

# MicroStrain Sensing Technical Note

## All 3DM-GX5/CX5/CV5 Models Current Firmware Upgrade

### Date

September 7, 2021

### Summary

This technical note details the most current firmware available for all models of MicroStrain Sensing **3DM-GX5**, **3DM-CX5** and **3DM-CV5** inertial sensors. The technical note additionally describes firmware changes since the last major firmware release and the use of SensorConnect software to perform the firmware upgrade.

### Detail

Every 3DM-GX5, 3DM-CX5 and 3DM-CV5 inertial sensor has two microprocessors. We refer to one microprocessor as the **NAV** processor and the other as the **IMU** processor. Each of these processors has a separate and distinct firmware. As we see in the table below, and as an example, the current firmware for the model 6253-4220 3DM-GX5-25 are NAV firmware 1.1.76 and IMU firmware 1.1.05. These firmwares are contained in the file object entitled `Philo_Firmware_2021_AUG_b11.zhex`.

### Current firmware by model

Base Model Number	Model Name	NAV Firmware Version	IMU Firmware Version	ZHEX File
6255-4250	3DM-GX5-10	1.1.76	1.1.05	Philo_Firmware_2021_AUG_b11.zhex
6254-4220	3DM-GX5-15	1.1.76	1.1.05	Philo_Firmware_2021_AUG_b11.zhex
6253-4220	3DM-GX5-25	1.1.76	1.1.05	Philo_Firmware_2021_AUG_b11.zhex
6252-4220	3DM-GX5-35	1.1.76	1.1.05	Philo_Firmware_2021_AUG_b11.zhex
6251-4220	3DM-GX5-45	1.1.76	1.1.05	Philo_Firmware_2021_AUG_b11.zhex
6275-4210	3DM-CX5-10	1.1.76	1.1.05	Philo_Firmware_2021_AUG_b11.zhex
6274-4260	3DM-CX5-15	1.1.76	1.1.05	Philo_Firmware_2021_AUG_b11.zhex
6273-4260	3DM-CX5-25	1.1.76	1.1.05	Philo_Firmware_2021_AUG_b11.zhex
6271-4260	3DM-CX5-45	1.1.76	1.1.05	Philo_Firmware_2021_AUG_b11.zhex
6259-4210	3DM-CV5-10	1.1.76	1.1.05	Philo_Firmware_2021_AUG_b11.zhex
6258-4260	3DM-CV5-15	1.1.76	1.1.05	Philo_Firmware_2021_AUG_b11.zhex
6257-4260	3DM-CV5-25	1.1.76	1.1.05	Philo_Firmware_2021_AUG_b11.zhex

### NAV Firmware for GX5/CX5 Models -45 and -35

Firmware Version	ChangeLog
1.1.68	Internal change for manufacturing; no impact on operation.
1.1.69	Fix bug where internal PPS would stay on when external GNSS was selected.
1.1.71	<ol style="list-style-type: none"><li>Fix bug where baud would not be correctly loaded/saved on 'all settings' command for -10 devices (doesn't impact -45 but shared code).</li><li>Updates to external attitude inputs to handle sensor2vehicle transform correctly.</li></ol>
1.1.72	Internal change for manufacturing; no impact on operation.

# All 3DM-GX5/CX5/CV5 Models

## Current Firmware Upgrade

### NAV Firmware for GX5/CX5 Models -45 and -35 (continued)

1.1.73	<ol style="list-style-type: none"><li>1. Added sensor2vehicle rotation commands that use quaternions (MIP_CMD_DESC_FILTER_SENSOR2VEHICLE_ROTATION_QUATERNION) and matrices (MIP_CMD_DESC_FILTER_SENSOR2VEHICLE_ROTATION_DCM).</li><li>2. Renamed the original sensor2vehicle transformation command from "MIP_CMD_DESC_FILTER_SENSOR2VEHICLE_TRANSFORMATION" to "MIP_CMD_DESC_FILTER_SENSOR2VEHICLE_ROTATION_EULER" to be more explicit about what is actually happening.</li><li>3. Sensor2Vehicle rotations now affect external heading inputs.</li><li>4. New commands to supported descriptors.</li><li>5. The total time for the filter to initialize from start-up has been extended from ~5 seconds to ~7 seconds to fix a bug when using external GNSS updates. Previously, external updates sent within the first 5 seconds of power on could result in filter instability. This was due to how the attitude was being initialized.</li><li>6. Fixed bug in Matrix to Quaternion conversion: For certain DCMs, the matrix to quat calculation would not properly calculate the quaternion, instead returning the default quaternion (example problem matrix = [1 0 0; 0 0 -1; 0 1 0]).</li><li>7. The filter initial position did not take into account the antenna offset vector; this has been fixed.</li><li>8. Fixed a bug introduced in 1.1.69, where the PPS selection hardware was not being updated correctly. When the user selects external GNSS updates at the GNSS source, it now switches the PPS to an input. When internal GNSS updates are the source, it is an output.</li><li>9. The bootloader has been updated to streamline updates when using USB.</li><li>10. LED indication logic has been changed - previously, when the device was in idle and the LED was pulsing, a command response would cause the LED to change to fast-blink (streaming) mode for 2 seconds. With the updated logic, the LED only enters fast-blink (streaming) mode if data is being streamed out of the device.</li><li>11. Added limited support for the MIP_CMD_DESC_FILTER_ADAPTIVE_FILTER_OPTIONS command. This command only affects adaptive filtering of GNSS position and velocity measurements, it does not control other measurements, as these are controlled via other commands. The only supported level parameter values are: 0 - OFF, 2 - MODERATE. The time_limit parameter has no effect on the 5-series devices.</li></ol>
1.1.74	Internal change for manufacturing; no impact on operation.
1.1.75	Internal change for manufacturing; no impact on operation.
1.1.76	Internal change for manufacturing; no impact on operation.

# All 3DM-GX5/CX5/CV5 Models

## Current Firmware Upgrade

### NAV Firmware for GX5/CX5/CV5 Models -25, -15 and -10

Firmware Version	ChangeLog
1.1.59	<ol style="list-style-type: none"> <li>Added separate week number and TOW settings on IMU driver.</li> <li>Updated tracking for excessive bytes found in IMU port buffer.</li> <li>Added propagation of time setting down to IMU from NAV when set_gps_time_element is called.</li> </ol>
1.1.60	Added changeable polarity handling for GNSS receiver enable (not relevant to this product but shared code).
1.1.63	<ol style="list-style-type: none"> <li>Added CX5 -25, -15 model number handling to basic status command responses.</li> <li>Added call to parse_all_packets on the command packet buffer so that any packets which got in prior to complete initialization would be processed instead of getting the '1 behind' problem.</li> <li>Fixed bug in external GPS time setting where byteswap happened out of order.</li> <li>Added propagation of external GPS time down to IMU.</li> <li>Fixed page flip problem in emulated EEPROM where transfer of values wasn't happening because those values were already located at the addresses specified at the last page (check before write functionality had been introduced to extend flash lifecycle, but introduced this bug to fix).</li> </ol>
1.1.65	<ol style="list-style-type: none"> <li>Put guards on updating from external GPS time that the difference had to be more than 1 second.</li> <li>Removed forward of load_all_default_setting to IMU when load_all_default was called.</li> </ol>
1.1.66	<ol style="list-style-type: none"> <li>Added CX5 -25, -15 model numbers to diagnostic status (missed it in earlier rev).</li> <li>Reinserted load_all_default_settings call to IMU when command is issued to NAV.</li> </ol>
1.1.68	Internal change for manufacturing; no impact on operation.
1.1.69	Internal change for manufacturing; no impact on operation.
1.1.70	Fixed bug which would leave internally generated PPS on if External PPS was selected (doesn't impact this product, but shared code).
1.1.72	<ol style="list-style-type: none"> <li>Added additional check for false PPS beacon_status to zero gps_latency.</li> <li>Incorporated changes relevant to external inputs in the sensor2vehicle transformed frame.</li> <li>Updated baud handling to operate correctly on the -10 series.</li> </ol>
1.1.74 and above	Please see <b>NAV Firmware for Models -45 and -35</b> as the firmware version numbers have been aligned and the project used to build the 2 images is largely the same.

# All 3DM-GX5/CX5/CV5 Models

## Current Firmware Upgrade

### IMU Firmware for All GX5/CX5 Models

Firmware Version	ChangeLog
1.0.38	<ol style="list-style-type: none"> <li>1. Baud escape code in Philo_Controller.</li> <li>2. EEPROM.</li> <li>3. Firmware update read flag.</li> <li>4. Primary com default baudrate change to 115200.</li> <li>5. Hw_specific_embedded_baudrate() instead of PRIMARY_COM_DEFAULT_BAUDRATE in IMU_Control.cpp.</li> <li>6. Production test serial fix.</li> <li>7. Ring buffer empty callback (Brendan).</li> <li>8. SPI slave autoinit (Brendan).</li> <li>9. Removed unused float from IIR_Resampler.</li> <li>10. Use std:: as appropriate.</li> <li>11. Fix byteswap in Bitfield class.</li> <li>12. Bitfield union fix for direct field assignment (IAR 8 or C++11 or later).</li> <li>13. C++11 ifdefs added in templates.hpp.</li> <li>14. Serial IRQs moved from IRQ serial to base serial.</li> </ol>
1.0.41	<ol style="list-style-type: none"> <li>1. Fix ADXL355/357 sync issue.</li> <li>2. Fix ADXL355/357 bias internal cal issue (ADXL errata).</li> <li>3. Add global_time_*_ns functions to support sync fix.</li> <li>4. Change DWT delay to global_time_sleep_ns in input_state.cpp (used for HWID on GX5/CX5).</li> <li>5. Lpd_projects\151033\Technical Data\Firmware\PHILO AUGUST 2018 ECO [GX5,CX5,CV5]\Firmware Images\Old.</li> </ol>
1.0.43	<ol style="list-style-type: none"> <li>1. Add temperature sensor low-pass filtering.</li> <li>2. Address race condition in global_time_sleep_ns.</li> <li>3. Lpd_projects\151033\Technical Data\Firmware\PHILO AUGUST 2018 ECO [GX5,CX5,CV5]\Firmware Images.</li> </ol>
1.1.00	<ol style="list-style-type: none"> <li>1. Use differential magnetometer measurements (one with SET, one with RESET) to improve rejection of magnetic disturbances (MMC5883).</li> <li>2. Fix ADXL355 self test sometimes reporting a false failure due to reading stale data from the accel.</li> </ol>
1.1.03	<ol style="list-style-type: none"> <li>1. Final version of firmware header &amp; command.</li> <li>2. Update debug commands.</li> <li>3. Add MEMS test commands.</li> </ol>
1.1.05	Fixed EEPROM writes causing IMU reset.

# All 3DM-GX5/CX5/CV5 Models

## Current Firmware Upgrade

### IMU Firmware for All CV5 Models

Firmware Version	ChangeLog
1.0.47	<ol style="list-style-type: none"><li>1. Baud escape code in Philo_Controller.</li><li>2. EEPROM.</li><li>3. Firmware update read flag.</li><li>4. Primary com default baudrate change to 115200.</li><li>5. Hw_specific_embedded_baudrate() instead of PRIMARY_COM_DEFAULT_BAUDRATE in IMU_Control.cpp.</li><li>6. Production test serial fix.</li><li>7. Ring buffer empty callback.</li><li>8. SPI slave autoint.</li><li>9. Removed unused float from IIR_Resampler.</li><li>10. Use std:: as appropriate.</li><li>11. Fix byteswap in Bitfield class.</li><li>12. Bitfield union fix for direct field assignment (IAR 8 or C++11 or later).</li><li>13. C++11 ifdefs added in templates.hpp.</li><li>14. Serial IRQs moved from IRQ serial to base serial.</li></ol>
1.0.49	<ol style="list-style-type: none"><li>1. Fix ADXL355/357 sync issue.</li><li>2. Fix ADXL355/357 bias internal cal issue (ADXL errata).</li><li>3. Add global_time_*_ns functions to support sync fix.</li><li>4. Change DWT delay to global_time_sleep_ns in input_state.cpp (used for HWID on GX5/CX5).</li><li>5. Lpd_projects\151033\Technical Data\Firmware\PHILO AUGUST 2018 ECO [GX5,CX5,CV5]\Firmware Images\Old.</li></ol>
1.0.50	<ol style="list-style-type: none"><li>1. Add temperature sensor low-pass filtering.</li><li>2. Address race condition in global_time_sleep_ns.</li><li>3. Lpd_projects\151033\Technical Data\Firmware\PHILO AUGUST 2018 ECO [GX5,CX5,CV5]\Firmware Images.</li></ol>
1.0.51	Fix accel factory bits to include bits 4-6 and not just 4-5. This prevented the high-g flag from being passed to the driver.
1.1.00	<ol style="list-style-type: none"><li>1. Use differential magnetometer measurements (one with SET, one with RESET) to improve rejection of magnetic disturbances (MMC5883).</li><li>2. Fix ADXL355 self test sometimes reporting a false failure due to reading stale data from the accel.</li></ol>
1.1.03	<ol style="list-style-type: none"><li>1. Final version of firmware header &amp; command.</li><li>2. Update debug commands.</li><li>3. Add MEMS test commands.</li></ol>
1.1.05	Change data ready line used by ADXL355 self test. Previously it was using int1, but the accel operating mode is changed for self test, so it should have been the physical data ready line. On CX5/GX5 this worked because int1 isn't wired and it fell back on a sleep statement, but on CV5 it is wired and so the logic failed. <i>Note:</i> Technically this change affects GX5 and CX5, but only CV5 is under ECO as the former do not seem to be exhibiting issues.

### Upgrading Firmware With SensorConnect

The firmware on all **3DM-GX5**, **3DM-CX5** and **3DM-CV5** inertial sensor models may be upgraded with MicroStrain Sensing's SensorConnect software. The Windows software is available for download and installation on the MicroStrain website at: <https://www.microstrain.com/software/sensorconnect>. The user is required to download the appropriate ZHEX file from the web page for the particular inertial sensor model. SensorConnect performs the upgrade under user control.



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