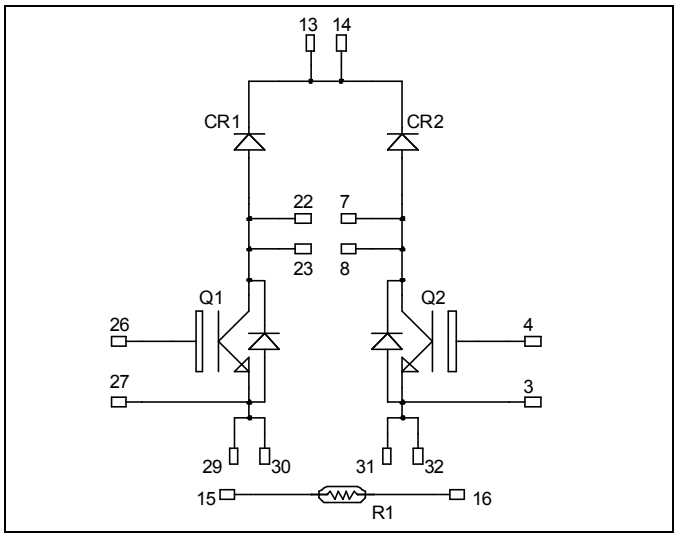
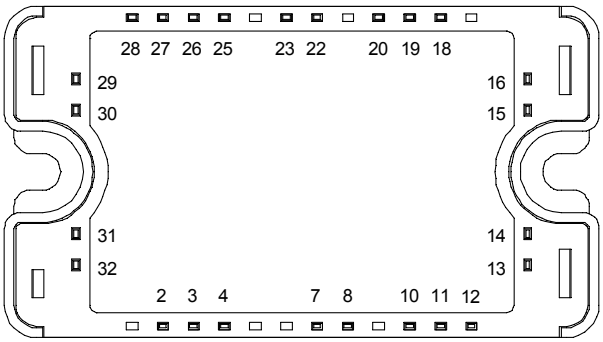
Dual Boost chopper NPT IGBT Power Module

V_{CES} = 600V
I_C = 50A @ Tc = 80°C





All multiple inputs and outputs must be shorted together
Example: 13/14 ; 29/30 ; 22/23 …

Application

- AC and DC motor control
- Switched Mode Power Supplies
- Power Factor Correction

Features

- Non Punch Through (NPT) Fast IGBT
  - Low voltage drop
  - Low tail current
  - Switching frequency up to 50 kHz
  - Soft recovery parallel diodes
  - Low diode VF
  - Low leakage current
  - RBSOA and SCSOA rated
  - Symmetrical design
- Kelvin emitter for easy drive
- Very low stray inductance
- High level of integration
- Internal thermistor for temperature monitoring

Benefits

- Outstanding performance at high frequency operation
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance
- Solderable terminals both for power and signal for easy PCB mounting
- Low profile
- Easy paralleling due to positive TC of VCEsat
- Each leg can be easily paralleled to achieve a single boost of twice the current capability
- RoHS compliant

Absolute maximum ratings

Symbol	*Parameter*		*Max ratings*	*Unit*
V_{CES}	Collector - Emitter Breakdown Voltage		600	V
I_C	Continuous Collector Current	T_C = 25°C	65	A
		T_C = 80°C	50	
I_{CM}	Pulsed Collector Current	T_C = 25°C	230	
V_{GE}	Gate – Emitter Voltage		±20	V
P_D	Maximum Power Dissipation	T_C = 25°C	250	W
RBSOA	Reverse Bias Safe Operating Area	T_j = 125°C	100A@500V	

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
I_{CES}	Zero Gate Voltage Collector Current	V_{GE} = 0V V_{CE} = 600V	T_j = 25°C			250	µA
			T_j = 125°C			500	
$V_{CE(sat)}$	Collector Emitter Saturation Voltage	V_{GE} =15V I_C = 50A	T_j = 25°C	1.7	2.0	2.45	V
			T_j = 125°C		2.2		
$V_{GE(th)}$	Gate Threshold Voltage	V_{GE} = V_{CE} , I_C = 1mA		4		6	V
I_{GES}	Gate – Emitter Leakage Current	V_{GE} = 20V, V_{CE} = 0V				400	nA

Dynamic Characteristics

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
C_{ies}	Input Capacitance	V_{GE} = 0V V_{CE} = 25V f = 1MHz			2200		pF
C_{oes}	Output Capacitance				323		
C_{res}	Reverse Transfer Capacitance				200		
Q_g	Total gate Charge	V_{GE} = 15V V_{Bus} = 300V I_C = 50A			166		nC
Q_{ge}	Gate – Emitter Charge				20		
Q_{gc}	Gate – Collector Charge				100		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (25°C) V_{GE} = 15V V_{Bus} = 400V I_C = 50A R_G = 2.7Ω			40		ns
T_r	Rise Time				9		
$T_{d(off)}$	Turn-off Delay Time				120		
T_f	Fall Time				12		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (125°C) V_{GE} = 15V V_{Bus} = 400V I_C = 50A R_G = 2.7Ω			42		ns
T_r	Rise Time				10		
$T_{d(off)}$	Turn-off Delay Time				130		
T_f	Fall Time				21		
E_{on}	Turn-on Switching Energy	V_{GE} = 15V V_{Bus} = 400V I_C = 50A R_G = 2.7Ω	T_j = 125°C		0.5		mJ
E_{off}	Turn-off Switching Energy		T_j = 125°C		1		

Chopper diode ratings and characteristics

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
V_{RRM}	Maximum Peak Repetitive Reverse Voltage			600			V
I_{RM}	Maximum Reverse Leakage Current	V_R=600V	T_j = 25°C			250	µA
			T_j = 125°C			500	
I_F	DC Forward Current		Tc = 70°C		60		A
V_F	Diode Forward Voltage	I_F = 60A			1.6	1.8	V
		I_F = 120A			1.9		
		I_F = 60A	T_j = 125°C		1.4		
t_{rr}	Reverse Recovery Time	I_F = 60A V_R = 400V di/dt =200A/µs	T_j = 25°C		130		ns
			T_j = 125°C		170		
Q_{rr}	Reverse Recovery Charge		T_j = 25°C		220		nC
			T_j = 125°C		920		

Temperature sensor NTC (see application note APT0406 on www.microsemi.com for more information).

Symbol	Characteristic	Min	Typ	Max	Unit
R_{25}	Resistance @ 25°C		50		kΩ
$B_{25/85}$	T_{25} = 298.15 K		3952		K

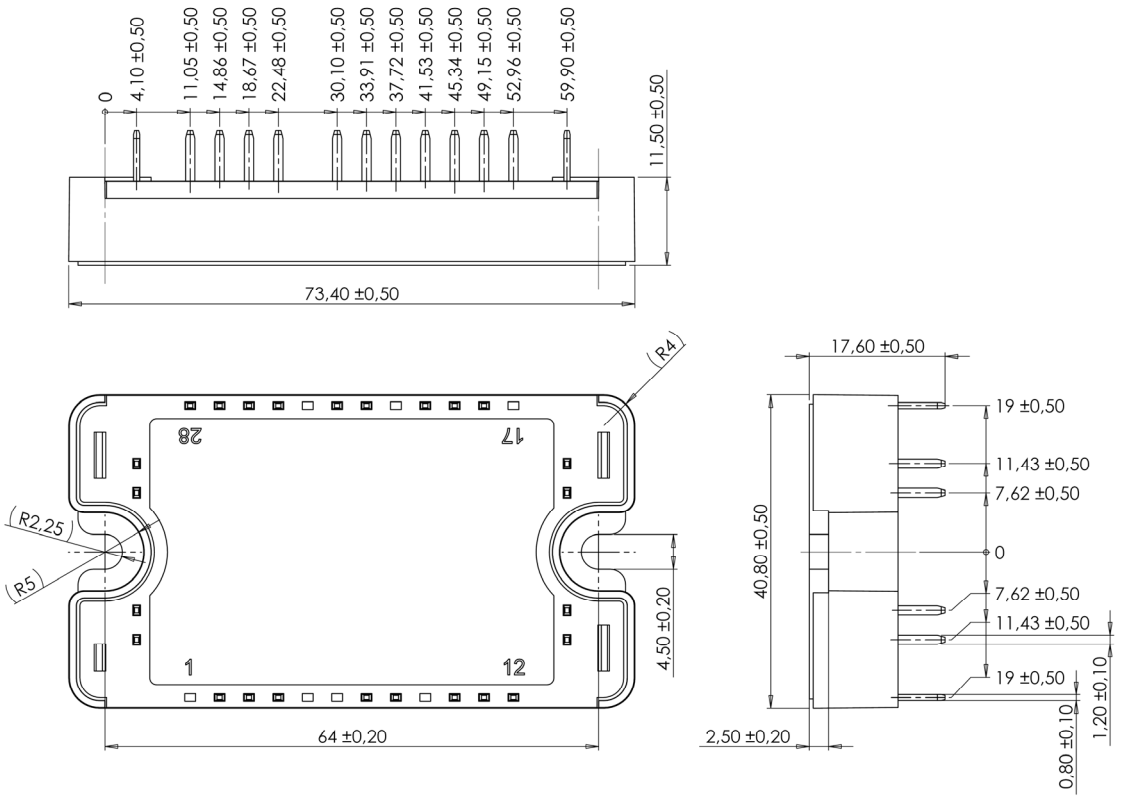
$$R_T = \frac{R_{25}}{\exp\left[B_{25/85}\left(\frac{1}{T_{25}} - \frac{1}{T}\right)\right]}$$

T: Thermistor temperature
R_T: Thermistor value at T

Thermal and package characteristics

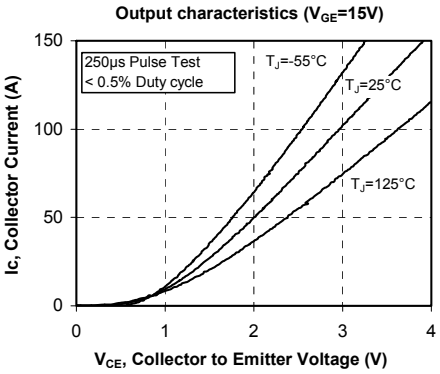
Symbol	Characteristic			Min	Typ	Max	Unit
R_{thJC}	Junction to Case Thermal Resistance		IGBT			0.5	°C/W
			Diode			0.9	
V_{ISOL}	RMS Isolation Voltage, any terminal to case t =1 min, 50/60Hz			4000			V
T_J	Operating junction temperature range			-40		150	°C
T_{STG}	Storage Temperature Range			-40		125	
T_C	Operating Case Temperature			-40		100	
Torque	Mounting torque	To heatsink	M4	2		3	N.m
Wt	Package Weight					110	g

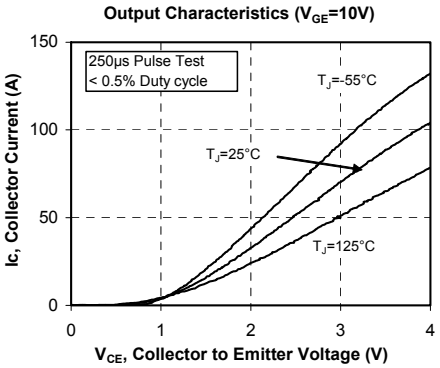
SP3 Package outline (dimensions in mm)

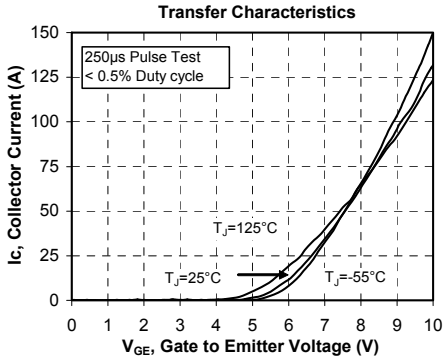


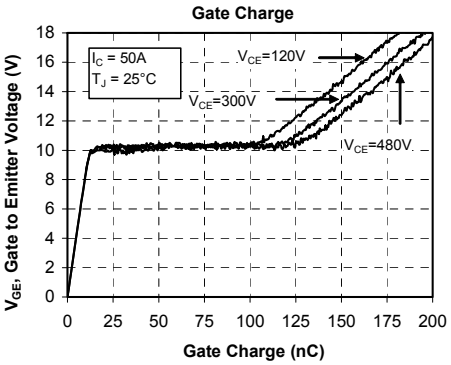
See application note 1901 - Mounting Instructions for SP3 Power Modules on www.microsemi.com

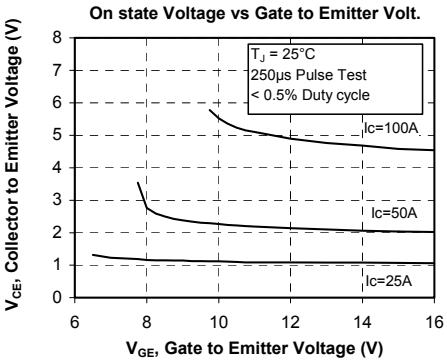
Typical Performance Curve

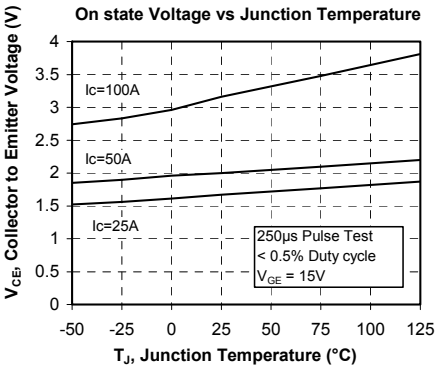


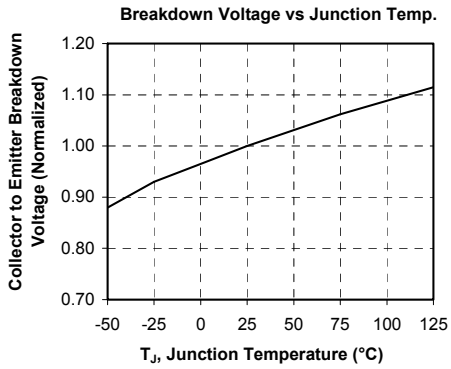


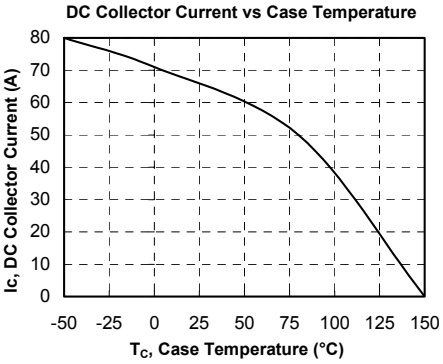


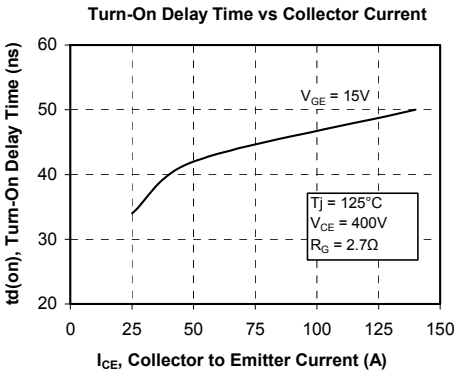


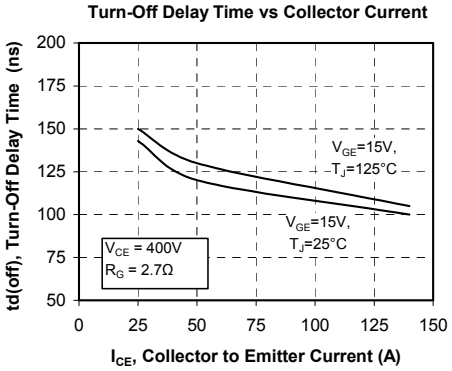


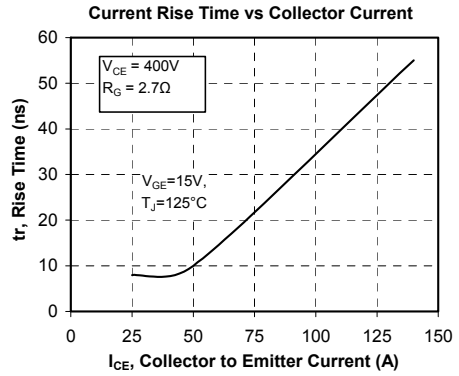


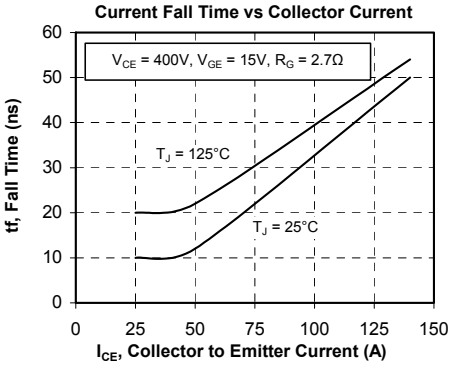


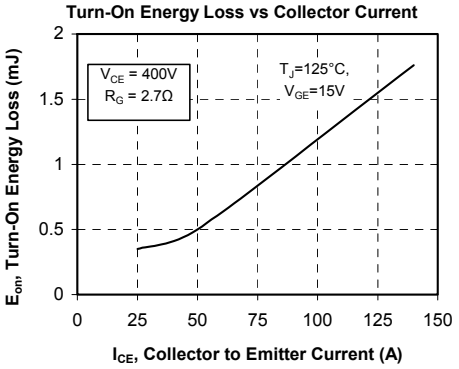


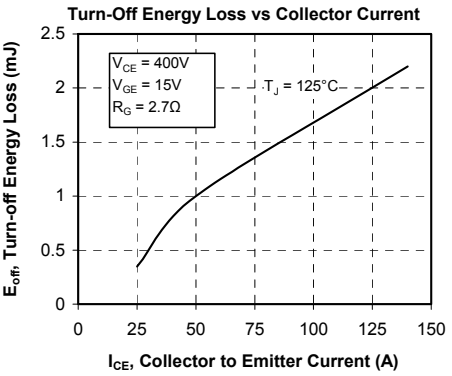

Turn-On Delay Time vs Collector Current
td(on), Turn-On Delay Time (ns)
V_{GE} = 15V
Tj = 125°C
V_{CE} = 400V
R_G = 2.7Ω
I_{CE}, Collector to Emitter Current (A)

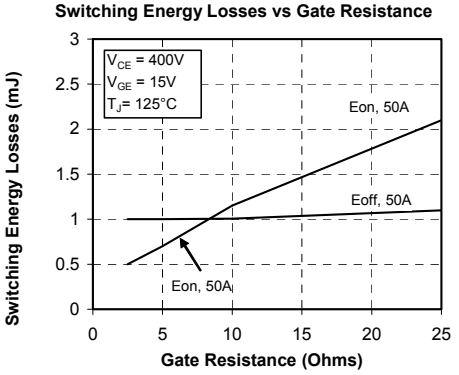

Turn-Off Delay Time vs Collector Current
td(off), Turn-Off Delay Time (ns)
V_{GE}=15V, T_J=125°C
V_{GE}=15V, T_J=25°C
V_{CE} = 400V
R_G = 2.7Ω
I_{CE}, Collector to Emitter Current (A)

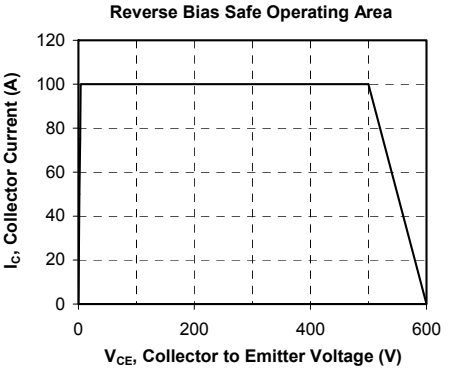

Current Rise Time vs Collector Current
tr, Rise Time (ns)
V_{CE} = 400V
R_G = 2.7Ω
V_{GE}=15V, T_J=125°C
I_{CE}, Collector to Emitter Current (A)

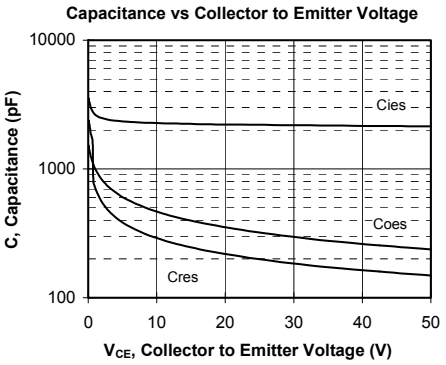

Current Fall Time vs Collector Current
tf, Fall Time (ns)
V_{CE} = 400V, V_{GE} = 15V, R_G = 2.7Ω
T_J = 125°C
T_J = 25°C
I_{CE}, Collector to Emitter Current (A)

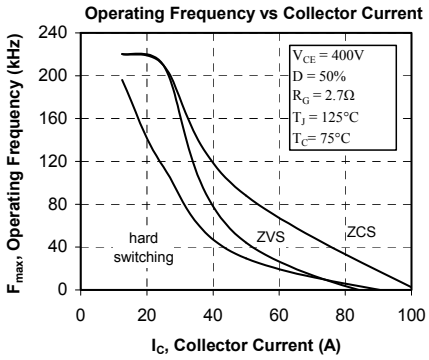

Turn-On Energy Loss vs Collector Current
E_{on}, Turn-On Energy Loss (mJ)
V_{CE} = 400V
R_G = 2.7Ω
T_J=125°C, V_{GE}=15V
I_{CE}, Collector to Emitter Current (A)

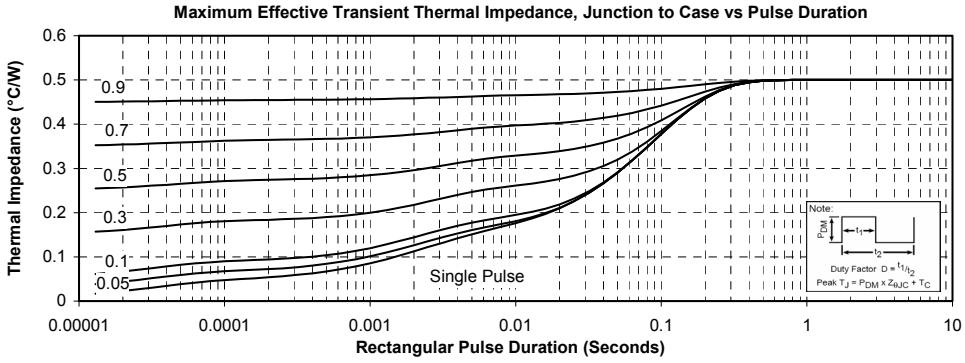

Turn-Off Energy Loss vs Collector Current
E_{off}, Turn-off Energy Loss (mJ)
V_{CE} = 400V
V_{GE} = 15V
R_G = 2.7Ω
T_J = 125°C
I_{CE}, Collector to Emitter Current (A)


Switching Energy Losses vs Gate Resistance
Switching Energy Losses (mJ)
V_{CE} = 400V
V_{GE} = 15V
T_J= 125°C
Eon, 50A
Eoff, 50A
Eon, 50A
Gate Resistance (Ohms)


Reverse Bias Safe Operating Area
I_C, Collector Current (A)
V_{CE}, Collector to Emitter Voltage (V)


Capacitance vs Collector to Emitter Voltage
C, Capacitance (pF)
10000
1000
100
Cies
Coes
Cres
0
10
20
30
40
50
VCE, Collector to Emitter Voltage (V)


Operating Frequency vs Collector Current
Fmax, Operating Frequency (kHz)
240
200
160
120
80
40
0
VCE = 400V
D = 50%
RG = 2.7Ω
TJ = 125°C
TC= 75°C
hard
switching
ZVS
ZCS
0
20
40
60
80
100
IC, Collector Current (A)


Maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration
Thermal Impedance (°C/W)
0.6
0.5
0.4
0.3
0.2
0.1
0
0.9
0.7
0.5
0.3
0.1
0.05
Single Pulse
Note:
PDM
t1
t2
Duty Factor D = t1/t2
Peak TJ = PDM x ZθJC + TC
0.00001
0.0001
0.001
0.01
0.1
1
10
Rectangular Pulse Duration (Seconds)

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