UM0979
User manual

STEVAL-MKI109V1 - eMotion motherboard for MEMS adapter board

Introduction

The STEVAL-MKI109V1 (eMotion) is a motherboard designed to provide the user with a complete ready-to-use platform for demonstration of MEMS devices mounted on adapter boards.

The eMotion board uses an STM32F102RB microcontroller which functions as a bridge between the sensor on the adapter board and the PC, on which it is possible to use the Unico graphical user interface (GUI) downloadable from the ST website or dedicated software routines for customized applications.

This user manual describes the hardware included with the demonstration kit and provides the information required to install and run the demonstration kit user interface.

For details regarding the features of each sensor, please refer to the datasheets available for each individual device.

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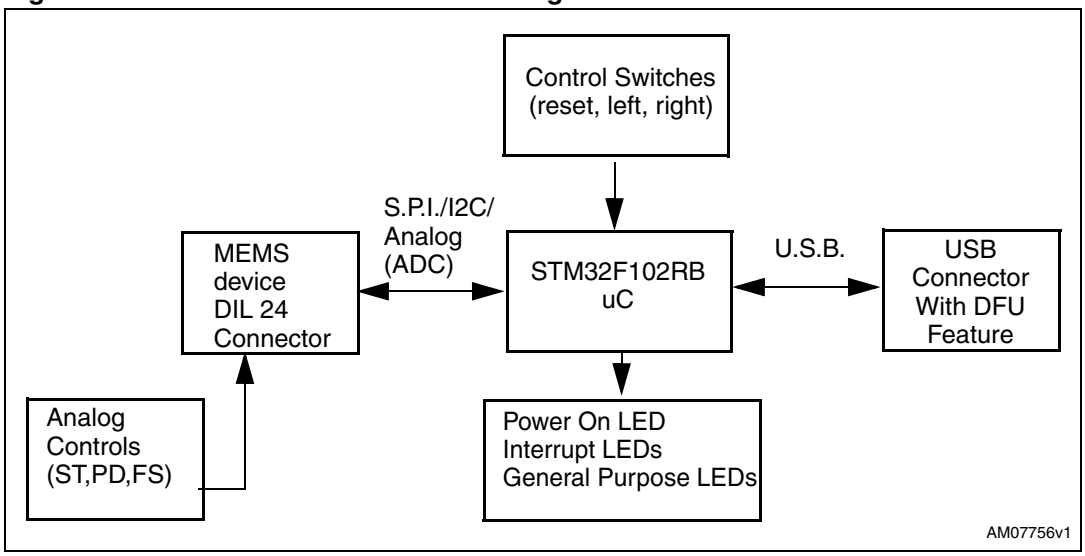
1 Demonstration kit description

The eMotion is a complete demonstration kit that allows demonstration of both digital and analog MEMS sensors. Thanks to its DIL 24 connector, a wide range of MEMS adapter boards can be used.

The block diagram of the demonstration kit is shown in *Figure 1*.

Figure 1. Demonstration board block diagram



As shown in the *Figure 1*, the eMotion demonstration kit is based on the STM32F102RB microcontroller and can be connected to the PC through the USB bus. Data coming from the MEMS sensor connected to the board can be read through the PC GUI provided with the kit.

The eMotion also implements the DFU (device firmware upgrade) feature, therefore, in the case of a new firmware release, it can be reprogrammed without the need to use a programmer. See www.st.com/mems for new firmware release.

The eMotion also integrates three general purpose LEDs, two LEDs connected directly to the interrupt pins of digital adapters and the power/USB LED. Moreover, the eMotion integrates three buttons: two are available to the user on a dedicated GPIO of the microcontroller, while the other is used as reset for the microcontroller.

All the MEMS adapter pins are available on two connectors placed on the board (*Figure 2* JP2 and JP3).

The top silk screen view and image of the full board are shown in *Figure 2* and *Figure 3* respectively.

Figure 2. Top silk screen of the eMotion kit

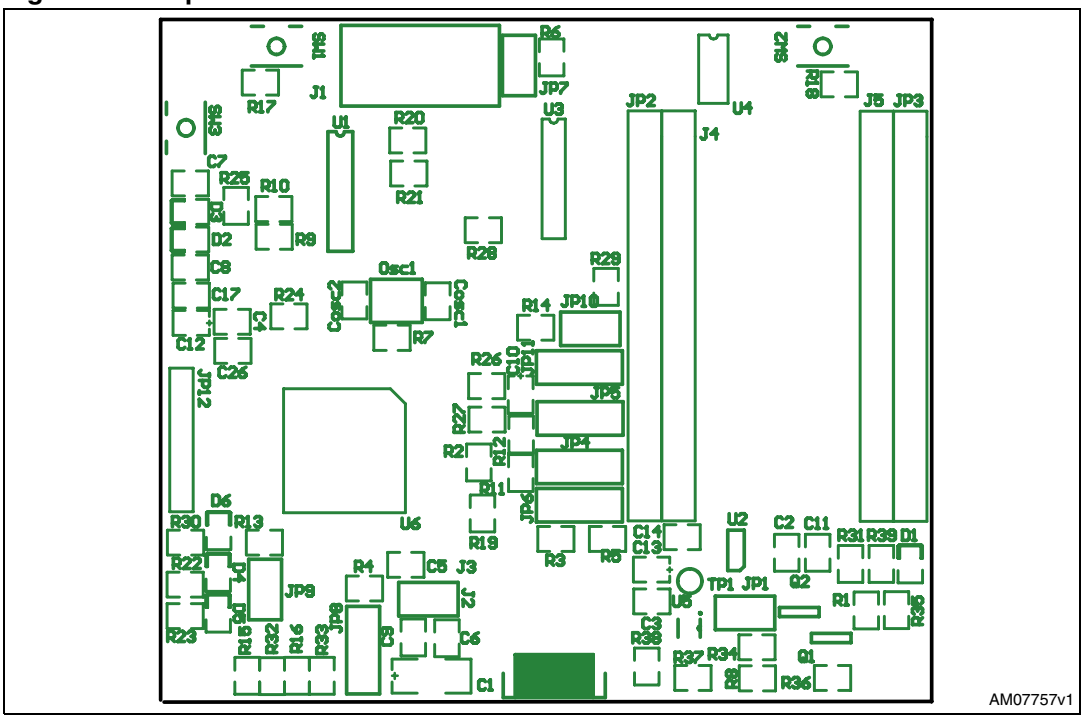
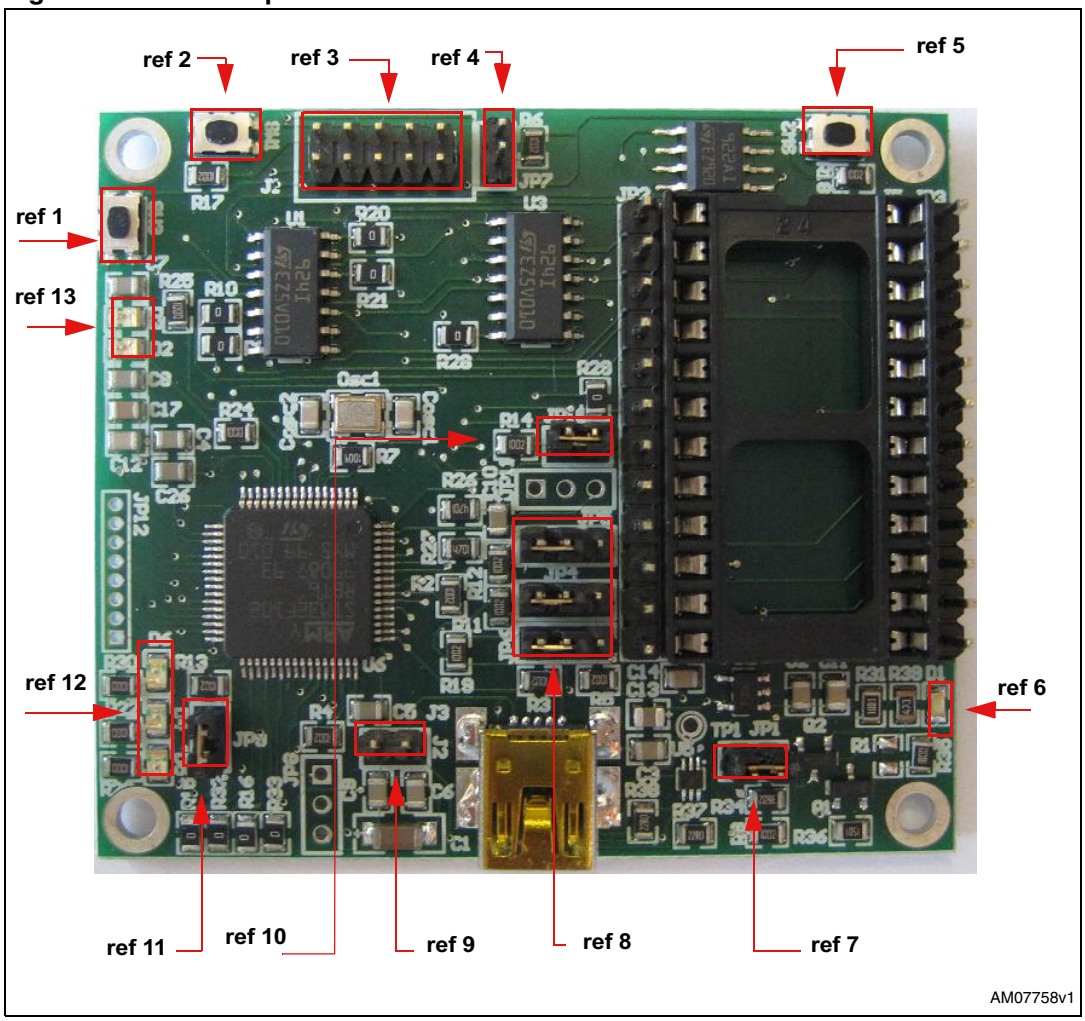


Figure 3. Board top view



In order to use the eMotion demonstration kit, installation of a dedicated driver is required, which is included in the installation pack, together with a GUI interface which allows simple interaction with the sensor. The steps required for driver and software installation are described in the following sections.

In *Figure 3* some main components placed on the top layer of the eMotion kit are highlighted.

- Jumpers JP9 and JP10 (*Figure 3*, ref 10, ref 11) are used to select the STM32 boot mode. When the eMotion is used together with MEMS adapters, JP9 and J1P0 must be fitted (see STM32 datasheet for more information).
- Jumper J2 (*Figure 3*, ref 7) can be used to directly supply the board (from 3.5 V to 6 V) instead of using the USB connector.
- Jumper JP1 allows the user to measure the sensor current consumption by connecting a multimeter in series with its terminals (*Figure 3*, ref 9).
- Jumpers JP4, JP5, and JP6 (*Figure 3*, ref 8) are used to manually set some features which are available for just some of the analog MEMS adapters (see *Table 1* for more details). JP4 is used to set the self test feature, JP5 to handle the power-down pin, and JP6 to reset the MEMS high-pass filter. When they are fitted on pins 2-3, these functions are handled by the firmware itself.

Table 1. Jumper configuration for power-down (PD), self test (ST) and high-pass filter reset (HP)

	Jumper on 1-2 position	Jumper on 2-3 position	Jumper unfitted
JP4 ST	logic level 1: self test ON	Self test is handled by the firmware	logic level 0: self test OFF, default
JP5 PD	logic level 1: power-down mode	Power-down is handled by the firmware	logic level 0: normal mode, default
JP6 HP	logic level 1: external high-pass filter reset	High-pass filter reset is handled by the firmware	logic level 0: normal mode, default

- J1 connector (*Figure 3*, ref 3) can be used to both reprogram the STM32 and to debug the code through the JTAG or SWD protocols.
- Jumper JP7 (*Figure 3*, ref 4) is used to select either JTAG (JP7 unfitted) or SWD (JP7 fitted) mode.

eMotion also integrates six LEDs and three buttons:

- LED D1 (*Figure 3*, ref 6) is switched on when the board is power supplied.
- LEDs D2 and D3 (*Figure 3*, ref 13) are directly connected to the interrupt pins of the MEMS digital adapters (if available on the sensor mounted on the adapter board).
- LEDs D4, D5, and D6 (*Figure 3*, ref 12) are general purpose LEDs and are used to indicate some firmware state. For example, LED D6 is switched on when a specific firmware is selected from those available. LED D5 on indicates that the microcontroller is well configured for communication with the sensor. Finally the LED D4, blinks according to the sensor data rate selected.
- Button SW3 (*Figure 3*, ref 1) is used to reset the STM32.
- Button SW1 and SW2 (*Figure 3*, ref 2 and ref 5) are connected to STM32 GPIOs and are available to the user.

2 eMotion board installation

The software package can be downloaded from the st.com website and includes the following directory structure:

- DRIVER: it contains the installation package for the USB drivers needed to connect the eMotion board to the PC
- DFU: it contains the installation package for the software needed to upgrade the firmware of the eMotion board (DFU)
- FIRMWARE: it contains the source code of the firmware of the eMotion board together with the corresponding binary file that can be flashed to the board using the DFU software.

The sections below describe the procedure to install the driver for the eMotion board and the DFU software.

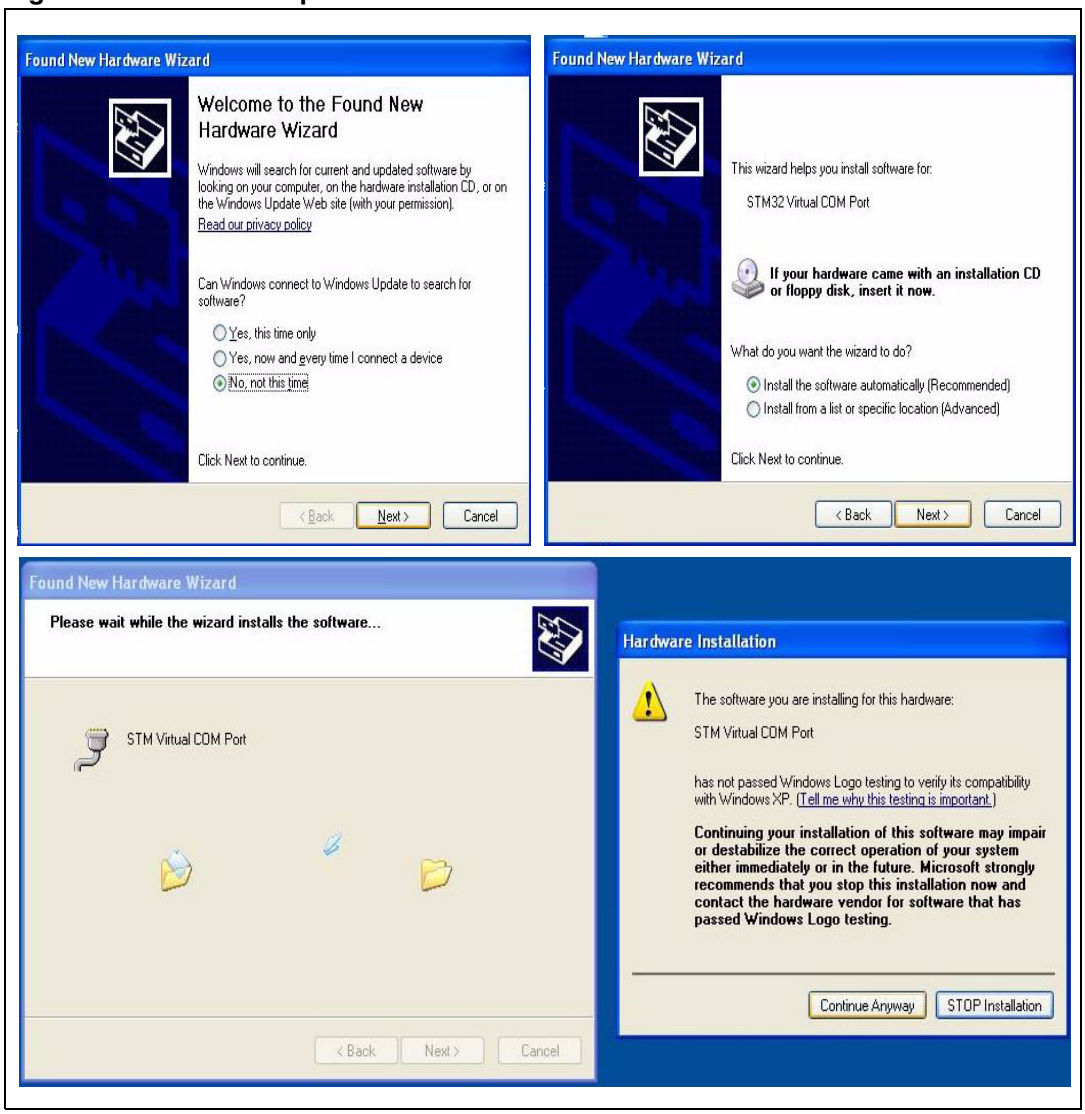
2.1 Hardware installation

To install the STM32 virtual COM port driver, launch the “VCPDriver_V1.1_Setup.exe” included in the package under the “DRIVER” folder and follow the instructions on the screen. Once the driver is installed, insert the demonstration kit board into a free USB port. The “Notify” icon should appear, as in *Figure 4*.

Figure 4. Notify icon

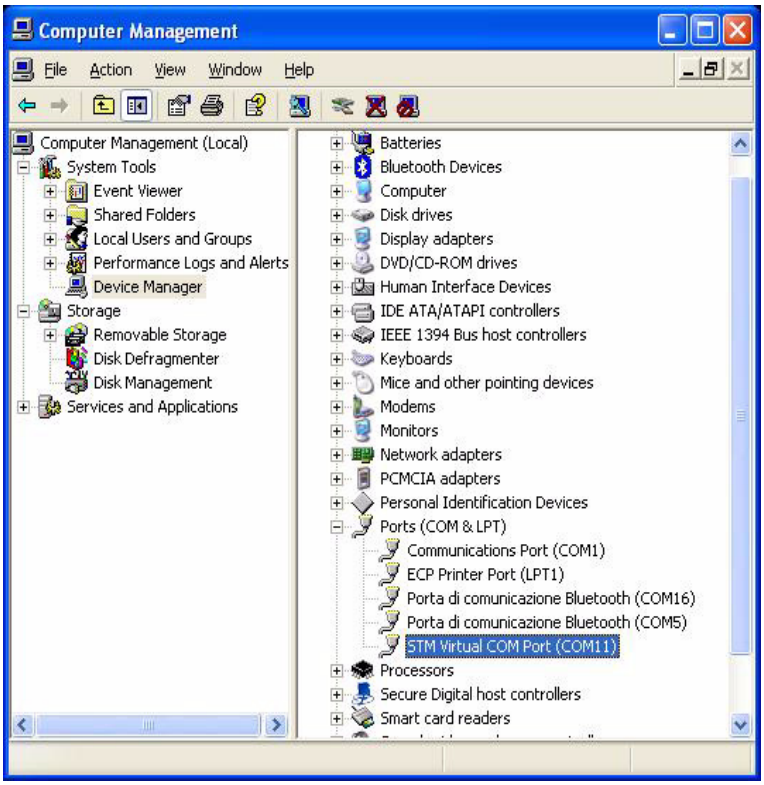
The “Hardware Update Wizard” window then appears (*Figure 5*), follow the instructions on the screen to complete the procedure. When driver installations starts, the user is prompted with the “Hardware Installation” dialog window, click the “Continue Anyway” button.

Figure 5. Hardware update Wizard



Now the eMotion should be recognized by the PC as a virtual COM. In order to check which COM port has been assigned to the board, right click on “My Computer” and select “Manage”, select “Device Manager” and scroll through the list until “Ports(COM & LPT)”. In the following example (*Figure 6*) the COM11 has been assigned to the board.

Figure 6. Virtual COM driver port assignment



2.2 DFU

To install the DFU software, launch the “DfuSe_Demo_V3.0_Setup.exe” included in the software package under the “DFU” folder and follow the instructions on the screen. To launch the software, select “Start > STMicroelectronics > DfuSe > DfuSe Demonstration”.

The MEMS DFU (Device Firmware Update) GUI is a graphical interface that allows the user to download and replace the firmware of a MEMS product division demonstration board directly from a PC through the USB port.

The MEMS MKI109V1 demonstration board has the capability of reprogramming an application through the USB, in accordance with the DFU class specification defined by the USB Implementers Forum. This capability is useful because it allows to reprogram the microcontroller directly in the field and is particularly well suited to USB applications where the same USB connector can be used both for the standard operating mode and for the reprogramming process.

For more details regarding DFU and the microcontroller ST GUI, see the related user manual located under “Start > STMicroelectronics > DfuSe > Docs > DfuSe Getting Started”.

3 Supported MEMS adapter boards

Table 2 below provides the complete list of supported adapter boards.

Table 2. List of supported MEMS adapter boards

Adapter board	Device
STEVAL-MKI009V1	LIS3LV02DL
STEVAL-MKI013V1	LIS302DL
STEVAL-MKI015V1	LIS344ALH
STEVAL-MKI082V1	LPY4150AL
STEVAL-MKI083V1	LPY450AL
STEVAL-MKI085V1	LPY410AL
STEVAL-MKI086V1	LPY403AL
STEVAL-MKI087V1	LIS331DL
STEVAL-MKI089V1	LIS331DLH
STEVAL-MKI090V1	LIS331DLF
STEVAL-MKI091V1	LIS331DLM
STEVAL-MKI092V1	LIS331HH
STEVAL-MKI095V1	LPR4150AL
STEVAL-MKI096V1	LPR450AL
STEVAL-MKI097V1	LPR430AL
STEVAL-MKI098V1	LPR410AL
STEVAL-MKI099V1	LPR403AL
STEVAL-MKI105V1	LIS3DH
STEVAL-MKI107V1	L3G4200D
STEVAL-MKI110V1	AIS328DQ
STEVAL-MKI112V1	LPS001WP

4 Supported commands

The microcontroller mounted on the eMotion board is equipped with dedicated firmware that supports a set of commands which allow to control either the digital or the analog output MEMS sensor and permits the acquisition of the measured data. The firmware also handles the communication between the board and the PC through the USB bus. These features allow the user to easily write their own applications to exploit the capabilities of the sensor chosen.

This section describes the commands that are supported by the firmware for the microcontroller of the eMotion demonstration kit.

4.1 Getting started

Before using the commands supported by the firmware, the following procedure must be performed:

1. Connect the eMotion to the USB port
2. Launch an application which allows to send commands through the virtual serial port. The remainder of this document assumes the use of “Microsoft© HyperTerminal” program available with the Windows XP operating system
3. Create a new connection, enter a name (e.g. “STEVAL-MKI0109V1”), and click “OK”
4. In the “Connect Using” field, select the virtual COM port to which the USB port has been mapped, and click “OK”
5. In port settings, set bits per second to 115200, data bits to 8, parity to none, stop bits to 1, and flow control to none. Click “OK”
6. On the “HyperTerminal” application window choose “files” > “properties” > “settings”, then click on the “ASCII Setup” button
7. Select “Send line ends with line feeds” and “Echo typed characters locally”
8. Click the “OK” button to close the “ASCII Setup” window
9. Click the “OK” button to close the “Properties” window.

Once this procedure has been completed the user can utilize the commands described in the following sections by typing them into the “HyperTerminal” window.

4.2 Supported commands

The firmware supports a wide range of MEMS adapters; the next section reports the complete list of supported commands (see *Table 3*) and their description.

Then, split into sections, the list of commands available for each sensor supported by the eMotion firmware is reported.

4.2.1 Commands list and description

Table 3. Supported commands list

Command	Description	Returned value
*setdbXXXVY	Selects firmware according to the adapter connected	
*start	Starts continuous data acquisition	(see *Table 4*)
*debug	Returns the output data in readable text format	(see *Table 5*)
*stop	Stops data acquisition	
*Zon	Forces 3-state	
*Zoff	Exits from 3-state	
*dev	Device name	e.g.: LIS3DH
*ver	Firmware version	e.g.: V1.0
*rAA	Accelerometer register read	e.g.: RAAhDDh
*wAADD	Accelerometer register write	
*grAA	Gyroscope register read	e.g.: GRAAhDDh
*gwAADD	Gyroscope register write	
*mrAA	Magnetometer register read	e.g.: MRAAhDDh
*mwAADD	Magnetometer register write	
*prAA	Pressure sensor register read	e.g.: PRAAhDDh
*pwAADD	Pressure sensor register write	
*single	It gets a single X, Y, and Z data acquisition	(see *Table 5*)
*list	Prints the list of MKIs supported	e.g.: MKI105V1
*listdev	Prints the list of devices supported	e.g.: LIS3DH
*echoon	Activates the write verbose mode	e.g.: RAAhDDh
*echooff	Deactivates the write verbose mode	
*fifostr	Accelerometer “FIFO stream” mode enable	st 0 0 0 0 0 0 IR FC FS
*fifomde	Accelerometer “FIFO mode” mode enable	st 0 0 0 0 0 0 IR FC FS
*fifotrg	Accelerometer “stream to FIFO” mode enable	st 0 0 0 0 0 0 IR FC FS
*fiforst	Accelerometer “reset” mode enable	st 0 0 0 0 0 0 IR FC FS
*gfifostr	Gyroscope “FIFO stream” mode enable	st 0 0 0 0 0 0 IR FC FS
*gfifomde	Gyroscope “FIFO mode” mode enable	st 0 0 0 0 0 0 IR FC FS
*gfifotrg	Gyroscope “stream to FIFO” mode enable	st 0 0 0 0 0 0 IR FC FS
*gfiforst	Gyroscope “reset” mode enable	st 0 0 0 0 0 0 IR FC FS
*gfifobts	Gyroscope “Bypass to FIFO” enable	st 0 0 0 0 0 0 IR FC FS
*PDON	Set power-down pin	

Table 3. Supported commands list (continued)

Command	Description	Returned value
*PDOFF	Clears power-down pin	
*STON	Sets self test pin	
*STOFF	Clears self test pin	
*HPON	Sets high-pass filter pin	
*HPOFF	Clears high-pass filter pin	
*FSON	Sets full scale pin	
*FSOFF	Clears full scale pin	

Note: IR: interrupt byte; FC: FIFO control register; FS: FIFO source register.

Set demonstration board

The command *setdbxxxvy selects the part of the firmware able to handle the adapter board sensor connected to the board. e.g., in order to select the firmware for the LIS3DH the command must be: setdb105V1. The D6 LED (green) is automatically switched on.

Start command

The *start command initiates the continuous data acquisition. When this command is sent to the device, it returns a string of bytes (plus carriage return and line feed) similar to “st OUT1 OUT2 OUT3 IR BT”.

The first two bytes are always *the ASCII char “s”* and *“t”* which correspond to the hexadecimal values {73h 74h}.

OUT1, OUT2, and OUT3 are the bytes that contain the values measured at device outputs; if the output data is represented on more than 8 bits, OUT1, OUT2, and OUT3 are split into two bytes: high byte (e.g.: “XH”) and low byte (e.g.: “XL”).

IR contains the interrupt bytes and BT contains the bytes that describe the state of the buttons integrated on the board.

Specifically, bit#0 of the “BT” data corresponds to the status of the SW1 button on the demonstration kit board: it is set to 1 when the SW1 is pressed (otherwise 0). Bit#1 has the same behavior but is dedicated to the SW2.

Before sending the *start command, the device must be out from 3-state and some registers must be configured according to user needs, therefore, *start must be preceded by a *zoff and some “Register Write” commands.

Table 4 shows the format of the string returned for each device when a *start command is sent.

Table 4. Returned values for *start command

STEVAL # (Device)	Returned value
STEVAL-MKI009V1 (LIS3LV02DL) STEVAL-MKI089V1 (LIS331DLH) STEVAL-MKI090V1 (LIS331DLF) STEVAL-MKI091V1 (LIS331DLM) STEVAL-MKI092V1 (LIS331HH) STEVAL-MKI105V1 (LIS3DH) STEVAL-MKI107V1 (L3G4200D) STEVAL-MKI110V1 (AIS328DQ)	s t XH XL YH YL ZH ZL int1 int2 sw1|sw2 \r \n
STEVAL-MKI013V1 (LIS302DL) STEVAL-MKI087V1 (LIS331DL)	s t X Y Z int1 int2 sw1|sw2 \r \n
STEVAL-MKI015V1 (LIS344ALH)	s t XH XL YH YL ZH ZL sw1 sw2 \r \n
STEVAL-MKI082V1 (LPY4150AL) STEVAL-MKI083V1 (LPY450AL) STEVAL-MKI085V1 (LPY410AL) STEVAL-MKI086V1 (LPY403AL) STEVAL-MKI095V1 (LPR4150AL) STEVAL-MKI096V1 (LPR450AL) STEVAL-MKI097V1 (LPR430AL) STEVAL-MKI098V1 (LPR410AL) STEVAL-MKI099V1 (LPR403AL)	s t vrefH vrefL o1H o1L out1H out1L out4H out4L o2H o2L out2H out2L out5H out5L o3H o3L out3H out3L out6H out6L sw1|sw2 \r \n
STEVAL-MKI112V1 (LPS001WP)	s t PH PL TEMPH TEMPL DH DL int1 sw1 sw2 \r \n

Note: 1 XH: X axis output high byte (same for Y axis, Z axis, P pressure, and TEMP temperature)

2 XL: X axis output low byte (same for Y axis, Z axis, P pressure, and TEMP temperature)

Debug command

The *debug command starts the continuous data acquisition in debug mode. When this command is sent to the board, it returns the output values measured by the device formatted in a readable text format. The values shown on the screen correspond to the LSB data shown as a decimal number.

Table 5 shows the format of the string returned for each device when a *debug command is sent.

Table 5. Returned values for *debug command

STEVAL # (Device)	Returned value
STEVAL-MKI009V1 (LIS3LV02DL) STEVAL-MKI013V1 (LIS302DL) STEVAL-MKI015V1 (LIS344ALH) STEVAL-MKI087V1 (LIS331DL) STEVAL-MKI089V1 (LIS331DLH) STEVAL-MKI090V1 (LIS331DLF) STEVAL-MKI091V1 (LIS331DLM) STEVAL-MKI092V1 (LIS331HH) STEVAL-MKI105V1 (LIS3DH) STEVAL-MKI110V1 (AIS328DQ)	X=XXXXX Y=YYYYY Z=ZZZZZ
STEVAL-MKI082V1 (LPY4150AL) STEVAL-MKI083V1 (LPY450AL) STEVAL-MKI085V1 (LPY410AL) STEVAL-MKI086V1 (LPY403AL) STEVAL-MKI095V1 (LPR4150AL) STEVAL-MKI096V1 (LPR450AL) STEVAL-MKI097V1 (LPR430AL) STEVAL-MKI098V1 (LPR410AL) STEVAL-MKI099V1 (LPR403AL)	VREF=VVVVV OUT1=XXXXX 4OUT1=XXXXX OUT3=YYYYY OUT6=YYYYY
STEVAL-MKI107V1 (L3G4200D)	P=PPPPP R=RRRRR Y=YYYYY
STEVAL-MKI112V1 (LPS001WP)	P=PPPPP T=TTTTT D=DDDDD

Stop command

The *stop command interrupts any acquisition session that has been started with either the *start or *debug commands.

Zon and Zoff

The *Zon and *Zoff commands are employed, respectively, to put into 3-state the STM32F102RB microcontroller mounted on the demonstration kit. These commands allow the isolation of the sensor from the microprocessor and let the user to interact with the sensor in a pure analog way.

By default, when the kit is first turned on, the lines are in 3-state mode and the user is required to send the *Zoff command to allow communication between the sensor and the microcontroller. If Zoff has not been launched, the firmware ignores any other command.

Device name

The *dev command retrieves the name of the adapter connected to the demonstration kit. The returned value is, for example, *"LIS3DH"*.

Firmware version

The *ver command queries the demonstration kit and returns the version of the firmware loaded in the microprocessor, for example, “V1.0”.

Accelerometer register read

The *rAA command allows the contents of the accelerometer registers in the demonstration kit board to be read. AA, expressed as a hexadecimal value and written in upper case, represents the address of the register to be read.

Once the read command is issued, the board returns RAAhDDh, where AA is the address sent by the user and DD is the data present in the register.

For example, to read the register at address 0x20, the user issues the command *r20, which returns, e.g., R20hC7h.

Accelerometer register write

The *wAADD command allows writing to the contents of the accelerometer registers in the demonstration kit board. AA and DD, expressed as hexadecimal values and written in upper case, represent, respectively, the address of the register and the data to be written. For example, to write 0xC7 to the register at address 0x20, the user issues the command *w20C7.

Gyroscope register read

The *grAA command allows the contents of the gyroscope registers in the demonstration kit board to be read. AA, expressed as hexadecimal value and written in upper case, represents the address of the register to be read.

Once the read command is issued, the board returns GRAAhDDh, where AA is the address sent by the user and DD is the data present in the register.

For example, to read the register at address 0x20, the user issues the command *gr20, which returns, e.g., GR20hC7h.

Gyroscope register write

The *gwAADD command allows writing to the contents of the gyroscope registers in the demonstration kit board. AA and DD, expressed as hexadecimal values and written in upper case, represent, respectively, the address of the register and the data to be written. To write 0xC7 to the register at address 0x20, for example, the user issues the command *gw20C7.

Magnetometer register read

The *mrAA command allows the contents of the magnetometer registers in the demonstration kit board to be read. AA, expressed as a hexadecimal value and written in upper case, represents the address of the register to be read.

Once the read command is issued, the board returns MRAAhDDh, where AA is the address sent by the user and DD is the data present in the register.

For example, to read the register at address 0x00, the user issues the command *mr00, which returns, e.g., MR00h10h.

Magnetometer register write

The *mwAADD command allows writing to the contents of the magnetometer registers in the demonstration kit board. AA and DD, expressed as hexadecimal values and written in upper case, represent, respectively, the address of the register and the data to be written. To write 0x20 to the register at address 0x01, for example, the user issues the command *mw0120.

Pressure sensor Register read

The *prAA command allows the contents of the pressure sensor registers in the demonstration kit board to be read. AA, expressed as a hexadecimal value and written in upper case, represents the address of the register to be read.

Once the read command is issued, the board returns PRAAhDDh, where AA is the address sent by the user and DD is the data present in the register.

For example, to read the register at address 0x20, the user issues the command *pr20, which returns, e.g., PR20h10h.

Pressure sensor Register write

The *pwAADD command allows writing to the contents of the pressure sensor registers in the demonstration kit board. AA and DD, expressed as hexadecimal values and written in upper case, represent, respectively, the address of the register and the data to be written. To write 0xC7 to the register at address 0x20, for example, the user issues the command *pw20C7.

Single acquisition

The *single command may be used to read just one set of data. It requires the sensor to be well configured and once invoked, returns the read values of one data sample.

The format of the returned value is exactly the same as the *debug command (*Table 5*), in fact, the *debug command is used for continuous data acquisition purposes whereas a *single command returns just one set of data.

List

The *list command returns the list of MKI adapters supported by the firmware, printed in ASCII format.

Listdev

The *listdev command returns the list of devices supported by the firmware, printed in ASCII format.

Echo on

The *echoon command is used to activate the write command verbose mode. Once this command is launched, after every write command the firmware automatically performs also a read of the register just written. This function is useful to check if the write has succeeded. For instance, if the *echoon command is launched, after a *w2027 it results R2027.

Echo off

The *echooff command stops the write command verbose mode.

Accelerometer FIFO stream mode enable

The *fifostr command is used to enable the accelerometer FIFO stream mode. For more details see the AN3308 application note.

Accelerometer FIFO mode enable

The *fifomde command is used to enable the accelerometer FIFO mode. For more details see the AN3308 application note.

Accelerometer Stream to FIFO mode enable

The *fifotrg command enables the accelerometer stream to FIFO mode. For more details see the AN3308 application note.

Accelerometer FIFO reset enable

The *fiforst command enables the accelerometer FIFO reset mode. For more details see the AN3308 application note.

Gyroscope FIFO stream mode enable

The *fifostr command is used to enable the gyroscope FIFO stream mode.

Gyroscope FIFO mode enable

The *gfifomde command is used to enable the gyroscope FIFO mode.

Gyroscope Stream to FIFO mode enable

The *gfifotrg command enables the gyroscope stream to FIFO mode.

Gyroscope FIFO reset enable

The *gfiforst command enables the gyroscope FIFO reset mode.

Gyroscope FIFO bypass to stream enable

The *gfifobts command enables the gyroscope bypass to stream mode.

PDON and PDOFF

The *PDON and *PDOFF commands are employed respectively to set to 1, and to clear to 0, the “power-down” pin in analog devices.

STON and STOFF

The *STON and *STOFF commands are employed respectively to set to 1, and to clear to 0, the “self test” pin in analog devices.

HPON and HPOFF

The *HPON and *HPOFF commands are employed respectively to set to 1, and to clear to 0, the “high-pass filter” pin in analog devices.

FSON and FSOFF

The *FSON and *FSOFF commands are employed respectively to set to 1 and to clear to 0 the “full scale” pin in analog devices.

4.2.2 Digital output accelerometers: supported commands

Table 6 below lists the commands supported by the following devices/demonstration boards:

- STEVAL-MKI009V1 (LIS3LV02DL)
- STEVAL-MKI013V1 (LIS302DL)
- STEVAL-MKI087V1 (LIS331DL)
- STEVAL-MKI089V1 (LIS331DLH)
- STEVAL-MKI090V1 (LIS331DLF)
- STEVAL-MKI091V1 (LIS331DLM)
- STEVAL-MKI092V1 (LIS331HH)
- STEVAL-MKI105V1 (LIS3DH)
- STEVAL-MKI110V1 (AIS328DQ)

Table 6. Digital output accelerometers: supported commands list

Command	Description	Returned value
*setdbXXXVY	Selects firmware according to the adapter connected	
*start	Starts continuous data acquisition	(see *Table 4*)
*debug	Returns the output data in readable text format	(see *Table 5*)
*stop	Stops data acquisition	
*Zon	Forces 3-state	
*Zoff	Exits from 3-state	
*dev	Device name	e.g.: LIS3DH
*ver	Firmware version	e.g.: V1.0
*rAA	Accelerometer register read	e.g.: RAAhDDh
*wAADD	Accelerometer register write	
*single	It gets a single X, Y, and Z data acquisition	(see *Table 5*)
*list	Prints the list of MKIs supported	e.g.: MKI105V1
*listdev	Prints the list of devices supported	e.g.: LIS3DH
*echoon	Activates the write verbose mode	e.g.: RAAhDDh
*echooff	Deactivates the write verbose mode	
*fifostr(1)	Accelerometer “FIFO stream” mode enable	st 0 0 0 0 0 0 IR FC FS
*fifomde(1)	Accelerometer “FIFO mode” mode enable	st 0 0 0 0 0 0 IR FC FS
*fifotrg(1)	Accelerometer “stream to FIFO” mode enable	st 0 0 0 0 0 0 IR FC FS
*fiforst(1)	Accelerometer “reset” mode enable	st 0 0 0 0 0 0 IR FC FS

1. Available only for devices with embedded FIFO.

Note: IR: interrupt byte; FC: FIFO control register; FS: FIFO source register.

4.2.3 Analog output accelerometers: supported commands

Table 7 below lists the commands supported by the following devices/demonstration boards:

- STEVAL-MKI015V1 (LIS344ALH)

Table 7. Analog Output Accelerometers: supported commands list

Command	Description	Returned value
*setdbXXXVY	Selects firmware according to the adapter connected	
*start	Starts continuous data acquisition	(see *Table 4*)
*debug	Returns the output data in readable text format	(see *Table 5*)
*stop	Stops data acquisition	
*Zon	Forces 3-state	
*Zoff	Exits from 3-state	
*dev	Device name	e.g.: LIS3DH
*ver	Firmware version	e.g.: V1.0
*single	It gets a single X, Y, and Z data acquisition	(see *Table 5*)
*list	Prints the list of MKIs supported	e.g.: MKI105V1
*listdev	Prints the list of devices supported	e.g.: LIS3DH
*echoon	Activates the write verbose mode	e.g.: RAAhDDh
*echooff	Deactivates the write verbose mode	
*PDON	Sets power-down pin	
*PDOFF	Clears power -down pin	
*STON	Sets self test pin	
*STOFF	Clears self test pin	
*FSON	Sets full scale pin	
*FSOFF	Clears full scale pin	

4.2.4 Digital output gyroscopes: supported commands

Table 8 below lists the commands supported by following devices/demonstration boards:

- STEVAL-MKI107V1 (L3G4200D)

Table 8. Digital output gyroscopes: supported commands list

Command	Description	Returned value
*setdbXXXVY	Selects firmware according to the adapter connected	
*start	Starts continuous data acquisition	(see *Table 4*)
*debug	Returns the output data in readable text format	(see *Table 5*)
*stop	Stops data acquisition	
*Zon	Forces 3-state	
*Zoff	Exits from 3-state	
*dev	Device name	e.g.: LIS3DH
*ver	Firmware version	e.g.: V1.0
*grAA	Gyroscope register read	e.g.: GRAAhDDh
*gwAADD	Gyroscope register write	
*single	It gets a single X, Y, and Z data acquisition	(see *Table 5*)
*list	Prints the list of MKIs supported	e.g.: MKI105V1
*listdev	Prints the list of devices supported	e.g.: LIS3DH
*echoon	Activates the write verbose mode	e.g.: RAAhDDh
*echooff	Deactivates the write verbose mode	
*gfifostr(1)	Gyroscope “FIFO stream” mode enable	st 0 0 0 0 0 0 IR FC FS
*gfifomde(1)	Gyroscope “FIFO mode” mode enable	st 0 0 0 0 0 0 IR FC FS
*gfifotrg(1)	Gyroscope “stream to FIFO” mode enable	st 0 0 0 0 0 0 IR FC FS
*gfiforst(1)	Gyroscope “reset” mode enable	st 0 0 0 0 0 0 IR FC FS
*gfifobts(1)	Gyroscope “bypass to FIFO” enable	st 0 0 0 0 0 0 IR FC FS

1. Available only for devices with embedded FIFO.

Note: IR: interrupt byte; FC: FIFO control register; FS: FIFO source register.

4.2.5 Analog output gyroscopes: supported commands

Table 9 below lists the commands supported by the following devices/demonstration boards:

- STEVAL-MKI082V1 (LPY4150AL)
- STEVAL-MKI083V1 (LPY450AL)
- STEVAL-MKI085V1 (LPY410AL)
- STEVAL-MKI086V1 (LPY403AL)
- STEVAL-MKI095V1 (LPR4150AL)
- STEVAL-MKI096V1 (LPR450AL)
- STEVAL-MKI097V1 (LPR430AL)
- STEVAL-MKI098V1 (LPR410AL)
- STEVAL-MKI099V1 (LPR403AL)

Table 9. Analog output gyroscopes: supported commands list

Command	Description	Returned value
*setdbXXXVY	Selects firmware according to the adapter connected	
*start	Starts continuous data acquisition	(see *Table 4*)
*debug	Returns the output data in readable text format	(see *Table 5*)
*stop	Stops data acquisition	
*Zon	Forces 3-state	
*Zoff	Exits from 3-state	
*dev	Device name	e.g.: LIS3DH
*ver	Firmware version	e.g.: V1.0
*single	It gets a single X, Y, and Z data acquisition	(see *Table 5*)
*list	Prints the list of MKIs supported	e.g.: MKI105V1
*listdev	Prints the list of devices supported	e.g.: LIS3DH
*echoon	Activates the write verbose mode	e.g.: RAAhDDh
*echooff	Deactivates the write verbose mode	
*PDON	Sets power-down pin	
*PDOFF	Clears power-down pin	
*STON	Sets self test pin	
*STOFF	Clears self test pin	
*HPON	Sets high-pass filter pin	
*HPOFF	Clears high-pass filter pin	

4.2.6 Digital output pressure sensor: supported commands

Table 10 below lists the commands supported by the following devices/demonstration boards:

- STEVAL-MKI112V1 (LPS001WP)

Table 10. Digital output pressure sensor: supported commands list

Command	Description	Returned value
*setdbXXXVY	Selects firmware according to the adapter connected	
*start	Starts continuous data acquisition	(see *Table 4*)
*debug	Returns the output data in readable text format	(see *Table 5*)
*stop	Stops data acquisition	
*Zon	Forces 3-state	
*Zoff	Exits from 3-state	
*dev	Device name	e.g.: LIS3DH
*ver	Firmware version	e.g.: V1.0
*prAA	Pressure sensor register read	e.g.: PRAAhDDh
*pwAADD	Pressure sensor register write	
*single	It gets a single X, Y, and Z data acquisition	(see *Table 5*)
*list	Prints the list of MKIs supported	e.g.: MKI105V1
*listdev	Prints the list of devices supported	e.g.: LIS3DH
*echoon	Activates the write verbose mode	e.g.: RAAhDDh
*echooff	Deactivates the write verbose mode	

4.3 Quick start

This section shows the basic sequence of commands, based on the LIS3DH accelerometer, to start a data communication session and to retrieve the X, Y, and Z acceleration data from the demonstration kit:

1. Connect the eMotion to the USB port
2. Start “Microsoft© HyperTerminal” and configure it as described in *Section 4.1*
3. Inside the “HyperTerminal” window, enter the command *setdb105v1 (supposing the LIS3DH adapter board is used, for other adapters see the relevant datasheets to check the register configuration), enter the command *Zoff to enable the control of the device by the STM32F102RB microcontroller, and *w2047 to switch on the LIS3DH and to set the data rate to 50 Hz
4. Send the *debug command to get the X, Y, and Z data measured by the sensor
5. Send *stop to end the continuous acquisition and visualization.

5 Schematic diagram

The schematic diagram of the eMotion demonstration kit is shown in *Figure 7* and *Figure 8*.

Figure 7. Schematic diagram of the eMotion board (power supply and USB)

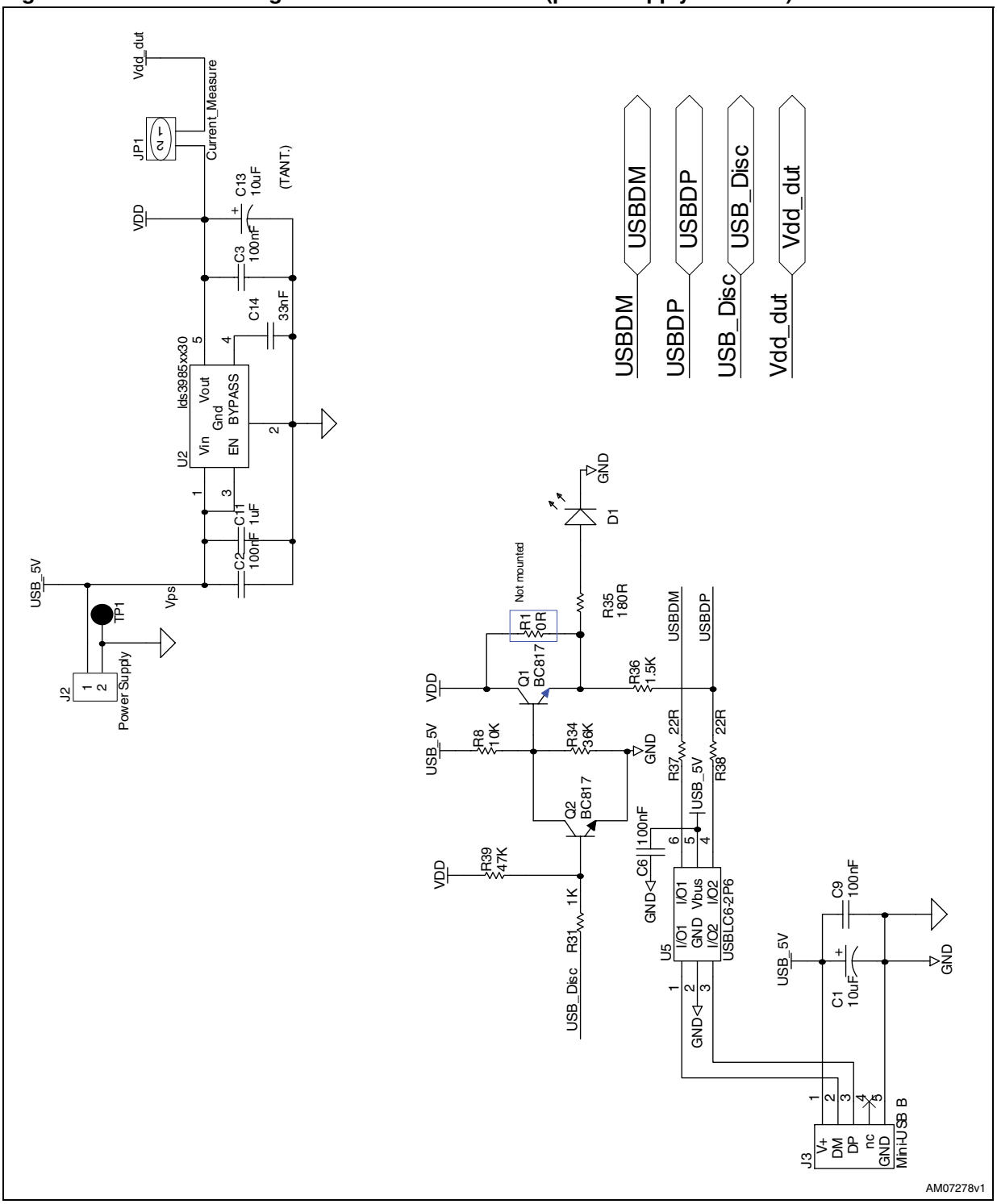
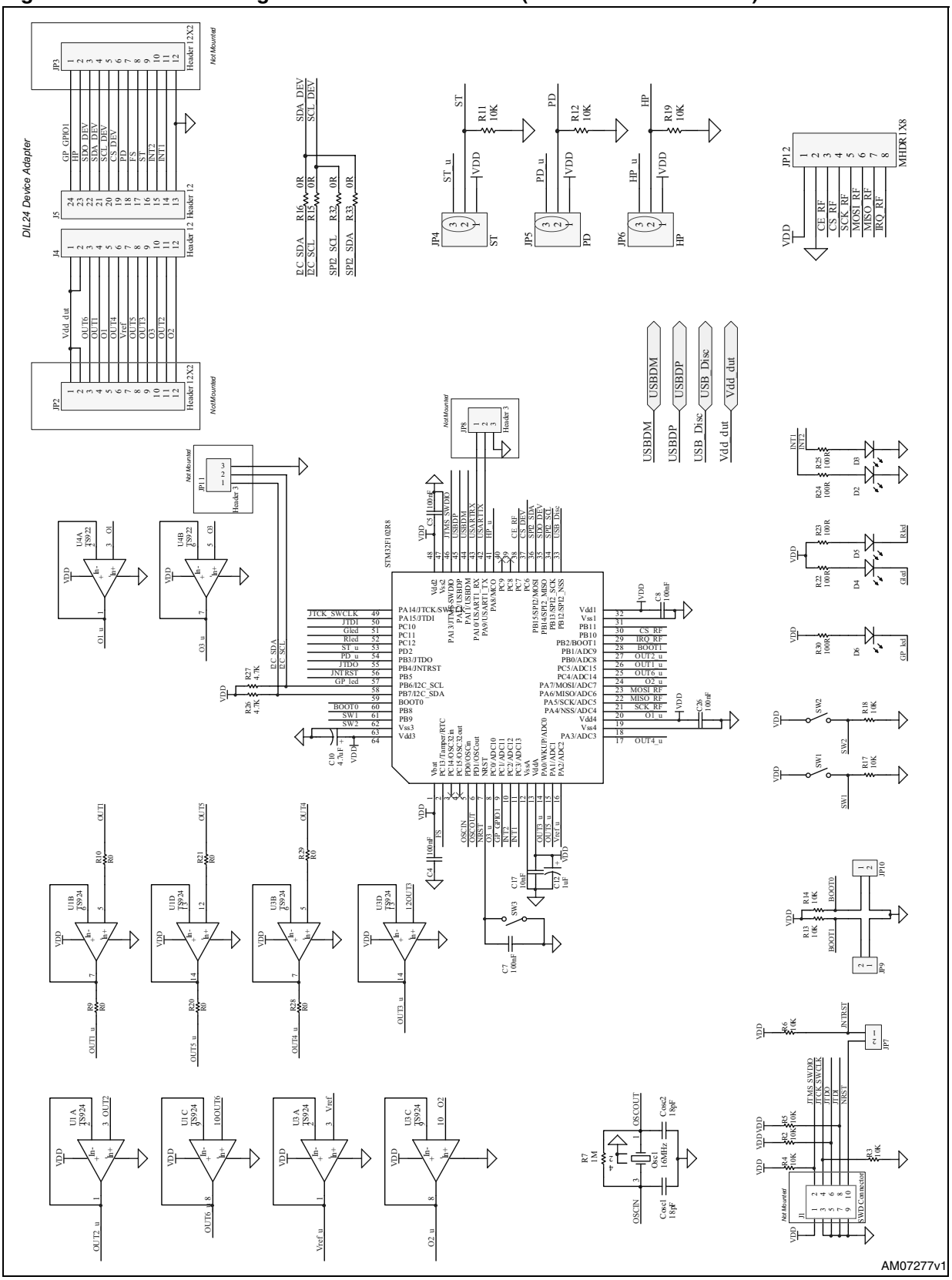


Figure 8. Schematic diagram of the eMotion board (STM32 and connectors)



6 Bill of materials

The bill of materials for the eMotion demonstration kit is provided in *Table 11* below.

Table 11. Bill of materials

Designator	Description	Comment	Footprint
C1	Capacitor	10 µF	C1206_POL
C2	Capacitor	100 nF	0805
C3	Capacitor	100 nF	0805
C4	Capacitor	100 nF	0805
C5	Capacitor	100 nF	0805
C6	Capacitor	100 nF	0805
C7	Capacitor	100 nF	0805
C8	Capacitor	100 nF	0805
C9	Capacitor	100 nF	0805
C10	Capacitor	4.7 µF	C0805_POL
C11	Capacitor	1 µF	0805
C12	Capacitor	1 µF	C0805_POL
C13	Capacitor	10 µF	C0805_POL
C14	Capacitor	33 nF	0805
C17	Capacitor	10 nF	0805
C26	Capacitor	100 nF	0805
Cosc1	Capacitor	18 pF	0805
Cosc2	Capacitor	18 pF	0805
D1	SMD LED	Blue LED	0805
D2	SMD LED	Green LED	0805
D3	SMD LED	Orange LED	0805
D4	SMD LED	Green LED	0805
D5	SMD LED	Red LED	0805
D6	SMD LED	Orange LED	0805
J1	Header_HE10_5X2	JTAG/SWD connector	HDR5X2 1.27 mm
J2	CON2	Power supply	Header 1x2 2 mm
J3	USB_mini_B	Mini-USB B	USB_mini_B
J4	Header 12	Header 12	HDR1X12
J5	Header 12	Header 12	JP 1X12
JP1	CON2	Current_Measure	Header 1x2 2 mm
JP2	Header 12	Header 12X2	HDR1X12
JP3	Header 12	Header 12X2	HDR1X12
JP4	Header 3	STMicroelectronics	Header 1x3 2 mm
JP5	Header 3	PD	Header 1x3 2 mm
JP6	Header 3	HP	Header 1x3 2 mm

Table 11. Bill of materials (continued)

Designator	Description	Comment	Footprint
JP7	CON2		Header 1x2 2 mm
JP9	CON2		Header 1x2 2 mm
JP10	CON2		Header 1x2 2 mm
Osc1	Ceramic SMD crystal 3.2X2.5 mm	16 MHz	Ceramic SMD Crystal 3.2x2.5 mm
Q1	BC817-25	BC817	SOT-23
Q2	BC817-25	BC817	SOT-23
R2	Resistor	10 kΩ	0805
R3	Resistor	10 kΩ	0805
R4	Resistor	10 kΩ	0805
R5	Resistor	10 kΩ	0805
R6	Resistor	10 kΩ	0805
R7	Resistor	1 MΩ	0805
R8	Resistor	10 kΩ	0805
R9	Resistor	0	0805
R10	Resistor	0	0805
R11	Resistor	10 kΩ	0805
R12	Resistor	10 kΩ	0805
R13	Resistor	10 kΩ	0805
R14	Resistor	10 kΩ	0805
R15	Resistor	0	0805
R16	Resistor	0	0805
R17	Resistor	10 kΩ	0805
R18	Resistor	10 kΩ	0805
R19	Resistor	10 kΩ	0805
R20	Resistor	0	0805
R21	Resistor	0	0805
R22	Resistor	100 Ω	0805
R23	Resistor	100 Ω	0805
R24	Resistor	100 Ω	0805
R25	Resistor	100 Ω	0805
R26	Resistor	4.7 kΩ	0805
R27	Resistor	4.7 kΩ	0805
R28	Resistor	0	0805
R29	Resistor	0	0805
R30	Resistor	100 Ω	0805
R31	Resistor	1 kΩ	0805
R32	Resistor	0	0805
R33	Resistor	0	0805
R34	Resistor	36 kΩ	0805

Table 11. Bill of materials (continued)

Designator	Description	Comment	Footprint
R35	Resistor	180 Ω	0805
R36	Resistor	1.5 kΩ	0805
R37	Resistor	22 Ω	0805
R38	Resistor	22 Ω	0805
R39	Resistor	47 kΩ	0805
SW1	SMT SWITCH		
SW2	SMT SWITCH		
SW3	SMT SWITCH		
U1	TS924	TS924	TS924
U2	Component_1	lds3985xx30	SOT23-5
U3	TS924	TS924	TS924
U4	TS922	TS922	SO8_2
U5	USBLC6-2P6	USBLC6-2P6	SOT-666
U6	STM32F103RB	STM32F102R8	LQFP64

7 Revision history

Table 12. Document revision history

Date	Revision	Changes
02-Mar-2011	1	Initial release.

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