

# IGBT Power Module

## 1200V / 225A

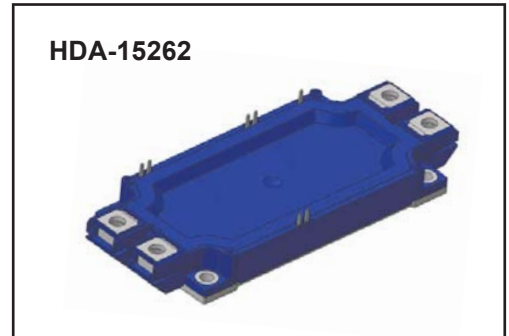
Preliminary

### Features

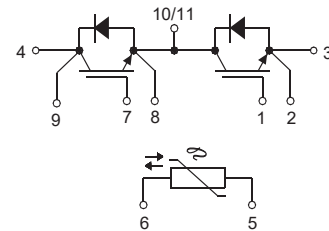
- ◆ Fast Switching Trench / Field Stop IGBT Technology
- ◆ Low Switching Losses
- ◆ Super Fast Diodes
- ◆ High Short Circuit Capability

### Applications

- ◆ Welder / Power Supply
- ◆ UPS / Inverter
- ◆ Industrial Motor Drive



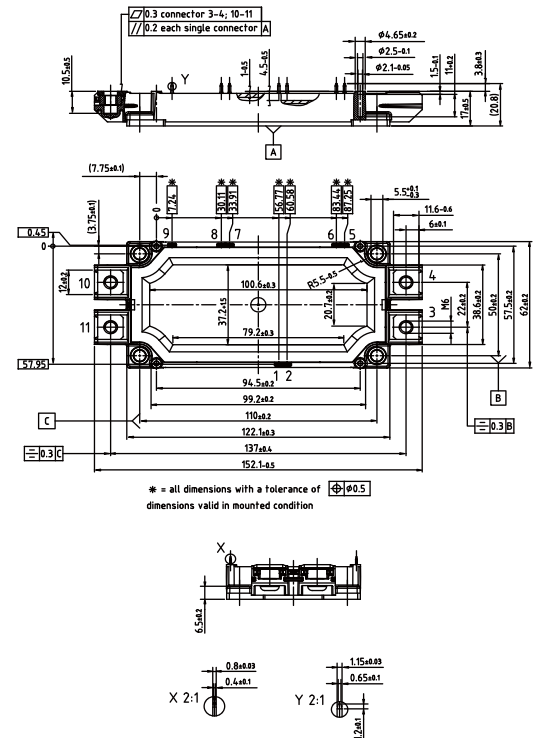
### Circuit Diagram Headline



### Maximum Ratings (T<sub>C</sub>=25°C)

Item	Symbol	Rated Value	Unit
Collector-Emitter Voltage	T <sub>VJ</sub> = 25°C V <sub>CEs</sub>	1200	V
Gate-Emitter Peak Voltage	V <sub>GES</sub>	±20	V
Continuous DC Collector Current	T <sub>C</sub> = 95°C T <sub>C</sub> = 25°C I <sub>C,nom.</sub> I <sub>C</sub>	225 320	A
Repetitive Peak Collector Current	t <sub>p</sub> = 1ms I <sub>CRM</sub>	450	A
Total Power Dissipation	P <sub>tot</sub>	1050	W
Isolation Voltage	RMS, f=50Hz, t=1min V <sub>iso</sub>	2500	V
Continuous DC Forward Current	I <sub>F</sub>	225	A
Repetitive Peak Forward Current	t <sub>p</sub> = 1ms I <sub>FRM</sub>	450	A
Temperature under switching conditions	T <sub>VJ op</sub>	-40 ~ +150	°C
Storage Temperature	T <sub>stg</sub>	-40 ~ +125	°C
Mounting Torque	Module Base to Heatsink (M5)	3~6	N.m
	Busbar to Terminal (M6)	3~6	

### Package Outlines



Dimensions in mm (1 mm = 0.0394")

**Electrical Characteristics** (  $T_{vj} = 25^{\circ}\text{C}$  )

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Collector-emitter saturation voltage	$V_{CEsat}$	$I_C = 225\text{A}, V_{GE} = 15\text{V}$ $T_{vj} = 25^{\circ}\text{C}$ $I_C = 225\text{A}, V_{GE} = 15\text{V}$ $T_{vj} = 125^{\circ}\text{C}$		1.8 2.1	2.1	V
Gate threshold voltage	$V_{GEth}$	$I_C = 7.6\text{mA}, V_{CE} = V_{GE}, T_{vj} = 25^{\circ}\text{C}$	5.5	6	6.6	V
Gate charge	$Q_G$	$I_C = 225\text{A}, V_{CE} = 600\text{V}, V_{GE} = 15\text{V}$		980		nC
Internal gate resistor	$R_{Gint}$	$T_{vj} = 25^{\circ}\text{C}$		2.36		$\Omega$
Input capacitance	$C_{ies}$	$f = 100\text{KHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{V}, V_{GE} = 0\text{V}$		21		nF
Output capacitance	$C_{oes}$	$f = 100\text{KHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{V}, V_{GE} = 0\text{V}$		1.0		nF
Reverse transfer capacitance	$C_{res}$	$f = 100\text{KHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{V}, V_{GE} = 0\text{V}$		0.19		nF
Collector-emitter cut-off current	$I_{CES}$	$V_{CE} = 1200\text{V}, V_{GE} = 0\text{V}, T_{vj} = 25^{\circ}\text{C}$			1	mA
Gate-emitter leakage current	$I_{GES}$	$V_{CE} = 0\text{V}, V_{GE} = 20\text{V}, T_{vj} = 25^{\circ}\text{C}$			100	nA
Turn-on delay time, inductive load	$t_{don}$	$I_C = 225\text{A}, V_{CE} = 600\text{V}$ $V_{GE} = \pm 15\text{V}$ $R_{G(on)} = 0.5\Omega, R_{G(off)} = 0.5\Omega$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$		193 213 212		ns
Rise time, inductive load	$t_r$	$I_C = 225\text{A}, V_{CE} = 600\text{V}$ $V_{GE} = \pm 15\text{V}$ $R_{G(on)} = 0.5\Omega, R_{G(off)} = 0.5\Omega$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$		70 74 84		ns
Turn-off delay time, inductive load	$t_{doff}$	$I_C = 225\text{A}, V_{CE} = 600\text{V}$ $V_{GE} = \pm 15\text{V}$ $R_{G(on)} = 0.5\Omega, R_{G(off)} = 0.5\Omega$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$		306 348 350		ns
Fall time, inductive load	$t_f$	$I_C = 150\text{A}, V_{CE} = 600\text{V}$ $V_{GE} = \pm 15\text{V}$ $R_{G(on)} = 0.5\Omega, R_{G(off)} = 0.5\Omega$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$		36 58 72		ns
Turn-on energy loss per pulse	$E_{on}$	$I_C = 225\text{A}, V_{CE} = 600\text{V}$ $V_{GE} = \pm 15\text{V}, (T_{vj} = 150^{\circ}\text{C})$ $R_{G(on)} = 0.5\Omega, R_{G(off)} = 0.5\Omega$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$		9.85 23.1 27.1		mJ
Turn-off energy loss per pulse	$E_{off}$	$I_C = 225\text{A}, V_{CE} = 600\text{V}$ $V_{GE} = \pm 15\text{V}, (T_{vj} = 150^{\circ}\text{C})$ $R_{G(on)} = 0.5\Omega, R_{G(off)} = 0.5\Omega$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$		14.8 19.1 20.5		mJ
SC data	$I_{SC}$	$V_{GE} \leq 15\text{V}, V_{CC} = 800\text{V}$ $V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$ $t_p \leq 10\mu\text{s}, T_{vj} = 150^{\circ}\text{C}$		900		A
Thermal resistance, junction to case	$R_{thJC}$	per IGBT			0.14	$^{\circ}\text{C/W}$
Thermal resistance, case to heatsink	$R_{thCH}$	per IGBT		0.031		$^{\circ}\text{C/W}$
External gate resistance	$R_{Gext}$	$T_{vj} = 25^{\circ}\text{C}$	0.5			$\Omega$

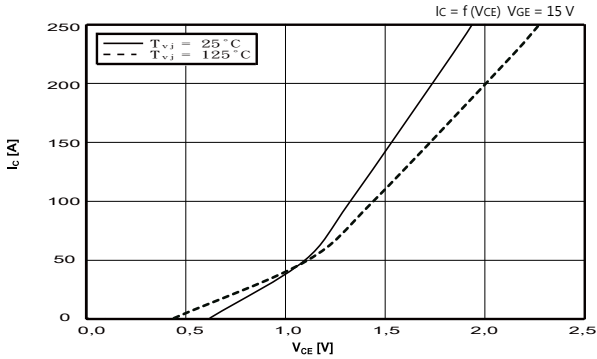
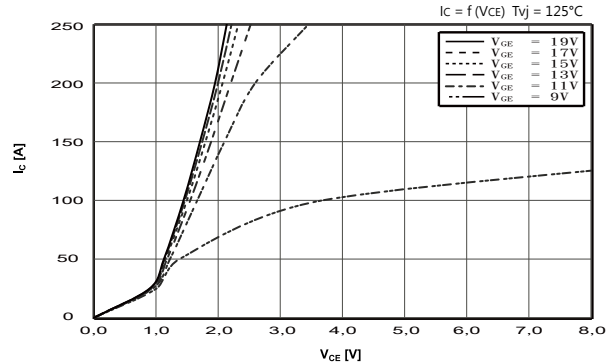
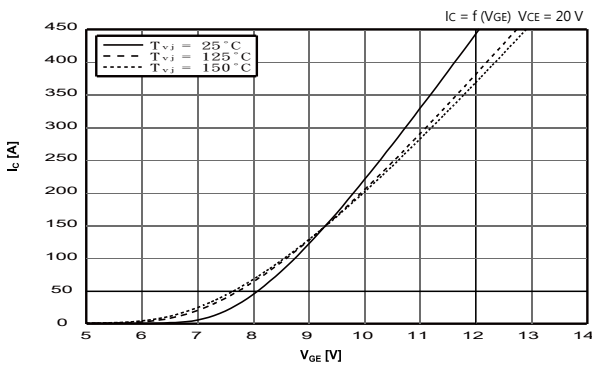
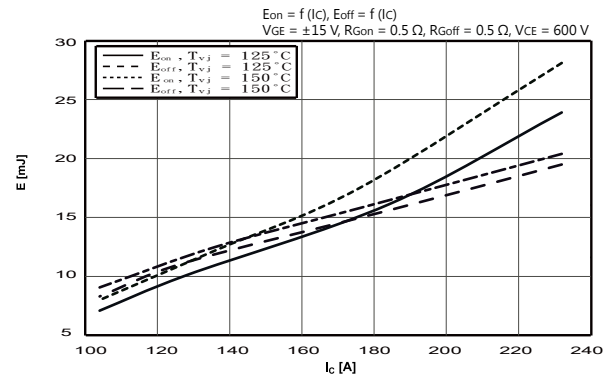
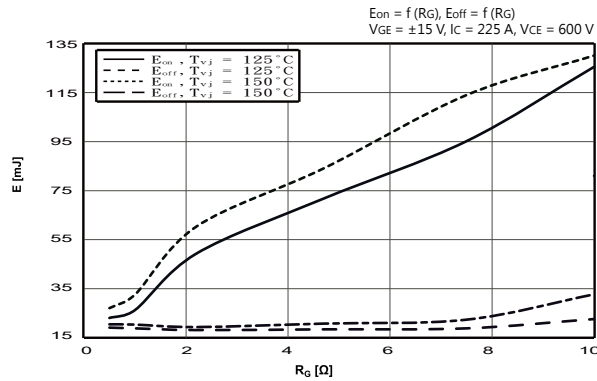
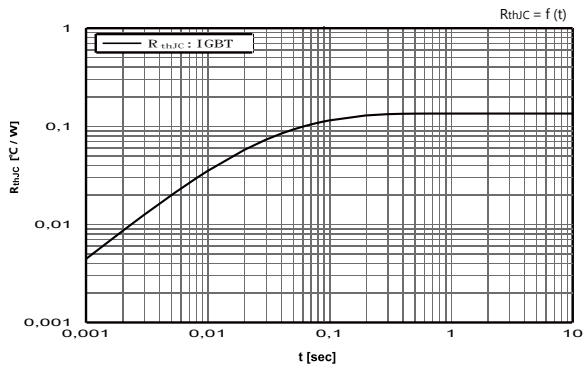
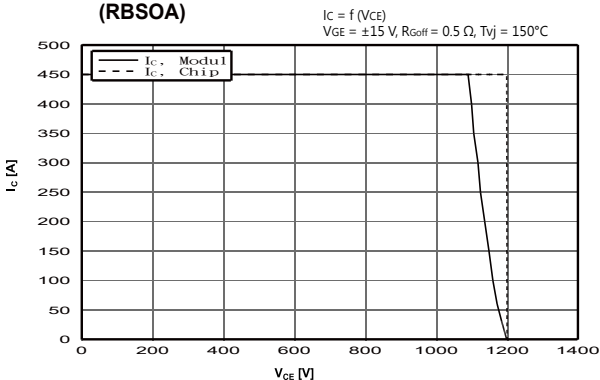
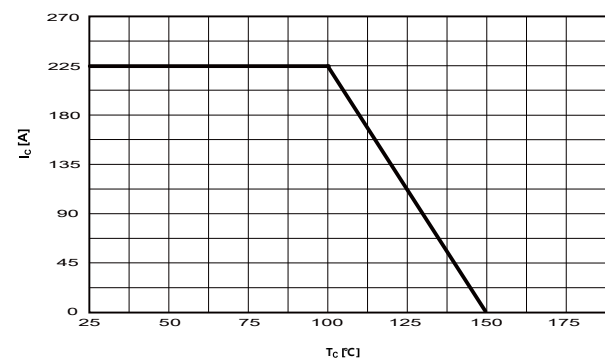
**■ Diode Ratings & Characteristics**

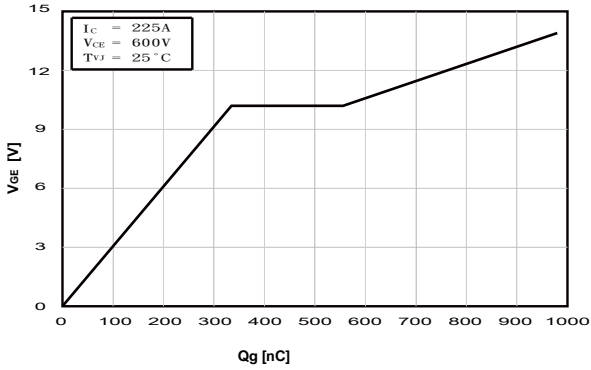
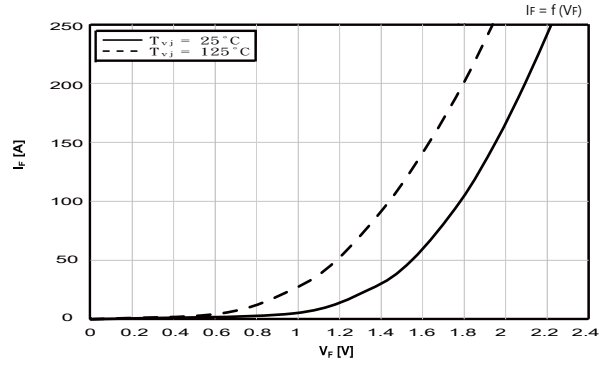
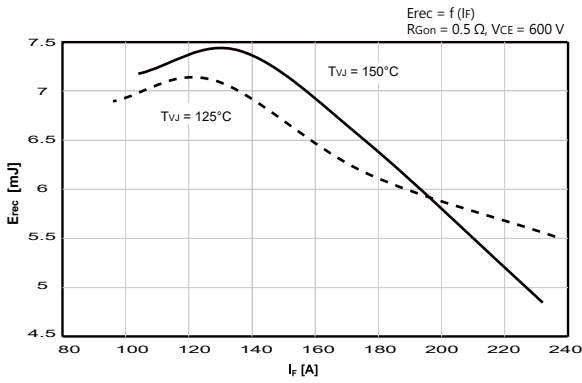
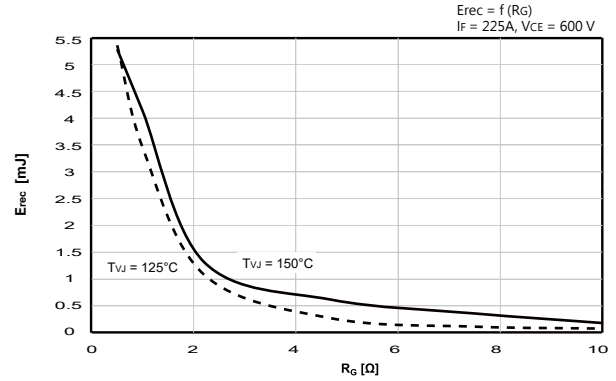
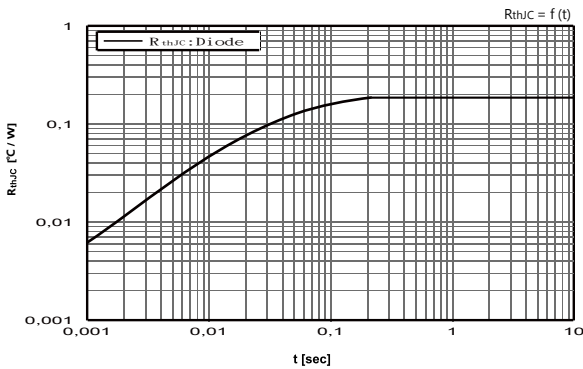
Characteristics	Symbol	Test Conditions	Value	Unit
Repetitive peak reverse voltage	$V_{RRM}$	$T_{vj} = 25^{\circ}\text{C}$	1200	V
Continuous DC forward current	$I_F$		225	A
Repetitive peak forward current	$I_{FRM}$	$t_p = 1\text{ms}$	450	A
$I^2t$ - value	$I^2t$	$V_R = 0\text{V}, t_p = 10\text{ms}, T_{vj} = 125^{\circ}\text{C}$	10000	A <sup>2</sup> s
		$V_R = 0\text{V}, t_p = 10\text{ms}, T_{vj} = 150^{\circ}\text{C}$	8100	

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Forward voltage	$V_F$	$I_F = 225\text{A}, V_{GE} = 0\text{V}$ $T_{vj} = 25^{\circ}\text{C}$		2.1	2.3	V
		$I_F = 225\text{A}, V_{GE} = 0\text{V}$ $T_{vj} = 125^{\circ}\text{C}$		1.9		
Peak reverse recovery current	$I_{RRM}$	$I_F = 225\text{A}, -di_F/dt = 3400\text{A}/\mu\text{s}$ $T_{vj} = 25^{\circ}\text{C}$		128		A
		$V_R = 600\text{V}$ $T_{vj} = 125^{\circ}\text{C}$		188		
		$V_{GE} = \pm 15\text{V}$ $T_{vj} = 150^{\circ}\text{C}$		184		
Recovered charge	$Q_{rr}$	$I_F = 225\text{A}, -di_F/dt = 3400\text{A}/\mu\text{s}$ $T_{vj} = 25^{\circ}\text{C}$		10730		nC
		$V_R = 600\text{V}$ $T_{vj} = 125^{\circ}\text{C}$		19270		
		$V_{GE} = \pm 15\text{V}$ $T_{vj} = 150^{\circ}\text{C}$		20210		
Reverse recovery energy	$E_{rec}$	$I_F = 225\text{A}, -di_F/dt = 3400\text{A}/\mu\text{s}$ $T_{vj} = 25^{\circ}\text{C}$		4747		uJ
		$V_R = 600\text{V}$ $T_{vj} = 125^{\circ}\text{C}$		5359		
		$V_{GE} = \pm 15\text{V}$ $T_{vj} = 150^{\circ}\text{C}$		5283		
Reverse Recovery Time	$T_{rr}$	$I_F = 225\text{A}, -di_F/dt = 3400\text{A}/\mu\text{s}, V_R = 600\text{V}, V_{GE} = \pm 15\text{V}, T_{vj} = 25^{\circ}\text{C}$		184		ns
Thermal resistance, junction to case	$R_{thJC}$	per diode			0.19	$^{\circ}\text{C}/\text{W}$
Thermal resistance, case to heatsink	$R_{thCH}$	per diode		0.042		$^{\circ}\text{C}/\text{W}$
Temperature under switching conditions	$T_{vj\text{op}}$		-40		150	$^{\circ}\text{C}$

**■ Package**

Parameter	Symbol	Test Conditions	Value	Unit
Creepage distance	$d_{creep}$	terminal to heatsink	14.5	mm
Creepage distance	$d_{creep}$	terminal to terminal	13.0	mm
Clearance	$d_{clear}$	terminal to heatsink	12.5	mm
Clearance	$d_{clear}$	terminal to terminal	10.0	mm

**Typical Characteristics**
**Preliminary Data**
**Fig.1 Output characteristic IGBT, Inverter (typical)**

**Fig.2 Output characteristic IGBT, Inverter (typical)**

**Fig.3 Transfer characteristic IGBT, Inverter (typical)**

**Fig.4 Switching losses IGBT, Inverter (typical)**

**Fig.5 Switching losses IGBT, Inverter (typical)**

**Fig.6 Transient thermal impedance IGBT, Inverter**

**Fig.7 Reverse bias safe operating area IGBT, Inverter (RBSOA)**

**Fig.8 Output characteristic IGBT, Inverter (typical)**


**Typical Characteristics**
**Preliminary Data**
**Fig.9 Gate Charge Characteristics(typical)**

**Fig.10 Forward characteristic of Diode, Inverter (typical)**

**Fig.11 Switching losses Diode, Inverter (typical)**

**Fig.12 Switching losses Diode, Inverter (typical)**

**Fig.13 Transient thermal impedance Diode, Inverter**


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