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# Technical Specifications

**Bidirectional SymCool™ IQ Intelligent Power Module with Driver, 1200V/160A**  
**Part Number : IPA01216DFx-HS**

## Description:

The SymCool™ IQ is a bidirectional intelligent power module (IPM) with integrated driver which makes the system design easy and seamless. It is based on Ideal Power's innovative B-TRAN™ with ultra-low on-state voltage drop. The integrated driver provides driving power for B-TRAN™ dies and protection features such as overcurrent protection, undervoltage protection, temperature sensing and a dedicated FLT pin. Novel packaging design techniques reduces the thermal resistance of the package and enhances the power density of the module.

## Key Features:

- Bidirectional Switching Operation
- Ultra-Low On-State Voltage Drop
- Low Switching Losses
- Switching Frequency: Up to 35 kHz
- Low Parasitic Inductance and Capacitance

## Applications:

- Solid-State Circuit Breaker
- Battery Disconnect Switch
- Vienna Rectifier
- T-Type Inverter
- Matrix Converter



SymCool™ IQ



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# 1 SymCool™ IQ Top-level Block Diagram

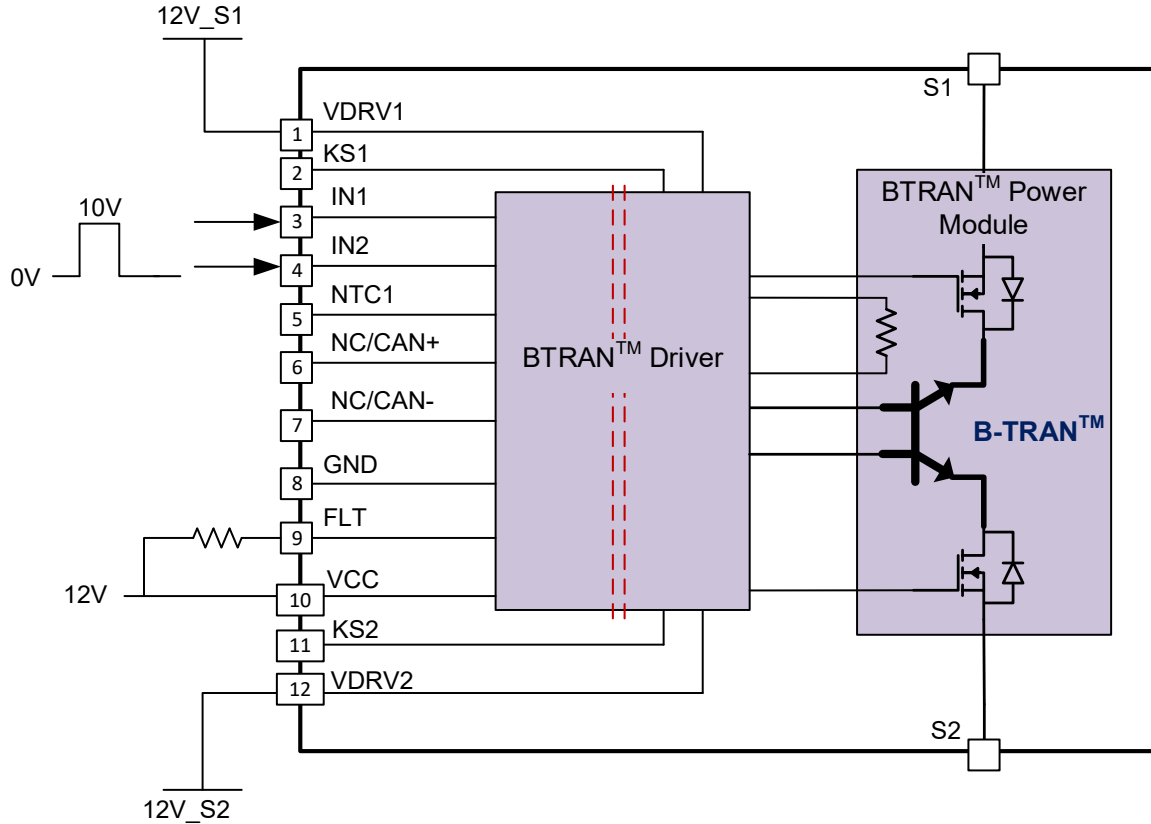


Figure 1 Pin Configuration

## 2 Maximum Ratings for SymCool™ IQ

### 2.1 Module Section

Description	Symbol	Conditions	Value	Unit
Storage temperature range	$T_{STG}$		-40 ~ +125	°C
Operating case temperature	$T_C$		-40 ~ +125	°C
Operating junction temperature	$T_J$		-40 ~ +150	°C
Isolated test voltage	$V_{ISO}$	1min, RMS, f=60Hz	2500	V



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### 2.2 Inverter Section

Description	Symbol	Conditions	Value	Unit
Blocking voltage	$V_{BR}$		1200	V
DC emitter current $T_c = 25^\circ\text{C}$ $T_c = 100^\circ\text{C}$	$I_E$		240 160	A A
Pulsed emitter current	$I_{Epulse}$		400	A
Emitter-Base breakdown voltage	$V_{EB}$		65	V
Short circuit withstand time	$t_{SC}$		15	$\mu\text{s}$
Power dissipation $T_c = 25^\circ\text{C}$ Power dissipation $T_c = 100^\circ\text{C}$	$P_{tot}$		2000 800	W
Operating junction temperature	$T_{vj}$		-40 ~ +150	$^\circ\text{C}$

### 2.3 Control Section

Description	Symbol	Conditions	Value	Unit
High side offset voltage	$V_{BR}$		1200	V
Drive voltage	$V_{DRV1/2}$		7 ~ 16	V
Control input voltage	$V_{IN1/2}$		0 ~ 15	V
$V_{CC}$ input voltage	$V_{CC}$		15	V
NTC output voltage	$V_{NTC}$		5	V
Driving current on $I_{DRVx}$	$I_{DRVx}$		12.5	A

## 3 Thermal Characteristics ( $T_j = 25^\circ\text{C}$ )

Description	Symbol	Conditions	Value			Unit
			Min.	Typ.	Max.	
Single B-TRAN™ thermal resistance, junction-case	$R_{thJC}$	High side V-phase		0.07	-	K/W





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## 4 Static Characteristics ( $T_J = 25^\circ\text{C}$ )

( $T_J = 25^\circ\text{C}$ , unless otherwise stated)

### 4.1 Inverter Section

Description	Symbol	Conditions	Value			Unit
			Min.	Typ.	Max.	
Emitter-Emitter saturation voltage	$V_{E1E2(on)}$	$V_{B1E1}$ or $V_{B2E2} = 1.5\text{V}$ , $I_{E1E2} = 160\text{A}$	---	0.6	0.8	V
Base-Emitter voltage (on-state)	$V_{B1E1}$ or $V_{B2E2}$	$I_{B1E1}$ or $I_{B2E2} = 20\text{A}$	1.4	1.5	1.6	V
Emitter-Base breakdown voltage (off-state)	$V_{R(B1E1)}$ or $V_{R(B2E2)}$	$I_{E1B1}$ or $I_{E2B2} = 1\text{mA}$	52	65	78	V
Emitter leakage current	$I_{E1B2}$ or $I_{E2B1}$	at $V_{E1B2}$ or $V_{E2B1} = 1200\text{V}$	---	200	400	$\mu\text{A}$
DC current gain	$h_{FE}$	$I_{E1E2} = 50\text{A}$		7	9	
	$h_{FE}$	$I_{E1E2} = 100\text{A}$		5	7	

### 4.2 Control Section

Description	Symbol	Conditions	Value			Unit
			Min.	Typ.	Max.	
Logic "1" input voltage	$V_{IN1/2}$	$V_{CC} = 12\text{V}$	-	3	12	V
Logic "0" input voltage	$V_{IN1/2}$	$V_{CC} = 12\text{V}$	0.7	0.9	-	V
$V_{CC}$ voltage	$V_{CC}$	w.r.t GND	8	12	14	V
Supply current	$I_{VCC}$				100	mA
Drive undervoltage lockout	$V_{DRVUVLOF}$	VDRV Falling	7.5	8.5	9.5	V
	$V_{DRVUVLOR}$	VDRV Rising	7.2	8	8.8	V
Drive voltage	$V_{RDV1/2}$			12	16	V
Drive current	$I_{DRV}$	$I_{EE} = 160\text{A}$ , $V_{DRV} = 12\text{V}$		6		A
NTC output voltage	NTC1	$T_J = 125^\circ\text{C}$				



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## 5 Dynamic Characteristics (T<sub>J</sub> = 25°C)

SymCool™ IQ Switching Characteristics-Switching Characteristics, Inductive Load (T<sub>J</sub> = 25°C)

Description	Symbol	Conditions	Value	Unit
Turn-on delay time	t <sub>d(on)</sub>	V <sub>E1E2</sub> = 600 V, I <sub>E1E2</sub> = 160 A V <sub>B1E1</sub> or V <sub>B2E2</sub> = 2V	20	ns
Rise time	t <sub>r</sub>		60	ns
Turn-off delay time	t <sub>d(off)</sub>		100	ns
Fall time	t <sub>f</sub>		200	ns
Turn-on energy	E <sub>on</sub>		1.7	mJ
Turn-off energy	E <sub>off</sub>		4.3	mJ
Total switching energy	E <sub>ts</sub>		6	mJ

## 6 Mechanical Characteristics and Ratings

Description	Symbol	Conditions	Value			Unit
			Min.	Typ.	Max.	
Mounting torque (Mounting to heat sink)		M6 Screw & washer	3	4	5	Nm
Mounting torque (Main terminal)		M6 Screw & washer	2.5	4	5	Nm
Weight				450		g
Single B-TRAN™ thermal resistance, junction-case	R <sub>thj-c</sub>			0.07	-	K/W

## 7 Recommended Operating Conditions

Description	Symbol	Conditions	Value	Unit
High Voltage Input	V <sub>BR</sub>		1200	V
Control VCC Voltage	V <sub>CC</sub>		12	V
Drive Voltage	V <sub>DRV1/2</sub>		12	V
Control Input Voltage	V <sub>IN1/2</sub>	w.r.t GND	+12	V
PWM Switching Frequency			<20	kHz



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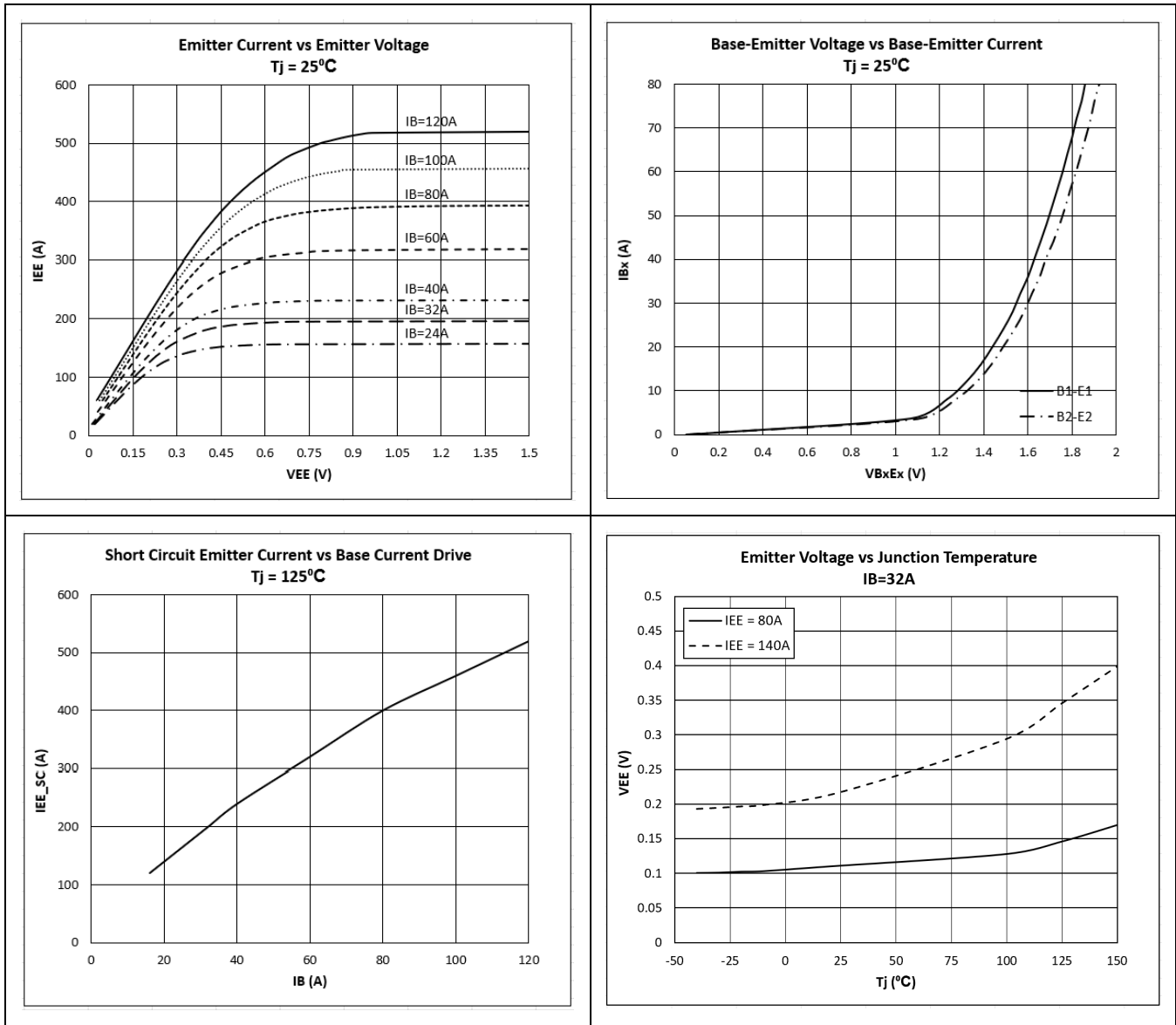
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## 8 Performance Curves



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## 9 Package Outline

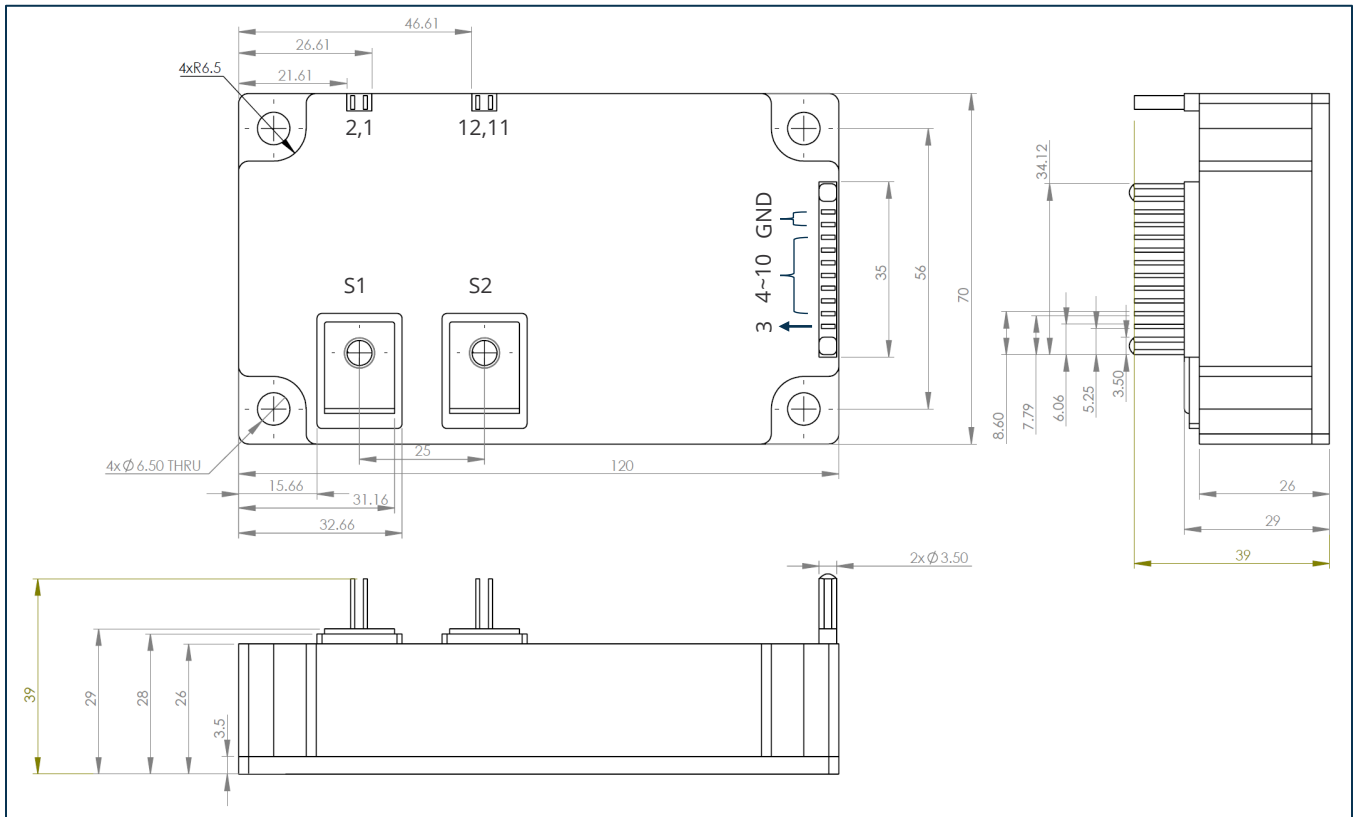


Figure 2 Package outline of SymCool™ IQ



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## 10 Switching Time Definition

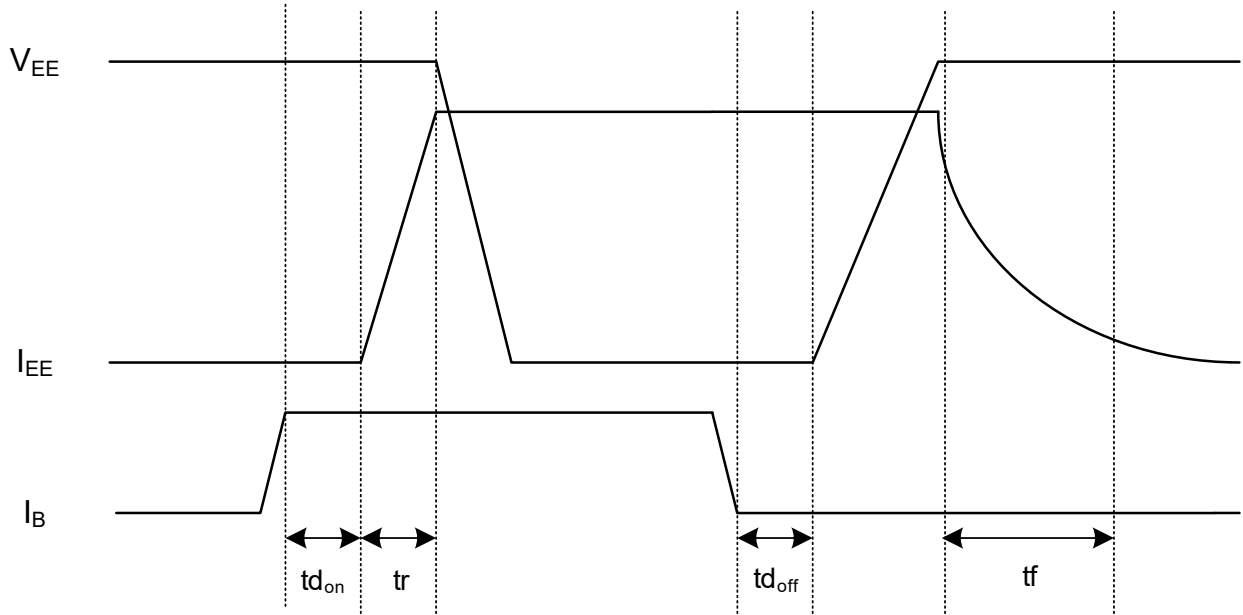


Figure 3 SymCool™ IQ Switching Time Definition



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## Important Notices

SymCool™ IQ specifications are subject to change. Ideal Power reserves the right to change limits, test conditions, and dimensions without notice. Information contained in this document are typical values and shall in no event be regarded as a guarantee of characteristics. With respect to any information regarding the application of the product, Ideal Power hereby disclaims all warranties and liabilities of any kind.

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