AsteRx-m2a 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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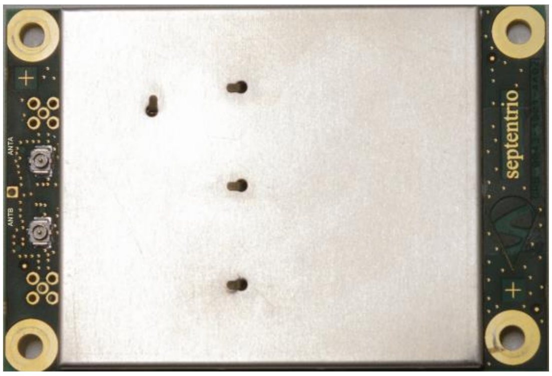
ROHS/WEEE NOTICE

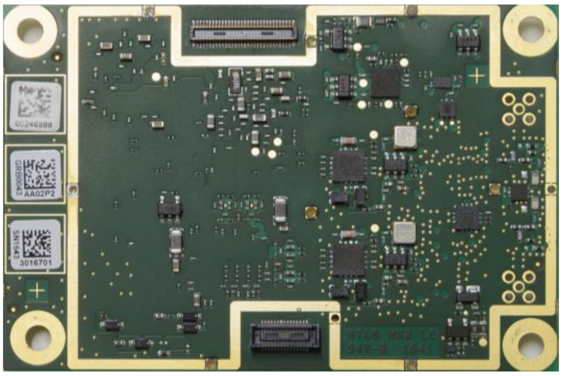
Septentrio receivers are compliant with the latest WEEE, RoHS and REACH directives. For more info see www.septentrio.com/en/environmental-compliance.

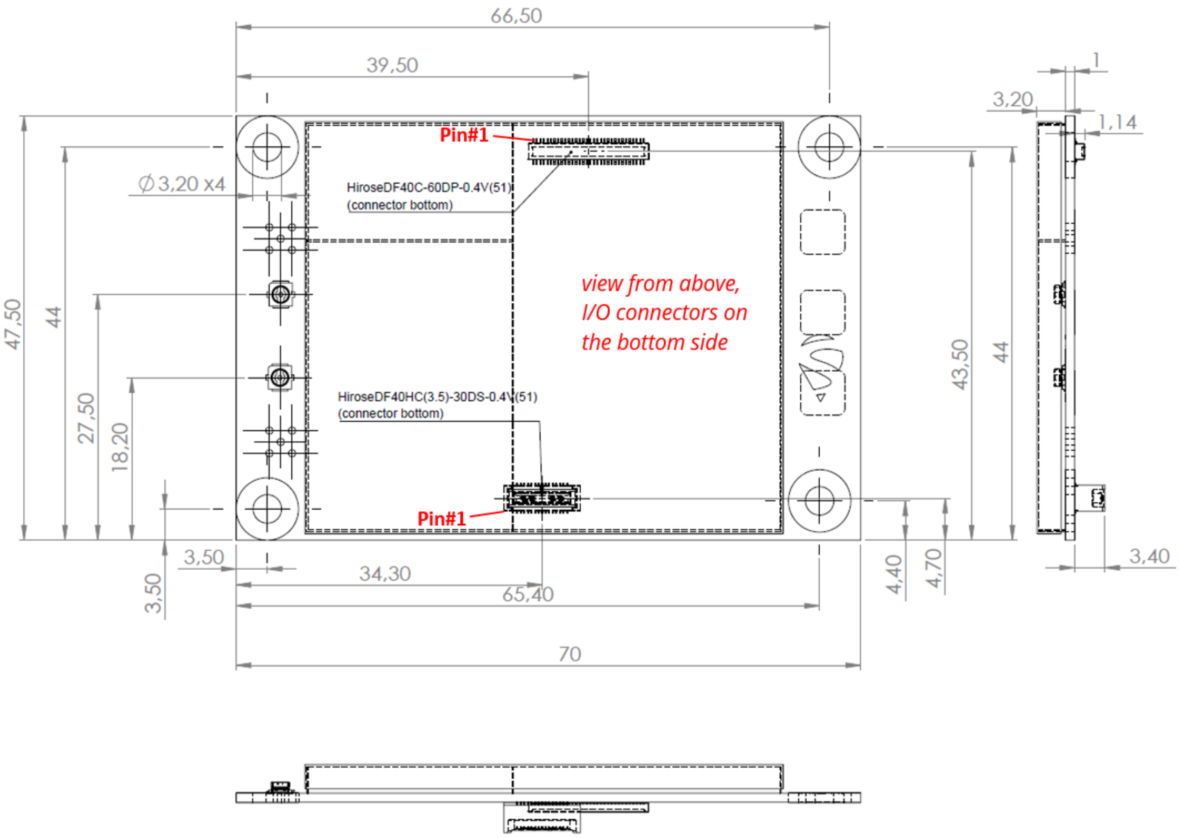
ESD PRECAUTIONS

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-m2a 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.

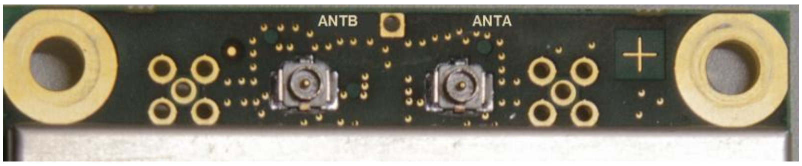
The following table shows the typical power consumption in dual-antenna mode for selected sets of signals:

Signals enabled with **setSignalTracking**	Power consumption
GPS L1+L2	1000 mW
GPS L1+L2, GLO L1+L2	1050 mW
All GNSS signals from all GNSS constellations	1115 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 main antenna must be connected to the ANTA u.FL and the auxiliary antenna must be connected to the ANTB u.FL 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 always applied • ANTB u.FL connector: DC applied unless the user command "**setFrontendMode, SingleAnt**" has been issued. 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
Guaranteed antenna current (ANTA or ANTB)	200 mA
Antenna current limit (ANTA or ANTB)	< 300 mA
Antenna net gain range[1]	15-45 dB For optimal performances, the net gain on ANTA and ANTB must not differ by more than 10dB.
Receiver noise figure (NFrx, see below)	10 dB (with 15-dB net gain) The receiver noise figure increases as the net gain increases, but its contribution to the system noise figure decreases. The worse case is for a net gain of 15dB.
RF nominal input impedance	50 Ohms
VSWR (ANTA or ANTB)	< 2.5:1 in 1200-1251 MHz and 1560-1610 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. NFrx depends on the net gain, but a good approximation (<0.5dB) of NFsys can be obtained by setting NFrx = 10dB.
- 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. In this case, the system noise figure is:

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

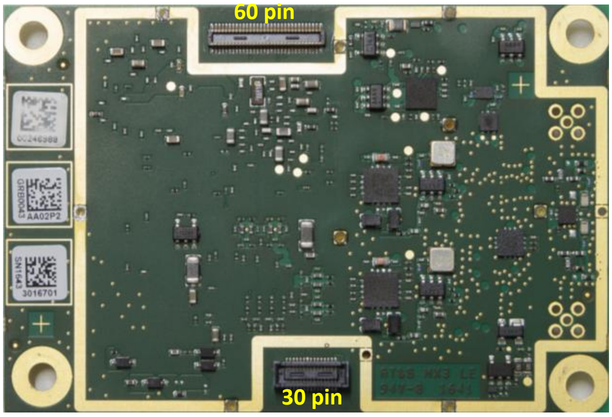
The C/N0, in dB-Hz, of a GNSS signal received at a power P can be computed by:

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

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.

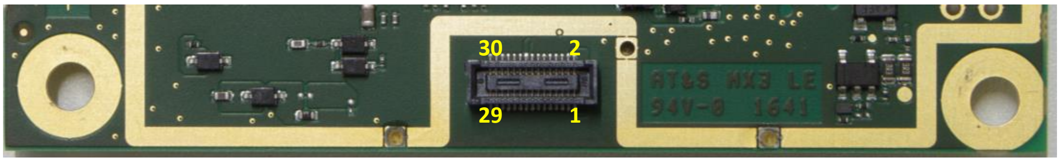
- When pull-up/down resistors are needed, use 10 kΩ.

- 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: $VI_L \leq 0.8V$, $VI_H \geq 2.0V$, $VO_L \leq 0.4V$, $VO_H \geq 2.4V$.
- PU: internally pulled up
- PD: internally pulled down
- K: keeper input type

2.5.1 30-pin Connector



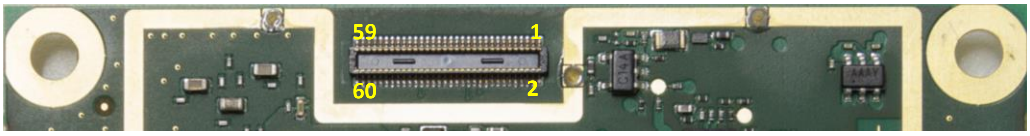
Connector type: Hirose 30 pins DF40HC (3.5)-30DS-0.4V(51)
Mating connector: Hirose DF40C-30DP-0.4V(51)

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 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.	
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-m2a drives this pin low when ready to receive data.	
13	RTS3	O	LVTTL	Serial COM3 RTS line. The AsteRx-m2a 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 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 10)	

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-m2a.	
14	CTS3	I, K	LVTTL	Serial COM 3 CTS line. Must be driven low when ready to receive data from the AsteRx-m2a.	
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-m2a 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 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. 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.

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).

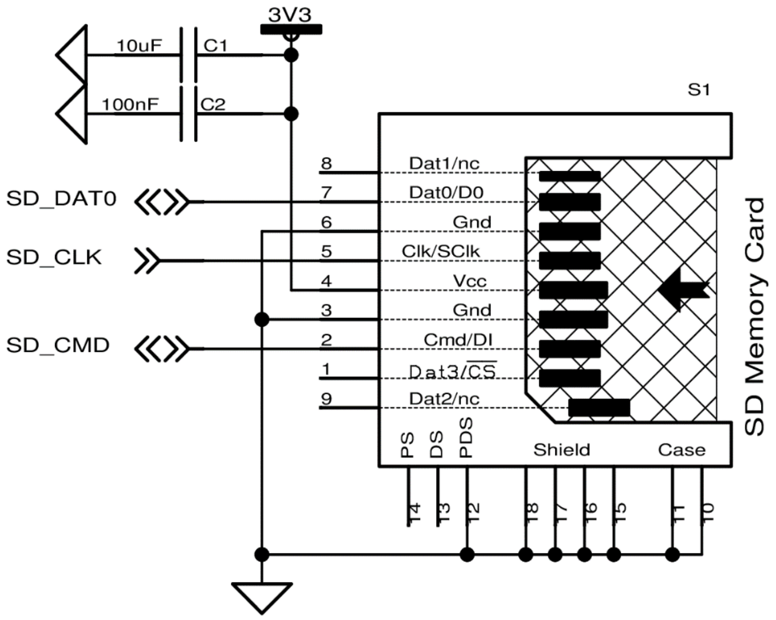
2. By entering the "**exePowerMode, StandBy**" user command. To wake up, the nPDN pin should be shortly driven low (at least for 50ms).

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**" 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

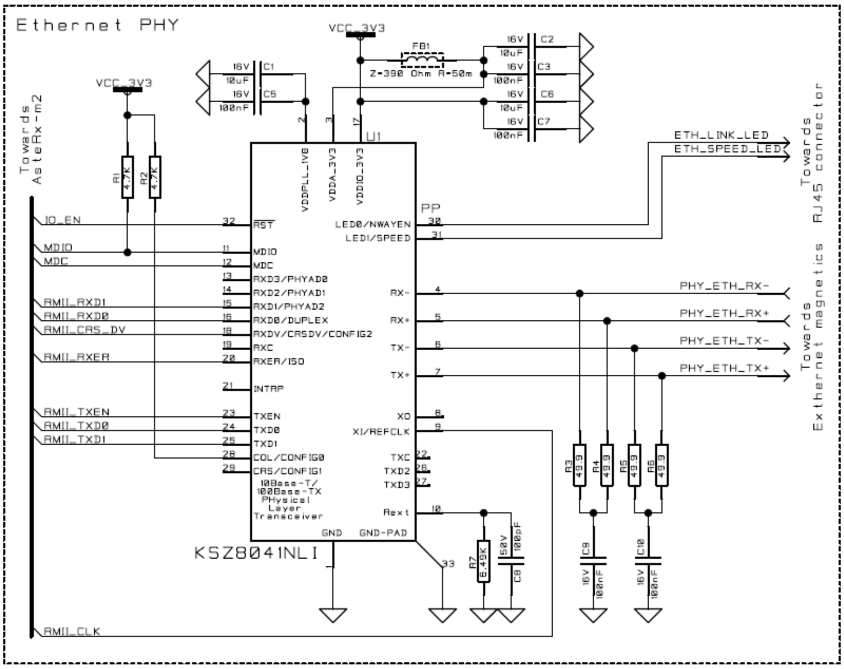
The user can configure the USB device interface in either USB 1.1 (full speed) mode, or in USB 2.0 (high speed) mode. USB 2.0 allows higher bandwidth (480 Mbps vs 12 Mbps), but may not be supported by all host hardware.

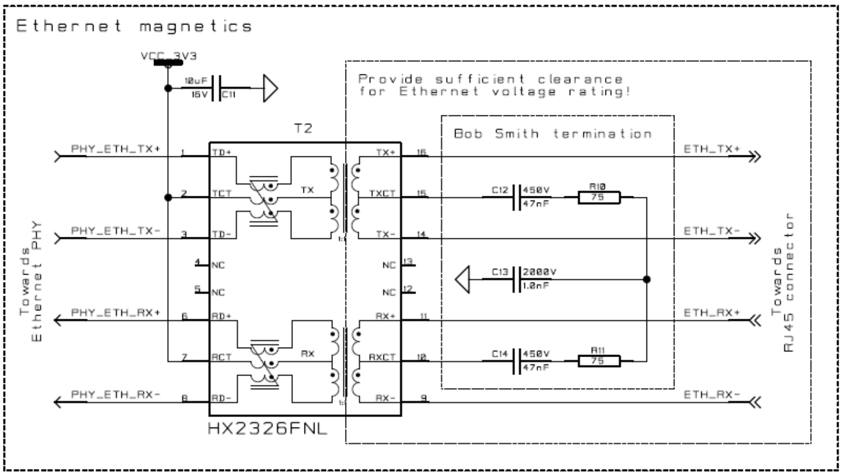
By default, USB is configured in USB 1.1 mode. The update files “AsteRx-m2a_USB_1_1.suf” and “AsteRx-m2a_USB_2_0.suf” located in the `USB/` folder of the firmware package can be used to change this. The current USB mode can be checked with the command “**lif, Identification**”.

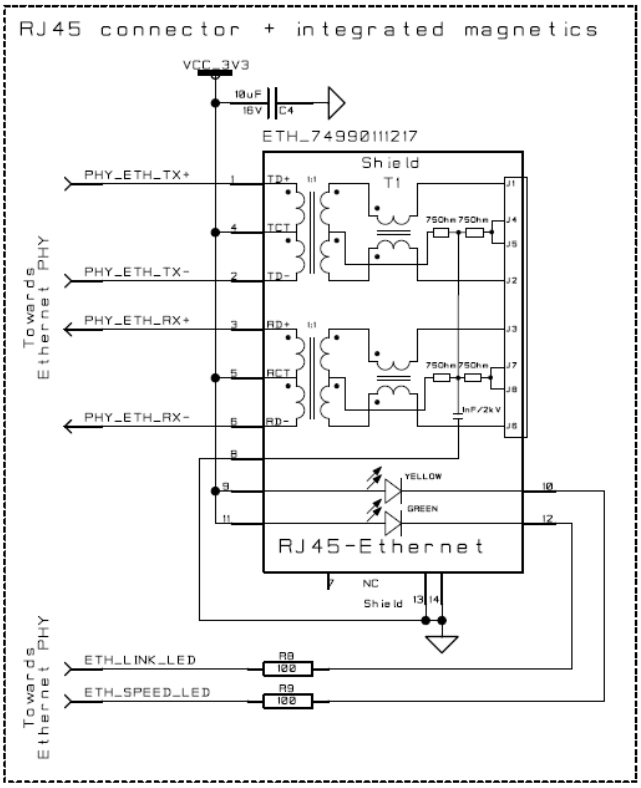
2.12 Ethernet

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.

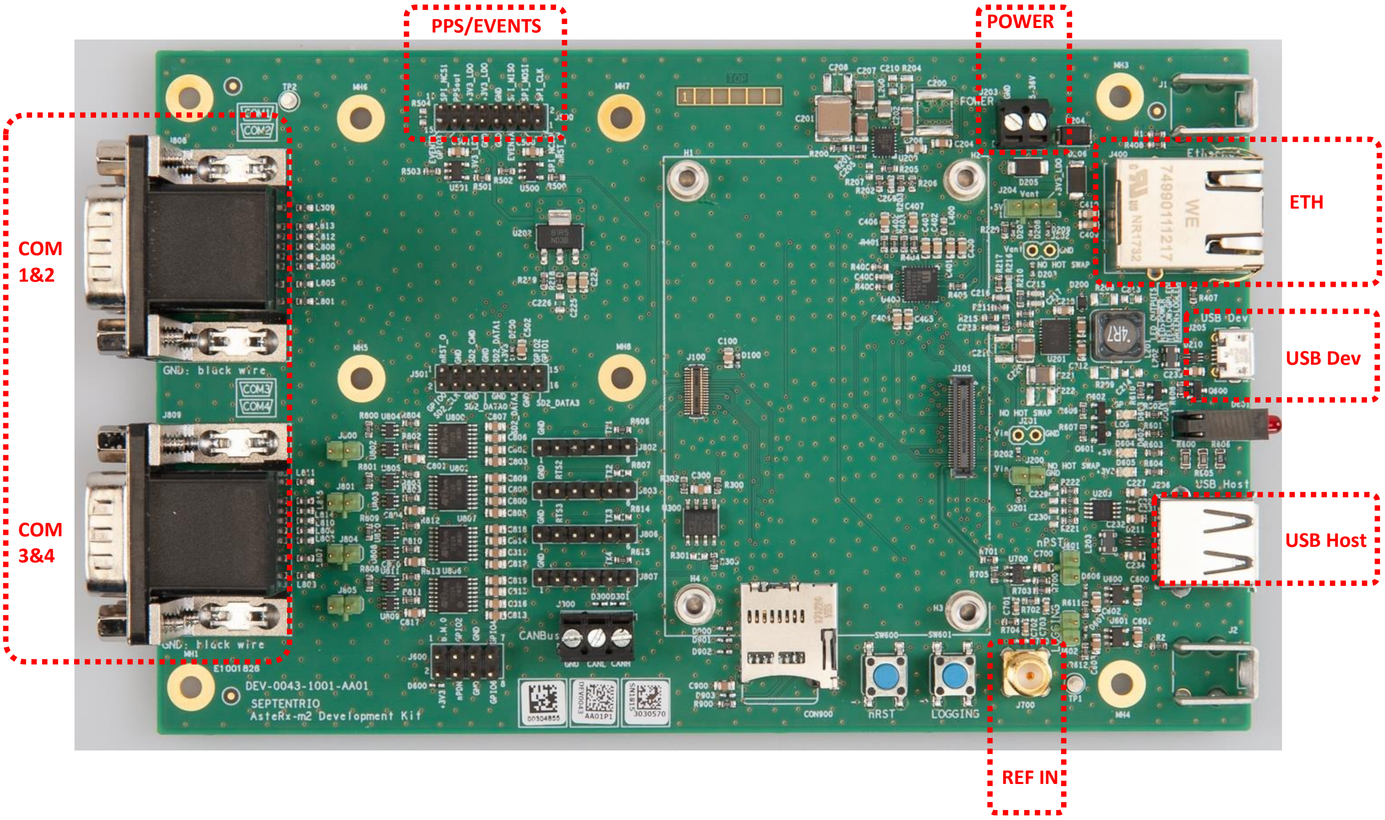
An example of application circuit is given in the next page. Two options are shown: stand-alone magnetics or magnetics integrated in a RJ45 connector.


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


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


RJ45 connector + integrated magnetics
VCC_3V3
ETH_7499011217
Shield
T1
PHY_ETH_TX+
PHY_ETH_TX-
PHY_ETH_RX+
PHY_ETH_RX-
Towards Ethernet PHY
YELLOW
GREEN
RJ45-Ethernet
ETH_LINK_LED
ETH_SPEED_LED

3 Development Kit



The AsteRx-m2a 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

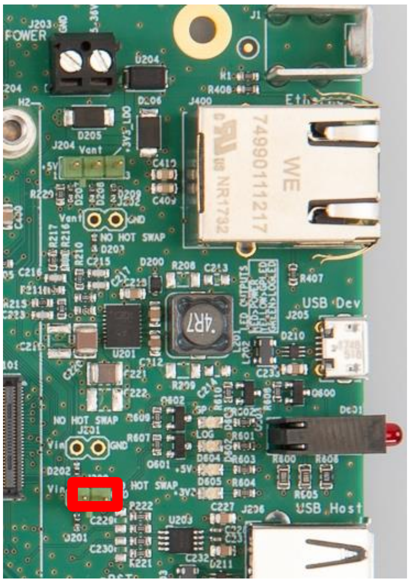
There are two ways to power the DevKit:

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-m2a 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.

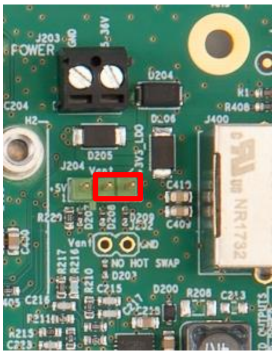
3.3 Antenna Connectors

There is no antenna connector on the DevKit. The antennas 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.

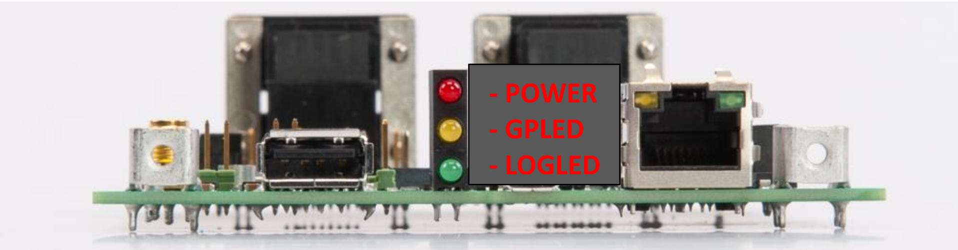
Vant = 5V

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.

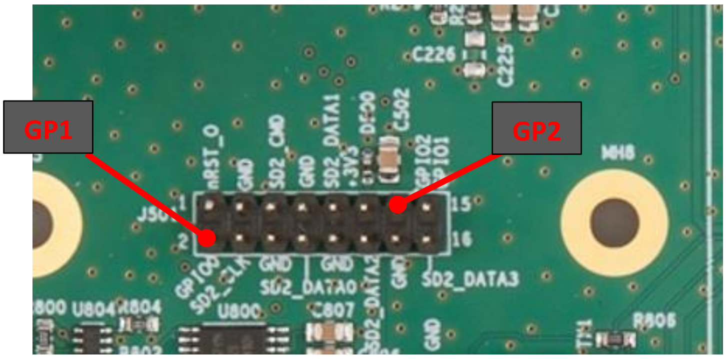
3.4 LEDs and General Purpose Output Pins



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-m2a board. See section 2.5.1 for the pinout, and Appendix A for a description of the LED behavior.

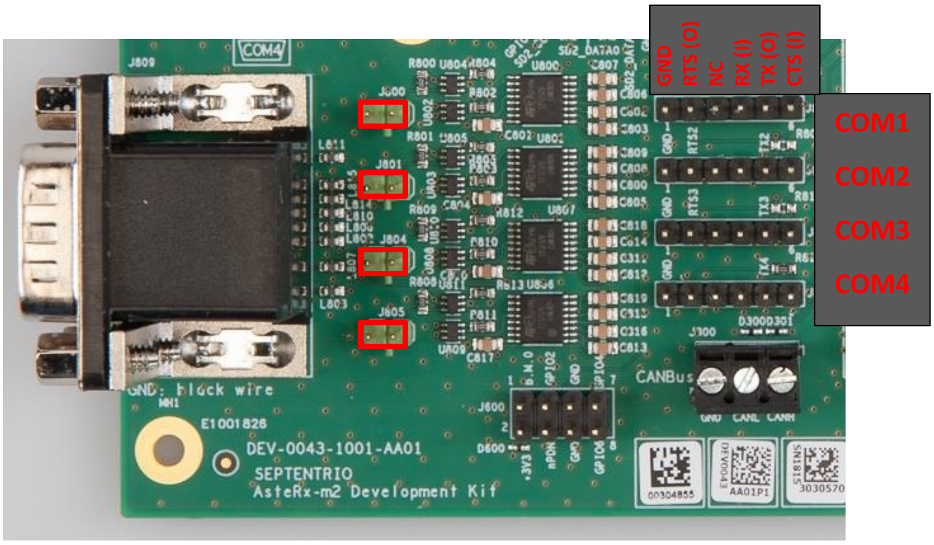
The 3.3V GP1 and GP2 outputs are available on the J501 header.



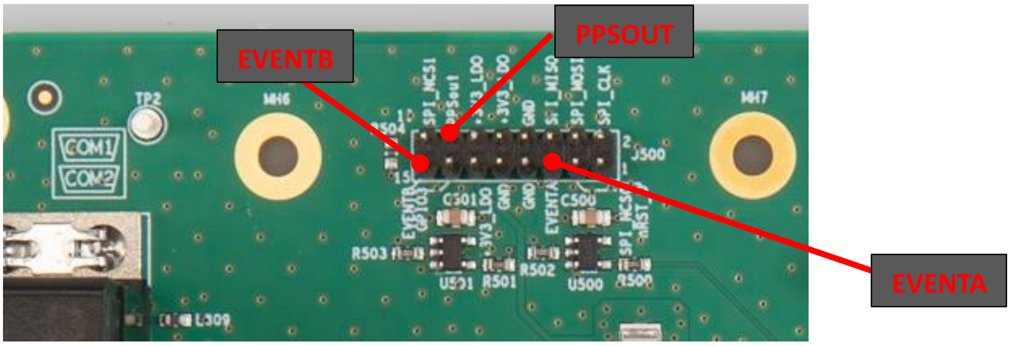
3.5 COM Ports

By default, the four COM ports of the AsteRx-m2a 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-m2a (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-m2a 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

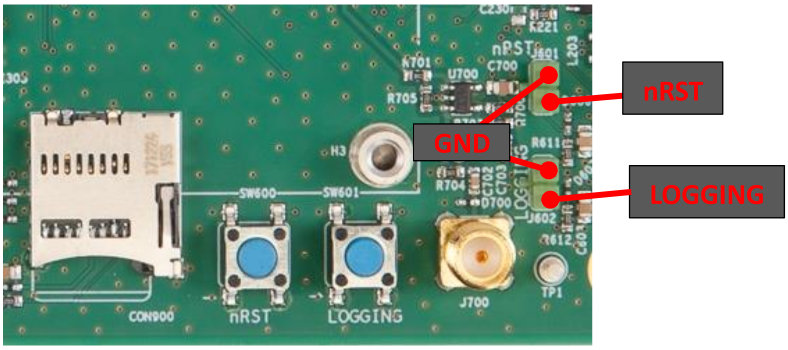
Reserved.

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-m2a low, which resets the receiver.

Pressing the LOGGING button drives the Button pin of the AsteRx-m2a 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.

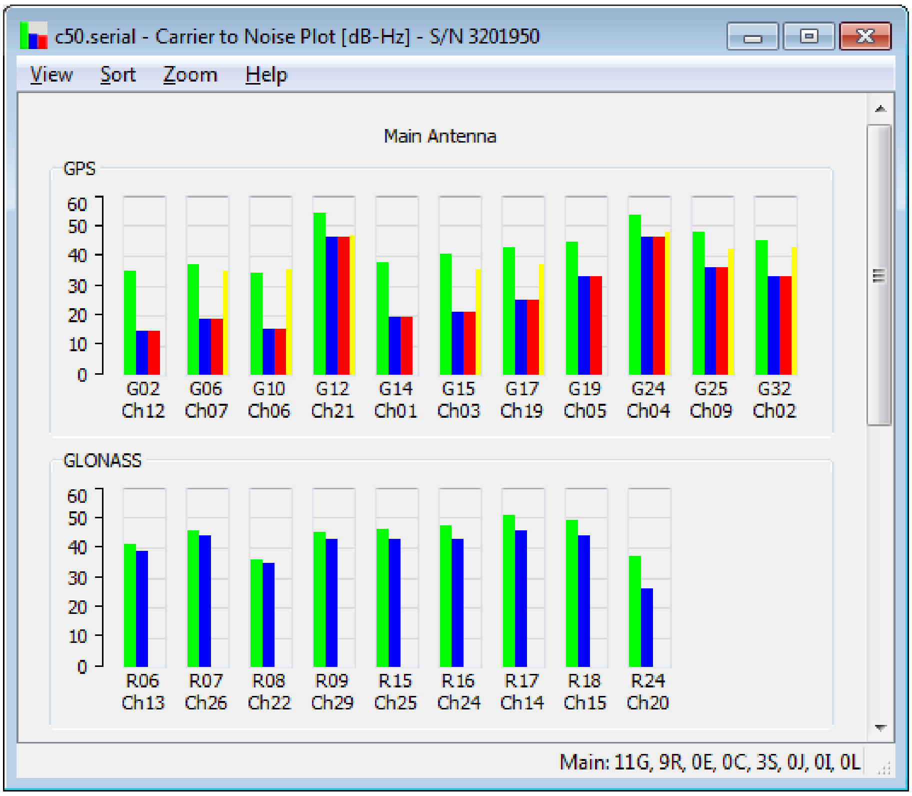
LED	LED Behaviour
LOGLED	LED is off when the SD card is not present or not mounted. LED is on when the SD card is present and mounted. Short blinks indicate logging activity.

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

Appendix B EMC Considerations

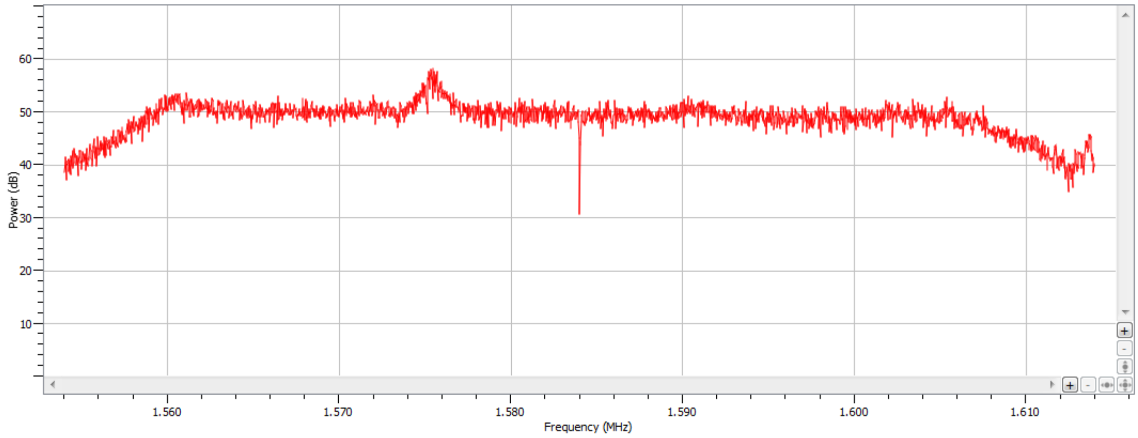
In applications in which the electronics are collocated with the GNSS antenna, cross-talk could be a major concern. GNSS signals are very weak and easily interfered by radiated harmonics of digital signals.

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 up to 45 dB-Hz on L2, as illustrated below.

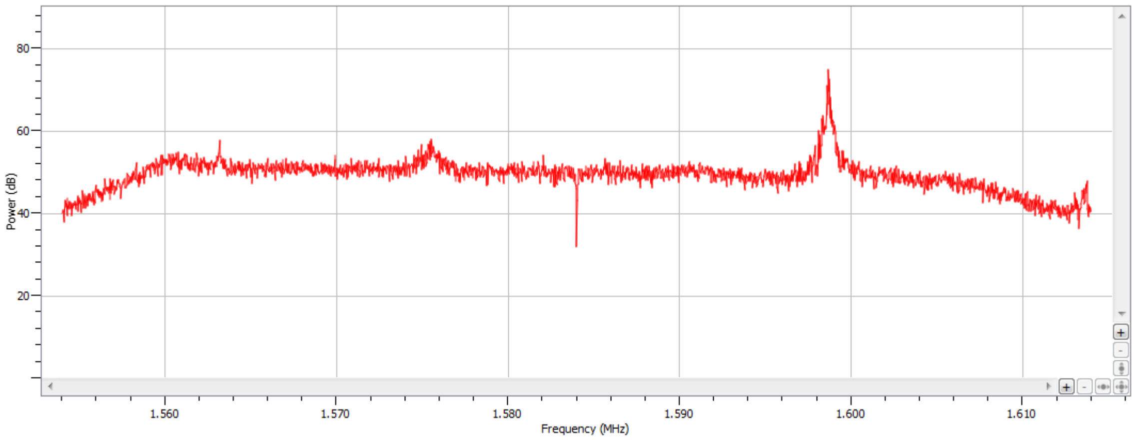


If the maximum C/N0 is lower than expected, interference and cross-talk from nearby electronics is likely, and the source of the problem needs to be identified. This is where the RF spectrum monitor built in the AsteRx-m2a comes in handy. The spectrum monitor can be accessed in RxControl under the *View / 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.

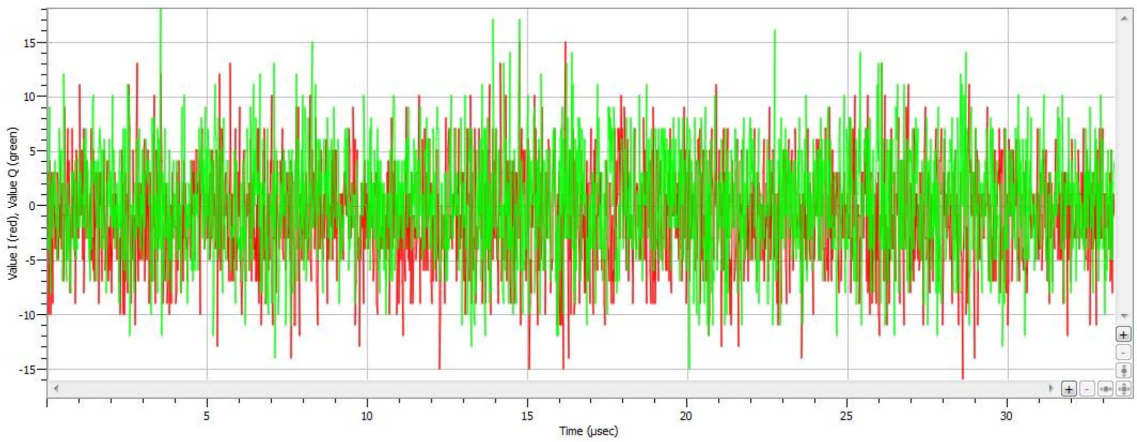


An example of interference is shown below. This particular interference at about 1598 MHz falls in the GLONASS L1 band and slightly degrades the L1 C/N0 of some GLONASS satellites.

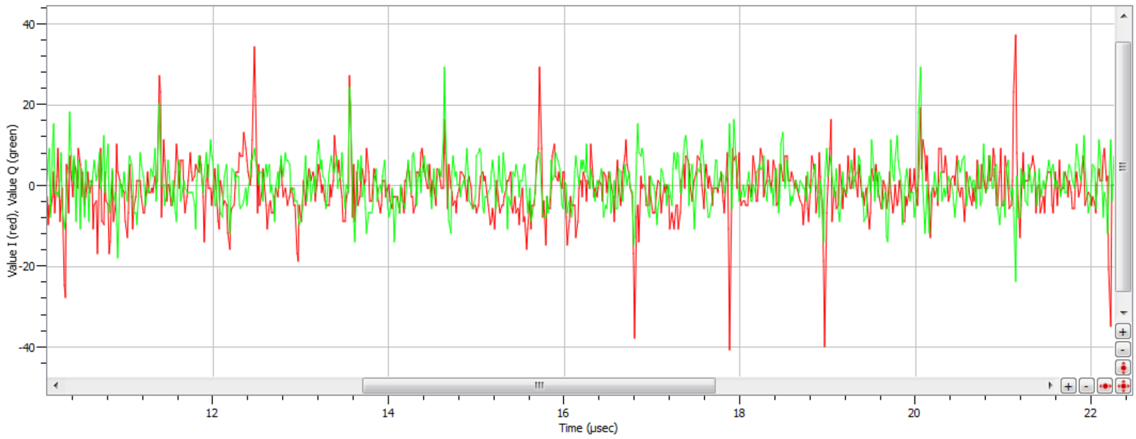


Try to keep personal computers and other equipment more than 2 meters away from the antenna while assessing electromagnetic compatibility of the integration.

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-m2a. 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-m2a has been designed to minimize radiation and can be used close to an antenna without additional shielding.