MGC3140

MGC3140 GestIC® Tuning User's Guide

Preface

Important: Notice to customers:
All documentation becomes dated, and this manual is no exception. Microchip tools and documentation are constantly evolving to meet customer needs, so some actual dialogs and/or tool descriptions may differ from those in this document. Please refer to our website (www.microchip.com) to obtain the latest documentation available.

Documents are identified with a “DS” number. This number is located on the bottom of each page, in front of the page number. The numbering convention for the DS number is “DSXXXXXA”, where “XXXXX” is the document number and “A” is the revision level of the document.

Introduction

This document describes how to tune GestIC® systems that consist of an MGC3140 gesture controller based on Microchip's GestIC technology and Gesture sensor.

Recommended Reading

For the latest information on using the device, read the *“MGC3140 3D Tracking and Gesture Controller Data Sheet”* (DS40002037) located on the Microchip website. The release notes (Readme) contain update information and known issues that may not be included in this user’s guide. For the latest information on using the Aurea GUI, refer to the *“Aurea Graphical User Interface User’s Guide”* (DS40001681) located on the Microchip website.

Table of Contents

1. Introduction

The MGC3140 Gesture IC (GestIC) has two types of parameters:

1. Run-time parameters that control basic functions such as selecting which of the five preset frequencies (between 1 and 5) to use, enabling and disabling gestures and forcing a recalibration (baseline). These are controlled by the host over the I^2C interface using messages defined in the MGC3140 run-time library interface specification reference.
2. Design-specific design-time parameters, which are configured once per project at design time and control design characteristics, such as electrode weighting, gesture timings, and signal thresholds. These parameters are configured using the Aurea Graphical User Interface application.

This document describes the tuning process for both the run-time and the design-time parameters.

1.1 Aurea

The Aurea Graphical Interface User's Guide describes the use of the Aurea graphical interface to:

- Monitor the output of the MGC3140
- Control MGC3140 run-time parameters
- Configure MGC3140 design-time parameters
- Load design-time parameter files onto the MGC3140
- Program the MGC3140
- Update the MGC3140 bootloader
- Save the MGC3140 firmware and parameterization data in order to provide a final firmware (FW)[(1)] and parameterization combination for manufacture

Note:

1. Combines the FW and parameters that are in Aurea that were loaded onto the device. Aurea does not read firmware from the device.

1.1.1 Firmware and Parameter Update Using Aurea

Aurea uses a compressed file containing MGC3140 firmware, bootloader and parameterization data as an image source for programming the MGC3140. It can also save the parameterization file and the existing firmware from the `.enz` file[(1)] into a new compressed file. This file is noted by the extension `.enz`.

Note:

1. The firmware cannot be read back from the IC. A newly created `.enz` file will create FW from the parameters tuned in Aurea (on the PC) and the FW used by Aurea to download to the MGC3140.

1.1.1.1 Aurea `.enz` File Format

An `.enz` file is simply a zip container containing a number of files including a special file called `contents.json` which describes the content of the `.enz` file.

- `Library.hex` – Contains MGC3140 firmware and bootloader in standard Intel® HEX format.
- `Library.settings` – A text description of design-time parameter settings.
- `Loader.hex` – Contains the MGC3140 bootloader in standard Intel HEX format.
- `Content.json` – Describes the contents of the `.enz` file.

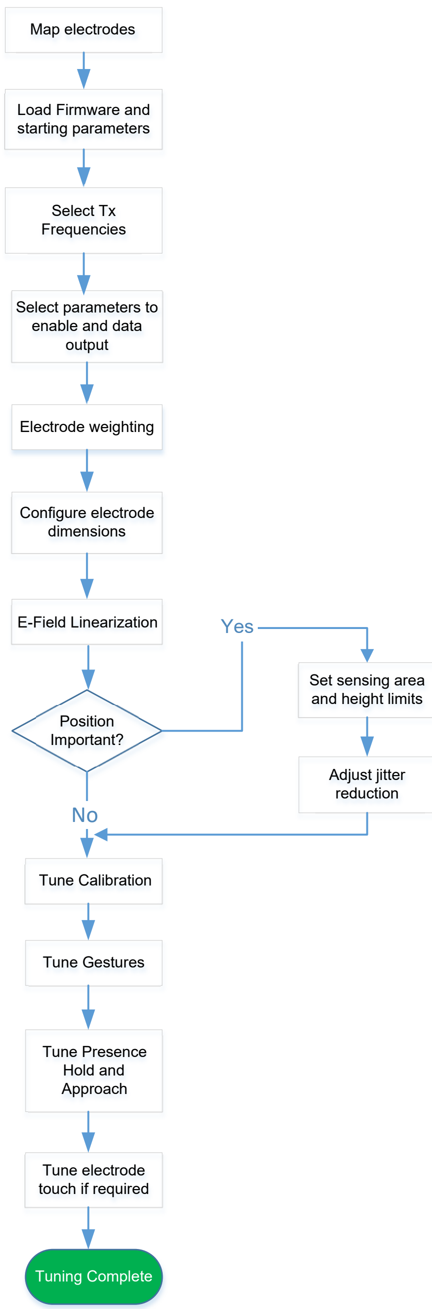
Note: Aurea will not program the bootloader if the current bootloader in the MGC3140 has the same version as in this file.

2. Tuning Flow

It has to be noted that the implemented tuning steps will depend on the customer requirements. Positional accuracy or reporting, some gestures or GestIC electrode touch, approach and power-saving may or may not be required.

The following flowchart shows the tuning flow.

Figure 2-1. MGC3140 Tuning Flow

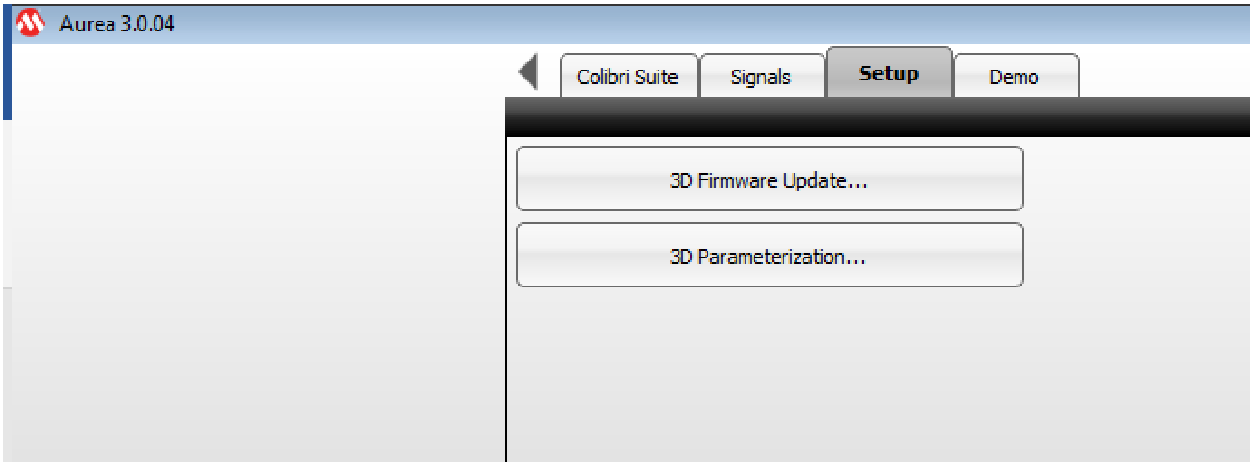


3. Tuning

During the setup process, tuning parameters are adjusted using slide bars that are dragged using the mouse. For fine tuning, click on the **Slider** and use the left-right arrow keys to adjust the parameter value.

In order to tune the design-time parameters, select the **Setup** tab in Aurea and press the **3D Parameterization** button.

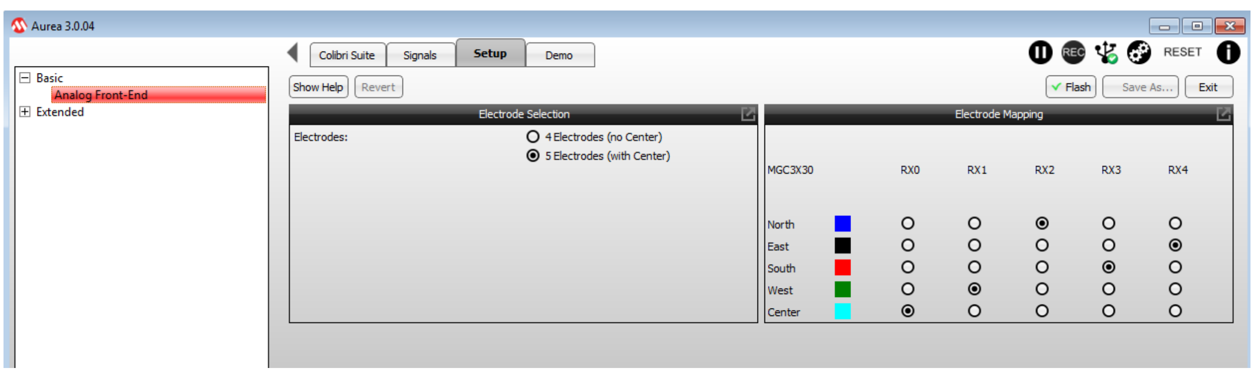
Figure 3-1. Aurea Parameterization



The **Aurea Setup** tab has two top-level menu items on the left:

- **Basic** – Allows basic setup of the Analog Front-End by mapping the receive electrodes to the MGC3140 receive pins. This feature provides Printed Circuit Board (PCB) layout flexibility.
- **Extended** – Allows detailed tuning.

Figure 3-2. Setup - Basic Menu



3.1 Electrode Mapping

The Analog Front-End (AFE) settings comprising of Electrode Selection and Electrode Mapping can be modified on this page. They adjust the connection between the MGC3140 and the external electrodes.

The settings are adjusted using the corresponding radio buttons or sliders.

- **Electrode Selection**
  The optional Center electrode can be enabled or disabled by checking the four electrodes (no Center) or five electrodes (with Center) check boxes.

- Four electrodes
  Only the four frame electrodes (North, East, South, and West) are used for signal processing.
- Five electrodes
  All four frame electrodes and the Center electrode are used for signal processing.

- **Electrode Mapping**
  The electrode mapping allocates the MGC3140 RX pins to the outlying electrodes. The correct electrode mapping can be verified by touching the electrode and monitoring the signals in the **Signals** tab. The corresponding electrode signal in the **Rx Signals** tab should then increase.

3.2 Extended Parameterization

When selected, the Extended menu item opens up the Firmware Selection window. The use of this window ensures that the correct firmware is loaded onto the MGC3140 for the design-time parameterization process.

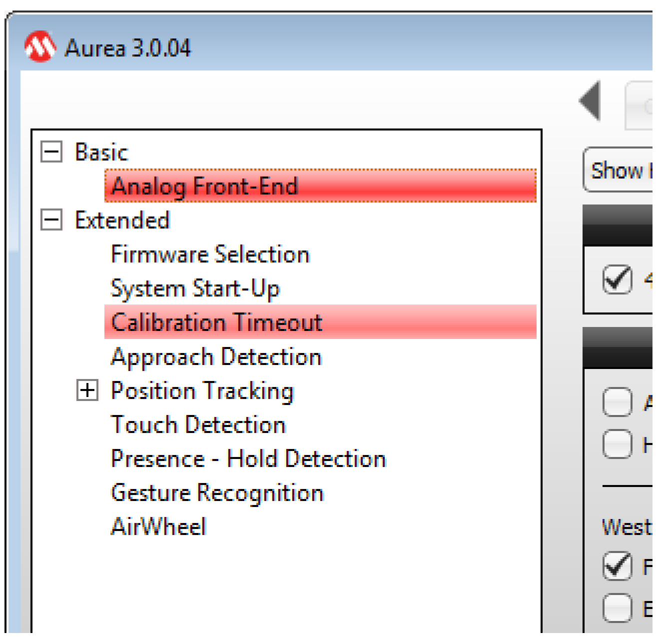
3.2.1 Firmware

Load the firmware and parameter file which will be used as a basis for the tuning using this window, as described in the *"Aurea Graphical User Interface User's Guide"* (DS40001681). Remember to select the "**Keep the current AFE parameters**" check box unless the AFE electrode selection and mapping of the parameters that are about to be downloaded are going to be used instead.

Once the firmware has been loaded, the full Extended Parameter window becomes available providing the following menu options. See figure below.

Note: The extended parameter options are only available after firmware and parameter download. They disappear after exiting the **Setup** tab, or disconnecting or resetting the MGC3140, and require another firmware and parameter download before becoming visible again.

Figure 3-3. Extended Parameter Window



3.2.2 System Start-up Window

This window provides the following features:

- Tx frequency selection
- Active features
- Sensor data output
- Start change notification

3.2.2.1 Tx Frequency Selection

The Tx frequency selection is available from the System Start-up window.

A range of five frequencies may be selected or deselected to avoid noise. The MGC3140 constantly monitors the noise levels on all selected frequencies and will hop to the lowest noise level frequency when the current frequency noise gets too high. The automatic frequency hopping can be limited by unchecking one or more frequencies in the list. The following frequencies are available: 42 kHz, 43 kHz, 44 kHz, 45 kHz, and 100 kHz.

3.2.2.2 Active Features

The Colibri Suite features can be active or inactive on MGC3140 start-up.

- **Approach Detection** – Selects if the Approach Detection feature is enabled at start-up.
- **Touch Detection** – Selects if the Touch Detection feature is enabled at start-up.
- **Gestures** – Selects if a particular gesture is active at start-up.
- **Flicks** – Flick selection has the behavior shown in the table below.

Table 3-1. Flick Selection

Double Flick	Edge Flick	Normal Flick	Description
0	0	0	None Active
0	0	1	Only Normal Flick reported
0	1	0	Only Edge Flick reported
0	1	1	Normal and Edge Flicks reported
1	0	0	Double Flick reported. Disables Normal and Edge Flicks. Normal and Edge Flicks are never reported.
1	0	1	Double Flick is reported. Disables Normal Flicks and Edge Flicks. Normal and Edge Flicks are never reported.
1	1	0	Double Flick reported. Disables Normal and Edge Flicks. Normal and Edge Flicks are never reported. If calibration after flick is enabled in the Gestures menu by selecting the '**triggers calib**' option, then calibrations may still be triggered when the hand leaves the sensing area after flicks, or in the middle of a Double Flick.
1	1	1	**These settings should not be selected.**

Note:
1. 0 = Not selected
2. 1 = Selected

- **Circles/AirWheel:** Discrete Circles and AirWheel are exclusive. The Airwheel has higher priority than discrete circles. When the AirWheel is enabled, only AirWheel information will be reported. To use the Discrete Circle gestures, AirWheel must be disabled.

Sensor Data Output

The Sensor Data Output I²C message (ID 0x91) contains all data which are generated in MGC3140. That includes recognized gestures as well as continuous data like position or raw sensor data.

A detailed description of the I²C message format can be found in the *"MGC3140 GestIC® Library Interface Description User's Guide"* (DS40001875).

If selected, data (On or Dynamic) will be added as a payload element to the sensor data output I²C message.

There are three options for data selection:

- **Off** – Data will never be sent.
- **On** – Data are sent with every packet.
- **Dynamic** – Only changes will be sent to minimize data traffic.

The following table lists the payload elements of the sensor data output message.

Table 3-2. Sensor Data Output Payload Elements

Data/Payload(1) Element	Library Command	Description
DSP Status	`DSPStatus`	This field contains the Calibration events information and the currently used Tx frequency.
Gesture Data	`GestureInfo`	This field contains the recognized gestures.
Touch Data	`TouchInfo`	This field contains the Touch events information.
AirWheel Data	`AirWheelInfo`	This field contains the AirWheel information.
Position Data	`xyzPosition`	This field contains the X, Y and Z position data.
Noise Power	`NoisePower`	This field contains the current measured signal variance.
Uncalibrated Signal Data	`CICData`	This field contains the Uncalibrated Signal (CIC) data.
Signal Deviation Data	`SDData`	This field contains the Signal Deviation (SD) data.
AirWheel counter decimated by factor 4		If set, AirWheel counter is only reported when a change of at least four bits has occurred.

Note:

1. Payload Element names are those defined in the *"MGC3140GestIC® Library Interface Description User's Guide"* (DS40001875).

State Change Notification

The sensor has also the possibility to report some Boolean states and, according to the same principle in the previous section, some can be ignored to minimize the number of messages.

These Boolean states are reported as part of two payload elements: 'System Data', always present in a message, and 'Gesture Data', that is present depending on the selection of the sensor data output (see Table 3-2).

The following table describes the Boolean states and to which payload element they belong to.

Table 3-3. Boolean State Descriptions

Payload Element[1]	Flag	Description
`SystemInfo`	Noise indication	The bit reports that environmental noise has been detected.
`SystemInfo`	DSP running	The bit reports that system is running (not sleeping).
`GestureInfo`	Gesture in progress indication	The bit reports that a gesture evaluation is ongoing.
`GestureInfo`	Garbage	The bit de/activates the report of Garbage gesture.
`GestureInfo`	Hand Presence	The bit reports that object is present in sensitive region.
`GestureInfo`	Hand Inside	The bit reports that object is present and above the sensor.
`GestureInfo`	Hand Hold	The bit reports that object is present and not moving.
`None`	Timestamp overflow indication	De/activates the 8-bit counter (timestamp) overflow message. This has impact on `TouchInfo` and `AirWheelInfo` messages.

Note:

1. Payload element names are those defined in the *"MGC3140GestIC® Library Interface Description User's Guide"* (DS40001875).

3.2.3 Calibration Tuning

Baseline calibration can be caused by a number of triggers:

1. User absent time-out – where no user movement or presence is detected within the User Absent Calibration Time-out period *(configured in the Calibration Time-out window)*.
2. User present time-out – where an SD that is greater than the threshold set for presence detection on any electrode indicates the presence of a hand which has not changed position for a specified time while the Hold flag is triggered *(configured in the Calibration Time-out window)*.
3. Touch time-out – where a touch has been detected for the Touch Calibration Time-out period *(configured in the Calibration Time-out window)*.
4. Negative Value – when SD achieves invalid negative values less than -4 for 100 ms *(cannot be configured)*.

5. Gesture – flick gestures may be configured to perform a baseline calibration on completion of the flick *(configured in the Gesture Control window)*.
6. Externally forced – host forces baseline calibration with an I^2C message.

The baseline calibration should be set to meet customer requirements.

It should be noted that the User Absent and Present Calibration Time-outs have an impact on the Approach Detection Idle Time-out before the system enters the Self Wake-up mode.

Related Links

3.2.6 Approach Detection
3.2.5 Presence, Hold and Approach

3.2.4 Gesture Tuning

The Gesture recognition and AirWheel windows permit the configuration of the following gestures:

- Normal Flicks *(Gesture recognition window)*
- Edge Flicks *(Gesture recognition window)*
- Double Flicks *(Gesture recognition window)*
- Circles *(Gesture recognition window)*
- AirWheels *(AirWheel window)*

3.2.4.1 Gesture Recognition Window

Check the "**Triggers Calib**" box if baseline calibration is required after a flick has exited the sensitive area. As the hand has to have left the sensing area before the calibration is performed, the sensor is not influenced by the user during calibration.

The idle system is properly calibrated when the signal deviation of all channels is at or near zero. Immediate feedback is given by the calibration indication in the Aurea status bar. Each time a selected gesture is performed and the system calibrated, the calibration indication blinks. Note that only flicks that cross the entire sensitive area will trigger calibration scans.

Larger Sensors – Gesture Duration

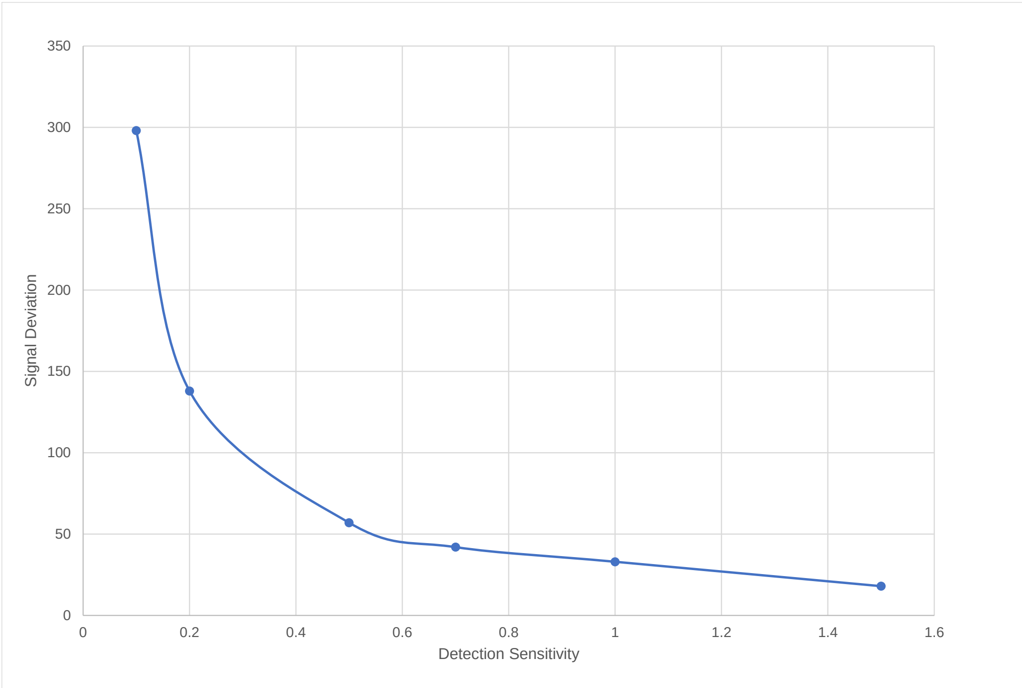
Default values are normally good but maximum gesture duration may need increasing for larger sensors or potential slower swipe speeds.

Detection Sensitivity

Detection Sensitivity is a gain which needs to be adjusted depending on the expected system noise. With low-detection sensitivity values, the gestures have to be performed very close to the electrodes. High values increase sensitivity but are also less robust to noise. The Detection Sensitivity slider 1 can take values between 0 and 3.

The figure below shows the variation of the SD against sensitivity to provide reliable gesture detection.

Figure 3-4. Minimum Signal Deviation for Reliable Gesture Detection



To adjust Detection Sensitivity, proceed as follows:

- For maximum robustness to noise:

1. Perform gestures as far away from the sensitive area as allowed by the application.
2. Reduce Detection Sensitivity until gestures are no longer detected.
3. At this point, amplitude from performed gestures is not enough to trigger gesture start. This is approximately the minimum sensitivity of the application.

- For maximum system sensitivity:

1. Perform gestures close to the sensitive area.
2. Increase Detection Sensitivity until gestures are no longer detected.
3. At this point, noise amplitude is enough to trigger gesture start. Noise is mixed with the performed gesture signal and no valid gesture is recognized. This is approximately the maximum sensitivity of the application.

Gesture Suppression Time

Gesture Suppression Time is a parameter utilized to prevent a user unintentionally triggering a gesture after touching the sensor and then removing the hand. This parameter can prevent that situation by blocking all gestures during a certain time after sensor touch is released. While gestures are blocked, the time is adjusted with this slider 1 taking values from 0 to 1.25s.

If Gesture Suppression Time is active (>0), touch detection also aborts ongoing gesture recognition.

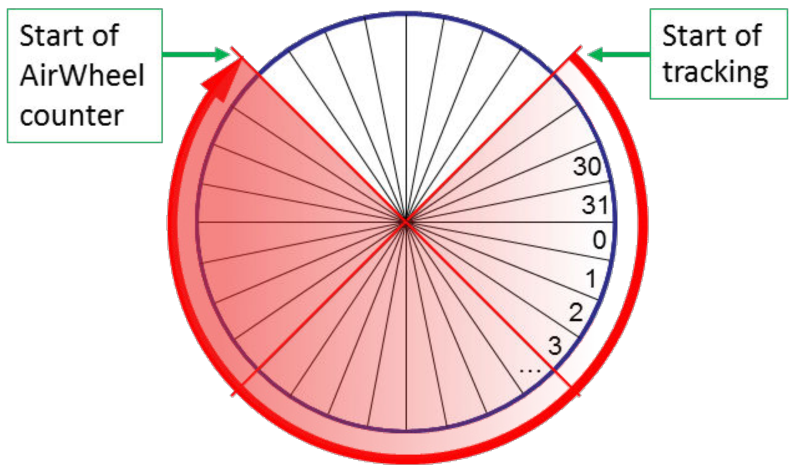
If the Touch Detection feature is disabled, this feature has no impact.

3.2.4.2 AirWheel Tuning Window

The AirWheel is part of the circular gestures suite. It provides a counter which is either increased or decreased for clockwise (CW) or counterclockwise circles (CCW), respectively. The direction can be inverted while AirWheel is ongoing. The counter will reflect the change in direction immediately.

The AirWheel counter (eight bits) accumulates the angle change during the circular movement. The lower five bits of the counter represent the current angular position with a resolution of 32 counts for each full revolution. Each time the angular position crosses 0, a full revolution is counted in the upper three bits. If rotation is in the CW direction, it adds one revolution, and if it is in the CCW direction, it subtracts one. Figure 3-5 shows the positive sense of rotation and the mapping between the value of the lower five bits and the angular position.

Figure 3-5. AirWheel Positive Direction and Minimum Arc Representation



Though it is expected to work out-of-the-box with most designs, the AirWheel functionality can be adjusted to suit a specific application.

Minimum Arc

Minimum Arc adjusts how many quadrants the user may rotate before the AirWheel counter starts. A higher value means that a bigger arc has to be performed before the counter starts. The value can be adjusted in the range between 1 and 8 quadrants; default is 3.

Figure 3-5 shows the three quadrants required between 'Start of position tracking', when the user starts rotating, until 'Start of AirWheel counter', when the counter starts to be updated. Higher Minimum Arc means the user may rotate more before the counter starts updating. Low Minimum Arc may lead to unintended AirWheel recognition when the user is performing other movement in the sensitive area.

Note: Minimum Arc also affects the Discrete Circle gestures. The same arc has to be performed to recognize a Discrete Circle gesture.

Note: Discrete Circle gestures and AirWheel are mutually exclusive. The AirWheel has priority over the Discrete Circles. When the AirWheel is enabled, then only AirWheel information will be reported. To use the Discrete Circles gestures, the application has to enable the clockwise and/or counterclockwise gestures and disable the AirWheel.

Related Links

3.2.2 System Start-up Window

3.2.5 Presence, Hold and Approach

The MGC3140 detects the presence of a hand when the following conditions are met:

1. Whenever the SD of any single electrode exceeds the Presence Threshold Single Electrode Threshold parameter.
2. Whenever the SD of all Rx electrodes exceed the Presence Threshold All Electrodes Threshold parameter.

Once the MGC3140 has detected the presence of a hand, it does the following:

1. Sets a Hand Presence flag. This flag can be seen in the Presence Hold State window.
2. Starts a timer for Hand Present gesture event.

When the hand-present timer reaches the Presence Duration time, the presence is reported, and a Hand Present is indicated in the Gestures window.

Figure 3-6. Hand Present Symbol

When the hand-hold timer reaches the hand-hold duration time, the Hand Hold is reported and a Hand Present is indicated in the Gestures window.

Figure 3-7. Hand Hold Symbol

The Hand Hold flag remains set unless the hand moves. The amount of movement allowed in order to keep the Hand Hold flag set is controlled by the Hand Tremble Threshold. This parameter specifies the amount of movement that a hand can move and still be classified as holding.

- Low values – only a small movement is necessary to clear the Hand Hold flag.
- High values – the hand can move and the Hand Hold flag will stay high.

If the amount of movement is sufficient to clear the Hand Hold flag, then:

1. The hand-hold timer is restarted, providing the hand is still present.
2. Any hand-hold indication in the Gesture window is cleared.
3. The ending of the Hand Hold is reported.

The Default Presence and Hold Default parameters are generally acceptable to most users, although the Hold Tremble Threshold may require some tuning.

The ActiveOutside parameter chooses if Hand Hold flag and Presence gesture can be active when the user is outside the sensor, but still in sensing space.

- **ActiveOutside** *checked* (default) means that Hand Presence is required to set Hand Hold and that Presence Duration starts counting on the rising edge of the Hand Presence Status flag.
- **ActiveOutside** *unchecked* means that Hand Inside is required to set Hand Hold and that Presence Duration starts counting on the rising edge of the Hand Inside Status flag.

The use of the Active Outside flag requires accurate knowledge of the sensor dimensions and accurate position reporting.

Related Links

3.2.8 Position Tracking
3.2.10 Sensing Area

3.2.6 Approach Detection

Approach Detection is used to preserve power, by placing the MGC3140 into a Lower-Power Sleep mode with infrequent scans.

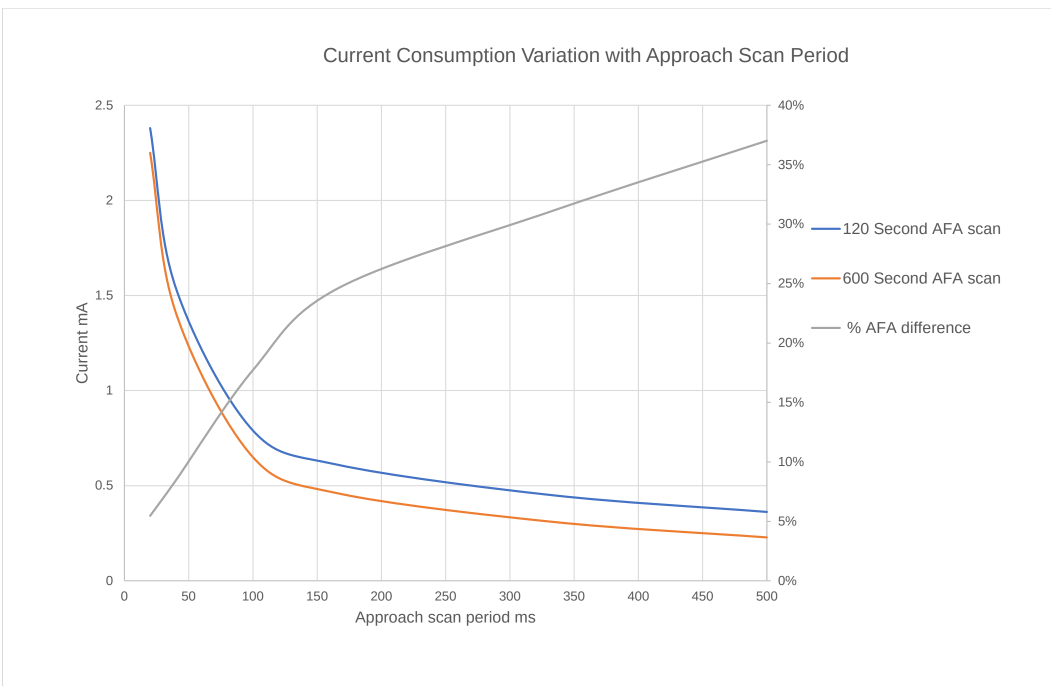
If configured, any combination of the Rx electrodes can be enabled for Approach Detection, and a hand will be detected by just one electrode. The Approach Electrode Selection window controls which electrodes are enabled for Approach Detection.

3.2.6.1 Approach Detection Power Tuning

A lack of activity for a specified time by the Idle Time-out parameter will result in the MGC3140 entering Sleep mode. When in Sleep mode, the MGC3140 periodically performs a scan looking for the presence of a hand. The interval between scans is set by the Approach Scan Interval parameter. The bigger the interval, the lower the power consumption, as shown in Figure 3-8.

When detecting a hand, the MGC3140 leaves Approach mode and reverts to normal continuous scanning.

Figure 3-8. Current Consumption Variation with Approach Scan Period and AFA Frequency

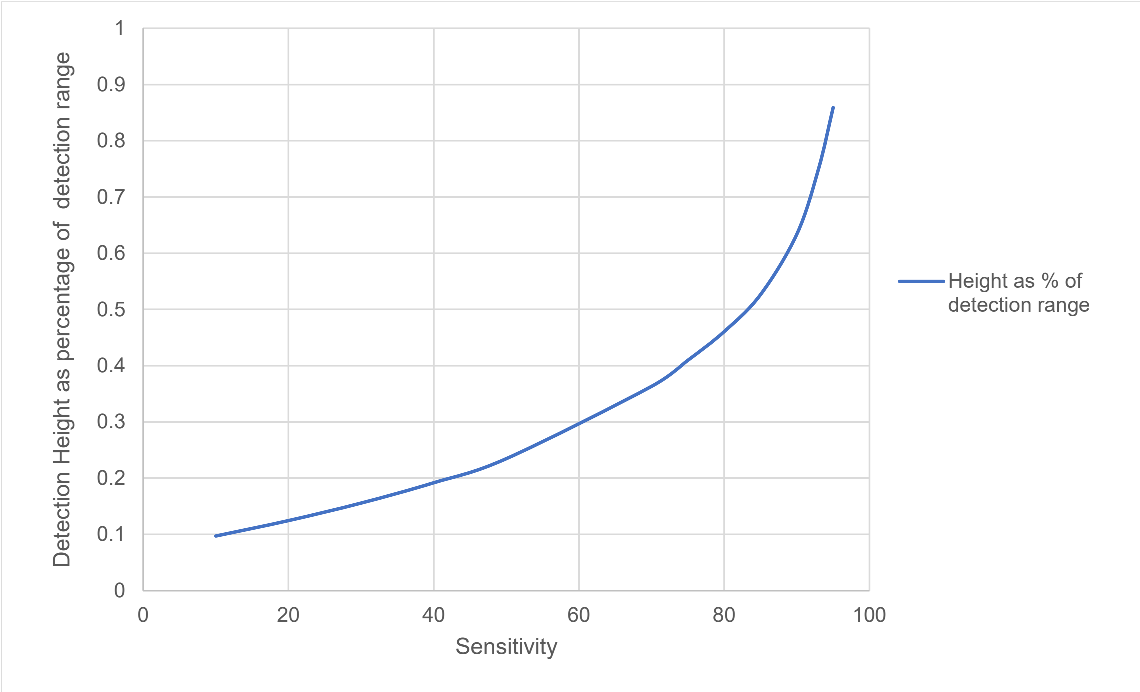


Note: AFA = Automatic Frequency Adaption

3.2.6.2 Approach Range

The approach range is determined by the sensor configuration, size and sensitivity setting, as shown in the figure below.

Figure 3-9. Approach Detection Height Against Sensitivity



The Sensitivity slider 1 selects how much signal change is necessary to wake up the system. The value can be adjusted in the range from 1 to 100; default is 76.

- High values will lead to a sensitive wake-up behavior. This means that small signal changes are enough to wake up the system. This results in higher detection range in the Self Wake-up mode, but may also lead to unintended wake-ups due to increased noise levels.
- Low values will lead to a less sensitive wake-up behavior. This means that higher signal changes are necessary to wake up the system. This results in smaller detection range in the Self Wake-up mode but, at the same time, the system will be less prone to unwanted wake-ups in case of increased noise levels.

3.2.7 Touch Detection

The Touch Threshold North, East, South, West, Center fields specify the SD values that have to be exceeded to validate the touch event. The range is 0 to 32768. The horizontal darker line in the Level window is adjusted according to the slider value.

- Touch each electrode in its geometric center and move the finger to the borders of the electrode while touching.
- Adjust corresponding Touch Threshold 1 according to the displayed SD value while the finger is positioned on the electrode. If touches are missed, the Touch Threshold might be needed to be decreased.

Note: The values in the Level window are shown in log scale.

The touched state is exited if the SD value drops below the Release Threshold. This threshold (horizontal lighter line in the Level window) is an adjustable percentage of the Touch Threshold. The percentage of the Touch Detection Threshold can be adjusted between 50% and 100%. To adjust it, proceed as follows:

- Touch each electrode in its geometric center and change the hand posture. If Touch state becomes released although the user is still touching, the Release Threshold needs to be decreased.

- If the finger is lifted from the surface, but a Touch state is still reported, the Release Threshold has to be increased.

3.2.7.1 Approach Speed

The Minimum Approach Speed parameter adjusts the minimum approach speed required to detect a touch event.

- If touch is only detected if the finger approaches quickly, decrease Minimum Approach Speed. However, when Minimum Approach Speed is too low, false alarms may occur when a finger is approaching slowly, but not touching.
- If Minimum Approach Speed is set to 0, the touch detection is not dependent on speed and it is only configured by the thresholds on the SD level.

3.2.7.2 Tap Settings

- **Max. Tap Time**
  A Single Tap is detected only when the time between a touch press and the consecutive release is smaller than the Max. Tap Time. Higher values allow taps with longer duration.

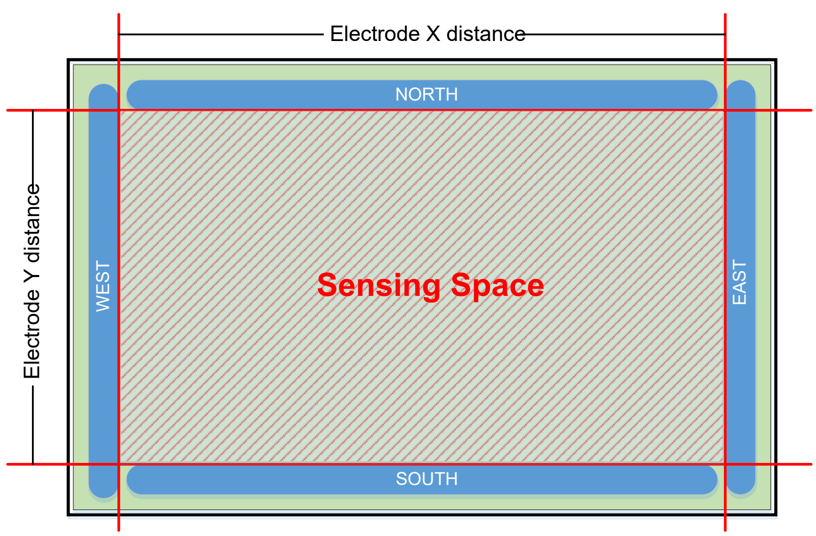
  The time can be adjusted using the corresponding slider, with values between 0 and 1s.
- **Max. Double Tap Interval**
  The Double Tap is detected when the time between the release of a Single Tap and the consecutive touch press is smaller than the Max. Double Tap Interval. Higher values allow longer intervals between taps. The time can be adjusted using the corresponding slider 1, that can take values between 0 and 1s.
- **Air Taps**
  If Air Taps are required, set the threshold low, depending on the height of the tap required and set the approach speed to a low value or even 0.

3.2.8 Position Tracking

3.2.8.1 Electrode Dimensions

To start position parameterization, the user needs to input the electrode dimensions. The figure below shows how to measure the electrode dimensions. Adjust the electrode X and Y distances by using the respective slider.

Figure 3-10. Electrode Dimensions



Default values are set for Emerald Development Kit V1.0 with default 95x60 mm Electrode (4-layer/1.5 mm PCB).

- `Electrode X Distance` corresponds to the distance between the inner edges of West and East electrodes.
- `Electrode Y Distance` corresponds to the distance between the inner edges of North and South electrodes.

3.2.8.2 Electrode Weighting

The Electrode Weighting is an optional step to adjust parameters for position tracking. Five measurements with the artificial hand and five reference measurements without it are conducted at a constant height of 30 mm. Always use the 30-mm Styrofoam spacer to establish the height. The drawing in the Electrode Weighting step will show the correct placement of the artificial hand for each measurement (West, North, East, South and Center).

The **Start Measurement** button will trigger the measurement. After pressing the button, a bar will show the progress of the measurement.

The reference needs to be measured within the next 10s to avoid influences from signal drifts. A down counter is displayed in the Visualization window. If the reference measurement was not acquired during these 10 seconds, a pop-up window will be displayed. The measurement needs to be repeated.

Removing the artificial hand and pressing the **Start Measurement** button will trigger the reference measurement. The measurement table displays the signal level with artificial hand (hand brick), without it (reference) and the difference between them (Delta).

The measurement process checks if the measured data is valid and if the environment is noisy.

When the data is not valid, it is displayed in red in the measurement table. If the variance of the signal was higher than ten digits during measurements, the noise indicator in the status bar blinks and Aurea shows a red message reporting that there was noise detected during the last measurement: *"Measurement variance exceeded threshold"*. If the Delta is negative, meaning that the reference level was higher than the one with artificial hand, a red message will be displayed: *"The Delta is negative"*.

The user has to check the measurement setup and repeat the measurement.

Typical reasons for failed measurements are:

- User activity in the sensing space while measuring
- PC not grounded
- Artificial hand is not grounded
- Artificial hand is shaking and the setup was not mechanically stable
- External noise sources (conducted or irradiated)

Once the Electrode Weighting step is finished, press the **OK** button.

It is not necessary to adjust/correct the 30-mm Styrofoam spacer brick for the thickness of the target device housing or for a decoration layer covering the electrodes.

The collected data corresponds to the Signal Deviation Mean (SDM) of the electrodes signal levels.

3.2.9 E-Field Linearization

The E-Field Linearization is an optional step to adjust parameters for position tracking. Four measurements with the artificial hand centered with the system and four reference measurements without it are conducted at different heights (10 mm, 30 mm, 50 mm and 80 mm). Always use a Styrofoam spacer to establish the height. The drawing in the E-Field Linearization step in Aurea shows the spacer to be used.

The **Start Measurement** button will trigger the measurement. After pressing the button, a bar will show the progress of the measurement.

The reference needs to be measured within the next 10s to avoid influences from signal drifts. A down counter is displayed in the Visualization window. If the reference measurement was not acquired during these 10s, a pop-up window will be displayed. The measurement needs to be repeated.

Removing the artificial hand and pressing the **Start Measurement** button will trigger the reference measurement. The measurement table displays the signal level with artificial hand (hand brick), without it (reference) and the difference between them (Delta).

The measurement process checks if the measured data is valid and if the environment is noisy. When the data is not valid, it is displayed in red in the measurement table. If the variance of the signal was higher than ten digits during measurements, the noise indicator in the status bar blinks and Aurea shows a red message reporting that there was noise detected during the last measurement: *"Measurement variance exceeded threshold"*. If the Delta is negative, meaning that the reference level was higher than the one with artificial hand, a red message will be displayed: *"The Delta is negative"*.

The user has to check the measurement setup and repeat the measurement.

Typical reasons for failed measurements are:

- User activity in the sensing space while measuring
- PC not grounded
- Artificial hand not grounded
- Artificial hand is shaking and the setup was not mechanically stable
- External noise sources (conducted or irradiated).

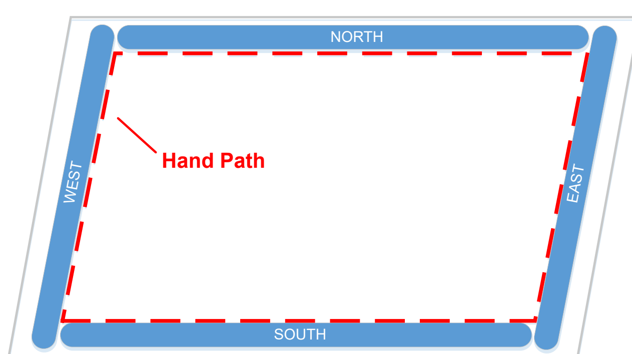
Once the E-Field Linearization step is finished, press the **OK** button.

Note: The collected data corresponds to the Signal Deviation Mean (SDM) of the electrodes signals levels.

3.2.10 Sensing Area

The Sensing Area parameterization step is intended to adapt the calculated XY position to the real electrode dimensions of the system. This is done by setting the four scaling parameters `X POS MIN`, `X POS MAX`, `Y POS MIN` and `Y POS MAX`. The grid of the 2D-position plot in the Visualization window will be scaled if a slider of these parameters is moved.

Figure 3-11. Sensing Area Hand Path



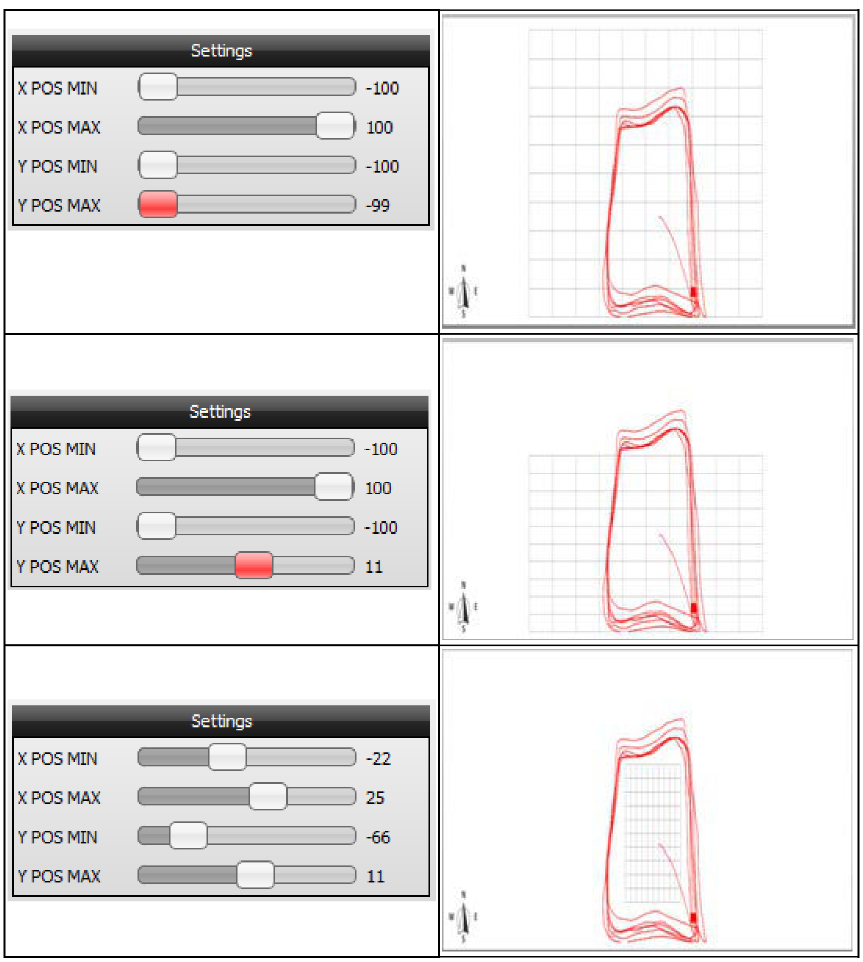
The **Apply** button will apply the current setting and will rescale the Visualization window according to the current setting. The **Clear** button will reset the position drawing.

The sub-steps within the Sensing Area step are as follows:

- While touching the device, move the hand posture, which is typical for the application, along the maximum XY positions which the user would like to reach in the application. Repeat the hand moving along the maximum XY position about ten times to get a more meaningful drawing. The 2D-signal plot in the Visualization window draws the calculated position based on the hand movement. It is likely that the real position does not fit the calculated position.
- Use the slider of the four scaling parameters to reduce the grid size until it fits within the deformed position drawing.
- Press **Apply** and check if reaching all XY positions with the same hand movement is now possible.
- If all positions can be reached, continue with the next parameterization step. If not, adjust the sliders and press **Apply** again until the positioning meets expectation.

The following graphic shows a typical position drawing and the parameter setting of the corresponding parameterization step. The grid and thus the scaling are changing with the parameter settings.

Figure 3-12. Sensing Area Tuning Examples



Note: Experiment with those settings to improve the system linearity. Typically, the system has a more linear behavior for smaller grid sizes.

3.2.11 Minimum Z Level

Minimum Z level tuning is similar to the Sensing Area step which was intended to adjust the XY positioning; the Z positioning step is intended to adjust the Z position calculation. The Z position is adjusted through two steps: minimum and maximum Z level. The first step is to adjust the minimum Z distance level (Z = 0) by configuring the `Z POS MIN` parameter. This parameter can be modified by using the respective slider. For fine tuning, click on the **slider** and use the arrow keys on the PC keyboard.

- Touch the surface of the sensing area with a typical hand posture for the application and keep the touch.
- Adjust the slider `Z POS MIN` until the green Z level illustrated in the 3D-signal plot hits the *zero level*. In this manner, the *zero level* is the lowest level which is possible to reach in the 3D-signal plot.
- The Z position must increase while the hand is moving up from the surface.

3.2.12 Maximum Z Level

The second step of the Z level adjustment is to identify the maximum Z distance level. This parameter setting can be modified by using the respective slider. For fine tuning, click on the **slider** and use the arrow keys on the PC keyboard.

The sub-steps within the Maximum Distance Level step are as follows:

- Set `Z POS MAX` to its maximum value.
- Touch the surface and then slowly remove the hand in Z direction with a hand posture that is typical for the application.
- The Z position will stop following the user's hand at some point.
- Adjust `Z POS MAX` such that the top of the grid is aligned with the green Z level.

3.2.13 Jitter Reduction

Jitter control is configured in the Filter Adjustment window. The filter adjustments are used to reduce the system jitter (position error when hand is stable) and to define the desired hand tracking speed.

3.2.13.1 Jitter Reduction

Place the hand on the corner, close to the electrodes (where the jitter is more visible), hold it for a few seconds and watch the position using the Position Tracking window. The position should not have high deviation in a distance.

Increase the Jitter Reduction parameter value to reduce system jitter. High values will lead to a more lethargic system behavior and will also slow down the tracking speed. Low values will lead to a more responsive system behavior and will speed up the tracking speed.

3.2.13.2 Speed

Perform hand gestures to check the tracking speed in the Position Tracking window. Adjust the Speed parameter value to speed up or to slow down the tracking speed.

4. Reference Material

- MGC3140 GestIC® Library Interface Description User's Guide (DS40001875)
- Aurea Graphical User Interface User's Guide (DS40001681)
- GestIC® Design Guide (DS40001716)
- MGC3140 3D Tracking and Gesture Controller Data Sheet (DS40002037)

5. Revision History

Revision	Description	Date
A	Initial release	September, 2018

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