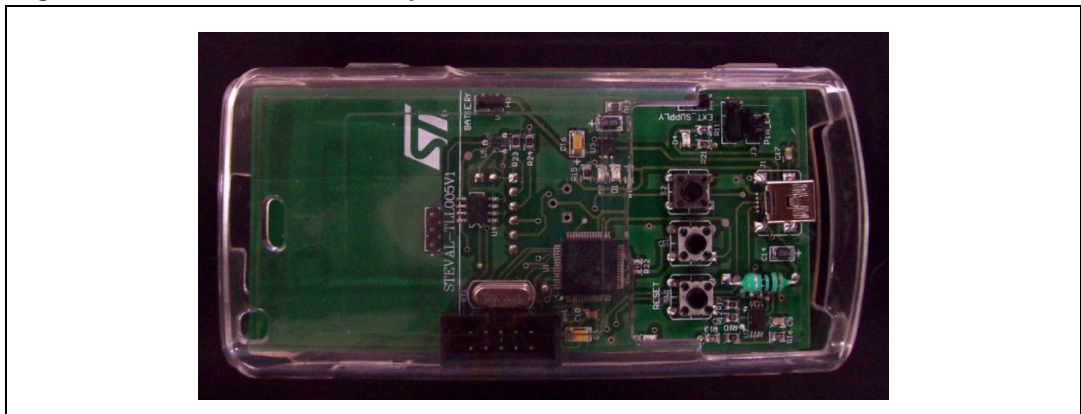


## STEVAL-TLL005V1 power flash demonstration board based on the STCF03 and ST7

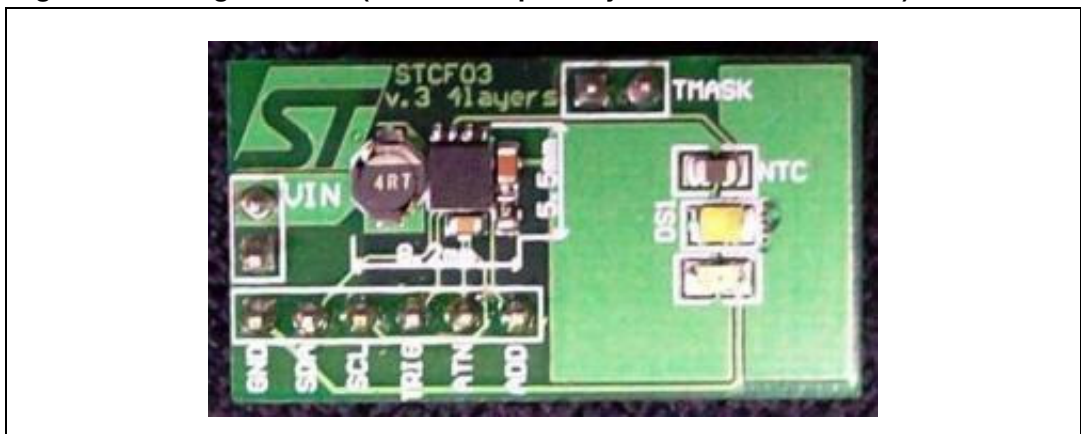
### Introduction

This document describes the functionality of the STEVAL-TLL005V1 power flash demonstration board based on STCF03 high power white LED driver and the ST7 8-bit microcontroller. The STCF03 is a high efficiency power supply solution to drive a single flash LED in camera phones, PDAs and other hand-held devices. It operates as a buck-boost converter to guarantee proper LED current control in all possible battery voltage and output voltage conditions. All functions of the device are controlled through an I<sup>2</sup>C interface via the ST7 microcontroller. The STEVAL-TLL005V1 includes both the motherboard (*Figure 1*) and daughterboard (also available separately as STEVAL-TLL004V1, *Figure 2*).

**Figure 1. STEVAL-TLL005V1 power flash demonstration board**



**Figure 2. Daughterboard (available separately as STEVAL-TLL004V1)**



# Contents

- 1      Getting started ..... 4**
  - 1.1    Package contents ..... 4
  - 1.2    Hardware description ..... 4
    - 1.2.1    On-board components ..... 5
  - 1.3    Power supply selection ..... 5
  
- 2      Connecting the demonstration board ..... 7**
  
- 3      Operation of the STEVAL-TLL005V1 demonstration board ..... 8**
  - 3.1    GUI mode ..... 8
    - 3.1.1    Using Packet\_creator.exe ..... 8
    - 3.1.2    Understanding the data packets in edit box ..... 10
    - 3.1.3    Management of flash mode, torch mode and auxiliary LED mode in the Packet\_creator GUI ..... 11
    - 3.1.4    Using Register\_Controller.EXE ..... 13
    - 3.1.5    Handling of flash mode, torch mode and auxiliary LED mode in the register\_controller GUI ..... 14
  - 3.2    Standalone mode ..... 17
    - 3.2.1    Configuring the switches (S1 and S2) ..... 17
    - 3.2.2    Running in standalone mode ..... 18
  - 3.3    Battery charging ..... 18
  - 3.4    Programming of the STEVAL-TLL005V1 using ICC ..... 19
  
- Appendix A    Schematic diagram ..... 20**
  - 3.5    STEVAL-TLL005V1 schematic diagram ..... 20
  
- Appendix B    Bill of material ..... 21**
  
- Revision history ..... 23**

## List of figures

Figure 1.	STEVAL-TLL005V1 power flash demonstration board . . . . .	1
Figure 2.	Daughterboard (available separately as STEVAL-TLL004V1) . . . . .	1
Figure 3.	STEVAL-TLL005V1 power flash demonstration board . . . . .	4
Figure 4.	J2 connection details for external power supply mode . . . . .	6
Figure 5.	J2 connection details for battery mode . . . . .	6
Figure 6.	Power flash demonstration board connections . . . . .	7
Figure 7.	Packet creator GUI . . . . .	9
Figure 8.	Packet creator showing the data packets . . . . .	10
Figure 9.	Commands showing the flash. . . . .	11
Figure 10.	Slider to configure torch . . . . .	12
Figure 11.	Slider to configure the auxiliary LED. . . . .	13
Figure 12.	Register controller Window. . . . .	14
Figure 13.	Flash mode configuration in the register controller GUI . . . . .	14
Figure 14.	Flash operation mode selection in the register controller GUI . . . . .	15
Figure 15.	Torch mode configuration in the register controller GUI . . . . .	15
Figure 16.	Torch operation mode selection in the register controller GUI . . . . .	16
Figure 17.	Auxiliary operation mode selection in the register controller GUI . . . . .	16
Figure 18.	Auxiliary LED configuration in the register controller GUI . . . . .	17
Figure 19.	Error message for command number in programming the switches . . . . .	18
Figure 20.	Battery connections . . . . .	19
Figure 21.	Circuit schematic of the STEVAL-TLL005V1 . . . . .	20

# 1 Getting started

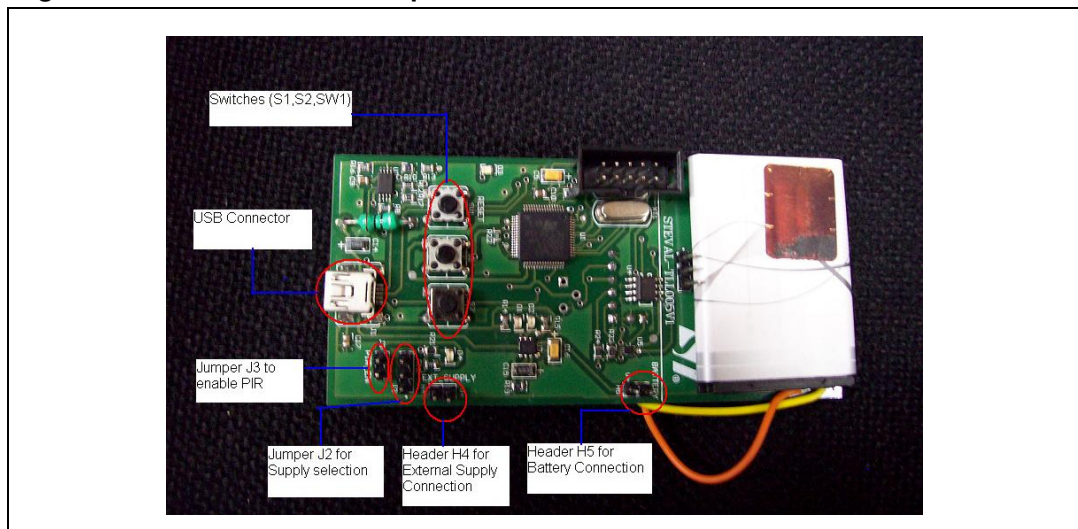
## 1.1 Package contents

The STEVAL-TLL005V1 power flash demonstration board package consist of the following:

- Hardware:
  - Motherboard
  - Daughterboard with STCF03 and power LED
- Documentation:
  - User manual
- GUI installation file with PC driver and PC GUI

## 1.2 Hardware description

**Figure 3. STEVAL-TLL005V1 power flash demonstration board**



### 1.2.1 On-board components

- The major components present on the motherboard are:
  - ST72651AR6 microcontroller
  - M24C02-W EEPROM
  - STBC08 battery charger
  - L6920 buck converter
  - ST2329 voltage translator
  - Jumper for connecting the Li-Ion battery
  - Jumpers to select the power supply mode (external supply or battery supply)
  - Jumper to connect external power supply
  - Mini USB jacket for USB connection
  - Programmable switches S1 and S2
  - Reset switch SW1
- Major blocks present on the daughterboard are:
  - STCF03 white LED driver
  - White LED
  - Red auxiliary LED

## 1.3 Power supply selection

The STEVAL-TLL005V1 can be powered either by a mobile Li-Ion battery (battery mode), or an external 5 V DC power supply (external power supply mode).

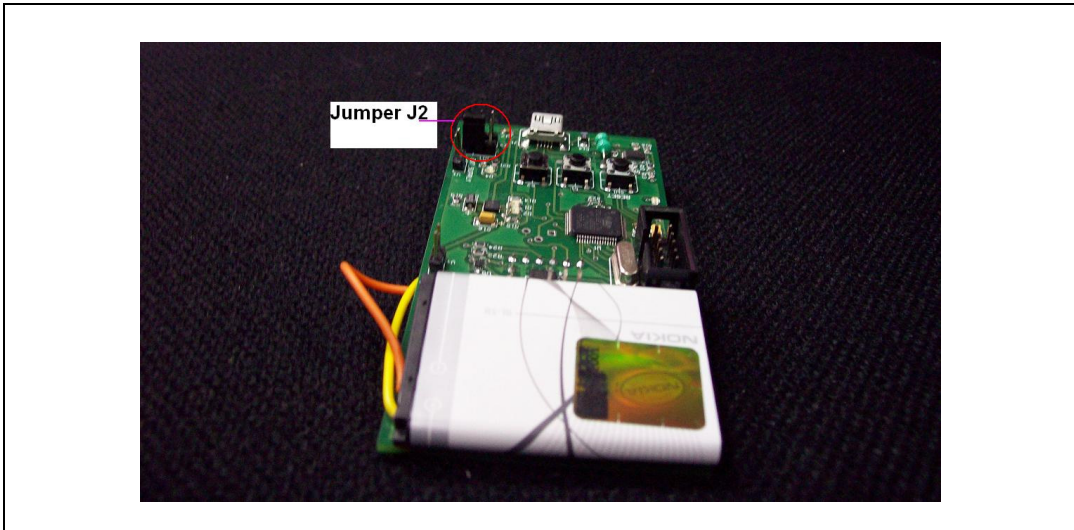
Selection of the required power mode is made using jumper J2.

### External power mode selection

If using an external 5 V DC power supply to power the demonstration board, perform the following steps:

- Connect the external DC power supply across header H4.
- Position the jumper across pins 1-2 of J2, as shown in [Figure 4](#).

Figure 4. J2 connection details for external power supply mode

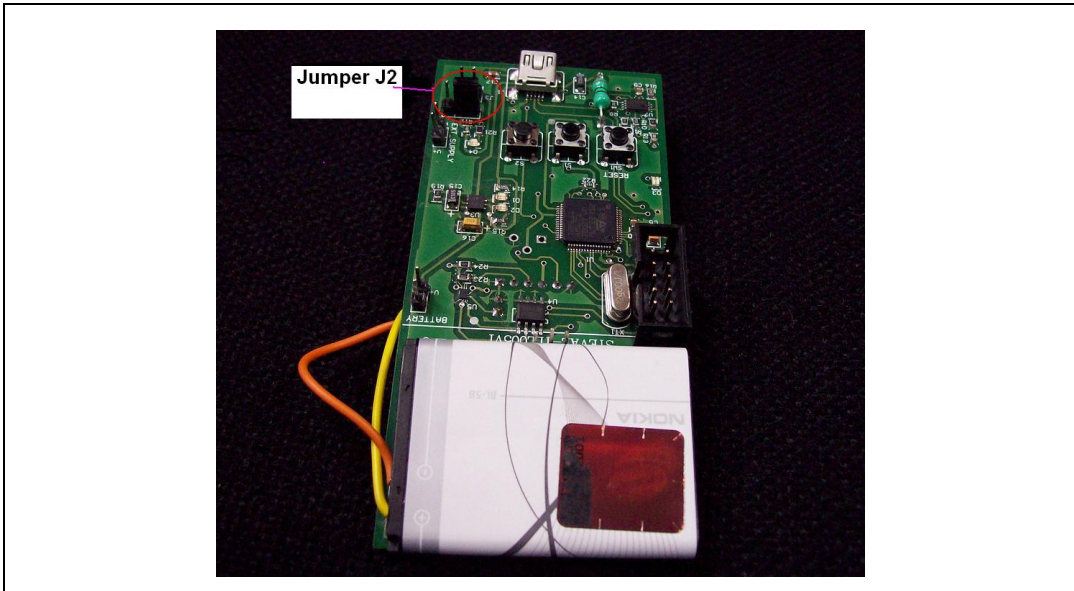


### Battery powered mode

To power the STEVAL-TLL005V1 by battery, perform the following steps:

- The Li-Ion battery should be connected across header H5. The positive terminal of the battery is connected to the V+ pin of the header.
- Position the jumper across pins 2 and 3 of J2, as shown in [Figure 5](#).

Figure 5. J2 connection details for battery mode





## 2 Connecting the demonstration board

The power flash demonstration board consists of a motherboard and a daughterboard. Connect the daughterboard to the motherboard using header H2. Mount the daughterboard as shown in [Figure 6](#).

The power flash demonstration board can be powered either through a battery or through an external power supply.

**Figure 6. Power flash demonstration board connections**



## 3 Operation of the STEVAL-TLL005V1 demonstration board

Once the daughterboard is mounted onto the motherboard, different configurations of the STCF03 are possible and the board can be evaluated in either of two modes:

- GUI mode
- Standalone mode

### 3.1 GUI mode

The power flash demonstration board is supported by a GUI (graphical user interface), through which the user can configure different settings for the STCF03 and run the sequence on the demonstration board.

The GUI consists of two executable files included in the demonstration board kit:

1. Packet\_creator.exe
2. Register\_Controller.exe

The board is connected to the computer using the USB cable, and uses a virtual COM port to communicate with the PC. This requires the installation of the virtual COM port driver.

To install the virtual COM port driver, first run the GUI.exe. A message appears requesting its driver path. Give the path of the driver folder.

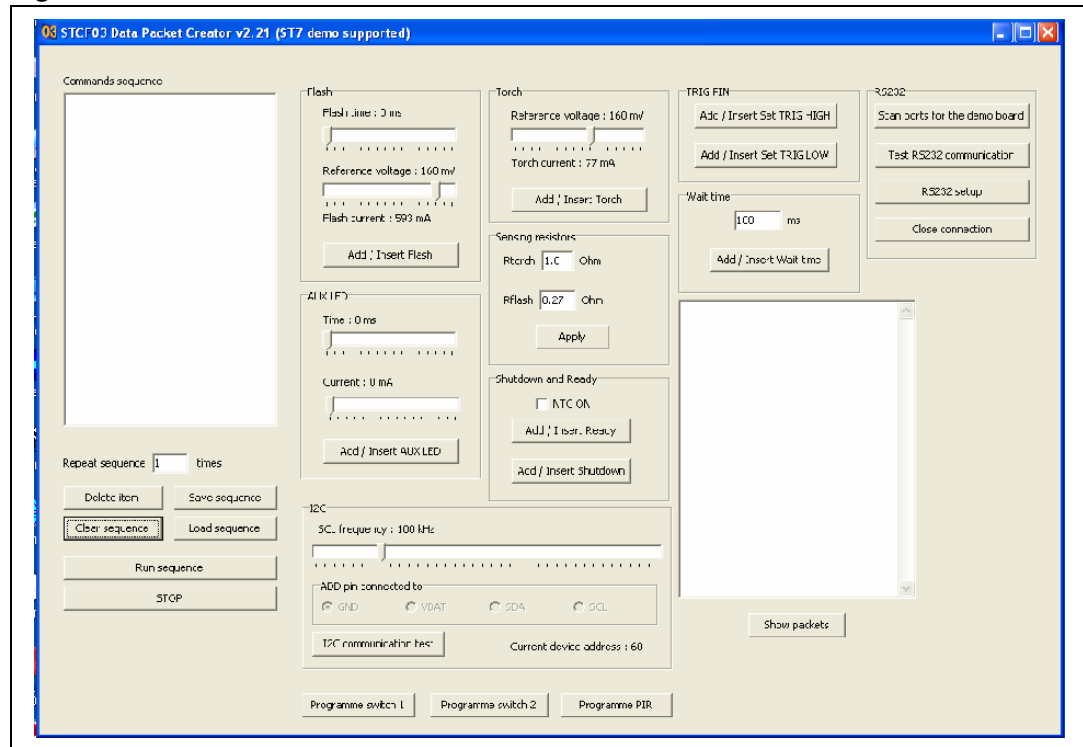
This folder contains 2 driver files, one for Microsoft® Windows® XP (Win2k\_XP) and another one for Microsoft Windows® 98 (Win98). Select the appropriate folder.

#### 3.1.1 Using Packet\_creator.exe

Run Packet\_creator.exe. The main window of the application is as shown in [Figure 7](#).



Figure 7. Packet creator GUI



Follow the steps below to use the GUI with the STEVAL-TLL005V1 demonstration board:

### Steps

1. Connect the motherboard to the computer using the USB cable.
2. Press the "Scan ports for the demonstration board" button. The program automatically detects to which port the demonstration board is connected. Alternatively, the user can manually set up the port by pressing the "RS232 setup" button.

**Note:** *To ensure proper operation, do not modify any other communication parameters. In particular, do not change the ADD pin connection setting. The ADD pin is grounded in the demonstration board, so selecting VBAT, SDA or SCL leads to an incorrect device address and failure of the I<sup>2</sup>C communication.*

3. I<sup>2</sup>C communication with the board can be verified by pressing the "scan ports for demonstration board" button on the GUI. The auxiliary LED on the daughterboard glows and the "I<sup>2</sup>C test pass" message is displayed on the GUI.
4. Once the communication setup is complete, creation of the sequences can start. Press any of the "Add/Insert ..." buttons to add or insert an item into the "Commands sequence" listbox. If no item in the listbox is selected, the new item is automatically added to the end of the sequence. If any item is selected, the new item is inserted above the selected one.
5. The selected item, or multiple items can be deleted by pressing the "Delete item" button. The entire sequence can be deleted by pressing the "Clear sequence" button. The sequence which has been created can be saved by pressing the "Save sequence" button.

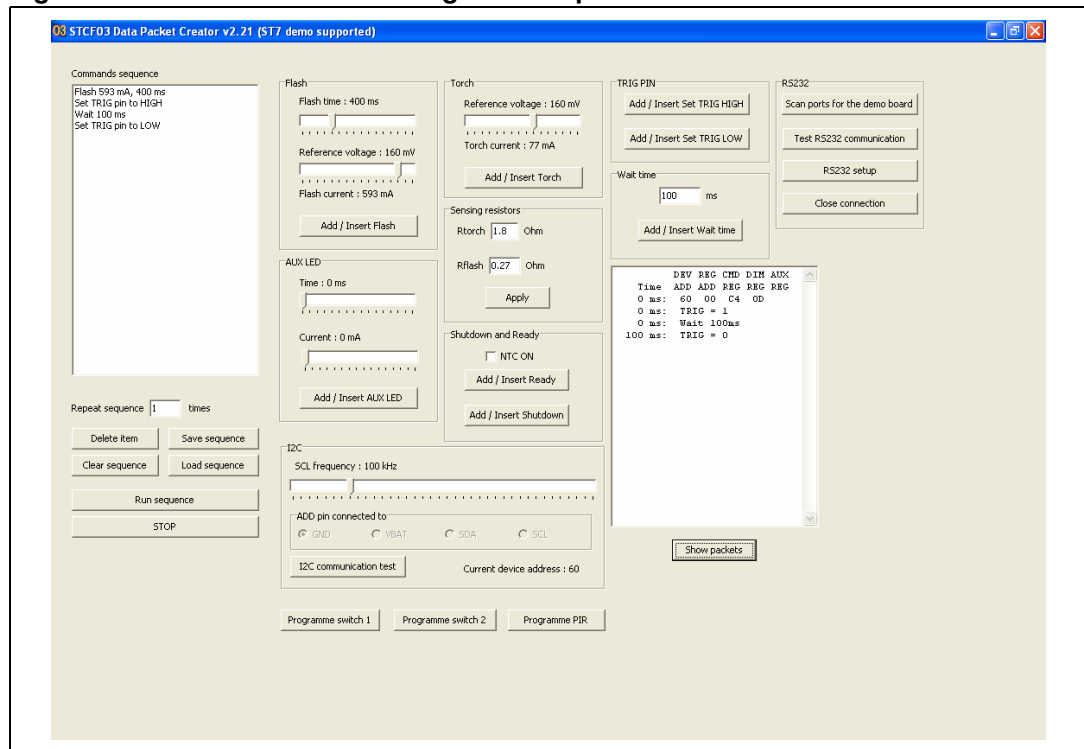
- button. The save dialog box appears and a filename can be entered. The sequences have a default extension of "seq".
6. To load a sequence that has been saved, press the "Load sequence" button. The open file dialog box appears and the desired sequence can be loaded.
  7. As soon as the sequence has been created or loaded, it can be run by pressing the "Run sequence" button. The sequence is then run and repeated as many times as specified in the "Repeat sequence" text box. The number of cycles can range from 0 to 255. A value of 255 makes the sequence run infinitely.
  8. The sequence can be stopped at any time by pressing the "STOP" button.

### 3.1.2 Understanding the data packets in edit box

The bytes in a packet are listed in the following order:

- Device address
- Register address
- Command register data
- Dimming register data
- Aux register data

**Figure 8. Packet creator showing the data packets**



Each line in this box starts with a time in milliseconds, followed by the action. "Action" refers to the sending of data through the I<sup>2</sup>C, management of the TRIG pin or waiting.

Any text in the edit box can be selected by the mouse and copied to any other application or into custom software source code. The data that should be sent to the STCF03 to achieve the desired operation can be easily identified, without the need for time-consuming study of the device datasheet.

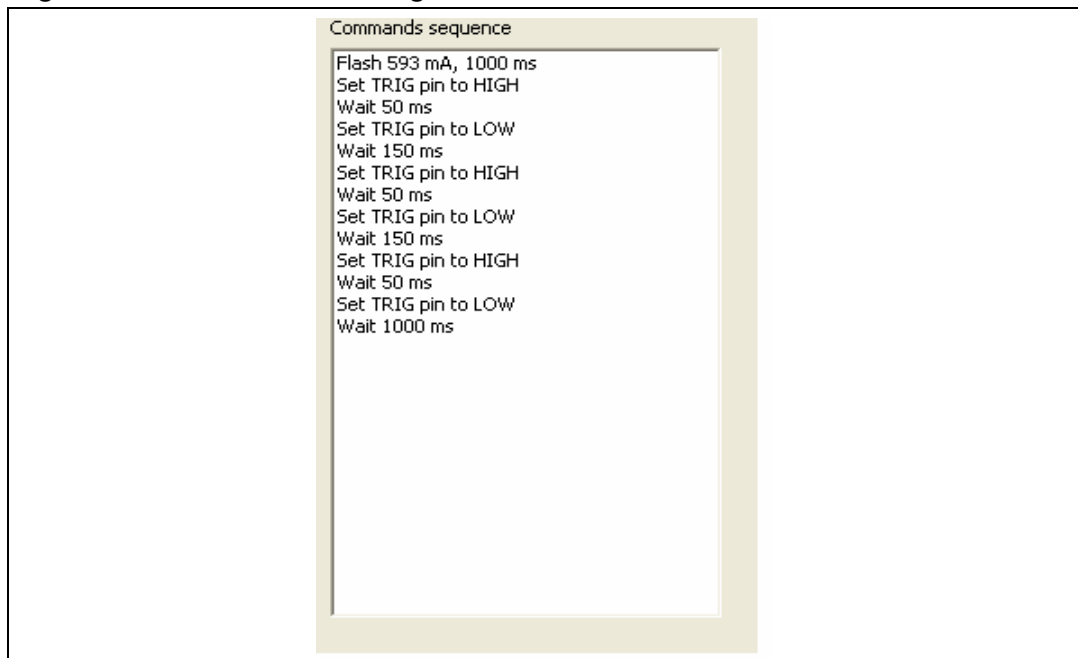
### 3.1.3 Management of flash mode, torch mode and auxiliary LED mode in the Packet\_creator GUI

The Packet\_creator GUI can demonstrate all the glow features of the STCF03. The different modes demonstrated are:

- Flash mode - Perform the following steps to run flash mode:
  - Insert the flash command by pressing the "add/insert flash" button on the GUI. Flash time and flash current should be configured beforehand.
  - Set the trigger pin to high by pressing the "Add/Insert Set TRIG HIGH" button on the GUI.
  - Insert the flash delay by pressing the "Add/Insert Wait time" button on the GUI. The delay is configured by typing a value in the wait time edit window. The time unit is milliseconds.
  - Set the trigger pin to low to switch off the flash by pressing the "Add/Insert Set TRIG LOW" button on the GUI.
  - After the sequence is complete, press the "Run sequence" button on the GUI.

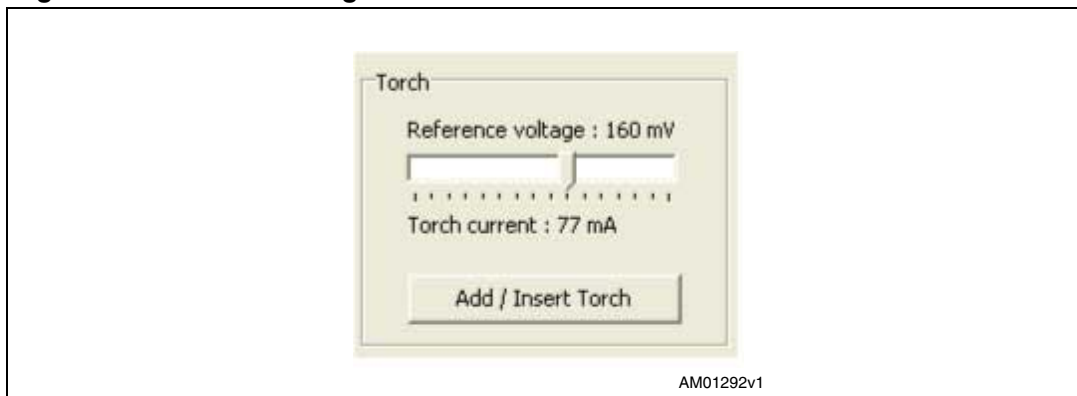
Flash mode can be observed by setting the trigger high and low a multiple number of times. Refer to the DEMO 2.seq example for flash mode. [Figure 9](#) shows the commands necessary to achieve 3 flashes of 50 ms each with a 150 ms delay between each flash, and a pause of 1 second after each 3<sup>rd</sup> flash.

**Figure 9. Commands showing the flash**

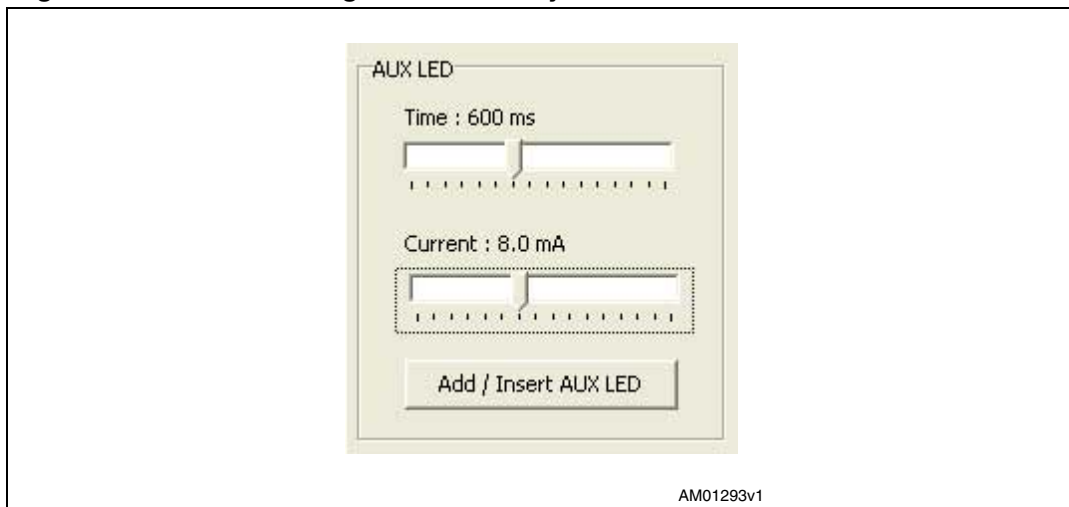


- Torch mode - to observe this mode, perform the following steps:
  - Configure the torch mode current by moving the slider in the torch area of the GUI (refer to [Figure 10](#)).
  - Insert the torch mode command by pressing the "Add/Insert torch" button on the GUI.
  - Press the "Run sequence" button on the GUI to see the torch LED on the board turn on.
  - This torch lasts for 2 seconds, then goes off automatically.
  - To abort the torch before the process is complete, press the "STOP" button on GUI.

**Figure 10. Slider to configure torch**



- Auxiliary LED mode - the functionality of the red auxiliary LED on the daughterboard can be configured through the GUI. The steps required to observe the auxiliary LED mode of the STCF03 are as follows:
  1. Configure the auxiliary LED time and current through the GUI (current and time should not be zero). See [Figure 11](#).
  2. Insert the auxiliary LED command by pressing the "Add/Insert AUX LED" button on the GUI.
  3. Press the "Run sequence" button on the GUI to observe the auxiliary LED on the board. The glow duration of the LED is equal to the time configured using the time slider in the "AUX LED" section.

**Figure 11. Slider to configure the auxiliary LED**

Any running sequence (flash/torch/auxiliary LED) can be aborted by pressing the STOP button on the GUI.

Also, users can create their own sequences by inserting different combinations of flash, torch and auxiliary LED.

When creating custom sequences, keep in mind these things.

- When the STCF03 uses its internal timer, the microcontroller must wait. Therefore, do not forget to use WAIT after the flash and the aux LED initialization
- When initializing a flash, do not forget to set the TRIG pin to HIGH
- “Add/insert ready” and “add/insert shutdown” takes the STF03 into a “ready” and “shutdown” state, respectively

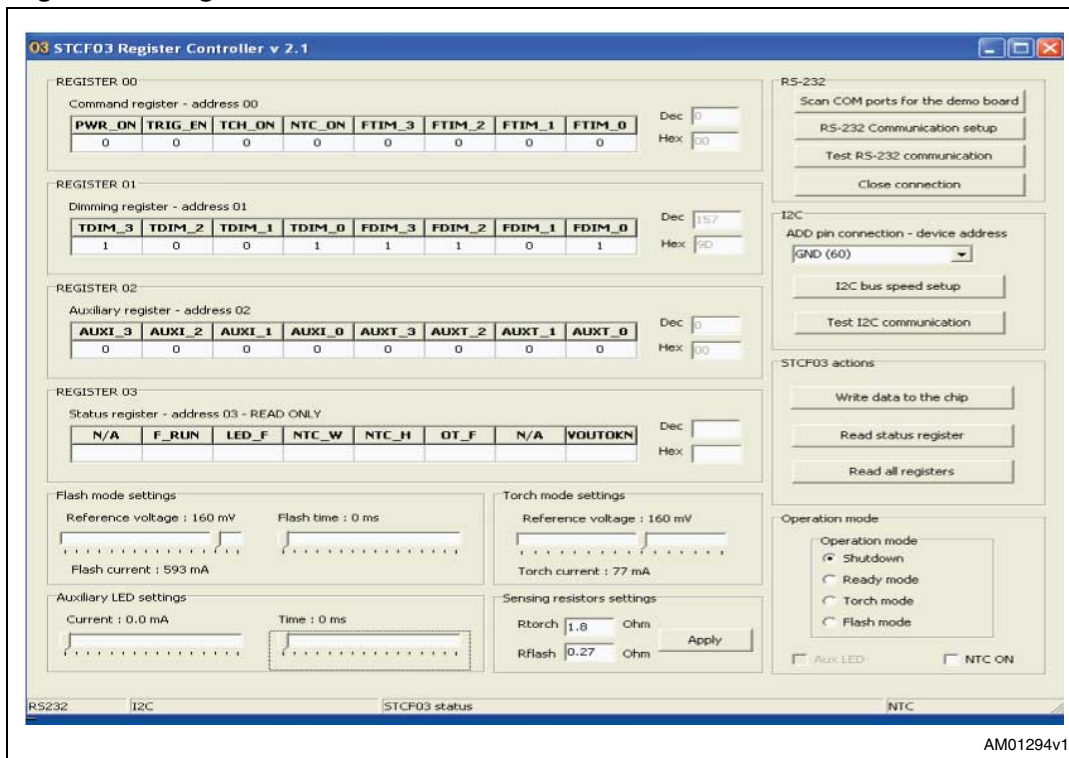
### 3.1.4 Using Register\_Controller.EXE

Run the Register\_Controller.EXE. The main window of the application is shown in [Figure 12](#). The GUI shows the bits of the different configuration registers (Command/Dimming/Auxiliary/Status registers).

Follow the steps below to run the board using Register\_Controller:

1. Press the "Scan COM ports for the demo board" button. The program automatically detects to which port the demonstration board is connected, or the port can be set up manually by pressing the "RS-232 Communication setup" button. To ensure proper functioning, no other communication parameters should be changed.
2. RS-232 communication can be tested by pressing the "Test RS-232 communication" button.
3. The ADD pin connection must be set to GND in order for the I<sup>2</sup>C device address to be correct.
4. I<sup>2</sup>C bus communication can be tested by pressing the "Test I<sup>2</sup>C communication" button. This button makes the auxiliary LED (red) glow on daughterboard.
5. Users can now configure the board in any of the allowed modes (flash/torch/Auxiliary mode) to run the application.

Figure 12. Register controller Window

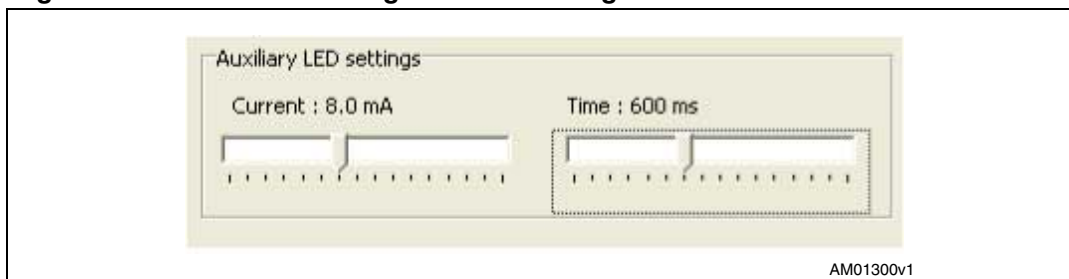


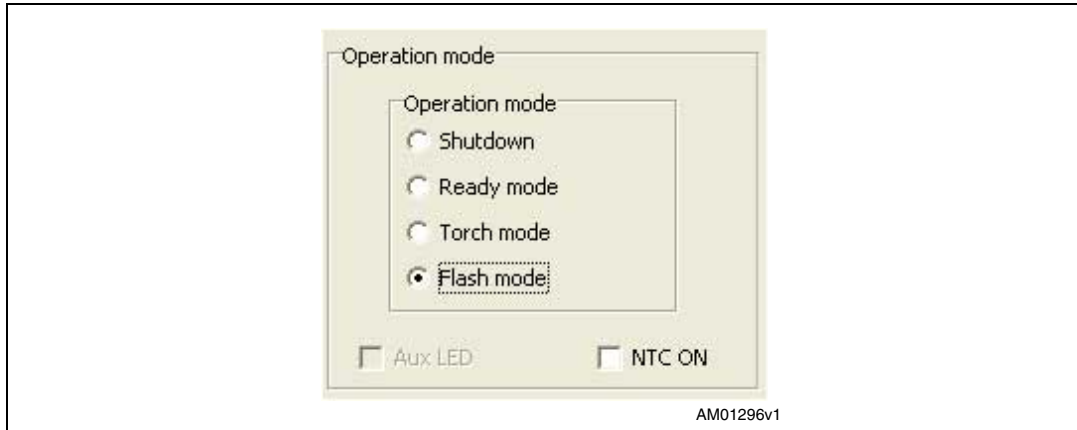
### 3.1.5 Handling of flash mode, torch mode and auxiliary LED mode in the register\_controller GUI

Four different modes are configurable through the Register\_Controller GUI:

- Flash mode - This mode demonstrates the flash of the white power LED on the board. To configure flash mode, perform the following steps:
  - Adjust the reference voltage using the slider bar. The corresponding value of the flash LED current is calculated immediately and displayed below the track bar, as shown in [Figure 13](#).
  - Adjust the desired flash time.
  - Select the "Flash mode" radio button in the "Operation mode" panel (see [Figure 14](#)).
  - Click on the "Write data to the chip" button.

Figure 13. Flash mode configuration in the register controller GUI



**Figure 14. Flash operation mode selection in the register controller GUI**

If all the settings are done correctly and the communication is working well, the LED flashes. If there is an error in communication, the user is informed of the type of error that has occurred.

- Torch mode - This mode demonstrates the continuous glow control of the STCF03. Perform the following steps to configure torch mode:
  - Adjust the reference voltage using the track bar. The corresponding value of the LED current is calculated immediately and displayed below the track bar, as illustrated in [Figure 15](#).
  - Click on "Torch mode" in the "Operation mode" panel (see [Figure 16](#))
  - Click on the "Write data to the chip" button.

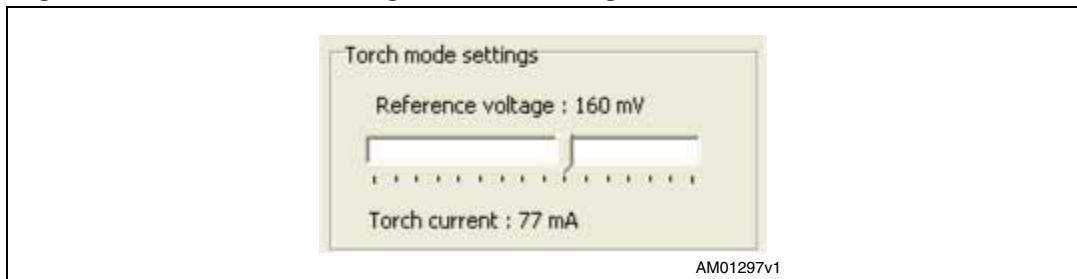
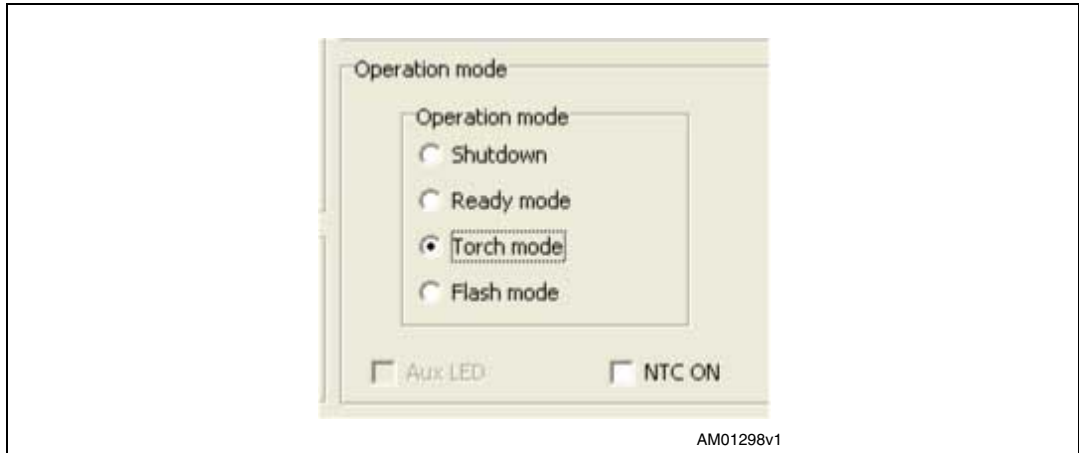
**Figure 15. Torch mode configuration in the register controller GUI**

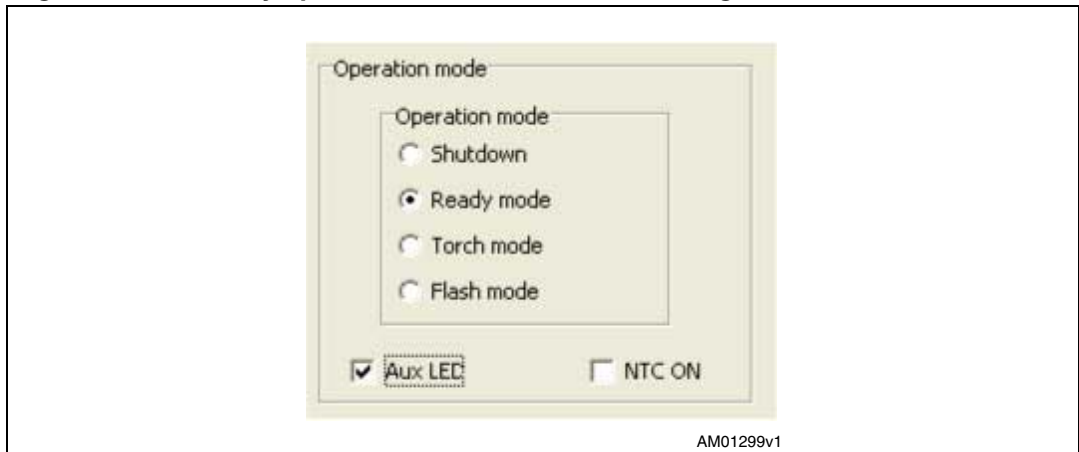


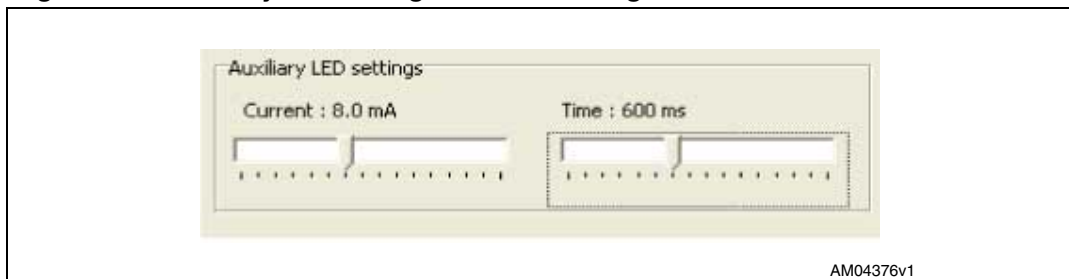
Figure 16. Torch operation mode selection in the register controller GUI



- Auxiliary LED mode - this mode shows the auxiliary LED control feature of the STCF03. To configure auxiliary LED control, perform the following steps:
  - Go to ready mode. The "Aux LED" checkbox becomes enabled.
  - Check the "Aux LED" checkbox, as shown in [Figure 17](#).
  - Adjust the current value.
  - Adjust the timer (see [Figure 18](#)).
  - Click on the "Write data to the chip" button.

Figure 17. Auxiliary operation mode selection in the register controller GUI



**Figure 18. Auxiliary LED configuration in the register controller GUI**

- Register read mode  
The status register value can be read at any time by pressing the "Read status register" button. The status register value is also read automatically by the MCU on every falling edge on the ATN pin. The value read is automatically sent to the PC. If the STCF03 is in shutdown mode, the value read is always 0. All register values can be read by pressing the "Read all registers" button.

*Note:* To use both data packet creator and register controller at the same time, press the "Close connection" button before switching to the other application.

## 3.2 Standalone mode

There are 2 buttons on the motherboard, S1 and S2, which can be used to run the demonstration board in standalone mode. In this case the user need not connect the board to the GUI for running the application (however, the functionality desired when the switches are pressed must be configured through GUI the first time).

### 3.2.1 Configuring the switches (S1 and S2)

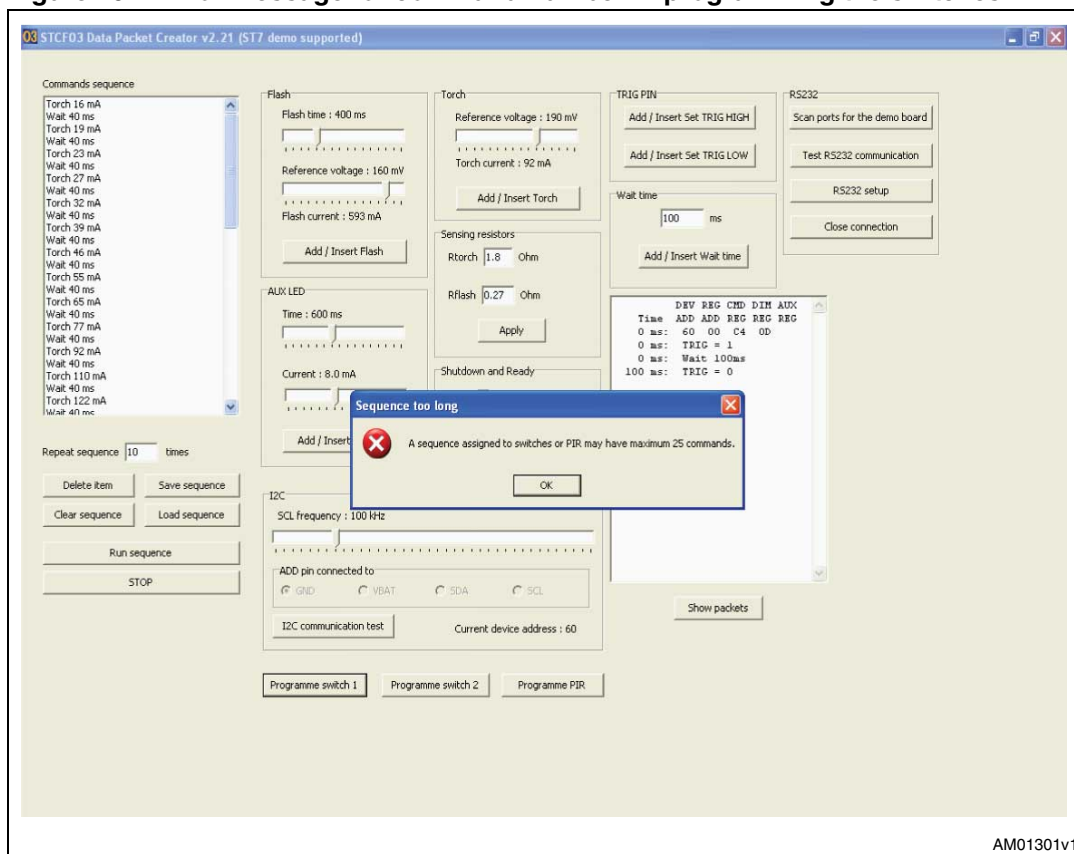
Follow the below steps below to configure the switches:

- Connect the board to the Packet\_creator GUI (refer to [Section 3.1.1](#)).
- Enter the required sequence in the command sequence area.
- Press the "Programme switch 1" button to configure switch 1 and "Programme switch 2" button to configure switch 2 with the functionality given in the command sequence area.
- Similarly, the sequence can be programmed for PIR functionality by pressing the "Programme PIR" button.
- At this point, all the switches are configured and pressing any switch on the board performs the programmed sequence.

*Note:* The number of commands that can be entered when programming the switches is limited to 25. Entering more than 25 commands in the command sequence produces an error message on the GUI (see [Figure 20](#)).

A PIR sensor is not mounted on the board. If a PIR sensor is installed, the jumper J3 must be set to enable PIR. With a PIR sensor installed and the J3 jumper correctly set, any motion detected by the PIR results in execution of the sequence programmed for the "Programme PIR" button.

Figure 19. Error message for command number in programming the switches



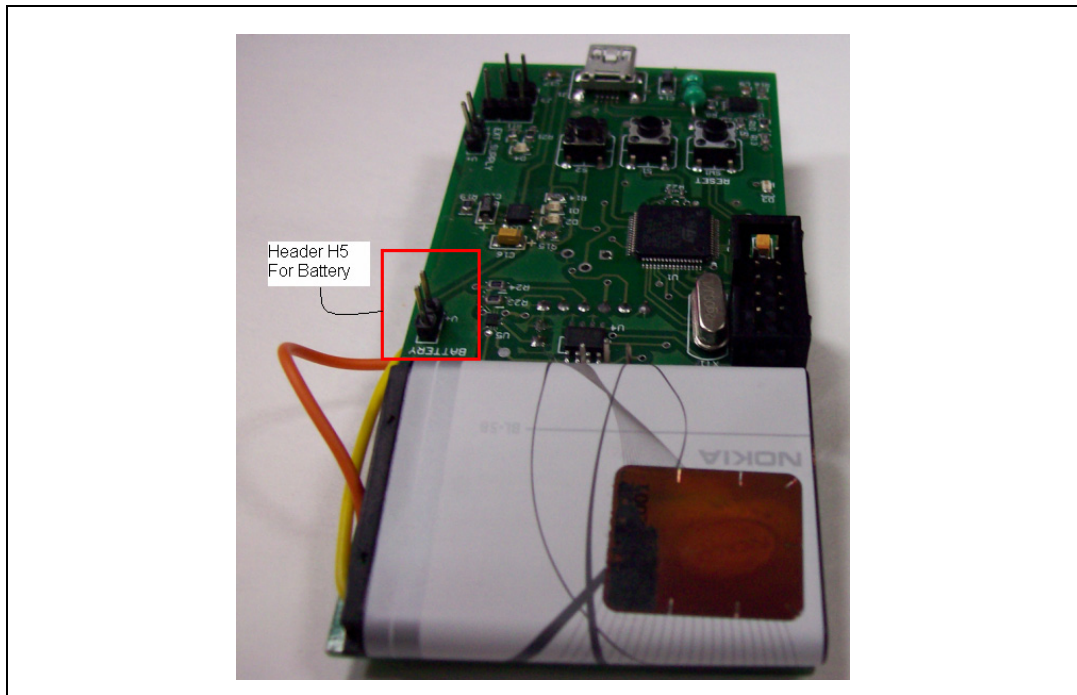
### 3.2.2 Running in standalone mode

- Program the switches as described in [Section 3.2.1](#).
- Disconnect the board from the GUI.
- Connect power to the board either through an external supply or using batteries.
- Press the buttons and observe the glow sequence on the daughterboard.

### 3.3 Battery charging

This system is tested with a Nokia BL-5B Li-Ion battery. There is a USB battery charger present on the board, so when the board is connected to a computer through a USB cable, the battery begins charging automatically. During battery charging, both the D1 and D2 LEDs are on. When charging is complete, the D1 LED goes off.

Batteries should be connected to header H5, ensuring that the batteries are installed observing the correct polarity of the positive and negative terminals ([Figure 20](#)).

**Figure 20. Battery connections**

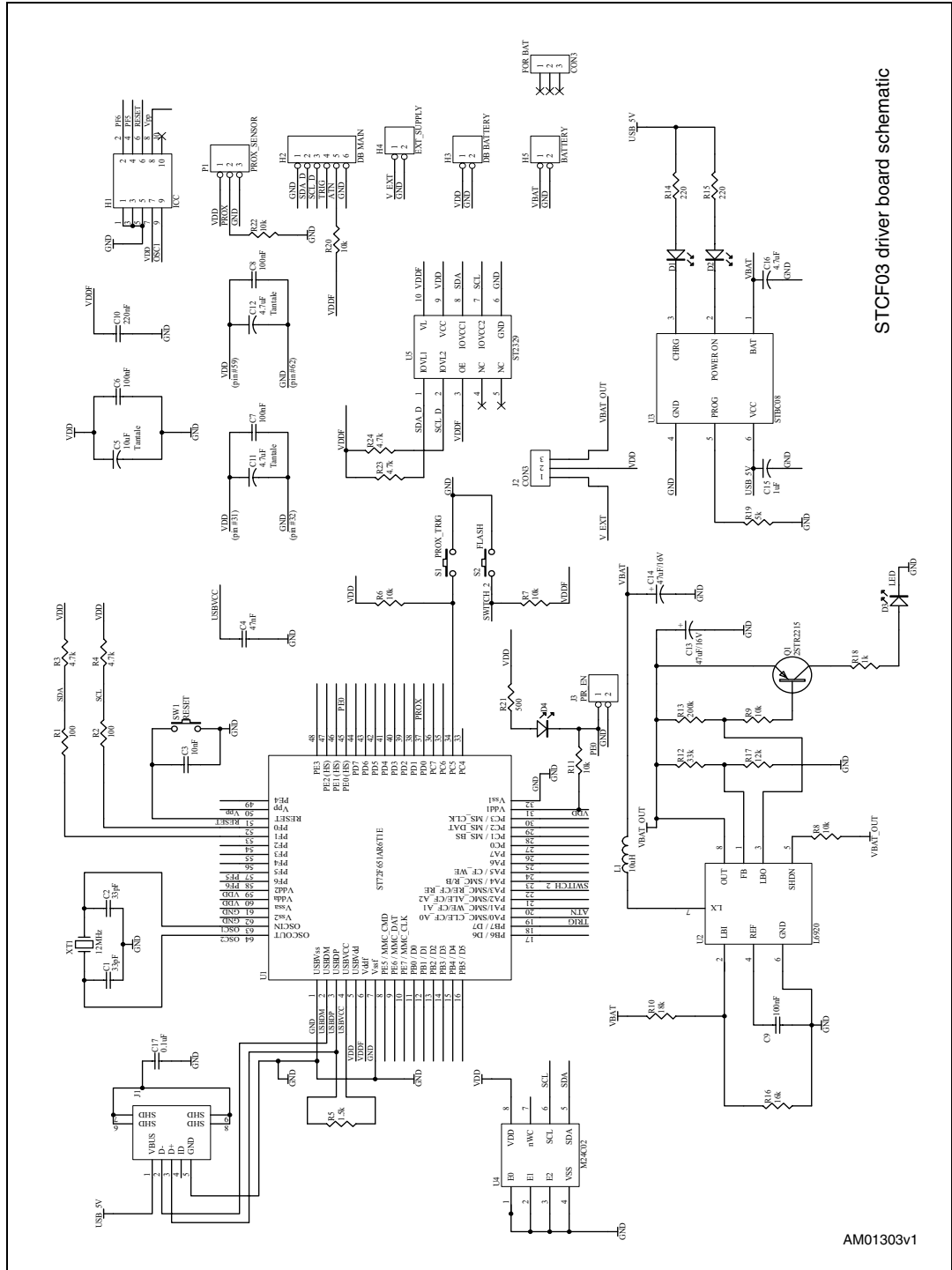
### 3.4 Programming of the STEVAL-TLL005V1 using ICC

The board is equipped with an ICC connector, so if a future microcontroller code change is required, the new code can be easily programmed. The board can be programmed using the INDART programmer.

# Appendix A Schematic diagram

## 3.5 STEVAL-TLL005V1 schematic diagram

Figure 21. Circuit schematic of the STEVAL-TLL005V1



## Appendix B Bill of material

**Table 1. STEVAL-TLL005V1 demonstration board bill of material**

Item	Qty	Designator	Part type	Footprint	Description
1	1	U1	ST72F651AR6T1E	TQFP64	Microcontroller
2	1	U2	L6920D	TSSOP8	Step-up converter
3	1	U3	STBC08PMR	DFN6	Battery charger
4	1	U4	M24C02-WMN	S08	EEPROM
5	1	U5	ST2329QTR	QFN10	Voltage translator
6	1	Q1	2STR2215	SOT-23	PNP transistor
7	2	R1,R2	100 k $\Omega$	805	Resistor
8	2	R14,R15	200 k $\Omega$	805	Resistor
9	1	R21	500 k $\Omega$	805	Resistor
10	1	R18	1 k $\Omega$	805	Resistor
11	1	R5	1.5 k $\Omega$	805	Resistor
12	4	R3,R4,R23,R24	4.7 k $\Omega$	805	Resistor
13	1	R19	5 k $\Omega$	805	Resistor
14	7	R6,R7,R8,R9, R11,R20,R22	10 k $\Omega$	805	Resistor
15	1	R17	12 k $\Omega$	805	Resistor
16	1	R16	16 k $\Omega$	805	Resistor
17	1	R10	18 k $\Omega$	805	Resistor
18	1	R12	33 k $\Omega$	805	Resistor
19	1	R13	200 k $\Omega$	805	Resistor
20	1	C17	0.1 $\mu$ F	805	Capacitor
21	1	C15	1 $\mu$ F	805	Capacitor
22	3	C11,C12,C16	4.7 $\mu$ F	805	Capacitor
23	1	C3	10 nf	805	Capacitor
24	1	C5	10 $\mu$ F	805	Capacitor
25	2	C1,C2	33 pf	805	Capacitor
26	1	C4	47 nf	805	Capacitor
27	2	C13,C14	47 uF/16 V	C1206	Capacitor
28	4	C6,C7,C8,C9	100 nF	805	Capacitor
29	1	C10	200 nf	805	Capacitor
30	1	XT1	12 Mhz	Crystal	Crystal
31	3	H4,H5,J3	2 Pin berg strip	Berg strip	Berg strip

Table 1. STEVAL-TLL005V1 demonstration board bill of material (continued)

Item	Qty	Designator	Part type	Footprint	Description
32	1	J3	3 Pin berg strip	Berg strip	Berg strip
33	1	H2	6 Pin berg strip	Berg strip	Berg strip
34	1	H3	2 Pin berg strip	Berg strip	Berg strip
35	3	S1,S2,SW1	Pushbutton switch	4 pin pushbutton switch	Pushbutton switch
36	1	H1	2 x 5 box header	Box header	ICC connector
37	1	L1	10 $\mu$ H	Axial	Through hole inductor
38	4	D1,D2,D3,D4	RED LED	805	SMD LED
39	1	P1	PIR sensor	3 pin connector	Not mounted



## Revision history

**Table 2. Document revision history**

Date	Revision	Changes
08-Jun-2009	1	Initial release

**Please Read Carefully:**

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

**UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.**

**UNLESS EXPRESSLY APPROVED IN WRITING BY AN AUTHORIZED ST REPRESENTATIVE, ST PRODUCTS ARE NOT RECOMMENDED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. ST PRODUCTS WHICH ARE NOT SPECIFIED AS "AUTOMOTIVE GRADE" MAY ONLY BE USED IN AUTOMOTIVE APPLICATIONS AT USER'S OWN RISK.**

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2009 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Philippines - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

[www.st.com](http://www.st.com)