



NMSD200B01

200 mA SYNCHRONOUS RECTIFIER FEATURING N-MOSFET AND SCHOTTKY DIODE

General Description

 NMSD200B01 is best suited for switching voltage regulator and power management applications. It improves efficiency and reliability of DC-DC controllers used in Voltage Regulator Modules (VRM) and can support continuous maximum current of 200mA. It features an ESD protected discrete N-MOSFET with low on-resistance and a discrete Schottky diode with low forward drop. It reduces component count, consumes less space and minimizes parasitic losses. The component devices can be used as a part of a circuit or as a stand alone discrete device.

Features

- N-MOSFET with ESD Gate Protection
- N-MOSFET with Low On-Resistance (R_{DS(ON)})
- Low V_f Schottky Diode
- Low Static, Switching and Conduction Losses
- Good Dynamic Performance
- Surface Mount Package Suited for Automated Assembly
- Lead Free By Design/RoHS Compliant (Note 1)
- "Green" Device (Note 2)

Mechanical Data

- Case: SOT-363
- Case Material: Molded Plastic. "Green Molding" Compound. UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020D
- Terminal Connections: See Diagram
- Terminals: Finish Matte Tin annealed over Alloy 42 leadframe. Solderable per MIL-STD-202, Method 208
- Marking & Type Code Information: See Page 7
- Ordering Information: See Last Page
- Weight: 0.006 grams (approximate)



Fig 1. SOT-363



Fig 2. Schematic and Pin Configuration

Sub-Components	Reference	Device Type	Figure
DMN601K_DIE (ESD Protected)	Q1	N-MOSFET	2
SD103AWS_DIE	D1	Schottky Diode	2

Maximum Ratings, Total Device @T_A = 25°C unless otherwise specified

	F	-	
Characteristic	Symbol	Value	Unit
Power Dissipation (Note 3)	Pd	200	mW
Power Derating Factor above 25 °C	P _{der}	1.6	mW/°C
Output Current	l _{out}	200	mA

Thermal Characteristics

Characteristic	Symbol	Value	Unit
Junction Operation and Storage Temperature Range	T _j , T _{stg}	-55 to +150	°C
Thermal Resistance, Junction to Ambient Air (Note 3) (Equivalent to one heated junction of N-MOSFET)	$R_{ ext{ heta}JA}$	625	°C/W

Notes: 1. No purposefully added lead.

2. Diodes Inc.'s "Green" policy can be found on our website at http://www.diodes.com/products/lead_free/index.php.

3. Device mounted on FR-4 PCB, 1 inch x 0.85 inch x 0.062 inch; pad layout as shown on Diodes Inc. suggested pad layout document AP02001, which can be found on our website at http://www.diodes.com/datasheets/ap02001.pdf.



Maximum Ratings: @T_A = 25°C unless otherwise specified Sub-Component Device: ESD Protected N-Channel MOSFET (Q1)

Chara	acteristic	Symbol	Value	Unit
Drain Source Voltage		V _{DSS}	60	V
Drain Gate Voltage (RGS <+ 1MO	hm)	V _{DGR}	60	V
Gate Source Voltage	Continuous	N/	+/-20	V
-	Pulsed (tp<50 uS)	V _{GSS}	+/-40	v
Drain Current (Page 1: Note 3)	Continuous (V _{gs} =10V)		200	
(b	Pulsed (tp<10uS, Duty Cycle<1%)	ID	800	mA
Continuous Source Current		I _S	200	mA

Sub-Component Device: Schottky Diode (D1) @TA = 25°C unless otherwise specified

Characteristic	Symbol	Value	Unit
Peak Repetitive Reverse Voltage	V _{RRM}		
Working Peak Reverse Voltage	V _{RWM}	40	V
DC Blocking Voltage	VR		
RMS Reverse Voltage	V _{R(RMS)}	28	V
Forward Continuous Current (Page 1: Note 3)	I _{FM}	350	mA
Non-Repetitive Peak Forward Surge Current @ t<1.0 s	I _{FSM}	1.5	A

Electrical Characteristics: ESD Protected N-Channel MOSFET (Q1) @T_A = 25°C unless otherwise specified

Characteristic	Symbol	Min	Тур	Max	Unit	Test Condition
OFF CHARACTERISTICS (Note 4)						
Drain-Source Breakdown Voltage, BV _{DSS}	V _{BR(DSS)}	60		—	V	$V_{GS} = 0V, I_D = 10\mu A$
Zero Gate Voltage Drain Current (Drain Leakage Current)	I _{DSS}	_	_	1	μΑ	$V_{GS} = 0V, V_{DS} = 60V$
Gate Body Leakage Current, Forward	IGSSF	_	_	10	μΑ	$V_{GS} = 20V, V_{DS} = 0V$
Gate Body Leakage Current, Reverse	I _{GSSR}	_	—	-10	μΑ	$V_{GS} = -20 V, V_{DS} = 0V$
ON CHARACTERISTICS (Note 4)						
Gate Source Threshold Voltage (Control Supply Voltage)	Veews	1	1.6	2.5	V	$V_{DS} = V_{GS} = 10V, I_{D} = 0.25mA$
Gale Source Threshold Voltage (Control Supply Voltage)	V _{GS(th)}	1.1	1.8	3	V	$V_{DS} = V_{GS} = 10V, I_{D} = 1mA$
Static Drain-Source On-State Voltage	N/	_	0.09	1.5	V	$V_{GS} = 5V, I_{D} = 50mA$
Static Drain-Source On-State Voltage	V _{DS(on)}	_	0.62	1.25	V	$V_{GS} = 10V, I_D = 500mA$
On-State Drain Current	I _{D(on)}	500	_	_	mA	$V_{GS} = 10V, V_{DS} > = 2^*V_{DS(ON)}$
Static Drain-Source On Resistance	R _{DS (on)}		1.6	3	0	$V_{GS} = 5V, I_{D} = 50mA$
Static Drain-Source On Resistance			1.25	2	Ω	$V_{GS} = 10V, I_D = 500mA$
Forward Transconductance	g fs	80	260	_	mS	$V_{DS} \ge 2^* V_{DS(ON)}$, ID=200mA
Dynamic Characteristics						
Input Capacitance	Ciss	—	—	50	pF	
Output Capacitance	Coss	—	—	25	pF	V _{DS} = 25V, V _{GS} = 0V, f = 1MHz
Reverse Transfer Capacitance	C _{rss}	_	_	5	pF	
Switching Characteristics	• •					
Turn-On Delay Time	t _{d(on)}	_	_	20	ns	
Turn-Off Delay Time	t _{d(off)}	_		40	ns	
Drain-Source (Body) Diode Characteristics and Maximum	Ratings					
Drain-Source Diode Forward On-Voltage	V _{SD}		0.88	1.5	V	$V_{GS} = 0V, I_S = 300 \text{ mA}^*$
Maximum Continuous Drain-Source Diode Forward Current (Reverse Drain Current)	I _S	_	_	300	mA	_
Maximum Pulsed Drain-Source Diode Forward Current	I _{SM}		—	800	mA	<u> </u>

Electrical Characteristics: Schottky Barrier Diode (D1) @T_A = 25°C unless otherwise specified

Characteristic	Symbol	Min	Тур	Max	Unit	Test Condition
Reverse Breakdown Voltage (Note 4)	V _{(BR)R}	40			V	$I_R = 10 \mu A$
Forward Valtage Drop (Note 4)			—	0.37	V	I _F =20mA
Forward Voltage Drop (Note 4)	V _{FM}			0.6	v	I _F =200mA
Peak Reverse Current (Note 4)	I _{RM}		_	5	μA	$V_R = 30V$
Total Capacitance	CT		28		pF	$V_{R} = 0V, f = 1.0 \text{ MHz}$
Reverse Recovery Time	t _{rr}		10		ns	$I_{F}=I_{R}=200 \text{ mA}, I_{rr}=0.1 \text{x}I_{R}, R_{L}=100 \Omega$

Notes: 4. Short duration pulse test used to minimize self-heating effect.



Typical Characteristics



Typical N-Channel MOSFET-Q1 (ESD Protected) Characteristics



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Fig. 12 Reverse Drain Current vs. Body Diode Forward Voltage



V_{GS}, GATE SOURCE VOLTAGE (V) Fig. 9 Static Drain-Source On-Resistance vs. Gate-Source Voltage



Fig. 11 Reverse Drain Current vs. Source-Drain Voltage





Schottky Barrier Diode – D1 Characteristics







Application Details

ESD Protected N-MOSFET (DMN601K) and Schottky Barrier Diode (SD103AWS) integrated as one in NMSD200B01 can be used as a discrete entity for general applications or part of circuits to function as a low side switch in a Synchronous Rectifier. The N-MOSFET is selected based on the input voltage range as the maximum duty cycles can be greater than 45%. Schottky diode is selected based on instantaneous Vf (less than 0.75 V) at maximum operation current. The Schottky diode dissipates very little power because it is on for only a small portion of the switching cycle. Normally it shows much lower leakage current and smaller on-resistance (R_{DS(ON)}) even compared to its monolithic counterpart. This device is designed to improve efficiency and reliability of synchronous buck converters used in voltage regulator modules (VRM). The lower V_f of the Schottky diode leads to lower static loss. Every time the high side MOSFET is turned on in the buck converter. the low side Schottky diode is forced to recover the stored charge and there will be lower loss due to the lower Reverse Recovery charge of the Schottky diode.

It is designed to replace a discrete N-MOSFET and a Schottky diode in two separate packages into one small package as shown in Fig. 17. The Schottky diode parallel to the MOSFET body diode is faster and has lower voltage drop compared to the integrated body diode. Overall this device consumes less board space and also helps to minimize conduction or switching losses due to parasitic inductances (e.g. PCB traces) in power supply applications. (Please see Fig. 18 for one example of typical application circuit used in conjunction with DC-DC converter as a part of power management system and Fig. 19 for low side DC load control.)





Typical Application Circuits



Fig. 18 Synchronous Buck Converter with Integrated Schottky Diode





(Comparator with Hysteresis)

Fig. 19 Low Side DC Load Control

Ordering Information (Note 5)

Device	Marking Code	Packaging	Shipping
NMSD200B01-7	SR1	SOT-363	3000/Tape & Reel

Notes: 5. For Packaging Details, go to our website at http://www.diodes.com/datasheets/ap02007.pdf.

Marking Information



SR1 = Product Type Marking Code, YM = Date Code Marking Y = Year, e.g., T = 2006 M = Month, e.g., 9 = September

Date Code Key

Year	200	6	2007		2008	20	09	2010		2011	2	2012
Code	Т		U		V	V	V	Х		Y		Z
Month	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Code	1	2	3	4	5	6	7	8	9	0	Ν	D



Mechanical Details



	SOT-363	
Dim	Min	Max
Α	0.10	0.30
В	1.15	1.35
С	2.00	2.20
D	0.65 No	ominal
F	0.30	0.40
н	1.80	2.20
J		0.10
K	0.90	1.00
L	0.25	0.40
М	0.10	0.25
α	0°	8°
All Di	mensions	in mm

Suggested Pad Layout: (Based on IPC-SM-782)



Fig. 22

Figure 22 Dimensions	SOT-363*
Z	2.5
G	1.3
Х	0.42
Y	0.6
С	1.9
E	0.65
*Typical dimens	sions in mm

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