AsteRx-m2 Product Group Hardware Manual

Version 1.5.0

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Septentrio
Greenhill Campus, Interleuvenlaan 15i
3001 Leuven, Belgium

http://www.septentrio.com
Phone: +32 16 300 800
Fax: +32 16 221 640
@septentrio

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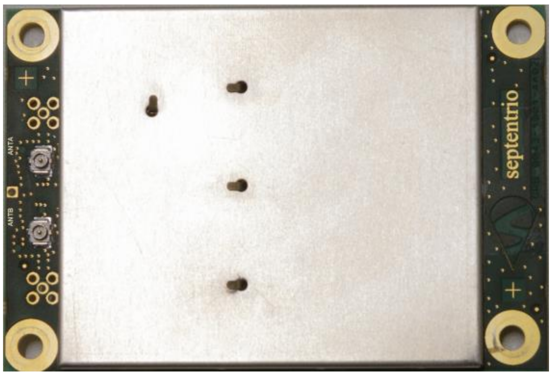
ROHS/WEEE NOTICE

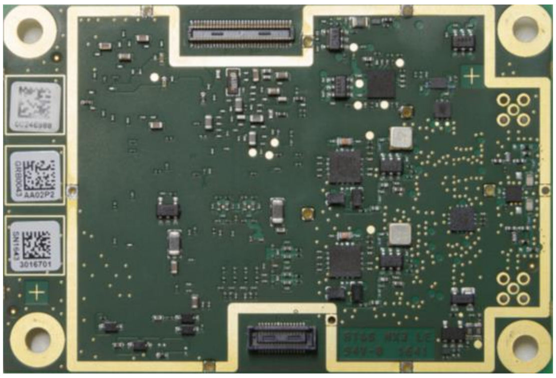
Septentrio receivers are compliant with the latest WEEE, RoHS and REACH directives. For more info see www.septentrio.com/en/environmental-compliance.

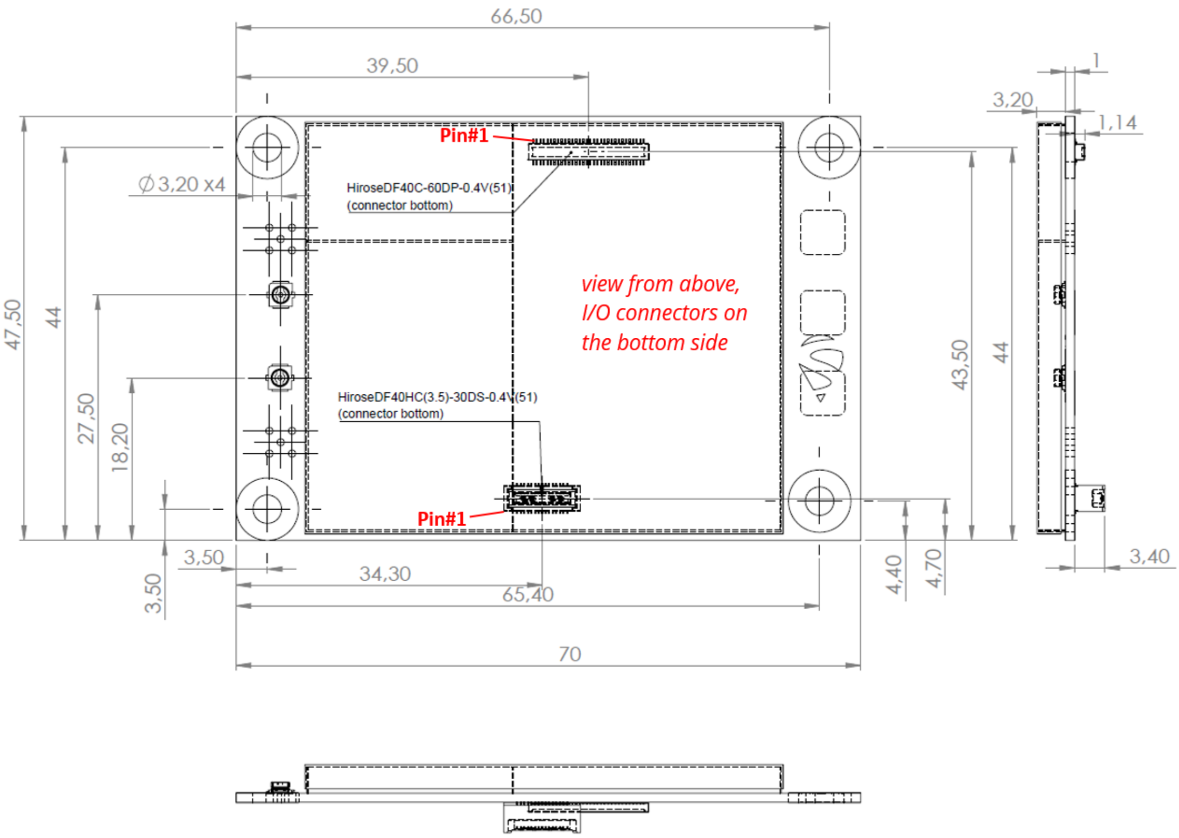
ESD PRECAUTIONS

The OEM module is sensitive to electrostatic discharge (ESD). Although it has a limited protection, it should only be manipulated in an ESD-safe environment and using ESD-safe tools and equipment. These tools are typically marked with the following symbol:

2 AsteRx-m2 OEM







All dimensions in millimeters.

Weight = 28 g

RF connectors (u.FL type) are mounted on top side of the PCB. The 30- and 60-pin Hirose I/O connectors are mounted on the bottom side.

2.1 Mounting

The four mounting holes are compatible with M3 screws. Use M3 3.5mm spacers. An example of applicable SMD spacer is THF-1.6-3.5-M3 from MAC8.

All mounting holes are grounded, and should preferably be connected to ground on the host PCB. Note however that the mounting holes should not be relied on as only ground return connection: a proper ground should be supplied to the GND pins of the I/O connector(s) as well.

2.2 Environmental

Operational: -40 to +85 °C
Storage: -55 to +85 °C

2.3 Power and Power Consumption

The board is powered through pin#1 and pin#2 of the 30-pin connector. Power supply voltage must be 3.3V +/-5%.

The power consumption depends on the set of GNSS signals enabled with the **setSignalTracking** command.

The following table shows the typical power consumption for selected sets of signals, when computing a standalone position at a 1-Hz rate.

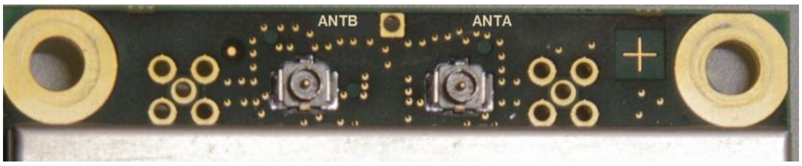
Signals enabled with **setSignalTracking**	Power consumption	Measurement conditions
GPSL1CA	620 mW	12 sats in tracking
GPSL1CA+GPSL2P	740 mW	12 sats in tracking
GPSL1CA+GPSL2P+GLOL1CA+GLOL2CA	770 mW	22 sats in tracking
All GNSS signals from all GNSS constellations	950 mW	32 sats in tracking

Enabling the built-in L-Band demodulator with the **setLBandSelectMode** command adds 100 mW.

Enabling wideband interference mitigation with the **setWBIMitigation** command adds 80 mW.

Consumption in standby mode: 10 mW
In-rush current: 1.3 A during less than 100 μs.
Maximum peak current during operation: 0.5 A.

2.4 RF Interface



The receiver takes its RF signal from either the ANTA u.FL connector or the ANTB u.FL connector. The signals from ANTA and ANTB are never combined, but the receiver selects one of them as RF input and ignores the other. The ANTB connector is selected if an active antenna is detected on that connector. Otherwise the ANTA connector is selected. Typically, the ANTA connector is to be used for internal antennas that are always connected to the AsteRx-m2, e.g. when the receiver and the antenna are integrated in the same system. The ANTB connector is to be used for external antennas that, if connected, replace the internal antenna.

Detection of the presence of an antenna on the ANTB connector is done by sensing the current drawn by that connector. If the current exceeds 6mA, an active antenna is assumed to be connected.

This default operation can be overruled with the **setAntennaConnector** command. Note that, in the command line interface, the ANTA u.FL connector is referred to as “Int” (for internal antenna), and the ANTB connector is referred to as “Ext” (for external antenna). The table below summarizes the different configurations:

Setting in **setAntennaConnector** command	RF signal source
auto (default)	ANTB if current >6mA, ANTA otherwise
Ext	ANTB
Int	ANTA

If the antenna is not powered by the receiver or when using passive antennas, automatic detection will fail. For example, when the antenna is connected to the ANTB u.FL connector through a power splitter with DC blocking, you must enter the **setAntennaConnector, Ext** command to guarantee correct operation.

Likewise, when connecting the ANTB u.FL connector to a GNSS signal simulator, you must enter the command “**setAntennaConnector, Ext**” to make sure the receiver is using the ANTB antenna connector.

2.4.1 Electrical Specifications

Antenna supply voltage	3-5.5V DC, set via pin#18 of the 30-pin connector • ANTA u.FL connector: DC applied only if the RF signal is taken from that connector (see above) • ANTB u.FL connector: DC always applied

	If pin#18 is not connected, there is no DC voltage to the antenna.
ANTA DC series impedance	< 2.2 Ohms
ANTB DC series impedance	< 4 Ohms
ANTB antenna detection current	6 mA
Guaranteed antenna current (ANTA or ANTB)	200 mA
Antenna current limit (ANTA or ANTB)	< 300 mA
Antenna net gain range[1]	0-50 dB
Receiver noise figure (NFrx, see below)	4.5 dB typ. on passive antenna 10 dB typ. with 15 dB pre-amplification 20 dB typ. with 30 dB pre-amplification
RF nominal input impedance	50 Ohms
VSWR (ANTA or ANTB)	< 2:1 in 1165-1255 MHz and 1525-1610 MHz range

[1] The net gain is the total pre-amplification of the distribution network in front of the receiver. Typically, this equals antenna active LNA gain minus coax losses in the applicable GNSS bands.

2.4.2 System Noise Figure and C/N0

The system noise figure, in dB, can be calculated as:

$$NFsys = 10*\log_{10}(10^{NFant/10} + (10^{NFrx/10}-1)/10^{Gpreamp/10})$$

where

- NFant is the antenna LNA noise figure, in dB;
- NFrx is the receiver noise figure, in dB. See table above;
- Gpreamp is the net gain in front of the receiver, in dB.

For example, with a 2.5-dB antenna LNA noise figure, 30-dB antenna LNA gain and 15-dB cable loss, Gpreamp = 30dB-15dB = 15dB and NRrx is 10dB (see table in section 2.4.1). In this case, the system noise figure is:

$$NFsys = 10.\log_{10}(10^{2.5/10}+ (10^{10/10}-1)/10^{15/10}) = 3.14 \text{ dB}.$$

The C/N0, in dB-Hz, of a GNSS signal received at a power P can be computed by:

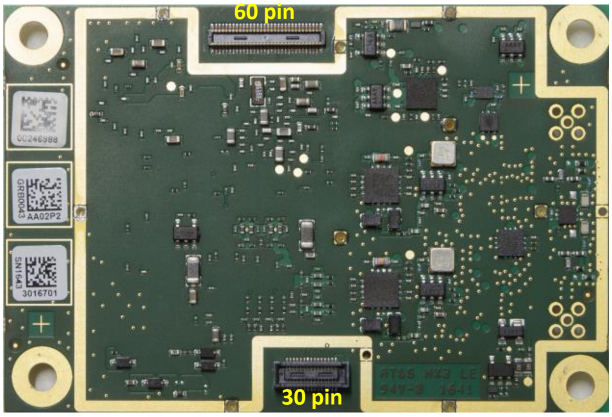
$$C/N0 = P - 10.\log_{10}(Tant + 290*(10^{NFsys/10}-1)) + 228.6 \text{ dB}$$

where

- P is the received GNSS signal power including the gain of the antenna passive radiating element, in dBW (e.g. -155dBW)
- Tant is the antenna noise temperature, in Kelvin. Typically Tant = 130K for an open-sky antenna.
- 228.6 is $-10*\log10(k_B)$ with k_B =1.38e-23 J/K the Boltzmann constant.

Note that, when connecting the receiver directly to a GNSS simulator, the applicable value for NFrx is that of a passive antenna (4.5dB), Tant=290K, NFant=0dB and Gpreamp=0dB.

2.5 I/O Connectors



The main connector is the 30-pin connector. That connector must always be connected.

The 60-pin connector provides additional signals (IO enable, serial CTS/RTS lines, GPIOs, Ethernet, 10-MHz reference input, etc). That connector can be ignored and left unconnected if these signals are not needed.

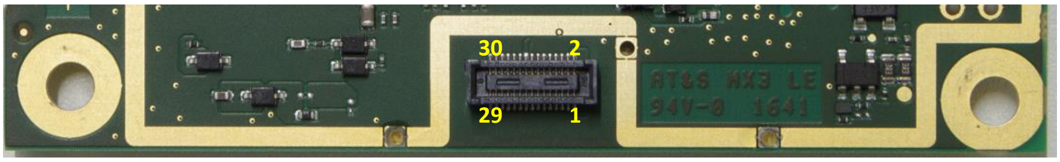
Warnings

- All ground pins must be connected (not applicable to the 60-pin connector if that connector is not used).
- Do not drive a non-zero voltage into input pins (pins type "I" in the tables below) when the receiver is not powered or is in standby (see section 2.9), and during the first 300 ms after these states. The IO_EN pin of the 60-pin connector indicates when the board is ready to accept input, and can be used to enable the drivers driving the input pins. Designs not using the 60-pin connector must either keep the input pins in hi-Z mode for at least 300 ms after applying power, or drive the nRST pin low for at least 300 ms after applying power. When not using the IO_EN pin, it is recommended not to put the board in standby mode.
- When pull-up/down resistors are needed, use 10 kΩ.
- Unused or reserved pins should be left unconnected unless explicitly mentioned otherwise.

Conventions

- Pin Type: I=Input, O=Output, P=Power, Ctrl=Control, Clk=Reference clock
- LVTTL=3V3 Low Voltage TTL: $VI_L \le 0.8V$, $VI_H \ge 2.0V$, $VO_L \le 0.4V$, $VO_H \ge 2.4V$.
- PU: pulled up
- PD: pulled down
- K: keeper input type

2.5.1 30-pin Connector



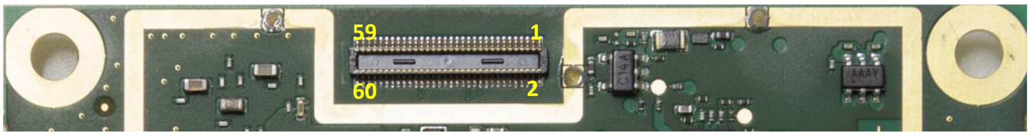
Connector type: Hirose 30 pins DF40HC (3.5)-30DS-0.4V(51)
Mating connector: Hirose DF40C-30DP-0.4V(51)

See the pin numbering convention in the above picture.

Pin#	Name	Type	Level	Description	Comment
1	Vin	P	3.3V +/-5%	Main power supply input	Both Vin pins (pin#1 and pin#2) must be tied together.
3	GND	Gnd	0	Ground.	
5	USB_D+	I/O	USB	USB data signal positive D+.	
7	USB_Vbus	Ctrl	4.40V ≤V≤ 5.25V	USB VBUS. ⚠ **This pin cannot be used to power the receiver!** ⚠ **Mandatory if USB is used.**	See section 2.11
9	TX1	O	LVTTL	Serial COM 1 transmit line (inactive state is high)	
11	GND	Gnd	0	Ground.	
13	TX2	O	LVTTL	Serial COM 2 transmit line (inactive state is high)	
15	TX3	O	LVTTL	Serial COM 3 transmit line (inactive state is high)	
17	GND	Gnd	0	Ground.	
19	EventA	I, PD	LVTTL	Event A or TimeSync input.	See section 2.7
21	Reserved			Reserved	
23	GND	Gnd	0	Ground.	
25	Button	I, K	LVTTL	Input can be connected to a push button used to control SD card logging. Low state is interpreted as “button pressed”.	Debouncing must be done externally (no debouncing circuit on board). See also section 2.10.
27	LOGLED	O	LVTTL	Internal logging status indicator. Max output current: 10 mA; output impedance: 20 Ohms	See Appendix A
29	GND	Gnd	0	Ground.	

Pin#	Name	Type	Level	Description	Comment
2	Vin	P	3.3V +/-5%	Main power supply input	Both Vin pins (pin#1 and pin#2) must be tied together.
4	GND	Gnd	0	Ground.	
6	USB_D-	I/O	USB	USB data signal negative D-.	
8	nRST	Ctrl,PU	LVTTL	Reset input, active negative. Receiver resets when driven low.	
10	RX1	I, K	LVTTL	Serial COM 1 receive line (inactive state is high).	
12	PPSout	O	LVTTL	PPS output. Output impedance: 50 ohms. Output current: 24 mA. Polarity and rate user selectable. During start up, this pin is pulled low with a 100-kOhm resistor. See Reference Guide for operating instructions. Pulse duration: 5ms.	
14	RX2	I, K	LVTTL	Serial COM 2 receive line (inactive state is high).	
16	RX3	I, K	LVTTL	Serial COM 3 receive line (inactive state is high).	
18	VANT	P	3< VANT < 5.5V	Antenna supply.	See section 2.4.1
20	nPDN	Ctrl,PU	LVTTL	Receiver is put in standby mode (low power mode) when driven low. Normal operation resumes when the pin level is high.	See section 2.9
22	GPLED	O	LVTTL	General purpose LED. Max output current: 10 mA; output impedance: 20 Ohms	See Appendix A
24	Reserved				
26	SD_CLK	O	LVTTL	SD card CLK line	See section 2.10
28	SD_CMD	O	LVTTL	SD card CMD line	See section 2.10
30	SD_DAT0	I/O	LVTTL	SD card DAT0 line	See section 2.10

2.5.2 60-pin connector



Connector type: Hirose DF40C-60DP-04V(51)
Mating connector: Hirose DF40HC(3.5)-60DS-0.4V(51)

See the pin numbering convention in the above picture.

Pin#	Name	Type	Level	Description	Comment
1	Reserved				
3	Reserved				
5	Reserved				
7	Reserved				
9	GP1	O	LVTTL	General purpose output. GP1 in **setGPIOFunctionality** command.	See section 2.8
11	RTS2	O	LVTTL	Serial COM2 RTS line. The AsteRx-m2 drives this pin low when ready to receive data.	
13	RTS3	O	LVTTL	Serial COM3 RTS line. The AsteRx-m2 drives this pin low when ready to receive data.	
15	TX4	O	LVTTL	Serial COM 4 transmit line (inactive state is high)	
17	Reserved				
19	Reserved				
21	Reserved				
23	Reserved				
25	Reserved				
27	Reserved				
29	GND	Gnd		Ground	
31	RMII_TXEN	O	LVTTL	LAN PHY transmit enable	See section 2.12
33	RMII_TXD1	O	LVTTL	LAN PHY transmit data 1	See section 2.12
35	RMII_CRS_DV	I	LVTTL	LAN PHY CRS	See section 2.12
37	RMII_RXER	I	LVTTL	LAN PHY RX error	See section 2.12
39	Reserved				
41	Reserved				
43	Reserved				
45	Reserved				
47	Reserved				
49	Reserved				
51	Reserved				
53	Reserved				
55	Reserved				
57	EventB	I,PD	LVTTL	Event B or TimeSync input.	See section 2.7
59	IO_EN	O	LVTTL	Level is high when board is in normal operating conditions and it is safe to drive the input pins (see warnings on page 11)	

Pin#	Name	Type	Level	Description	Comment
2	Reserved				
4	GND	Gnd		Ground	
6	Reserved				
8	GND	Gnd		Ground	
10	Reserved				
12	CTS2	I, K	LVTTL	Serial COM 2 CTS line. Must be driven low when ready to receive data from the AsteRx-m2.	
14	CTS3	I, K	LVTTL	Serial COM 3 CTS line. Must be driven low when ready to receive data from the AsteRx-m2.	
16	RX4	I, K	LVTTL	Serial COM 4 receive line (inactive state is high).	
18	GND	Gnd		Ground	
20	Reserved				
22	Reserved				
24	Reserved				
26	Reserved				
28	Reserved				
30	GND	Gnd		Ground	
32	RMII_CLK	O	LVTTL	LAN PHY Clock	See section 2.12
34	RMII_TXD0	O	LVTTL	LAN PHY transmit data 0	See section 2.12
36	GND	Gnd		Ground	
38	RMII_RXD0	I	LVTTL	LAN PHY receive data 0	See section 2.12
40	RMII_RXD1	I	LVTTL	LAN PHY receive data 1	See section 2.12
42	GND	Gnd		Ground	
44	GP2	O	LVTTL	General purpose output. GP2 in **setGPIOFunctionality** command.	See section 2.8
46	Reserved				
48	Reserved				
50	GND	Gnd		Ground	
52	Reserved				
54	MDIO	I/O	LVTTL	LAN PHY control data	See section 2.12
56	MDC	O	LVTTL	LAN PHY control clock	See section 2.12
58	GND	Gnd		Ground	
60	REF IN	Clk		10-MHz frequency reference input AC-coupled, 13-kOhm input impedance, 2-5Vpp	See section 2.6

2.6 External Frequency Reference Input (REF IN)

An external 10 MHz frequency reference can be fed into the receiver through pin#60 of the 60-pin connector (REF IN). The 10 MHz signal can be a sine wave or a square wave with a peak-to-peak amplitude between 2V and 5V, for example it can be an LVTTL clock signal.

At start-up, the AsteRx-m2 checks the presence of the external frequency reference on pin#60. If a signal is present, the receiver uses that signal as primary frequency reference, instead of its internal TCXO. The reference signal must be present on pin#60 at receiver boot and must remain present at all times during receiver operation.

This feature is under permission. Make sure that the FreqSync permission is enabled if you need to use the REF IN pin. If the receiver detects a 10 MHz signal on its REF IN pin and the FreqSync permission is disabled, most output will be blocked.

2.7 Event/TimeSync inputs

The receiver features two event inputs (EventA on the 30-pin connector, and EventB on the 60-pin connector), which can be used to time tag external events with a time resolution of 20ns. Use the **setEventParameters** command to configure these pins (e.g. to set the polarity). Note that this feature requires the TimedEvent permission to be enabled in the receiver.

If the TimeSync permission is enabled, the event inputs can also be configured as TimeSync source using the **setTimeSyncSource** command. When an event pin is configured as TimeSync source, the AsteRx-m2 expects to see a one-pulse-per-second (1PPS) signal on that pin. It will then synchronize its internal time base (i.e. the time at which GNSS measurements are sampled) to that 1PPS signal. TimeSync is typically used in conjunction with REF IN (see section 2.6) to fully synchronize the receiver internal time base with the time of an external clock.

Note that there is a delay of 15 to 50 ns between the PPS pulse at the TimeSync pin and the receiver internal time base. That delay is dependent on the phase difference between the 10 MHz frequency at the REF IN input and the PPS pulse at the TimeSync input. It is possible to measure this delay by synchronizing the PPS OUT pulse with the internal time base, with the **setPPSParameters,,,,RxClock** command.

2.8 General Purpose Output (GPx)

The GP1 and GP2 pins of the 60-pin connector are general purpose LVTTL digital outputs, of which the level can be programmed with the **setGPIOFunctionality** command.

During the first seconds after powering up the board, these pins are in tristate. Use an external pull-down or pull-up resistor to have the desired level during boot.

The GPx pins can drive a maximum current of 10mA.

2.9 Standby Mode

In standby mode, all receiver functions are turned off and the power consumption is very low (see section 2.3). There are two ways to enter standby mode:

1. By driving the nPDN pin low (pin#20 of the 30-pin connector). The receiver wakes up when the nPDN pin level is high again (there is an internal pull-up).

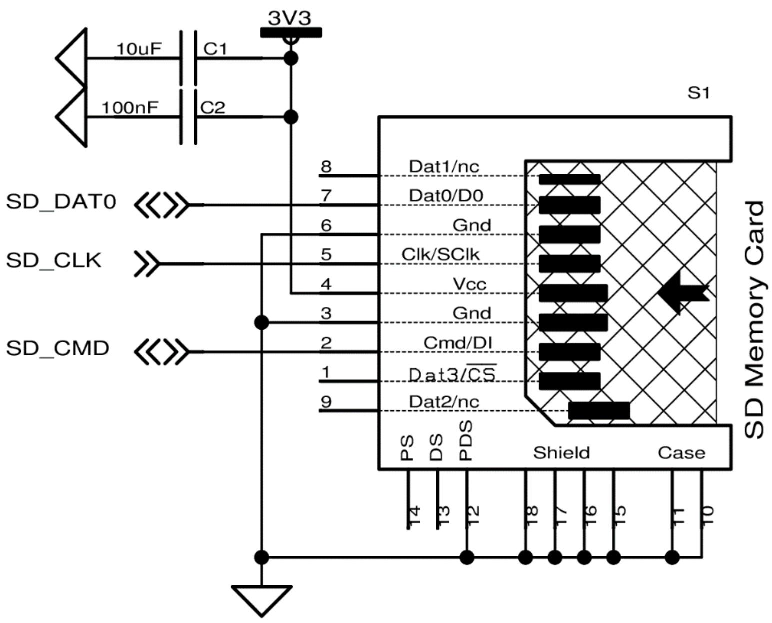
2. By entering the "**exePowerMode, StandBy**" user command. To wake up, the nPDN pin should be shortly driven low (at least for 50ms).

It is also possible to schedule automatic standby/wakeup periods using the **setWakeUpInterval** command.

Note that entering standby mode takes a few seconds during which all running processes are shutdown.

2.10 SD Memory Card Usage

The receiver can interface to an external SD memory card through the SD-card pins of the 30-pin connector. The receiver supports the 1-bit SD transfer mode with 3V3 signaling. An example circuit to a 9-pin SD memory card socket is shown below. The maximum clock frequency (SD_CLK) is 33.000 MHz.



See instructions in the Reference Guide for details on how to configure SD card logging. The receiver is compatible with SD cards of up to 32GB. The file system is FAT32.

Shortly driving the button pin (pin#25 of 30-pin connector) low toggles logging on and off. Driving the button pin low for at least 5 seconds unmounts the SD card if it was mounted, or mounts it if it was unmounted. The SD card mount status can be checked with the LOGLED pin (see Appendix A).

When powering off the receiver while logging is ongoing, it can be that the last seconds of data are lost. To avoid data losses, it is advised to first unmount the SD card. This can be done in two ways:

1. By entering the command "**exeManageDisk, DSK1, Unmount**", or "**exePowerMode, StandBy**" before turning off the receiver.

2. By driving the button pin (pin#25) low for at least 5 seconds before turning off the receiver.

2.11 USB Interface

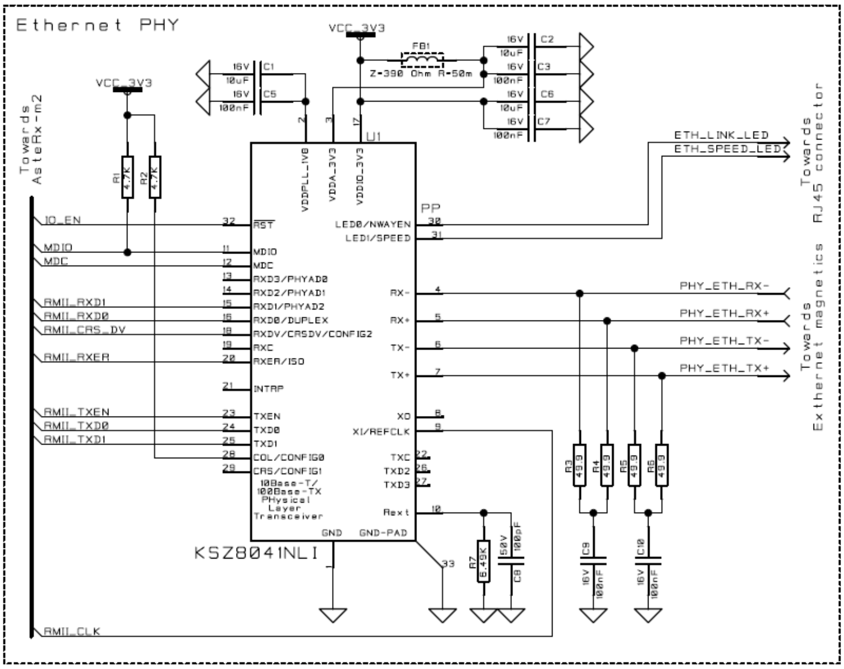
The user can configure the USB device interface in either USB 1.1 (full speed) mode, or in USB 2.0 (high speed) mode. USB 2.0 allows higher bandwidth (480 Mbps vs 12 Mbps), but may not be supported by all host hardware.

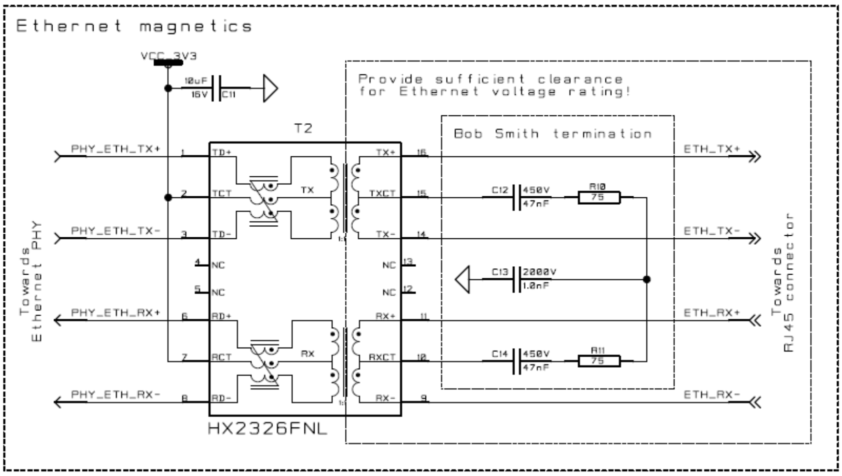
By default, USB is configured in USB 1.1 mode. The update files "AsteRx-m2_USB_1_1.suf" and "AsteRx-m2_USB_2_0.suf" located in the `USB/` folder of the firmware package can be used to change this. The current USB mode can be checked with the command "**lif, Identification**".

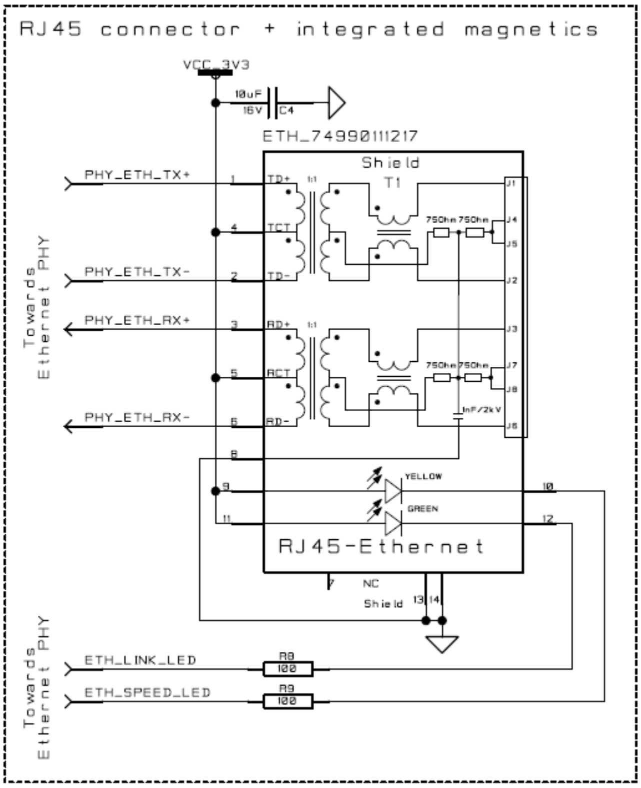
2.12 Ethernet

The receiver supports full duplex 10/100 Base-T Ethernet communication. The Ethernet PHY and magnetics are to be implemented on the host board. Connection with the PHY is through the RMII interface available on the 60-pin connector.

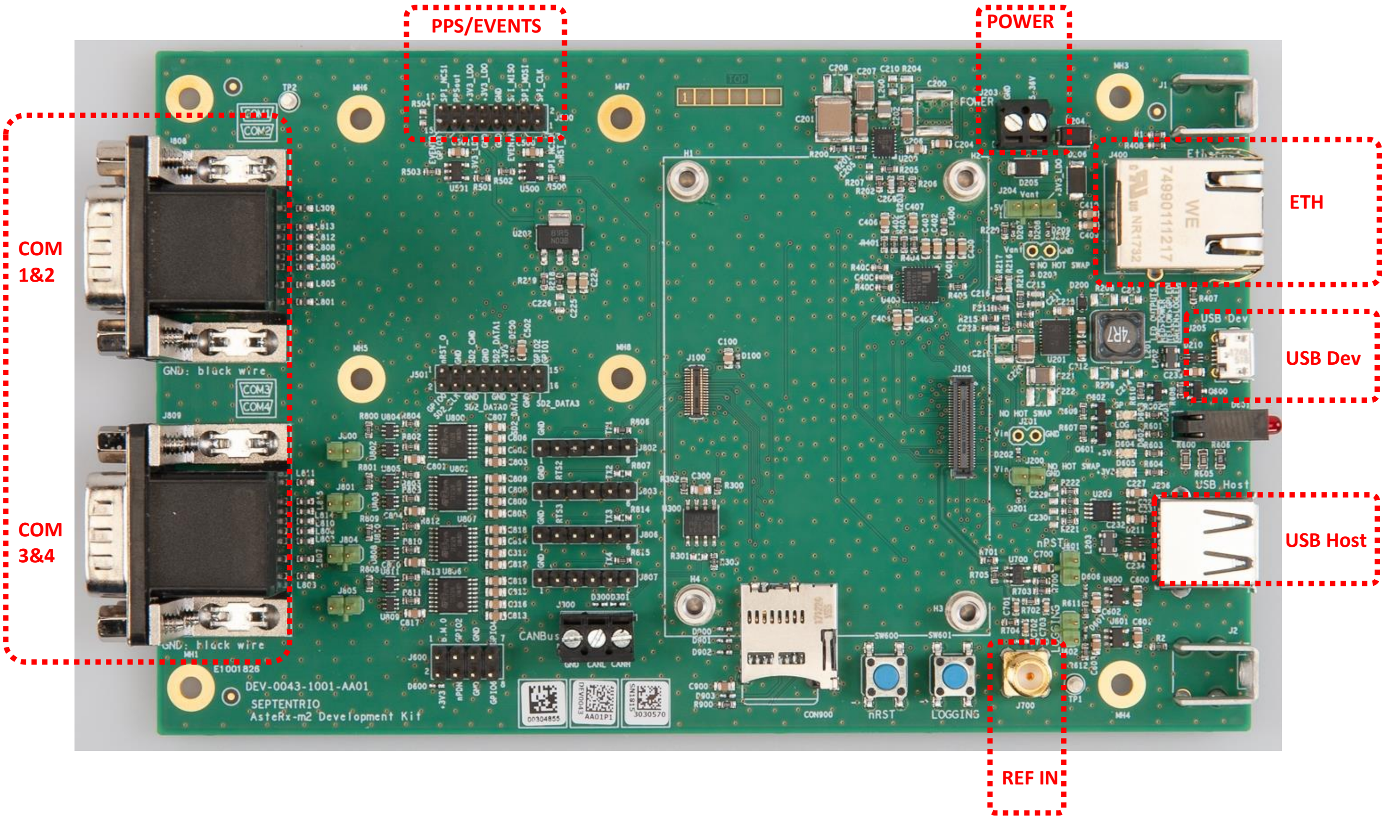
An example of application circuit is given in the next page. Two options are shown: stand-alone magnetics or magnetics integrated in a RJ45 connector.


Ethernet PHY
VCC_3V3
FB1
Z=390 Ohm R=50m
Towards AsteRx-m2
Towards RJ45 connector
Towards Ethernet magnetics
ETH_LINK_LED
ETH_SPEED_LED
PHY_ETH_RX-
PHY_ETH_RX+
PHY_ETH_TX-
PHY_ETH_TX+
IO_EN
MDIO
MDC
RMII_RXD1
RMII_RXD0
RMII_CRS_DV
RMII_RXER
RMII_TXEN
RMII_TXD0
RMII_TXD1
RMII_CLK
U1
KSZ8041NLI
10Base-T/100Base-TX Physical Layer Transceiver


Ethernet magnetics
VCC_3V3
Provide sufficient clearance for Ethernet voltage rating!
Bob Smith termination
T2
HX2326FNL
Towards Ethernet PHY
Towards RJ45 connector
PHY_ETH_TX+
PHY_ETH_TX-
PHY_ETH_RX+
PHY_ETH_RX-
ETH_TX+
ETH_TX-
ETH_RX+
ETH_RX-


RJ45 connector + integrated magnetics
VCC_3V3
ETH_74990111217
Shield
T1
RJ45-Ethernet
YELLOW
GREEN
Towards Ethernet PHY
PHY_ETH_TX+
PHY_ETH_TX-
PHY_ETH_RX+
PHY_ETH_RX-
ETH_LINK_LED
ETH_SPEED_LED

3 Development Kit



The AsteRx-m2 Development Kit is specifically designed to simplify the development process for new integrations.

3.1 Header Types

All headers have a pitch of 2.54mm, with the exception of J500 (PPS/EVENTS) and J501 (GP). Those headers have a 2mm pitch.

3.2 Powering the DevKit

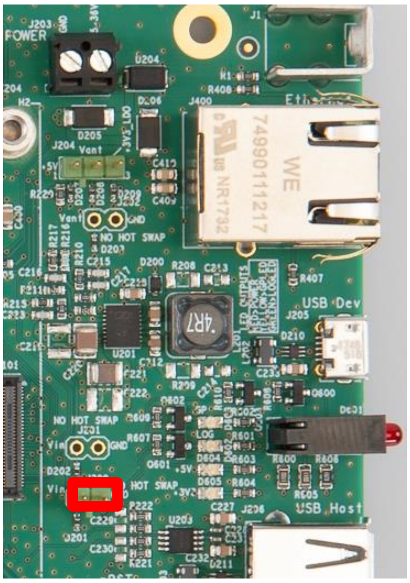
There are two ways to power the DevKit:

1. From the USB Dev connector (J205). This allows powering the board from a PC or from a standard phone-charger adapter. The supported USB voltage range is 4.5V-5.5V.
2. Using the POWER connector (J203). The supported voltage range is 5-36V.

When powering from the USB Dev connector, it is recommended to use the USB cable provided with the DevKit. Low-quality USB cables often suffer from excessive voltage drop, preventing correct operation.

It is safe to provide power to both connectors in parallel. The DevKit will use the source with the highest voltage.

Make sure that a jumper is placed on header J200, as shown below. Otherwise the DevKit will be powered, but not the OEM board.



To measure the power consumption of the AsteRx-m2 OEM board (excluding the contribution from the DevKit and the antenna), remove the jumper on J200 and connect the two pins to the probes of a multimeter in current-sensing mode. Measure the current flowing between the two pins and multiply it by 3.3V to obtain the power consumption. It is recommended to set the multimeter in high ampere setting to keep the voltage drop as low as possible.

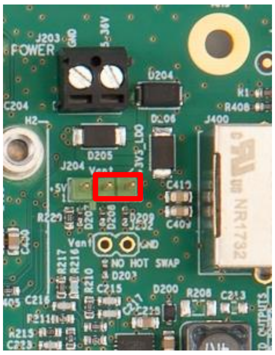
3.3 Antenna Connectors

There is no antenna connector on the DevKit. The antenna must be connected directly to the u.FL connectors on the OEM board. See section 2.4 for details.

The DC voltage (5V or 3.3V) at the antenna connectors is determined by the position of the jumper on header J204, as shown below.

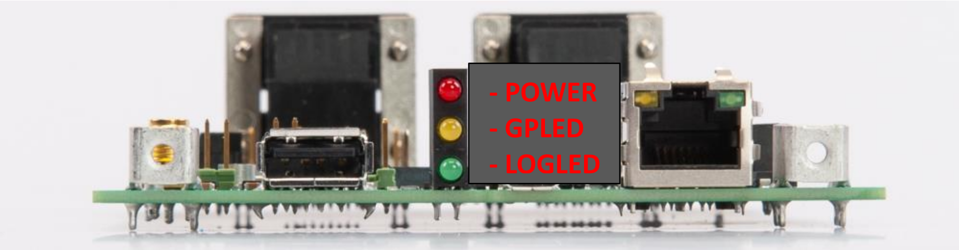
Vant = 5V

Vant = 3.3V



The jumper can be removed if the antenna does not need to be powered by the receiver. In that case, there is no DC voltage at the antenna connector.

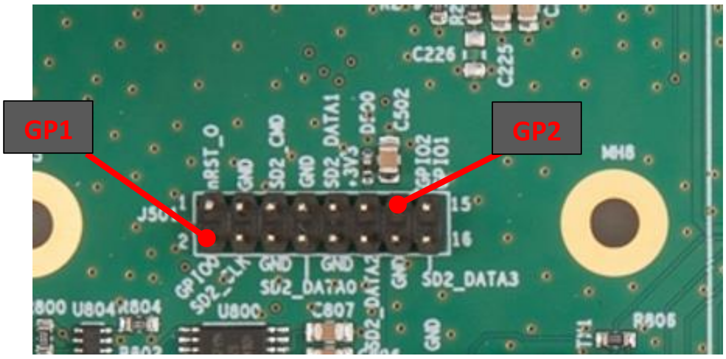
3.4 LEDs and General Purpose Output Pins



The POWER LED lights when the DevKit is powered.

The GPLED and LOGLED are connected to the homonymous pins of the 30-pin connector of the AsteRx-m2 board. See section 2.5.1 for the pinout, and Appendix A for a description of the LED behavior.

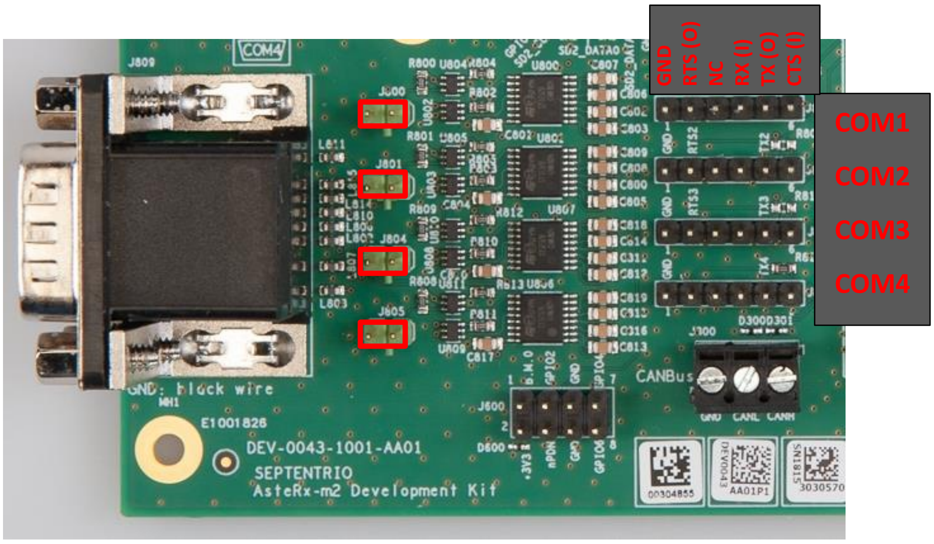
The 3.3V GP1 and GP2 outputs are available on the J501 header.



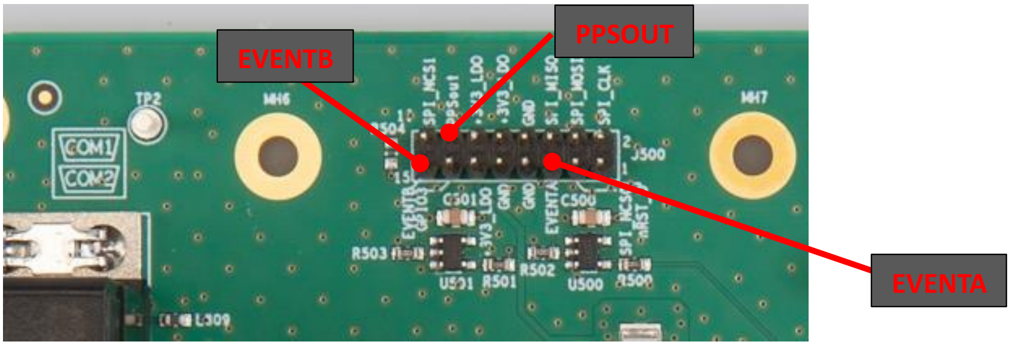
3.5 COM Ports

By default, the four COM ports of the AsteRx-m2 are routed to the four DB9 connectors. Electrical levels on the BD9 conform to the RS232 standard. RTS/CTS lines are supported only on COM2 and COM3. Connection to a PC is done through a null-modem cable.

Alternatively, 3.3V TTL signals are available through four 6-pin headers, as shown below. The pinout is compatible with standard FTDI 6-pin SIL connectors. To route a COM port to the 6-pin header instead of the BD9 connector, a jumper must be placed on J800 (COM1), J801 (COM2), J804 (COM3) and/or J805 (COM4). Only those COM ports for which the jumper is placed are routed to the 6-pin header. The other COM ports are still routed to the DB9 connectors, using the RS232 levels.



3.6 PPS Out and Event Inputs



The PPSout pin of header J500 is directly connected to the PPSOut pin of the AsteRx-m2 (see section 2.5.1). The PPS level is 3.3V.

The EVENTA and EVENTB pins of J500 are connected to the EventA and EventB pins of the AsteRx-m2 through a buffer. The voltage level at the header pins must be between -0.5V and +6V. These pins are pulled-down by a 100kOhm resistor. See section 2.7 for more details.

3.7 Ethernet

The DevKit supports 10/100 Base-T Ethernet. It is not possible to power the DevKit through the Ethernet connector.

3.8 USB Dev

That connector can be attached to a PC to power the DevKit and to communicate with the receiver over its USB port.

3.9 USB Host

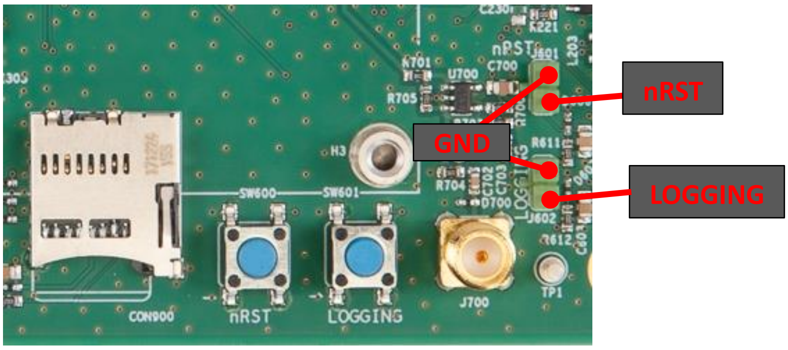
Reserved.

3.10 REF IN

The REF IN connector can be used to feed the receiver with an external 10-MHz sinusoidial frequency reference. See section 2.6.

Input impedance: 50 Ω.
Input level: between -10dBm and +14dBm (0.2Vpp to 3.2Vpp).

3.11 Buttons



Pressing the nRST button drives the nRST pin of the AsteRx-m2 low, which resets the receiver.

Pressing the LOGGING button drives the Button pin of the AsteRx-m2 low. This can be used to enabled and disable logging, as described in section 2.10.

The buttons are also connected to J601 and J602 2-pin headers (see above picture). Tying the nRST or LOGGING pins of these headers to ground is the same as pressing the respective button.

3.12 SD Card Socket

The receiver can log files on the micro SD Card in this socket. See section 2.10 for a description of the SD Card logging.

Appendix A LED Status Indicators

The LED pins can be used to monitor the receiver status. They can be used to drive external LEDs (max drive current 10mA). It is assumed that the LED lights when the electrical level of the corresponding pin is high.

The general-purpose LED (GPLED pin) is configured with the **setLEDMode** command. The following modes are supported. The default mode is "PVTLED".

<table>
<tr><th>GPLED mode</th><th>LED Behaviour</th></tr>
<tr><td>PVTLED</td><td>LED lights when a PVT solution is available.</td></tr>
<tr><td>DIFFCORLED</td><td>Differential correction indicator. In rover PVT mode, this LED reports the number of satellites for which differential corrections have been provided in the last received differential correction message (RTCM or CMR).
<table>
<tr><th>LED behaviour</th><th>Number of satellites with corrections</th></tr>
<tr><td>LED is off</td><td>No differential correction message received</td></tr>
<tr><td>blinks fast and continuously (10 times per second)</td><td>0</td></tr>
<tr><td>blinks once, then pauses</td><td>1, 2</td></tr>
<tr><td>blinks twice, then pauses</td><td>3, 4</td></tr>
<tr><td>blinks 3 times, then pauses</td><td>5, 6</td></tr>
<tr><td>blinks 4 times, then pauses</td><td>7, 8</td></tr>
<tr><td>blinks 5 times, then pauses</td><td>9 or more</td></tr>
</table>
The LED is solid 'ON' when the receiver is outputting differential corrections as a static base station.</td></tr>
<tr><td>TRACKLED</td><td>
<table>
<tr><th>LED behaviour</th><th>Number of satellites in tracking</th></tr>
<tr><td>blinks fast and continuously (10 times per second)</td><td>0</td></tr>
<tr><td>blinks once, then pauses</td><td>1, 2</td></tr>
<tr><td>blinks twice, then pauses</td><td>3, 4</td></tr>
<tr><td>blinks 3 times, then pauses</td><td>5, 6</td></tr>
<tr><td>blinks 4 times, then pauses</td><td>7, 8</td></tr>
<tr><td>blinks 5 times, then pauses</td><td>9 or more</td></tr>
</table>
</td></tr>
</table>

The LOGLED reports the SD card mount status and logging activity.

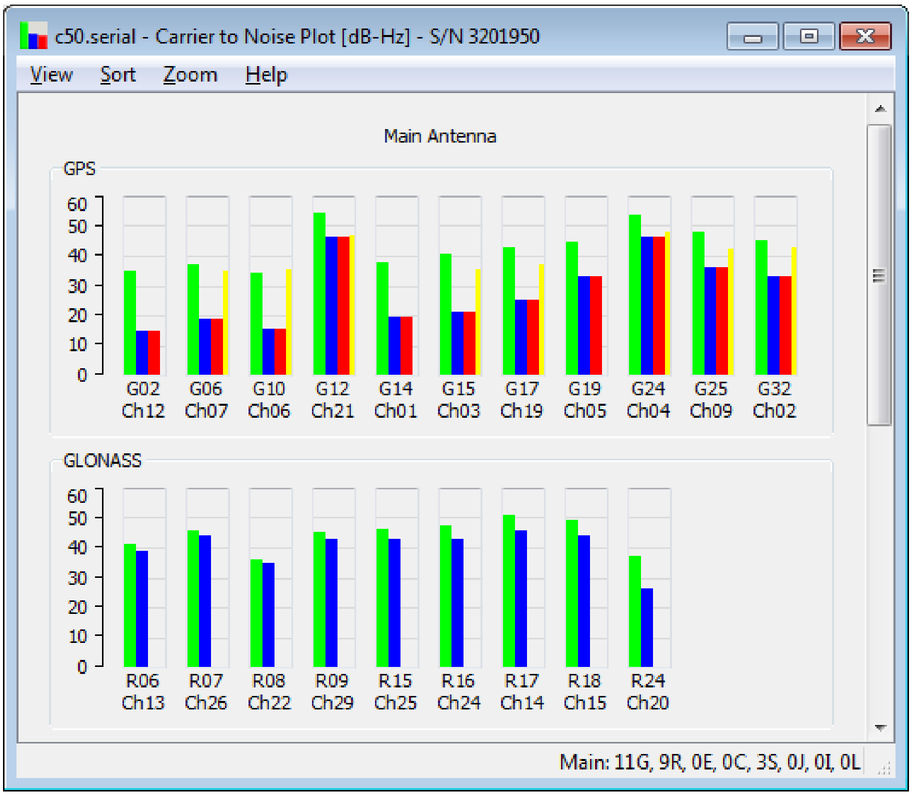
LED	LED Behaviour
LOGLED	LED is off when the SD card is not present or not mounted. LED is on when the SD card is present and mounted. Short blinks indicate logging activity.

During boot, i.e. during the first seconds after powering the receiver, the state of the LEDs is not defined.

Appendix B EMC Considerations

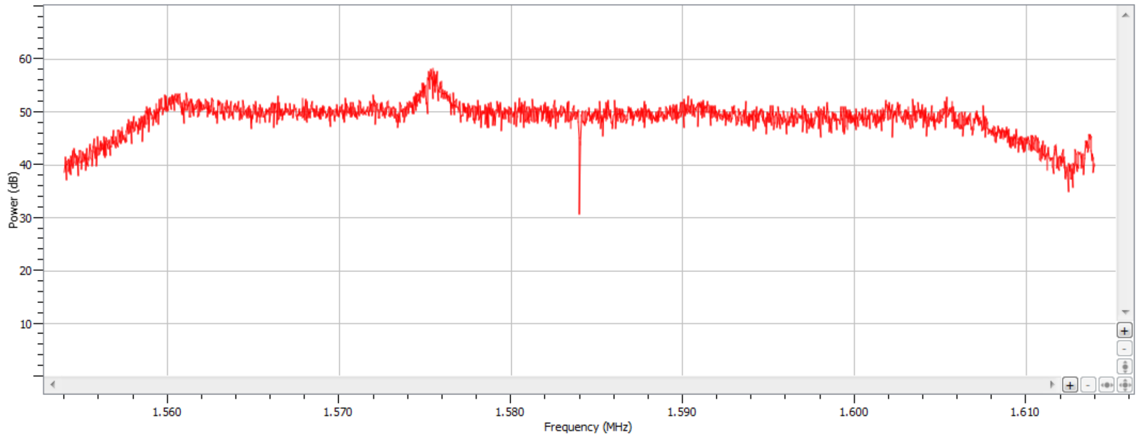
In applications in which the electronics are collocated with the GNSS antenna, cross-talk could be a major concern. GNSS signals are very weak and easily interfered by radiated harmonics of digital signals.

The most useful indicator of the signal reception quality is the C/N0 of the satellites in view. The C/N0 can be viewed in the RxControl graphical interface by clicking *View / Carrier to Noise Plot*. In open-sky conditions, the C/N0 values should reach up to 50 dB-Hz for the strong signals on L1 and L5, and up to 45 dB-Hz on L2, as illustrated below.

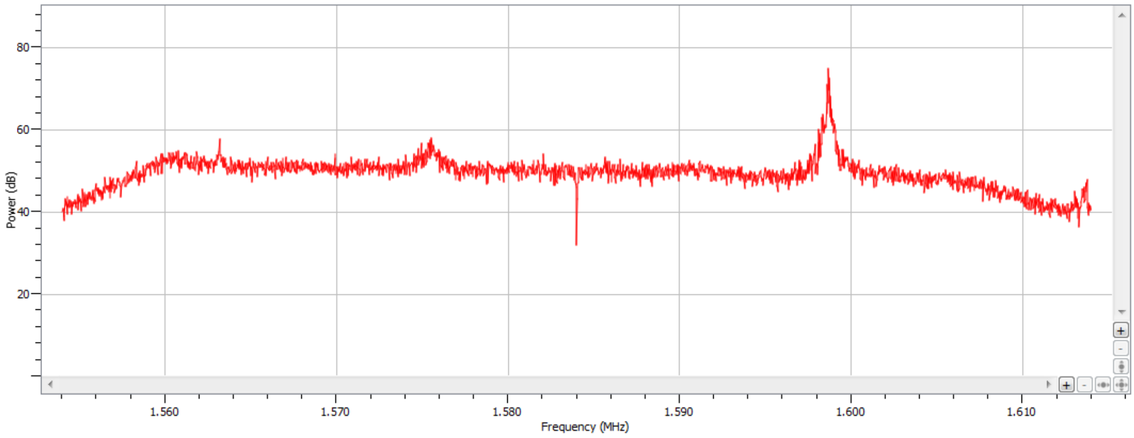


If the maximum C/N0 is lower than expected, interference and cross-talk from nearby electronics is likely, and the source of the problem needs to be identified. This is where the RF spectrum monitor built in the AsteRx-m2 comes in handy. The spectrum monitor can be accessed in RxControl under the *View / Spectrum View* menu. The spectrum can also be monitored offline if the `BBSamples` SBF blocks are logged.

The figure below shows a clean open-sky L1-band spectrum. The bump at 1575MHz corresponds to the GNSS signals at the L1/E1 frequency, and is normal.

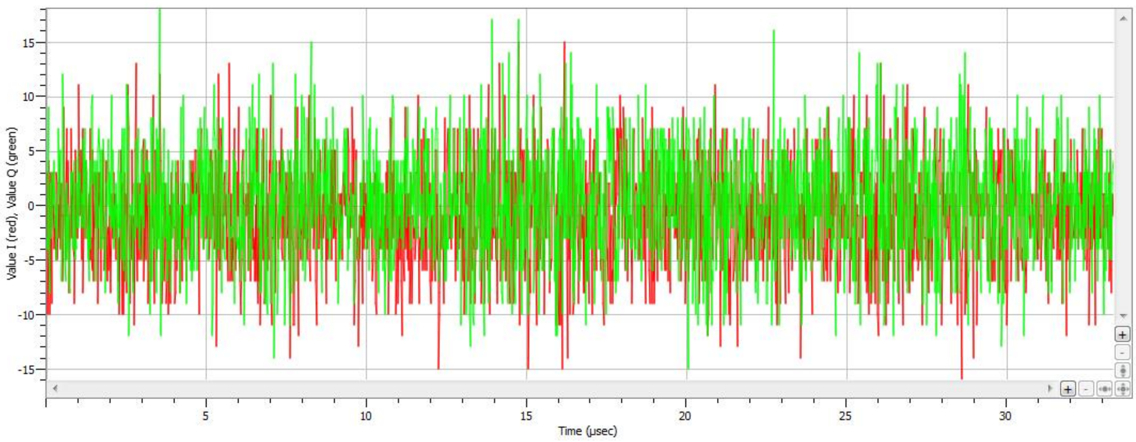


An example of interference is shown below. This particular interference at about 1598 MHz falls in the GLONASS L1 band and slightly degrades the L1 C/N0 of some GLONASS satellites.

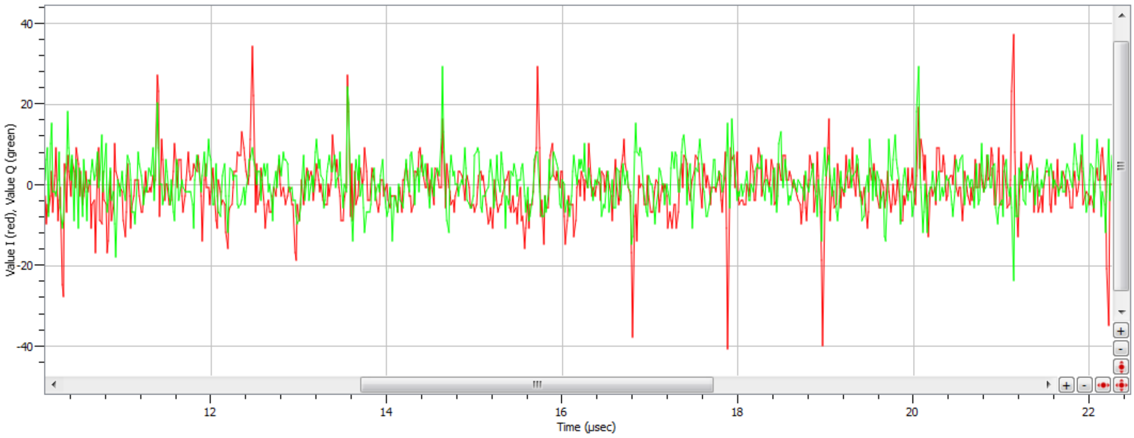


Try to keep personal computers and other equipment more than 2 meters away from the antenna while assessing electromagnetic compatibility of the integration.

RxControl also allows to observe the time domain signal. This should look like white Gaussian noise as illustrated below.



Intermittent interference (μs-scale) has little impact if its duty cycle is below 10%. For example, these short pulses from a digital circuit close to the antenna are essentially harmless.



If interference is detected, look for the root cause by switching off devices. Typical sources of interference are:

- Unshielded flat cables carrying digital signals or power signals towards digital circuits. Particularly, cable joints tend to radiate.
- High-speed digital devices, such as application processors, modems and cameras.
- Digital signals on the application board (e.g. clock signals, SDIO signals).

If spectral peaks are observed in the spectrum, this usually relates to radiated harmonics. The source can be identified by looking for an integer relation between the observed spectral peaks and the system frequencies. For example, peaks at 1200 and 1248 MHz are an indication of an interfering source at 48 MHz as this maps to the 25^{th} and 26^{th} harmonic of a 48 MHz signal. This may correspond to the frequency of a microcontroller in the application.

Integration cross-talk can be solved in a number of ways:

- Shift the clock frequency of the interfering signal to avoid the GNSS bands.
- Use shielding tape with conductive adhesive.
- Shield radiating circuits, preferably all around.
- Put digital signals in inner layers of the application board.
- Change the antenna location by experimentation.
- Enable the interference mitigation feature of the AsteRx-m2. Narrow spectral peaks can be eliminated with the notch filters (see the **setNotchFiltering** command). Intermittent wide-band cross-talk can often be eliminated with the wide band interference canceller (see the **setWBIMitigation** command).

AsteRx-m2 has been designed to minimize radiation and can be used close to an antenna without additional shielding.