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MGC3130
Hillstar Development Kit
User's Guide

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Object of Declaration: MGC3130 Hillstar Development Kit User's Guide

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This declaration of conformity is issued by the manufacturer.
The development/evaluation tool is designed to be used for research and development in a laboratory environment. This development/evaluation tool is not a Finished Appliance, nor is it intended for incorporation into Finished Appliances that are made commercially available as single functional units to end users under EU EMC Directive 2004/108/EC and as supported by the European Commission's Guide for the EMC Directive 2004/108/EC (8th February 2010).
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Signed for and on behalf of Microchip Technology Inc. at Chandler, Arizona, USA

Derek Carlson
VP Development Tools

16-July-2013
Date

NOTES:

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Preface

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.

For the most up-to-date information on development tools, see the MPLAB® IDE online help. Select the Help menu, and then Topics to open a list of available online help files.

INTRODUCTION

This chapter contains general information that will be useful to know before using the MGC3130 Hillstar Development Kit. Items discussed in this chapter include:

- Document Layout
- Conventions Used in this Guide
- Warranty Registration
- Recommended Reading
- The Microchip website
- Development Systems Customer Change Notification Service
- Customer Support
- Revision History

DOCUMENT LAYOUT

This document describes the installation and use of the MGC3130 Hillstar Development Kit. The document is organized as follows:

- **Chapter 1. "Overview"**
- **Chapter 2. "Getting Started"**
- **Chapter 3. "Hillstar Boards – Hardware Description"**
- **Chapter 4. "Design In: Hillstar In Target Application"**
- **Chapter 5. "Troubleshooting"**
- **Appendix A. "Schematics"**
- **Appendix B. "Sensitivity Profile and Capacitances"**
- **Appendix C. "Parameterization Support"**
- **Appendix D. "Driver Installation Manual"**
- **Appendix E. "Glossary"**

CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

DOCUMENTATION CONVENTIONS

Description	Represents	Examples
Arial font:		
Italic characters	Referenced books	*MPLAB® IDE User's Guide*
	Emphasized text	...is the *only* compiler...
Initial caps	A window	the Output window
	A dialog	the Settings dialog
	A menu selection	select Enable Programmer
Quotes	A field name in a window or dialog	"Save project before build"
Underlined, italic text with right angle bracket	A menu path	*File>Save*
Bold characters	A dialog button	Click **OK**
	A tab	Click the **Power** tab
N'Rnnnn	A number in verilog format, where N is the total number of digits, R is the radix and n is a digit.	4'b0010, 2'hF1
Text in angle brackets < >	A key on the keyboard	Press <Enter>, <F1>
Courier New font:		
Plain Courier New	Sample source code	`#define START`
	Filenames	`autoexec.bat`
	File paths	`c:\mcc18\h`
	Keywords	`_asm, _endasm, static`
	Command-line options	`-Opa+, -Opa-`
	Bit values	`0, 1`
	Constants	`0xFF, 'A'`
Italic Courier New	A variable argument	*`file`*`.o`, where *`file`* can be any valid filename
Square brackets [ ]	Optional arguments	`mcc18 [options]` *`file`* `[options]`
Curly brackets and pipe character: { | }	Choice of mutually exclusive arguments; an OR selection	`errorlevel {0|1}`
Ellipses...	Replaces repeated text	`var_name [, var_name...]`
	Represents code supplied by user	`void main (void) { ... }`

WARRANTY REGISTRATION

Please complete the enclosed Warranty Registration Card and mail it promptly. Sending in the Warranty Registration Card entitles users to receive new product updates. Interim software releases are available at the Microchip website.

RECOMMENDED READING

This user's guide describes how to use the MGC3130 Hillstar Development Kit. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

GestIC® Design Guide: Electrodes and System Design (DS40001716)

This document describes the MGC3130 system characteristic parameters and the design process. It enables the user to generate a good electrode design and to parameterize the full GestIC system.

MGC3030/MGC3130 GestIC® Library Interface Description (DS40001718)

This document is the interface description of the MGC3130's GestIC Library. It outlines the function of the Library's message interface, and contains the complete message reference to control and operate the MGC3130 system.

MGC3030/MGC3130 3D Gesture Controller Data Sheet (DS40001667)

Consult this document for information regarding the MGC3130 3D Tracking and Gesture Controller.

Aurea Graphical User Interface User's Guides (DS40001681)

This document describes how to use the MGC3130 Aurea Graphical User Interface.

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- **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software
- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip consultant program member listing
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives™

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- **Compilers** – The latest information on Microchip C compilers, assemblers, linkers and other language tools. These include all MPLAB® C compilers; all MPLAB assemblers (including MPASM™ assembler); all MPLAB linkers (including MPLINK™ object linker); and all MPLAB librarians (including MPLIB™ object librarian).
- **Emulators** – The latest information on Microchip in-circuit emulators.This includes the MPLAB REAL ICE™ and MPLAB ICE 2000 in-circuit emulators.
- **In-Circuit Debuggers** – The latest information on the Microchip in-circuit debuggers. This includes MPLAB ICD 3 in-circuit debuggers and PICkit™ 3 debug express.
- **MPLAB® IDE** – The latest information on Microchip MPLAB IDE, the Windows® Integrated Development Environment for development systems tools. This list is focused on the MPLAB IDE, MPLAB IDE Project Manager, MPLAB Editor and MPLAB SIM simulator, as well as general editing and debugging features.
- **Programmers** – The latest information on Microchip programmers. These include production programmers such as MPLAB REAL ICE in-circuit emulator, MPLAB ICD 3 in-circuit debugger and MPLAB PM3 device programmers. Also included are nonproduction development programmers such as PICSTART® Plus and PICkit 2 and 3.

CUSTOMER SUPPORT

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Field Application Engineer (FAE)
- Technical Support

Customers should contact their distributor, representative or field application engineer (FAE) for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in the back of this document.

Technical support is available through the website at:

http://www.microchip.com/support.

REVISION HISTORY

Revision A (October, 2013)

This is the initial release of the document.

Revision B (January, 2016)

Updated Recommended Reading section; Updated Figures 2-1, 3-2, 3-6, A-2, A-3 and A-4.

NOTES:

Chapter 1. Overview

1.1 INTRODUCTION

The MGC3130 is a 3G gesture controller based on Microchip's GestIC® technology. It is developed as a mixed-signal controller. The MGC3130 has one transmit and five very sensitive receive channels that are capable to detect changes of a transmitted electrical field (E-field) corresponding to capacitive changes in the femtofarad (1 fF = 10^{-15}F) range.

In order to transmit and receive an electrical field, electrodes have to be connected to the transmitting and receiving channels of the MGC3130 controller. The spatial arrangement of the electrodes allows the chip to determine the center of gravity of the electric field distortion, and thus position tracking and gesture recognition of a user's hand in the detection space.

1.2 HILLSTAR CONCEPT AND DELIVERABLES

The Hillstar Development Kit is designed to support an easy integration of Microchip's MGC3130 3D Gesture and Tracking Controller into customer's applications. It provides MGC3130 system setup, related hardware and software references.

With the MGC3130 Software Package, including Aurea Graphical User Interface and GestIC Library, the MGC3130 Software Development Kit (SDK) and PIC18 Host Reference code, design-in is easy in five steps:

1. Feature Definition
2. Electrode Design
3. MGC3130 Parameterization
4. Host Application Programming
5. Verification

Hillstar hardware builds a complete MGC3130 reference system consisting of three individual PCBs:

- MGC3130 Unit
- I^2C to USB Bridge
- Reference Electrode with a 95x60 mm sensitive area

It can be plugged to a PC via USB cable and used for evaluation of MGC3130 chip and GestIC technology. During the customer's design-in process the individual boards can be combined according to the customers need.

Three examples are given below:

- Combine MGC3130 Unit and I^2C to USB Bridge to evaluate customized electrodes
- Use I^2C to USB Bridge to parameterize and debug the MGC3130 application circuitry in the customer's design
- Combine MGC3130 Unit and Electrodes to develop gesture-driven applications for PC-based or embedded software environments

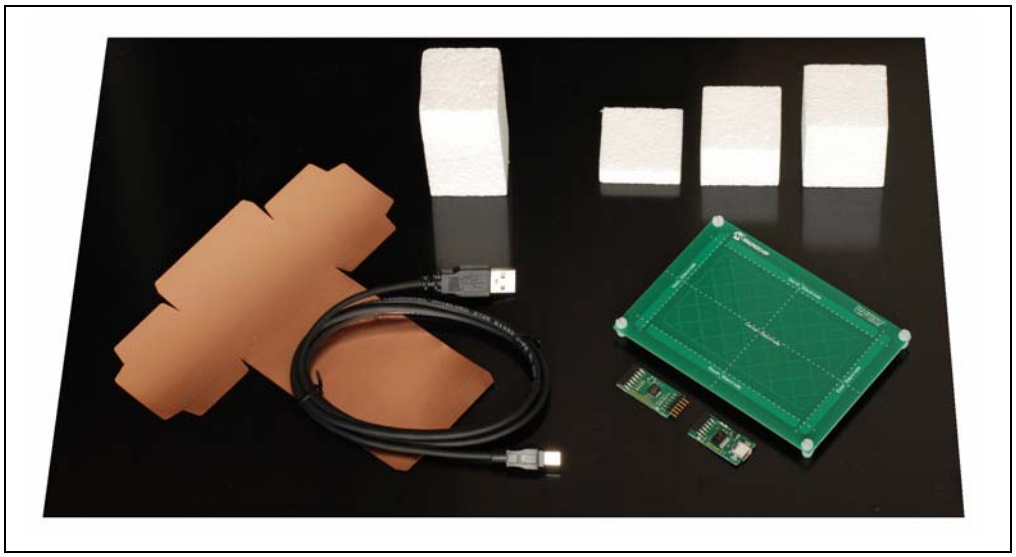
The Hillstar Development Kit provides an artificial test hand, further called hand brick, helping to stimulate the human hand operating the GestIC application. The hand brick has to be used during the design-in process to parametrize and evaluate customer's applications. The hand brick's surface is conductive and connected to GND via cable in order to reproduce the grounding conditions of the human body.

1.3 HILLSTAR DEVELOPMENT KIT PACKAGE CONTENT

The Hillstar Development Kit package content is listed below:

- MGC3130 Module
- I^2C to USB Bridge Module
- 4-layer reference electrode (95x60 mm sensitive area)
- 'Hand brick' set (self-assembly, four foam blocks, one copper foil)
- USB Cable for PC connection

FIGURE 1-1: HILLSTAR DEVELOPMENT KIT



The 'hand brick' set is used during the design-in process for sensor calibration and performance evaluation purposes. For usage and assembly information, refer to **Appendix C. "Parameterization Support"**.

1.4 HILLSTAR DEVELOPMENT KIT REFERENCE ELECTRODES

The Hillstar Development Kit includes a collection of layout references (Gerber files) for electrode designs and ready-to-use sensor modules with MGC3130 backside assembly.

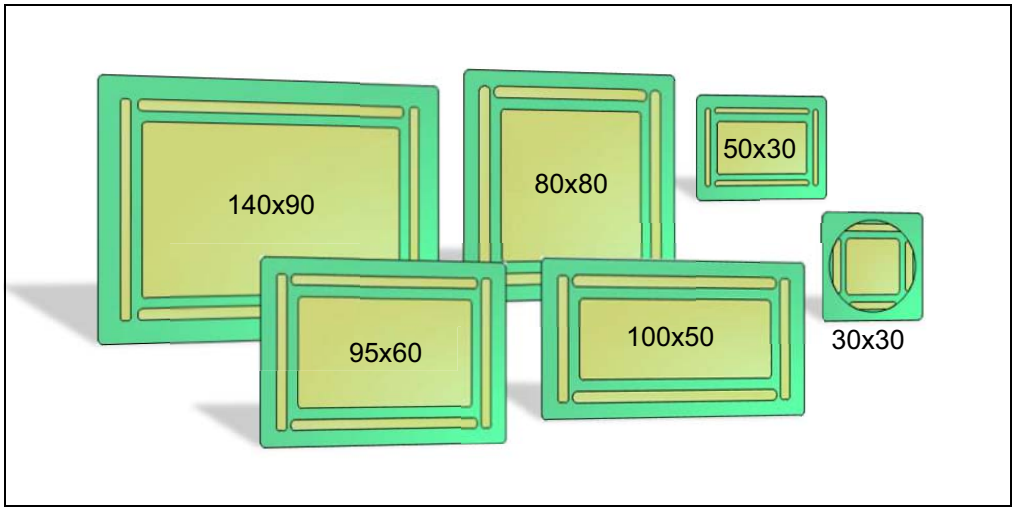
The following electrode designs are included:

- **140x90 mm sensitive area** – outline 168 x 119 mm
- **95x60 mm sensitive area** – outline of 120 x 85 mm
- **80x80 mm sensitive area** – outline 104 x 104 mm
- **100x50 mm sensitive area** – outline 128 x 72 mm
- **50x30 mm sensitive area** – outline 63 x 47 mm
- **30x30 mm sensitive area** – outline 49 x 49 mm

Sensor Modules

- **95x60 mm sensitive area** – outline of 120 x 85 mm
- **30x30 mm sensitive area** – outline 49 x 52 mm

FIGURE 1-2: HILLSTAR DEVELOPMENT KIT REFERENCE ELECTRODES



Dimensions of the designs are given in Table 1-1 and Figure 1-3 below.

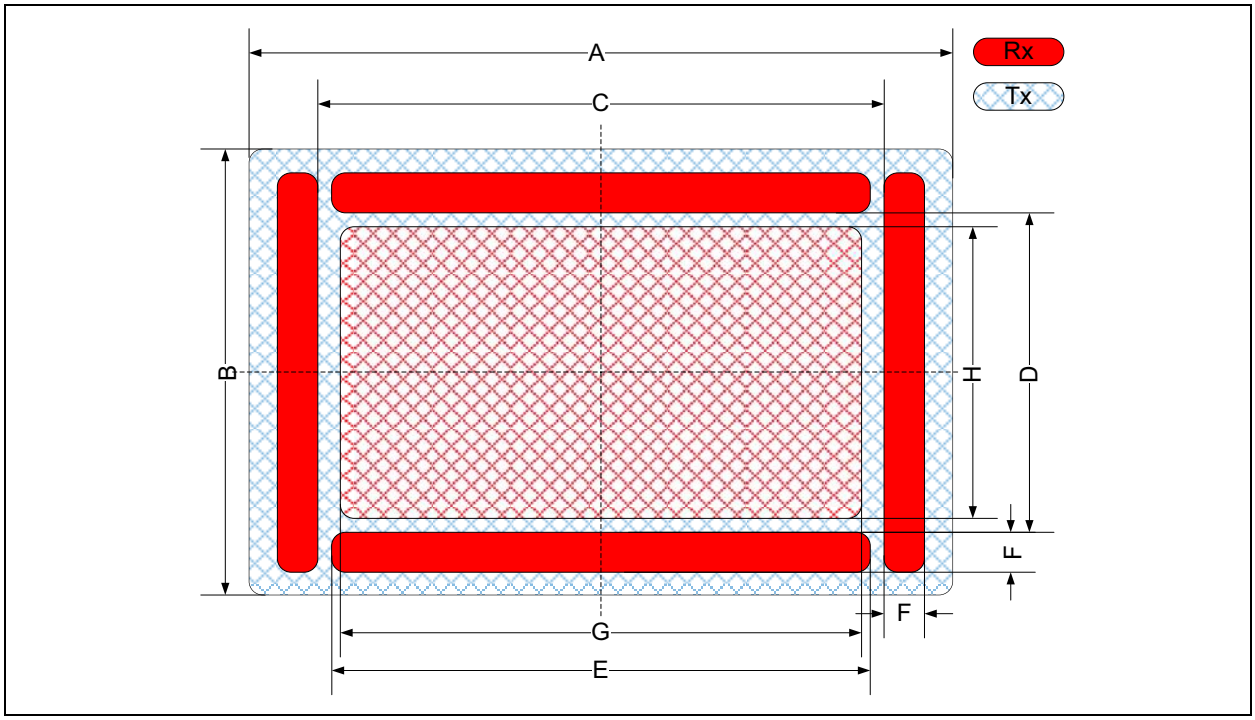
TABLE 1-1: ELECTRODE DIMENSIONS

Sensitive Area	140x90 mm	95x60 mm(1)	80x80 mm	100x50 mm	50x30 mm	30x30 mm(2)
Version	1.0	1.0	1.0	1.0	1.0	1.0
Layer	2	2	2	2	2	2
Aspect Ratio	approx. 3:2	approx. 3:2	1:1	approx. 2:1	5:3	1:1
A	168 mm	120 mm	104 mm	128 mm	63 mm	49 mm
B	119 mm	85 mm	104 mm	72 mm	47 mm	49 mm
C	138 mm	95,7 mm	79.8 mm	103,6 mm	50 mm	31.8 mm
D	88,7 mm	60,5 mm	79.8 mm	46,8 mm	30 mm	27,3 mm
E	131,7 mm	91,7 mm	75,8 mm	99,6 mm	46 mm	27,3 mm
F	5 mm	5 mm	5 mm	5 mm	2,5 mm	3,5 mm
G	128 mm	85,7 mm	69,8 mm	93,6 mm	44 mm	25,8 mm
H	78,7 mm	50, 5 mm	69, 8 mm	36, 8 mm	24 mm	25,8 mm
Center Electrode cross-hatching	3%	3%	5%	5%	5%	5%
Tx Electrode cross-hatching -under center electrode -outside center electrode	 50 % 20 %	 50% 20%	 50% 20%	 50 % 20 %	 50 % 20 %	 50 % 20 %

Note 1: These dimensions are also valid for 95x60 mm sensor module.

2: These dimensions are also valid for 30x30 mm sensor module except the B dimension which is equal to 52 and Tx electrode which is solid instead of cross-hatched.

FIGURE 1-3: ELECTRODE DIMENSIONS



The Gerber data of all electrode reference designs are included in the MGC3130 Hillstar Hardware Reference package and can be downloaded from Microchip's website www.microchip.com/GestICGettingStarted.

1.5 MGC3130 SOFTWARE PACKAGE – AUREA GUI AND GestIC LIBRARY

The MGC3130 Software Package contains all relevant system software and documentation. Hillstar Development Kit is supported by MGC3130 Software Package 0.4 and following versions.

The package contains:

- Aurea PC software
- GestIC Library binary file
- GestIC Parameterization files
- Windows CDC driver
- Documentation

The latest MGC3130 software package can be downloaded from Microchip's website www.microchip.com/GestICGettingStarted.

1.6 MGC3130 SOFTWARE DEVELOPMENT KIT (SDK)

The MGC3130 Software Development Kit (SDK) supports the integration of MGC3130 into a software environment. Thus, it includes a C reference code for GestIC API, a precompiled library for Windows operating systems and a demo application using the GestIC API interface.

Hillstar Development Kit is supported by MGC3130 SDK 0.4 and the following versions.

The latest SDK can be downloaded from Microchip's website www.microchip.com/GestICGettingStarted.

NOTES:

Chapter 2. Getting Started

Hillstar Development Kit can be used as a stand-alone GestIC system and evaluated in conjunction with the Aurea PC software. This section describes how to get started.

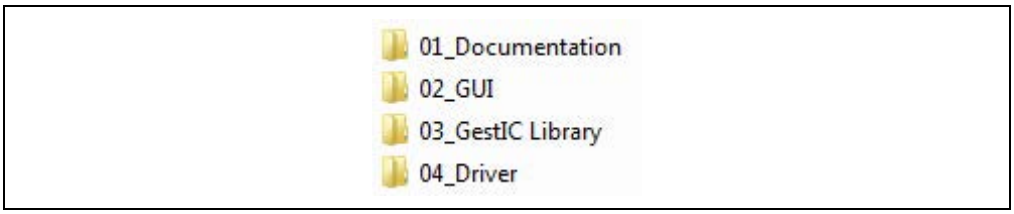
2.1 PREREQUISITES

The following prerequisites have to be fulfilled:

- PC with Windows 7 or Windows 8 operating system and USB port and minimum screen resolution of 1024x768
- Hillstar Development Kit (MGC3130 Unit, I^2C to USB Bridge, 95x60 mm frame electrode)
- MGC3130 Software Package 0.4 and following versions

The MGC3130 Software Package is available as a `.zip` file. Unzip the file, run `setup.exe` and install the package to your PC. The folder structure is as shown in Figure 2-1.

FIGURE 2-1: FOLDER STRUCTURE

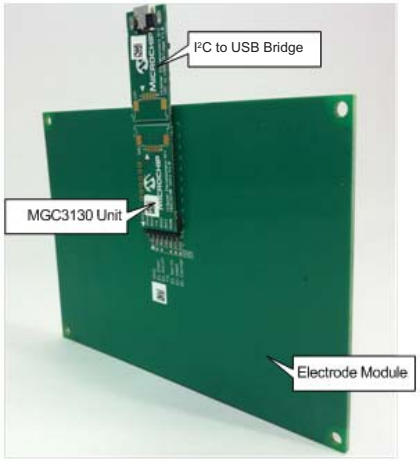


2.2 STEP 1: BUILD-UP DEVELOPMENT KIT

Connect Electrodes, MGC3130 Unit and I^2C to USB Bridge as shown in Figure 2-2.

Note: Make sure the MGC3130 Unit and the I^2C USB Bridge are already connected before plugging in the USB connection.

FIGURE 2-2: HILLSTAR DEVELOPMENT KIT ASSEMBLING



2.3 STEP 2: CONNECTING HILLSTAR DEVELOPMENT KIT WITH YOUR PC

Use the supplied USB cable to connect the Hillstar Development Kit to your PC. The Power LEDs on both, I^2C to USB Bridge and MGC3130 Unit will illuminate. Furthermore, LED 1 on the I^2C to USB Bridge will flash very fast (~10 Hz). In case LED 1 is flashing slow (~1 Hz), the Windows CDC driver is already installed on your PC. Please skip the next step and go to **Section 2.5 "Step 4: Start Aurea"**.

2.4 STEP 3: INSTALL WINDOWS CDC DRIVER

The Windows CDC driver can be found in the MGC3130 Software Package in folder `04_Driver`.

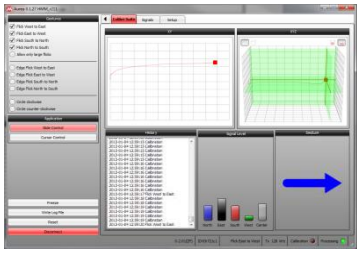
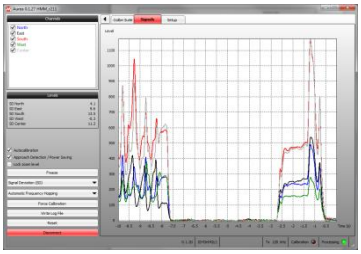
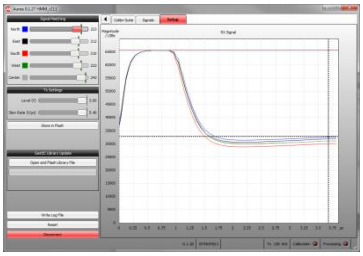
When the Hillstar Development Kit is connected to your PC for the first time, Windows requests the appropriate device driver and guides you through the installation process. Alternatively, you can install the driver manually, (e.g., using the device manager). An example for Windows 7 is given in **Appendix D. "Driver Installation Manual"**.

2.5 STEP 4: START AUREA

Aurea Graphical User Interface, shown in Figure 2-3, is included in the MGC3130 Software Package in the folder `02_GUI`.

Open `Aurea.exe`. Aurea detects the connected device automatically and is ready for use.

FIGURE 2-3: AUREA GRAPHICAL USER INTERFACE

Evaluate Colibri Suite	Discover Signals	Setup MGC3130
		
1. Positions Tracking 2. Gesture Recognition 3. Demo applications	1. View signals 2. Write log file 3. Advanced features	1. AFE parameterisation 2. Colibri Suite parameterization 3. Update GestIC Library 4. Measure Electrode capacitances

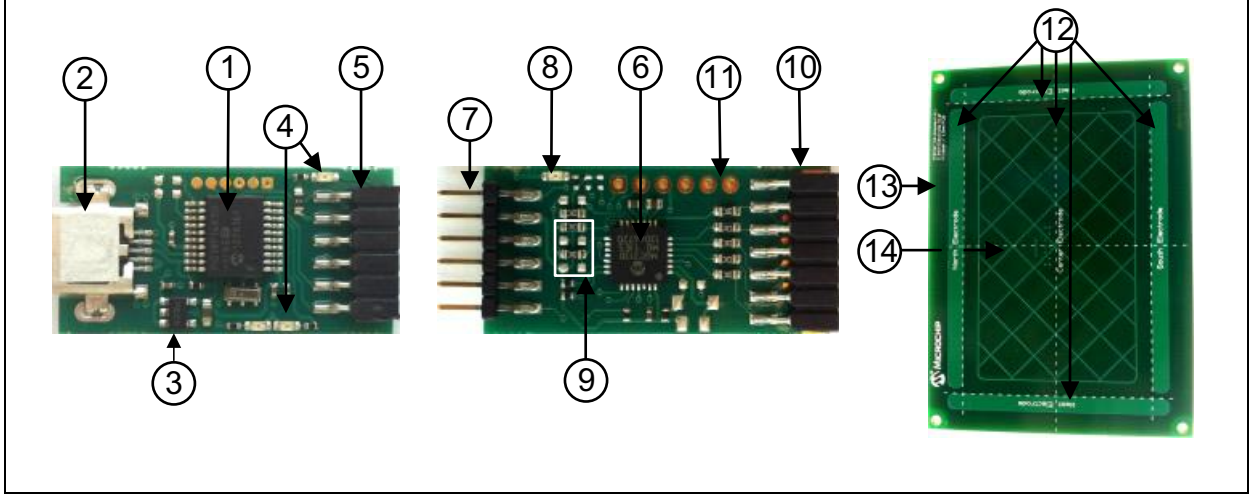
NOTES:

Chapter 3. Hillstar Boards – Hardware Description

3.1 OVERVIEW

The Hillstar key components are listed below and highlighted in Figure 3-1.

FIGURE 3-1: HILLSTAR DEVELOPMENT KIT OVERVIEW



3.1.1 I²C to USB Bridge

1. PIC18F14K50 USB microcontroller
2. Micro-USB connector
3. MCP1801T LDO voltage regulator (converts 5V USB to 3.3 V board supply)
4. Status LEDs (power, communication status)
5. Data interface: 6-pin socket for data communication and power supply

3.1.2 MGC3130 Unit

6. MGC3130 3D Tracking and Gesture Controller
7. Data interface: 6-pin header for data communication and power supply
8. Status LED (power)
9. Interface select
10. Electrode interface: 7-pin socket
11. GesturePort interface (pads for 5 EIOs, 1 GND)

3.1.3 95x60 mm Reference Electrode PCB

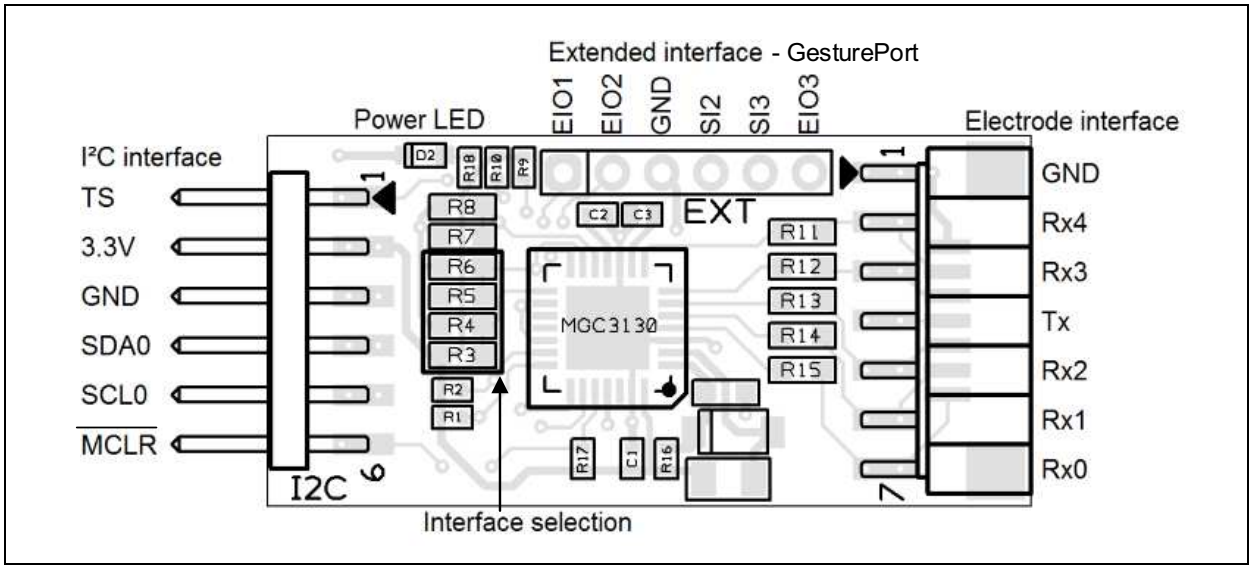
12. Receive electrodes
13. Acrylic cover glass (120 x 85 x 2 mm)
14. Electrode interface: 7-pin header (mounted on backside)

The Gerber data of all Hillstar Development Kit components are included in the MGC3130 Hillstar Hardware Reference package and can be downloaded from Microchip's website www.microchip.com/GestICGettingStarting.

3.2 MGC3130 UNIT

The key element of the MGC3130 Unit is Microchip's MGC3130 3D Tracking and Gesture Controller. The layout print of the unit is shown in Figure 3-2.

FIGURE 3-2: MGC3130 UNIT



The unit provides a 2 mm 7-pin board-to-board connector (socket) to connect the electrode. The interface includes the following signals: GND, Rx4, Rx3, Tx, Rx2, Rx1, and Rx0. Alternatively, the board-to-board connector can be replaced by a 1 mm Flexible Printed Circuitry (FPC) connector which is prepared as a design option. The five Rx channels of the MGC3130 (Rx0…Rx4) are connected to the receive electrodes via 10 kΩ resistors in order to suppress irradiated high-frequency signals (R11, R12, R13, R14, and R15). The MGC3130 signal generator is connected via the Tx signal to the transmit electrode.

The data connection to the Hillstar I^2C to USB Bridge is realized by a 6-pin 2 mm board-to-board connector (header). The interface includes the following signals: EIO0, 3.3V, GND, SDA0, SCL0, and $\overline{\text{MCLR}}$. Alternatively, it is possible to use a 1 mm FPC connector which can be assembled to the bottom side.

The MGC3130 unit acts as an I²C slave device. Table 3-1 shows the configuration of the MGC3130 interface selection pins (IS1, IS2) which can be pulled to VDD or to GND via resistors (R3, R4, R5, and R6) to select the I²C slave address. The I²C device address 0x42 is set as default.

TABLE 3-1: MGC3130 UNIT I²C INTERFACE SELECTION

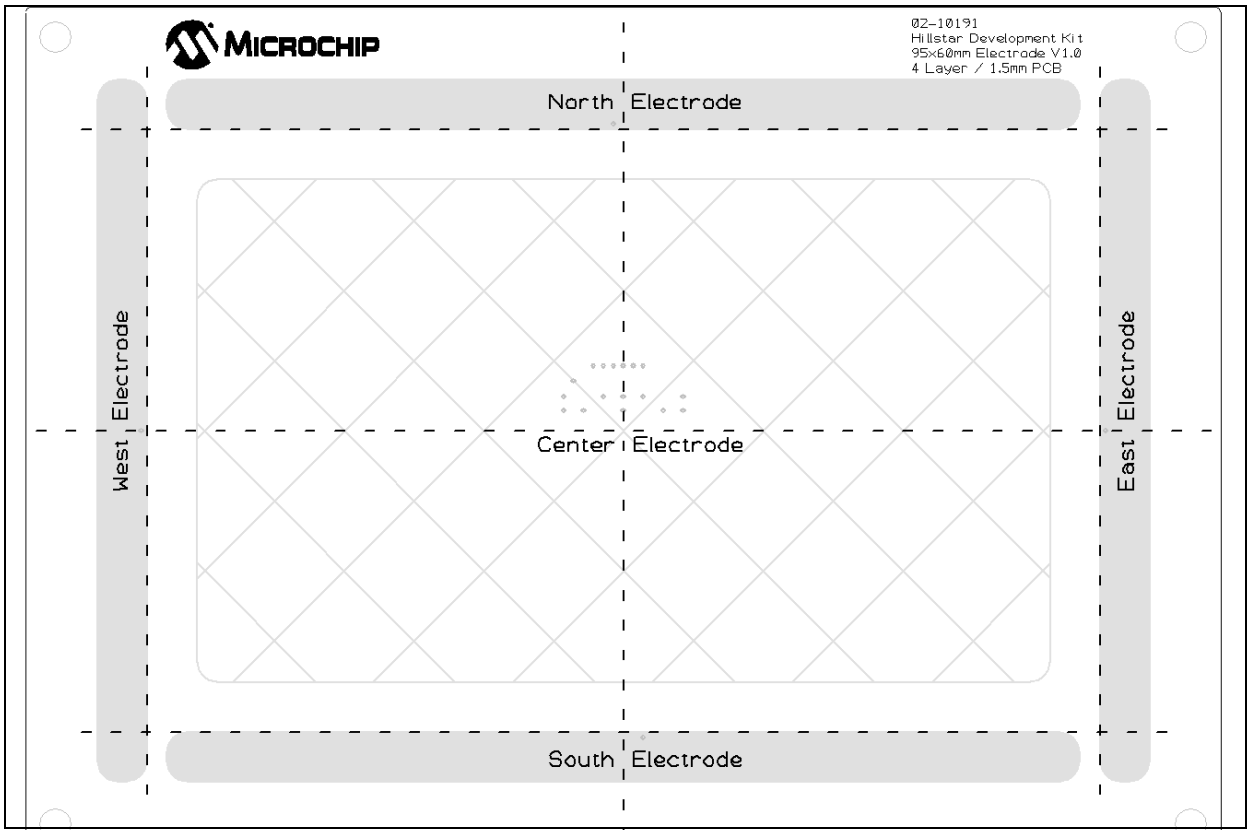
MGC3130 Interface Selection Pins		Mode (Address)	Assembly Option			
IS2	IS1		R3	R4	R5	R6
0	0	I²C 0 Slave Address = 0x42 (default)	n.p.	10 kΩ	n.p.	10 kΩ
1	0	I²C 0 Slave Address = 0x43	10 kΩ	n.p.	n.p.	10 kΩ

For Schematics, Layout and Bill of Material of the MGC3130 Unit please refer to **Section Appendix A. "Schematics"**.

3.3 HILLSTAR 95x60 mm REFERENCE ELECTRODE

The 95x60 mm Reference Electrode provided with the Hillstar Development Kit consists of one Tx and a set of five Rx electrodes (north, east, south, west, center), which are placed in two different layers. An additional ground layer is placed underneath the Tx electrode and shields the electrode's back from external influences.

FIGURE 3-3: HILLSTAR PCB ELECTRODE



The PCB is connected to the MGC3130 Unit by the 2 mm 7-pin board-to-board connector. The interface includes the following signals: GND, Rx4, Rx3, Tx, Rx2, Rx1, and Rx0.

The dimension of the board is 120 x 85 mm; the sensitive area is 95 x 60 mm.