FDC1004QEVM User Guide

User's Guide

Literature Number: SNAU178
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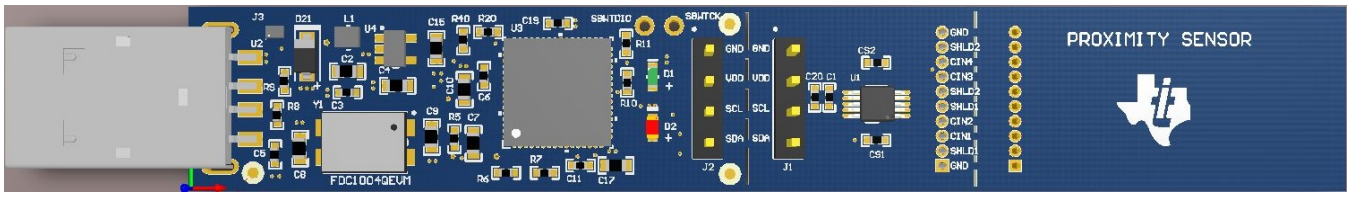
1 Introduction



The FDC1004QEVM evaluation kit is a plug and play system to test and evaluate the FDC1004Q, AEC-Q100 qualified, 4-channel capacitive to digital converter. The EVM is a breakable PCB which consists of 3 sections. The first section is a USB to I2C converter based on MSP430F5528 micro-controller, the second section contains the FDC1004Q and the third section is a touchless sensor (to demonstrate the sensitivity of the FDC1004Q) . The third section can be removed and replace with customized sensors to evaluate the capabilities of the FDC1004Q in various applications. The FDC1004QEVM can be used with the FDC1004EVM GUI. The software is able to configure the FDC1004Q's registers, display on four graphs (one for each measurement) the capacitive values and export data in CSV format.

The EVM contains one FDC1004Q (See Table 1).

Table 1. Ordering

DEVICE	IC	Package
U1	FDC1004QDGS	VSSOP 10pin

2 Setup

This section provides a general description about FDC1004QEVM, its I/O connectors and how to properly setup the evaluation module.

2.1 FDC1004QEVM

The FDC1004QEVM is divided in three sections:

1. USB to I2C section: this has the purpose to interface the communication of FDC1004Q to a USB port.
2. FDC1004Q section: this section embeds FDC1004Q capacitive to digital converter.
3. Sensor section: this section contains a capacitive sensor that can be used for human proximity.

The EVM has precut lines on the borders of each section that allow for a flexible and specific system design. As an example of the flexibility of this design, the sensor can be replaced with a customer sensor, or the MCU section can be separated to allow for a remote placement of the FDC1004Q.

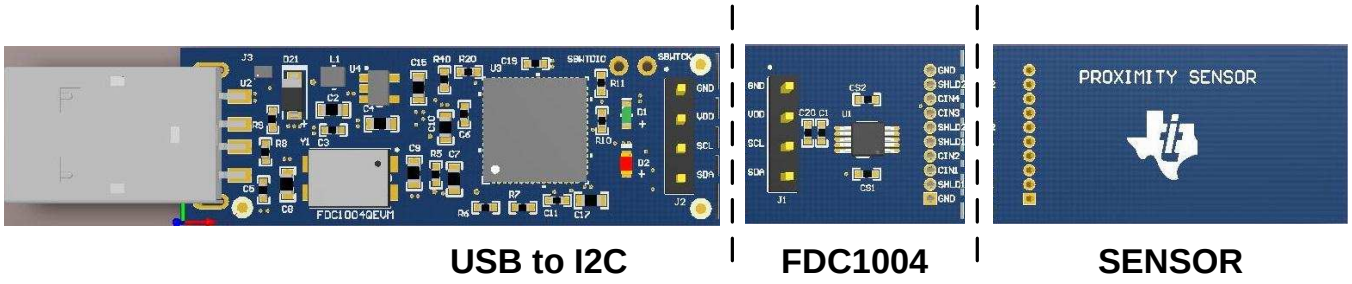


Figure 1. FDC1004QEVM : Sections

2.2 Input/Output Connector Description

J1, J2: 4x1 Header: the I/O ports of sections between the USB to I2C and the FDC1004Q sections. This provides the I2C communication channel and the power connections between these two sections should the EVM be separated into sections. A simple 4 wire cable can be used to interface the sections.

Table 2. J1, J2 Pin Out

Pin	Pin	Description
J1.1	J2.1	GND
J1.2	J2.2	VDD
J1.3	J2.3	SCL
J1.4	J2.4	SDA

J3: USB interface to connect the EVM to a PC; it also provides power to the EVM.

J4: 10x1 Headers. This is not populated by default. It provides an easy method to change sensors or to remotely place the sensor away from the FDC1004Q. This connector with its counterpart, J5, allows the communication of the two modules through a 10-wire cable.

Table 3. J4 Pin Out

Pin	Description
J4.1	GND
J4.2	SHLD1
J4.3	CIN1
J4.4	CIN2
J4.5	SHLD1
J4.6	SHLD2
J4.7	CIN3
J4.8	CIN4
J4.9	SHLD2
J4.10	GND

J5: 10x1 Header, for the electrical connection between the FDC1004 and the sensor section.

Table 4. J5 Pin Out

Pin	Description
J5.1	Not Connected
J5.2	SHLD1
J5.3	CIN1
J5.4	Not Connected
J5.5	SHLD1
J5.6	Not Connected
J5.7	Not Connected
J5.8	Not Connected
J5.9	Not Connected
J5.10	Not Connected

2.3 HW Setup

The power supply of FDC1004Q is provided by the LDO (U4), which is sourced from the USB 5.0V. The I2C communication with FDC1004Q is fully managed by the MSP430F5528IRGC microcontroller (U3). The FDC1004Q has a fixed I2C address.

2.4 SW Setup

Ensure that the FDC1004QEVM GUI and the drivers have been installed on the host computer. Plug the EVM into an available USB port on the host.

2.5 Operation

Plug the EVM into the host computer. The host computer should automatically detect the device as an EVM. Launch the GUI and configure the desired data acquisition mode for FDC1004Q. Then, it should automatically start measuring on the configured sensors.

3 Board Layout

Figure 2 and Figure 3 show the board layout of the FDC1004QEVM.

Sensor layout has been designed to demonstrate human proximity sensing with a single sensor. A shield layer below the sensor and a shield ring around the sensor is designed to significantly reduce parasitic capacitance interference from directions not intended to sense the target. The intended sensing area for this EVM is towards the top side of the sensor. For more information about shielding, refer to the application note *Capacitive Sensing: The Ins and Outs of Active Shielding* (SNOA926).

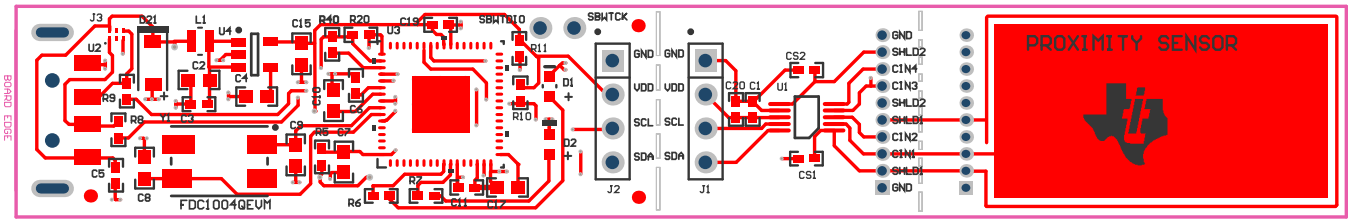


Figure 2. Top Layer Routing

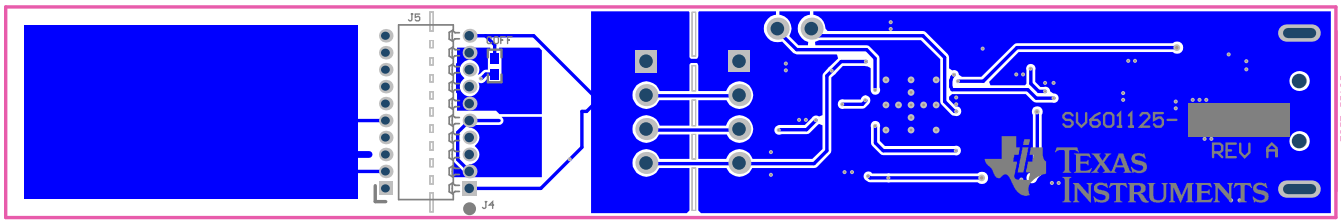


Figure 3. Bottom Layer Routing

4 Schematic

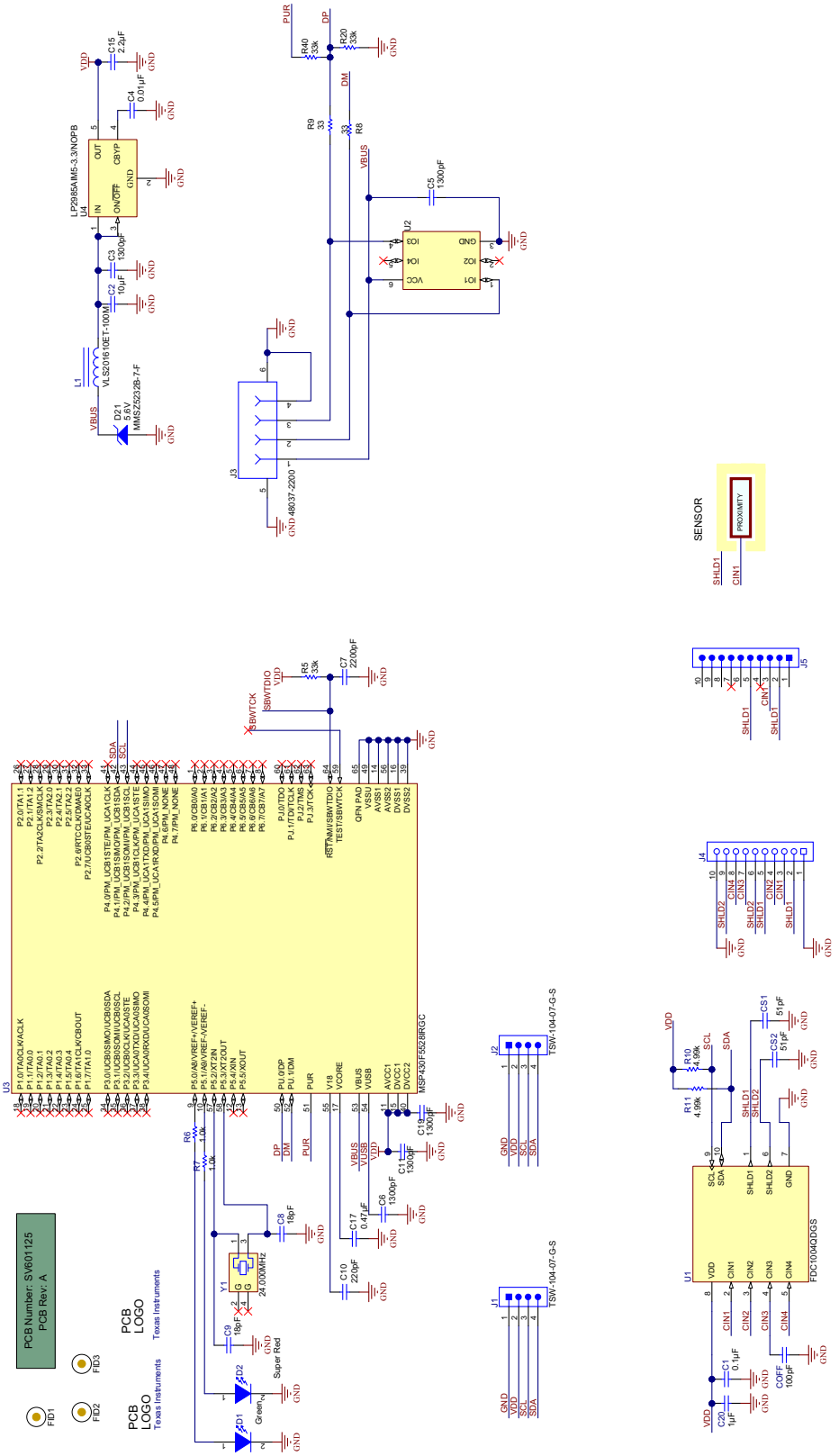


Figure 4. FDC1004QEVM Schematic

Table 5. Bill of Materials

Qty	Designator	Description	Footprint	Manufacturer Part Number
1	C1	CAP, CERM, 0.1uF, 6.3V, +/-10%, X5R, 0402	402	C1005X5R0J104K050BA
1	C2	CAP CER 10UF 10V 10% X5R 0603	603	C1608X5R1A106K080AC
4	C3, C5, C11, C19	CAP CER 0.1UF 16V 5% X7R 0402	402	0402YC132KAT2A
1	C4	CAP, CERM, 0.01uF, 25V, +/-5%, C0G/NP0, 0603	603	C1608C0G1E103J080AA
1	C6	CAP CER 220PF 50V 1% NP0 0402	402	0402YC132KAT2A
1	C7	CAP, CERM, 2200pF, 50V, +/-10%, X7R, 0603	603	C0603X222K5RACTU
2	C8, C9	CAP CER 18PF 100V 5% NP0 0603	603	GRM1885C2A300JA01D
1	C10	CAP, CERM, 220pF, 50V, +/-1%, C0G/NP0, 0603	603	06035A221FAT2A
1	C15	CAP, CERM, 2.2uF, 10V, +/-10%, X5R, 0603	603	C0603C225K8PACTU
1	C17	CAP, CERM, 0.47uF, 10V, +/-10%, X7R, 0603	603	C0603C474K8RACTU
1	C20	CAP, CERM, 1uF, 6.3V, +/-20%, X5R, 0402	402	C1005X5R0J105M050BB
0	COFF	CAP, CERM, 100pF, 50V, +/-5%, C0G/NP0, 0402	402	GRM1535C1H101JDD5D
0	CS1, CS2	CAP, CERM, 51pF, 50V, +/-5%, C0G/NP0, 0402	402	GRM1555C1H510JA01D
1	D1	LED SMARTLED GREEN 570NM 0603	603	LG L29K-G2J1-24-Z
1	D2	LED 660NM SUPER RED DIFF 0603SMD	603	SML-LX0603SRW-TR
1	D21	Diode, Zener, 5.6V, 500mW, SOD-123	SOD-123	MMSZ5232B-7-F
0	J1, J2	Header, TH, 100mil, 4x1, Gold plated, 230 mil above insulator	TSW-104-07-G-S	TSW-104-07-G-S
1	J3	Connector, USB Type A, 4POS R/A, SMD	CONN_USB_0480372200	480372200
0	J4	Receptacle, 50mil 10x1, R/A, TH	CONN_851-43-010-20-001000	851-43-010-20-001000
0	J5	Header, 50mil, 10x1, R/A, TH	CONN_850-80-010-20-001101	850-80-010-20-001101
1	L1	INDUCTOR POWER 10UH .45A SMD	VLS201610E	VLS201610ET-100M
1	R5	RES, 33k ohm, 5%, 0.063W, 0402	402	CRCW040233K0JNED
2	R6, R7	RES 1K OHM 1/10W 5% 0402 SMD	402	CRCW040233R0JNED
2	R8, R9	RES, 33 ohm, 5%, 0.063W, 0402	402	CRCW040233R0JNED
2	R10, R11	RES, 4.99k ohm, 1%, 0.063W, 0402	402	CRCW04024K99FKED
1	R20	RES,1M ohm, 5%, 0.063W, 0402	402	RC0402JR-071ML
1	R40	RES 1.5K OHM 1/16W 5% 0402 SMD	402	CRCW04021K50JNED
1	U1	Q Grade 4-Channel Capacitance-to-Digital Converter for Capacitive Sensing Solutions, DGS0010A	DGS0010A	FDC1004QDGS
1	U2	4-CHANNEL ESD-PROTECTION ARRAY FOR HIGH-SPEED DATA INTERFACES, DRY006A	DRY0006A	TPD4E004DRY
1	U3	Mixed Signal MicroController, RGC0064B	RGC0064B	MSP430F5528IRGCT
1	U4	Micropower 150 mA Low-Noise Ultra Low-Dropout Regulator, 5-pin SOT-23, Pb-Free	MF05A_N	LP2985AIM5-3.3/NOPB
1	Y1	CRYSTAL 24.000MHZ 18PF SMD	ABMM	ABMM-24.000MHZ-B2-T

Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

DATE	REVISION	NOTES
April 2015	*	Initial release.

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3 *Regulatory Notices:*

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      3.1.1 *Notice applicable to EVMs not FCC-Approved:*

      This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

      3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

      CAUTION

      This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

      Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

      FCC Interference Statement for Class A EVM devices

      NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

3.2 *Canada*

3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

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http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

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If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required by Radio Law of Japan to follow the instructions below with respect to EVMs:

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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