I2C Communication Description

Product: Digital Mass Flow Sensor (KPI-DMFS-1)

Inter-Integrated Circuit (or I2C) is a widely used data bus allowing multiple devices to share data over short distances. In addition to a shared ground, only two primary lines are needed: a data line (SDA) and a clock (SCL). One or multiple devices act as a Master to send both addresses and commands to Slave devices, which respond according to the commands. The user will need to provide an external device configured and programmed as a Master in order to communicate with the Digital Mass Flow Sensor.

For every command, the slave address must be written as the first seven bits, with either a 0 or 1 as the last bit, 0 being Write, 1 being Read. If it is an address plus the write bit, after receiving an acknowledge (ACK), the Master must then write an 8-bit command. If the address plus the read bit is written, after receiving an acknowledge, the slave will respond with data.

The basic sequence of commands for initializing the unit, for flow reading, is as follows:

1. Select Gas
    a. Optionally, verify gas selection (I2C Read)
2. Select flow type (LBM, SLPM)
    a. Optionally, verify flow type selection (I2C Read)
    b. After gas and flow selection have been verified, if these settings are not expected to ever change, you can optionally write the Save Settings command, and skip straight to step 3 upon subsequent start-ups
3. Start flow conversion
4. Now able to continuously read flow through I2C Read commands (values must be converted using divisor conversion chart)

If, instead of flow, temperature is wanted:

1. Select temperature
    a. Optionally, verify temperature selection (I2C Read)
    b. After temperature selection has been verified, if this setting is not expected to ever change, you can optionally write the Save Settings command, and skip straight to step 2 upon subsequent start-ups
2. Start conversion
3. Now able to continuously read temperature through I2C Read commands (values must be converted using divisor conversion chart)

The following page has a complete reference table for the slave address, as well as I2C commands that the Digital Mass Flow Sensor responds to.

I2C Slave Address and Commands

Digital Mass Flow Sensor Slave Address	
0x10	Hex
0b0010000	Binary

I2C Write and Read Commands, with Slave Address	
0x20	I2C Write, Hex
0x21	I2C Read, Hex

Digital Mass Flow Sensor Slave Commands	
Command	Description
0x01	Select Flow – Standard Liters Per Minute (SLPM)
0x02	Select Flow – Pound Mass Per Minute (LBM)
0x03	Select Temperature – Celsius (C)
0x04	Select Gas – Air
0x05	Select Gas – Oxygen
0x06	Read Serial Number
0x11	Start Conversion
0x77	Save Settings

When writing commands 0x01 through 0x05, the Digital Mass Flow Sensor will respond with those same commands upon receiving an I2C Read, in order that the user may confirm that the device received the correct command, if the user so wishes.

Ex:

1. 0x20 (I2C Write)
2. ACK
3. 0x04 (Select Gas – Air)
4. ACK
5. 0x21 (I2C Read)
6. ACK
7. 0x00 (First Data Byte)
8. ACK
9. 0x04 (Second Data byte)

Therefore, the two-byte response would be 0x0004, or 0x04, the same as the written command for Select Gas – Air.

Conversion Values

Each reading setting comes back as a 16-bit decimal value, and must be converted to its actual value using a different divisor, as listed below.

Setting	Divisor
SLPM	100.0
LBM	10000.0
Temperature	100.0

So, for example, if reading standard liters per minute, and the value comes back as decimal 15,784 – after dividing by 100.0, this value becomes 157.84 (SLPM), which is the flow rate.

Example I2C Flow Reading Sequence:

1. 0x20 (I2C Write Command)
2. ACK
3. 0x04 (Select Gas – Air)
4. ACK
5. 0x20 (I2C Write Command)
6. ACK
7. 0x01 (Select Flow – Standard Liters Per Minutes)
8. 0x20 (I2C Write Command)
9. ACK
10. 0x11 (Start Conversion)
11. 0x21 (I2C Read)
12. ACK
13. Receive First byte (Ex: 0x3D, or 0b00111101)
14. ACK
15. Receive Second byte (Ex: 0xA8, or 0b10101000)
16. Combine first and second bytes (0x3DA8, or 0b0011110110101000), to get the decimal value (15,784) – and convert the value using the chart and your particular setting (15,784 / 100.0 = 157.84 SLPM)