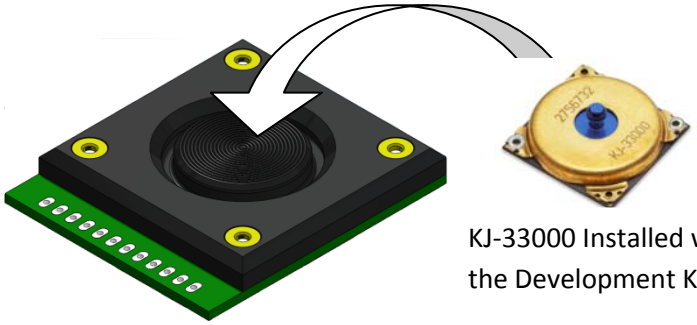
# Joystick I²C Development Kit Programming and Application Note



KJ-33000 Installed within the Development Kit.

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# 1. DESCRIPTION AND APPLICATION

## 1.1. DESCRIPTION

The KJ-33000-002 is a developer's kit that includes the installed KJ-3300 Joystick. The Joystick is a digital joystick that communicates via an $I^2C$ interface. This Application Note describes how to communicate with the Joystick.

## 1.2. APPLICATION

The Joystick is developed for hand held telecommunication and electronic devices. Refer to manufacturer's website (www.knowles.com) for current application notes.

# 2. $I^2C$ Interface

The $I^2C$ controller can operate up to 400kHz (fast mode). Seven-bit addressing is implemented. The preprogrammed $I^2C$ address is 0x38. If the ADDR line is tied to $V_{DD}$, the device will respond to address 0x39.

A read initiated from the device returns two bytes. The first byte contains a left justified 4 bit value for the X axis while the second byte contains a left justified 4 bit value for the Y axis. The least significant 4 bits of both bytes are zero filled.

A write initiated to the device will send it into either Low Power Mode or Sleep Mode depending on the value of the least significant bit. A '1' corresponds to Low Power Mode while a '0' corresponds to Sleep Mode.

The open drain interrupt line is asserted (low level) on a change in either the X or Y value. No interrupts are generated when there are consecutive zeros on both axes.

# 3. Programming Examples

## 3.1. Communication to the Joystick

Communicating with the joystick using the $I^2C$ bus, simply send the start condition, send the address of the device (0x38 or 0x39 based on the ADDR Pin) indicating a read operation. When an Idle condition exists, read a byte from the device ( X displacement ), issue an acknowledgement, then on the next idle, read another byte from the device ( Y-displacement ). Finally, issue a no-acknowledgement, wait for an idle condition and issue a stop condition.

Sample:

```
IdleI2C ();                 // Wait for an Idle Condition
StartI2C ();                // Issue a Start Condition
IdleI2C ();                 // Wait for an Idle Condition
address = 0x38 << 1 | 0x01; // Joystick Address Plus Read
ack = WriteI2C (address);   // Write the address plus read
IdleI2C ();                 // Wait for an Idle Condition
JoystickX = ReadI2C ();     // Read Joystick X displacement
AckI2C ();                  // Issue an Acknowledge Condition
IdleI2C ();                 // Wait for an Idle Condition
JoystickY = ReadI2C ();     // Read Joystick Y displacement
NotAckI2C ();               // Issue the No-Ack Condition
IdleI2C ();                 // Wait for an Idle Condition
StopI2C ();                 // Release the Bus
```

## 3.2. Lookup Tables

Lookup tables can be used to translate the displacement data to a more meaningful value. The X and Y data in the previous example will be found in the most significant 4 bits of the variables JoystickX and JoystickY. These values can be simply bit shifted right by 4 bits using the bitwise >> operator.

```
JoystickX = JoystickX >> 4;
JoystickY = JoystickY >> 4;
```

Each of the Joystick variables is now a number between 0 and 15 (4 bits). A lookup table consisting of a simple 16 byte array could be used to translate the value output by the joystick to a more relevant number. For example, the array:

```
char Xspeed[16] = {0,1,2,3,4,5,6,7,0,-1,-2,-3,-4,-5,-6,-7};
```

would be used to translate the actual output of the device to a real, displacement number.

**Please note that due to the most significant bit indicating positive or negative displacement, there are 2 possibilities of zero in the joystick. 0b1000 is the same as 0b0000. The data in the array will then translate actual displacement to a number corresponding to the physical position of the stick.**

Lookup tables could also be used to expand the 4 bit value to a signed 8 bit value. For example:

```
char Xspeed[16] = {0,15,31,47,63,79,95,111,0,-15,-31,-47,-63,-79,-95,-111};
```

linearly expands the value output by the joystick by indexing the JoystickX value in the array.

```
LookupXSpeed = Xspeed[JoystickX];
```

## 3.3. Low Power Modes

There are two low power modes to the joystick; low power and sleep mode. To put the joystick into low power mode, a simple write to the joystick with the least significant bit being a one is required. To put the joystick into sleep mode, the least significant bit of the write must be a zero.

Sample:

```
IdleI2C ();                 // Wait for an Idle Condition
StartI2C ();                // Issue a Start Condition
IdleI2C ();                 // Wait for an Idle Condition
address = 0x38 << 1 | 0x00; // Joystick Address Plus Write
ack = WriteI2C (address);   // Write the address plus read
IdleI2C ();                 // Wait for an Idle Condition
ack = WriteI2C (0);         // Put the joystick into Low Pwr
NotAckI2C ();               // Issue the No-Ack Condition
IdleI2C ();                 // Wait for an Idle Condition
StopI2C ();                 // Release the Bus
```

This example will put the Joystick into sleep mode. The current consumption of the device will be at its minimum in this mode.

# 4. I²C Demo Board

## 4.1. Clarification of Pins

For physical pin number, please see the product data sheet.

$AV_{DD}$ - Analog power supply : 3.3V typical

$V_{IO}$ – I/O power supply, 1.8V or connect to $V_{DD}$

Test – Connect to ground

ADDR – GND for address 0x38, $V_{DD}$ for address 0x39

SCL - $I^2C$ clock line

Int – not necessary for operation, asserted at change of X or Y

SDA – $I^2C$ data line

$V_{PP}$ – Programming power supply: Connect to VDD

$V_{SS}$ – Digital ground

$V_{DD}$ – Digital power supply: 3.3V typical

N/C - No connection

$AV_{SS}$ – Analog ground

Corner Pads – Connect to ground for best RF performance