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**STEVAL-IHI001V1 demonstration board: washing machine user interface based on the ST7LITE49M and STLED316S**

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## **Introduction**

The STEVAL-IHI001V1 is a demonstration board designed to simulate the user interface of a modern washing machine.

The board is based on the low-cost 8-bit ST7LITE49M microcontroller equipped with an I<sup>2</sup>C bus interface, and the STLED316S serial interfaced 6-digit LED controller with key-scan.

The demonstration board is designed to work as a stand-alone application, or as a motherboard for the STEVAL-IHI002V1 daughter board, which features the STMPE1208S capacitive sensing device and can be plugged into the STEVAL-IHI001V1 to operate as a capacitive single touch keyboard.

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## 1 STLED316S: serial interfaced LED controller with key-scan

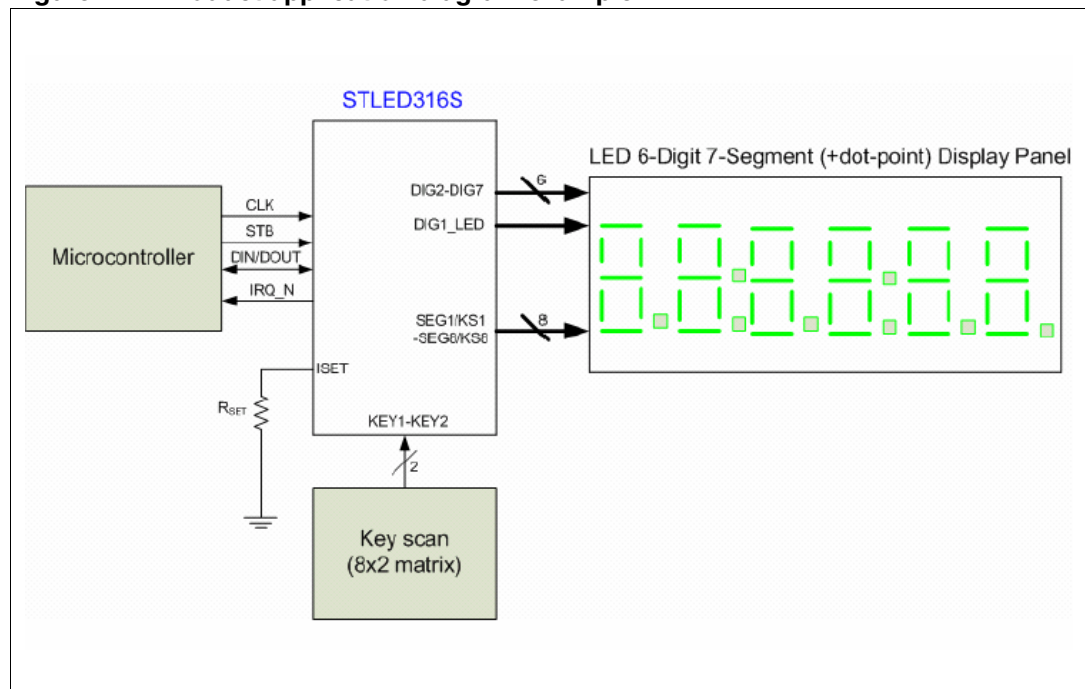
The device used for the washing machine user interface is a compact LED controller and driver. It interfaces with the MCU through a simple 3-wire serial interface.

The STLED316S drives up to 56 LEDs connected in a common anode configuration. Individual digits may be addressed and updated directly, without re-writing the entire display panel.

The maximum segment current is set through a single external resistor ( $R_{SET}$ ).

Additionally, the STLED316S includes key scanning for an 8x2 key matrix, which automatically scans a matrix of up to 16 keys.

**Figure 1. Product application diagram example**



The STLED316S is equipped with an internal display RAM memory to store the data transmitted from the MCU through the serial interface.

The device is programmed through a variety of read/write commands that permit the user to set the display panel and manage the keyboard.

To avoid scanning the keyboard repeatedly searching for a pressed key, an additional IRQ signal can be connected to the MCU. An interrupt is generated whenever a key is pressed.

## 2 Demonstration board application schematic

The demonstration board power supply is designed using a L5970D step-down switching regulator. The input supply voltage may vary in the range of 5 V to 30 VDC, allowing the user to connect a standard AC notebook computer power supply. The input is reverse-polarity protected (D6), and over-voltage protected (TR1).

The power supply output voltage is set at 5 VDC by mean of 2 resistors (R2, R3).

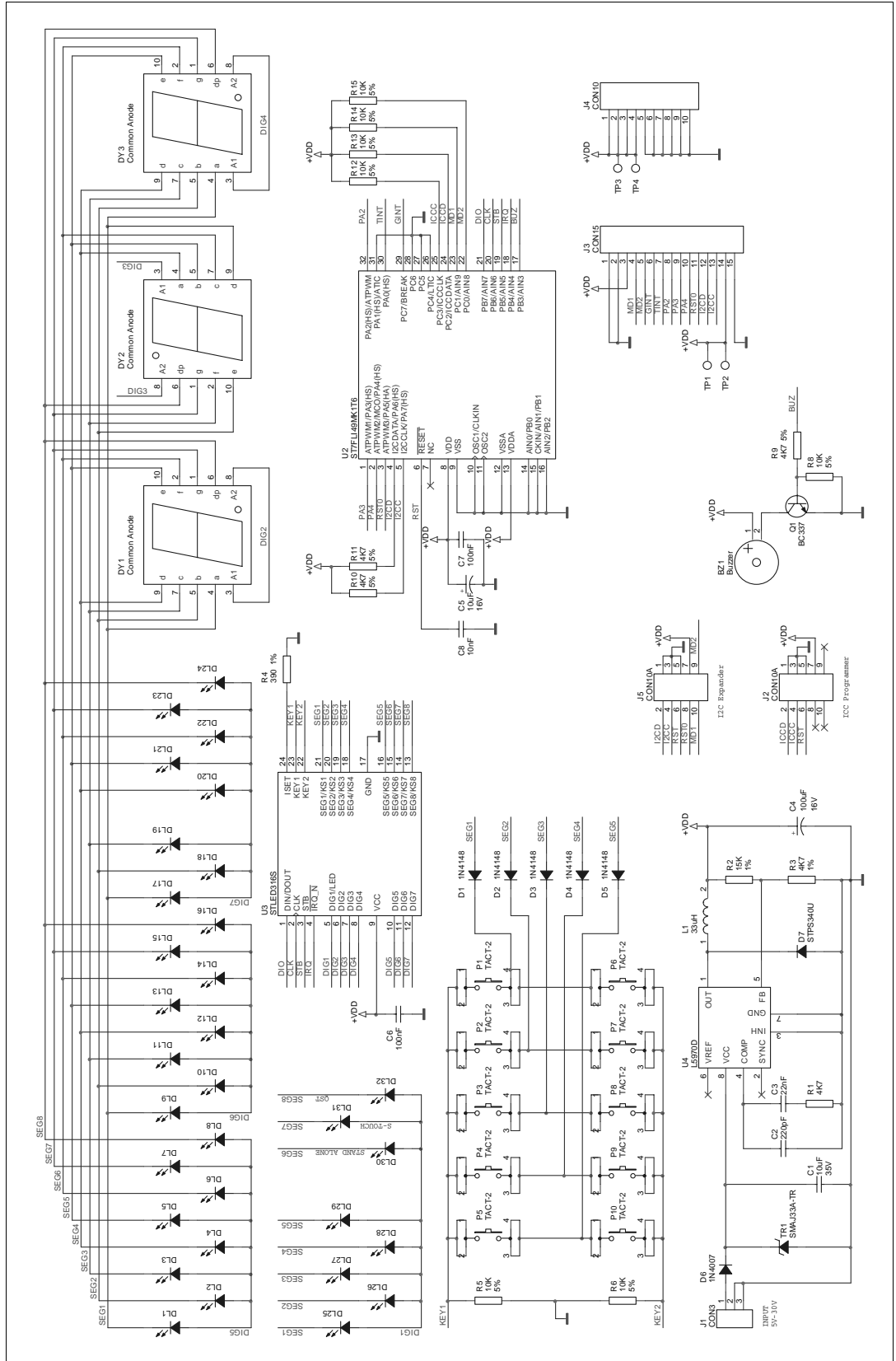
The ST7LITE49M MCU (U2) runs at 8 MHz by means of an internal oscillator, avoiding the need for any external components. Pull-up resistors R10 and R11 are used for the I<sup>2</sup>C bus, while R12 and R13 prevent the MCU from entering the programming mode unintentionally. Finally, R14 and R15 set the working mode (MD1, MD2 at logic 1 is "standalone mode").

The LEDs, display and keyboard are entirely managed through U3, (STLED316S). 8 segment lines are multiplexed with 7 digit lines, allowing a total of 56 LEDs (in a common anode configuration) to be controlled by a single STLED316S device. R4 sets the LED peak current.

Communication between the MCU and the STLED316S is achieved by means of 3 pins: data input/output (DIO), clock (CLK) and strobe (STB). An extra IRQ pin generates an interrupt request any time a key on the keyboard is pressed.

The demonstration board is equipped with connectors J3 and J4 to allow connection to the STEVAL-IHI002V1 daughter demonstration board. The board is also equipped with ICC programming connector J2 to program the MCU in-circuit. An extra I<sup>2</sup>C bus connector (J5) is foreseen to eventually connect other boards or devices via I<sup>2</sup>C bus.

Figure 2. Demonstration board application schematic



### 3 Bill of material

Table 1. Bill of material

| Item | Qty | Reference          | Part                      | Manufacturer       |
|------|-----|--------------------|---------------------------|--------------------|
| 1    | 1   | BZ1                | Buzzer KPE242             |                    |
| 2    | 1   | C1                 | 10 $\mu$ F 35 V SMD       | EPCOS              |
| 3    | 1   | C5                 | 10 $\mu$ F 10 V SMD       | EPCOS              |
| 4    | 1   | C2                 | 220 pF 0805 SMD           |                    |
| 5    | 1   | C3                 | 22 nF 0805 SMD            |                    |
| 6    | 1   | C4                 | 100 $\mu$ F 16 V SMD      | EPCOS              |
| 7    | 2   | C6, C7             | 100 nF 0805 SMD           |                    |
| 8    | 1   | C8                 | 10 nF 0805 SMD            |                    |
| 9    | 32  | DL1-DL32           | L-LTL4231N                |                    |
| 10   | 3   | DY1, DY2, DY3      | HD-A552RD common anode    |                    |
| 11   | 5   | D1, D2, D3, D4, D5 | 1N4148 DO-35              |                    |
| 12   | 1   | D6                 | 1N4007 DO-41              |                    |
| 13   | 1   | D7                 | STPS340U                  | STMicroelectronics |
| 14   | 1   | J1                 | K375A connector           |                    |
| 15   | 2   | J2, J5             | MLW10G 10 pin connector   |                    |
| 16   | 1   | J3                 | BL815G 15 pin connector   |                    |
| 17   | 1   | J4                 | BL810G 10 pin connector   |                    |
| 18   | 1   | L1                 | DO3316P-333MLB 33 $\mu$ H | Coilcraft          |
| 19   | 10  | P1-P10             | P-B1720C push-button      |                    |
| 20   | 1   | Q1                 | BC337 TO-92               |                    |
| 21   | 3   | R1, R10, R11       | 4K7 0805 SMD              |                    |
| 22   | 2   | R3, R9             | 4K7 1206 SMD              |                    |
| 23   | 1   | R2                 | 15 k $\Omega$ 1206 SMD    |                    |
| 24   | 1   | R4                 | 390 1206 SMD              |                    |
| 25   | 3   | R5, R6, R8         | 10 k $\Omega$ 1206 SMD    |                    |
| 26   | 4   | R12, R13, R14, R15 | 10 k $\Omega$ 0805 SMD    |                    |
| 27   | 1   | TR1                | SMAJ33A-TR Transil™       | STMicroelectronics |
| 28   | 1   | U2                 | ST7FLI49MK1T6             | STMicroelectronics |
| 29   | 1   | U3                 | STLED316SMTR              | STMicroelectronics |
| 30   | 1   | U4                 | L5970D                    | STMicroelectronics |

## 4 STEVAL-IHI001V1 demonstration board photos

Figure 3. Front view

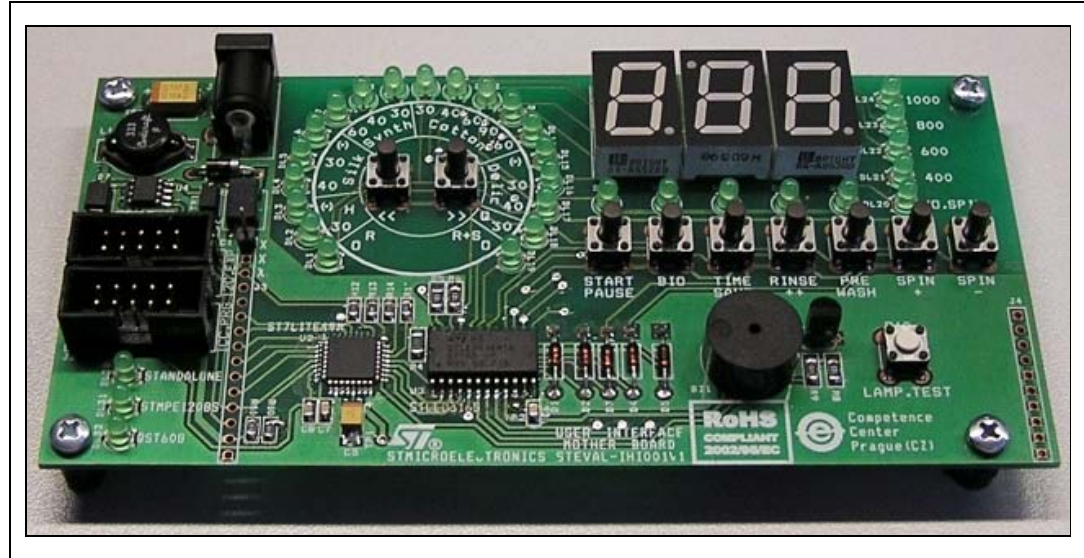
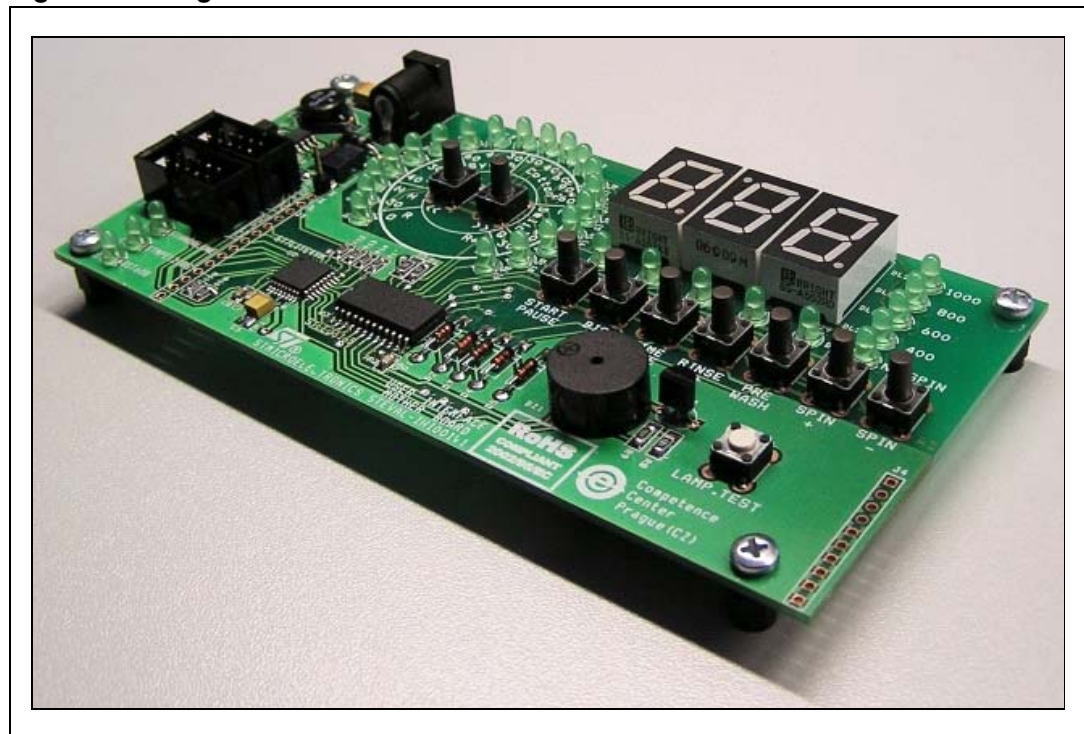


Figure 4. Angle view



## 5 References and related materials

For further information related to the functionality of the devices mentioned in this application note, please refer to the following documents:

1. ST7LITE49M datasheet
2. STLED316S datasheet
3. L5970D datasheet



## 6 Revision history

**Table 2. Document revision history**

| Date        | Revision | Changes          |
|-------------|----------|------------------|
| 16-Jun-2008 | 1        | Initial release. |

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