FAIRCHILD

SEMICONDUCTOR®

Motion-SPM ™

FPAB30BH60B

Smart Power Module(SPM®) for Front-End Rectifier

General Description

FPAB30BH60B is an advanced smart power module(SPM®) of PFC(Power Factor Correction) that Fairchild has newly developed and designed mainly targeting mid-power application especially for an air conditioners. It combines optimized circuit protection and drive IC matched to high frequency switching IGBT. System reliability is futher enhanced by the integrated under-voltage lock-out and over-current protection function.

Features

- Low thermal resistance due to Al_2O_3-DBC substrate
- 600V-30A Single phase IGBT PWM converter including a drive IC for gate driving and protection
- Typical switching frequency of 20kHz
- Isolation rating of 2500Vrms/min.

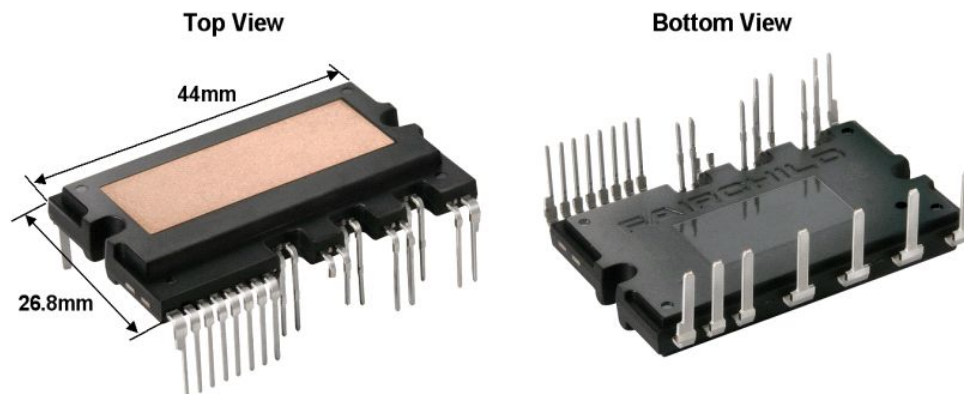### Applications

- Home appliances application like air conditioner

Top View

44mm

26.8mm

Bottom View

Fig. 1.

Integrated Power Functions

• PFC converter for single-phase AC/DC power conversion (Please refer to Fig. 3)

Integrated Drive, Protection and System Control Functions

• For IGBT: Gate drive circuit, Overcurrent circuit protection (OC), Control supply circuit under-voltage (UV) protection
• Fault signaling: Corresponding to a UV fault and OC fault
• Input interface: 3.3/5V CMOS/LSTTL compatible, Schmitt trigger input
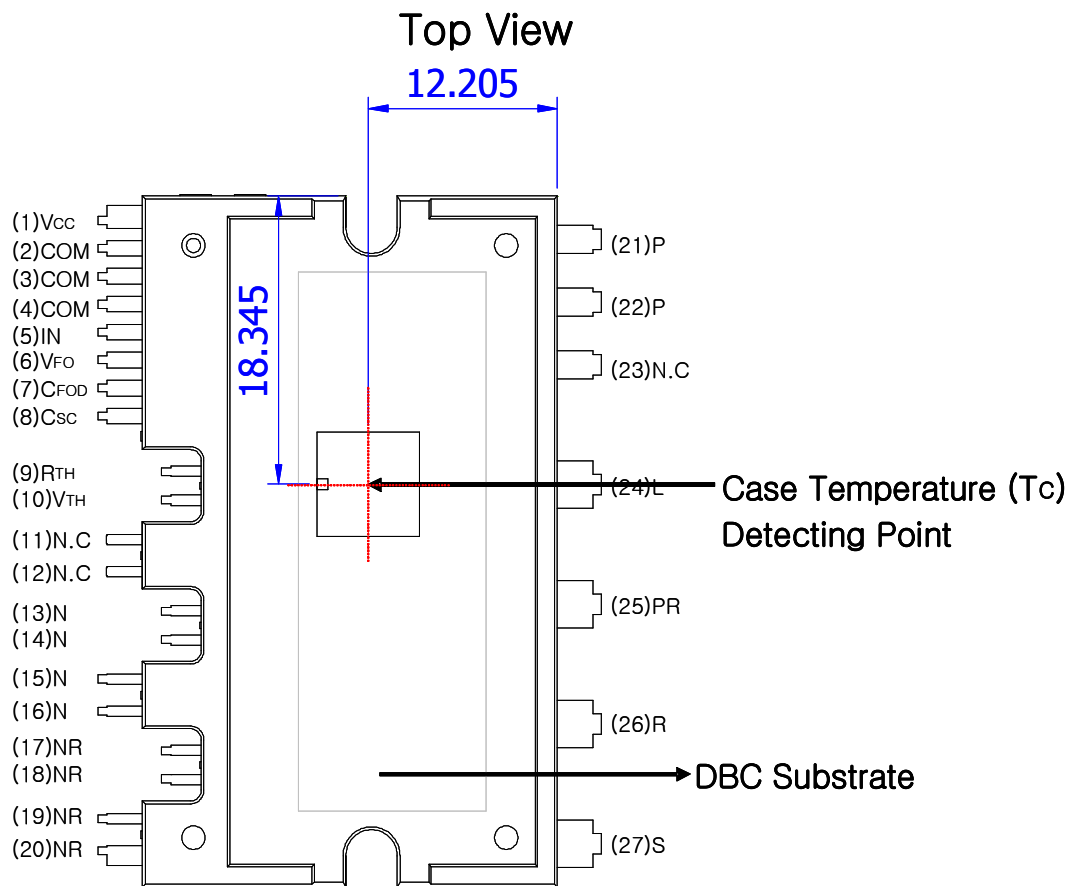
Pin Configuration

Top View

12.205

18.345

(1)V_{CC}
(2)COM
(3)COM
(4)COM
(5)IN
(6)V_{FO}
(7)C_{FOD}
(8)C_{SC}

(9)R_{TH}
(10)V_{TH}

(11)N.C
(12)N.C

(13)N
(14)N

(15)N
(16)N

(17)NR
(18)NR

(19)NR
(20)NR

(21)P
(22)P
(23)N.C
(24)L
(25)PR
(26)R
(27)S

Case Temperature (Tc) Detecting Point

DBC Substrate

Fig. 2.

Note : For the measurement point of case temperature(T_C), please refer to Fig. 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 Time Selection
8	C_{SC}	Capacitor (Low-pass Filter) for Over Current Detection
9	$R_{(TH)}$	NTC Thermistor terminal
10	$V_{(TH)}$	NTC Thermistor terminal
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.

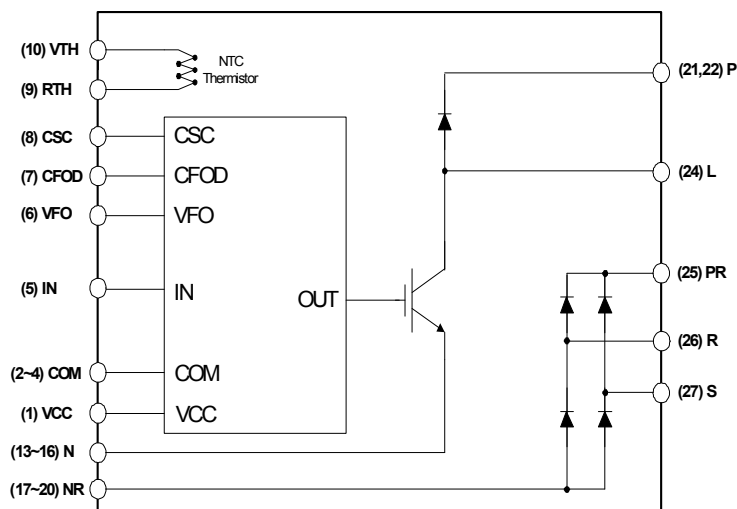## Internal Equivalent Circuit and Input/Output Pins

Fig. 3.

Package Marking & Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FPAB30BH60B	FPAB30BH60B	SPM27-IC	-	-	10

Absolute Maximum Ratings (T$_J$ = 25°C, Unless Otherwise Specified)
Converter Part

Item	Symbol	Condition	Rating	Unit
Supply Voltage	V$_i$	Applied between R-S	264	V$_{RMS}$
Supply Voltage (Surge)	V$_{i(Surge)}$	Applied between R-S	500	V
Output Voltage	V$_{PN}$	Applied between P- N	450	V
Output Voltage (Surge)	V$_{PN(Surge)}$	Applied between P- N	500	V
Collector-emitter Voltage	V$_{CES}$		600	V
Each IGBT Collector Current	I$_C$	T$_C$ = 25°C, T$_J$ < 150°C	30	A
Each IGBT Collector Current (peak)	I$_{CP}$	T$_C$ = 25°C, T$_J$ < 150°C Under 1ms pulse width	60	A
Collector Dissipation	P$_C$	T$_C$ = 25°C per One IGBT	104	W
Repititive Peak Reverse Voltage	V$_{RRM}$		600	V
Peak Forward Surge Current	I$_{FSM}$	Single half sine-wave	350	A
Operating Junction Temperature	T$_J$		-40 ~ 150	°C

Control Part

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

Total System

Item	Symbol	Condition	Rating	Unit
Storage Temperature	T$_{STG}$		-40 ~ 125	°C
Isolation Voltage	V$_{ISO}$	60Hz, Sinusoidal, AC 1 minute, Connection Pins to DBC	2500	V$_{rms}$

Thermal Resistance

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Junction to Case Thermal Resistance	R$_{\theta(j-c)Q}$	IGBT	-	-	1.2	°C/W
	R$_{\theta(j-c)F}$	FRD	-	-	1.4	°C/W
	R$_{\theta(j-c)R}$	Rectifier	-	-	1.7	°C/W

Electrical Characteristics (T$_J$ = 25°C, Unless Otherwise Specified)

Converter Part

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
IGBT saturation voltage	V$_{CE(sat)}$	V$_{CC}$ =15V, V$_{IN}$ = 5V; I$_C$ =30A	-	2.2	2.8	V
FRD forward voltage	V$_{FF}$	I$_F$ = 30A	-	1.9	2.6	V
Rectifier forward voltage	V$_{FR}$	I$_F$ = 30A	-	1.2	1.5	V
Switching Times	t$_{ON}$	V$_{PN}$ = 400V, V$_{CC}$ = 15V, I$_C$ =30A	-	500	-	ns
	t$_{C(ON)}$	V$_{IN}$ = 0V ↔ 5V, Inductive Load	-	200	-	ns
	t$_{OFF}$	(Note 1)	-	420	-	ns
	t$_{C(OFF)}$		-	100	-	ns
	t$_{rr}$		-	60	-	ns
	I$_{rr}$		-	7	-	A
Collector - emitter Leakage Current	I$_{CES}$	V$_{CE}$ = V$_{CES}$	-	-	250	μA

Note
1. 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 Fig. 4

Electrical Characteristics

(a) Turn-on   **(b) Turn-off**
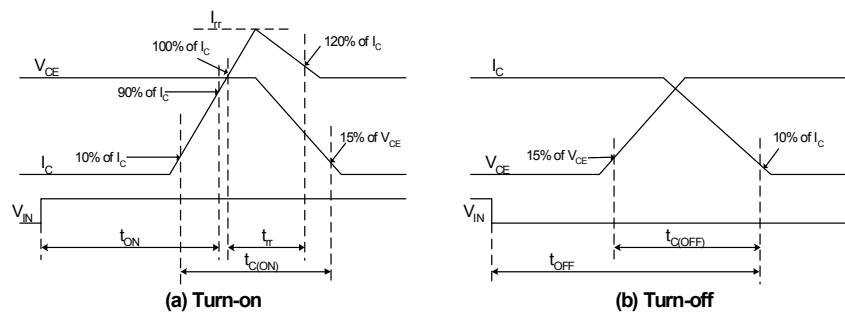
Fig. 4. Switching Time Definition

Control Part

Item	Symbol	Condition		Min.	Typ.	Max.	Unit
Quiescent V$_{CC}$ Supply Current	I$_{QCCL}$	V$_{CC}$ = 15V, IN = 0V	V$_{CC}$ - COM	-	-	26	mA
Fault Output Voltage	V$_{FOH}$	V$_{SC}$ = 0V, V$_{FO}$ Circuit: 4.7kΩ to 5V Pull-up		4.5	-	-	V
	V$_{FOL}$	V$_{SC}$ = 1V, V$_{FO}$ Circuit: 4.7kΩ to 5V Pull-up		-	-	0.8	V
Over Current Trip Level	V$_{SC(ref)}$	V$_{CC}$ = 15V		0.45	0.5	0.55	V
Supply Circuit Under-Voltage Protection	UV$_{CCD}$	Detection Level		10.7	11.9	13.0	V
	UV$_{CCR}$	Reset Level		11.2	12.4	13.2	V
Fault-out Pulse Width	t$_{FOD}$	C$_{FOD}$ = 33nF (Note 2)		1.4	1.8	2.0	ms
ON Threshold Voltage	V$_{IN(ON)}$	Applied between IN - COM		2.8	-	-	V
OFF Threshold Voltage	V$_{IN(OFF)}$			-	-	0.8	V
Resistance of Thermistor	R$_{TH}$	@ T$_{TH}$ = 25°C (Note3, Fig. 9)		-	47.0	-	kΩ
		@ T$_{TH}$ = 100°C (Note3, Fig. 9)		-	2.9	-	kΩ

Note
2. 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]
3. T$_{TH}$ is the temperature of know case temperature(Tc), please make the experiment considering your application.

Recommended Operating Condition

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Input Supply Voltage	V_i	Applied between R-S	187	220	253	V
Output Voltage	V_{PN}	Applied between P-N		380	400	V
Control Supply Voltage	V_{CC}	Applied between $V_{CC(L)}$- COM	13.5	15	16.5	V
Control supply variation	dV_{CC}/dt		-1	-	1	V/μs
PWM Input Frequency	f_{PWM}	$T_J \le 150°C$ per IGBT		20		kHz
Allowable Input Current (Peak)	I_i	$T_C < 90°C$, V_i=220V, V_{PN}=380V V_{PWM}=20KHz			30	A

Mechanical Characteristics and Ratings

Item	Condition		Limits			Units
			Min.	Typ.	Max.	
Mounting Torque	Mounting Screw: - M3	Recommended 0.62N•m	0.51	0.62	0.72	N•m
Device Flatness	Note Fig. 5		0	-	+120	μm
Weight			-	15.00	-	g
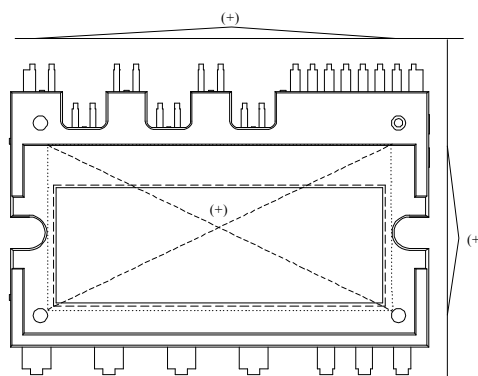
Fig. 5. Flatness Measurement Position

Time Charts of SPMs Protective Function

Input Signal

Internal IGBT
Gate-Emitter Voltage

Control Supply Voltage

UV
detect

P3

P2

P5

UV
reset

Output Current

P1

P6

Fault Output Signal

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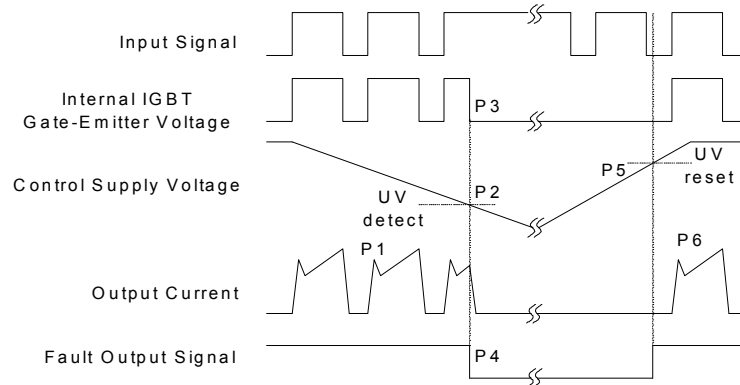
P1 : Normal operation - IGBT ON and conducting current
P2 : Under voltage detection
P3 : IGBT gate interrupt
P4 : Fault signal generation
P5 : Under voltage reset
P6 : Normal operation - IGBT ON and conducting current

Fig. 6. Under-Voltage Protection

Input Signal

P5

Internal IGBT
Gate-Emitter Voltage

P6

OC Detection →

Output Current

P1

P4

P7

Sensing Voltage

P2

OC Reference
Voltage (0.5V)

RC Filter Delay

Fault Output Signal

P3

P8
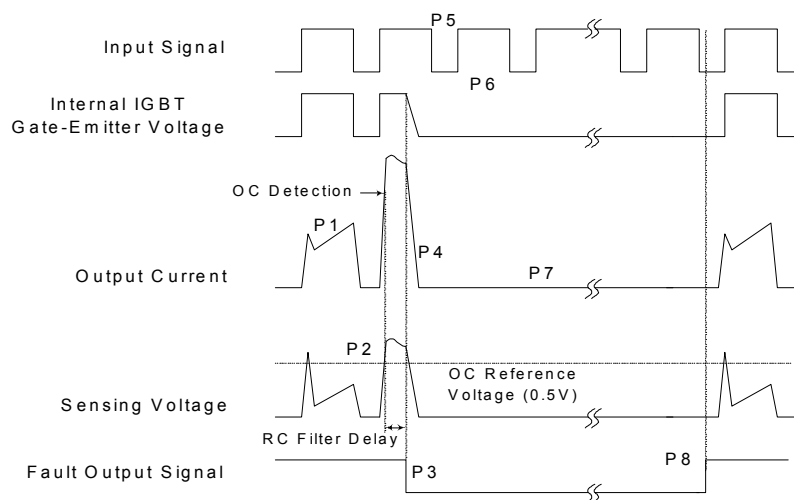
P1 : Normal operation - IGBT ON and conducting current
P2 : Over current detection
P3 : IGBT gate interrupt / Fault signal generation
P4 : IGBT is slowly turned off
P5 : IGBT OFF signal
P6 : IGBT ON signal - but IGBT cannot be turned on during the fault Output activation
P7 : IGBT OFF state
P8 : Fault Output reset and normal operation start
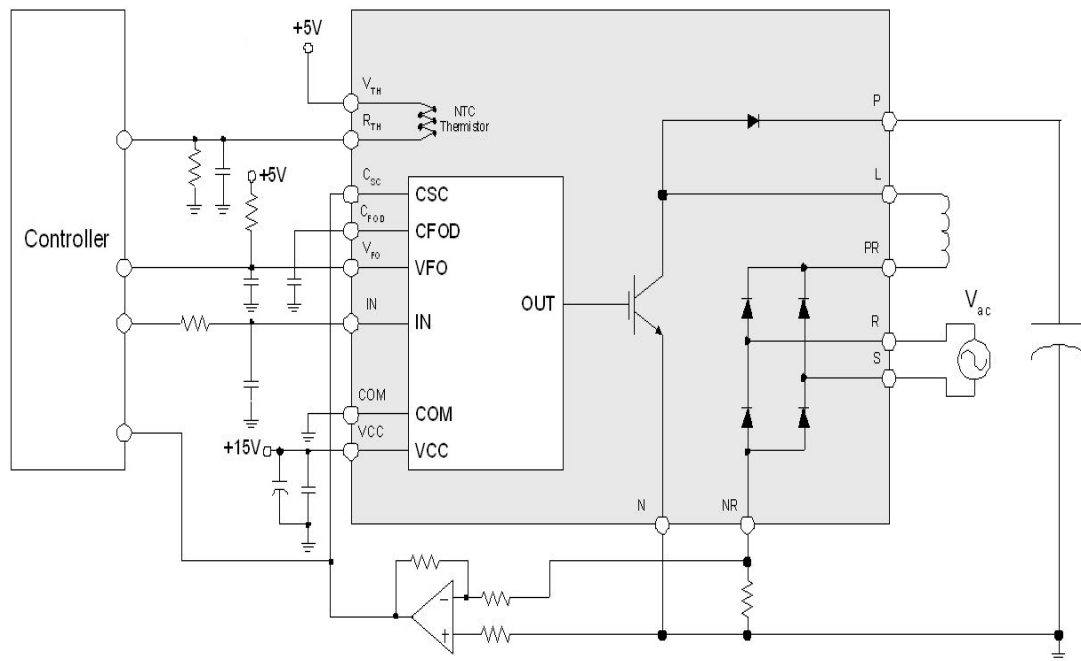
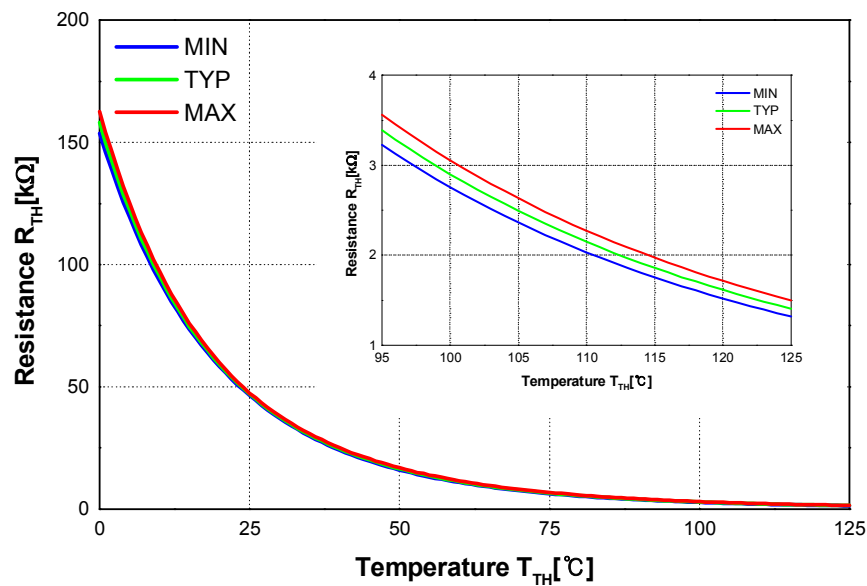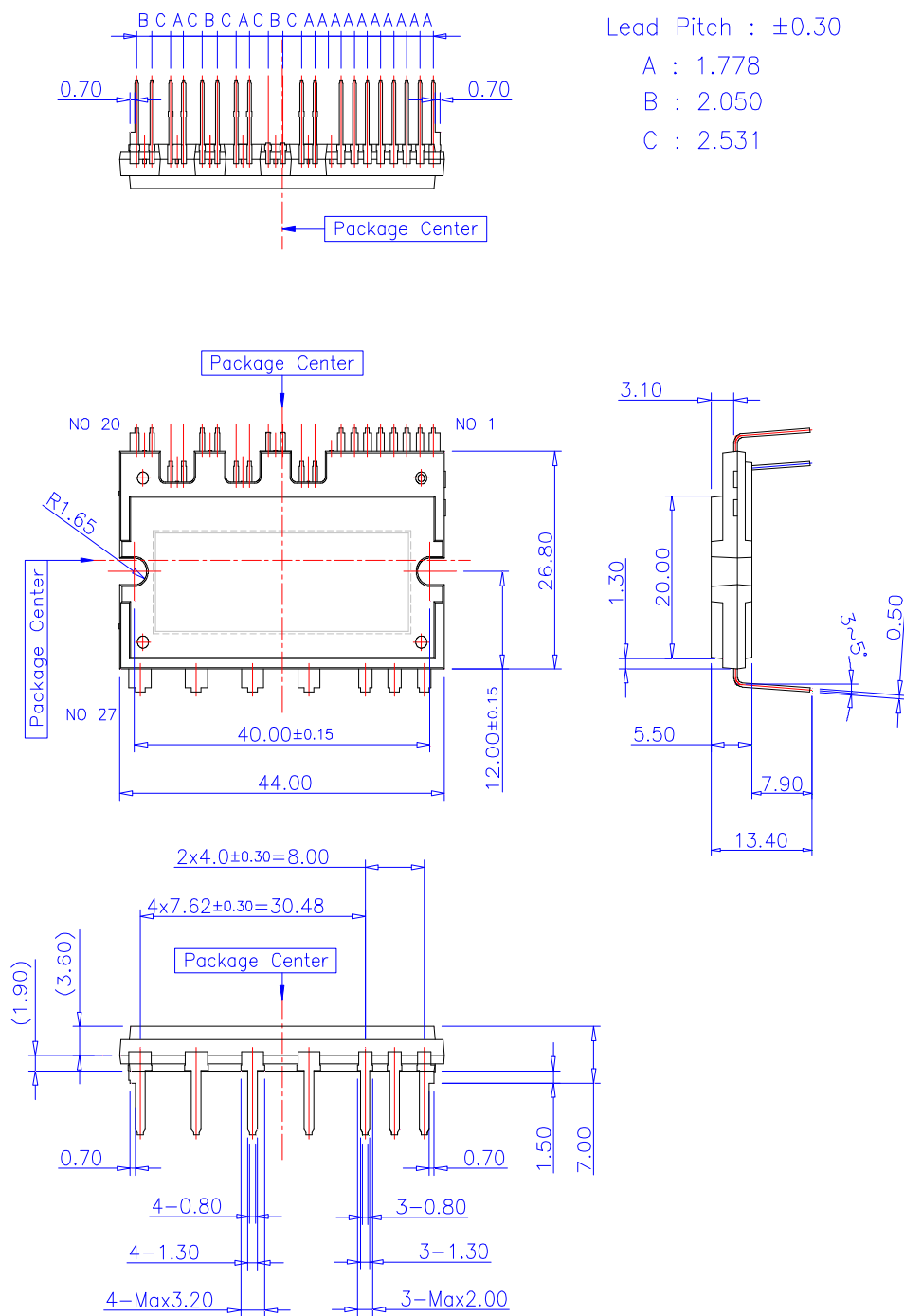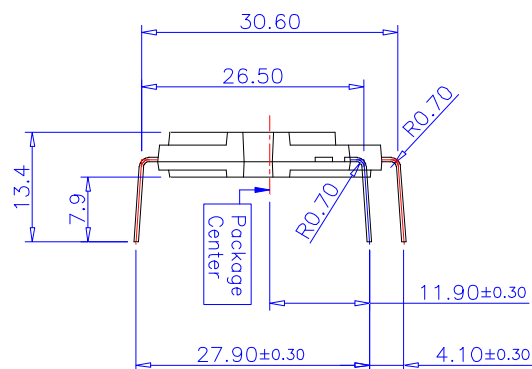**Fig. 7. Over Current Protection**

Fig. 8. Application Example

R-T Curve

Fig. 9. R-T Curve of the Built-in Thermistor

Detailed Package Outline Drawings

Lead Pitch : ±0.30
A : 1.778
B : 2.050
C : 2.531

B C A C B C A C B C A A A A A A A A A A

0.70   0.70

Package Center

NO 20   NO 1

R1.65

Package Center

26.80

1.30

20.00

12.00±0.15

NO 27

40.00±0.15

44.00

3.10

0.50

3~5°

5.50

7.90

13.40

2x4.0±0.30=8.00

4x7.62±0.30=30.48

(1.90)   (3.60)

Package Center

0.70   0.70

1.50

7.00

4-0.80   3-0.80

4-1.30   3-1.30

4-Max3.20   3-Max2.00

Detailed Package Outline Drawings

30.60

26.50

13.4

7.9

R0.70

R0.70

Package Center

11.90±0.30

27.90±0.30

4.10±0.30

Lead Forming Dimension

Package Center

(2.306)

(1.553)

19.694±0.30

20.447±0.30

Package Center

(2.76)

(2.76)

19.24±0.30

19.24±0.30

PKG Center to Lead Distance

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Detailed Package Outline Drawings

DETAIL LEAD

LEAD TYPE 2

LEAD TYPE 3   LEAD TYPE 1

3.90±0.20

0.50±0.10   0.50±0.10   0.50±0.10

X   X'

MAX1.20   MAX0.70   MAX0.85

LEAD TYPE 1   LEAD TYPE 2   LEAD TYPE 3

SCALE 2 : 1

0.50   0.70   0.50

0.50   0.50   0.50
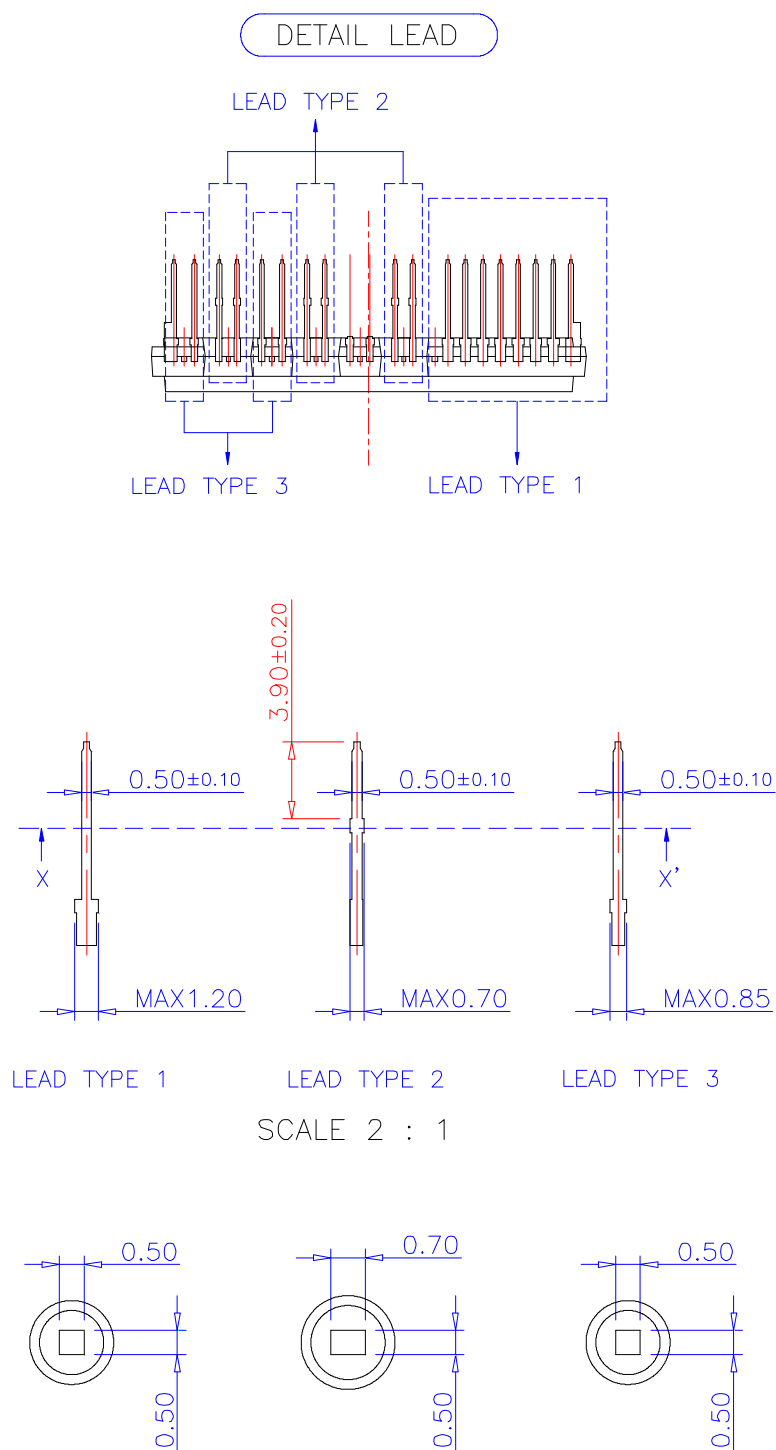
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