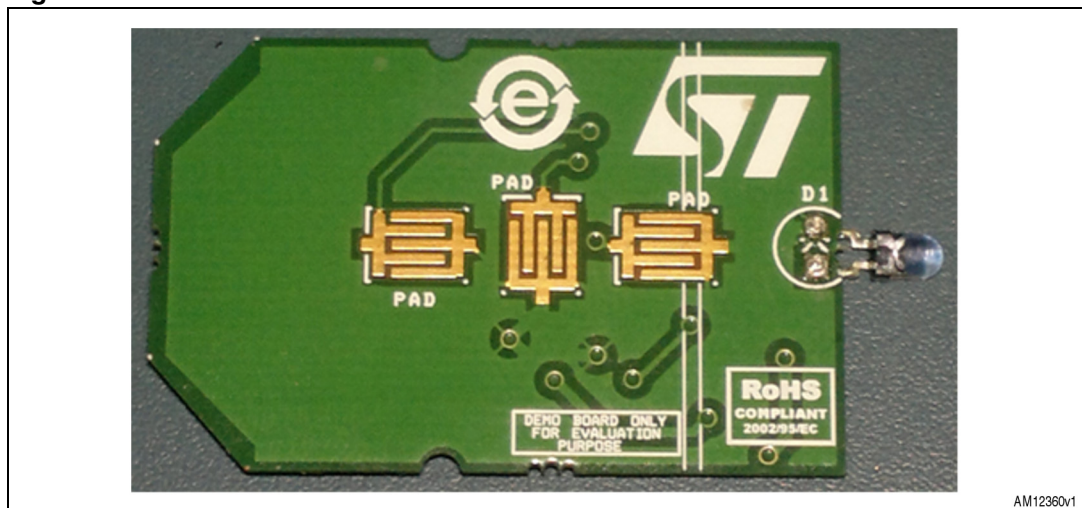


Introduction

The IR transmitter solution features three buttons which can be used to transmit three unique IR commands for various IR remote control applications. It is a direct implementation of the AN2957 application note, 'Implementing an RC5 infrared transmitter using the IR timer modulator of the STM8L101xx microcontroller'. An STM8L101xx low power MCU is used to implement this design. The existing firmware, which is supplied with the application note, was modified slightly to accommodate for the three keys present in the design which are used to control speed-up, speed-down and power-on/off toggle operations. The circuit runs on a CR2032 coin cell battery and is designed to fit into a small key fob type enclosure.

Figure 1. IR remote transmitter STEVAL-IHM037V1



This document explains the different parts and functions of the IR remote transmitter.

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1 Getting started

1.1 Package

The remote fan speed controller includes the following:

- Hardware content:
 - IR transmitter board with key fob enclosure including three-button carbon contact pad
- Documentation:
 - User manual (this document)
 - Schematics, Gerber files, BOM
- Firmware
 - Already programmed STM8L device soldered on the demonstration board
 - Object files are also available for the firmware.

1.2 Initial setup

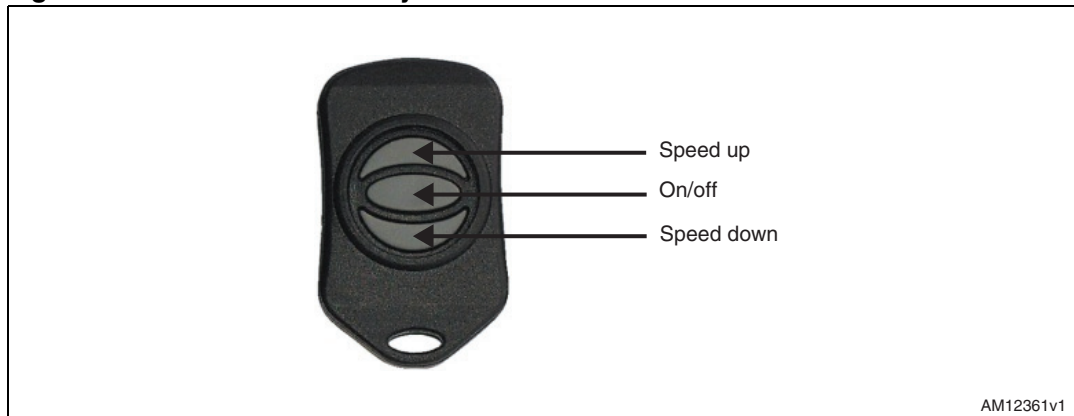
The IR remote controller board can be set up as follows:

1. Remove the board from the enclosure using a flat head screwdriver to separate the two parts of the key fob enclosure.
2. Install a CR2032 battery by sliding it into the battery retainer on the bottom side of the PCB with the battery +ve terminal on top, as indicated on the retainer.
3. Place the board back inside the upper half of the enclosure containing the slot for the carbon contact pad such that the contact switch footprints on the top layer are aligned below the carbon contact pad.
4. Snap fit the lower part of the enclosure by applying gentle pressure all around so that the two pieces lock into each other.
5. Now the key fob can be used to transmit the pre-programmed IR RC5 commands used to control the fan speed/dimmer intensity and it's ON/OFF state.

2 System overview

2.1 Hardware design description

Figure 2. IR transmitter in key fob enclosure



2.1.1 STEVAL-IHM037V1 IR remote transmitter

This application is based on the direct implementation of the ST application note AN2957 with slight modifications to support the three keys.

Table 1 lists the commands used for the three keys on the transmitter:

Table 1. RC5 commands

Key function	Device address	Device instruction	14 bits transmitted
Speed up	SAT1 [8]	Number 8 [8]	10X01000001000
On/off	SAT1 [8]	Number 0 [0]	10X01000000000
Speed down	SAT1 [8]	Balance left [27]	10X01000011011

The RC5 frame is 14 bits long and comprises the following:

- 1 start bit (always 1)
- 1 field bit
- 1 toggle bit (represented in Table 1 as X). It changes state every time a key is released and pressed again.
- 5-bit device address (32 possible addresses)
- 6-bit device instruction (64 possible instructions).

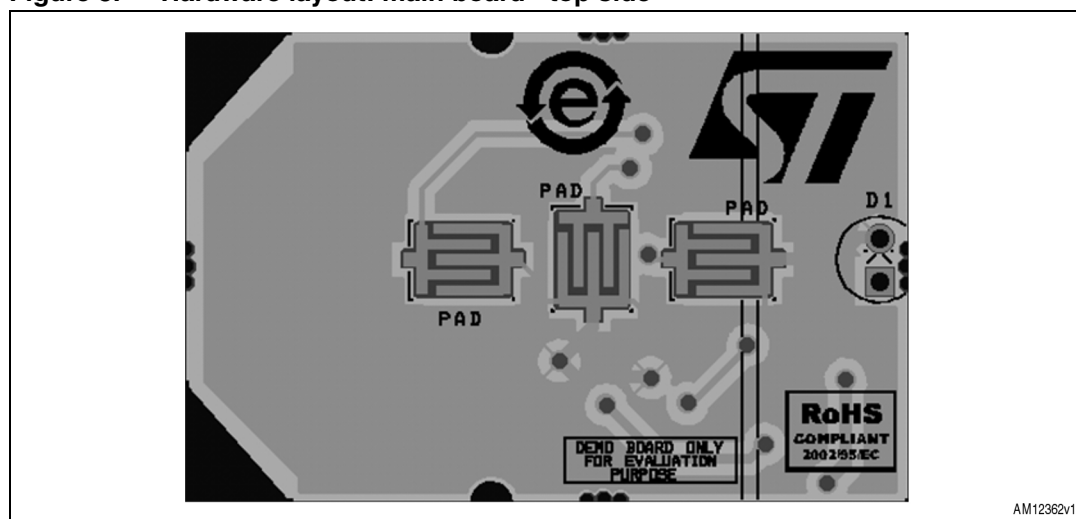
2.1.2 Modifying the RC5 device address and instructions for the three keys

The RC5.h file in the project folder (refer to the firmware for the AN2957 application note) contains all the definitions for the standard device addresses as well as the device instructions as per RC5 protocol. The global variables 'Address' and 'Instruction' defined in main.c are used to store the RC5 address and instruction codes to be transmitted. In this modified code, the MCU wakes up from Halt mode using external interrupt whenever any key is pressed on the remote. The program then checks which particular key was pressed and assigns the relevant RC5 address and instruction to the 'Address' and 'Instruction' variables respectively. It then calls the SendFrame() function to transmit the RC5 frame. This process is repeated as long as the key is pressed. Once the key is released, the system goes back to the low power Halt mode. The values that are assigned to the 'Address' and 'Instruction' variables can be changed inside the while(1) infinite loop in main.c file for each of the three keys to customize the remote. This enables the remote to transmit any valid RC5 frame for the three available keys.

2.2 Hardware layout

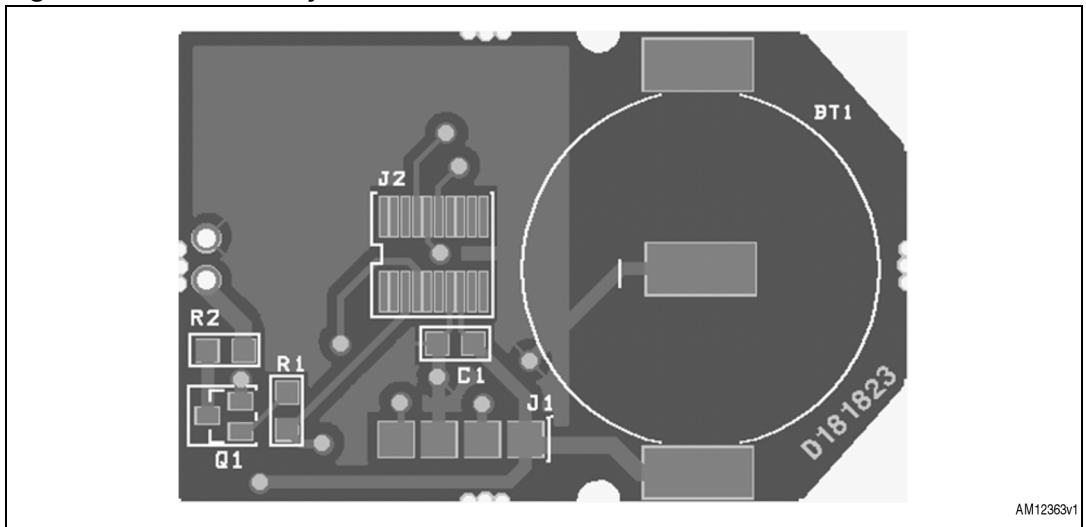
The STEVAL-IHM037V1 component layout for top and bottom layers is shown below in [Figure 5](#) and [6](#) respectively. It helps the user to locate different components/sections on the board.

Figure 3. Hardware layout: main board - top side



AM12362v1

Figure 4. Hardware layout: main board - bottom side



AM12363v1

3 Hardware schematics

Figure 5 and 6 represent the schematic diagrams for the board.

Figure 5. IR remote transmitter STEVAL-IHM037V1

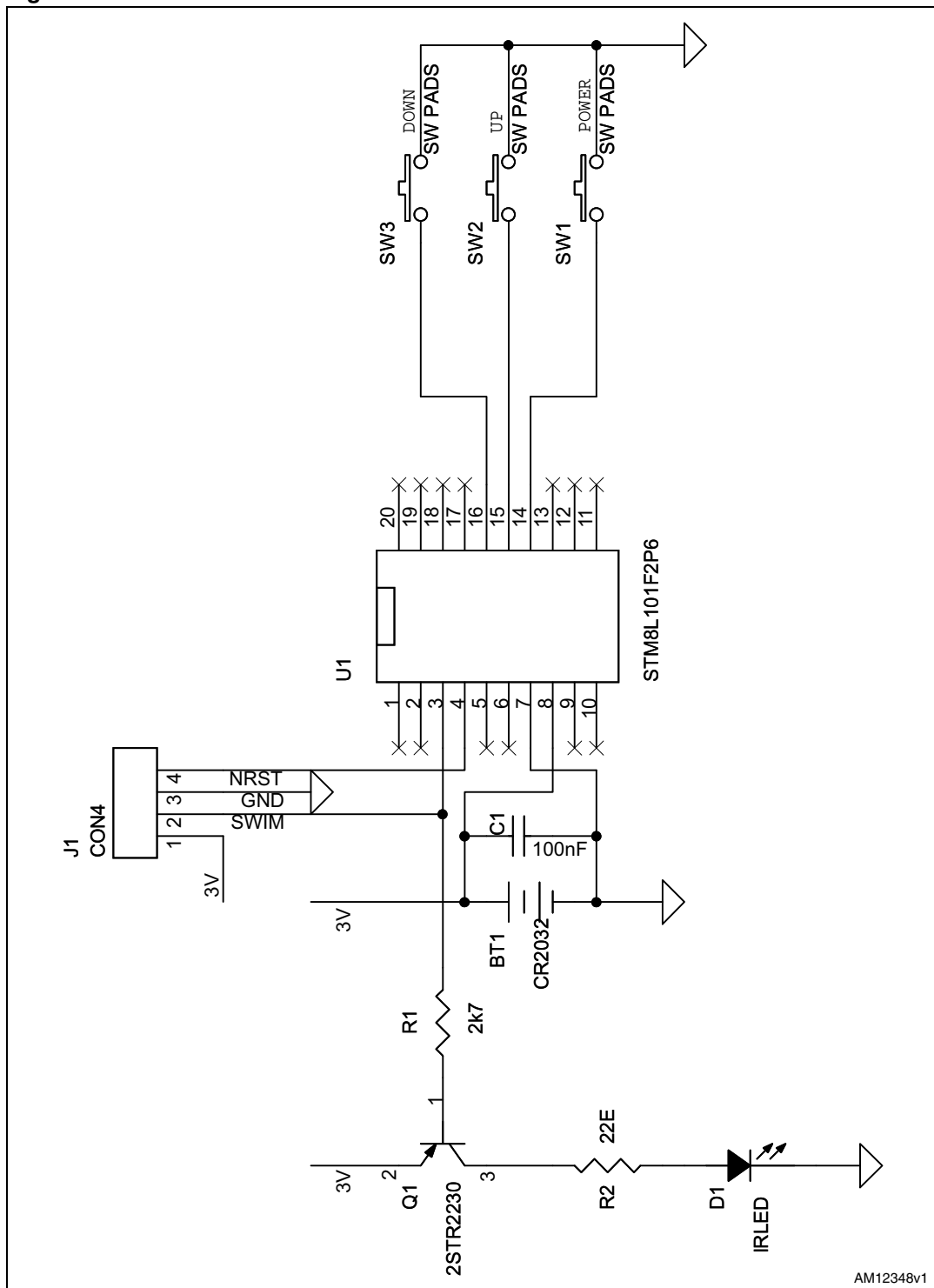
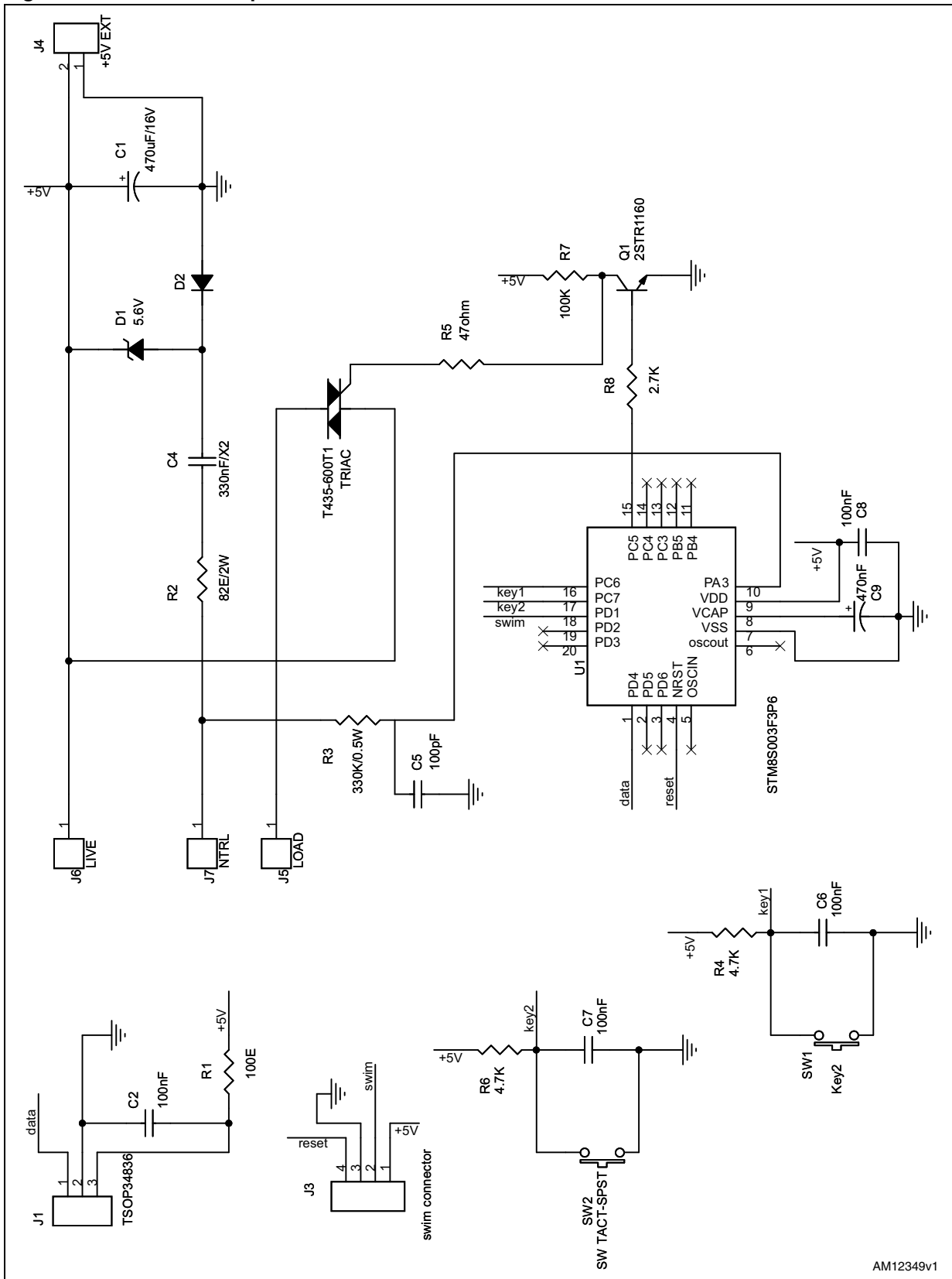


Figure 6. Remote fan speed controller



AM12349v1

3.1 Bill of materials

Table 2. BOM

Category	Reference designator	Component description	Package	Manufacturer	Manufacturer's ordering code / orderable part number	Supplier	Supplier ordering code
Document / project reference: BOM for the AC Fan speed controller/dimmer							
ST devices	U1	STM8S003F3 value line series MCU	TSSOP-20	STMicroelectronics	STM8S003F3P6		
	Q1	Logic level TRIAC	TO-220AB	STMicroelectronics	T435-600T		
	Q2	NPN transistor	SOT-23	STMicroelectronics	2STR1160		
Other devices	TSOP	IR receiver 38 kHz, DOME AXIAL	TSOP 2.54 mm	Vishay	TSOP34838	Digi-key	751-1386-5-ND
	D1	Zener diode 5.6 V/ 0.5 W	SOD123	Any	DDZ5V6B-7	Digi-key	DDZ5V6BDICT-ND
	D2	LL4148	SOD80	Any	LLN4148	Digi-key	LL4148FSCT-ND
Capacitors	C1	470 μ F/16 V electrolytic	Radial 8 mm diameter / 3.5 mm pitch	Any		Digi-key	P5141-ND
	C2, C6,C7,C8	100 nF ceramic	SMD0805	Any			
	C4 ⁽¹⁾	330 nF or 680 nF/X2 rated film capacitor	22.5 mm pitch	Vishay	BFC238312334 or BFC233920684	Digi-key	2222 383 12334-ND or BC2591-ND
	C5	100 pF ceramic	SMD0805	Any			
	C9	470 nF ceramic	SMD0805	Any			
Resistors	R1,R5	100 Ω	SMD0805	Any			
	R2	82, 2 W	Leaded	Yageo	RSF200JB-82R	Digi-key	82W-2-ND

**Table 2. BOM (continued)**

Category	Reference designator	Component description	Package	Manufacturer	Manufacturer's ordering code / orderable part number	Supplier	Supplier ordering code
Resistors	R3	330 k Ω /0.5 W	Leaded	Any		Digi-key	PPC330KW-1CT-ND
	R4,R6	4.7 k Ω	SMD0805	Any			
	R7	100 k Ω	SMD0805	Any			
	R8	2.7 k Ω	SMD0805	Any			
Switches	SW1, SW2	Pushbutton switch right angle	Switch tactile SPST-NO 0.05 A 12 V	TT Electronics	SWT6-R6K	Digi-key	987-1385-ND
Document / project reference: BOM for the IR remote transmitter							
ST devices	U1	STM8L101 8-bit low power MCU	TSSOP-20	STMicroelectronics	STM8L101F2P6		
	Q1	PNP transistor	SOT-23	STMicroelectronics	2STR2260		
Other devices	IRLED	940 nm IR LED	3 mm through hole	Vishay	TSAL4400	Digi-key	751-1201-ND
	BT1	3 V CR2032 battery retainer		Memory protection devices	BK-833	Digi-key	BHSD-2032-SMCT-ND
Capacitors	C1	100 nF ceramic	SMD0805	Any			
Resistors	R1	22 Ω	SMD0805	Any			
Switches	SW1, SW2, SW3 ⁽²⁾	Carbon contact pushbutton switch on PCB	ENIG gold plated carbon contact switch (PCB)			3	
Enclosure	N/A	BOSS 3 button key fob enclosure	Enclosure	Boss Enclosures	2955-20R-3	Farnell	1264656

1. C4 X2 rating is important for reliable operation. A DC rated capacitor (even rated at 1000 V DC) fails over time as it is not designed to withstand the stress conditions present on AC supply lines. Use 330 nF for 230 V AC nominal supply voltage and increase to 680 nF for 110 V AC supply.
2. SW1, SW2, SW3 are carbon contact footprints on the PCB while the actual carbon contact is integrated into the enclosure. Alternately, a 2-pin tactile SMD switch from MULTICOMP part no. DTSM-32S-B can be used on the same footprint.

Appendix A Definitions

Table 3. Definitions for acronyms

Acronym	Definition
IR	Infrared
MCU	Micro controller unit

Revision history

Table 4. Document revision history

Date	Revision	Changes
07-Dec-2012	1	Initial release.

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