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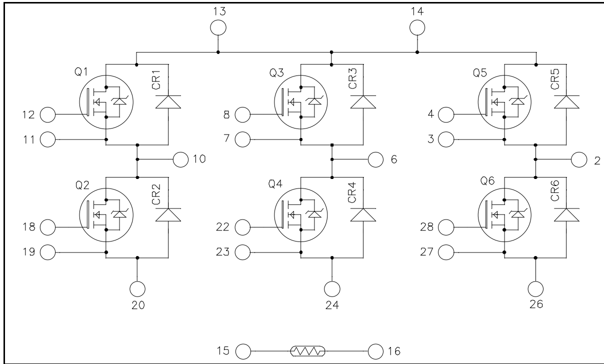
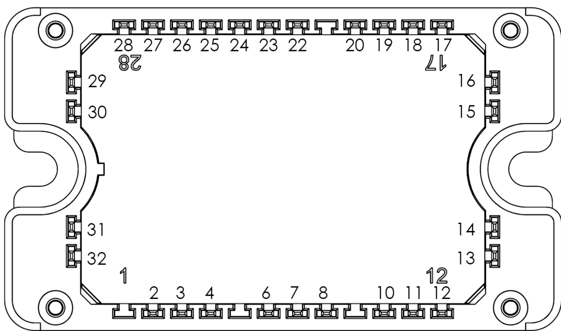
Microsemi Power Matters.™

APTMC120TAM34CT3AG

3 phase bridge
SiC MOSFET Power Module

V_{DSS} = 1200V
R_{DSon} = 34mΩ max @ Tj = 25°C
I_D = 74A @ Tc = 25°C





Pins 20, 24 & 26 must be shorted together to perform a 3 phase bridge.

Application

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

Features

- ***SiC Power MOSFET***
  - High speed switching
  - Low $R_{DS(on)}$
  - Ultra low loss
- ***SiC Schottky Diode***
  - Zero reverse recovery
  - Zero forward recovery
  - Temperature Independent switching behavior
  - Positive temperature coefficient on VF
- Very low stray inductance
- Kelvin source for easy drive
- Internal thermistor for temperature monitoring
- AlN substrate for improved thermal performance

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
- RoHS Compliant

All ratings @ T_j = 25°C unless otherwise specified

Absolute maximum ratings (per SiC MOSFET)

Symbol	*Parameter*		*Max ratings*	*Unit*
V_{DSS}	Drain - Source Voltage		1200	V
I_D	Continuous Drain Current	T_c = 25°C	74	A
		T_c = 80°C	58	
I_{DM}	Pulsed Drain current		150	
V_{GS}	Gate - Source Voltage		-10/25V	V
R_{DSon}	Drain - Source ON Resistance		34	mΩ
P_D	Power Dissipation	T_c = 25°C	375	W

CAUTION: These Devices are sensitive to Electrostatic Discharge. Proper Handling Procedures Should Be Followed.

Electrical Characteristics (per SiC MOSFET)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
I_{DSS}	Zero Gate Voltage Drain Current	$V_{GS} = 0V$, $V_{DS} = 1200V$			10	100	µA
$R_{DS(on)}$	Drain – Source on Resistance	$V_{GS} = 20V$ $I_D = 50A$	$T_j = 25°C$		25	34	mΩ
			$T_j = 175°C$		52		
$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}$, $I_D = 15mA$		2	2.6	4	V
I_{GSS}	Gate – Source Leakage Current	$V_{GS} = 20$ V, $V_{DS} = 0V$				600	nA

Dynamic Characteristics (per SiC MOSFET)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
C_{iss}	Input Capacitance	$V_{GS} = 0V$ $V_{DS} = 1000V$ f = 1MHz			2788		pF
C_{oss}	Output Capacitance				220		
C_{rss}	Reverse Transfer Capacitance				15		
Q_g	Total gate Charge	$V_{GS} = -5/+20V$ $V_{Bus} = 800V$ $I_D = 50A$			161		nC
Q_{gs}	Gate – Source Charge				46		
Q_{gd}	Gate – Drain Charge				50		
$T_{d(on)}$	Turn-on Delay Time	$V_{GS} = -5/+20V$ $V_{Bus} = 800V$ $I_D = 50A$ $R_L = 16\Omega$; $R_{Gext} = 20\Omega$			21		ns
T_r	Rise Time				19		
$T_{d(off)}$	Turn-off Delay Time				50		
T_f	Fall Time				30		
E_{on}	Turn on Energy	Inductive Switching $V_{GS} = -5/+20V$ $V_{Bus} = 600V$ $I_D = 50A$ $R_{Gext} = 20\Omega$	$T_j = 150°C$		1.1		mJ
E_{off}	Turn off Energy		$T_j = 150°C$		0.6		
R_{Gint}	Internal gate resistance				1.1		Ω
R_{thJC}	Junction to Case Thermal Resistance					0.4	°C/W

Body diode ratings and characteristics (per SiC MOSFET)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
V_{SD}	Diode Forward Voltage	$V_{GS} = -5V$ $I_{SD} = 25A$	$T_j = 25°C$		4		V
			$T_j = 175°C$		3.5		
t_{rr}	Reverse Recovery Time	$I_{SD} = 50A$; $V_{GS} = -5V$ $V_R = 800V$; $di_F/dt = 1000A/µs$			45		ns
Q_{rr}	Reverse Recovery Charge				406		nC
I_{rr}	Reverse Recovery Current				13.5		A

SiC schottky diode ratings and characteristics (per SiC diode)

Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
V_{RRM}	Peak Repetitive Reverse Voltage					1200	V
I_{RRM}	Reverse Leakage Current	V_R=1200V	T_j = 25°C		35	200	µA
			T_j = 175°C		65	400	
I_F	DC Forward Current		Tc = 100°C		20		A
V_F	Diode Forward Voltage	I_F = 20A	T_j = 25°C		1.5	1.8	V
			T_j = 175°C		2.2	3	
Q_C	Total Capacitive Charge	I_F = 20A, V_R = 1200V di/dt =500A/µs			99		nC
C	Total Capacitance	f = 1MHz, V_R = 400V			93		pF
		f = 1MHz, V_R = 800V			67		
R_{thJC}	Junction to Case Thermal Resistance					1.1	°C/W

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

Symbol	Characteristic		Min	Typ	Max	Unit
R_{25}	Resistance @ 25°C			50		kΩ
$\Delta R_{25}/R_{25}$				5		%
$B_{25/85}$	T_{25} = 298.15 K			3952		K
ΔB/B		T_C=100°C		4		%

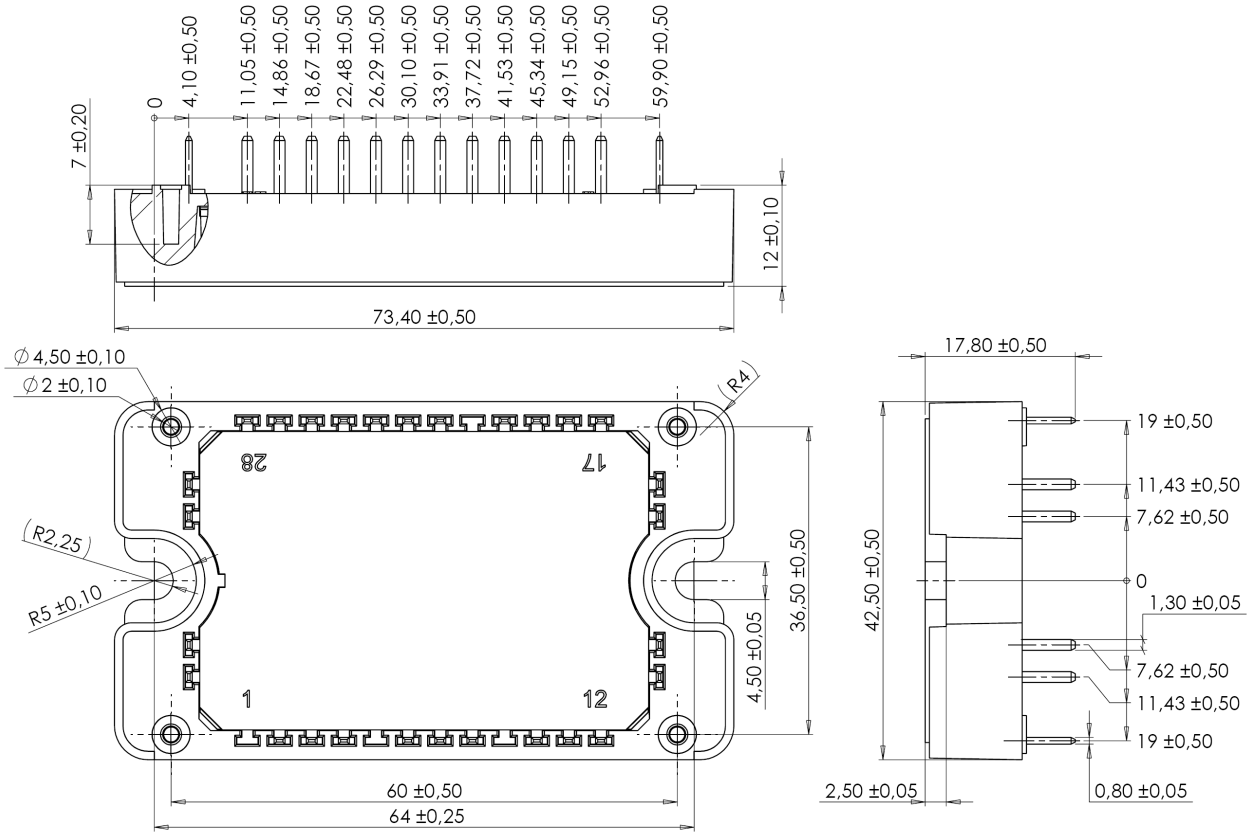
$$R_T = \frac{R_{25}}{\exp\left[B_{25/85}\left(\frac{1}{T_{25}} - \frac{1}{T}\right)\right]}$$

T: Thermistor temperature
R_T: Thermistor value at T

Thermal and package characteristics

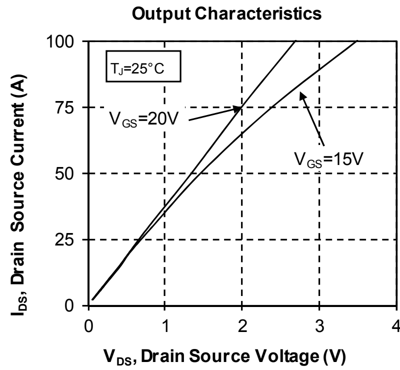
Symbol	Characteristic			Min	Max	Unit
V_{ISOL}	RMS Isolation Voltage, any terminal to case t =1 min, 50/60Hz			4000		V
T_J	Operating junction temperature range			-40	175	°C
T_{JOP}	Recommended junction temperature under switching conditions			-40	$T_J$max -25	
T_{STG}	Storage Temperature Range			-40	125	
T_C	Operating Case Temperature			-40	125	
Torque	Mounting torque	To heatsink	M4	2	3	N.m
Wt	Package Weight				110	g

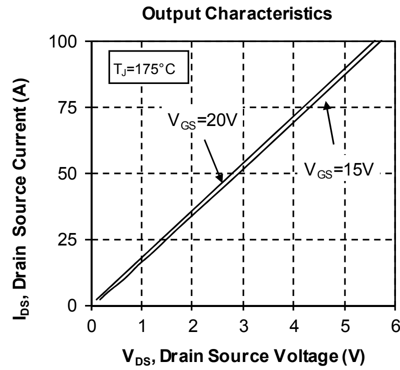
Package outline (dimensions in mm)

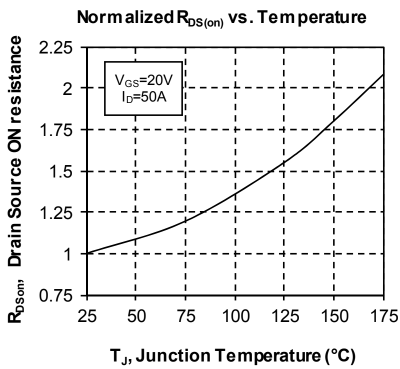


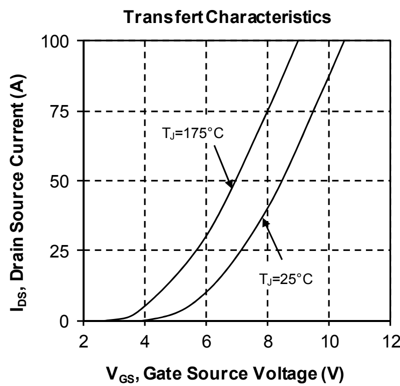
See application note 1906 - Mounting Instructions for SP3F Power Modules on www.microsemi.com

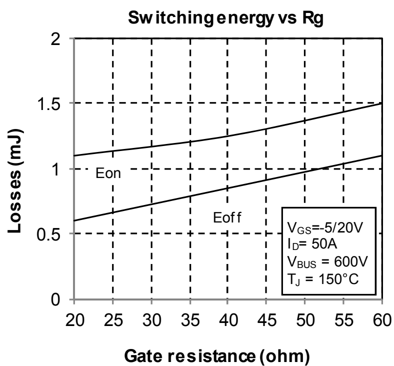
Typical SiC MOSFET Performance Curve

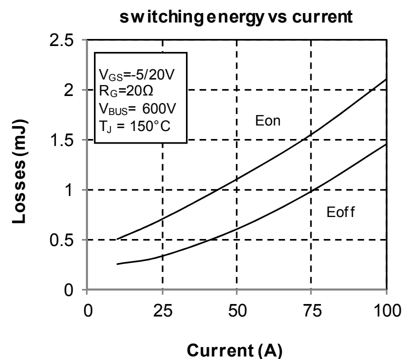


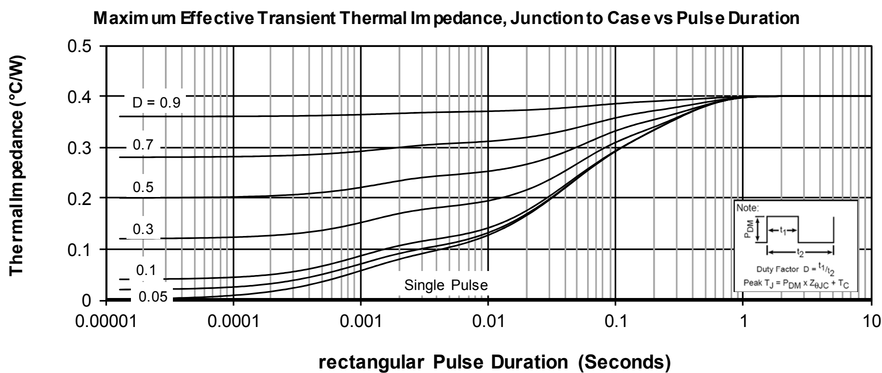


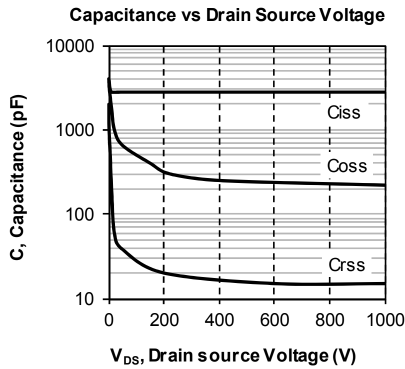


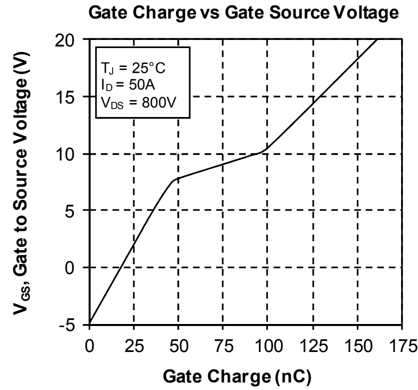


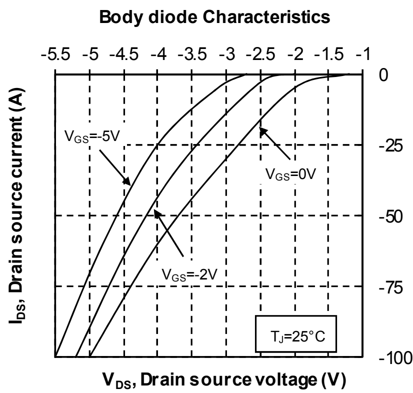


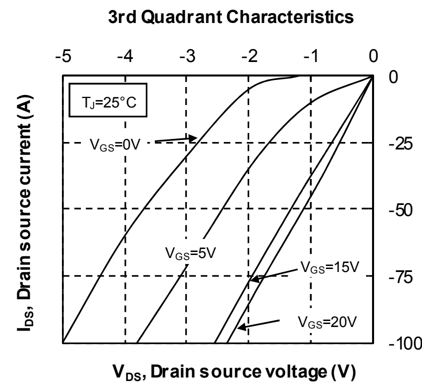


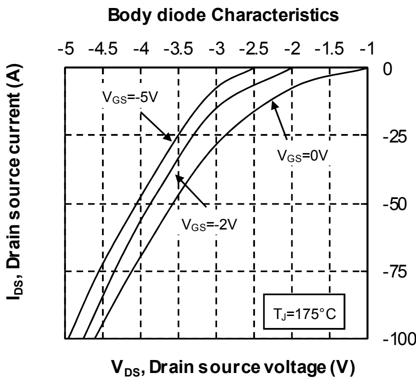


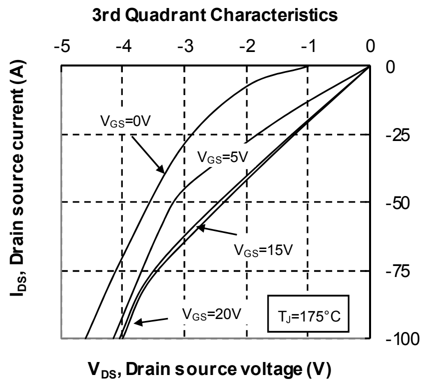

Capacitance vs Drain Source Voltage
C, Capacitance (pF)
10000
1000
100
10
Ciss
Coss
Crss
0 200 400 600 800 1000
VDS, Drain source Voltage (V)

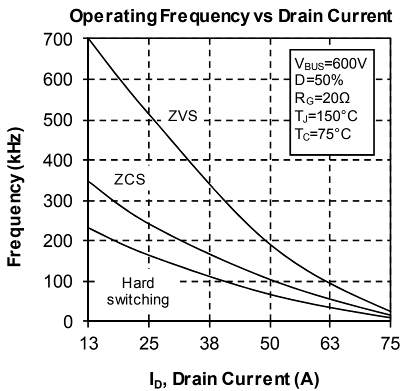

Gate Charge vs Gate Source Voltage
TJ = 25°C
ID = 50A
VDS = 800V
VGS, Gate to Source Voltage (V)
20 15 10 5 0 -5
0 25 50 75 100 125 150 175
Gate Charge (nC)


Body diode Characteristics
-5.5 -5 -4.5 -4 -3.5 -3 -2.5 -2 -1.5 -1
0 -25 -50 -75 -100
VGS=-5V
VGS=0V
VGS=-2V
TJ=25°C
IDS, Drain source current (A)
VDS, Drain source voltage (V)

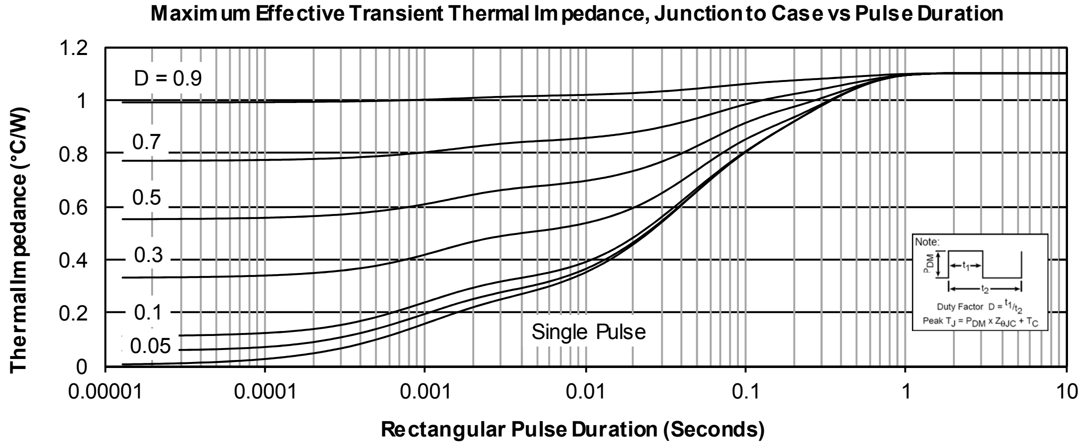

3rd Quadrant Characteristics
-5 -4 -3 -2 -1 0
0 -25 -50 -75 -100
TJ=25°C
VGS=0V
VGS=5V
VGS=15V
VGS=20V
IDS, Drain source current (A)
VDS, Drain source voltage (V)

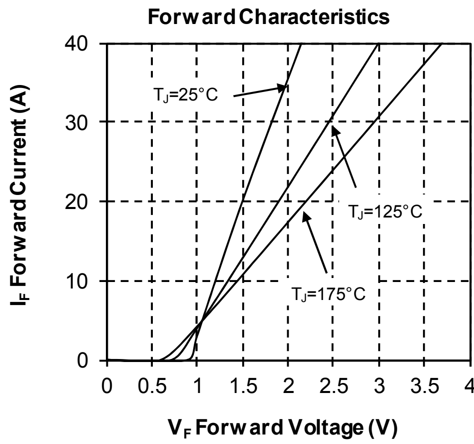

Body diode Characteristics
-5 -4.5 -4 -3.5 -3 -2.5 -2 -1.5 -1
0 -25 -50 -75 -100
VGS=-5V
VGS=0V
VGS=-2V
TJ=175°C
IDS, Drain source current (A)
VDS, Drain source voltage (V)

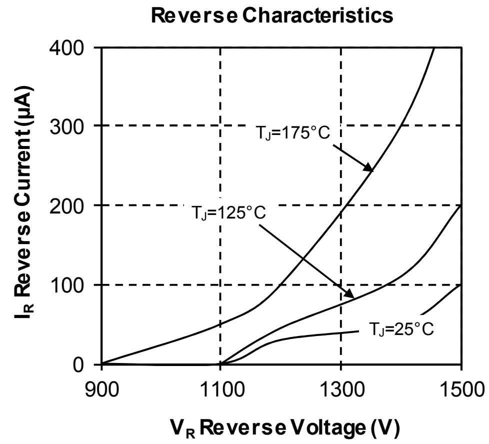

3rd Quadrant Characteristics
-5 -4 -3 -2 -1 0
0 -25 -50 -75 -100
VGS=0V
VGS=5V
VGS=15V
VGS=20V
TJ=175°C
IDS, Drain source current (A)
VDS, Drain source voltage (V)

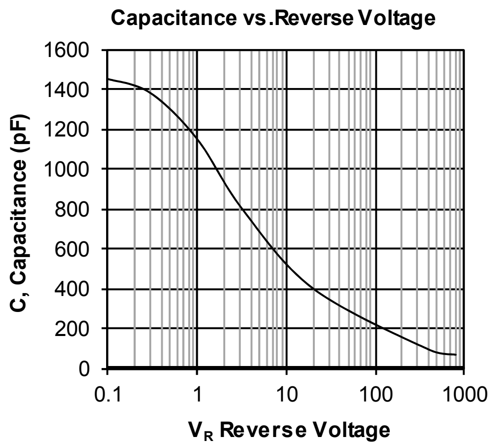

Operating Frequency vs Drain Current
700 600 500 400 300 200 100 0
VBUS=600V
D=50%
RG=20Ω
TJ=150°C
TC=75°C
ZVS
ZCS
Hard
switching
Frequency (kHz)
13 25 38 50 63 75
ID, Drain Current (A)

Typical SiC diode Performance Curve









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