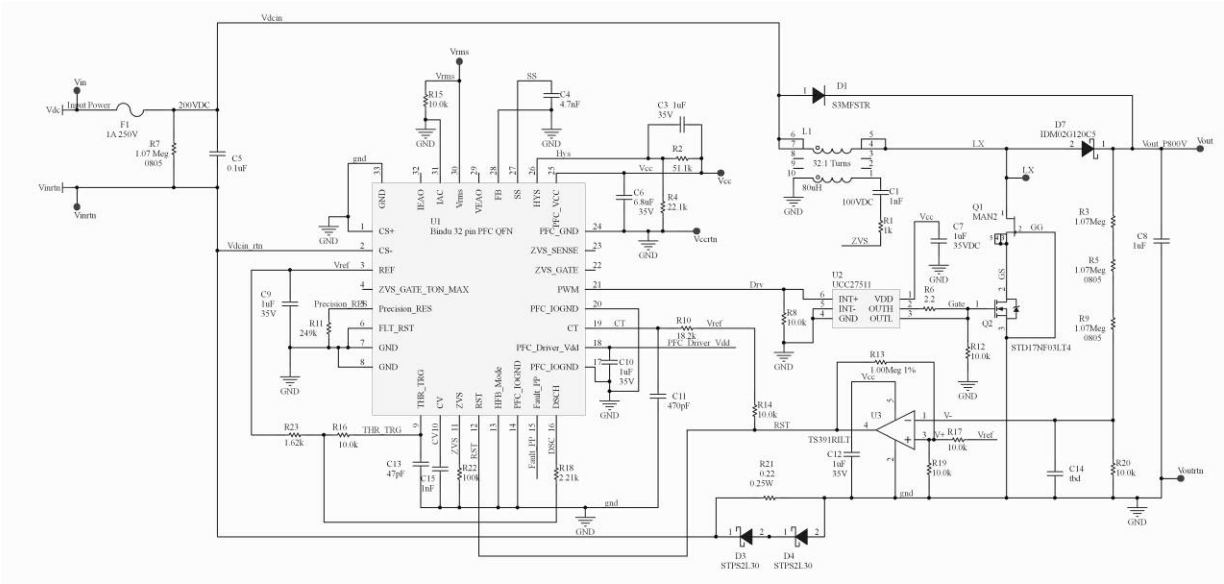
NEXGEN POWER SYSTEMS

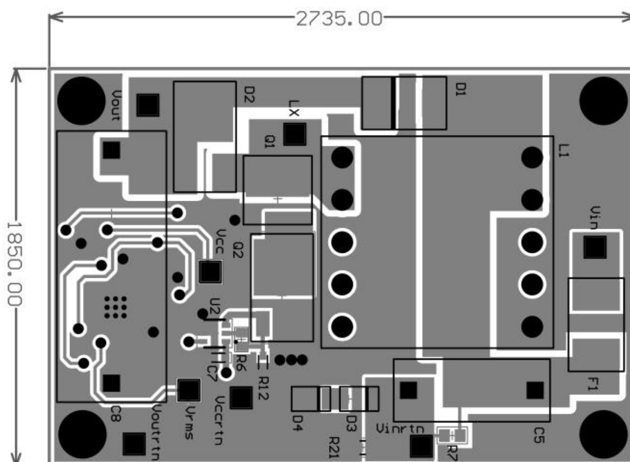
NexGen PN Vertical GaN™ Diode
Replaces High Voltage 1200V SiC Diode in 1MHz, 800V Boost Application

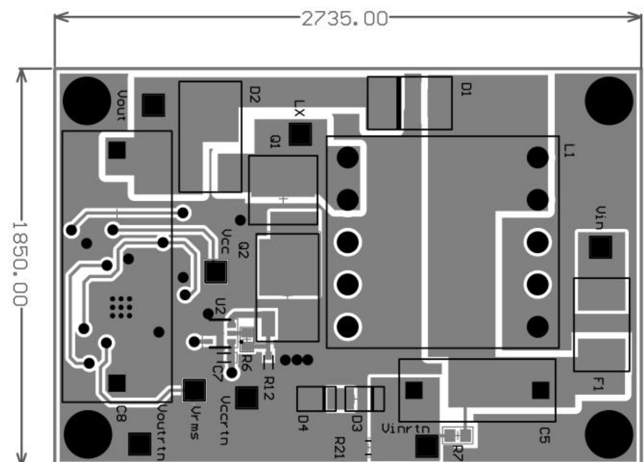
Introduction

This paper summarizes the evaluation of a 1200V, 20A NexGen GaN diode in NexGen's 200V to 800V boost demonstration board switching at 1MHz. Performance was compared to a reference implementation with a 2A 1200V SiC diode from Infineon, part number IDM02G120C5, boost diode D7 in figure 1.

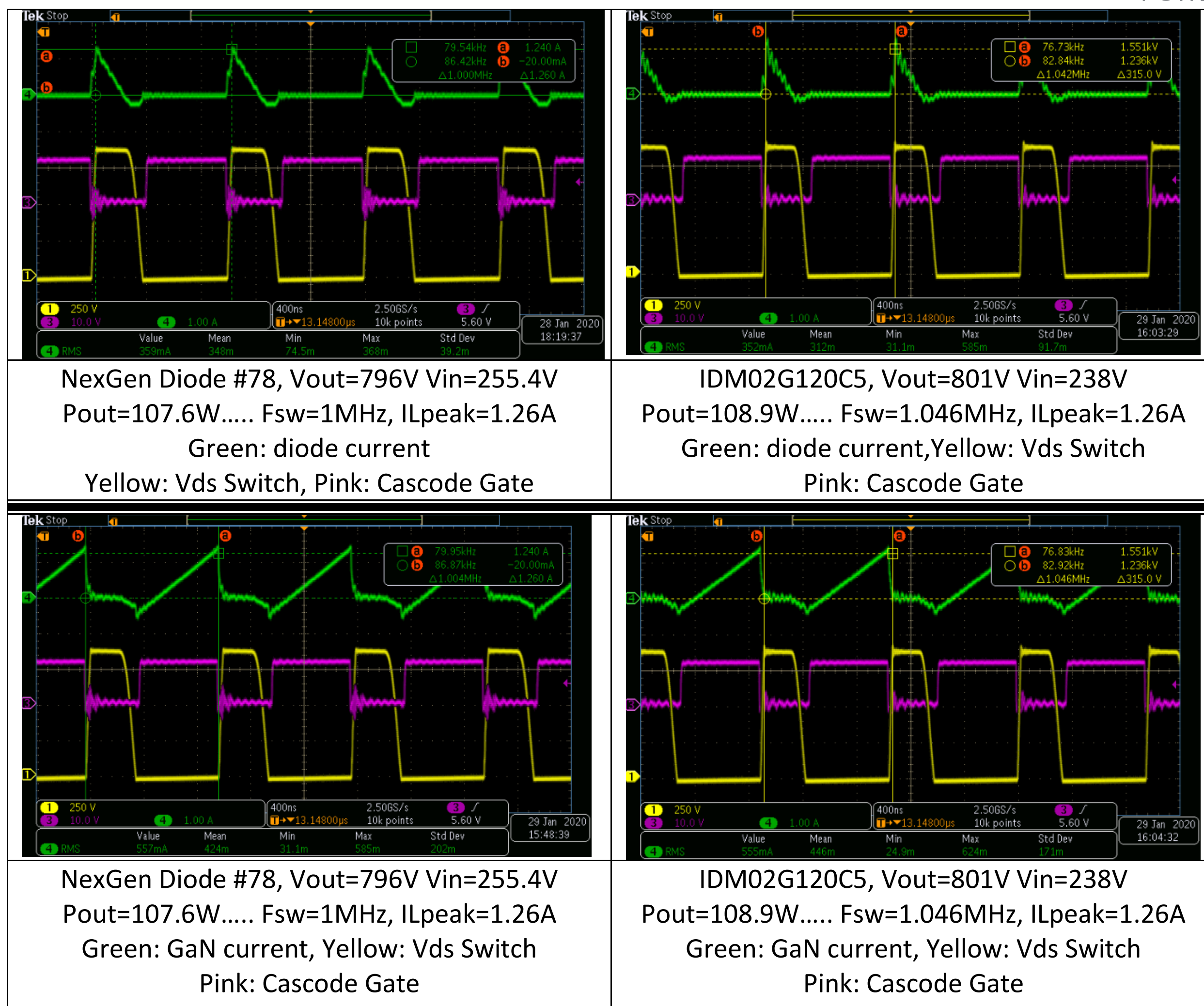
Efficiency was virtually identical with a softer forward conduction and less ringing with the NexGen device. Figure 3 waveforms include the switch node and the transistor and diode currents for the converter with both the Infineon SiC Schottky Diode and the NexGen's GaN PN diode.







© Copyright 2020 NexGen Power Systems Inc. | Proprietary and Confidential



NexGen Diode #78, Vout=796V Vin=255.4V
Pout=107.6W….. Fsw=1MHz, ILpeak=1.26A
Green: diode current
Yellow: Vds Switch, Pink: Cascode Gate

IDM02G120C5, Vout=801V Vin=238V
Pout=108.9W….. Fsw=1.046MHz, ILpeak=1.26A
Green: diode current,Yellow: Vds Switch
Pink: Cascode Gate

NexGen Diode #78, Vout=796V Vin=255.4V
Pout=107.6W….. Fsw=1MHz, ILpeak=1.26A
Green: GaN current, Yellow: Vds Switch
Pink: Cascode Gate

IDM02G120C5, Vout=801V Vin=238V
Pout=108.9W….. Fsw=1.046MHz, ILpeak=1.26A
Green: GaN current, Yellow: Vds Switch
Pink: Cascode Gate

Figure 3. Waveforms.

Device	Vin (V)	Iin (mA)	Vout (V)	Iout (mA)	Pin (W)	Pout (W)	Ploss (W)	n (%)
Nexgen #A78	100	154	295	49.8	15.4	14.7	0.7	95.4
Nexgen #A78	150	244	455	77.3	36.6	35.2	1.4	96.1
Nexgen #A78	200	336	615	104.5	67.2	64.3	2.9	95.6
Nexgen #A78	238.4	407	740	125.6	97.0	92.9	4.1	95.8
Nexgen #A78	255.4	440	796	135.2	112.4	107.6	4.8	95.8
IDM02G120C5	238	477	801	136	113.5	108.9	4.6	96.0

Table 1. Efficiency Table

© Copyright 2020 NexGen Power Systems Inc. | Proprietary and Confidential

IDM02G120C5

5th Generation thinQ!™ 1200 V SiC Schottky Diode

Electrical Characteristics, at T_j=25°C, unless otherwise specified

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
Static Characteristic						
DC blocking voltage	V_{DC}	T_j = 25°C	1200	-	-	V
Diode forward voltage	V_F	I_F= 2 A, T_j=25°C I_F= 2 A, T_j=150°C	- -	1.4 1.7	1.65 2.30	V
Reverse current	I_R	V_R=1200 V, T_j=25°C V_R=1200 V, T_j=150°C		1.2 6	18 90	µA

AC Characteristics, at T_j=25°C, unless otherwise specified

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
Dynamic Characteristics						
Total capacitive charge	Q_C	V_R = 800 V, T_j=150°C $Q_C = \int_0^{V_R} C(V)dV$	-	14	-	nC
Total Capacitance	C	V_R=1 V, f=1 MHz V_R=400 V, f=1 MHz V_R=800 V, f=1 MHz	- - -	182 13 10	- - -	pF

Summary

No significant performance difference between the two implementations could be observed, despite NexGen’s GaN PN diode being designed to handle up to 20A current, compared to 2A of the SiC reference device. This is attributed to the smaller intrinsic capacitances and capacitive charges of the GaN diode.
Additionally, the implementation variant using NexGen’s Vertical GaN™ PN diode shows a noticeable cleaner current waveforms with points to a softer forward recovery with the GaN PN diode.
The performance achieved with a 1200V, 20A Vertical GaN™ PN diode prototype as a boost diode in a 200V to 800V, 100W converter demonstrates the viability and performance benefits of Vertical GaN™ PN diodes which opens the path to alternatives for the current dominance of high voltage SiC Diodes.

Encouraged by these promising results, testing with other Vertical GaN™ PN diode configurations in other applications with higher switching frequency will continue and performance will be compared to implementations using SiC diodes. Additional application notes will be published as new data is becoming available.

© Copyright 2020 NexGen Power Systems Inc. | Proprietary and Confidential