HEXAGON | NovAtel

APN-105

Using PIM222A™ & HK222™ for Data Collection

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Overview

The PIM222A is a solder-down module, which combines dual antenna ALIGN® and SPAN® GNSS Inertial Navigation System into one module to provide position, velocity, attitude, and time solution for mass market users. PIM222A uses dual antenna ALIGN for fast INS alignment and improved heading performance. The module comes with an onboard IMU, and can support an external IMU connected via SPI, to help bridge GNSS outages. RTCM V3 corrections are natively supported to perform dual frequency RTK for precise positioning.

The HK222 Evaluation Kit simplifies access to the PIM222A module for evaluation purpose.

This aims to help users start using PIM222A and HK222 for data collection quickly. For more detail on explanation of commands and logs, please refer to PIM222A Evaluation Kit User Guide.

GNSS Operational Modes

The PIM222A module supports GPS, Beidou, and Galileo satellite constellations. It comes with two operational modes, which supports L1, L2 and L1, L5 signals respectively. To change the operational mode of the PIM222A requires updating the Teseo V Measurement Engines using NovAtel Application Suite.

Mode 1	Mode 2
GPS L1CA	GPS L1CA
GPS L2C	GPS L5
BeiDou B1I	BeiDou B1I
BeiDou B2I	BeiDou B2a
Galileo E1	Galileo E1
Galileo E5b	Galileo E5a

Using RTK Corrections

The following RTCM correction messages at 1 Hz are the recommended minimum for achieving RTK solution:

Message Number	Message Name
1006	Stationary RTK Reference Station ARP with Antenna Height
1033	Receiver and Antenna Descriptors
1077	GPS MSM 7
1097	Galileo MSM 7
1127	Beidou MSM 7

COM2 of PIM222A/HK222 is by default setup to receive RTCM V3 correction data at baud rate 460800. Please ensure correction is sent to COM2 of PIM222A in corresponding baud rate and format.

If a different baud rate is used for RTK corrections, please add, or change existing baud rate command in the configuration file as shown below (using baud rate 115200 as an example, supported baud rate includes 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, and 921600):

BaudRate: COM2,115200

Proceed to Configure PIM222A/HK222 for details on how to create a configuration file and load configuration to the PIM222A module.

Updating the PIM222A Module using NovAtel Application Suite

NovAtel Application Suite is used for updating firmware, updating Teseo V Measurement Engine 1, and updating Teseo V Measurement Engine 2. Currently, it does not support loading of configuration files yet. (This feature will be added to NovAtel Application Suite at a future time.) Please note that Measurement Engine 1 and Measurement Engine 2 should use the same operational mode.

Please kindly contact NovAtel Support at **support.novatel@hexagon.com** for PIM222A firmware and Measurement Engine firmware.

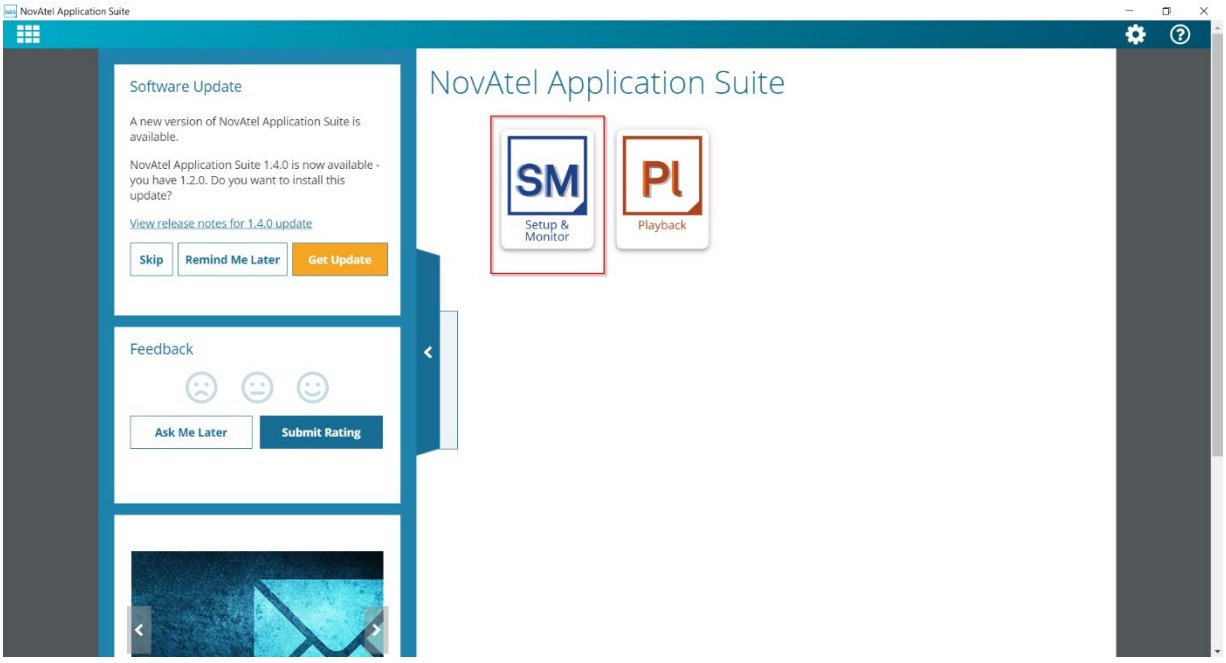
Before connecting the PIM222A using NovAtel Application Suite, ensure the PIM222A is configured with **PIMTP** interfacemode. **PIMTP** interfacemode is factory default setting. If interfacemode has been changed for PIM222A module, please add, or change existing interfacemode command in configuration file as shown below:

InterfaceMode:COM1,PIMTP,PIMTP

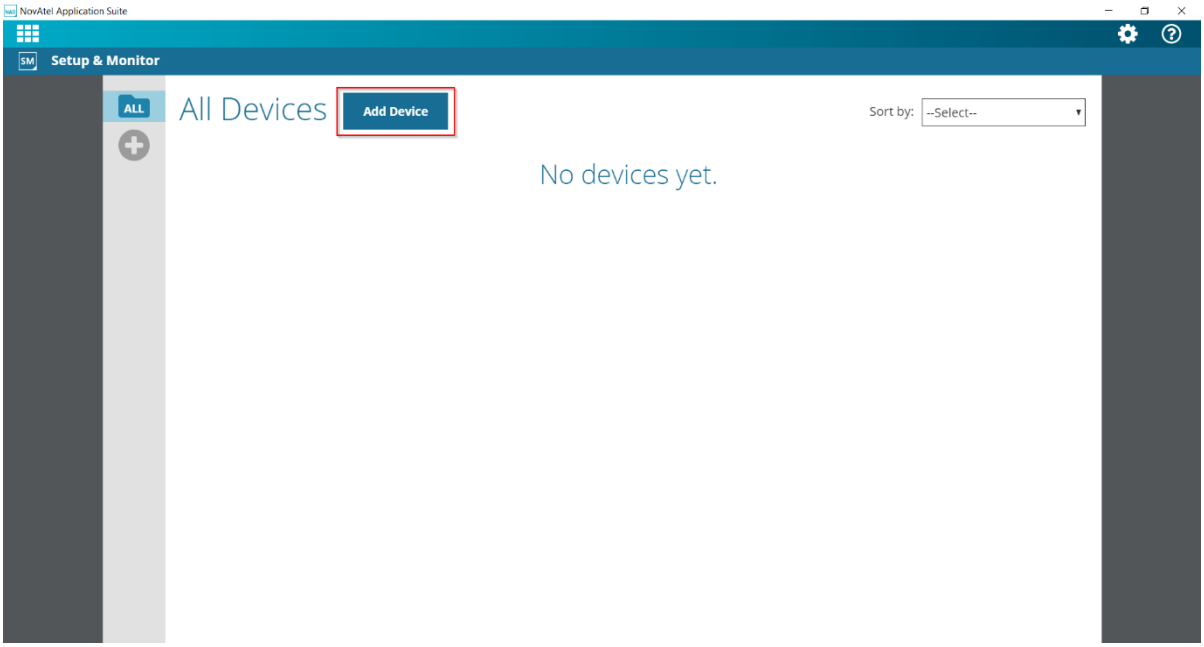
Proceed to Configure PIM222A/HK222 for details on how to create a configuration file and load configuration to the PIM222A module.

6-Step Firmware and Measurement Engine Firmware Update Procedure:

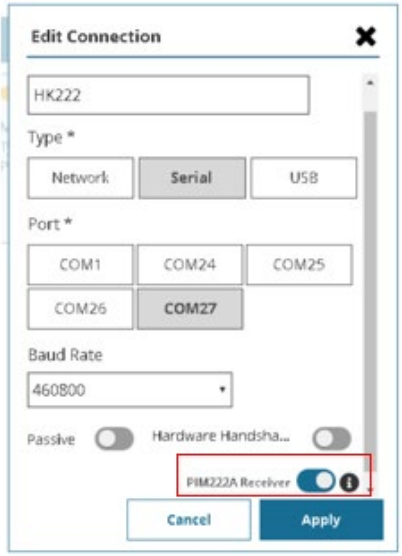
1. Open NovAtel Application Suite and Click ‘Setup & Monitor’:



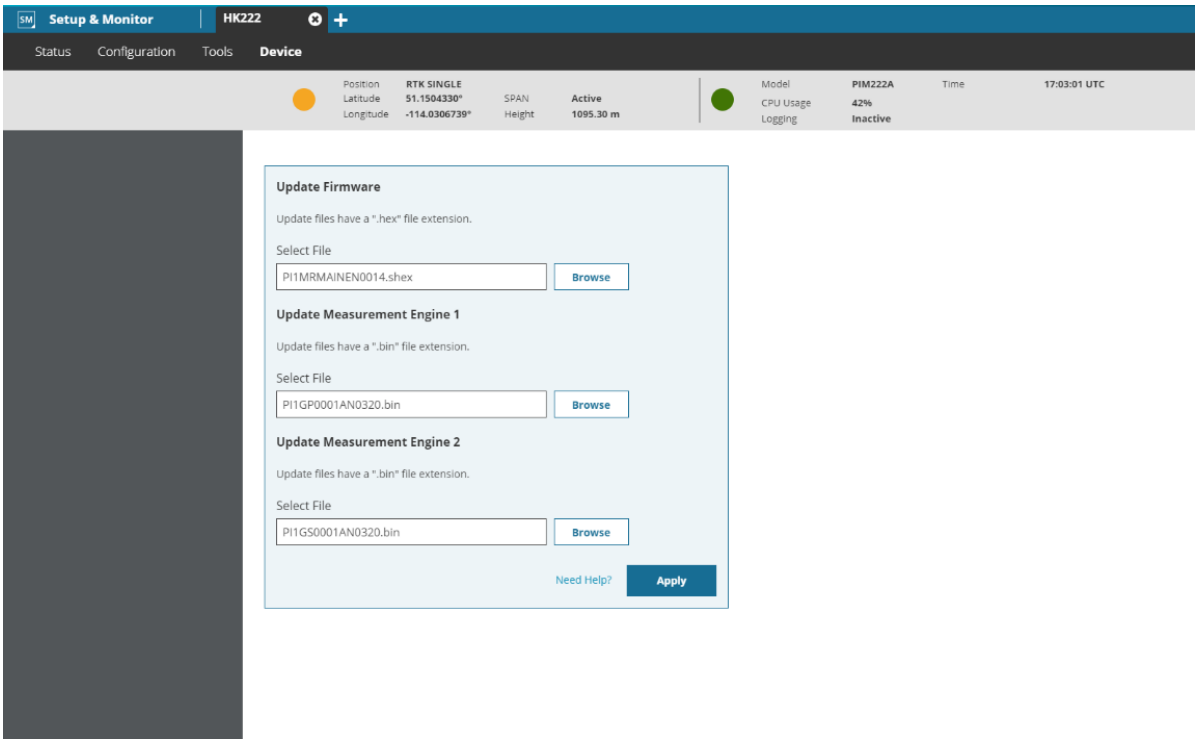
2. Click ‘Add Device’:



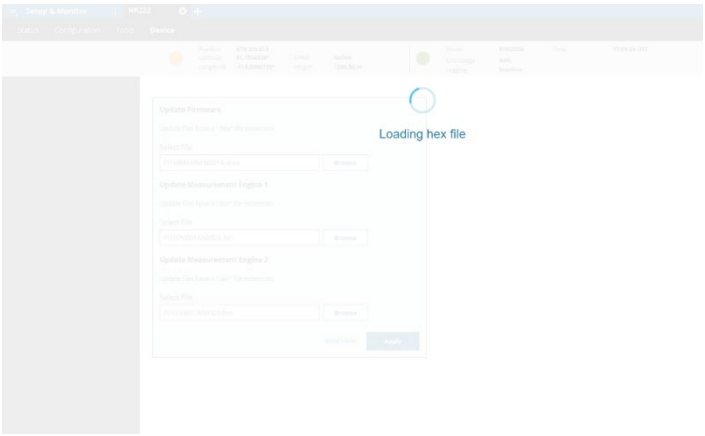
3. Select the COM port corresponding to ‘COM1’ used for the PIM222A/HK222 and toggle on ‘PIM222A Receiver’ option:

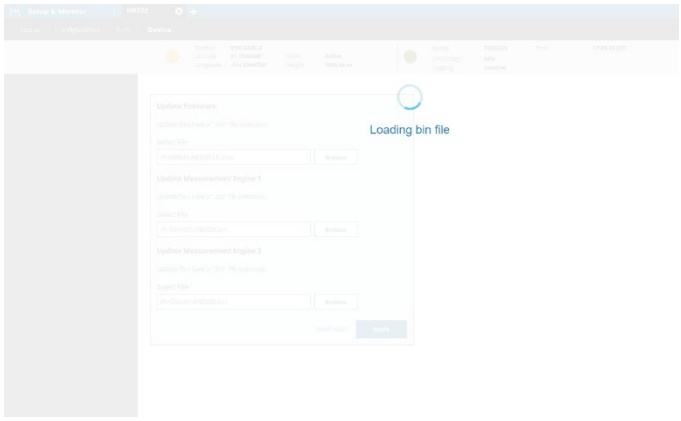


4. Go to ‘Device’ drop down menu and click ‘Update’, be sure to have the correct file selected for ‘Update Firmware’, ‘Update Measurement Engine 1’, and ‘Update Measurement Engine 2’ fields respectively:

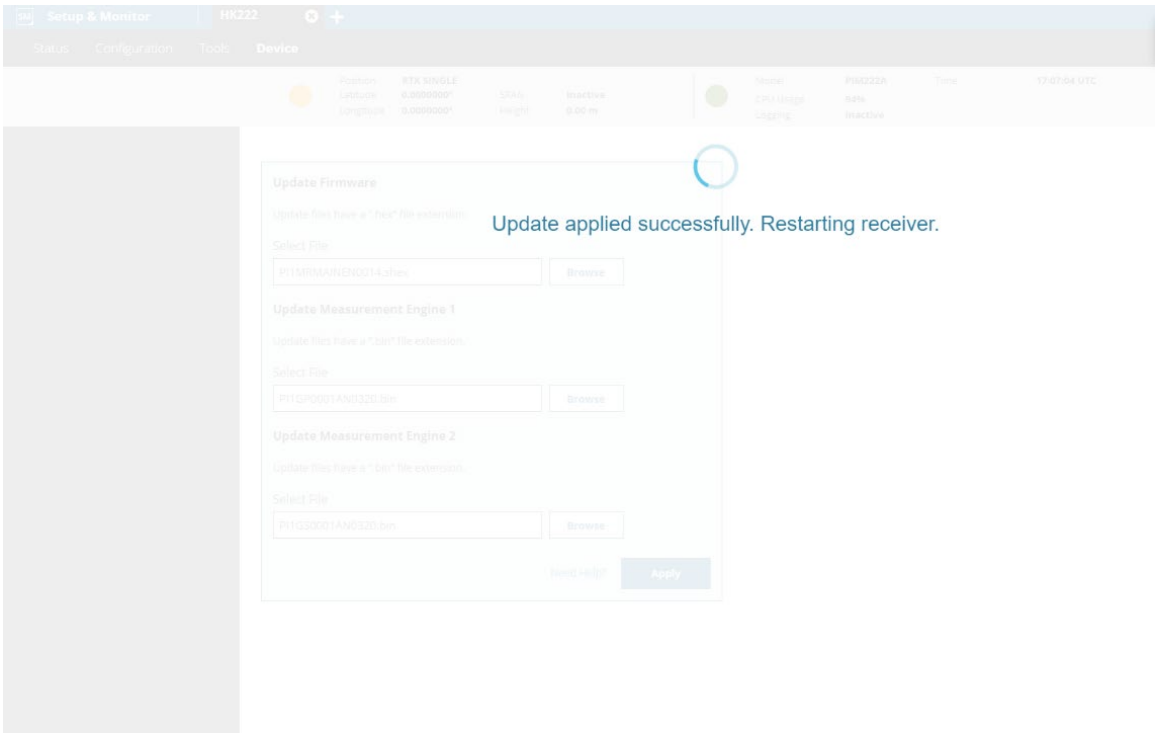


5. Click ‘Apply’ button to update the PIM222A/HK222. NovAtel Application Suite will display current stage of loading process:





6. NovAtel Application Suite will indicate firmware update have been applied successfully and restart the receiver:



Configure PIM222A/HK222

Unlike NovAtel OEM product, PIM222A/HK222 cannot be configured directly using OEM style commands and logs. PIM222A/HK222 requires loading of a configuration file containing special style commands and logging request. This section will only explore examples of common configurations. For more details on commands and logs, please see **Section '3.5.2 Configuration File and Configuration Commands'** in PIM222A Evaluation Kit User Guide.

Commands and Logs

By default, PIM222A COM1 is configured for logging at baud rate 460800. Please see table below for examples of recommended commands and logs that will satisfy data collection and debugging needs.

Using SPAN® Only	Using SPAN® + CAN Vehicle DMI Data
IMU:internal	IMU:internal
BaudRate:COM1,921600	BaudRate:COM1,921600
LogNMEA:COM1,GGA,TIME,0.1,0	LogNMEA:COM1,GGA,TIME,0.1,0
LogNMEA:COM1,GST,TIME,0.1,0	LogNMEA:COM1,GST,TIME,0.1,0
LogNMEA:COM1,PASHR,TIME,0.1,0	LogNMEA:COM1,PASHR,TIME,0.1,0
LogNMEA:COM1,VTG,TIME,0.1,0	LogNMEA:COM1,VTG,TIME,0.1,0
LogNMEA:COM1,GSA,TIME,1.0,0	LogNMEA:COM1,GSA,TIME,1.0,0
LogNMEA:COM1,GSV,TIME,1.0,0	LogNMEA:COM1,GSV,TIME,1.0,0
LogNMEA:COM1,HDT,CHANGE,0,0	LogNMEA:COM1,HDT,CHANGE,0,0
LogNMEA:COM1,ZDA,TIME,1.0,0	LogNMEA:COM1,ZDA,TIME,1.0,0
LogNMEA:COM1,TXT_RXSTATUS,CHANGE,0,0	LogNMEA:COM1,TXT_RXSTATUS,CHANGE,0,0
LogNMEA:COM1,TXT_ITV,TIME,1.0,0	LogNMEA:COM1,TXT_ITV,TIME,1.0,0
LogNMEA:COM1,TXT_VERSION,CHANGE,0,0	LogNMEA:COM1,TXT_VERSION,CHANGE,0,0
LogNMEA:COM1,TXT_RXERROR,CHANGE,0,0	LogNMEA:COM1,TXT_RXERROR,CHANGE,0,0
LogNMEA:COM1,TXT_SOLUTIONINFO,TIME,1.0,0	LogNMEA:COM1,TXT_SOLUTIONINFO,TIME,1.0,0
INSRotation:RBV,0,0,90,3.0,3.0,3.0	INSRotation:RBV,0,0,90,3.0,3.0,3.0
INSTranslation:Ant1,-0.210,-0.458,0.737,0.03,0.03,0.03	INSTranslation:Ant1,-0.210,-0.458,0.737,0.03,0.03,0.03
INSTranslation:Ant2,-0.208,0.492,0.736,0.03,0.03,0.03	INSTranslation:Ant2,-0.208,0.492,0.736,0.03,0.03,0.03
PIMDebug	PIMDebug
	CAN:CAN1,500K
	DMI:CAN1,DMI_LUA
	INSTranslation:DMI,0.00,0.00,-0.84,0.03,0.03,0.03
	SetVehicleParameters:2.789,1.6256,1.6256,FRONT_WHEEL_ACKERMANN,0
	PIMDMIDebug

Additional Notes	
• IMU command configures IMU connected, it supports 'internal', 'G325', and 'G320' as input, which corresponds to internal IMU and ESPON IMUs. • BaudRate command configures comport baud rate for PIM222A. It is recommended to use baud rate 921600 when using debug logging requests (marked in blue) to avoid data loss. • LogNMEA command configures NMEA logging requests. • INSRotation command is used to configure RBV (rotation from IMU body to vehicle frame), input fields are in the order of X, Y, Z, X std dev, Y std dev, and Z std dev respectively. • INSTranslation command is used to configure ANT1 and ANT2 lever arm in IMU body frame, input fields are in the order of X, Y, Z, X std dev, Y std dev, and Z std dev respectively. • PIMDebug logs necessary GNSS and INS debug data.	• CAN command configures CAN port communication with supported baud rate of '250K', '500K', or '1M'. • DMI command configures interpretation of CAN data to extract DMI information. It supports use of LUA script for interpreting vehicle CAN data (See Appendix). • INSTranslation command for DMI is required when using vehicle CAN data. The data is required in IMU Body Frame, from IMU Centre of Navigation to Centre to Vehicle Rear Axle, in the order of X, Y, Z, X std dev, Y std dev, and Z std dev respectively. • SetVehicleParameters has the following fields: <wheel base in meteres>,<rear axle length in meters>,<front axle length in meters>,<steering method>,<secondary wheel base>. This command is required for using vehicle CAN DMI data. • The last two field for SetVehicleParameters does not change for passenger road vehicles from the example above. • PIMDMIDebug logs necessary DMI debug data.
Red is used to indicate commands that will change according to user application & installation.	
Black is used to indicate NMEA logs that is commonly used.	
Blue is used to indicate debug data logging request.	

Loading Configuration onto PIM222A/HK222

To load configuration onto PIM222A/HK222, two tools are required: WinLoad and datablk.exe package.

1. First, create a text file with configuration listed above.
2. Save configuration text file in the same folder as datablk.exe package (LoadConfig.bat is included).

3. Open command prompt in this folder, run ‘LoadConfig.bat <configuration text file>’ as shown below:

```
C:\Tests\LongHornProtoB\LoadConfig_Winload>LoadConfig.bat config.txt

Create HEX file...

Create DataBlk...
*
* datablk - NovAtel Inc. data block utility n
* Executable Version: 2.29
* Header Version: 2
*
Processing temp.hex to config.txt.hex

Use Winload to load the generated config.txt.hex onto the receiver

C:\Tests\LongHornProtoB\LoadConfig_Winload>
```

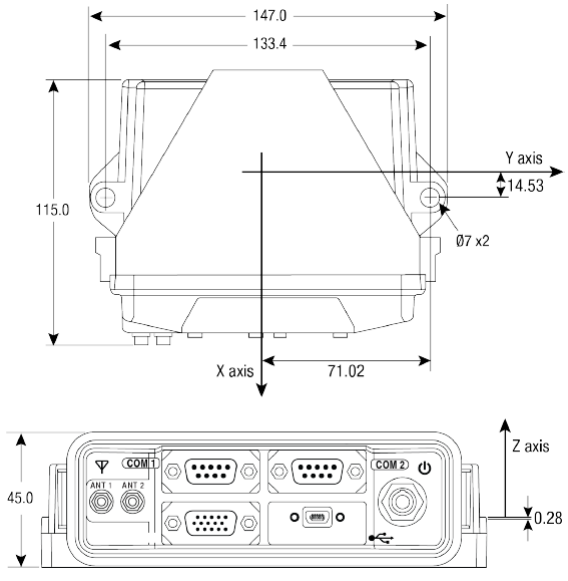
4. Configuration file will be converted to .hex file.
5. Launch WinLoad, select ‘File’->’File Open’ to open configuration .hex file.
6. Configure ‘Com Port Setup’ in ‘Settings’ tab, select corresponding com port, use 460800 as ‘Download Baudrate’, use 9600 as ‘Connect Baudrate’.
7. Click ‘Write Flash’ and power cycle PIM222A/HK222 when prompted.
8. The loading process is complete when ‘Done’ appears in WinLoad display area.
9. Close WinLoad and power cycle the receiver for the configurations to take effect.

Setup and Installation

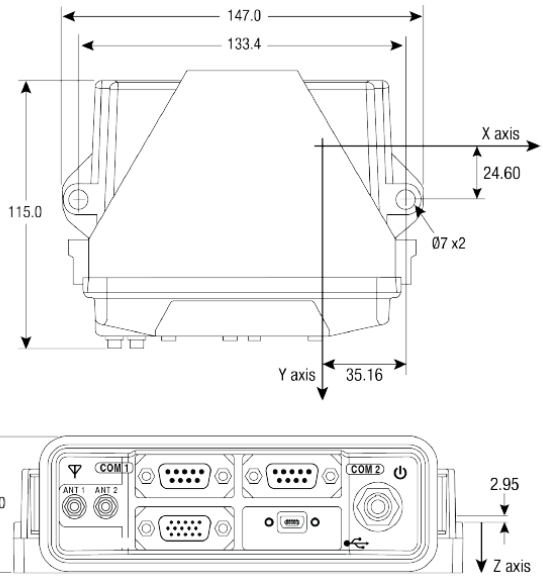
The PIM222A/HK222 is recommended to be screwed down on to vehicle chassis to accurately measure vehicle motion. Lever arm offsets for ANT1, ANT2, and DMI should be measured from IMU Centre of Navigation to antenna phase centres and centre rear wheel axle respectively in IMU Body Frame. Dual antenna is recommended to help maintain INS Azimuth performance in low dynamic environment. Antennas should be installed at least 50 cm apart, and preferably using the longest allowable baseline on the vehicle.

Please see the following drawings for IMU Centre of Navigation and IMU Body Frame:

Internal IMU



External IMU (EPSON G325 Connected via Onboard SPI)



COM1 – RS232 serial port used for logging with default baud rate of 460800.
COM2 – RS232 serial port used for receiving RTCM V3 correction messages with default baud rate of 460800.
I/O – provide PPS output and CAN DMI input.

Best Practice for Data Collection

1. Load PIM222A/HK222 receiver with desired configuration file – PIMDebug is recommended for troubleshooting purpose.
2. Mount PIM222A/HK222 receiver on a rigid structure away from vibration source, such as chassis or floor of vehicle.
3. Initiate data collection at a location with clear visibility of the sky, away from tall buildings and trees.
4. Start logging, then power cycle PIM222A to ensure all information is captured from power up.
5. Collect 5-minute static data.
6. PIM222A supports both AIDED_TRANSFER (dual antenna) and KINEMATIC alignment automatically.
    a. It is recommended to perform the following kinematics to converge INS solution:
    b. Perform figure 8 type of motion.
    c. Stop for 5 seconds.
    d. Repeat 10 to 15 minutes or until System Converged is flagged in INS extended solution status.
7. Start data collection in area of interest.
8. Repeat Step 6 at the end of the data collection if collecting data with a truth system.
9. Collect 5-minute static data.
10. Stop logging and end data collection process.

External References

Please kindly contact NovAtel Support at **support.novatel@hexagon.com** for PIM222A Evaluation Kit User Guide.

Appendix

Example of Using LUA Script in Configuration File

To enable LUA implementation for CAN DMI Support:

- The DMI line must use DMI_LUA (i.e. “DMI:CAN1,DMI_LUA”)
- Include the LUA script at the end of a config file

Example of a config file with LUA CAN Script (in Bolded Blue):

```
IMU:internal
INSRotation:RBV,0.00,0.00,90.00,3.0,3.0,3.0
INSTranslation:Ant1,-0.210,-0.458,0.737,0.03,0.03,0.03
INSTranslation:Ant2,-0.208,0.492,0.736,0.03,0.03,0.03
INSTranslation:DMI,0.00,0.00,-0.84,0.03,0.03,0.03
SetVehicleParameters:2.789,1.6256,1.6256,FRONT_WHEEL_ACKERMANN,0
LogNMEA:COM1,GGA,TIME,0.02,0
CAN:CAN1,500K
DMI:CAN1,DMI_LUA
LUA_CAN_SCRIPT:
MESSAGE_WHEELS = 0x407
messageIDTable = {}
messageIDTable[0] = MESSAGE_WHEELS

function processCANData(inputTable)
   local returnTable = {}
   if inputTable["MessageID"] == MESSAGE_WHEELS then
      returnTable["front right"],
      returnTable["front left"],
      returnTable["rear right"],
      returnTable["rear left"]
      = string.unpack(">i2i2i2i2", inputTable["Data"])
   end
   return returnTable
end
```

Contact Hexagon | NovAtel

support.novatel@hexagon.com 1-800-NOVATEL (U.S. and Canada) or 1-403-295-4900
For more contact information, please visit novatel.com/contact-us