DYNASTREAM® INNOVATIONS

Revision History - AP2 RF Transceiver Module

D00001363 Rev1.5

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Table of Contents

This document presents the revision history of AP2 module family, consisting of ANTAP281M4IB and ANTAP281M5IB. It describes the known exceptions to the datasheet and the corresponding workarounds and fixes or enhancements.

The table below lists all the AP2 module revisions and their respective known issues and upgrades. For the details of each upgrade or issue, please refer to the corresponding section. Power consumption specifications have been updated along with the module revision. The table indicates the locations of the correct specification.

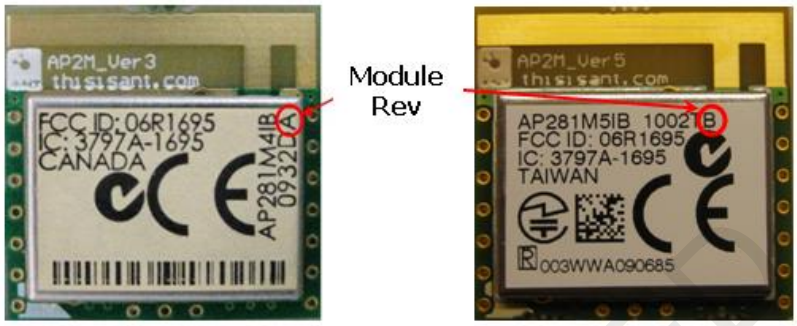
Issues/Upgrades \ Module Rev	H	G	F	E	D	C	B	A	4
2.1 Uplink Communication Failure in Slave Channel		x	x	x	x	x	x	x	x
2.2 Suspend Does Not Enter Low Power Mode		x	x	x	x	x	x	x	x
2.3 Fail to Reset and Return to IDLE State from DEEP SLEEP		x	x				x	x	x
2.4 Suspend Operation Hanging Communication Issue		x	x	x	x	x	x	x	x
2.5 Include-Exclude List Issue		x	x	x	x	x	x	x	x
2.6 Proximity Search Issue When Multiple Active Search Channels			x	x	x	x	x	x	x
2.7 Upgrade: Search Priority Setting	x	x							
2.8 Upgrade: Wild Cards in Inclusion/Exclusion List	x	x							
2.9 Slow Start-Up and Failure of Synchronous Reset Issue				x	x	x			
2.10 Floating 32KHz Crystal Inputs Issue					x	x			
2.11 Missing Background Scanning Channel Issue						x			
2.12 ANT Receiver Default Setting Issue						x			
2.13 Supply Voltage Issue							x	x	x
2.14 Slave Channel Unable to Transmit Issue								x	x
2.15 Asynchronous Serial Mode Issue								x	x
Power consumption specification as in the datasheet	x	x	x						
Power consumption specification as in the appendix				x	x	x	x	x	x

1. Module Revision

The module revision can be identified using one of two simple approaches, as outlined below.

1.1 Product Sticker

AP281MxIB module revisions are visually identified by the last character of a 6 character tracking code as illustrated:



Note: Revision 4 modules do not have RF regulatory approval markers, but a plain sticker with product name and the 6-character tracking code.

1.2 Firmware Version

In the case that the module sticker is difficult to access, or the module tracking code is unclear, an ANT Version Command (0x3E) may be issued through the module serial communication to acquire the version string. For more information on using the ANT Version Command, refer to “ANT Message Protocol and Usage”.

The table below shows the correlation between the module revision and the firmware version.

AP2 Module Rev	Firmware Version String
H	AP2-8 1.09
G	AP2-8 1.07
F	AP2-8 1.06
E	AP2-8 1.06XO
D	AP2-8 1.05XO
C	AP2-8 1.04XO
B	AP2-8 1.02
A	AP2-8 1.01
4	AP2-8 1.01

2. Known Issues and Upgrades

This section describes the identified issues and upgrades. Each issue is described in a common format including symptoms, conditions, consequences and workaround. The most recent is described first.

2.1 Uplink Communication Failure on Slave Channel

Module revisions 4, A, B, C, D, E, F and G are affected. This issue has been resolved in module revision H and above.

Symptoms: Sending data from a slave device does not work. A TRANSFER_IN_PROGRESS error code (0x1F) is returned when attempting to send data.
Conditions: If an acknowledged message is pending on a slave channel when the channel is closed, then the channel will not be able to send new data and will continue reporting TRANSFER_IN_PROGRESS. Typical occurrences would be sending an acknowledged message while the device is in SEARCHING state and then having the search timeout. Burst messages do not cause this condition as they are not permitted to be queued when a channel is not in TRACKING state.
Consequences: After the condition described above is reached, the pending acknowledged message is stuck in the buffer and is not sent, even when a connection is re-established with a master device. This prevents any other messages (Broadcast, Acknowledged, or Burst) to be rejected with a TRANSFER_IN_PROGRESS error code.
Workarounds: Un-assigning and re-assigning the affected channel will clear the pending message, allowing normal operation to resume. Sending an acknowledged message should not be attempted when a slave channel is not in TRACKING state. In new versions, attempting to send an acknowledged message when the channel is in ASSIGNED state is rejected. Messages sent while the channel is SEARCHING are flushed when the channel closes.

2.2 Suspend Does Not Enter Low Power Mode

Module revisions 4, A, B, C, D, E, F and G are affected. This issue has been resolved in module revision H and above. The issue is described in the Product Anomaly Notice of nRF24AP2 (PAN-022) v2.0 from Nordic Semiconductor. The relevant content is copied here.

Symptoms: Suspend does not enter low power mode when SUSPEND line is held low and SLEEP is high, instead the active current is drawn. Low power mode is entered when SUSPEND returns to high, provided SLEEP is still high.
Conditions: All
Consequences:

Active current draw when a low power mode is expected.
Workarounds: Pulse SUSPEND line low instead of holding it low. Device will still reset all ANT channels and will then draw the expected low current.

2.3 Fail to Reset and Return to IDLE State from DEEP SLEEP

Module revisions 4, A, B, F and G are affected. This issue has been resolved in module revision H and above. The issue is described in the Product Anomaly Notice of nRF24AP2 (PAN-022) v2.0 from Nordic Semiconductor. The relevant content is copied here.

Symptoms: The module fails to reset and return to IDLE state from DEEP SLEEP. The DEEP SLEEP state may be entered into by sending the SLEEP serial message (0xC5) followed by the assertion of the SLEEP signal.
Conditions: Not all devices are affected by this anomaly. Testing indicates that between 10 to 30% are affected and if it is affected the anomaly have no dependence on external conditions like supply voltage or temperature. Even if the device is affected it may reset and return to IDLE state from DEEP SLEEP, but sooner or later it will fail.
Consequences: The module that fail to reset and return to IDLE state from DEEP SLEEP will remain in the low power state until reset by reset pin or power on reset.
Workarounds: There are two possible workarounds: 1. Use IDLE state (SLEEP and SUSPEND) instead of DEEP SLEEP state. The consequence of this workaround is an increase in power consumption of 1.5uA in low power state. 2. If DEEP SLEEP state is used, the host MCU must reset the module by using reset pin or power on reset to return to IDLE state.

2.4 Suspend Operation Hanging Communication Issue

Module revisions 4, A, B, C, D, E, F and G are affected. This issue has been resolved in module revision H and above.

Symptoms: In asynchronous serial mode, the SUSPEND operation may cause the module to fail either RF communication or serial communication. After exiting SUSPEND state, the module does not transmit or receive RF messages even though serial communication is still functional or the module does not transmit or receive serial messages.
Conditions: The module is using asynchronous serial communication and exits from SUSPEND mode

Consequences: The module cannot communicate with other ANT devices or the serial communication fails
Workarounds: There are two workarounds that cover both cases: 1. Reset device with RESET pin after exiting SUSPEND mode 2. Using the Reset command or RESET pin in place of SUSPEND will have the same effect but avoid the possibility of entering into the unresponsive state

2.5 Include-Exclude List Issue

Module revisions 4, A, B, C, D, E, F and G are affected. This issue has been resolved in module revision H and above.

Symptoms: Use of Include/Exclude list with certain multiple searching channel configurations can result in an inability to acquire devices on some of the searching channels. Devices may not be able to acquire master channel(s) as expected when a lower numbered channel is using an Include/Exclude list.
Conditions: If multiple actively searching channels can match the ID of a device, the lowest numbered channel with inclusion/exclusion enabled will override the expected search behaviours of the higher numbered channels and have its inclusion/exclusion list applied to the higher numbered channels. Example 1: Device A: Ch0 and Ch1 are both searching with channel IDs set to 0, 1, 1. Ch0 has an exclusion list with 33, 1, 1 set. Device B: Master with channel ID 33, 1, 1. In this scenario, Device A, Ch1 would be expected to acquire the Master channel from Device B. However, since the channel ID of Ch0 also matches the Master channel ID, the exclusion list of Ch0 is applied and the Master channel is not acquired by either searching channel. This will persist as long as Ch0 is in search mode. Example 2: Device A: Ch0 and Ch1 are both searching with channel IDs set to 0, 1, 1. Ch0 has an inclusion list without 33, 1, 1 set. Device B: Master with channel ID 33, 1, 1. In this scenario, Device A, Ch1 would be expected to acquire the Master channel from Device B. However, since the channel ID of Ch0 also matches the Master channel ID, the inclusion list of Ch0 is applied and the Master channel is not acquired by either searching channel. This will persist as long as Ch0 is in search mode.
Consequences: Device cannot be acquired when it should be.

Workarounds:
Avoid the aforementioned conditions, such as Choosing exclusive channel ID mask for search channels Do not open multiple search channels using exclusion/inclusion lists at the same time. In situations where inclusion/exclusion is only required on a single channel set it as the highest numbered channel.

2.6 Proximity Search Issue When Multiple Active Search Channels

Module revisions 4, A, B, C, D, E and F are affected. This issue has been resolved in module revision G and above.

Symptoms:
The proximity requirement of a searching channel may effectively be voided if another channel search was activated first.
Conditions:
A channel with a proximity requirement begins searching after another channel with the same RF channel and network key had began searching, and is still actively searching.
Consequences:
Any active search may find and cause synchronization to a device specified by another pending channel search, provided that the RF channels and network keys are the same. If a pending channel search has a proximity requirement, it will be ignored by the active channel search, potentially resulting in the acquisition of a device outside of the intended proximity bin threshold.
Workarounds:
To avoid this situation it is recommended that proximity searches be done autonomously, without any other active or pending channel searches.

2.7 Upgrade: Search Priority Setting

The upgrade to the search priority feature applies to module revision G and above.

This upgrade allows more control over multiple channel searches, such that users are able to set search priority levels on each channel. If multiple channels are in search mode simultaneously, the channel that was given the highest priority will be set as the ‘main searching’ channel. This feature is particularly useful when attempting to manage multiple channels on different networks, RF frequencies or with different proximity search settings.

For details on the channel search priority command, please refer to the “ANT Message Protocol and Usage” document.

2.8 Upgrade: Wild Cards in Inclusion/Exclusion List

This upgrade refers to module revision G and above.

This upgrade allows the use of wild card values in channel IDs that are added to inclusion/exclusion lists. This feature is particularly useful when trying to manage multiple device types during pairing.

For more details on the Inclusion /Exclusion list command, please refer to the “ANT Message Protocol and Usage” document.

2.9 Slow Start-Up and Failure of Synchronous Reset Issue

Module revisions C, D and E are affected. In these revisions, the module start up time is increased significantly. The module I/O interrupts also have longer latency to register comparing to other versions of the AP2 module and other ANT modules. This affects synchronous reset and can potentially slow synchronous serial communication rates. There is no impact to asynchronous serial communication

Symptoms: Module exhibits longer initialization time and longer I/O interrupt response times. Module may not respond to a Synchronous Reset condition.
Conditions: AP2 module version C, D and E using synchronous serial communication.
Consequences: The module takes about 500 milliseconds longer to initialize. Synchronous Reset timing is changed. Synchronous communication rates may be slowed.
Workarounds: Prolong any timeouts relating to initialization time. Increase the duration between SRDY and MRDY transitions (t_{SYNC_RESET}) for Synchronous Reset to be ~2 ms instead of ~250 us.

2.10 Floating 32KHz Crystal Inputs Issue

Module revisions C and D are affected. This issue has been resolved in module revision E and above.

Symptoms: Module exhibits momentary increased power consumption, which becomes larger with increased voltage and reduced temperature. This excess current can be anywhere from 1-500 uA, predominately depending on the voltage, and can last for upwards of 300 seconds predominately depending on the temperature.
Conditions: This behaviour occurs with higher voltages and lower temperatures. Supply voltages below 2.8 V do not exhibit this behaviour at all across the operational temperature range (85°C to -40°C). Temperatures above 0°C settle to the correct current consumption in less than 30 seconds for 3.3 V and below.
Consequences: Module draws more static current than specification but otherwise performs normally.
Workarounds: Providing supply voltage below 2.8 V eliminates this problem. Operating at higher temperatures reduces the time of higher current consumption

2.11 Missing Background Scanning Channel Issue

Module revision C is affected. This issue has been resolved in module revision D and above.

Symptoms: Background scanning channel is not supported. If a channel is opened as a background scanning channel, it will perform as a normal receive channel.
Conditions: Any Revision C module.
Consequences: Background scanning channel does not perform as expected and behaves as a normal receive/slave channel.
Workarounds: None. Designs that require Background Scanning must use revision D and above.

2.12 ANT Receiver Default Setting Issue

Module revision C is affected. This issue has been resolved in module revision D and above. A simple workaround can also be implemented on the host controller.

Symptoms: An uninitialized setting in the radio causes reduced receiver performance. Shorter communication range may be observed.
Conditions: Any time when a channel is assigned, this incorrect default setting is applied.
Consequences: Lower than expected receive performance may be observed.
Workarounds: Re-configure any channel being used with the following message after assigning a channel [A4][02][6A][XX][57][9B] The following response should be observed: [A4][03][40][XX][6A][00][8D] XX is the hex value of the channel number being used. The checksums in the above sample messages ([9B] and [8D] respectively) are for an XX value of 00. This fix will not require removal once corrected parts are available, as this command will simply become redundant.

2.13 Supply Voltage Issue

Module revisions 4, A and B are affected. The issue has been resolved at the module level in revisions C, D and E, and at the semiconductor level in module revisions F and above. The issue is described in the product anomaly notice of nRF24AP2 PAN-022 v1.0 and v2.0 from Nordic Semiconductor. The relevant content is copied below.

Symptoms: Within a narrow supply voltage window, channels between devices may become difficult or impossible to maintain as one device’s timing becomes seriously affected, resulting in sporadic transmission or reception of data packets. It may be difficult or impossible to establish or maintain a stable link between the affected device and another. Searches and possibly search timeouts are expected to appear on the slave side of the link.
Conditions: The symptoms may be visible for a supply voltage window of 10mV to 50mV which will vary in size and position between 2.5 to 3.6V from device to device and operating temperature.
Consequences: These modules are not recommended for volume production in applications where the supply voltage can be in the 2.5 to 3.6V window, for example when the device is supplied directly from a CR2032 coin cell battery. These modules can be used in volume production in applications where the supply voltage is regulated below 2.5V, for example using an external voltage regulator to supply the device. The modules devices can be used for development, prototyping and FCC/ETSI qualification.
Workarounds: For volume production, use a regulated supply below 2.5V or use an active version where this is fixed.

2.13.1 Module Correction

A module level fix has been implemented and these modules are marked as revision C, D or E.

The fix slightly affects the module current consumption in Idle and Suspend mode. It also removes the Deep Sleep mode. The updated parameters are as follows. There are no changes to other unlisted parameters of previous versions. See appendix for reference.

Symbol	Parameter (condition)	Notes	Min	Typ.	Max	Units
	Current Consumption					
$I_{DeepSleep}$	Deep sleep command			0.5		µA
I_{Idle}	No active channels – no communications			~~2.0~~ 3.0		µA
$I_{Suspend}$	Asynchronous suspend activated			~~2.0~~ 3.0		µA

2.14 Slave Channel Unable to Transmit Issue

Module revisions 4 and A are affected. The issue has been resolved in revision B and above. The issue is described in the product anomaly notice of nRF24AP2 (PAN-014 ver 1.1) from Nordic Semiconductor. The relevant content is copied below.

Symptoms:

A slave channel is able to receive from a channel master, but is unable to transmit successfully back to the channel master.
Conditions: A combination of slow channel rate and high differential clock error between the master and slave device is required. The slave channel rate must be 0.75Hz or slower. At 0.75Hz the differential clock error must be at the maximum allowed clock error specified of 100ppm, which would arise from a +50ppm error on one device and -50ppm on the other. At 0.5Hz, the slowest possible channel rate, a differential clock error of 60ppm or greater is required to cause this problem.
Consequences: Loss of backchannel communication from the channel slave to the channel master
Workarounds: Using a message rate of faster than 0.75 Hz, or ensuring a differential clock error of less than 60ppm, will ensure proper operation. A differential clock of less than 60ppm can be achieved by using a 16MHz crystal with ±30ppm tolerance.

2.15 Asynchronous Serial Mode Issue

Module revisions 4 and A are affected. This issue has been resolved in module revision B and above. The issue is described in the product anomaly notice of nRF24AP2 (PAN-014 ver 1.1) from Nordic Semiconductor. The relevant content is copied below.

Symptoms: When waking up the AP2 in asynchronous serial mode, the first message sent to the AP2 after the RTS line is lowered may not be successfully received.
Conditions: The first time that the RTS line is lowered after the SLEEP enable line is transitioned from HIGH to LOW, while in asynchronous serial mode, the AP2 parts can take up to 600us after the RTS line is lowered before it is able to correctly receive asynchronous serial data.
Consequences: The first asynchronous serial message sent after transitioning the SLEEP enable line can be lost.
Workarounds: Either wait 600us after the RTS line is lowered immediately following a wake up of the AP2 before sending the first message, or ensure that a valid response is received and if not resend the message.

3. 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. Users can also seek application support from Dynastream Innovations, www.thisisant.com.

3.1 ANT Forum

Users are encouraged to participate in the ANT Forum for any engineering discussions. The Forum is moderated by the application engineering team of Dynastream Innovations. ANT forum is free to use at www.thisisant.com/antforum

3.2 Public Technical References

Documents:

- nRF24AP2 Product Specification, Nordic Semiconductor
- Product Anomaly Notification (PAN-014), Nordic Semiconductor
- Product Anomaly Notification (PAN-022), Nordic Semiconductor
- ANT AP2 RF Transceiver Module Datasheet, Dynastream Innovations
- ANT Application Note 11: ANT Channel Search and Background Scanning Channel, Dynastream Innovations

The above documents are available at www.dynastream.com, www.thisisant.com or www.nordicsemi.no

3.3 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

Appendix: Current Consumption Specification

Along with the version upgrades of AP2 module, the current consumption specification has been updated. Here is a complete record of the specification for each version.

Module Revision 4, A and B

Symbol	Parameter (condition)	Notes	Min	Typ.	Max	Units
	Current Consumption					
$I_{DeepSleep}$	Deep sleep command			0.5		µA
I_{Idle}	No active channels – no communications			2.0		µA
$I_{Suspend}$	Asynchronous suspend activated			2.0		µA
I_{Base_32kXO}	Base Active current (32.768 KHz crystal oscillator or external clock source)			3.0		µA
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)		11		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			2.9		mA
$I_{Msg\_Rx\_ByteSync}$	Average current / Rx message in byte sync mode			17		µA
$I_{Msg\_Rx\_BitSync}$	Average current / Rx message in bit sync mode			30		µA
$I_{Msg\_Rx\_57600}$	Average current / Rx message in async mode at 57600 baud			20		µA
$I_{Msg\_Rx\_50000}$	Average current / Rx message in async mode at 50000 baud			20		µA
$I_{Msg\_Rx\_38400}$	Average current / Rx message in async mode at 38400 baud			23		µA
$I_{Msg\_Rx\_19200}$	Average current / Rx message in async mode at 19200 baud			30		µA
$I_{Msg\_Rx\_9600}$	Average current / Rx message in async mode at 9600 baud			48		µA
$I_{Msg\_Rx\_4800}$	Average RF current / Rx message in async mode at 4800 baud			83		µA
$I_{Msg\_TxAck\_ByteSync}$	Average current / Acknowledged Tx message in byte sync mode			36		µA
$I_{Msg\_TxAck\_BitSync}$	Average current / Acknowledged Tx message in bit sync mode			48		µA
$I_{Msg\_TxAck\_57600}$	Average current / Acknowledged Tx message in async mode at 57600 baud			42		µA
$I_{Msg\_TxAck\_50000}$	Average current / Acknowledged Tx message in async mode at 50000 baud			40		µA
$I_{Msg\_TxAck\_38400}$	Average current / Acknowledged Tx message in async mode at 38400 baud			44		µA
$I_{Msg\_TxAck\_19200}$	Average current / Acknowledged Tx message in async mode at 19200 baud			55		µA

Symbol	Parameter (condition)	Notes	Min	Typ.	Max	Units
$I_{Msg\_TxAck\_9600}$	Average current / Acknowledged Tx message in async mode at 9600 baud				78	µA
$I_{Msg\_TxAck\_4800}$	Average current / Acknowledged Tx message in async mode at 4800 baud				132	µA
$I_{Msg\_RxAck\_ByteSync}$	Average current / Acknowledged Rx message in byte sync mode				20	µA
$I_{Msg\_RxAck\_BitSync}$	Average current / Acknowledged Rx message in bit sync mode				34	µA
$I_{Msg\_RxAck\_57600}$	Average current / Acknowledged Rx message in async mode at 57600 baud				22	µA
$I_{Msg\_RxAck\_50000}$	Average current / Acknowledged Rx message in async mode at 50000 baud				22	µA
$I_{Msg\_RxAck\_38400}$	Average current / Acknowledged Rx message in async mode at 38400 baud				27	µA
$I_{Msg\_RxAck\_19200}$	Average current / Acknowledged Rx message in async mode at 19200 baud				33	µA
$I_{Msg\_RxAck\_9600}$	Average current / Acknowledged Rx message in async mode at 9600 baud				53	µA
$I_{Msg\_RxAck\_4800}$	Average current / Acknowledged Rx message in async mode at 4800 baud				86	µA
$I_{Msg\_Tx\_ByteSync}$	Average current / Tx-only message in byte sync mode		5)		13	µA
$I_{Msg\_Tx\_BitSync}$	Average current / Tx-only message in bit sync mode		5)		28	µA
$I_{Msg\_Tx\_57600}$	Average current / Tx-only message in async mode at 57600 baud		5) 6)		23	µA
$I_{Msg\_Tx\_50000}$	Average current / Tx-only message in async mode at 50000 baud		5) 6)		19	µA
$I_{Msg\_Tx\_38400}$	Average current / Tx-only message in async mode at 38400 baud		5) 6)		21	µA
$I_{Msg\_Tx\_19200}$	Average current / Tx-only message in async mode at 19200 baud		5) 6)		30	µA
$I_{Msg\_Tx\_9600}$	Average current / Tx-only message in async mode at 9600 baud		5) 6)		63	µA
$I_{Msg\_Tx\_4800}$	Average current / Tx-only message in async mode at 4800 baud		5) 6)		108	µA
$I_{Msg\_TR\_ByteSync}$	Average current / Tx message in byte sync mode				24	µA
$I_{Msg\_TR\_BitSync}$	Average current / Tx message in bit sync mode				36	µA
$I_{Msg\_TR\_57600}$	Average current / Tx message in async mode at 57600 baud		6)		33	µA
$I_{Msg\_TR\_50000}$	Average current / Tx message in async mode at 50000 baud		6)		31	µA
$I_{Msg\_TR\_38400}$	Average current / Tx message in async mode at 38400 baud		6)		32	µA

Symbol	Parameter (condition)	Notes	Min	Typ.	Max	Units
$I_{Msg\_TR\_19200}$	Average current / Tx message in async mode at 19200 baud	6)		42		µA
$I_{Msg\_TR\_9600}$	Average current / Tx message in async mode at 9600 baud	6)		70		µA
$I_{Msg\_TR\_4800}$	Average current / Tx message in async mode at 4800 baud	6)		120		µA
I_{Ave}	Broadcast Tx-only @ 0.5Hz in byte sync mode	5) 7)		12		µA
I_{Ave}	Broadcast Tx-only @ 2Hz in byte sync mode	5) 7)		48		µA
I_{Ave}	Broadcast Rx @ 0.5Hz in byte sync mode	7)		8.5		µA
I_{Ave}	Broadcast Rx @ 2Hz in byte sync mode	7)		34		µA
I_{Ave}	Acknowledged Tx @ 0.5Hz in byte sync mode	7)		18		µA
I_{Ave}	Acknowledged Tx @ 2Hz in byte sync mode	7)		72		µA
I_{Ave}	Acknowledged Rx @ 0.5Hz in byte sync mode	7)		10		µA
I_{Ave}	Acknowledged Rx @ 2Hz in byte sync mode	7)		40		µA
I_{Ave}	Burst continuous @ 20kbps in byte sync mode	7) 8)		4.75		mA
I_{Ave}	Burst continuous @ 7.5kbps in bit sync mode	7) 8)		4		mA
I_{Ave}	Burst continuous @ 20kbps in async mode at 57600 baud	7) 8)		5.9		mA
I_{Ave}	Burst continuous @ 20kbps in async mode at 50000 baud	7) 8)		4.9		mA
I_{Ave}	Burst continuous @ 13.8kbps in async mode at 38400 baud	7) 8)		4.7		mA
I_{Ave}	Burst continuous @ 8.4kbps in async mode at 19200 baud	7) 8)		4.2		mA

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 that external 32.768 kHz crystal oscillator is used

Module Revision C, D and E

The following parameters are changed in these revisions. There are no changes to other unlisted parameters of previous versions.

Symbol	Parameter (condition)	Notes	Min	Typ.	Max	Units
	Current Consumption					
$I_{DeepSleep}$	Deep sleep command			0.5		µA
I_{Idle}	No active channels – no communications			~~2.0~~ 3.0		µA
$I_{Suspend}$	Asynchronous suspend activated			~~2.0~~ 3.0		µA

Module Revision F and above

Please refer to the current release of AP2 module datasheet.