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MGC3130 – Sabrewing Single-Zone Evaluation Kit User's Guide

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MGC3130 – SABREWING SINGLE-ZONE EVALUATION KIT USER'S GUIDE

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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 web site (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 Sabrewing Single-Zone Evaluation Kit. Items discussed in this chapter include:

- Document Layout
- Conventions Used in this Guide
- Warranty Registration
- Recommended Reading
- The Microchip Web Site
- Development Systems Customer Change Notification Service
- Customer Support
- Software License Information
- Document Revision History

DOCUMENT LAYOUT

This document describes the installation and use of the Sabrewing Single-Zone Evaluation Kit. The document is organized as follows:

- **Chapter 1. "Overview"**
- **Chapter 2. "Getting Started"**
- **Chapter 3. "MGC3130 – Sabrewing Evaluation Board"**
- **Chapter 4. "Troubleshooting"**
- **Appendix A. "Schematics"**
- **Appendix B. "Sensitivity Profile and Capacities"**
- **Appendix C. "Driver Installation Manual"**
- **Appendix D. "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 web site.

RECOMMENDED READING

This user's guide describes how to use the Sabrewing Single-Zone Evaluation Kit. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

MGC3130 – Single-Zone 3D Gesture Controller Data Sheet (DS41667)

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

MGC3130 – Aurea Graphical User Interface User's Guide (DS41681)

This document describes the installation and use of Aurea. Microchip's Aurea is a Windows-based graphical user interface that can be used to demonstrate, evaluate and configure Microchip's MGC3130 3D tracking and Gesture Controller.

THE MICROCHIP WEB SITE

Microchip provides online support via our web site at www.microchip.com. This web site is used as a means to make files and information easily available to customers.

Information about GestIC® technology and MGC3130 can be directly accessed via www.microchip.com/gestic.

Documentation and software releases of the Sabrewing Evaluation Board can be found at www.microchip.com/GestICGettingStarted.

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- **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.

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

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Technical support is available through the web site at:

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

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DOCUMENT REVISION HISTORY

Revision A (March 2013)

- Initial release of the document.

NOTES:

Chapter 1. Overview

1.1 INTRODUCTION

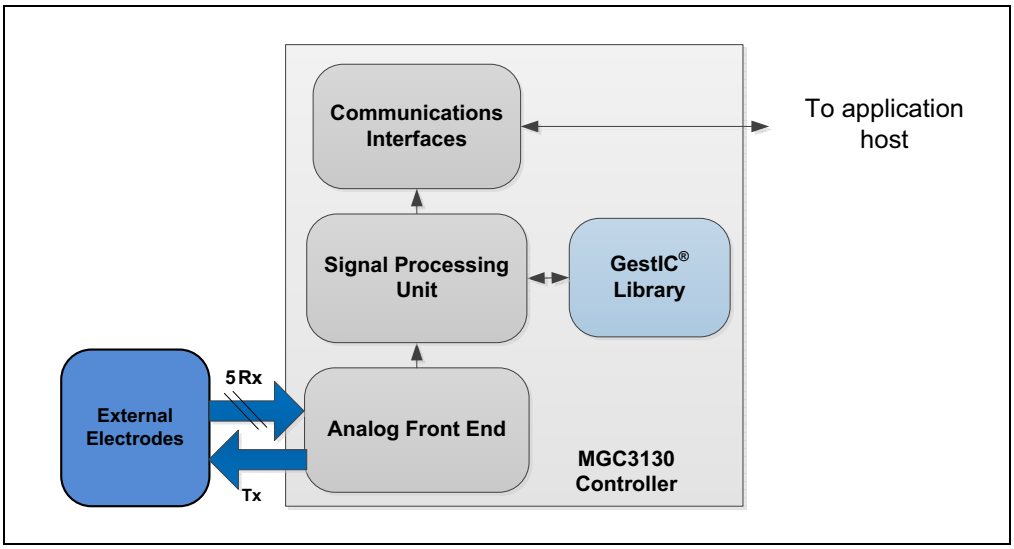
1.1.1 MGC3130 System Overview

The MGC3130 is the first product 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 distortions of a transmitted electrical field (E-field) corresponding to capacitive changes in the femtofarad (1fF = 10^{-15F}) 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 allow the chip to determine the center of gravity of the electric field distortion, and thus position tracking of a user's hand in the detection space.

The entire system solution is composed by three main building blocks (see Figure 1-1):

- MGC3130 Controller Chip
- Embedded GestIC Library
- External Electrodes

FIGURE 1-1: MGC3130 CONTROLLER SYSTEM



1.1.2 MGC3130 Controller

The MGC3130 features the following main building blocks:

- Low-noise Analog Front End (AFE)
- Digital Signal Processing Unit (SPU)
- Flexible Communication Interfaces

The MGC3130 controller provides a transmit signal to generate the E-field, conditions the analog signals from the receiving electrodes and processes this data digitally on the SPU. Data exchange between the MGC3130 and the host is conducted via the communication interfaces.

Please refer to the *"MGC3130 Single-Zone 3D Gesture Controller Data Sheet"* (DS41667) for more details.

1.1.3 GestIC® Library

The embedded GestIC library is optimized to ensure continuous and real-time free-space Position Tracking and Gesture Recognition, concurrently. It is fully configurable and allows required parameterization for individual application and electrode layouts.

1.1.4 External Electrodes

Five Rx electrodes and one Tx electrode are connected to MGC3130. An electrode needs to be individually designed for optimal E-field distribution and detection of E-field variations inflicted by a user.

1.2 SABREWING EVALUATION KIT

The MGC3130 Single-Zone Evaluation Kit "Sabrewing" is designed for evaluation of Microchip's MGC3130 3D Tracking and Gesture Controller core features which contains:

- Hand Position Tracking in three dimensions (x, y, z)
- Hand Gesture Recognition based on a stochastic Hidden Markov Model (HMM)
- Approach detection for power saving

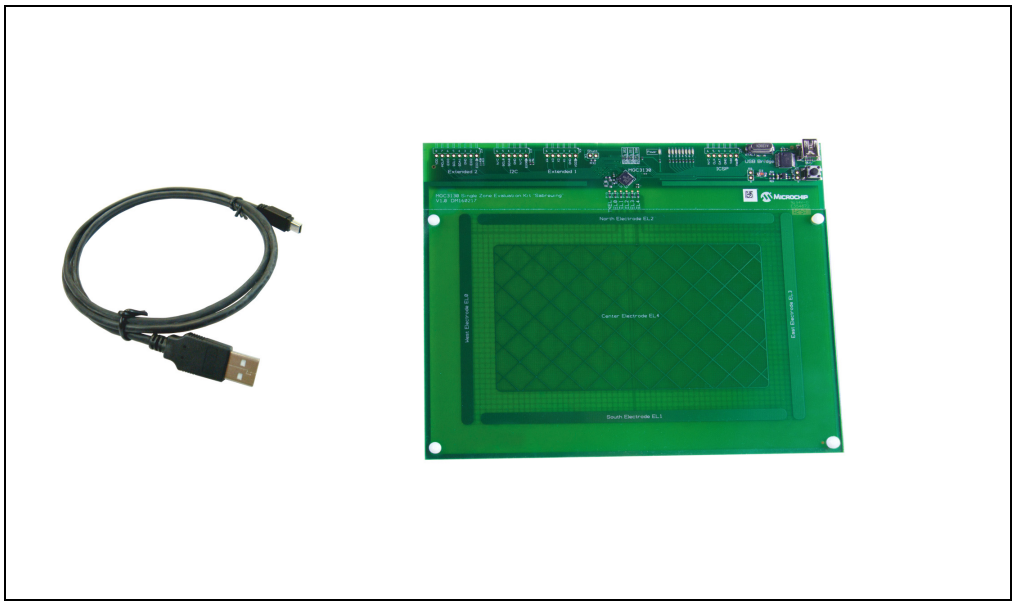
1.2.1 Sabrewing Single-Zone Evaluation Board

The Sabrewing Evaluation Board features the MGC3130 reference circuit, an I^2C™ to USB Bridge and built-in 7" single-zone frame electrodes.

The package contains:

- Sabrewing Evaluation Board
- USB Cable

FIGURE 1-2: SABREWING EVALUATION BOARD PACKAGE



1.2.2 MGC3130 Software Release Package

The MGC3130 software release package contains all relevant system software and can be downloaded from Microchip's web site www.microchip.com/GestICGettingStarted.

The package contains:

- Aurea PC software
- GestIC Library binary file
- Windows CDC driver

NOTES:

Chapter 2. Getting Started

2.1 PREREQUISITES

The following prerequisites have to be fulfilled to run the Sabrewing system:

- PC with Windows® XP, Windows 7 or Windows 8 operating system and USB 2.0 port
- Sabrewing Evaluation Board
- Latest MGC3130 software release package

The MGC3130 software release package is available as a .zip file (www.microchip.com/GestICGettingStarted). Unzip the file, run `setup.exe` and install the release package to your PC. The folder structure is as shown in Figure 2-1.

FIGURE 2-1: FOLDER STRUCTURE

2.2 STEP 1: CONNECTING SABREWING WITH YOUR PC

Use the supplied USB cable to connect the Sabrewing Evaluation Board to your PC. The Power LED on the Sabrewing Board should illuminate. Furthermore, LED 1 and LED 2 should blink simultaneously.

In case LED 1 and LED 2 blink alternatingly, the Windows CDC driver is already installed on your PC. Please skip the next step and go to **Section 2.4 "Step 3: Start Aurea"**.

2.3 STEP 2: INSTALL WINDOWS CDC DRIVER

The Windows CDC driver can be found in the MGC3130 software release package folder *`04_Driver`*.

When the Sabrewing Evaluation Board is connected to your PC for the first time, Windows requests the appropriate device driver and guides you through the installation process.

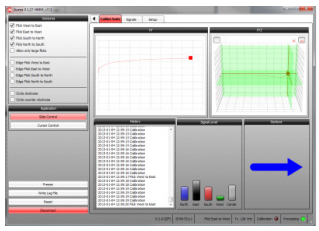
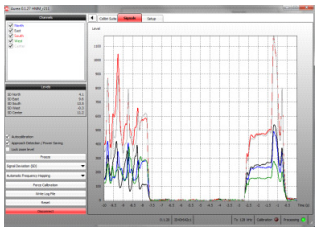
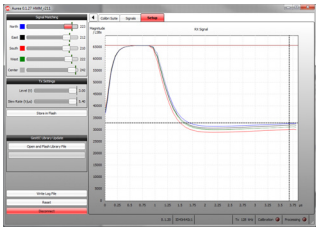
Alternatively, you can install the driver manually, e.g. using the device manager. An example for Windows 7 is given in **Appendix C. "Driver Installation Manual"**.

2.4 STEP 3: START AUREA

Aurea Graphical User Interface, shown in Figure 2-2, is included in the MGC3130 software release package in the folder *`02_Aurea`*.

Open `Aurea.exe`. Aurea detects the connected device automatically and is ready for use. For more information on Aurea, refer to the "*MGC3130 – Aurea Graphical User Interface User's Guide"* (DS41681).

FIGURE 2-2: AUREA GRAPHICAL USER INTERFACE

Evaluate Colibri Suite	Discover Signals	Setup MGC3130
		
1. Positions Tracking	1. View signals	1. Signal matching
2. Gesture Recognition	2. Write log file	2. Tx settings
3. Demo applications	3. Advanced features	3. Update GestIC Library

Chapter 3. MGC3130 – Sabrewing Evaluation Board

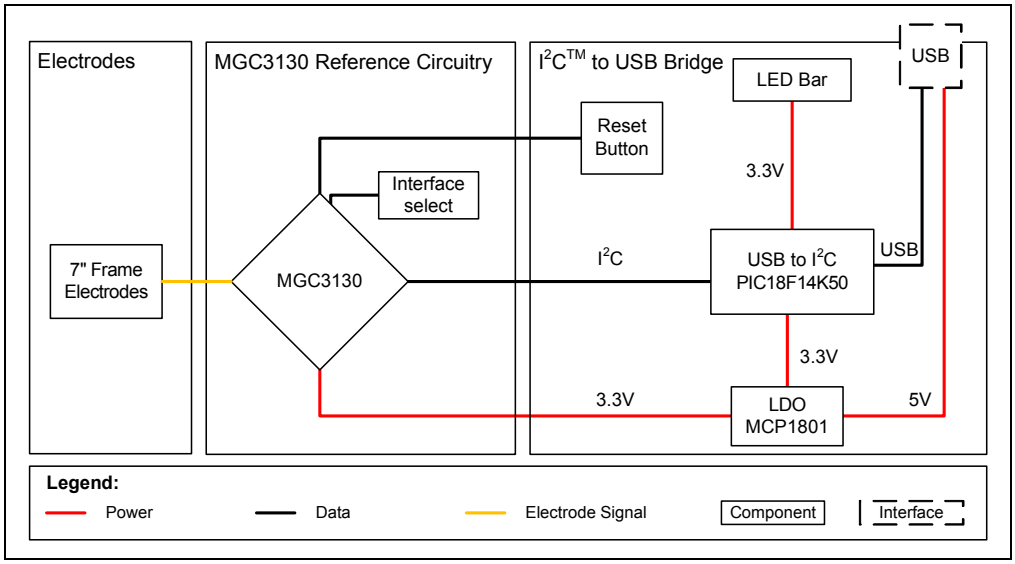
3.1 BOARD CONSTRUCTION AND LAYOUT

The Sabrewing Evaluation Board, shown as a block diagram in Figure 3-1, is organized in three sections:

- MGC3130 Reference Circuitry
- Built-in 7" frame sensing electrodes
- I^2C to USB Bridge

In the following chapters, they are explained in detail.

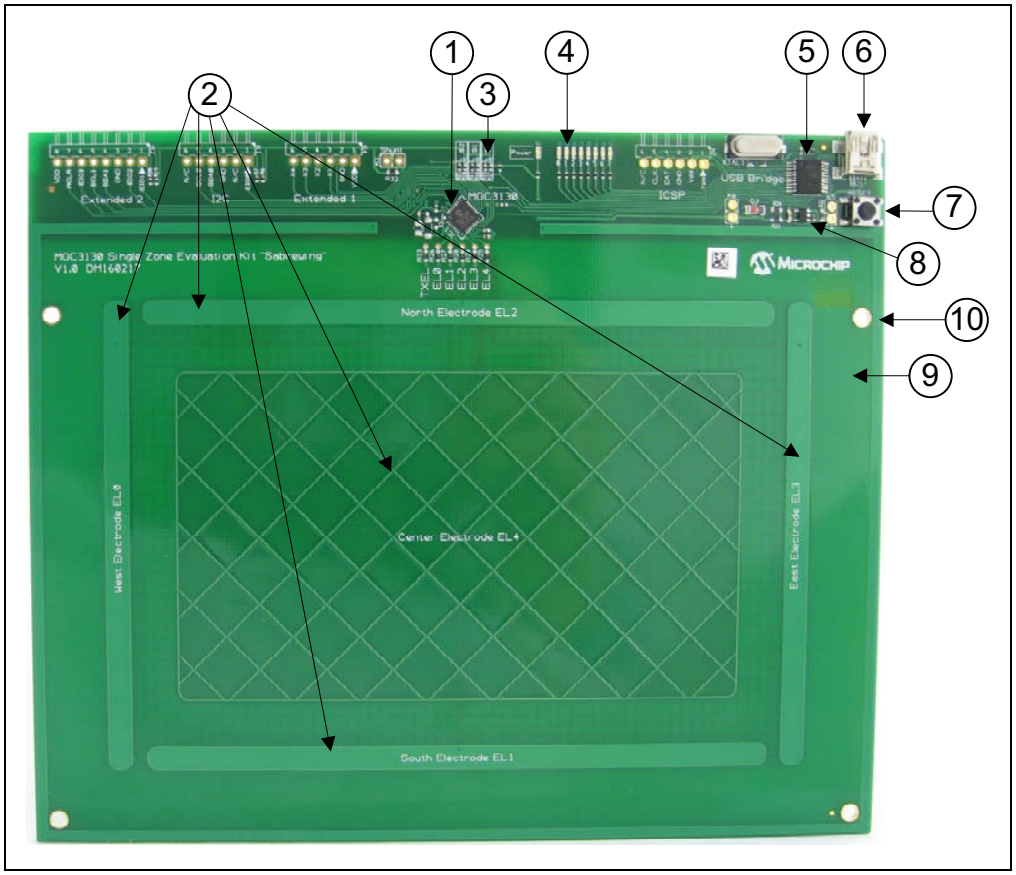
FIGURE 3-1: SABREWING EVALUATION BOARD BLOCK DIAGRAM



The key components of the Sabrewing Evaluation Board are listed below and highlighted in Figure 3-2:

1. MGC3130 3D Tracking and Gesture Controller
2. Built-in 7" frame electrodes
3. Interface select
4. LED bar signalling when board is powered and indicating the communication status
5. Microchip's PIC18F14K50 USB microcontroller passing messages between MGC3130 and the PC
6. USB mini-B connector to connect the board to a PC
7. Reset button resetting the MGC3130
8. Microchip's MCP1801 LDO voltage regulator converting 5V USB power to 3.3V board supply
9. Acrylic glass (180 x 116.5 x 2 mm) simulating the housing of a target device
10. Plastic rivets mounting the acrylic glass to the PCB

FIGURE 3-2: SABREWING EVALUATION BOARD KEY ELEMENTS



3.2 MGC3130 REFERENCE CIRCUITRY

The key element of the MGC3130 Reference Circuitry is Microchip's MGC3130 3D Tracking and Gesture Controller. It is powered by a single 3.3V power supply. The MGC3130 Reset is controlled by the Reset button on the board or via the PIC18F14K50. The communication to the USB bridge is realized through I^2C0.

The five Rx channels of the chip are connected to the electrodes via 1 kOhm resistors in order to suppress irradiated high-frequency signals.

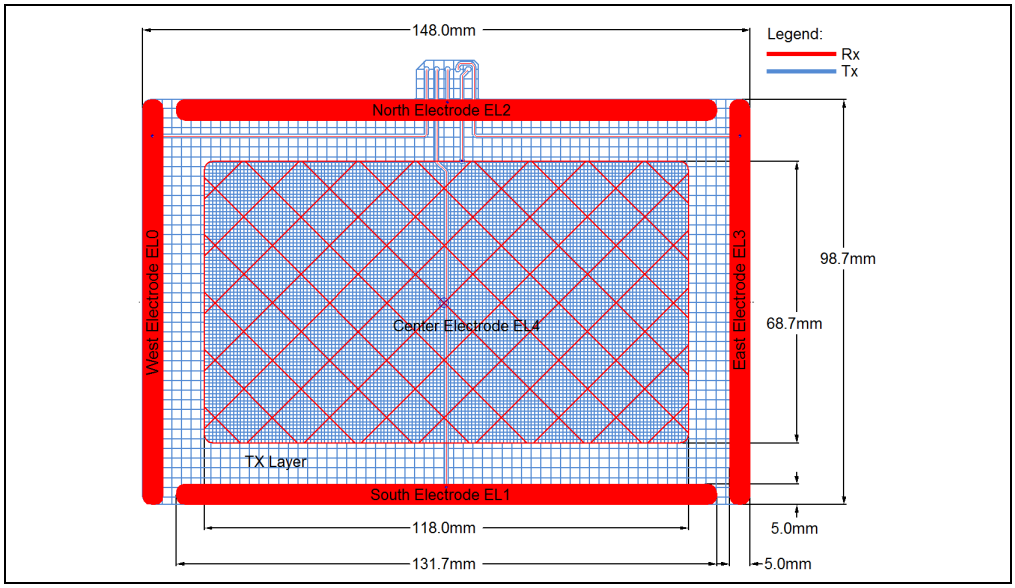
Please refer to the "*MGC3130 Single-Zone 3D Gesture Controller Data Sheet*" (DS41667).

3.3 ELECTRODES

The Sabrewing Evaluation Board uses a Double Layer Electrode Design with the electrodes built right into the PCB. They consist of one Tx and five Rx electrodes (north, east, south, west, center), which are placed in different layers (Figure 3-3).

The dimensions on the electrode's outer edges are 148 mm x 98.7 mm. The aspect ratio of the sensing area is 3:2.

FIGURE 3-3: ELECTRODE LAYOUT



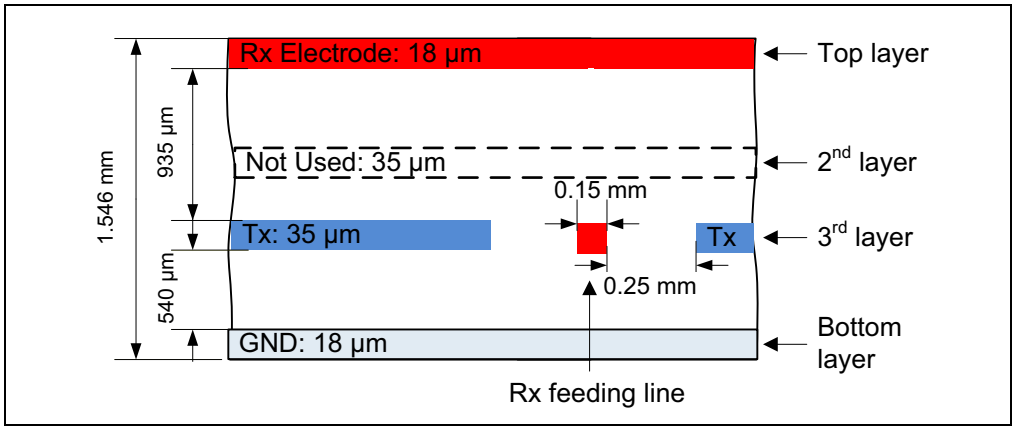
The electrode layout is based on a four-layer PCB design using FR4 material.

Three functional layers are used:

- Layer 1 (Top): Rx electrodes
- Layer 3: Tx electrode and Rx feeding lines
- Layer 4 (Bottom): Ground

Layer 2 is not used.

FIGURE 3-4: PCB LAYER STACK



The design of Rx electrodes includes four frame electrodes and one center electrode, as shown in Figure 3-3. The frame electrodes are named according to their cardinal directions - north, east, south and west. The dimensions of the four Rx frame electrodes define the maximum sensing area. The center electrode is structured (hatched) to get a similar input signal level as the four frame electrodes.

The Tx electrode spans over the complete area underneath the Rx electrodes. It is structured to reduce the capacitances between Rx and Tx (C_{RxTx}). The area below the center electrode covers 50% of the copper plane, the area around only 20%.

The Rx feeding lines are also routed in the third layer. They are embedded into the Tx electrode (refer to Figure 3-3 and Figure 3-4). This supports shielding of the feeding lines.

Dimensions are given in Table 3-1.

In a target system design the GND layer is not required. It is added for the Sabrewing Board as a shielding layer and shall simulate the presence of static components which are placed in the target device underneath the sensing electrodes. In order to keep ground capacitances ($C_{TxGND,}$ C_{RxGND}) below 1nF, the GND layer is structured in a way that 40% of the area is covered with copper.

Note 1: Please refer to the "*MGC3130 Single-Zone 3D Gesture Controller Data Sheet"* (DS41667) for the electrodes equivalent circuitry, capacitances (C_{RxTx}, $C_{RxGND,}$ C_{TxGND}) and their typical values.

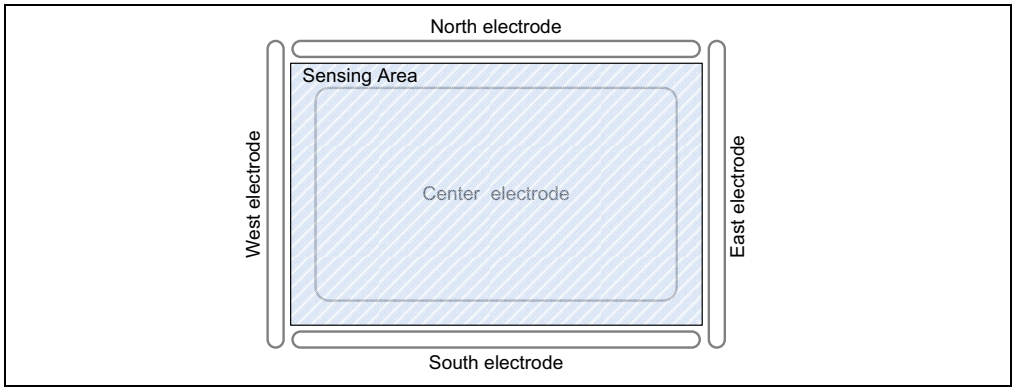
2: The integration of GestIC® technology into a target device does not require the GND layer. If no shielding is needed, or if the device already contains grounded planes, a two layer design is preferable.

TABLE 3-1: ELECTRODE DESIGN

	Length	Width	Coverage
Horizontal Electrodes (Rx)	131.7 mm	5 mm	solid
Vertical Electrodes (Rx)	98.7 mm	5 mm	solid
Center Electrode (Rx)	118 mm	68.7 mm	5% structured
Tx Electrode (refer to Figure 3-3) Part I (under center Electrode) Part II (outside Part I)	148 mm 118 mm 148 mm	98.7 mm 68.7 mm 98.7 mm	 50% structured 20% structured
Ground Area	180 mm	126.6 mm	40% structured

The sensing area of the Sabrewing board, depicted in Figure 3-5, is defined as the area enclosed by the four frame electrodes. Depending on the parameterization, it can differ from the physical dimensions of the electrodes.

FIGURE 3-5: SENSING AREA



3.4 I²C™ TO USB BRIDGE

The communication between the MGC3130 and the host PC is controlled by the I²C to USB Bridge section. The message exchange is handled by Microchip's PIC18F14K50 USB microcontroller. The PIC18F14K50 is also used to indicate the communication status on a LED bar and to control MGC3130 hardware Reset.

The board is powered via the USB port. Microchip's Low Dropout (LDO) Voltage Regulator MCP1801 is used to transform the 5V USB power to 3.3V required for the MGC3130 and the PIC18F14K50.

The LEDs indicate the following:

- POWER – signals that the Sabrewing board is powered (3.3V)
- LED1/2 – blink simultaneously to indicate that there is no data transfer on the USB port
- LED1/2 – blink alternating to indicate that there is data transfer on the USB port
- LED 5 – is on when there is data on the I²C bus
- LEDs 0, 3, 4, 6 and 7 are not used

NOTES:

Chapter 4. Troubleshooting

POWER LED DOES NOT ILLUMINATE

In case the power LED does not illuminate, it is likely the board is not powered.

Possible Solutions:

1. Check the board is connected to your PC's USB port.
2. Change the USB cable or use a different USB port on your PC.
3. Check if the PC is switched on.

LED 1 AND LED 2 BLINK SIMULTANEOUSLY

When LED 1 and LED 2 blink simultaneously, there is no data transfer on the USB port.

Possible Solutions:

1. Make sure the Windows CDC driver is installed (refer to **Section 2.3 "Step 2: Install Windows CDC Driver"**).
2. Reconnect the board by unplugging and plugging in again the USB connection.

SIGNAL STREAMING STOPS

Signal stream in Aurea GUI stops when there is no approach towards the sensing area. This behavior is intended. When using the Aurea GUI, the Wake-up on Approach feature is automatically enabled.

Possible Solutions:

Disable the Wake-up on Approach feature in the Real-Time Control bar of Aurea by unchecking the ***Approach Detection/Power Saving*** checkbox for continuous signal streaming.

SIGNAL MATCHING PARAMETERS MISMATCHED BY USER

Signal matching parameters have been mismatched and accidently stored into the Flash.

Possible Solutions:

1. Perform "Autoparameterization" in the **Aurea Setup** tab. Make sure there is no hand approach towards the electrodes during autoparamterization process.
2. Restore the default Signal Matching parameters by re-flashing the original MGC3130 GestIC® library file refer to the "*MGC3130 – Aurea Graphical User Interface User's Guide* (DS41681).

NOTES:

Appendix A. Schematics

A.1 INTRODUCTION

This appendix contains the MGC3130 Sabrewing Evaluation Board schematic and Bill of Material.

A.2 BILL OF MATERIAL

TABLE A-1: SABREWING SINGLE-ZONE EVALUATION BOARD BILL OF MATERIAL

Qty.	Description	Name
1	Connector, Mini USB 5-Pin Type B, SMD	BU1
2	Capacitor, 100nF, 10%, X7R, SMD 0402	C1, C2
1	Capacitor, 220nF, 10%, X5R, SMD 0402	C3
2	Capacitor, 1µF, 10%, X5R, 10V, SMD 0402	C4, C5
1	Capacitor, 4.7µF, 20%, X5R, 6.3V, SMD 0402	C6
1	Capacitor, 10 µF, 20%, X5R, 6.3V, SMD 0603	C7
2	Capacitor, 18pF, 5%, NP0, 50V, SMD 0402	C9, C10
9	LED, 571nm green clear, 0603 SMD	D2, D4, D5, D6, D7, D8, D9, D10, D11
1	Diode, Zener, 500mW, 3.8V, SMD	D3
1	IC, MGC3130 3D Tracking and Gesture Controller, 28-Pin QFN	IC1
1	IC, MCP1801T LDO, Voltage Regulator, 2.3V, 150 mA, 5-Pin SOT-23	IC2
1	IC, PIC18F14K50 USB Flash Microcontroller, 20-Pin SSOP	IC3
9	Resistor, 1kΩ, 1%, 1/16W, SMD 0402	R1, R2, R3, R4, R5, R8, R9, R12, R14
2	Resistor, 1.8kΩ, 1%, 1/16W, SMD 0402	R6, R7
3	Resistor, 10kΩ, 1%, 1/16W, SMD 0402	R11, R13, R21
1	Resistor, 150kΩ, 1%, 1/16W, SMD 0402	R16
6	Resistor, 0Ω, 1%, 1/16W, SMD 0603	R22, R23, R24, R32, R33, R35