

# Playing with Fusion

SEN-36005 Time of Flight Sensor – CAN User’s Guide

## Introduction

The SEN-36005 is a highly integrated time-of-flight ranging/distance sensor with a 1M bit CAN (Controller Area Network) interface.

All messages used extended (29-bit) CAN identifiers.

Multi-byte data fields are little endian (least significant byte first). The number 0x1234 in hexadecimal is encoded in two bytes. The first byte is 0x34 and the second byte is 0x12.

Many messages include a ‘Device ID’ as the least significant byte of the CAN message identifier. This device ID is programmed into each SEN-36005 by the end user and is used to identify individual devices on a CAN bus. All sensors ship with a default device ID of zero.

CAN IDs were updated in November 2019 to comply with FRC CAN guidelines. The current CAN ID is listed as ‘Message ID’. The original ID is listed in parenthesis after the ID.

## Glossary

CAN	Controller Area Network
DLC	Data Length Code; The number of data bytes present in CAN message (0-8)
TOF	Time of flight

## Transmitted messages

### Heartbeat

Heartbeat message is transmitted once a second and provides the sensor firmware version and hardware serial number

**Message ID:** 0x1F0B01FF (previously 0x18F0FFss)  
**DLC:** 8  
**Byte 0:** Reserved, always 0  
**Bytes 1-3:** Hardware serial number  
**Bytes 4-5:** Manufacturer part number, always 0x110  
**Bytes 6-7:** Firmware version

### Calibration State

VL53L1x calibration parameters

**Message ID:** 0x060B03ss (ss = device ID, previously 0x0CF912ss)  
**DLC:** 3  
**Byte 0:** VL53L1x Optical center  
**Bits 0-3:** Y position  
**Bits 4-7:** X position  
**Bytes 1-2:** Range offset in millimeters

## Measured Distance

The Measured distance message is transmitted each time a measurement is completed. By default this message is transmitted every 100 ms however this can be adjusted via the Ranging Configuration message.

<b>Message ID:</b>	0x060B01ss (ss = device ID, previously 0x0CF910ss)																		
<b>DLC:</b>	8																		
<b>Bytes 0-1:</b>	Measured distance in millimeters																		
<b>Byte 2:</b>	Ranging Status																		
	<table><thead><tr><th>Value</th><th>Description</th></tr></thead><tbody><tr><td>0</td><td>Measured distance is valid</td></tr><tr><td>1</td><td>Sigma estimator check is above internally defined threshold</td></tr><tr><td>2</td><td>Return signal value is below the internal defined threshold</td></tr><tr><td>4</td><td>Return signal phase is out of bounds</td></tr><tr><td>5</td><td>Hardware failure</td></tr><tr><td>7</td><td>Wrapped target, non-matching phases</td></tr><tr><td>8</td><td>Internal algorithm underflow or overflow</td></tr><tr><td>14</td><td>The measured distance is invalid</td></tr></tbody></table>	Value	Description	0	Measured distance is valid	1	Sigma estimator check is above internally defined threshold	2	Return signal value is below the internal defined threshold	4	Return signal phase is out of bounds	5	Hardware failure	7	Wrapped target, non-matching phases	8	Internal algorithm underflow or overflow	14	The measured distance is invalid
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<b>Byte 3:</b>	Measurement Quality																		
<b>Bytes 4-7:</b>	Signal return rate in mega counts per second times 65536. To convert to real units, divide by 65536																		

## Measurement Quality

The measurement quality message is transmitted along with the Measured Distance message, each time a measurement is completed

<b>Message ID:</b>	0x060B02ss (ss = device ID, previously 0x0CF911ss)
<b>DLC:</b>	8
<b>Bytes 0-3:</b>	Ambient light level in mega counts per second times 65536. This is effectively the amount of IR light received by the sensor. To convert to real units, divide by 65536
<b>Bytes 4-7:</b>	Standard deviation of the measured distance value, multiplied by 65536. To convert to the standard deviation in millimeters, divide by 65536

## Received Messages

### Ranging Configuration

The Ranging Configuration message is used to configure the distance measurement sample rate, the ranging mode, and the VL53L1x ROI (Range of Interest). Not all parameters need to be specified. A parameter will be ignored by the sensor if the can message DLC is shorter than the length needed to represent the parameter value or if the parameter value is the two's complement of -1 (all bits are 1)

<b>Message ID:</b>	0x060B04ss (ss = device ID, previously 0x0CF913ss)								
<b>DLC:</b>	8								
<b>Byte 0:</b>	Ranging mode. Short mode (default) works the best in bright lighting conditions, but can only measure 1.3 meters. Long mode can measure up to 4 meters in the dark, but may only be able to measure shorter distances depending on the lighting conditions. See the VL53L1x datasheet for more information								
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1	Medium Mode								
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<b>Bytes 1-2:</b>	Measurement sample period in milliseconds. Value must be greater than 24 ms and less than or equal to 1000 ms.								
<b>Byte 3:</b>	Reserved								
<b>Byte 4:</b>	ROI top left X coordinate								
<b>Byte 5:</b>	ROI top left y coordinate								
<b>Byte 6:</b>	ROI bottom right X coordinate								
<b>Byte 7:</b>	ROI bottom right Y coordinate								

### Device Configuration

The Device Configuration is used to set the device id (least significant byte of CAN ID). This message is unique in that the message ID is fixed. Since the device ID is not part of the CAN ID, the particular device is specified by the serial number and manufacturer part number (available from the Heartbeat message) in bytes 1-5.

<b>Message ID:</b>	0x1F0B03FF (previously 0x0CAAFF9)
<b>DLC:</b>	7
<b>Byte 0:</b>	Command byte, must be 0x0C
<b>Bytes 1-3:</b>	Hardware serial number
<b>Bytes 4-5:</b>	Manufacturer part number, always 0x110
<b>Byte 6:</b>	New device ID

## Device Identification

The Device Identification messages flashes the sensor LED for five seconds to identify a physical sensor. Since the device ID is not part of the CAN ID, the particular device is specified by the serial number and manufacturer part number (available from the Heartbeat message) in bytes 1-5.

**Message ID:** 0x1F0B03FF (previously 0x0CAAFF9)  
**DLC:** 6  
**Byte 0:** Command byte, must be 0x0D  
**Bytes 1-3:** Hardware serial number  
**Bytes 4-5:** Manufacturer part number, always 0x110