STM8L15LPBOARD
low-power demonstration board

Introduction

The STM8L15LPBOARD low-power demonstration board demonstrates all the STM8L15x low-power modes, and permits the user to take consumption measurements in all modes.
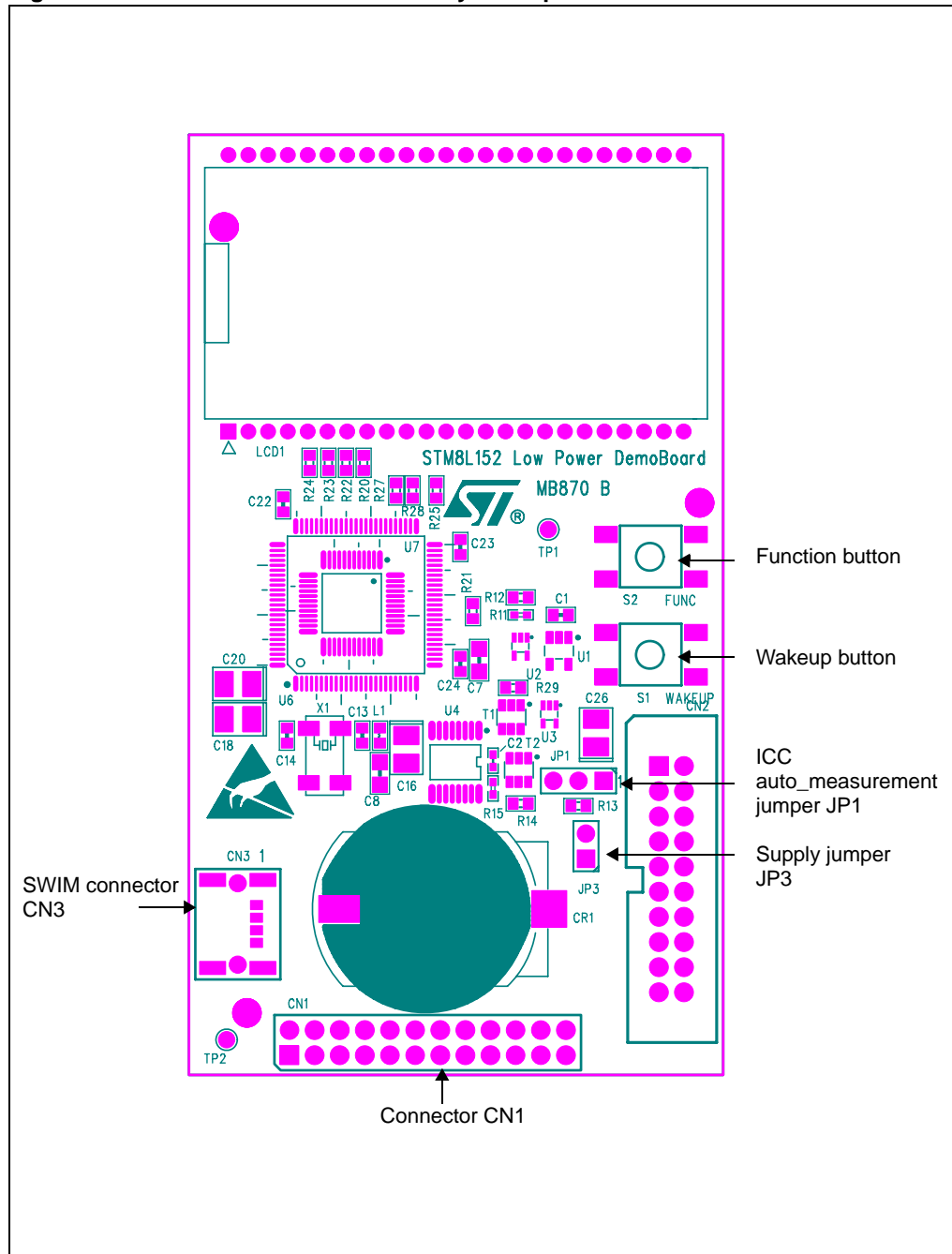
Features

■ SWIM debug support

■ MCU consumption auto-measurement circuit

■ Function and wakeup buttons

■ 32.768 kHz quartz

■ MCU pins connector

Figure 1.   The STM8L15LPBOARD

1   Hardware layout

Figure 2.   STM8L15LPBOARD board layout: top view

**Figure 3.   STM8L15LPBOARD board layout: bottom view**

2 Overview

2.1 Power supply (JP1, JP3)

The STM8L15LPBOARD is powered by a lithium battery CR2032 when jumper JP3 is closed.

Depending on the JP1 position, the MCU consumption auto-measurement circuit can be used.

Table 1.   JP1 setting

JP1 position	Description
1 2 3	VDD power is directly connected to MCU VDD when JP1 is set as shown to the left (default setting). Note: For manual IDD measurement the JP1 jumper must be removed and replaced by an ammeter connected between pin 1 and 2 of JP1.
1 2 3	Connect VDD power to MCU with current-sampling resistor (2 ohm or 2 Kohm) in series for current measurement when JP1 is set as shown to the left.

2.2 LCD glass (R26, C12)

The STM8L15LPBOARD drives a 4-mux LCD glass SBLCDA2. The LCD voltage reference VLCD is shorted to VDD with a 0 ohm resistor (R26).

The internal LCD voltage reference embedded in the STM8L15LPBOARD can be used when R26 is removed. R26 is located on the bottom side of the board.

A I µF capacitor C12 is connected to VLCD for internal booster usage.

2.3 SWIM connector (CN3)

A SWIM connector CN3 is available for programming and debugging.

2.4 Buttons (PC0, PC1)

Two buttons with wakeup interrupt capability are available.

FUNCTION: PC0

WAKEUP: PC1

2.5 External quartz (PC5, PC6)

A 32.768 kHz quartz is connected to LSE pins PC5 and PC6. It can be used either as the RTC clock, or to run the CPU.

2.6 I/O access connector (CN1)

The CN1 connector provides access to VDD, GND, RESET and 8 STM8L15LPBOARD I/Os.

The table below gives the CN1 I/O pIn connections.

Table 2. I/O connections

Pin	I/O
1	VDD
2	PA1-RESET
3	PD6
4	PD7
5	PC2
6	PC3
7	PC4
8	PC7
9	PE6
10	PE7
11-22	NC
23	GND
24	NC

2.7 MCU consumption auto-measurement circuit (JP1)

For IDD measurement the circuit below is implemented on the STM8L15LPBOARD. This circuit requires jumper JP1 to be connected between pins 2 and 3.

Figure 4.   IDD measurement circuit

Table 3.   IDD measurement circuit pinout

Signal	Pin
ICC_Measurement	PF0
ICC_WAKEUP (on rising edge)	PA3
ICC_CNT_EN (active low)	PA2

In Run mode, IDD current is measured by MAX9938FEUK+ (U1) connected to the 2 ohm shunt resistor. In this case ICC_CNT_EN remains high during measurement.

In Halt mode, the operational amplifier MAX9938FEUK+ (U1) is connected to the 2 Kohm shunt resistor. To measure a current corresponding to the Halt mode the procedure is:

1.   Configure ADC to measure voltage on the ICC_measurement pin.

2.   Configure ICC_WAKEUP as interrupt input on rising edge.

3.   Enter in Halt or Active Halt mode with ICC_CNT_EN low.

4.   ICC_WAKEUP rising edge wakeup the MCU after 300 ms.

5.   start ADC conversion as soon as possible after wakeup in order to measure the voltage corresponding to Halt mode on 1 uF capacitor C1.

6.   Reset the counter by programming ICC_CNT_EN High to avoid 2 Kohm to be connected later on VDD_MCU.

In Halt mode, the 2 K resistor is connected when T3 goes off after entering Halt mode. The Q12 counter output allows connection of the 2 K resistor when the current ICC becomes very low.

The Halt mode measurement procedure can be used in Low power modes if the IDD current does not exceed 12 uA; otherwise the Run measurement procedure must be used up to 12 mA.

3 Demonstration

The jumper JP1 must be in the required position before launching the demo:

● if automatic consumption measurement is not used, JP1 must be between pins 1 and 2,

● if automatic consumption measurement is used, JP1 must be between pins 2 and 3.

The Wakeup button is used:

● to exit each mode and go to the next mode proposal,

● to answer "no" to a question, and so go on to the next one.

The Function button is used:

● for specific functions as described below,

● to answer "yes" to the questions and chose the modes.

3.1 Select power modes

After power-on, 2 main demonstration modes are proposed through the LCD screen.

● Demonstration mode with auto-measurement circuit (press Function to see the consumption measurement result in each mode).

● Demonstration mode with manual consumption measurement.

1. The first question on the LCD screen is: "AUTO" for auto-measurement circuit?
   a) If Wakeup is pressed, the auto-measurement circuit is not used.
   b) If Function is pressed, this mode is chosen. In AUTO IDD mode, the MCU consumption is displayed in each chosen mode.

2. The next question is: "RTC": do you want to initialize the Real Time Clock?
   a) If Wakeup is pressed, RTC is not initialized.
   b) If Function is pressed, the RTC initialization procedure will start. The RTC initialization procedure sets the time: Start with "SEC": press Function until you reach the good value for the seconds, then press Wakeup to go to next. Then do the same for "MIN" and "HOUR".

3. The next questions are for the power mode choice:
   a) Press Function to enter the proposed mode.
   b) Press Wakeup to go to the next mode proposal.

If the Wakeup button is pressed after a mode has been selected, the MCU is woken-up and the next power mode selection is proposed.

To go back to the first steps of the procedure, a power-on is necessary.

3.2 Mode details

Table 4.   Modes

Mode	Description
Mode 1	Run mode at 16 MHz, execution from Flash, display battery voltage on LCD. Press Function button to toggle between battery voltage display and time display.
Mode 2	Wait for Interrupt at 16 MHz, a message is displayed on the LCD.
Mode 3	Low-power Run.
Mode 4	Low-power Wait.
Mode 5	Active-halt with LCD, a message is displayed on the LCD.
Mode 6	Active-halt without LCD.
Mode 7	Halt (no RTC nor LCD). Rev 2: in this mode the RTC is disabled. Power-on is necessary if you wish to initialize the RTC again.

4   Revision history

Table 5.   Document revision history

Date	Revision	Changes
04-Sep-2009	1	Initial release.
18-Sep-2009	2	*Section 2.7* Q13 changed to Q12, 100 ms changed to 300 ms. *Chapter 3* : removed sentence "After 1 minute with no action, the STM8L15LPBOARD goes into Halt mode automatically". *Section 3.2* : mode 5 description modified.

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.

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