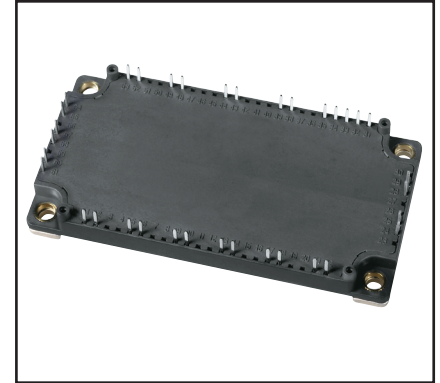
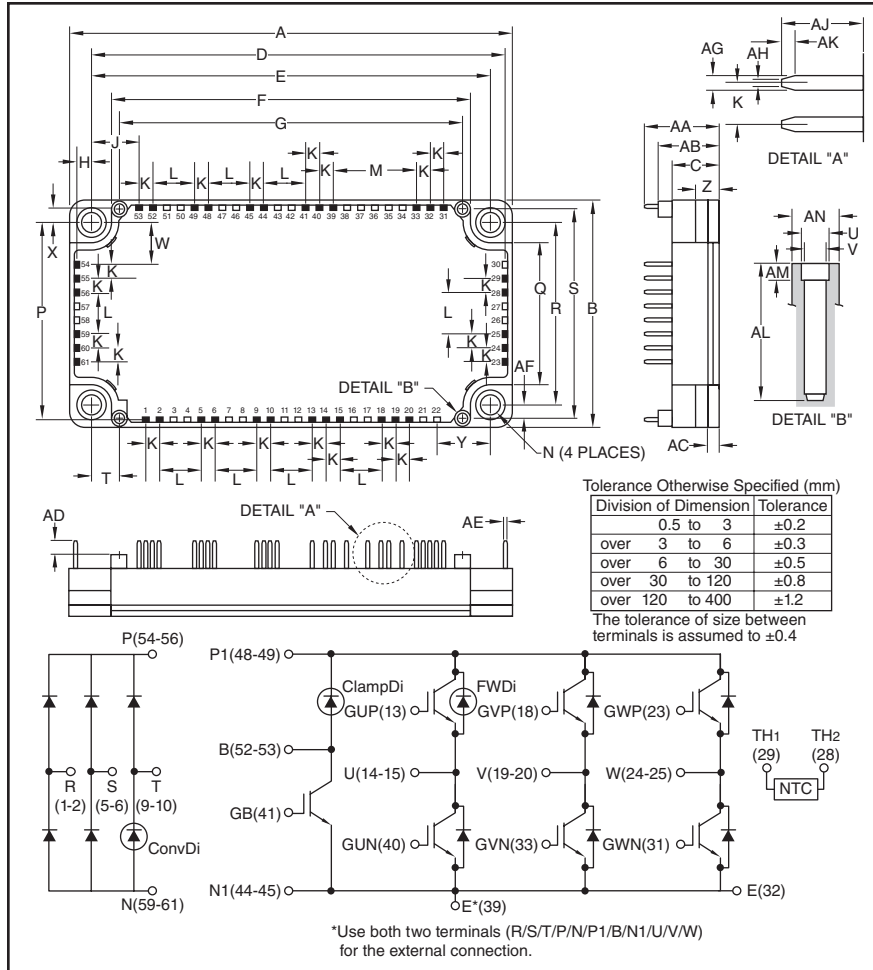


### NX-S Series CIB Module (3Ø Converter + 3Ø Inverter + Brake) 35 Amperes/1200 Volts



#### Description:

CIBs are low profile and thermally efficient. Each module consists of a three-phase diode converter section, a three-phase inverter section and a brake circuit. A thermistor is included in the package for sensing the baseplate temperature. 6th Generation CSTBT chips yield low loss.

#### Features:

- Low Drive Power
- Low  $V_{CE(sat)}$
- Discrete Super-Fast Recovery Free-Wheel Diode
- Isolated Baseplate for Easy Heat Sinking

#### Applications:

- AC Motor Control
- Motion/Servo Control
- Photovoltaic/Fuel Cell

#### Ordering Information:

Example: Select the complete module number you desire from the table below -i.e. CM35MXA-24S is a 1200V ( $V_{CES}$ ), 35 Ampere CIB Power Module.

Type	Current Rating Amperes	$V_{CES}$ Volts (x 50)
CM	35	24

#### Outline Drawing and Circuit Diagram

Dimensions	Inches	Millimeters
A	4.79	121.7
B	2.44	62.0
C	0.51	13.0
D	4.49	114.05
E	4.33±0.02	110.0±0.5
F	3.89	99.0
G	3.72	94.5
H	0.16	4.06
J	0.51	13.09
K	0.15	3.81
L	0.45	11.43
M	0.9	22.86
N	0.22 Dia.	5.5 Dia.
P	2.13	54.2
Q	1.53	39.0
R	1.97±0.02	50.0±0.5
S	2.26	57.5
T	0.30	7.75
U	0.102 Dia.	2.6 Dia.

Dimensions	Inches	Millimeters
V	0.088 Dia.	2.25 Dia.
W	0.46	11.66
X	0.16	4.2
Y	0.59	15.0
Z	0.27	7.0
AA	0.81	20.5
AB	0.67	17.0
AC	0.12	3.0
AD	0.14	3.5
AE	0.03	0.8
AF	0.15	3.75
AG	0.05	1.15
AH	0.025	0.65
AJ	0.29	7.4
AK	0.05	1.2
AL	0.49	12.5
AM	0.12	3.0
AN	0.17 Dia.	4.3 Dia.

**CM35MXA-24S**  
**NX-S Series CIB Module**  
**(3Ø Converter + 3Ø Inverter + Brake)**  
 35 Amperes/1200 Volts

## Absolute Maximum Ratings, $T_j = 25^\circ\text{C}$ unless otherwise specified

### Inverter Part IGBT/FWDi

Characteristics	Symbol	Rating	Units
Collector-Emitter Voltage ( $V_{GE} = 0V$ )	$V_{CES}$	1200	Volts
Gate-Emitter Voltage ( $V_{CE} = 0V$ )	$V_{GES}$	$\pm 20$	Volts
Collector Current (DC, $T_C = 125^\circ\text{C}$ ) <sup>*2,*3</sup>	$I_C$	35	Amperes
Collector Current (Pulse, Repetitive) <sup>*4</sup>	$I_{CRM}$	70	Amperes
Total Power Dissipation ( $T_C = 25^\circ\text{C}$ ) <sup>*2,*3</sup>	$P_{tot}$	355	Watts
Emitter Current ( $T_C = 25^\circ\text{C}$ ) <sup>*2,*3</sup>	$I_E^{*1}$	35	Amperes
Emitter Current (Pulse, Repetitive) <sup>*4</sup>	$I_{ERM}^{*1}$	70	Amperes
Maximum Junction Temperature	$T_{j(max)}$	175	$^\circ\text{C}$

### Brake Part IGBT/FWDi

Characteristics	Symbol	Rating	Units
Collector-Emitter Voltage ( $V_{GE} = 0V$ )	$V_{CES}$	1200	Volts
Gate-Emitter Voltage ( $V_{CE} = 0V$ )	$V_{GES}$	$\pm 20$	Volts
Collector Current (DC, $T_C = 125^\circ\text{C}$ ) <sup>*2,*3</sup>	$I_C$	35	Amperes
Collector Current (Pulse, Repetitive) <sup>*4</sup>	$I_{CRM}$	70	Amperes
Total Power Dissipation ( $T_C = 25^\circ\text{C}$ ) <sup>*2,*3</sup>	$P_{tot}$	355	Watts
Repetitive Peak Reverse Voltage ( $V_{GE} = 0V$ )	$V_{RRM}$	1200	Volts
Forward Current ( $T_C = 25^\circ\text{C}$ ) <sup>*2,*3</sup>	$I_F^{*1}$	35	Amperes
Forward Current (Pulse, Repetitive) <sup>*4</sup>	$I_{FRM}^{*1}$	70	Amperes
Maximum Junction Temperature	$T_{j(max)}$	175	$^\circ\text{C}$

### Converter Part ConvDi

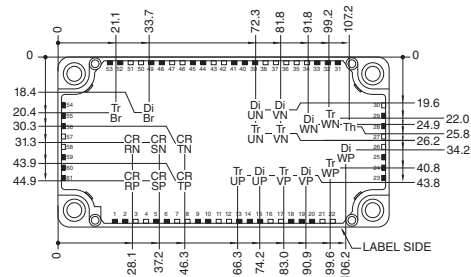
Characteristics	Symbol	Rating	Units
Repetitive Peak Reverse Voltage	$V_{RRM}$	1200	Volts
Recommended AC Input Voltage	$E_a$	440	$V_{RMS}$
DC Output Current (3-phase Full Wave Rectifying, $T_C = 125^\circ\text{C}$ ) <sup>*2,*3</sup>	$I_O$	35	Amperes
Surge Forward Current (Sine Half Wave 1 Cycle Peak Value, $f = 60\text{ Hz}$ , Non-repetitive)	$I_{FSM}$	350	Amperes
Current Square Time (Value for One Cycle of Surge Current)	$I_t^2$	510	$\text{A}^2\text{s}$
Maximum Junction Temperature	$T_{j(max)}$	150	$^\circ\text{C}$

\*1 Represent ratings and characteristics of the anti-parallel, emitter-to-collector free wheeling diode (FWDi).

\*2 Case temperature ( $T_C$ ) and heatsink temperature ( $T_S$ ) is measured on the surface (mounting side) of the baseplate and the heatsink side just under the chips. Refer to the figure to the right for chip location.

The heatsink thermal resistance should be measured just under the chips.  
 \*3 Junction temperature ( $T_j$ ) should not increase beyond maximum junction temperature ( $T_{j(max)}$ ) rating.

\*4 Pulse width and repetition rate should be such that device junction temperature ( $T_j$ ) does not exceed  $T_{j(max)}$  rating.



Each mark points to the center position of each chip.

Tr\*P / Tr\*N / Tr\*Br (\* = U/V/W): IGBT      Di\*P / Di\*N (\* = U/V/W): FWDi  
 Di\*Br: Clamp Di      CR\*P / CR\*N (\* = R/S/T): Conv Di  
 Th: NTC Thermistor

**CM35MXA-24S**  
**NX-S Series CIB Module**  
**(3Ø Converter + 3Ø Inverter + Brake)**  
**35 Amperes/1200 Volts**

## Absolute Maximum Ratings, $T_j = 25^\circ\text{C}$ unless otherwise specified

### Module

Characteristics	Symbol	Rating	Units
Maximum Case Temperature*2	$T_{C(max)}$	125	$^\circ\text{C}$
Operating Junction Temperature	$T_{j(op)}$	-40 to +150	$^\circ\text{C}$
Storage Temperature	$T_{stg}$	-40 to +125	$^\circ\text{C}$
Isolation Voltage (Terminals to Baseplate, f = 60Hz, AC 1 minute)	$V_{ISO}$	2500	Volts

## Electrical Characteristics, $T_j = 25^\circ\text{C}$ unless otherwise specified

### Inverter Part IGBT/FWDi

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Collector-Emitter Cutoff Current	$I_{CES}$	$V_{CE} = V_{CES}, V_{GE} = 0V$	—	—	1	mA
Gate-Emitter Leakage Current	$I_{GES}$	$V_{GE} = V_{GES}, V_{CE} = 0V$	—	—	0.5	$\mu\text{A}$
Gate-Emitter Threshold Voltage	$V_{GE(th)}$	$I_C = 3.5\text{mA}, V_{CE} = 10V$	5.4	6.0	6.6	Volts
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$ (Terminal)	$I_C = 35A, V_{GE} = 15V, T_j = 25^\circ\text{C}^{*5}$	—	1.80	2.25	Volts
		$I_C = 35A, V_{GE} = 15V, T_j = 125^\circ\text{C}^{*5}$	—	2.00	—	Volts
		$I_C = 35A, V_{GE} = 15V, T_j = 150^\circ\text{C}^{*5}$	—	2.05	—	Volts
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$ (Chip)	$I_C = 35A, V_{GE} = 15V, T_j = 25^\circ\text{C}^{*5}$	—	1.70	2.15	Volts
		$I_C = 35A, V_{GE} = 15V, T_j = 125^\circ\text{C}^{*5}$	—	1.90	—	Volts
		$I_C = 35A, V_{GE} = 15V, T_j = 150^\circ\text{C}^{*5}$	—	1.95	—	Volts
Input Capacitance	$C_{ies}$		—	—	3.5	nF
Output Capacitance	$C_{oes}$	$V_{CE} = 10V, V_{GE} = 0V$	—	—	0.7	nF
Reverse Transfer Capacitance	$C_{res}$		—	—	0.06	nF
Gate Charge	$Q_G$	$V_{CC} = 600V, I_C = 35A, V_{GE} = 15V$	—	82	—	nC
Turn-on Delay Time	$t_{d(on)}$		—	—	300	ns
Rise Time	$t_r$	$V_{CC} = 600V, I_C = 35A, V_{GE} = \pm 15V,$	—	—	200	ns
Turn-off Delay Time	$t_{d(off)}$	$R_G = 18\Omega, \text{Inductive Load}$	—	—	600	ns
Fall Time	$t_f$		—	—	300	ns
Emitter-Collector Voltage	$V_{EC}^{*1}$ (Terminal)	$I_E = 35A, V_{GE} = 0V, T_j = 25^\circ\text{C}^{*5}$	—	1.80	2.25	Volts
		$I_E = 35A, V_{GE} = 0V, T_j = 125^\circ\text{C}^{*5}$	—	1.80	—	Volts
		$I_E = 35A, V_{GE} = 0V, T_j = 150^\circ\text{C}^{*5}$	—	1.80	—	Volts
Emitter-Collector Voltage	$V_{EC}^{*1}$ (Chip)	$I_E = 35A, V_{GE} = 0V, T_j = 25^\circ\text{C}^{*5}$	—	1.70	2.15	Volts
		$I_E = 35A, V_{GE} = 0V, T_j = 125^\circ\text{C}^{*5}$	—	1.70	—	Volts
		$I_E = 35A, V_{GE} = 0V, T_j = 150^\circ\text{C}^{*5}$	—	1.70	—	Volts
Reverse Recovery Time	$t_{rr}^{*1}$	$V_{CC} = 600V, I_E = 35A, V_{GE} = \pm 15V$	—	—	300	ns
Reverse Recovery Charge	$Q_{rr}^{*1}$	$R_G = 18\Omega, \text{Inductive Load}$	—	1.9	—	$\mu\text{C}$
Internal Lead Resistance	$R_{CC}^{*1} + EE'$	Main Terminals-Chip, Per Switch, $T_C = 25^\circ\text{C}^{*2}$	—	—	5.7	m $\Omega$
Internal Gate Resistance	$r_g$	Per Switch	—	0	—	$\Omega$

\*1 Represent ratings and characteristics of the anti-parallel, emitter-to-collector free wheeling diode (FWDi).

\*2 Case temperature ( $T_C$ ) and heatsink temperature ( $T_s$ ) is measured on the surface (mounting side) of the baseplate and the heatsink side just under the chips. Refer to the figure on page 1 for chip location. The heatsink thermal resistance should be measured just under the chips.

\*3 Junction temperature ( $T_j$ ) should not increase beyond maximum junction temperature ( $T_{j(max)}$ ) rating.

\*4 Pulse width and repetition rate should be such that device junction temperature ( $T_j$ ) does not exceed  $T_{j(max)}$  rating.

\*5 Pulse width and repetition rate should be such as to cause negligible temperature rise.

**CM35MXA-24S**  
**NX-S Series CIB Module**  
**(3Ø Converter + 3Ø Inverter + Brake)**  
**35 Amperes/1200 Volts**

## Electrical Characteristics, $T_j = 25^\circ\text{C}$ unless otherwise specified

### Brake Part IGBT/FWDI

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Collector-Emitter Cutoff Current	$I_{CES}$	$V_{CE} = V_{CES}, V_{GE} = 0V$	—	—	1	mA
Gate-Emitter Leakage Current	$I_{GES}$	$V_{GE} = V_{GES}, V_{CE} = 0V$	—	—	0.5	$\mu\text{A}$
Gate-Emitter Threshold Voltage	$V_{GE(th)}$	$I_C = 3.5\text{mA}, V_{CE} = 10V$	5.4	6.0	6.6	Volts
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$ (Terminal)	$I_C = 35A, V_{GE} = 15V, T_j = 25^\circ\text{C}^{*5}$	—	1.80	2.25	Volts
		$I_C = 35A, V_{GE} = 15V, T_j = 125^\circ\text{C}^{*5}$	—	2.00	—	Volts
		$I_C = 35A, V_{GE} = 15V, T_j = 150^\circ\text{C}^{*5}$	—	2.05	—	Volts
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$ (Chip)	$I_C = 35A, V_{GE} = 15V, T_j = 25^\circ\text{C}^{*5}$	—	1.70	2.15	Volts
		$I_C = 35A, V_{GE} = 15V, T_j = 125^\circ\text{C}^{*5}$	—	1.90	—	Volts
		$I_C = 35A, V_{GE} = 15V, T_j = 150^\circ\text{C}^{*5}$	—	1.95	—	Volts
Input Capacitance	$C_{ies}$		—	—	3.5	nF
Output Capacitance	$C_{oes}$	$V_{CE} = 10V, V_{GE} = 0V$	—	—	0.7	nF
Reverse Transfer Capacitance	$C_{res}$		—	—	0.06	nF
Gate Charge	$Q_G$	$V_{CC} = 600V, I_C = 35A, V_{GE} = 15V$	—	82	—	nC
Turn-on Delay Time	$t_{d(on)}$		—	—	300	ns
Rise Time	$t_r$	$V_{CC} = 600V, I_C = 35A, V_{GE} = \pm 15V,$	—	—	200	ns
Turn-off Delay Time	$t_{d(off)}$	$R_G = 18\Omega, \text{Inductive Load}$	—	—	600	ns
Fall Time	$t_f$		—	—	300	ns
Internal Gate Resistance	$r_g$	Per Switch	—	0	—	$\Omega$
Repetitive Peak Reverse Current	$I_{RRM}$	$V_R = V_{RRM}, V_{GE} = 0V$	—	—	1	mA
Forward Voltage	$V_F$ (Terminal)	$I_F = 35A, V_{GE} = 0V, T_j = 25^\circ\text{C}^{*5}$	—	1.80	2.25	Volts
		$I_F = 35A, V_{GE} = 0V, T_j = 125^\circ\text{C}^{*5}$	—	1.80	—	Volts
		$I_F = 35A, V_{GE} = 0V, T_j = 150^\circ\text{C}^{*5}$	—	1.80	—	Volts
Forward Voltage	$V_F$ (Chip)	$I_F = 35A, V_{GE} = 0V, T_j = 25^\circ\text{C}^{*5}$	—	1.70	2.15	Volts
		$I_F = 35A, V_{GE} = 0V, T_j = 125^\circ\text{C}^{*5}$	—	1.70	—	Volts
		$I_F = 35A, V_{GE} = 0V, T_j = 150^\circ\text{C}^{*5}$	—	1.70	—	Volts
Reverse Recovery Time	$t_{rr}$	$V_{CC} = 600V, I_F = 35A, V_{GE} = \pm 15V$	—	—	300	ns
Reverse Recovery Charge	$Q_{rr}$	$R_G = 18\Omega, \text{Inductive Load}$	—	1.9	—	$\mu\text{C}$

\*5 Pulse width and repetition rate should be such as to cause negligible temperature rise.

**CM35MXA-24S**  
**NX-S Series CIB Module**  
**(3Ø Converter + 3Ø Inverter + Brake)**  
**35 Amperes/1200 Volts**

## Electrical Characteristics, $T_j = 25^\circ\text{C}$ unless otherwise specified

### Converter Part ConDi

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Repetitive Peak Reverse Current	$I_{RRM}$	$V_R = V_{RRM}, T_j = 150^\circ\text{C}$	—	—	4	mA
Forward Voltage	$V_F$ (Terminal)	$I_F = 35\text{A}^{*5}$	—	1.2	1.6	Volts

### NTC Thermistor Part

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Zero Power Resistance	$R_{25}$	$T_C = 25^\circ\text{C}^{*2}$	4.85	5.00	5.15	$k\Omega$
Deviation of Resistance	$\Delta R/R$	$T_C = 100^\circ\text{C}^{*2}, R_{100} = 493\Omega$	-7.3	—	+7.8	%
B Constant	$B_{(25/50)}$	Approximate by Equation <sup>*6</sup>	—	3375	—	K
Power Dissipation	$P_{25}$	$T_C = 25^\circ\text{C}^{*2}$	—	—	10	mW

<sup>\*2</sup> Case temperature ( $T_C$ ) and heatsink temperature ( $T_S$ ) is measured on the surface (mounting side) of the baseplate and the heatsink side just under the chips. Refer to the figure on page 1 for chip location. The heatsink thermal resistance should be measured just under the chips.

<sup>\*5</sup> Pulse width and repetition rate should be such as to cause negligible temperature rise.

$$^{*6} B_{(25/50)} = \ln\left(\frac{R_{25}}{R_{50}}\right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}}\right)$$

$R_{25}$ ; Resistance at Absolute Temperature  $T_{25}$  [K];  $T_{25} = 25 [^\circ\text{C}] + 273.15 = 298.15$  [K]  
 $R_{50}$ ; Resistance at Absolute Temperature  $T_{50}$  [K];  $T_{50} = 50 [^\circ\text{C}] + 273.15 = 323.15$  [K]

**CM35MXA-24S**  
**NX-S Series CIB Module**  
**(3Ø Converter + 3Ø Inverter + Brake)**  
**35 Amperes/1200 Volts**

### Thermal Resistance Characteristics, $T_j = 25^\circ\text{C}$ unless otherwise specified

Thermal Resistance, Junction to Case <sup>*2</sup>	$R_{th(j-c)Q}$	Per Inverter IGBT, per 1/6 Module	—	—	0.42	K/W
Thermal Resistance, Junction to Case <sup>*2</sup>	$R_{th(j-c)D}$	Per Inverter FWDi, per 1/6 Module	—	—	0.69	K/W
Thermal Resistance, Junction to Case <sup>*2</sup>	$R_{th(j-c)Q}$	Brake Part IGBT	—	—	0.42	K/W
Thermal Resistance, Junction to Case <sup>*2</sup>	$R_{th(j-c)D}$	Brake Part ClampDi	—	—	0.69	K/W
Thermal Resistance, Junction to Case <sup>*2</sup>	$R_{th(j-c)D}$	Converter Part ConvDi, per 1/6 Module	—	—	0.45	K/W
Contact Thermal Resistance, Case to Heatsink <sup>*2</sup>	$R_{th(c-s)}$	Thermal Grease Applied, per 1 Module <sup>*7</sup>	—	0.015	—	K/W

### Mechanical Characteristics

Mounting Torque	$M_s$	Mounting to Heatsink, M5 Screw	22	27	31	in-lb
Weight	m		—	300	—	Grams
Creepage Distance	$d_s$	Terminal to Terminal	6.47	—	—	mm
		Terminal to Baseplate	14.27	—	—	mm
Clearance	$d_a$	Terminal to Terminal	6.47	—	—	mm
		Terminal to Baseplate	12.33	—	—	mm
Flatness of Baseplate	$e_c$	On Centerline X, Y <sup>*8</sup>	$\pm 0$	—	$\pm 100$	$\mu\text{m}$

### Recommended Operating Conditions, $T_a = 25^\circ\text{C}$

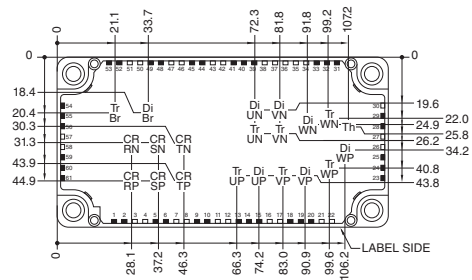
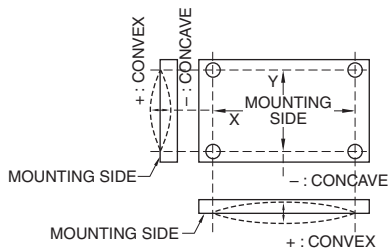
(DC) Supply Voltage	$V_{CC}$	Applied Across P-N/P1-N1 Terminals	—	600	850	Volts
Gate (-Emitter Drive) Voltage	$V_{GE(on)}$	Applied Across GB-Es / G*P-*/ G*N-Es	13.5	15.0	16.5	Volts
(* = U, V, W) Terminals						
External Gate Resistance	$R_G$	Inverter Part IGBT	18	—	180	$\Omega$
		Brake Part IGBT	18	—	180	$\Omega$

<sup>\*2</sup> Case temperature ( $T_C$ ) and heatsink temperature ( $T_S$ ) is measured on the surface (mounting side) of the baseplate and the heatsink side just under the chips. Refer to the figure to the right for chip location.

The heatsink thermal resistance should be measured just under the chips.

<sup>\*7</sup> Typical value is measured by using thermally conductive grease of  $\lambda = 0.9$  [W/(m • K)].

<sup>\*8</sup> Baseplate (mounting side) flatness measurement points (X, Y) are shown in the figure below.



Each mark points to the center position of each chip.

Tr\*P / Tr\*N / TrBr (\* = U/V/W): IGBT      Di\*P / Di\*N (\* = U/V/W): FWDi  
 DiBr: Clamp Di      CR\*P / CR\*N (\* = R/S/T): Conv Di  
 Th: NTC Thermistor