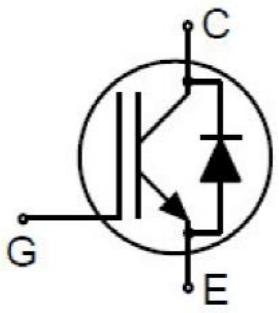
Trench FS IGBT with Full Rated Diode

TGKU40N65EH5

Features

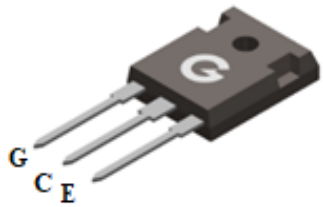
HF

- High breakdown voltage to 650V for improved reliability
- Trench-stop technology offering:
  - High speed switching
  - High ruggedness, temperature stable behavior
  - Low $V_{CE(SAT)}$
  - Easy parallel switching capability due to positive temperature coefficient in $V_{CE(SAT)}$
- Enhanced avalanche capability
- RoHS compliant with Halogen-free
- Qualified to AEC-Q101 Standards



Applications

- Uninterruptible power supplies
- Solar inverter



TO-247

Mechanical Data

- Case: TO-247
- Molding Compound: UL Flammability Classification Rating 94V-0
- Terminals: Matte tin-plated leads; solderability-per MIL-STD-202, Method 208

Ordering Information

Part Number	Package	Shipping Quantity	Marking Code
TGKU40N65EH5	TO-247	30 pcs / Tube	KU40N65EH5

Maximum Ratings (@ T_C = 25°C unless otherwise specified)

Parameter	Symbol	Value	Unit
Collector-to-Emitter Voltage	V_{CES}	650	V
Gate-Emitter Voltage	V_{GES}	±20	V
DC Collector Current (T_C = 25°C, limited by maximum T_J)	I_C	80	A
DC Collector Current (T_C = 100°C, limited by maximum T_J)		40	A
Diode Continuous Forward Current (T_C = 25°C, limited by maximum T_J)	I_F	80	A
Diode Continuous Forward Current (T_C = 100°C, limited by maximum T_J)		40	A
Pulsed Collector Current (Pulse width limited by maximum T_J, V_{GE} = 15V)	I_{CM}	160	A
Pulsed Source-Drain Current (Pulse width limited by maximum T_J)	I_{FM}	160	A
Soldering Temperature, Wave Soldering 1.6mm (0.063in.) from case for 10s	T_{sold}	260	°C
Power Dissipation (T_C = 25°C)	P_D	250	W
Operating Junction Temperature Range	T_J	-55 ~ +175	°C
Storage Temperature Range	T_{STG}	-55 ~ +150	°C

Thermal Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit
Thermal Resistance Junction-to-Case, IGBT	$R_{\theta JC}$	-	0.48	0.6	°C/W
Thermal Resistance Junction-to-Case, Diode		-	0.72	0.8	°C/W
Thermal Resistance Junction-to-Air	$R_{\theta JA}$	-	-	40	°C/W

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

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
Static Characteristics						
$V_{(BR)CES}$	Collector-Emitter Breakdown Voltage	V_{GE} = 0V, I_C = 250μA	650	-	-	V
I_{CES}	Collector-Emitter Leakage Current	V_{CE} = 650V, V_{GE} = 0V	-	-	40	μA
I_{GES}	Gate to Emitter Leakage Current	V_{GE} = ±20V, V_{CE} = 0V	-	-	±200	nA
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	V_{GE} = 15V, I_C = 40A, T_J = 25°C	-	1.8	2.3	V
		V_{GE} = 15V, I_C = 40A, T_J = 175°C	-	2.5	-	V
$V_{GE(th)}$	Gate Threshold Voltage	V_{CE} = V_{GE}, I_C = 250μA	3.6	4.4	5.2	V
R_G	Gate Resistance	V_{GS} = 0V, f = 1MHz	-	1.84	-	Ω
Dynamic Characteristics						
Q_G	Total Gate-Charge	V_{CC} = 520V, V_{GE} = 15V, I_C = 40A	-	67	-	nC
C_{ies}	Input Capacitance	V_{CE} = 30V V_{GE} = 0V f = 1MHz	-	2192	-	pF
C_{oes}	Output Capacitance		-	87	-	
C_{res}	Reverse Transfer Capacitance		-	7	-	
Switching Characteristics						
$t_{d(on)}$	Turn-on Delay Time	V_{CE} = 400V V_{GE} = 15V I_C = 40A R_G = 20Ω T_J = 25°C	-	42	-	ns
t_r	Turn-on Rise Time		-	84	-	
$t_{d(off)}$	Turn-Off Delay Time		-	124	-	
t_f	Turn-Off Fall Time		-	80	-	
E_{on}	Turn-On Switching Loss		-	1.37	-	mJ
E_{off}	Turn-Off Switching Loss		-	0.58	-	

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

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
Dynamic Characteristics						
V_{FM}	Diode Forward Voltage	I_F = 40A, V_{GE} = 0V	-	1.75	-	V
t_{rr}	Reverse recovery time	V_{GS} = 0V, I_F = 40A di/dt = 300A/μs	-	97	-	ns
Q_{rr}	Reverse recovery charge		-	428	-	nC
I_{rrm}	Peak Reverse Recovery Current		-	8.3	-	A

Ratings and Characteristics Curves (@ T_A = 25°C unless otherwise specified)

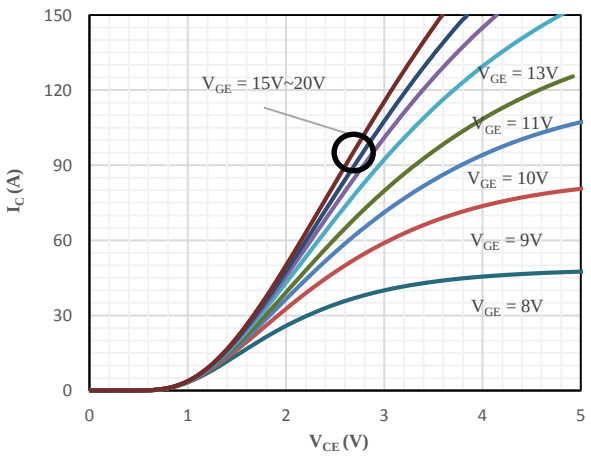


Fig 1 Typical Output Characteristics

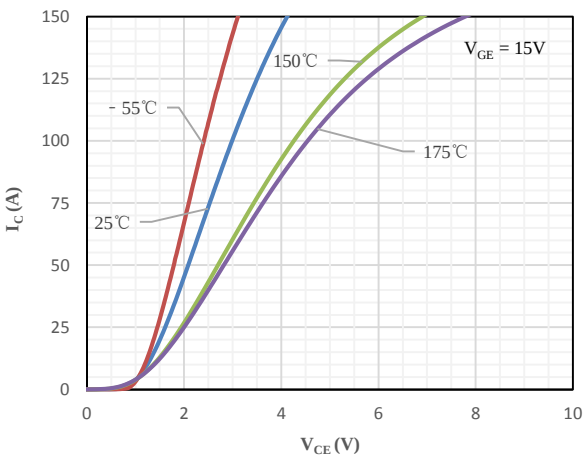


Fig 2 Saturation Voltage Characteristics

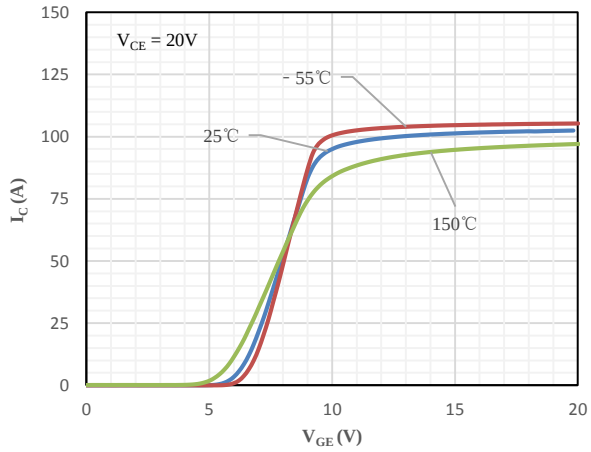


Fig 3 Transfer Characteristics

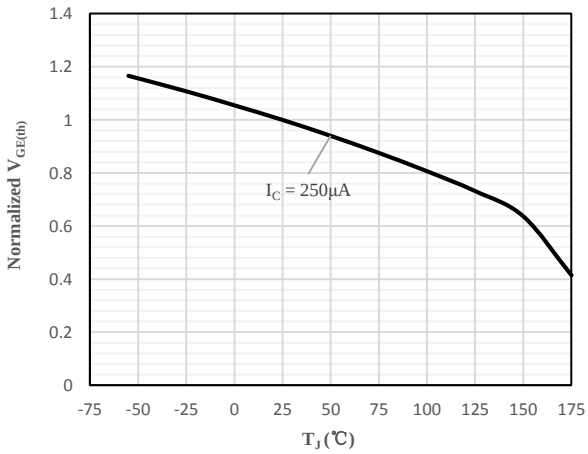


Fig 4 Normalized $V_{GE(th)}$ vs. Junction Temperature

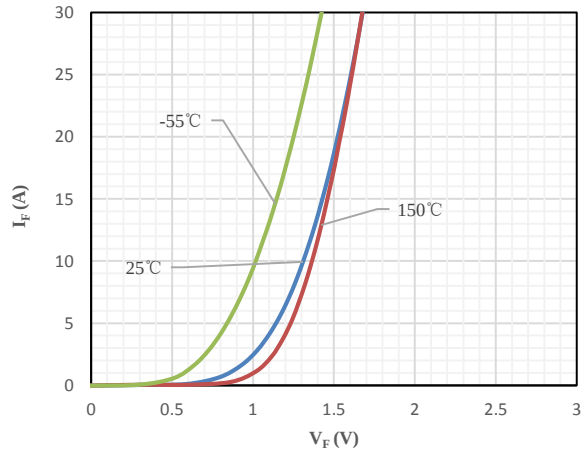


Fig 5 Diode forward current as a function of forward voltage V_F vs. I_F

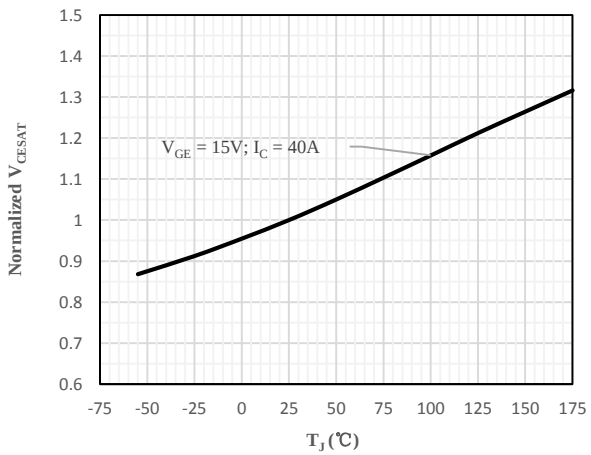


Fig 6 Normalized Collector-Emitter Saturation Voltage vs. Junction Temperature

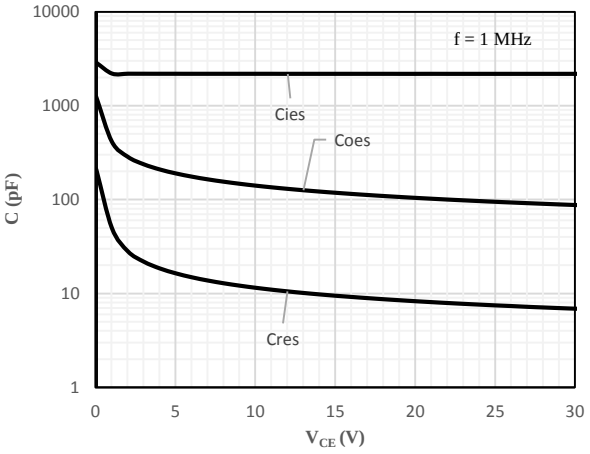


Fig 7 Capacitance Characteristics

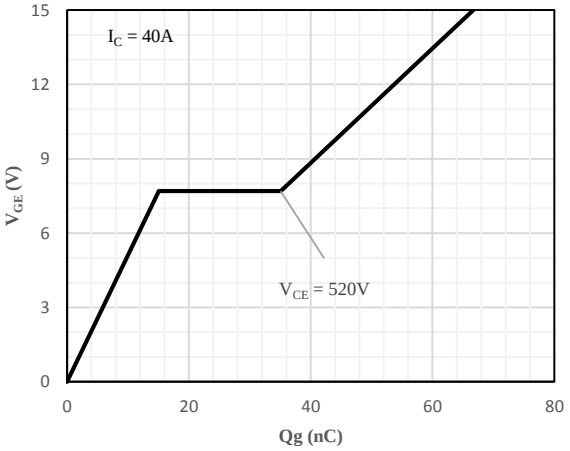


Fig 8 Gate-Charge Characteristics

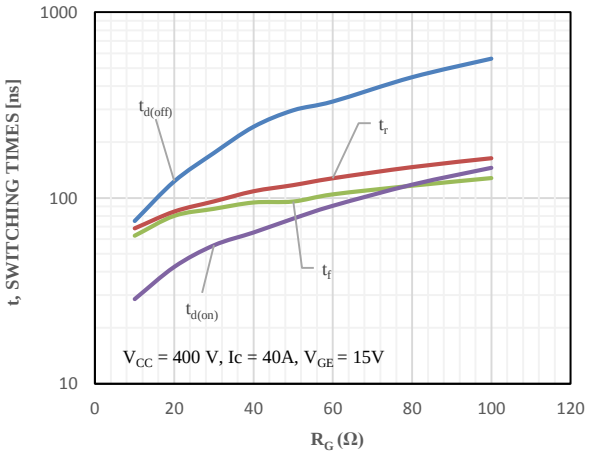


Fig 9 Switching Times vs. Gate Resistor

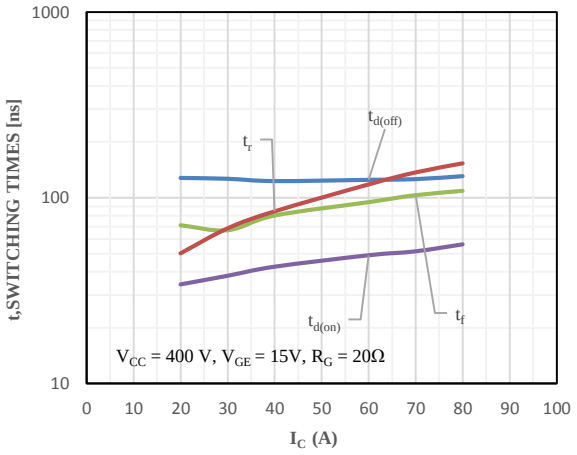


Fig 10 Switching Times vs. Collector Current

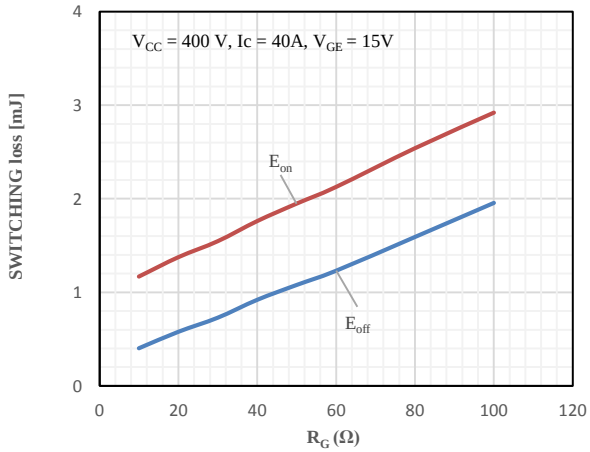


Fig 11 Switching Loss vs. Gate Resistor

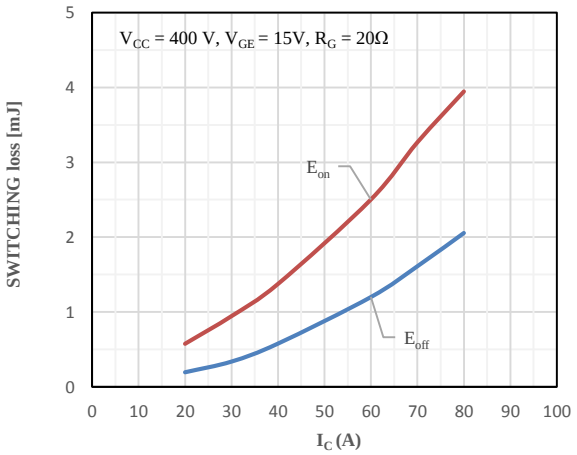


Fig 12 Switching Loss vs. Collector Current

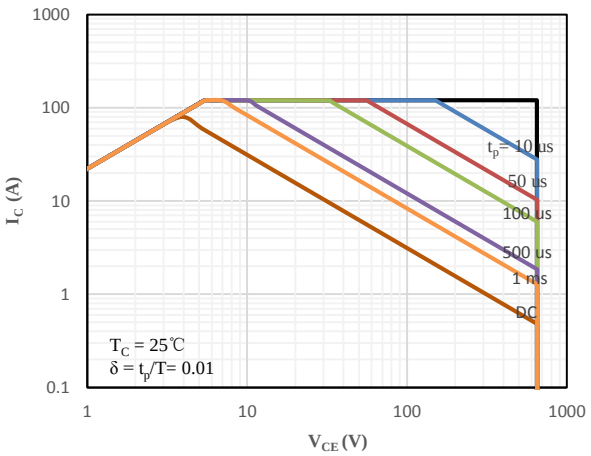


Fig 13 SOA characteristics

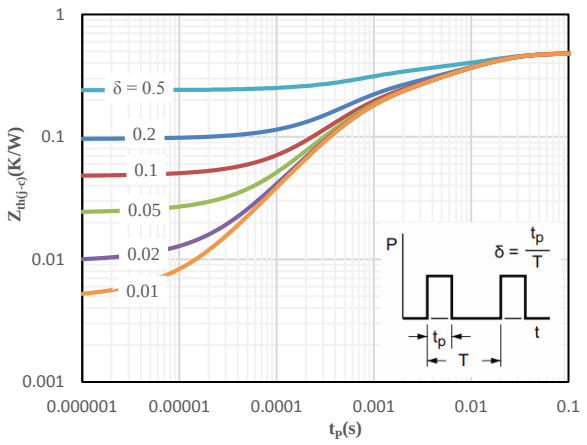


Fig 14 Maximum transient thermal impedance

Waveform definitions

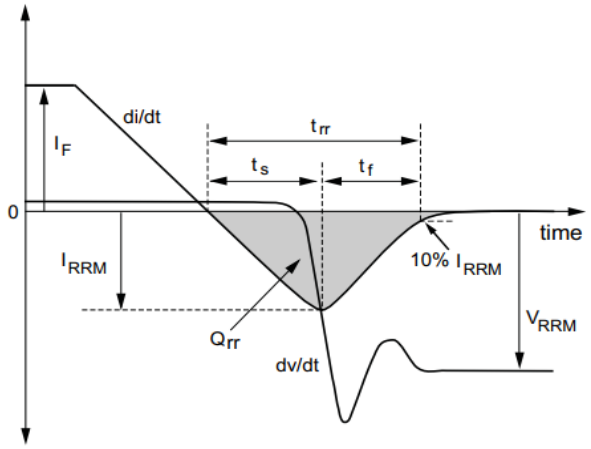


Fig 1 Diode Reverse Recovery Waveform Definitions

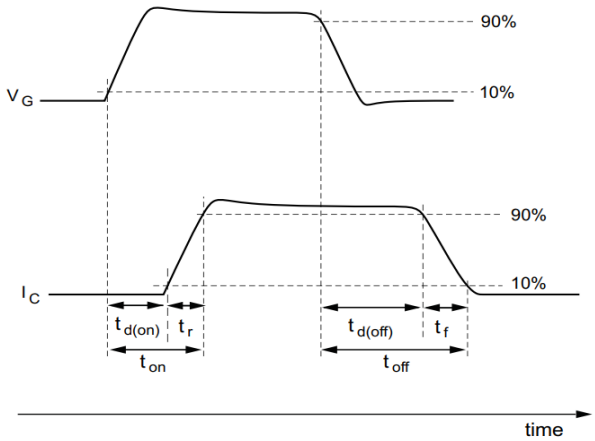
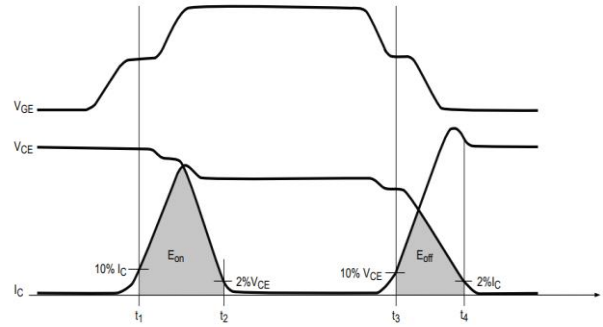


Fig 2 IGBT Switching Times Definitions



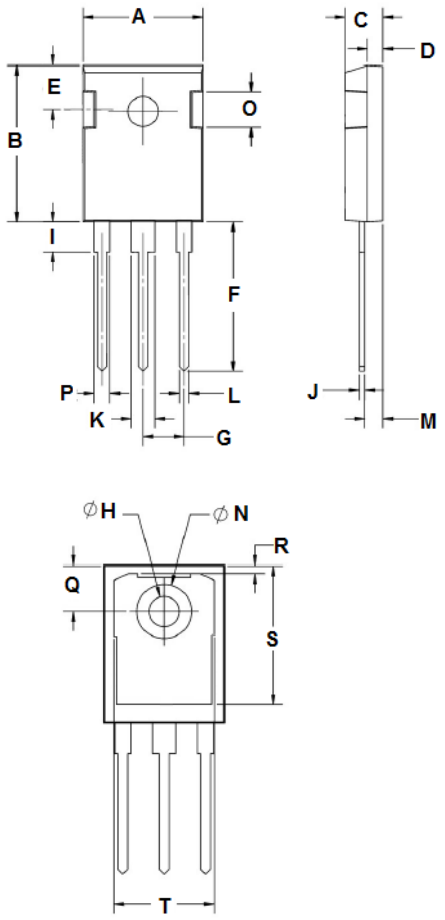
Where

$$E_{on}=\int_{t_1}^{t_2} V_{CE}\, I_C\, dt$$

$$E_{off}=\int_{t_3}^{t_4} V_{CE}\, I_C\, dt$$

Fig 3 IGBT Switching Energy Loss Definitions

Package Outline Dimensions (Unit: mm)



TO-247		
Dimension	**Min.**	**Max.**
A	15.50	16.10
B	20.70	21.30
C	4.70	5.30
D	1.80	2.20
E	5.20	5.80
F	19.70	20.30
G	5.20	5.60
H	3.30	3.70
I	3.90	4.30
J	0.50	0.70
K	2.80	3.20
L	1.00	1.40
M	2.20	2.60
N	7.00	7.20
O	4.90	5.30
P	1.80	2.20
Q	5.70	6.10
R	0.80	1.20
S	17.00	17.80
T	13.60	14.20