

SMP-BQ24133-MVK MAVRK Submodule

User's Guide



Literature Number: SLVU696
March 2012

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SMP-BQ24133-MVK MAVRK Submodule

1 Introduction

This document discusses the Modular and Versatile Reference Kit (MAVRK) [BQ24133](#) battery charger submodule. After reading this guide, a developer should understand the features of the [SMP-BQ24133-MVK](#). For more information on the MAVRK system, see the [MAVRK introduction page](#).

2 EVM Overview

The SMP-BQ24133-MVK highlights the BQ24133 switched-mode Li-ion and Li-polymer stand-alone battery charger.

The BQ24133 submodule is responsible for charging a single-cell Li-ion or Li-polymer battery on battery-powered [MAVRK PMU](#) modules, such as the [PMU-BAT-MVK](#). When used with the PMU-BAT-MVK, the SMP-BQ24133-MVK can be used independently or as part of a battery-management system.

2.1 EVM Description

[Figure 1](#) shows the SMP-BQ24133-MVK module.

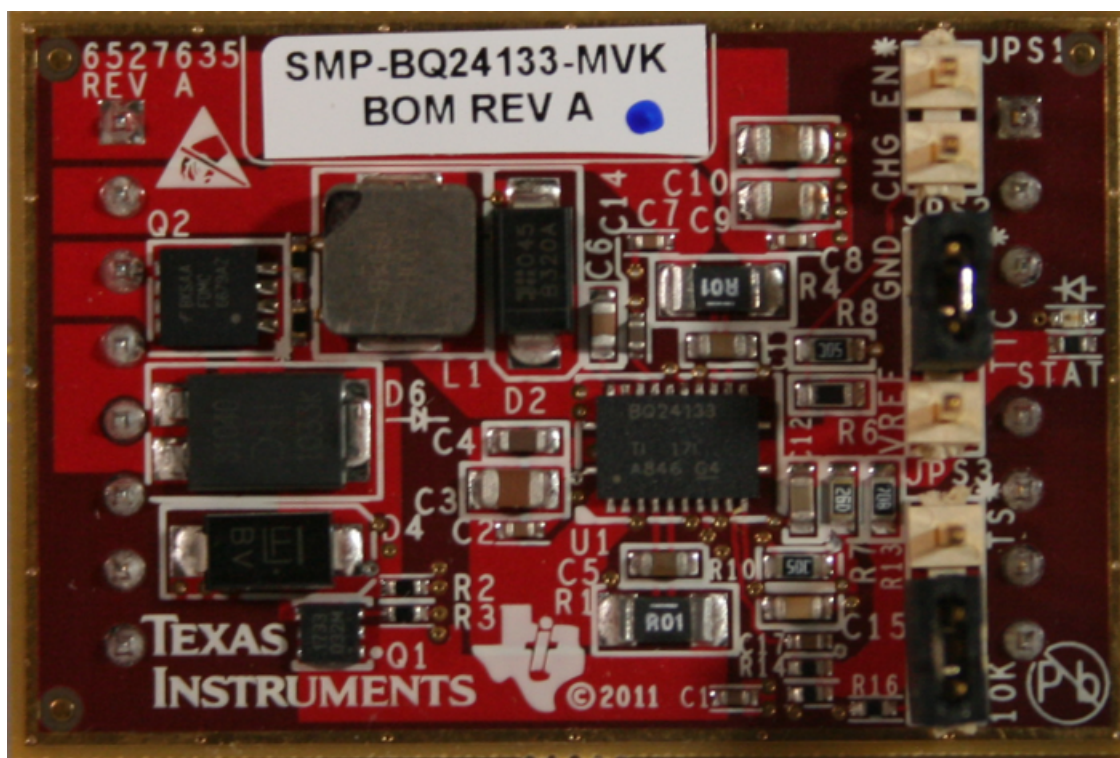


Figure 1. SMP-BQ24133-MVK Submodule

The SMP-BQ24133-MVK contains the BQ24133 integrated circuit (IC) and all other onboard components necessary to charge a single-cell Li-ion battery. The output current of the SMP-BQ24133-MVK can be set to up to 4 A, and is configured by default for a 700-mA charge current. The BQ24133 is intended to be used with a MAVRK PMU battery carrier board to evaluate the BQ24133 performance independently or in conjunction with a gas gauge and/or DC-DC converters.

2.2 Features

2.2.1 BQ24133 Features

- 1.6-MHz synchronous switched-mode charger with 4-A integrated n-MOSFETs
- Up to 94% efficiency
- 30-V input rating with adjustable overvoltage protection:
 - 4.5 to 17-V input operating voltage range
- Battery charge voltage: 1-, 2-, or 3-cell with 4.2 V per cell
- High integration:
 - Automatic power path selector between adapter and battery
 - Dynamic power management
 - Integrated 20-V switching MOSFETs
 - Integrated bootstrap diode
 - Internal loop compensation
 - Internal digital soft start
- Safety:
 - Thermal regulation loop throttles back current to limit $T_j = 120^{\circ}\text{C}$
 - Thermal shutdown
 - Battery thermistor sense hot and cold charge suspend and battery detection
 - Input overvoltage protection with programmable threshold
 - Cycle-by-cycle current limit
- Accuracy:
 - $\pm 0.5\%$ charge voltage regulation
 - $\pm 4\%$ charge current regulation
 - $\pm 4\%$ input current regulation
- Less than 15 μA of battery current with adapter removed
- Less than 1.5 mA of input current with adapter present
- Small QFN package of input current from adapter to monitor overall:
 - 24 pin, 3.5-mm \times 5.5-mm QFN

2.2.2 SMP-BQ24133-MVK Features

- Compatible with [MAVRK PMU](#) battery carrier boards
- Breadboard compatible with 0.1-inch headers

2.3 Featured Applications

The SMP-BQ24133-MVK MAVRK submodule can be used on the following applications:

- Tablet PC
- Netbook and ultramobile computers
- Portable data capture terminals
- Portable printers
- Medical diagnostics equipment

- Battery bay chargers
- Battery back-up systems

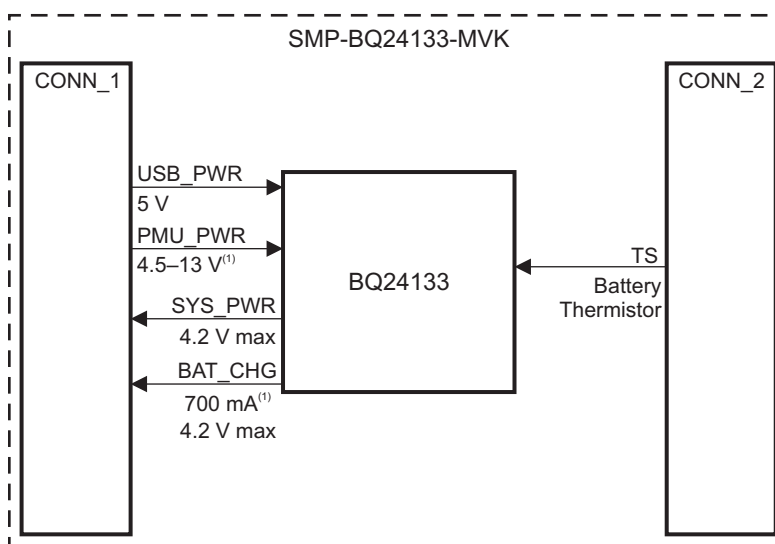
2.4 Highlighted Products

The SMP-BQ24133-MVK MAVRK submodule highlights the following devices:

- [BQ24133 1.6-MHz Synchronous Switched-Mode Li-Ion and Li-Polymer Stand-alone Battery Charger](#)
- CSD17313Q2 30V N Channel NexFET™ Power MOSFET

2.5 Block Diagram

Figure 2 shows the SMP-BQ24133-MVK block diagram.



(1) Default settings. These values can be modified by changing resistor dividers.

Figure 2. SMP-BQ24133-MVK Block Diagram

2.6 EVM Wiki

The most up-to-date information on this module can be found at the [SMP-BQ24133-MVK MAVRK Submodule wiki page](#).

2.7 EVM Landing Page

Ordering information and availability of this module can be found at the [SMP-BQ24133-MVK MAVRK Submodule tool folder](#).

3 Hardware Description

3.1 Power Requirements

The SMP-BQ24133-MVK can charge a single-cell Li-ion or Li-polymer battery connected to a battery PMU carrier board, such as the PMU-BAT-MVK. On the PMU-BAT-MVK, the battery can be connected to screw terminal P₄ or to connector P₆. The charging voltage can be provided through the PMU-BAT-MVK input screw terminal (P₅) or the onboard USB connector. The default charge voltage range of the SMP-BQ24133-MVK is 4.5 to 13 V. The default charge range can be modified by adjusting the OVPSET resistor divider composed of R₉ and R₁₂. An OVPSET voltage above 1.6 V indicates input overvoltage, and a voltage below 0.5 V indicates input undervoltage. Charging is disabled when an input overvoltage or undervoltage condition occurs.

The SMP-BQ24133-MVK default charge current is 700 mA. The charge current can be modified by changing resistors R₆ and R₈. The charge current is given by:

$$I_{CHG} = V_{REF} \left(\frac{R_8}{(R_6 + R_8) \cdot 20 \cdot R_4} \right)$$

where V_{REF} is 3.3 V and R₄ is 0.01 Ω. The output current of the charger should not exceed 4 A.

The default input current limit is 2.5 A, which can be adjusted with resistors R₇ and R₁₀. The input current set point I_{DPM} is given by:

$$I_{DPM} = V_{REF} \left(\frac{R_{10}}{(R_7 + R_{10}) \cdot 20 \cdot R_1} \right)$$

where V_{REF} is 3.3 V and R₁ is 0.01 Ω.

3.2 Connector Signal Descriptions

For information about the SMP-BQ24133-MVK connector pinouts, see [Hardware Design Guide for MAVRK PMU Charger Submodules](#).

3.3 Getting Started: Configuring the EVM

The SMP-BQ24133-MVK can be connected to the charger slot of a battery PMU carrier board, such as the PMU-BAT-MVK, as explained on the [Configuring Power Submodules on a PMU Carrier Board](#) page. The SMP-BQ24133-MVK submodule is intended for unremovable battery applications. Therefore, a battery must be connected to the charger to ensure power to the system. If the battery does not have a thermistor (TS) terminal or if a fuel gauge is connected to the thermistor, the TS jumper (JPS3) on the SMP-BQ24133-MVK must be set to 10 kΩ (jumper between JPS3 pins 2 and 3).

When the charge enable (CHG_EN) jumper (JPS1) is disconnected, the module charges the battery automatically when a USB or power supply input is provided.

3.4 EVM Jumpers, LEDs, and Test Points

[Table 1](#) lists all the LEDs and jumpers available on the BQ24133 MAVRK submodule.

Table 1. EVM LEDs and Headers

Reference Designator	Function
JPS1	Charge Enable header. Install jumper to disable charging.
JPS2	Safety Timer and termination control. Float to set the fast charge safety timer to 560 mins. Connect jumper between pins 1 and 2 to disable the charge termination and safety timer. Connect jumper between pins 2 and 3 to disable the safety timer but allow the charge termination.
JPS3	Temperature qualification input selection header. Connect jumper between pins 1 and 2 to use battery thermistor, or between 2 and 3 to disable the temperature qualification feature. If using in conjunction with a fuel gauge submodule that connects to the battery thermistor or if the battery does not have a thermistor terminal, connect jumper between pins 2 and 3.
D3	Status LED. OFF when charge in progress. ON when charge is complete or in sleep mode. Blinking at 0.5 Hz when fault occurs, including charge suspend, input overvoltage, timer fault, and battery absent.

4 Board Files

4.1 Bill of Materials

[Download PDF](#) of the bill of materials (BOM).

Table 2 lists the bill of materials.

Table 2. Bill of Materials

Item	SMP-BQ24133-MVK	Reference Designator	Value	Part Description	Temp °C	Manufacturer	Manufacturer Part Number	Note
1	5	C1, C2, C7, C8, C17	0.1 µF	Capactor, Ceramic, 0.1 µF, 50 V, X7R, 10%, 0402	–55 to 125	TDK Corporation	C1005X7R1H104K	
2	1	C3	4.7 µF	Capactor, Ceramic, 4.7 µF, 50 V, X5R, 10%, 0805	–55 to 85	TDK Corporation	C2012X5R1H475K	
3	2	C4, C13	1.0 µF	Capactor, Ceramic, 1.0 µF, 25 V, X7R 10% 0603	–55 to 125	Murata Electronics	GRM188R71E105KA12D	
4	2	C5, C11	0.1 µF	Capactor, Ceramic, 0.1 µF, 10%, 16 V, X7R, 0603	–55 to 125	AVX Corporation	0603YC104KAT2A	
5	1	C6	0.047 µF	Capactor, Ceramic, 0.047 µF, 50 V, ±10%, X7R, 0603	–55 to 125	Murata Electronics North America	GRM188R71H473KA61D	
6	2	C9, C10	10 µF	Capactor, Ceramic, 10 µF, 25 V, ±10%, X5R, 0805	–55 to 85	Murata Electronics	GRM21BR61E106KA73L	
7	1	C12	1.0 µF	Capactor, Ceramic, 1.0 µF, 25 V, ±10%, X5R, 0603	–55 to 85	Murata Electronics	GRM188R61E105KA12D	
8	1	C14	1.0 µF	Capactor, Ceramic, 1.0 µF, 16 V, X5R, 10%, 0402	–55 to 85	Taiyo Yuden	EMK105BJ105KV-F	
9	1	C15	0.1 µF	Capactor, Ceramic, 0.1 µF, 25 V, 10%, X7R, 0603	–55 to 125	Murata Electronics	GRM188R71E104KA01D	
10	1	C16	330 pF	Capactor, Ceramic, 330 pF, 5%, 50 V, X7R, 0402	–55 to 125	AVX Corporation	04025C331JAT2A	
11	1	CONN_1	1 × 8 THVT	High temperature, 100-inch pitch, 1 × 8 Overall 430L Post Gold, Single, 230 Post height	–55 to 125	Samtec	HMTSW-108-07-L-S-230	
12	1	CONN_2	1 × 8 THVT	High temperature, 100-inch pitch, 1 × 8 Overall 430L Post Light Gold, Single, 230 Post height Pin 4 is polarized	–55 to 125	Samtec	HMTSW-108-07-L-S-230-004	
13	1	D2	B220A-13-F	Diode, Schottky, 2 A, 20 V, SMA		Diodes Inc	B220A-13-F	
14	1	D3	GREEN	LED Green, 0.2-mm 13MCD 0402 SMD	–40 to 85	Rohm Semiconductor	SML-P12PTT86	
15	1	D4	SMAJ20A-13-F	TVS 400 W, 20 V, UNIDIRECT SMA	–55 to 150	Diodes Inc	SMAJ20A-13-F	
16	1	D6	PDS1040-13	Diode, Schottky, 40 V, 10 A, POWERDI5		Diodes Inc	PDS1040-13	
17	1	JPS1	Jumper_1x2_100_430L	CONNECTOR_HDR_THVT_1x2_100_M		Samtec	HMTSW-102-07-G-S-230	
18	1	JPS2	Jumper_1x3_100_430L	CONNECTOR_HDR_THVT_1x3_100_M		Samtec	HMTSW-103-07-G-S-230	Short pins 1 and 2
19	1	JPS3	Jumper_1x3_100_430L	CONNECTOR_HDR_THVT_1x3_100_M		Samtec	HMTSW-103-07-G-S-230	Short pins 2 and 3 (assembly drawing incorrectly states pins 1 and 2)
20	1	L1	3.3 µH	Inductor, Power, 3.3 µH, 5.0 A, SMD	–55 to 125	Vishay/Dale	IHLP2020CZER3R3M01	

Table 2. Bill of Materials (continued)

Item	SMP-BQ24133-MVK	Reference Designator	Value	Part Description	Temp °C	Manufacturer	Manufacturer Part Number	Note
21	1	Q1	CSD17313Q2	MOSFET, N-Channel, 30 V, 5 A ,2.3 W, 6-SON		Texas Instruments	CSD17313Q2	
22	1	Q2	FDMC6679AZ	MOSFET, P-Channel 30 V, 11.5 A, 2.3 W, POWER33	–55 to 150	Fairchild Semiconductor	FDMC6679AZ	
23	2	R1, R4	0.01 Ω	Resistor, 0.01 Ω, 1/4 W, 1%, 1206 SMD	±75ppm/°C	Vishay/Dale	WSL1206R0100FEA	
24	2	R2, R3	4.02 kΩ	Resistor, 4.02 kΩ, 1/10 W, 1%, 0402 SMD	±100ppm/°C	Panasonic - ECG	ERJ-2RKF4021X	
25	1	R5	5.1 Ω	Resistor, 5.1 Ω, 0.1 W, –100/+600ppm/°C, 0402	–100/+600ppm/°C	Panasonic - ECG	ERJ-2GEJ5R1X	
26	1	R6	732 kΩ	Resistor, 732 kΩ, 1/10 W, 1%, 0603, SMD	±100ppm/°C	Panasonic - ECG	ERJ-3EKF7323V	
27	1	R7	182 kΩ	Resistor, 182 kΩ, 1/10 W, 1%, 0603, SMD	±100ppm/°C	Panasonic - ECG	ERJ-3EKF1823V	
28	2	R8, R10	32.4 kΩ	Resistor, 32.4 kΩ, 1/10 W, 1%, 0603, SMD	±100ppm/°C	Panasonic - ECG	ERJ-3EKF3242V	
29	1	R9	715 kΩ	Resistor, 715 kΩ, 1/10 W, 1%, 0603, SMD	±100ppm/°C	Panasonic - ECG	ERJ-3EKF7153V	
30	1	R11	680 Ω	Resistor, 680 Ω, 1/10 W, 5%, 0402, SMD	±200ppm/°C	Panasonic - ECG	ERJ-2GEJ681X	
31	1	R12	100 kΩ	Resistor, 100 kΩ, 1/10 W, 1%, 0603, SMD	±100ppm/°C	Panasonic - ECG	ERJ-3EKF1003V	
32	1	R13	5.23 kΩ	Resistor, 5.23 kΩ, 1/10 W, 1%, 0603, SMD	±100ppm/°C	Panasonic - ECG	ERJ-3EKF5231V	
33	1	R14	100 Ω	Resistor, Thick Film, 100 Ω, 0.1 W, ±200ppm/°C, ±5%, 0402	±200ppm/°C	Panasonic - ECG	ERJ-2GEJ101X	
34	1	R15	10 kΩ	Resistor, Thick Film, 10 kΩ, 0.1 W, ±200ppm/°C, ±5%, 0402	±200ppm/°C	Panasonic - ECG	ERJ-2GEJ103X	
35	1	R16	30.1 kΩ	Resistor, 30.1 kΩ, 1/10 W, 1%, 0402, SMD	±100ppm/°C	Panasonic - ECG	ERJ-2RKF3012X	
36	1	R17	100 kΩ	Resistor, 100 kΩ, 1/10 W, 1%, 0402, SMD	±100ppm/°C	Panasonic - ECG	ERJ-2RKF1003X	
37	1	R18	1 kΩ	Resistor, Thick Film 1.0 kΩ, 1/10 W, ±5%, 0402	±200ppm/°C	Panasonic - ECG	ERJ-2GEJ102X	
40	1	U1	BQ24133RGY	IC BATT CHARGE LI-ION/POL 24VQFN	–40 to 85	Texas Instruments	BQ24133RGY	
41	1	LB1	Line 1 Line 2	SMP-BQ24133-MVK BOM REV A2		Brady	THT-14-423-10	See Assembly DWG for Label location
42	2	XJ1, XJ2	Shunt_100	Headers and wire housings, 0.100 SHUNT		Samtec	SNT-100-BK-G	

4.2 Layout

[Download PDF](#) of additional board layers.

Figure 3 through Figure 10 show the separate SMP-BQ24133-MVK board layers.

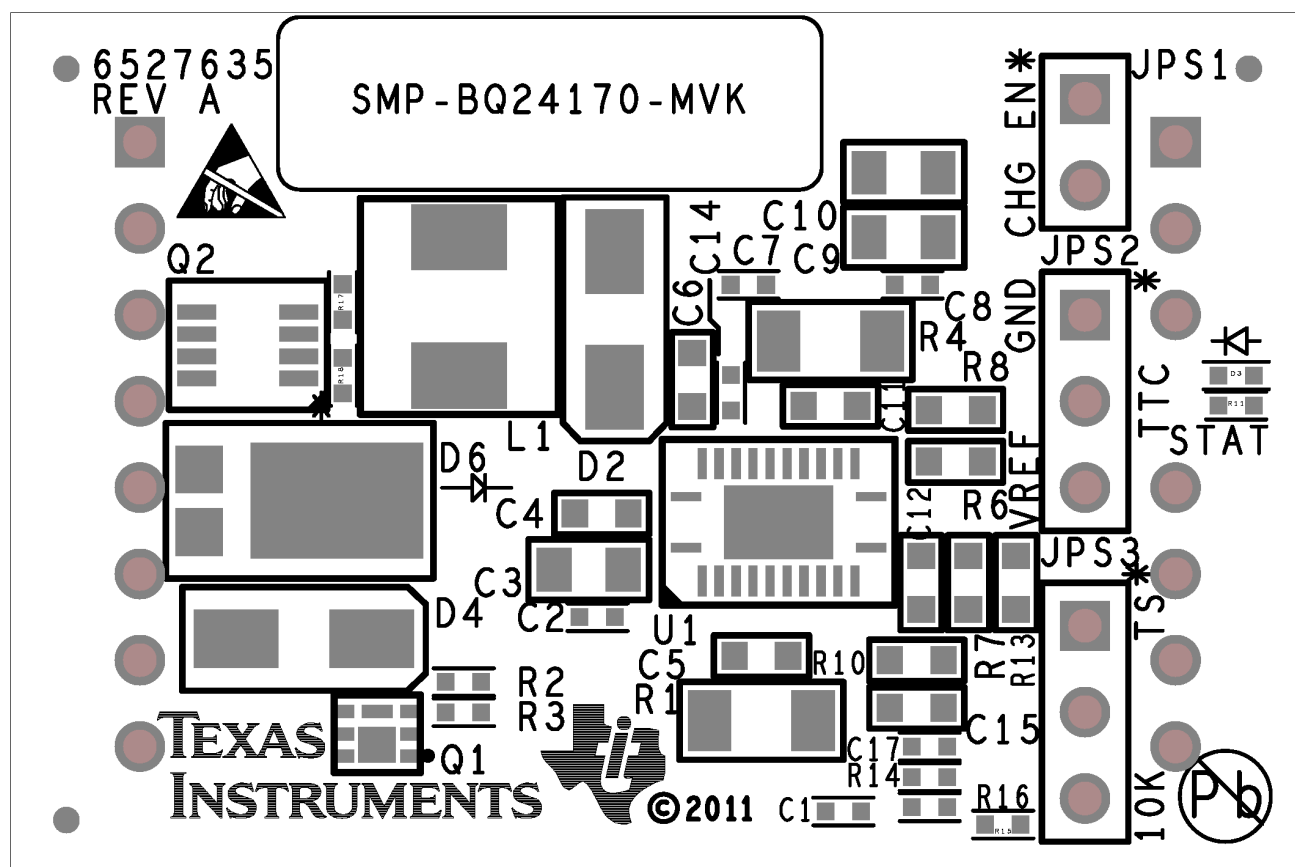


Figure 3. SMP-BQ24133-MVK Board Silkscreen – Top Side

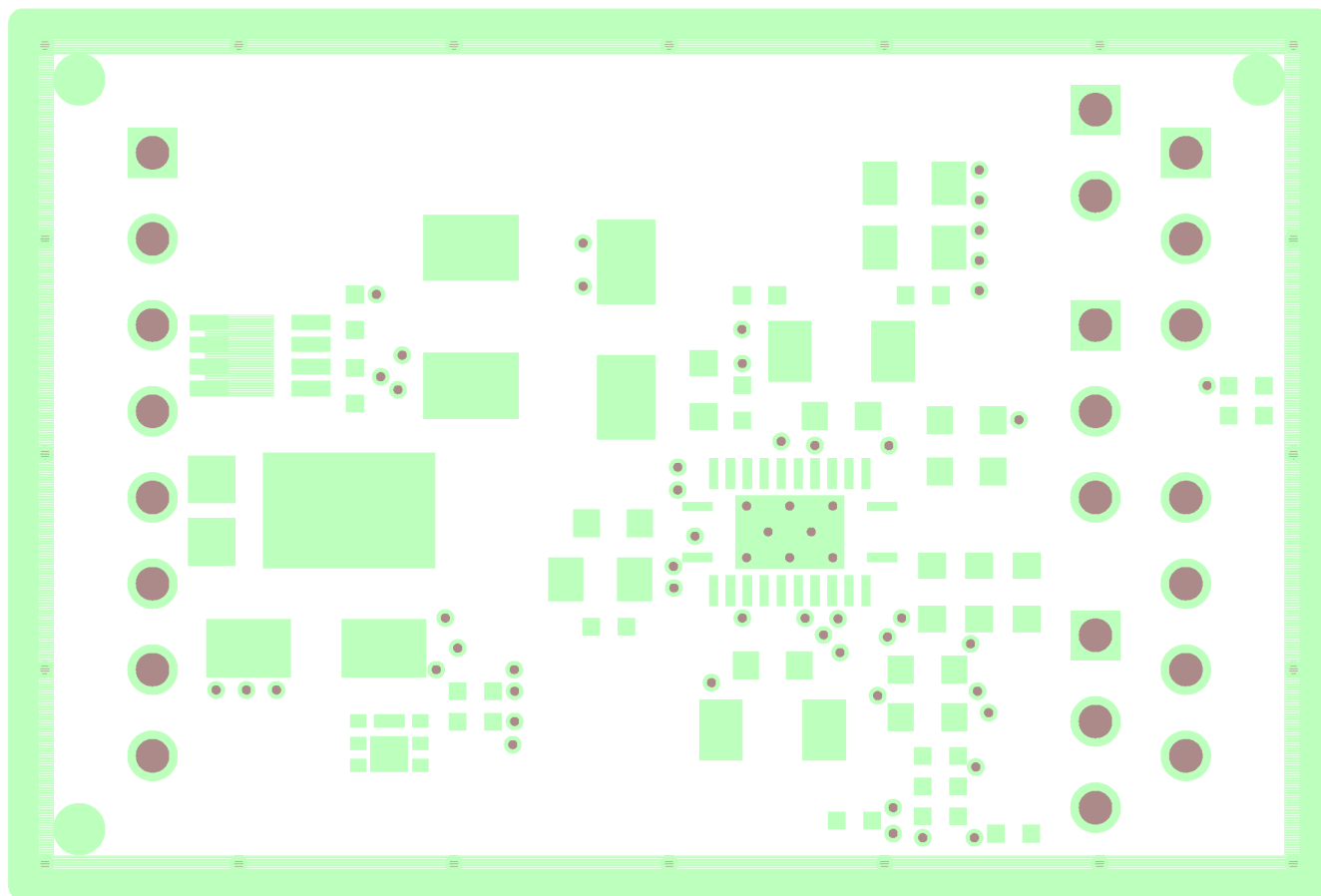


Figure 4. SMP-BQ24133-MVK Board Solder Mask – Top Side

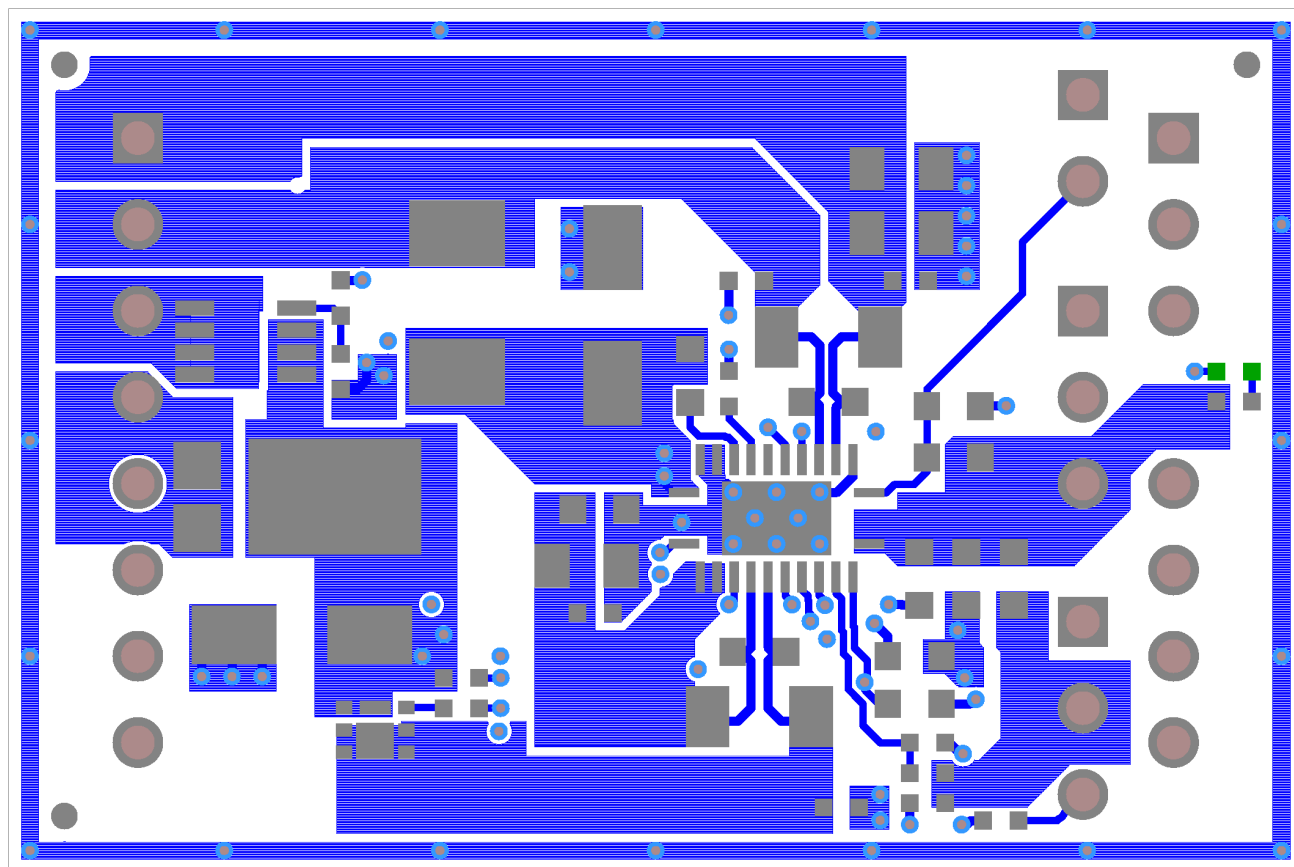


Figure 5. SMP-BQ24133-MVK Board Layer 1 – Top Side

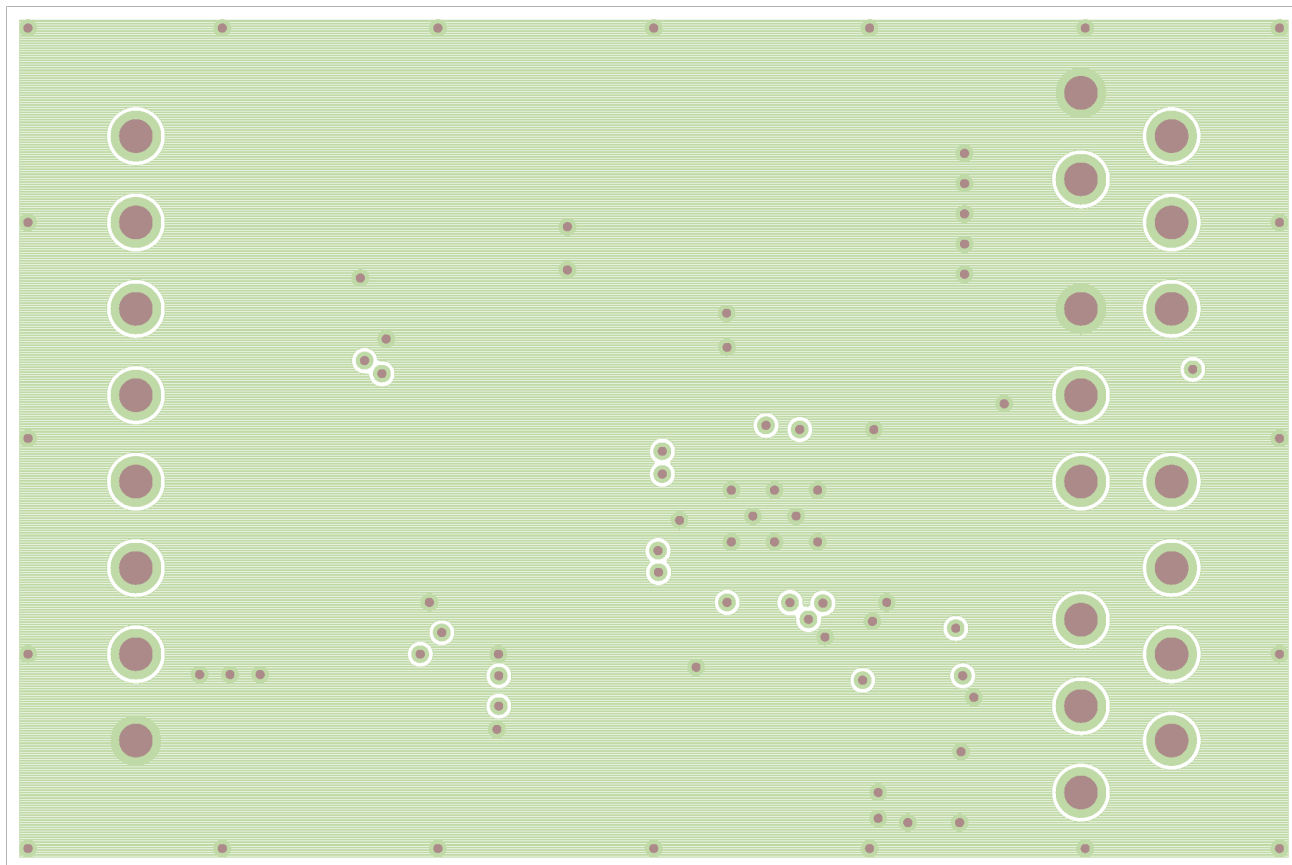


Figure 6. SMP-BQ24133-MVK Board Layer 2 – Ground Plane

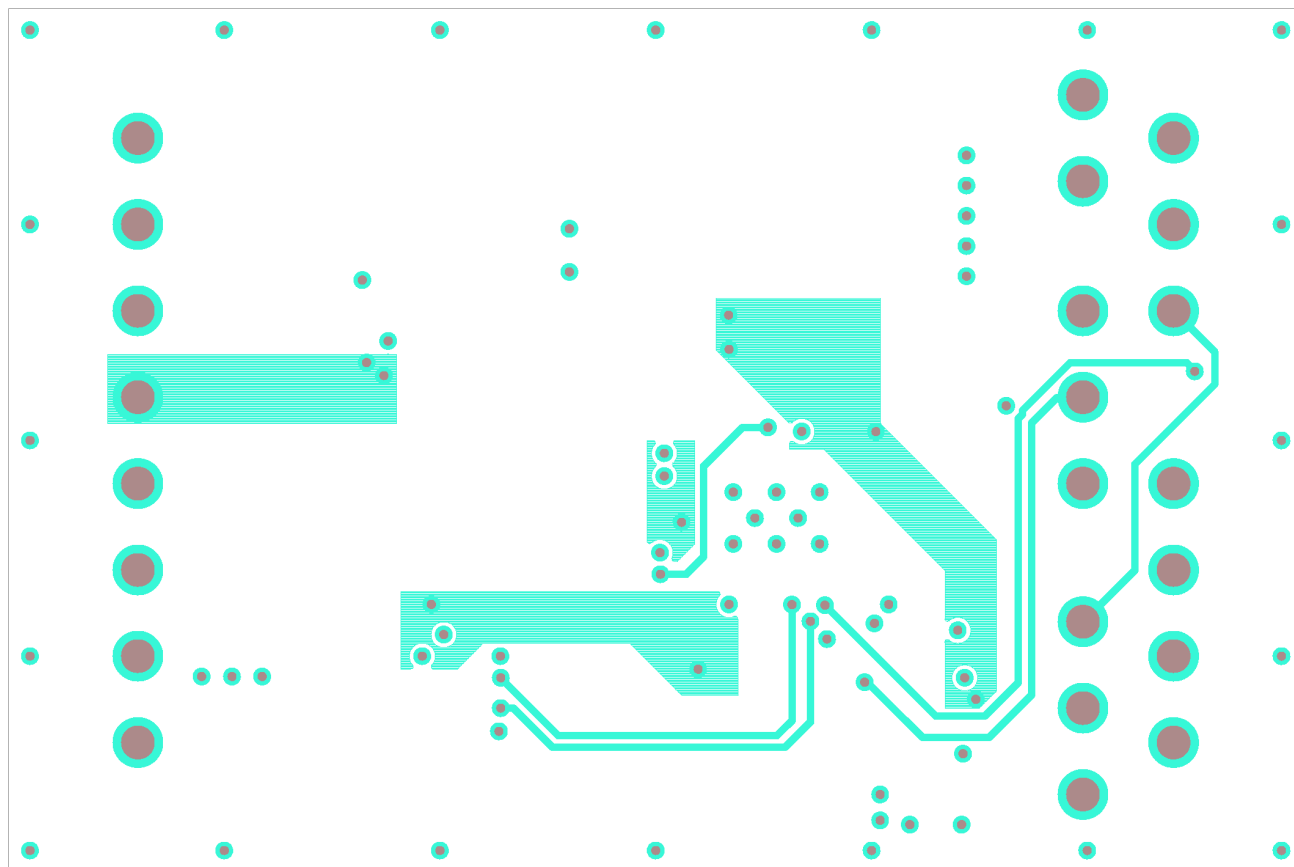


Figure 7. SMP-BQ24133-MVK Board Layer 3 – Signal

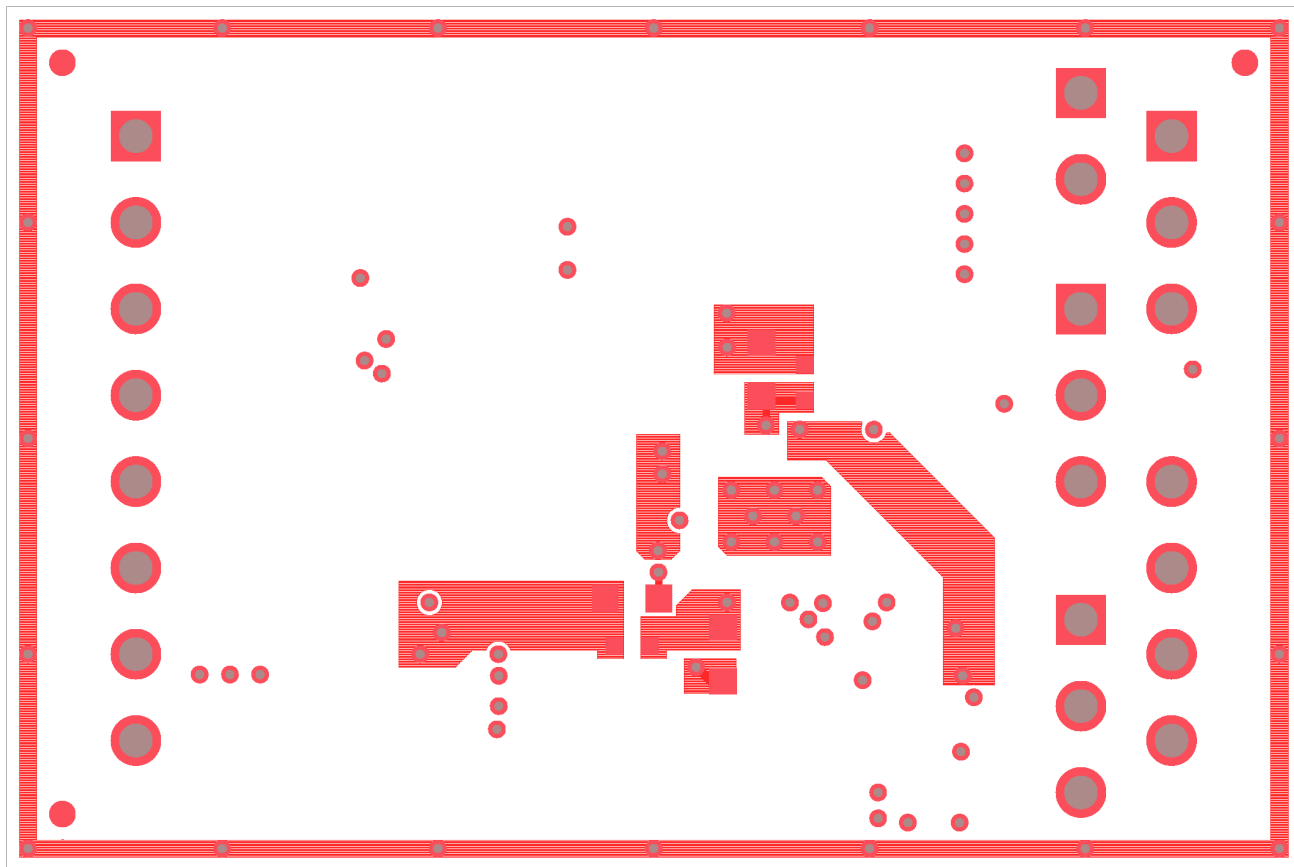


Figure 8. SMP-BQ24133-MVK Board Layer 4 – Bottom Side

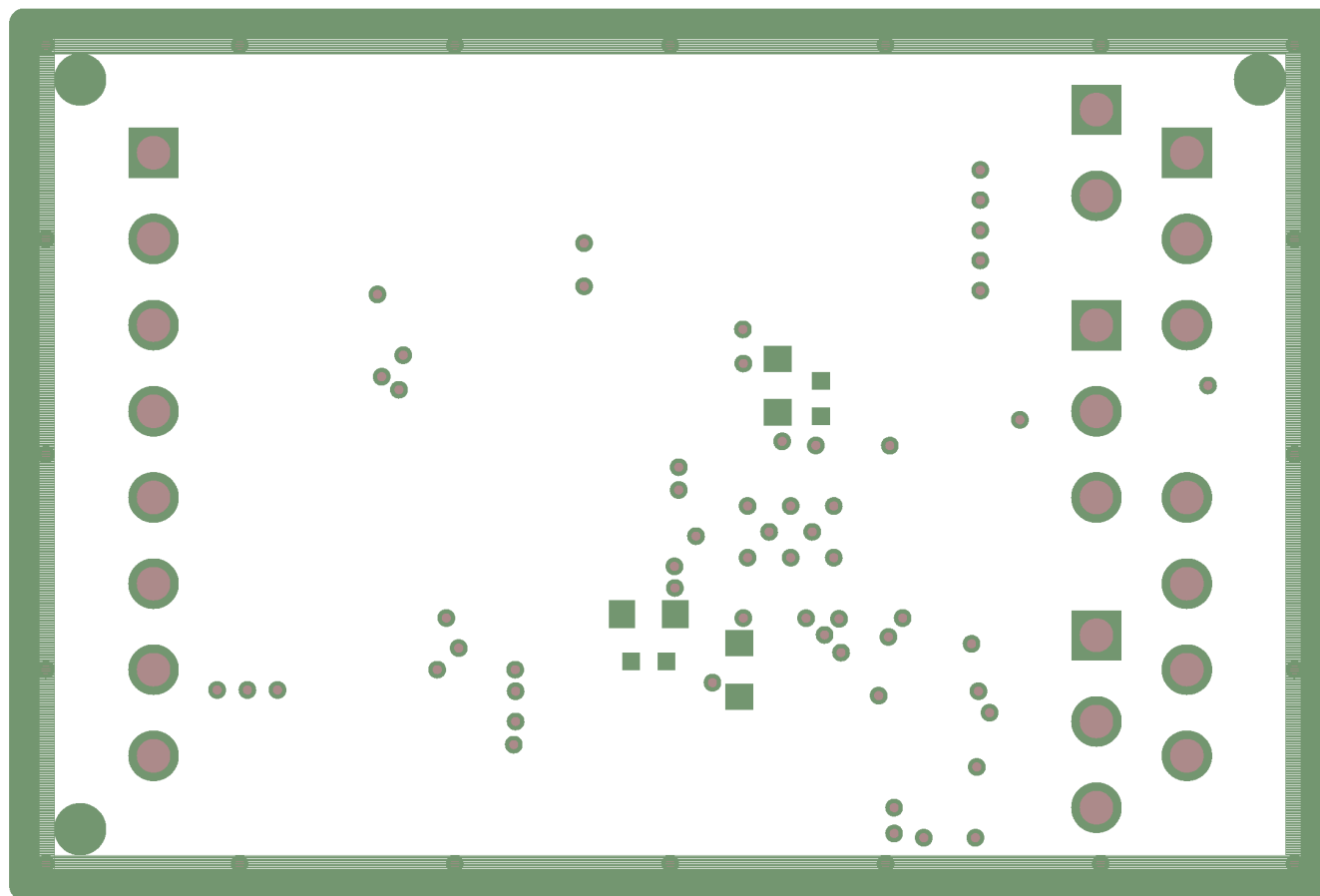


Figure 9. SMP-BQ24133-MVK Board Solder Mask – Bottom Side

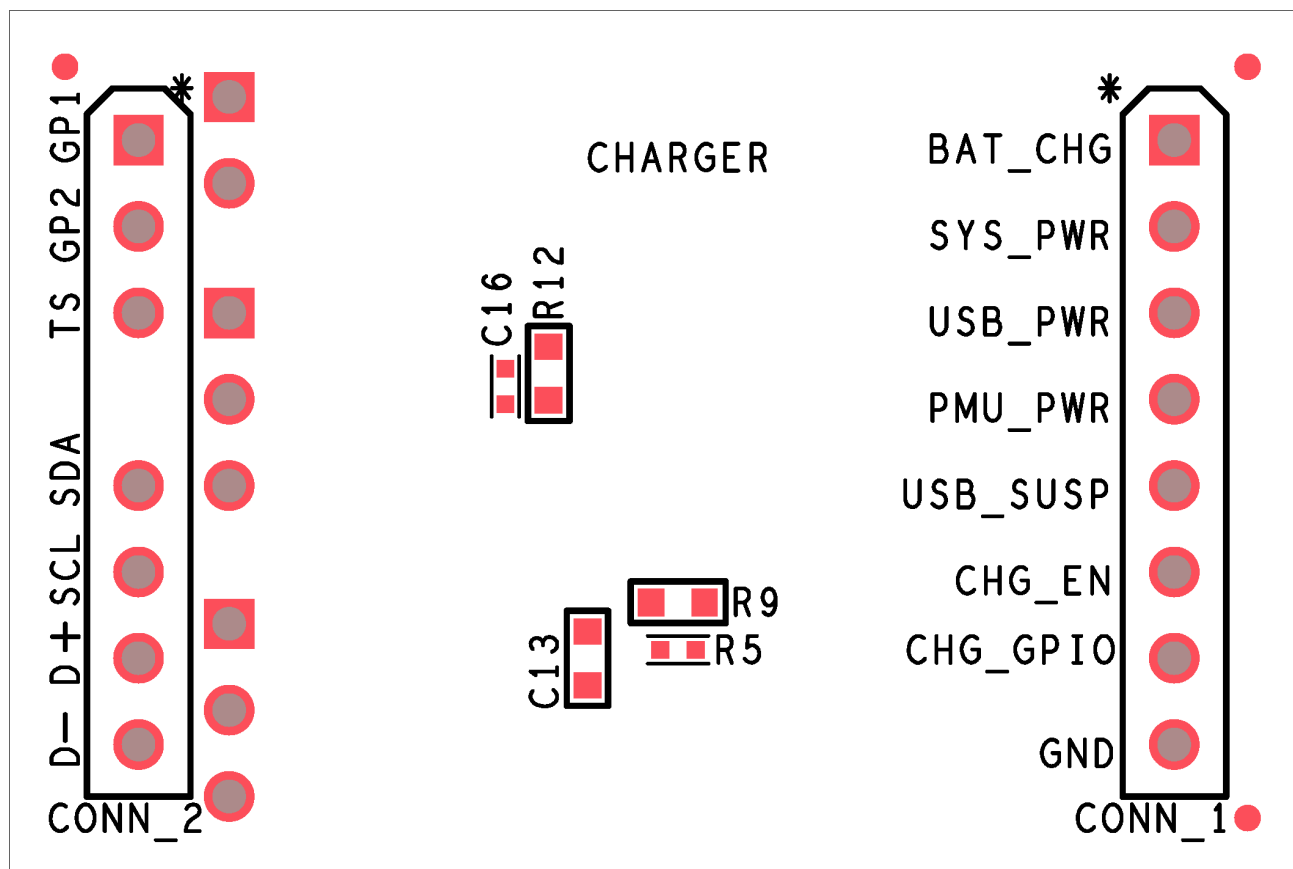


Figure 10. SMP-BQ24133-MVK Board Silkscreen – Bottom Side

4.3 Schematics

[Download PDF](#) of the schematic.

Figure 11 shows the SMP-BQ24133-MVK schematic.

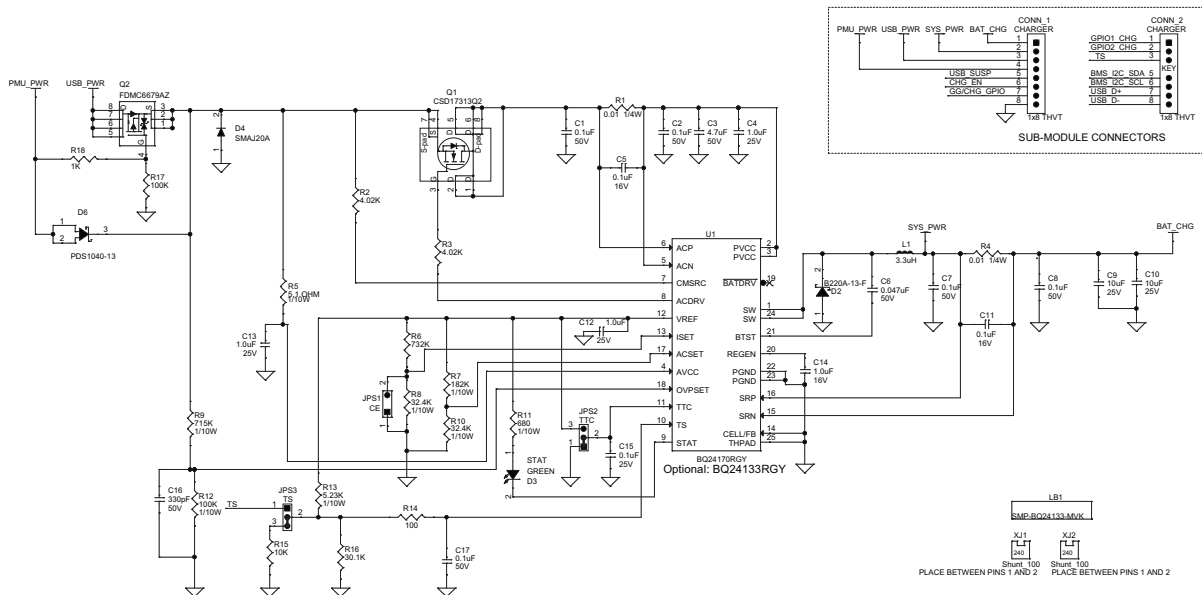


Figure 11. SMP-BQ24133-MVK Schematic

4.4 Fabrication Drawings

[Download PDF](#) of the fabrication drawing.

Figure 12 shows the SMP-BQ24133-MVK fabrication drawing.

UNLESS OTHERWISE SPECIFIED, ALL NOTES ARE APPLICABLE.
NOTES PRECEDED BY AN UNMARKED "1" ARE NOT APPLICABLE.

1. ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED.
2. PC SHALL BE FABRICATED TO IPC-6012, CLASS II AND WORKMANSHIP SHALL CONFORM TO IPC-600, CLASS II
3. CURRENT REVISIONS:
4. MINIMUM COPPER WALL THICKNESS SHALL BE .001 INCH. FOR ALL PLATED THROUGH HOLES.
5. BOARD MATERIAL SHALL BE 1/16" 370HR OR EQUIVALENT. BOARD SHALL MEET OR EXCEED IPC-4101/26. COLOR: NATURAL.
6. BOARD MATERIAL AND CONSTRUCTION TO BE UL 94V-0 APPROVED AND MARKED ON THE FINISHED BOARD.
7. OVERALL BOARD THICKNESS TO BE .062 +/- .005 AND APPLIES AFTER ALL LAMINATION AND PLATING PROCESSES. MEASURED FROM COPPER TO COPPER.
8. TO BE PLACED IN COPPER ON BOTTOM SIDE OF THE BOARD.
9. PLATE ALL EXPOSED AREAS WITH ELECTROLESS NICKEL IMMERSION GOLD. NICKEL: 100 MICRO-INCHES MIN GOLD: 2-8 MICRO-INCHES MIN
10. APPLY LPI SOLDERMASK OVER BARE COPPER (SNOBIC) COLOR: RED
11. SOLDERMASK SHALL CONFORM TO IPC-SM-840 CLASS H, CURRENT REVISION
12. SOLDERMASK ARTWORK HAS ZERO (0) OVERSIZED PADS.
13. FABRICATION VENDOR IS ALLOWED TO ADJUST THE COMPONENT SOLDERMASK PADS TO MEET THEIR TOOLING REQUIREMENTS.
14. SILKSCREEN-APPLY NON-CONDUCTIVE LPI OR EQUIVALENT PER THE ARTWORK COLOR: WHITE
15. P.C. BOARD TO BE FREE OF DIRT, OIL, FINGER PRINTS, ETC.
16. BOARD WARPAGE: WARP AND TWIST SHALL NOT EXCEED .0075 INCH PER INCH MEASURED AT ANY LOCATION OR DIRECTION ON THE BOARD.
17. BOARD MUST BE ELECTRICALLY TESTED USING SUPPLIED IPC-D-356 NETLIST.

LAYER 1	TOP	Copper Foil 0.5oz / Plate to 1.5oz min Layer 1
LAYER 2	FR-4 370	Pre-preg 0.008" (3 x 1080)
LAYER 3	FR-4 370	Core 0.040" 0.5oz / 0.5oz Layer 2 & 3
LAYER 4	FR-4 370	Pre-preg 0.008" (3 x 1080)
LAYER 4	BOTTOM	Copper Foil 0.5oz / Plate to 1.5oz min Layer 4

DRILL CHART: TOP to BOTTOM				
ALL UNITS ARE IN MILS				
FIGURE	SIZE	TOLERANCE	PLATED	QTY
+	10.0	+3.0/-3.0	PLATED	78
o	38.0	+3.0/-3.0	PLATED	23

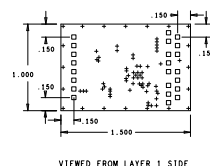


Figure 12. SMP-BQ24133-MVK Fabrication Drawing

4.5 Gerber Files

[Download a ZIP](#) of the Gerber files.

Figure 13 shows a single screen capture of the SMP-BQ24133-MVK Gerber files.



Figure 13. SMP-BQ24133-MVK Gerber Files

4.6 Cadence Schematic and Board Files

[Download a ZIP](#) of the Cadence schematic and board files.

Figure 14 shows a single screen capture of the SMP-BQ24133-MVK Cadence schematic files.



Figure 14. SMP-BQ24133-MVK Cadence Schematic and Board Files

5 MAVRK Links

5.1 Additional Information on MAVRK

Visit the [MAVRK wiki pages](#) to get comprehensive information on MAVRK.

5.2 MAVRK Questions

Post any questions on the [MAVRK Forum](#).

5.3 Additional Technical Information on MAVRK Hardware

Review the wiki pages related to [designing MAVRK hardware](#).

5.4 Additional Technical Information on MAVRK Software

Review the wiki pages related to [working with MAVRK software](#).

5.5 Obtaining a MAVRK Board

See the [MAVRK Starter Kit tool folder page](#) to order a MAVRK starter kit. To order other modules, search for them by name on the [TI Web site](#) to find their tool folder pages.

6 Precautions and Certifications

6.1 ESD Precautions

Adhere to the following guidelines to avoid ESD damage to the board components:

- Ground any person handling boards either with a wrist strap or ESD protective footwear, used in conjunction with a conductive or static-dissipative floor or floor mat.
- Ensure that the work surface where boards are placed for handling, processing, testing, and so forth, are made of static-dissipative material and are grounded to ESD ground.
- Either remove all insulator materials from the work area or they must be neutralize them with an ionizer. Cover static-generating clothes with an ESD-protective smock.
- When boards are stored, transferred between operations or workstations, or shipped, maintain them in a Faraday-shield container whose inside surface (touching the boards) is static dissipative.

6.2 Certifications

[FCC and ICES standard EMC test report for the SMP-BQ24133-MVK Submodule, aboard the MB-PRO-MVK motherboard](#)

[Eco-Info and Lead-Free Home](#)

[RoHS Compliant Solutions](#)

[Statement on Registration, Evaluation, Authorization of Chemicals \(REACH\)](#)

7 Revision History

The following table summarizes the versions of the SMP-BQ24133-MVK MAVRK Submodule User's Guide.

Note: Numbering may vary from previous verisons.

Version	Literature Number	Date	Notes
*	SLVU696	March 2011	See ⁽¹⁾

⁽¹⁾ SMP-BQ24133-MVK MAVRK Submodule User's Guide, (SLVU696) - initial release.

EVALUATION BOARD/KIT/MODULE (EVM) ADDITIONAL TERMS

Texas Instruments (TI) provides the enclosed Evaluation Board/Kit/Module (EVM) under the following conditions:

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING LIMITED WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please visit www.ti.com/esh or contact TI.

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REGULATORY COMPLIANCE INFORMATION

As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

For EVMs **not** subject to the above rules, this evaluation board/kit/module is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by TI to be a finished end product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant

Caution

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concerning EVMs including detachable antennas

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

Concernant les EVMs avec appareils radio

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

【Important Notice for Users of this Product in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

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EVALUATION BOARD/KIT/MODULE (EVM) WARNINGS, RESTRICTIONS AND DISCLAIMERS

For Feasibility Evaluation Only, in Laboratory/Development Environments. Unless otherwise indicated, this EVM is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. It should not be used as all or part of a finished end product.

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard.
3. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

Certain Instructions. It is important to operate this EVM within TI's recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. 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 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

Agreement to Defend, Indemnify and Hold Harmless. You agree to defend, indemnify and hold TI, its licensors and their representatives harmless from and against any and all claims, damages, losses, expenses, costs and liabilities (collectively, "Claims") arising out of or in connection with any use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

Safety-Critical or Life-Critical Applications. If you intend to evaluate the components for possible use in safety critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

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