Reference Board User's Manual
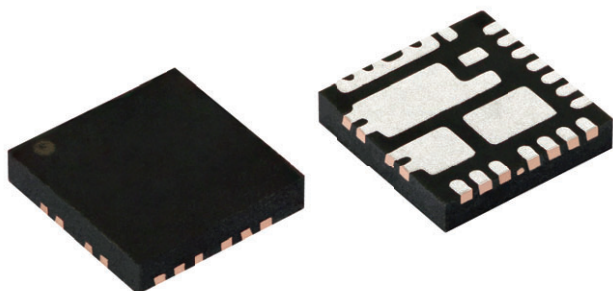# High Voltage Synchronous Buck Regulators: 3 V to 24 V
# SiC431 (24 A), SiC437 (12 A), SiC438 (8 A)

FEATURES

- Versatile
  - Single supply operation from 3 V to 24 V input voltage
  - Adjustable output voltage down to 0.6 V
  - Scalable solution
    8 A (SiC438), 12 A (SiC437), 24 A (SiC431)
  - Output voltage tracking and sequencing with pre-bias start up
  - ± 1 % output voltage accuracy at -40 °C to +125 °C
- Highly efficient
  - 97 % peak efficiency
  - 1 µA supply current at shutdown
  - 50 µA operating current not switching
- Highly configurable
  - Four programmable switching frequencies available: 300 kHz, 500 kHz, 750 kHz, and 1 MHz
  - Adjustable soft start and adjustable current limit
  - 3 modes of operation: forced continuous conduction, power save, or ultrasonic
- Robust and reliable
  - Cycle-by-cycle current limit
  - Output overvoltage protection
  - Output undervoltage / short circuit protection with auto retry
  - Power good flag and over temperature protection
- Design tools
  - Supported by Vishay PowerCAD Online Design Simulation (www.vishay.com/power-ics/powercad-list/)
  - Design support kit (www.vishay.com/ppg?74589)
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

DESCRIPTION

The SiC431/437/438 is family of synchronous buck regulators with integrated high side and low side power MOSFETs. Its power stage is capable of supplying up to 24 A continuous current at 1 MHz switching frequency. This regulator produces an adjustable output voltage down to 0.6 V from 3 V to 24 V input rail to accommodate a variety of applications, including computing, consumer electronics, telecom, and industrial. SiC43x series employs a constant ON time control architecture that supports ultrafast transient response with minimum output capacitance and tight ripple regulation at very light load. The device is internally compensated and no external ESR network is required for loop stability purposes. The device also incorporates a power saving scheme that significantly increases light load efficiency. The regulator integrates a full protection feature set, including output over voltage protection (OVP), cycle by cycle over current protection (OCP) short circuit protection (SCP) and thermal shutdown (OTP). It also has UVLO and a user programmable soft start. The SiC43x series is available in lead (Pb)-free power enhanced MLP44-24L package in 4 mm x 4 mm dimension.

ORDERING TABLE

PART NUMBER	MODE	OUTPUT CURRENT
SiC431AEVB-A	Ultrasonic	24 A
SiC431BEVB-A	Power safe	24 A
SiC437AEVB-B	Ultrasonic	12 A
SiC437BEVB-B	Power safe	12 A
SiC438AEVB-B	Ultrasonic	8 A
SiC438BEVB-B	Power safe	8 A

APPLICATIONS

- Industrial and automation
- Home automation
- Industrial and server computing
- Networking, telecom, and base station power supplies
- Wall transformer regulation
- Robotics
- High end hobby electronics: remote control cars, planes, and drones
- Battery management systems
- Power tools
- Vending, ATM, and slot machines

SPECIFICATIONS

This reference board allows the end user to evaluate the SiC43x series microBUCK® regulators for their features and functionalities. The user may also change the operating range may be modified by making changes to the jumper connections. See section "Selection Jumpers" below in the document.
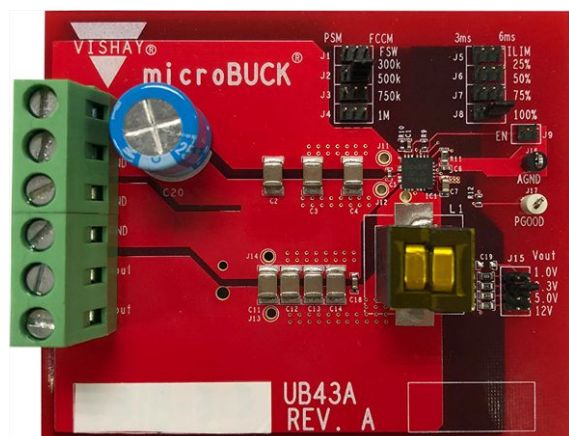
CONNECTION AND SIGNAL / TEST POINTS

Power Terminals (J10)

- +V_{IN} (pin 1), V_{IN} GND (pin 2)
Connect to a voltage source to this pin. The minimum input voltage will be 3 V. For input voltages (V_{IN}) below 4.5 V an external V_{DD} and V_{DRD} is required.

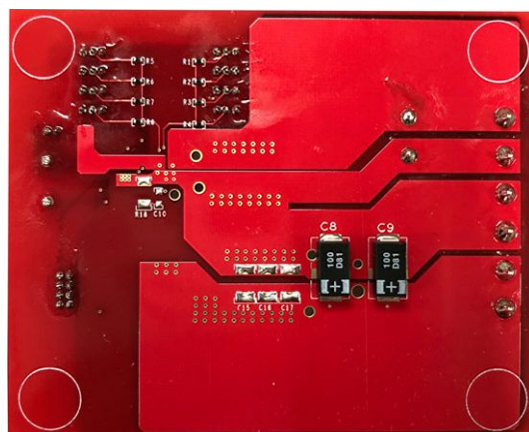**- +V_{OUT} (pins 5 and 6), V_{OUT} GND (pins 3 and 4)**

Fig. 1 - SiC43x EVB

SELECTION JUMPERS

Mode Select

J1, to J8 and J15: there are 4 jumpers which allow the user to select one of four modes of operation.

J1 to J4 to select switching frequency: 300 kHz to 1 MHz. Short pins 1 and 2 for PSM mode, short pins 2 and 3 for FCCM mode

J5 to J8 to select over current trip (I_{LIM}). Short pins 1 and 3 to select 6 mS soft start, short pins 2 and 3 to select 6 mS soft start

J15 to select output voltage: 1 V, 3.3 V, 5 V and 12 V

Enable

J9: this is the jumper that enables/disables the part.

With J9 left open, the device is enabled, via R9 to V_{IN+}. To disable the part, short J9.

SIGNALS AND TEST LEADS

Input Voltage Sense

V_{IN_SENSE} (TP11), GND$_{IN\_SENSE}$ (TP12): this allows the user to measure the voltage directly at the input of the regulator bypassing any losses generated by connections to the board. These test points can also be as a remote sense port of a power source with remote sense capability.

Output Voltage Sense

V_{OUT_SENSE} (TP13), GND$_{OUT\_SENSE}$ (TP14): this allows the user to measure the output voltage directly at the sense point of the regulator bypassing any losses generated by connections to the board. These test points can also be as a remote sense port of an external load with remote sense capability.
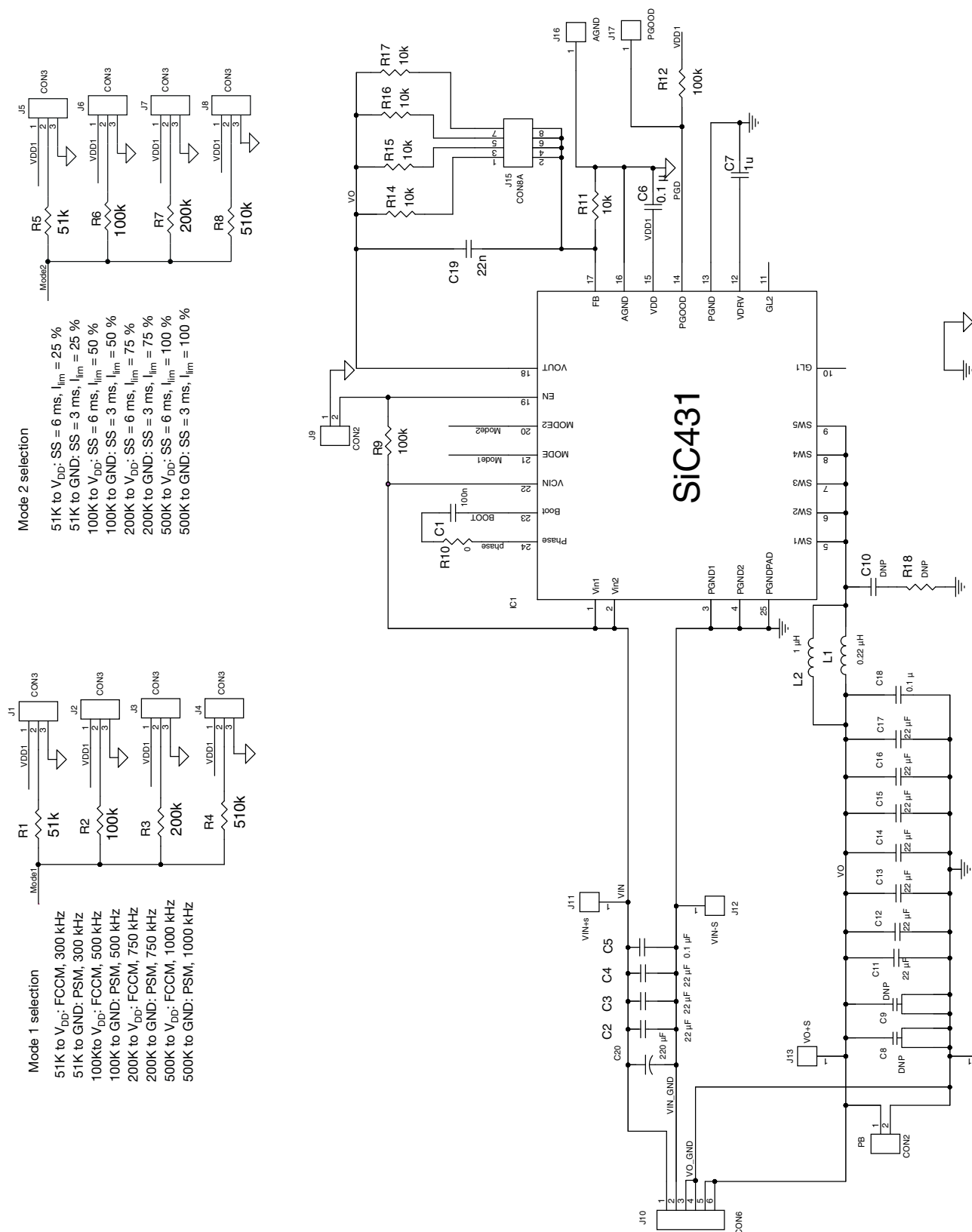
Power Good Indicator

PGD (J17): is an open drain output and is pulled up with a 100 kΩ resistor, R12, to V_{DD1} (≈ 5 V). When FB or V_{OUT} are within -10 % to +20 % of the set voltage this pin will go HI to indicate the output is okay. To prevent false triggering during transient events, the P_{GOOD} has a 25 µS blanking time.
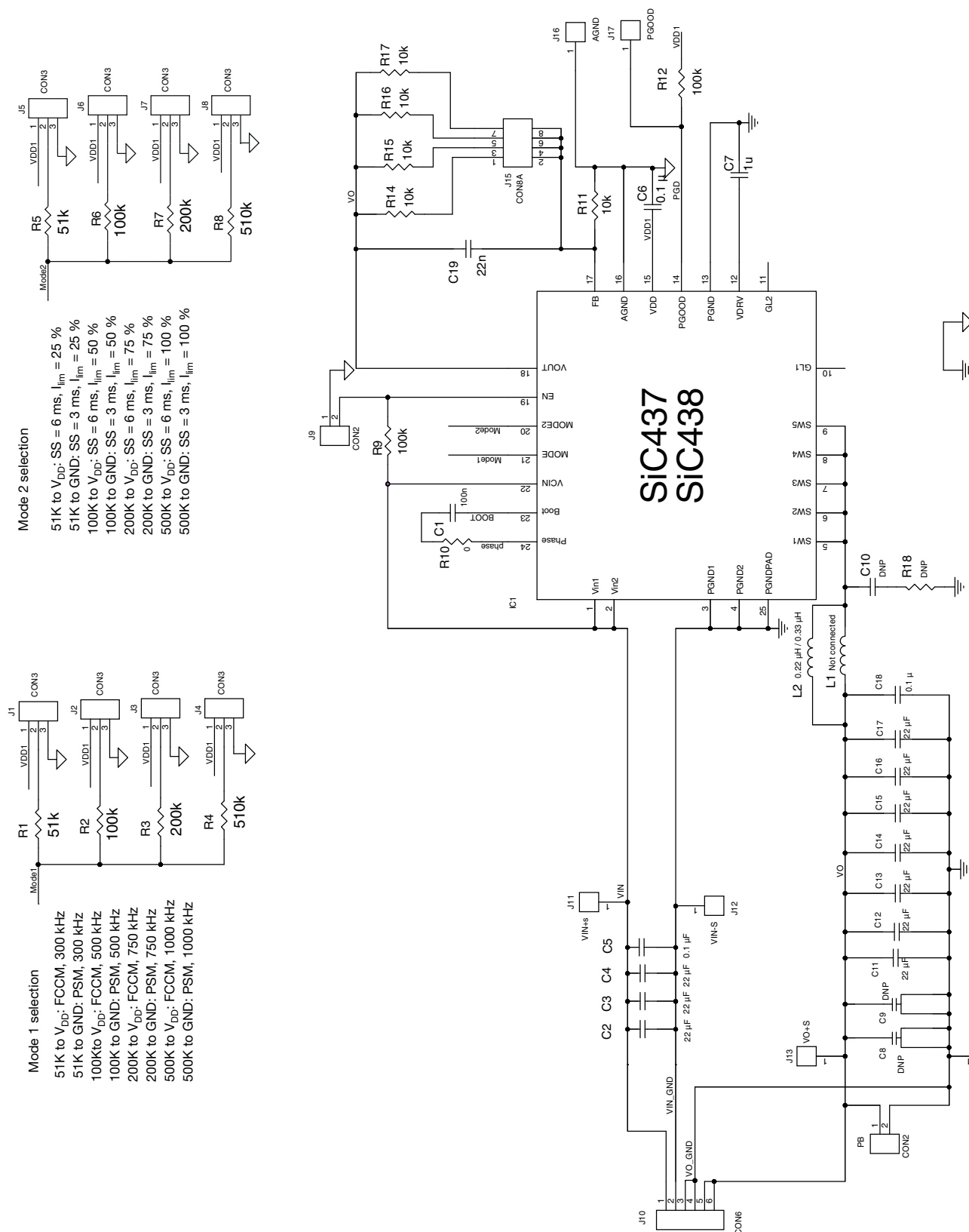
Power Up Procedure

Before turning on the reference board, the user needs to select one of the three modes by shorting one jumper (see section on mode selection). It is recommend to disable the SiC431 before making any changes to the jumpers.

SCHEMATIC FOR SiC431

Mode 2 selection

51K to V_DD: SS = 6 ms, I_lim = 25 %
51K to GND: SS = 3 ms, I_lim = 25 %
100K to V_DD: SS = 6 ms, I_lim = 50 %
100K to GND: SS = 3 ms, I_lim = 50 %
200K to V_DD: SS = 6 ms, I_lim = 75 %
200K to GND: SS = 3 ms, I_lim = 75 %
500K to V_DD: SS = 6 ms, I_lim = 100 %
500K to GND: SS = 3 ms, I_lim = 100 %

Mode 1 selection

51K to V_DD: FCCM, 300 kHz
51K to GND: PSM, 300 kHz
100K to V_DD: FCCM, 500 kHz
100K to GND: PSM, 500 kHz
200K to V_DD: FCCM, 750 kHz
200K to GND: PSM, 750 kHz
500K to V_DD: FCCM, 1000 kHz
500K to GND: PSM, 1000 kHz

SCHEMATIC FOR SiC437, SiC438

Mode 2 selection

51K to V_{DD}: SS = 6 ms, I_{lim} = 25 %
51K to GND: SS = 3 ms, I_{lim} = 25 %
100K to V_{DD}: SS = 6 ms, I_{lim} = 50 %
100K to GND: SS = 3 ms, I_{lim} = 50 %
200K to V_{DD}: SS = 6 ms, I_{lim} = 75 %
200K to GND: SS = 3 ms, I_{lim} = 75 %
500K to V_{DD}: SS = 6 ms, I_{lim} = 100 %
500K to GND: SS = 3 ms, I_{lim} = 100 %

Mode 1 selection

51K to V_{DD}: FCCM, 300 kHz
51K to GND: PSM, 300 kHz
100Kto V_{DD}: FCCM, 500 kHz
100K to GND: PSM, 500 kHz
200K to V_{DD}: FCCM, 750 kHz
200K to GND: PSM, 750 kHz
500K to V_{DD}: FCCM, 1000 kHz
500K to GND: PSM, 1000 kHz

SiC437
SiC438

SCHEMATIC, DESIGN, BILL OF MATERIALS, AND GERBER FILES FOR PCB FABRICATION

These files are as follows:

- "*.DSN" for schematic design file

- "*.DBK" for data backup file for Orcad

- ".opj" Orcad project file. Any schematic work should always be opened with the opj file. Use of a DSN file for this purpose is not advised

- "*.xlsx" is the bill of materials (BOM) derived from the schematic

- "*.PDF" is the PDF version of the schematic from the "*.DSN" file

The Fab files for the high power and low power are located in a separate sub directory and contain gerbers,.brd files (Allegro), etc. for PCB fabrication.

PCB LAYOUT FOR SiC431
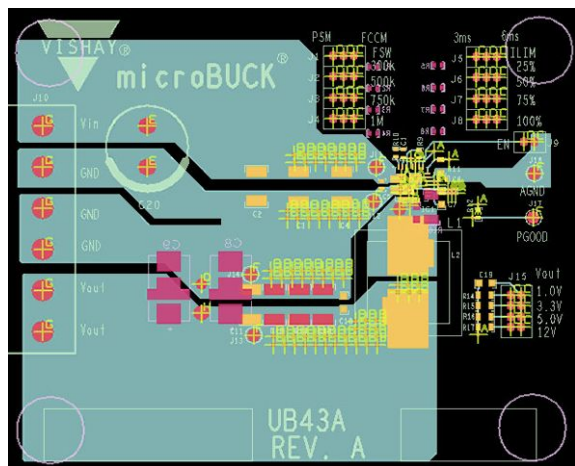
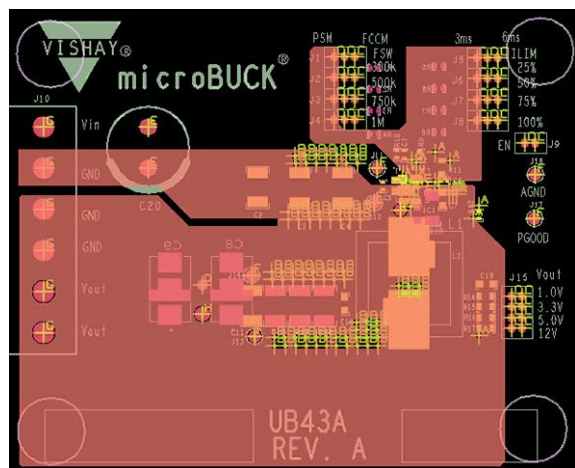
Fig. 2 - Top Layer
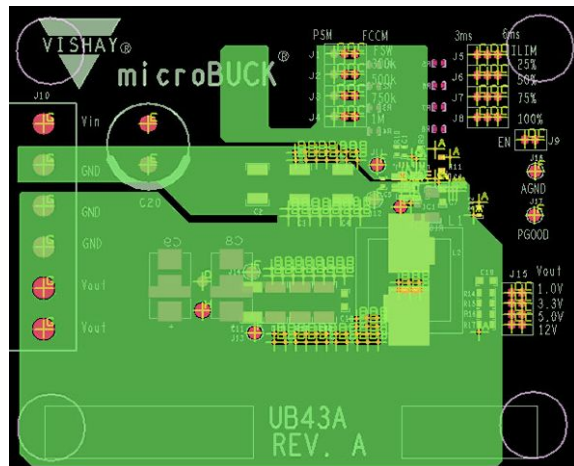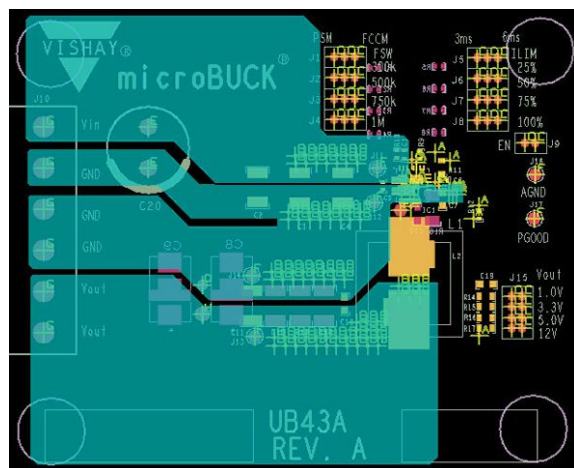

Fig. 5 - Inner Layer 4

Fig. 3 - Inner Layer 2

Fig. 6 - Inner Layer 5
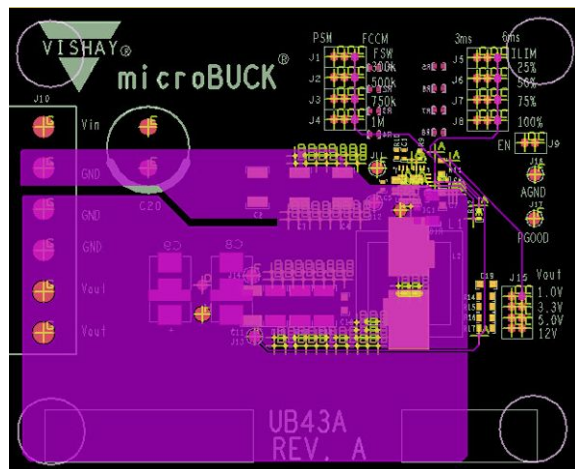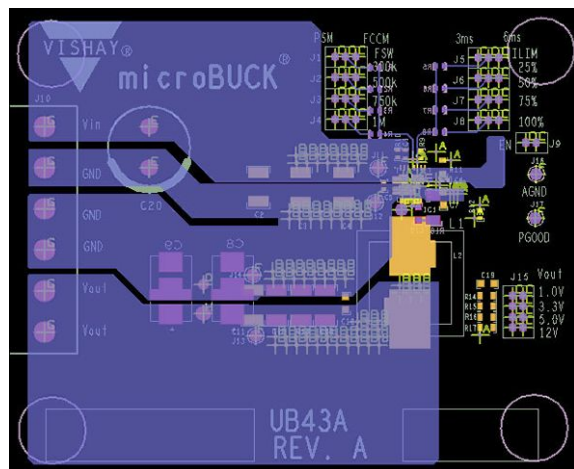

Fig. 4 - Inner Layer 3

Fig. 7 - Bottom Layer
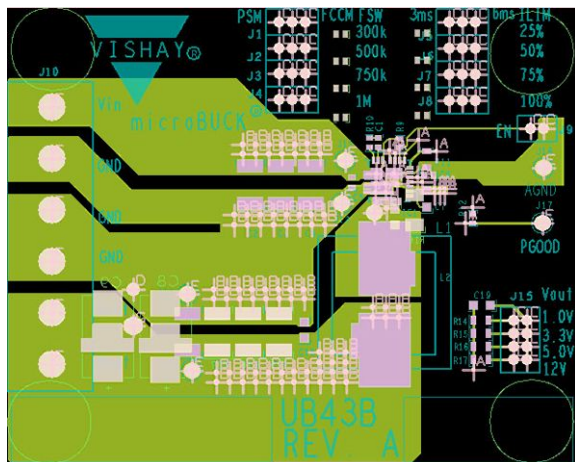
PCB LAYOUT FOR SiC437, SiC438
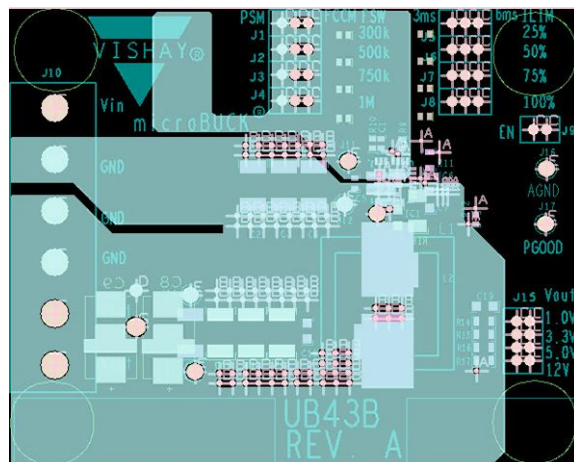

Fig. 8 - Top Layer

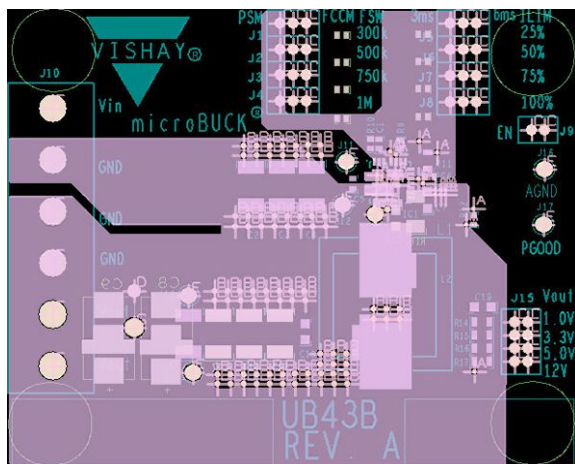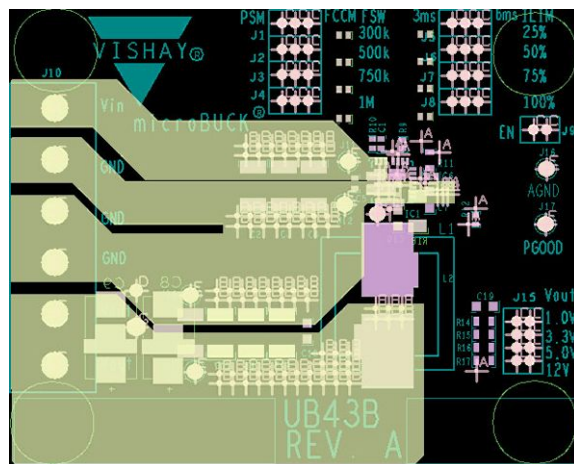Fig. 11 - Inner Layer 4
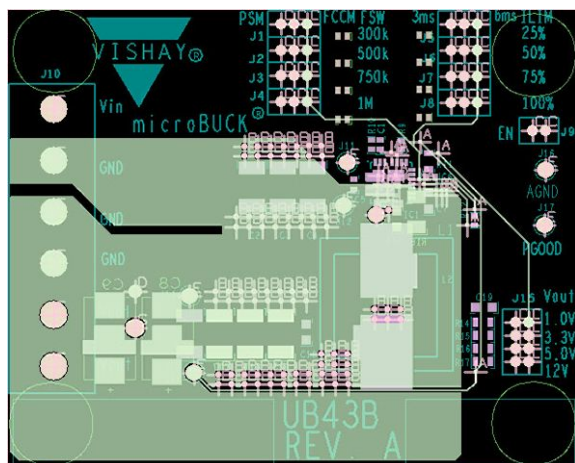

Fig. 9 - Inner Layer 2

Fig. 12 - Inner Layer 5
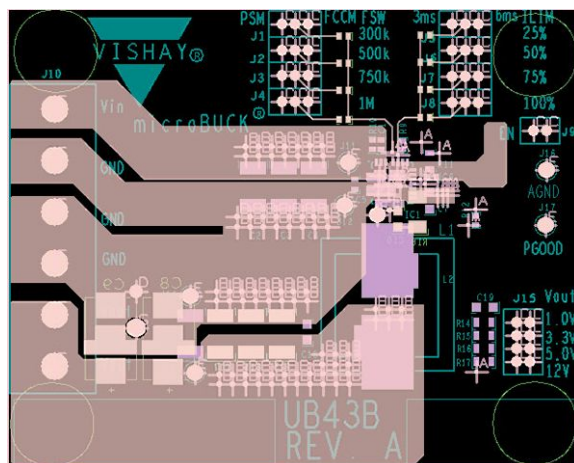

Fig. 10 - Inner Layer 3

Fig. 13 - Bottom Layer

BILL OF MATERIAL REPORT, SiC431

SYM_NAME	COMP_VALUE	REFDES	PART NUMBER
0402	0.1 µF	C1, C5, C6	GRM155R71H104ME14D
1210	22 µF	C2, C3, C4	CL32B226KAJNFNE
0603	1 µF	C7	GCM188R71E105KA64D
POSCAP	100 µF	C8, C9	20TQC100MYF
0603	DNP	C10	
1210	22 µF	C11, C12, C13, C14	CL32B226KAJNFNE
	DNP	C15, C16, C17	
0603	0.1 µF	C18	GCM188R71E104KA57D
CAP10P2x5	220 µF	C20	UBT1E221M
SiC431	SiC431	IC1	
MINIJUMPER3	CON3	J1, J2, J3, J4, J5, J6, J7, J8, J9	M50-3530342
CON6	CON6	J10	277-1581-ND
TP30	VIN+s	J11	36-5000-ND
TP30	VIN-S	J12	36-5001-ND
TP30	VO+S	J13	36-5000-ND
TP30	VO-S	J14	36-5001-ND
MINIJUMPER2x4	CON8A	J15	S9015E-04-ND
TP30	AGND	J16	36-5001-ND
TP30	PGOOD	J17	36-5002-ND
	DNP	L1	
IHLP	1 µH	L2	ZPWM-101014MA-1R0K
0402	51k	R1, R5	CRCW040251K0FKED
0402	100k	R2, R6, R9, R12	CRCW0402100KFKED
0402	200k	R3, R7	CRCW0402200KFKED
0402	510k	R4, R8	CRCW0402510KFKED
0402	0	R10	CRCW04020000Z0ED
0603	10k	R11	TNPW060310K0BXEN
0603	6.65k	R14	TNPW06036K65BEEA
0603	45.3k	R15	TNPW060345K3BEEA
0603	73.2k	R16	TNPW060373K2BEEA
0603	191k	R17	TNPW0603191KBEEA
1206	DNP	R18	
JUMPER		OFF BOARD x3	NPB02SVFN-RC

BILL OF MATERIAL REPORT, SiC437, SiC438			
SYM_NAME	COMP_VALUE	REFDES	PART NUMBER
0402	0.1 µF	C1, C5, C6	GRM155R71H104ME14D
1210	22 µF	C2, C3, C4	CL32B226KAJNFNE
0603	1 µF	C7	GCM188R71E105KA64D
POSCAP	100 µF	C8, C9	20TQC100MYF
0603	DNP	C10	
1210	22 µF	C13, C14	CL32B226KAJNFNE
	DNP	C11, C12, C15, C16, C17	
0603	0.1 µF	C18	GCM188R71E104KA57D
SiC437/8	SiC437/8	IC1	
MINIJUMPER3	CON3	J1, J2, J3, J4, J5, J6, J7, J8,J 9	M50-3530342
CON6	CON6	J10	277-1581-ND
TP30	VIN+s	J11	36-5000-ND
TP30	VIN-S	J12	36-5001-ND
TP30	VO+S	J13	36-5000-ND
TP30	VO-S	J14	36-5001-ND
MINIJUMPER2x4	CON8A	J15	S9015E-04-ND
TP30	AGND	J16	36-5001-ND
TP30	PGOOD	J17	36-5002-ND
	DNP	L1	
	DNP	L1	
IHLP	2.2 µH	L2 (for SiC437x)	IHLP4040DZER2R2M01
IHLP	3.3 µH	L2 (for SiC438x)	IHLP4040DZER3R3M5A
0402	51k	R1, R5	CRCW040251K0FKED
0402	100k	R2, R6, R9, R12	CRCW0402100KFKED
0402	200k	R3, R7	CRCW0402200KFKED
0402	510k	R4, R8	CRCW0402510KFKED
0402	0	R10	CRCW04020000Z0ED
0603	10k	R11	TNPW060310K0BXEN
0603	6.65k	R14	TNPW06036K65BEEA
0603	45.3k	R15	TNPW060345K3BEEA
0603	73.2k	R16	TNPW060373K2BEEA
0603	191k	R17	TNPW0603191KBEEA
1206	DNP	R18	
JUMPER		OFF BOARD x3	NPB02SVFN-RC

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