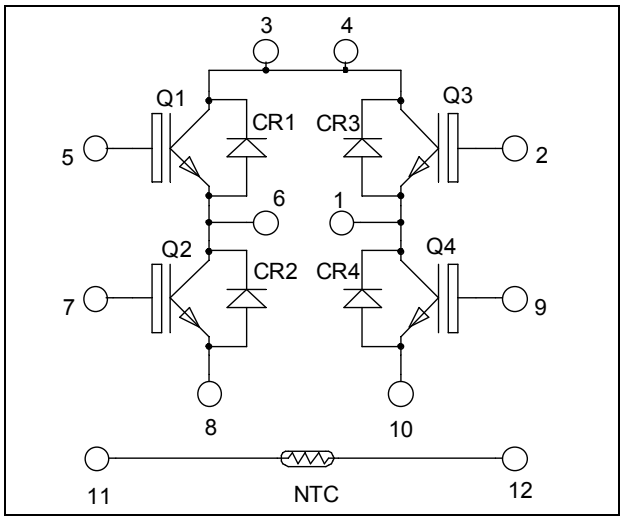
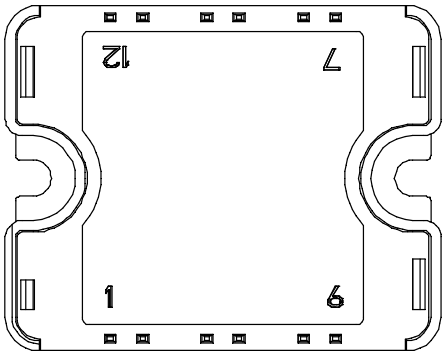
Microsemi
POWER PRODUCTS GROUP

APTGF50H60T1G

Full - Bridge NPT IGBT Power Module

V_{CES} = 600V
I_C = 50A* @ Tc = 80°C





Pins 3/4 must be shorted together

Application

- Welding converters
- Switched Mode Power Supplies
- Uninterruptible Power Supplies
- Motor control

Features

- Non Punch Through (NPT) Fast IGBT
  - Low voltage drop
  - Low tail current
  - Switching frequency up to 100 kHz
  - Soft recovery parallel diodes
  - Low diode VF
  - Low leakage current
  - RBSOA and SCSOA rated
- Very low stray inductance
  - Symmetrical design
- Internal thermistor for temperature monitoring
- High level of integration

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
- Each leg can be easily paralleled to achieve a phase leg 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	

* Specification of IGBT device but output current must be limited to 40A to not exceed a delta of temperature greater than 35°C for the connectors.

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		

Reverse 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			25	µA
			T_j = 125°C			500	
I_F	DC Forward Current		Tc = 80°C		30		A
V_F	Diode Forward Voltage	I_F = 30A			1.8	2.2	V
		I_F = 60A			2.2		
		I_F = 30A	T_j = 125°C		1.5		
t_{rr}	Reverse Recovery Time	I_F = 30A V_R = 400V di/dt =200A/µs	T_j = 25°C		25		ns
			T_j = 125°C		160		
Q_{rr}	Reverse Recovery Charge		T_j = 25°C		35		nC
			T_j = 125°C		480		

Thermal and package characteristics

Symbol	Characteristic			Min	Typ	Max	Unit
R_{thJC}	Junction to Case Thermal Resistance	IGBT				0.5	°C/W
		Diode				1.2	
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					80	g

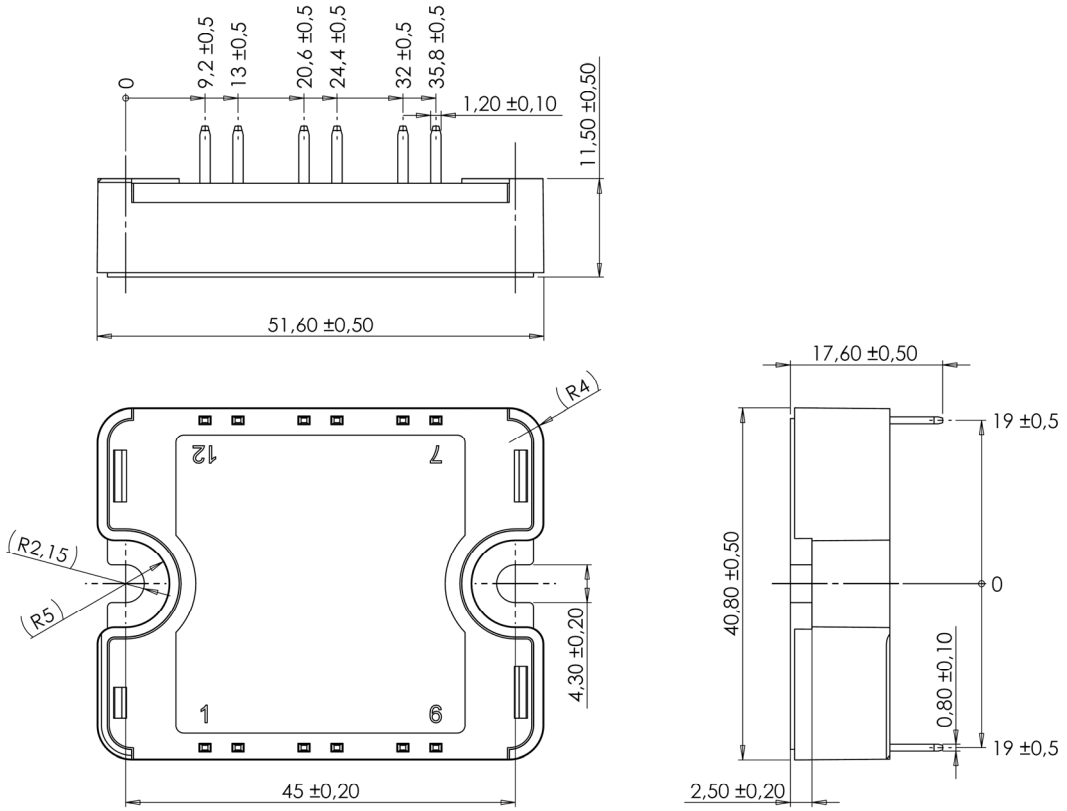
Temperature sensor NTC (see application note APT0406 on www.microsemi.com for more information).

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

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

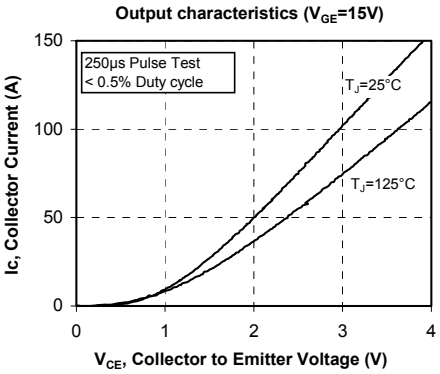
T: Thermistor temperature
R_T: Thermistor value at T

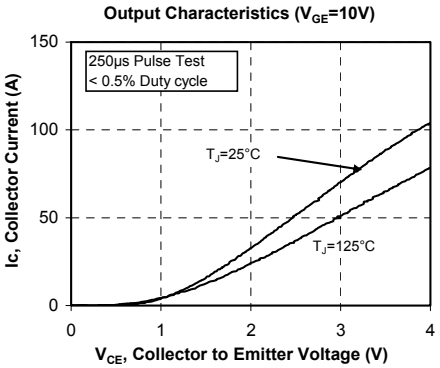
SP1 Package outline (dimensions in mm)

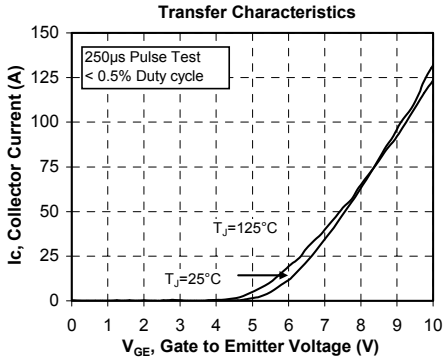


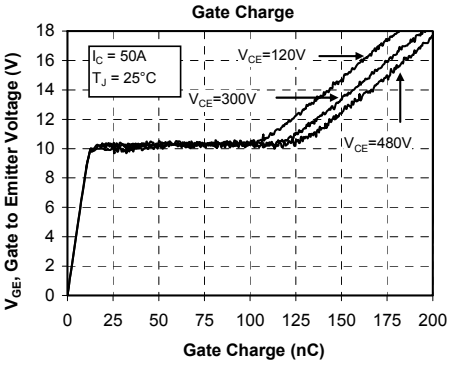
See application note 1904 - Mounting Instructions for SP1 Power Modules on www.microsemi.com

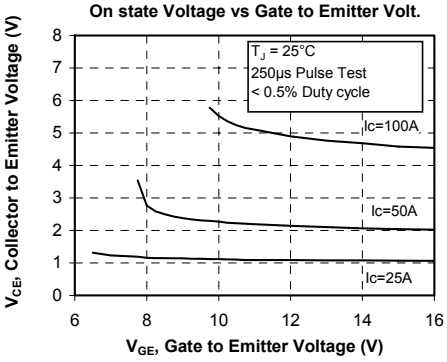
Typical Performance Curve

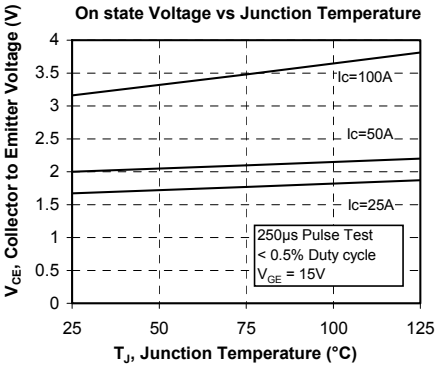


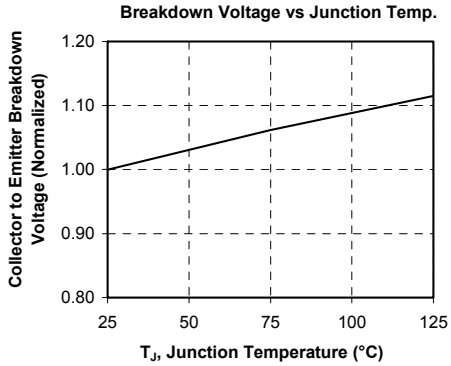


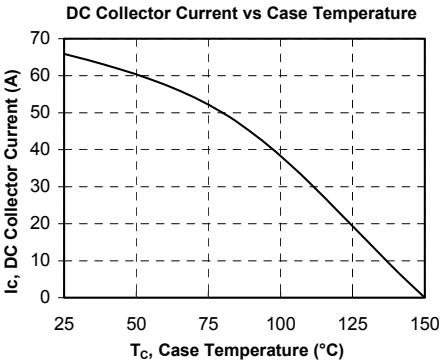


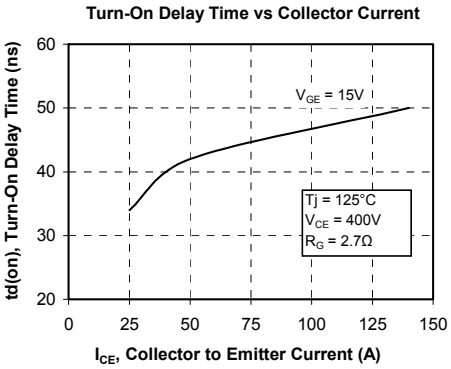


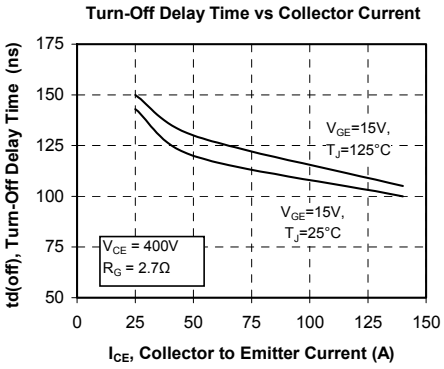


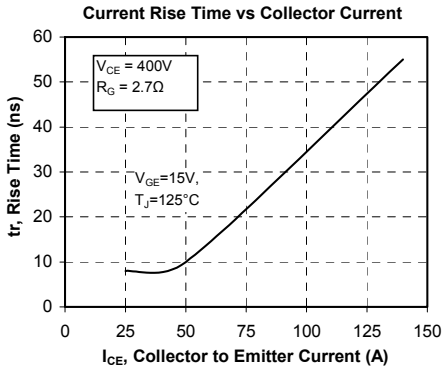


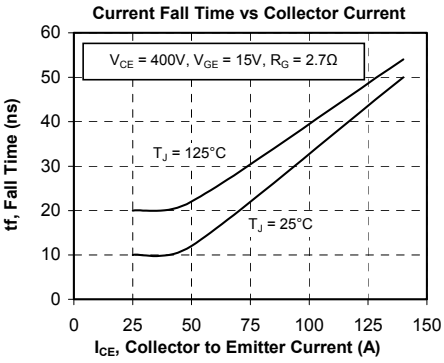


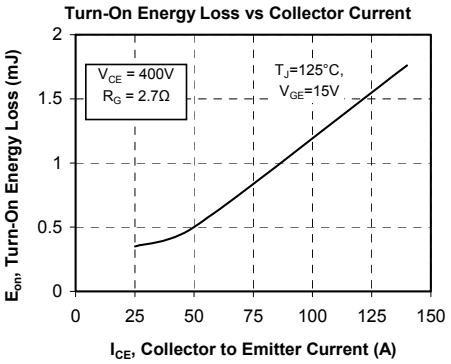


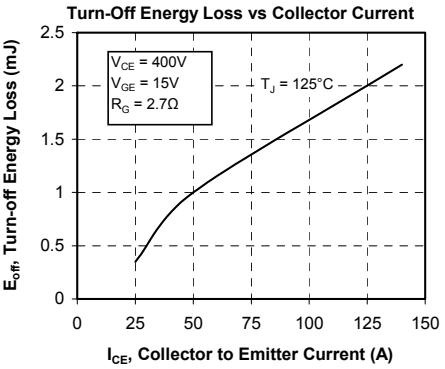

Turn-On Delay Time vs Collector Current
td(on), Turn-On Delay Time (ns)
60
50
40
30
20
0
25
50
75
100
125
150
VGE = 15V
Tj = 125°C
VCE = 400V
RG = 2.7Ω
ICE, Collector to Emitter Current (A)

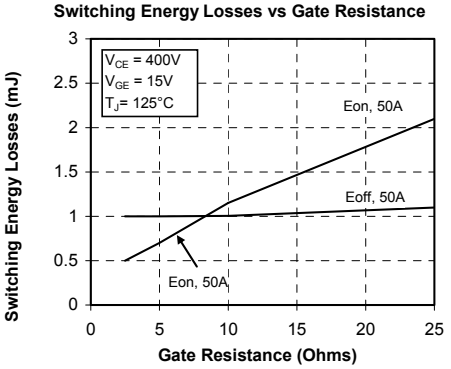

Turn-Off Delay Time vs Collector Current
td(off), Turn-Off Delay Time (ns)
175
150
125
100
75
50
0
25
50
75
100
125
150
VGE=15V,
TJ=125°C
VGE=15V,
TJ=25°C
VCE = 400V
RG = 2.7Ω
ICE, Collector to Emitter Current (A)

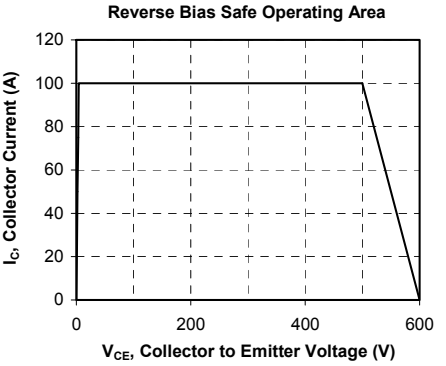

Current Rise Time vs Collector Current
tr, Rise Time (ns)
60
50
40
30
20
10
0
0
25
50
75
100
125
150
VCE = 400V
RG = 2.7Ω
VGE=15V,
TJ=125°C
ICE, Collector to Emitter Current (A)

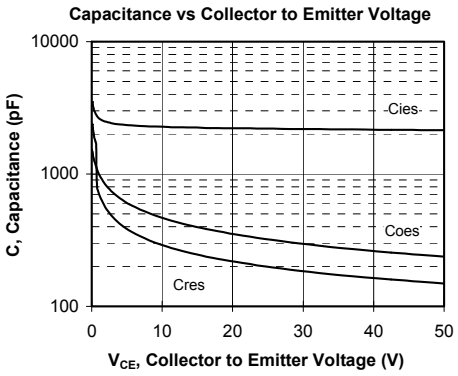

Current Fall Time vs Collector Current
tf, Fall Time (ns)
60
50
40
30
20
10
0
0
25
50
75
100
125
150
VCE = 400V, VGE = 15V, RG = 2.7Ω
TJ = 125°C
TJ = 25°C
ICE, Collector to Emitter Current (A)

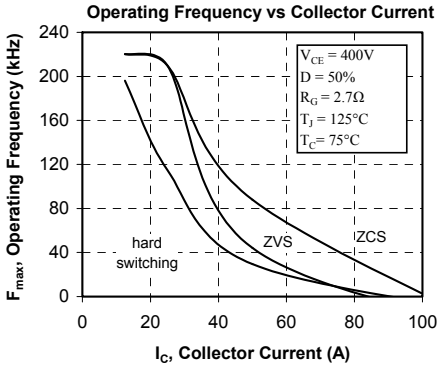

Turn-On Energy Loss vs Collector Current
Eon, Turn-On Energy Loss (mJ)
2
1.5
1
0.5
0
0
25
50
75
100
125
150
VCE = 400V
RG = 2.7Ω
TJ=125°C,
VGE=15V
ICE, Collector to Emitter Current (A)

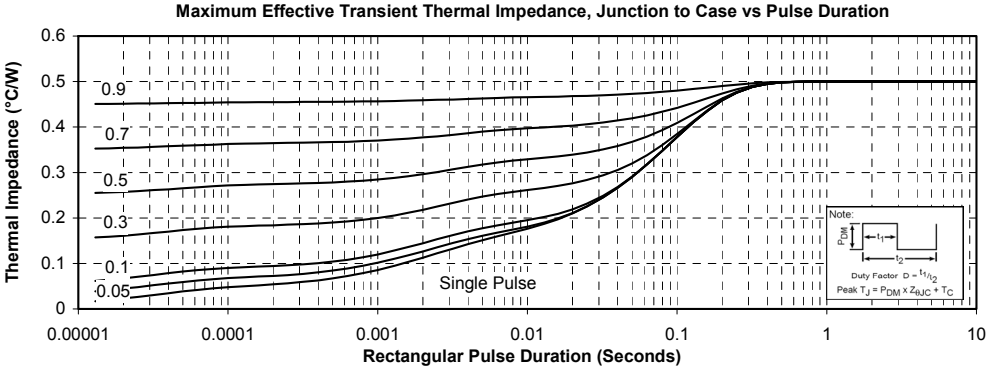

Turn-Off Energy Loss vs Collector Current
Eoff, Turn-off Energy Loss (mJ)
2.5
2
1.5
1
0.5
0
0
25
50
75
100
125
150
VCE = 400V
VGE = 15V
RG = 2.7Ω
TJ = 125°C
ICE, Collector to Emitter Current (A)


Switching Energy Losses vs Gate Resistance
Switching Energy Losses (mJ)
3
2.5
2
1.5
1
0.5
0
0
5
10
15
20
25
VCE = 400V
VGE = 15V
TJ= 125°C
Eon, 50A
Eoff, 50A
Eon, 50A
Gate Resistance (Ohms)


Reverse Bias Safe Operating Area
IC, Collector Current (A)
120
100
80
60
40
20
0
0
200
400
600
VCE, 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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