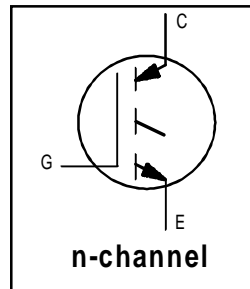


IRG4PC40W

INSULATED GATE BIPOLAR TRANSISTOR

Features

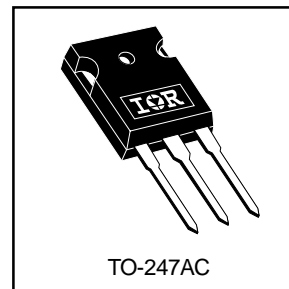
- Designed expressly for Switch-Mode Power Supply and PFC (power factor correction) applications
- Industry-benchmark switching losses improve efficiency of all power supply topologies
- 50% reduction of Eoff parameter
- Low IGBT conduction losses
- Latest-generation IGBT design and construction offers tighter parameters distribution, exceptional reliability



$V_{CES} = 600V$
$V_{CE(on) typ.} = 2.05V$
@ $V_{GE} = 15V, I_C = 20A$

Benefits

- Lower switching losses allow more cost-effective operation than power MOSFETs up to 150 kHz ("hard switched" mode)
- Of particular benefit to single-ended converters and boost PFC topologies 150W and higher
- Low conduction losses and minimal minority-carrier recombination make these an excellent option for resonant mode switching as well (up to >>300 kHz)



Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Breakdown Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	40	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	20	
I_{CM}	Pulsed Collector Current ①	160	
I_{LM}	Clamped Inductive Load Current ②	160	
V_{GE}	Gate-to-Emitter Voltage	± 20	V
E_{ARV}	Reverse Voltage Avalanche Energy ③	160	mJ
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	160	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	65	
T_J	Operating Junction and Storage Temperature Range	-55 to + 150	°C
T_{STG}			
	Mounting torque, 6-32 or M3 screw.	10 lbf•in (1.1N•m)	

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	0.77	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.24	—	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	—	40	
Wt	Weight	6 (0.21)	—	g (oz)

Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
V _{(BR)CES}	Collector-to-Emitter Breakdown Voltage	600	—	—	V	V _{GE} = 0V, I _C = 250μA
V _{(BR)ECS}	Emitter-to-Collector Breakdown Voltage ④	18	—	—	V	V _{GE} = 0V, I _C = 1.0A
ΔV _{(BR)CES/ΔT_J}	Temperature Coeff. of Breakdown Voltage	—	0.44	—	V/°C	V _{GE} = 0V, I _C = 1.0mA
V _{CE(ON)}	Collector-to-Emitter Saturation Voltage	—	2.05	2.5	V	I _C = 20A I _C = 40A I _C = 20A, T _J = 150°C V _{GE} = 15V See Fig.2, 5
		—	2.36	—		
		—	1.90	—		
V _{GE(th)}	Gate Threshold Voltage	3.0	—	6.0		V _{CE} = V _{GE} , I _C = 250μA
ΔV _{GE(th)/ΔT_J}	Temperature Coeff. of Threshold Voltage	—	13	—	mV/°C	V _{CE} = V _{GE} , I _C = 250μA
g _{fe}	Forward Transconductance ⑤	18	28	—	S	V _{CE} = 100V, I _C = 20A
I _{CES}	Zero Gate Voltage Collector Current	—	—	250	μA	V _{GE} = 0V, V _{CE} = 600V V _{GE} = 0V, V _{CE} = 10V, T _J = 25°C V _{GE} = 0V, V _{CE} = 600V, T _J = 150°C
		—	—	2.0		
		—	—	2500		
I _{GES}	Gate-to-Emitter Leakage Current	—	—	±100	nA	V _{GE} = ±20V

Switching Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
Q _g	Total Gate Charge (turn-on)	—	98	147	nC	I _C = 20A V _{CC} = 400V V _{GE} = 15V See Fig.8
Q _{ge}	Gate - Emitter Charge (turn-on)	—	12	18		
Q _{gc}	Gate - Collector Charge (turn-on)	—	36	54		
t _{d(on)}	Turn-On Delay Time	—	27	—	ns	T _J = 25°C I _C = 20A, V _{CC} = 480V V _{GE} = 15V, R _G = 10Ω
t _r	Rise Time	—	22	—		
t _{d(off)}	Turn-Off Delay Time	—	100	150		
t _f	Fall Time	—	74	110		
E _{on}	Turn-On Switching Loss	—	0.11	—	mJ	Energy losses include "tail" See Fig. 9,10, 14
E _{off}	Turn-Off Switching Loss	—	0.23	—		
E _{is}	Total Switching Loss	—	0.34	0.45		
t _{d(on)}	Turn-On Delay Time	—	25	—	ns	T _J = 150°C, I _C = 20A, V _{CC} = 480V V _{GE} = 15V, R _G = 10Ω Energy losses include "tail" See Fig.10,11, 14
t _r	Rise Time	—	23	—		
t _{d(off)}	Turn-Off Delay Time	—	170	—		
t _f	Fall Time	—	124	—		
E _{is}	Total Switching Loss	—	0.85	—	mJ	
L _E	Internal Emitter Inductance	—	13	—	nH	Measured 5mm from package
C _{ies}	Input Capacitance	—	1900	—	pF	V _{GE} = 0V V _{CC} = 30V f = 1.0MHz See Fig. 7
C _{oes}	Output Capacitance	—	140	—		
C _{res}	Reverse Transfer Capacitance	—	35	—		

Notes:

- ① Repetitive rating; V_{GE} = 20V, pulse width limited by max. junction temperature. (See fig. 13b)
- ② V_{CC} = 80%(V_{CES}), V_{GE} = 20V, L = 10μH, R_G = 10Ω, (See fig. 13a)
- ③ Repetitive rating; pulse width limited by maximum junction temperature.

④ Pulse width ≤ 80μs; duty factor ≤ 0.1%.

⑤ Pulse width 5.0μs, single shot.

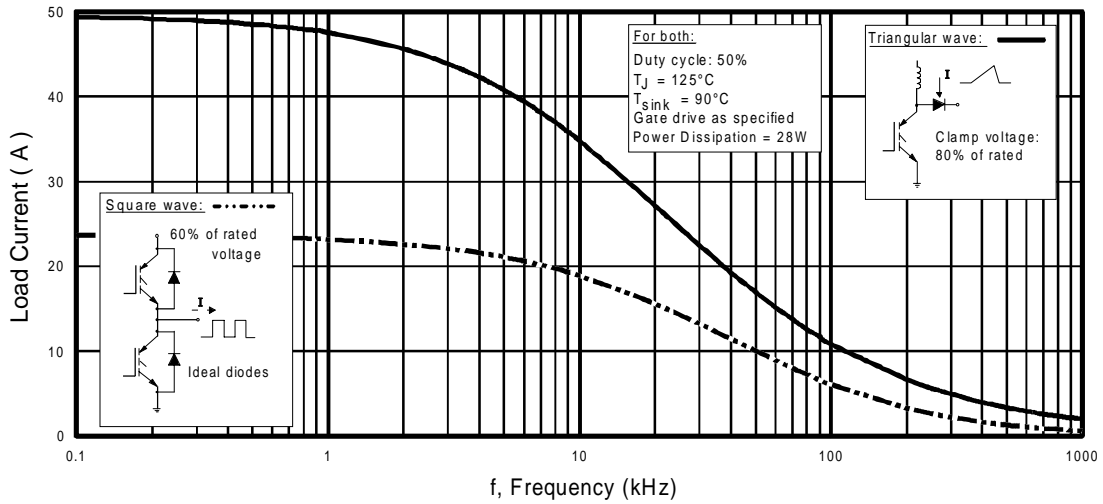


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

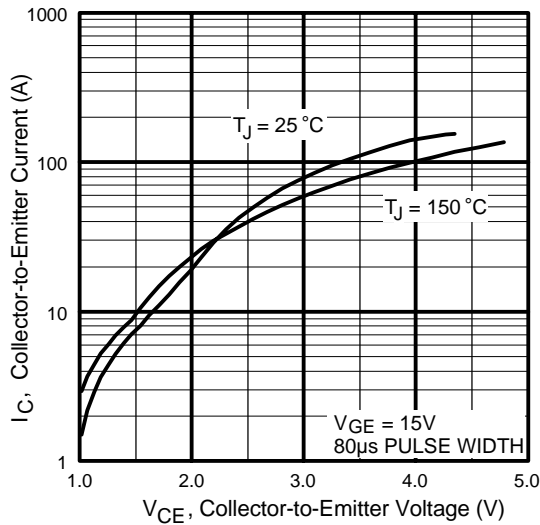


Fig. 2 - Typical Output Characteristics

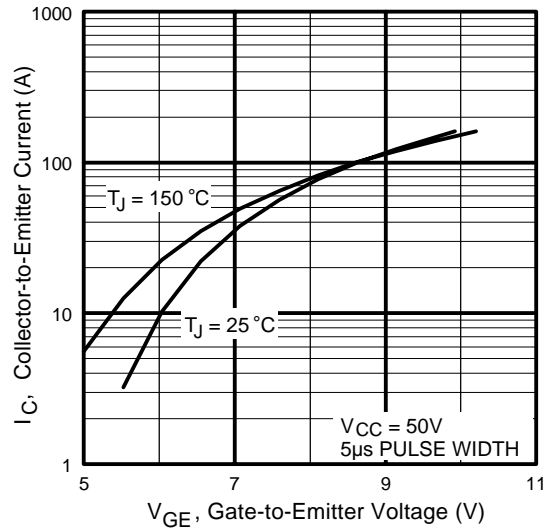


Fig. 3 - Typical Transfer Characteristics

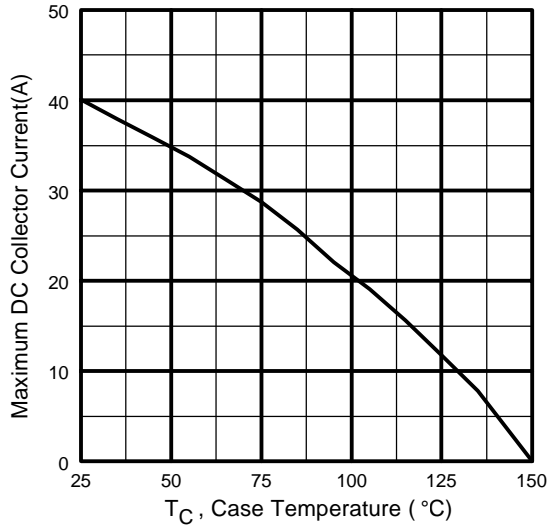


Fig. 4 - Maximum Collector Current vs. Case Temperature

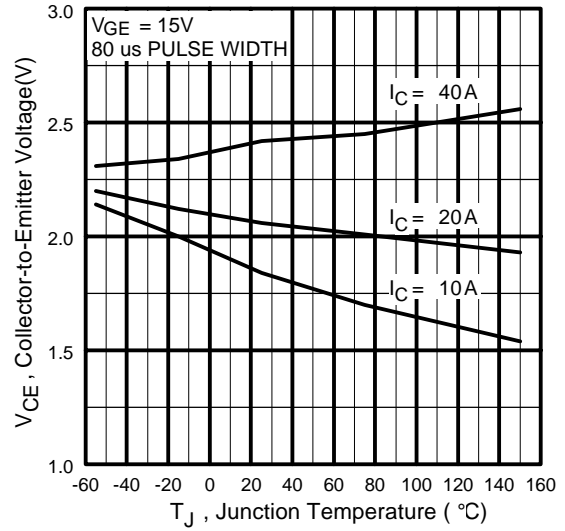


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

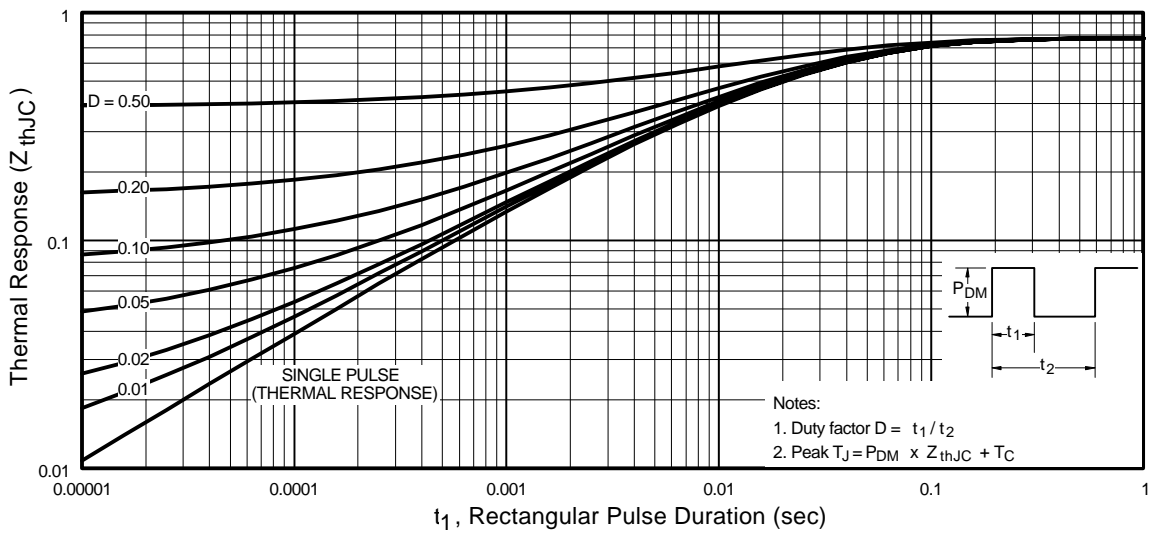


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

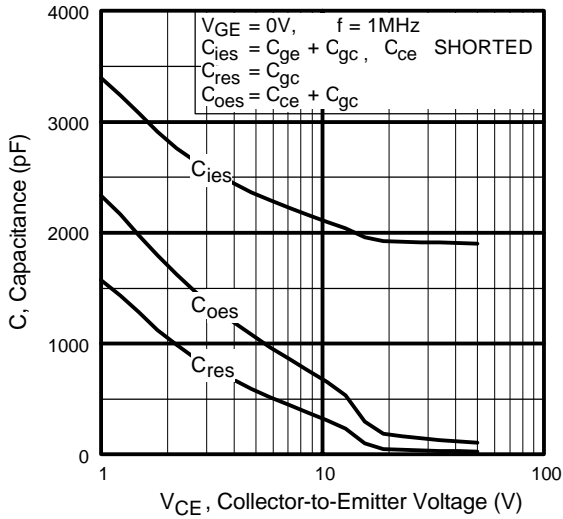


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

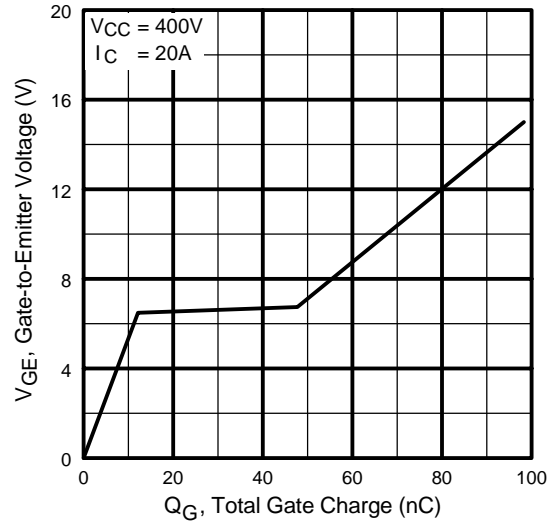


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

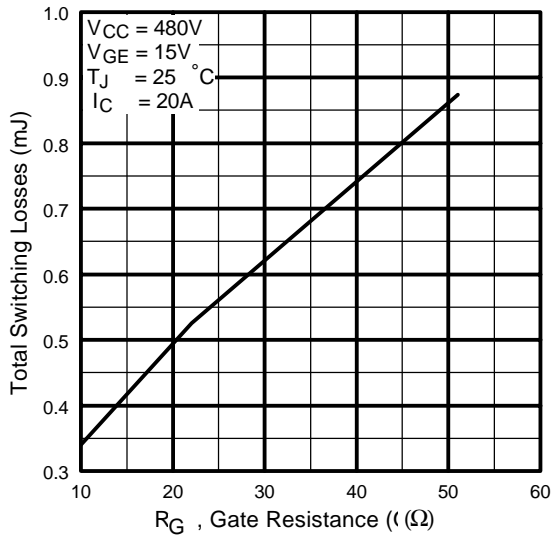


Fig. 9 - Typical Switching Losses vs. Gate Resistance

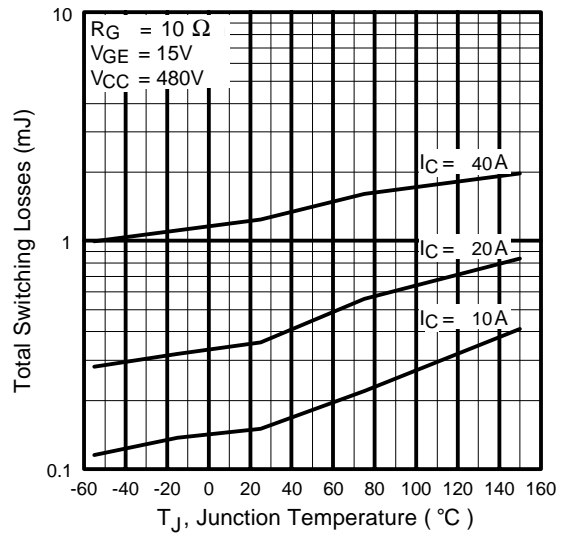


Fig. 10 - Typical Switching Losses vs. Junction Temperature

IRG4PC40W

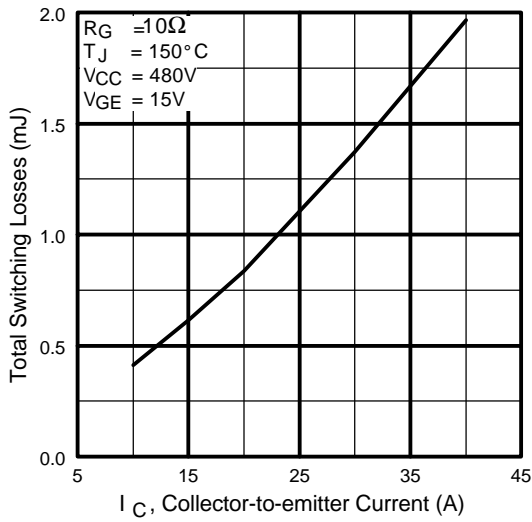


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

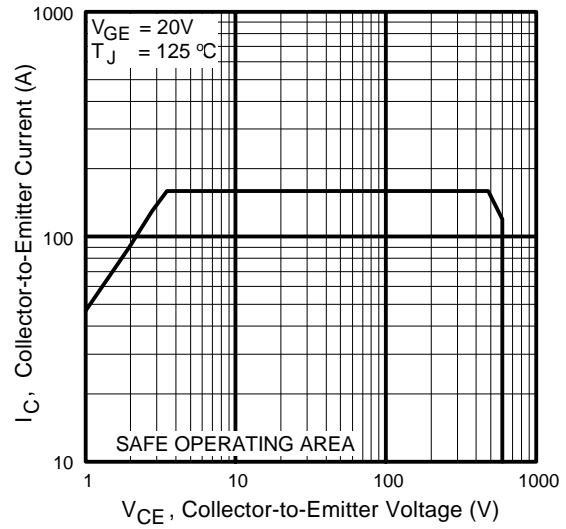


Fig. 12 - Turn-Off SOA



* Driver same type as D.U.T.; $V_c = 80\%$ of $V_{ce(max)}$
 * Note: Due to the 50V power supply, pulse width and inductor will increase to obtain rated I_d .

Fig. 13a - Clamped Inductive Load Test Circuit



Fig. 13b - Pulsed Collector Current Test Circuit



Fig. 14a - Switching Loss Test Circuit

* Driver same type as D.U.T., $V_C = 480V$

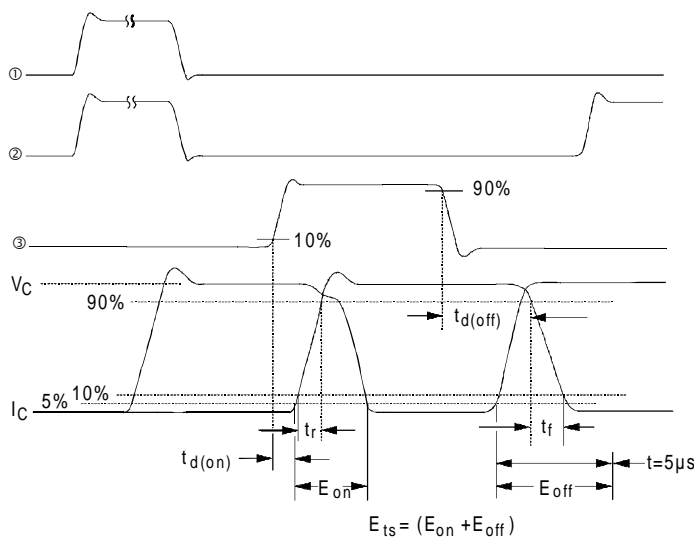
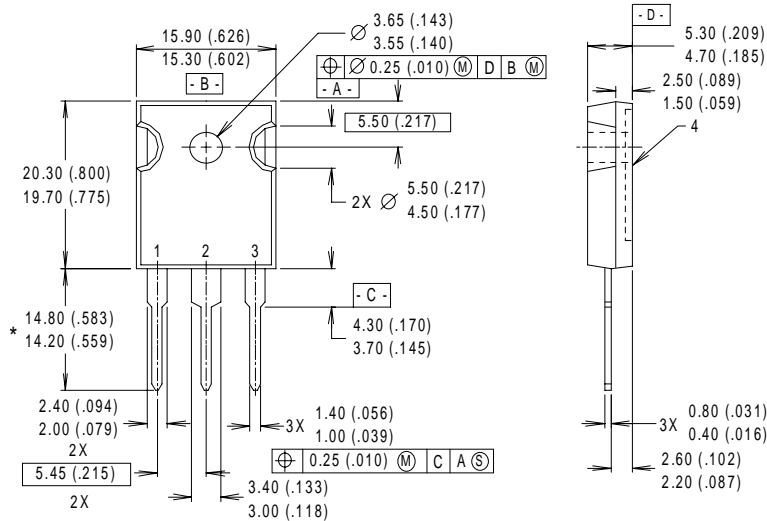


Fig. 14b - Switching Loss Waveforms

IRG4PC40W

International
IR Rectifier

Case Outline and Dimensions — TO-247AC



- NOTES:
- 1 DIMENSIONS & TOLERANCING PER ANSI Y14.5M, 1982.
 - 2 CONTROLLING DIMENSION : INCH.
 - 3 DIMENSIONS ARE SHOWN MILLIMETERS (INCHES).
 - 4 CONFORMS TO JEDEC OUTLINE TO-247AC.

- LEAD ASSIGNMENTS
- 1 - GATE
 - 2 - COLLECTOR
 - 3 - EMITTER
 - 4 - COLLECTOR

* LONGER LEADED (20mm)
VERSION AVAILABLE (TO-247AD)
TO ORDER ADD "-E" SUFFIX
TO PART NUMBER

CONFORMS TO JEDEC OUTLINE TO-247AC (TO-3P)

Dimensions in Millimeters and (Inches)

International
IR Rectifier

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IR CANADA: 15 Lincoln Court, Brampton, Ontario L6T3Z2, Tel: (905) 453 2200

IR GERMANY: Saalburgstrasse 157, 61350 Bad Homburg Tel: ++ 49 (0) 6172 96590

IR ITALY: Via Liguria 49, 10071 Borgaro, Torino Tel: ++ 39 011 451 0111

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IR SOUTHEAST ASIA: 1 Kim Seng Promenade, Great World City West Tower, 13-11, Singapore 237994 Tel: ++ 65 (0)838 4630

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Data and specifications subject to change without notice. 4/00