



TangerineSDR



TangerineSDR
Magnetometer Modules (MAG)
Requirements Document

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VERSION HISTORY

Version Number	Implemented By	Revision Date	Approved By	Approval Date	Description of Change
0.1	T. McDermott	July 11, 2019			Original Issue.
0.2	T. McDermott	July 16, 2019			Change interface to I2C mode to utilize available range extender IC. Change cable power method. Set objectives to 100 kb/s to determine reach of 30m. Revise cost goal.
0.3	T. McDermott	July 24, 2019			Change PMOD power to +5VDC only. Add direct use case.
0.3.1	T. McDermott	August 1, 2019			Reformat and Change Document Number
0.4	T. McDermott	September 9, 2019			On the figure clarify that the extender cable is Cat 5 or 6 with RJ45 connectors and remove the word Ethernet.
0.4.1	T. McDermott	December 18, 2020			Add NSF grant support information

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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).

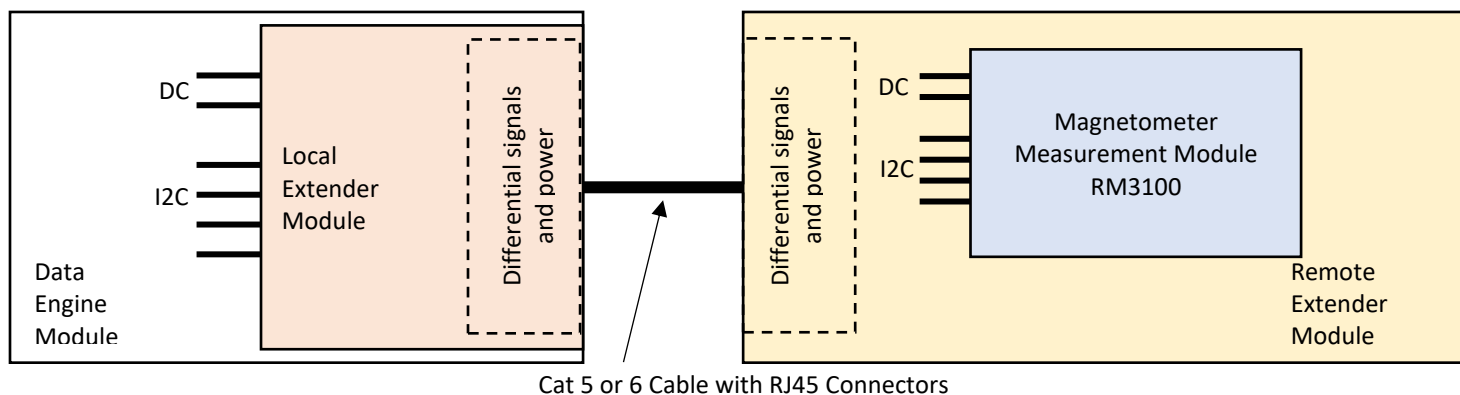
Figure 1 is a block diagram of the Magnetometer and range extension modules.

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. Cost Goal

The cost goal (parts cost) of the three modules, not including interconnecting cable is \$50.

1.2. 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. Power Supply

The Local Extender Module shall be powered by +5 VDC by the Tangerine SDR Data Engine PMOD connector. The interface will operate in I2C mode. The interface will operate with 3.3 volt logic levels in the I2C interface.

The local extender module will be powered from the +5V input via a low-dropout regulator to +3.3 VDC which will power the active device.

The local extender module will power the cable with nominally +5VDC via a current limiter device.

The Remote module will be powered via the interconnecting cable. The nominal +5V cable voltage will be regulated to +3.3 VDC via a low-dropout regulator at the remote extender. That voltage will power the remote extender active device and the Magnetometer measurement module which is plugged onto the remote extender via 0.1 inch pin headers.

The current draw from the collection of three modules (local module plus remote module plus measurement module) is anticipated to be nominally 25 mA when inactive with brief peaks to 75 mA. Most of the power consumption is from the cable termination resistors and line drivers.

3. Local Module Outputs

The local module connects to both the Tangerine SDR DE module and the external cable RJ-45 connector. The external cable has 8 pins arranged as 4 pairs. The 2 I2C differential signals plus 2 pairs (4 wires) in the cable. The DC power will be sourced using two wires (one pair). This leaves one pair of wires unused.

4. Magnetometer Module Performance Requirements

The detailed performance requirements of the magnetometer are determined by the specifications of the measurement module. Those specifications are contained in the RM-3100 datasheet from the manufacturer.

5. Other Use Cases

The combination of the three modules shall also support direct connection to the local host computer without connection to the Tangerine Data Engine. This will use 3.3 V I2C logic interface to the local host, and whatever cable is needed to adapt the PMOD pinout of the local extender to the local host I2C, +5V power, and ground. All 3 modules (local extender, remote extender, measurement) are identical between the DE and Local Host uses.

6. Acknowledgments / Other Information

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