Telaire Products
Amphenol Advanced Sensors

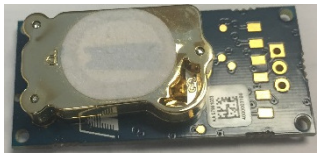
T6743 Automotive CO2 Sensor

1. Introduction

The T6743 from Telaire is an automotive qualified Carbon Dioxide Sensor that can be used in different configurations to meet customer needs for this type of sensor. Offering 3 operating modes, the sensor can monitor the cabin during Park, be used as a sensor for demand based ventilation systems in drive, and as high limit sensor. The sensor is derived from Telaire's 25 years of experience in commercial CO2 sensors with production of automotive qualified sensors from Amphenol Advanced Sensors.

Telaire offer flexibility in configuration, and where commercially viable are prepared to customize both the packaging and LIN stack to meet customer needs.

2. Electrical Interface



There are three connections to the sensor using 3 pin thru hole connector. Pin1 (V+ = 9-16VDC) is designated by the square pin pad.
Pin 2 (LIN) is the center pin.
Pin 3 (GND) is opposite the square pad.

3. LIN Interface

The LIN stack implements the LIN 2.0 specification. It's default baud rate is 19.2 kBd and includes the auto-baud feature to compensate of errors in the master controllers' baud rate (± 5%).

3.1 Nodes

The LIN Description File (LDF) defined 2 nodes, a Master node and a Slave node. The customer supplies the Master node. The T6743 is the Slave node.

3.1.1 Master

The Master node publishes one signal, ICO2_MeasurementMode, to which the slave subscribes. The purpose is to put the sensor into 1 of 3 different CO2 gas measurement modes.

- Drive
- Park
- No Measure

See Section 2.2 for more details.

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3.1.2 Slave

The slave node publishes 4 signals, to which the master subscribes.

- ICO2_Value
- ICO2_Alarm
- ICO2_Defect
- ICO2_ResponseError

See Section 2.2 for more details.

2.2 Signals

A description of the 5 signals follows.

2.2.1 ICO2_Alarm

The ICO2_Alarm signal is published by the slave and subscribed to by the master. It has 3 encodings. The signal is used to indicate that the gas concentration has exceeded an upper limit value (30000 ppm). The alarm has hysteresis so in the event that the measured gas exceeds this upper limit the signal will stay set until the measurement falls below the corresponding lower limit (2500 ppm).

- 0x00 (‘00’B) – No Alarm. The current measurement is less than the critical gas concentration.
- 0x01 (‘01’B) – Gradient. This signal is not used.
- 0x02 (‘10’B) – Limit. The current measurement exceeds the upper limit gas concentration. This signal will stay set until the gas concentration falls below the lower limit gas concentration.

Both the upper and lower limit values are adjustable during factory calibration.

2.2.2 ICO2_Value

The ICO2_CO2Value is published by the slave and subscribed to by the master. It is the current measured value of gas concentration. It is a 16-bit number and the range of values is between 0 and 65500 ppm

The value 65534 (0xFFFE) is reserved for the initial value, indicating that the sensor has yet to take a measurement.

The value 65535 (0xFFFF) is reserved to indicate error conditions. Note that this value is not currently used.

2.2.3 ICO2_Defect

The ICO2_Defect signal is published by the slave and subscribed to by the master. It indicates that there is an unrecoverable error in the sensor. The factory should be consulted if this error is asserted.

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2.2.4 ICO2_MeasurementMode

The ICO2_MeasurementMode signal is published by the master and subscribed to by the slave. It sets the gas measurement period.

- 0x00 (‘000’B) – No Measure. In this mode the gas concentration is not measured. This is the lowest power mode available but provides no useful information.
- 0x01 (‘001’B) – Drive. In this mode the gas concentration is measured every 5 seconds. This consumes the most power from the vehicle but give the most up to date results.
- 0x02 (‘010’B) – Park. In this mode the gas concentration, under normal conditions is measured every 300 seconds (5 minutes). This is a very low power mode.
- 0x03 (‘011’B) through 0x07 (‘111’B) – These modes are ignored by the sensor.

See Section 2.3.1 for a more detailed explanation of Park mode operation.

2.2.5 ICO2_ResponseError

The ICO2_ResponseError signal is published by the slave and subscribed to by the master. This signal is implemented by the LIN stack. It is set whenever a frame received by the node or a frame transmitted by the node contains an error in the response field. It is cleared after transmission.

2.3 Frames

There are 2 frames defined in the LDF.

2.3.1 ICO2e_01 (PID = 29 / 0x1D)

This frame is published by the master and subscribed to by the sensor (i.e., slave). It consists of 1 scalar signal that is 3 bits in length. The entire frame is 8 bytes long and the frame ID is 0x1D.

Name	Offset (in bits)	Length (in bits)
ICO2_MeasurementMode	0	3

From the LDF the signal encoding is as follows:

- 0x00 (‘000’B) – No Measure. The sensor will not do any measurements.
- 0x01 (‘001’B) – Drive. The sensor will make a gas measurement every 5 seconds and never sleep.
- 0x02 (‘010’B) – Park. The sensor will make a measurement based on the last measured as concentration. The measurement periodicity is described in the table below.

GAS PPM	Measurement Rate (in seconds)
0 – 9999	300 seconds (5 minutes)
10000 – 19999	180 seconds (3 minutes)
20000 – 29999	120 seconds (2 minutes)

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30000 – 65500	5 seconds

- 0x07 (‘111’B) – Error. This signal, and the signals 3 – 6 (‘011’B – ‘110’B) are ignored by the sensor.

2.3.2 ICO2_s_01 (PID = 31 / 0x1F)

This frame is published by the sensor (i.e., slave) and subscribed to by the master. It consists of 4 scalar signals for a total of 20 bits in length. The entire frame is 8 bytes long and the frame ID is 0x1F.

Name	Offset (in bits)	Length (in bits)
ICO2_CO2Value	0	16
ICO2_Alarm	16	2
ICO2_ResponseError	18	1
ICO2_Defect	19	1

2.4 Signal Encoding

Signal encoding is described in the LDF, which is available from Telaire. It is included here for completeness.

```
Signal_encoding_types {
    ICO2_Alarm_encoding {
        logical_value,0x00,"No_Alarm" ;
        logical_value,0x01,"Gradient" ;
        logical_value,0x02,"Limit" ;
    }
    ICO2_CO2Value_encoding {
        logical_value,0xFFFE,"Init" ;
        logical_value,0xFFFF,"Error" ;
        physical_value,0,65500,1.0000,0.0000,"Unit_PPM" ;
    }
    ICO2_MeasurementMode_encoding {
        logical_value,0x00,"No_Monitoring" ;
        logical_value,0x01,"Drive_Mode" ;
        logical_value,0x02,"Park_Mode" ;
        logical_value,0x07,"Error" ;
    }
    ICO2_ResponseError_encoding {
        logical_value,0x00,"Normal" ;
        logical_value,0x01,"Error" ;
    }
    ICO2_Defect {
        logical_value,0x00,"Ok" ;
        logical_value,0x01,"Defect" ;
    }
}
```

2.5 Node Configuration

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The LIN stack implements all mandatory LIN 2.0 Node Configuration requests. The sensor also responds to several User Defined requests.

2.5.1 Read by Identifier

In the examples that follow the default NAD is 0x43 (67). Wildcard values are used in the following Node Configuration requests.

2.5.1.1 LIN Product Identification (Identifier = 0)

As programmed the sensor has the LIN Product Identification set to all zeros. A request to read the LIN Product Identification (SID = 0xB2, D1 = 0x00) will return all zeros.

Request

NAD	PCI	SID	D1	D2	D3	D4	D5
0x43	0x06	0xB2	0x00	0xFF	0x7F	0xFF	0xFF

Response

NAD	PCI	RSID	D1	D2	D3	D4	D5
0x43	0x06	0xF2	0x00	0x00	0x00	0x00	0x00

Where the response is

- D1 is the Supplier ID, LSB
- D2 is the Supplier ID, MSB
- D3 is the Function ID, LSB
- D4 is the Function ID, MSB
- D5 is the Variant

These 5 bytes are defined by the end customer.

2.5.1.2 Serial Number (Identifier = 1)

As programmed, the sensor has the Product Serial Number set to all ones. A request to read the Serial Number (SID = 0xB2, D1 = 0x01) will return all ones.

Request

NAD	PCI	SID	D1	D2	D3	D4	D5
0x43	0x06	0xB2	0x01	0xFF	0x7F	0xFF	0xFF

Response

NAD	PCI	RSID	D1	D2	D3	D4	D5

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0x43	0x05	0xF2	0xFF	0xFF	0xFF	0xFF	0xFF

Where the response is

- D1 is the Serial Number digit 0, LSB
- D2 is the Serial Number digit 1
- D3 is the Serial Number digit 2
- D4 is the Serial Number digit 3, MSB
- D5 is unused (defaults to 0xFF)

2.5.2 User Defined (Identifiers 32 through 63)

The sensor has several properties that can be queried. Only the relevant ones will be documented here.

2.5.2.1 GAS PPM (Identifier = 36)

The current CO2 gas ppm can be read using identifier 0x24 (36).

Request

NAD	PCI	SID	D1	D2	D3	D4	D5
0x43	0x06	0xB2	0x26	0xFF	0x7F	0xFF	0xFF

Response

NAD	PCI	RSID	D1	D2	D3	D4	D5
0x43	0x03	0xF2	0x90	0x01	0xFF	0xFF	0xFF

Where

- D1 is the CO2 gas ppm, LSB
- D2 is the CO2 gas ppm, MSB
- D3 is unused (defaults to 0xFF)
- D4 is unused (defaults to 0xFF)
- D5 is unused (defaults to 0xFF)

The CO2 gas ppm can be calculated as

D2 * 256 + D1

So in this example

1 * 256 + 144 = 400 ppm

2.5.2.2 Firmware Revision (Identifier = 38)

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The firmware revision can be read using identifier 0x26 (38).

Request

NAD	PCI	SID	D1	D2	D3	D4	D5
0x43	0x06	0xB2	0x26	0xFF	0x7F	0xFF	0xFF

Response

NAD	PCI	RSID	D1	D2	D3	D4	D5
0x43	0x03	0xF2	0x04	0x00	0xFF	0xFF	0xFF

Where

- D1 is the firmware revision, LSB
- D2 is the firmware revision, MSB
- D3 is unused (defaults to 0xFF)
- D4 is unused (defaults to 0xFF)
- D5 is unused (defaults to 0xFF)

In this case the response is a firmware revision, number 9.

3.0 Additional Considerations

There are additional functions of the sensor.

3.1 Sleep and Wakeup

When the LIN controller issues the go-to-sleep command or there is no activity on the LIN bus for more than 5 seconds the sensor will go into deep sleep. This will automatically put the sensor into Park mode where the sample rate is based on the last measured CO2 gas concentration (see Section 2.3.1).

An important caveat is that if the senor is in Park mode and if the CO2 gas concentration has, or will, exceed the upper limit value (30000 ppm) the sensor come out of deep sleep mode and continue to make measurements at an accelerated rate. Additionally, the sensor will send a wakeup signal to the master controller as long as this condition exists.

If the sensor is placed into the No Measure mode, no measurements will be made and no wakeup signal will be sent, regardless of the last CO2 gas measurement. In this mode the sensor is in its lowest power state.

3.2 Park Mode Timeout

Assuming there is no LIN bus activity, the sensor will initially be in Park mode. After 8 hours, in this condition, the sensor will automatically go into No Measure mode. The sensor will be in deep sleep and will not make further measurements regardless of the CO2 gas concentration.

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