ASL-01 Operational Description (Theory of Operation)

The August Smart Lock (ALS-01) is a device that allows remote locking/unlocking of a user's door. The ASL-01 is placed over the door's existing "dead-bolt" lock on the inside of the user's door. The ASL-01 measures 3.39" dia. x 2.24" height (86mm dia. x 57mm height) and weighs 14.0 oz. (400 g). No special tools are required for installing and removing the lock once the mounting plate has initially been installed (requiring a common screwdriver included with each lock). The ASL-01 is mounted and secured by means of a set of mounting tabs (operated by the user's fingers) on the back of each unit. The ASL-01 can be easily installed and removed giving the user access to the serial number, FCC, and IC information (the labels are placed on the back of the ASL-01 for aesthetic reasons). After installing the ASL-01 and inserting batteries (x 4 AA alkaline), the unit begins broadcasting (Bluetooth low energy (BLE)) advertising packets. The advertising packet broadcast interval is once every 318.75 ms (at a power level of 0dBm). The user connects to the ASL-01 using their smartphone (iOS or Android) running the August smart lock application.

Once the ASL-01 has been discovered by the user's smartphone, the August application will connect to the ASL-01 automatically. After connecting, the user can registers and calibrates the ASL-01. Once calibrated, the user can lock and unlock their door via the ASL-01 and a smartphone. Any Bluetooth v4.0 (BLE) master (or central) can query and connect to the ASL-01 (which is always a client or peripheral) but the commands to change the state of the lock (unlock, lock & calibrate), are proprietary and encrypted.

Connections with a BLE master will terminate after 30 seconds if no valid commands are received by the ASL-01. The 30 second time-out feature prevents radio jamming. When the ASL-01 is not connected to the user's smart phone or other BLE master, the unit will return to advertising mode. The maximum power output of the ALS-01 is based on the Bluetooth BLE radio of the Texas Instrument CC2541 microcontroller (which has a maximum output power of 0dBm). The ASL-01 receiver sensitivity is -88dBm (typical).

Steps for Operating the ASL-01:

Remote Unlock:

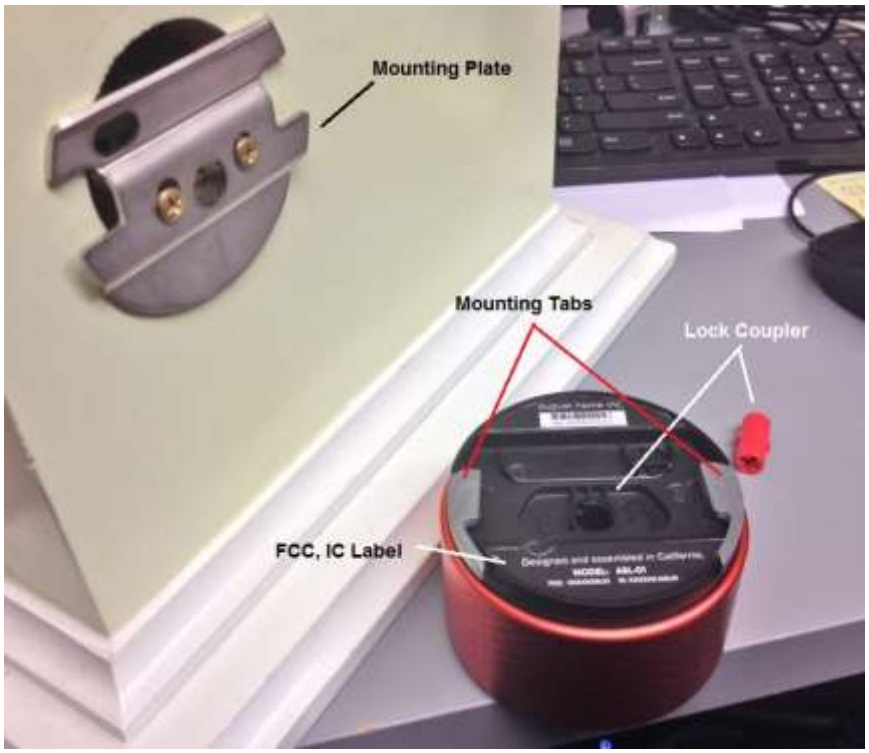
1. Start the August smart lock application on smartphone.
2. Stand near the ASL-01 and wait for the application to indicate it has established a connection.
3. Operate the ASL-01 and lock by pressing buttons on the smartphone application.
4. Open the door and Enter/Exit home.
5. Use smartphone application to re-lock the door.

The ASL-01 does not prevent the user from using their door lock in the traditional way. Keys can still be used to lock/unlock the door and the ASL-01 can be manually rotated to lock/unlock the door from the inside of the home.

ASL-01 Operational Description (Theory of Operation) (continued.)

Mounting the ASL-01 on a door:

Once the mounting plate has been install on the door, the ASL-01 is easily installed/removed via the mounting tabs.



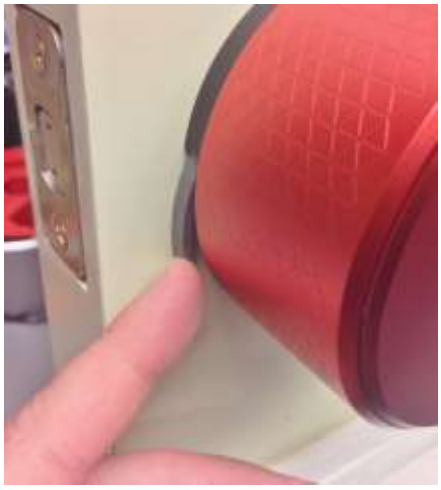
Insert coupler.

Open mounting tabs.

ASL-01 Operational Description (Theory of Operation) (continued.)

Attach ASL-01 to coupler.

Hold ASL-01 in place.



Press down on the tabs.

ASL-01 is installed.

ASL-01 Operational Description (Theory of Operation) (continued.)

Removing the ASL-01 from a door:


Place finger under mounting taps and lift.


Lift the mounting tabs on both sides of the lock until they are in the open positon.

ASL-01 Operational Description (Theory of Operation) (continued.)

Hold ASL-01 in place and remove. The serial number and FCC/IC information is easily accessible.

ASL-01 Audio and visual indicators:

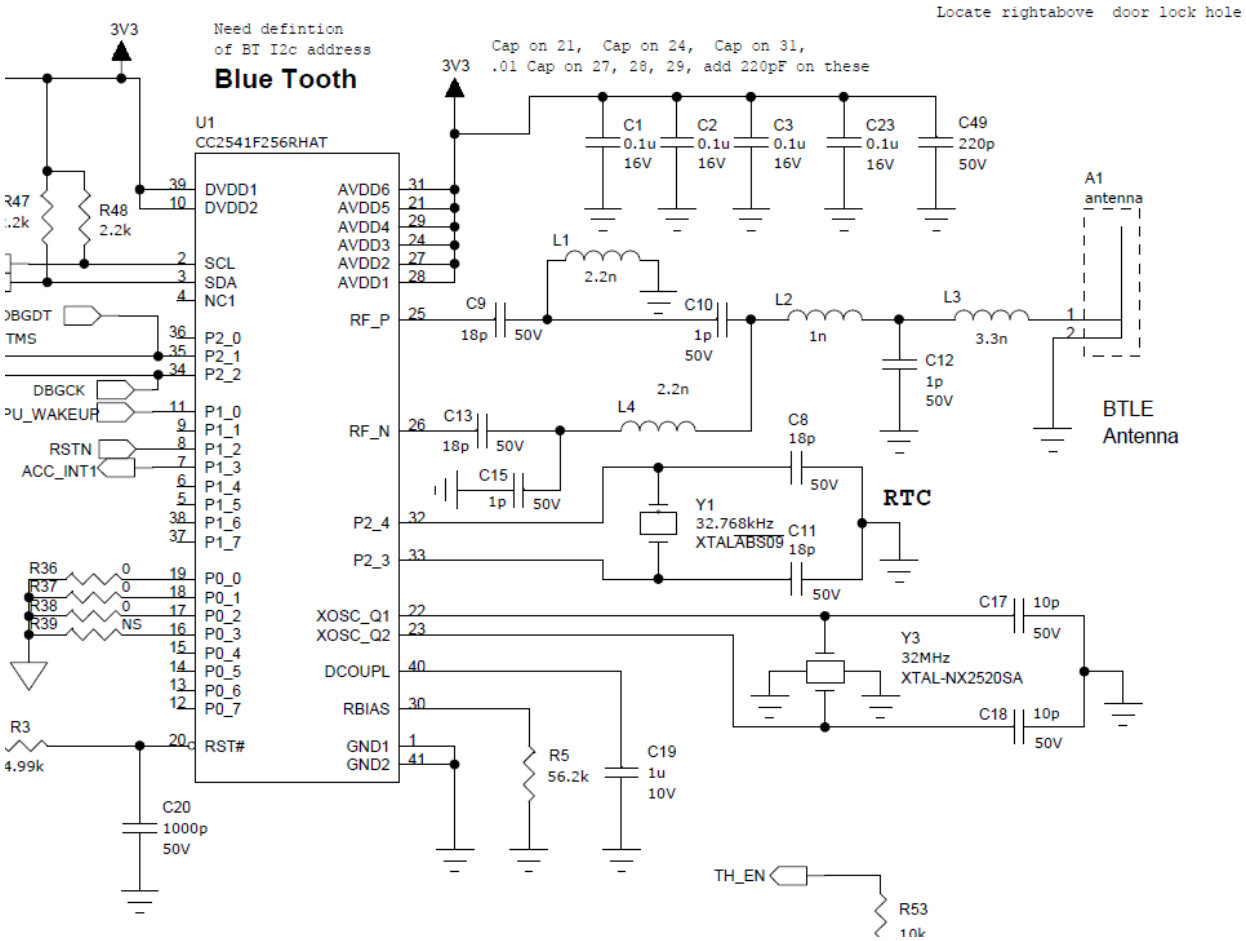
The ASL-01 contains 16 LEDs (x8 red, x8 green) arranged in a ring configuration visible through micro perforation in the aluminum face plate. These LEDs are used to produce animations indicating to the user the operating states of the ASL-01. The ASL-01 also contains a speaker with a maximum output power of 1Watt to provide audio feedback to the user during operation.

ASL-01 Operational Description (Theory of Operation) (continued.)

ASL-01 RF Section:

The RF section of the ASL-01 was designed around the CC2541 chip from Texas Instruments. This is a microcontroller which contains a Bluetooth low energy radio. The RF section of the ASL-01 schematic is a replica of the FCC certified Texas Instruments "Keyfob" reference design (Shown on the next page). The matching network is used to match the output impedance of the CC2541 (70 ohms typical) to the 50 ohm antenna.

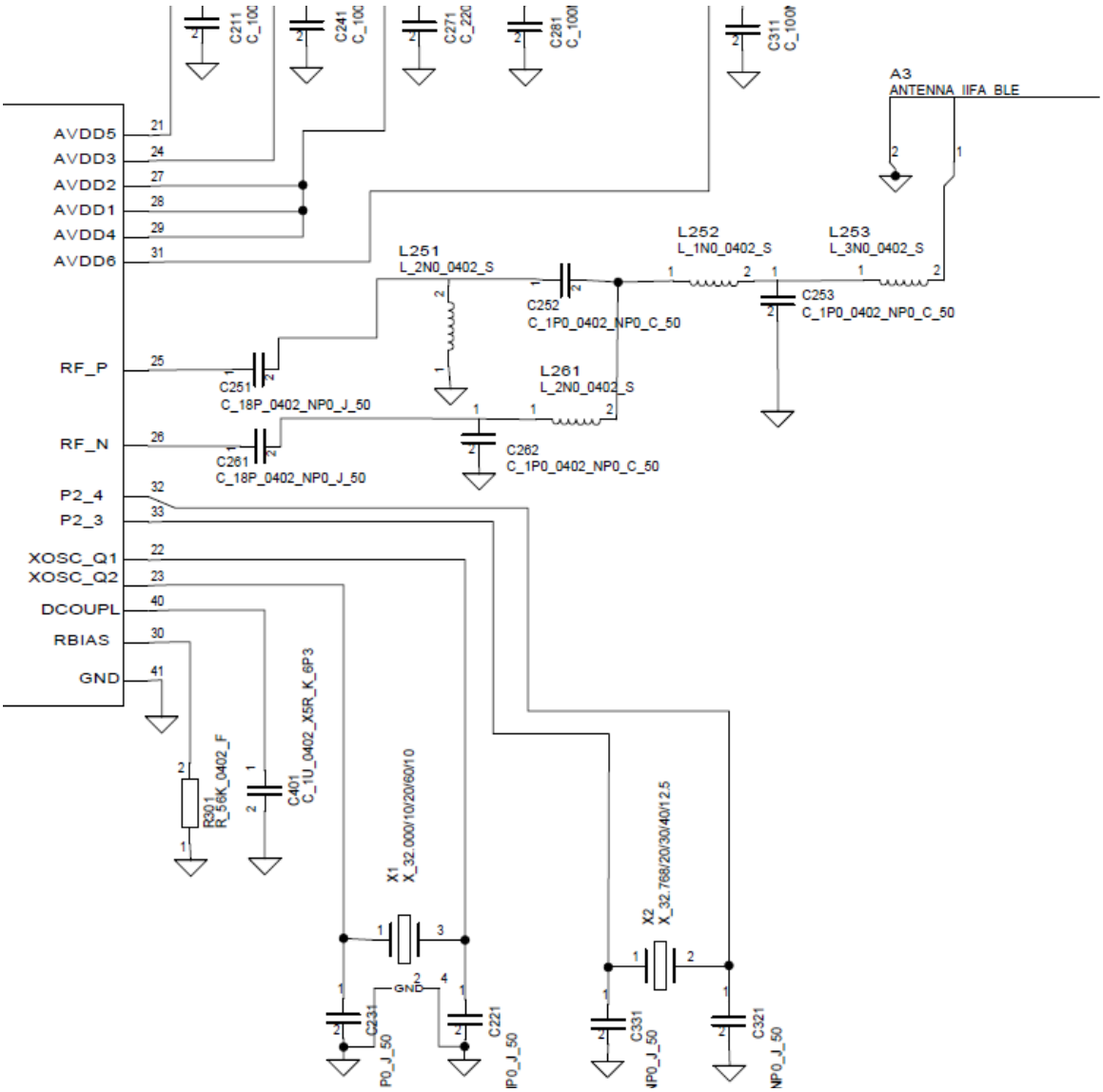
Specification and Frequencies: Bluetooth v4.0 (BLE), 2.4GHz ISM band (2402MHz to 2480MHz),
Channels: 40 x 2.0MHz channels
Data rate & Modulation: 1Mbps, GFSK, 250 kHz deviation.
Transmitted Power: 0dBm Max.
Receive Sensitivity: -84dBm Typical
Antenna: Printed circuit board Internal Single-band (Internal IFA)
Antenna Gain in dBi: 3dBi Typical



ASL-01 CC2541 RF Section from Schematic

ASL-01 Operational Description (Theory of Operation) (continued.)

Note: From the CC2541 Datasheet, Texas Instruments (page 8):
Output Power delivered to a single-ended 50-Ω load through a balun (or matching network) using maximum recommended output power setting= 0dBm typical maximum and -23dBm typical minimum.

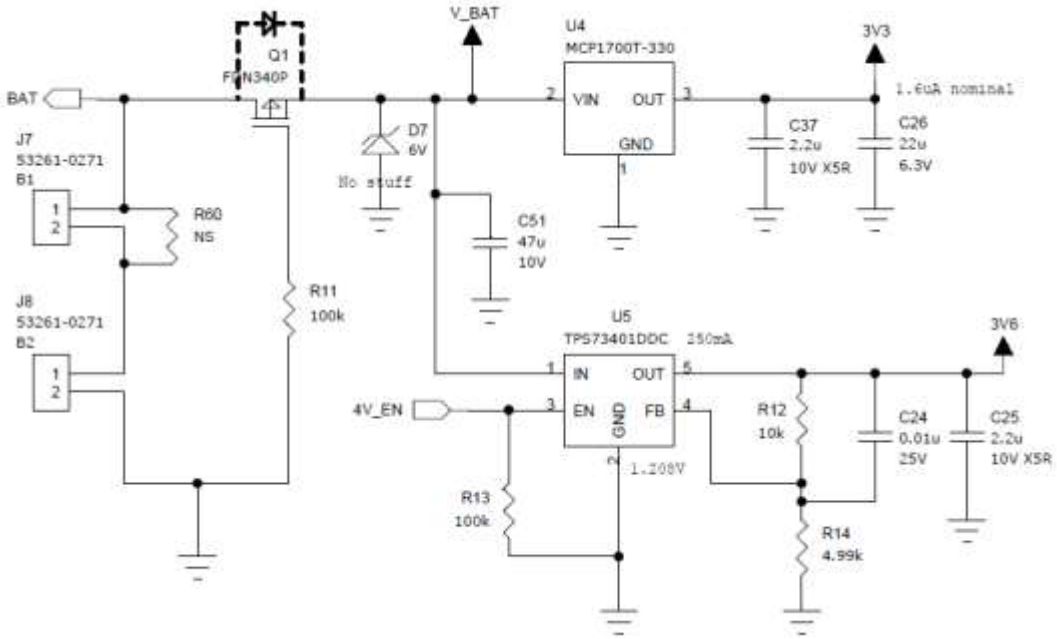


Texas Instruments Keyfob reference design CC2541 RF Section from Schematic

ASL-01 Operational Description (Theory of Operation) (continued.)

Power Requirements:

The power/voltage requirements for the ASL-01 are based on the input voltage limitations of the low drop-out regulators of the power supply and the operating voltage/current of the motor and driver circuits. The input voltage regulators limit the voltage input to +7.0VDC maximum and the motor and driver circuit have a minimum operational voltage of +4.0VDC minimum (+6.0VDC nominal based on the motor specifications). The overall system current varies greatly depending on the mode of operation. When power is applied to the ASL-01, the ASL-01 will begin sending BLE advertising packets at regular time intervals of 318.75ms. During this time interval, a BLE transmit and receive takes place requiring 30mA maximum for transmit and 500uA maximum for receive. The duration of this process lasts less than 10ms at which point the system returns to a sleep state consuming less than 100uA. When a connection is made with the ASL-01 and the lock is operated (e.g. unlock/lock), the current can increase to 2.0A maximum depending on the torque required to turn the particular lock the ASL-01 is attached to. The lock/unlock process lasts for a duration of 5 to 10 seconds depending on the angles and torque required to operate the particular lock. The maximum deliverable torque of the ASL-01 is 10in/lbs. The overall quiescent current of the ASL-01 is < 200uA (i.e. when not advertising or moving the lock). In order to meet the voltage and current requirements of the ASL-01, x4 AA alkaline batteries are used as the power source. Under normal operating conditions (five unlock/lock cycles at 23°C), the alkaline batteries can last from several months to one year depending on the age and quality of the batteries installed.



ASL-01 Power Supply Section from Schematic

ASL-01 Operational Description (Theory of Operation) (continued.)

Environmental requirements:

The ASL-01 is designed to be operate in doors over the commercial temperature range. The operating temperature range is +32°F to +131°F (0°C to 55°C) and the storage temperature range is -4°F to +140°F (-40°C to 60°C). The operating humidity range are 10% to 85% noncondensing and the storage humidity range is 5% to 90% noncondensing. The ASL-01 is not hermetically sealed and is not designed to operate in corrosive environments.