H-Bridge in APM16 Series for LLC and Phase-shifted DC-DC Converter

NXV65HR51DZ1, NXV65HR51DZ2

Features

- SIP or DIP H−Bridge Power Module for On−board Charger (OBC) in EV or PHEV
-

June, 2021 − Rev. 2
Publication Order Number:
NXV65HR51DZ1/D

ORDERING INFORMATION

Part Number	Package	Lead Forming	Snubber Capacitor Inside	DBC Material	Pb−Free and RoHS Compliant	Operating Temperature (T_A)	Packing Method
NXV65HR51DZ1	APM16−CAA	Y−Shape	No	Al_2O_3	Yes	−40°C ~ 125°C	Tube
NXV65HR51DZ2	APM16−CAB	L−Shape	No	Al_2O_3	Yes	−40°C ~ 125°C	Tube

Pin Configuration and Description

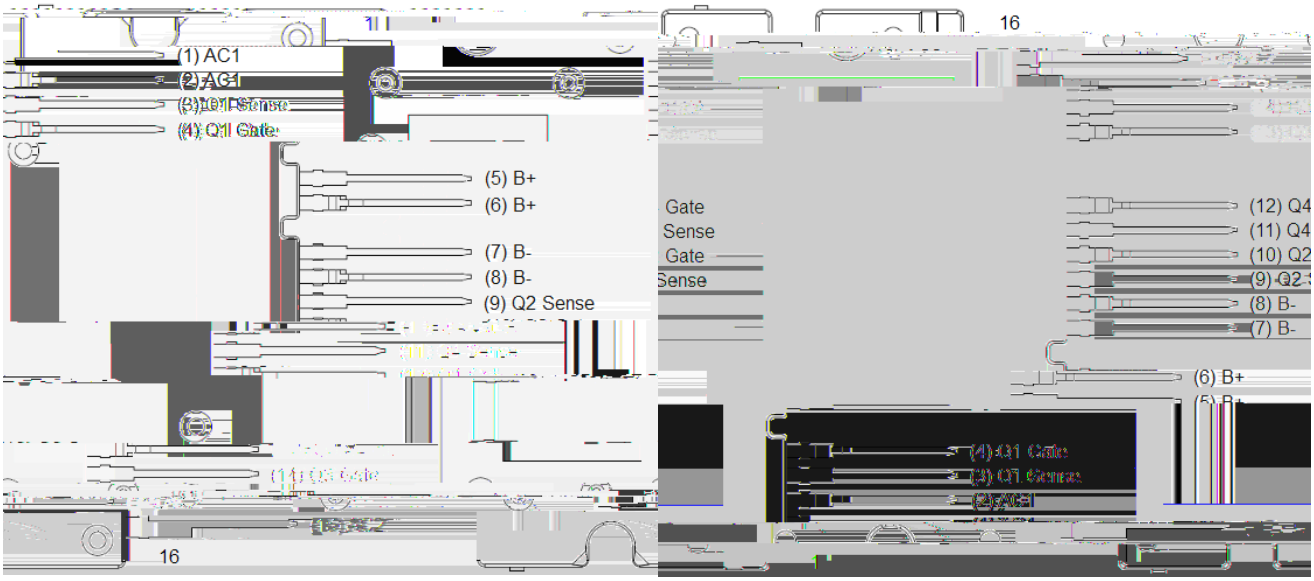


Figure 1. Pin Configuration

Table 1. PIN DESCRIPTION

Pin Number	Pin Name	Pin Description
1, 2	AC1	Phase 1 Leg of the H−Bridge
3	Q1 Sense	Source Sense of Q1
4	Q1 Gate	Gate Terminal of Q1
5, 6	B+	Positive Battery Terminal
7, 8	B−	Negative Battery Terminal
9	Q2 Sense	Source Sense of Q2
10	Q2 Gate	Gate Terminal of Q2
11	Q4 Sense	Source Sense of Q4
12	Q4 Gate	Gate Terminal of Q4
13	Q3 Sense	Source Sense of Q3
14	Q3 Gate	Gate Terminal of Q3
15, 16	AC2	Phase 2 Leg of the H−Bridge

Internal Equivalent Circuit

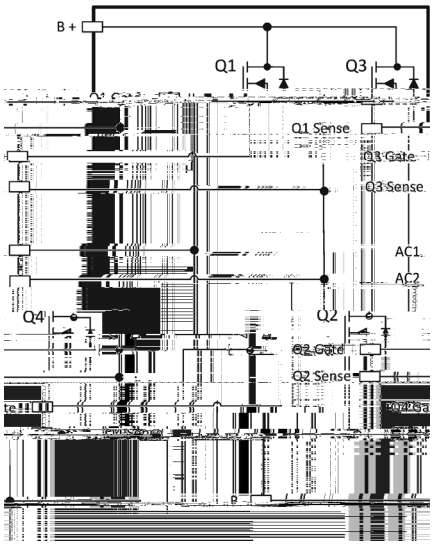


Figure 2. Internal Block Diagram

Table 2. ABSOLUTE MAXIMUM RATINGS (T_J = 25°C, Unless Otherwise Specified)

Symbol	Parameter	Max	Unit
V_{DS} (Q1~Q4)	Drain−to−Source Voltage	650	V
V_{GS} (Q1~Q4)	Gate−to−Source Voltage	±20	V
I_D (Q1~Q4)	Drain Current Continuous (T_C = 25°C, V_{GS} = 10 V) (Note 1)	33	A
	Drain Current Continuous (T_C = 100°C, V_{GS} = 10 V) (Note 1)	21	A
E_{AS} (Q1~Q4)	Single Pulse Avalanche Energy (Note 2)	623	mJ
P_D	Power Dissipation (Note 1)	135	W
T_J	Maximum Junction Temperature	−55 to +150	°C
T_C	Maximum Case Temperature	−40 to +125	°C
T_{STG}	Storage Temperature	−40 to +125	°C

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. Maximum continuous current and power, without switching losses, to reach T_J = 150°C respectively at T_C = 25°C and T_C = 100°C; defined by design based on MOSFET $R_{DS(ON)}$ and $R_{\theta JC}$ and not subject to production test
2. Starting T_J = 25°C, I_{AS} = 6.5 A, R_G = 25 Ω

DBC Substrate

0.63 mm Al_2O_3 alumina with 0.3 mm copper on both sides.

Lead Frame

OFC copper alloy, 0.50 mm thick. Plated with 8 μm to 25.4 μm thick Matte Tin

Flammability Information

Table 3. ELECTRICAL SPECIFICATIONS (T_J = 25°C, Unless Otherwise Specified)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
BV_{DSS}	Drain−to−Source Breakdown Voltage	I_D = 1 mA, V_{GS} = 0 V	650	−	−	V
$V_{GS(th)}$	Gate to Source Threshold Voltage	V_{GS} = V_{DS}, I_D = 3.3 mA	3.0	−	5.0	V
$R_{DS(ON)}$	Q1 – Q4 MOSFET On Resistance	V_{GS} = 10 V, I_D = 20 A	−	44	51	mΩ
$R_{DS(ON)}$	Q1 – Q4 MOSFET On Resistance	V_{GS} = 10 V, I_D = 20 A, T_J = 125°C (Note 3)	−	79	−	mΩ
g_{FS}	Forward Transconductance	V_{DS} = 20 V, I_D = 20 A (Note 3)	−	30	−	S
I_{GSS}	Gate−to−Source Leakage Current	V_{GS} = ±20 V, V_{DS} = 0 V	−100	−	+100	nA
I_{DSS}	Drain−to−Source Leakage Current	V_{DS} = 650 V, V_{GS} = 0 V	−	−	10	μA
DYNAMIC CHARACTERISTICS (Note 3)						
C_{iss}	Input Capacitance	V_{DS} = 400 V V_{GS} = 0 V f = 1 MHz	−	4864	−	pF
C_{oss}	Output Capacitance		−	109	−	pF
C_{rss}	Reverse Transfer Capacitance		−	16	−	pF
$C_{oss(eff)}$	Effective Output Capacitance	V_{DS} = 0 to 520 V V_{GS} = 0 V	−	652	−	pF
R_g	Gate Resistance	f = 1 MHz	−	2	−	Ω
$Q_{g(tot)}$	Total Gate Charge	V_{DS} = 380 V I_D = 20 A V_{GS} = 0 to 10 V	−	123	−	nC
Q_{gs}	Gate−to−Source Gate Charge		−	37.5	−	nC
Q_{gd}	Gate−to−Drain “Miller” Charge		−	49	−	nC
SWITCHING CHARACTERISTICS						
t_{on}	Turn−on Time	V_{DS} = 400 V I_D = 20 A V_{GS} = 10 V R_G = 4.7 Ω (Note 3)	−	87	−	ns
$t_{d(on)}$	Turn−on Delay Time		−	47	−	ns
t_r	Turn−on Rise Time		−	43	−	ns
t_{off}	Turn−off Time		−	148	−	ns
$t_{d(off)}$	Turn−off Delay Time		−	118	−	ns
t_f	Turn−off Fall Time		−	29	−	ns
BODY DIODE CHARACTERISTICS						
V_{SD}	Source−to−Drain Diode Voltage	I_{SD} =				

PARAMETER DEFINITIONS

Reference to T

TYPICAL CHARACTERISTICS

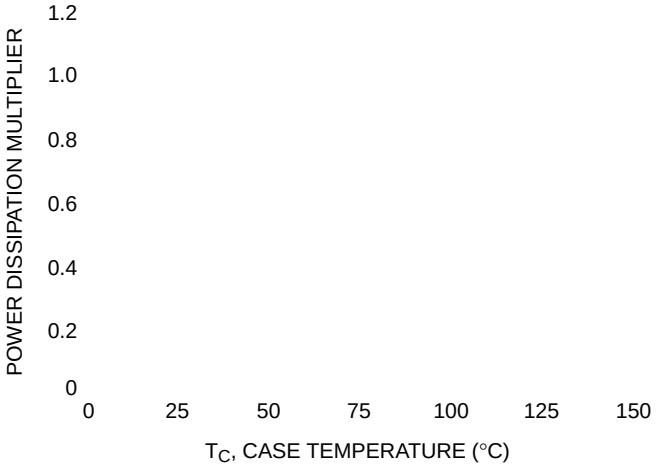


Figure 4. Normalized Power Dissipation vs. Case

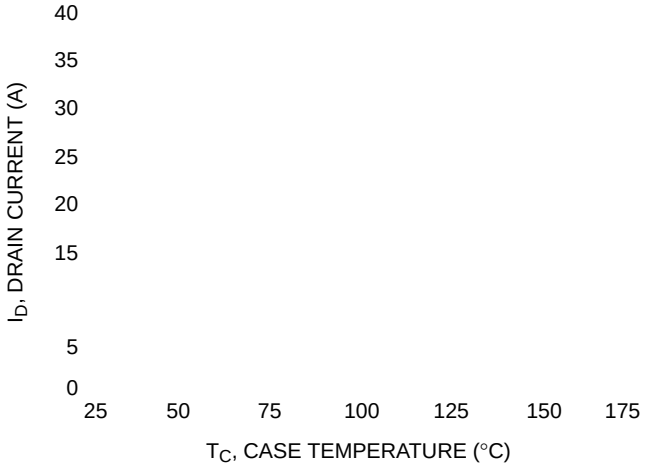


Figure 5. Maximum Continuous I_D vs. Case Temperature

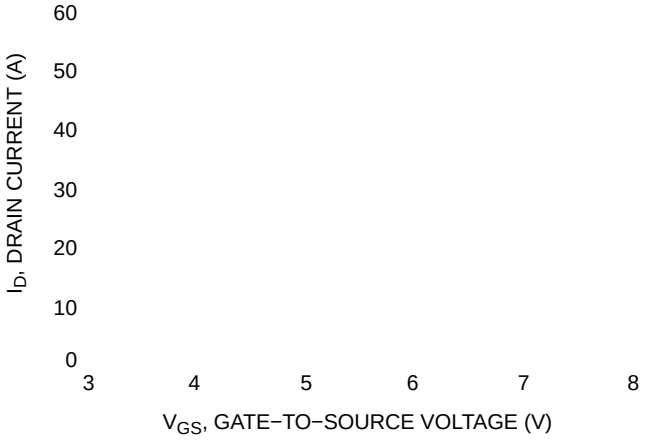


Figure 6. Transfer Characteristics

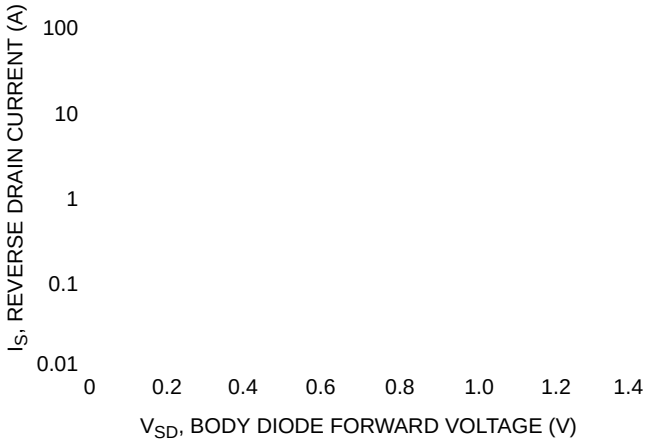


Figure 7. Forward Diode

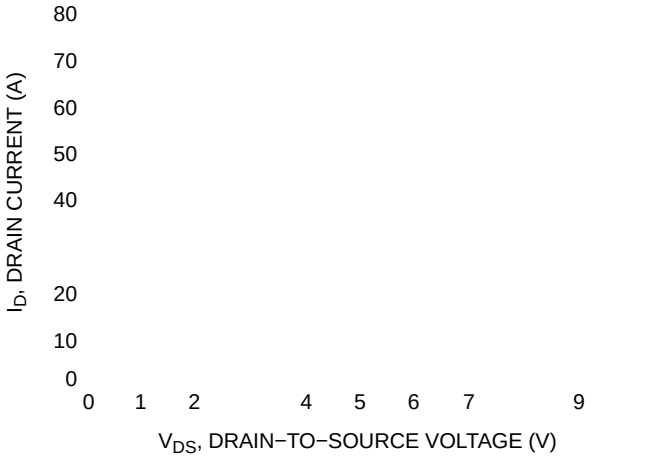


Figure 8. On Region Characteristics (25 C)

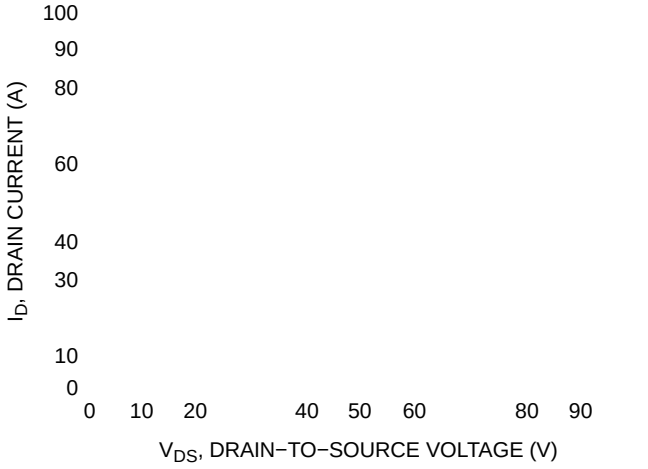
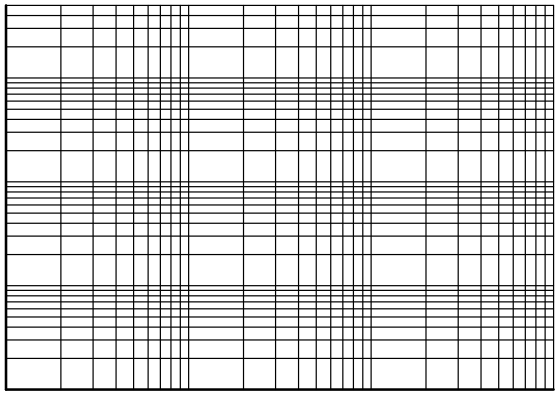


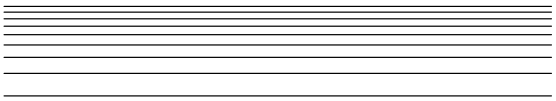
Figure 9. On Region Characteristics (150 C)

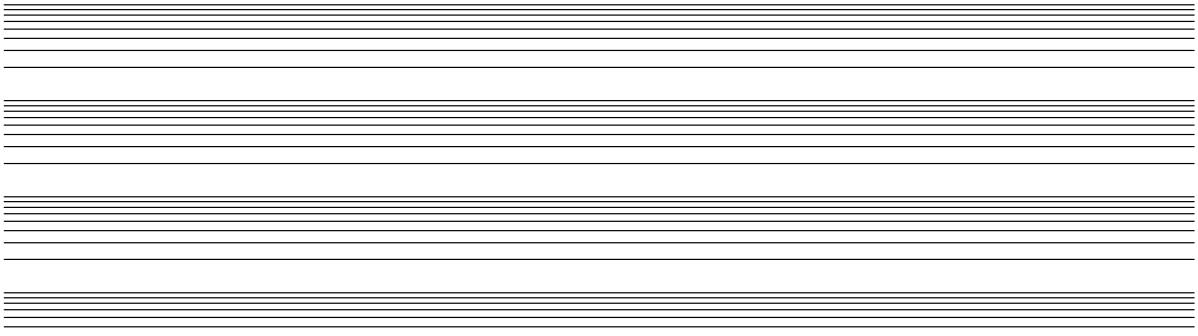
TYPICAL CHARACTERISTICS

Figure 10. On−

TYPICAL CHARACTERISTICS





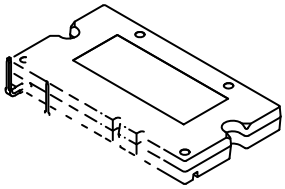


PACKAGE DIMENSIONS

APMCA−A16 / 16LD, AUTOMOTIVE MODULE
CASE MODGF
ISSUE A

DATE 02 MAY 2019

PACKAGE DIMENSIONS



APMCA−B16 / 16LD, AUTOMOTIVE MODULE
CASE MODGJ
ISSUE A

DATE 02 MAY 2019