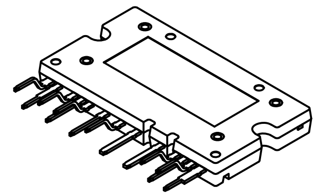
ASPM16 Series for Exciter Motor Application Automotive 650 V 75 A Smart Power Module

NFVF97565L1ZT1



ASPMCA−A16
CASE MODGH

General Description

NFVF97565L1ZT1 is an advanced automotive smart power module providing a fully−featured, high−performance full bridge inverter output stage for Exciter Motor Application.

Features

- 650 V − 75 A Full Bridge Inverter
- 13 pin Automotive Smart Power Module
- AQG324 Qualified and PPAP Capable
- Low−Loss, Short−Circuit Rated IGBTs
- Very Low Thermal Resistance using AlN DBC Substrate
- Thermistor
- UL Certified No. E209204 (UL1557)
- Single In Line Package
- Isolation Rating: 2500 V_{rms} / 1 min
- Comparative Tracking Index (CTI) = 600
- Pb−Free and RoHS Compliant

Applications

- Exciter Motor Application

Integrated Power Functions

- 650 V − 75 A IGBT Full Bridge Inverter for DC / AC Power Conversion (Please Refer to Figure 2)

MARKING DIAGRAM

NFVF97565L1ZT1
ZZZ ATYWW
NNNNNNN

NFVF97565L1ZT1	= Specific Device Code
ZZZ	= Lot ID
AT	= Assembly & Test Location
Y	= Year
W	= Work Week
NNN	= Serial Number

ORDERING INFORMATION

See detailed ordering and shipping information on page 6 of this data sheet.

Pin Configuration

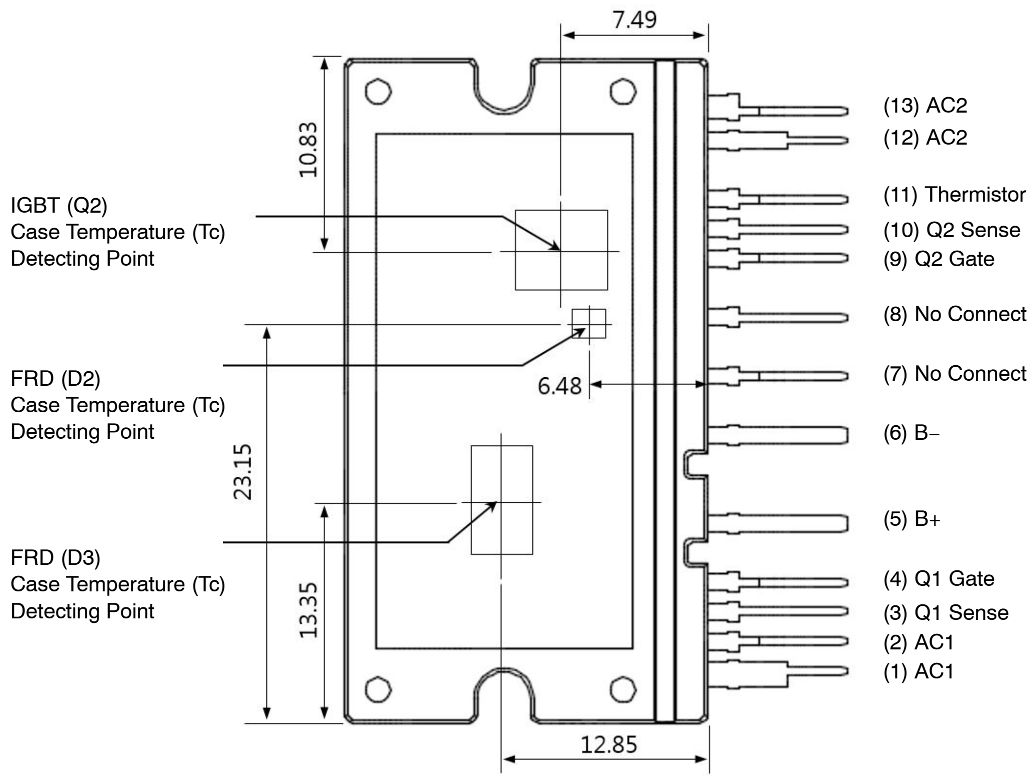


Figure 1. Bottom View

PIN DESCRIPTIONS

Pin No.	Pin Name	Pin Description
1	AC1	AC1
2	AC1	AC1
3	Q_1 Sense	Sense of Q_1 IGBT
4	Q_1 Gate	Gate of Q_1 IGBT
5	B+	Positive Battery Input
6	B−	Negative Battery Input
7	No Connect	
8	No Connect	
9	Q_2 Gate	Gate of Q_2 IGBT
10	Q_2 Sense	Sense of Q_2 IGBT
11	Thermistor	Thermistor
12	AC2	AC2
13	AC2	AC2

Internal Equivalent Circuit and Input/Output Pins

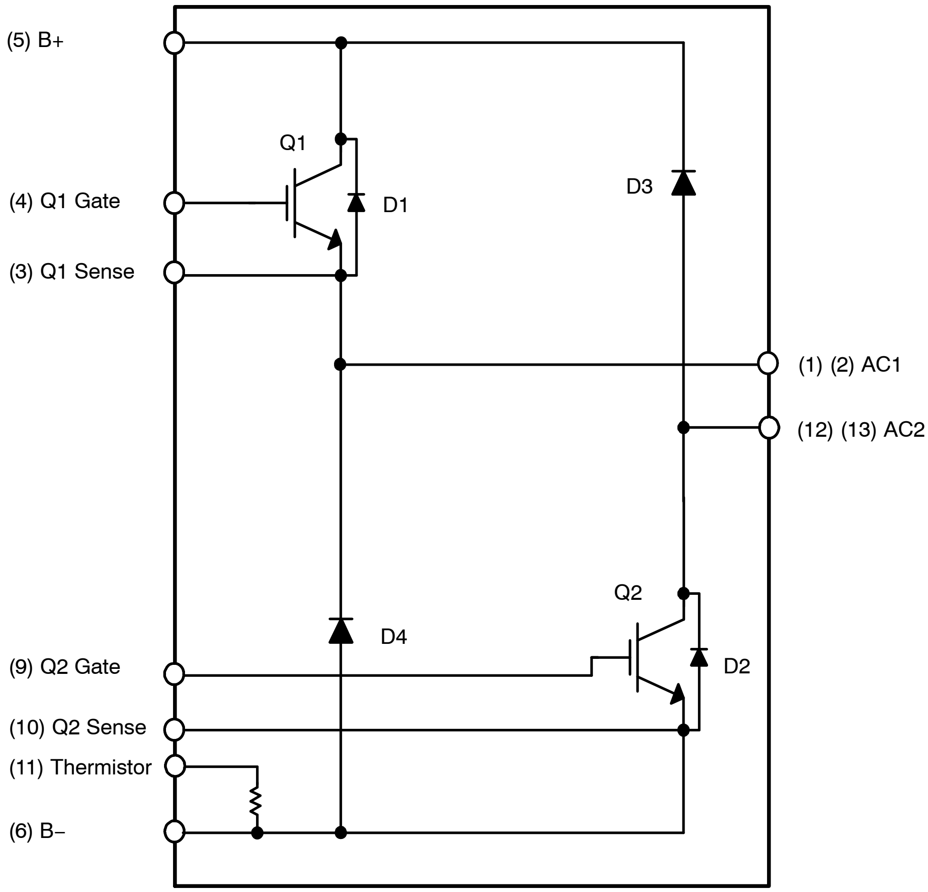


Figure 2. Internal Block Diagram

ABSOLUTE MAXIMUM RATINGS (T_C = 25°C, Unless Otherwise Specified)

Symbol	Parameter	Conditions	Rating	Unit
IGBT AND FRD PART				
V_{CES}	IGBT Collector − Emitter Voltage		650	V
I_C	Each IGBT Collector Current	T_C = 25°C, T_J ≤ 175°C (Note 1)	150	A
	Each IGBT Collector Current	T_C = 100°C, T_J ≤ 175°C (Note 1)	75	A
I_{CM}	Each IGBT Pulsed Collector Current	T_J ≤ 175°C, Under 1 ms Pulse Width (Note 2)	225	A
V_{RRM}	FRD Repetitive Reverse Voltage		650	V
I_F (D3, D4)	Each FRD Forward Current	T_C = 25°C, T_J ≤ 175°C (Note 1)	150	A
	Each FRD Forward Current	T_C = 100°C, T_J ≤ 175°C (Note 1)	75	A
I_{FM} (D3, D4)	Each FRD Pulsed Forward Current	T_J ≤ 175°C, Under 1ms Pulse Width (Note 2)	225	A
I_F (D1, D2)	Each FRD Forward Current	T_C = 25°C, T_J ≤ 175°C (Note 1)	30	A
	Each FRD Forward Current	T_C = 100°C, T_J ≤ 175°C (Note 1)	15	A
I_{FM} (D1, D2)	Each FRD Pulsed Forward Current	T_J ≤ 175°C, Under 1ms Pulse Width (Note 2)	45	A
I^2t	I^2t for FRD (D3, D4) Current square time	Value Corresponding to 1cycle of half wave 60 Hz, surge on−state current, T_J = 85°C (Note 1)	200	A^2s
	I^2t for FRD (D1, D2) Current square time		30	A^2s
V_{GE}	Transient Gate−Emitter Voltage		±20	V
P_C	IGBT Power Dissipation	T_C = 25°C per One Chip (Note 3)	483	W
P_K	FRD (D3, D4) Part Power Dissipation	T_C = 25°C per One Chip (Note 3)	375	W
	FRD (D1, D2) Part Power Dissipation	T_C = 25°C per One Chip (Note 3)	74.6	W
T_J	Operating Junction Temperature		−40~175	°C
TOTAL SYSTEM				
T_{SC}	Short Circuit Withstand Time	V_{GE} = 15 V, V_{CE} ≤ 450 V, T_J ≤ 175°C	6	μs
T_{STG}	Storage Temperature		−40~150	°C
T_C	Module Case Operation Temperature	(Note 4)	−40~150	°C
V_{ISO}	Isolation Voltage	60 Hz, Sinusoidal, AC 1 minute, Connection Pins to Heat Sink Plate	2500	Vrms

THERMAL RESISTANCE

Symbol	Parameter	Conditions	Min.	Typ.	Max	Unit
$R_{th(j-c)Q}$	Junction to Case Thermal Resistance (Note 3)	IGBT part	−	−	0.31	°C/W
$R_{th(j-c)F}$		FWD (D3, D4) Part	−	−	0.40	°C/W
$R_{th(j-c)F}$		FWD (D1, D2) Part	−	−	2.01	°C/W
L_σ	Package Stray Inductance	B+ to B− (Note 5)		20		nH

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.

NOTES:
1. These values had been made an acquisition by the calculation considered to design factor, and Pulse width and period are limited due to junction temperature.
2. Repetitive rating : Pulse width limited by max junction temperature.
3. For the measurement point of case temperature (T_C), please refer to Figure 1 and Figure 2 of chip location, and case temperature and heat sink temperature are defined on the each surface of base plate and heat sink just under the chips. DBC discoloration and Picker Circle Printing allowed, please refer to application note AN−9190 (Impact of DBC Oxidation on SPM Module Performance).
4. T_C is depend on the real operation condition.
5. Stray inductance measured per IEC 60747−15.

ELECTRICAL CHARACTERISTICS

Symbol		Parameter	Conditions	Min.	Typ.	Max.	Unit
IGBT AND FRD PART (T_J = 25°C as specified)							
$\Delta BV_{CES} / \Delta T_J$		Temperature Coefficient of Break−down Voltage	V_{GE} = 0 V , I_C = 1 mA	–	0.6	–	V/°C
$V_{CE(SAT)}$ (Q1, Q2)		Collector−Emitter Saturation Voltage	V_{GE} = 15 V, I_C = 75 A, T_J = 25°C	1.30	1.55	1.95	V
			V_{GE} = 15 V, I_C = 75 A, T_J = 175°C	1.50	1.70	2.25	V
V_F (D3, D4)		FRD Forward Voltage	I_F = 50 A, T_J = 25°C	–	2.10	2.70	V
			I_F = 50 A, T_J = 175°C	–	1.90	–	V
V_F (D1, D2)		FRD Forward Voltage	I_F = 15 A, T_J = 25°C	–	1.80	2.40	V
			I_F = 15 A, T_J = 175°C	–	1.70	–	V
$V_{GE(TH)}$		Gate−Emitter Threshold Voltage	V_{GE} = V_{CE}, I_C = 75 mA, T_J = 25°C	4.2	5.25	7.5	V
Q_g		Total Gate Charge	V_{CE} = 400 V, V_{GE} = 15V, I_C = 75 A	–	500	–	nC
Q_{ge}		Gate to Emitter Charge		–	30	–	nC
Q_{gc}		Gate to Collector Charge		–	250	–	nC
C_{ies}		Input Capacitance	V_{CE} = 30 V, V_{GE} = 0 V, f_{sw} = 1 MHz	–	6350	–	pF
C_{oes}		Output Capacitance		–	230	–	pF
C_{res}		Reverse Capacitance		–	105	–	pF
R_g		Internal IGBT Gate Resistor	T_J = 25°C	–	1.2	10	Ω
I_{GES}		Gate−Emitter Leakage Current	V_{CE} = 0 V, V_{GE} = 20 V, T_J = 25°C	–	–	1000	nA
IGBT	$t_{d(on)}$	IGBT Switching Times and Losses	V_{CE} = 400 V, V_{GE} = 15 V, I_C = 75 A, T_J = 25°C, R_g = 8 Ω, Inductive Load See Figure 13	–	130	–	ns
	t_r			–	70	–	ns
	E_{ON}			–	2.5	–	mJ
	$t_{d(OFF)}$			–	500	–	ns
	t_f			–	70	–	ns
	E_{OFF}			–	3.8	–	mJ
IGBT	$t_{d(on)}$	IGBT Switching Times and Losses	V_{CE} = 400 V, V_{GE} = 15 V, I_C = 75 A, T_J = 175°C, R_g = 8 Ω, Inductive Load See Figure 13	–	150	–	ns
	t_r			–	74	–	μs
	E_{ON}			–	3.7	–	mJ
	$t_{d(OFF)}$			–	575	–	ns
	t_f			–	74	–	ns
	E_{OFF}			–	3.9	–	mJ
FRD	t_{rr}	FRD Switching Times and Losses (D3, D4)	V_{AK} = 400 V, R_g = 8 Ω, I_A = 75 A, T_J = 25°C	–	50	–	ns
	Q_{rr}			–	200	–	nC
	I_{RRM}			–	8	–	A
	E_{rr}			–	150	–	μJ
FRD	t_{rr}	FRD Switching Times and Losses (D3, D4)	V_{AK} = 400 V, R_g = 8 Ω, I_A = 75 A, T_J = 175°C	–	60	–	ns
	Q_{rr}			–	240	–	nC
	I_{RRM}			–	9.6	–	A
	E_{rr}			–	180	–	μJ
I_{CES}		Collector−Emitter Leakage Current	T_J = 25°C, V_{CE} = V_{CES}	–	–	250	μA
I_R		Anode−Cathode Leakage Current	T_J = 25°C, V_{AK} = V_{CES}	–	–	250	μA

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.

PACKAGE MARKING AND ORDERING INFORMATION

Device Marking	Device	Package	Packing Type	Quantity
NFVF97565L1ZT1	NFVF97565L1ZT1	ASPM16−CAA	Tube	12

TYPICAL PERFORMANCE CHARACTERISTICS

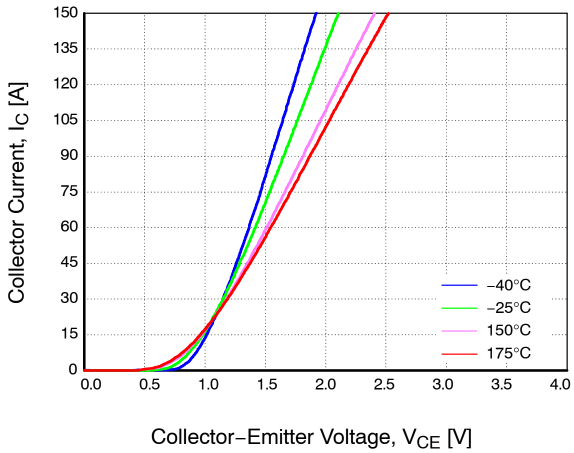


Figure 3. Typical Output Characteristics [Q1 and Q2 IGBT]

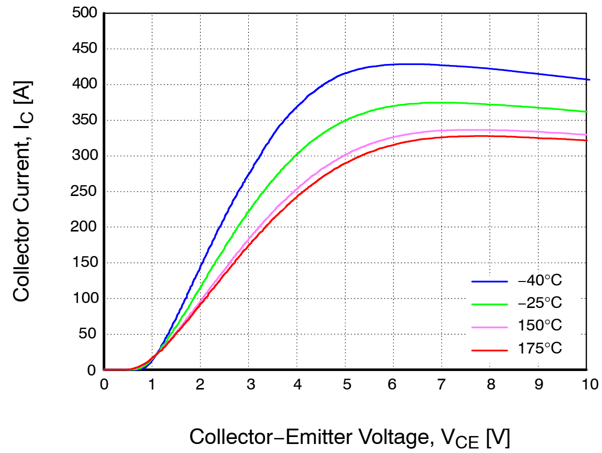


Figure 4. Typical Output Saturation Characteristics [Q1 and Q2 IGBT]

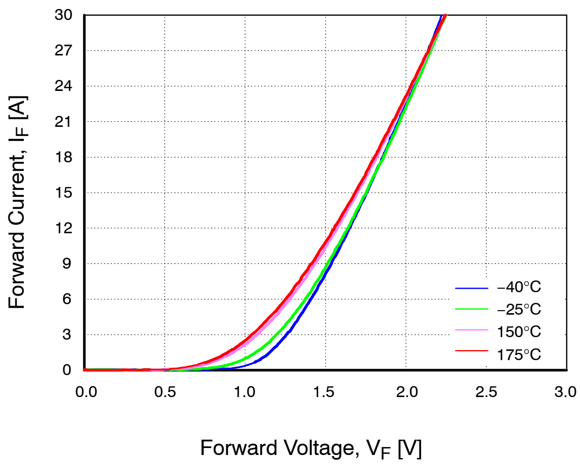


Figure 5. Typical 15 A Diode Forward Voltage

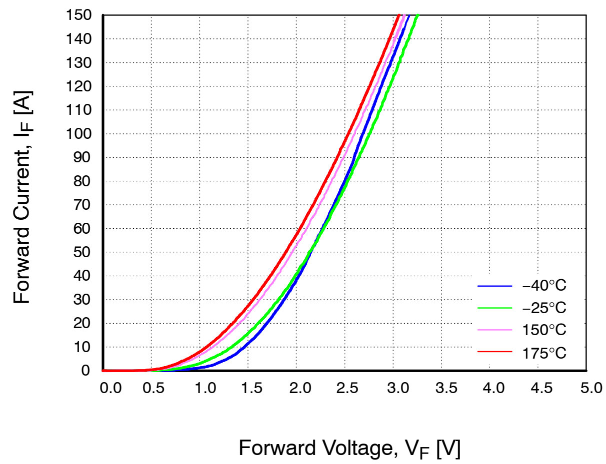


Figure 6. Typical 50 A Diode Forward Voltage

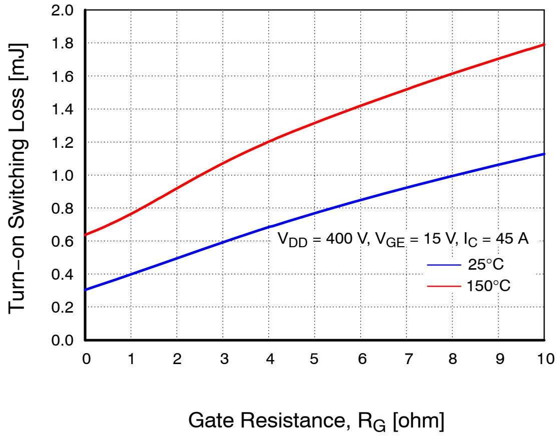


Figure 7. Turn−on Loss vs. Gate Resistance

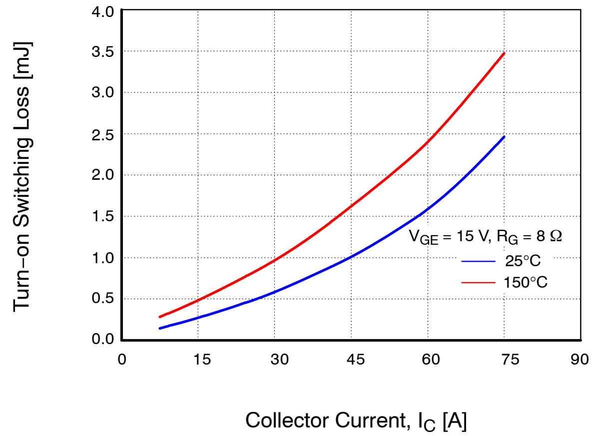


Figure 8. Turn−on Loss vs. Collector Current

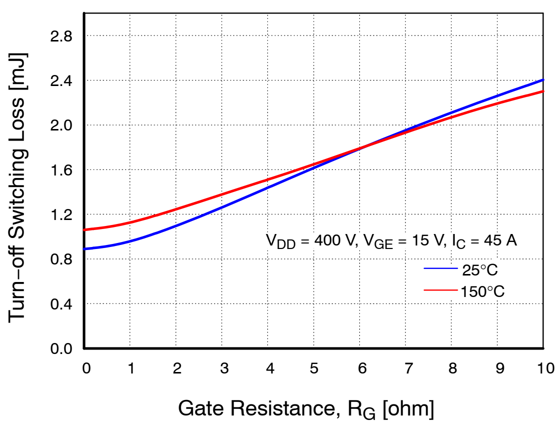


Figure 9. Turn−off Loss vs. Gate Resistance

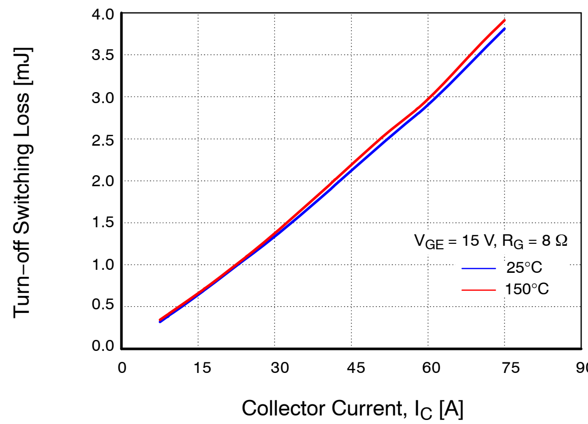


Figure 10. Turn−off Loss vs. Collector Current

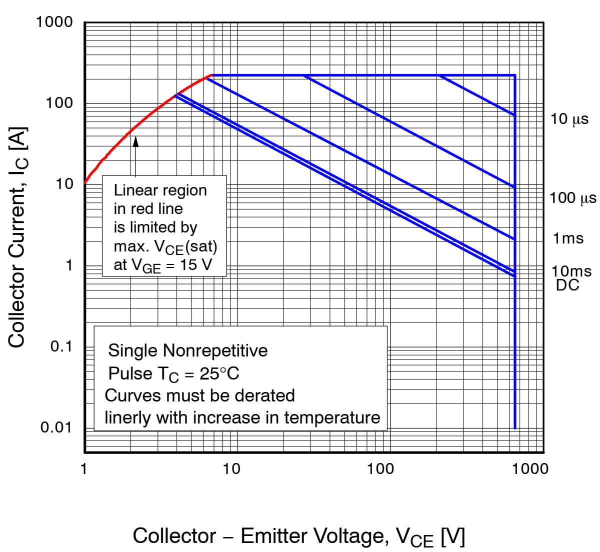


Figure 11. FBSOA Characteristics

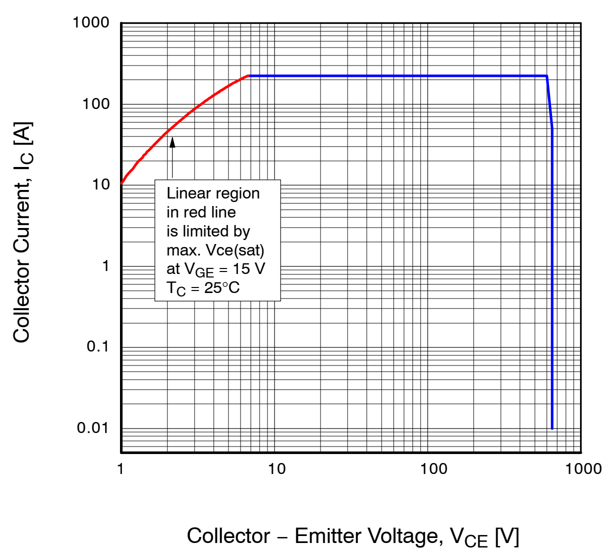


Figure 12. RBSOA Characteristics

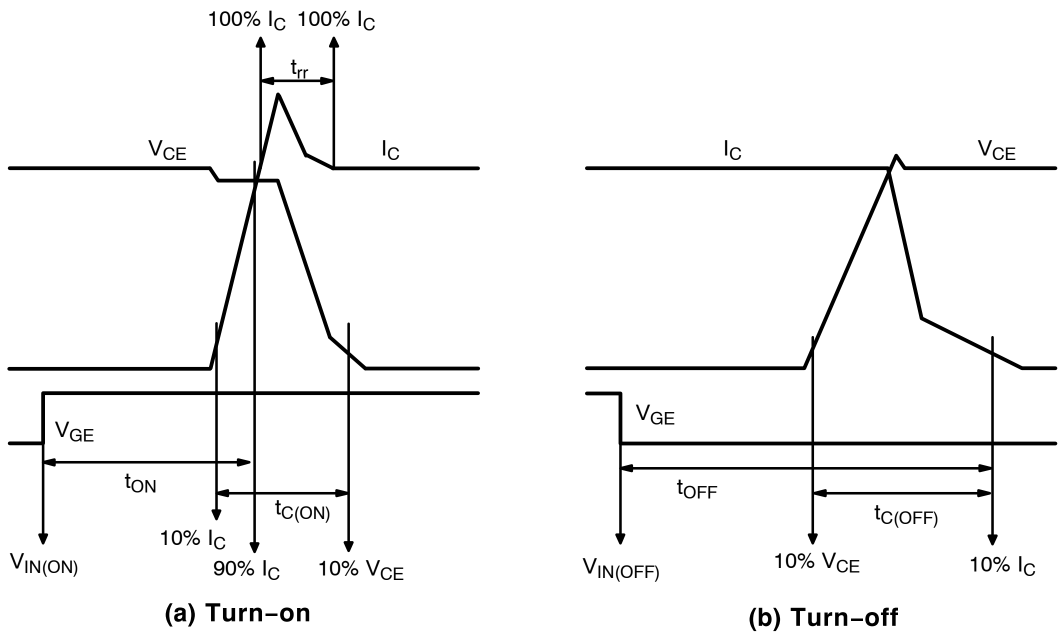


Figure 13. Switching Time Definition

NTC THERMISTOR

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
RTH	Resistance of Thermistor	@T_{TH} = 25°C	–	47	–	kΩ
		@T_{TH} = 100°C	–	2.9	–	kΩ

6. T_{TH} is the temperature of thermistor itself. To know temperature (T_C), please make the experiment considering your application.

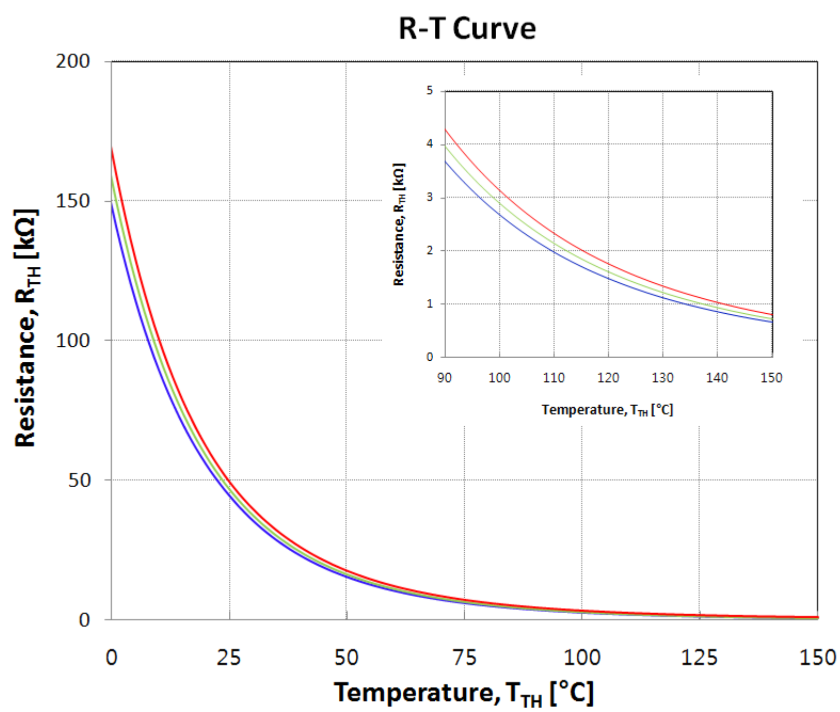


Figure 14. R−T Curve of The Built−in Thermistor

MECHANICAL CHARACTERISTICS AND RATINGS

Parameter	Conditions	Limits			Unit
		Min.	Typ.	Max.	
Device Flatness	See Figure 15	0	–	150	μm
Weight		–	10	–	g

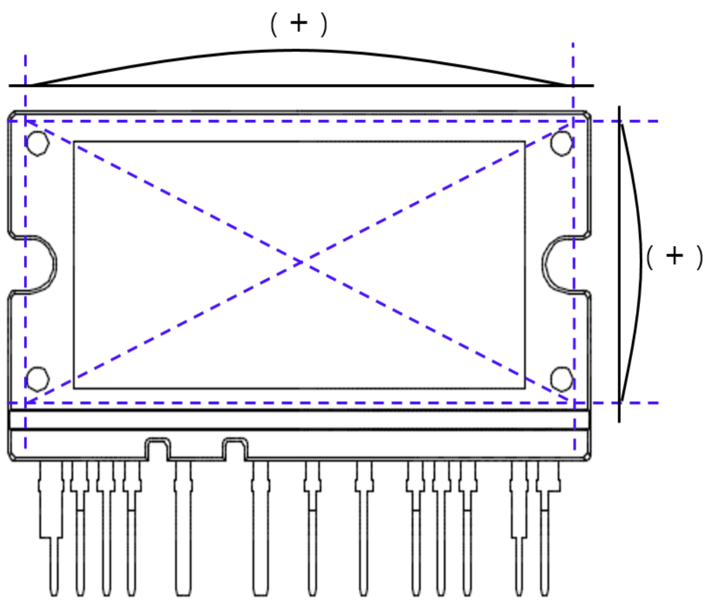
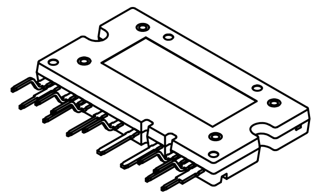


Figure 15. Flatness Measurement Position



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CASE MODGH
ISSUE B

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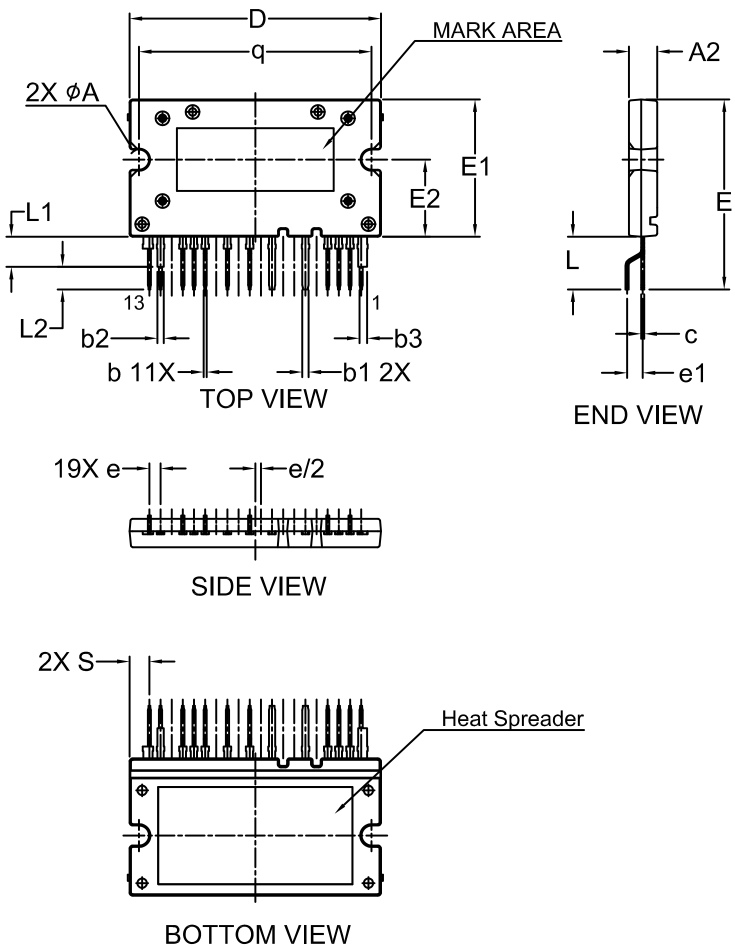

NOTES:

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.
A2	4.30	4.50	4.70
b	0.45	0.50	0.60
b1	0.95	1.00	1.10
b2	0.95	1.00	1.10
b3	1.15	1.20	1.30
c	0.45	0.50	0.60
D	39.90	40.10	40.30
E	29.80	30.30	30.80
E1	21.70	21.90	22.10
E2	12.10	12.30	12.50
e	1.478	1.778	2.078
e1	2.20	2.50	2.80
L	8.10	8.40	8.70
L1	4.80 REF		
L2	3.30	3.60	3.90
q	36.85	37.10	37.35
S	3.159 REF		
ϕA	2.95	3.20	3.45

GENERIC MARKING DIAGRAM*

XXXXXXXXXXXXXXXX
ZZZ ATYWW
NNNNNNN

XXXX = Specific Device Code
ZZZ = Lot ID
AT = Assembly & Test Location
Y = Year
W = 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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