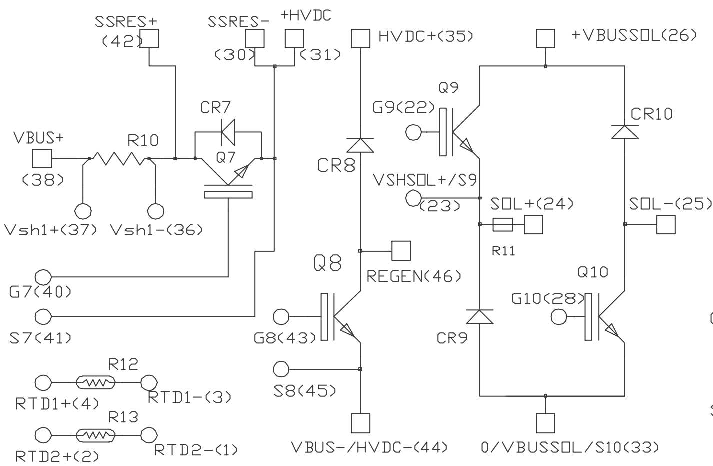
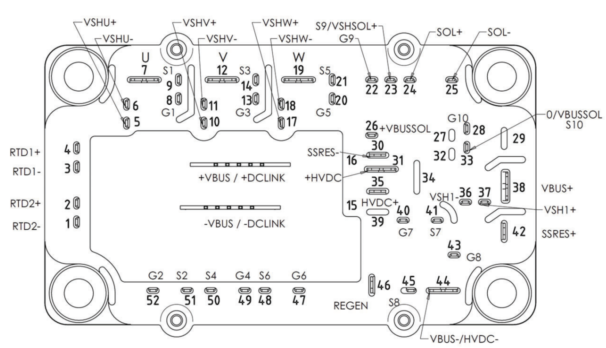
MSCGLQ100X065CTYZBNMG

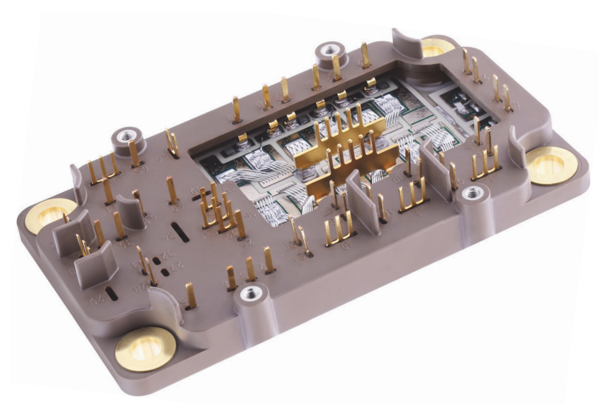
Three-Phase Bridge, Brake, Soft Start, and Solenoid Power Module

Product Overview

The MSCGLQ100X065CTYZBNMG device is a three-phase bridge, brake, soft start, and solenoid power module.







Note: All ratings at T_J = 25 °C, unless otherwise specified.

⚠ CAUTION These devices are sensitive to electrostatic discharge. Proper handling procedures must be followed.

Features

The MSCGLQ100X065CTYZBNMG device has the following key features:

- Silicon Carbide (SiC) Schottky Diode
- IGBT4
- Low stray inductance
- Lead frames for power connections
- Si_3N_4 substrate for improved thermal performance
- AlSiC base plate for extended reliability and reduced weight
- Extended storage temperature range
- Internal thermistor for temperature monitoring

Benefits

The MSCGLQ100X065CTYZBNMG device has the following benefits:

- Stable temperature behavior
- Very rugged
- Solderable terminals for easy PCB mounting
- Direct mounting to heatsink (isolated package)
- Low junction-to-case thermal resistance
- RoHS Compliant

Application

The MSCGLQ100X065CTYZBNMG device has the following applications:

- Hybrid Power Device (HPD) for Electro-Mechanical Actuator (EMA) and Electro-Hydrostatic Actuator (EHA) systems
- High reliability Power Core Module (PCM)
- Modular power module for Power Drive Electronic (PDE)

1. Electrical Specification

The following sections describe the electrical specifications of the MSCGLQ100X065CTYZBNMG device.

1.1 Q1 to Q6 and Q8 IGBTs (Per IGBT): Three-Phase Bridge and Brake

The following table lists the absolute maximum ratings (per IGBT) of the Q1 to Q6 and Q8 IGBTs.

Table 1-1. Absolute Maximum Ratings: Q1 to Q6 and Q8 IGBTs

Symbol	Parameter		Maximum Ratings	Unit
V_{CES}	Collector-emitter voltage		650	V
I_C	Continuous collector current	T_C = 25 °C	150	A
		T_C = 80 °C	100	
I_{CM}	Pulsed collector current	T_C = 25 °C	250	
V_{GE}	Gate-emitter voltage		±20	V
P_D	Power dissipation	T_C = 25 °C	400	W

The following table lists the electrical characteristics (per IGBT) of the Q1 to Q6 and Q8 IGBTs.

Table 1-2. Electrical Characteristics: Q1 to Q6 and Q8 IGBTs

Symbol	Characteristic	Test Conditions		Min.	Typ.	Max.	Unit
I_{CES}	Zero gate voltage collector current	V_{GE} = 0V; V_{CE} = 650V		—	—	50	µA
$V_{CE(sat)}$	Collector emitter saturation voltage	V_{GE} = 15V I_C = 100A	T_J = 25 °C	1.4	1.85	2.3	V
			T_J = 150 °C	—	2.2	—	
$V_{GE(th)}$	Gate threshold voltage	V_{GE} = V_{CE}; I_C = 1.6 mA		4.2	5.1	5.6	
I_{GES}	Gate-emitter leakage current	V_{GE} = 20V; V_{CE} = 0V		—	—	150	nA

The following table lists the dynamic characteristics (per IGBT) of the Q1 to Q6 and Q8 IGBTs.

Table 1-3. Dynamic Characteristics: Q1 to Q6 and Q8 IGBTs

Symbol	Characteristic	Test Conditions		Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	V_{GE} = 0V V_{CE} = 25V f = 1 MHz		—	6100	—	pF
C_{oes}	Output capacitance			—	232	—	
C_{res}	Reverse transfer capacitance			—	180	—	
Q_G	Gate charge	V_{GE} = 15V V_{CE} = 480V I_C = 100A		—	630	—	nC
$T_{d(on)}$	Turn-on delay time	V_{GE} = ±15V V_{Bus} = 400V I_C = 100A R_G = 3.6Ω	T_J = 150 °C	—	19	—	ns
T_r	Rise time			—	29	—	
$T_{d(off)}$	Turn-off delay time			—	227	—	
T_f	Fall time				22	—	
E_{on}	Turn-on energy	V_{GE} = ±15V V_{Bus} = 400V I_C = 100A R_G = 3.6Ω	T_J = 150 °C	—	1.5	—	mJ
E_{off}	Turn-off energy			—	2	—	
R_G	Integrated gate resistor			—	2	—	Ω
I_{sc}	Short circuit data	V_{GE} ≤ 15V V_{Bus} = 400V t_p ≤ 5 µs	T_J = 150 °C	—	700	—	A
R_{thJC}	Junction-to-case thermal resistance			—	—	0.37	°C/W

1.2 CR1 to CR8 SiC Diodes (Per SiC Diode): Three-Phase Bridge, Brake, and Soft Start

The following table lists the ratings and characteristics (per SiC diode) of the CR1 to CR8 SiC diodes.

Table 1-4. Ratings and Characteristics: CR1 to CR8 SiC Diodes

Symbol	Characteristic	Test Conditions		Min.	Typ.	Max.	Unit
V_{RRM}	Peak repetitive reverse voltage			—	—	700	V
I_{RM}	Reverse leakage current	V_R = 700V	T_J = 25 °C	—	15	200	µA
			T_J = 175 °C	—	250	—	
I_F	DC forward current	T_J = 175 °C	T_C = 60 °C	—	50	—	A
V_F	Diode forward voltage	I_F = 50A	T_J = 25 °C	—	1.5	1.8	V
			T_J = 175 °C	—	1.9	—	
Q_C	Total capacitive charge	V_R = 400V		—	133	—	nC
C	Total capacitance	f = 1 MHz, V_R = 200V		—	248	—	pF
		f = 1 MHz, V_R = 400V		—	216	—	
R_{thJC}	Junction-to-case thermal resistance			—	—	1.075	°C/W

1.3 Q7 IGBT: Soft Start

The following table lists the absolute maximum ratings of the Q7 IGBT.

Table 1-5. Absolute Maximum Ratings: Q7 IGBT

Symbol	Parameter		Maximum Ratings	Unit
V_{CES}	Collector-emitter voltage		650	V
I_C	Continuous collector current	T_C = 25 °C	270	A
		T_C = 90 °C	150	
I_{CM}	Pulsed collector current	T_C = 25 °C	300	
V_{GE}	Gate-emitter voltage		±20	V
P_D	Power dissipation	T_C = 25 °C	555	W

The following table lists the electrical characteristics of the Q7 IGBT.

Table 1-6. Electrical Characteristics: Q7 IGBT

Symbol	Characteristic	Test Conditions		Min.	Typ.	Max.	Unit
I_{CES}	Zero gate voltage collector current	V_{GE} = 0V V_{CE} = 650V		—	—	50	μA
$V_{CE(sat)}$	Collector emitter saturation voltage	V_{GE} = 15V I_C = 150A	T_J = 25 °C	—	1.5	1.9	V
			T_J = 150 °C	—	1.7	—	
$V_{GE(th)}$	Gate threshold voltage	V_{GE} = V_{CE} I_C = 2.5 mA		5.0	5.8	6.5	
I_{GES}	Gate-emitter leakage current	V_{GE} = 20V V_{CE} = 0V		—	—	600	nA

The following table lists the dynamic characteristics of the Q7 IGBT.

Table 1-7. Dynamic Characteristics: Q7 IGBT

Symbol	Characteristic	Test Conditions		Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	V_{GE} = 0V V_{CE} = 25V f = 1 MHz		—	9.2	—	nF
C_{oes}	Output capacitance			—	0.57	—	
C_{res}	Reverse transfer capacitance			—	0.27	—	
Q_G	Gate charge	V_{GE} = ±15V V_{CE} = 300V I_C = 150A		—	1.6	—	μC
$T_{d(on)}$	Turn-on delay time	V_{GE} = ±15V V_{Bus} = 300V I_C = 150A R_G = 3.3Ω	T_J = 150 °C	—	130	—	ns
T_r	Rise time			—	50	—	
$T_{d(off)}$	Turn-off delay time			—	300	—	
T_f	Fall time			—	70	—	
E_{on}	Turn-on energy	V_{GE} = ±15V V_{Bus} = 300V I_C = 150A R_G = 3.3Ω	T_J = 150 °C	—	1.5	—	mJ
E_{off}	Turn-off energy			—	5.3	—	
I_{sc}	Short circuit data	V_{GE} ≤ 15V V_{Bus} = 360V t_p ≤ 6 μs	T_J = 150 °C	—	750	—	A
R_{Gint}	Internal gate resistance			—	2	—	Ω
R_{thJC}	Junction-to-case thermal resistance			—	—	0.27	°C/W

1.4 Q9 and Q10 IGBTs (Per IGBT): Solenoid

The following table lists the absolute maximum ratings (per IGBT) of the Q9 and Q10 IGBTs.

Table 1-8. Absolute Maximum Ratings: Q9 and Q10 IGBTs

Symbol	Parameter		Maximum Ratings	Unit
V_{CES}	Collector-emitter voltage		1200	V
I_C	Continuous collector current	T_C = 25 °C	27	A
		T_C = 80 °C	15	
I_{CM}	Pulsed collector current	T_C = 25 °C	30	
V_{GE}	Gate-emitter voltage		±20	V
P_D	Power dissipation	T_C = 25 °C	80	W

The following table lists the electrical characteristics (per IGBT) of the Q9 and Q10 IGBTs.

Table 1-9. Electrical Characteristics: Q9 and Q10 IGBTs

Symbol	Characteristic	Test Conditions		Min.	Typ.	Max.	Unit
I_{CES}	Zero gate voltage collector current	V_{GE} = 0V V_{CE} = 1200V		—	—	100	μA
$V_{CE(sat)}$	Collector emitter saturation voltage	V_{GE} = 15V I_C = 8A	T_J = 25 °C	1.6	1.85	2.1	V
			T_J = 150 °C	—	2.25	—	
$V_{GE(th)}$	Gate threshold voltage	V_{GE} = V_{CE} I_C = 0.3 mA		5.3	5.8	6.3	
I_{GES}	Gate-emitter leakage current	V_{GE} = 15V V_{CE} = 0V		—	—	150	nA
C_{ies}	Input capacitance	V_{GE} = 0V V_{CE} = 25V f = 1 MHz		—	490	—	pF
C_{res}	Reverse transfer capacitance			—	30	—	
R_{thJC}	Junction-to-case thermal resistance			—	—	1.85	°C/W

1.5 CR9 and CR10 SiC Diodes (Per SiC diode): Solenoid

The following table lists the ratings and characteristics (per SiC diode) of the CR9 and CR10 SiC diodes.

Table 1-10. Ratings and Characteristics: CR9 and CR10 SiC Diodes

Symbol	Characteristic	Test Conditions		Min.	Typ.	Max.	Unit
V_{RRM}	Peak repetitive reverse voltage			—	—	700	V
I_{RM}	Reverse leakage current	V_R = 700V	T_J = 25 °C	—	5	200	µA
			T_J = 175 °C	—	50	—	
I_F	DC forward current	T_J = 175 °C	T_C = 60 °C	—	10	—	A
V_F	Diode forward voltage	I_F = 10A	T_J = 25 °C	—	1.5	1.8	V
			T_J = 175 °C	—	1.9	—	
Q_C	Total capacitive charge	V_R = 400V		—	27	—	nC
C	Total capacitance	f = 1 MHz, V_R = 200V		—	49	—	pF
		f = 1 MHz, V_R = 400V		—	46	—	
R_{thJC}	Junction-to-case thermal resistance			—	—	4.69	°C/W

1.6 Electrical Shunt Characteristics

The following tables list the electrical shunt characteristics of the MSCGLQ100X065CTYZBNMG device.

Table 1-11. Shunt (R7 to R9)

Symbol	Characteristic		Min.	Typ.	Max.	Unit
R_i	Resistance value	i = 7, 8, 9	—	0.3	—	mΩ
T_{Ri}	Tolerance	TCR Max 20 ppm/°C (from 20 °C to 60 °C)	—	1	1.5	%
P_{Ri}	Load capacity		—	—	5	W
I_{Ri}	Current capacity		—	—	129	A

Table 1-12. Shunt (R10)

Symbol	Characteristic		Min.	Typ.	Max.	Unit
R_i	Resistance value	i = 10	—	0.2	—	mΩ
T_{Ri}	Tolerance	TCR Max 20 ppm/°C (from 20 °C to 60 °C)	—	1	1.5	%
P_{Ri}	Load capacity		—	—	5	W
I_{Ri}	Current capacity		—	—	158	A

Table 1-13. Shunt (R11)

Symbol	Characteristic		Min.	Typ.	Max.	Unit
R_i	Resistance value	i = 11	—	15	—	mΩ
RSoli	Resistance value with SOL+ connector [1]	TCR Max 50 ppm/°C (from 20 °C to 60 °C)	—	15.25	—	
T_{Ri}	Tolerance		—	1	1.5	%
P_{Ri}	Load capacity		—	—	3	W
I_{Ri}	Current capacity		—	—	14	A

Note:

1. Value that integrates the resistivity of the SOL+ connector considering the user PCB mounted on the spacers and soldered on the power module according with the IPC A610, class 3.

1.7 Temperature Sensor PTC

The following table lists the temperature sensor PTC of the MSCGLQ100X065CTYZBNMG device.

Table 1-14. Temperature Sensor PTC

Symbol	Characteristic	Typ.	Unit
R_0	Resistance at 0 °C	1000	Ω
A	—	3.9083×10^{-3}	$°C^{-1}$
B	—	-5.775×10^{-7}	$°C^{-2}$
C	—	-4.183×10^{-12}	$°C^{-4}$
ΔT	—	$\pm(0.3 + 0.005 \times \lvert T \rvert)$	°C

For temperature range of 0 °C up to 175 °C, $R_T = R_0 (1 + A \times T + B \times T^2)$

For temperature range of −55 °C up to 0 °C, $R_T = R_0 (1 + A \times T + B \times T^2 + C (T - 100) T^3)$

Where:

T: Temperature in °C

R_T: Thermistor value at T

Note: For more information, see APT0406—Using NTC Temperature Sensor Integrated into Power Module.

1.8 Thermal and Package Characteristics

The following table lists the thermal and package characteristics of the MSCGLQ100X065CTYZBNMG device.

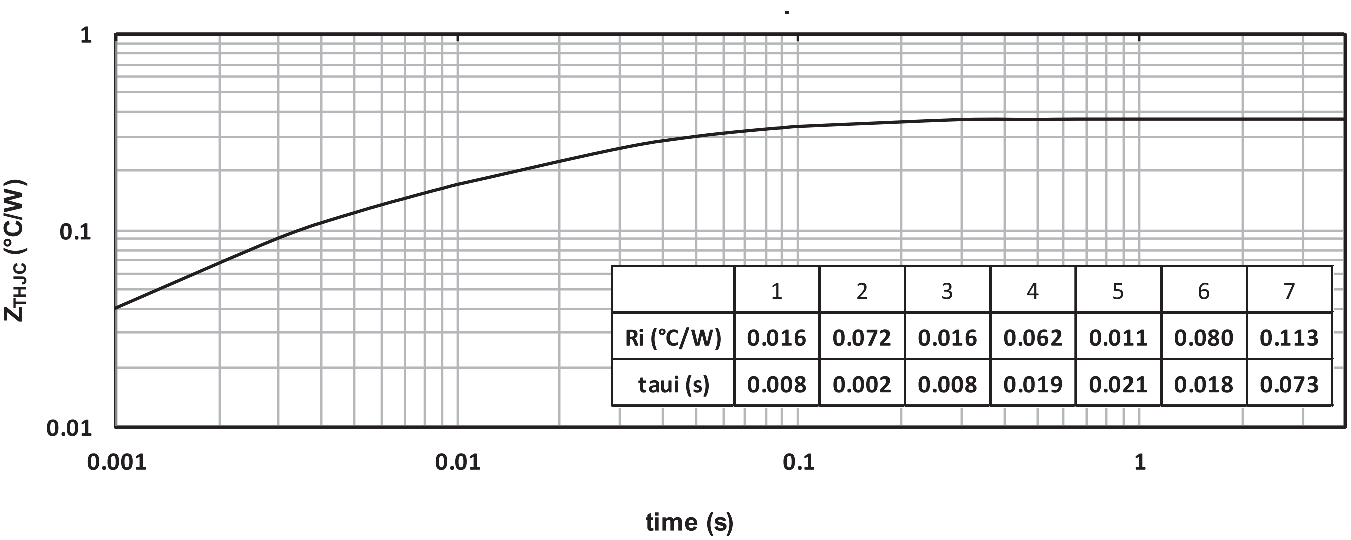
Table 1-15. Thermal and Package Characteristics

Symbol	Characteristic			Min.	Max.	Unit
V_{ISOL}	RMS isolation voltage, any terminal to case, t = 1 min, at 1 bar			4000	—	V
$V_{ISOL}PTC$	RMS isolation voltage, PTC to any other electrical terminals, t = 1 min at 1 bar, 50/60 Hz			1500	—	
T_J	Operating junction temperature range			–55	175	°C
T_{JOP}	Recommended junction temperature under switching conditions			–55	T_{Jmax}–25	
T_{STG}	Storage temperature range			–60	125	
T_C	Operating case temperature			–55	125	
Torque	Mounting torque	Insert	M2.5	—	0.3	N.m
		To heatsink	M6	3	5	
Wt	Package weight			—	150	g

1.9 Typical IGBT Performance Curve (Q1 to Q6 and Q8)

The following figures show the performance curves of the Q1 to Q6 and Q8 IGBTs.

Figure 1-1. Maximum Thermal Impedance



	1	2	3	4	5	6	7
Ri (°C/W)	0.016	0.072	0.016	0.062	0.011	0.080	0.113
taui (s)	0.008	0.002	0.008	0.019	0.021	0.018	0.073

Figure 1-2. Output Characteristics (V_{GE} = 15V)

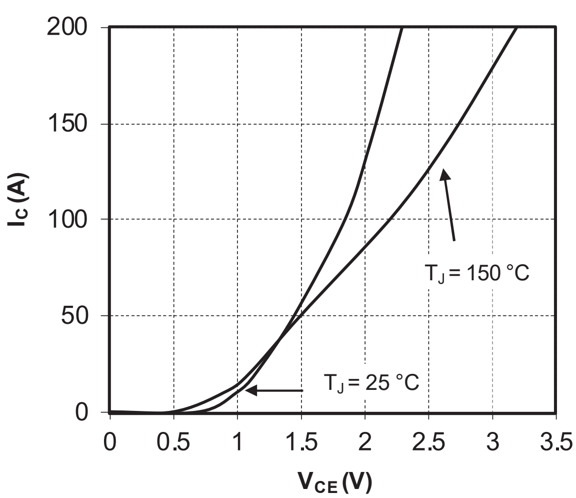


Figure 1-3. Output Characteristics, T_J = 150 °C

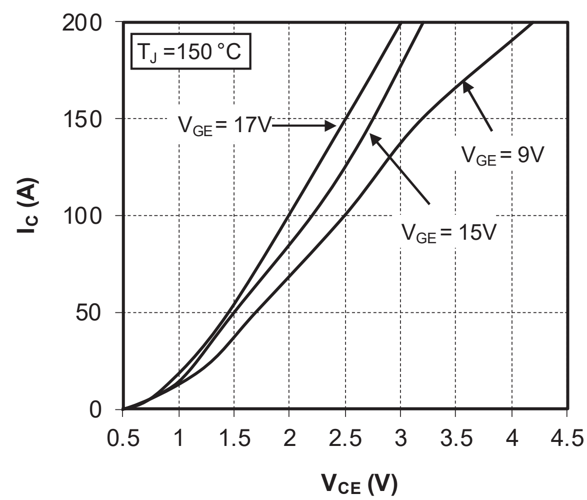


Figure 1-4. Transfer Characteristics

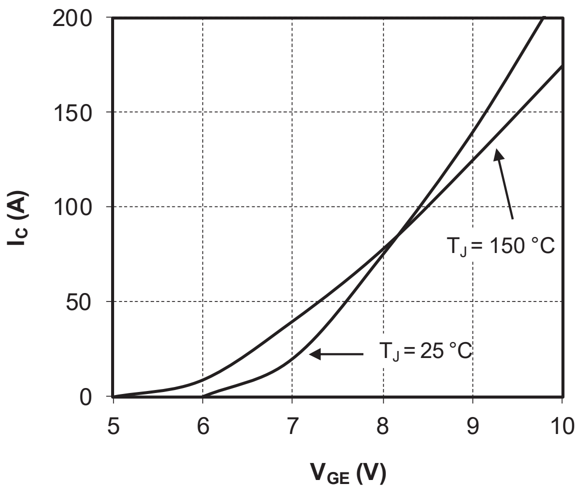


Figure 1-5. Energy Losses vs. Collector Current

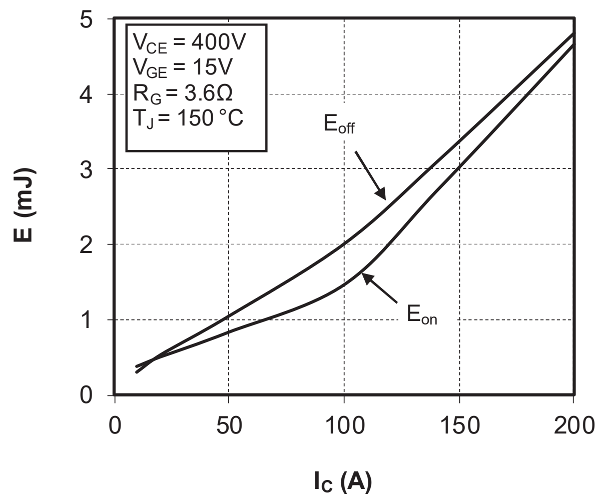


Figure 1-6. Switching Energy Losses vs. Gate Resistance

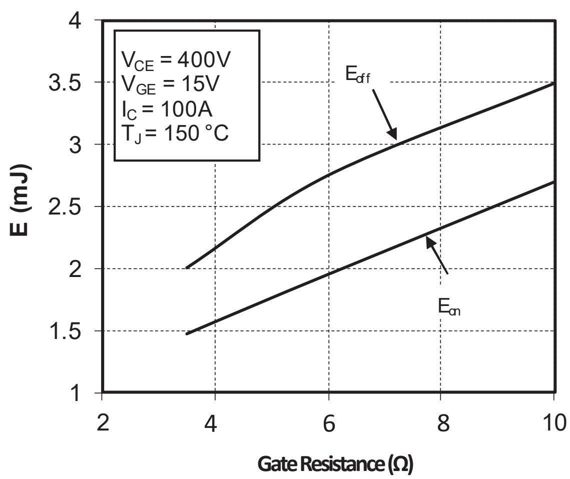
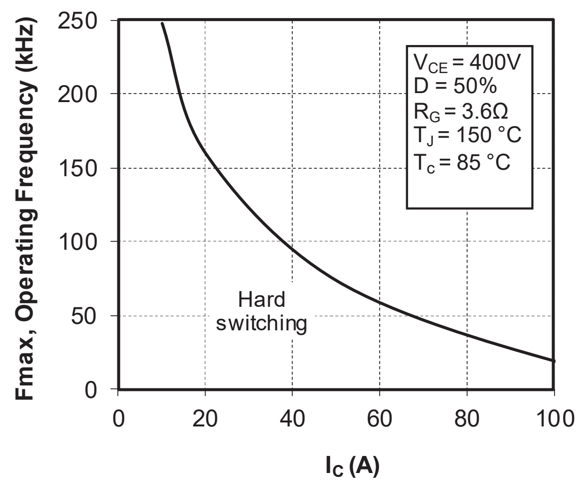


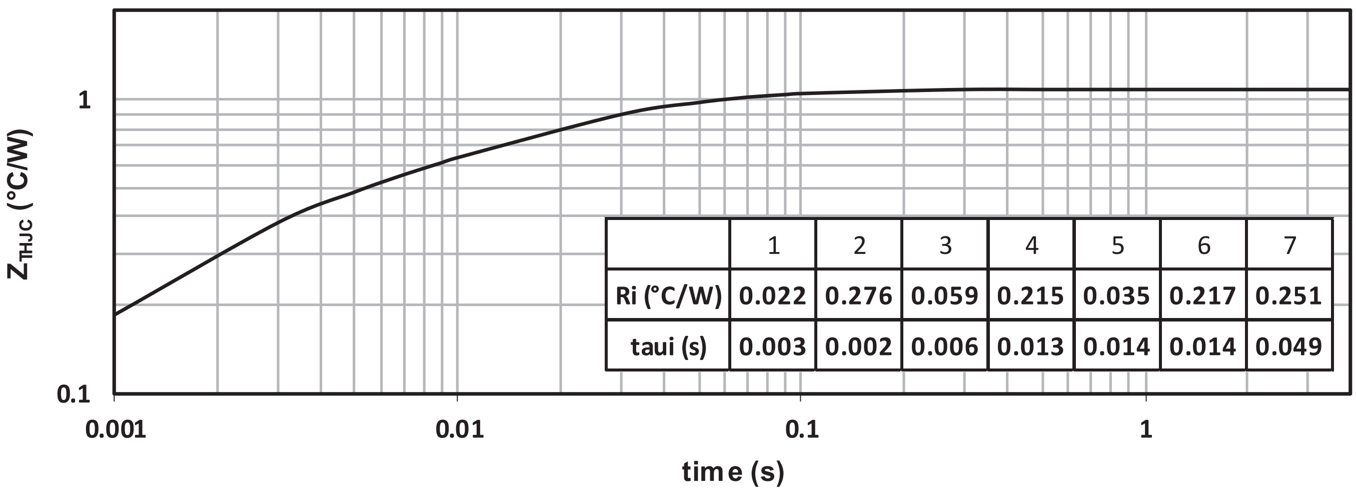
Figure 1-7. Operating Frequency vs. Collector Current



1.10 Typical SiC Diode Performance Curve (CR1 to CR8)

The following figures show the performance curves of the CR1 to CR8 SiC diodes.

Figure 1-8. Maximum Thermal Impedance



	1	2	3	4	5	6	7
Ri (°C/W)	0.022	0.276	0.059	0.215	0.035	0.217	0.251
taui (s)	0.003	0.002	0.006	0.013	0.014	0.014	0.049

Figure 1-9. Forward Characteristics

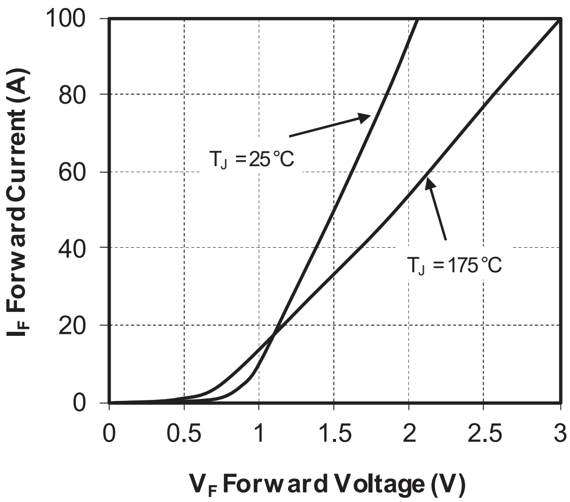
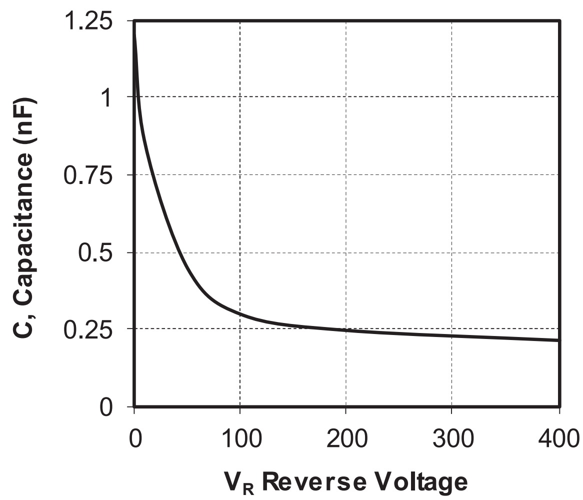


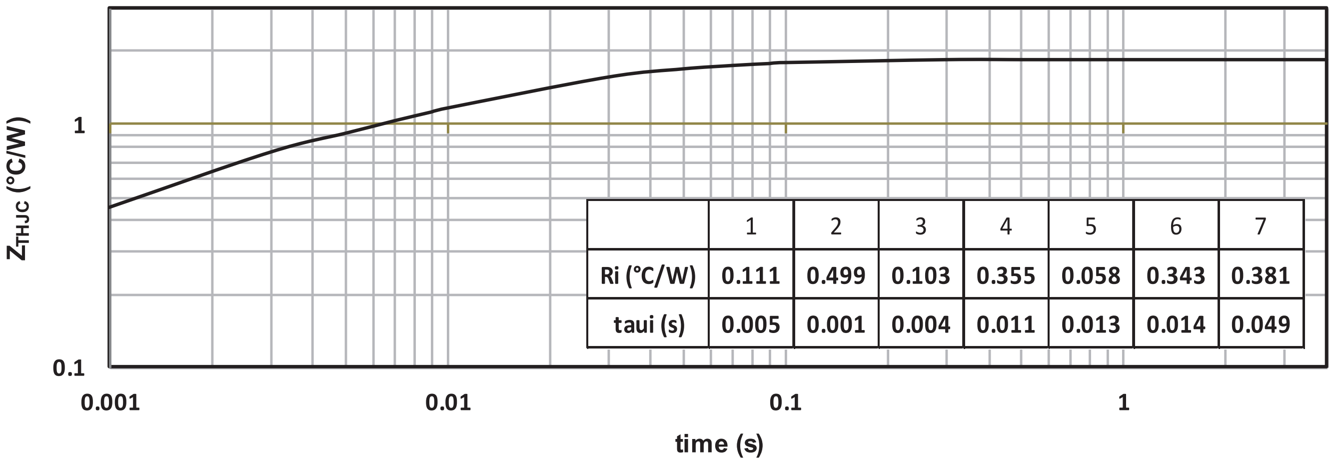
Figure 1-10. Capacitance vs. Reverse Voltage



1.11 Typical IGBT Performance Curve (Q9 and Q10)

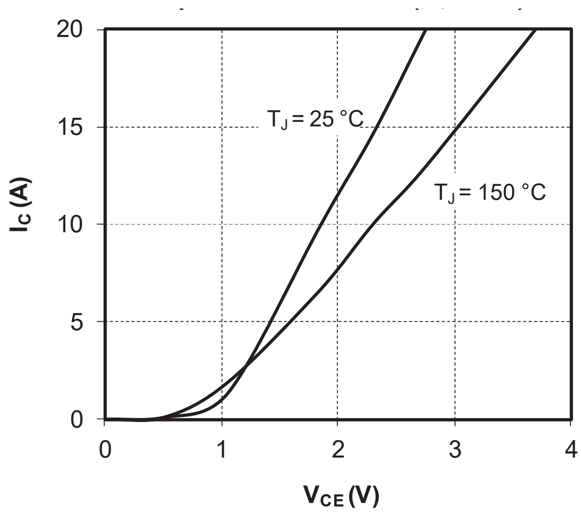
The following figures show the performance curves of the Q9 and Q10 IGBTs.

Figure 1-11. Maximum Thermal Impedance



	1	2	3	4	5	6	7
Ri (°C/W)	0.111	0.499	0.103	0.355	0.058	0.343	0.381
taui (s)	0.005	0.001	0.004	0.011	0.013	0.014	0.049

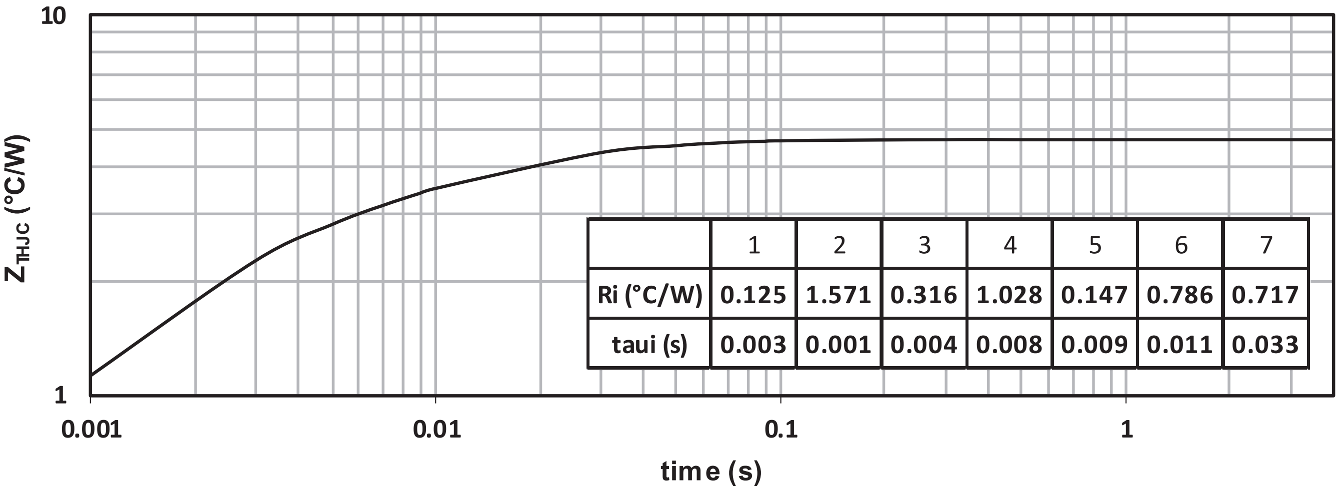
Figure 1-12. Output Characteristics (V_{GE} = 15V)



1.12 Typical SiC Diode Performance Curve (CR9 and CR10)

The following figures show the performance curves of the CR9 and CR10 SiC diodes.

Figure 1-13. Maximum Thermal Impedance



	1	2	3	4	5	6	7
Ri (°C/W)	0.125	1.571	0.316	1.028	0.147	0.786	0.717
taui (s)	0.003	0.001	0.004	0.008	0.009	0.011	0.033

Figure 1-14. Forward Characteristics

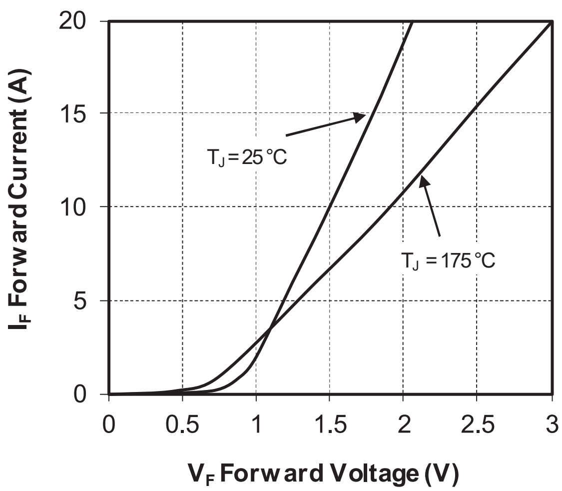
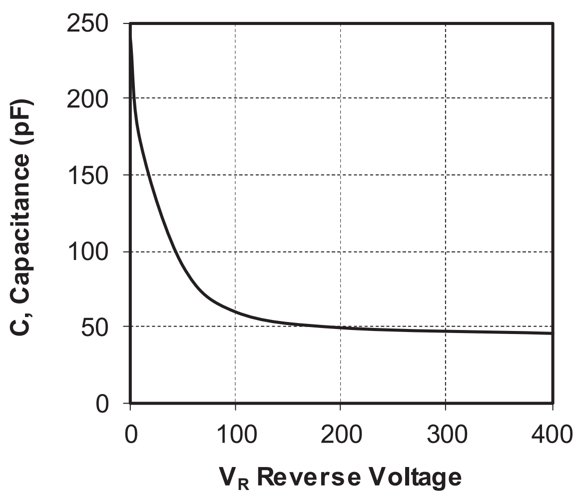


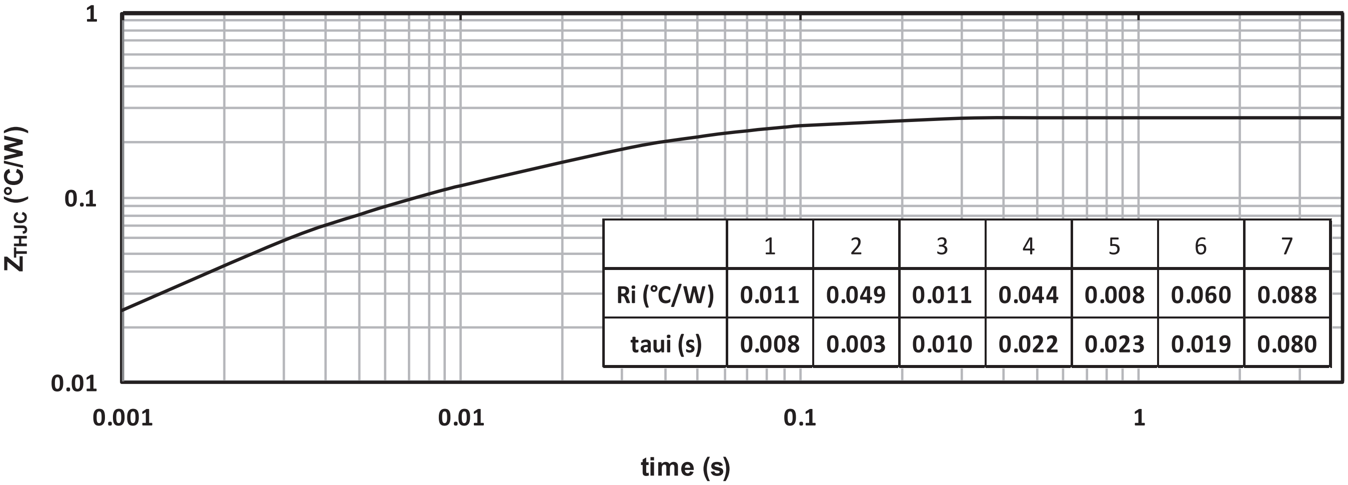
Figure 1-15. Capacitance vs. Reverse Voltage



1.13 Typical IGBT Performance Curve (Q7)

The following figures show the performance curves of the Q7 IGBT.

Figure 1-16. Maximum Thermal Impedance



	1	2	3	4	5	6	7
Ri (°C/W)	0.011	0.049	0.011	0.044	0.008	0.060	0.088
taui (s)	0.008	0.003	0.010	0.022	0.023	0.019	0.080

Figure 1-17. Output Characteristics (V_{GE} = 15V)

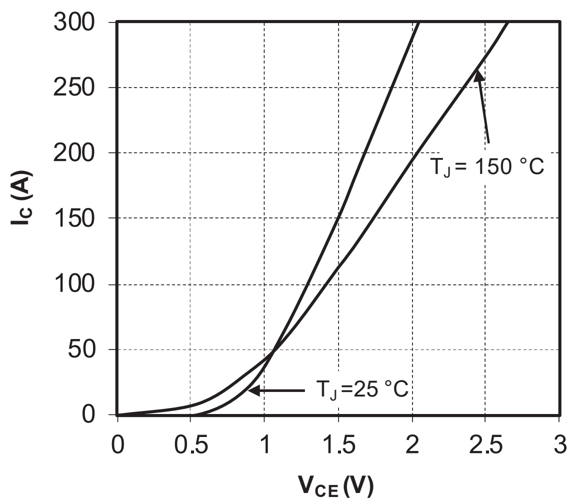


Figure 1-18. Output Characteristics

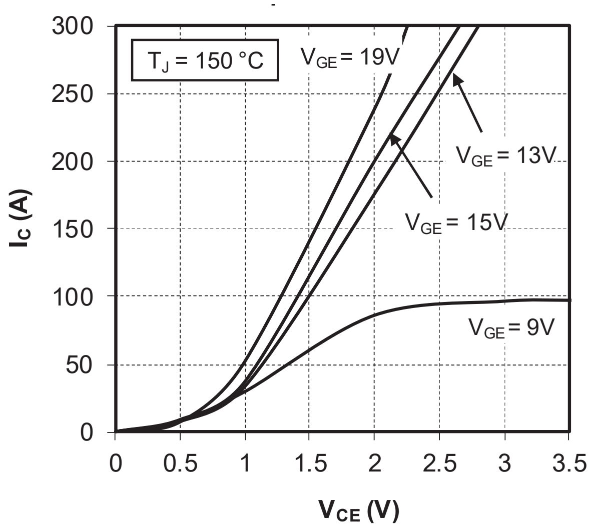


Figure 1-19. Transfer Characteristics

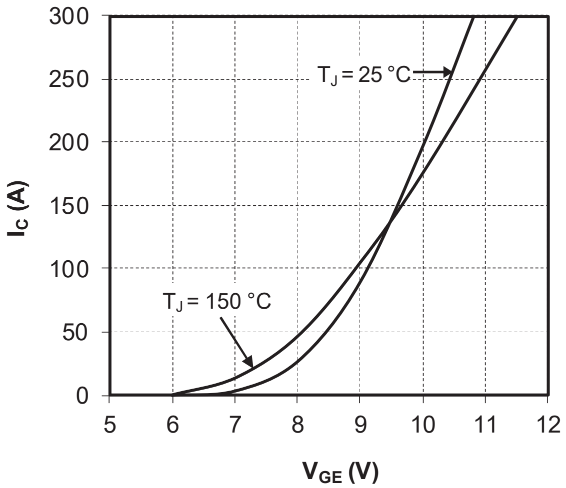


Figure 1-20. Energy Losses vs. Collector Current

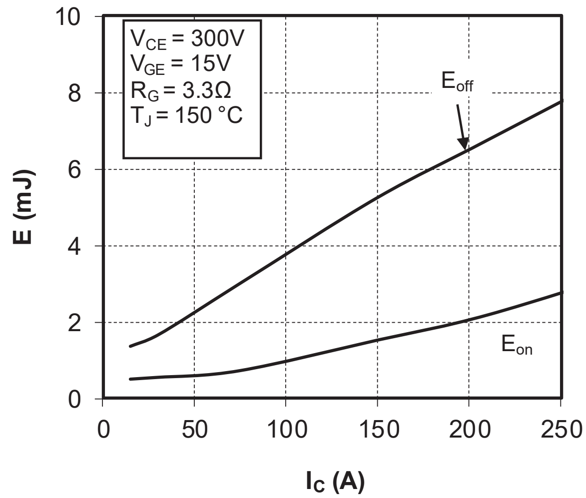


Figure 1-21. Switching Energy Losses vs. Gate Resistance

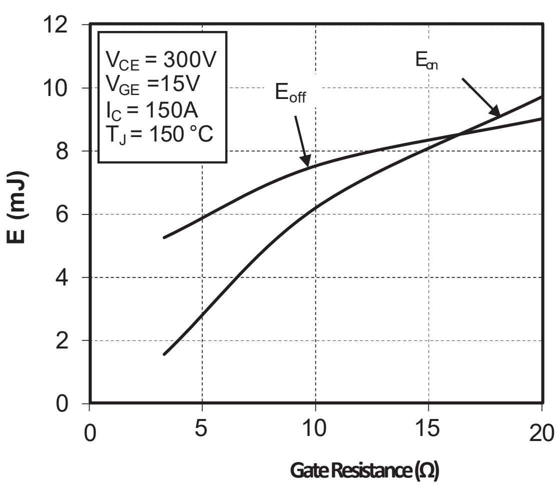
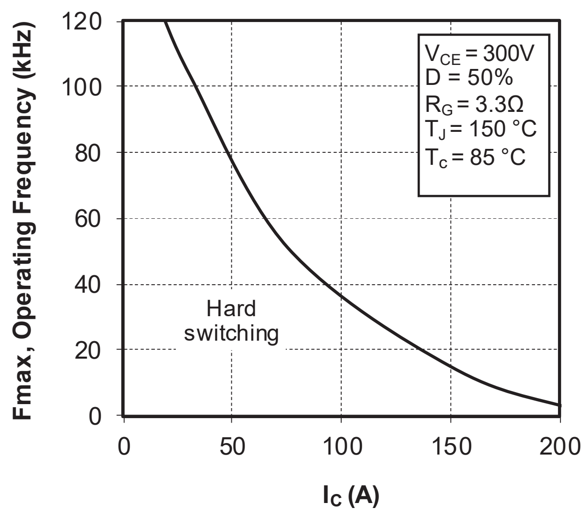


Figure 1-22. Operating Frequency vs. Collector Current



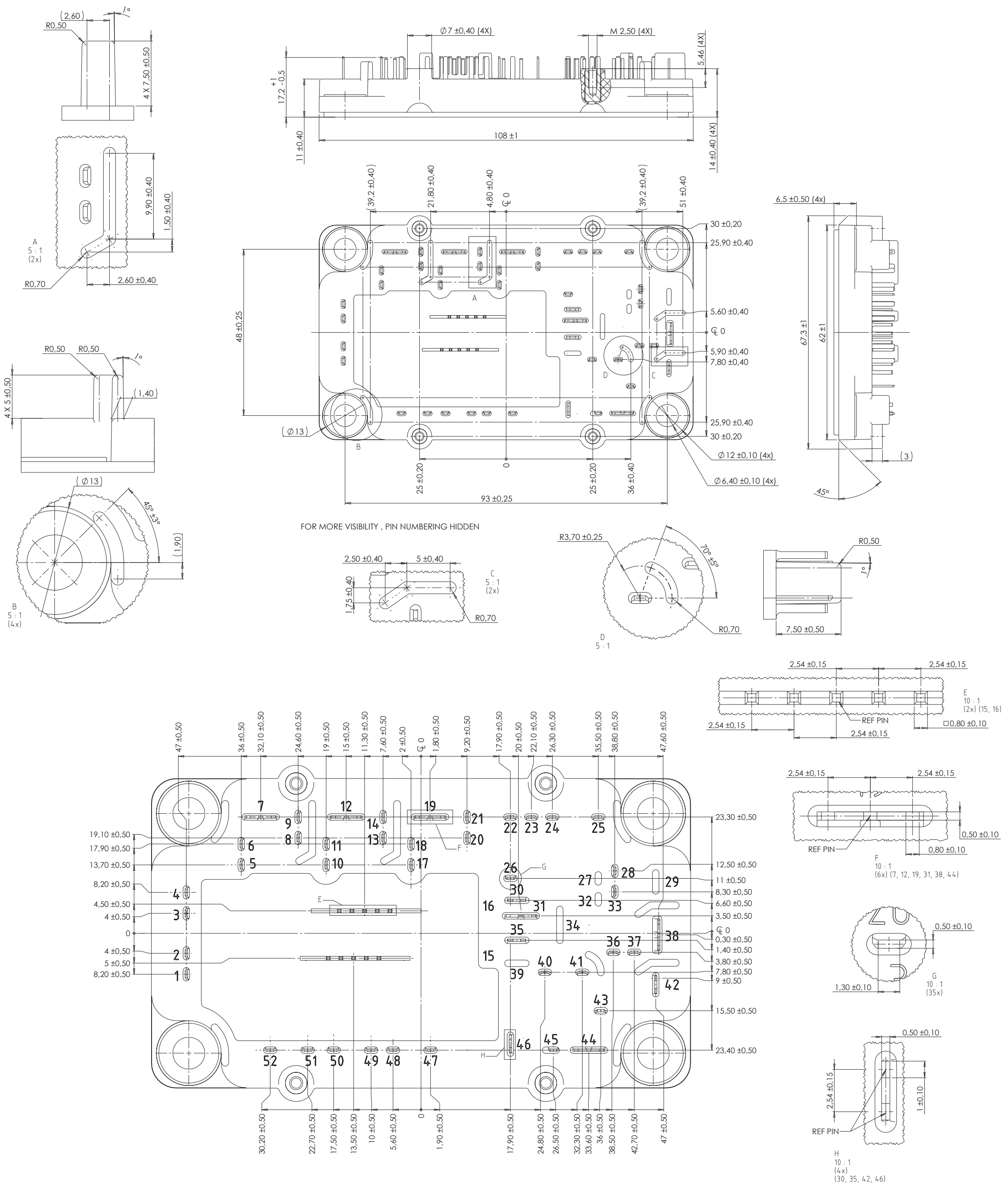
2. Package Specifications

The following section describes the package specification of the MSCGLQ100X065CTYZBNMG device.

2.1 Package Outline

The following figure shows the package outline drawing of the MSCGLQ100X065CTYZBNMG device. The dimensions in the following figure are in millimeters.

Figure 2-1. Package Outline Drawing



3. Revision History

The revision history describes the changes that were implemented in the document. The changes are listed by revision, starting with the most current publication.

Revision	Date	Description
A	02/2023	Initial revision

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