XM125 I²C Distance Detector

User Guide

XM125 I²C Distance Detector

User Guide

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Contents

1 Acconeer SDK Documentation Overview

To better understand what SDK document to use, a summary of the documents are shown in the table below.

Table 1: SDK document overview.

Name	Description	When to use
	RSS API documentation (html)	
rss_api	The complete C API documentation.	- RSS application implementation - Understanding RSS API functions
	User guides (PDF)	
A121 Assembly Test	Describes the Acconeer assembly test functionality.	- Bring-up of HW/SW - Production test implementation
A121 Breathing Reference Application	Describes the functionality of the Breathing Reference Application.	- Working with the Breathing Reference Application
A121 Distance Detector	Describes usage and algorithms of the Distance Detector.	- Working with the Distance Detector
A121 SW Integration	Describes how to implement each integration function needed to use the Acconeer sensor.	- SW implementation of custom HW integration
A121 Presence Detector	Describes usage and algorithms of the Presence Detector.	- Working with the Presence Detector
A121 Smart Presence Reference Application	Describes the functionality of the Smart Presence Reference Application.	- Working with the Smart Presence Reference Application
A121 Sparse IQ Service	Describes usage of the Sparse IQ Service.	- Working with the Sparse IQ Service
A121 Tank Level Reference Application	Describes the functionality of the Tank Level Reference Application.	- Working with the Tank Level Reference Application
A121 Touchless Button Reference Application	Describes the functionality of the Touchless Button Reference Application.	- Working with the Touchless Button Reference Application
A121 Parking Reference Application	Describes the functionality of the Parking Reference Application.	- Working with the Parking Reference Application
A121 STM32CubeIDE	Describes the flow of taking an Acconeer SDK and integrate into STM32CubeIDE.	- Using STM32CubeIDE
A121 Raspberry Pi Software	Describes how to develop for Raspberry Pi.	- Working with Raspberry Pi
A121 Ripple	Describes how to develop for Ripple.	- Working with Ripple on Raspberry Pi
A121 ESP32 User Guide	Describes how to develop with A121 and ESP32 targets.	- Working with ESP32 targets
XM125 Software	Describes how to develop for XM125.	- Working with XM125
XM126 Software	Describes how to develop for XM126.	- Working with XM126
I2C Distance Detector	Describes the functionality of the I2C Distance Detector Application.	- Working with the I2C Distance Detector Application
I2C Presence Detector	Describes the functionality of the I2C Presence Detector Application.	- Working with the I2C Presence Detector Application
I2C Breathing Reference Application	Describes the functionality of the I2C Breathing Reference Application.	- Working with the I2C Breathing Reference Application
	A121 Radar Data and Control (PDF)	
A121 Radar Data and Control	Describes different aspects of the Acconeer offer, for example radar principles and how to configure	- To understand the Acconeer sensor - Use case evaluation
	Readme (txt)	
README	Various target specific information and links	- After SDK download

2 I²C Distance Detector Application

The I²C Distance Detector is an application that implements the Acconeer Distance Detector with a register based I²C interface.

The functionality of the distance detector is described in *A121 Distance Detector User Guide.pdf* or in Acconeer Docs.

Note: Some of the registers like **start** and **end** have a different unit in the I²C Distance Detector, millimeters instead of meters, to make it easier to handle the register values as integers.

2.1 I²C Address Configuration

The device has a configurable I²C address. The address is selected depending on the state of the **I2C_ADDR** pin according to the following table:

Connected to GND	0x51
Not Connected	0x52
Connected to VIN	0x53

2.2 I2C Speed

The device supports I2C speed up to 100kbps in Standard Mode and up to 400kbps in Fast Mode.

2.3 Usage

The module must be ready before the host starts I²C communication.

The module will enter ready state by following this procedure.

- Set **WAKE_UP** pin of the module HIGH.
- Wait for module to be ready, this is indicated by the **MCU_INT** pin being HIGH.
- Start I²C communication.

The module will enter a low power state by following this procedure.

- Wait for module to be ready, this is indicated by the **MCU_INT** pin being HIGH.
- Set the **WAKE_UP** pin of the module LOW.
- Wait for ready signal, the **MCU_INT** pin, to become LOW.

2.3.1 Read Detector Status

The status of the module can be acquired by reading the *Detector Status* register, The most important bits are the **Busy** and **Error** bits.

The **Busy** bit must not be set when a new command is written. If any of the **Error** bits are set the module will not accept any commands except the **RESET_MODULE** command.

2.3.2 Writing a command

A command is written to the *Command* register. When a command is written the **Busy** bit in the *Detector Status* register is set and it will be cleared automatically when the command has finished.

2.3.3 Setup and Measure

Before the module can perform distance measurements it must be configured and calibrated. The following steps is an example of how this can be achieved.

Note: The configuration parameters can not be changed after a **APPLY_CONFIG_AND_CALIBRATE** or a **APPLY_CONFIGURATION** command. If reconfiguration is needed the module must be restarted by writing **RESET_MODULE** to the *Command* register.

- Power on module
- Read *Detector Status* register and verify that neither **Busy** nor **Error** bits are set.

- Write configuration to configuration registers, for example *Start* register and *End* register.
- Write **APPLY_CONFIG_AND_CALIBRATE** to *Command* register.
- Poll *Detector Status* until **Busy** bit is cleared.
- Verify that no **Error** bits are set in the *Detector Status* register.
- Write **MEASURE_DISTANCE** to *Command* register.
- Poll *Detector Status* until **Busy** bit is cleared.
- Verify that no **Error** bits are set in the *Detector Status* register.
- Read *Detector Result* register
  - If **MEASURE_DISTANCE_ERROR** is set the measurement failed.
  - If **CALIBRATION_NEEDED** is set the sensor needs to be re-calibrated with the **RECALIBRATE** command.
  - The number of peak distances detected can be read in the **NUM_DISTANCES** field.
- Read *PeakX Distance* and *PeakX Strength* registers depending on how many distances that were detected.
- The module is ready for a new **MEASURE_DISTANCE** command.

2.4 Advanced Usage

2.4.1 Apply Configuration and Calibration separately

Some use-cases requires control over when the system is calibrated, therefore the **Apply Configuration** and **Calibrate** can be performed as individual steps.

- Power on module
- Read *Detector Status* register and verify that neither **Busy** nor **Error** bits are set.
- Write configuration to configuration registers, for example *Start* register and *End* register.
- Write **APPLY_CONFIGURATION** to *Command* register
- Poll *Detector Status* until **Busy** bit is cleared.
- Verify that no **Error** bits are set in the *Detector Status* register.
- Write **CALIBRATE** to *Command* register
- Poll *Detector Status* until **Busy** bit is cleared.
- Verify that no **Error** bits are set in the *Detector Status* register.
- The module is ready for a **MEASURE_DISTANCE** command.

2.4.2 Re-calibration

Re-calibration must be done as soon as the **CALIBRATION_NEEDED** bit is set in the *Detector Result* register.

Re-calibration is performed by writing **RECALIBRATE** to the *Command* register.

2.4.3 Measure on Wake Up Mode

Measure on Wake Up mode can be enabled by writing a non-zero value to the *Measure On Wakeup* register. When **Measure on Wake Up** is enabled, the module will perform a distance measurement every time it is woken by the **WAKE_UP** pin. The measurement will be ready when the **MCU_INT** pin becomes HIGH.

2.4.4 Debug UART logs

UART logging can be enabled on the DEBUG UART by writing **ENABLE_UART_LOGS** to the *Command* register.

The detector configuration can be logged on the UART by writing **LOG_CONFIGURATION** to the *Command* register.

UART logging can be disabled by writing **DISABLE_UART_LOGS** to the *Command* register.

2.4.5 Reset Module

The module can be restarted by writing **RESET_MODULE** to the *Command* register.

After the restart the detector must be configured again.

3 Register Protocol

3.1 I²C Slave Address

The default slave address is 0x52.

3.2 Protocol Byte Order

Both register address, 16-bit, and register data, 32-bit, are sent in big endian byte order.

3.2.1 I²C Write Register(s)

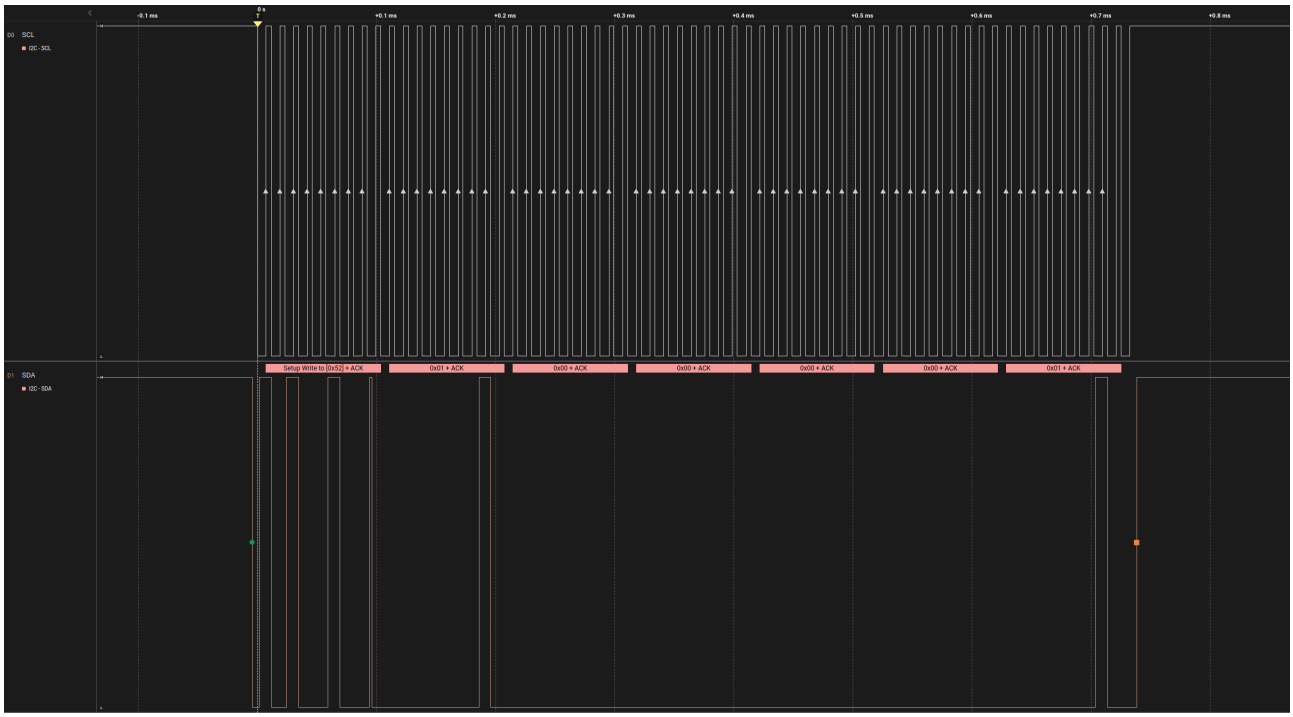
A write register operation consists of an I²C write of two address bytes and four data bytes for each register to write. Several registers can be written in the same I²C transaction, the register address will be incremented by one for each four data bytes.

Example 1: Writing six bytes will write one register, two address bytes and four data bytes.

Example 2: Writing 18 bytes will write four registers, two address bytes and 16 data bytes.

Example operation, write 0x11223344 to address 0x0025.

Description	Data
I²C Start Condition	
Slave Address + Write	0x52 + W
Address to slave [15:8]	0x00
Address to slave [7:0]	0x25
Data to slave [31:24]	0x11
Data to slave [23:16]	0x22
Data to slave [15:8]	0x33
Data to slave [7:0]	0x44
I²C Stop Condition	



Example Waveform: Write register with address 0x0100, the data sent from the master to the slave is 0x00000001

3.2.2 I²C Read Register(s)

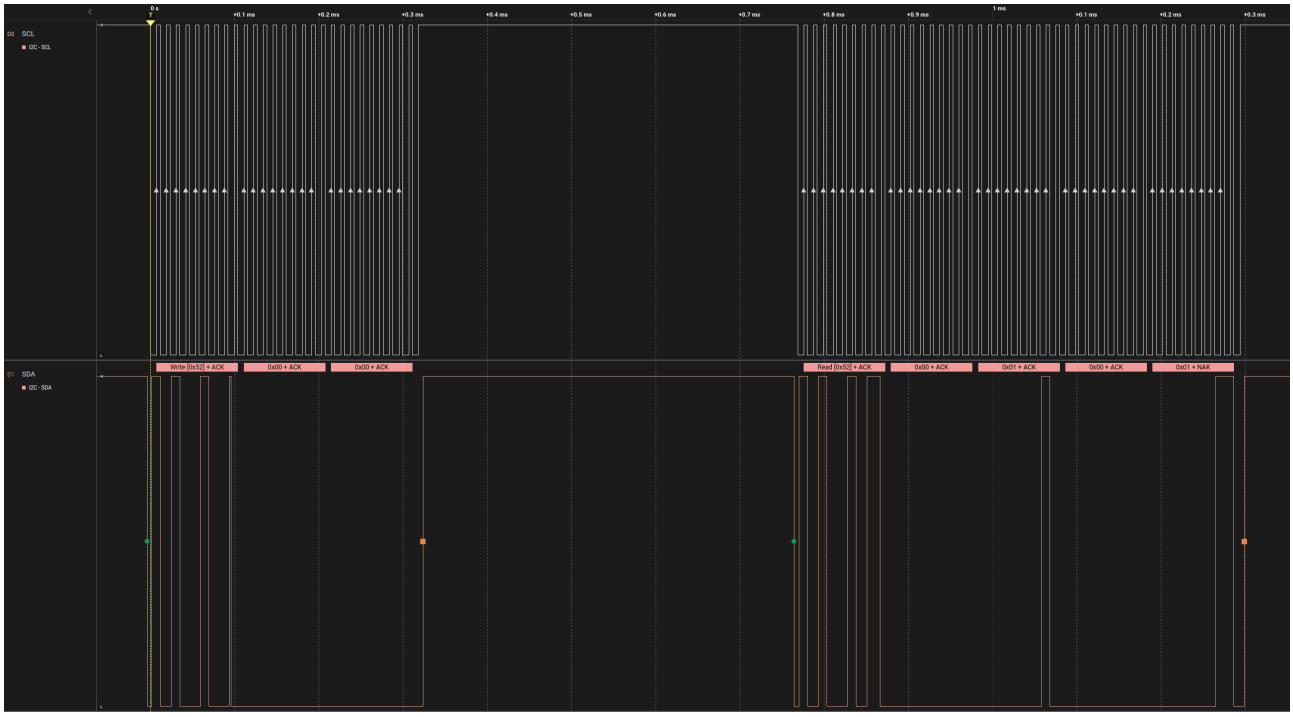
A read register operation consists of an I²C write of two address bytes followed by an I²C read of four data bytes for each register to read. Several registers can be read in the same I²C transaction, the register address will be incremented by one for each four data bytes.

Example 1: Writing two bytes and reading four bytes will read one register.

Example 2: Writing two bytes and reading 16 bytes will read four registers.

Example operation, read 0x12345678 from address 0x0003.

Description	Data
I²C Start Condition	
Slave Address + Write	0x52 + W
Address to slave [15:8]	0x00
Address to slave [7:0]	0x03
I²C Stop Condition	
I²C Start Condition	
Slave Address + Read	0x52 + R
Data from slave [31:24]	0x12
Data from slave [23:16]	0x34
Data from slave [15:8]	0x56
Data from slave [7:0]	0x78
I²C Stop Condition	

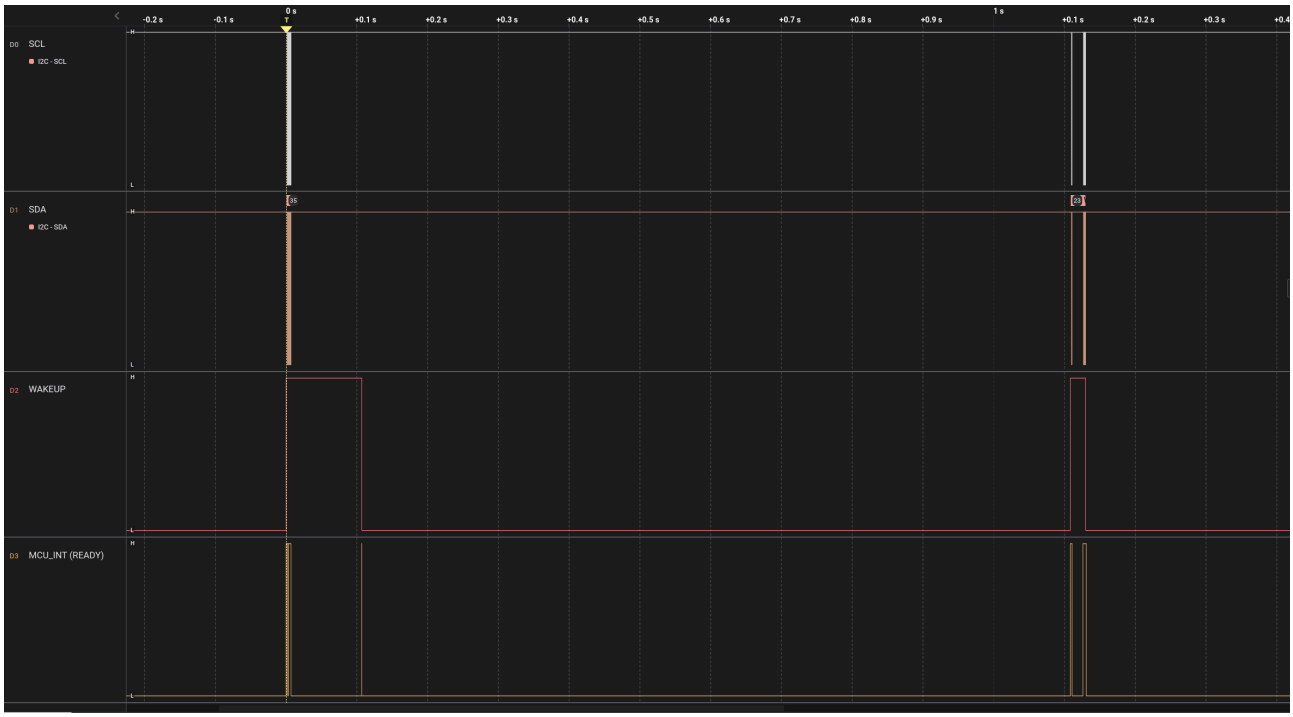


Example Waveform: Read register with address 0, the data sent from the slave to the master is 0x00010001

3.3 Register Protocol - Low Power Mode

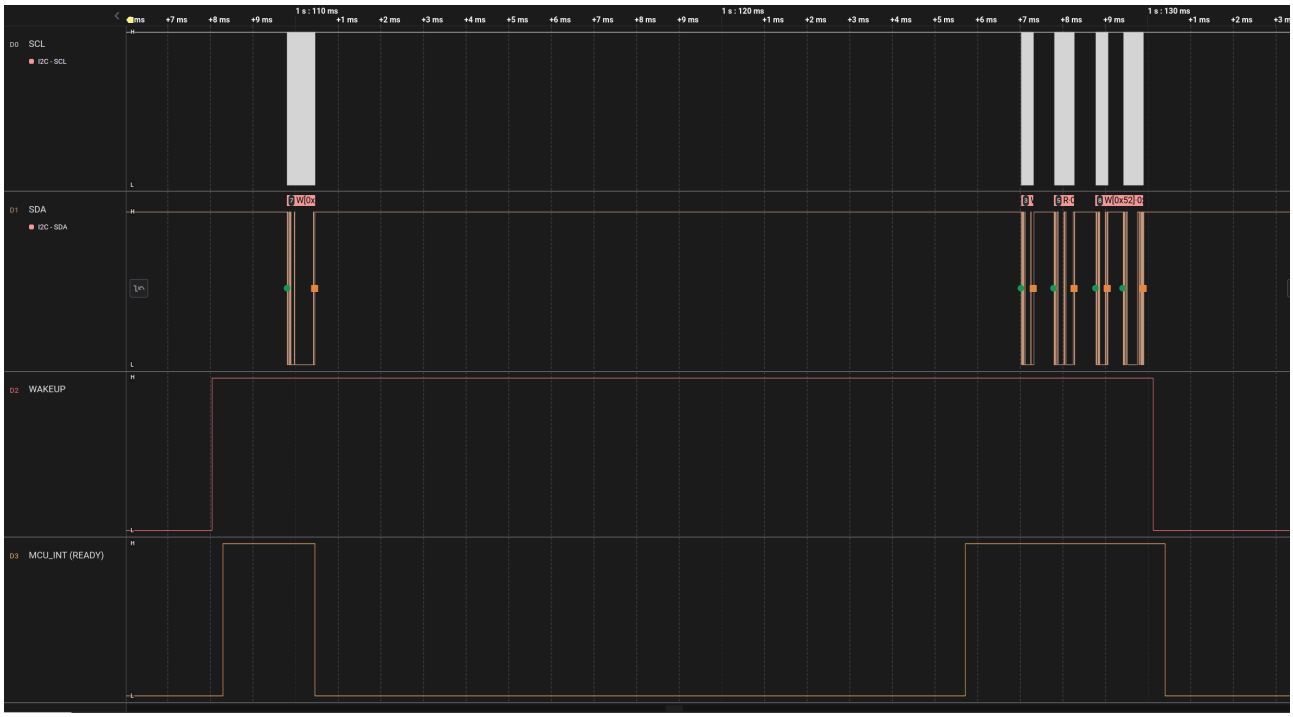
3.3.1 I²C Communication with Low Power Mode

Low power example



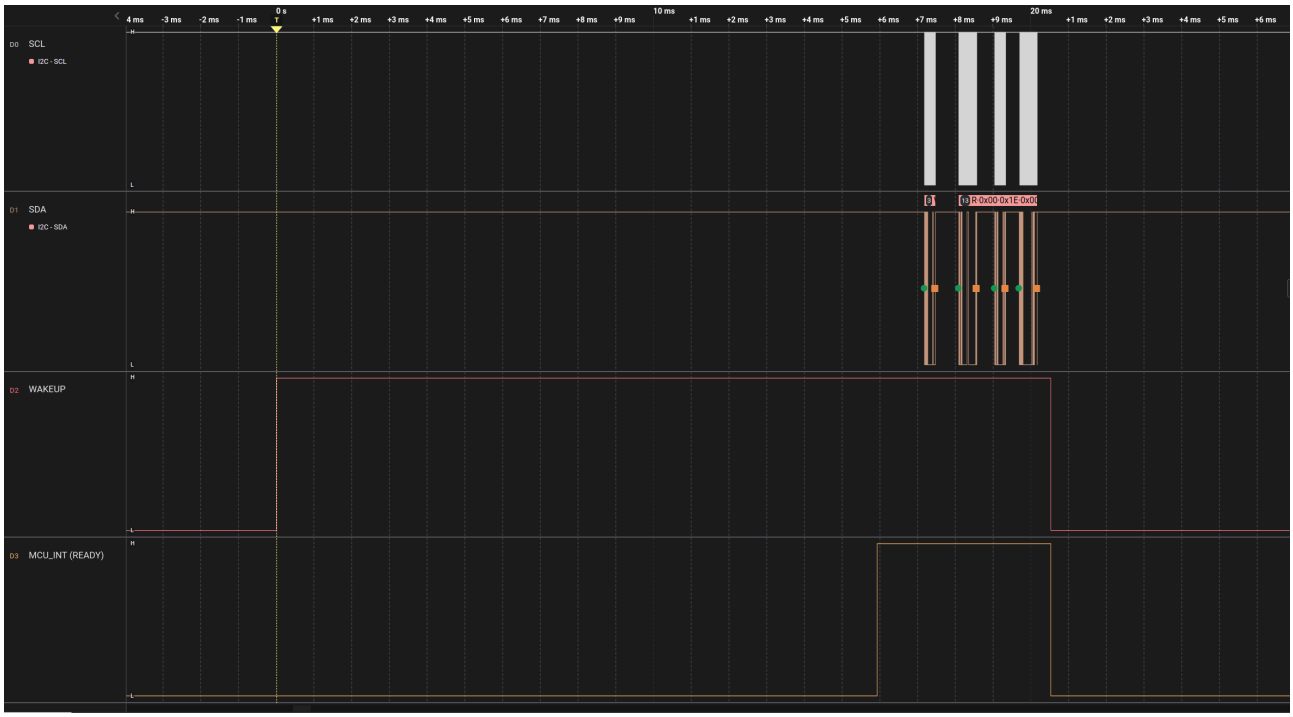
Low Power Example: Wake up, Setup Distance Detector, Power down, Wait 1s, Wake up, Measure distance, Power down

Low Power Example: Magnification of Wake up, Setup Distance Detector, Power down



Low Power Example: Magnification of Wake up, Measure distance, Power down

Low power example with 'Measure on wake up'



Measure on Wake Up Example: Magnification of Wake up, Measure on wake up, Power down

4 File Structure

The I²C Distance Detector application consists of the following files.

```
├── Src
│   ├── applications
│   │   └── i2c
│   │       ├── acc_reg_protocol.c
│   │       ├── distance_reg_protocol_access.c
│   │       ├── distance_reg_protocol.c
│   │       ├── i2c_application_system_stm32.c
│   │       └── i2c_distance_detector.c
├── Inc
│   ├── acc_reg_protocol.h
│   ├── distance_reg_protocol.h
│   ├── i2c_application_system.h
│   └── i2c_distance_detector.h
```

- **acc_reg_protocol.c** A generic protocol handler implementation.
- **distance_reg_protocol.c** The specific register protocol setup for the I²C Distance Detector.
- **distance_reg_protocol_access.c** The register read and write access functions for the I²C Distance Detector.
- **i2c_application_system_stm32.c** System functions, such as I²C handling, GPIO control and low power state
- **i2c_distance_detector.c** The I²C Distance Detector application.

5 Embedded Host Example

This is an example implementation of the host read and write register functions using the STM32 SDK.

5.1 Register Read/Write functions

```
#include <inttypes.h>
#include <stdbool.h>
#include <stdint.h>

#include "distance_reg_protocol.h"

// Use 1000ms timeout
#define I2C_TIMEOUT_MS 1000

// The STM32 uses the i2c address shifted one position
// to the left (0x52 becomes 0xa4)
#define I2C_ADDR 0xa4

// The register address length is two bytes
#define REG_ADDRESS_LENGTH 2

// The register data length is four bytes
#define REG_DATA_LENGTH 4


/**
 * @brief Read register value over I2C
 *
 * @param[in] reg_addr The register address to read
 * @param[out] reg_data The read register data
 * @returns true if successful
 */
bool read_register(uint16_t reg_addr, uint32_t *reg_data)
{
```

```
    HAL_StatusTypeDef status = HAL_OK;

    uint8_t transmit_data[REG_ADDRESS_LENGTH];

    transmit_data[0] = (reg_addr >> 8) & 0xff;
    transmit_data[1] = (reg_addr >> 0) & 0xff;

    status = HAL_I2C_Master_Transmit(&STM32_I2C_HANDLE, I2C_ADDR,
                                     transmit_data, REG_ADDRESS_LENGTH,
                                     I2C_TIMEOUT_MS);
    if (status != HAL_OK)
    {
        return false;
    }

    uint8_t receive_data[REG_DATA_LENGTH];

    status = HAL_I2C_Master_Receive(&STM32_I2C_HANDLE, I2C_ADDR,
                                    receive_data, REG_DATA_LENGTH,
                                    I2C_TIMEOUT_MS);
    if (status != HAL_OK)
    {
        return false;
    }


    // Convert bytes to uint32_t
    uint32_t val = receive_data[0];
    val = val << 8;
    val |= receive_data[1];
    val = val << 8;
    val |= receive_data[2];
    val = val << 8;
    val |= receive_data[3];
    *reg_data = val;

    return true;
}


/**
 * @brief Write register value over I2C
 *
 * @param[in] reg_addr The register address to write
 * @param[in] reg_data The register data to write
 * @returns true if successful
 */
bool write_register(uint16_t reg_addr, uint32_t reg_data)
{
    HAL_StatusTypeDef status = HAL_OK;

    uint8_t transmit_data[REG_ADDRESS_LENGTH + REG_DATA_LENGTH];

    // Convert uint16_t address to bytes
    transmit_data[0] = (reg_addr >> 8) & 0xff;
    transmit_data[1] = (reg_addr >> 0) & 0xff;
    // Convert uint32_t reg_data to bytes
    transmit_data[2] = (reg_data >> 24) & 0xff;
    transmit_data[3] = (reg_data >> 16) & 0xff;
    transmit_data[4] = (reg_data >> 8) & 0xff;
    transmit_data[5] = (reg_data >> 0) & 0xff;
```

```
    status = HAL_I2C_Master_Transmit(&STM32_I2C_HANDLE, I2C_ADDR,
                                     transmit_data,
                                     REG_ADDRESS_LENGTH + REG_DATA_LENGTH,
                                     I2C_TIMEOUT_MS);
    if (status != HAL_OK)
    {
        return false;
    }

    return true;
}
```

5.2 Detector setup functions

```
#include "distance_reg_protocol.h"

/**
 * @brief Test if configuration of detector is OK
 *
 * @returns true if successful
 */
bool configuration_ok(void)
{
    uint32_t status = 0
    if (!read_register(DISTANCE_REG_DETECTOR_STATUS_ADDRESS, &status))
    {
        //ERROR
        return false;
    }

    uint32_t config_ok_mask =
         DISTANCE_REG_DETECTOR_STATUS_FIELD_RSS_REGISTER_OK_MASK |
         DISTANCE_REG_DETECTOR_STATUS_FIELD_CONFIG_CREATE_OK_MASK |
         DISTANCE_REG_DETECTOR_STATUS_FIELD_SENSOR_CREATE_OK_MASK |
         DISTANCE_REG_DETECTOR_STATUS_FIELD_DETECTOR_CREATE_OK_MASK |
         DISTANCE_REG_DETECTOR_STATUS_FIELD_DETECTOR_BUFFER_OK_MASK |
         DISTANCE_REG_DETECTOR_STATUS_FIELD_SENSOR_BUFFER_OK_MASK |
         DISTANCE_REG_DETECTOR_STATUS_FIELD_CALIBRATION_BUFFER_OK_MASK |
         DISTANCE_REG_DETECTOR_STATUS_FIELD_CONFIG_APPLY_OK_MASK |
         DISTANCE_REG_DETECTOR_STATUS_FIELD_SENSOR_CALIBRATE_OK_MASK |
         DISTANCE_REG_DETECTOR_STATUS_FIELD_DETECTOR_CALIBRATE_OK_MASK;

   if (status != config_ok_mask)
   {
        //ERROR
       return false;
   }

   return true;
}


/**
 * @brief Wait for detector not busy
 *
 * @returns true if successful
 */
bool wait_not_busy(void)
{
```

```
    uint32_t status = 0
    do
    {
        if (!read_register(DISTANCE_REG_DETECTOR_STATUS_ADDRESS, &status))
        {
            //ERROR
            return false;
        }
    } while((status & DISTANCE_REG_DETECTOR_STATUS_FIELD_BUSY_MASK) != 0);

    return true;
}


bool example_setup_and_measure(void)
{
    // Set start at 1000mm
    if (!write_register(DISTANCE_REG_START_ADDRESS, 1000))
    {
        //ERROR
        return false;
    }
    // Set end at 5000mm
    if (!write_register(DISTANCE_REG_END_ADDRESS, 5000))
    {
        //ERROR
        return false;
    }

    // Apply configuration
    if (!write_register(
            DISTANCE_REG_COMMAND_ADDRESS,
            DISTANCE_REG_COMMAND_ENUM_APPLY_CONFIG_AND_CALIBRATE))
    {
        //ERROR
        return false;
    }

    // Wait for the configuration and calibration to be done
    if (!wait_not_busy())
    {
        //ERROR
        return false;
    }

    // Test if configration of detector was OK
    if (!configuration_ok())
    {
        //ERROR
        return false;
    }

    // Measure
    if (!write_register(DISTANCE_REG_COMMAND_ADDRESS,
                        DISTANCE_REG_COMMAND_ENUM_MEASURE_DISTANCE))
    {
        //ERROR
        return false;
    }

    // Wait for measure distance to be done
```

```
    if (!wait_not_busy())
    {
        //ERROR
        return false;
    }

    // Read detector result
    uint32_t result;
    if (!read_register(DISTANCE_REG_DISTANCE_RESULT_ADDRESS, &result))
    {
        //ERROR
        return false;
    }

    // Did we detect a peak?
    uint32_t num_distances =
        (result & DISTANCE_REG_DISTANCE_RESULT_FIELD_NUM_DISTANCES_MASK) >>
        DISTANCE_REG_DISTANCE_RESULT_FIELD_NUM_DISTANCES_POS;

    // Print peak if found
    if (num_distances > 0)
    {
        uint32_t peak_distance_mm;
        if (read_register(DISTANCE_REG_PEAK0_DISTANCE_ADDRESS, &
           peak_distance_mm))
        {
            printf("Peak distance: %" PRIu32 " mm\n", peak_distance_mm);
        }
        else
        {
            //ERROR
            return false;
        }
    }
    else
    {
        printf("No peak detected\n");
    }

    return true;
}
```

6 Registers

6.1 Register Map

Address	Register Name	Type
0x0000	Version	Read Only
0x0001	Protocol Status	Read Only
0x0002	Measure Counter	Read Only
0x0003	Detector Status	Read Only
0x0010	Distance Result	Read Only
0x0011	Peak0 Distance	Read Only
0x0012	Peak1 Distance	Read Only
0x0013	Peak2 Distance	Read Only
0x0014	Peak3 Distance	Read Only
0x0015	Peak4 Distance	Read Only
0x0016	Peak5 Distance	Read Only
0x0017	Peak6 Distance	Read Only
0x0018	Peak7 Distance	Read Only
0x0019	Peak8 Distance	Read Only
0x001a	Peak9 Distance	Read Only
0x001b	Peak0 Strength	Read Only
0x001c	Peak1 Strength	Read Only
0x001d	Peak2 Strength	Read Only
0x001e	Peak3 Strength	Read Only
0x001f	Peak4 Strength	Read Only
0x0020	Peak5 Strength	Read Only
0x0021	Peak6 Strength	Read Only
0x0022	Peak7 Strength	Read Only
0x0023	Peak8 Strength	Read Only
0x0024	Peak9 Strength	Read Only
0x0040	Start	Read / Write
0x0041	End	Read / Write
0x0042	Max Step Length	Read / Write
0x0043	Close Range Leakage Cancellation	Read / Write
0x0044	Signal Quality	Read / Write
0x0045	Max Profile	Read / Write
0x0046	Threshold Method	Read / Write
0x0047	Peak Sorting	Read / Write
0x0048	Num Frames Recorded Threshold	Read / Write
0x0049	Fixed Amplitude Threshold Value	Read / Write
0x004a	Threshold Sensitivity	Read / Write
0x004b	Reflector Shape	Read / Write
0x004c	Fixed Strength Threshold Value	Read / Write
0x0080	Measure On Wakeup	Read / Write
0x0100	Command	Write Only
0xffff	Application Id	Read Only

6.2 Register Descriptions

6.2.1 Version

Address	0x0000
Access	Read Only
Register Type	field
Description	Get the RSS version.

Bitfield	Pos	Width	Mask
MAJOR	16	16	0xffff0000

MINOR	8	8	0x0000ff00
PATCH	0	8	0x000000ff

MAJOR - Major version number

MINOR - Minor version number

PATCH - Patch version number

6.2.2 Protocol Status

Address	0x0001
Access	Read Only
Register Type	field
Description	Get protocol error flags.

Bitfield	Pos	Width	Mask
PROTOCOL_STATE_ERROR	0	1	0x00000001
PACKET_LENGTH_ERROR	1	1	0x00000002
ADDRESS_ERROR	2	1	0x00000004
WRITE_FAILED	3	1	0x00000008
WRITE_TO_READ_ONLY	4	1	0x00000010

PROTOCOL_STATE_ERROR - Protocol state error

PACKET_LENGTH_ERROR - Packet length error

ADDRESS_ERROR - Register address error

WRITE_FAILED - Write register failed

WRITE_TO_READ_ONLY - Write to read only register

6.2.3 Measure Counter

Address	0x0002
Access	Read Only
Register Type	uint
Description	Get the measure counter, the number of measurements performed since restart.

6.2.4 Detector Status

Address	0x0003
Access	Read Only
Register Type	field
Description	Get detector status flags.

Bitfield	Pos	Width	Mask
RSS_REGISTER_OK	0	1	0x00000001
CONFIG_CREATE_OK	1	1	0x00000002
SENSOR_CREATE_OK	2	1	0x00000004
DETECTOR_CREATE_OK	3	1	0x00000008
DETECTOR_BUFFER_OK	4	1	0x00000010
SENSOR_BUFFER_OK	5	1	0x00000020
CALIBRATION_BUFFER_OK	6	1	0x00000040
CONFIG_APPLY_OK	7	1	0x00000080
SENSOR_CALIBRATE_OK	8	1	0x00000100

DETECTOR_CALIBRATE_OK	9	1	0x00000200
RSS_REGISTER_ERROR	16	1	0x00010000
CONFIG_CREATE_ERROR	17	1	0x00020000
SENSOR_CREATE_ERROR	18	1	0x00040000
DETECTOR_CREATE_ERROR	19	1	0x00080000
DETECTOR_BUFFER_ERROR	20	1	0x00100000
SENSOR_BUFFER_ERROR	21	1	0x00200000
CALIBRATION_BUFFER_ERROR	22	1	0x00400000
CONFIG_APPLY_ERROR	23	1	0x00800000
SENSOR_CALIBRATE_ERROR	24	1	0x01000000
DETECTOR_CALIBRATE_ERROR	25	1	0x02000000
DETECTOR_ERROR	28	1	0x10000000
BUSY	31	1	0x80000000

RSS_REGISTER_OK - RSS register OK

CONFIG_CREATE_OK - Configuration create OK

SENSOR_CREATE_OK - Sensor create OK

DETECTOR_CREATE_OK - Detector create OK

DETECTOR_BUFFER_OK - Detector get buffer size OK

SENSOR_BUFFER_OK - Memory allocation of sensor buffer OK

CALIBRATION_BUFFER_OK - Memory allocation of calibration buffer OK

CONFIG_APPLY_OK - Detector configuration apply OK

SENSOR_CALIBRATE_OK - Sensor calibrate OK

DETECTOR_CALIBRATE_OK - Detector calibrate OK

RSS_REGISTER_ERROR - RSS register error

CONFIG_CREATE_ERROR - Configuration create error

SENSOR_CREATE_ERROR - Sensor create error

DETECTOR_CREATE_ERROR - Detector create error

DETECTOR_BUFFER_ERROR - Detector get buffer size error

SENSOR_BUFFER_ERROR - Memory allocation of sensor buffer error

CALIBRATION_BUFFER_ERROR - Memory allocation of calibration buffer error

CONFIG_APPLY_ERROR - Detector configuration apply error

SENSOR_CALIBRATE_ERROR - Sensor calibrate error

DETECTOR_CALIBRATE_ERROR - Detector calibrate error

DETECTOR_ERROR - Detector error occured, restart necessary

BUSY - Detector busy

6.2.5 Distance Result

Address	0x0010
Access	Read Only
Register Type	field
Description	The result from the distance detector.

Bitfield	Pos	Width	Mask
NUM_DISTANCES	0	4	0x0000000f
NEAR_START_EDGE	8	1	0x00000100

CALIBRATION_NEEDED	9	1	0x00000200
MEASURE_DISTANCE_ERROR	10	1	0x00000400
TEMPERATURE	16	16	0xffff0000

NUM_DISTANCES - The number of detected distances

NEAR_START_EDGE - Indicating that there might be an object near the start point of the measured range

CALIBRATION_NEEDED - Indication of sensor calibration needed. The sensor calibration needs to be redone

MEASURE_DISTANCE_ERROR - The measure command failed

TEMPERATURE - Temperature in sensor during measurement (in degree Celsius). Note that it has poor absolute accuracy and should only be used for relative temperature measurements.

6.2.6 Peak0 Distance

Address	0x0011
Access	Read Only
Register Type	uint
Unit	mm
Description	The distance to peak 0. Note: This value is a factor 1000 larger than the RSS value.

6.2.7 Peak1 Distance

Address	0x0012
Access	Read Only
Register Type	uint
Unit	mm
Description	The distance to peak 1. Note: This value is a factor 1000 larger than the RSS value.

6.2.8 Peak2 Distance

Address	0x0013
Access	Read Only
Register Type	uint
Unit	mm
Description	The distance to peak 2. Note: This value is a factor 1000 larger than the RSS value.

6.2.9 Peak3 Distance

Address	0x0014
Access	Read Only
Register Type	uint
Unit	mm
Description	The distance to peak 3. Note: This value is a factor 1000 larger than the RSS value.

6.2.10 Peak4 Distance

Address	0x0015
Access	Read Only
Register Type	uint
Unit	mm
Description	The distance to peak 4. Note: This value is a factor 1000 larger than the RSS value.

6.2.11 Peak5 Distance

Address	0x0016
Access	Read Only
Register Type	uint
Unit	mm
Description	The distance to peak 5. Note: This value is a factor 1000 larger than the RSS value.

6.2.12 Peak6 Distance

Address	0x0017
Access	Read Only
Register Type	uint
Unit	mm
Description	The distance to peak 6. Note: This value is a factor 1000 larger than the RSS value.

6.2.13 Peak7 Distance

Address	0x0018
Access	Read Only
Register Type	uint
Unit	mm
Description	The distance to peak 7. Note: This value is a factor 1000 larger than the RSS value.

6.2.14 Peak8 Distance

Address	0x0019
Access	Read Only
Register Type	uint
Unit	mm
Description	The distance to peak 8. Note: This value is a factor 1000 larger than the RSS value.

6.2.15 Peak9 Distance

Address	0x001a
Access	Read Only
Register Type	uint
Unit	mm
Description	The distance to peak 9. Note: This value is a factor 1000 larger than the RSS value.

6.2.16 Peak0 Strength

Address	0x001b
Access	Read Only
Register Type	int
Description	The reflective strength of peak 0. Note: This value is a factor 1000 larger than the RSS value.

6.2.17 Peak1 Strength

Address	0x001c
Access	Read Only
Register Type	int
Description	The reflective strength of peak 1. Note: This value is a factor 1000 larger than the RSS value.

6.2.18 Peak2 Strength

Address	0x001d
Access	Read Only
Register Type	int
Description	The reflective strength of peak 2. Note: This value is a factor 1000 larger than the RSS value.

6.2.19 Peak3 Strength

Address	0x001e
Access	Read Only
Register Type	int
Description	The reflective strength of peak 3. Note: This value is a factor 1000 larger than the RSS value.

6.2.20 Peak4 Strength

Address	0x001f
Access	Read Only
Register Type	int
Description	The reflective strength of peak 4. Note: This value is a factor 1000 larger than the RSS value.

6.2.21 Peak5 Strength

Address	0x0020
Access	Read Only
Register Type	int
Description	The reflective strength of peak 5. Note: This value is a factor 1000 larger than the RSS value.

6.2.22 Peak6 Strength

Address	0x0021
Access	Read Only
Register Type	int
Description	The reflective strength of peak 6. Note: This value is a factor 1000 larger than the RSS value.

6.2.23 Peak7 Strength

Address	0x0022
Access	Read Only
Register Type	int
Description	The reflective strength of peak 7. Note: This value is a factor 1000 larger than the RSS value.

6.2.24 Peak8 Strength

Address	0x0023
Access	Read Only
Register Type	int
Description	The reflective strength of peak 8. Note: This value is a factor 1000 larger than the RSS value.

6.2.25 Peak9 Strength

Address	0x0024
Access	Read Only
Register Type	int
Description	The reflective strength of peak 9. Note: This value is a factor 1000 larger than the RSS value.

6.2.26 Start

Address	0x0040
Access	Read / Write
Register Type	uint
Unit	mm
Description	The start of measured interval in millimeters. Note: This value is a factor 1000 larger than the RSS value.
Default Value	250

6.2.27 End

Address	0x0041
Access	Read / Write
Register Type	uint
Unit	mm
Description	The end of measured interval in millimeters. Note: This value is a factor 1000 larger than the RSS value.
Default Value	3000

6.2.28 Max Step Length

Address	0x0042
Access	Read / Write
Register Type	uint
Description	Used to limit step length. If set to 0 (default), the step length is calculated based on profile.
Default Value	0

6.2.29 Close Range Leakage Cancellation

Address	0x0043
Access	Read / Write
Register Type	bool
Description	Enable the close range leakage cancellation logic.
Default Value	True

6.2.30 Signal Quality

Address	0x0044
Access	Read / Write
Register Type	int
Description	High signal quality results in a better SNR (because of higher HWAAS) and higher power consumption. Note:This value is a factor 1000 larger than the RSS value.
Default Value	15000

6.2.31 Max Profile

Address	0x0045
Access	Read / Write
Register Type	enum
Description	Max profile.
Default Value	PROFILE5

Enum	Value
PROFILE1	1
PROFILE2	2
PROFILE3	3
PROFILE4	4
PROFILE5	5

PROFILE1 - Profile 1

PROFILE2 - Profile 2

PROFILE3 - Profile 3

PROFILE4 - Profile 4

PROFILE5 - Profile 5

6.2.32 Threshold Method

Address	0x0046
Access	Read / Write
Register Type	enum
Description	Threshold method.
Default Value	CFAR

Enum	Value
FIXED_AMPLITUDE	1
RECORDED	2
CFAR	3
FIXED_STRENGTH	4

FIXED_AMPLITUDE - Fixed amplitude threshold

RECORDED - Recorded threshold

CFAR - CFAR threshold

FIXED_STRENGTH - Fixed strength threshold

6.2.33 Peak Sorting

Address	0x0047
Access	Read / Write
Register Type	enum
Description	Peak sorting method.
Default Value	STRONGEST

Enum	Value
CLOSEST	1
STRONGEST	2

CLOSEST - Sort peaks by range, closest first

STRONGEST - Sort peaks by amplitude, strongest first

6.2.34 Num Frames Recorded Threshold

Address	0x0048
Access	Read / Write
Register Type	uint
Description	The number frames to use for recorded threshold.
Default Value	100

6.2.35 Fixed Amplitude Threshold Value

Address	0x0049
Access	Read / Write
Register Type	uint
Description	Fixed amplitude threshold value Note: This value is a factor 1000 larger than the RSS value.
Default Value	100000

6.2.36 Threshold Sensitivity

Address	0x004a
Access	Read / Write
Register Type	uint
Description	Threshold sensitivity (0 <= sensitivity <= 1000) Note: This value is a factor 1000 larger than the RSS value.
Default Value	500

6.2.37 Reflector Shape

Address	0x004b
Access	Read / Write
Register Type	enum
Description	Reflector shape.
Default Value	GENERIC

Enum	Value
GENERIC	1
PLANAR	2

GENERIC - Generic reflector shape

PLANAR - Planar reflector shape

6.2.38 Fixed Strength Threshold Value

Address	0x004c
Access	Read / Write
Register Type	int
Description	Fixed strength threshold value Note: This value is a factor 1000 larger than the RSS value.
Default Value	0

6.2.39 Measure On Wakeup

Address	0x0080
Access	Read / Write
Register Type	bool
Description	Perform measure on wake up.
Default Value	False

6.2.40 Command

Address	0x0100
Access	Write Only
Register Type	enum
Description	Execute command.

Enum	Value
APPLY_CONFIG_AND_CALIBRATE	1
MEASURE_DISTANCE	2
APPLY_CONFIGURATION	3
CALIBRATE	4
RECALIBRATE	5
ENABLE_UART_LOGS	32
DISABLE_UART_LOGS	33
LOG_CONFIGURATION	34
RESET_MODULE	1381192737

APPLY_CONFIG_AND_CALIBRATE - Apply configuration, calibrate sensor and detector

MEASURE_DISTANCE - Measure distance

APPLY_CONFIGURATION - Apply the configuration

CALIBRATE - Calibrate sensor and detector

RECALIBRATE - Re-calibrate sensor and detector

ENABLE_UART_LOGS - DEBUG: Enable UART Logs

DISABLE_UART_LOGS - DEBUG: Disable UART Logs

LOG_CONFIGURATION - DEBUG: Print detector configuration to UART

RESET_MODULE - Reset module, needed to make a new configuration

6.2.41 Application Id

Address	0xffff
Access	Read Only
Register Type	enum
Description	The application id register.

Enum	Value
DISTANCE_DETECTOR	1
PRESENCE_DETECTOR	2
REF_APP_BREATHING	3

DISTANCE_DETECTOR - Distance Detector Application

PRESENCE_DETECTOR - Presence Detector Application

REF_APP_BREATHING - Breathing Reference Application

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