# ISL29501-CS-EVKIT1Z

Cat Shark User Guide

UG081
Rev 0.00
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## Description

The ISL29501-CS-EVKIT1Z is a distance measurement reference design consisting of an optical board and a controller board. It combines the ISL29501 chip with an OSRAM SFH 4550 IR emitting LED and OSRAM SFH 213FA photo-diode. The two circuit boards are connected together with a flat flex cable. Included is a USB flash drive containing the evaluation software for a PC and related technical documents.

The ISL29501-CS-EVKIT1Z kit also allows quick evaluation of the ISL29501 performance for a 2m sensing system.

## Specifications

This board has been configured and optimized for the following operating conditions:

- Micro USB 2.0 connection
- $V_{IN}$ = 5V (USB power)
- $I_{DD}$ maximum = 225mA
- P optical maximum = 70mW
- Wavelength = 860nm
- Optical duty cycle maximum = 50%
- Emission angle = ±3°
- Coherent light - No

## Key Features

- Self contained measurement system
- Enables proximity detection and distance measurement
- Emitter DAC with programmable current up to 255mA
- Operates in continuous or single shot mode
- On-chip active ambient light rejection
- Regulated power 2.7V to 3.3V USB or external supply
- $I^2C$ interface supporting 1.8V and 3.3V bus
- Small size 38mmx20mm

## References

- ISL29501 Datasheet
- AN1966, "ISL29501 Sand Tiger Optics Application Note"
- AN1917, "ISL29501 Layout Design Guide"
- UG054, "ISL29501 Evaluation Software User Guide"
- AN1967, "Temperature and Ambient Light Data Collection"

## Ordering Information

| PART NUMBER | DESCRIPTION |
|---|---|
| ISL29501-CS-EVKIT1Z | ISL29501 Cat Shark evaluation kit, (EVB, USB cable, software, technical documentation) |

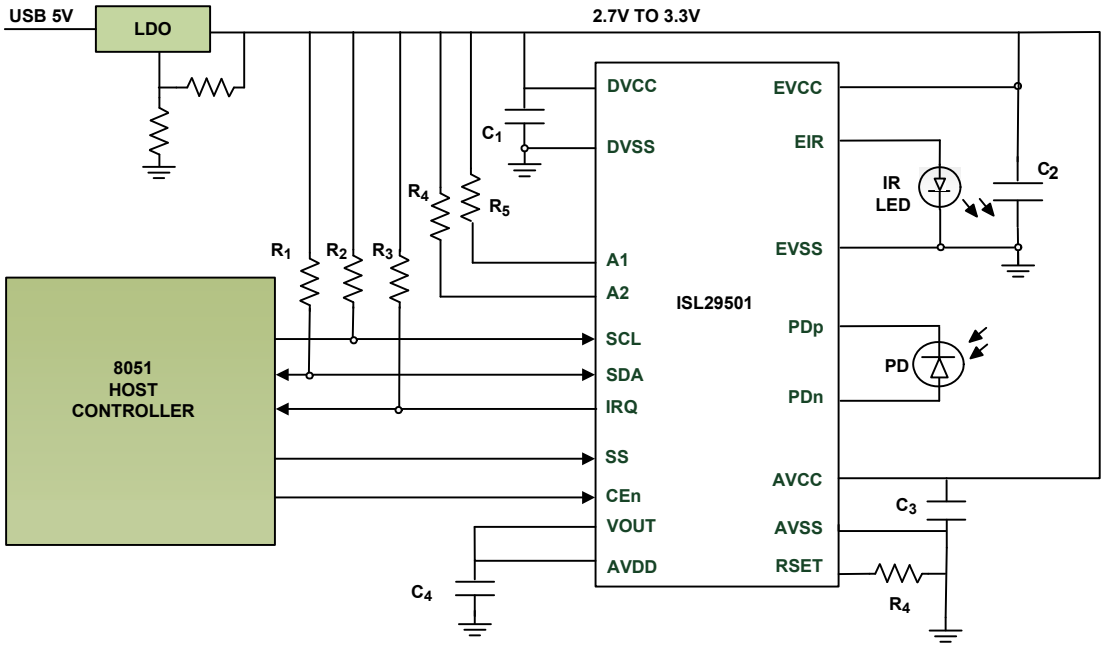



FIGURE 1. CAT SHARK BLOCK DIAGRAM

# Functional Description

The ISL29501-CS-EVKIT1Z is both a reference design and evaluation board set that provides a single platform to evaluate the features of the ISL29501. The ISL29501-CS-EVKIT1Z circuit board and supplied enclosure have been designed to deliver maximum electrical and optical performance.

The system sends out light pulses through the emitter LED and receives returned light pulses that reflect off a target on the optics board. The difference in phase of the emitted signal and the return signal is converted to distance by the ISL29501 and is graphed in the evaluation software. The magnitude of the return signal is graphed as well. This and additional data are available in the chip registers, see UG054, “ISL29501 Evaluation Software User Guide” for additional details.

# Operating Features

The ISL29501-CS-EVKIT1Z evaluation kit is shown in Figures 2 and 3. The hardware enable function is controlled by a software switch. A Power-Good (PG) LED indicates that the LDO is regulating properly when not lit.

## External Power Supply

For high current/high duty cycle setups USB power may not be able to power the board.

## External Microprocessor

For debugging of customer written software, it might be useful to connect the Cat Shark to a different microprocessor. All signals are available on the optics board connector J1. See the schematic for details. SCL and SDA are compatible with 1.8V microprocessors but unfortunately the support pins require 3V signaling.

## System Calibration

Before meaningful measurements can be made the calibration registers in the chip need to be loaded. This can be done in two ways. The first is to load a profile that contains data into the GUI. This can be one of the Intersil provided profiles or one that was saved previously by the user. See UG054, “ISL29501 Evaluation Software User Guide” for further details. The second is to calibrate the board directly.

## Calibrating Cat Shark

There are 3 separate standard calibrations that need to be executed in order to calibrate the system. These are magnitude, crosstalk and distance calibrations.

### MAGNITUDE CALIBRATION

Magnitude calibration is done after the emitter current and duty cycle settings are programmed. It is a dark (no light) calibration that takes less than 1s to run. Run this calibration from the GUI.

### CROSSTALK CALIBRATION

Crosstalk is defined as a signal that reaches the ISL29501 chip directly without bouncing off the target. This can be electrical or optical. At close range and large return signal values, crosstalk has a minor impact on distance measurements. At the far end of the distance range, the crosstalk might exceed the signal, adding error to measurements.

For this calibration, the user makes a distance measurement with the return signal blocked from reaching the photo-diode. This can be done in two ways. The first is to cover the emitter or photo-diode optically preventing any of the emitted signals from reaching the photo-diode. The second is to point the board toward infinity so there is no return signal. Care must be taken since small amounts of signal will be returned by objects up to 4 meters away. The emitting angle of the light is ±3° so you must be sure that there are no objects within this cone when doing this calibration.

Since the chip sees none of the emitted signal, anything received is crosstalk. Run this calibration from the GUI after running Magnitude calibration.

### DISTANCE CALIBRATION

Variation in delay of emitters, photo-diodes and the ISL29501 will change the signal path delay. To compensate for this a reference point at a known distance needs to be established. This reference is calculated during distance calibration. The process involves making a distance measurement at a known distance. While it is not critical it is best to use a reference distance about 25% of the intended range. The GUI will write the correct registers that establish the reference distance inside the chip.

It is important that there are no objects inside the ±3° emitting angle other than the target.

Once these calibration registers are written, all succeeding distances will have this measured value subtracted from the real-time value. Run this calibration from the GUI after running crosstalk calibration. See UG054, “ISL29501 Evaluation Software User Guide” for details on how to run the calibrations in the GUI.

# Operating Range

The controller circuit board contains an LDO to convert the input voltage to the ISL29501 operating voltage range, 2.7V to 3.3V. By default, the controller board is configured for USB power. The LDO resistors are rationed to create a 3.0V power rail. All other set-up conditions can be configured through the chip registers and evaluation software.

# PCB Layout Guidelines

The ISL29501-CS-EVKIT1Z PCB layout has been optimized for electrical and thermal performance. Care needs to be placed in decoupling circuits and noise isolation. Cat Shark follows good design techniques but additional suggestions are available in AN1917, “ISL29501 Layout Design Guide” (see Figures 6 and 9).

NOTE: Visible on the bottom side of the board are the emitter LED and photo-diode. Each is surrounded by a brass tube. These tubes are grounded and serve as terminators for any electric fields. They prevent crosstalk from the emitter to the photo-diode.

# Quick Start Guide

To start making distance measurements follow these simple steps.

1. The board set comes assembled with the optics board connected to the controller board with an 8-pin flex cable. This cable should be as short as possible to minimize voltage drops.
2. Plug the USB cable into the controller board design and the PC.
3. Point the emitter toward the desired target.
4. Double click “TOF.exe” to start the GUI.
5. From the GUI do a File → Load Profile → filename to load safe initial register settings and calibration data.
6. Click either “Start” or “Step” to begin making distance measurements.

# Changing Settings

Once the board is running and making measurements, the user may want to change settings. The user has the ability to change any of the chip registers with the evaluation software, see UG054, “ISL29501 Evaluation Software User Guide” for details. It is important to note that if the pulse duty cycle or the emitter current is changed, the user must redo the standard calibrations. This process is described in the sections under “Calibrating Cat Shark” on page 2.

# Temperature Compensation

The ISL29501 has a temperature compensation built into the chip. This is an advanced calibration, which involves collecting temperature vs distance data and programming the compensation registers. Initially, Intersil will generate these coefficients from customer collected data. The process for collecting data is described in AN1967, “Temperature and Ambient Data Collection”.

It is strongly recommended that customers should evaluate these parameters as a last step in their evaluation. To avoid temperature effects low integration times, reg 0x10 < 0x06 should be used.

FIGURE 2. ISL29501-CS1Z TOP

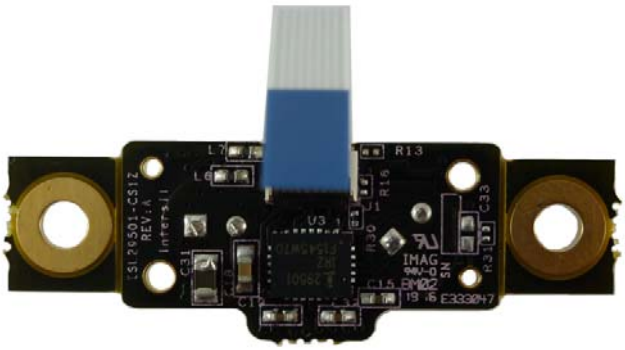


FIGURE 3. ISL29501-CS1Z BOTTOM.

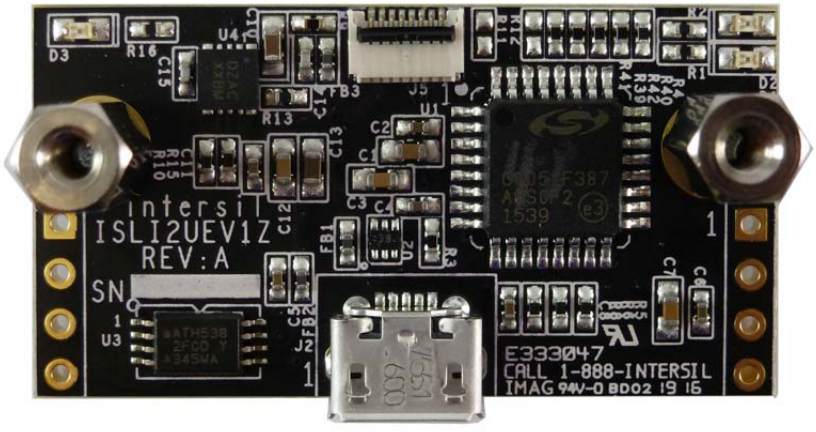



FIGURE 4. ISLI2UEV1Z

# ISL29501-CS-EVKIT1Z Circuit Schematic

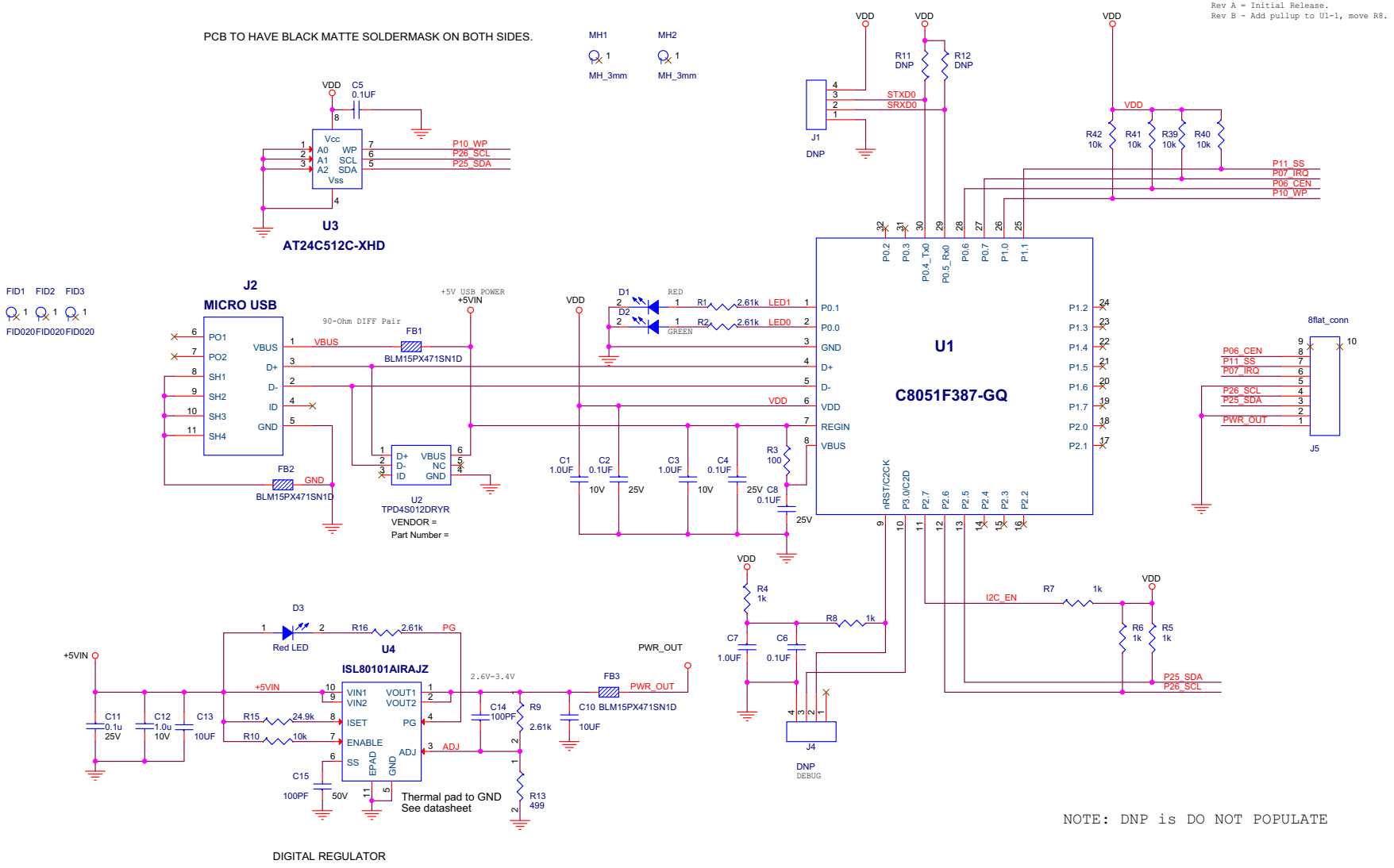
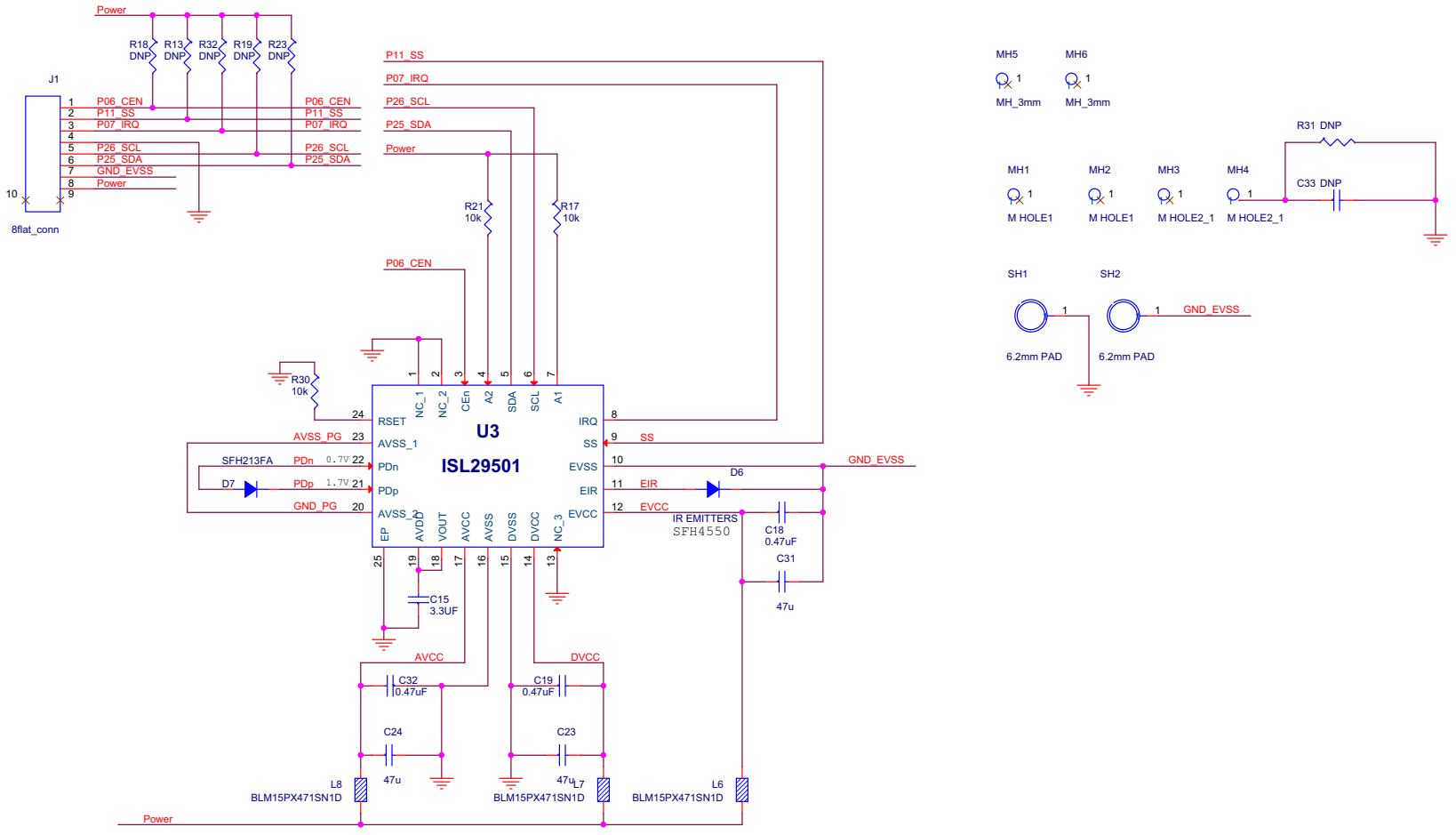



**FIGURE 5. ISLI2UEV1Z SCHEMATIC**

# ISL29501-CS-EVKIT1Z Circuit Schematic (Continued)




NOTE: DNP is DO NOT POPULATE

**FIGURE 6. ISL29501-CS1Z SCHEMATIC - OPTICS SHEET**

# ISLI2UEV1Z Bill of Materials

| MANUFACTURER PART | QTY | UNITS | REFERENCE DESIGNATOR | DESCRIPTION | MANUFACTURER |
|---|---|---|---|---|---|
| ISLI2UEV1ZREVBPCB | 1 | ea | | PWB-PCB,ISLI2UEV1Z, REVB, ROHS | IMAGINEERING INC |
| GRM155R71E104KE14D | 6 | ea | C2, C4, C5, C6, C8, C11 | CAP,SMD, 0402, 0.1µF, 25V, 10%, X7R, ROHS | MURATA |
| 0402YA101KAT2A | 2 | ea | C14, C15 | CAP, SMD, 0402, 100pF, 16V, 10%, NP0, ROHS | AVX |
| 0603ZC105KAT2A | 4 | ea | C1, C3, C7, C12 | CAP, SMD, 0603, 1.0µF, 10V, 10%, X7R, ROHS | AVX |
| GRM188R61C106KAALD | 2 | ea | C10, C13 | CAP, SMD, 0603, 10µF, 16V, 10%, X5R, ROHS | MURATA |
| 1050170001 | 1 | ea | J2 | CONN-RECEPTACLE, USB-MICRO B, SMD, 5 CONTACT, R/A, ROHS | MOLEX |
| 5034800800 | 1 | ea | J5 | CONN-FFC/FPC FLAT FLEX, SMD, 8P, 0.5mmPITCH, R/A, ROHS | MOLEX |
| LTST-C191KGKT | 1 | ea | D2 | LED, SMD, 0603, GREEN CLEAR, 2V, 20mA, 574nm, 35mcd, ROHS | LITEON/VISHAY |
| LTST-C191KRKT | 2 | ea | D1, D3 | LED, SMD, 0603, RED CLEAR, 2V, 20mA, 631nm, 54mcd, ROHS | LITEON/VISHAY |
| AT24C512C-XHD | 1 | ea | U3 | IC-2-WIRE SERIAL EEPROM, 8P, TSSOP, 1MHz, 512KBIT, ROHS | ATMEL |
| C8051F387-GQ | 1 | ea | U1 | IC-PROGRAMMED USB µCONTROLER, 32P, LQFP, 8-BIT, 48MIPS, ROHS | SILICON LABORATORIES |
| ISL80101AIRAJZ | 1 | ea | U4 | IC-1A LDO ADJ.VOLT REGULATOR, 10P, DFN, 3x3, ROHS | INTERSIL |
| TPD4S012DRYR | 1 | ea | U2 | IC-TVS, 4-CHANNEL ESD SOLUTION, 6P, SON6, ROHS | TEXAS INSTRUMENTS |
| CR0402-16W-1000FT | 1 | ea | R3 | RES, SMD, 0402, 100Ω, 1/16W, 1%, TF, ROHS | VENKEL |
| CR0402-16W-1001FT | 5 | ea | R4, R5, R6, R7, R8 | RES, SMD, 0402, 1k, 1/16W, 1%, TF, ROHS | VENKEL |
| ERJ-2RKF1002X | 5 | ea | R10, R39, R40, R41, R42 | RES, SMD, 0402, 10k, 1/16W, 1%, TF, ROHS | PANASONIC |
| ERJ-2RKF2492 | 1 | ea | R15 | RES, SMD, 0402, 24.9k, 1/16W, 1%, TF, ROHS | PANASONIC |
| CR0402-16W-2611FT | 4 | ea | R1, R2, R9, R16 | RES, SMD, 0402, 2.61k, 1/16W, 1%, TF, ROHS | VENKEL |
| CR0402-16W-4990FT | 1 | ea | R13 | RES, SMD, 0402, 499Ω, 1/16W, 1%, TF, ROHS | VENKEL |
| BLM15BD471SN1D | 3 | ea | FB1, FB2, FB3 | FERRITE BEAD, 1 LINE SIGNAL, SMD, 0402, 470Ω at 100MHz, 200mA, ROHS | MURATA |
| | 0 | ea | J1, J4, R11, R12 | DO NOT POPULATE OR PURCHASE | |
| LABEL-DATE CODE | 1 | ea | AFFIX TO BACK OF PCB | LABEL-DATE CODE_LINE 1: YRWK/REV#, LINE 2: BOM NAME | INTERSIL |

# ISL29501-CS1Z Optics Board Bill of Materials

| QTY | UNITS | REFERENCE DESIGNATOR | DESCRIPTION | MANUFACTURER | MANUFACTURER PART |
|---|---|---|---|---|---|
| 1 | ea | | PWB-PCB, ISL29501-CS1Z, REVA, ROHS | IMAGINEERING INC | ISL29501-CS1ZREVAPCB |
| 1 | ea | C15 | CAP, SMD, 0402, 3.3µF, 4V, 20%, X5R, ROHS | TAIYO YUDEN | AMK105BJ335MV-F |
| 2 | ea | C19, C32 | CAP, SMD, 0402, 0.47µF, 25V, 10%, X5R, ROHS | TDK | C1005X5R1E474K050BB |
| 1 | ea | C18 | CAP, SMD, 0603, 0.47µF, 25V, 10%, X7R, ROHS | MURATA | GRM188R71E474KA12D |
| 3 | ea | C23, C24, C31 | CAP, SMD, 0805, 47µF, 10V, 20%, X5R, ROHS | TDK | C2012X5R1A476M125AC |
| 1 | ea | J1 | CONN-FFC/FPC FLAT FLEX, SMD, 8P, 0.5mmPITCH, R/A, ROHS | MOLEX | 5034800800 |
| 1 | ea | D6 | LED-EMITTER IR, TH, T1 3/4, 1.5V, 100mA, 850nm, ROHS | OSRAM | SFH4550 |
| 1 | ea | U3 | IC-TOF SIGNAL PROCESSOR, 24P, QFN, ROHS | INTERSIL | ISL29501IRZ-T7 |
| 3 | ea | R17, R21, R30 | RES, SMD, 0201, 10k, 1/20W, 1%, TF, ROHS | PANASONIC | ERJ-1GEF1002C |
| 3 | ea | L6, L7, L8 | FERRITE BEAD, 1 LINE SIGNAL, SMD, 0402, 470Ω at 100MHz, 200mA, ROHS | MURATA | BLM15BD471SN1D |
| 2 | ea | SH1, SH2 *Surrounds D6, D7. | TUBE-BRASS, Alloy#260/270, 0.250D, 0238ID, 0.394LENGTH, ROHS | K&S Precision Metals | CATSHARK-BRASSTUBE |
| 0 | ea | C33 | DO NOT POPULATE OR PURCHASE | | |
| 0 | ea | R13, R18, R19, R23, R31, R32 | DO NOT POPULATE OR PURCHASE | | |
| 1 | ea | AFFIX TO BACK OF PCB | LABEL-DATE CODE_LINE 1: YRWK/REV#, LINE 2: BOM NAME | INTERSIL | LABEL-DATE CODE |
| 1 | ea | D7 | IC-PHOTODIODE, RADIAL, 2P, 5mm, 50V, 900nm, 1nA, ROHS | OSRAM | SFH213-FA |

# ISL29501-CS-EVKIT1Z Cat Shark Assembly Bill of Materials

| QTY | UNITS | REFERENCE DESIGNATOR | DESCRIPTION | MANUFACTURER | MANUFACTURER PART |
|---|---|---|---|---|---|
| 1 | ea | SEE ASSEMBLY INSTRUCTIONS | CABLE, FLAT-FLEX, 8CONDUCT, 0.5mmPITCH, 30mmLENGTH, ROHS | MOLEX | 152660073 |
| 1 | ea | BAG & SHIP W/BOARD | CABLE-USB TYPE A MALE to TYPE MICRO-B MALE, 3FT, ROHS | QUALTEK ELECTRONICS | 3025010-03 |
| 1 | ea | SEE DOCUMENT #1 | PWB-FG, ISL29501-CS1Z, ROHS | INTERSIL | ISL29501-CS1ZFG |
| 1 | ea | SEE DOCUMENT #1 | PWB-FG, ISLI2UEV1Z, ROHS | INTERSIL | ISLI2UEV1ZFG |
| 4 | ea | SEE ASSEMBLY INSTRUCTIONS | SCREW, M2.5, 4mm, METRIC, PANHEAD, SLOTTED, STEEL, ROHS | KEYSTONE | 29300 |
| 2 | ea | SEE ASSEMBLY INSTRUCTIONS | STANDOFF, M2.5, 8mm, METRIC, F/F, HEX, THREAD, BRASS, ROHS | ASSMANN ELECTRONICS INC | V6516B |
| 1 | ea | Place assy in bag | BAG, STATIC BUBBLE, 4X5, SELF-SEAL, ROHS | ULINE | S-6660 |
| 1 | ea | Face boards top to top. Insert screws from bottom of boards and attach standoffs between board tops. Connect cable between J1 on ISL29501-CS1Z and J5 on ISLI2UEV1Z. Lift retainers on connectors, insert cable, and lower retainers to secure cable. | Instructions for assembly. | INTERSIL | ASSEMBLY INSTRUCTIONS |
| 1 | ea | FINAL ASSEMBLY DWG | See attached document for manual or visual instruction | INTERSIL | DOCUMENT #1 |

# Board Layouts

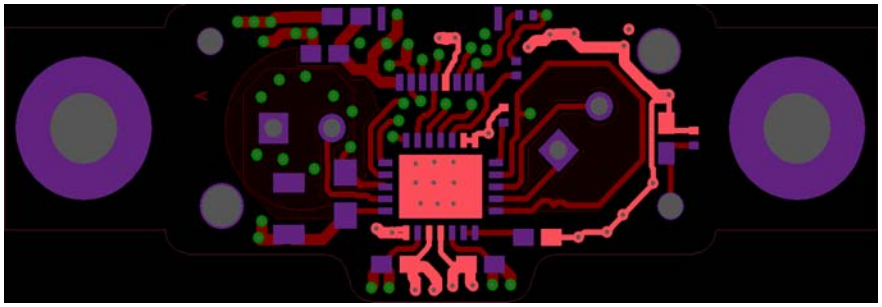


FIGURE 6A. LAYER 1

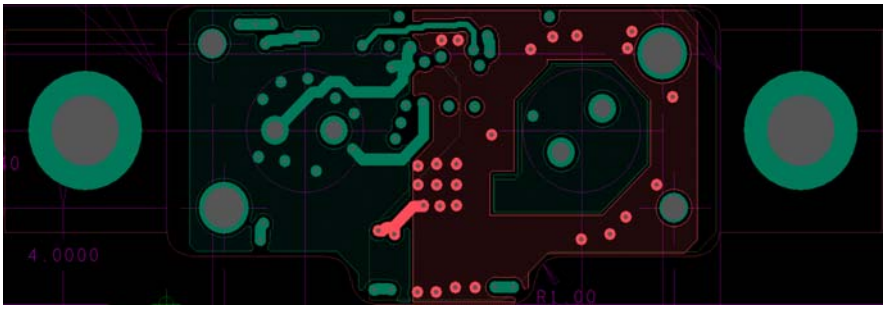


FIGURE 6B. LAYER 2

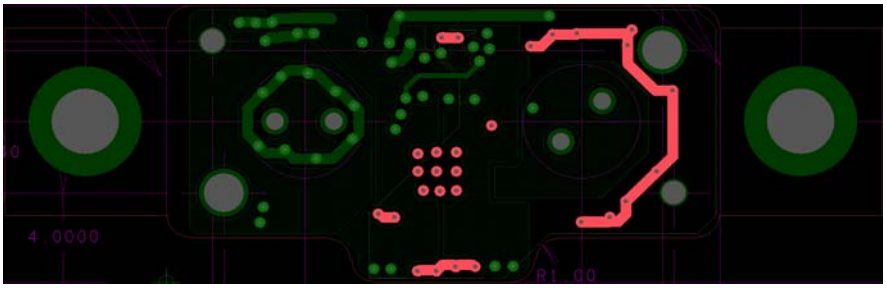


FIGURE 6C. LAYER 3

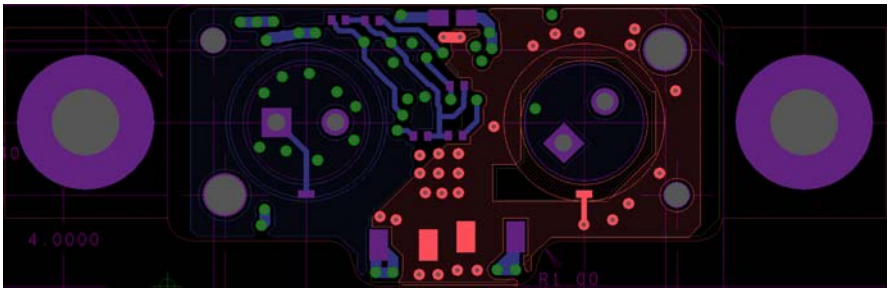


FIGURE 6D. LAYER 4

FIGURE 6. ISL29501-CS1Z PCB LAYERS

## Board Layouts (Continued)

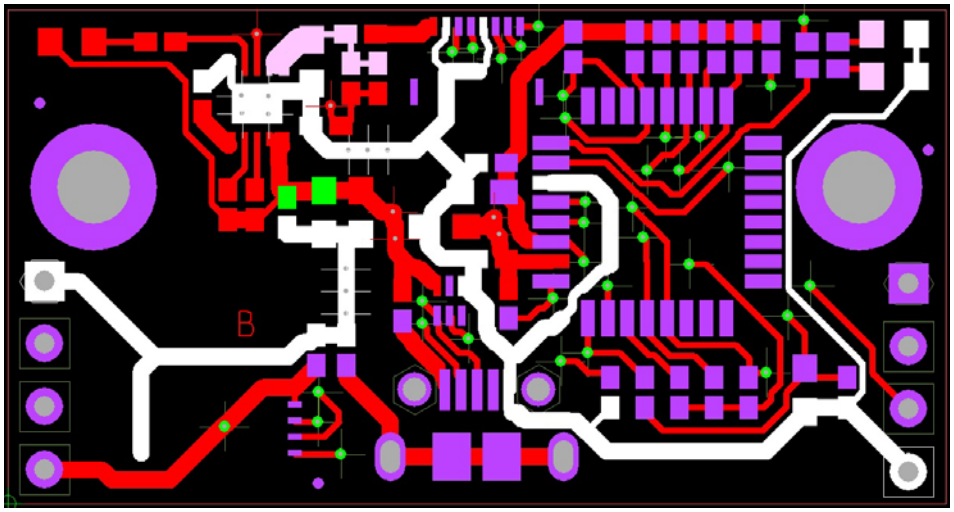



FIGURE 7. LAYER 1

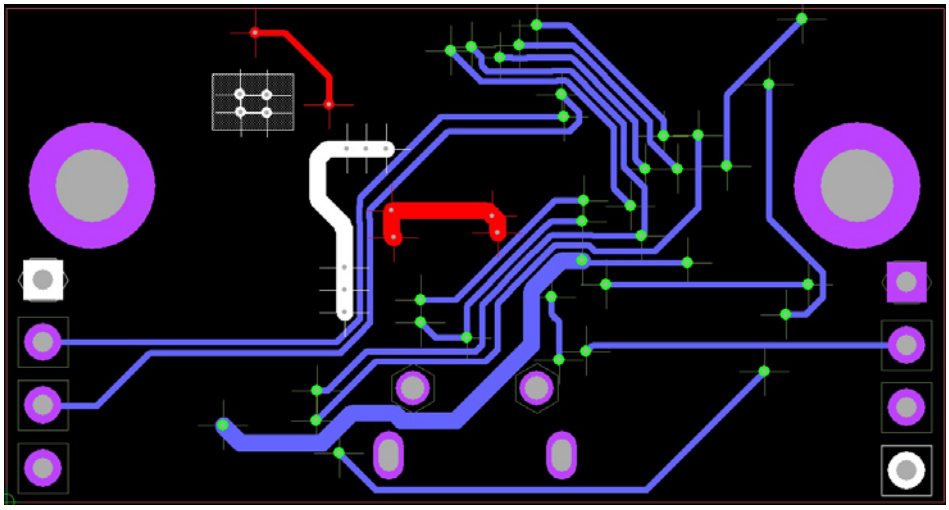


FIGURE 8. LAYER 2

FIGURE 9. ISLI2UEV1Z PCB – LAYERS (VIEWED FROM TOP)

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