DATA SHEET
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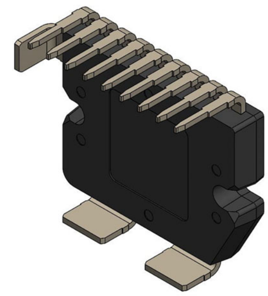
Single Phase Inverter Automotive Power MOSFET Module

NXV08A170DB2



APM12−CBA
CASE MODBG

Features

- Half Bridge Inverter for Variable Speed Motor Drive
- Current Sensing and Temperature Sensing
- Electrically Isolated DBC Substrate for Low Thermal Resistance
- Compact Design for Low Total Module Resistance
- Module Serialization for Full Traceability
- C Snubber for Low EMI
- AQG324 Qualified
- PPAP Capable
- This Device is Pb−free, RoHS and UL94−V0 Compliant

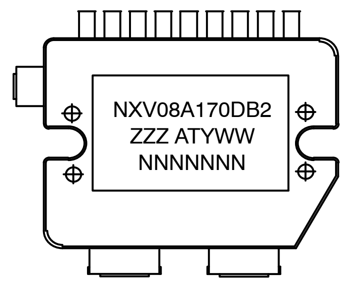
Applications

- 48 V Motor Control

Benefits

- Enable Design of Small, Efficient and Reliable System for Reduced Vehicle Fuel Consumption and CO_2 Emission
- Enable Low Thermal Resistance
- Simplified Vehicle Assembly

MARKING DIAGRAM



NXV08A170DB2	= Specific Device Code
ZZZ	= Lot ID
AT	= Assembly & Test Location
Y	= Year
WW	= Work Week
NNN	= Serial Number

ORDERING INFORMATION

See detailed ordering and shipping information on page 10 of this data sheet.

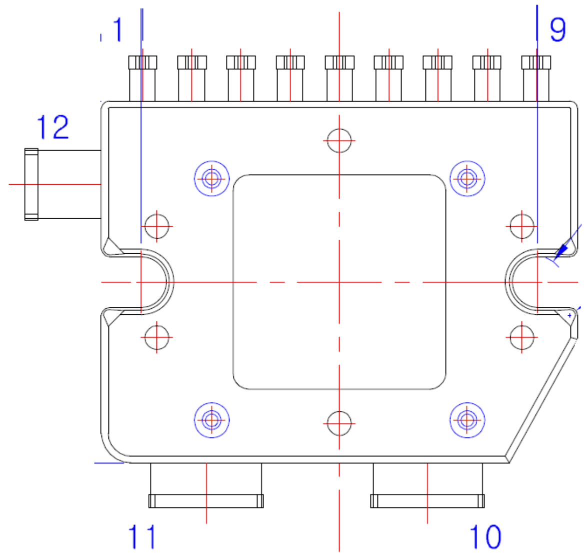


Figure 1. Pin Configuration

PIN DESCRIPTION

Pin Number	Pin Name	Pin Description
1	Q2LG	Low side MOSFET (Q2) Gate
2	Q2LS	Low side MOSFET (Q2) source sense
3	NTC+	Thermistor 1
4	NTC−	Thermistor 2
5	Shunt N	Shunt N
6	Shunt P	Shunt P
7	Q1HS	High side MOSFET (Q1) source sense
8	VLINK	B+ Sense
9	Q1HG	High side MOSFET (Q1) Gate
10	B+	B+ connection
11	GND	GND connection
12	POUT	Phase connection

Block Diagram

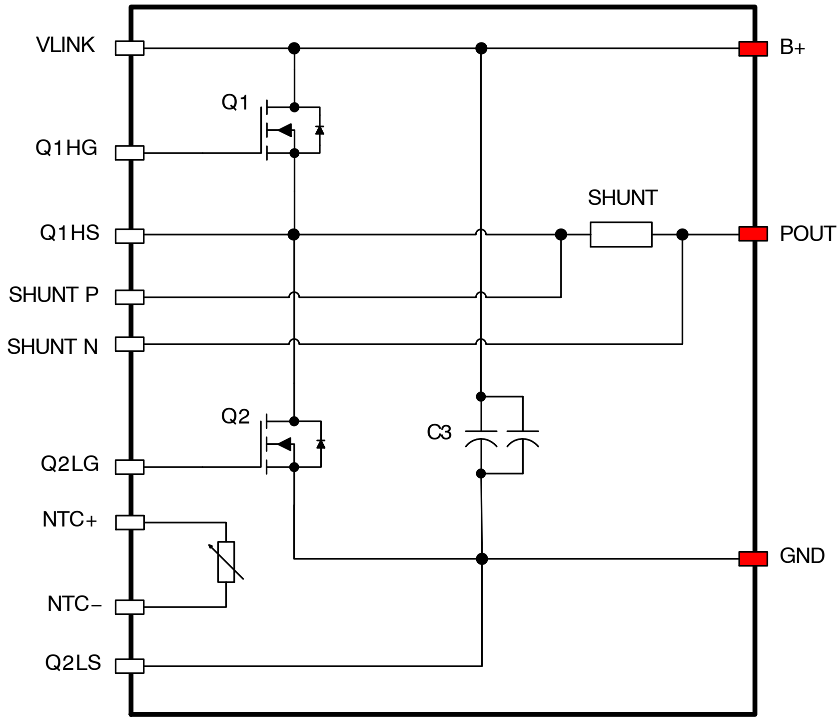


Figure 2. Schematic

Flammability Information

All materials present in the power module meet UL flammability rating class 94V−0.

Compliance to RoHS Directives

The power module is 100% lead free and RoHS compliant 2000/53/C directive.

Solder

Solder used is a lead free SnAgCu alloy.

ABSOLUTE MAXIMUM RATINGS (T_J = 25°C unless otherwise noted)

Symbol	Parameter	Value	Unit
V_{DS}	Drain to Source Voltage	80	V
V_{GS}	Gate to Source Voltage	±20	V
I_D	Drain Current Continuous (Note 1)	200	A
E_{AS}	Single Pulse Avalanche Energy (Note 2)	685	mJ
$T_{J(max)}$	Maximum Junction Temperature	175	°C
T_{STG}	Storage Temperature Range	−40 ~ +125	°C
V_{ISO}	Isolation Voltage	2000	Vrms

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Defined by design, not subject to production testing. The value is the result of the calculation, Min (package limit max current, Silicon limit max current) where the silicon limit current is calculated based on the maximum value which is not to exceed T_J = 175°C on maximum thermal limitation and on resistance.
2. Starting T_J = 25°C, L = 0.47 mH, I_{AS} = 54 A, V_{DD} = 80 V during inductor charging and V_{DD} = 0 V during time in avalanche.

THERMAL CHARACTERISTICS

Symbol	Parameter	Min	Typ	Max	Unit
$R_{\theta JC}$	Thermal Resistance, Junction−to−Case (Note 3)	−	−	0.82	K/W

3. Test method compliant with MIL−STD−883−1012.1, case temperature measured below the package at the chip center. Cosmetic oxidation and discolor on the DBC surface is allowed.

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted)

Parameters	Test Conditions	Symbol	Min	Typ	Max	Unit
Drain−to−Source Breakdown Voltage	I_D = 250 μA, V_{GS} = 0 V	B_{VDSS}	80	−	−	V
Drain−to−Source Leakage Current	V_{DS} = 80 V, V_{GS} = 0 V	I_{DSS}	−	−	1	μA
Gate−to−Source Leakage Current	V_{GS} = ±20 V	I_{GSS}	−	−	±100	nA
Gate−to−Source Threshold Voltage	V_{GS} = V_{DS}, I_D = 250 μA	$V_{GS(th)}$	2.0	−	4.0	V
Body Diode Forward Voltage of MOSFET	I_{SD} = 80 A, V_{GS} = 0 V	V_{SD}	−	0.8	1.2	V
Drain−to−Source On Resistance, Q1	I_D = 80 A, V_{GS} = 10 V (Note 4)	$R_{DS(ON)Q1}$	−	0.66	0.99	mΩ
Drain−to−Source On Resistance, Q2		$R_{DS(ON)Q2}$	−	0.90	1.35	mΩ
Drain−to−Source On Resistance, Module Level Q1		$R_{DS(ON)\ Module\ Q1}$	−	1.75	2.40	mΩ
Drain−to−Source On Resistance, Module Level Q2		$R_{DS(ON)\ Module\ Q2}$	−	1.75	2.40	mΩ

4. All bare die MOSFETs have same die size and same level of $R_{DS(ON)}$ value. However the different $R_{DS(ON)}$ values listed in the datasheet are due to the different access points available inside the module for $R_{DS(ON)}$ measurement. Q1 (High side FET) has shorter $R_{DS(ON)}$ measurement path in the layout, in this reason, $R_{DS(ON)}$ value of Q1 can be used for simple power loss calculation.

Resistance Measurements Methods

MOSFET MEASUREMENTS

	+ Force	− Force	+ Sense	− Sense		+ Force	− Force	+ Sense	− Sense
Q1	B+	Phase	Vlink	Q1 Sorce	Q2	Phase	GND	Q1 Source	Q2 Source
PIN#	9	11	8	5	PIN#	11	10	5	2

MODULE PATH MEASUREMENTS

	+ Force	− Force	+ Sense	− Sense		+ Force	− Force	+ Sense	− Sense
Q1	B+	Phase	B+	Phase	Q2	Phase	GND	Phase	GND
PIN#	9	11	9	11	PIN#	11	10	11	10

CURRENT SENSE RESISTOR

Symbol	Parameter	Min	Typ	Max	Unit
R_{SHUNT}	Current Sense Resistor, Id = 80 A (Note 5)	0.293	0.304	0.317	mΩ

5. Except resistance value, all the other characteristic is guaranteed by supplier.

COMPONENTS

Component	Specification	Quantity	Type
MOSFET	80 V Bare die reference discrete part, FDBL86361_F085	2	Bare Die
Current Sense Resistor	0.3 mΩ	1	Discrete
Capacitor	DC 100 V, 68000 pF	2	Discrete
NTC	10 kΩ	1	Discrete

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted)

Parameter	Symbol	Test Condition		Min	Typ	Max	Unit
OFF CHARACTERISTICS							
Input Capacitance	C_{iss}	V_{DS} = 40 V, V_{GS} = 0 V, f = 1 MHz		–	14000	–	pF
Output Capacitance	C_{oss}			–	9450	–	pF
Reverse Transfer Capacitance	C_{rss}			–	100	–	pF
Gate Resistance	R_g	f = 1 MHz		–	2.9	–	Ω
Total Gate Charge	$Q_{g(tot)}$	V_{GS} = 0 V to 10 V	V_{DD} = 64 V, I_D = 80 A	–	195	–	nC
Threshold Gate Charge	$Q_{g(th)}$	V_{GS} = 0 V to 2.7 V		–	35	–	nC
Gate to Source Gate Charge	Q_{gs}	V_{DD} = 64 V, I_D = 80 A		–	66	–	nC
Gate to Drain “Miller” Charge	Q_{gd}			–	45	–	nC
ON CHARACTERISTICS							
Turn−On Time	t_{on}	V_{DD} = 48 V, I_D = 80 A, V_{GS} = 10 V, R_{GEN} = 6 Ω (Note 6)		–	250	–	ns
Turn−On Delay Time	$t_{d(on)}$			–	65	–	ns
Turn−On Rise Time	t_r			–	184	–	ns
Turn−Off Delay Time	$t_{d(off)}$			–	153	–	ns
Turn−Off Fall Time	t_f			–	123	–	ns
Turn−Off Time	t_{off}			–	276	–	ns
BODY DIODE CHARACTERISTICS							
Reverse Recovery Time	T_{rr}	V_{SD} = 64 V, I_{SD} = 125 A, dI/dt = 100 A/μs		–	112	–	ns
Reverse Recovery Charge	Q_{rr}			–	208	–	nC

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

6. By characterization, the measurement is limited by test set up.

TYPICAL CHARACTERISTICS

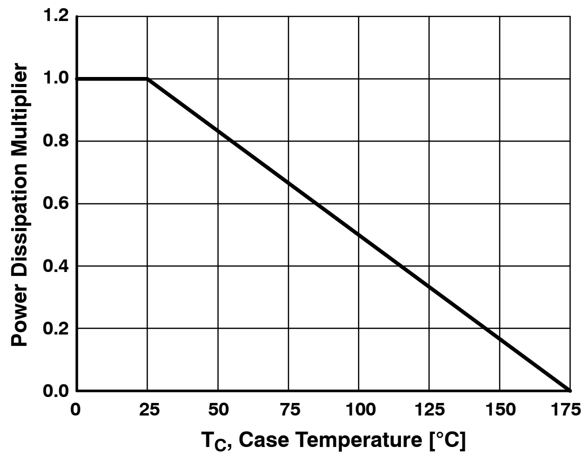


Figure 3. Normalized Power Dissipation vs. Case Temperature

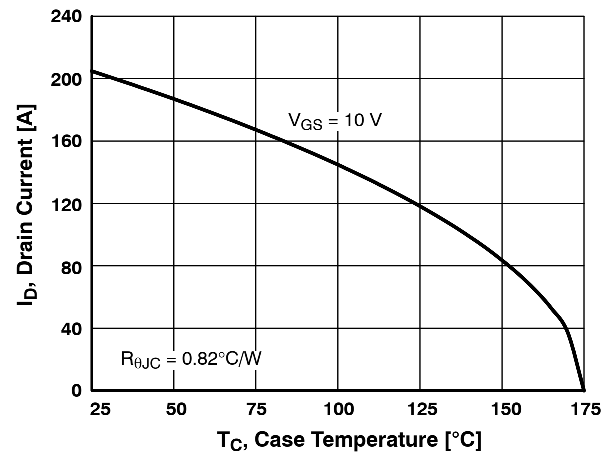


Figure 4. Maximum Continuous Drain Current vs. Case Temperature

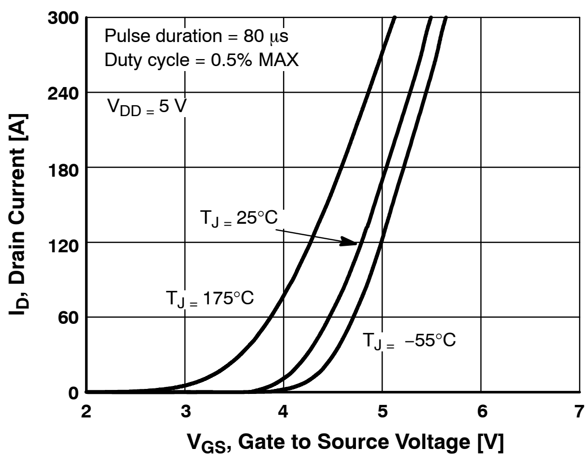


Figure 5. Transfer Characteristics

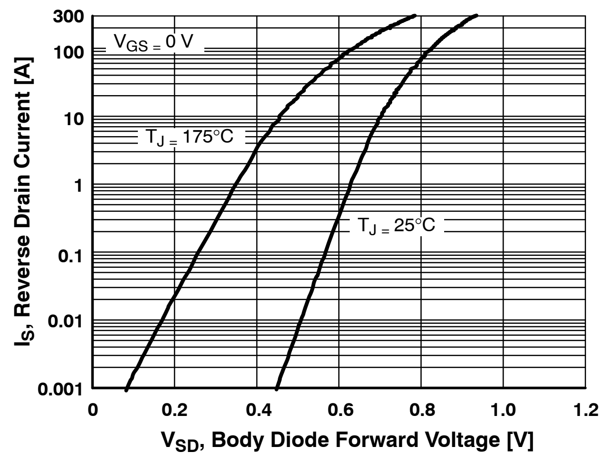


Figure 6. Forward Diode Characteristics

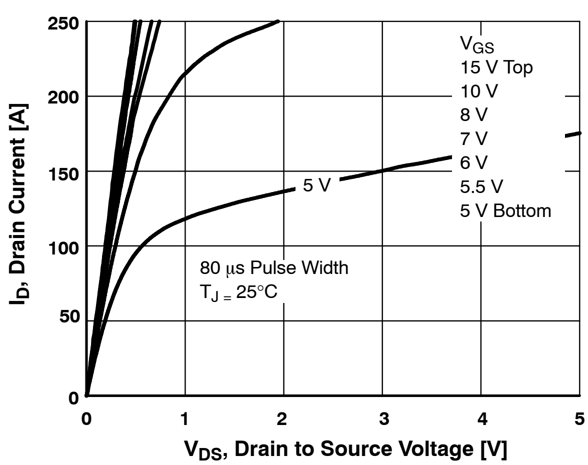


Figure 7. Saturation Characteristics (25°C)

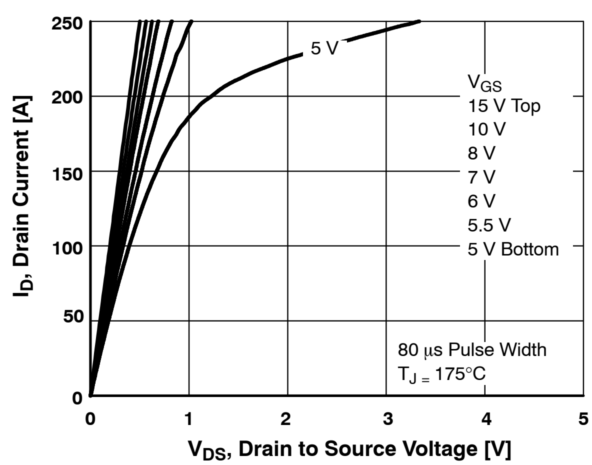


Figure 8. Saturation Characteristics (175°C)

TYPICAL CHARACTERISTICS (continued)

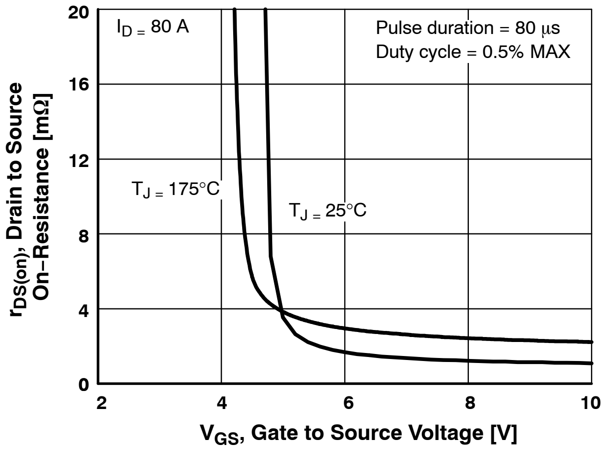


Figure 9. R_{DSON} vs. Gate Voltage

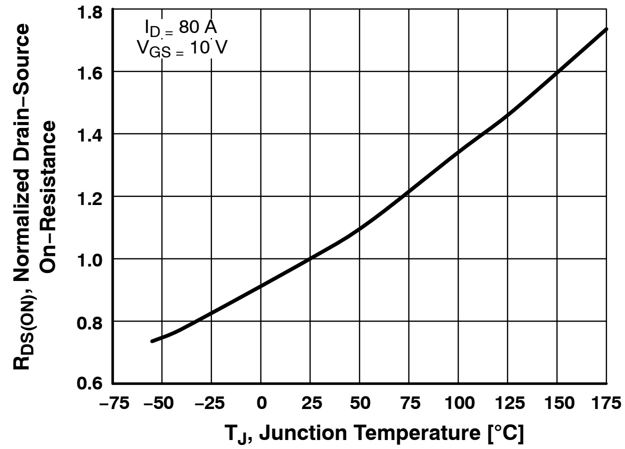


Figure 10. Normalized R_{DSON} vs. Junction Temperature

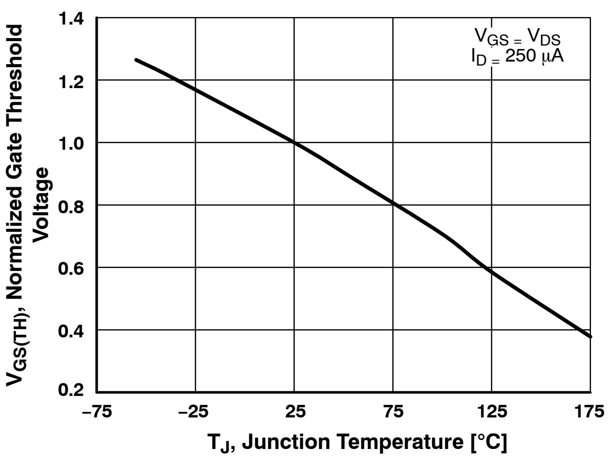


Figure 11. Normalized $V_{GS(TH)}$ vs. Temperature

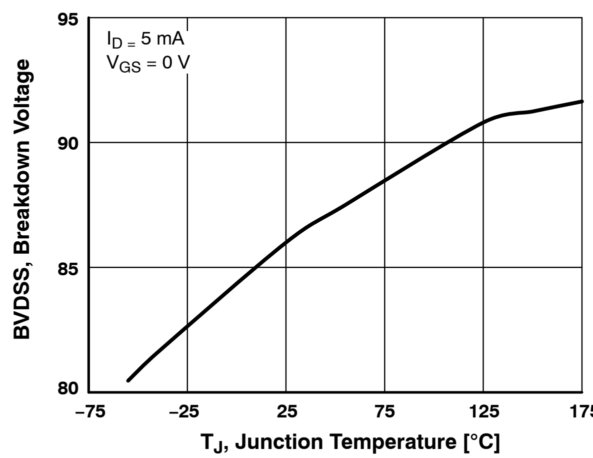


Figure 12. Breakdown Voltage vs. Temperature

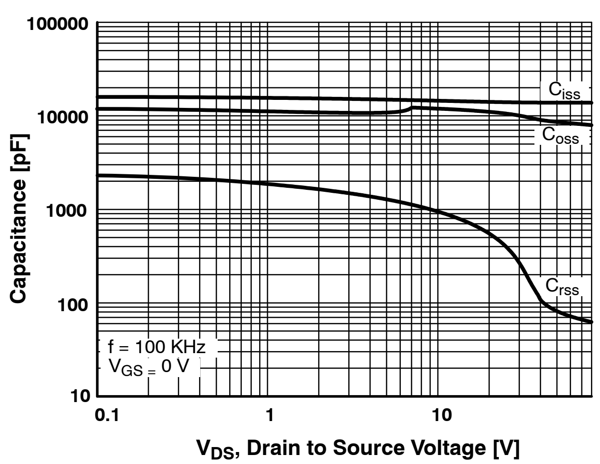


Figure 13. Capacitance Variation

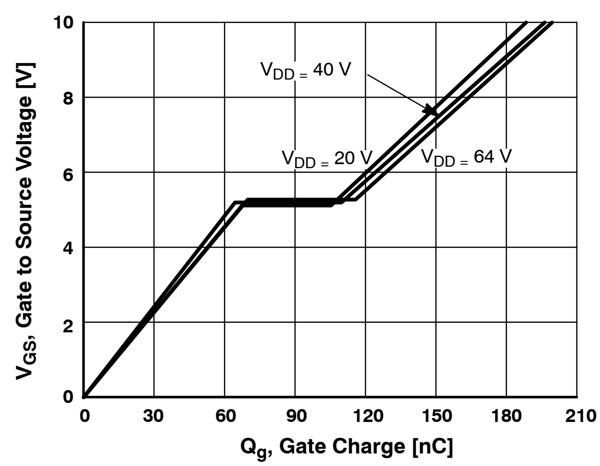
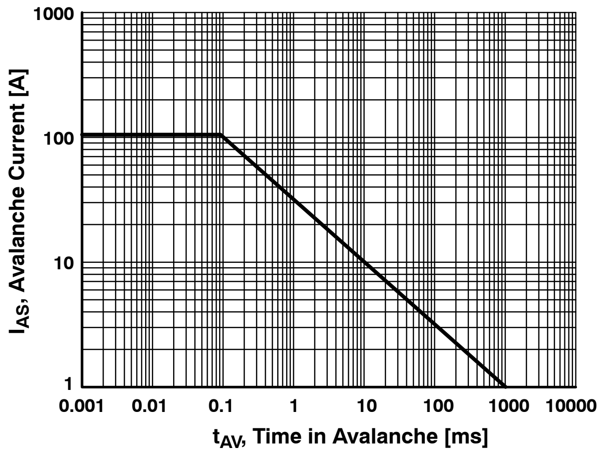


Figure 14. Gate Charge

TYPICAL CHARACTERISTICS (continued)



Refer to **onsemi** Application Notes AN7514 and AN7515.

Figure 15. Unclamped Inductive Switching Capability

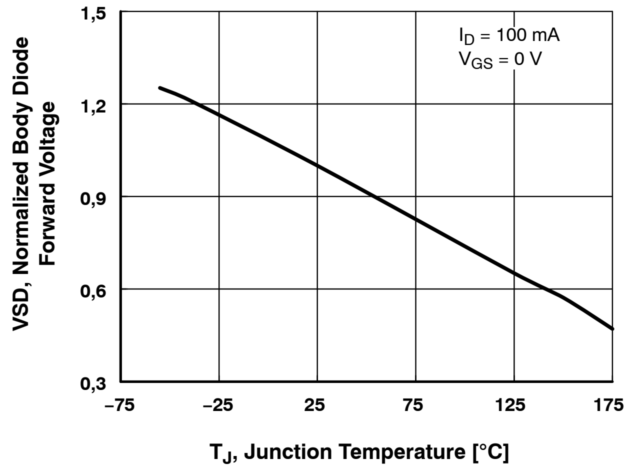


Figure 16. Forward Diode Characteristic

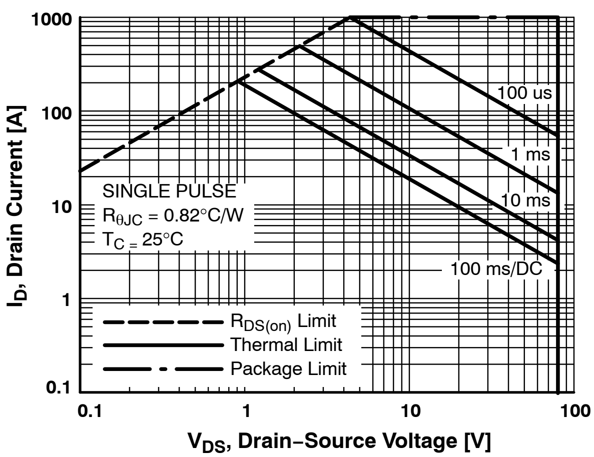


Figure 17. Safe Operation Area

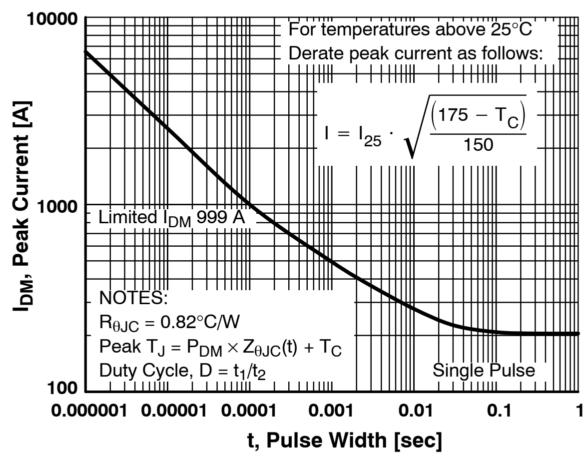


Figure 18. Peak Current Capability

TYPICAL CHARACTERISTICS (continued)

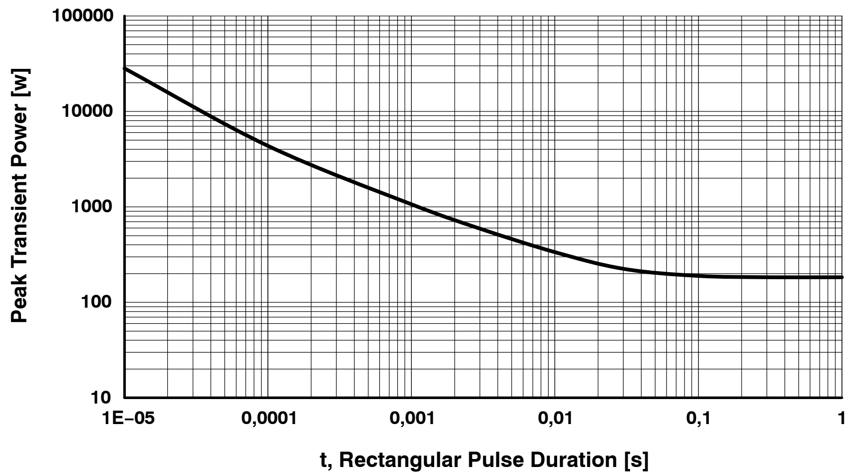


Figure 19. Peak Power Capability

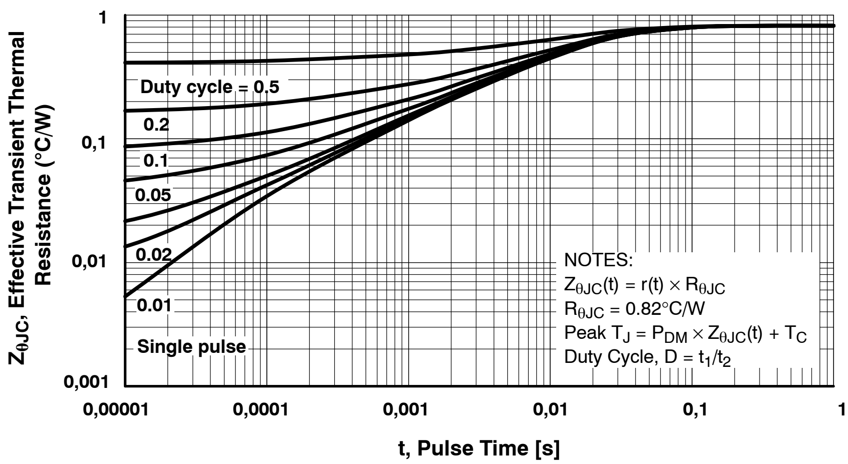


Figure 20. Maximum Transient Thermal Impedance

PACKAGE DIMENSIONS

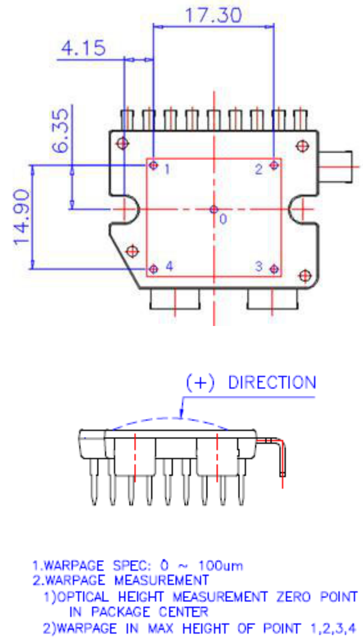


Figure 21. Flatness Measurement Position

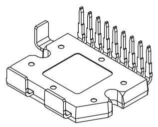
MECHANICAL CHARACTERISTICS AND RATINGS

Parameter	Test Conditions	Min	Typ	Max	Units
Device Flatness	Refer to the package dimensions	0	–	100	um
Mounting Torque	Mounting screw – M3, Recommended 0.7 N–m	0.6	–	1.4	N–m
Weight		–	10	–	g
Compression Test	Maximum load, test speed: 0.5 mm/min (Note 7)	–	–	22	kN

7. Guaranteed by experiment, valid only in confirmed condition.

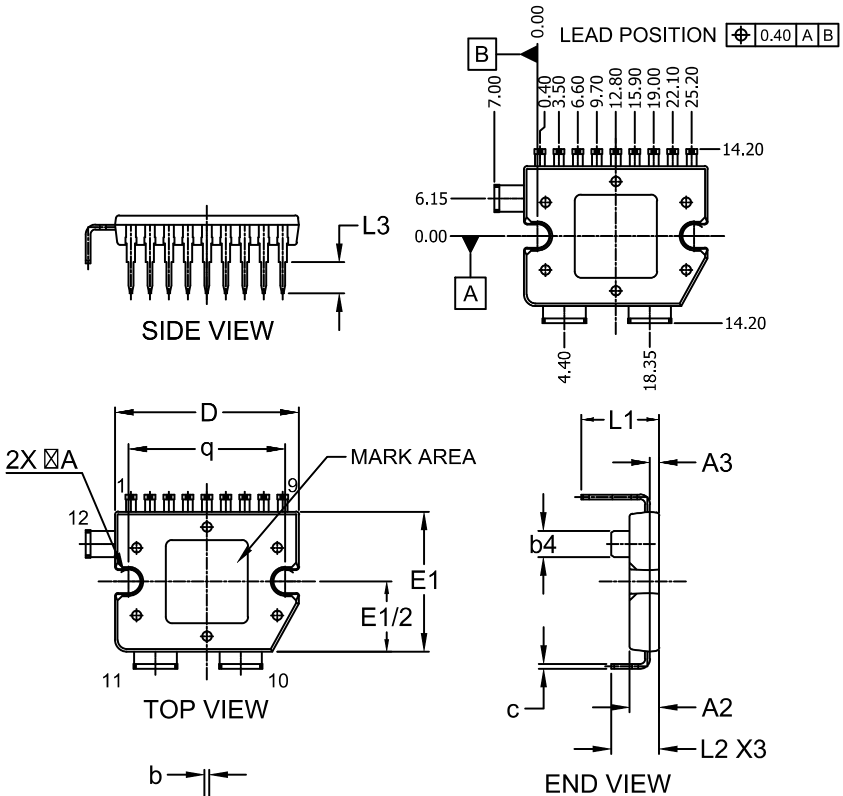
PACKAGE MARKING AND ORDERING INFORMATION

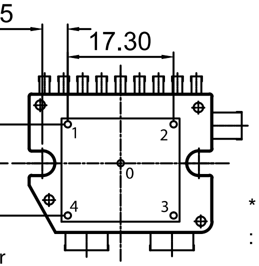
Device	Part Number	Package	Pb–Free and RoHS Compliant	Packing Method
NXV08A170DB2	NXV08A170DB2	APM12–CBA	Yes	Tray



APM12−SERIES AUTOMOTIVE MODULE
CASE MODBG
ISSUE B

DATE 16 DEC 2021





NOTES:
1. DIMENSIONING AND TOLERANCING PER. ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR EXTRUSIONS.

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	3.70	3.80	3.90
A2	4.60	4.80	5.00
A3	1.30	1.50	1.70
b	0.70	0.80	0.90
b1	1.25	1.35	1.45
b2	6.80	7.00	7.20
b3	6.70	6.90	7.10
b4	4.10	4.30	4.50
c	0.75	0.80	0.85
D	29.80	30.00	30.20
E1	22.60	22.80	23.00
L1	12.40	12.70	13.00
L2	7.50	7.80	8.10
L3	4.90	5.10	5.30
q	25.50	25.60	25.70

* WARPAGE(POINT 1,2,3,4 BASED ON 0)
: 0~100um

* For additional Information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDER RM/D.

GENERIC
MARKING DIAGRAM*

XXXXXXXXXXXXXXXX
ZZZ ATYWW
NNNNNNN

XXXX = Specific Device Code
ZZZ = Lot ID
AT = Assembly & Test Location
Y = Year
WW = Work Week
NNN = Serial Number

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, “G” or microdot “▪”, may or may not be present. Some products may not follow the Generic Marking.

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DESCRIPTION:	**APM12−SERIES AUTOMOTIVE MODULE**	**PAGE 1 OF 1**

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