![Microsemi POWER PRODUCTS GROUP logo]

Ultra Fast NPT - IGBT®

The Ultra Fast 650V NPT-IGBT® family of products is the newest generation of IGBTs optimized for outstanding ruggedness and best trade-off between conduction and switching losses.

Features

- **Low Saturation Voltage**
- **Low Tail Current**
- **RoHS Compliant** 🍃

- **Short Circuit Withstand Rated**
- **High Frequency Switching**
- **Ultra Low Leakage Current**

(B) TO-247

D³PA K (S)

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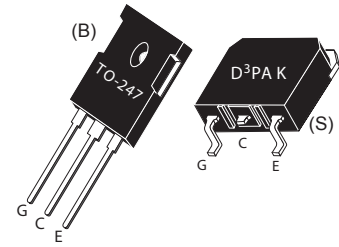
Unless stated otherwise, Microsemi discrete IGBTs contain a single IGBT die. This device is recommended for applications such as induction heating (IH), motor control, general purpose inverters and uninterruptible power supplies (UPS).

MAXIMUM RATINGS

All Ratings: T_C = 25°C unless otherwise specified.

Symbol	Parameter	Ratings	Unit
V_{ces}	Collector Emitter Voltage	650	V
V_{GE}	Gate-Emitter Voltage	±30	
I_{C1}	Continuous Collector Current @ T_C = 25°C	134	A
I_{C2}	Continuous Collector Current @ T_C = 110°C	65	
I_{CM}	Pulsed Collector Current ①	260	
SCWT	Short Circuit Withstand Time: V_{CE} = 600V, V_{GE} = 15V, T_C=125°C	10	µs
P_D	Total Power Dissipation @ T_C = 25°C	595	W
T_J, T_{STG}	Operating and Storage Junction Temperature Range	-55 to 150	°C
T_L	Max. Lead Temp. for Soldering: 0.063" from Case for 10 Sec.	300	

STATIC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Min	Typ	Max	Unit
$V_{(BR)CES}$	Collector-Emitter Breakdown Voltage (V_{GE} = 0V, I_C = 250uA)	650			Volts
$V_{GE(TH)}$	Gate Threshold Voltage ($V_{CE} = V_{GE}$, I_C = 1.0mA, T_j = 25°C)	3.5	5.0	6.5	
$V_{CE(ON)}$	Collector-Emitter On Voltage (V_{GE} = 15V, I_C = 70A, T_j = 25°C)		1.9	2.4	
	Collector-Emitter On Voltage (V_{GE} = 15V, I_C = 70A, T_j = 125°C)		2.4		
	Collector-Emitter On Voltage (V_{GE} = 15V, I_C = 140A, T_j = 25°C)		2.6		
I_{CES}	Collector Cut-off Current (V_{CE} = 650V, V_{GE} = 0V, T_j = 25°C) ②		10	250	µA
	Collector Cut-off Current (V_{CE} = 650V, V_{GE} = 0V, T_j = 125°C) ②		100		
I_{GES}	Gate-Emitter Leakage Current (V_{GE} = ±20V)			±250	nA

⚠ **CAUTION: These Devices are Sensitive to Electrostatic Discharge. Proper Handling Procedures Should Be Followed.**

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
C_{ies}	Input Capacitance	Capacitance		4250		
C_{oes}	Output Capacitance	$V_{GE} = 0V$, $V_{CE} = 25V$		847		pF
C_{res}	Reverse Transfer Capacitance	$f = 1MHz$		415		
V_{GEP}	Gate to Emitter Plateau Voltage	Gate Charge		7.0		V
Q_g [3]	Total Gate Charge	$V_{GE} = 15V$		226	305	
Q_{ge}	Gate-Emitter Charge	$V_{CE}= 325V$		26	35	nC
Q_{gc}	Gate- Collector Charge	$I_C = 70A$		104	140	
$t_{d(on)}$	Turn-On Delay Time	Inductive Switching (25°C)		19		
t_r	Current Rise Time	$V_{CC} = 433V$		45		ns
$t_{d(off)}$	Turn-Off Delay Time	$V_{GE} = 15V$		170		
t_f	Current Fall Time	$I_C = 70A$		67		
E_{on2} [5]	Turn-On Switching Energy	$R_G = 4.3\Omega$ [4]		1505	2260	μJ
E_{off} [6]	Turn-Off Switching Energy	$T_J = +25°C$		1460	1970	
$t_{d(on)}$	Turn-On Delay Time	Inductive Switching (125°C)		19		
t_r	Current Rise Time	$V_{CC} = 433V$		45		ns
$t_{d(off)}$	Turn-Off Delay Time	$V_{GE} = 15V$		190		
t_f	Current Fall Time	$I_C = 70A$		74		
E_{on2} [5]	Turn-On Switching Energy	$R_G = 4.3\Omega$ [4]		1560	2340	μJ
E_{off} [6]	Turn-Off Switching Energy	$T_J = +125°C$		1720	2580	

THERMAL AND MECHANICAL CHARACTERISTICS

Symbol	Characteristic	Min	Typ	Max	Unit
$R_{\theta JC}$	Junction to Case Thermal Resistance			.21	°C/W
$R_{\theta JA}$	Junction to Ambient Thermal Resistance			40	
W_T	Package Weight		.22		oz
			6.2		g
Torque	Mounting Torque (TO-247 Package), 4-40 or M3 screw			10	in-lbf
				6.2	N·m

1 Repetitive Rating: Pulse width and case temperature limited by maximum junction temperature.

2 Pulse test: Pulse Width < 380μs, duty cycle < 2%.

3 See Mil-Std-750 Method 3471.

4 R_G is external gate resistance, not including internal gate resistance or gate driver impedance. (MIC4452)

5 E_{on2} is the energy loss at turn-on and includes the charge stored in the freewheeling diode.

6 E_{off} is the clamped inductive turn-off energy measured in accordance with JEDEC standard JESD24-1.

Microsemi reserves the right to change, without notice, the specifications and information contained herein.
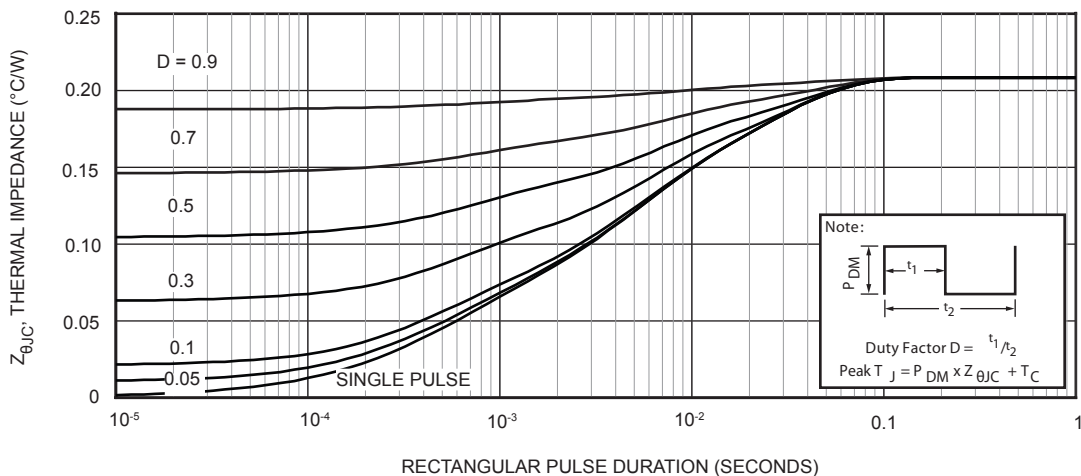

RECTANGULAR PULSE DURATION (SECONDS)
Figure 1, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration
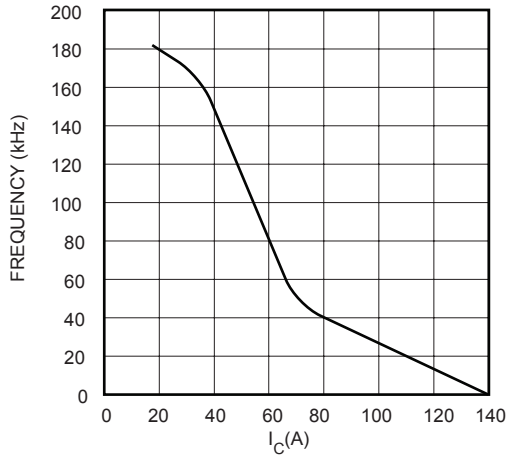
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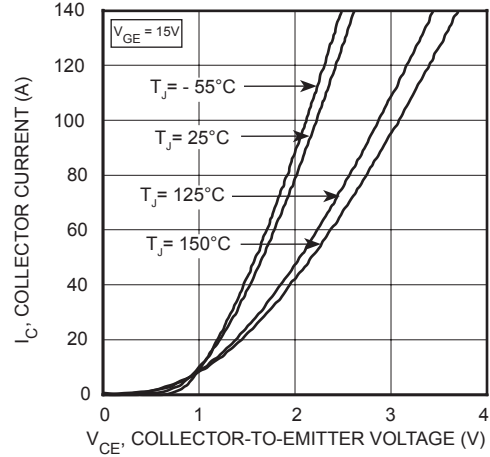
FIGURE 2, Max Frequency vs Current (T$_{case}$ = 75°C)

FIGURE 3, Saturation Voltage Characteristics (T$_J$ = 25°C)
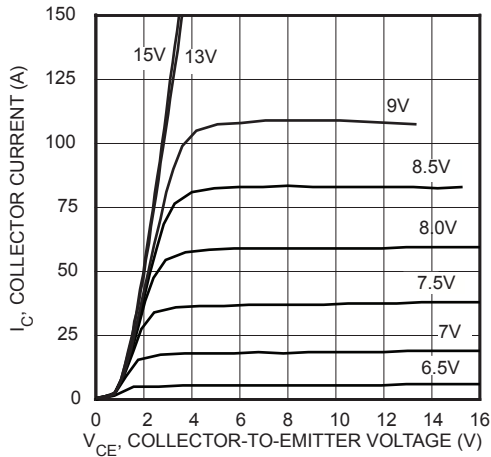
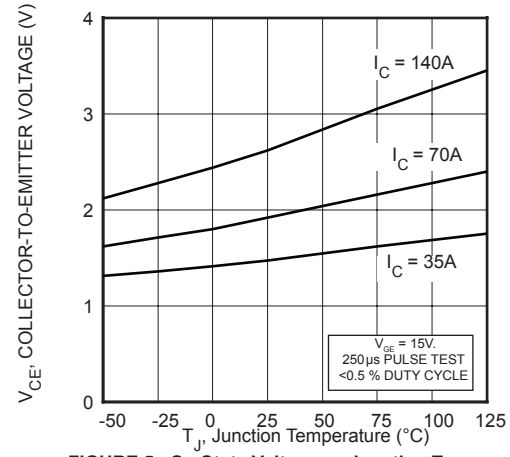**FIGURE 4, Output Characteristics (T$_J$ = 25°C)**

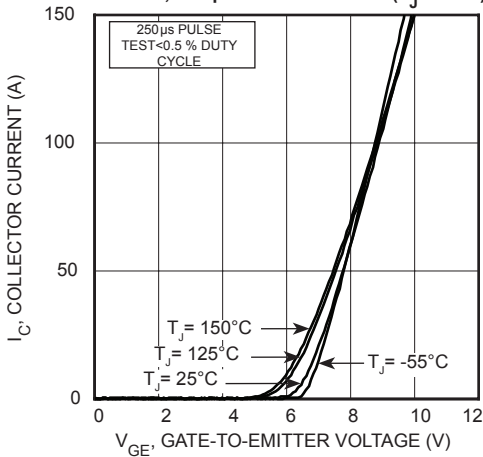**FIGURE 5, On State Voltage vs Junction Temperature**
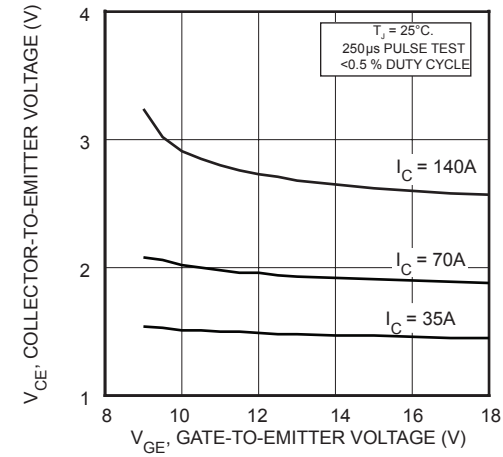
FIGURE 6, Transfer Characteristics
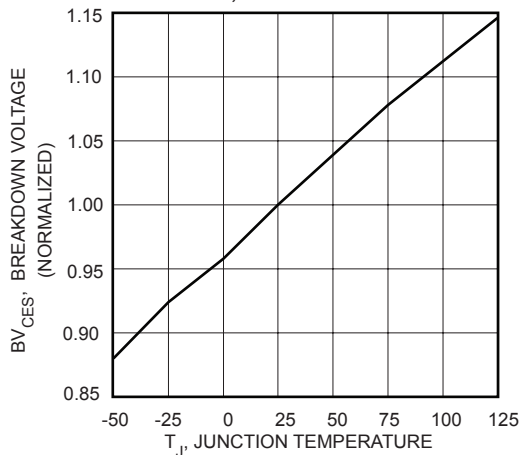
FIGURE 7, On State Voltage vs Gate-to-Emitter Voltage
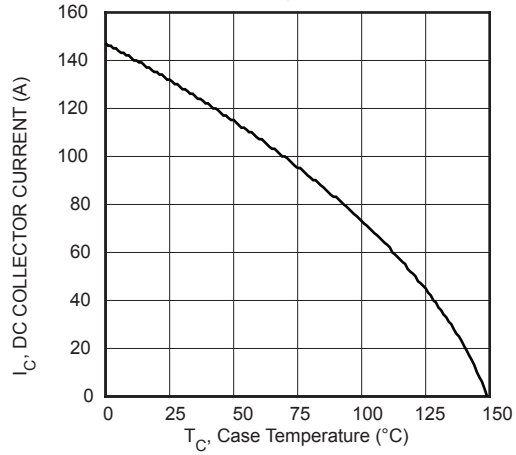
FIGURE 8, Breakdown Voltage vs Junction Temperature

FIGURE 9, DC Collector Current vs Case Temperature

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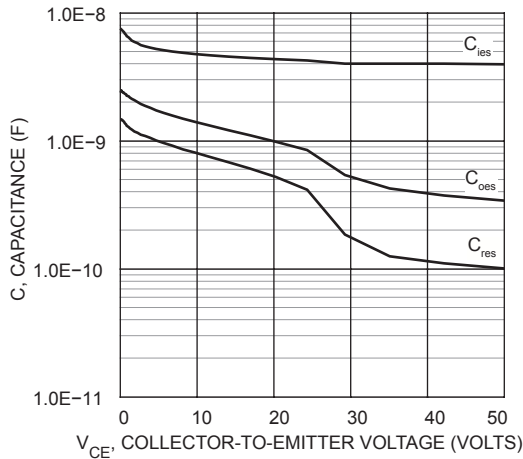
FIGURE 10, Capacitance vs Collector-To-Emitter Voltage
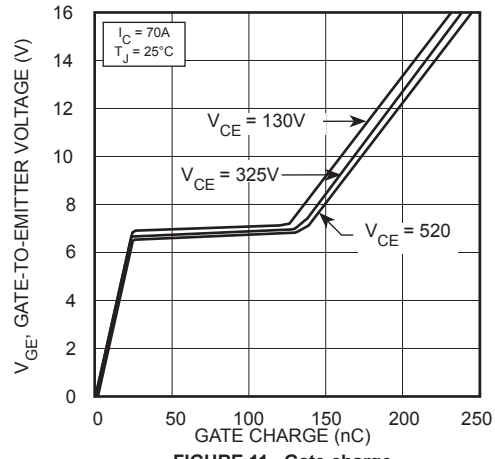
FIGURE 11, Gate charge
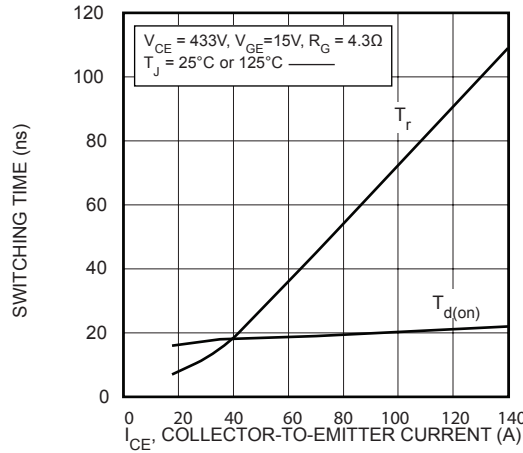
FIGURE 12, Turn-On Time vs Collector Current
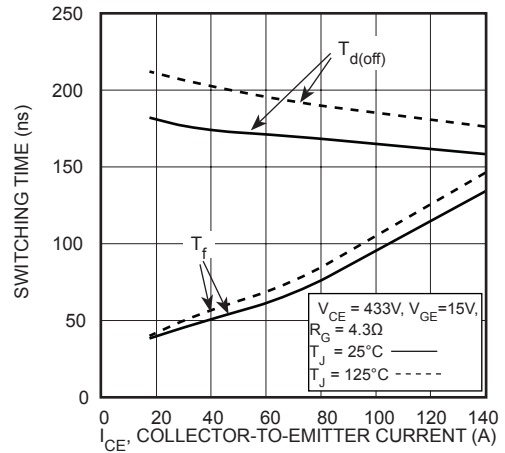
FIGURE 13, Turn-Off Time vs Collector Current
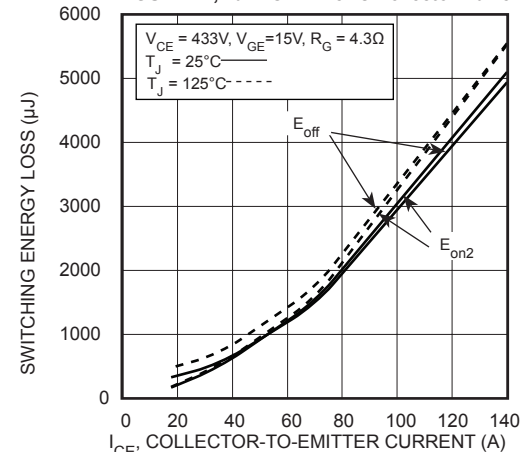
FIGURE 14, Energy Loss vs Collector Current
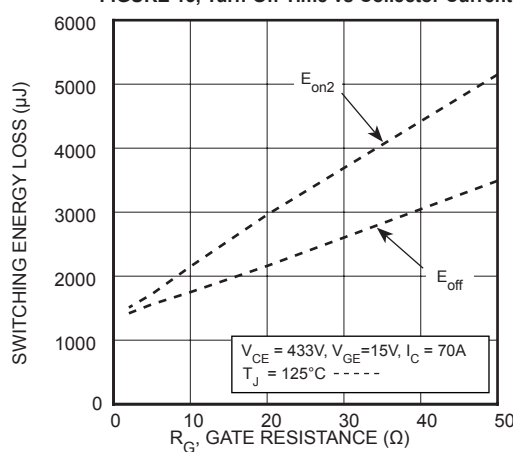
FIGURE 15, Energy Loss vs Gate Resistance
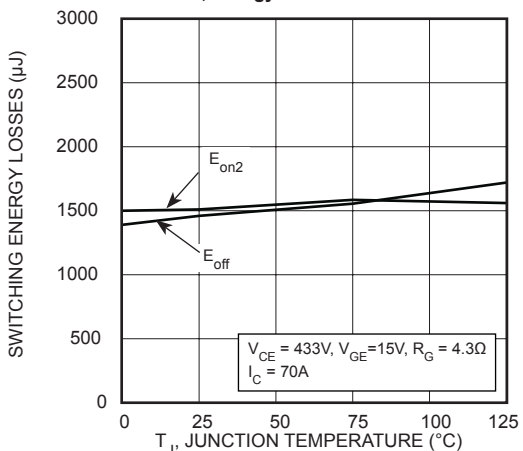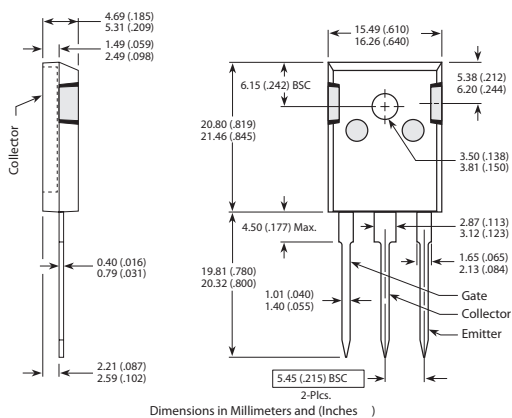
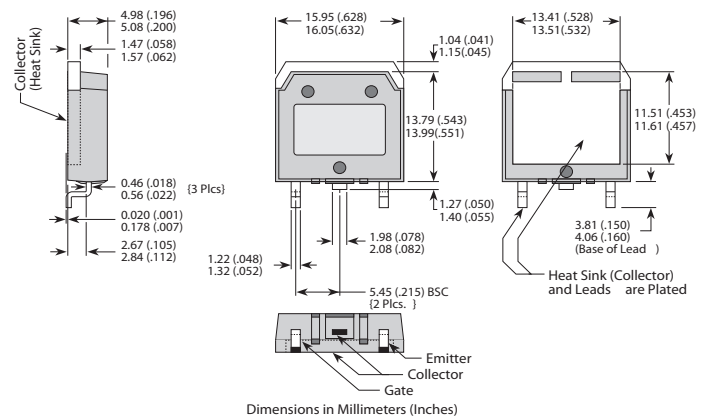FIGURE 16, Swiitching Energy vs Junction Temperature
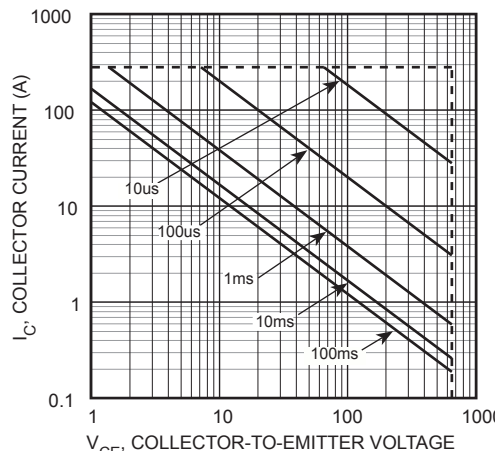
FIGURE 17, Minimum Switching Safe Operating Area

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TO-247 Package Outline

Collector

4.69 (.185)
5.31 (.209)

1.49 (.059)
2.49 (.098)

0.40 (.016)
0.79 (.031)

2.21 (.087)
2.59 (.102)

15.49 (.610)
16.26 (.640)

6.15 (.242) BSC

20.80 (.819)
21.46 (.845)

4.50 (.177) Max.

19.81 (.780)
20.32 (.800)

1.01 (.040)
1.40 (.055)

5.45 (.215) BSC
2-Plcs.

5.38 (.212)
6.20 (.244)

3.50 (.138)
3.81 (.150)

2.87 (.113)
3.12 (.123)

1.65 (.065)
2.13 (.084)

Gate
Collector
Emitter

Dimensions in Millimeters and (Inches)

D³PAK Package Outline
e3 : 100% Sn Plating

Collector
(Heat Sink)

4.98 (.196)
5.08 (.200)

1.47 (.058)
1.57 (.062)

0.46 (.018)
0.56 (.022) {3 Plcs}

0.020 (.001)
0.178 (.007)

2.67 (.105)
2.84 (.112)

15.95 (.628)
16.05 (.632)

1.04 (.041)
1.15 (.045)

13.79 (.543)
13.99 (.551)

1.27 (.050)
1.40 (.055)

1.98 (.078)
2.08 (.082)

1.22 (.048)
1.32 (.052)

5.45 (.215) BSC
{2 Plcs. }

Emitter
Collector
Gate

13.41 (.528)
13.51 (.532)

11.51 (.453)
11.61 (.457)

3.81 (.150)
4.06 (.160)
(Base of Lead)

Heat Sink (Collector)
and Leads are Plated

Dimensions in Millimeters (Inches)

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