FGD-02F EVAL BOARD

Dosimeter Board and Software

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The power of small things

FEATURES

- USB FGDOS® radiation sensor board
- Plug'n'play system
- Radiation sensor FGD-02F in QFN package
- Miniaturized detection system
- Data logging direct from the PC
- Dosimeters easy configuration via software
- Software with plotted data from FGD-02F

APPLICATIONS

- Radiation sensors
- Active and passive dosimetry
- Space
- Particle Physics Facilities

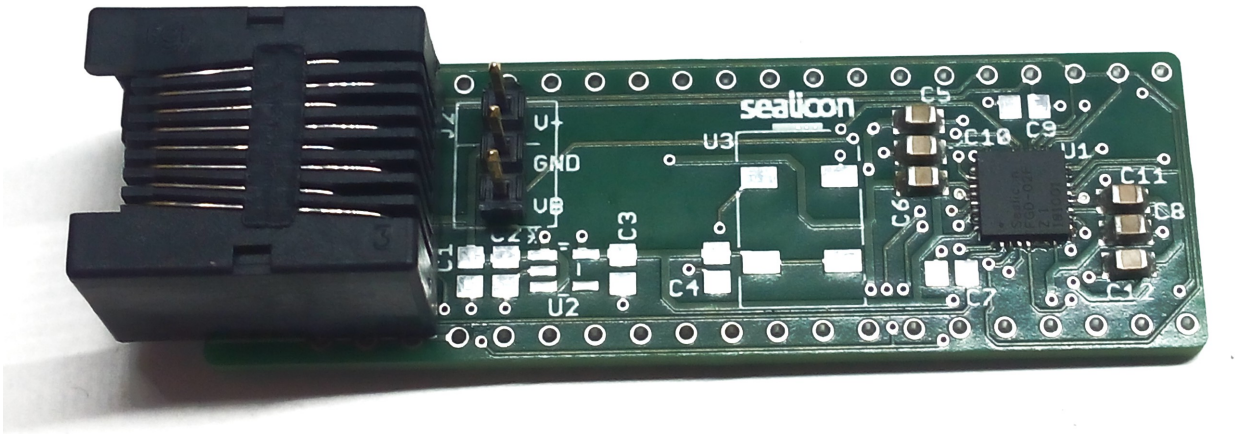
GENERAL DESCRIPTION

FGD-02F EVAL is an easy-to-use measuring board developed to collect data directly from an FGD-02F, containing two FGDOS® sensors.

The FGD-02F EVAL is designed to be inserted to a DLP2232H USB adapter and directly connected via USB to the PC.

FGD-02F is provided in a 32 pin QFN 5x5 mm package. Sensor configuration and access to radiation measurement results can be achieved via serial communication.

A dedicated PC software allows easy configuration and radiation data representation from FGD-02F.



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ABSOLUTE MAXIMUM RATINGS

These ratings do not imply permissible operating conditions; functional operation is not guaranteed. Exceeding these ratings may damage the device

Item	Symbol	Parameter	Conditions			Unit
No.				Min	Max	
G001	VB	Permissible Voltage at VB			20	V
G002	V()	Voltage at NIRQ, VCCD, VB, VCC, SCK, NCS, ENWR, NRES, MISO, NCS, MOSI, CK	Referenced to GND		5.5	V

ELECTRICAL CHARACTERISTICS

Operating Conditions: VB=18V, VCC=4.5V .. 5.5V, VCCD = VCC, Tj=-40 .. 85 ºC, Rad. source = Co60, TID=0Gy unless otherwise stated

Item No.	Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Total Device							
001	VB	Permissible Programmer Voltage at VB	Referenced to GND	15		20	V
002	I(VB)	Recharge current at VB	Recharge Disabled Recharge Enabled			1 50	µA
003	VCC	Permissible Supply Voltage at VCC	Referenced to GND	4.5		5.5	V
004	I(VCC)	Supply current at VCC	POWR(2:0) = 111 High-sensitivity Mode Low-sensitivity Mode POWR(2:0) = 000			2 1 TBD	mA
005	VCCD	Permissible Supply Voltage at VCCD	Referenced to GND	4.5		5.5	V
006	I(VCCD)	Supply current at VCCD	POWR(2:0) = 111 POWR(2:0) = 000			2 TBD	mA
005	Vc(Io)	Clamp Voltage at VB,VCC, VCCD, MISO, NIRQ, ENWR, NCS, SCK, MOSI, CK	I()=10mA	-1.5		-0.6	V
Digital Input/Outputs							
100	Isc()lo	Short Circuit Current lo at NIRQ, MISO		-40		-4	mA
101	Isc()hi	Short Circuit Current hi at NIRQ, MISO		4		40	mA
102	Vs()lo	Saturation Voltage lo at NIRQ, MISO	I()=2mA	-0.4			V
103	Vs()hi	Saturation Voltage hi at NIRQ, MISO	I()=-2mA			0.4	V
104	Vt()hi	Input Threshold Voltage hi at ENWR, NCS, SCK, MOSI, NRES, CK				2	V
105	Vt()lo	Input Threshold Voltage lo at ENWR, NCS, SCK, MOSI, NRES, CK		0.8			V
106	I()pd	Pull down Current at ENWR, NCS, SCK, MOSI, NRES, CK		1		50	µA

FGD-02F EVAL USB KIT CONTENTS

Each FGD-02F EVAL Kit includes the following parts:

- 1 x FGD-02F EVAL board to be used as a sensor. It includes 1 FGD-02F sensor in QFN package.

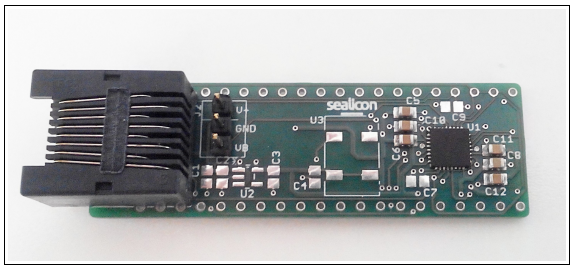

Figure 1: FGD-02F EVAL board as sensor

- 1 x FGD-02F EVAL board to be used as gateway, with no FGD-02F sensor.

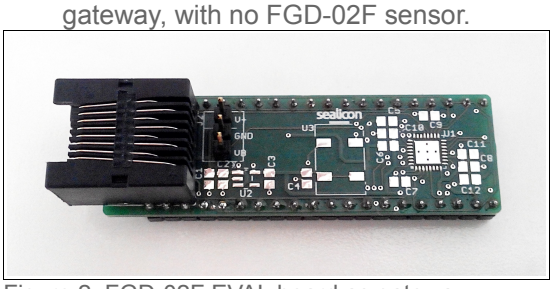

Figure 2: FGD-02F EVAL board as gateway

- 1 x DLP2232H controller to be used as USB communication interface.
- 1 x 1.5 m Ethernet cable, to connect the sensor FGD-02F EVAL board with the gateway FGD-02F EVAL board.
- 1 x USB cable.

Board connectors

The FGD-02F EVAL board has three main connectors. The first connector is a 40-Pin socket in DIP package, where the DLP2232H usb driver can be inserted.

The second connector is an RJ45 socket with the minimum required lines (8 pins) for communicating with another FGD-02F EVAL board.

Finally, a three-pin connector (V+, VB and GND) is provided. The board can be supplied either through the DLP2232H module from the USB connector or externally through pins V+ and GND. VB is dedicated to the FGD-02F recharging process and it should be configured between 18V and 19V.

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GETTING STARTED WITH FGD-02F EVAL SYSTEM

The FGD-02F EVAL system requires a Windows based system. To start communication with the FGD-02F sensors the following basic steps should be followed:

1. Install the DLP2232H interface drivers provided in the USB pen drive in the kit.

2. The DLP2232H module must be configured with jumpers JP1 to JP3 as it is shown in Figure 3. JP1 plugged, JP2 and JP3 unplugged.

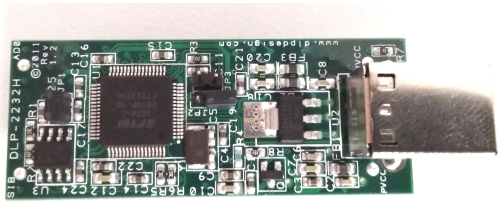


Figure 3: DLP2232H jumpers configuration

3. Insert the FGD-02F EVAL board as gateway, with no FGD-02F sensors, onto the DLP2232H driver, as shown in Figure 4.

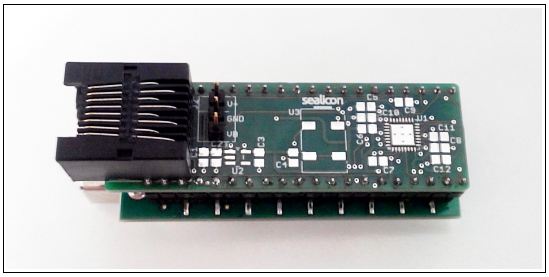


Figure 4: FGD-02F EVAL as gateway inserted on DLP2232H driver

4. Connect the FGD FGD-02F 02F EVAL board containing the FGD-02F sensors with the FGD-02F EVAL board as gateway with the Ethernet cable provided.

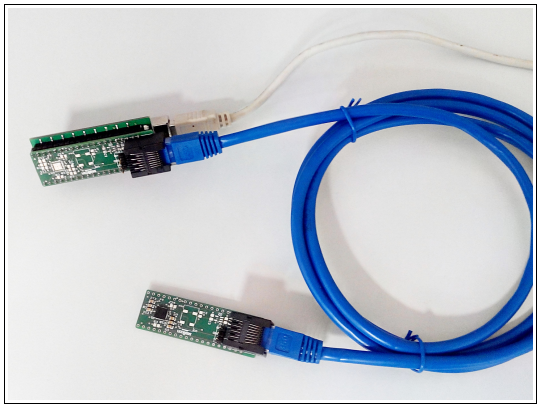
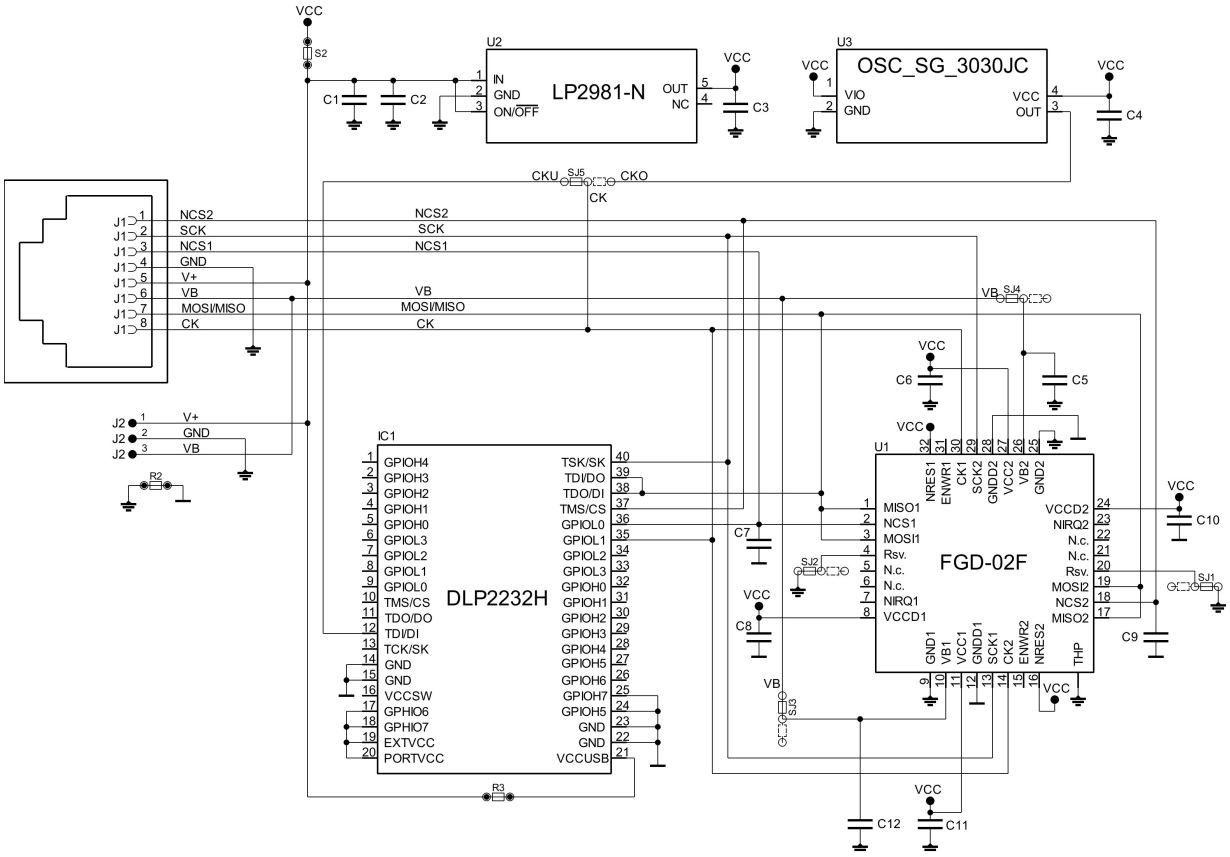


Figure 5: Final setup

5. Connect the PC to the DLP2232H driver board with the USB cable provided. Figure 5 shows how this final setup looks like.
6. Execute in the computer the software provided with the kit. See FGD-02F FDG1DEMO software chapter for further information.
7. Apply VB to the three-pin male connector, in case sensor recharges are envisaged (see FGD-02F datasheet for more details on recharging process).

SCHEMATIC



ASSEMBLY PART LIST

Device	Sensor Board	Gateway Board	Comment
C1...4, C7, C9	Not soldered	Not soldered	X7R 10V, tolerance 10%
C5, C6, C8, C10...12	100 nF	Not soldered	X7R 10V, tolerance 10%
IC1	Not soldered	DLP2232H	USB adapter chip
J1	RJ45	RJ45	Ethernet input connector
J2	WSL3	WSL3	3 pin connector male
SJ1, SJ2	Solder Jumper	Solder Jumper	Connected to GND
SJ3, SJ4	Solder Jumper	Solder Jumper	Connected to VB
SJ5	Solder Jumper	Solder Jumper	Connected to CKU
U1	FGD-02F_Z	Not soldered	Floating gate dosimeter
U2	Not soldered	Not soldered	Micropower 5V LDO regulator
U3	Not soldered	Not soldered	32.768 kHz oscillator

FGD-02F FGD1DEMO SOFTWARE

The software to communicate with FGD-02F EVAL board, together with the DLP2232H drivers, are provided in the USB stick included in the demoboard kit.

FGD1DEMO software can work with FGD-02F and FGD-03F products. As the application is executed, it recognizes the chip from the EVAL board and it adapts its configuration accordingly.

A graphical user interface (GUI) is included in the software to allow easier system configuration and data handling. Figure 6 shows the default view of the GUI.

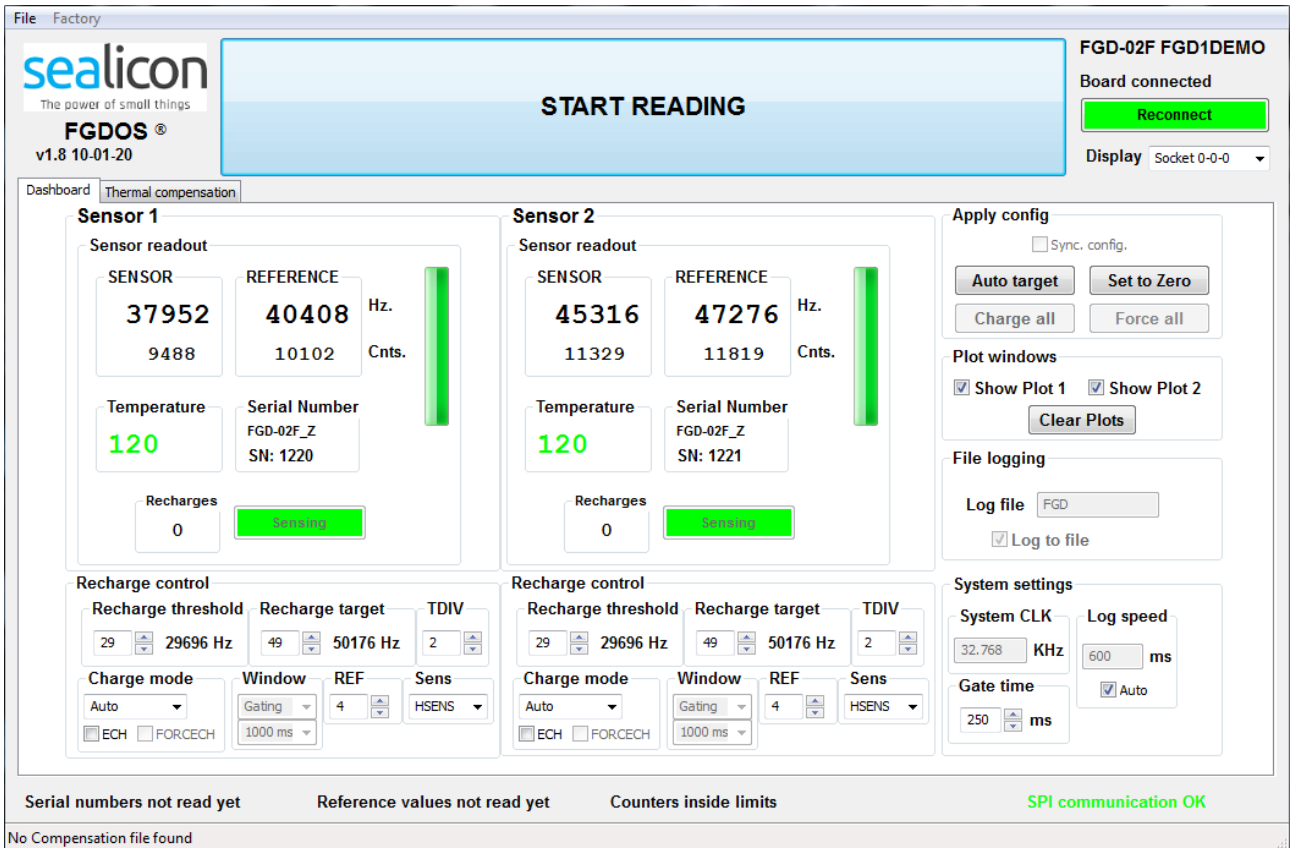


Figure 6. Default view of the GUI for controlling FGD-02F sensors with Dashboard panel selected

As the application is executed, it reads the internal configuration of the FGD-02F and loads it on the Dashboard. The **Reconnect** button gives information about the connection between the computer and the usb driver. If no connection is available, the button turns red and an error message dialog box pops up, as it is shown in Figure 7. Each time the Reconnect button is clicked, a new attempt to establish usb connection is carried out. The button turns back to green if the attempt was successful.

Sensor reading

Pushing **START READING** button starts a continuous reading of both sensors. The **Dashboard panel** contains readout and configuration information of both sensors. The sensor readout section includes read information of the FGDOS sensor, the internal reference, the temperature sensor and the serial number of the sensor. The data is read once every 600 ms, and the screen is updated accordingly. Numerical

values of **SENSOR** and **REFERENCE** should be shown in green, meaning that a correct new value was read. This is shown in Figure 8. If the measured data is old, it is shown in black, while red values are shown when an overflow has occurred.

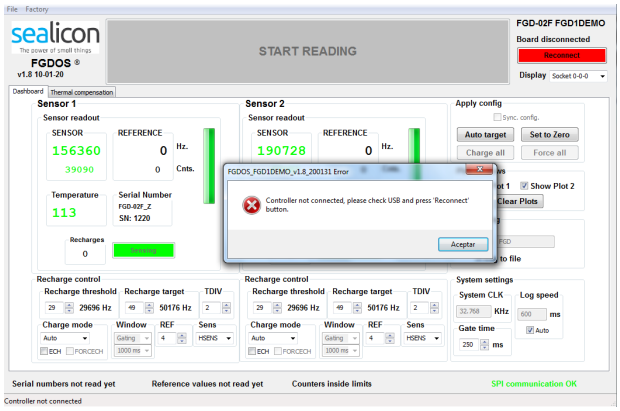


Figure 7. USB connection error message

Figure 8. Dashboard showing correct sensor and reference measurements

Applying temperature compensation files

Temperature compensation files are provided with the demoboard kit. After execution, FGD1DEMO software tries to apply the compensation file provided. This file should be stored in the same root as the software for automatic application of the compensation files. However, the compensation can be achieved manually by selecting the **Thermal Compensation** panel and pushing **Load compensation data from file,** as shown in Figure 9.

Once loaded, if **Enable Compensation** from thermometer sensor is checked, the corrected temperature measured value will be shown in the **Dashboard** panel, as shown in Figure 10.

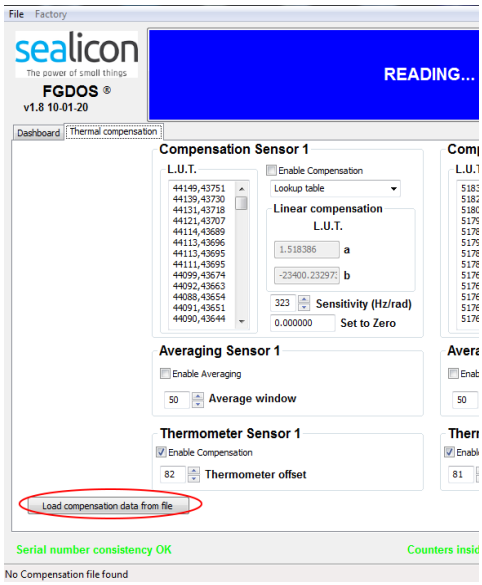


Figure 9. Loading compensation file

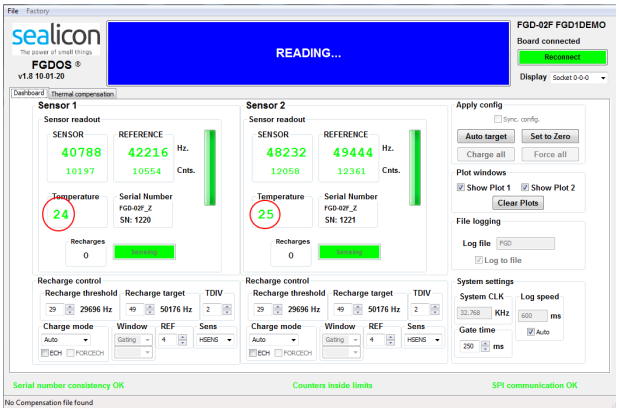


Figure 10. Temperature result after applying compensation file

File logging

Each measured data, together with the most relevant chip configuration bits, is stored in a file in the same root file where FGD1DEMO is located, under the name:

FGD_02F_SN1

where SN1 is the serial Number of sensor 1.

Logging action is only carried out as long as a Read action is active. If the reading process is stopped and restarted after a period of time, the new measured data will be appended to the previous

data in the same log file.

Plotting signals

As a default setting, each read data is plot in two separated windows, one for each sensor, as shown in Figure 11.

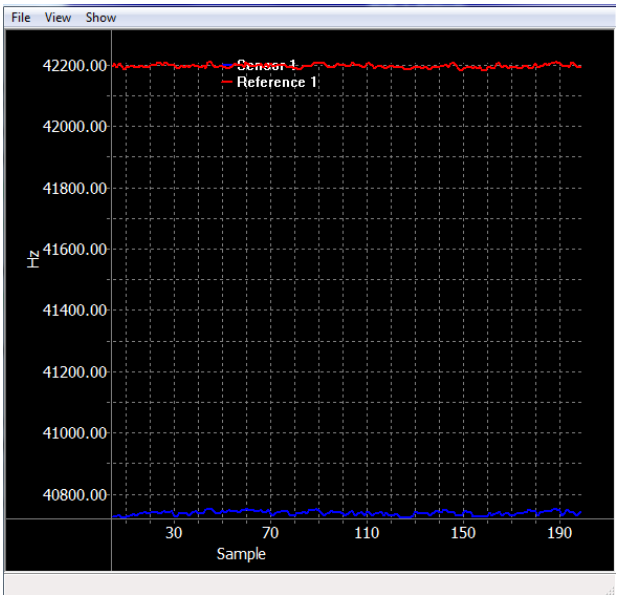


Figure 11. Plot window for Sensor1 and Reference1

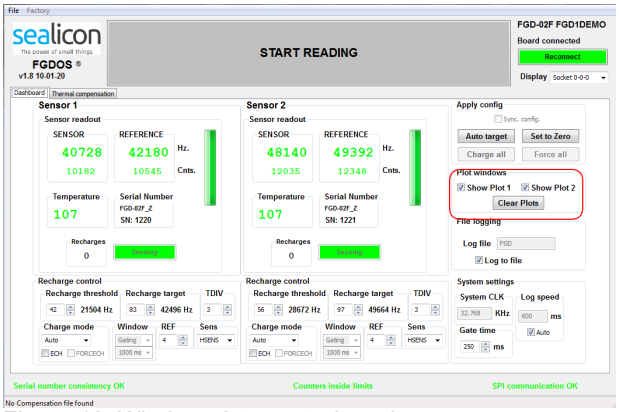


Figure 12: Window plots control section

The Plot windows control section in the **Dashboard** panel allows hiding separately each window and clearing both plots (see Figure 12). It is also possible to apply an averaging filter to the plotted data, where the number of the averaged samples can also be configured. These options can be found in **Thermal Compensation** panel.

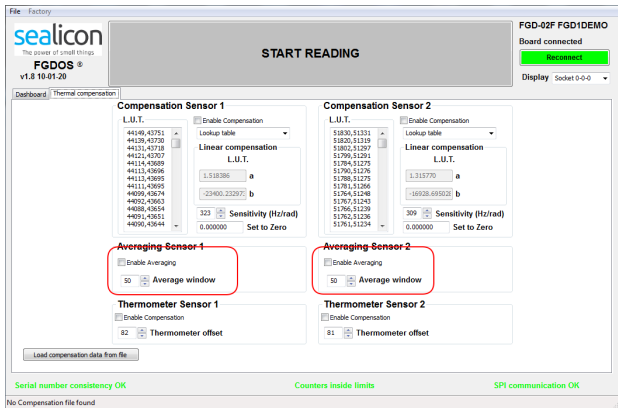


Figure 13: Option for average filter to plotted data

Additional configuration options regarding Sensitivity Mode and Reference selection value is available for each sensor, as shown in Figure 14.

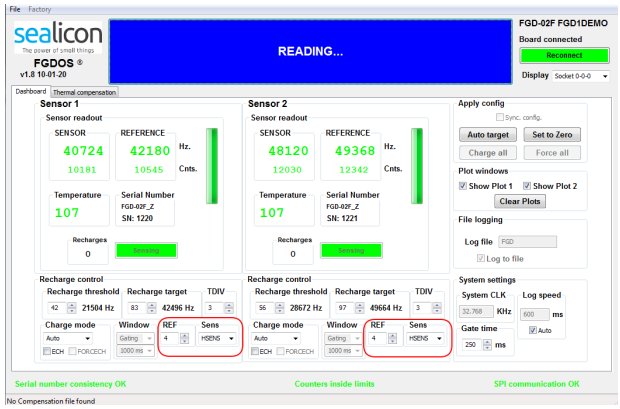


Figure 14: Sensitivity Mode selection

RECHARGING FGD_02F SENSOR

Sensor recharge is required when it has been exposed to enough radiation dose to cause a certain drop (discharge) of FSENS compared to FREF. The amount of discharge allowed before triggering a recharge operation depends on the application requirements, but a maximum drop of 20KHz is usually recommended.

For maximum accuracy, it is preferable to keep FSENS and FREF as close as possible, especially when post-processing methods like look-up-tables (LUT) are applied for temperature compensation.

Please read this chapter carefully before proceeding to sensor recharge. If sensor recharge operation is not executed properly, it may lead to sensor overcharge. Sensor overcharge will not necessarily damage the sensor, but it may have an impact on performance and accuracy of the readings.

Step 1. Selecting Recharge target

Recharge operation must be initiated by selecting the **Recharge Target**, shown in Figure 15.This is the desired final sensor recharge value.

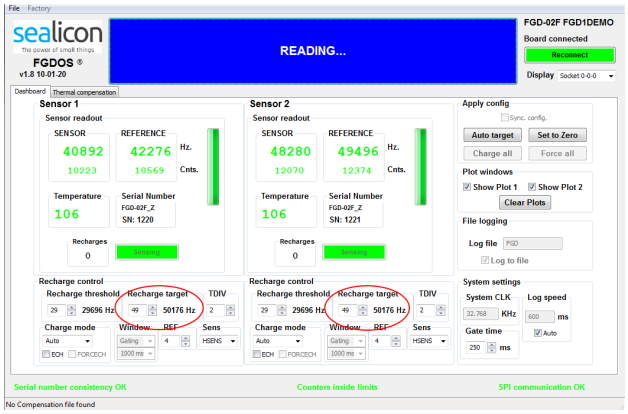


Figure 15. Recharge target configuration registers

This target value can be introduced manually by the user using the spin control, or using the **Auto Target** function, shown in Figure 16.

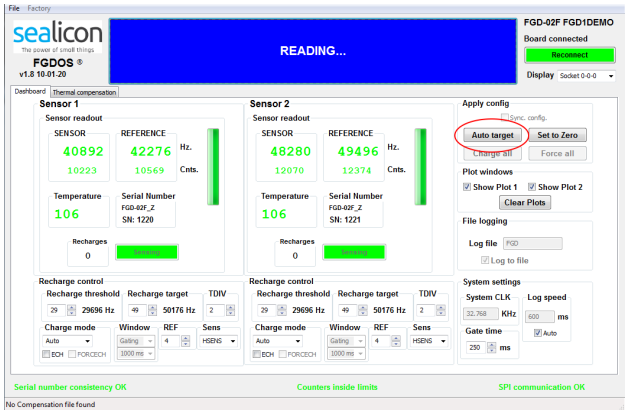


Figure 16: Auto target push button

When the **Auto target** button is pushed, the **Recharge Target** values are automatically configured to their optimum value. This is, the closest value possible to the Reference for each sensor, as shown in Figure 17.

Figure 17. Proposed recharge target value by Auto Target function

Step 2. Configuration for Automatic Recharge

Once the **Recharge Target** is configured, the recharge operation can be carried out. The different options in the **Recharge Control** section should be configured previous to triggering the recharge action. In Figure 18, **Charge Mode** is set to Auto and the **ECH** checkbox is disabled, i.e. the recharge

process is still not enabled. With this configuration, the status indicator will indicate **"Sensing" in green** as long as the SENSOR value (in Hz) stays above the **Recharge Threshold** value.

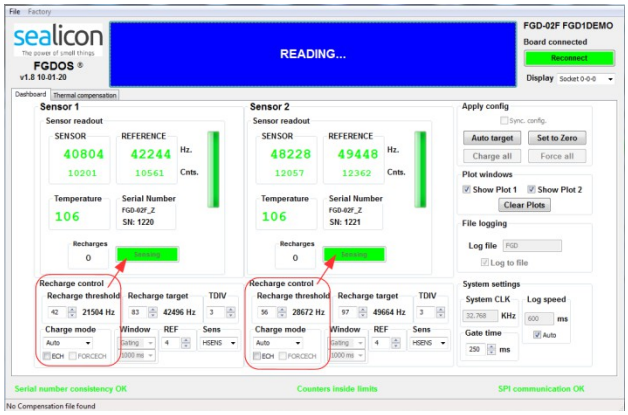


Figure 18. Recharging system configuration

In the example of Figure 18, both sensors are signaling **Sensing** status since

Sensor1 = 40804 Hz > Rech. Thres.1 = 21504 Hz

Sensor2 = 48228 Hz > Rech. Thres.2 = 28672 Hz

If any of both SENSOR values goes below its Recharge Threshold, the status indicator will change to **"Charge Requested",** in blue. An example of this is shown in Figure 19, where Recharge Threshold values have been increased intentionally to force the status indicator to change to "Charge Requested".

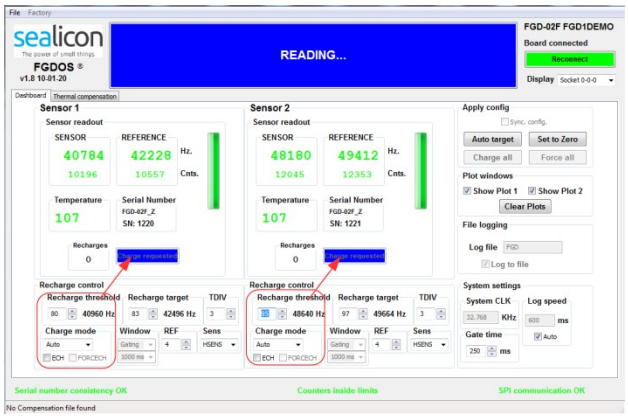


Figure 19. Recharge requested

The charge request situation is evaluated independently for each sensor. This is, it is possible that one sensor shows "Charge Request" status while the other one still showing "Sensing" status. When a recharge is requested, **sensors will recharge automatically after checking checkbox ECH**, as in Figure 20. The recharge will stop automatically when the SENSOR reaches the value specified at Recharge Target.

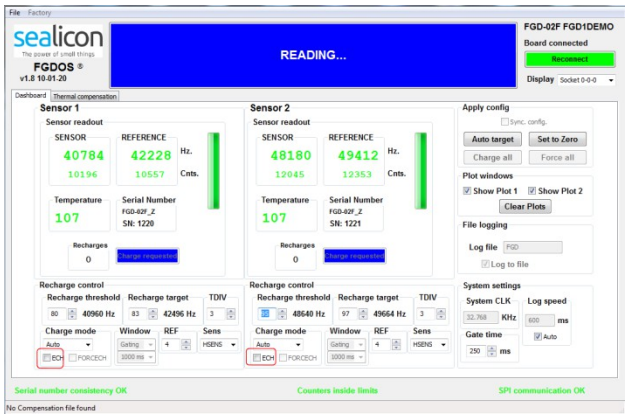


Figure 20. ECH checkboxes trigger a recharge process

Maximum accuracy is achieved when FSENS value is as close as FREF. Thus, for low dose monitoring, it may be desirable to trigger a recharge when FREF-FSENS difference is in the order of few kHz or even less. If this is the situation, **specify a Recharge Threshold two units below the specified value at Recharge Target.** For instance, if suggested Recharge Target is 83 (42496 Hz) then set Recharge Threshold to 81 (41472 Hz). It is desirable to keep threshold slightly below Target since recharge process can have some overshoot. Never use Recharge Threshold value higher than Recharge Target.

The number of recharges carried out is also available. This number is volatile and it is cleared once the sensor is powered down.

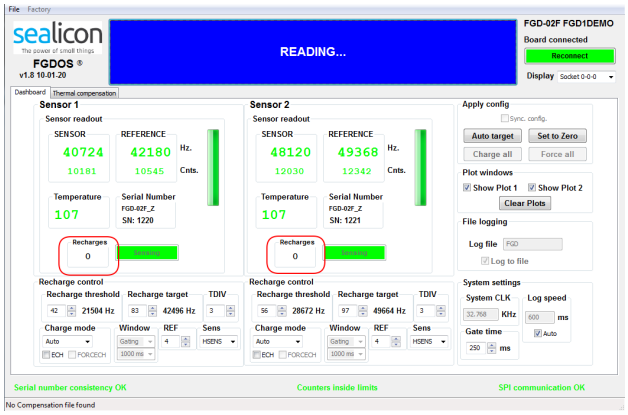


Figure 21: Number of recharges been carried out

The number of recharges carried out is also available. This number is volatile and it is cleared once the sensor is powered down.

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DATASHEET REVISION HISTORY

Rel.	Rel. Date	Chapter	Modification	Page
A1.0	30/07/2019		Initial Release	
A1.1	29/10/2019	Datasheet	Changed from “Confidential” to “Preliminary”	
		Datasheet	Changed contact info	
		ORDERNG INFO	Removed FGD-02F_Z TC	12/12
A1.2	19/11/2019	TEMP. COMPENSATION	Chapter added	10/12
A1.3	15/01/2020	FGD-02F EVAL USB KIT CONTENTS	USB Cable added	4/12
A1.4	11/03/2020	RECHARGING FGD-02F SENSOR	Chapter added	11/15
A1.5	31/03/20	GETTING STARTED WITH FGD-02F EVAL SYSTEM	JP2 unplugged	5/15

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ORDERING INFORMATION

Product	Description
FGD-02F_Z	FGD-02F_Z sensor, non-characterized, QFN32
FGD-02F_Z RTC	FGD-02F_Z sensor, radiation and temperature characterized, QFN32
FGD-02F EVAL RTC	Evaluation board with FGD-02F_Z sensor, radiation and temperature characterized

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