



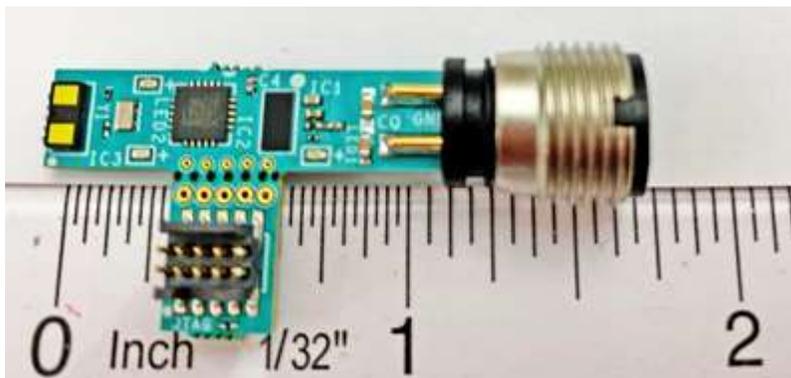
Part Number: MAXREFDES171#

Description: IO-LINK DISTANCE SENSOR

Introduction

Advanced factory automation solutions, such as Industry 4.0, require increasing numbers of smart sensors, which are typically controlled using IO-Link[®] for the point-to-point serial communication between the sensor and controller (master). As a leading provider of IO-Link sensor transceiver and master transceiver ICs, Maxim also provides complete reference design solutions to help our customers improve their time to market. These proven designs cover all of the hardware and software requirements needed for compliance with the IO-Link standard. The complete reference design, including all of the ICs and external protection devices such as TVS diodes, is provided on a 30mm x 7.5mm printed circuit board (PCB).

Maxim Integrated and Technologie Management Gruppe Technologie und Engineering (TMG TE) collaborated in designing the MAXREFDES171# as a reference design that is compliant with the IO-Link version 1.1/1.0 standard. The MAXREFDES171# design consists of an industry-standard MAX22513 IO-Link device transceiver, a MAX32660 ultra-low-power 16-bit microcontroller utilizing the TMG TE IO-Link device stack, and a commercially available VL53L1 distance sensor.



Features

- IEC 61131-9
- TMG TE IO-Link Stack
- IO-Link version 1.1 compliant
- Measures Distances up to 4m

Applications

- Industrial Automation
- Distance/Proximity Measurement
- 1D Gesture Recognition
- Smart Sensors

Figure 1 shows the system block diagram.

System Diagram

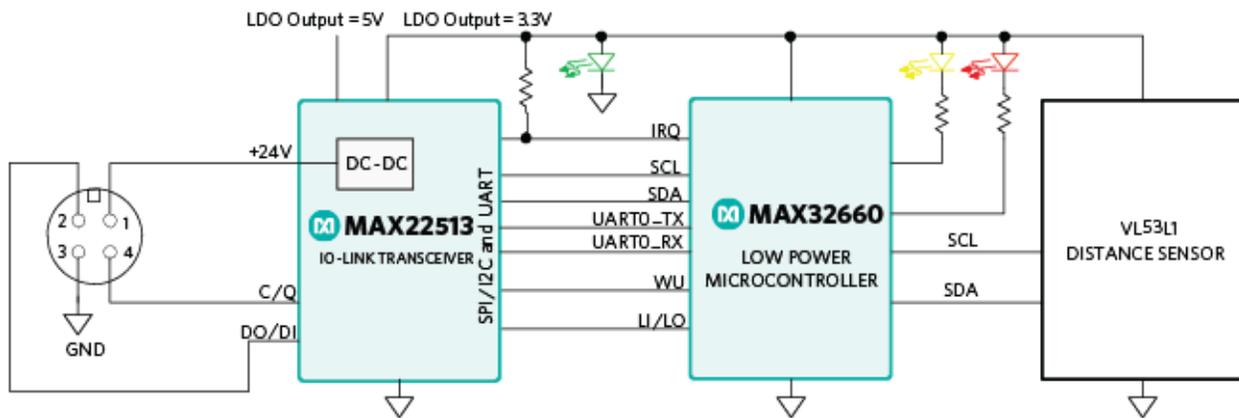


Figure 1. The MAXREFDES171# reference design block diagram.

Detailed Description

Detailed Description of Hardware

The MAXREFDES171# IO-Link distance sensor consumes minimal power, space, and cost, making it a complete solution for distance and proximity sensing in many industrial control and automation applications.

The MAX22513 IO-Link device transceiver is compliant with the IO-Link version 1.1/1.0 physical layer specification. It integrates the high-voltage functions commonly found in industrial sensors, including drivers, a high-efficiency DC-DC buck regulator, and two linear regulators all in a tiny 4.1mm x 2.1mm WLP. The MAX22513 features extensive integrated protection to ensure robust communication in harsh industrial environments. All four IO pins (V24, C/Q, DO/DI, and GND) are reverse-voltage and short-circuit protected, and feature integrated $\pm 1\text{kV}/500\Omega$ surge protection. This enables a very small PCB area with no required external components (such as TVS diodes). The low-on resistance drivers (C/Q and DO/DI) further reduce power dissipation, thus this reference design consumes minimal power with very low thermal dissipation. Operation is specified for normal 24V supply voltages up to 36V. Transient protection is simplified due to high voltage tolerance (65V absolute maximum rating) in addition to the integrated surge protection.

The DC-DC buck regulator significantly reduces system power dissipation by dropping from 24V to lower voltage more efficiently than a linear regulator. The two integrated

LDO regulators within MAX22513 allow the 3.3V and 5V rails to be generated, saving external components and space. The DC-DC regulator can supply up to 300mA load current, making this transceiver ideal for sensors that require high load current, but at lower voltages than 24V where LDOs are inefficient in translating 24V directly to lower voltages.

The MAX22513 features a flexible control interface, allowing control through either an SPI or I²C interface. In this design, we use I²C to reduce the number of pins required by the microcontroller. I²C allows both the MAX22513 and the sensor IC to be on the same bus. The I²C (or SPI) interface provides extensive diagnostics (from MAX22513), and a 3-wire UART interface is provided for IO-Link operation.

The MAX32660 is an ultra-low-power, cost-effective, highly integrated microcontroller that combines a flexible and versatile power management unit with the powerful Arm[®]Cortex[®]-M4 with floating point unit (FPU). The device integrates up to 256KB of flash memory and 96KB of RAM to accommodate application and sensor code. It supports SPI, UART, and I²C communication in a tiny, 1.6mm x 1.6mm, 16 WLP.

The VL53L1X is a ToF, laser-ranging sensor that provides accurate distance ranging up to 400cm. The ranging sensor is programmed with firmware and is controlled by a simple I²C interface that only requires SCL and SDA, since the device address is preprogrammed by default to 0x52 (saving address pins). The module does not have a cover for the receiving lens, so care needs to be taken to keep the lens clean, otherwise distance measurement performance will be impacted. The VL53L1X is in a small, 4.9mm x 2.5mm x 1.6mm module and operates over the -20°C to +85°C temperature range. This is the limiting item for the reference design operating temperature range, as the MAX22513 IO-Link transceiver can operate over the -40°C to +125°C temperature range.

The MAXREFDES171# does NOT require external devices such as varistors or TVS diodes for protection due to the integrated surge protection within MAX22513 at the IO-Link interface. This reference design meets both IEC 61000-4-2 (ESD) and IEC 61000-4-4 (EFT) standards. It is designed to meet surge capability (2A at t = 1.2/50µs) and has a low clamping voltage of <70V.

The MAXREFDES171# uses an industry-standard M12 connector, allowing a 4-wire or a conventional 3-wire cable to be used, which keeps costs low. The MAXREFDES171# consumes less than 9mA (typ), including the green LED “3.3V alive signal” and the yellow LED that blinks for each distance sensor reading. A red LED indicates if a fault occurs.