Application note

How to use a sensor on a DIL 24 socket in X-CUBE-MEMS1 package applications

Introduction

The X-CUBE-MEMS1 software package allows you to build applications based on sensor data from STM32 Nucleo development platforms mounting a compatible X-NUCLEO expansion board with several high performance ST motion MEMS and environmental sensors.

You can, however, substitute individual sensors on the X-NUCLEO expansion board with single sensor boards with compatible pins for the standard DIL 24 socket.

1 Step by step procedure to replace an on-board sensor with a DIL 24 sensor

In this example, we replace the LSM6DSL sensor on the X-NUCLEO-IKS01A2 expansion board with the LSM6DSO sensor connected to a board with a DIL 24 socket.

We have chosen the DataLogFusion application (using MotionFX sensor fusion algorithm) running on the NUCLEO-L476RG development board.

With minor modifications, you can follow the same procedure for other sensors, expansion boards and STM32 Nucleo board platforms as well.

Step 1. Add the sensor in the board configuration header file.

In the *inc/iks01a2_conf.h* file, disable the use of the LSM6DSL sensor by inserting "0U" as highlighted below in bold, and enable the LSM6DSO sensor by adding the define statement also shown below in bold.

```
#define USE_IKS01A2_ENV_SENSOR_HTS221_0       1U
#define USE_IKS01A2_ENV_SENSOR_LPS22HB_0              1U

#define USE_IKS01A2_MOTION_SENSOR_LSM6DSL_0           0U
#define USE_IKS01A2_MOTION_SENSOR_LSM303AGR_ACC_0     1U
#define USE_IKS01A2_MOTION_SENSOR_LSM303AGR_MAG_0     1U

#define USE_IKS01A2_MOTION_SENSOR_LSM6DSO_0           1U
```

Step 2. Add the sensor drivers in a project for a specific IDE (for example, SW4STM32) and include the path to the sensor drivers into the project settings.

Figure 1. Add LSM6DSO sensor drivers in a project for the SW4STM32 IDE

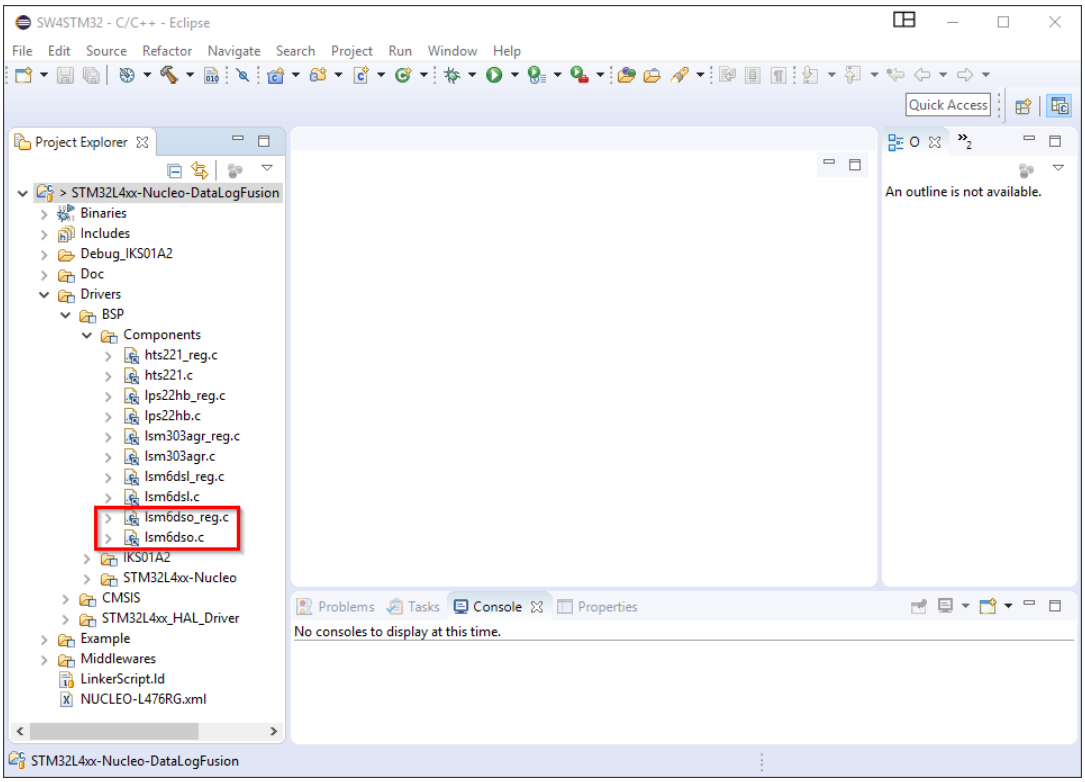
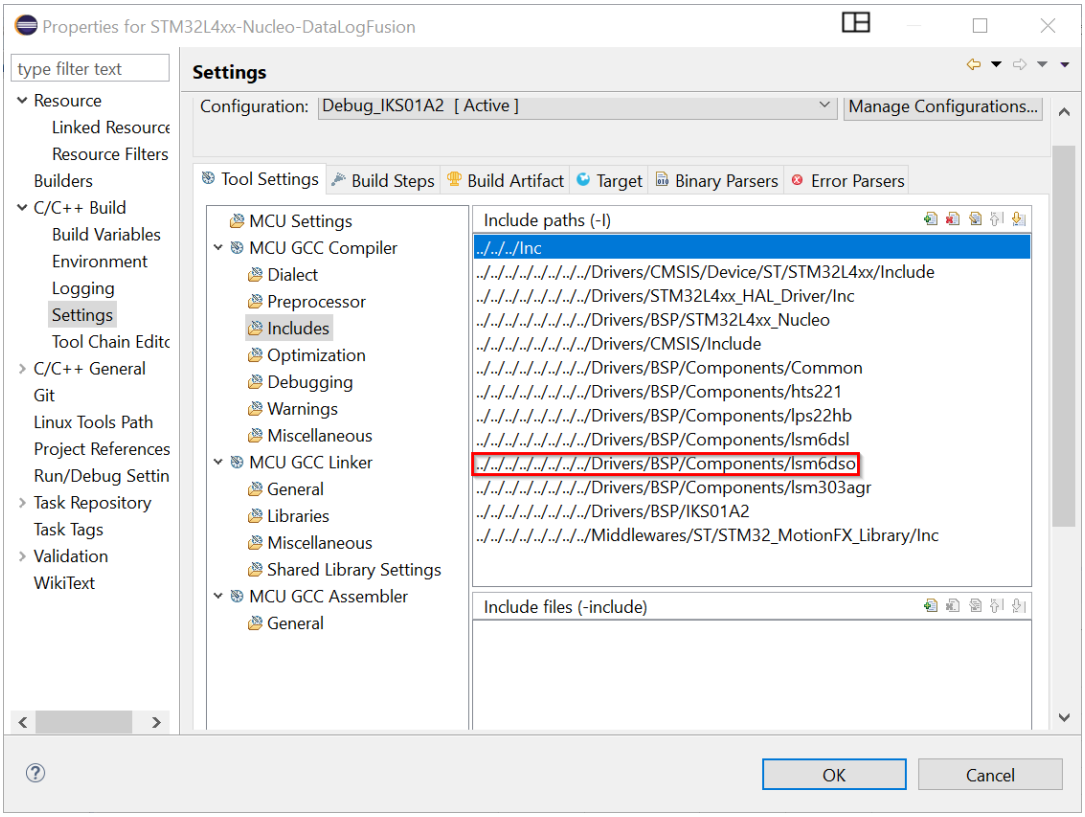


Figure 2. Add LSM6DSO sensor including path to a project for the SW4STM32 IDE



Step 3. Substitute the sensor on the X-NUCLEO expansion board with the single sensor on the DIL 24 socket board in the X-CUBE-MEMS1 application.

Step 3a. Substitute the LSM6DSL sensor handler with the LSM6DSO sensor handler in the *src/main.c* file, `main()` function (in bold below).

```
  /* Acquire data from enabled sensors and fill Msg stream */
  RTC_Handler(&msg_dat);
  Accelero_Sensor_Handler(&msg_dat, IKS01A2_LSM6DSO_0);
  Gyro_Sensor_Handler(&msg_dat, IKS01A2_LSM6DSO_0);
  Magneto_Sensor_Handler(&msg_dat, IKS01A2_LSM303AGR_MAG_0);
  Humidity_Sensor_Handler(&msg_dat, IKS01A2_HTS221_0);
  Temperature_Sensor_Handler(&msg_dat, IKS01A2_HTS221_0);
  Pressure_Sensor_Handler(&msg_dat, IKS01A2_LPS22HB_0);
```

Step 3b. Substitute the LSM6DSL sensor initialization with LSM6DSO initialization in the *src/main.c* file, `Init_Sensors()` function (in bold below).

```
/**
 * @brief  Initialize all sensors
 * @param  None
 * @retval None
 */
static void Init_Sensors(void)
{
  (void)IKS01A2_MOTION_SENSOR_Init(IKS01A2_LSM6DSO_0, MOTION_ACCELERO | MOT
ION_GYRO);
  (void)IKS01A2_MOTION_SENSOR_Init(IKS01A2_LSM303AGR_MAG_0, MOTION_MAGNETO)
;
  (void)IKS01A2_ENV_SENSOR_Init(IKS01A2_HTS221_0, ENV_TEMPERATURE | ENV_HUM
IDITY);
  (void)IKS01A2_ENV_SENSOR_Init(IKS01A2_LPS22HB_0, ENV_PRESSURE);
}
```

Step 3c. Add the LSM6DSO sensor Unicleo ID from the table below to the *src/DemoSerial.c* file (in bold below the table).

Table 1. Unicleo-GUI supported sensors and IDs

Accelerometer/gyroscope		Magnetometer		Pressure/temperature		Humidity/temperature	
Name	ID	Name	ID	Name	ID	Name	ID
LSM6DS0	1	LIS3MDL	1	LPS25HB	1	HTS221	1
LSM6DS3	2	LSM303AGR_MAG	2	LPS22HB	3	STTS751	2
LSM6DSL	3	LIS2MDL	3	LPS22HH	4		
LIS2DH12	4						
H3LIS331DL	5						
LSM303AGR	6						
LSM6DSO	7						
LIS2DW12	8						
LSM6DSR	9						
LSM6DSOX	10						

```
#define LPS25HB_UNICLEO_ID_ONBOARD 1
#define LPS25HB_UNICLEO_ID_DIL 2
#define LPS22HB_UNICLEO_ID 3
#define HTS221_UNICLEO_ID 1
#define LSM6DS0_UNICLEO_ID 1
#define LSM6DS3_UNICLEO_ID 2
#define LSM6DSL_UNICLEO_ID 3
#define LSM6DSO_UNICLEO_ID 7
#define LIS3MDL_UNICLEO_ID 1
#define LSM303AGR_UNICLEO_ID_MAG 2
```

Step 3d. Substitute LSM6DSL sensor disable with LSM6DSO disable in the *src/DemoSerial.c* file, `HandleMSG()` function, `CMD_ACCELERO_GYRO_Init` case (in bold below).

```
Serialize_s32(&Msg->Data[3], LSM6DSO_UNICLEO_ID, 4);
```

Step 3e. Substitute LSM6DSL sensor enable with LSM6DSO enable in the *src/DemoSerial.c* file, `HandleMSG()` function, `CMD_Start_Data_Streaming` case (in bold below).

```
if ((SensorsEnabled & ACCELEROMETER_SENSOR) == ACCELEROMETER_SENSOR)
{
   (void)IKS01A2_MOTION_SENSOR_Enable(IKS01A2_LSM6DSO_0, MOTION_ACCELERO);
}
if ((SensorsEnabled & GYROSCOPE_SENSOR) == GYROSCOPE_SENSOR)
{
   (void)IKS01A2_MOTION_SENSOR_Enable(IKS01A2_LSM6DSO_0, MOTION_GYRO);
}
```

Step 3f. Substitute LSM6DSL sensor disable with LSM6DSO disable in the *src/DemoSerial.c* file, `HandleMSG()` function, `CMD_Stop_Data_Streaming` case (in bold below).

```
(void)IKS01A2_MOTION_SENSOR_Disable(IKS01A2_LSM6DSO_0, MOTION_ACCELERO);
(void)IKS01A2_MOTION_SENSOR_Disable(IKS01A2_LSM6DSO_0, MOTION_GYRO);
```

Step 4. Change sensor orientation (optional).

In the *MotionFX_Manager.c* file `MotionFX_manager_init()` function, check accelerometer, gyroscope and magnetometer sensor orientation setup with real DIL 24 sensor orientation and update if necessary.

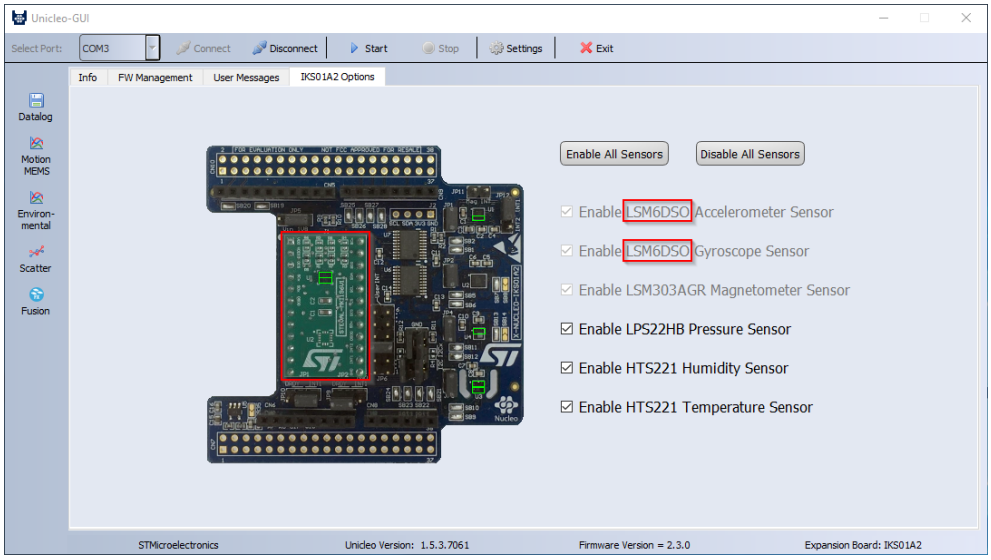
In our case, we need to check accelerometer and gyroscope sensor orientation setup with LSM6DSO (DIL 24 module) orientation (in bold below).

```
/**
 * @brief  Initialises MotionFX algorithm
 * @param  None
 * @retval None
 */
void MotionFX_manager_init(void)
{
  char acc_orientation[4];
  char gyro_orientation[4];
  char mag_orientation[4];

  acc_orientation[0] = 'n';
  acc_orientation[1] = 'w';
  acc_orientation[2] = 'u';

  gyro_orientation[0] = 'n';
  gyro_orientation[1] = 'w';
  gyro_orientation[2] = 'u';

  mag_orientation[0] = 'n';
  mag_orientation[1] = 'e';
  mag_orientation[2] = 'u';
```

Note: In this example, no change is needed as the LSM6DSL sensor on the X-NUCLEO expansion board and the LSM6DSO sensor on the DIL 24 module have the same orientation.

Step 5. Build the application and run the Unicleo-GUI SW to check if the LSM6DSO sensor is active and the Motion Sensor Fusion algorithm is working properly.

Figure 3. Running DataLogFusion application with LSM6DSO sensor (DIL 24 module) in Unicleo-GUI SW



RELATED LINKS

STEVAL-MKI196V1 evaluation board

LSM6DSO datasheet freely available at www.st.com

LSM6DSO application note: AN5192, "LSM6DSO: always-on 3D accelerometer and 3D gyroscope", freely available at www.st.com

Revision history

Table 2. **Document revision history**

Date	Revision	Changes
11-Jun-2019	1	Initial release

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