Using VTMs as 26 – 55 V Input Bus Converters

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Contents

Introduction

The VTM Current Mulitplier is a fundamental building block of Factorized Power Architecture (FPA). This new power conversion architecture separates the functions of the DC-DC converter – regulation, isolation, and transformation – into two building blocks. The PRM Regulator provides upstream regulation while the VTM provides isolation and transformation to the load (Fig. 1). Using the high switching frequency Sine Amplitude Conversion topology, the VTM is a very power dense module capable of delivering current to rapidly changing loads.

Wide Input Bus Conversion

Although the VTM was primarily designed to work with a PRM, it can also be used alone as a wide input BCM Bus Converter. The standard BCM has an input range of 38 – 55 Vdc. By using a VTM the input range can be 26 – 55 Vdc. When the VTM is used as a BCM, an initial Vcc pulse must be applied to the VTM control (VC) pin. The following circuit in Fig. 2 can be used to provide this VC pulse.

Figure 1
PRM / VTM connections

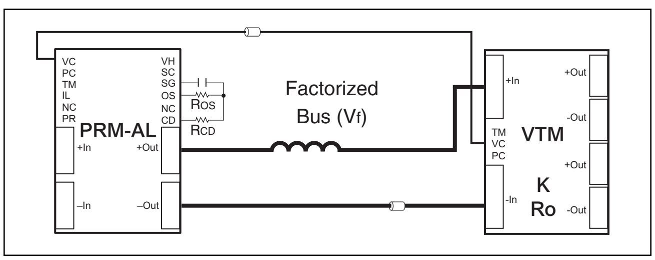
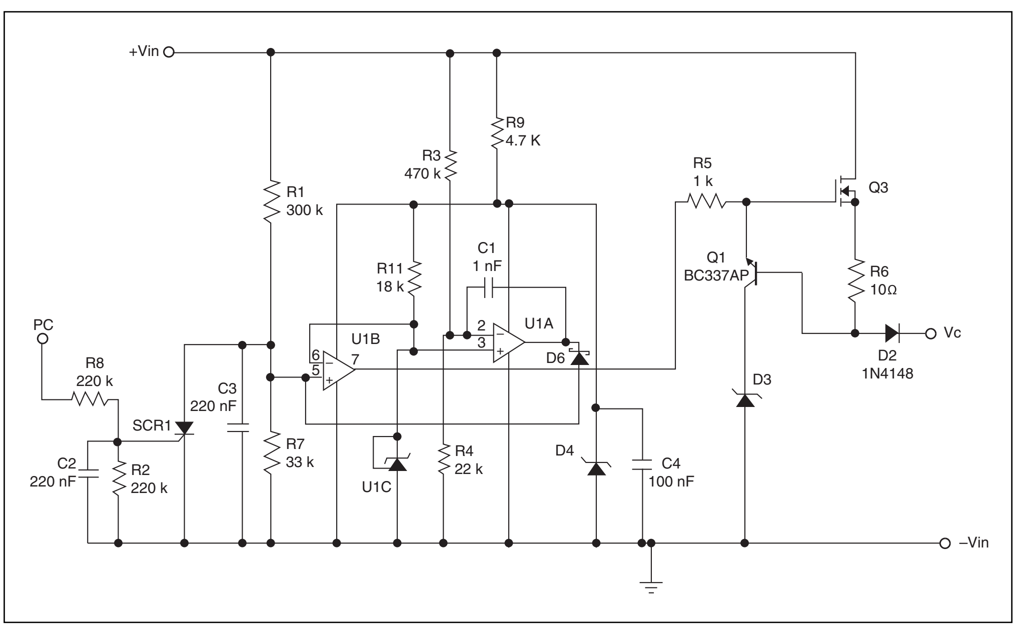


Figure 2
External VC circuit



This circuit is designed to provide a brief jump-start pulse of typically less than 10 ms through a series pass N-channel MOSFET. To ensure that this MOSFET does not provide pulses unnecessarily, a dual OP-Amp and bandgap reference U1 (TSM103W) checks whether the applied voltage to the VTM is within its operating range of 26 – 55 Vdc. If this is the case, a pulse is applied to the VC pin of the VTM until the PC signal goes high.

To ensure that the output has stabilized before the pulse is turned off, a time delay has been added. C2 is slowly charged through R8 until SCR1 turns on and switches off the output pulse via U1. Minimizing the pulse duration to the VTM helps reduce the size of MOSFET needed.

Please note that high load capacitance can activate the VTM Over Current Protection (OCP) circuit during start up. This can result in continuous pulsing to the VC port. Similar effects are also seen if overloaded. See Fig. 6 (overloaded VTM). Using the VTM as a stand-alone device allows the designer to take advantage of the converter's high efficiency, power density, and rapid transient response when operated from a regulated source. It also provides a wider input range over the standard Bus Converter Module's pulse width.

Bill of Materials

Circuit Ref.	Part Number	Description & Notes
U1	TSM103WID	ST Dual OP-Amp & bandgap reference. SMD SO-8
SCR1	P0102BL	ST Thyristor SMD SOT-23
Q3	IRLL110/BSS123	N-Channel enhancement mode MOSFET SMD SOT-223/SOT-23
Q1	BC817	NPN Transistor BC337 equivalent SMD SOT-23
D2	BAV70	Diode SMD SOT-23 (1N4148 equivalent)
D3	BZX84C15	Zener diode 15 V 300 mW or greater SMD SOT-23
D4	BZX84C24	Zener diode 24 V 300 mW or greater SMD SOT-23
D6	BAT54	Schottky barrier diode SMD SOT-23
C1	1n	Capacitor ceramic X7R or better
C2	220n	Capacitor ceramic X7R or better
C3	220n	Capacitor ceramic X7R or better
C4	100n	Capacitor ceramic X7R or better
R1	300k	Resistor 0.125 W or greater. SMD 0805 (100 V rated)
R2	220K	Resistor 0.0625 W or greater. SMD 0603
R3	470K	Resistor 0.125 W or greater. SMD 0805 (100 V rated)
R4	22K	Resistor 0.0625 W or greater. SMD 0603
R5	1K	Resistor 0.125 W or greater. SMD 0805
R6	10R	Resistor 0.125 W or greater. SMD 0805
R7	33K	Resistor 0.0625 W or greater. SMD 0603
R8	220K	Resistor 0.0625 W or greater. SMD 0603
R9	4.7K	Resistor 0.5 W rated or greater.
R11	18K	Resistor 0.125 W or greater. SMD 0805

Operating Waveforms

Figures 3 through 6 show scope plots of VC pulse as tested with a V048F160T015.

Figure 3
Vin = 48 Vdc
VC pulse versus Vout
at turn-on

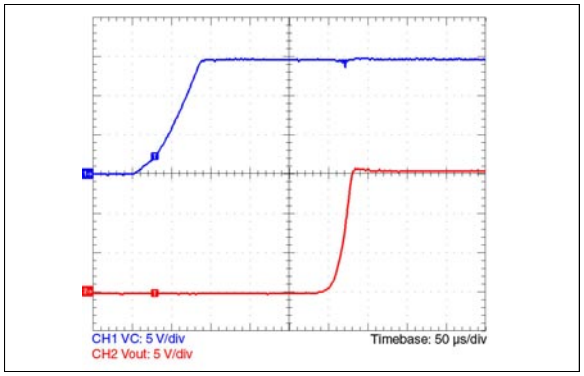


Figure 4
Vin = 48 Vdc
VC pulse versus PC
at turn-on

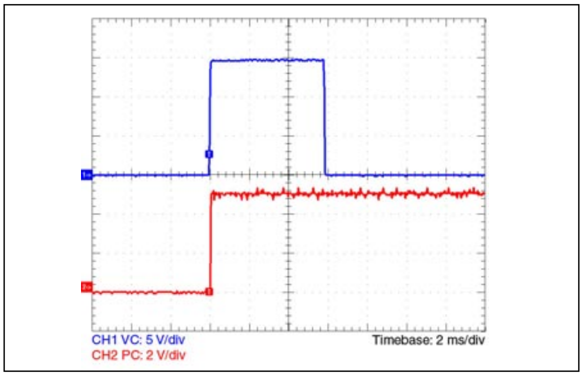


Figure 5
Vin = 48 Vdc
VC pulse versus
VC current

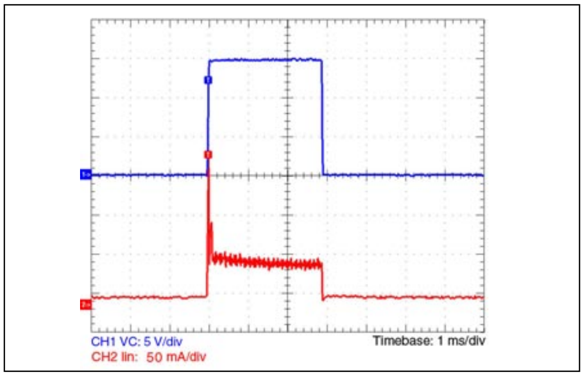


Figure 6
Vin = 48 Vdc; Iout = 15 A
VC pulse during fault
condition versus
VC current