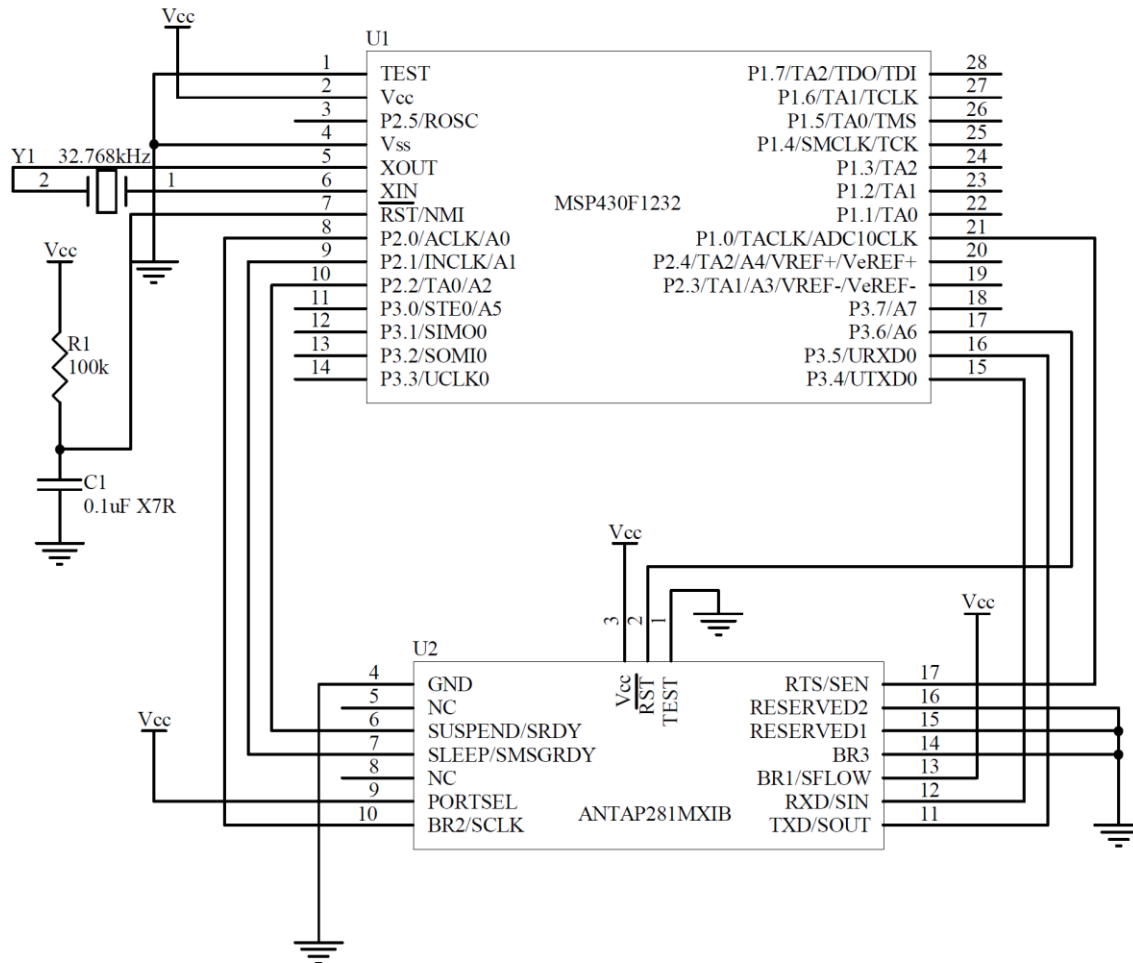
### 1.3.2 Byte Sync Mode



Notes:

- Module SOUT, SIN, and SCLK connected directly to hardware USART of microcontroller.
- SEN needs to be on an interrupt capable I/O pin on the microcontroller. (Interrupt pins located on Port 1&2 on the MSP430F1232)

### 1.3.3 Bit Sync Mode



**Notes:**

- All interface signals are connected directly to I/O pins on the microcontroller.
- SCLK and SEN need to be on an interrupt capable I/O pin on the microcontroller. (Interrupt pins located on Port 1&2 on the MSP430F1232)

### 1.4 Mounting Guideline

Refer to the recommended footprint drawing in section 4.

It is best to position the AP2 module so that the copper keepout area is on the edge or over hanging the edge of the mating PCB. If the copper keepout layer is completely within the boundaries of the PCB, the ground plane should not fully surround the copper keepout. If this is not possible, the copper keepout should be made much larger to prevent RF degradation. The ground plane is recommended to extend to the full size of the mating PCB, with the exception of the copper keepout.

To connect to M5IB type of AP2 module, the mating socket is Molex 52991-0208.

### 1.5 Reflow Guideline

AP281M4IB module is rated at moisture sensitive level 2 (MSL=2). To handle and Use these modules, please follow the standard IPC/JEDEC J-STD-033B.1, "Handling, Packing, Shipping and Use of Moisture/Reflow Sensitive Surface Mount Devices".

To reflow, it is recommended that the peak solder joint/pad temperatures NOT exceeding 240°C. If possible, pre-heat the assembly within the oven profile for ~30 seconds at ~150 °C. Follow the solder paste manufacturer's recommendations, especially regarding temperature ramp rate and the time above liquidus.

### **1.6 Pick-n-Place**

AP281M4IB module has the package option of 500 modules on a JEDEC standard 13" reel to facilitate machine pick and place. Please refer to section 4 for tape and reel dimensions.

## 2 Regulatory Approval

The ANT AP2 module has received regulatory approvals in the United States (FCC), Canada (IC), Europe (ETSI), Japan (ARIB), Australia and New Zealand. Such approvals allow the user to place the module inside a finished product and, in usual case, not require regulatory testing for an intentional radiator, provided no changes or modifications are made to the module circuitry. This does not preclude the possibility that some other form of authorization or testing may be required for the finished product. Changes or modifications could void the user's authority to operate the equipment. The end user must comply with all of the instructions provided by the Grantee, which indicate installation and/or operating conditions necessary for compliance.

### 2.1 United States

The AP2 module has been tested and found to comply with Part 15 of the FCC interference limits for Class B devices. Operation is subject to the following two (2) 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.

This equipment generates, uses and can radiate radio frequency energy and may cause harmful interference to radio communications if not installed and used in accordance with the instructions. 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 the receiver.
- Connect the equipment into an outlet that is on a different circuit from the receiver.
- Consult the dealer or an experienced radio/TV technician for help.

This product does not contain any user-serviceable parts. Unauthorized repairs or modifications could result in permanent damage to the equipment, and void your warranty and your authority to operate this device under Part 15 regulations.

The AP2 module is labeled with its own FCC ID, O6R1695 (note: First Character is the letter O, not the # 0.) If the FCC ID 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: O6R1695" or "Contains FCC ID: O6R1695". Any similar wording that expresses the same meaning may be used.

### 2.2 Industry Canada Compliance

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

(Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.)

To comply with Industry Canada regulations, it is required that product containing the AP2 module display a label referring to the enclosed module. This exterior label can use wording similar to the following: "Contains IC: 3797A-1695"

This information shall be affixed in such a manner as not to be removable except by destruction or defacement. The size of the lettering shall be legible without the aid of magnification but is not required to be larger than 8-point font size. If the device is too small to meet this condition, the information can be included in the user manual upon agreement with Industry Canada.

## 2.3 CE Declaration of Conformity

The AP2 module is declared to be in conformance with the essential requirements and other relevant provisions of Directive 73/23/EEC and 1999/5/EC, as a low-powered unlicensed transmitter:

- EN 60950-1:2006 Safety of Information Technology Equipment
- EN 300 440-2 v1.1.1 Electromagnetic compatibility and Radio spectrum Matters (ERM); Short range devices

## 2.4 Japan

The AP281M5IB module has been granted type certificate (certified number 003WWA090685) in accordance with the provisions of Article 38-24, Paragraph 1 of the Radio Law, in the classification of Article 2-1-19.

In a finished product, the RF module has to remain user-installable at any time; otherwise, such that the module is soldered on another board, the finished product will have to be re-certified.

## 2.5 Australia & New Zealand

The AP2 module has been tested and found to comply with AS/NZS 4268:2003, Radio equipment and systems – Short range devices. The ACMA/MED supplier code number is N 20233.

### 3 Electrical Specifications

Absolute Maximum Ratings	
Voltage applied at $V_{CC}$ to $V_{SS}$	-0.3V to +3.6V
Input voltage at any pin	-0.3V to $V_{CC} + 0.3V$ ; max +3.6V
Operating temperature	-40°C to +85°C
Storage temperature	-40°C to +85°C

**Note:** Stress exceeding one or more of the above maximum ratings may cause permanent damage.  
Conditions:  $V_{CC} = +3.0V$ ,  $V_{SS} = 0V$ ,  $T_A = -40^{\circ}C$  to  $+85^{\circ}C$

Symbol	Parameter (condition)	Notes	Min	Typ.	Max	Units
Operating conditions						
$V_{CC}$	Supply voltage		1.9	3.0	3.6	V
$T_A$	Operating temperature		-40		+85	°C
Digital input pin						
$V_{IH}$	HIGH level input voltage		$0.7V_{CC}$		$V_{CC}$	V
$V_{IL}$	LOW level input voltage		$V_{SS}$		$0.3V_{CC}$	V
Digital output pin						
$V_{OH}$	HIGH level output voltage ( $I_{OH}=-0.5mA$ )		$V_{CC} - 0.3$		$V_{CC}$	V
$V_{OL}$	LOW level output voltage ( $I_{OL}=0.5mA$ )		$V_{SS}$		0.3	V
General RF conditions						
$f_{OP}$	Operating frequency	1)	2403		2480	MHz
$PLL_{res}$	PLL Programming resolution			1		MHz
$f_{XTAL}$	Crystal frequency			16		MHz
$\Delta f$	Frequency deviation			$\pm 160$		kHz
$R_{GFSK}$	Air data rate in each burst on-air			1		Mbps
$F_{CHANNEL}$	Non-overlapping channel spacing			1		MHz
Transmitter operation						
$P_{RF}$	Maximum output power	2)		0	+4	dBm
$P_{RFC}$	RF power control range		16	18	20	dB
$P_{RFcr}$	RF power accuracy				$\pm 4$	dB
$P_{BW}$	20dB bandwidth for modulated carrier			950	1100	kHz

Symbol	Parameter (condition)	Notes	Min	Typ.	Max	Units
$P_{RF1.1}$	1st adjacent channel transmit power 1MHz				-20	dBc
$P_{RF2.1}$	2nd adjacent channel transmit power 2MHz				-40	dBc
Receiver operation						
$RX_{MAX}$	Maximum received signal at <0.1% BER			0		dBm
$RX_{SENS}$	Sensitivity at 0.1% BER			-85		dBm
$C/I_{CO}$	C/I co-channel			9		dBc
$C/I_{1ST}$	1st adjacent channel selectivity C/I 1MHz			8		dBc
$C/I_{2ND}$	2nd adjacent channel selectivity C/I 2MHz			-20		dBc
$C/I_{3RD}$	3rd adjacent channel selectivity C/I 3MHz			-30		dBc
Current Consumption (for rev F and above) measured at $V_{CC} = 3.0V$ , $T_A = 25^\circ C$						
$I_{DeepSleep}$	Deep sleep command			0.5		$\mu A$
$I_{Idle}$	No active channels – no communications			2.0		$\mu A$
$I_{Suspend}$	Asynchronous suspend activated			2.0		$\mu A$
$I_{Base\_32kXO}$	Base Active current (32.768 KHz crystal oscillator)	8)		3.0		$\mu A$
$I_{PeakTX}$	Peak Tx current @ 0dBm output power	3)		15		mA
$I_{PeakTX-6}$	Peak Tx current @ -6dBm output power	3)		13		mA
$I_{PeakTX-12}$	Peak Tx current @ -12dBm output power	3)		12		mA
$I_{PeakTX-18}$	Supply peak current @ -18dBm output power	3)		11		mA
$I_{PeakRx}$	Peak Rx current	4)		17		mA
$I_{Search}$	Search current			2.8		mA
$I_{Msg\_Rx\_ByteSync}$	Average current / Rx message in byte sync mode			21		$\mu A$
$I_{Msg\_Rx\_BitSync}$	Average current / Rx message in bit sync mode			30		$\mu A$
$I_{Msg\_Rx\_57600}$	Average current / Rx message in async mode at 57600 baud			22		$\mu A$
$I_{Msg\_Rx\_50000}$	Average current / Rx message in async mode at 50000 baud			25		$\mu A$
$I_{Msg\_Rx\_38400}$	Average current / Rx message in async mode at 38400 baud			31		$\mu A$
$I_{Msg\_Rx\_19200}$	Average current / Rx message in async mode at 19200 baud			40		$\mu A$
$I_{Msg\_Rx\_9600}$	Average current / Rx message in async mode at 9600 baud			65		$\mu A$

Symbol	Parameter (condition)	Notes	Min	Typ.	Max	Units
I <sub>Msg_Rx_4800</sub>	Average RF current / Rx message in async mode at 4800 baud			115		μA
I <sub>Msg_TxAck_ByteSync</sub>	Average current / Acknowledged Tx message in byte sync mode			35		μA
I <sub>Msg_TxAck_BitSync</sub>	Average current / Acknowledged Tx message in bit sync mode			48		μA
I <sub>Msg_TxAck_57600</sub>	Average current / Acknowledged Tx message in async mode at 57600 baud			54		μA
I <sub>Msg_TxAck_50000</sub>	Average current / Acknowledged Tx message in async mode at 50000 baud			52		μA
I <sub>Msg_TxAck_38400</sub>	Average current / Acknowledged Tx message in async mode at 38400 baud			58		μA
I <sub>Msg_TxAck_19200</sub>	Average current / Acknowledged Tx message in async mode at 19200 baud			72		μA
I <sub>Msg_TxAck_9600</sub>	Average current / Acknowledged Tx message in async mode at 9600 baud			112		μA
I <sub>Msg_TxAck_4800</sub>	Average current / Acknowledged Tx message in async mode at 4800 baud			192		μA
I <sub>Msg_RxAck_ByteSync</sub>	Average current / Acknowledged Rx message in byte sync mode			26		μA
I <sub>Msg_RxAck_BitSync</sub>	Average current / Acknowledged Rx message in bit sync mode			36		μA
I <sub>Msg_RxAck_57600</sub>	Average current / Acknowledged Rx message in async mode at 57600 baud			28		μA
I <sub>Msg_RxAck_50000</sub>	Average current / Acknowledged Rx message in async mode at 50000 baud			29		μA
I <sub>Msg_RxAck_38400</sub>	Average current / Acknowledged Rx message in async mode at 38400 baud			35		μA
I <sub>Msg_RxAck_19200</sub>	Average current / Acknowledged Rx message in async mode at 19200 baud			44		μA
I <sub>Msg_RxAck_9600</sub>	Average current / Acknowledged Rx message in async mode at 9600 baud			69		μA
I <sub>Msg_RxAck_4800</sub>	Average current / Acknowledged Rx message in async mode at 4800 baud			120		μA
I <sub>Msg_Tx_ByteSync</sub>	Average current / Tx-only message in byte sync mode	5)		17		μA
I <sub>Msg_Tx_BitSync</sub>	Average current / Tx-only message in bit sync mode	5)		32		μA
I <sub>Msg_Tx_57600</sub>	Average current / Tx-only message in async mode at 57600 baud	5) 6)		32		μA



Symbol	Parameter (condition)	Notes	Min	Typ.	Max	Units
$I_{Msg\_Tx\_50000}$	Average current / Tx-only message in async mode at 50000 baud	5) 6)		28		$\mu A$
$I_{Msg\_Tx\_38400}$	Average current / Tx-only message in async mode at 38400 baud	5) 6)		34		$\mu A$
$I_{Msg\_Tx\_19200}$	Average current / Tx-only message in async mode at 19200 baud	5) 6)		50		$\mu A$
$I_{Msg\_Tx\_9600}$	Average current / Tx-only message in async mode at 9600 baud	5) 6)		90		$\mu A$
$I_{Msg\_Tx\_4800}$	Average current / Tx-only message in async mode at 4800 baud	5) 6)		170		$\mu A$
$I_{Msg\_TR\_ByteSync}$	Average current / Tx message in byte sync mode			27		$\mu A$
$I_{Msg\_TR\_BitSync}$	Average current / Tx message in bit sync mode			42		$\mu A$
$I_{Msg\_TR\_57600}$	Average current / Tx message in async mode at 57600 baud	6)		42		$\mu A$
$I_{Msg\_TR\_50000}$	Average current / Tx message in async mode at 50000 baud	6)		40		$\mu A$
$I_{Msg\_TR\_38400}$	Average current / Tx message in async mode at 38400 baud	6)		45		$\mu A$
$I_{Msg\_TR\_19200}$	Average current / Tx message in async mode at 19200 baud	6)		60		$\mu A$
$I_{Msg\_TR\_9600}$	Average current / Tx message in async mode at 9600 baud	6)		100		$\mu A$
$I_{Msg\_TR\_4800}$	Average current / Tx message in async mode at 4800 baud	6)		180		$\mu A$
$I_{Ave}$	Broadcast Tx-only @ 0.5Hz in byte sync mode	5) 7)		14		$\mu A$
$I_{Ave}$	Broadcast Tx-only @ 2Hz in byte sync mode	5) 7)		54		$\mu A$
$I_{Ave}$	Broadcast Rx @ 0.5Hz in byte sync mode	7)		11		$\mu A$
$I_{Ave}$	Broadcast Rx @ 2Hz in byte sync mode	7)		42		$\mu A$
$I_{Ave}$	Acknowledged Tx @ 0.5Hz in byte sync mode	7)		18		$\mu A$
$I_{Ave}$	Acknowledged Tx @ 2Hz in byte sync mode	7)		70		$\mu A$
$I_{Ave}$	Acknowledged Rx @ 0.5Hz in byte sync mode	7)		13		$\mu A$
$I_{Ave}$	Acknowledged Rx @ 2Hz in byte sync mode	7)		52		$\mu A$
$I_{Ave}$	Burst continuous @ 20kbps in byte sync mode	7) 8)		5.9		mA
$I_{Ave}$	Burst continuous @ 7.5kbps in bit sync mode	7) 8)		6.1		mA

Symbol	Parameter (condition)	Notes	Min	Typ.	Max	Units
I <sub>Ave</sub>	Burst continuous @ 20kbps in async mode at 57600 baud	7) 8)		6.3		mA
I <sub>Ave</sub>	Burst continuous @ 20kbps in async mode at 50000 baud	7) 8)		5.9		mA
I <sub>Ave</sub>	Burst continuous @ 13.8kbps in async mode at 38400 baud	7) 8)		5.7		mA

- 1) Usable band is determined by local regulations
- 2) Maximum output power with 0dBm output power setting. Antenna load impedance = 15Ω +j88Ω
- 3) Time of maximum Tx only current is typical 300μs and maximum 350μs
- 4) Time of maximum current consumption in RX is typical 500μs and maximum 1ms
- 5) Transmit only operation provides no ANT channel management across the air channel and is not recommended for normal operation
- 6) Asynchronous serial messages contained two 0 pad bytes, thereby adding to the average current. Values will be lower without the use of 0 pad bytes
- 7) Does not include base current. See current calculation examples below
- 8) Value calculated assuming the onboard 32.768 kHz crystal oscillator is enabled. The ANT\_CrystalEnable() message must be used to enable this clock source.
- 9) The current consumption data is for module Rev F and above. For the specification of other revisions, please refer to the AP2 module errata

#### Example Current Calculations:

1. Transmit channel with Broadcast data at 4Hz with a bit synchronous serial interface and onboard source of 32.768kHz clock.

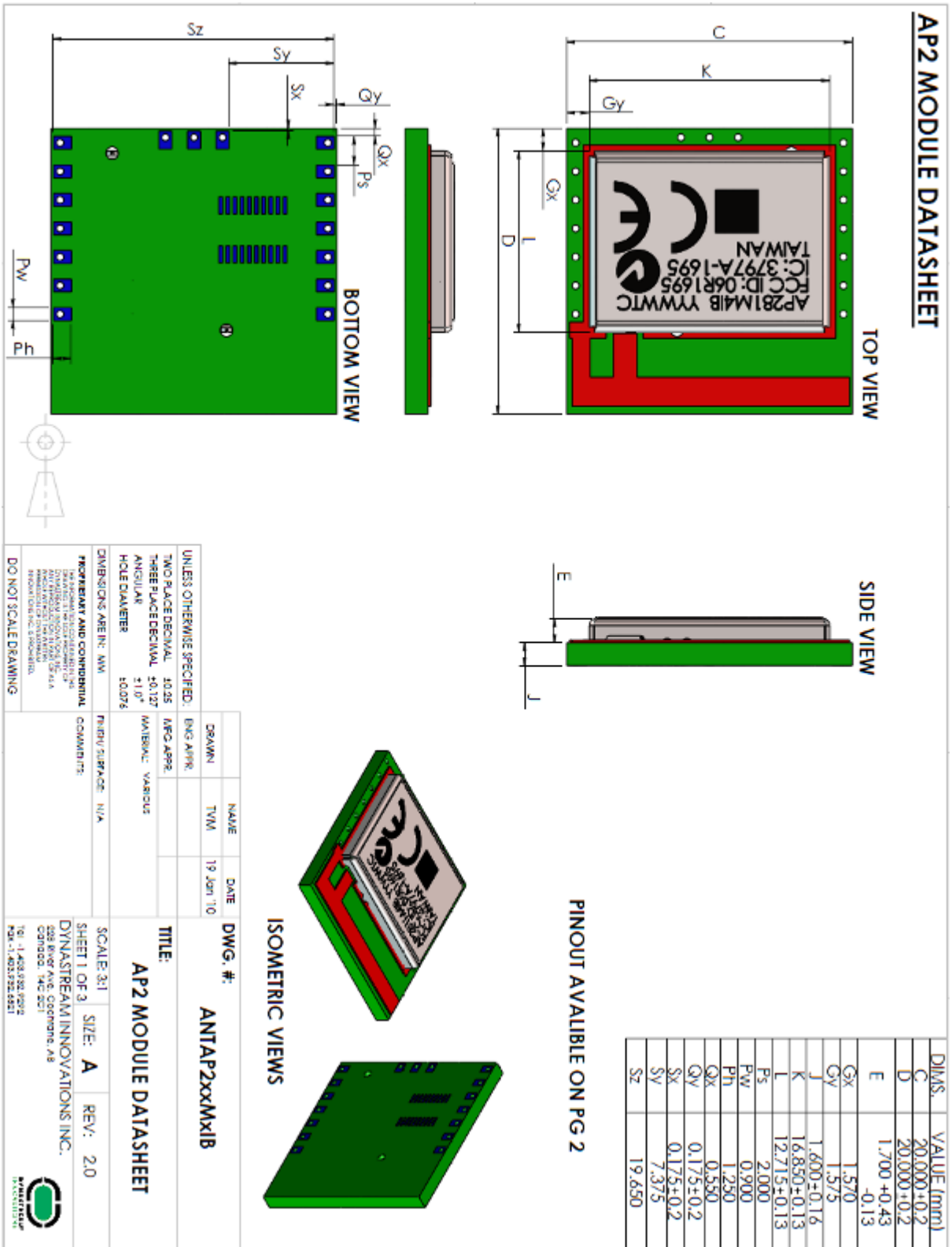
$$\begin{aligned}
 I_{ave} &= (I_{Msg\_TR\_BitSync} * Message\_Rate) + I_{Base\_32KXO} \\
 &= (36\mu A/message * 4messages) + 3.0 \mu A \\
 &= 147 \mu A
 \end{aligned}$$

2. Receive channel with Acknowledged data at 2Hz with an asynchronous serial interface at 57600 baud and onboard source of 32.768kHz clock.

$$\begin{aligned}
 I_{ave} &= (I_{Msg\_Ack\_Rx\_57600} * Message\_Rate) + I_{Base\_32kXO} \\
 &= (22 \mu A/message * 2messages) + 3.0 \mu A \\
 &= 47 \mu A
 \end{aligned}$$

An online power consumption estimator is provided here: <http://www.thisisant.com/calculator>

### 4 Mechanical Drawings

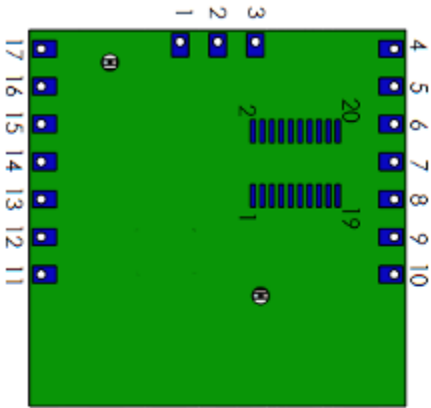




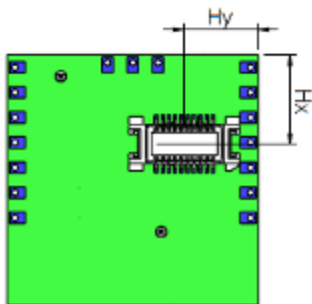
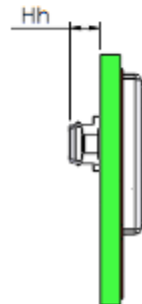
NOTES:

1. AVOID PLACING METAL COMPONENTS NEAR THE PRINTED ANTENNA OF THE AP2. HAVING METAL OBJECTS / LARGE GROUND PLANES IN THIS AREA CAN REDUCE THE RF PERFORMANCE
2. AP2 DEVELOPMENT MODULES COME WITH A STANDARD MOLEX HEADER
  - AP2 MALE HEADER IS MOLEX P/N 537480208
  - MATING FEMALE HEADER IS MOLEX P/N 529910208
  - ANGLED FEATURE ON HEADER DOES NOT VISUALLY REPRESENT PIN 1. FOLLOW PINOUT BELOW FOR PIN NUMBERING AND ORIENTATION
3. FOR ANIAP2xxMxIB, THE LAST X VALUE REPRESENTS THE PLACEMENT OF OPTIONAL HEADER:
  - ANIAP2xxM4IB - SMT VERSION OF MODULE
  - ANIAP2xxM5IB - VERSION WITH MOLEX HEADER

**ANIAP2xxMxIB PINOUT (BOTTOM VIEW)**



DIMS.	VALUE (mm)
Hh	2.435
Hx	7.102
Hy	5.878



ANIAP2xxM5IB



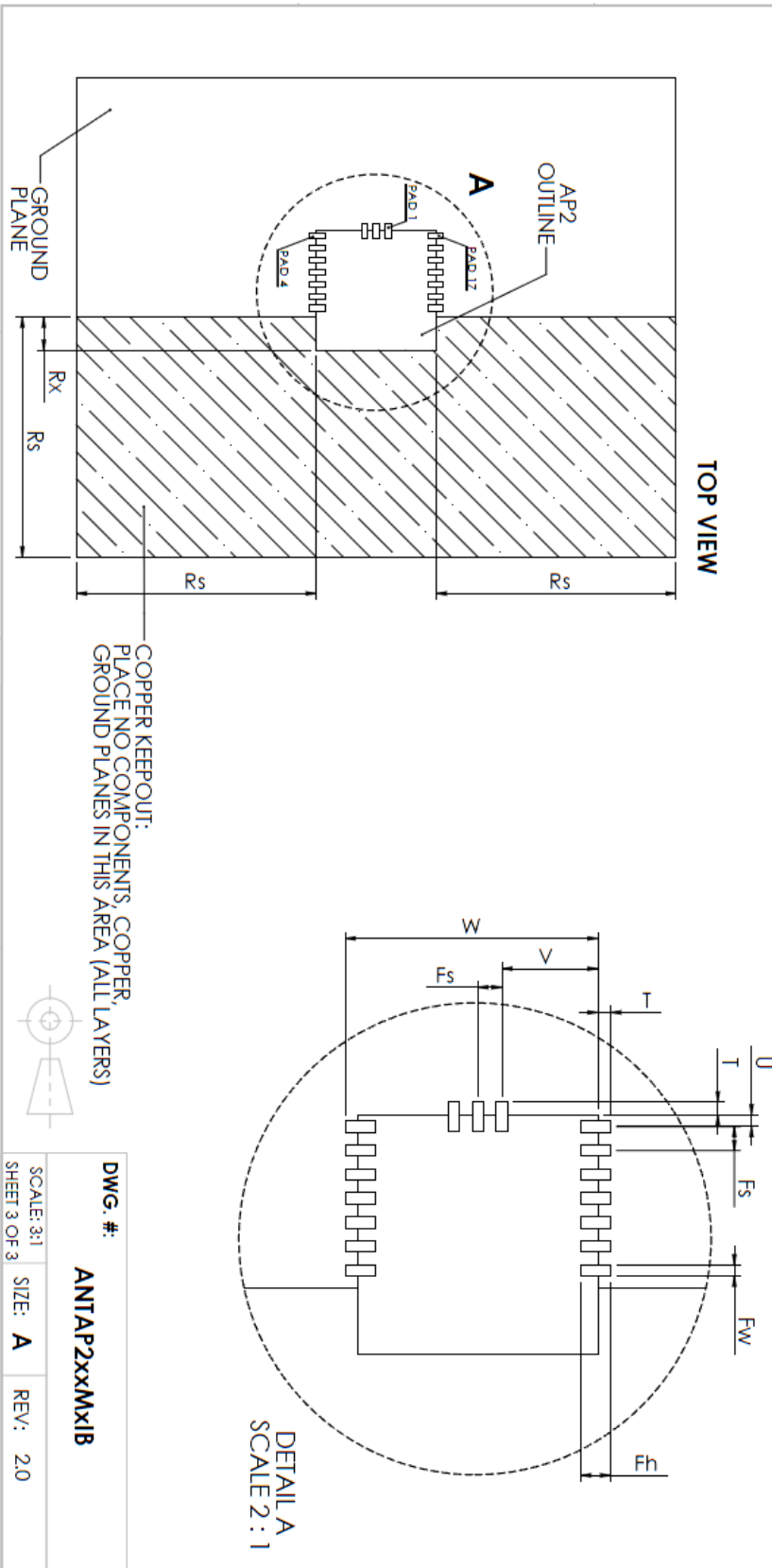
DWG. #:	ANIAP2xxMxIB		
SCALE: 2:1	SIZE: A	REV: 2.0	
SHEET 2 OF 3			

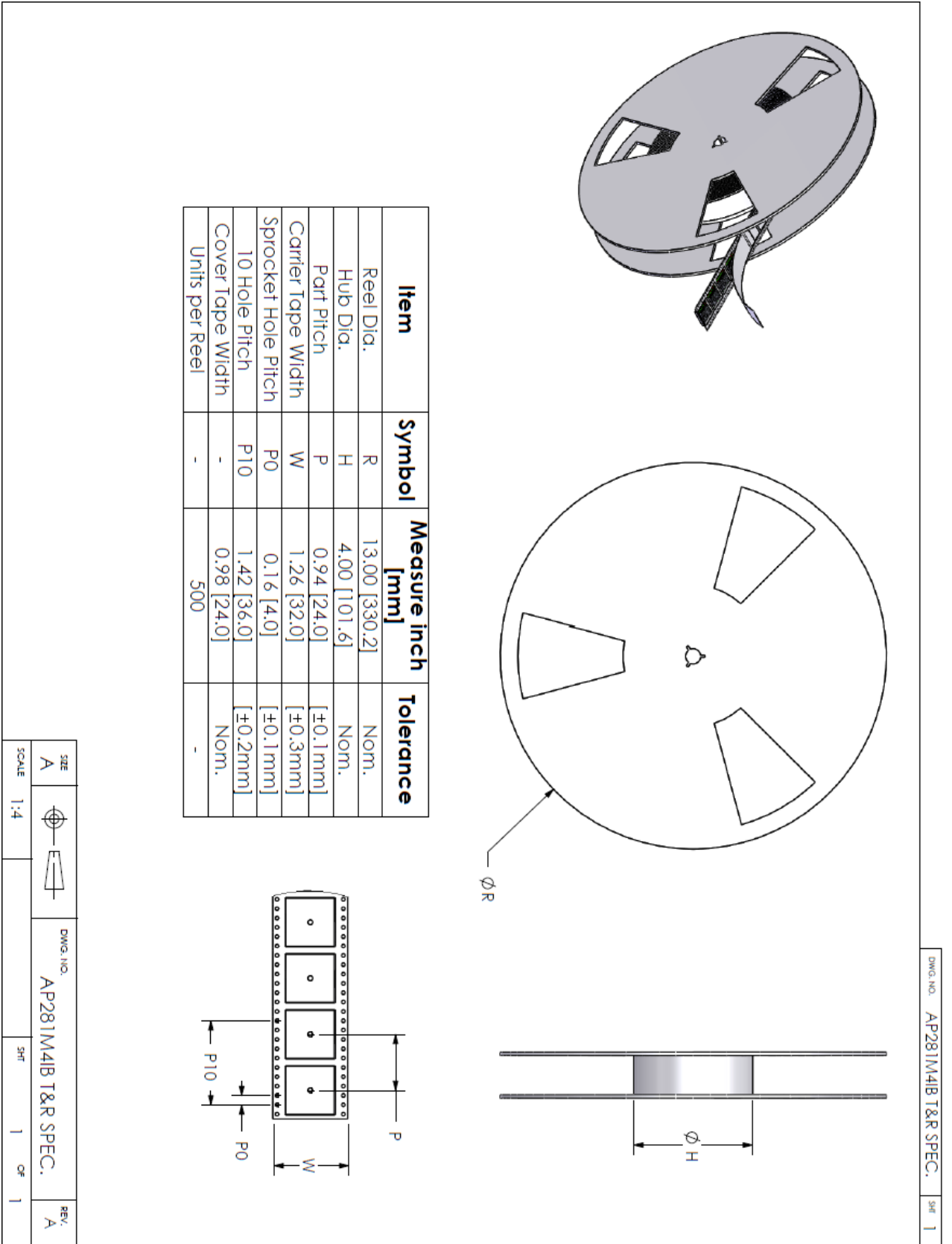
**RECOMMENDED SURFACE MOUNT FOOTPRINT FOR MATING AP2xxM4IB**

**MATING PCB NOTES:**

1. THE GROUND PLANE SHOULD BE EXTENDED TO THE FULL SIZE OF THE MATING PCB, WITH THE EXCEPTION OF THE COPPER KEEPCUT.
2. IT IS BEST TO POSITION THE AP2 SO THAT THE COPPER KEEPCUT IS ON THE EDGE OR OVER HANGING THE EDGE OF THE MATING PCB. IF THE COPPER KEEPCUT LAYER IS COMPLETELY WITHIN THE BOUNDARIES OF THE PCB, THE GROUND PLANE SHOULD NOT FULLY SURROUND THE COPPER KEEPCUT. IF THIS IS NOT POSSIBLE, THE COPPER KEEPCUT SHOULD BE MADE MUCH LARGER TO PREVENT RF DEGRADATION.
3. WHEN DETERMINING THE REQUIRED FOOTPRINT FOR FEMALE HEADER (MOLEX P/PN 529910208), USE THE SUGGESTED FOOTPRINT PROVIDED BY THE COMPONENT MANUFACTURER.

DIMS.	VALUE (mm)
Rs	40,000 min
Rx	5,500
T	1,070
U	1,000
V	8,000
W	21,070
Fw	0,950
Fh	2,500
Fs	2,000





DWG. NO. AP281M4IB T&R SPEC. SH# 1

SIZE A  
SCALE 1:4  
DWG. NO. AP281M4IB T&R SPEC.  
SH# 1 OF 1  
REV. A

## 5 Technical Support

The AP2 module takes the reference design of nRF24AP2 from Nordic Semiconductor. Users can seek technical support, esp. about hardware, from Nordic Semiconductor, [www.nordicsemi.no](http://www.nordicsemi.no). Users can also seek application support from Dynastream Innovations, [www.thisisant.com](http://www.thisisant.com).

### 5.1 ANT Forum

Users are encouraged to participate in the ANT forum moderated by the application engineering team of Dynastream Innovations for any engineering discussions. Joining the ANT forum is free and open at [www.thisisant.com/antforum](http://www.thisisant.com/antforum)

### 5.2 Public Technical References

Documents:

1. AP2 RF Transceiver Module Revision History, Dynastream Innovations
2. nRF24AP2 Product Specification, Nordic semiconductor
3. Product Anomaly Notification (PAN-014), Nordic Semiconductor
4. Product Anomaly Notification (PAN-022), Nordic Semiconductor
5. ANT Message Protocol and Usage, Dynastream Innovations
6. Interfacing with ANT General Purpose Chipsets and Modules, Dynastream Innovations

The above documents are available at [www.dynastream.com](http://www.dynastream.com), [www.thisisant.com](http://www.thisisant.com) or [www.nordicsemi.no](http://www.nordicsemi.no)

### 5.3 ANT Developer's Zone and ANT+ Adopter Zone

ANT development software tools, application notes, reference designs and other public resources are found in the ANT developer's zone at <http://www.thisisant.com/pages/support/developer-zone>.

To begin development with the ANT+ interoperability, please become an ANT+ Adopter or ANT+ Alliance member to obtain the access to the ANT+ Adopter Zone. ANT+ documents and design tools contained in the ANT+ Adopter zone include the ANT+ Device Profiles, ANT-FS specification, ANT software (PC/Mac) libraries with source codes, and embedded reference designs with source codes.

### 5.4 ANT Social Networks

ANT is on the following social networks,

YouTube: <http://www.youtube.com/user/ANTAlliance>

Twitter: <http://twitter.com/ANTPlus>

LinkedIn: <http://www.linkedin.com/groups?gid=1379137>