IXYS

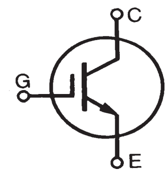
Preliminary Technical Information

GenX3™ 600V IGBTs

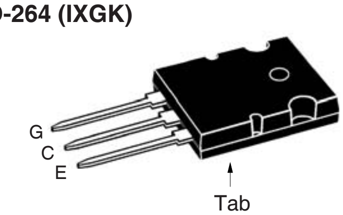
IXGK320N60B3
IXGX320N60B3

V_{CES} = 600V
I_{C90} = 320A
$V_{CE(sat)}$ ≤ 1.6V

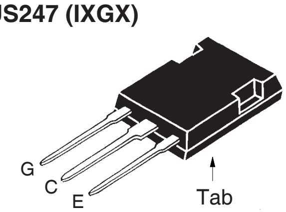
Medium-Speed Low-Vsat PT IGBTs for 5-40 kHz Switching



TO-264 (IXGK)



PLUS247 (IXGX)



G = Gate   E = Emitter
C = Collector   Tab = Collector

Symbol	Test Conditions	Maximum Ratings	
V_{CES}	T_J = 25°C to 150°C	600	V
V_{CGR}	T_J = 25°C to 150°C, R_{GE} = 1MΩ	600	V
V_{GES}	Continuous	±20	V
V_{GEM}	Transient	±30	V
I_{C25}	T_C = 25°C (Chip Capability)	500	A
I_{C90}	T_C = 90°C	320	A
I_{LRMS}	Terminal Current Limit	160	A
I_{CM}	T_C = 25°C, 1ms	1200	A
SSOA (RBSOA)	V_{GE}= 15V, T_{VJ} = 125°C, R_G = 1Ω Clamped Inductive Load	I_{CM} = 320 $V_{CE} \le V_{CES}$	A V
P_C	T_C = 25°C	1700	W
T_J		-55 ... +150	°C
T_{JM}		150	°C
T_{stg}		-55 ... +150	°C
T_L	Maximum Lead Temperature for Soldering	300	°C
T_{SOLD}	1.6 mm (0.062 in.) from Case for 10	260	°C
M_d	Mounting Torque (IXGK)	1.13/10	Nm/lb.in.
F_C	Mounting Force (IXGX)	20..120/4.5..27	N/lb.
Weight	TO-264 PLUS247	10 6	g g

Symbol	Test Conditions (T_J = 25°C, Unless Otherwise Specified)	Characteristic Values Min.	Typ.	Max.	
BV_{CES}	I_C = 1mA, V_{GE} = 0V	600			V
$V_{GE(th)}$	I_C = 4mA, V_{CE} = V_{GE}	3.0		5.0	V
I_{CES}	V_{CE} = V_{CES}, V_{GE} = 0V			75	µA
	T_J = 125°C			2	mA
I_{GES}	V_{CE} = 0V, V_{GE} = ± 20V			±400	nA
$V_{CE(sat)}$	I_C = 100A, V_{GE} = 15V, Note 1		1.4	1.6	V
	I_C = 320A		2.0		V

Features

- Optimized for Low Conduction and Switching Losses
- High Current Capability
- Square RBSOA

Advantages

- High Power Density
- Low Gate Drive Requirement

Applications

- Power Inverters
- UPS
- Motor Drives
- SMPS
- PFC Circuits
- Battery Chargers
- Welding Machines
- Lamp Ballasts

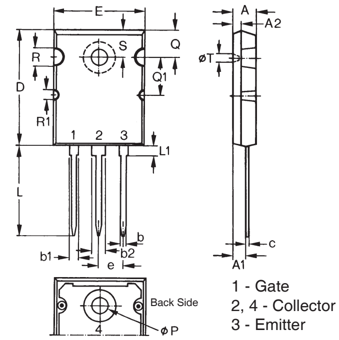
Symbol	Test Conditions (T_J = 25°C, Unless Otherwise Specified)	Characteristic Values Min.	Typ.	Max.	
g_{fs}	I_C = 60A, V_{CE} = 10V, Note 1	70	125		S
C_{ies}	V_{CE} = 25V, V_{GE} = 0V, f = 1MHz		18		nF
C_{oes}			960		pF
C_{res}			130		pF
Q_g	I_C = 320A, V_{GE} = 15V, V_{CE} = 0.5 • V_{CES}		585		nC
Q_{ge}			105		nC
Q_{gc}			215		nC
$t_{d(on)}$	**Inductive Load, T_J = 25°C**		44		ns
t_{ri}	I_C = 100A,V_{GE} = 15V		66		ns
E_{on}	V_{CE} = 0.8 • V_{CES}, R_G = 1Ω		2.7		mJ
$t_{d(off)}$			250		ns
t_{fi}			165		ns
E_{off}			3.5	5.0	mJ
$t_{d(on)}$	**Inductive Load, T_J = 125°C**		40		ns
t_{ri}	I_C = 100A,V_{GE} = 15V		67		ns
E_{on}	V_{CE} = 0.8 • V_{CES}, R_G = 1Ω		3.5		mJ
$t_{d(off)}$			330		ns
t_{fi}			265		ns
E_{off}			5.4		mJ
R_{thJC}				0.073	°C/W
R_{thCS}			0.15		°C/W

Note 1. Pulse test, t ≤ 300μs, duty cycle, d ≤ 2%.

PRELIMINARY TECHNICAL INFORMATION

The product presented herein is under development. The Technical Specifications offered are derived from data gathered during objective characterizations of preliminary engineering lots; but also may yet contain some information supplied during a pre-production design evaluation. IXYS reserves the right to change limits, test conditions, and dimensions without notice.

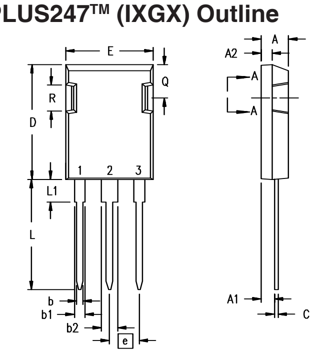
TO-264 AA (IXGK) Outline



1 - Gate
2, 4 - Collector
3 - Emitter

Dim.	Millimeter Min.	Max.	Inches Min.	Max.
A	4.82	5.13	.190	.202
A1	2.54	2.89	.100	.114
A2	2.00	2.10	.079	.083
b	1.12	1.42	.044	.056
b1	2.39	2.69	.094	.106
b2	2.90	3.09	.114	.122
c	0.53	0.83	.021	.033
D	25.91	26.16	1.020	1.030
E	19.81	19.96	.780	.786
e	5.46 BSC		.215 BSC	
J	0.00	0.25	.000	.010
K	0.00	0.25	.000	.010
L	20.32	20.83	.800	.820
L1	2.29	2.59	.090	.102
P	3.17	3.66	.125	.144
Q	6.07	6.27	.239	.247
Q1	8.38	8.69	.330	.342
R	3.81	4.32	.150	.170
R1	1.78	2.29	.070	.090
S	6.04	6.30	.238	.248
T	1.57	1.83	.062	.072

PLUS247™ (IXGX) Outline



Terminals: 1 - Gate
2 - Collector
3 - Emitter

Dim.	Millimeter Min.	Max.	Inches Min.	Max.
A	4.83	5.21	.190	.205
A_1	2.29	2.54	.090	.100
A_2	1.91	2.16	.075	.085
b	1.14	1.40	.045	.055
b_1	1.91	2.13	.075	.084
b_2	2.92	3.12	.115	.123
C	0.61	0.80	.024	.031
D	20.80	21.34	.819	.840
E	15.75	16.13	.620	.635
e	5.45 BSC		.215 BSC	
L	19.81	20.32	.780	.800
L1	3.81	4.32	.150	.170
Q	5.59	6.20	.220	0.244
R	4.32	4.83	.170	.190

Fig. 1. Output Characteristics @ T_J = 25ºC

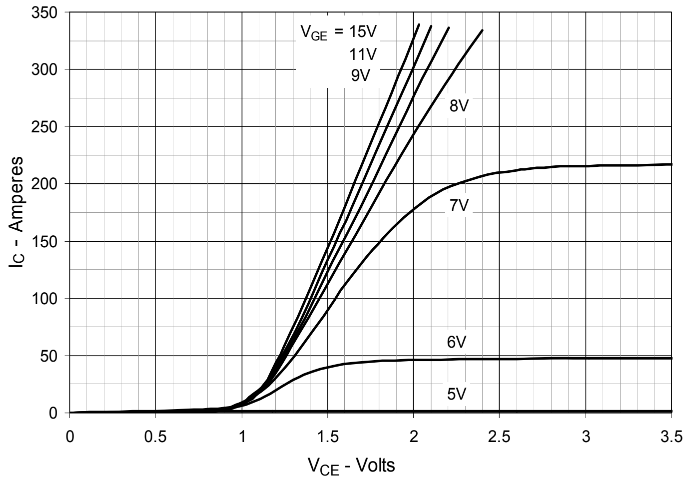


Fig. 2. Output Characteristics @ T_J = 125ºC

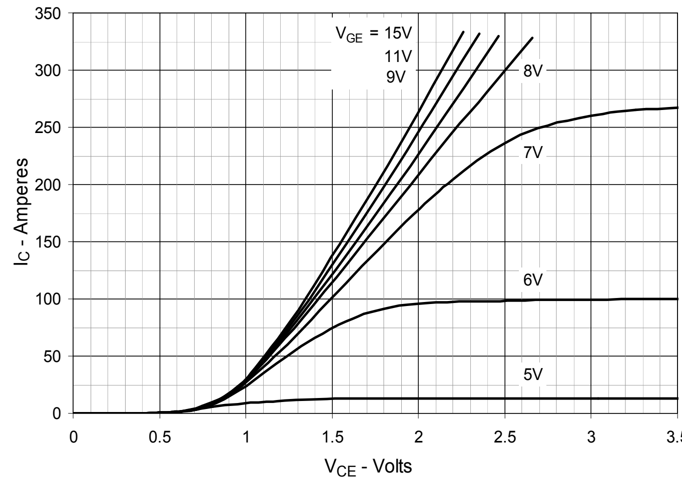


Fig. 3. Dependence of $V_{CE(sat)}$ on Junction Temperature

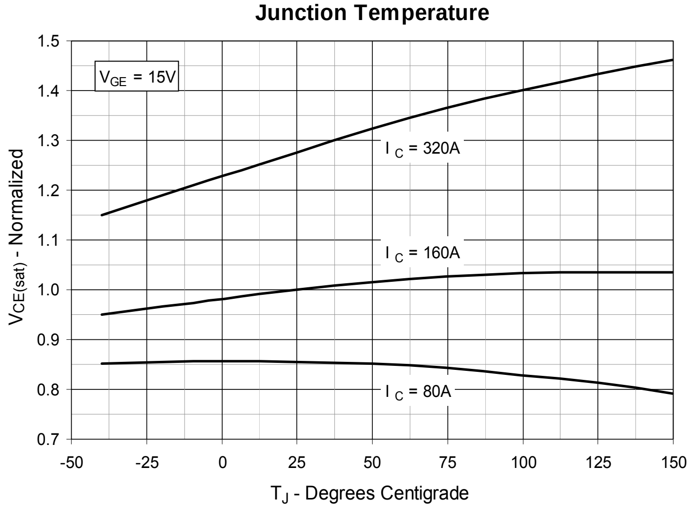


Fig. 4. Collector-to-Emitter Voltage vs. Gate-to-Emitter Voltage

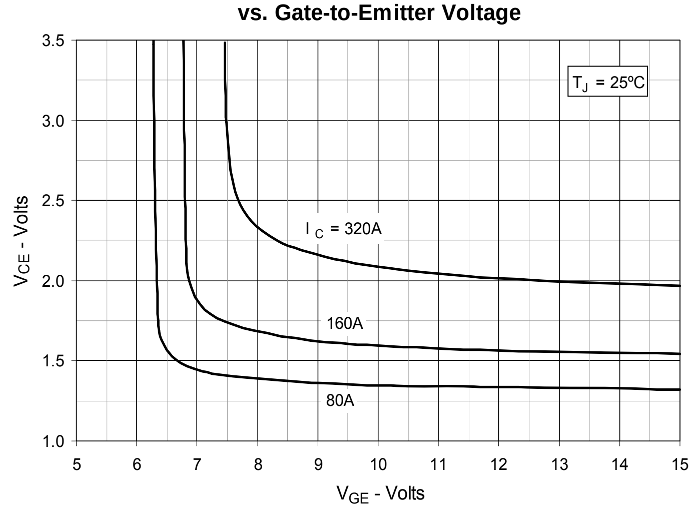


Fig. 5. Input Admittance

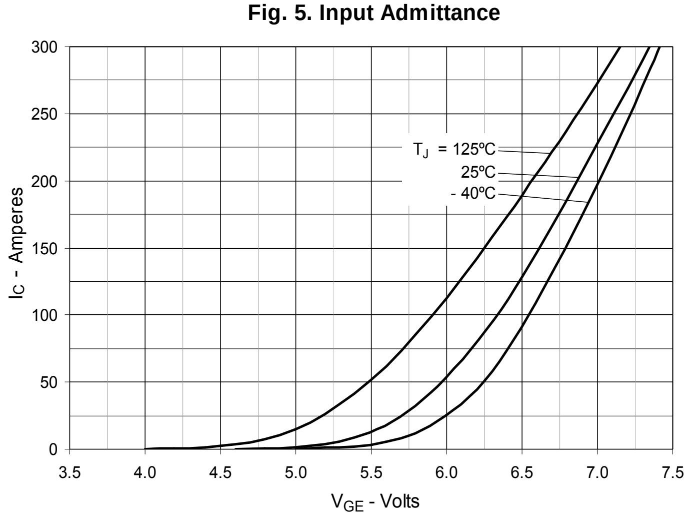


Fig. 6. Transconductance

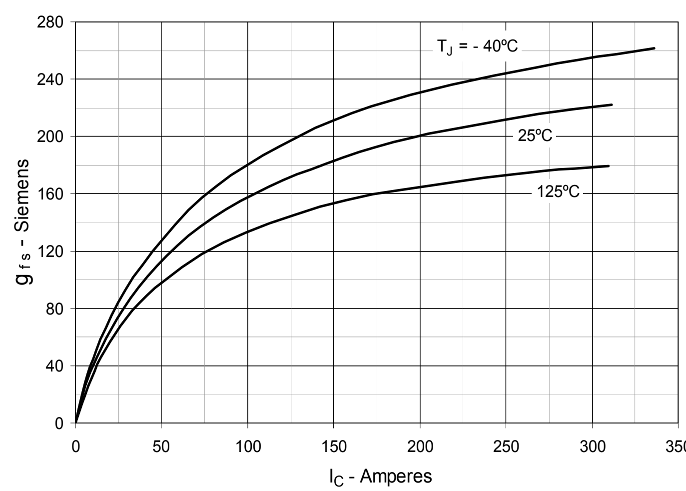


Fig. 7. Gate Charge

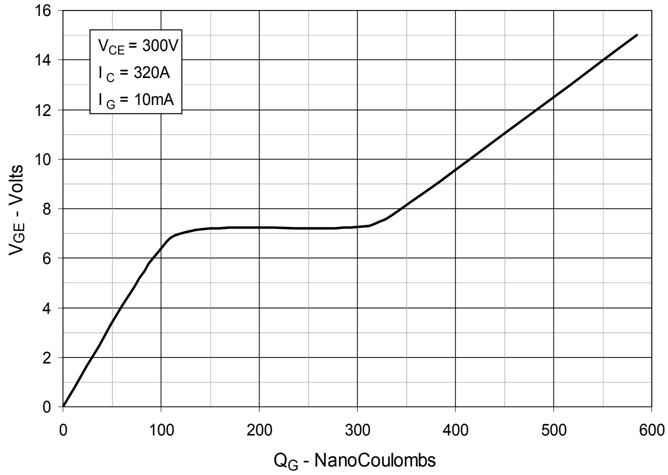


Fig. 8. Capacitance

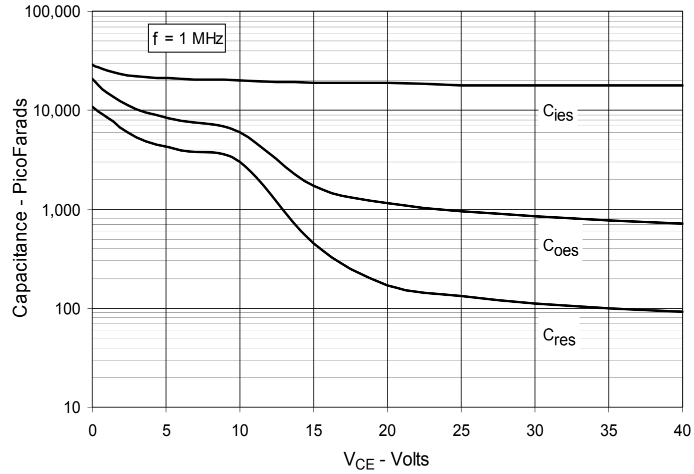


Fig. 9. Reverse-Bias Safe Operating Area

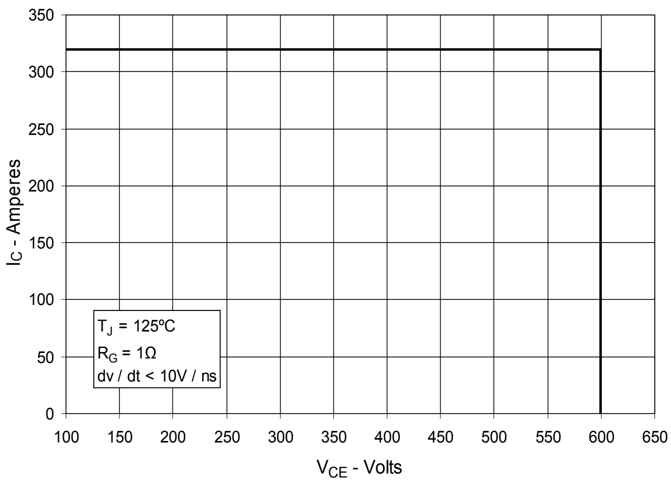


Fig. 10. Maximum Transient Thermal Impedance

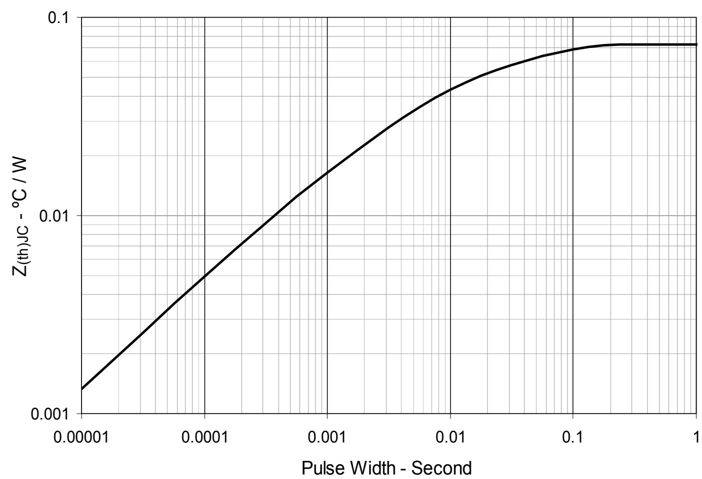


Fig. 11. Inductive Switching Energy Loss vs. Gate Resistance

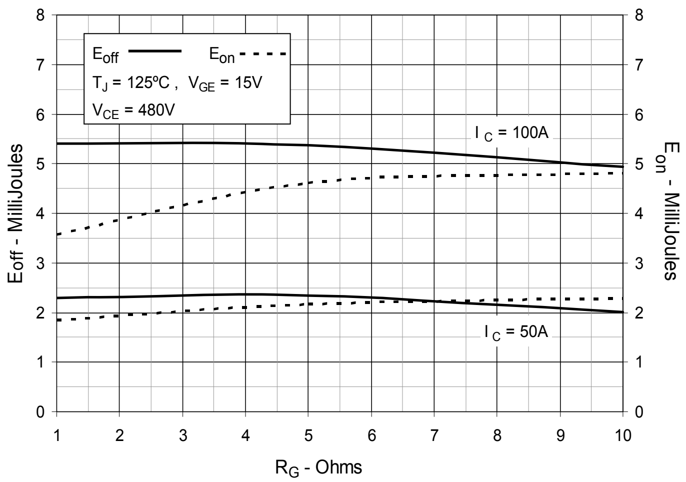


Fig. 12. Inductive Switching Energy Loss vs. Collector Current

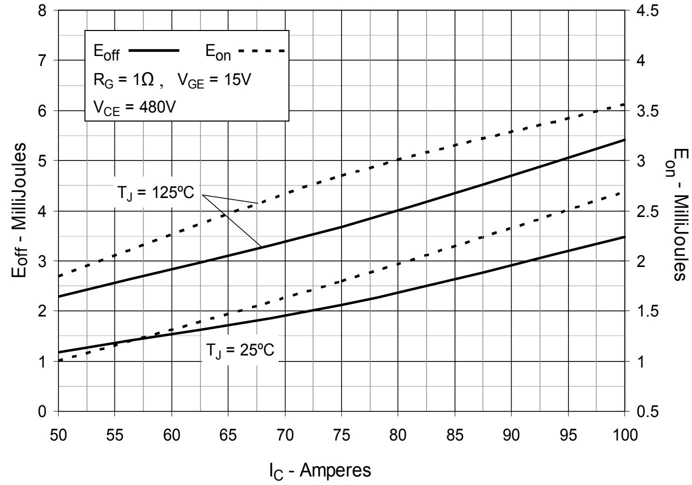


Fig. 13. Inductive Switching Energy Loss vs. Junction Temperature

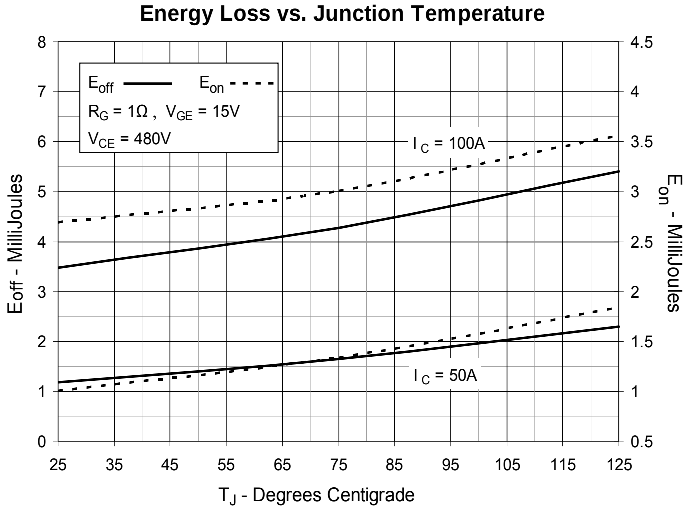


Fig. 14. Inductive Turn-off Switching Times vs. Gate Resistance

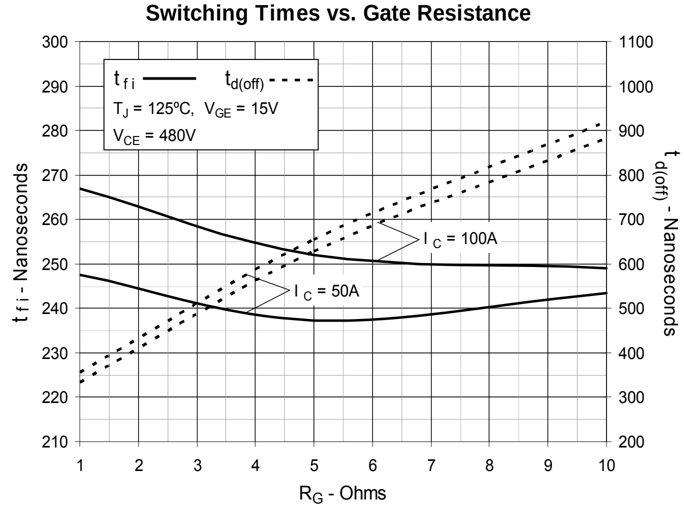


Fig. 15. Inductive Turn-off Switching Times vs. Collector Current

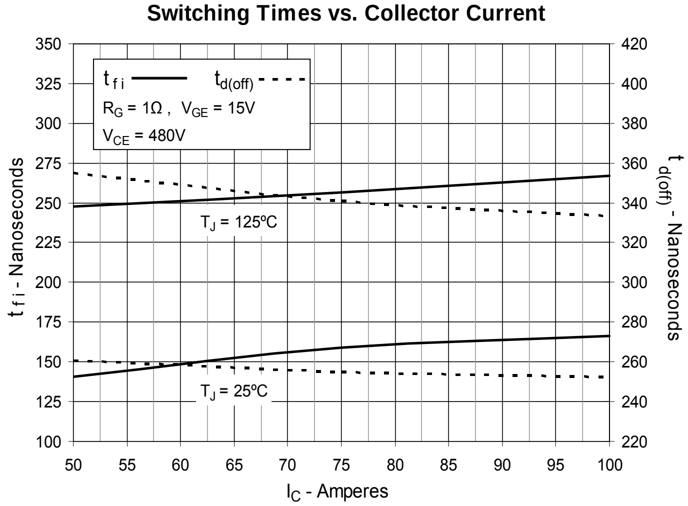


Fig. 16. Inductive Turn-off Switching Times vs. Junction Temperature

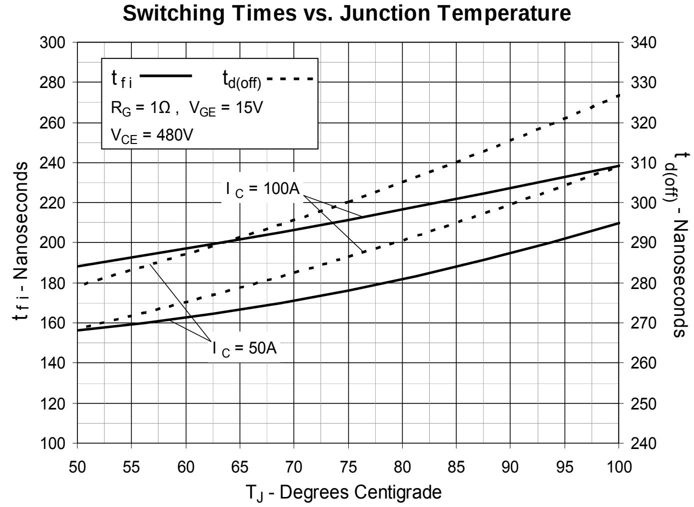


Fig. 17. Inductive Turn-on Switching Times vs. Gate Resistance

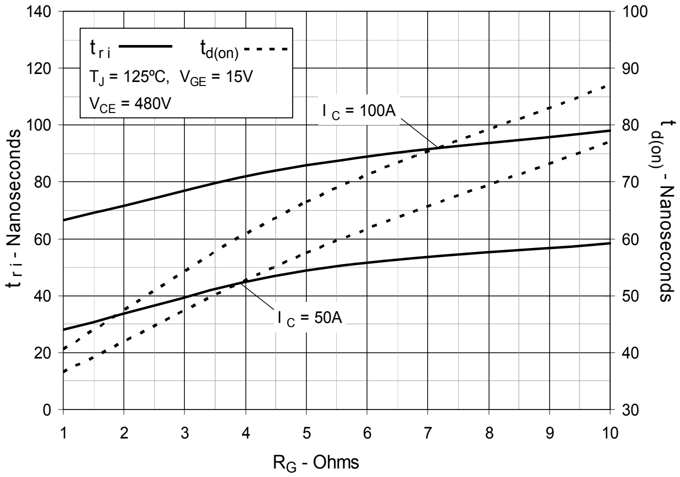


Fig. 18. Inductive Turn-on Switching Times vs. Collector Current

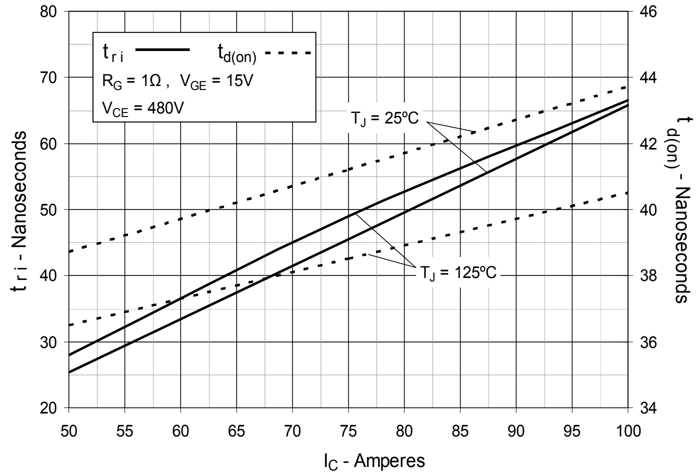
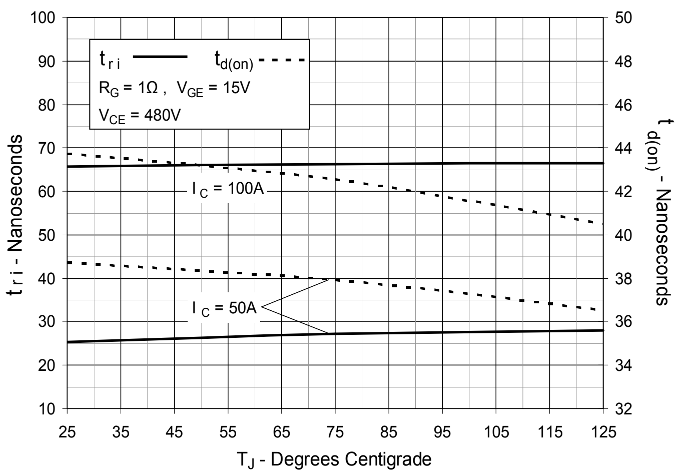
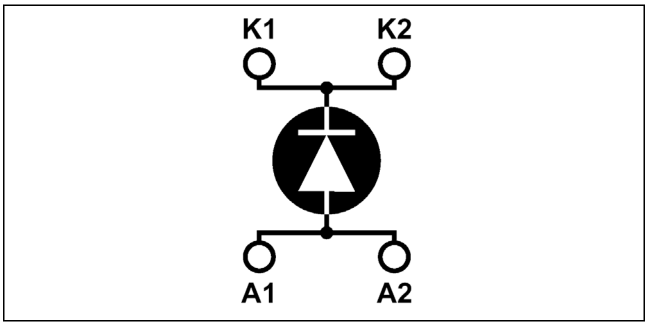


Fig. 19. Inductive Turn-on Switching Times vs. Junction Temperature



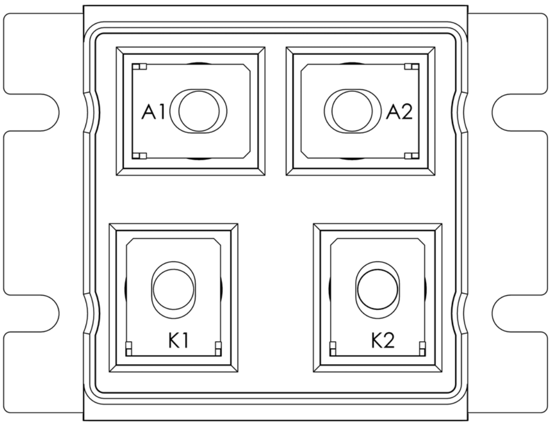
Single diode Power Module

V_{CES} = 1200V
I_C = 400A @ Tc = 80°C



Application

- Anti-Parallel diode
  - Switchmode Power Supply
  - Inverters
- Snubber diode
- Uninterruptible Power Supply (UPS)
- Induction heating
- Welding equipment
- High speed rectifiers
- Electric vehicles



Features

- Ultra fast recovery times
- Soft recovery characteristics
- Very low stray inductance
- High blocking voltage
- High current
- Low leakage current

Benefits

- Low losses
- Low noise switching
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance
- RoHS Compliant

Absolute maximum ratings

Symbol	Parameter			Max ratings	Unit
V_R	Maximum DC reverse Voltage			1200	V
V_{RRM}	Maximum Peak Repetitive Reverse Voltage				
$I_{F(AV)}$	Maximum Average Forward Current	Duty cycle = 50%	T_c = 25°C	450	A
			T_c = 80°C	400	
$I_{F(RMS)}$	RMS Forward Current			750	
I_{FSM}	Non-Repetitive Forward Surge Current		T_j = 25°C	5000	

CAUTION: These Devices are sensitive to Electrostatic Discharge. Proper Handling Procedures Should Be Followed. See application note APT0502 on www.microsemi.com

All ratings @ T_j = 25°C unless otherwise specified

Electrical Characteristics

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
V_F	Diode Forward Voltage	$I_F = 500A$				2.5	V
		$I_F = 1000A$			2.5		
		$I_F = 500A$	$T_j = 150°C$			2.0	
I_{RM}	Maximum Reverse Leakage Current	$V_R = 1200V$	$T_j = 25°C$			2500	µA
			$T_j = 125°C$			5000	
C_T	Junction Capacitance	$V_R = 200V$			600		pF

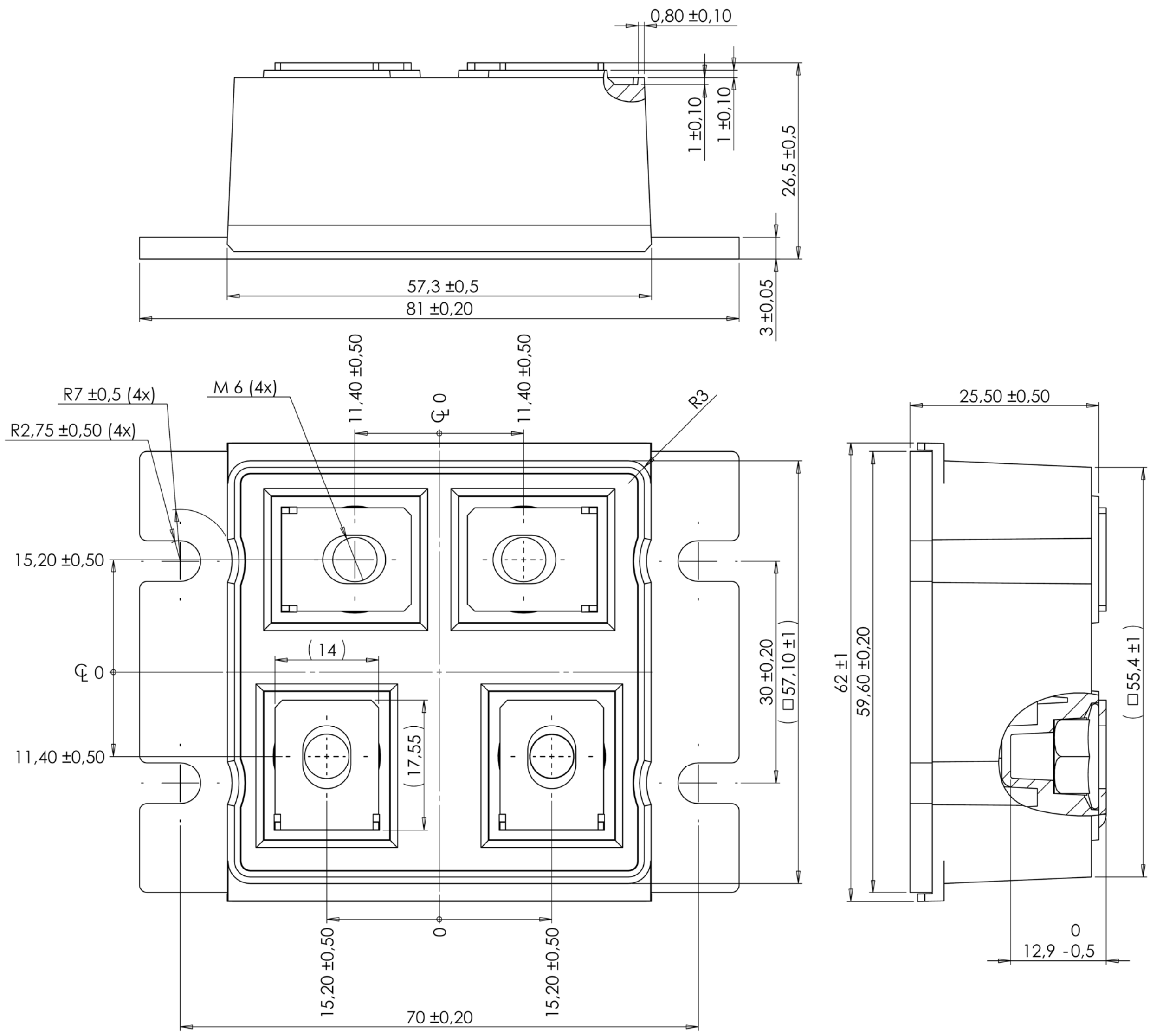
Dynamic Characteristics

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
t_{rr1}	Reverse Recovery Time	I_F=1A,V_R=30V di/dt = 15A/µs	$T_j = 25°C$		90		ns
t_{rr2}		$I_F = 500A$ $V_R = 650V$ di/dt=1000A/µs	$T_j = 25°C$		110		
t_{rr3}			$T_j = 100°C$		175		
t_{fr1}	Forward Recovery Time	$I_F = 500A$ $V_R = 650V$ di/dt=1000A/µs	$T_j = 25°C$		220		ns
t_{fr2}			$T_j = 100°C$		220		
I_{RRM1}	Reverse Recovery Current		$T_j = 25°C$		70		A
I_{RRM2}			$T_j = 100°C$		120		
Q_{rr1}	Reverse Recovery Charge		$T_j = 25°C$		10		µC
Q_{rr2}			$T_j = 100°C$		30		
V_{fr1}	Forward Recovery Voltage		$T_j = 25°C$		26		V
V_{fr2}			$T_j = 100°C$		26		
$d_{IM/dt}$	Rate of Fall of Recovery Current		$T_j = 25°C$		1200		A/µs
			$T_j = 100°C$		800		

Thermal and package characteristics

Symbol	Characteristic			Min	Typ	Max	Unit
R_{thJC}	Junction to Case Thermal Resistance					0.08	°C/W
V_{ISOL}	RMS Isolation Voltage, any terminal to case t =1 min, 50/60Hz			4000			V
T_J	Operating junction temperature range			-40		150	°C
T_{STG}	Storage Temperature Range			-40		125	
T_C	Operating Case Temperature			-40		100	
Torque	Mounting torque	To heatsink	M5	2.5		3.5	N.m
		For terminals	M6	3		4	
Wt	Package Weight					250	g

LP4 Package outline (dimensions in mm)



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Life Support Application

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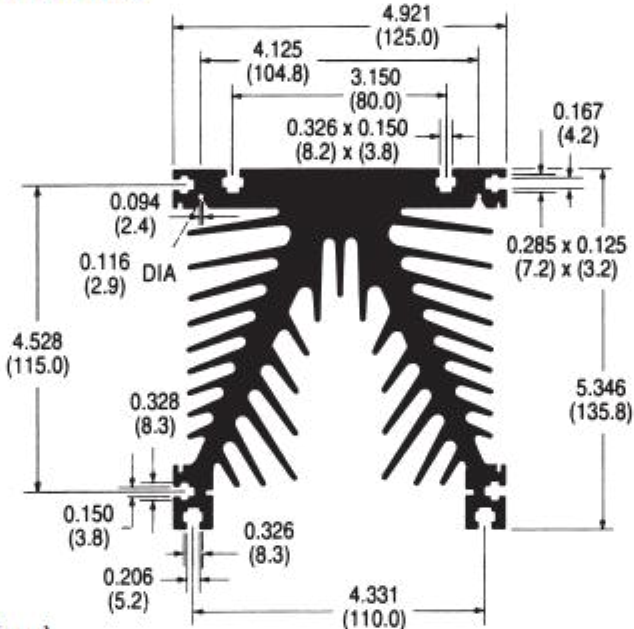
Buyer agrees not to use Products in any Life Support Applications and to the extent it does it shall conduct extensive testing of the Product in such applications and further agrees to indemnify and hold Seller, and its officers, employees, subsidiaries, affiliates, agents, sales representatives and distributors harmless against all claims, costs, damages and expenses, and attorneys' fees and costs arising, directly or directly, out of any claims of personal injury, death, damage or otherwise associated with the use of the goods in Life Support Applications, even if such claim includes allegations that Seller was negligent regarding the design or manufacture of the goods.

Buyer must notify Seller in writing before using Seller's Products in Life Support Applications. Seller will study with Buyer alternative solutions to meet Buyer application specification based on Sellers sales conditions applicable for the new proposed specific part.

Standard P/N, Finish Black Anodized	Gold Iridite	Length in. (mm)	Thermal Resistance at Typical Load Natural Convection (Øsa) (°CW)	Forced Convection (Øsa) (°CW)	Weight lbs. (grams)
392-120AB	392-120AG	4.725 (120.0)	0.50	0.16 @ 100 CFM	4.452 (2019.43)
392-180AB	392-180AG	7.087 (180.0)	0.43	0.11 @ 100 CFM	6.636 (3010.09)
392-300AB	392-300AG	11.811 (300.0)	0.33	0.08 @ 100 CFM	10.420 (4726.51)

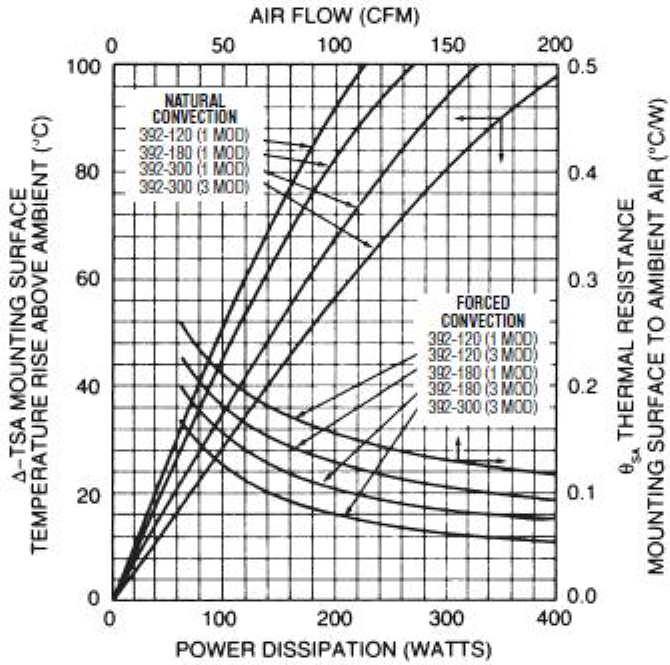
MECHANICAL DIMENSIONS

392 SERIES (EXTRUSION PROFILE 5658)



Dimensions: in. (mm)

NATURAL AND FORCED CONVECTION CHARACTERISTICS



DATASHEET NEW 48V MODULE

DuraBlue™ Advanced Shock & Vibration Technology

FEATURES AND BENEFITS*

- Up to 1,000,000 duty cycles or 10 year DC life
- 48V DC working voltage
- Active cell balancing
- Temperature output
- Overvoltage outputs available
- High power density
- Extreme Vibration Environment Compatible

TYPICAL APPLICATIONS

- Hybrid vehicles
- Rail
- Heavy industrial equipment
- UPS systems

PRODUCT SPECIFICATIONS

ELECTRICAL	BMOD0165 P048 C01
Rated Capacitance[1]	165 F
Minimum Capacitance, initial[1]	165 F
Maximum Capacitance, initial[1]	198 F
Maximum ESR_{DC}, initial[1]	6.0 mΩ
Test Current for Capacitance and ESR_{DC}[1]	100 A
Rated Voltage	48 V
Stored Energy[4]	53 Wh
Absolute Maximum Voltage[2]	51 V
Absolute Maximum Current	1,900 A
Maximum Series Voltage	750 V
Capacitance of Individual Cells[8]	3,000 F
Stored Energy, Individual Cell[8]	3.0 Wh
Number of Cells	18

TEMPERATURE	
Operating Temperature (Cell Case Temperature)	
Minimum	-40°C
Maximum	65°C
Storage Temperature (Stored Uncharged)	
Minimum	-40°C
Maximum	70°C

*Results may vary. Additional terms and conditions, including the limited warranty, apply at the time of purchase. See the warranty details for applicable operating and use requirements.

Maxwell TECHNOLOGIES Enabling Energy's Future™

PRODUCT SPECIFICATIONS (Cont'd)

PHYSICAL	BMOD0165 P048 C01
Mass, typical	14.2 kg
Power Terminals	M8/M10
Recommended Torque - Terminal	20 Nm (M8)/30 Nm (M10)
Vibration Specification	ISO 16750-3, Table 12
Shock Specification	IEC 60068-2-27, -29
Environmental Protection	IP65
Cooling	Natural Convection
MONITORING / CELL VOLTAGE MANAGEMENT	
Internal Temperature Sensor[3]	NTC Thermistor (10 kΩ)
Temperature Interface	Analog
Cell Voltage Monitoring[3]	Overvoltage Alarm (open collector)
Connector (Mating)	Deutsch DTM04-4P, Amphenol ATM04-4P
Cell Management System	CMS 2.0
SAFETY	
Short Circuit Current, typical (Current possible with short circuit from rated voltage. Do not use as an operating current.)	8,100 A
Certifications	RoHS, UL810a (50 volts)
High-Pot Test[9]	2,750 VDC

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TYPICAL CHARACTERISTICS

THERMAL CHARACTERISTICS	BMOD0165 P048 C01
Thermal Resistance ($R_{ca,}$ All Cell Cases to Ambient), typical[5]	0.40°C/W
Thermal Capacitance (C_{th}), typical	13,000 J/°C
Maximum Continuous Current (ΔT = 15 °C)[5] (BOL, Beginning of Life)	79 A, RMS
Maximum Continuous Current (ΔT = 40 °C)[5] (BOL, Beginning of Life)	130 A, RMS
LIFE	
DC Life at High Temperature[1] (held continuously at Rated Voltage and Maximum Operating Temperature)	1,500 hours
Capacitance Change (% decrease from minimum initial value)	20%
ESR Change (% increase from maximum initial value)	100%
Projected DC Life at 25°C[1] (held continuously at Rated Voltage)	10 years
Capacitance Change (% decrease from minimum initial value)	20%
ESR Change (% increase from maximum initial value)	100%
Projected Cycle Life at 25°C[1,6,7]	1,000,000 cycles
Capacitance Change (% decrease from minimum initial value)	20%
ESR Change (% increase from maximum initial value)	100%
Test Current	100 A
Shelf Life (Stored uncharged at 25°C)	4 years

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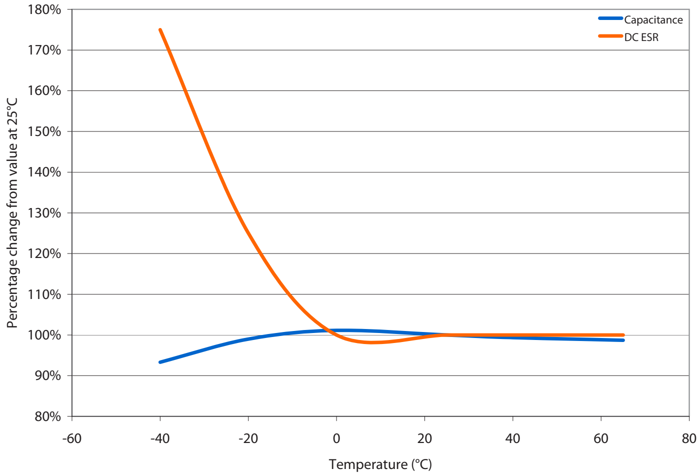
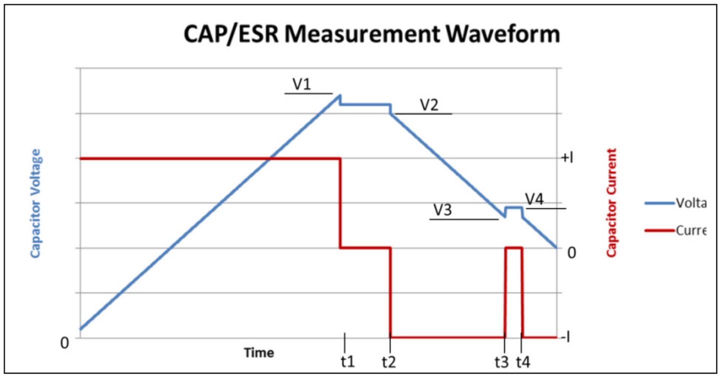
ESR AND CAPACITANCE VS TEMPERATURE

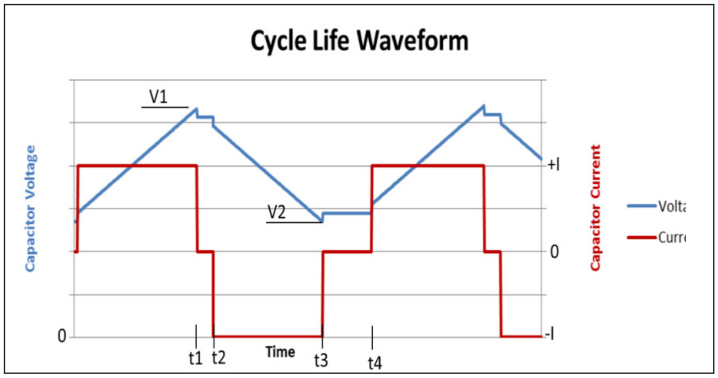


NOTES

1. Capacitance and ESR_{DC} measured at 25°C using specified test current per waveform below.
2. Absolute maximum voltage, non-repeated. Not to exceed 1 second.
3. Please refer to module user manual for additional technical details.
4. $E_{stored} = \frac{½ CV^2}{3{,}600}$
5. $\Delta T = I_{RMS}{}^2 \times ESR \times R_{ca}$
6. Cycle using specified test current per waveform below.
7. Cycle life varies depending upon application-specific characteristics. Actual results will vary.
8. Per United Nations material classification UN3499, all Maxwell ultracapacitors have less than 10 Wh capacity to meet the requirements of Special Provisions 361. Both individual ultracapacitors and modules composed of those ultracapacitors shipped by Maxwell can be transported without being treated as dangerous goods (hazardous materials) under transportation regulations.
9. Duration = 60 seconds. Not intended as an operating parameter.

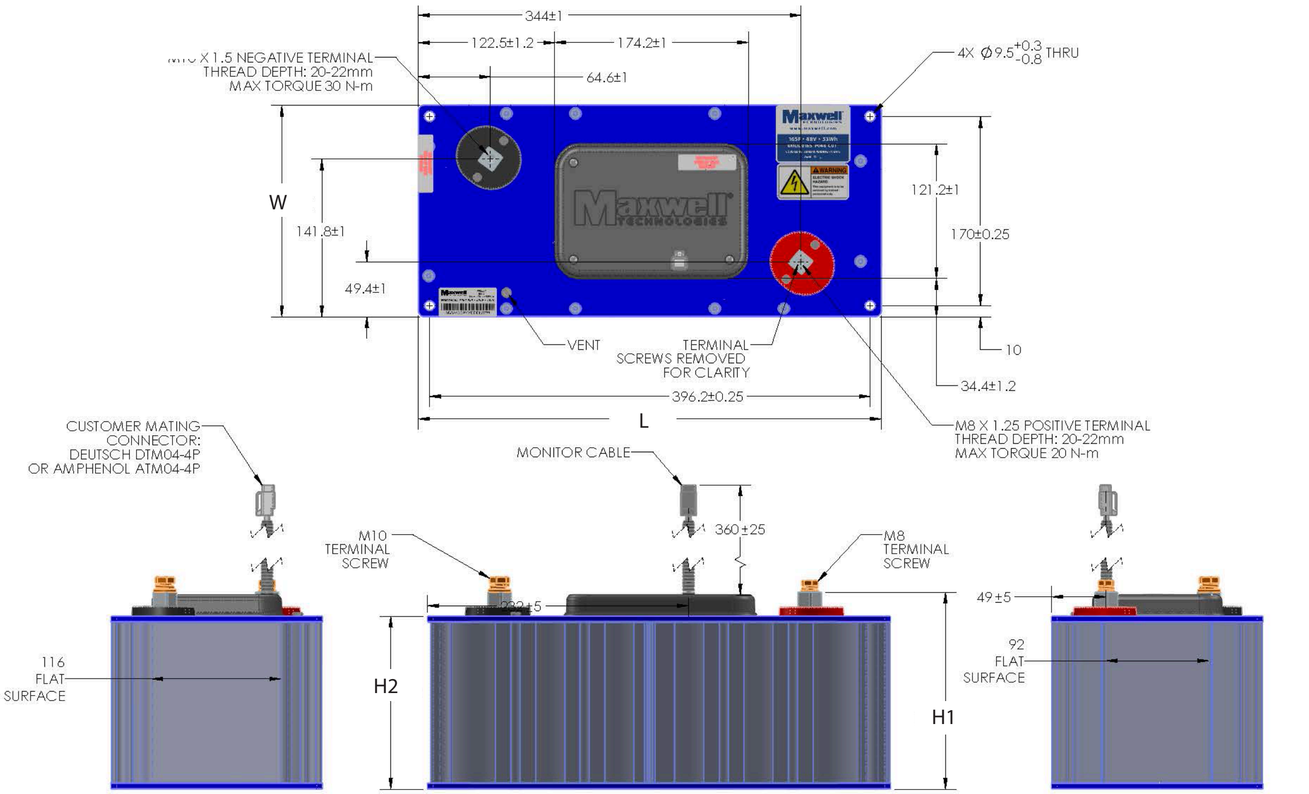


V1 = V_{rated} t2 - t1 = 15 seconds Capacitance = I x (t3-t2)/(V2-V3)
V3 = 0.5 x V_{rated} t4 - t3 = 5 seconds ESR = (V4 - V3)/I



V1 = V_{rated} t2 - t1 = 5 seconds (I=0)
V2 = 0.5 x V_{rated} t4 - t3 = 15 seconds (I=0)

BMOD0165 P048 C01



Part Description	Dimensions (mm)				Package Quantity
	L (max)	W (max)	H1 (max)	H2 (max)	
BMOD0165 P048 C01	418	194	179	157	1

Product dimensions are for reference only unless otherwise identified. Product dimensions and specifications may change without notice.
Please contact Maxwell Technologies directly for any technical specifications critical to application. All products featured on this datasheet are covered by the following U.S. patents and their respective foreign counterparts: 6643119, 7180726, 7295423, 7342770, 7352558, 7384433, 7440258, 7492571, 7508651, 7580243, 7791860, 7816891, 7859826, 7883553, 7935155, 8072734, 8098481, 8279580, and patents pending.

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