



TangerineSDR



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Magnetometer Module (MAG)

Interface Control Document

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1. Introduction

The Personal Space Weather Station (PSWS) Magnetometer Module provides 3-axis magnetic field measurements for input to the PSWS Tangerine SDR Data Engine (DE) module. It consists of 3 modules:

- A magnetometer measurement module: PNI Sensor RM-3100.
- A local range extender module.
- A remote range extender module.

The measurement module is an assembled and tested module made by PNI Sensor Inc., model RM-3100. This module can use I2C or SPI to interface to a computer. It will need to be remotely mounted away from the space weather station to avoid distortion of the magnetic field by nearby metallic objects. For this project the I2C interface will be utilized.

The local extender module plugs onto to the Tangerine SDR Data Engine module and provides a means to extend the I2C interface and power through a cable to the remote range extender module. It sources low-voltage current-limited DC power and two differential signals (SDA and SCL) on an external cable to the remote module. It provides ESD protection on the cable interface.

The remote range extender module terminates the cable coming from the local range extender module, derives and regulates received power, terminates the extended I2C connection from the cable, and provides a socket for the measurement module to plug onto. The two receivers in each direction will be terminated in 100 ohms (the nominal characteristic differential impedance of each twisted pair).

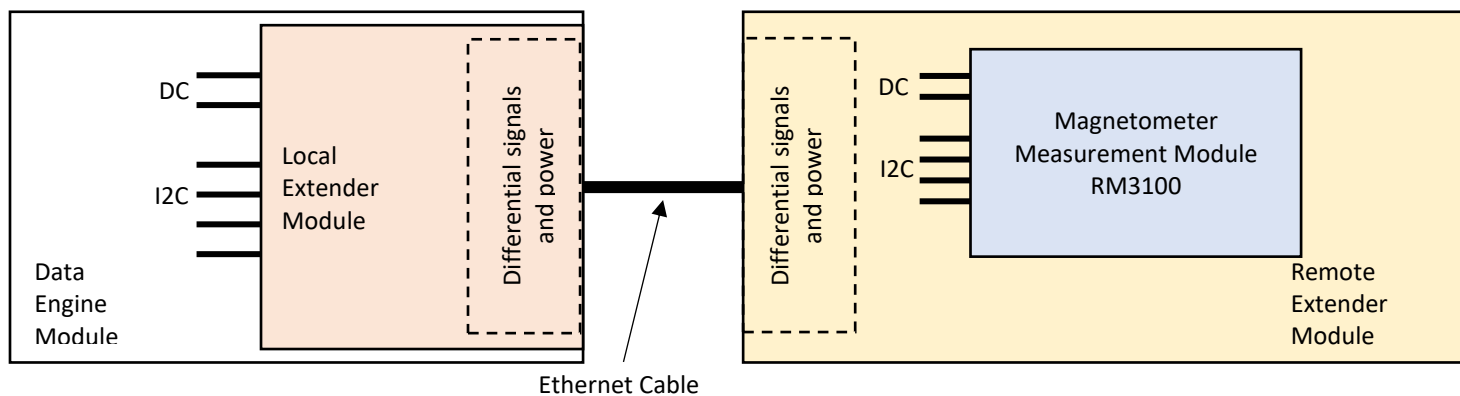
Figure 1 is a block diagram of the Magnetometer and range extension modules.

The interconnecting cable will utilize Cat 5e or Cat 6 Unshielded twisted-pair (UTP) copper cable, 24 gauge or larger. It will be connectorized with RJ-45 plugs. This allows the use of off-the-shelf Ethernet cables. The format is not Ethernet, nor is it compatible with Ethernet. It will be designed to minimize the potential of damage if inadvertently connected to an Ethernet device.

If radiated interference from the cable is an issue then Shielded twisted-pair (STP) Cat 6a Ethernet cable will be utilized instead. The local and remote modules shall provide shield-grounding RJ45 connectors in either case.

The maximum allowable length of the cable shall be TBD meters, and the I2C rate shall be TBD kb/s. The objective (to be finalized after characterization) is 30 meters (100

feet) and 100 kb/s. The reach is dependent on data rate due to round-trip propagation delay.



**Figure 1 – Block Diagram of the three Magnetometer Modules
(Measurement, Local Extender, Remote Extender)**

1.1. References

PNI Sensor RM-3100 User manual – downloadable from:

<https://www.pnicorp.com/download/rm3100-user-manual/>

PNI Sensor RM3100 Sales Sheet (datasheet) – downloadable from:

<https://www.pnicorp.com/rm3100/>

NXP I2C PCA9615 Range Extender IC:

<https://cdn.sparkfun.com/assets/a/5/1/3/6/PCA9615.pdf>

2. Electrical Interfaces

This section defines the electrical interfaces of the Magnetometer Modules, including the connectors, connector pin outs, signals, and signal formats. All the active devices on all 3 modules run on +3.3V power. Both the local and remote modules derive +3.3V from the +5V power connections using Low-Drop-Out regulators.

2.1. Local Extender Module

J1 – PMOD Connector to Data Engine or Local Host.

Connector Pin #	Signal Name	Signal Electrical Format	Input / Output / Bidirectional	Description
1	+ 5VDC		I	Provides +5 VDC power to the module. Expected current draw is 25 mA average, peaks to 75 mA.
2	SCL	3.3V CMOS	I	I2C SCLK Input
3	SDA	3.3V BiDir	B	I2C SDTA signal input and output.
4				NC
5				NC
6	GND			Ground (power and signal).

J2 – Shielded RJ45 Receptacle to Remote Extender. See note on pair grouping.

Connector Pin #	Signal Name	Signal Electrical Format	Input / Output / Bidirectional	Description
1	SCL+	Differential	O	Differential SCL to balanced pair
2	SCL-	Differential	O	Differential SCL to balanced pair
3	SDA+	Differential	B	Differential Bidirectional SDA to balanced pair
4	VCC	+5 VDC	O	Current-Limited Power to Cable
5	VCC	+5 VDC	O	Current-Limited Power to Cable
6	SDA-	Differential	B	Differential Bidirectional SDA to balanced pair
7	RET	Power Return	O	Ground and power return to Cable
8	RET	Power Return	O	Ground and power return to Cable
Shield	GND	Ground		Cable Shield

Note that Ethernet Cables are pre-constructed with the pairs connected as:

1,2

3,6

4,5

7,8

It is important that pairs not be split between different signals, SDA is connected to the 3,6 signal pair.

2.2. Remote Extender Module

J1 – Measurement Module Interface. Two 0.1 inch 7-pin female headers. The headers are spaced 0.9 inches apart. The pin numbering and mechanical layout follows the PNI3100 documentation (see figure 3.1).

Connector Pin #	Signal Name	Signal Electrical Format	Input / Output / Bidirectional	Description
1	SCL	3.3V CMOS	O	I2C SCL to Measurement Module
2	SA1	Ground	O	I2C Slave Address 1
3	SDA	3.3V Bidir	B	I2C SDA
4	SA0	Ground	O	I2C Slave Address 0
5				No Connect
6				No Connect
7	AVSS	Ground		Analog Ground
8				No Connect
9				No Connect
10	I2C_En	+3.3V PUP	O	I2C Mode Enable – pullup resistor
11				No Connect
12	DVDD	+3.3V		+3.3VDC Supply
13	AVDD	+3.3V_A		+3.3VDC Filtered supply
14	DVSS	Ground		Digital Ground

J2 – Shielded RJ45 Receptacle to Remote Extender. See note on pair grouping.

Connector Pin #	Signal Name	Signal Electrical Format	Input / Output / Bidirectional	Description
1	SCL+	Differential	I	Differential SCL to balanced pair
2	SCL-	Differential	I	Differential SCL to balanced pair
3	SDA+	Differential	B	Differential Bidirectional SDA to balanced pair
4	VCC	+5 VDC	I	Current-Limited Power from Cable
5	VCC	+5 VDC	I	Current-Limited Power from Cable
6	SDA-	Differential	B	Differential Bidirectional SDA to balanced pair
7	RET	Power Return	I	Ground and power return to Cable
8	RET	Power Return	I	Ground and power return to Cable
Shield	GND	Ground		Cable Shield

Note that Ethernet Cables are constructed with the twisted pairs already connected as:

- 1,2
- 3,6
- 4,5
- 7,8

It is important that pairs not be split between different signals, SDA is connected to the 3,6 signal pair.

2.3. Measurement Module

This module is an off-the-shelf commercial product the PNI Sensor RM-3100. The interface is described in the manufacturer's documentation. The unit can be purchased with or without 0.1 inch header pins installed. If purchased without, then the user will be required to install and solder the pins. These pins are used to plug the Measurement module onto the Remote extender module.

3. Mechanical Interfaces

This section describes the mechanical packaging of the magnetometer modules, including board profile, mounting and screw holes, and connector placement.

The Local Extender Module is intended to be mounted to the receiver metal enclosure directly at the Ethernet Connector Shield. This minimizes the inductance of the shield to the case enclosure in order to minimize radiated emissions on the cable.

The Remote Extender module will like be mounted in a plastic case to avoid disturbing the magnetic field around the measurement module. The Measurement module physically plugs onto the remote extender module. Thus the Ethernet Shield is directly connected to the Measurement Module ground return minimizing radiated emissions due to the small electrical loop area.

The Measurement Module Profile is shown in Figure 3.1 The Local Extender Module profile is shown in Figure 3.2 (TBD), and the Remote Extender Module Profile is shown in Figure 3.3 (TBD).

Dimensions in mm

Dimensions are max. unless otherwise noted

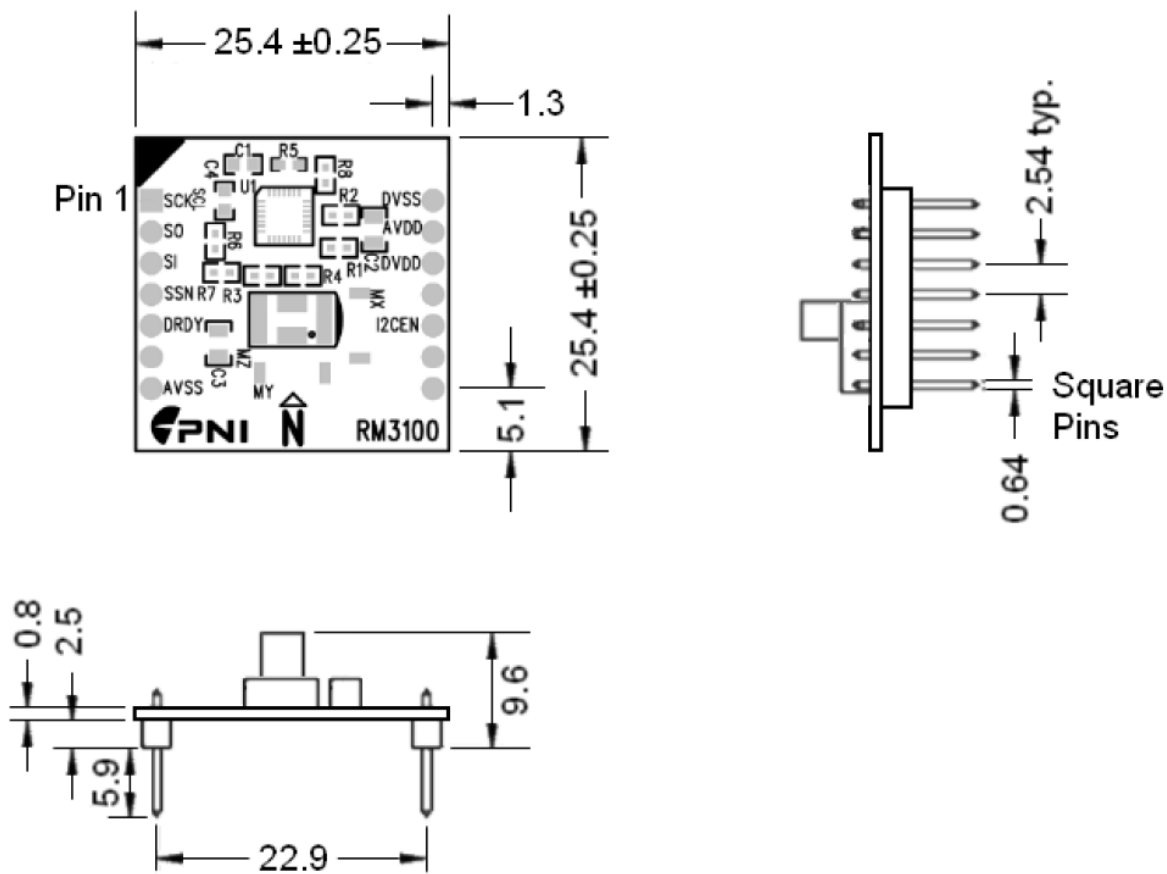


Figure 3-1: RM3100 Evaluation Board Mechanical Drawing