



Is Now Part of



ON Semiconductor®

To learn more about ON Semiconductor, please visit our website at
www.onsemi.com

ON Semiconductor and the ON Semiconductor logo are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.



FPAB30BH60

PFC SPM® 3 Series for Single-Phase Boost PFC

Features

- UL Certified No. E209204 (UL1557)
- 600 V - 30 A Single-Phase Boost PFC with Integral Gate Driver and Protection
- Very Low Thermal Resistance Using Al₂O₃ DBC Substrate
- Full-Wave Bridge Rectifier and High-Performance Output Diode
- Built-in NTC Thermistor for Temperature Monitoring
- Optimized for 20kHz Switching Frequency
- Isolation Rating: 2500 Vrms/min.

Applications

- Single-Phase Boost PFC Converter

Related Source

- [AN-9090 - PFC SPM 3 Series User's Guide](#)
- [AN-9091 - Boost PFC Inductor Design Guide](#)

General Description

The FPAB30BH60 is a PFC SPM® 3 module providing a fully-featured, high-performance Boost PFC (Power Factor Correction) input power stage for consumer, medical, and industrial applications. These modules integrate optimized gate drive of the built-in IGBT to minimize EMI and losses, while also providing multiple on-module protection features including under-voltage lockout, over-current shutdown, thermal monitoring, and fault reporting. These modules also feature a full-wave rectifier, and high-performance output diode for additional space savings and mounting convenience

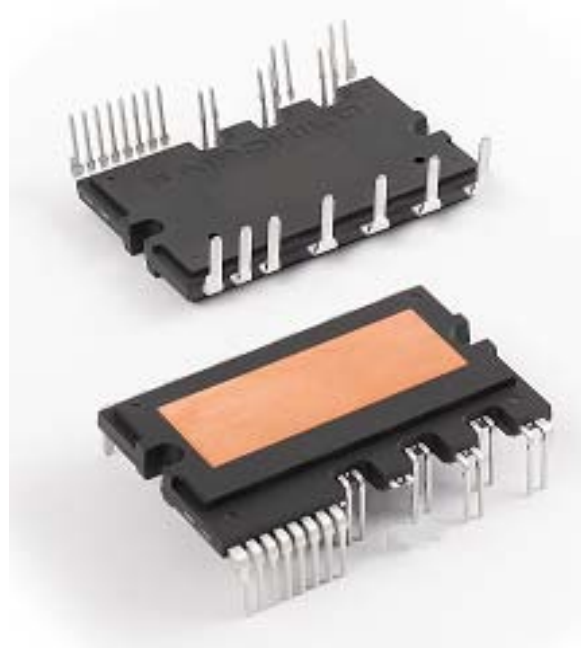


Figure 1. Package Overview

Package Marking & Ordering Information

Device	Device Marking	Package	Packing Type	Quantity
FPAB30BH60	FPAB30BH60	SPMIA-027	Rail	10

Integrated Power Functions

- PFC converter for single-phase AC / DC power conversion (please refer to Figure 3)

Integrated Drive, Protection, and System Control Functions

- For IGBTs: gate drive circuit, Over-Current Protection (OCP), control supply circuit Under-Voltage Lock-Out (UVLO) Protection
- Fault signal: corresponding to OC and UV fault
- Built-in thermistor: temperature monitoring
- Input interface: active-HIGH interface, works with 3.3 / 5 V logic, Schmitt-trigger input

Pin Configuration

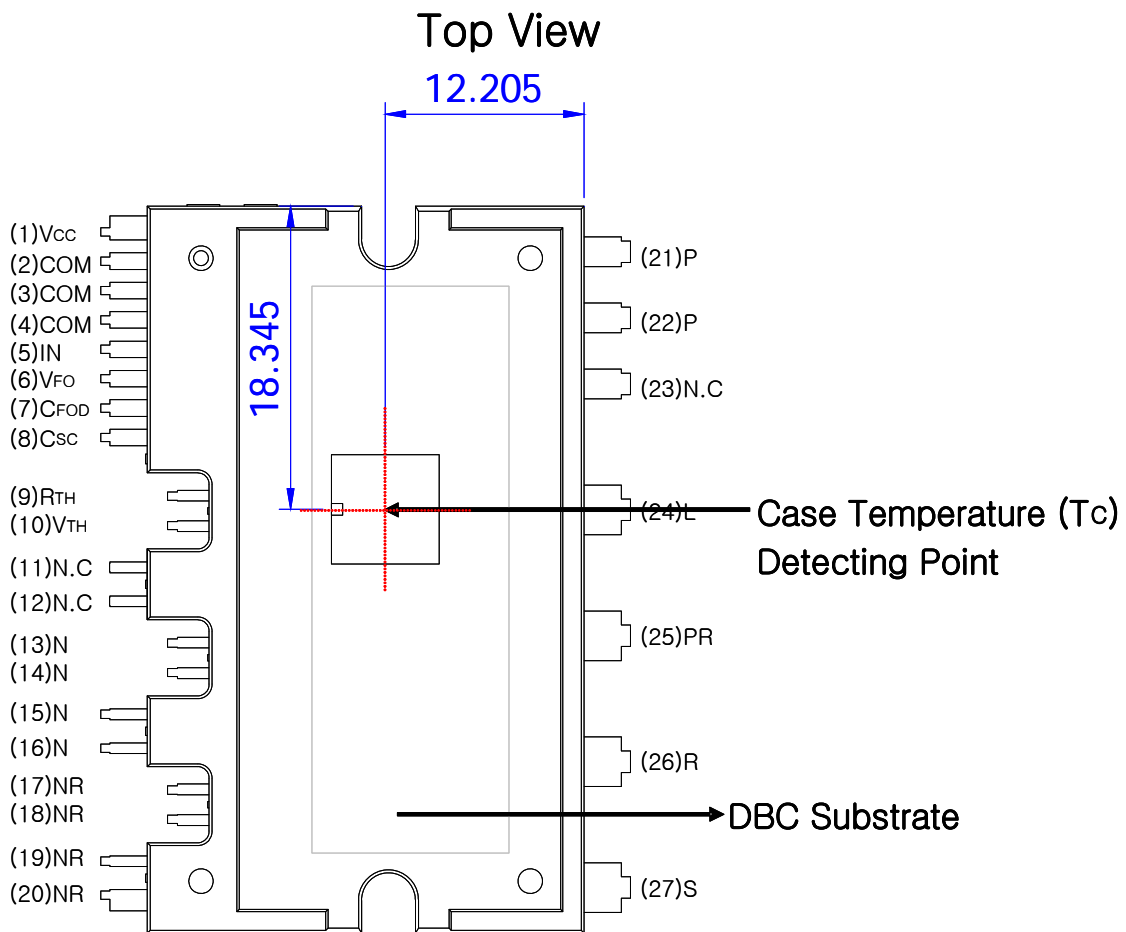


Figure 2. Top View

Notes :

1. For the measurement point of case temperature(T_c), please refer to Figure 2.

Pin Descriptions

Pin Number	Pin Name	Pin Description
1	V _{CC}	Common Bias Voltage for IC and IGBT Driving
2,3,4	COM	Common Supply Ground
5	IN	Signal Input for IGBT
6	V _{FO}	Fault Output
7	C _{FOD}	Capacitor for Fault Output Duration Selection
8	C _{SC}	Capacitor (Low-Pass Filter) for Over-Current Detection
9	R _(TH)	Series Resistor for The Use of Thermistor
10	V _(TH)	Thermistor Bias Voltage
11,12	N.C	No Connection*
13~16	N	IGBT Emitter
17~20	N _R	Negative DC-Link of Rectifier
21,22	P	Positive Rail of DC-Link
23	N.C	No Connection
24	L	Reactor Connection Pin
25	P _R	Positive DC-Link of Rectifier
26	R	AC Input for R-Phase
27	S	AC Input for S-Phase

* 11th and 12th pins are cut. Please refer to package outline drawings for more detail.

Internal Equivalent Circuit and Input/Output Pins

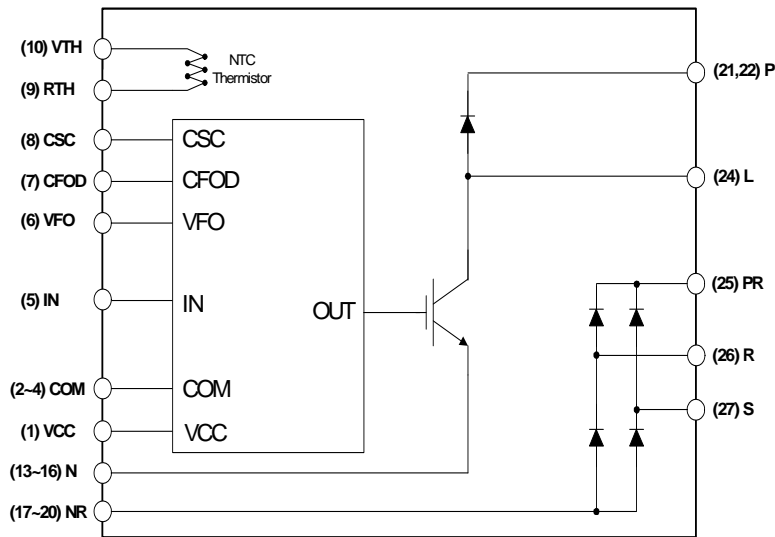


Figure 3. Internal Block Diagram

Absolute Maximum Ratings ($T_J = 25^\circ\text{C}$, unless otherwise specified.)**Converter Part**

Symbol	Item	Condition	Rating	Unit
V_i	Supply Voltage	Applied between R - S	264	V_{rms}
$V_{i(\text{Surge})}$	Supply Voltage (Surge)	Applied between R - S	500	V
V_{PN}	Output Voltage	Applied between P - N	450	V
$V_{\text{PN}(\text{Surge})}$	Output Voltage (Surge)	Applied between P - N	500	V
V_{CES}	Collector - Emitter Voltage		600	V
I_{FSM}	Peak Forward Surge Current	Single Half Sine-Wave	250	A
I_i	Input Current (100% Load)	$T_C < 95^\circ\text{C}$, $V_i = 220\text{ V}$, $V_{\text{PN}} = 390\text{ V}$, $V_{\text{PWM}} = 20\text{ kHz}$	25	A
$I_{i(125\%)}$	Input Current (125% Load)	$T_C < 95^\circ\text{C}$, $V_i = 220\text{ V}$, $V_{\text{PN}} = 390\text{ V}$, $V_{\text{PWM}} = 20\text{ kHz}$, 1 Minute Non-Repetitive	30	A
P_C	Collector Dissipation	$T_C = 25^\circ\text{C}$	169	W
T_J	Operating Junction Temperature		-20 ~ 150	$^\circ\text{C}$

Notes:

1. The maximum junction temperature rating of the power chips integrated within the PFC SPM® product is 150°C ($@T_C \leq 100^\circ\text{C}$). However, to insure safe operation of the PFC SPM product, the average junction temperature should be limited to $T_{\text{J(ave)}} \leq 125^\circ\text{C}$ ($@T_C \leq 100^\circ\text{C}$)

Control Part

Symbol	Item	Condition	Rating	Unit
V_{CC}	Control Supply Voltage	Applied between V_{CC} - COM	20	V
V_{IN}	Input Signal Voltage	Applied between IN - COM	-0.3 ~ $V_{\text{CC}}+0.3$	V
V_{FO}	Fault Output Supply Voltage	Applied between V_{FO} - COM	-0.3 ~ $V_{\text{CC}}+0.3$	V
I_{FO}	Fault Output Current	Sink Current at V_{FO} Pin	5	mA
V_{SC}	Current Sensing Input Voltage	Applied between C_{SC} - COM	-0.3 ~ $V_{\text{CC}}+0.3$	V

Total System

Symbol	Item	Condition	Rating	Unit
T_C	Module Case Operating Temperature		-20 ~ 100	$^\circ\text{C}$
T_{STG}	Storage Temperature		-40 ~ 125	$^\circ\text{C}$
V_{ISO}	Isolation Voltage	60 Hz, Sinusoidal, AC 1 Minute, Connect Pins to Heat Sink Plate	2500	V_{rms}

Thermal Resistance

Symbol	Item	Condition	Min.	Typ.	Max.	Unit
$R_{\theta(j-c)Q}$	Junction to Case Thermal Resistance	IGBT	-	-	0.74	$^\circ\text{C}/\text{W}$
$R_{\theta(j-c)F}$		FRD	-	-	1.44	$^\circ\text{C}/\text{W}$
$R_{\theta(j-c)R}$		Rectifier (per 1 / 4 module)	-	-	2.07	$^\circ\text{C}/\text{W}$

Notes:

2. For the measurement point of case temperature(T_C), please refer to Figure 2.

Electrical Characteristics (T_J = 25°C, Unless Otherwise Specified.)

Converter Part

Symbol	Item	Condition	Min.	Typ.	Max.	Unit
V _{CE(SAT)}	IGBT Saturation Voltage	V _{CC} = 15 V, V _{IN} = 5 V, I _C = 30 A	-	2.0	2.8	V
V _{FF}	FRD Forward Voltage	I _F = 30 A	-	1.8	2.5	V
V _{FR}	Rectifier Forward Voltage	I _F = 30 A	-	1.2	1.5	V
t _{ON}	Switching Times	V _{PN} = 400 V, V _{CC} = 15V, I _C = 30 A V _{IN} = 0 V ↔ 5 V, Inductive Load (Note 3)	-	650	-	ns
t _{C(ON)}			-	400	-	ns
t _{OFF}			-	620	-	ns
t _{C(OFF)}			-	200	-	ns
t _{rr}			-	60	-	ns
I _{rr}			-	3.5	-	A
I _{CES}	Collector - Emitter Leakage Current	V _{CE} = V _{CES}	-	-	250	μA

Notes:

3. t_{ON} and t_{OFF} include the propagation delay time of the internal drive IC. t_{C(ON)} and t_{C(OFF)} are the switching time of IGBT itself under the given gate driving condition internally. For the detailed information, please see Figure 4.

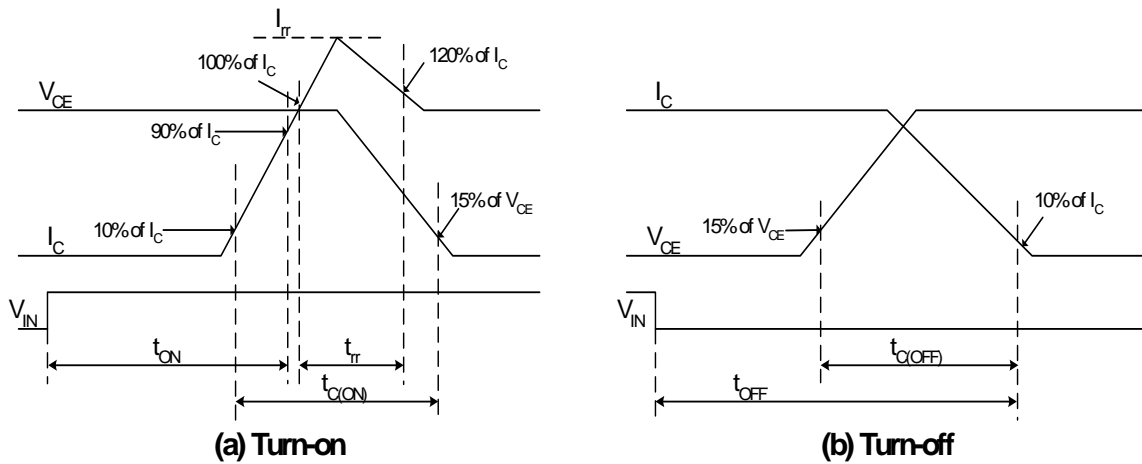


Figure 4. Switching Time Definition

Control Part

Symbol	Item	Condition	Min.	Typ.	Max.	Unit
I _{QCCL}	Quiescent V _{CC} Supply Current	V _{CC} = 15 V, IN = 0 V V _{CC} - COM	-	-	26	mA
V _{FOH}	Fault Output Voltage	V _{SC} = 0 V, V _{FO} Circuit: 4.7 kΩ to 5 V Pull-up	4.5	-	-	V
V _{FOL}		V _{SC} = 1 V, V _{FO} Circuit: 4.7 kΩ to 5 V Pull-up	-	-	0.8	V
V _{SC(ref)}	Over-Current Trip Level	V _{CC} = 15 V	0.45	0.5	0.55	V
UV _{CCD}	Supply Circuit Under-Voltage Protection	Detection Level	10.7	11.9	13.0	V
UV _{CCR}		Reset Level	11.2	12.4	13.2	V
t _{FOD}	Fault-Out Pulse Width	C _{FOD} = 33 nF (Note 3)	1.4	1.8	2.0	ms
V _{IN(ON)}	ON Threshold Voltage	Applied between IN - COM	2.8	-	-	V
V _{IN(OFF)}	OFF Threshold Voltage		-	-	0.8	V
R _{TH}	Resistance of Thermistor	at T _{TH} = 25°C (Note 4, Figure 5)	-	50	-	kΩ
		at T _{TH} = 100°C (Note 4, Figure 5)	-	2.99	-	kΩ

Notes:

3. The fault-out pulse width t_{FOD} depends on the capacitance value of C_{FOD} according to the following approximate equation : C_{FOD} = 18.3 x 10⁻⁶ x t_{FOD}[F]
4. T_{TH} is the temperature of know case temperature(T_C), please make the experiment considering your application.

R-T Graph

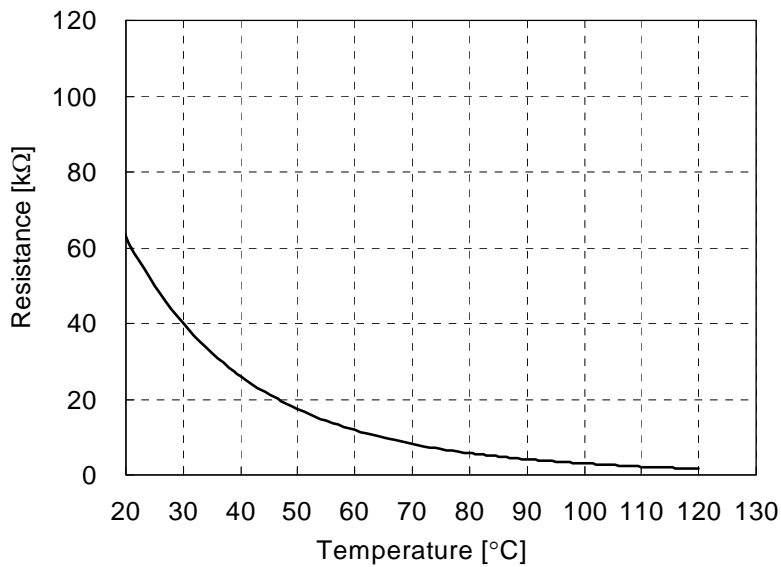


Figure 5. R-T Curve of the Built-In Thermistor

Recommended Operating Condition

Symbol	Item	Condition	Min.	Typ.	Max.	Unit
V_i	Input Supply Voltage	Applied between R - S	187	220	253	V_{rms}
V_{PN}	Output Voltage	Applied between P - N	-	380	400	V
V_{CC}	Control Supply Voltage	Applied between $V_{CC(L)}$ - COM	13.5	15.0	16.5	V
dV_{CC}/dt	Control Supply Variation		-1	-	1	V/ μ s
f_{PWM}	PWM Input Frequency	$T_J \leq 150^\circ\text{C}$	-	20	-	kHz
I_i	Allowable Input Current	$T_C < 90^\circ\text{C}$, $V_i = 220\text{ V}$, $V_{PN} = 380\text{ V}$ $V_{PWM} = 20\text{ kHz}$	-	-	30	A_{peak}

Mechanical Characteristics and Ratings

Item	Condition		Min.	Typ.	Max.	Unit
Mounting Torque	Mounting Screw: M3	Recommended 0.62 N•m	0.51	0.62	0.72	N•m
Device Flatness	See Figure 6		0	-	+120	μm
Weight			-	15.00	-	g

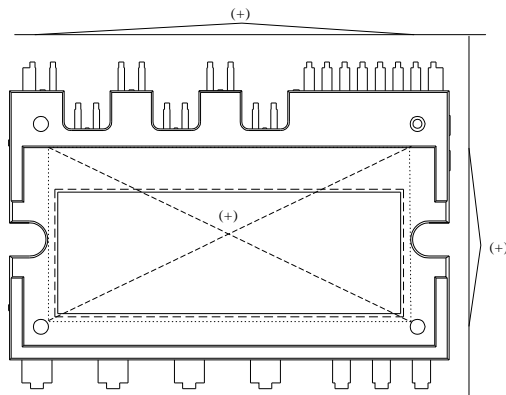
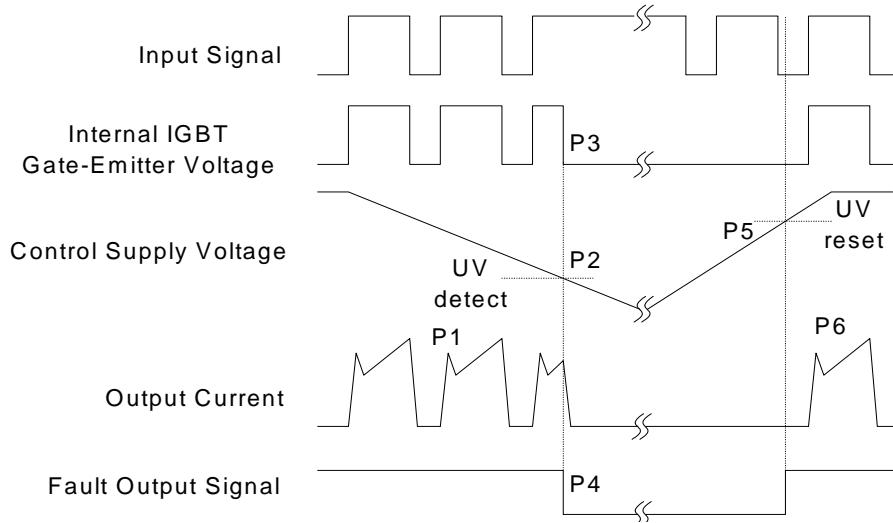


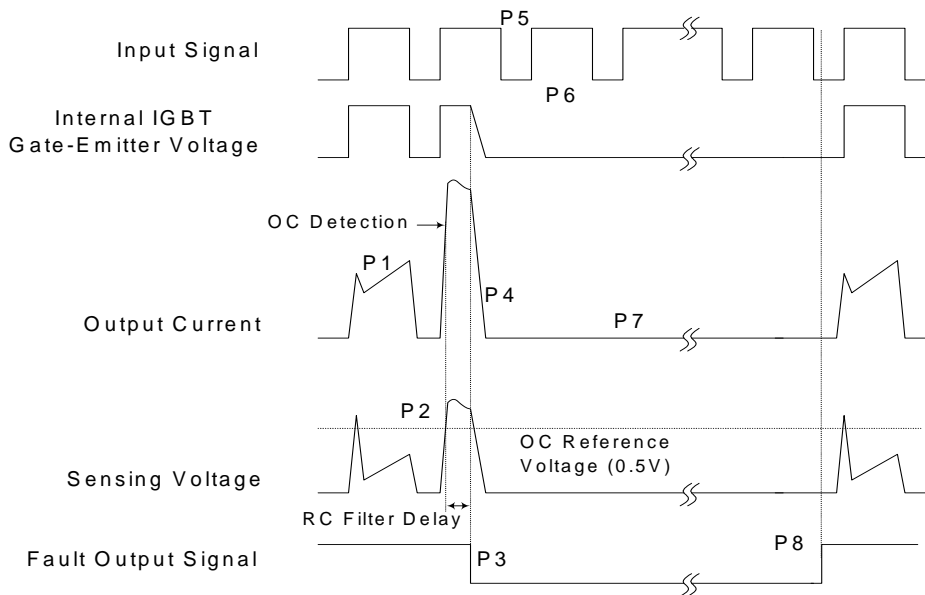
Figure 6. Flatness Measurement Position

Time Charts of Protective Function



- P1 : Normal operation: IGBT ON and conducting current
- P2 : Under-voltage detection
- P3 : IGBT gate interrupt
- P4 : Fault signal generation
- P5 : Under-voltage reset
- P6 : Normal operation: IGBT ON and conducting current

Figure 7. Under-Voltage Protection



- P1 : Normal operation: IGBT ON and conducting current
- P2 : Over current detection
- P3 : IGBT gate interrupt / fault signal generation
- P4 : IGBT is slowly turned off
- P5 : IGBT OFF signal
- P6 : IGBT ON signal: but IGBT cannot be turned on during the fault output activation
- P7 : IGBT OFF state
- P8 : Fault output reset and normal operation start

Figure 8. Over-Current Protection

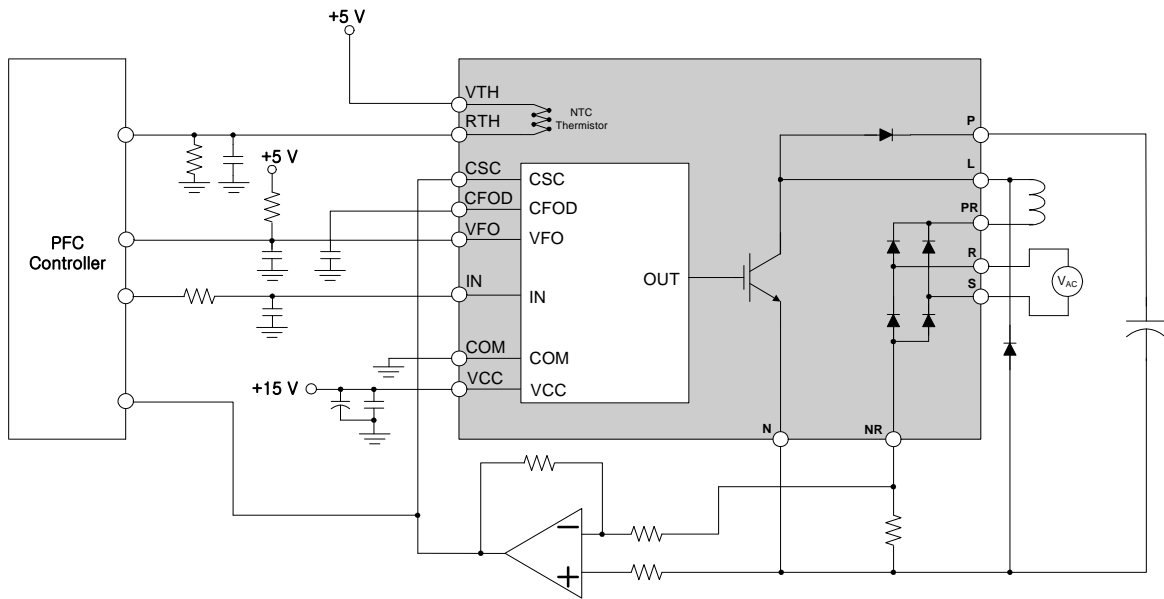
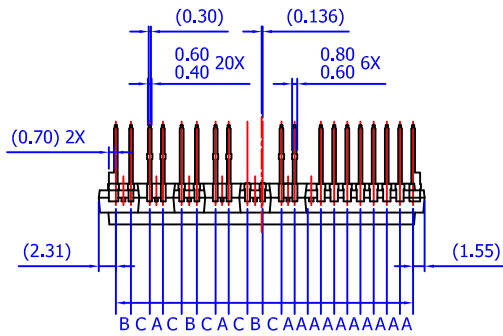


Figure 9. Application Example

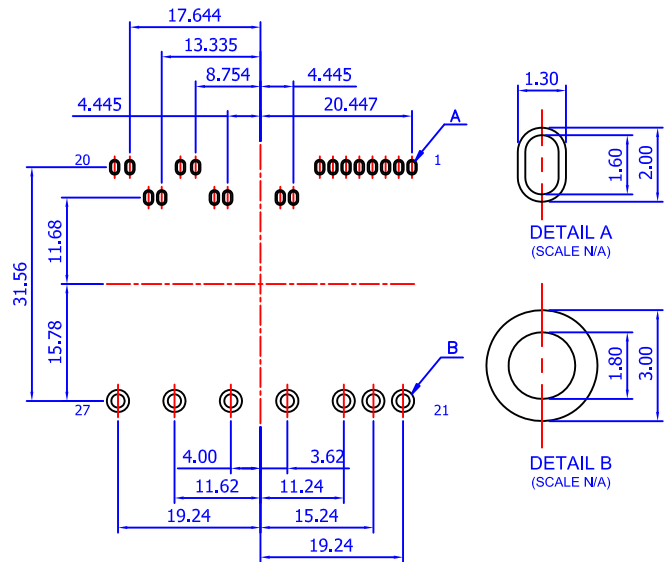
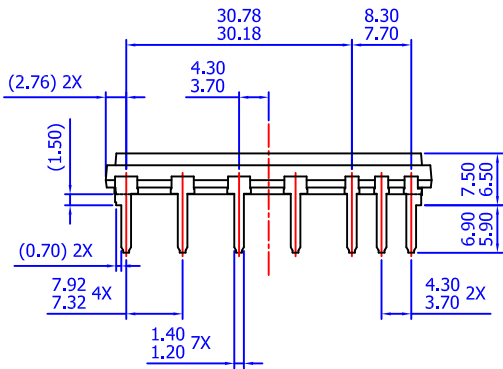
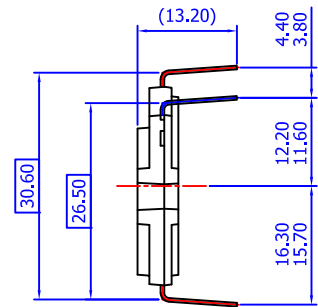
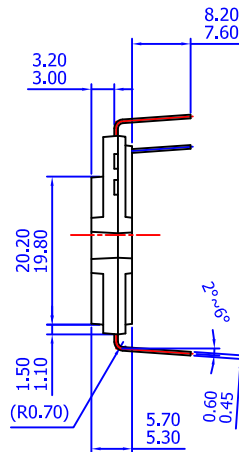
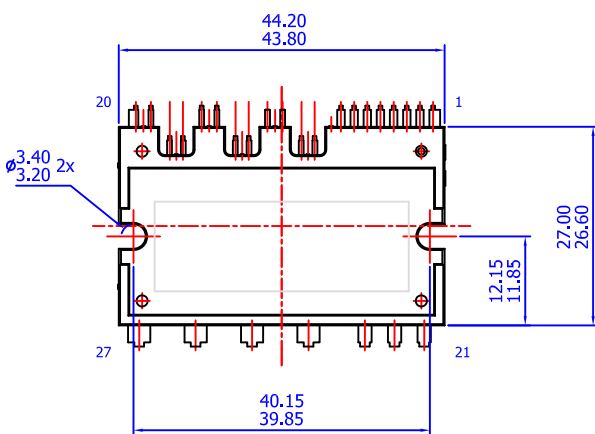
Notes:

5. Each capacitors should be located as close to PFC SPM® product pins as possible.
6. It's recommended that anti-parallel diode should be connected with IGBT.



LEAD PITCH (TOLERANCE : ±0.30)

- A : 1.778
- B : 2.050
- C : 2.531



- NOTES: UNLESS OTHERWISE SPECIFIED
- A) THIS PACKAGE DOES NOT COMPLY TO ANY CURRENT PACKAGING STANDARD
 - B) ALL DIMENSIONS ARE IN MILLIMETERS
 - C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS
 - D) () IS REFERENCE
 - E) [] IS ASSY QUALITY
 - F) DRAWING FILENAME: MOD27BEREV3
 - G) FAIRCHILD SEMICONDUCTOR

LAND PATTERN RECOMMENDATIONS



ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855 Toll Free
USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81-3-5817-1050

ON Semiconductor Website: www.onsemi.com
Order Literature: <http://www.onsemi.com/orderlit>
For additional information, please contact your local
Sales Representative