

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

NFVF97565L1ZT1

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

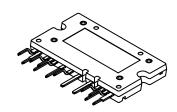
- 650 V 75 A Full Bridge Inverter
- 13 pin Automotive Smart Power Module
- AQG324 Qualified and PPAP Capable
- Low-Loss, Short-Circuit Rated IGBTs
- Very Low Thermal Resistance using AIN DBC Substrate
- Thermistor
- UL Certified No. E209204 (UL1557)
- Single In Line Package
- Isolation Rating: 2500 V_{rms} / 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)



ASPMCA-A16 CASE MODGH

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

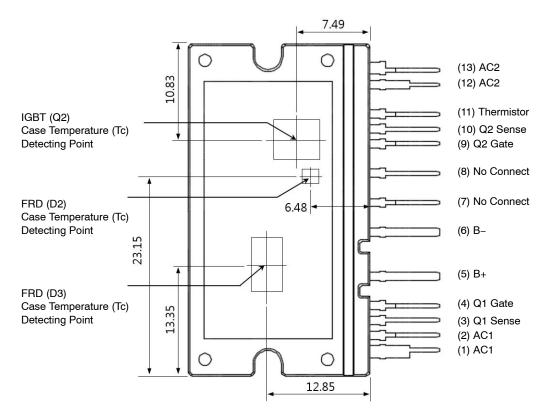


Figure 1. Top View

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

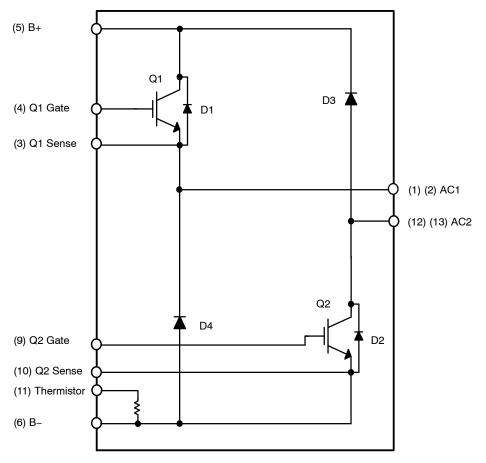


Figure 2. Internal Block Diagram

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

Symbol	Parameter	Conditions	Rating	Unit
BT AND FR	D 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	Α
	Each IGBT Collector Current	T _C = 100°C, T _J ≤ 175°C (Note 1)	75	Α
I _{CM}	Each IGBT Pulsed Collector Current	T _J ≤175°C, Under 1 ms Pulse Width (Note 2)	225	А
V_{RRM}	FRD Repetitive Reverse Voltage		650	V
I _F	Each FRD Forward Current	T _C = 25°C, T _J ≤ 175°C (Note 1)	150	Α
(D3, D4)	Each FRD Forward Current	T _C = 100°C, T _J ≤ 175°C (Note 1)	75	Α
I _{FM} (D3, D4)	Each FRD Pulsed Forward Current	T _J ≤175°C, Under 1ms Pulse Width (Note 2)	225	А
I _F	Each FRD Forward Current	FRD Forward Current $T_C = 25^{\circ}C, T_J \le 175^{\circ}C \text{ (Note 1)}$		Α
(D1, D2)	Each FRD Forward Current	T _C = 100°C, T _J ≤ 175°C (Note 1)	15	Α
I _{FM} (D1, D2)	Each FRD Pulsed Forward Current	T _J ≤175°C, Under 1ms Pulse Width (Note 2)	45	Α
I ² t	I ² t for FRD (D3, D4) Current square time	Value Corresponding to 1 cycle of half wave	200	A ² s
	I ² t for FRD (D1, D2) Current square time		30	A ² s
V _{GE}	Transient Gate-Emitter Voltage		±20	V
Pc	IGBT Power Dissipation	T _C = 25°C per One Chip (Note 3)	483	W
PK	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
OTAL SYST	ЕМ			
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.	Тур.	Max	Unit
$R_{th(j-c)Q}$	Junction to Case	IGBT part	-	-	0.31	°C/W
R _{th(j-c)} F	Thermal Resistance (Note 3)	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		nΗ

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.	Тур.	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 _E	FRD Forward Voltage	I _F = 50 A, T _J = 25°C	-	2.10	2.70	V
(D3	, D4)		I _F = 50 A, T _J = 175°C	-	1.90	-	V
(D4	√ _F	FRD Forward Voltage	I _F = 15 A, T _J = 25°C	-	1.80	2.40	V
(D1	, D2)		I _F = 15 A, T _J = 175°C	-	1.70	_	V
V _{GI}	E(TH)	Gate-Emitter Threshold Voltage	$V_{GE} = V_{CE}, I_{C} = 75 \text{ mA}, T_{J} = 25^{\circ}\text{C}$	4.2	5.25	7.5	V
(\mathfrak{Q}_{g}	Total Gate Charge	$V_{CE} = 400 \text{ V}, V_{GE} = 15 \text{ V}, I_{C} = 75 \text{ A}$	-	500	_	nC
C	Q _{ge}	Gate to Emitter Charge		-	30	-	nC
C	Q _{gc}	Gate to Collector Charge		-	250	-	nC
C	'ies	Input Capacitance	$V_{CE} = 30 \text{ V}, V_{GE} = 0 \text{ V},$	-	6350	-	pF
С	oes	Output Capacitance	f _{sw} = 1 MHz	-	230	-	pF
	res	Reverse Capacitance	1	-	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}	1		-	2.5	-	mJ
	t _{d(OFF)}			-	500	-	ns
	t _f			-	70	-	ns
	E _{OFF}	1		-	3.8	-	mJ
IGBT	t _{d(on)}	IGBT Switching Times and Losses	V _{CE} = 400 V, V _{GE} = 15 V,	-	150	-	ns
	t _r	-	I_C = 75 A, T_J = 175°C R_g = 8 Ω Inductive Load See Figure 13	-	74	-	μS
	E _{ON}			-	3.7	_	mJ
	t _{d(OFF)}	1		-	575	_	ns
	t _f	1		-	74	-	ns
	E _{OFF}	1		-	3.9	-	mJ
FRD	t _{rr}	FRD Switching Times and Losses	$V_{AK} = 400 \text{ V}, R_g = 8 \Omega, \\ I_A = 75 \text{ A}, T_J = 25^{\circ}\text{C}$	-	50	-	ns
	Q _{rr}	(D3, D4)	$I_A = 75 \text{ A}, T_J = 25^{\circ}\text{C}$	-	200	_	nC
	I _{RRM}	1		-	8	_	Α
	E _{rr}	1		-	150	_	μJ
FRD	t _{rr}	FRD Switching Times and Losses	$V_{AK} = 400 \text{ V}, R_g = 8 \Omega, I_A = 75 \text{ A}, T_J = 175^{\circ}\text{C}$	-	60	_	ns
	Q _{rr}	(D3, D4)	I _A = 75 A, T _J = 175°C	-	240	_	nC
ŀ	I _{RRM}	1		-	9.6	_	A
	E _{rr}	1		_	180	-	μJ
lc	ES	Collector-Emitter Leakage Current	T _J = 25°C, V _{CE} = V _{CES}	_	-	250	μA
I _R		Anode-Cathode Leakage Current	$T_J = 25^{\circ}C$, $V_{AK} = V_{CES}$	_	_	250	μ A

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

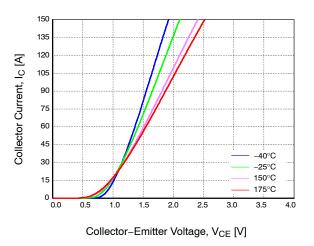


Figure 3. Typical Output Characteristics [Q1 and Q2 IGBT]

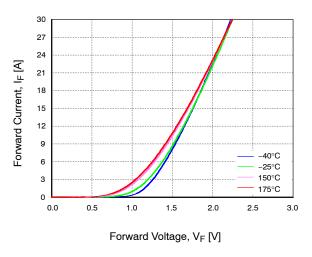
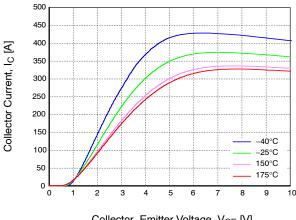


Figure 5. Typical 15 A Diode Forward Voltage



Collector-Emitter Voltage, V_{CE} [V]

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

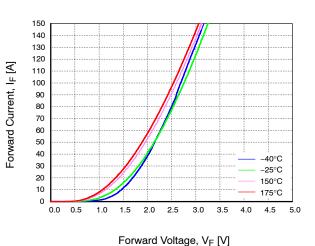


Figure 6. Typical 50 A Diode Forward Voltage

Turn-on Switching Loss [mJ]

Turn-off Switching Loss [mJ]

Collector Current, I_C [A]

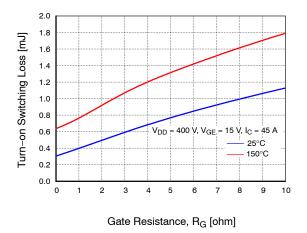


Figure 7. Turn-on Loss vs. Gate Resistance

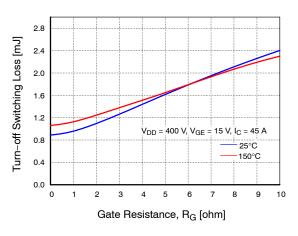


Figure 9. Turn-off Loss vs. Gate Resistance

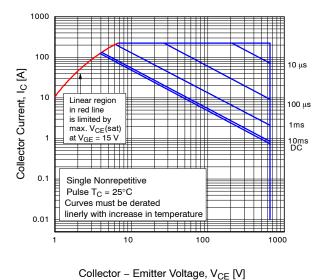


Figure 11. FBSOA Characteristics

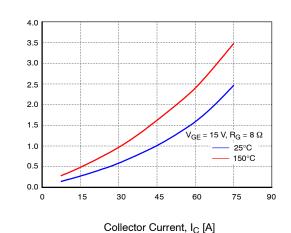


Figure 8. Turn-on Loss vs. Collector Current

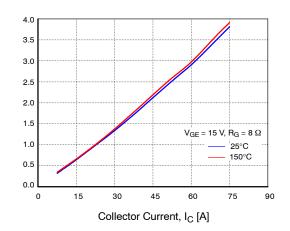
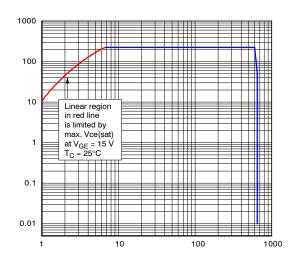


Figure 10. Turn-off Loss vs. Collector Current



Collector - Emitter Voltage, V_{CE} [V]

Figure 12. RBSOA Characteristics

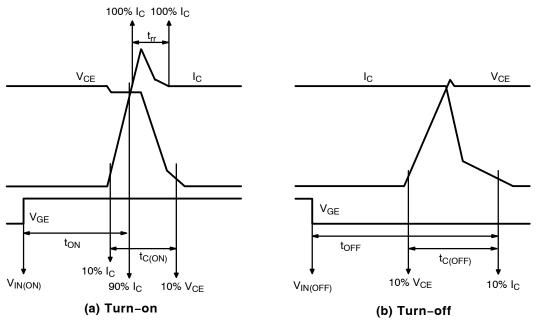


Figure 13. Switching Time Definition

NTC THERMISTOR

Symbol	Parameter	Conditions	Min.	Тур.	Max.	Unit
Rтн	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.

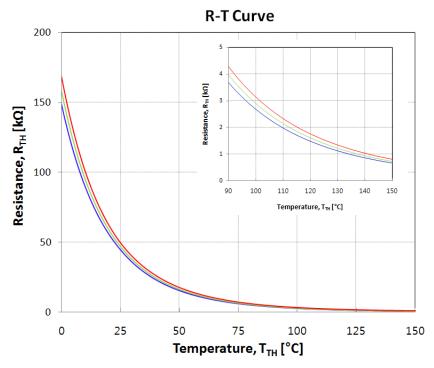


Figure 14. R-T Curve of The Built-in Thermistor

MECHANICAL CHARACTERISTICS AND RATINGS

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

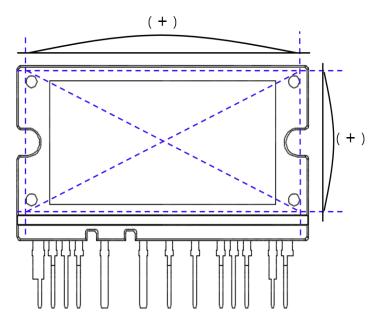
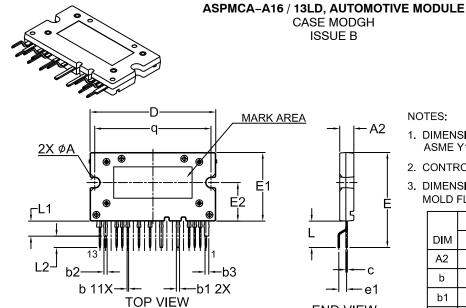
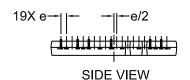
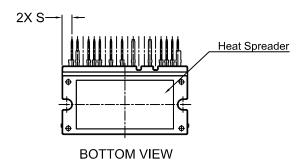


Figure 15. Flatness Measurement Position

DATE 03 NOV 2020







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.

	MILLIMETERS				
DIM	MIN.	NOM.	MAX.		
A2	4.30	4.50	4.70		
р	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		
O	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		
е	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				
ØΑ	2.95	3.20	3.45		

GENERIC MARKING DIAGRAM*

XXXXXXXXXXXXXXX ZZZ ATYWW NNNNNN

XXXX = Specific Device Code

ZZZ = Lot ID

ΑT = Assembly & Test Location

END VIEW

Υ = 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.

DOCUMENT NUMBER: 98AON94739G Electronic versions are uncontrolled except when accessed directly from Printed versions are uncontrolled except when stamped "CONTROLLEI "			
DESCRIPTION:	ASPMCA-A16 / 13LD, AUT	OMOTIVE MODULE	PAGE 1 OF 1

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