Description

The ZMOD4410 Evaluation Kit (EVK) is designed for evaluating IDT's ZMOD4410 Gas Sensor Module for TVOC. The total volatile organic compounds (TVOC) measurement is one of the indicators for indoor air quality (IAQ).

The *ZMOD4410 Evaluation Software* allows Windows®-based operating systems to communicate with the ZMOD4410 EVK via a USB connection on the user's computer, which functions as a master. The software and additional related documentation is available on the IDT website.

The EVK's Communication Board (HiCom) handles the interface between the user's computer and the ZMOD4410 module mounted on the ZMOD4410 Sensor Board (Daughter Board). Note: Only one Communication Board with one Sensor Board can be connected to the computer at a time.

The ZMOD4410 Evaluation Kit uses an FDTI controller on the Communication Board to handle the USB protocol, translate communications, and synchronize communications with the I2C interface. The Sensor Board includes a decoupling capacitor.

The Communication Board has devices mounted on both sides. The components on the top side generate a stable supply voltage. A potentiometer can be used to adjust the internal supply voltage in the typical range from 1.7V to 3.6V. Alternatively, the user's external supply voltage can be used. The intensity of the adjacent LED is proportional to the supply voltage.

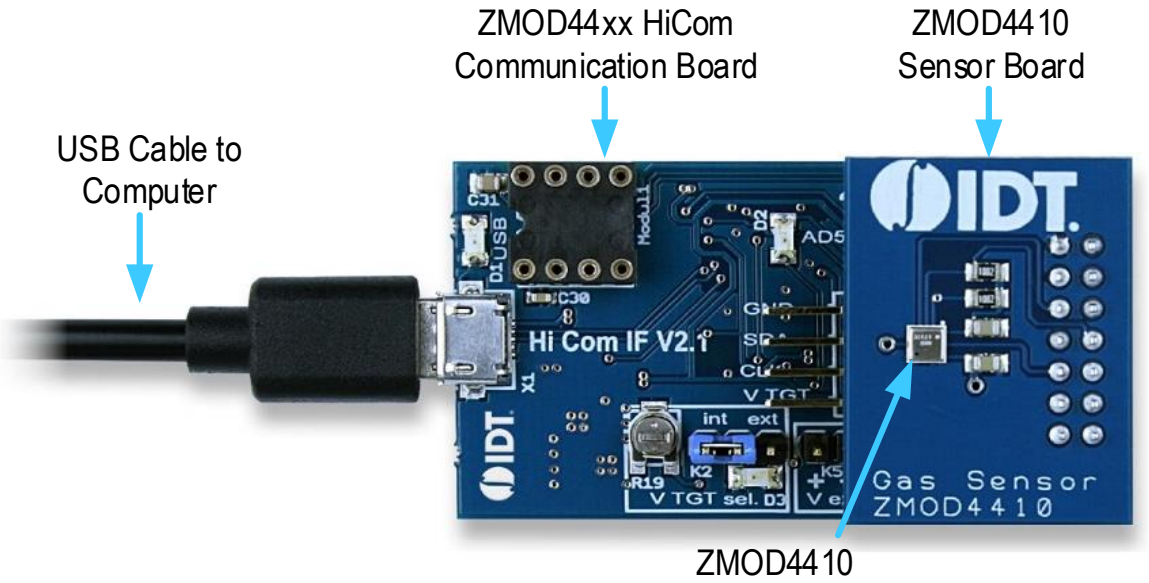
Features

- User-friendly EVK expedites configuration and evaluation of the ZMOD4410 Gas Sensor
- The modular design of the EVK allows simple connection of Sensor Boards for different gas sensor derivatives and easy integration with other sensor products via the I2C interface
- The required *ZMOD4410 Evaluation Software* is available for download on the IDT website, which also provides back-ground information on TVOC, gas sensing, and sensor programming.
- The bill of materials (BOM) and schematics for the ZMOD4410 Communication Board and Sensor Board are provided at www.IDT.com/ZMOD4410-EVK.

ZMOD4410-EVK Contents

- ZMOD44xx HiCom Communication Board
- ZMOD4410 Sensor Board with ZMOD4410 Gas Sensor Module
- 0.5m Type-B USB to Micro-USB Cable

ZMOD4410 Evaluation Kit



Note: Product images contained in this document are representations. Actual product configurations and versions are subject to change.

Important Notes

Disclaimer

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(i) delivered hardware or software

(ii) non-observance of instructions contained in this manual and in any other documentation provided to user, or

(iii) misuse, abuse, use under abnormal conditions, or alteration by anyone other than IDT.

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Restrictions in Use

IDT's ZMOD4410 Evaluation Kit, consisting of the ZMOD4410 HiCom Communication Board, ZMOD4410 Sensor Board, and the *ZMOD4410 Evaluation Software*, is designed for evaluation purpose only. IDT's ZMOD4410 Evaluation Kit must not be used for calibration, test, qualification, or production.

Important Equipment Warning: Ensure the correct connection of all cables. Supplying the board using the wrong polarity could result in damage to the board and/or the equipment. Check that all jumpers have been placed as specified in this document.

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1. Setup

1.1 First Startup

To set-up and operate the ZMOD4410 Evaluation Kit (EVK) with the ZMOD4410, refer to the *ZMOD4410 EVK Quick Start Guide* document included in the kit.

1.2 Required or Recommended User Equipment

By default, the internal supply voltage for powering the Sensor Board is generated from the USB voltage supplied by the user's computer via the USB cable. If there is a need for currents higher than the defined USB Standard (usually 500mA at 5V), an external voltage supply source can be used instead of the internally generated voltage supply provided on the Communication Board. For details, see section 1.4.

The external supply must meet these requirements:

- Voltage: 1.7V to 3.6V
- Current must meet the user's specifications.

1.3 User Computer Requirements and Setup

1.3.1 Computer Requirements

A Windows®-based computer is required for interfacing with the EVK and configuring the ZMOD4410. The user must have administrative rights on the computer to download and install the *ZMOD4410 Evaluation Software*.

The computer must meet the following requirements:

- 1GB RAM
- Hard drive with at least 500MB free space
- 1 USB port
- Windows Vista/Windows 7/Windows 8/Windows 10
- Internet access for initial download of the drivers and software

Important: Before installing and activating the software, assemble and connect the hardware for the kit to the user's computer according to steps 1 through 3 in section 1.4.

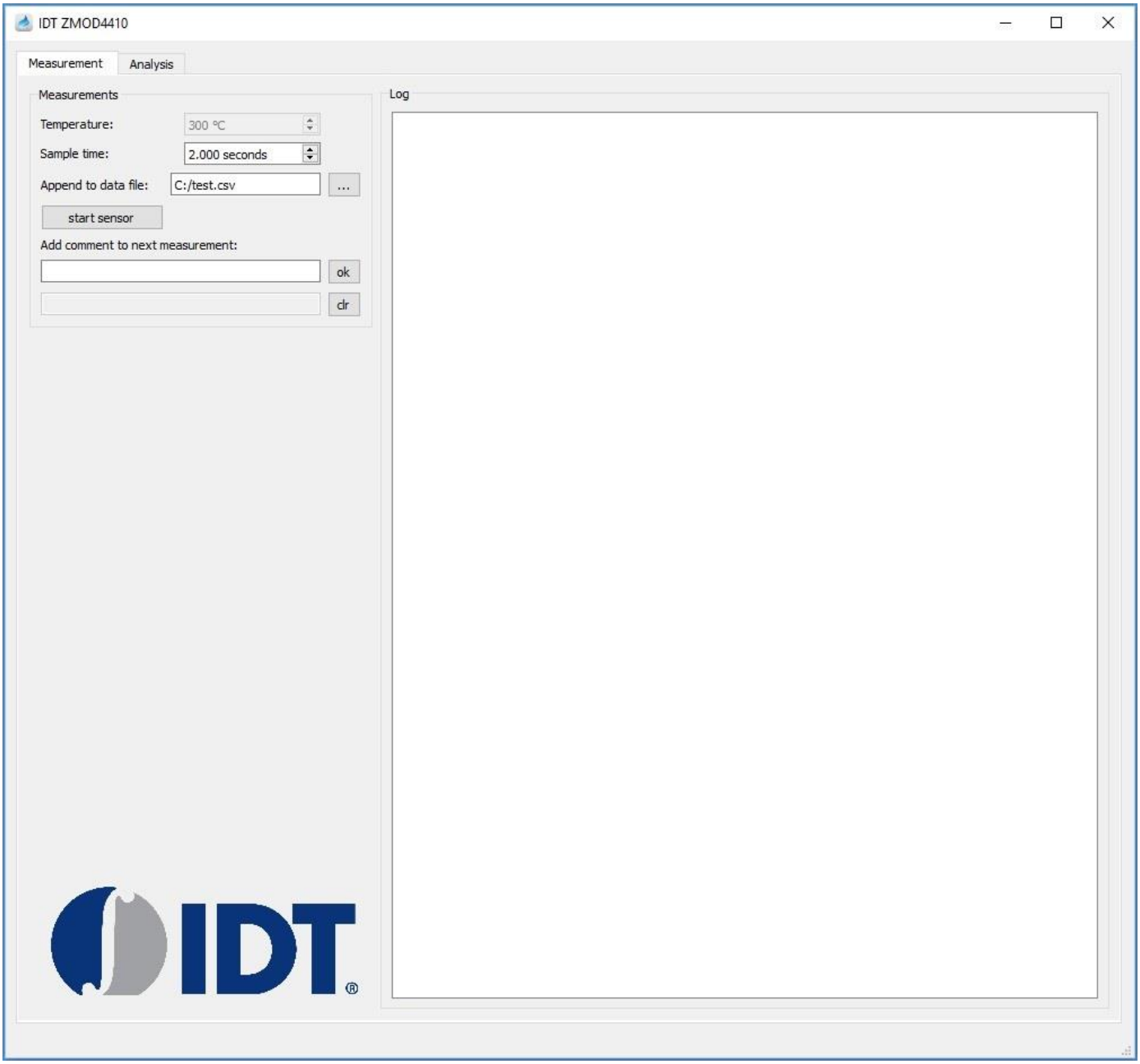
1.3.2 Software Installation and Setup

Before installing the *ZMOD4410 Evaluation Software*, the USB drivers for the FTDI device must be installed. Download the drivers and corresponding installation guides from the FTDI website (www.ftdichip.com). The ZMOD4410 Evaluation Software accesses the FTDI controller through the *D2XX DLL*. The drivers will not affect the operation of any other USB peripherals. The kit does not need to be connected during installation of the drivers.

Follow these procedures to download and install the *ZMOD4410 Evaluation Software* with the kit connected:

1. Download the *ZMOD4410 Evaluation Software* zip file at www.IDT.com/ZMOD4410-EVK.
2. Create a folder on the user's computer for the software (e.g., C:\Program Files (x86)\IDT Software). Extract the contents of the downloaded zip file into this folder.
3. Double-click on the extracted batch file *ZMOD4410_Evaluation_Software.bat* to start the software. Figure 1 shows an example of the initial display after execution.

Figure 1. Initial Display after Installation of the *ZMOD4410 Evaluation Software*



1.4 EVK Hardware Connections and Initial Power-up

Follow these procedures to set up the EVK hardware before installing and activating the software.

1. Refer to Figure 2, Figure 3, and Table 1 to determine the correct jumper settings for the ZMOD4410 Communication Board depending on whether an external supply or the internal voltage supply on the board is used.
   - If using an external supply, ensure that the jumper is across the pins labeled “ext” on the K2 connector. In this case, without connecting the external supply to the Communication Board, verify that the external voltage supply setting does not exceed the voltage supply specifications of 3.6V given in the *ZMOD4410 Datasheet.* With the external supply off, connect the external voltage to the 2-pin “+ - V ext” header adjacent to the K2 jumper with the orientation indicated in Figure 3. Note: There are no adjustments possible on either the Communication Board or Sensor Board for adjusting an external voltage supply if this option is used.
   - If the internal voltage supply is used, ensure that the jumper is across the pins labeled “int” on the K2 connector.
2. Install the ZMOD4410 Sensor Board on the 14-pin connector on the ZMOD4410 Communication Board taking care to ensure the proper orientation of the Sensor Board as shown on page 1.
3. Insert the micro-USB cable into the X1 connector on the Communication Board and connect it to a free USB port on the user’s computer.
   - If the external voltage supply has been selected, turn on the external supply and verify that the D3 LED adjacent to the potentiometer is on. See Figure 2. Note: The intensity of the green D3 LED is proportional to the supply voltage.
4. Install and activate the software as described in section 1.3.2.
5. If the internal voltage is used, the *ZMOD4410 Evaluation Software* activates the internal voltage. In this case, use the metal potentiometer to the left of the K2 connector to adjust the VDD supply voltage in the typical range from 1.7V to 3.6V as measured across the V_TGT and GND pins available on the K3 connector as shown in Figure 3. Its initial adjustment on delivery provides a voltage VDD ≈ 2.0V. Once a measurement has been started by the software, the green D3 LED adjacent to K2 will light with an intensity proportional to the voltage supply that was set using the potentiometer.
6. Verify that the red D1 LED is on, which indicates that the kit is properly connected and powered.

The Communication Board provides the additional K3 and Modul1 connectors for the following optional uses as described in Table 1. To make use of any of these options, contact IDT for further instructions (see contact information on last page).

- Extra measurement options (e.g., current consumption to determine the power requirements of the ZMOD4410)
- Connections for additional sensors (e.g., IDT humidity sensor HS3001)
- A trigger pin for an external signal control (HIGH/LOW)

Figure 2. Jumper Settings and Connectors on the Top Side of the ZMOD4410 Communication Board

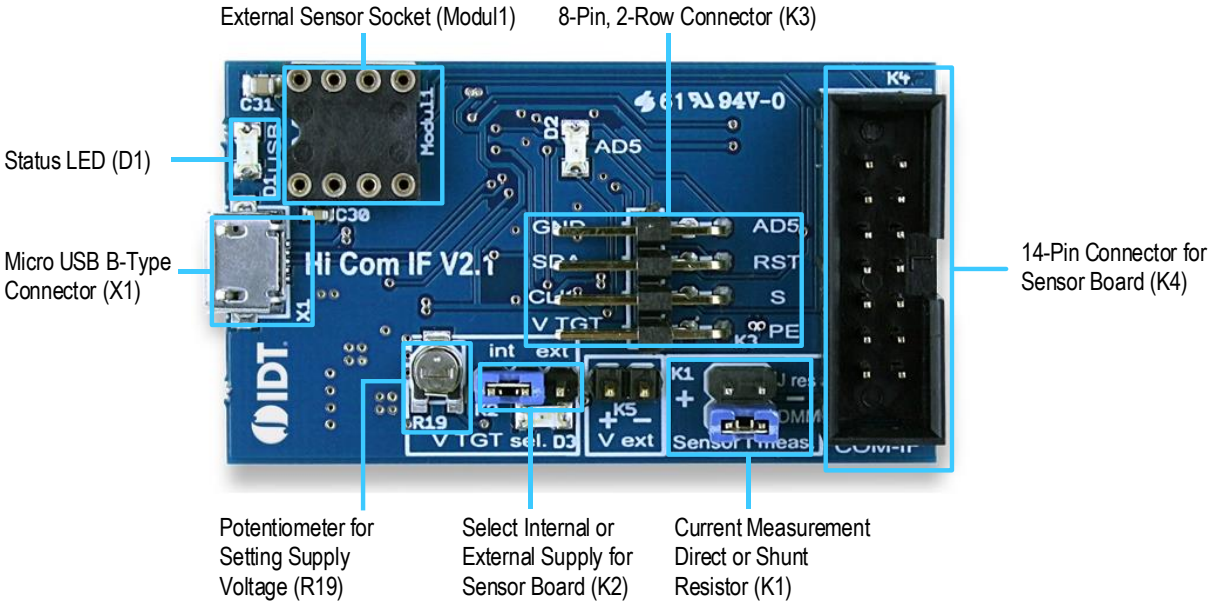
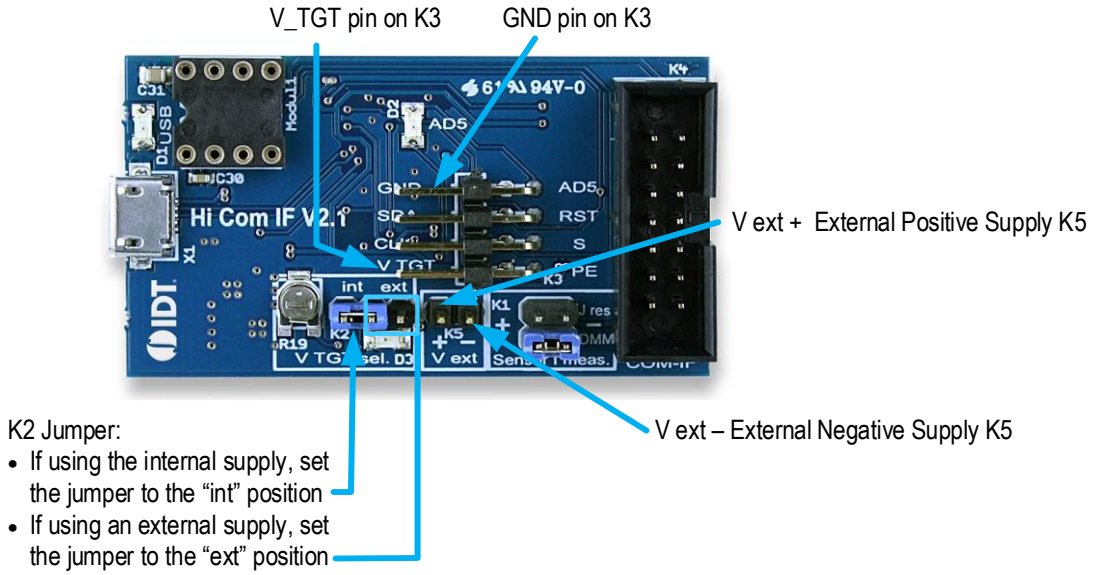


Table 1. Evaluation Kit Connection Descriptions

Connector	Type	Description
K1	4-pin, 2-row header	This jumper can be used to break the supply voltage line to measure the current consumption of a connected Sensor Board. Important: During normal operation, ensure that a jumper is on the "DMM" position as shown in Figure 2.
K2	3-pin header	This jumper selects either the internal or external voltage supply. See Figure 3 for the proper position for the jumper.
K3	8-pin, 2-row right-angle header	This connector can be used to connect the ZMOD4410 in different configurations or to measure the communication lines and voltages on the ZMOD4410 Sensor Board. AD5 is a GPIO pin that can be controlled via the software. Contact IDT for further instructions.
K4	14-pin connector	This is the connector for installing the ZMOD4410 Sensor Board on the Communication Board.
K5	2-pin header	This is the connector for an optional external voltage supply (see Figure 3).
D1	Status LED	This LED lights if the Communication Board is powered correctly.
D2	Status LED	This LED lights if the trigger pin is set by the software.
D3	Status LED	This LED will light with an intensity proportional to the internal voltage supply that was set using the potentiometer.
X1	Micro USB B-type	This is the micro-USB cable connector for connecting the Communication Board to the user's computer.
R19	Potentiometer	This resistor adjusts the internal supply voltage. It can be adjusted by rotating the resistor with a small screwdriver.
Modul1	DIL socket	This socket can be used to add external components (e.g., a humidity sensor) to the Communication Board. Contact IDT for further instructions.

Figure 3. Jumper Settings, Connections, and Test Points on the Communication Board for the Internal or External Supply Voltage



2. Usage Guide

The *ZMOD4410 Evaluation Software* has two different tabs:

- "Measurement" tab (section 2.1.1)
- "Analysis" tab (section 2.1.2)

The tab can be selected clicking on the name the main screen. When the *ZMOD4410 Evaluation Software* is executed, it shows by default the "Measurement" tab (see Figure 1).

On the "Measurement" tab, the user can control the properties of the ZMOD4410's gas measurements. When the "start sensor" button is clicked, the measurement starts running continuously with the given sample time (the default is 2 seconds). IDT recommends 300°C as the default temperature. IDT strongly recommends increasing the sample rate for longer measurement series in order to not reach the limit of the computer's power.

On the "Analysis" tab, the measurements will be displayed and are processed by different algorithms to calculate the indoor air quality (IAQ) or equivalent carbon dioxide (eCO2). The algorithm takes the first 15 measurements for calibration. Other features such as TVOC concentration measurement, temperature measurement, and others are also possible. Contact IDT for further instructions.

The different software tabs, buttons, and entry fields are described in the following sections.

2.1 Software Modes

2.1.1 "Measurement" Tab

Click on the "Measurement" tab to display the measurement options. On this tab, the user can control the properties of the ZMOD4410's gas measurements, which includes setting the temperature in °C and changing the sample time in seconds used during the gas measurements.

When the "start sensor" button is clicked, the measurement starts running continuously with the interval selected under "Sample time" via the up/down arrows. The results will be automatically added to the plots in the "Analysis" tab and continuously saved in a comma separated file (CSV), which is user-selected via the file selection dialog accessed by clicking the "…" button adjacent to the "Append to data file" field, which displays the selected path and file name.

A comment (for example, "Apply test gas") can be added to the data entry by adding a string to the "Add comment to next measurement" field and then clicking the "ok" button. If a measurement is already in progress, the comment will be added to the next measurement. If a comment is on hold waiting for the next measurement, it can be deleted by clicking the "clr" button. The comments will be displayed in the plot shown on the "Analysis" tab and will be saved in the CSV result file. This facilitates tracking the user's experimental investigations.

2.1.2 "Analysis" Tab

Click on the tab to display the "Analysis" tab (see Figure 4).

The "Analysis" tab shows three plots:

- IAQ rating according to the standards of the German Federal Environmental Agency (UBA).
- eCO2 concentration (in ppm)
- Raw sensor signal (in Ω)

For more information on IAQ and eCO2, refer to the *ZMOD4410 White Paper – TVOC and Indoor Air Quality* and the *ZMOD4410 Application Note – Estimating Carbon Dioxide.*

Above the graphs, there are three sections for user interaction:

- "Data source"
- "Misc"
- "Algorithm Result"

The available user options are described in Table 2.

The “Analysis” tab can be used to see the active measurement data and to load previously acquired measurement result files by using the “load data file” button. For this usage, it is not necessary to connect the ZMOD4410 Evaluation Kit hardware. The “Analysis” tab supports data files with data from multiple sensors if the loaded CSV file has the required format. One sensor will be processed and displayed at a time.

The default algorithms applied in the “Analysis” tab calculate gas concentrations for eCO2 and IAQ. Other algorithm results, for example, calculations of concentrations of ethanol and total volatile organic compounds (TVOC), are also available upon request.

The algorithm results will be displayed as a colored bar in the “Algorithm Result” section above the graphs (see Table 2) and in the “Algorithm Result” plots. The first 15 measurements after the start of a measurement are taken for initialization process. To export the data from the “Analysis” tab into a separate measurement file (CSV), click the “export data” button. Note that only the data shown in the recent plots will be exported.

Figure 4 “Analysis” Tab

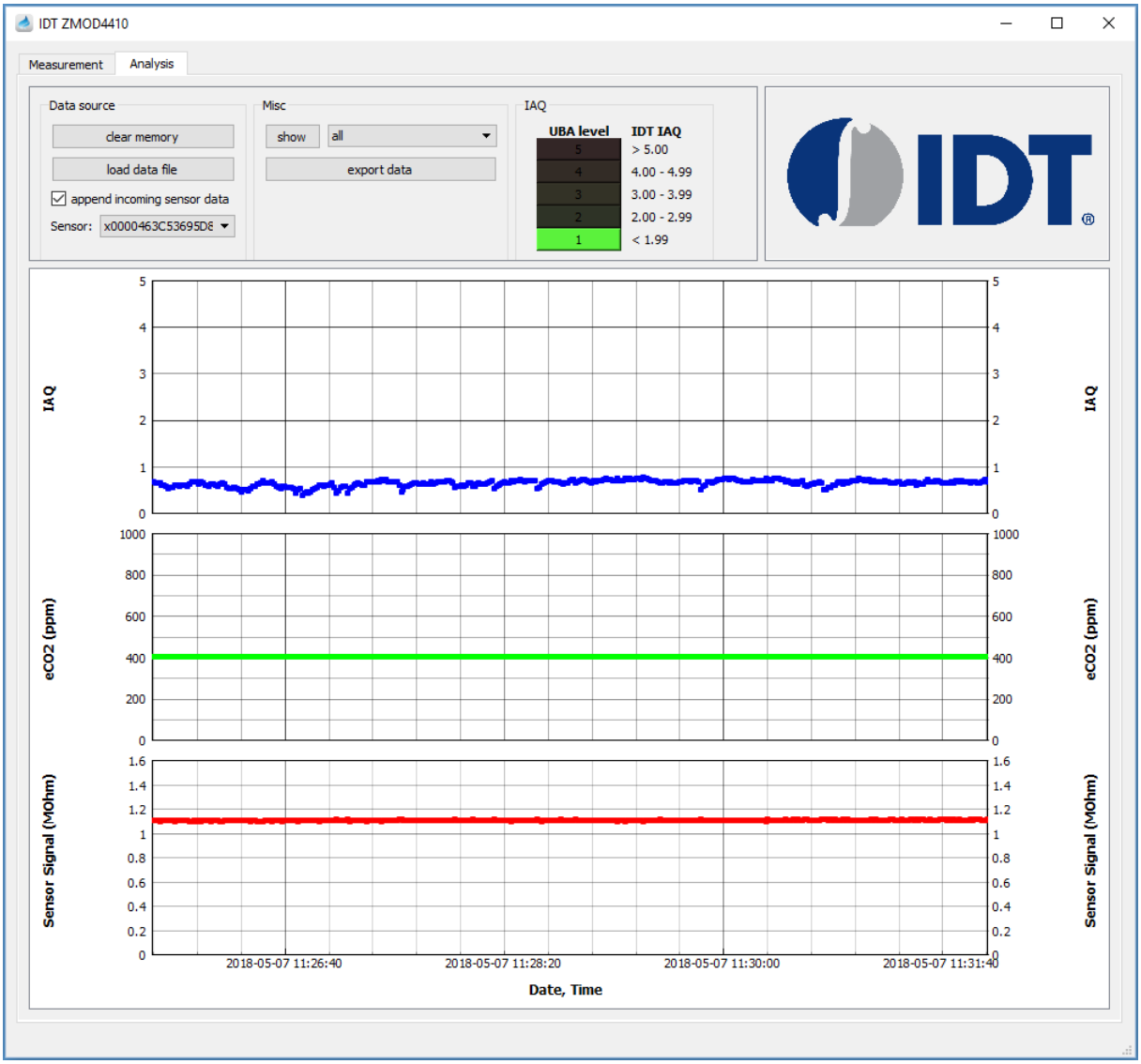
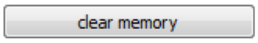
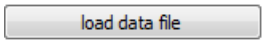
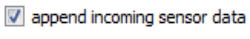
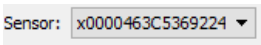
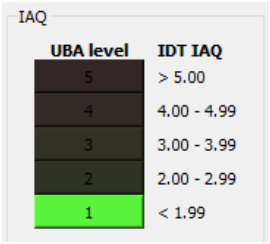
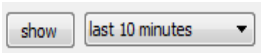
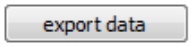


Table 2. Analysis Tab User Options

Display Section	Button/Action	Description
"Data source"		The "clear memory" button will delete all current data from the plots (memory). The data in the measurement file will remain.
		The "load data file" button will open a file selection dialog. This function can be used to display and analyze data from a measurement file acquired earlier. The data file must have the same structure as the measurement file created by the *ZMOD4410 Evaluation Software.*
		The "append incoming sensor data" checkbox activates the functionality to append the current measurement data to the plots in the "Analysis" tab.
		If measurements are acquired simultaneously for multiple ZMOD4410 gas sensors, the measurement results file can contain data from different sensors. In the "Sensor" drop-down menu, the user can choose a sensor to display by selecting the unique sensor identification number.
"Algorithm Result"		The first measurements of the algorithm will be taken for sensor stabilization. The "Algorithm Result" field will indicate how many measurements have been completed during this period. Raw sensor signals are shown on the "Sensor Signal (Ohms)" plot during this time, but the algorithm results are only calculated after stabilization. Note that this does not cover the full stabilization of the sensor module but rather covers only the first minutes during startup. Recommendation: IDT recommends a sample time of 2 seconds for these 15 measurements resulting in 30 seconds for the initialization measurements.
		After the stabilization measurements, the "Algorithm Result" field shows a colored bar representing the results for the algorithm. The example shown here is for IAQ with the rating from the Federal German Environmental Agency (UBA) and the corresponding IDT IAQ rating.
"Misc"		The drop-down menu adjacent to the "show" button provides options for selecting the time period for showing the recent history or the complete data. Click the "show" button to apply new settings to the plots.
		The "export data" button will open a file selection dialog for selecting a path to immediately save the measurement results and the processed algorithm results of the "Analysis" tab. The file will be saved in comma-separated format (CSV).

3. Schematics

Figure 5. Communication Board Schematic (1)

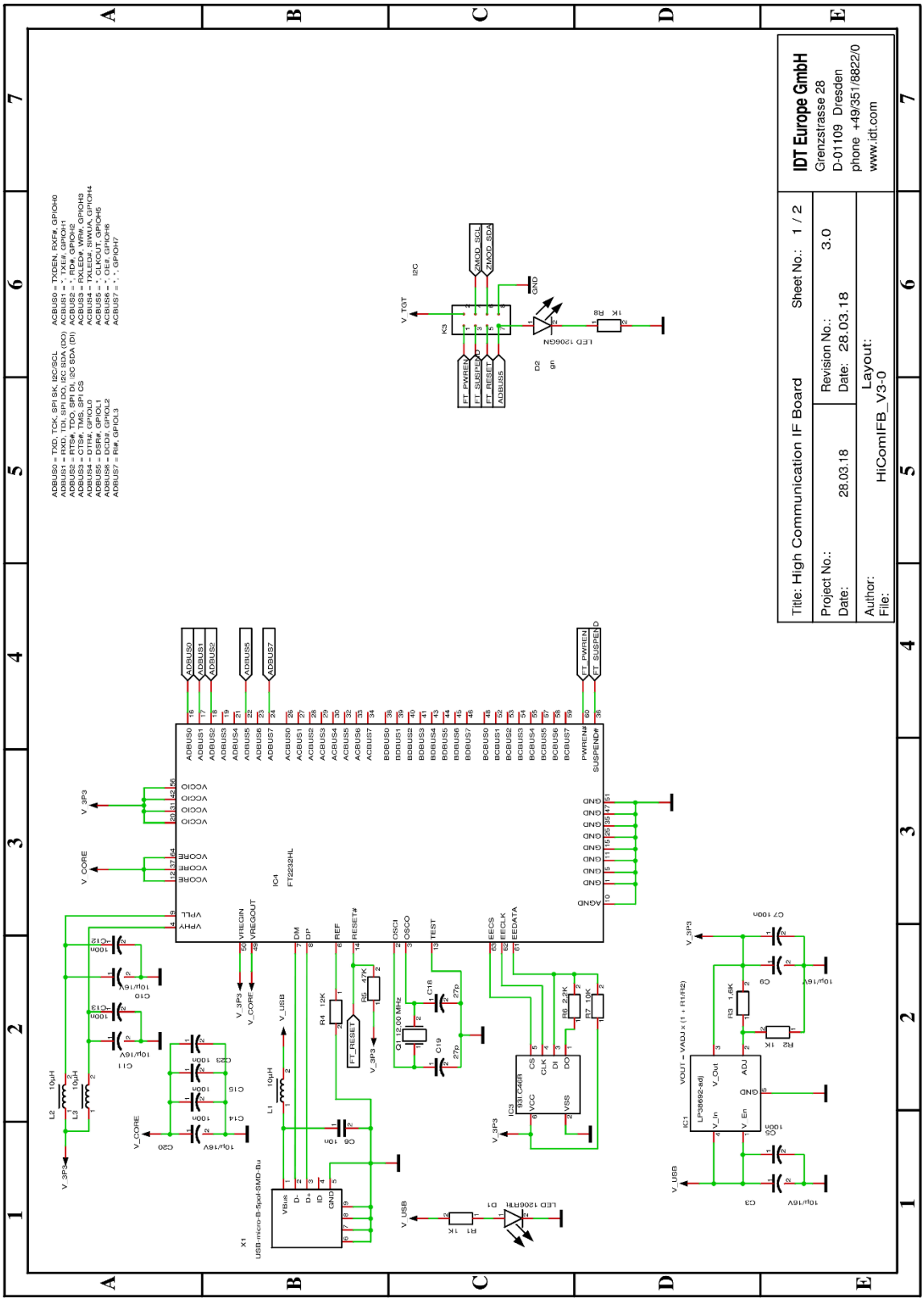


Figure 6. Communication Board Schematic (2)

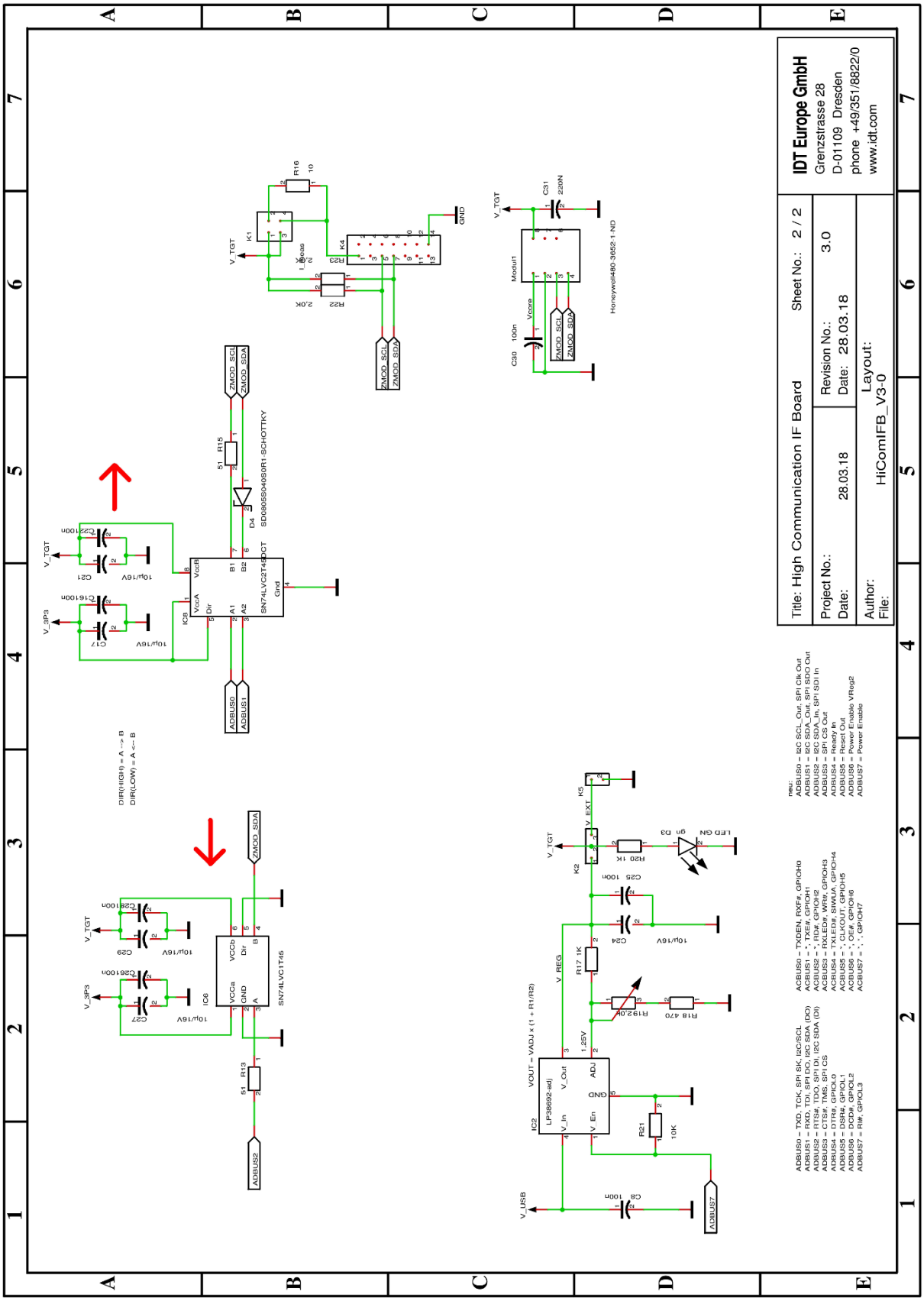
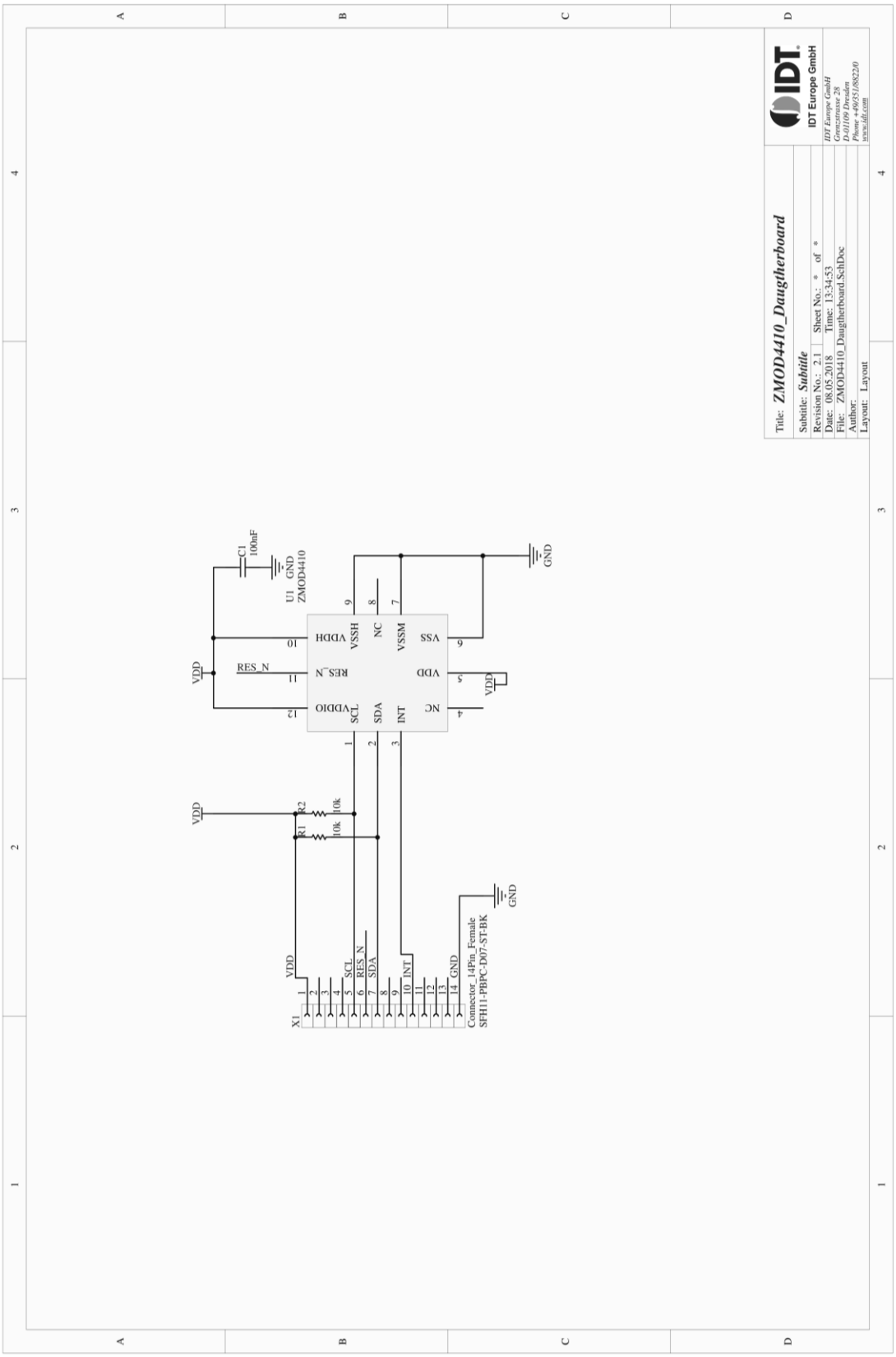


Figure 7. Sensor Board Schematic



4. Bill of Materials (BOM)

Table 3. Communication Board BOM

Pos	Name	Value	Package
1	C3	10µF/16V	0805
2	C5	100nF	0603
3	C6	10nF	0805
4	C7	100nF	0603
5	C8	100nF	0603
6	C9	10µF/16V	0805
7	C10	10µF/16V	0805
8	C11	10µF/16V	0805
9	C12	100nF	0603
10	C13	100nF	0603
11	C14	100nF	0603
12	C15	100nF	0603
13	C16	100nF	0603
14	C17	10µF/16V	0805
15	C18	27pF	0603
16	C19	27pF	0603
17	C20	10µF/16V	0805
18	C21	10µF/16V	0805
19	C22	100nF	0603
20	C23	100nF	0603
21	C24	10µF/16V	0805
22	C25	100nF	0603
23	C26	100nF	0603
24	C27	10µF/16V	0805
25	C28	100nF	0603
26	C29	10µF/16V	0805
27	C30	100nF	0603
28	C31	220nF	0805
29	D1	LED 1206RT	1206-DIODE
30	D2	LED 1206GN	1206-DIODE
31	D3	LED 1206GN	1206-DIODE
32	D4	SD0805S040S0R1-SCHOTTKY	0805-DIODE

Pos	Name	Value	Package
33	IC1	LP38692-adj	SOT-223-5
34	IC2	LP38692-adj	SOT-223-5
35	IC3	93LC46B	SOT23-6
36	IC4	FT2232HL	LQFP64
37	IC6	SN74LVC1T45	SOT23-6
38	IC8	SN74LVC2T45DCT	SSOP8_0,65
39	K1	I_meas	2X02
40	K2	Select	1X03
41	K3	K2X4	2X04-90
42	K4	K2X7	LH-14
43	K5	V_EXT	1X02
44	L1	10µH	1210
45	L2	10µH	1210
46	L3	10µH	1210
47	Modul1	Honeywell480-3652-1-ND	DIL8 SMD SOCKEL
48	Q1	12.00MHz	QUARZ-ABM3
49	R1	1kΩ	0805
50	R2	1kΩ	0805
51	R3	1.6kΩ	0805
52	R4	12kΩ	0805
53	R5	47kΩ	0805
54	R6	2.2kΩ	0805
55	R7	10kΩ	0805
56	R8	1kΩ	0805
57	R13	51Ω	0805
58	R15	51Ω	0805
59	R16	10Ω	0805
60	R17	1kΩ	0805
61	R18	470Ω	0805
62	R19	2.0kΩ	TRIMMER-3142SERIES
63	R20	1kΩ	0805
64	R21	10kΩ	0805

Pos	Name	Value	Package
65	R22	2.0kΩ	0805
66	R23	2.0kΩ	0805
67	X1	USB-micro-B-5pol-SMD-Bu	USB-MICRO_TYPB_AMTEK

Table 4. Sensor Board BOM

Designator	Quantity	Manufacturer	Manufacturer Part Number
C1	1	Taiyo Yuden	LMK105BJ104KV-F
U1	1	IDT	ZMOD4410
X1	1	Sullins	SFH11-PBPC-D07-ST-BK

5. Board Layout

Figure 8. HiCom Communication Board Layout – Top Layer

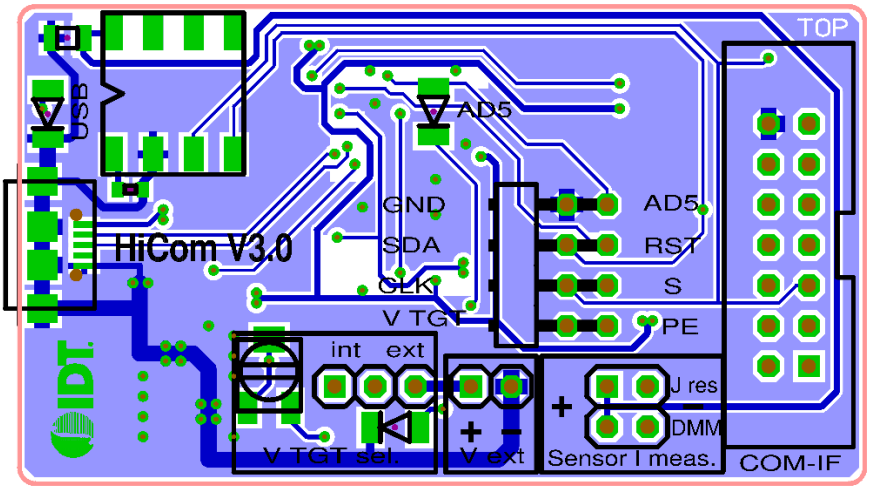


Figure 9. HiCom Communication Board Layout – Bottom Layer

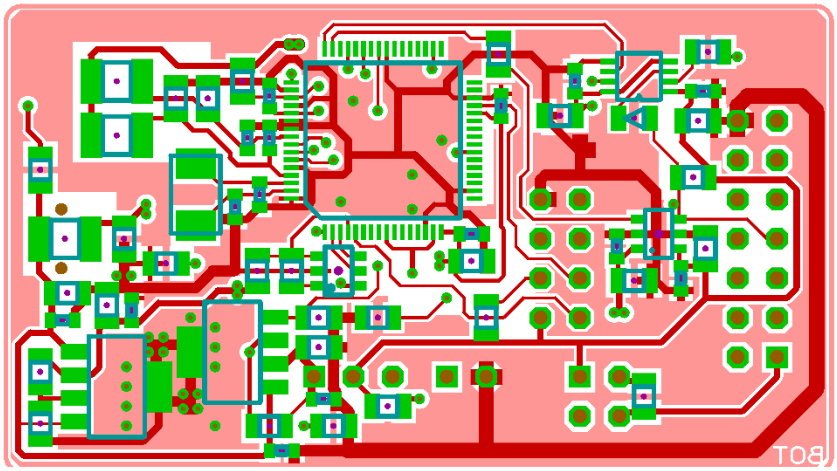


Figure 10. Sensor Board Layout – Top Layer

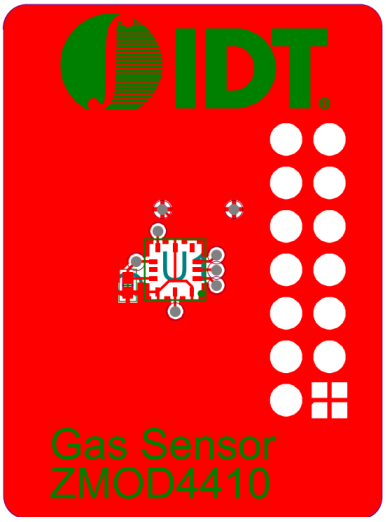
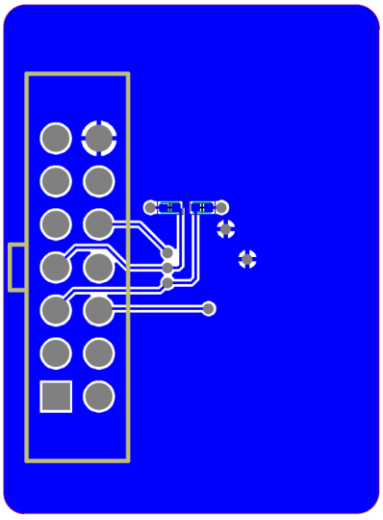


Figure 11. Sensor Board Layout – Bottom Layer



6. Ordering Information

Orderable Part Number	Description
ZMOD4410-EVK-HC	ZMOD4410 Evaluation Kit including the ZMOD4410 Sensor Board, ZMOD4410 HiCom Communication Board (USB Interface), and Micro-USB Cable. (The *ZMOD4410 Evaluation Software* is available for download free of charge on www.IDT.com/ZMOD4410-EVK.)

7. Revision History

Revision Date	Description of Change
May 19, 2018	Initial release.

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