

Designer's™ Data Sheet

Insulated Gate Bipolar Transistor

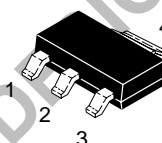
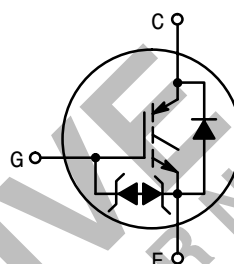
N-Channel Enhancement-Mode Silicon Gate

MMG05N60D

IGBT
0.5 A @ 25°C
600 V

This IGBT contains a built-in free wheeling diode and a gate protection zener diodes. Fast switching characteristics result in efficient operation at higher frequencies. This device is ideally suited for high frequency electronic ballasts.

- Built-In Free Wheeling Diode
- Built-In Gate Protection Zener Diodes
- Industry Standard Package (SOT223)
- High Speed E_{off} : Typical $6.5 \mu\text{J}$ @ $I_C = 0.3 \text{ A}$; $T_C = 125^\circ\text{C}$ and $dV/dt = 1000 \text{ V}/\mu\text{s}$
- Robust High Voltage Termination
- Robust Turn-Off SOA



1 = G
2 = 4 = C
3 = E

CASE 318E-04
STYLE 13
TO-261A

MAXIMUM RATINGS ($T_J = 25^\circ\text{C}$ unless otherwise noted)

Parameters	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CES}	600	Vdc
Collector-Gate Voltage ($R_{GE} = 1.0 \text{ M}\Omega$)	V_{CGR}	600	Vdc
Gate-Emitter Voltage — Continuous	V_{CGR}	± 15	Vdc
Collector Current — Continuous @ $T_C = 25^\circ\text{C}$ — Continuous @ $T_C = 90^\circ\text{C}$ — Repetitive Pulsed Current (1)	I_{C25} I_{C90} I_{CM}	0.5 0.3 2.0	Adc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$	P_D	1.0	Watt
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-55 to 150	$^\circ\text{C}$
Thermal Resistance — Junction to Case — IGBT — Junction to Ambient	$R_{\theta JC}$ $R_{\theta JA}$	30 150	$^\circ\text{C}/\text{W}$
Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 5 seconds	T_L	260	$^\circ\text{C}$

UNCLAMPED DRAIN-TO-SOURCE AVALANCHE CHARACTERISTICS ($T_C \leq 150^\circ\text{C}$)

Single Pulse Drain-to-Source Avalanche Energy — Starting @ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$ $V_{CE} = 100 \text{ V}$, $V_{GE} = 15 \text{ V}$, Peak $I_L = 2.0 \text{ A}$, $L = 3.0 \text{ mH}$, $R_G = 25 \Omega$	E_{AS}	125 40	mJ

(1) Pulse width is limited by maximum junction temperature repetitive rating.

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. SOA Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

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MMG05N60D

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-to-Emitter Breakdown Voltage (V _{GE} = 0 Vdc, I _C = 250 μAdc) Temperature Coefficient (Positive)	V _{(BR)CES}	600 —	680 0.7	— —	Vdc V/°C
Zero Gate Voltage Collector Current (V _{CE} = 600 Vdc, V _{GE} = 0 Vdc, T _C = 25°C) (V _{CE} = 600 Vdc, V _{GE} = 0 Vdc, T _C = 125°C)	I _{CES} I _{CES}	— —	0.1 5.0	5.0 50	μAdc
Gate-Body Leakage Current (V _{GE} = ±15 Vdc, V _{CE} = 0 Vdc)	I _{GES}	—	10	100	μAdc

ON CHARACTERISTICS

Collector-to-Emitter On-State Voltage (V _{GE} = 15 Vdc, I _C = 0.3 Adc, T _C = 25°C) (V _{GE} = 15 Vdc, I _C = 0.3 Adc, T _C = 125°C)	V _{CE(on)}	— —	1.6 1.5	2.0 —	Vdc
Gate Threshold Voltage (V _{CE} = V _{GE} , I _C = 250 μAdc) Threshold Temperature Coefficient (Negative)	V _{GE(th)}	3.5 —	— 6.0	6.0 —	Vdc mV/°C
Forward Transconductance (V _{CE} = 10 Vdc, I _C = 0.5 Adc)	g _{fe}	0.3	0.42	—	Mhos

DYNAMIC CHARACTERISTICS

Input Capacitance	(V _{CE} = 20 Vdc, V _{GE} = 0 Vdc, f = 1.0 MHz)	C _{ies}	—	75	100	pF
Output Capacitance		C _{oes}	—	11	20	
Transfer Capacitance		C _{res}	—	1.6	5.0	

DIODE CHARACTERISTICS

Diode Forward Voltage Drop (I _{EC} = 0.3 Adc, T _C = 25°C) (I _{EC} = 0.3 Adc, T _C = 125°C) (I _{EC} = 0.1 Adc, T _C = 25°C) (I _{EC} = 0.1 Adc, T _C = 125°C)	V _{FEC}	— — — —	5.0 5.2 2.3 2.3	6.0 — 3.0 —	Vdc
Reverse Recovery Time @ T _C = 25°C I _F = 0.4 Adc, V _R = 300 Vdc, dI _F /dt = 10 A/μs	t _{rr}	—	150	—	ns
Reverse Recovery Stored Charge I _F = 0.4 Adc, V _R = 300 Vdc, dI _F /dt = 10 A/μs	Q _{RR}	—	35	—	μC

SWITCHING CHARACTERISTICS (1)

Turn-Off Delay Time	(V _{CC} = 300 Vdc, I _C = 0.4 Adc, V _{GE} = 15 Vdc, L = 3.0 mH, R _G = 25 Ω, T _C = 25°C, dV/dt = 1000 V/μs) Energy losses include "tail"	t _{d(off)}	—	28	—	ns
Fall Time		t _f	—	150	—	
Turn-Off Switching Loss		E _{off}	—	3.25	4.25	
Turn-Off Delay Time	(V _{CC} = 300 Vdc, I _C = 0.4 Adc, V _{GE} = 15 Vdc, L = 3.0 mH, R _G = 25 Ω, T _C = 125°C, dV/dt = 1000 V/μs) Energy losses include "tail"	t _{d(off)}	—	21	—	ns
Fall Time		t _f	—	280	—	
Turn-Off Switching Loss		E _{off}	—	8.0	10	
Gate Charge	(V _{CC} = 300 Vdc, I _C = 0.3 Adc, V _{GE} = 15 Vdc)	Q _T	—	6.4	—	nC

(1) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.

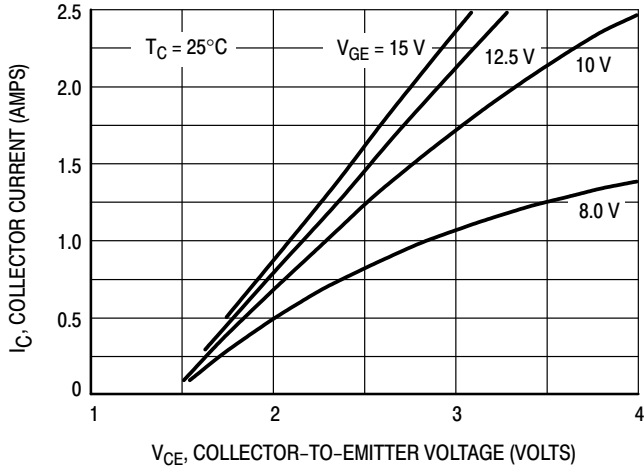


Figure 1. Saturation Characteristics

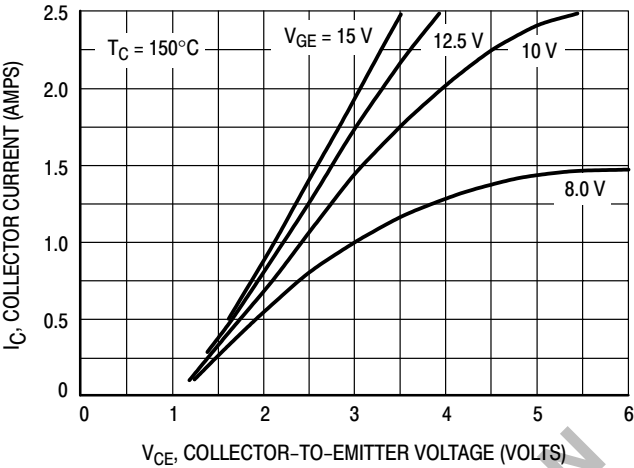


Figure 2. Saturation Characteristics

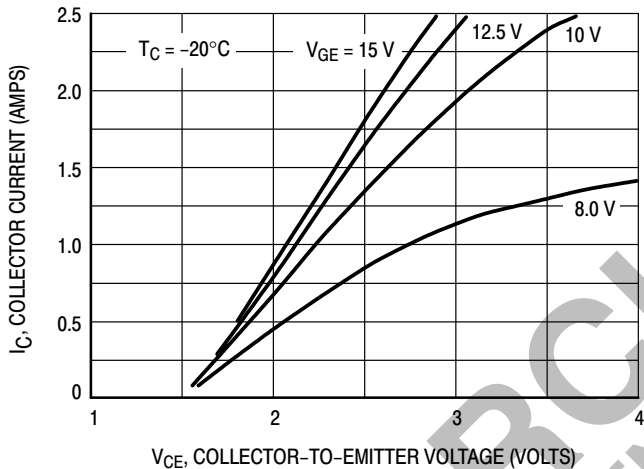


Figure 3. Saturation Characteristics

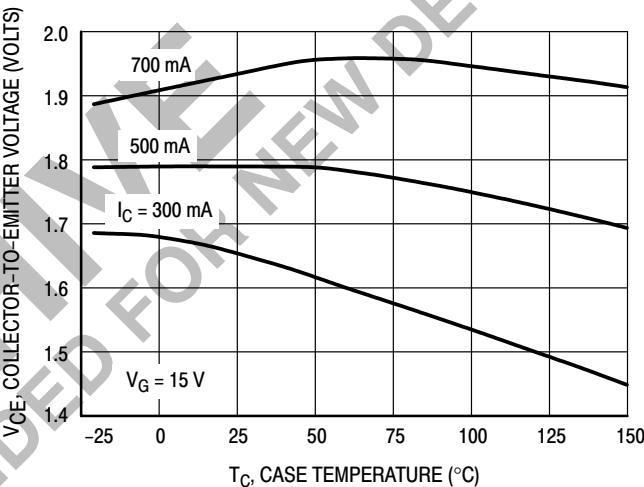


Figure 4. Collector-To-Emitter Saturation Voltage versus Case Temperature

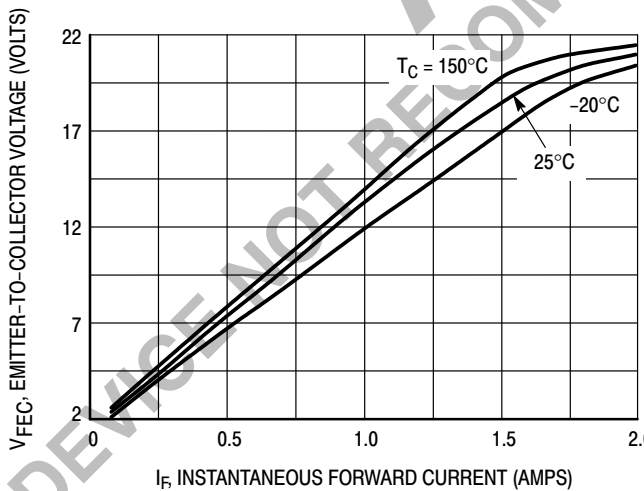


Figure 5. Diode Forward Voltage

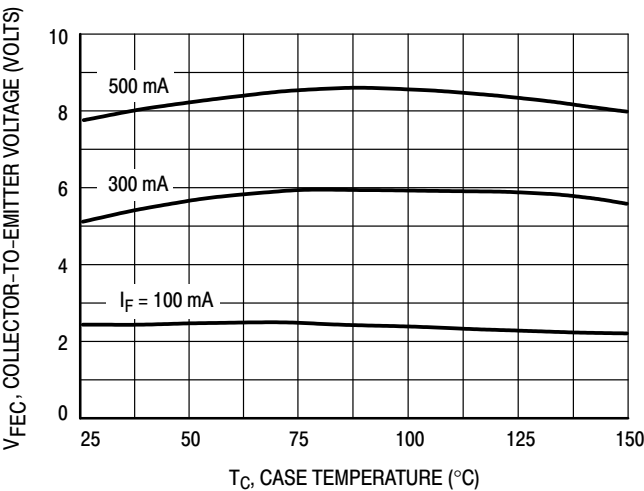


Figure 6. Diode Forward Voltage versus Case Temperature

MMG05N60D

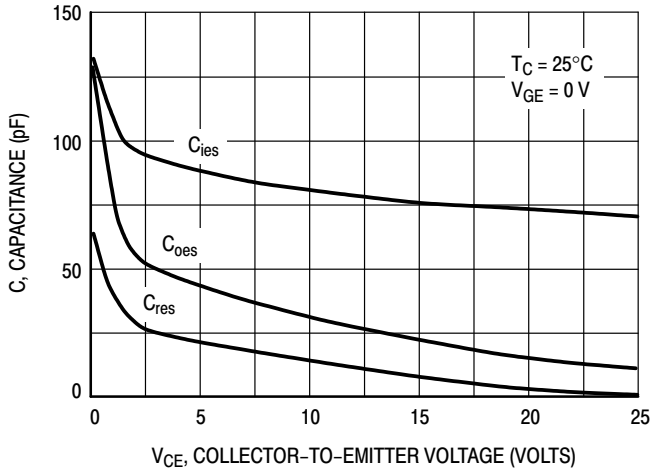


Figure 7. Capacitance Variation

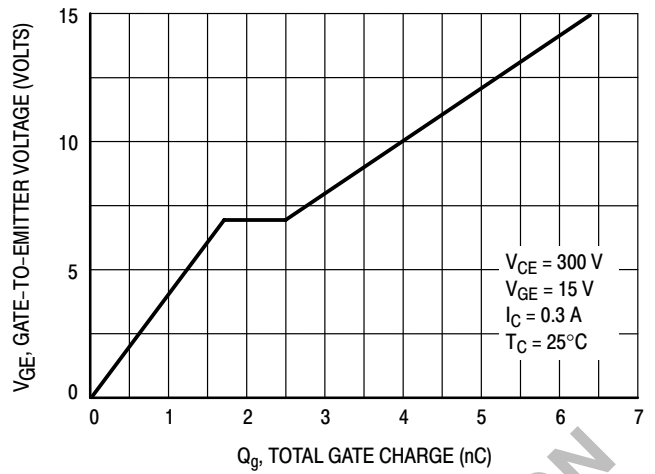


Figure 8. Gate-To-Emitter Voltage versus Total Charge

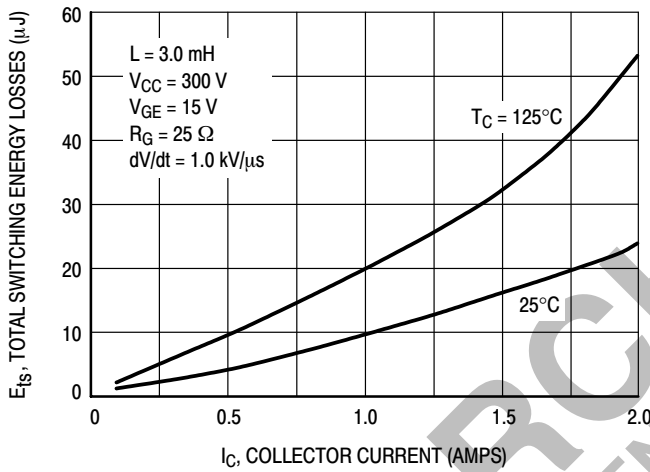


Figure 9. Total Switching Losses versus Collector Current

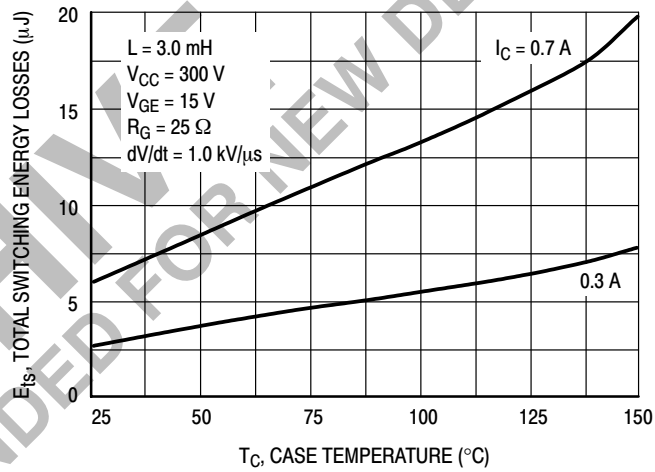


Figure 10. Total Switching Losses versus Case Temperature

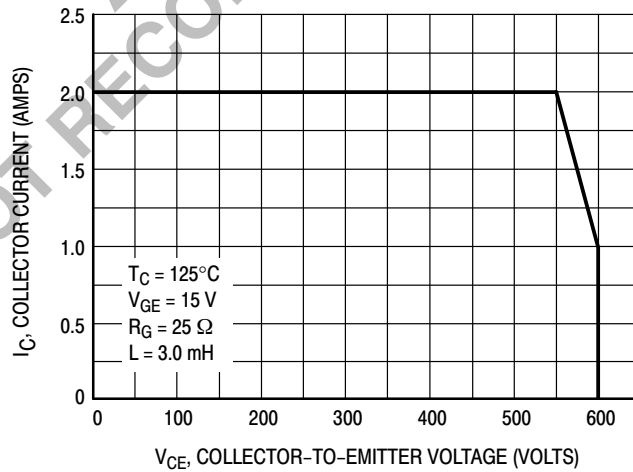


Figure 11. Minimum Turn-Off Safe Operating Area

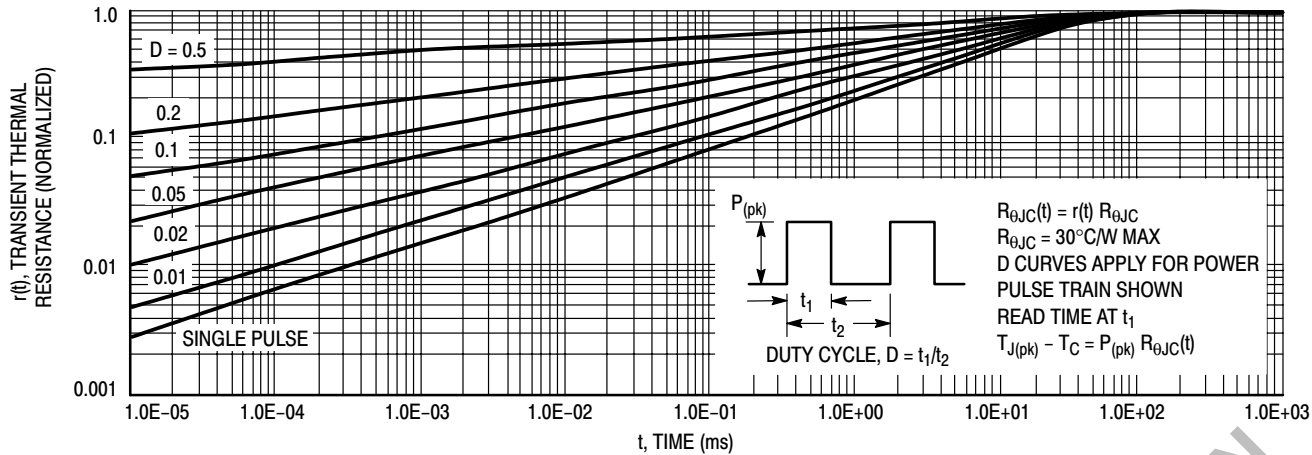
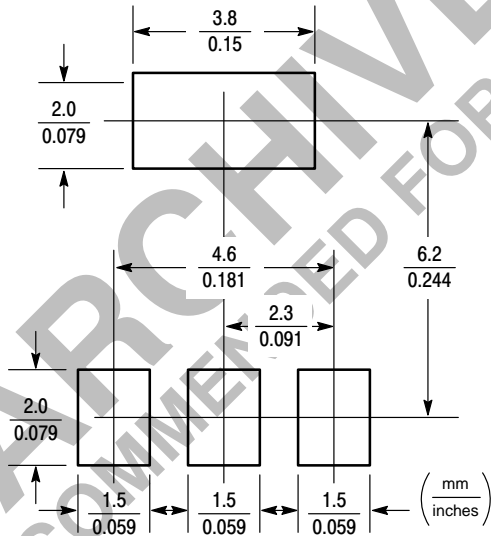
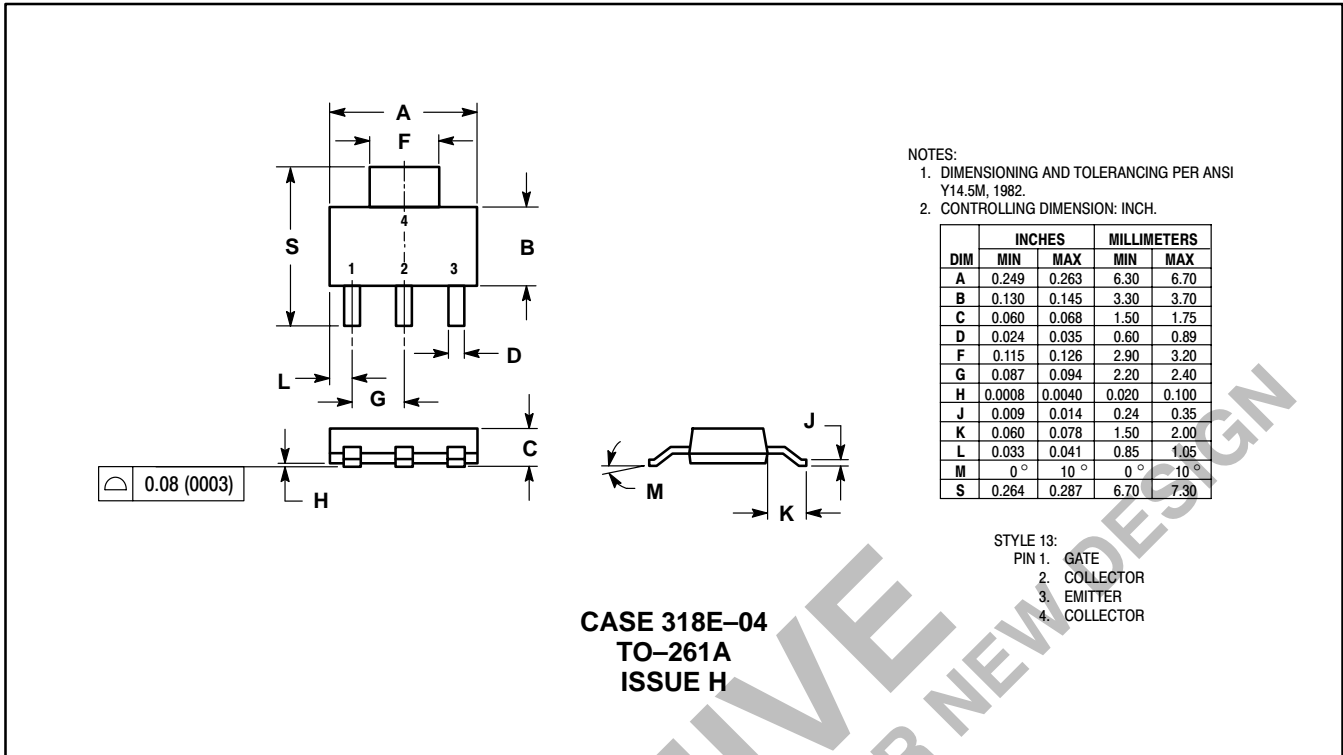


Figure 12. Typical Thermal Response



PACKAGE DIMENSIONS



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