UM0756
User manual

STEVAL-ICB003V1 front panel demonstration board based on the STLED316S and the STMPE1208S

Introduction

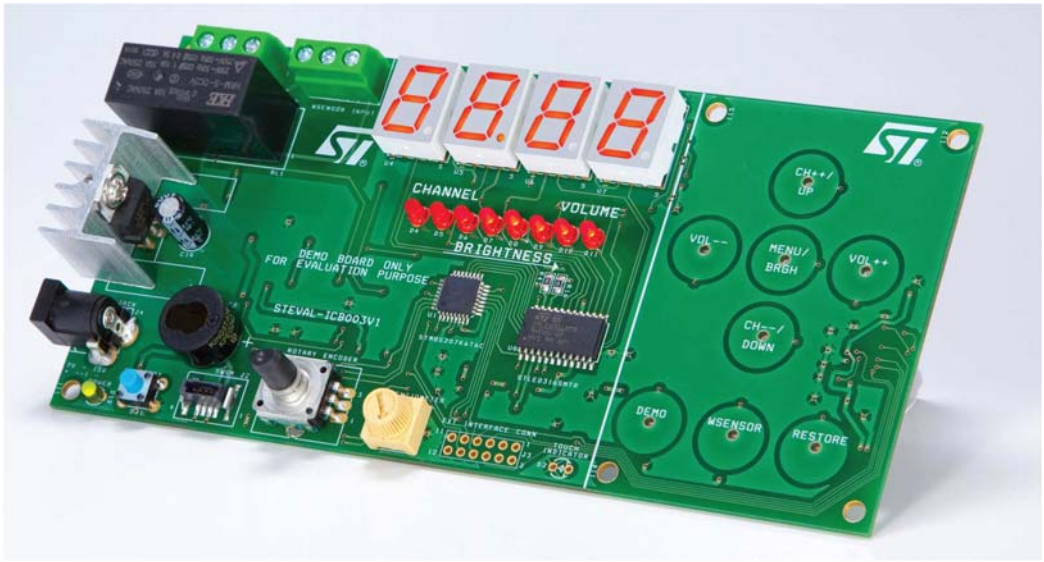
This document explains the functioning of the STEVAL-ICB003V1 demonstration board, which represents a general purpose front panel solution utilizing an STLED316S LED driver, STMPE1208S capacitive touch sensor and an STM8 series microcontroller (STM8S207K6). The basic idea is to develop a generic front panel for white goods in general. Some features such as quadrature rotary encoder interface, power management feature and a logic level input for water level sensor have also been provided to increase versatility.

The objective of this demonstration board is to display the capabilities of STLED316S and STMPE1208S for a sophisticated front panel to address the market segment of front panels for DVD players, DVD recorders, set-top boxes, washing machines and many more, while keeping system cost as low as possible. The system design focuses on 3 key areas - standby management for low power consumption, general touch key as well as rotary encoder input and a water level sensing which accepts a 38 - 43 kHz output from a water level sensor.

All user I/O is handled by the STLED316S inputs only, with little MCU overhead. For example, rotary encoder, buzzer and water level sensor inputs are handled by the STLED316S only, without consuming MCU resources.

In the sections that follow, the operation of the system is explained. Once the board is connected to the power supply, the system is ready to perform operations.

Figure 1. STEVAL-ICB003V1 front panel demonstration board



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1 Features

The key features of the STEVAL-ICB003V1 demonstration board are:

- 4 seven-segment LED displays
- 8 touch keys
- 8 x 3-mm LEDs
- 1 bi-color LED for on/standby indication
- 1 interrupt assert LED
- On-board buzzer
- Rotary encoder for up/down functions
- Standby management for low power operation
- Relay for switching host power
- Power supply connector for single 9 V supply
- Wakeup feature from system standby
- Embedded in-circuit programming capability through SWIM interface
- Water level sensor input, for 38-43 kHz water sensors

2 Getting started

2.1 System requirements

The system operates in standalone mode with a single (9 V - 15 V) DC supply. For power supply connection, refer to *Section 2.3*.

2.2 Package content

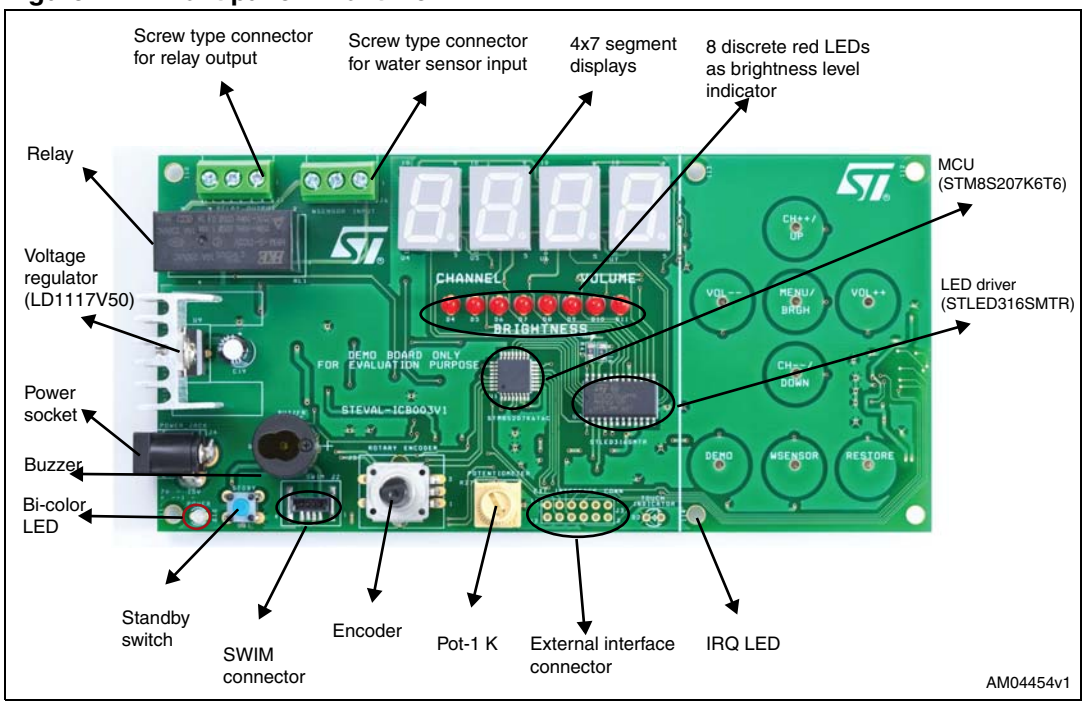
The demonstration board package includes:

- Hardware
  - One demonstration board
- Documentation
  - User manual

2.3 Hardware installation

The demonstration board can be powered through an external power supply having a (9 V - 15 V) output, typically.

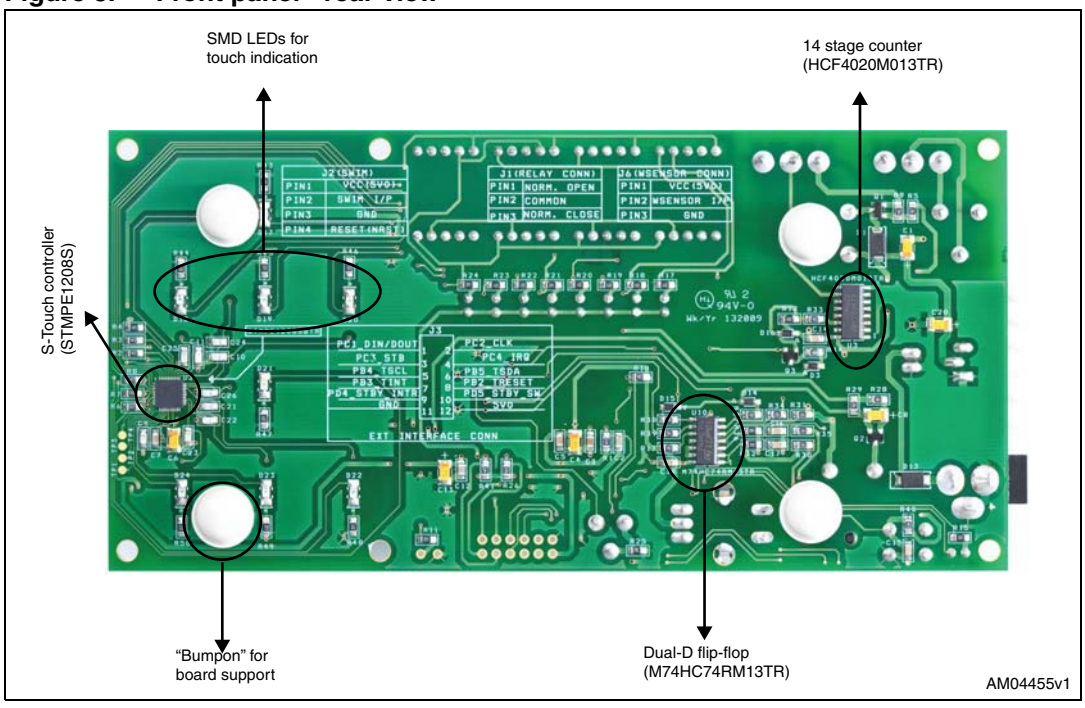
Figure 2. Front panel - front view



The major components present on the front of the board are (see *Figure 2*):

- Microcontroller - STM8S207K6T6
- LED driver - STLED316S
- LED display - 4 seven-segment digits
- On-board fabricated touch keypad containing 8 touch keys
- Relay
- Potentiometer
- Rotary encoder
- 5 mm pitch screw-type connector for the relay interface
- 5 mm pitch screw-type connector for water sensor input
- LED as touch indicator
- Standby switch
- Bicolor LED as power-LED
- Buzzer
- External interface jumper
- SWIM connector
- Power connector

Figure 3. Front panel - rear view



The major components present on the back of the board are (see *Figure 3*):

- Touch key controller - STMPE1208S
- 14 stage counter - HCF4020
- Dual D flip-flop - M74HC74
- SMD LEDs as touch indicators

2.4 Powering on the system

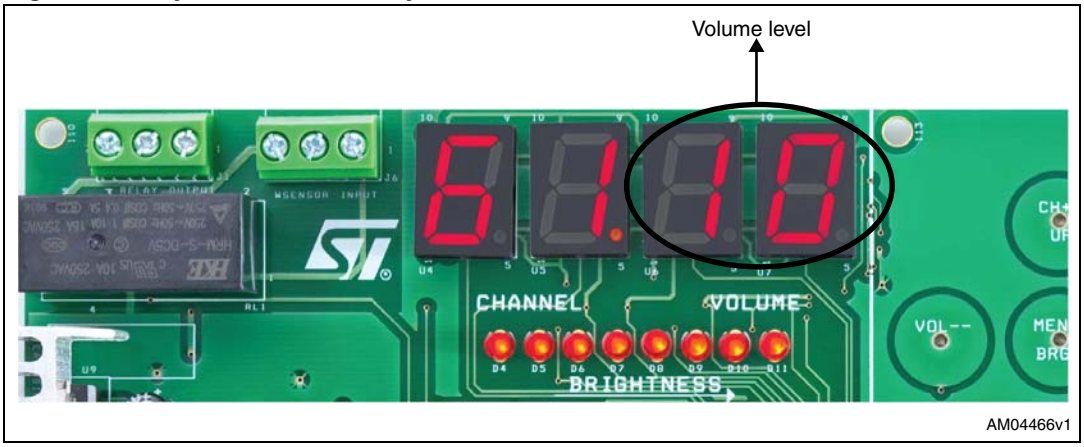
The system is easy to use. As soon as the DC power supply is connected, the system is running. The power supply connections should be made as shown in *Figure 4*.

Figure 4. Power supply connections

At power-on a welcome message "STLED316S" is displayed, which scrolls across the LED display from right to left.

After approximately 4-5 seconds, the last set of channel, volume and brightness values are displayed.

Figure 5. System stable, ready to use



2.5 Default setting of the system

The system is programmed with the following default settings:

- Channel = minimum (00)
- Volume = minimum (00)
- Brightness = maximum, which is level 8 (14/16)

3 System operation modes

The system operates in various modes depending on user actions:

3.1 Normal mode

The system operates in normal mode in normal working conditions. In this mode, the user can increase or decrease the volume level or channel number using the touch keys or the rotary encoder.

The user can also see the water level by touching the corresponding key. Additionally, the user can reset the various parameters to the default values by touching the restore key.

3.2 Brightness mode

In this mode, the user can increase or decrease the brightness of the LED display using the touch keys or the rotary encoder. The brightness level of the display is indicated by the number of glowing discrete LEDs.

If the system is in normal mode, the user can enter brightness mode by touching the menu/brgh key.

The system exits brightness mode after 5 seconds, or if any key other than CH++/UP or CH--/DOWN is touched.

3.3 Demo mode

In this mode, the system continues demonstrating the various types of brightness variance options possible with the STLED316S device.

The two different modes are:

- Constant brightness of all the digits of the STLED316S
- Variable brightness of all the digits of the STLED316S

The system exits the demo mode if any key is touched.

3.4 Standby mode

In this mode, the front panel is in low power mode and the power of the main host system is switched off using the on-board relay.

As the front panel is in low power mode, neither any key nor the rotary encoder operates when the system is in the standby mode.

The system can be put into standby mode by pressing the on-board STDBY switch. The system comes out of standby on pressing the STDBY switch again. (For details refer to *Section 4.3.2*)

4 Using the front panel board

4.1 Touch keys

There are 8 different touch keys on the front panel for various operations. Whenever a key is touched, a buzzer emits a beep and an LED blinks as an indication of the touch. The various keys and their descriptions are provided in the sections that follow.

4.1.1 VOL++

When the system is in normal mode, the user can increase the volume by one unit by touching the key labeled as VOL++. The volume continues to increase to its maximum value if the user does not release the key (*Figure 6*).

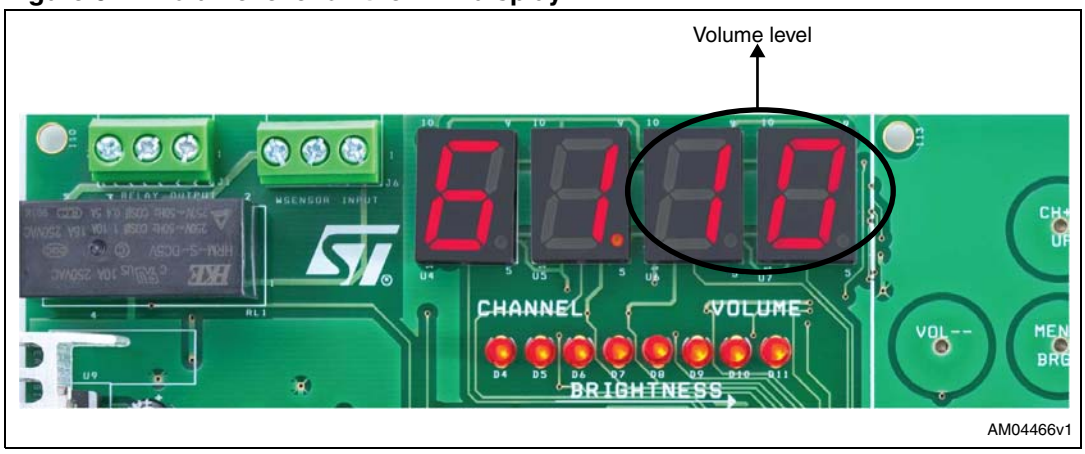
Note: The volume does not increase or roll back when it reaches its maximum value, which is 99.

4.1.2 VOL--

When the system is in normal mode, the user can decrease the volume by one unit by touching the key labeled as VOL--. The volume continues to decrease to its minimum value if the user does not release the key (*Figure 6*).

Note: The volume does not decrease or roll back when it reaches its minimum value, which is 00.

Figure 6. Volume level on the LED display



4.1.3 CH++/UP

When the system is in normal mode, on touching this key the channel number is increased by one unit. The channel number continues to increase to its maximum value if the user does not release the key.

When the system is in brightness mode, on touching this key the brightness of the display is increased by one unit. The brightness continues to increase to its maximum value if the user does not release the key (*Figure 7*).

Note: The channel number rolls back to the minimum value (00) when it reaches its maximum value, which is 99.

The brightness does not increase or roll back when it reaches its maximum value, which is level 8 or 14/16.

4.1.4 CH--/DOWN

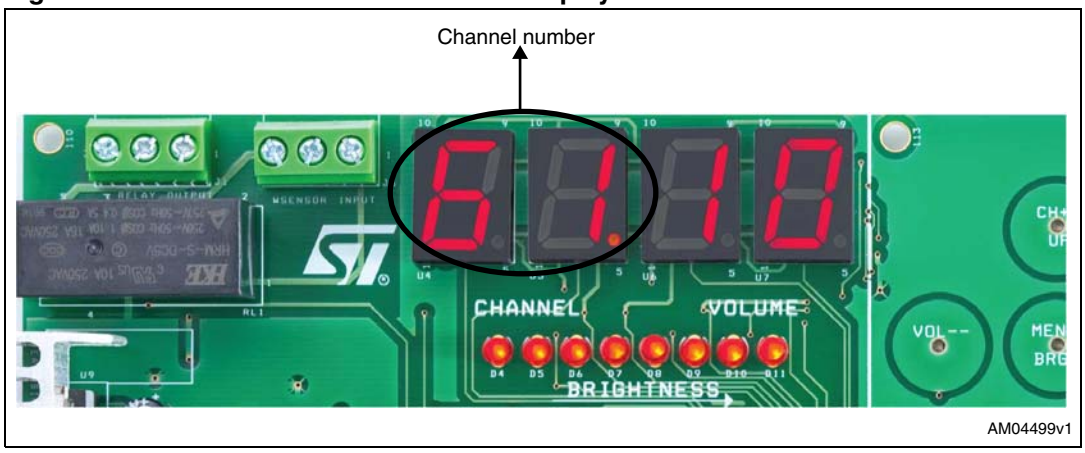
When the system is in normal mode, on touching this key the channel number is decreased by one unit. The channel number continues to decrease to its minimum value if the user does not release the key.

When the system is in brightness mode, on touching this key the brightness of the display is decreased by one unit. The brightness continues to decrease to its minimum value if the user does not release the key (*Figure 7*).

Note: The channel number rolls back to the maximum value (99) when it reaches its minimum value, which is 00.

The brightness does not decrease or roll back when it reaches its minimum value, which is level 1 or 1/16.

Figure 7. Channel number on the LED display

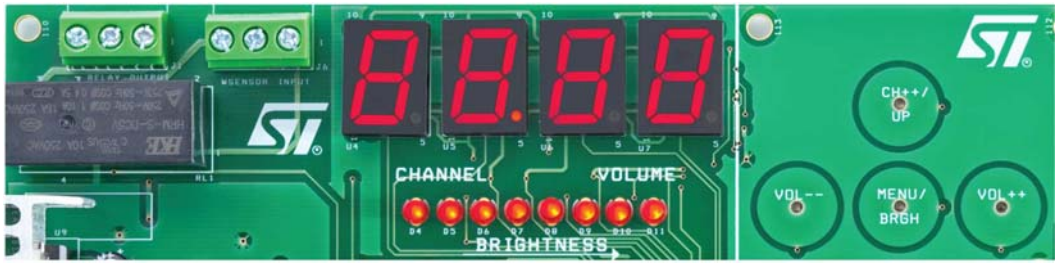


4.1.5 MENU/BRGH

This key is used to put the system into brightness mode. When this key is touched the system enters brightness mode and "8888" is displayed on the 7-segment LED display with the current brightness level.

The brightness of the display can be increased or decreased using the CH++/UP and CH--/DOWN touch keys. The brightness can also be varied using the rotary encoder (see *Section 4.2*). Discrete LEDs on the board represent the brightness level of the display (*Figure 8*).

Figure 8. Message display when the MENU/BRGH key is pressed



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4.1.6 Demo mode

This key is used to put the system into demo mode. In this mode the system demonstrates the capability of the STLED316S device to vary the brightness of the individual LED DIGIT output to a different brightness level.

In this mode, the system displays two messages in sequence:

- When message "8881" is displayed on the LED display, the LED digits glow with the same brightness (*Figure 9*).
- When message "8882" is displayed on the LED display, the LED digits glow with a different brightness (*Figure 10*).

Figure 9. Demo mode message: same brightness

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Figure 10. Demo mode message: different brightness

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The system remains in demo mode and messages are displayed in sequence until any other key is touched.

4.1.7 WSENSOR

The system has the capability to measure the output of the water level sensor to determine water level. When the WSENSOR key is touched, the present water level is displayed on the LED display (for details refer to *Section 4.3.1*).

The display is changed to the default display after 5 seconds.

4.1.8 RESTORE

When this key is touched the system restores the factory default values for volume, channel and brightness (see *Section 2.5*).

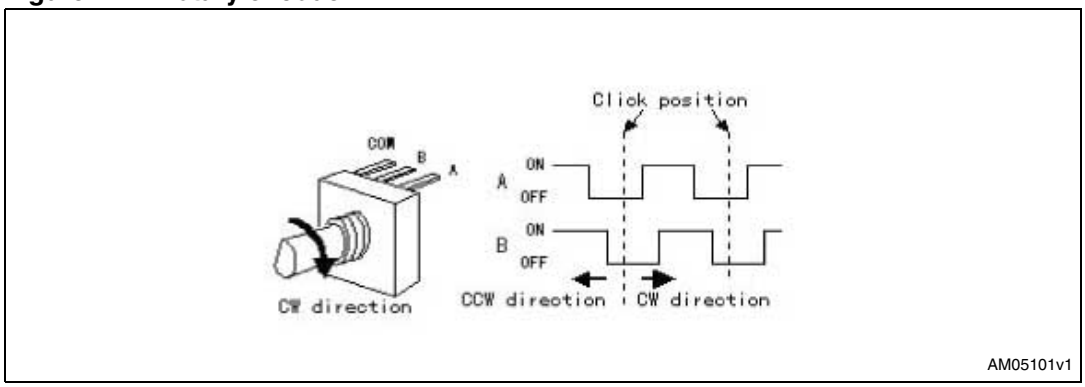
4.2 Rotary encoder

The system has a free-running rotary encoder on the board. This encoder can be used to increase/decrease the volume when the system is in the normal mode, or to increase/decrease the brightness of the LED display when the system is in brightness mode.

The encoder can be rotated clockwise or counter-clockwise to increase or decrease the system parameters.

The free-running rotary encoder can be given countless rotations in any direction. This encoder gives two square wave outputs which are phase-shifted from each other, and the type of phase shift gives an indication of the direction of rotation. The number of pulses in the square wave signal provides the number of rotations (*Figure 11*).

Figure 11. Rotary encoder



In this system, the output of the rotary encoder is given to a dual D flip-flop to stabilize and predefine the default level of the two signals. The output of the flip-flop is provided to the key inputs of the LED316S device (see schematic in *Section 6*). Depending on the rotation of the encoder the two key press interrupts follow the order.

Note: The decoding of the rotary encoder using the STLED316S device saves the extra I/O of the FP MCU, which would otherwise detect the sensor input.

Note: The decoding of the rotary encoder can be done in parallel with the normal working of the other keys, if these functions are included in the system. In the present system, the rotary encoder is decoded along with the water level measurement, which is also connected at the key inputs of the STLED316S device (see Section 4.3.1).

4.3 Additional features

4.3.1 Water sensor

The system has the capability to decode the output of the water level sensor. The output of the water level sensor is a square wave signal which varies based on the level of the water. The output signal variations are provided in table *Table 1*.

Table 1. Water sensor output values

Sr. no.	Water level	Square wave frequency
1	Lower than midpoint	38 kHz
2	At midpoint	40 kHz
3	Above midpoint	43 kHz

The output of the water level sensor can be sent to connector J6 (*Figure 2*) on the board, the details of which are as follows:

Table 2. Connection details for water sensor input to the front panel

Pin. no.	Input signal
1	5V0
2	Water sensor output
3	GND

The output of the water level sensor is divided by 1024 using a digital counter (a 14-stage counter is wired to a 10-bit counter) and is used to switch ON/OFF the transistor that is connected between the key and segment pins of the STLED316S device. When the transistor switches ON, the STLED316S device interprets this as a key press and interrupts the FP MCU. The MCU reads the STLED316S interrupt and the STLED316S device again prepares to take the other square wave input signal.

The system measures the square wave output signal every 3 seconds and processes the result to alert the system when the water level changes from the midpoint level.

When the water level changes from the midpoint level, the buzzer in the system starts producing an audible alarm (tic-tic-tic) until the water level again reaches the midpoint.

The user can see the current water level at any time by touching the WSENSOR key of the system. As per the level of the water, the various messages are displayed on the LED display (*Figure 12* and *13*, *Table 3*).

Table 3. Water level messages

Sr. no.	Water level	LED display - message
1	Lower than midpoint	-LO-
2	At midpoint	----

Table 3. Water level messages (continued)

Sr. no.	Water level	LED display - message
3	Above midpoint	-HI-
4	No input signal	III

Figure 12. Water level message: below midpoint

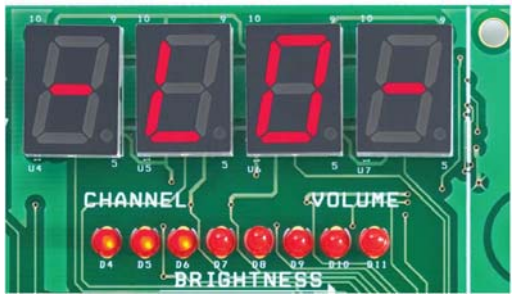


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Figure 13. Water level message: at midpoint

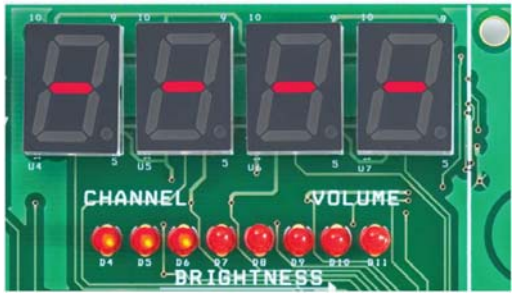

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Figure 14. Water level message: above midpoint

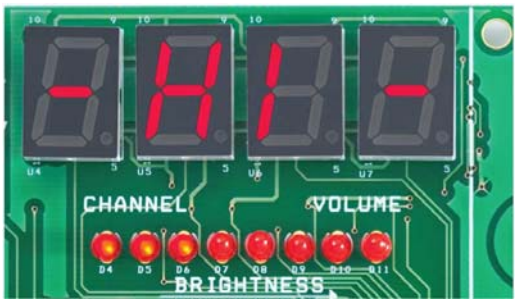

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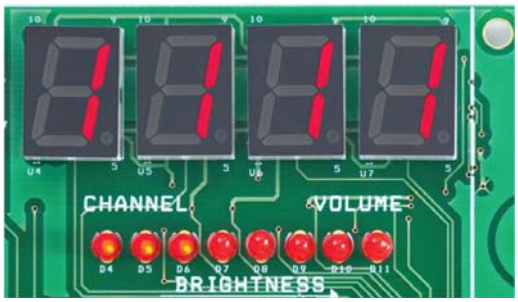
Figure 15. Water level message: no input signal



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The system by design has a margin of +/- 500 Hz at the midpoint level to compensate for the water level sensor accuracy. So if the square wave signal being input to the system is between 39.5 kHz and 40.5 kHz, the system will show it as the water level at the midpoint.

Also, if the input to the system is below 30 kHz, the system interprets this as no input provided to the system. This is to provide for a damaged water level sensor.

Note: The measurement of the water level sensor using the STLED316S device saves the extra I/O of the FP MCU, which would otherwise detect the sensor input.

Water level measurement can be done in parallel with the normal working of the other keys, if this function is included in the system. In the present system, water level is being

measured along with the rotary encoder which is also attached at the key inputs of the STLED316S device.

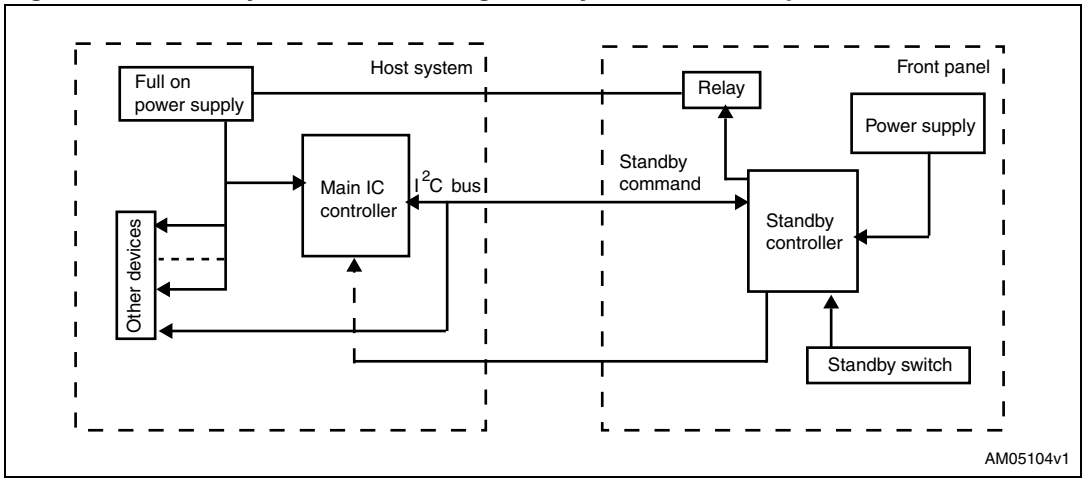
The system operates at 5 V, so the logic level of the water level signal should be within the range of 3.5 V - 5 V for high and 0 V - 1.5 V for low logic.

To use the water level sensor, a 1 kΩ resistor should be soldered on R33 of the STEVAL-ICB003V1 board. Without this, the system will not detect the water sensor level signal.

4.3.2 Standby

The system demonstrates a smart power management control system to control the power of other host systems in order to save the maximum amount of power during standby. The block diagram of the control system is as shown in *Figure 16*.

Figure 16. Standby mechanism using host system and front panel



The host system can be connected to the front panel using jumpers J1 and J3 (see *Table 4* and *5*).

Table 4. Connection of jumper J1

Pin. no.	Input signal	Function
1	Normally open	Normally open
2	Common	Common
3	Normally closed	Normally closed

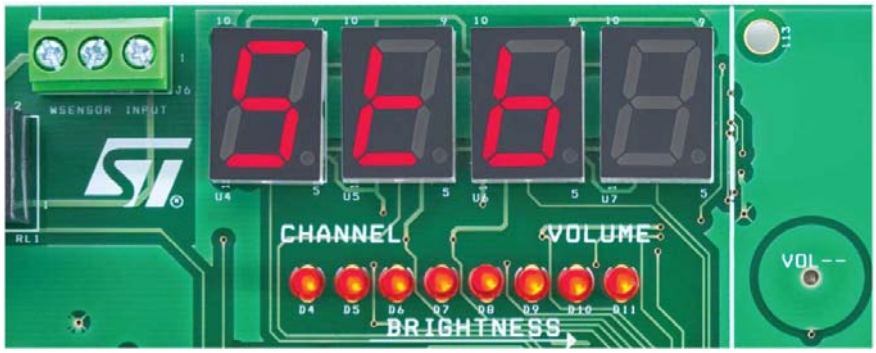
Table 5. Connection of jumper J3

Pin. no.	Input signal	Function
9	PD4_STBY_INTR	Interrupt from STEVAL-ICB003V1 to host controller indicating that STBY key has been pressed
11	GND	Ground reference of STEVAL-ICB003V1

For the signal from the pin PD4_STBY_INTR, the host should configure its pin as input floating with interrupt.

If the system is working normally and the standby switch is pressed, the system prepares to enter the standby and displays "Stb" on the LED display, and the power-LED glows red (*Figure 17*). The front panel indicates to the main host controller that the standby switch has been pressed and waits for the standby command from the host system.

Figure 17. Standby in progress



The host system should detect the signal from the front panel and within 10 seconds should send the standby command (0xAD) to the front panel through I^2C, indicating that the host system is ready and the front panel can cut off the power supply of the host system (see *Table 6*).

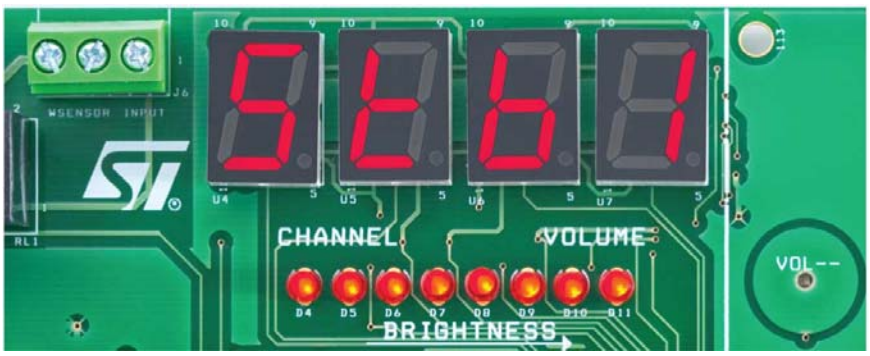
Table 6. Details of I^2C communication with the STEVAL-ICB003V1

Sr. no.	Description	Value in hexadecimal
1	I^2C address of STEVAL-ICB003V1	0xA0
2	Command for standby	0xAD
3	Command for no-action	0xFD

There are three different possibilities which are explained as follows:

- **Front panel receives a command other than the standby command from the host system:** the system exits standby and normal operation of the system continues.
- **Front panel receives the standby command:** the front panel cuts off the power of the host system through the on-board relay.
- **Front panel receives no command from the host system:** front panel waits for timeout (10 sec) to occur, then the front panel cuts off the power of the host system through the on-board relay and "stb1" appears on the LED display.

Figure 18. Standby of system after timeout



When the system is in standby, the front panel is also disabled and the touch keys and rotary encoder do not work.

Now when the system is in standby and the standby switch is pressed again, the front panel exits standby mode and switches ON the power of the host system using the on-board relay. The front panel displays the channel number and volume on the LED display and the power LED glows green (*Figure 5*).

4.3.3 Buzzer

The system has an on-board DC buzzer which is used to improve user interaction. The buzzer is driven from the LED digit output of the STLED316S device. For details of the circuit, see the schematic in *Section 6*.

The buzzer is controlled by the STLED316S and a transistor. The digital output of the STLED316S device switches ON/OFF the transistor to turn the buzzer ON/OFF.

As the STLED316S is a scanning device and brightness of a particular LED digit is controlled by the duration that the digit is kept ON during one complete scanning, the intensity of the buzzer volume varies greatly with the brightness setting of the digit. In the system there is no change in the volume of the buzzer when the brightness is changed using the touch keys or rotary encoder, but if the brightness is changed using the potentiometer, then the buzzer volume varies (*Section 4.3.4*).

4.3.4 Potentiometer

The system has an on-board potentiometer which can be used to set the brightness level of the LED display. With the rotation of the knob of the potentiometer (clockwise/counter-clockwise) the value of the resistance connected to the ISET pin of the STLED316S is changed and therefore the current flowing though the LED digits is also changed, causing the brightness of the display to vary.

The variation of the brightness using the potentiometer is a hardware setting, and thus it can be changed at any time without entering brightness mode.

Note: The maximum and minimum brightness of the LED display is set by the value of the resistance connected to the ISET pin of the STLED316S device which in turn depends on the potentiometer.

A minimum value of the ISET resistance is required for the buzzer to work. Thus the potentiometer should be set accordingly.

5 Connecting an external microcontroller to the demonstration board

Jumper J3 has been provided on the board for probing the important output signals of the board (see *Section 6*). This jumper can be used to connect an external microcontroller to the demonstration board. The following steps should be followed when connecting an external microcontroller to the demonstration board:

- Remove (de-solder) the STM8S207K6 microcontroller (U1) from the board.
- Connection the STLED316S device:
  - Connect pin 1 (PC1_DIN/DOUT) of jumper J3 to the pin of the external microcontroller using the data and commands that are to be sent to the STLED316S device (U8)
  - Connect pin 2 (PC2_CLK) of jumper J3 to the pin of the external microcontroller using the clock signal that is to be sent to the STLED316S device (U8).
  - Connect pin 3 (PC3_STB) of jumper J3 to the pin of the external microcontroller using the control signal (STROBE) that is to be sent the STLED316S device (U8).
  - Connect pin 4 (PC4_IRQ) of jumper J3 to the pin of the external microcontroller which is configured as interrupt input and is to receive the interrupt signals coming from the STLED316S device (U8).
- Connection to the touch screen controller(STMPE1208S):
  - Connect pin 5 (PB4_TSCL) of jumper J3 to the I^2C SCL pin of the external microcontroller.
  - Connect pin 6 (PB5_TSDA) of jumper J3 to the I^2C SDA pin of the external microcontroller.
  - Connect pin 7 (PB3_TINT) of jumper J3 to the pin of the external microcontroller which is configured as interrupt input and is to receive the interrupt signals coming from the STMPE1208S device (U2).
  - Connect pin 8 (PB2_TRESET) of jumper J3 to the pin of the external microcontroller which is configured as push-pull output and is to be used to reset the STMPE1208S device (U2).
- Connection for standby feature:
  - Connect pin 9 (PD4_STBY_INTR) of jumper J3 to the pin of the external microcontroller which is to provide the standby interrupt to the other host system.
  - Connect pin 10 (PD5_STBY_SW) of jumper J3 to the interrupt pin of the external microcontroller which is to take the switch input from the STBY switch (SW2).
- Connection for power management
  - Connect pin 11 (GND) of jumper J3 to the GND pin of the external microcontroller to create a common ground level (reference) for the whole system.
  - Connect pin 12 (5V0) of jumper J3 to the VDD pin of the external microcontroller.

Note: The pins of the external microcontroller must be configured as described in the datasheet of the STLED316S and STMPE1208S devices.

The working of the board depends on the software being loaded in the memory of the external microcontroller.

The setup cannot perform the SWIM communication with the external microcontroller using the jumper J3.

6 Schematics diagrams and bill of material

Figure 19. Schematic of demonstration board STEVAL-ICB003V1 (1 of 2)

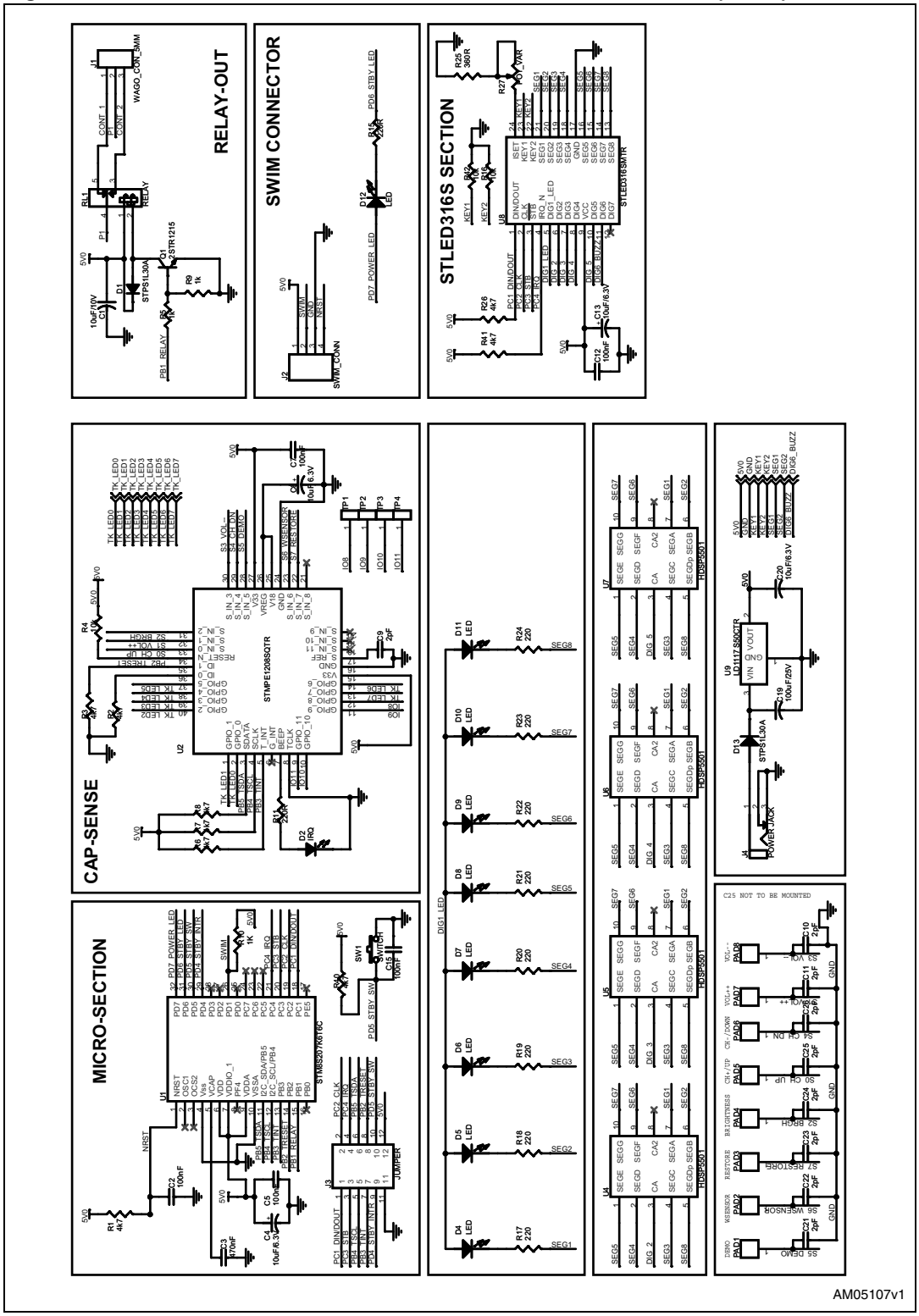


Figure 20. Schematic of demonstration board STEVAL-ICB003V1 (2 of 2)

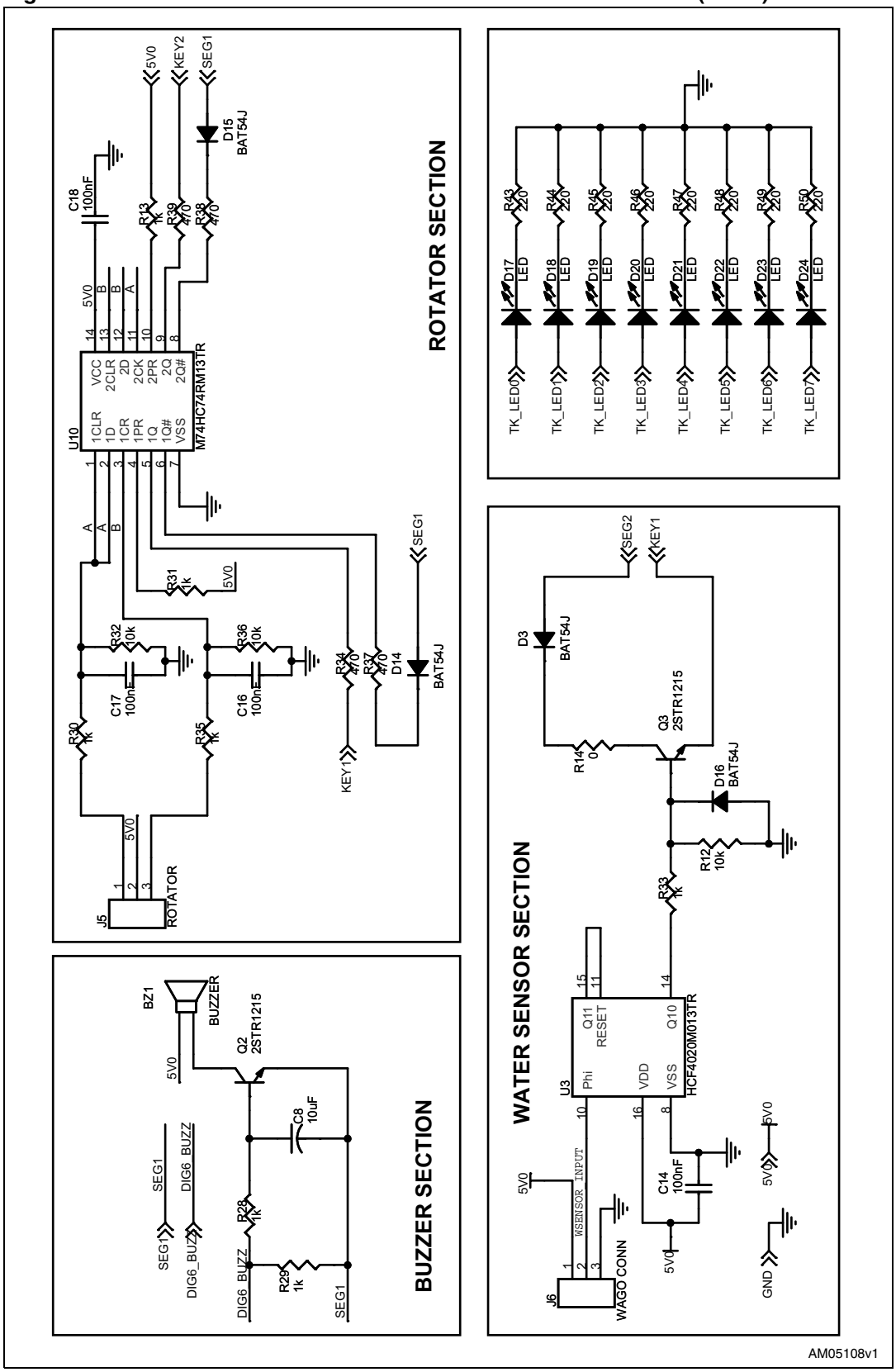


Table 7. Bill or material

Cat.	S. no.	Ref. designator	Component descr.	Package	Manuf.	Orderable part no.	Supplier	Supplier order code	Qty
ST devices	1	U1	STM8 microcont.	LQFP	ST	STM8S207K 6T6C	ST	STM8S207K 6T6C	1
	2	U2	STMPE1218S/touch key controller	QFN40	ST	STMPE1208 SQTR	ST	STMPE1208 SQTR	1
	3	U3	HCF4020M 013TR/ counter	SO-16	ST	HCF4020M013TR	ST	HCF4020M013TR	1
	4	U8	STLED316S /LED driver	SO-20	ST	STLED316S MTR	ST	STLED316S MTR	1
	5	U9	LD1117V50 /regulator	TO-220	ST	LD1117V50	ST	LD1117V50	1
	6	U10	M74HC74R M13TR, flip-flop	SO-16	ST	M74HC74RM 13TR	ST	M74HC74R M13TR	1
	7	D1, D13	STPSIL30A/ Schottky diode	SMA	ST	STPS1L30A	ST	STPS1L30A	2
	8	D3,D14, D15, D16	BAT54 signal diode	SOD323	ST	BAT54JFILM	ST	BAT54JFILM	4
	9	Q1,Q2,Q3	2STR1215 small signal BJT	SOT23	ST	2STR1215	ST	2STR1215	3
Connectors and jumpers	10	J1, 6	3 pin WAGO	5 mm pitch	Panasonic ECG	PA001-3 or equivalent	Farnell	1357319	2
	11	J2	4 pin SWIM connector	SMD with mm pitch	ERNI	284697	ERNI	284697	1
	12	J3	6 x 2 pin DIL Berg	2.5 mm pitch	Any				1
	13	J4	Power jack	6 mm	Cliff Electronic Comp.	DC10B or equivalent	Farnell	224960	1

Table 7. Bill or material (continued)

Cat.	S. no.	Ref. designator	Component descr.	Package	Manuf.	Orderable part no.	Supplier	Supplier order code	Qty
LEDs	14	D2,D4,D5,D6,D7,D8,D9,D10, D11	LED red	LED-3 mm	Multicop	MCL034PD or equivalent	Farnell	1581112	9
	15	D12	Bicolor LED	5 mm	Dialight Corp.	521-9628F or equivalent	Farnell	1461589	1
	16	D17,D18, D19,D20, D47	Red SMD LED for touch recognition	SMD0805	Panasonic SSG	LNJ206R5RUX or equivalent	Digi-Key	P11496TR-ND	5
	17	D22,D23, D24	Green SMD LED for touch recognition	SMD0805	Panasonic SSG	LN1371SGTR or equivalent	Digi-Key	P516TR-ND	3
	18	U4,U5,U6,U7	HDSP5501 common anode	0.55 inch, 2.5 mm pitch	Avago Tech.	HDSP-5501 or equivalent	Farnell	1003293	4
Capac.	19	C9,C10,C11,C21,C22, C23,C24, C25,C26	2 pF	SMD0805	Panasonic ECG	ECJ-2VC1H020C or equivalent	Digi-Key	PCC020CNTR-ND	9
	20	C2,C5,C7,C12,C14, C15,C16, C17,C18	100 nF	SMD0805	Panasonic ECG	ECJ-2VB1E104K or equivalent	Digi-Key	PCC1828CT-ND	9
	21	C3	470 nF	SMD0805	Panasonic ECG	ECJ-2VF1C474Z or equivalent	Digi-Key	PCC1847TR-ND	1
	22	C1,C4,C6,C8,C13,C20,	10 µF/10 V tantalum	Type 1	Vishay/ Sprague	293D106X96R3A2TE3 or equivalent	Mouser	74-293D106X96R3A2TE3	6
	23	C19	100 µF/25 V	Through hole	Multicop	MCGPR25V107M6.3X11 or equivalent	Farnell	9451188	1

Table 7. Bill or material (continued)

Cat.	S. no.	Ref. designator	Component descr.	Package	Manuf.	Orderable part no.	Supplier	Supplier order code	Qty
Resistors	24	R14	0	SMD0805	Panasonic ECG	ERJ-6GEY0R00V or equivalent	Digi-Key	P0.0ATR-ND or equivalent	1
	25	R17,R18, R19,R20, R21,R22 R23,R24, R43,R44, R45,R46, R47,R48, R49,R50, R11,R15	220 Ω	SMD0805	Panasonic ECG	ERJ-6GEYJ221V or equivalent	Digi-Key	P220ATR-ND	18
	26	R25	360 Ω	SMD0805	Panasonic ECG	ERJ-6GEYJ361V or equivalent	Digi-Key	P360ATR-ND	1
	27	R34,R37, R38,R39	470 Ω	SMD0805	Panasonic ECG	ERJ-6GEYJ471V or equivalent	Digi-Key	P470ATR-ND	4
	28	R5,R9,R10, R13,R28, R29,R30, R31,R33, R34,R35, R37,R38, R39	1kΩ	SMD0805	Panasonic ECG	ERJ-6GEYJ102V or equivalent	Digi-Key	P1.0KATR-ND	14
	29	R1,R2,R3,R 6,R7,R8,R2 6,R40, R41	4.7 kΩ	SMD0805	Panasonic ECG	ERJ-6GEYJ472V or equivalent	Digi-Key	P4.7KATR-ND	9
	30	R4,R12, R16,R32, R36,R42	10 kΩ	SMD0805	Panasonic ECG	ERJ-6GEYJ103V or equivalent	Digi-Key	P10KACT-ND	6
	31	R27	POT - 0 to 1 kΩ	Through hole	VISHAY Spectrol	63M-T607-102 or equivalent	Farnell	9608206	1

Table 7. Bill or material (continued)

Cat.	S. no.	Ref. designator	Component descr.	Package	Manuf.	Orderable part no.	Supplier	Supplier order code	Qty
Misc Components	32	SW1	Tact switch	Through hole	Tyco Electronics	FSM6JH	Farnell	1555983	1
	33	J5	Rotary encoder	Through hole	ALPS	EC12E2424407	Farnell	1520813	1
	34	RL1	SPDT relay	Through hole	Multicomp	HRM-S DC5V	Farnell	9480021	1
	35	BZ1	Buzzer DC	Through hole	Kingstate	KPEG242	Farnell	1502726	1
	36	Bump on	Bumpers small hemisphere WHT	Paste	3 M Electronic Specialty	SJ-5003	Mouser	517-SJ-5003WH	4
	37	Heat sink	Heat sink for TO-220 packaged IC	-	Futurlec	TO220LGBA or equivalent	Futurlec	TO220LGBA or equivalent	1

Note: C25 not to be mounted

7 Revision history

Table 8. Document revision history

Date	Revision	Changes
09-Oct-2009	1	Initial release.

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