UM0943
User manual

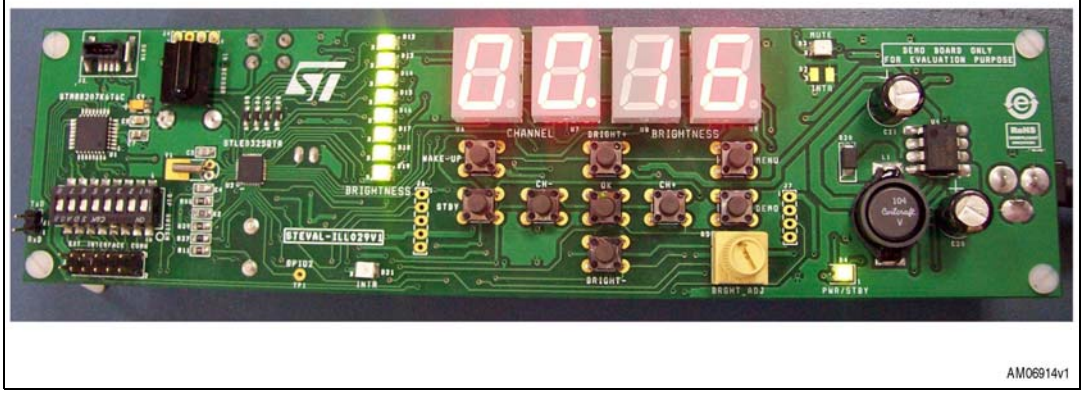
STEVAL-ILL029V1 front panel demonstration board based on the STLED325

Introduction

This user manual explains the operation of a front panel demonstration board based on the advanced LED controller driver STLED325 and the STM8S207K6 8-bit microcontroller as the I^2C master. The objective of this demonstration board is to show the features of the LED controller driver STLED325, such as key scanning, RTC, IR decoding, standby management, etc., for the market segment of DVD players, DVD recorders, set-top boxes, washing machines and more, while keeping system costs as low as possible.

The system can be operated using the various front panel keys provided, as well as by remote control. System I/O is handled completely by the STLED325 with minimal load on the host processor.

Figure 1. STLED325 front panel demo



The salient features of the system are:

- 4-digit, 7-segment (and decimal point) LED display
- 8 discrete LEDs
- 8 front panel keys for channel and brightness up/down, ok, menu, and standby
- A bicolor power/standby LED
- An interrupt LED (blinks with the interrupt)
- A potentiometer for adjusting display brightness
- Demonstration mode
- Multi format remote control operation (only RC5 currently supported, but easily extendable for various other formats.
- Embedded in-circuit programming using a SWIM interface for the STM8S207K6

Refer to datasheet STM8S207K6; *Performance line, 24 MHz. 8-bit MCU, up to 128 Kbytes Flash, integrated EEPROM,10-bit ADC, timers, 2 UARTs, SPI, I²C, CAN*.

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1 Hardware description

Figure 2. Demonstration board front view

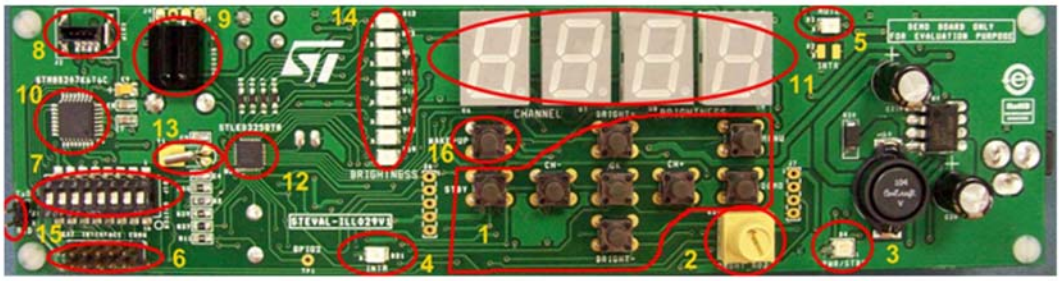
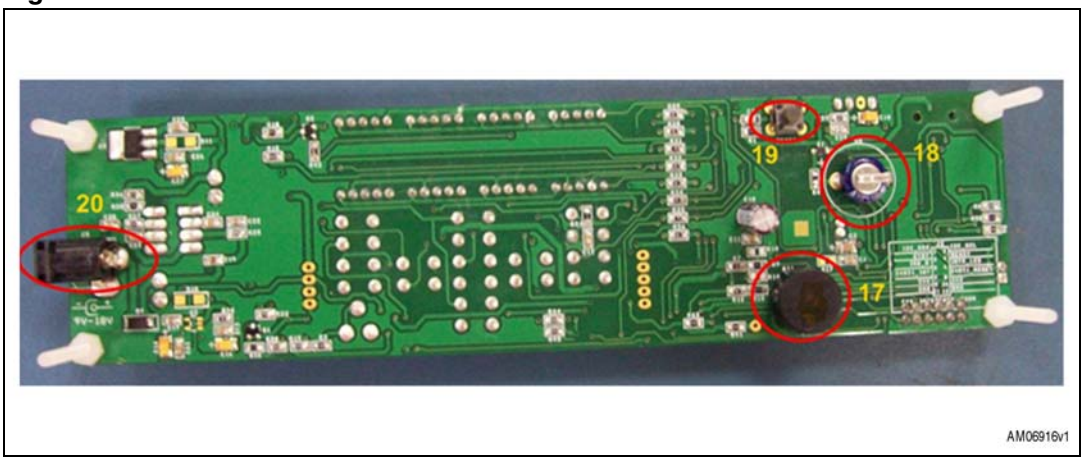


Figure 3. Demonstration board rear view



Major components present on the board are (the numbers in parentheses refer to the numbers marked on the board images):

- 8 front panel keys (1): CH+, CH-, BRGHT+, BRGHT-, STBY, MENU, OK, DEMO
- BRGHT_ADJ potentiometer (2)
- PWR/STBY LED (3)
- Interrupt LED (4)
- MUTE LED (5)
- External host interface connector (6)
- DIP switch (7)
- SWIM connector (8)
- IR sensor circular header (9)
- STM8S207K6 microcontroller (10)

- 7-segment (+dot) display (11)
- STLED325 (12)
- 32.768 kHz RTC crystal (13)
- 8 discrete LEDs for brightness (14)
- UART pinouts (15)
- Wake-up key: WAKE UP (16)
- DC buzzer for alarm function (17)
- Super cap for backup (18) (battery backup can be replaced by a lithium ion battery for longer backup time)
- System reset switch (19)
- DC power jack (20)

1.1 Power supply unit

The board is equipped with a DC jack into which an external adaptor (9 V-18 V, 500 mA) can be plugged. The board consists of a 5 V output switching regulator for higher efficiency and a 3.3 V output linear regulator onboard to give regulated outputs, as required. The board may also be powered up using a PC laptop adaptor. The user must ensure that the external PSU jack is of the center positive type, although reverse polarity does not damage the demonstration board. A bicolor “PWR/STBY” LED (D4) is shown in *Figure 2*. When in normal operation the PWR/STBY LED is green and turns red when the system is in standby condition.

Figure 4. DC power jack

1.2 7-segment (+decimal point) and discrete LED display

The board consists of 4 7-segment (+decimal point) display modules driven by the STLED325. By default, the two digits on the left display the channel information and the two digits on the right display the brightness level information.

Figure 5. 7-segment LED display

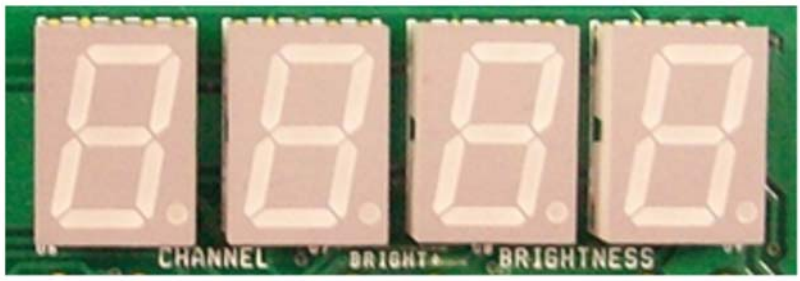


Figure 6. Discrete LEDs

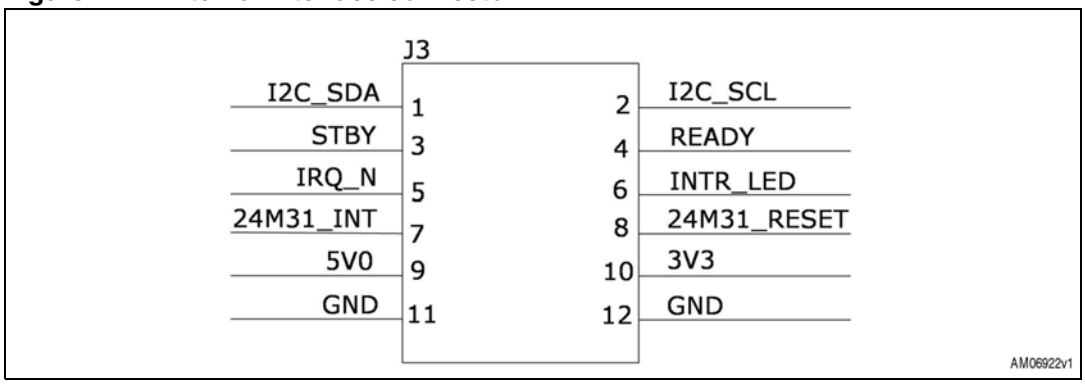
1.3 Front panel keys/wake-up key

The board is provided with 8 front panel keys: CH+, CH-, BRGHT+, BRGHT-, OK, MENU, DEMO and STBY. There is one pin designated as WAKE-UP to wake-up the system from STANDBY.

1.4 DIP switch/external interface connector

The board consists of an 8-position DIP switch (SW2). All the switches should be in the ON position (towards circle/ON side) for the demo to work. When the device STLED325 is required to be isolated from the onboard STM8S207K6 host and controlled through an external I^2C host, all the switches should be moved to the OFF position. Then, the STLED325 control pins can be accessed through the external interface connector (J3). A detailed description of the external interface connector is provided on the bottom silkscreen of the board and also listed below for reference.

Figure 7. External interface connector



1.5 IR sensor connector

A 38 kHz IR sensor is mounted at J4 for IR control and supports RC5 protocol.

1.6 Interrupt LED

There is a blue interrupt LED (D21 : INTR) which blinks whenever an interrupt is asserted from the device which may be due to a front panel key press, remote control key press, RTC alarm, wake-up from standby, etc.

2 Getting started

2.1 Package contents

The STLED325 front panel demonstration board package includes:

- Demonstration board (STEVAL-ILL029V1)
- User manual (UM0943)
- Schematic
- Gerber files

2.2 System requirements

The system operates in standalone mode by powering externally through an external adaptor (9 V-18 V, 500 mA). The board can also be powered up using a laptop adaptor.

2.3 Powering on the system

As soon as the DC power supply is plugged in, the system is up and running. The PWR/STBY LED (D4) is green with the MUTE LED (D3) turned off.

2.4 Startup display sequence/default setting of the system

On startup the system displays a rotating text welcome message “STLED325” on the 7-segment display. Then, “c h b r” is displayed for about 2 seconds, after which the system displays the channel number and brightness level information. When the board is powered on for the first time, the following default settings are programmed:

- Channel number: 00
- Brightness information: 01 (01/16)

Subsequently, every time the board is powered on, it retains the last configured data and displays the same on startup. The STM8S207K6 internal EEPROM is used to store the user data (channel number and brightness information), and this feature is not available if an external host is used.

3 System features

3.1 Brightness adjustment through potentiometer

The system is also provided with a potentiometer “BRGHT_ADJ” (R5) which can be used to vary the brightness of the LEDs by setting the output current. The brightness increases when the potentiometer is rotated clockwise and decreases with an anti-clockwise rotation.

3.2 Channel number/brightness level display mode

In this mode the system displays the channel number (on the far left, two 7-segment display modules) and brightness level (on the far right, two displays). Channel number and brightness can be increased/decreased using the front panel keys provided on the board (CH+, CH-, BRGHT+, BRGHT-). Similar operations can be performed using remote control keys, as explained in *Section 3.5*.

The maximum and minimum limits for channel numbers are 99 and 00, while the maximum and minimum values for brightness level are 16 and 1 (16/16, 1/16).

The brightness level is also shown by the number of discrete LEDs lit up. (1 LED each for 2 levels).

3.3 RTC operation

The STLED325 also features a built-in RTC. The MENU key on the front panel is provided to select RTC set/view options. Various front panel keys can be used to operate the real time clock.

Press MENU to enter into and navigate through menu options. Press MENU once - “RTC” is displayed. Now press OK to enter into RTC options. Now using the MENU key the user can navigate through “TIME” (view time), “DATE” (view date), “SETT” (set time), “SETD” (set date), and “SETA” (set alarm).

3.3.1 Display time

Press MENU to go to “RTC” and then OK. “TIME” is displayed and press OK again to go to view time. “HH.MM” is displayed for a second to signify the time display in hours-minutes format, followed by current RTC time display with hours and minutes separated by a “.”. Press OK again to exit to the channel-brightness display.

3.3.2 Display date

Press MENU and then OK. Use the MENU key again to reach “DATE” and press the OK key. “DD.MM” is displayed for a second to signify date display in date-month format after which the current RTC date is displayed. Date and month data are separated by a “.”. Press OK again to exit to the channel-brightness display.

3.3.3 Set time

Press MENU and then OK. Use MENU key to go to “SETT” and press OK. The system prompts the user to enter time in “Hours-Minutes” format. Use the front panel keys BRGHT+

and BRGHT- to increase and decrease the value and CH- and CH+ to move left/right. The seconds field is taken as 0.

After adjusting the time, press OK. The time is set and the system returns to channel-brightness display.

3.3.4 Set date

Press MENU and then OK. Press MENU again multiple times to go to “SETD”. Now press OK. The system prompts to enter date in “Date-Month” format. Use front panel keys Bright+ and Bright- to increase and decrease the value and CH- and CH+ to move left and right. After adjusting the date press OK again. Now the system prompts to enter year (two digits “e.g. 10 for 2010” and week day (1- Monday, 2 - Tuesday, etc.). After entering the information, press OK. The date is set and the system returns to channel-brightness display.

3.3.5 Set alarm

Press MENU and then OK. Press MENU again multiple times to go to “SETA”. Now press OK. The system shows the current RTC time and prompts the user to enter Alarm time in “Hours-Minutes” format. Use front panel keys Bright+ and Bright- to increase and decrease the value and CH- and CH+ to move left/right. The seconds' field is taken as 0 and current RTC date as alarm date automatically. After adjusting the value, press OK again. The alarm is set and the system returns to channel-brightness display.

3.3.6 Alarm condition display

When the alarm alert is received from the STLED325 internal RTC, “-AL-” is displayed along with the buzzer sound (tick-tick sound: This buzzer is driven by GPIO1 of the STLED325). In case the system was in display RTC mode (display RTC time/ RTC date) when the alarm condition is met, the system display remains at its previous display state (display RTC) during the alarm while the buzzer still sounds. The alarm goes off when any interrupt is received (FP key press/RC key press) and the system returns to channel-brightness display.

3.4 Demonstration mode

The system enters into demonstration mode by pressing the demo key on the front panel. In this mode scrolling text with varying brightness and increasing scrolling speed is displayed continuously.

Text displayed: “STLED325 front panel demo” followed by blinking of 325 two times (left aligned and right aligned).

The system comes out of demo mode and returns to its “channel-brightness” display mode when either of the front panel or RC keys is pressed or the RTC alarm condition is met.

3.5 Remote control operation

The system currently supports only RC5 protocol; however, it can be easily adapted to implement other RC protocols. The MENU options support changing the currently used RC protocol but is not currently implemented in the system. For more details, refer to the data brief STLED325; *Front panel demonstration board based on the STLED325 and STM8S*.

The following RC operations can be done using the IR decoding feature of the STLED325:

- Device address programmed: 0x08
- Channel up (key value: 7 and key value: 45)
- Channel down (key value: 14 and key value: 44)
- Brightness increase (key value: 8)
- Brightness decrease (key value: 27)
- Demo (key value: 21)
- Standby (key value: 12)

Figure 8. Example RC5 remote

3.6 Standby mode/hot keys

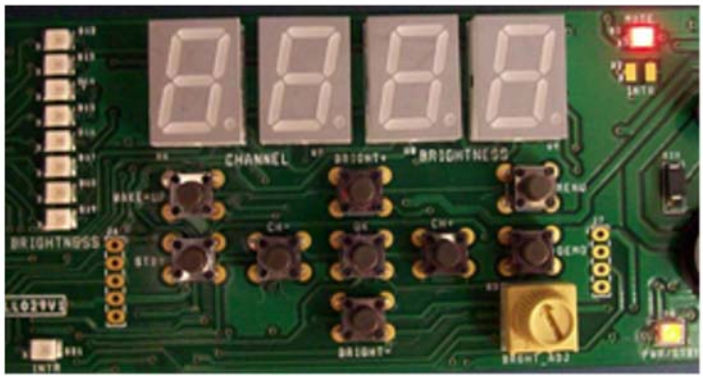
The STLED325 also features standby power management to host. The system can enter into standby mode by:

- Pressing the front panel standby key
- Remote control standby key

On entering standby mode PWR/STBY LED (D4) turns red. MUTE LED (D3) also turns ON. “STBY” is displayed on the LED panel for about two seconds (refer to *Figure 9*) after which the complete display is blanked (discrete LEDs also turned off, refer to *Figure 10*). If the system was in display RTC mode (time/date display) when the standby key was pressed, the 7-segment display does not get blanked but displays RTC during standby mode. (discrete LEDs are off). During standby all the front panel and RC keys except the hot keys are non-functional.

Figure 9. Entering into standby

Figure 10. System is in standby



The system can exit standby mode in any of the following ways:

- Wake-up key press
- Front panel hot key press (STBY and OK are configured as hot keys)
- Remote control hot key press (RC STANDBY key is configured as a hot key)
- RTC alarm

The system returns to “channel-brightness” display after exiting standby mode.

Appendix A STEVAL-ILL029V1 schematics

Figure 11. Microcontroller section

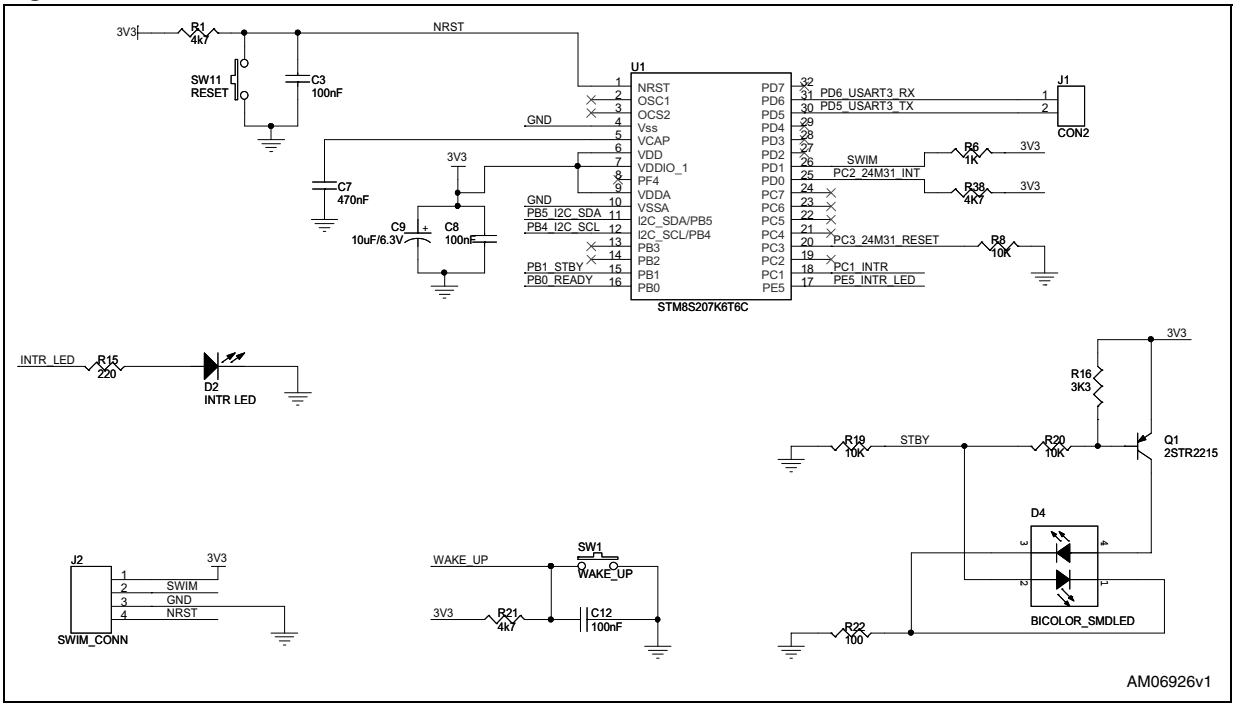


Figure 12. Power supply section

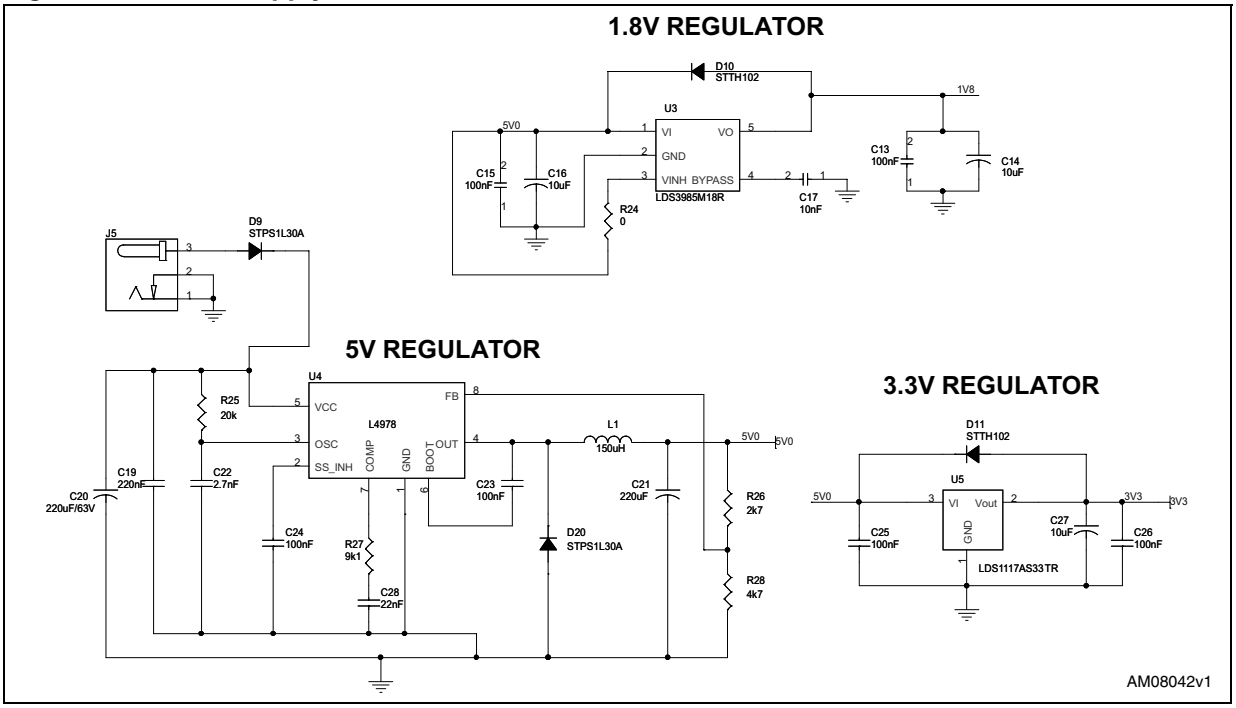


Figure 13. Discrete LED and seven segment LED section

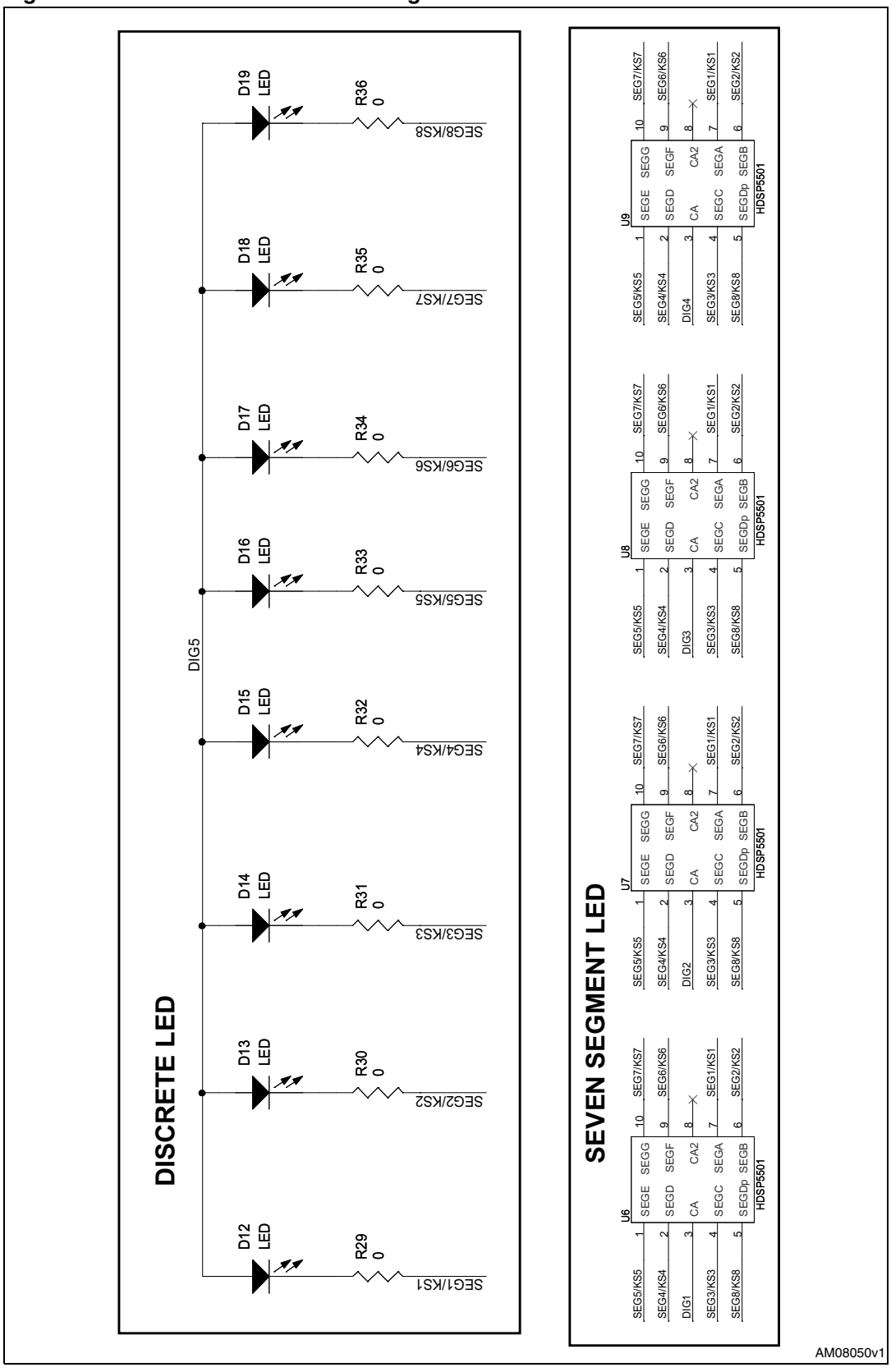


Figure 14. STLED325 section

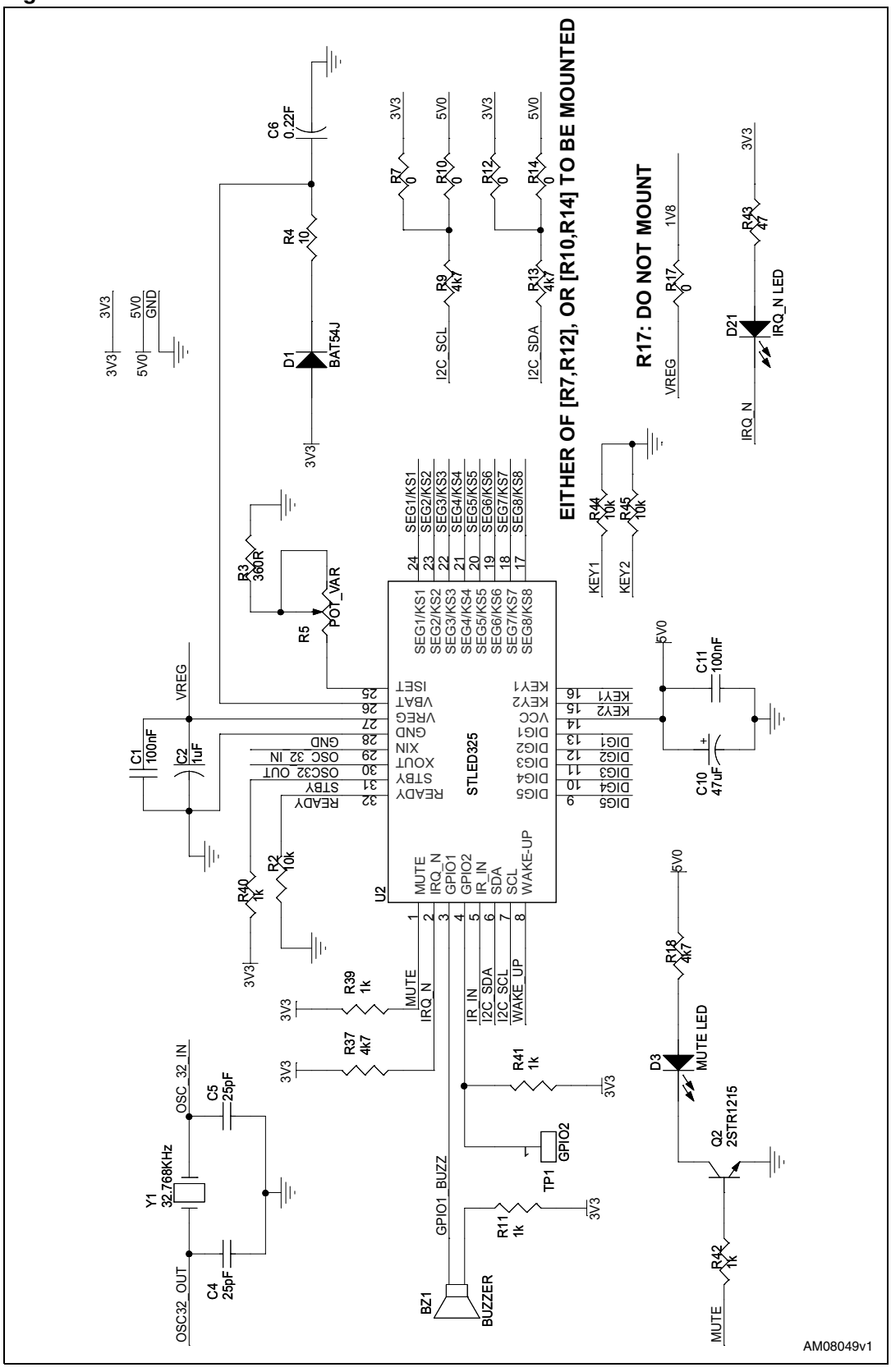


Figure 15. Keyscan circuit section

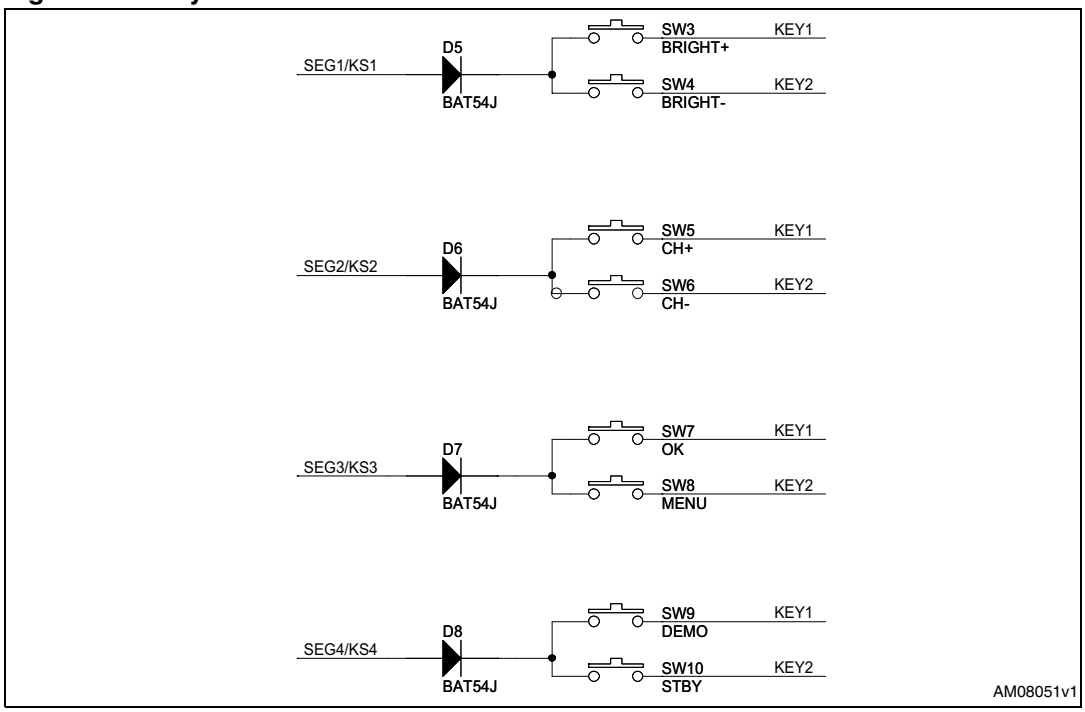
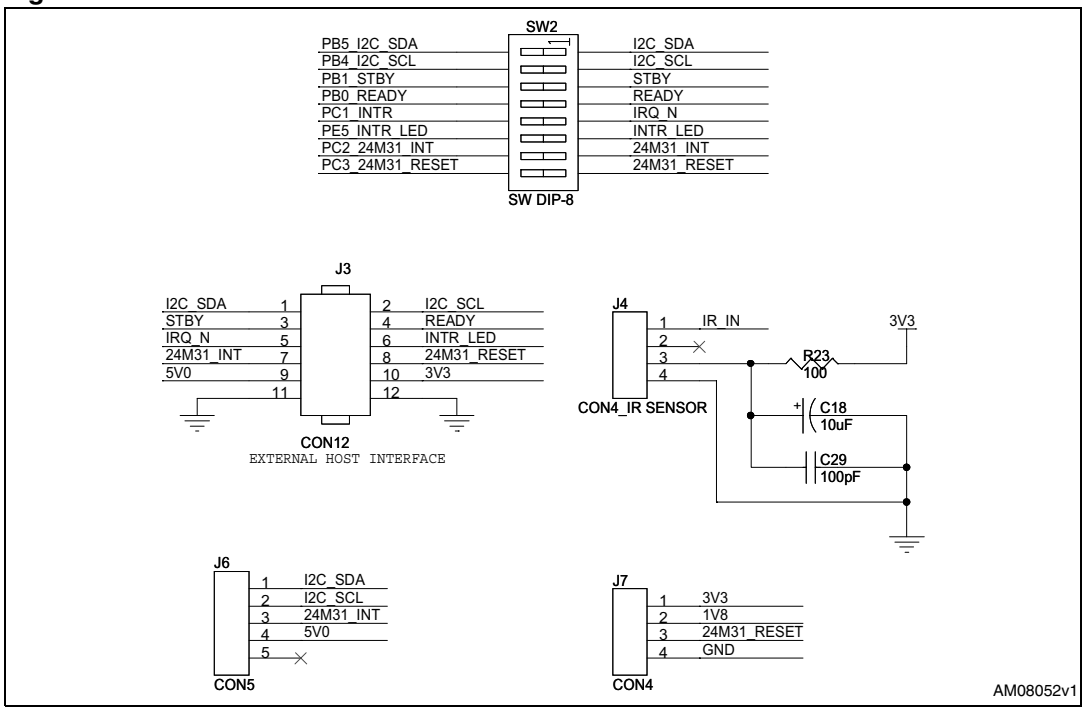


Figure 16. Connectors section



Appendix B Bill of material

Table 1. BOM

Ref. des.	Component description	Package	Manufacturer	Manufacturer's ordering code / orderable part number	Supplier	Supplier ordering code
U1	STM8S207K6 8-bit microcontroller	LQFP32	STMicroelectronics	STM8S207K6T6C	STMicroelectronics	STM8S207K6T6C
U2	LED controller/driver	QFN32	STMicroelectronics	STLED325QTR	STMicroelectronics	STLED325QTR
U3(do not mount)	LDS3985M18TR/voltage regulator	SOT23-5L	STMicroelectronics	LDS3985M18TR	STMicroelectronics	LDS3985M18TR
U4	L4978	DIP8	STMicroelectronics	L4978	STMicroelectronics	L4978
U5	LD1117AS33TR	SOT-223	STMicroelectronics	LD1117AS33TR	STMicroelectronics	LD1117AS33TR
D1, D5, D6, D7, D8	BAT54J	SOD323	STMicroelectronics	BAT54JFILM	STMicroelectronics	BAT54JFILM
D9, D20	Schottky diode	SMA	STMicroelectronics	STPS1L30A	STMicroelectronics	STPS1L30A
D10, D11 (do not mount)	Diode	SMA	STMicroelectronics	STTH102	STMicroelectronics	STTH102
Q1	PNP transistor	SOT-23	STMicroelectronics	2STR2215	STMicroelectronics	2STR2215
Q2	NPN transistor	SOT-23	STMicroelectronics	2STR1215	STMicroelectronics	2STR1215
Y1	32.768 kHz crystal	Through hole	Vishay/Dale	XT26TTA32K768	Mouser	73-XT26T
BZ1	Piezoelectric Buzzer	Through hole	CUI	CEP-2242	Digi-Key	102-1115-ND
D4	Bicolor PWR/STBY LED	PLCC-4	Kingbright	KAA-3528ESGC	Farnell	1318239
D2	Interrupt LED (Blue)	PLCC2	OSRAM Opto Semiconductors Inc	LB T673-L2P1-35-0-10-R18-Z	Digi-Key	475-1387-1-ND
D3	Mute LED (Red)	PLCC2	Avago Technologies US	HSMC-A101-S00J1	Digi-Key	516-2122-2-ND

Table 1. BOM (continued)

Ref. des.	Component description	Package	Manufacturer	Manufacturer's ordering code / orderable part number	Supplier	Supplier ordering code
U6, U7, U8, U9	HDSP5501 common anode	0.55 inch, 2.5 mm pitch	Avago Technologies US Inc.	HDSP-5501	Digi-Key	516-1212-5-ND
SW2	DIP-8 switch	SMT	C & K	SDA08H0SBD	Mouser	611-SDA08H0SBD
SW1, SW3, SW4, SW5, SW6, SW7, SW8, SW9, SW10, SW11	Tactile switches	6.0x6.0x7.0 mm 160gf through hole	ALPS	SKHHBWA010	Mouser	688-SKHHBW
J1, J4, J6, J7 (J6 and J7 not mounted)	Single row bergstrip	2.54 mm pitch through hole	Protectron	P9102-40-12-1	Protectron	P9102-40-12-1
J3	Dual row bergstrip	2.54 mm pitch through hole	Protectron	P9103-80-12-1	Protectron	P9103-80-12-1
J4 (do not mount)	4-pin female bergstrip header (do not mount)	2.54 mm pitch through hole	Protectron	P9301-36-11	Protectron	P9301-36-11
J5	DC Jack connector	2.5 mm right angle locking type	Protectron	PDCJ01-08	Protectron	PDCJ01-08
L1	100 µH	SMD	Coil-craft	DS5022P-104MLB	Coil-craft	DS5022P-104MLB
R1,R9,R13,R18, R21,R28,R37, R38	4.7 kΩ	SMD0805	Panasonic - ECG	ERJ-6GEYJ472V or equivalent	Digi-Key	P4.7KATR-ND
R2,R8,R19,R20, R44,R45	10 kΩ	SMD0805	Panasonic - ECG	ERJ-6GEYJ103V or equivalent	Digi-Key	P10KACT-ND
R3	360 Ω	SMD0805	Panasonic - ECG	ERJ-6GEYJ361V or equivalent	Digi-Key	P360ATR-ND
R4	10 Ω	SMD0805	Panasonic - ECG	ERJ-6GEYJ100V or equivalent	Digi-Key	P10ATR-ND

Table 1. BOM (continued)

Ref. des.	Component description	Package	Manufacturer	Manufacturer's ordering code / orderable part number	Supplier	Supplier ordering code
R16	3.3 Ω	SMD0805	Panasonic - ECG	ERJ-6GEYJ472V or equivalent	Digi-Key	P3.3KATR-ND
R6,R11,R39,R40,R41,R42	1 kΩ	SMD0805	Panasonic - ECG	ERJ-6GEYJ102V or equivalent	Digi-Key	P1.0KATR-ND
R7,R10,R12, R14,R17,R24, R29,R30,R31, R32,R33,R34, R35,R36 (Do not mount: R10, R14, R17)	0	SMD0805	Panasonic - ECG	ERJ-6GEY0R00V or equivalent	Digi-Key	P0.0ATR-ND or equivalent
R15	220 Ω	SMD0805	Panasonic - ECG	ERJ-6GEYJ221V or equivalent	Digi-Key	P220ATR-ND
R22, R23	100 Ω	SMD0805	Panasonic - ECG	ERJ-6GEYJ101V	Digi-Key	P100ATR-ND
R25	20 kΩ	SMD0805	Panasonic - ECG	ERJ-6GEYJ203V or equivalent	Digi-Key	P20KATR-ND
R26	2.7 kΩ	SMD0805	Panasonic - ECG	ERJ-6GEYJ272V or equivalent	Digi-Key	P2.7KATR-ND
R27	9.1 kΩ	SMD0805	Panasonic - ECG	ERJ-6ENF9101V or equivalent	Digi-Key	P9.10KCCT-ND
R43	47 Ω	SMD0805	Panasonic - ECG	ERJ-P06J470V or equivalent	Digi-Key	P47ADCT-ND
C1,C3,C8,C11, C12,C13,C15, C23,C24,C25, C26	100 nF	SMD0805	Panasonic - ECG or equivalent	ECJ-2VB1E104K or equivalent	Digi-Key	PCC1828CT-ND
C2	1 µF	SMD1206	Panasonic - ECG	ECJ-3YB1C105K or equivalent	Digi-Key	PCC1882CT-ND

Table 1. BOM (continued)

Ref. des.	Component description	Package	Manufacturer	Manufacturer's ordering code / orderable part number	Supplier	Supplier ordering code
C4,C5	25 pF	SMD0805	AVX Corporation	08051A200JAT2A CAP CERM	Digi-Key	478-3735-1-ND
C7	470 nF	SMD0805	Murata Electronics North America	GRM21BF51E474ZA01L or equivalent	Digi-Key	490-1730-1-ND
C9,C14,C16, C18,C27	10 µF	Case A	Vishay/Sprague or equivalent	293D106X96R3A2TE3 or equivalent	Mouser	74-293D106X96R3A2TE3
C10	47 µF	Leaded 50 V 47 µF 6.3x11 20 % 2.5 LS	Nichicon	UPS1H470MED	Mouser	647-UPS1H470MED
C17	10 nF	SMD0805	Panasonic - ECG	ECJ-2VB1H103K	Digi-Key	PCC103BNCT-ND
C19	220 nF	SMD0805	Panasonic - ECG	ECJ-1VB1A224K	Digi-Key	PCC1749CT-ND
C20, C21	220 µF/63 V	Through hole	Panasonic - ECG	EEU-FM1E221	Digi-Key	P12383-ND
C22	2.7 nF	SMD0805	Panasonic - ECG	ECJ-2VB1H272K	Digi-Key	PCC272BNCT-ND
C28	22 nF	SMD0805	Panasonic - ECG	ECJ-2VB1H223K	Digi-Key	PCC223BGCT-ND
C29	100 pF	SMD0805	Panasonic - ECG	ECJ-2VC1H101J	Digikey	PCC101CGCT-ND
C6	0.22 pF Supercap		Cornell Dubilier	EDLSD224H5R5C	Mouser	598-EDLSD224H5R5C
R5	Potentiometer (0 - 1 kΩ)	Through hole	VISHAY Spectrol	63M-T607-102 or equivalent	Farnell	9608206
IR Sensor	IR sensor (38 kHz)	Through hole	Vishay Semiconductors	TSOP31238	Farnell	1469635
Mounting Screws	Slotted pan head screw 4-40 thread 1" Long		AEL Hardware		AEL Hardware	
Mounting nuts	440 hex nut natural nylon (UL94V-2) natural nylon (UL94V-2)		AEL Hardware		AEL Hardware	

Revision history

Table 2. Document revision history

Date	Revision	Changes
03-Sep-2010	1	Initial release.

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