FS236BQ Half-Bridge IPM

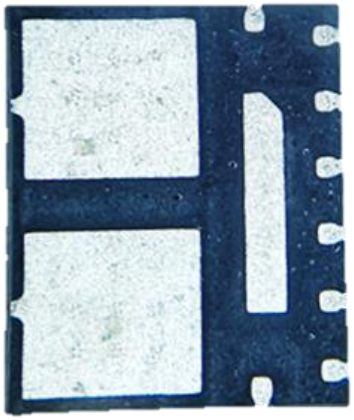
Description

FS236BQ is a 3A, 600V half-bridge module designed for advanced appliance motor drive applications such as energy saving fans and pumps. FT's technology offers an extremely compact, high performance half-bridge topology in an isolated package. This advanced IPM offers a combination or FT's low $R_{DS(ON)}$. The IPM is designed with Enhanced VDMOSFET technology and the industry benchmark half-bridge high voltage, rugged drive technology in a small QFN package. At only 5x6mm and featuring integrated bootstrap functionality, the compact footprint of this surface-mount package makes it suitable for applications that are space-constrained.

Features

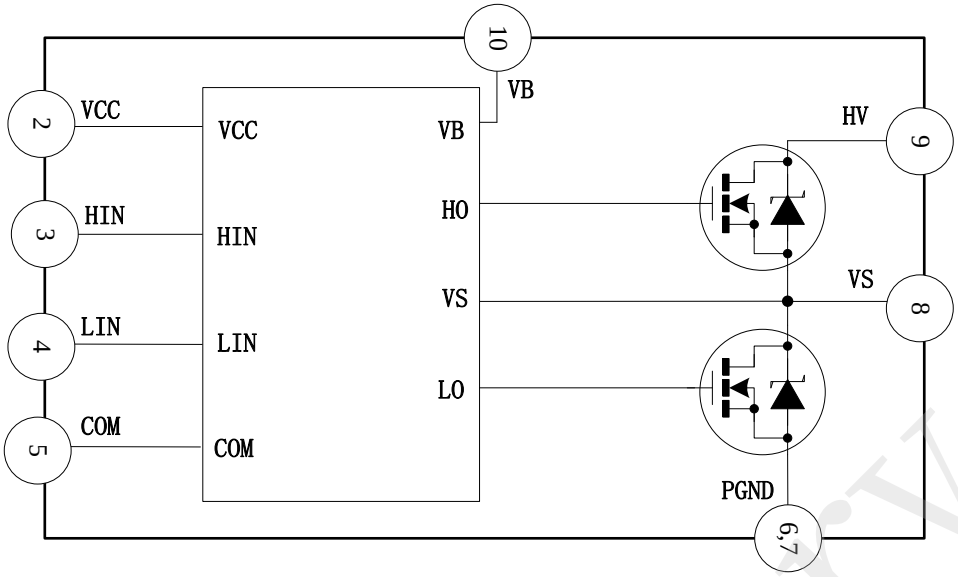
- Built-in 600V3A fast recovery MOSFET
- Built-in high voltage Gate driver circuit(HVIC)
- Power supply pressure range: 13.5V ~20V
- 3.3V/5V logic input compatible
- Under-voltage lockout for all channels
- Optimized dV/dt for loss and EMI trade offs
- Cross-conduction prevention logic
- Active high HIN and LIN
- Isolation 1500V_{RMS} min
- ROHS compliant

Package(QFN10L-5*6)

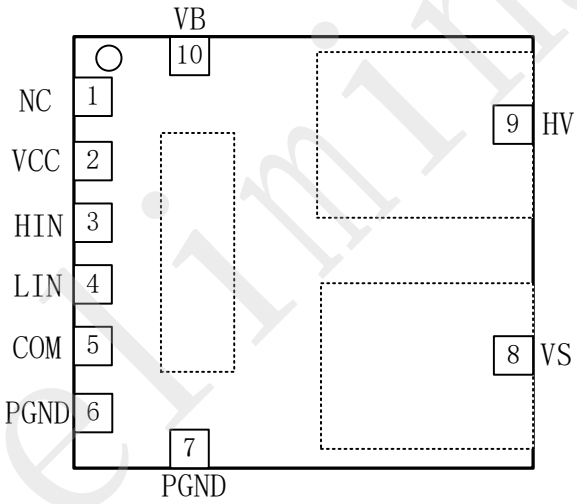


QFN10L-5*6

Internal Electrical Schematic



Module Pin-Out Description



Pin	Name	Description
1	NC	Not Connect
2	VCC	Low side and logic fixed supply
3	HIN	Logic Input for High Side (Active High)
4	LIN	Logic Input for Low Side (Active High)
5	COM	Low Side Gate Drive Return
6,7	PGND	Low Side Source Connection
8	VS	Phase Output
9	HV	DC Bus
10	VB	High Side Floating Supply

Absolute Maximum Ratings

Absolute maximum ratings indicate sustained limits beyond which damage to the module may occur. These are not tested at manufacturing. All voltage parameters are absolute voltages referenced to VSS unless otherwise stated in the table. The thermal resistance and power dissipation ratings are measured under board mounted and still air condition.

Symbol	Description	Min	Max	Unit
BV_{DSS}	MOSFET Blocking Voltage	-	600	V
$I_{O\ 25}$	DC output current per MOSFET @ TC=25°C(Note1)	-	3	A
$I_{O\ 80}$	DC output current per MOSFET @ TC=80°C	-	2	A
I_{OP}	Peak output current per MOSFET @ TC=25°C	-	8	A
Pd	Power dissipation per MOSFET @ TC =25°C	-	3.9	W
T_J	Maximum Operating Junction Temperature	-	150	°C
T_L	Lead temperature (soldering 30 seconds)	-	260	°C
T_S	Storage Temperature Range	-40	150	°C
R_{thJA}	Thermal resistance, junction to case, each MOSFET	-	32	°C/W
V_B	High side floating supply voltage	-0.3	V_S + 20 V	V
V_S	High side floating supply offset voltage	V_B - 20	V_B +0.3 V	V
VCC	Low Side fixed supply voltage	-0.3	20	V
V_{IN}	Logic input voltage LIN, HIN	-0.3	V_{CC} +0.3	V
V_{ISO}	Isolation voltage(1min)(Note2)	-	1500	V

Note1: Calculated based on maximum junction temperature. Bond wires current limit is 1.0A.

Note2: Characterized, non tested at manufacturing.

Note3: In any case, power dissipation should not exceed P_D.

Note4: Voltages above the absolute maximum ratings may damage the chip.

Recommended Operating Conditions

Symbol	Description	Min	Typ	Max	Units
HV	Positive DC Bus Input Voltage	---	300	400	V
V_S	High Side Floating Supply Offset Voltage	(Note 1)	---	400	V
V_{BS}	High Side Supply Voltage	13.5	15	16.5	V
V_{CC}	Low Side and Logic Supply Voltage	13.5	15	16.5	V
V_{IN}	Logic Input Voltage	COM	---	VCC	V
t_{dead}	Blanking Time for Preventing Arm-Short	1.0	---	---	us
f_{PWM}	PWM Carrier Frequency	---	15	20	kHz

For proper operation the module should be used within the recommended conditions. All voltages are absolute referenced to COM. The V_S offset is tested with all supplies biased at 15V differential.

Note1: Logic operational for VS of (COM – 5V) to (COM + 400V). Logic state held for VS of (COM – 5V) to (COM –V_{BS}).

Note2: The long-term operation of the chip outside the recommended conditions may affect its reliability. It is not recommended to work in an environment that exceeds the recommended conditions.

Static Electrical Characteristics (V_{BIAS} (V_{CC}, V_{BS})=15V, T_J=25℃, unless otherwise specified.)

Symbol	Description	Min	Typ	Max	Units	Conditions
BV_{DSS}	Drain-to-Source Breakdown Voltage	600	---	---	V	I_{LK}=1mA
I_{LK}	Zero Gate Voltage Drain Current	---	---	250	uA	V_{DS}=600V
$R_{DS(ON)}$	Drain to Source ON Resistance	---	2.4	3.0	Ω	I_d = 1.5A
V_{SD}	Diode Forward Voltage	---	---	1.2	V	I_d = 1.5A
V_{IH}	Logic "1" input voltage for HIN/LIN	2.8	---	---	V	
V_{IL}	Logic "0" input voltage for HIN/LIN	---	---	0.8	V	
V_{CCUV+}	VCC Supply Under-Voltage, Positive Going Threshold	11.2	12	12.8	V	
V_{CCUV-}	VCC supply Under-Voltage, Negative Going Threshold	10.2	11	11.8	V	
V_{CCUVH}	VCC Supply Under-Voltage Lock- Out Hysteresis	0.6	1	-	V	
V_{BSUV+}	VBS Supply Under-Voltage, Positive Going Threshold	9.4	10.2	11	V	
V_{BSUV-}	VBS supply Under-Voltage, Negative Going Threshold	8.4	9.2	10	V	
V_{BSUVH}	VBS Supply Under-Voltage Lock- Out Hysteresis	0.6	1	-	V	
I_{QBS}	Quiescent VBS Supply Current	---	75	120	uA	V_{IN}=0V or 5V
I_{QCC}	Quiescent VCC Supply Current	---	160	300	uA	V_{IN}=0V or 5V
I_{IN+}	Input Bias Current	---	25	50	uA	V_{IN}=5V
I_{IN-}	Input Bias Current	---	---	1	uA	V_{IN}=0V

Dynamic Electrical Characteristics

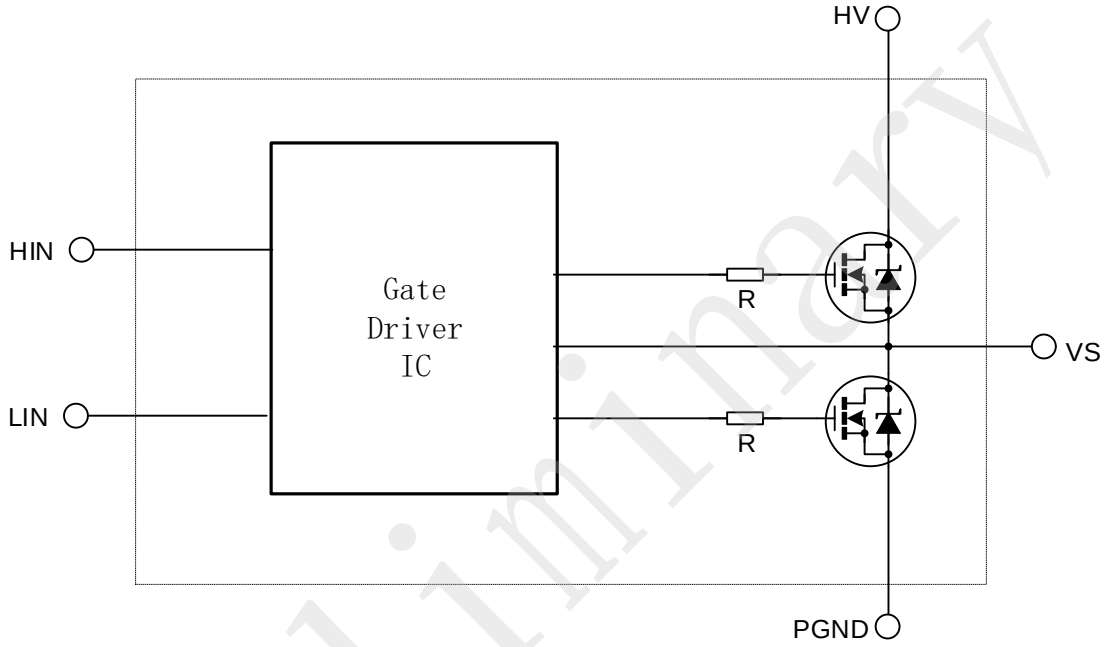
V_{BIAS} (V_{CC}, V_{BS})=15V, T_J=25℃, unless otherwise specified.

Symbol	Description	Min	Typ	Max	Units	Conditions
T_{ON}	Input to Output Propagation Turn-On Delay Time	---	0.8	1.5	uS	ID=1mA, HV=50V
T_{OFF}	Input to Output Propagation Turn-Off Delay Time	---	0.8	1.5	uS	ID=1mA, HV=50V
$T_{FIL,IN}$	Input Filter Time (HIN, LIN)	---	200	---	nS	

MOSFET Avalanche Characteristics

Symbol	Description	Min	Typ	Max	Units	Conditions
E_{AS}	Single Pulse Avalanche Energy	---	110	---	mJ	T_J=25°C, L=10mH, I_{AS}=4.7A, TO-252 package.
trr	Reverse Recovery Time	--	75	--	ns	I_S=3A, di/dt=100A/us

Input-Output Logic Level Table



HIN	LIN	VS
High	Low	HV
Low	High	PGND
Low	Low	*
High	High	**

* The VS voltage has two states. If the current flows from PGND to VS, the VS voltage is PGND; if the current flows from VS to HV, the VS voltage is HV

** Cross-conduction condition

Typical Application

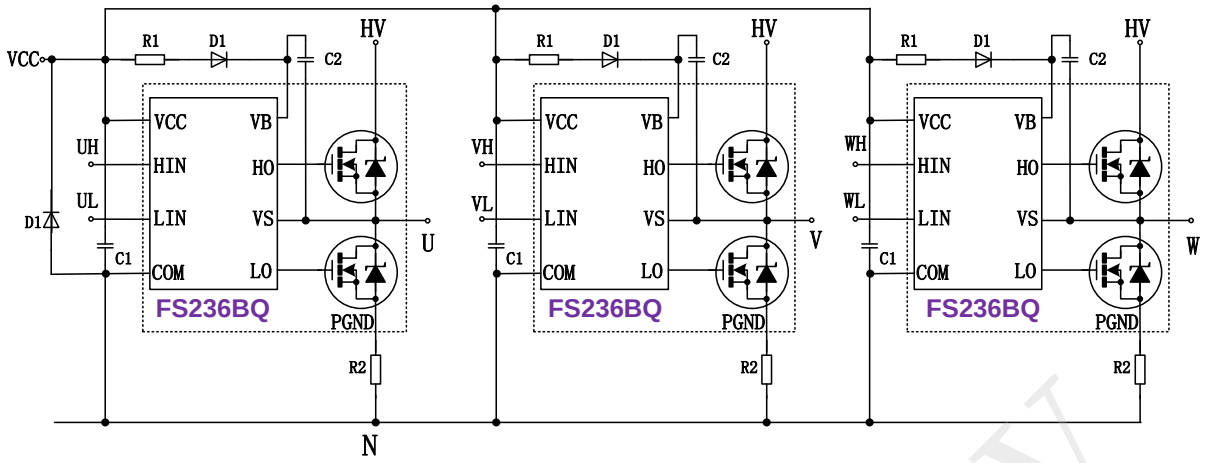
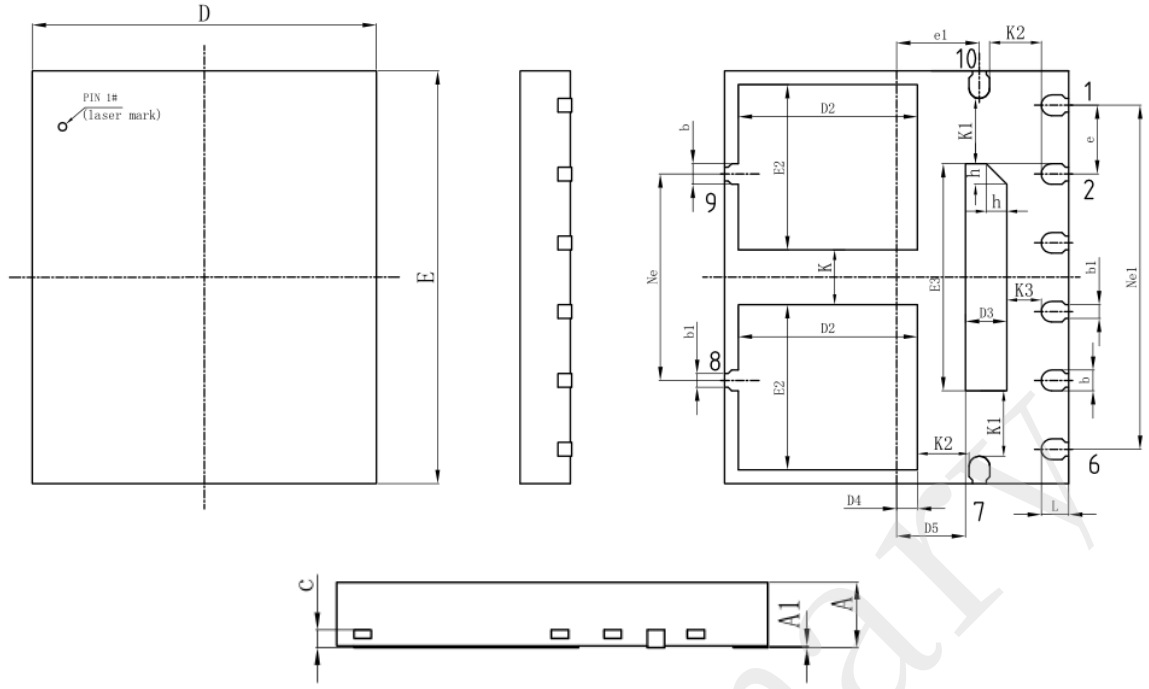


Figure: Typical Application Connection

1. In order to provide a good decoupling between VCC-COM and VB-VS terminals, the capacitors shown in the figure should be connected at these terminals and located very close to the module pins.
2. Value of the boot-strap capacitors depends upon the switching frequency.
3. Ground wires and output terminals, should be thick and short in order to avoid surge voltage and malfunction of HVIC.
4. It is recommended to connect high frequency non-inductive capacitor beside filter capacitor between HV&N with short wire to avoid surge destruction.
5. RC filtering capacitor maybe connected to inputs to prevent surge noise caused by wrong input signal.
6. High voltage (600V or more) and fast recovery type (less than 100ns) diodes D1 should be used in the bootstrap circuit. A resistor R1 (larger than 10ohm) must be added in series with the bootstrap diode.
7. To prevent ICs from surge destruction, it is recommended to insert a Zener diode D2 (18V,1W) nearby each pair of supply terminals.

Package Outline



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	——	0.02	0.05
b	0.25	0.30	0.35
b1	0.15	0.20	0.25
c	0.18	0.203	0.25
D	4.90	5.00	5.10
D2	2.50	2.60	2.70
D3	0.50	0.60	0.70
D4	0.25	0.30	0.35
D5	0.95	1.00	1.05
e	1.00BSC		
e1	1.20BSC		
Ne	3.00BSC		
Ne1	5.00BSC		
E	5.90	6.00	6.10
E2	2.30	2.40	2.50
E3	3.20	3.30	3.40
L	0.35	0.40	0.45
h	0.25	0.30	0.35
K	0.80REF		
K1	0.95REF		
K2	0.75REF		
K3	0.50REF		

Part Number	Package Type	Marking ID	Package Method	Quantity
FS236BQ	QFN10L-5*6	FS236BQ	Tray	490

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