Application Circuit of Low Power Consumption Op-Amp TC75S102F

Reference Guide

RD229-RGUIDE-01

TOSHIBA ELECTRONIC DEVICES & STORAGE CORPORATION

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1. Introduction

Future market growth is expected in sensing applications of IoT and also in the energy harvesting applications which are important for becoming carbon neutral. Targeting these markets, we have released a low power op-amp TC75S102F, and developed an Application Circuit using this Low Power Consumption Op-Amp TC75S102F as a reference design (hereafter referred to as "this design").

This Reference Guide describes the specification and operation procedure of this design. This design uses low power op-amp(s) TC75S102F, Schottky barrier diodes 1SS389 to prevent reverse current flow to the power supply terminal, a Zener diode CEZ5V6 to protect from overvoltage, a MOSFET SSM3K15AFU for driving LED, and a low dropout regulator (LDO) TCR3UF20A as a power supply IC.

2. Specifications and Appearance

2.1 Specifications

Table 2.1 lists the main specifications of various designs of this application circuit.

Table 2.1 Specifications

Design Name	Onboard Sensor	Charging Method	Operation
A1	Light sensor (photodiode)	USB Type-C®	LED turns on after sensor detection
A2			LED blinking interval changes according to the sensor value
A3		USB Type-C® Solar cell	
B1	Pressure sensor (Polymer thick film)	USB Type-C®	LED turns on after sensor detection
B2			LED blinking interval changes according to the sensor value
B3		USB Type-C® Solar cell	
C1	Sound sensor (MEMS microphone)	USB Type-C®	LED turns on after sensor detection
C2			LED turns on after sensor detection (equipped with Op-Amp offset cancelling DC servo function)
C3		USB Type-C® Solar cell	

2.2 Circuit Block Diagram

Fig. 2.1 shows the block diagram of this circuit.

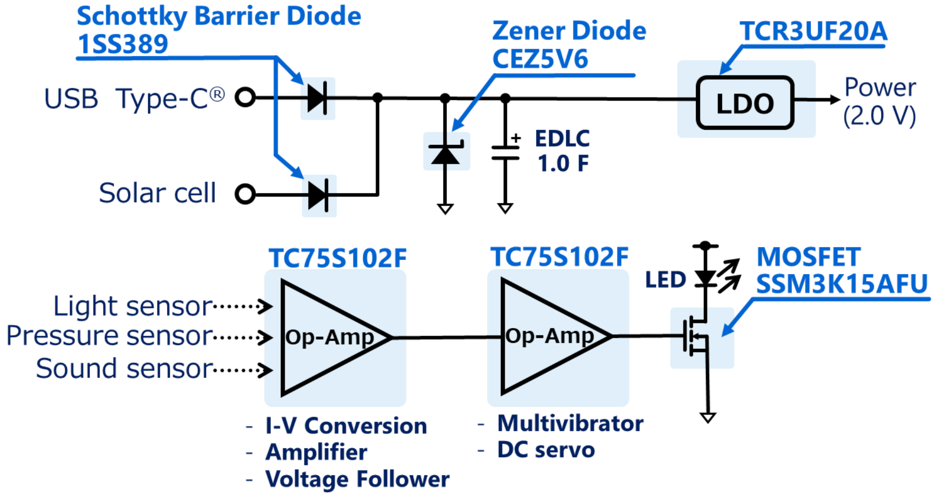


Fig. 2.1 Circuit Block Diagram

2.3 Appearance and Component Arrangement

Fig. 2.2 to 2.10 show the external appearance of this design, and Fig. 2.11 and 2.12 show the layout of major components.

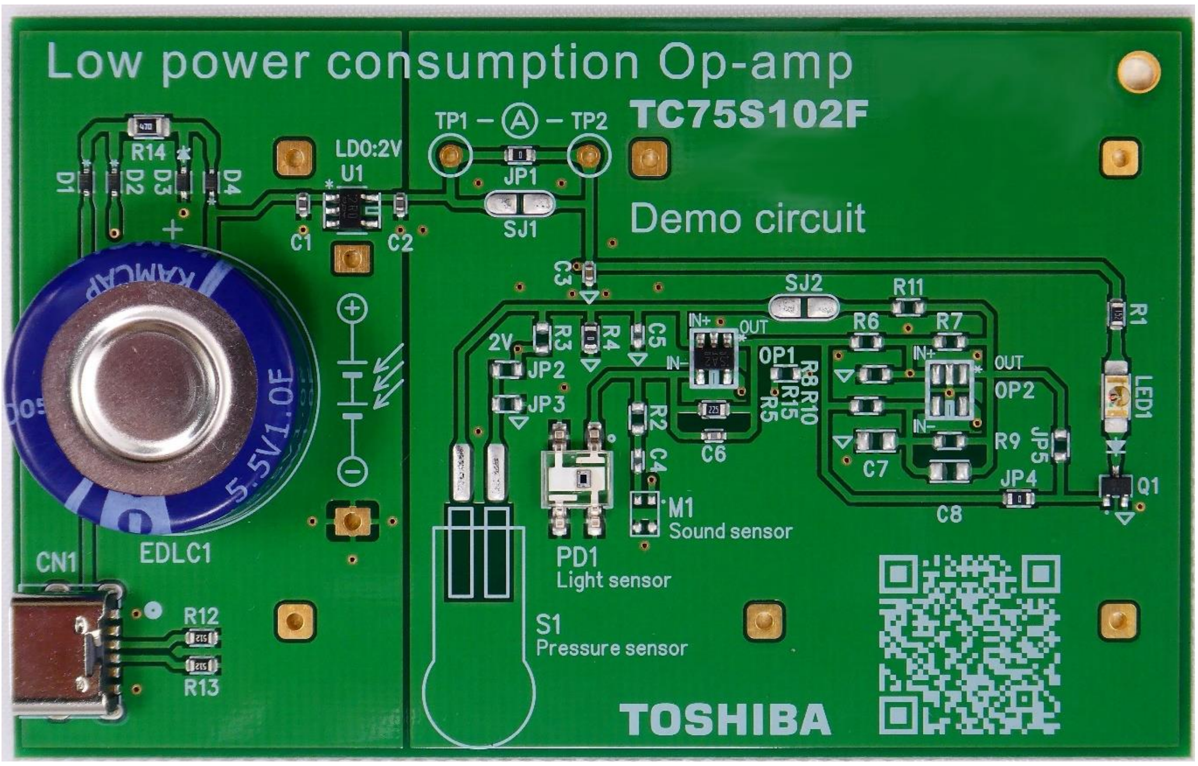


Fig. 2.2 Front Side of the Board (Design A1)

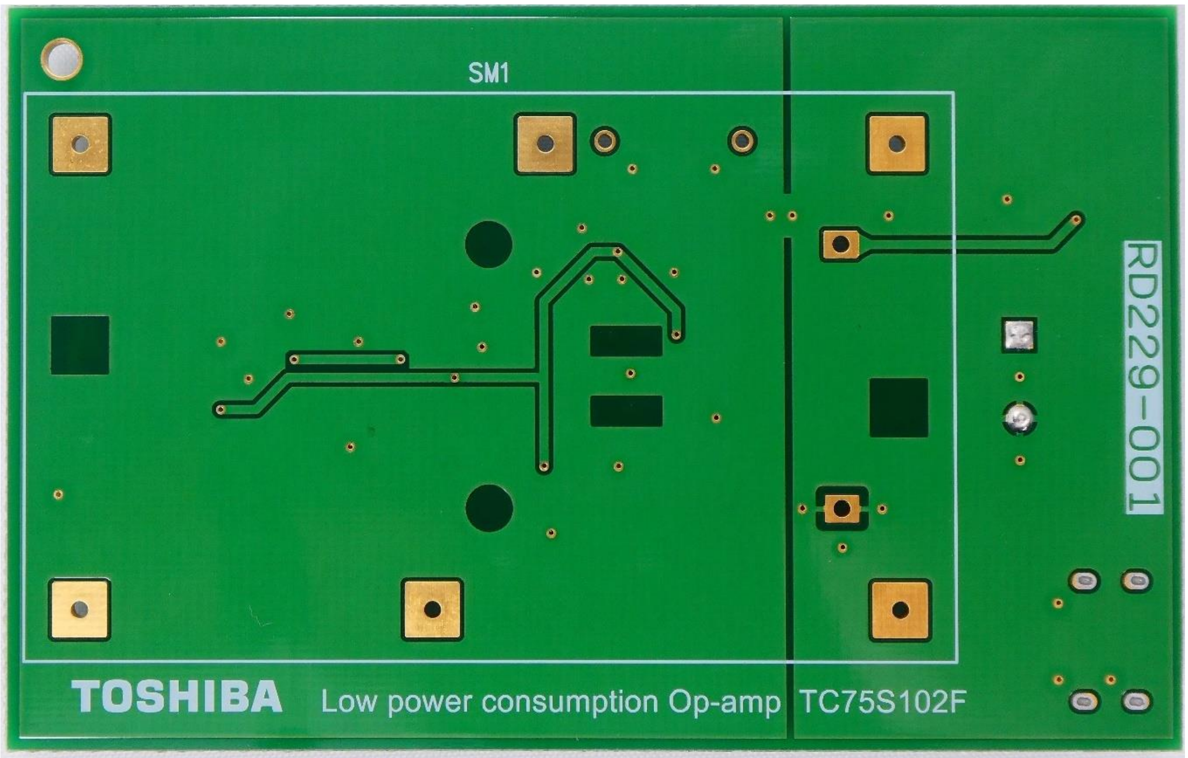


Fig. 2.3 Back Side of the Board (Design A1, A2, B1, B2, C1, C2)

Fig. 2.4 Front Side of the Board (Design A2)

Fig. 2.5 Front Side of the Board (Design A3)

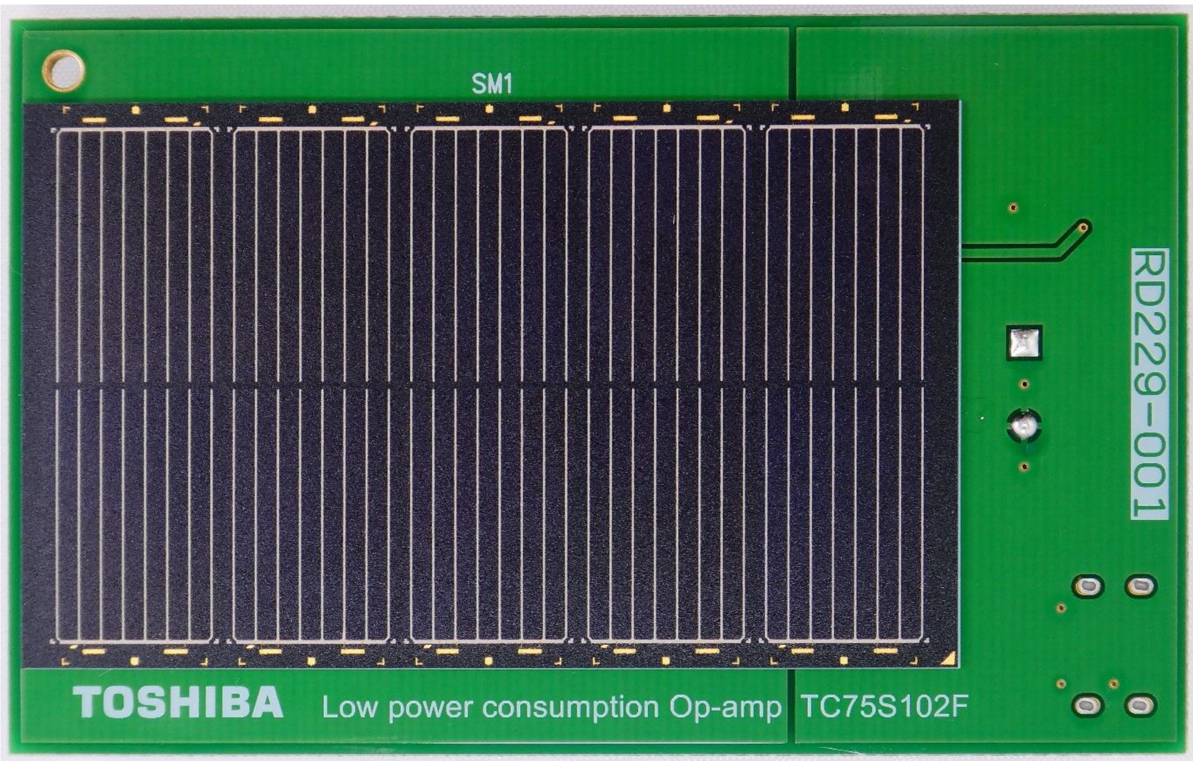


Fig. 2.6 Backside of the Board (Design A3, B3, C3)

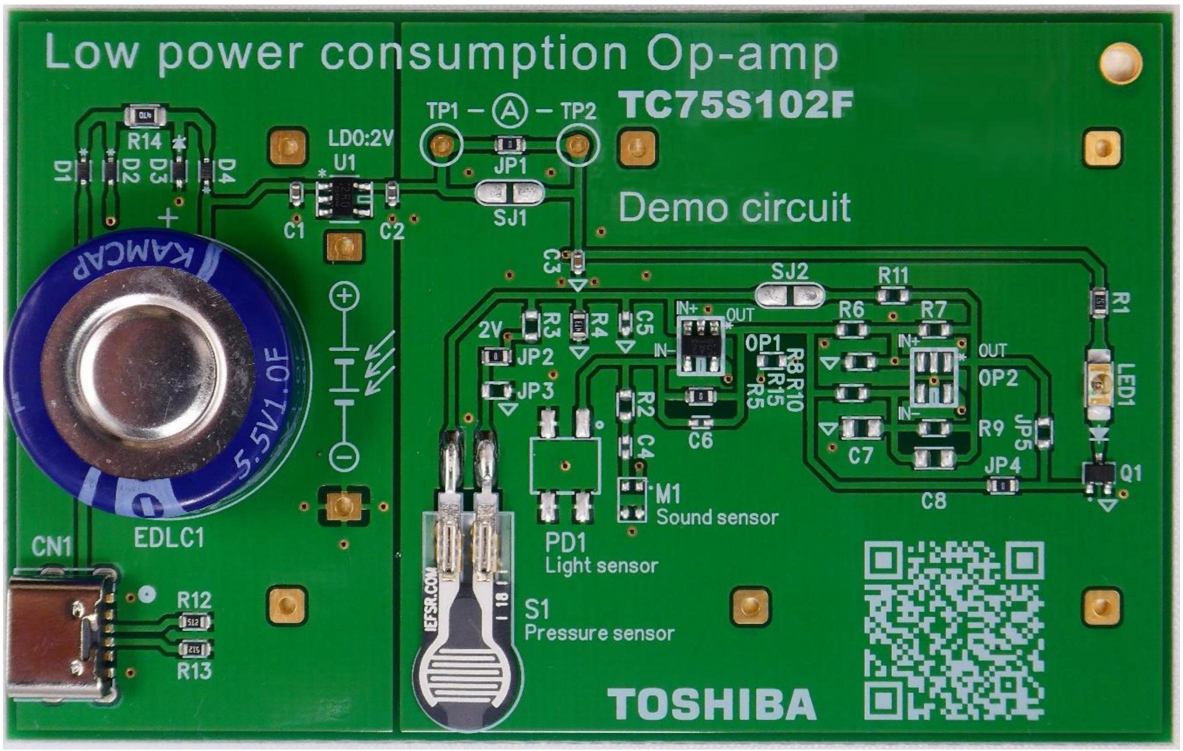


Fig. 2.7 Front Side of the Board (Design B1)

Fig. 2.8 Front Side of the Board (Design B2)

Fig. 2.9 Front Side of the Board (Design C1)

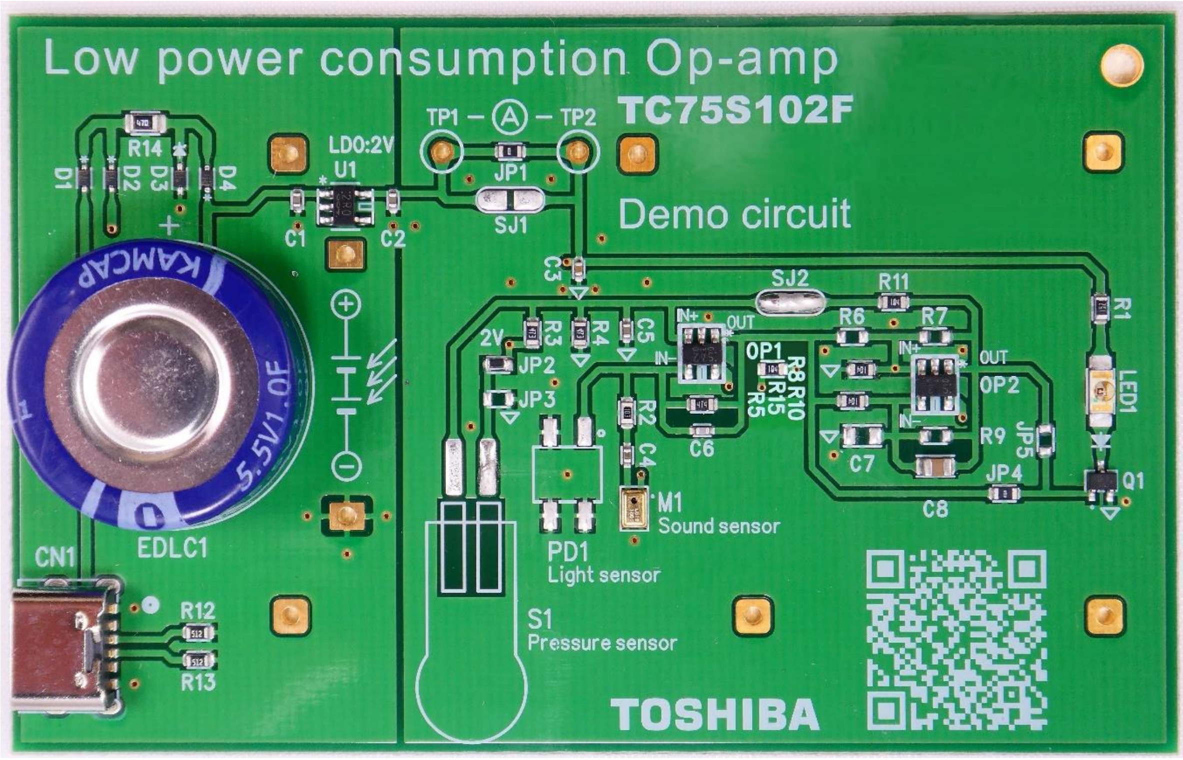


Fig. 2.10 Front Side of the Board (Design C2)

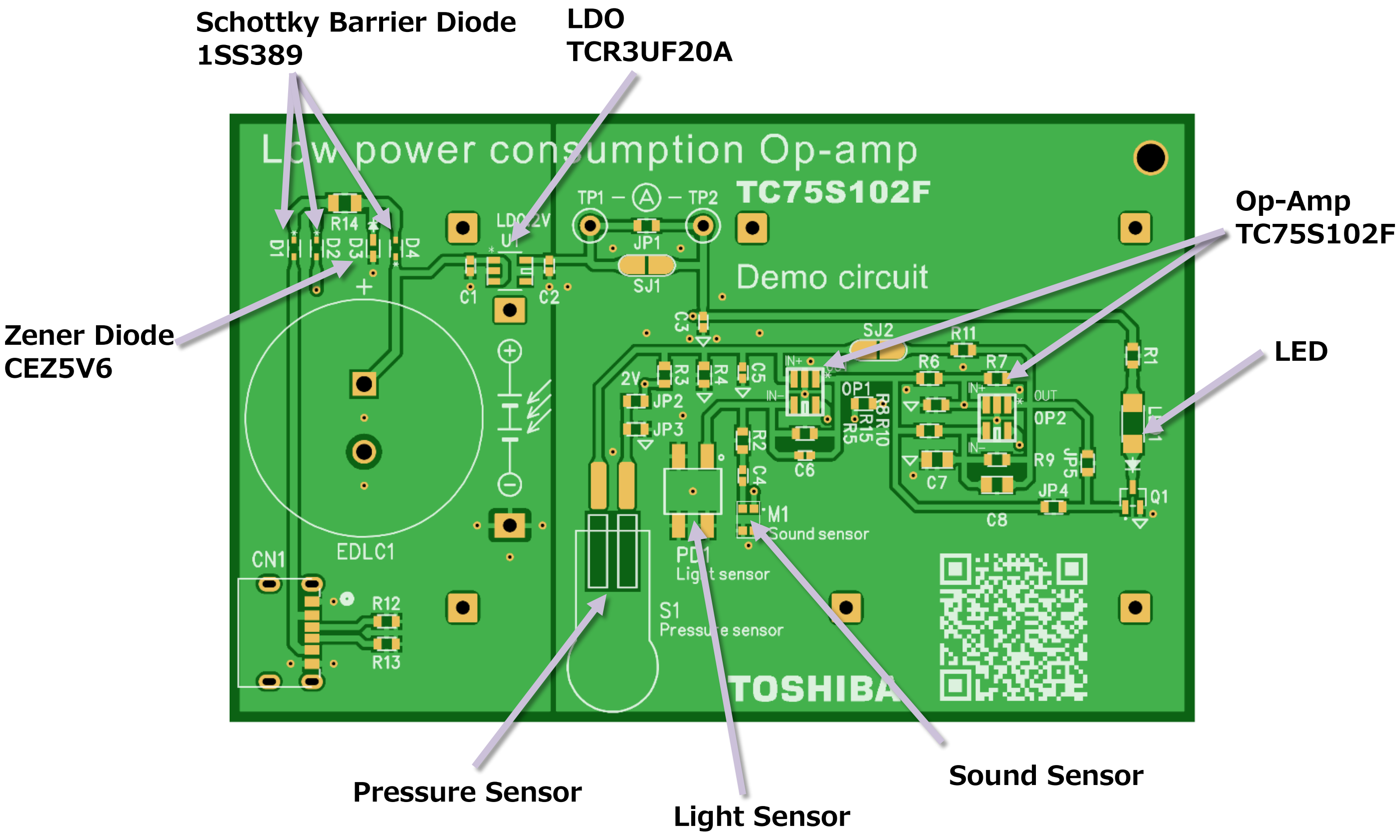


Fig. 2.11 PCB Component Layout (Front Side)

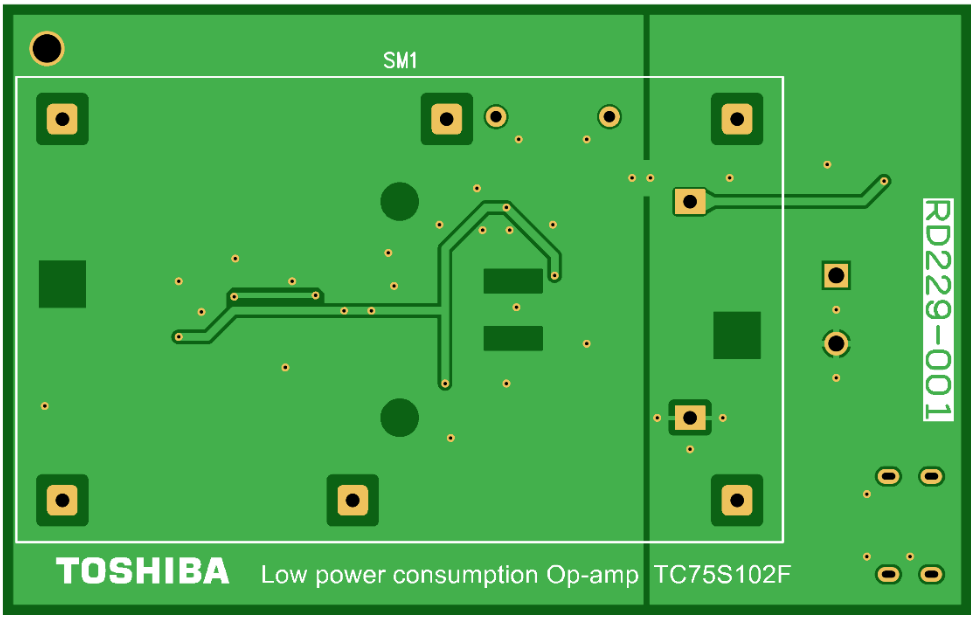


Fig. 2.12 PCB Component Layout (Back Side)

3. Schematic Diagram, Bill of Material, and PCB Pattern

3.1 Schematic Diagram

Refer to the following files:

Light-sensor board (Design A1) RD229-SCHEMATIC1-xx.pdf
Light-sensor board (Design A2) RD229-SCHEMATIC2-xx.pdf
Light-sensor board (Design A3) RD229-SCHEMATIC3-xx.pdf
Pressure-sensor board (Design B1) RD229-SCHEMATIC4-xx.pdf
Pressure-sensor board (Design B2) RD229-SCHEMATIC5-xx.pdf
Pressure-sensor board (Design B3) RD229-SCHEMATIC6-xx.pdf
Sound-sensor board (Design C1) RD229-SCHEMATIC7-xx.pdf
Sound-sensor board (Design C2) RD229-SCHEMATIC8-xx.pdf
Sound-sensor board (Design C3) RD229-SCHEMATIC9-xx.pdf
(xx is the revision number.)

3.2. Bill of Material

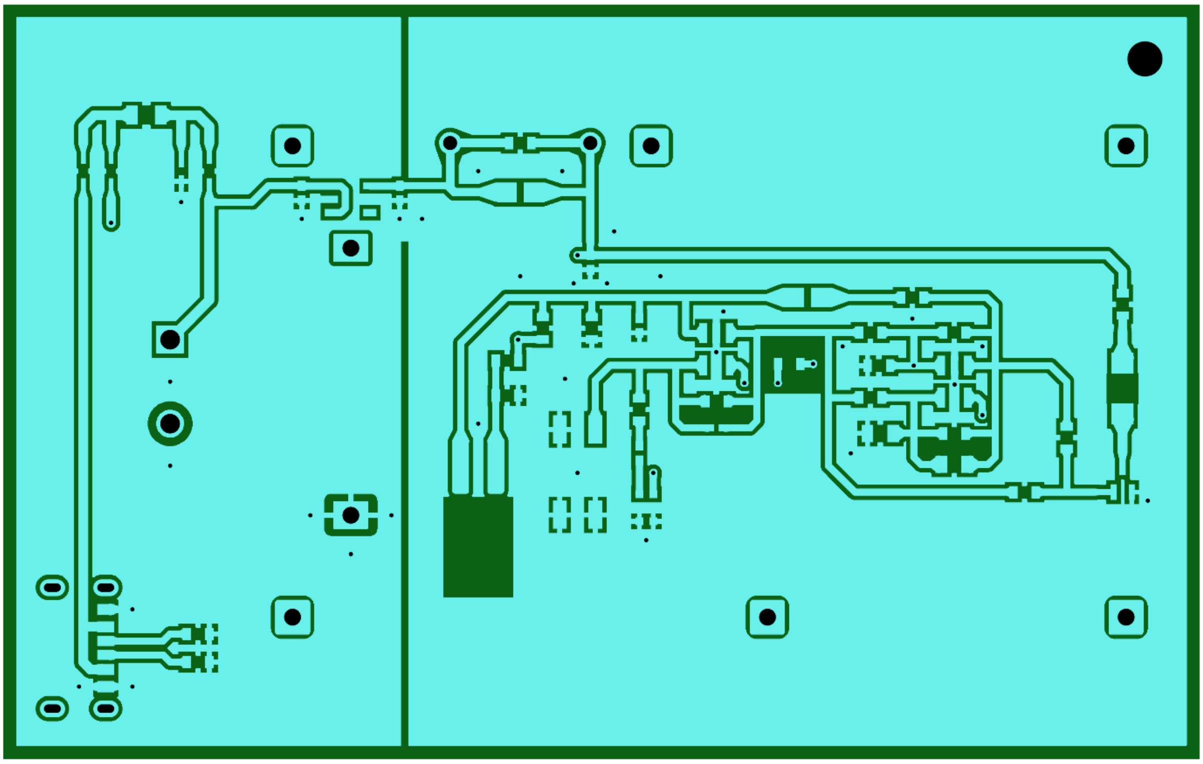
Refer to the following file:

RD229-BOM-xx.pdf
(xx is the revision number.)

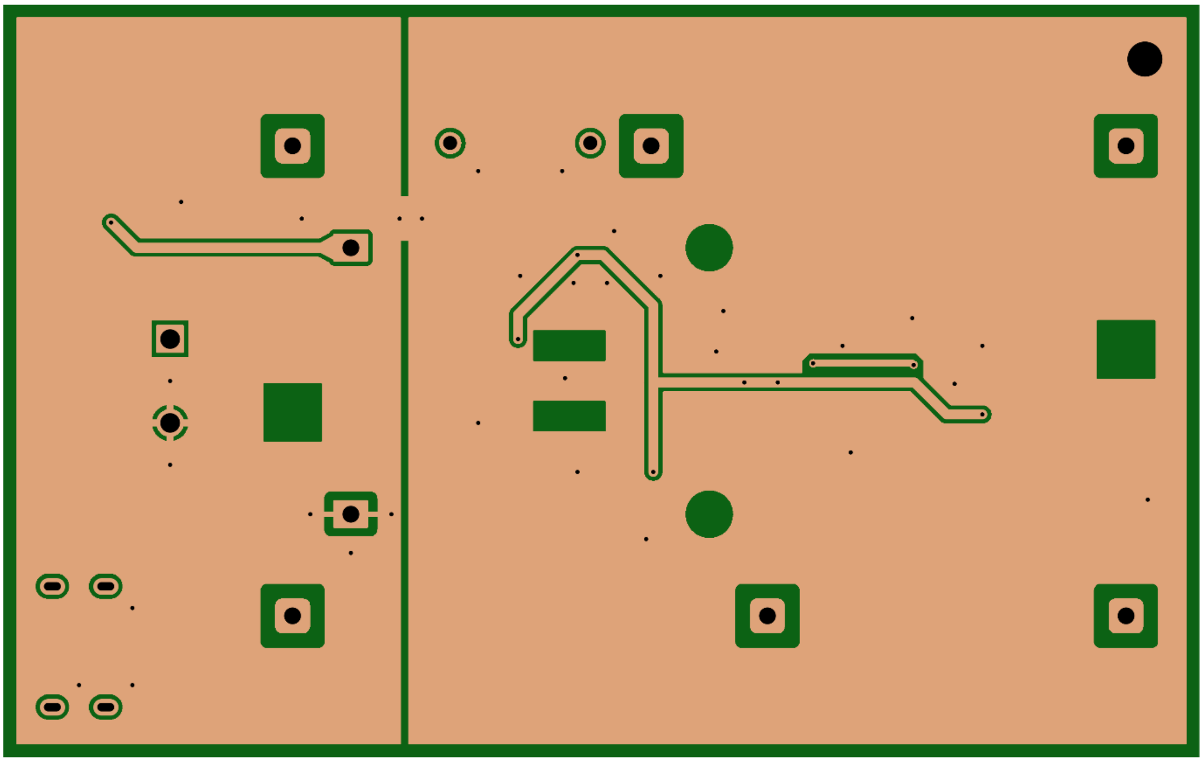
3.3. PCB Pattern

Fig. 3.1 shows the pattern diagram of the board.
Also refer to the following file:

RD229-LAYER-xx.pdf
(xx is the revision number.)



<LAYER1 >



<LAYER2>

Fig. 3.1 PCB Pattern (Front View)

4. Operation

4.1 Operation Method

The standard procedure for starting this circuit is as follows.

4.1.1. Pre-charge

・Connect a USB charger to USB Type-C® connector (CN1) to charge the electric double layer capacitor.

(about 30 seconds).

・For the designs with solar cell (design A3, B3, C3), irradiate the solar cell with sunlight, etc. to charge the electric double layer capacitor.

(for approximately 2 minutes on a sunny day).

It can also be charged using USB Type-C® connector.

・After that, the USB charger can be disconnected, and the board can be used standalone.

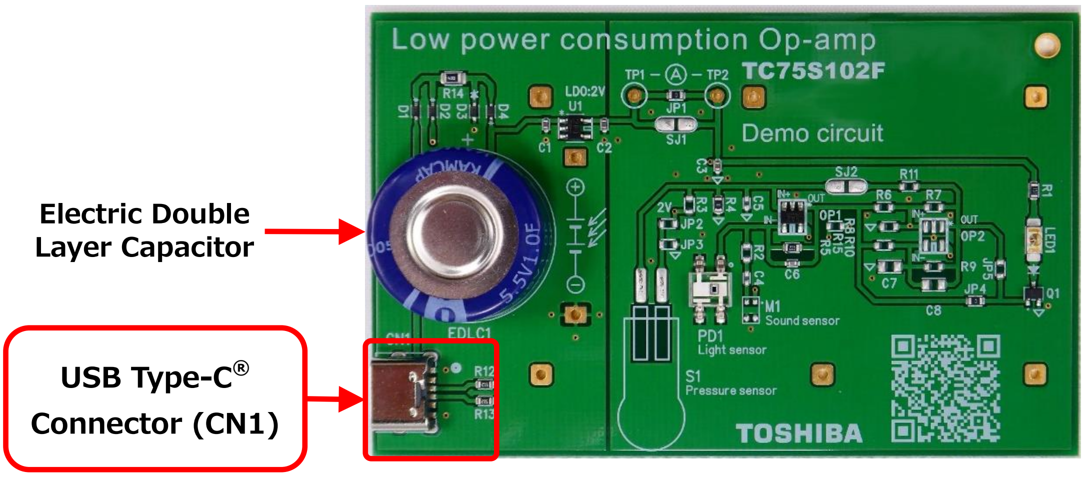


Fig. 4.1 Front Side of the Board (Example of Design A2)

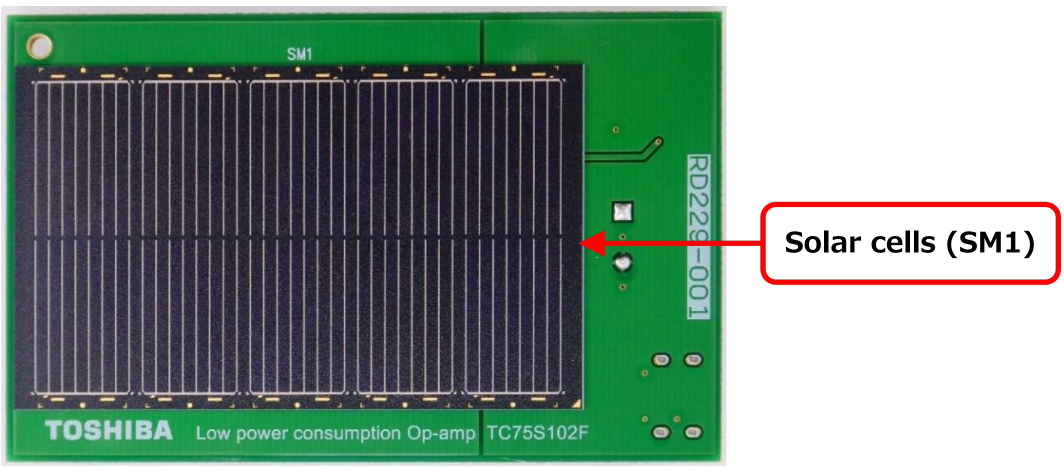


Fig. 4.2 Back Side of the Board (Example of Solar Cell Mounted Board)

4.1.2. For Design A1, A2, A3

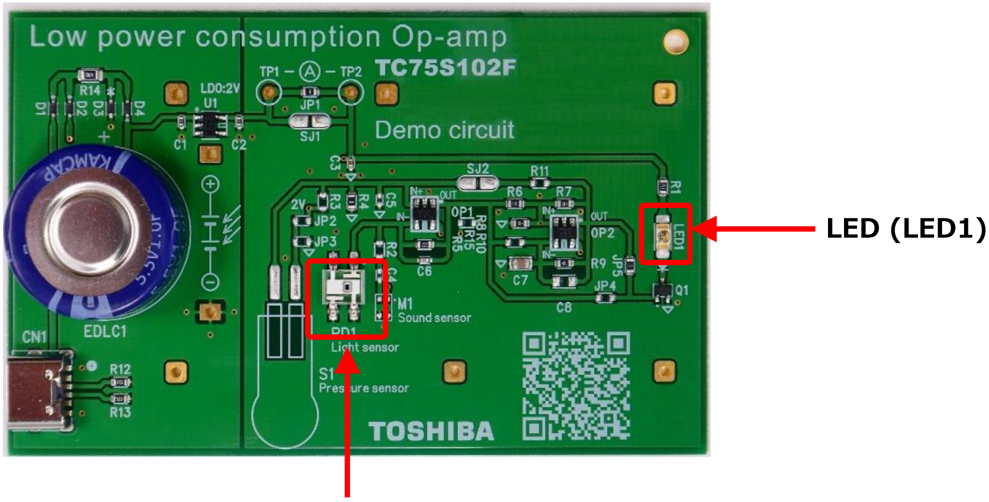


Fig. 4.3 Light Sensor Board (Example)

・Design A1

The LED turns on when the light sensor detects the light.

・Design A2, A3

The LED blinking interval changes according to the brightness of light detected by the light sensor.

(If the brightness increases, the blinking interval becomes shorter).

4.1.3. For Design B1, B2, B3

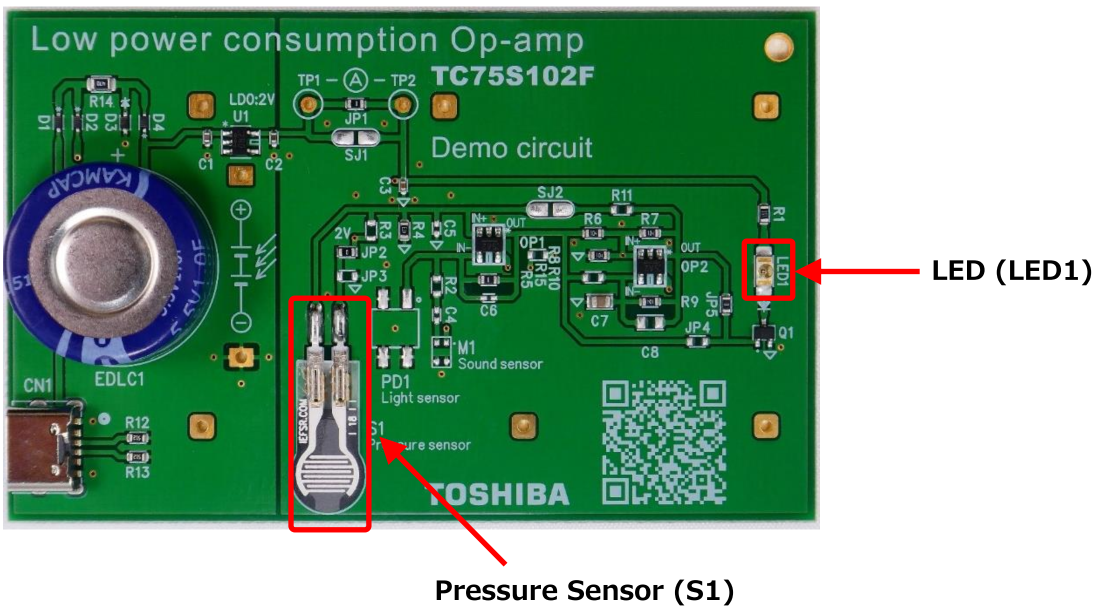


Fig. 4.4 Pressure Sensor Board (Example)

・Design B1
The LED turns on when pressure is applied to the pressure sensor.

・Design B2, Design B3
The LED blinking interval changes according to the pressure applied on the sensor.
(if the pressure increases the blinking interval decreases.)

4.1.4. For Design C1, C2, C3

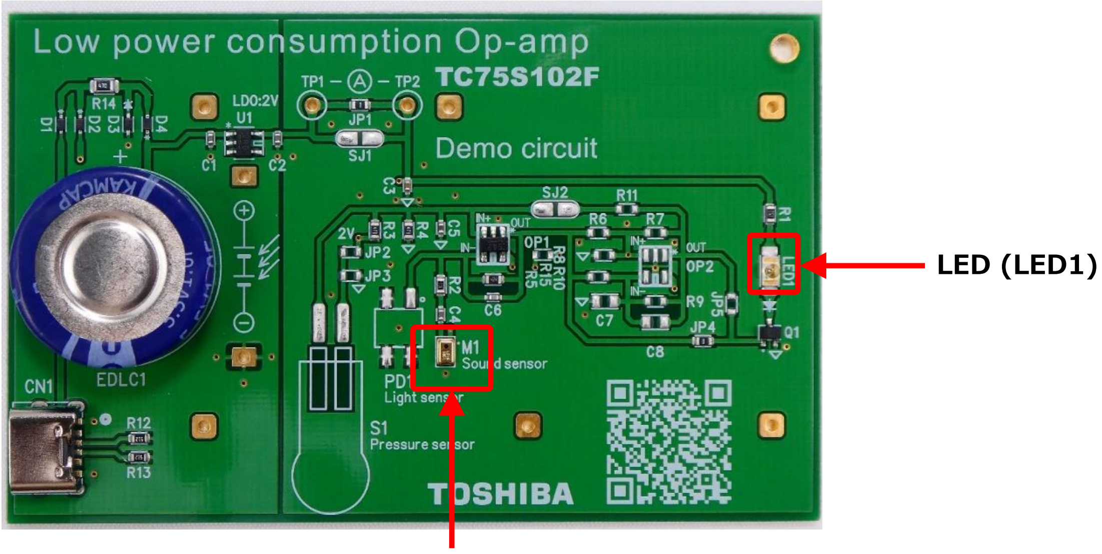


Fig. 4.5 Sound Sensor Board (Example)

The LED turns on when the sound sensor detects the sound.

4.2 External Connector Specifications

The external connector specifications of this circuit are as follows.

Table 4.1 Input Connector Specifications

Input Port	Input Voltage
CN1 (USB Type-C®)	5 V

5. Precautions

・Be careful not to touch any component of the board other than the sensor, as it may get destroyed by static electricity.

・Do not apply excessive voltage to USB Type-C® connector.

・Be careful not to short-circuit the pins of the electric double layer capacitor.

・When disposing of this board, follow the instructions from your local authorities.

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