AFE-BREAKOUT-MVK MAVRK Module

Technical Reference Manual

Literature Number: SLAU380
October 2011

Contents

1 Purpose of this document

This document discusses the Modular and Versatile Reference Kit (MAVRK) AFE Breakout module. The AFE-BREAKOUT-MVK provides quick visual inspection of the AFE bus signals via LEDs, as well as a way to easily interface electrically to the AFE bus through headers.

2 EVM Overview

2.1 EVM Description

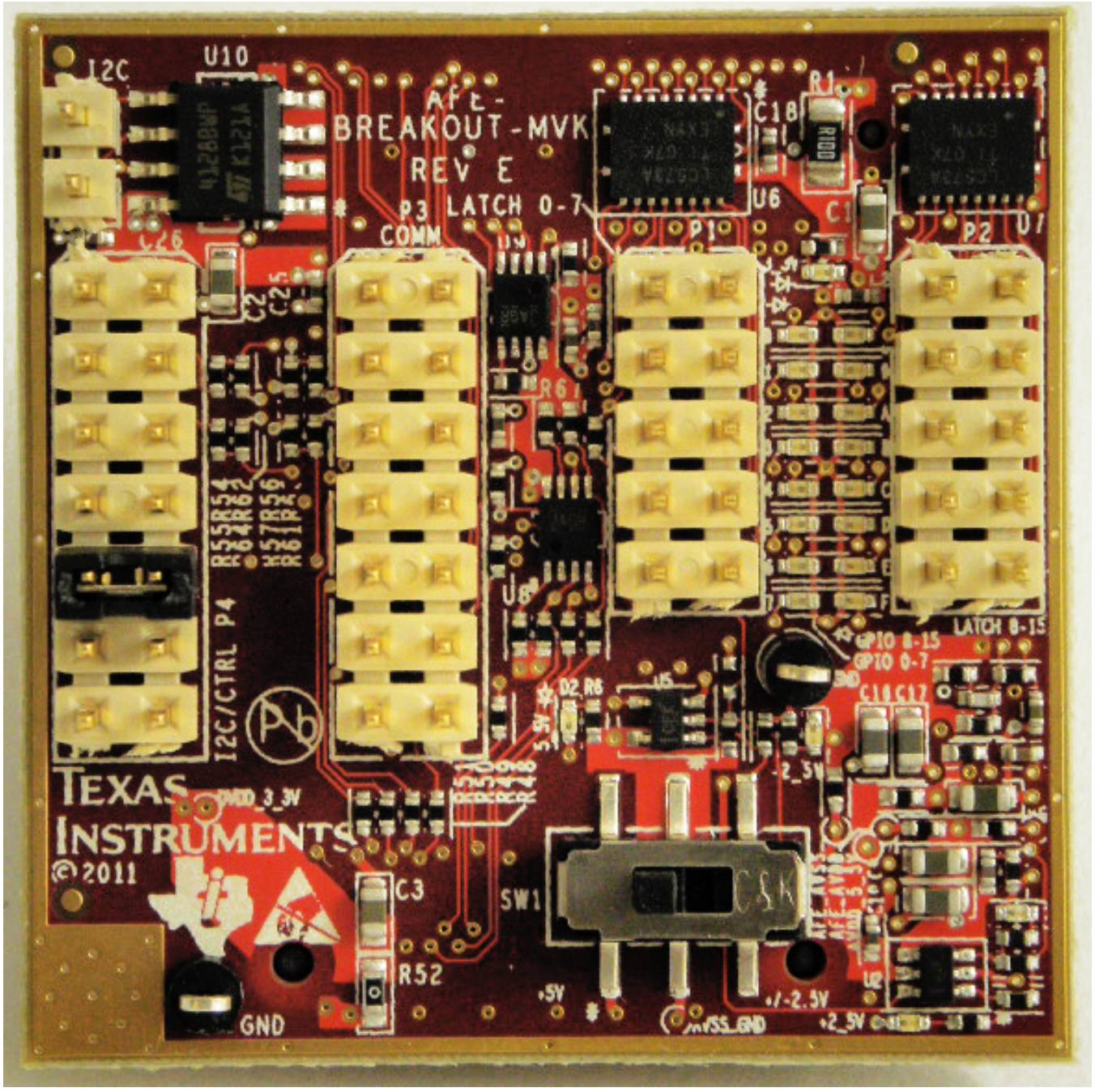

Figure 1.

The AFE-BREAKOUT-MVK enables easy debug of the AFE bus by making all the pins available on standard 100mil pin headers for probing or connecting to an external logic analyzer. Furthermore, each GPIO is connected to an LED that turns on when the pin is in a logic high state. A D-type latch holds the state of the GPIOs while the MCU communicates to other AFE modules. The Hardware Design Guide for MAVRK AFE Modules contains more information regarding the GPIO latch.

2.2 Highlighted Products

The following devices are utilized on the AFE Breakout board:

- TS5A3159 1-Ohm SPDT Analog Switch
- TPS62120 15V, 75mA, 96% efficiency Step-Down Converter
- TPS63700 Adjustable, -15V Output Inverting DC/DC Converter in 3x3 QFN
- SN74LVC1G08 Single 2-Input Positive-AND Gate
- SN74LVC573A Octal Transparent D-Type Latches With 3-State Outputs
- TS5A2066 Dual-Channel 10-Ohm SPST Analog Switch

2.3 EVM Wiki

AFE Breakout Wiki

2.4 EVM Landing Page

AFE Breakout Module Product Folder

3 Hardware Description

3.1 Power Requirements

The AFE-BREAKOUT-MVK can be connected to a MAVRK Motherboard through any of the AFE slots. Power (3.3 V and 5.5 V) is supplied by the host board through the AFE connectors. DC/DC converters on the AFE Breakout board generate +5 V or +/-2.5 V rails for the SCI modules to use.

Please note that if you use a companion (adjacent) SCI module that generates power to the AFE slot, you should remove resistors R53 and R60.

3.2 Connector Signal Descriptions

For detailed connector pinout information, see the AFE Pinout for MAVRK.

3.3 Getting Started: Configuring the EVM

The preferred method of working with this EVM is through a MAVRK Motherboard. The motherboard, along with a MAVRK MCU module, provides the needed power and digital control for this EVM. When used with the MB-PRO-MVK, the AFE-BREAKOUT-MVK can be used in any of the 4 AFE slots to test both the left and right MCU busses. See the Hardware Design Guide for MAVRK AFE Modules for details on AFE-MCU communication.

3.4 EVM Jumpers, LEDs, and Test Points

Table 1 lists all the LEDs and headers available on the AFE Breakout board. The headers are connected directly to the AFE bus and care should be taken when probing them. Click Here to see a map of the LEDS on the board.

Table 1: EVM LEDs and Headers

Table 1.

Reference Designator	Function
D1	DVDD_3_3V indicator LED. Turns on when DVDD_3_3V is present.
D2	AVDD_5_5V indicator LED. Turns on when AVDD_5_5V is present.
D5	+5 V indicator LED. Turns on when the +5 V rail is enabled.
D6	+2.5 V indicator LED. Turns on when the +/-2.5 V split rail is enabled.

Table 1. (continued)

D8	-2.5 V indicator LED. Turns on when the +/-2.5 V split rail is enabled.
D10-D25	AFE_GPIO1_x logic state indicator LEDs. Turns on when theÃ AFE_GPIO1_x logic level is high.
P1	Latch 0-7 header. Provides access to AFE_GPIO_[0:7] signals.
P2	Latch 8-15 header. Provides access to AFE_GPIO_[8:15] signals.
P3	COMM header. Provides access to UART, SPI, CAN, and Inter-AFE communication lines.
P4	I2S/CTRL Header. Provides access to the I2S lines as well as the module control signals.
P5	I2C header. Provides acess to the I2C clock and data lines.
SW1	Analog power supply selection switch. Selects between single (+5 V) and dual (+/-2.5 V) supplies.

4 Software Description

4.1 MAVRK Software Minimum Requirements

- IAR Embedded Workbench software or TI Code Composer Studio software installed on PC
- MSP-FET430UIF - MSP430 USB Debugging Interface
- USB Cable(A to Micro AB) to power the MAVRK Pro motherboard
- Windows XP SP3 or Windows 7

4.2 How to get the MAVRK Software

You will need the MAVRK Software repository installed on your PC. This repository will sync the MAVRK firmware to your PC.

Please see Software Installation Guide.

4.3 Where do I find the MAVRK Qt Demo Application?

An application to visual packet information from the embedded system can be found in the **mavrk_qt_tool** software repository under the **Released Version - QT Demo Application** directory. Please see Software Installation Guide for instructions on cloning the QT Tool project.

If you desire to create your own Qt demonstration, please reference the following resources:

- MAVRK Qt GUI SDK Installation Guide
- MAVRK Qt GUI Build Guide

4.4 Where do I find the Demo and Test Code?

From the software library, synchronized from the Gerrit server you will find:

- Driver code related to the specific part can be found in a folder under the **mavrk_embedded\Modular_EVM_Libraries\Components** directory.
- Projects utilizing this part are located under the **mavrk_embedded\Modular_EVM_Projects** folder.

5 Software Project

5.1 Getting Started

A software project named AFE_Breakout_Demo exists in the **mavrk_embedded\Modular_EVM_Projects\Component_Demo_Projects\AFE_Breakout_Board_Demo_Project** software repository directory. This project contains demo code for using the UART, SPI and I2C buses in the AFE breakout board. MAVRK Boards may be interconnected via the AFE breakout boards using the above mentioned buses.

This demo expectst the AFE Breakout board to be in the AFE1 slot.

There actually three difference configuration in the one project (one for each bus). To select one of the configurations click on the drop down box in the "Workspace" window (on the left hand side of the screen) and select the bus that you would like to use. Only one configuration can be used at one time. There are three choices:

- UART_Demo
- I2C_Demo
- SPI_Demo

After selecting one of the configurations compile (using "Make") the project and program the board.

5.2 UART Demo

Generally for board to board communications, there would be atleast two boards. In this case only one is used. The way that send and receive is verified in this project is by connecting the RX and TX lines on the AFE breakout board. What the loopback does is any signal that is transmitted will come back to this device. So when there is a valid receive this proves that the device can transmit and receive successfully. The signals for the UART bus are located on the P3 header on the AFE breakout board. The TX signal is located on header P3 on the 3rd pin. The RX signal is on the same header on the 5th pin. A standard jumper may be used to interconnect these two signals.

The UART is set by default in the *mvk_Init_MAVRK_Standard_Settings* function to a baud rate of 460K and 8 bits data, no parity and one stop bit.

Before writing to the UART a handle has to be created and registered using this function call:

```
UartDebugHandle = mvk_Register_UART_Tx (MAVRK_UART_P1P2, MAVRK_AFE1, 2, SET, CLEAR); // Priority
2, Fast Print, Do not overwrite
```

This sets the *UartDebugHandle* to the device which is in AFE1 slot. This handle is later used to communicate with this device.

Then it continuually makes this function call which sends the message out.

```
mvk_UART_Debug_PrintF_Flush (UartDebugHandle, "Hello from MCU UART", 19);
```

The demo continually sends a "Hello from UART". To verify that this transfer is sending and receiving correctly, a breakpoint may be placed in the *user_Decode_UART_RX_Data(...)* function. This function is called when there is an incoming UART character. The character that has arrived is given in the *data* parameter. A watch may be placed on this variable and viewed to determine which character has just arrived.

For more information on utilizing the MAVRK UART APIs please refer to MAVRK UART Functions.

5.3 SPI Demo

The SPI demo continually sends a message through the SPI bus. As in the case with UART, a loopback is used on the MOSI (output) and MISO (input) pins to test the input portion of the SPI bus.

The signals for the SPI bus are located on the P3 header on the AFE breakout board. The SPI clock is on pin 9, the chip select in on pin 7, MOSI is on pin 11 and MISO in on pin 13.

To setup the SPI port this function call is used:

```
mvk_Configure_SPI_Device_Working_Settings (MAVRK_AFE1, &AFE1_SPI_device_settings);
```

Which configures the SPI bus to the AFE1 module device settings.

The project continually sends "Hello from MCU SPI". This sending and receiving may be verified by placing a breakpoint on the SPI call (*mvk_Write_SPI_Payload (MAVRK_AFE1, "Hello from MCU SPI", read, 18, 0)*. After this line is executed the *read* variable will hold the results of the input (which should be the message).

For more information on utilizing the MAVRK SPI APIs please refer to MAVRK SPI Functions.

5.4 I2C Demo

The I2C demo is different from the previous buses demo in that it does not use a loopback. It however writes to an EEPROM chip that is located on the AFE breakout board. This EEPROM (16Kx8) is used to store device information for the breakout board. This information is stored on the highest 256 bytes of the memory. This area should not be overwritten. Any other area is free to be used.

The project writes to the EEPROM chip an 8-bit value and reads that value back to make sure that it was written properly. The bus that is used to do this transfer is I2C.

The actual I2C write call happens deeper in the program but one example is this:

```
mvk_Write_I2C (I2C_slave_address, device_slot, EEPROM24xx128_I2C_write_data,
total_number_write_bytes);
```

The first parameter is the I2C slave address to write to, the second is the device slot to use for the write (in this case MAVRK_AFE1), then the write data, and the amount of data to write. An example of the I2C read function may be found in the mvk_Read_EEPROM_24xx128 () function which may be found in EEPROM24xx128.c.

This demo also demonstrates how the LEDs may be used in the breakout board. Currently only 8 of the LEDs are controllable. They are on the left column.

For more information on utilizing the MAVRK I2C APIs please refer to MAVRK I2C Bus Functions.

5.5 Outputing and Inputing on the GPIO

It is only possible to output on the GPIO bus on the AFE breakout board as the bus is behind a register (Note: this is only the case on the AFE breakout board). Also although there are 16 lines on the bus, only the lower half are controllable.

There are two ways to configure this bus and use it. One way is to configure the whole port in one instruction or either break up the configuration to pin by pin.

To configure and set the whole bus in one instruction this function call is used:

```
mvk_Write_AFE_GPIO (0xff, MAVRK_AFE1); // turns on the whole port on
```

To set the port pin by pin this function may be used:

```
mvk_Write_AFE_GPIO_Pin (AFE_GPIO_PIN_7, CLEAR, MAVRK_AFE1); // writes to the top most pin to set
it off only
```

This function call turns off the highest pin (7). The range of pins that may be used are AFE_GPIO_PIN_0...AFE_GPIO_PIN_7.

6 Board Files

6.1 Bill of Materials (BOM)

Download a PDF of the bill of materials.

AFE-BREAKOUT-MVK Bill of Materials

Figure 2.

6.2 Layout (PDF)

Download a PDF of additional board layers.

AFE-BREAKOUT-MVK Board Top Silkscreen

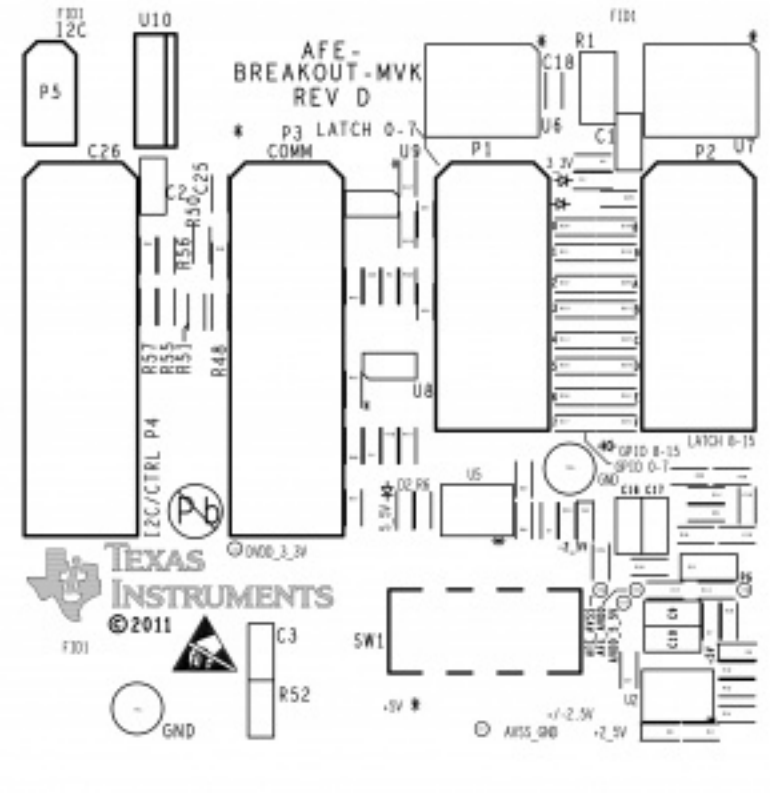

Figure 3.

6.3 Schematics (PDF)

Download a PDF of the schematic.

AFE-BREAKOUT-MVK Schematics

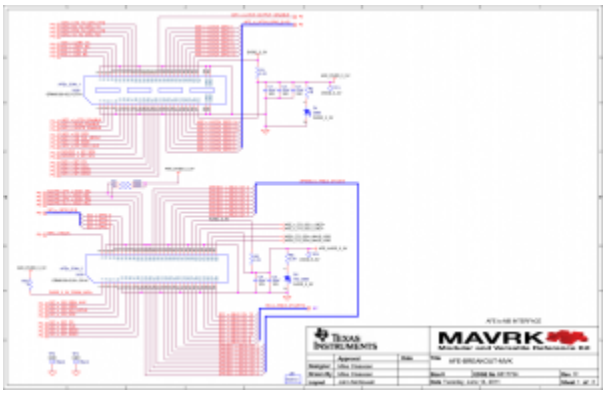

Figure 4.

6.4 Fabrication Drawings (PDF)

Download a PDF of the fabrication drawing.

AFE-BREAKOUT-MVK Fabrication Drawing

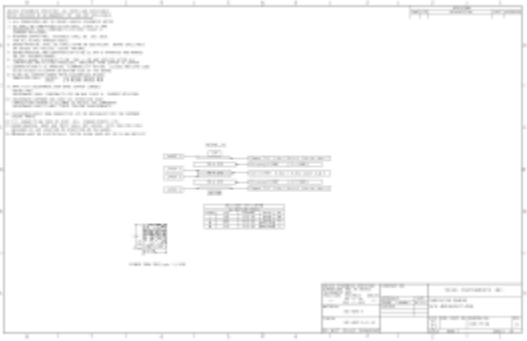

Figure 5.

6.5 Request Gerber and Schematic files

To request Gerber or schematic files for the AFE-BREAKOUT-MVK module, please visit the MAVRK Gerber Request webpage.

7 MAVRK Links

7.1 I want more info on MAVRK

MAVRK Home Page

7.2 I have MAVRK Questions

MAVRK Forum (Recommended):

7.3 I want more Technical Info on MAVRK Hardware

Table 2.

• Hardware Design Guide for MAVRK MCU Modules • Hardware Design Guide for MAVRK Modules • Hardware Design Guide for MAVRK PMU Charger Sub-Modules • Hardware Design Guide for MAVRK PMU DC/DC Sub-Modules	• Hardware Design Guide for MAVRK PMU Gas Gauge Sub-Modules • Hardware Design Guide for MAVRK PMU High-Power DC/DC Sub-Modules • Hardware Design Guide for MAVRK SCI Modules • Hardware Design Guide for MAVRK SCI Sub-Modules	• Hardware Design Guide for the uMAVRK Analog Interface • Hardware Design Guide for the uMAVRK Power Interface • Template - Hardware User's Guide

7.4 I want more Technical Info on MAVRK Software

Table 3.

• Demo Application - ADS1298 Demo on MAVRK • Demo Application - Sensors on uMAVRK • Demo Application - TCA8418 on MAVRK • Demo Application - UART Passthrough on MAVRK • Demo Application - UART Receiver on MAVRK • Demo Application - Wireless Keyboard on MAVRK • How to Convert a Project from IAR to CCS • IAR Broken Options Error • IAR Project Open Error • MAVRK - TortoiseGit Frequently Asked Questions • MAVRK Partners and Resources • MAVRK Qt Demo Application User Guide • MAVRK Qt GUI Build Guide	• MAVRK Qt GUI SDK Installation Guide • MAVRK Radio Network • MAVRK Software Developers Guide • MAVRK Software Installation Guide • Running the TCA-8418 Demo (CCS) • Running the TCA8418 Demo (IAR) • Software - API Documentation for MAVRK Embedded Software Libraries • Software - CC11xx, CC25xx, CC430 Radio API Guide • Software - CPU Power Down Logic on Standard MAVRK Applications • Software - Coding Conventions for MAVRK Software • Software - Customizing a Demo Project • Software - Doxygen Conventions for MAVRK Software • Software - MAVRK Adding the Radio Demo to Another Demo	• Software - MAVRK Embedded Project Abstraction Layers • Software - MAVRK I2C Bus Functions • Software - MAVRK SPI Bus Functions • Software - MAVRK UART Functions • Software - Main Processing Loop in Standard MAVRK Applications • Software - My First MAVRK Application (Using Code Composer) • Software - My First MAVRK Application (Using IAR) • Software - Programming with Elprotronic's FET-Pro430 Flash Programmer • Software - Selecting the CCS Workspace Directory • Software - Troubleshooting the MAVRK COM Port Connection to QT • Software Design Guide for MAVRK Modules • Stellaris-ICDI Programming

7.5 I want to get a MAVRK board

MAVRK Home Page

8 Important Notices

8.1 ESD Precautions

The following guidelines should be followed in order to avoid ESD damage to the board components:

- Any person handling boards must be grounded either with a wrist strap or ESD protective footwear, used in conjunction with a conductive or static-dissipative floor or floor mat.
- The work surface where boards are placed for handing, processing, testing, etc., must be made of static-dissipative material and be grounded to ESD ground.
- All insulator materials either must be removed from the work area or they must be neutralized with an ionizer. Static-generating clothes should be covered with an ESD-protective smock.
- When boards are being stored, transferred between operations or workstations, or shipped, they must be maintained in a Faraday-shield container whose inside surface (touching the boards) is static dissipative.

8.2 Certifications

Eco-Info & Lead-Free Home

RoHS Compliant Solutions

Statement on Registration, Evaluation, Authorization of Chemicals (REACh)

FCC and EMC test report for the MAVRK STK-PRO430-MVK Starter Kit, featuring the AFE-BREAKOUT-MVK Module

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8.5 EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of â€“2.5V to +5V and the output voltage range of 0V to 5V. Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power. Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load

specification, please contact a TI field representative. During normal operation, some circuit components may have case temperatures greater than +30°C. The EVM is designed to operate properly with certain components above +30°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

Table 4.

	For technical support on MAVRK please post your questions on The MAVRK Toolbox Forum *. Please post only comments about the article* ***AFE-BREAKOUT-MVK MAVRK Module*** *here.*

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