MP4420A

2A, 36V, High-Efficiency, Synchronous, Step-Down Converter

DESCRIPTION

The MP4420A is a high-efficiency, synchronous, rectified, step-down, switch-mode converter with built-in power MOSFETs. It offers a very compact solution that achieves 2A of continuous output current with excellent load and line regulation over a wide input supply range.

The MP4420A uses synchronous mode operation to achieve higher efficiency over the output current load range. Current-mode operation provides fast transient response and eases loop stabilization.

Full protection features include over-current protection (OCP) and thermal shutdown.

The MP4420A requires a minimal number of readily available, standard, external components and is available in a compact, 8-pin, TSOT23 package.

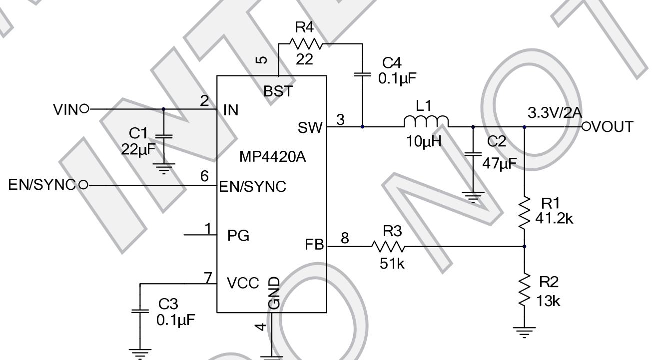
FEATURES

- Wide 4V to 36V Continuous Operating Input Range
- 90mΩ/55mΩ Low $R_{DS(ON)}$ Internal Power MOSFETs
- High-Efficiency Synchronous Mode Operation
- Default 410kHz Switching Frequency
- Synchronizes to a 200kHz to 2.2MHz External Clock
- High Duty Cycle for Automotive Cold Crank
- Forced CCM
- Internal Soft Start
- Power Good
- Over-Current Protection (OCP) and Hiccup
- Thermal Shutdown
- Output Adjustable from 0.8V
- Available in a TSOT23-8 Package

APPLICATIONS

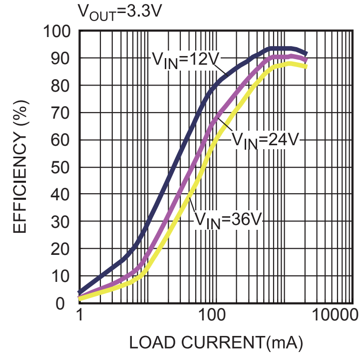
- Automotive
- Industrial Control System
- Distributed Power Systems

TYPICAL APPLICATION



Efficiency vs. Load Current

V_{OUT}=3.3V



ORDERING INFORMATION

Part Number*	Package	Top Marking
MP4420AGJ	TSOT23-8	*See Below*

* For Tape & Reel, add suffix –Z (e.g. MP4420AGJ–Z)

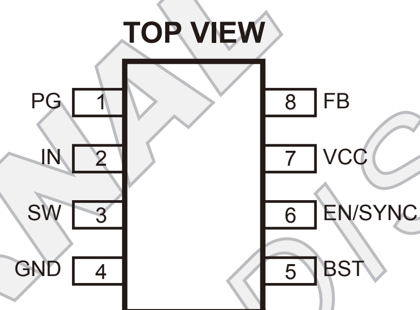
TOP MARKING

|APJY

APJ: Product code of MP4420AGJ
Y: Year code

PACKAGE REFERENCE

TOP VIEW



TSOT23-8

ABSOLUTE MAXIMUM RATINGS [1]

V_{IN} ....-0.3V to 40V
V_{SW} ....-0.3V to 41V
V_{BS} .... V_{SW} + 6V
All other pins .... -0.3V to 6V [2]
Continuous power dissipation (T_A = +25°C) [3]
TSOT23-8 .... 1.25W
Junction temperature ....150°C
Lead temperature ....260°C
Storage temperature .... -65°C to 150°C

Recommended Operating Conditions

Continuous supply voltage (V_{IN})..........4V to 36V
Output voltage (V_{OUT})................0.8V to 0.9 x V_{IN}
Operating junction temp. (T_J)... -40°C to +125°C

Thermal Resistance [4]	θ_{JA}	θ_{JC}	
TSOT23-8	100	55	°C/W

NOTES:

1) Absolute maximum ratings are rated under room temperature unless otherwise noted. Exceeding these ratings may damage the device.
2) For details on EN's ABS MAX rating, please refer to the Enable/SYNC Control section on page 14.
3) The maximum allowable power dissipation is a function of the maximum junction temperature T_J (MAX), the junction-to-ambient thermal resistance θ_{JA}, and the ambient temperature T_A. The maximum allowable continuous power dissipation at any ambient temperature is calculated by P_D (MAX) = (T_J (MAX)-T_A)/θ_{JA}. Exceeding the maximum allowable power dissipation produces an excessive die temperature, causing the regulator to go into thermal shutdown. Internal thermal shutdown circuitry protects the device from permanent damage.
4) Measured on JESD51-7, 4-layer PCB.

ELECTRICAL CHARACTERISTICS

V_{IN} = 12V, T_J = -40°C to +125°C (5), unless otherwise noted. Typical values are at T_J = +25°C.

Parameter	Symbol	Condition	Min	Typ	Max	Units
Supply current (shutdown)	I_{SHDN}	V_{EN} = 0V			8	μA
Supply current (quiescent)	I_Q	V_{EN} = 2V, V_{FB} = 1V, no switching		0.6	0.8	mA
HS switch on resistance	R_{ON_HS}	V_{BST-SW} = 5V		90	155	mΩ
LS switch on resistance	R_{ON_LS}	V_{CC} = 5V		55	105	mΩ
Switch leakage	I_{LKG_SW}	V_{EN} = 0V, V_{SW} = 12V			1	μA
Current limit	I_{LIMIT}	Under 40% duty cycle	3.4	5.6	7.8	A
Oscillator frequency	f_{SW}	V_{FB} = 750mV	320	410	500	kHz
Foldback frequency	f_{FB}	V_{FB} < 400mV	70	100	130	kHz
Maximum duty cycle	D_{MAX}	V_{FB} = 750mV, 410kHz	92	95		%
Minimum on time (6)	t_{ON_MIN}			70		ns
Sync frequency range	f_{SYNC}		0.2		2.4	MHz
Feedback voltage	V_{FB}	T_J = 25°C	780	792	804	mV
			776		808	
Feedback current	I_{FB}	V_{FB} = 820mV		10	100	nA
EN rising threshold	V_{EN_RISING}		1.15	1.4	1.65	V
EN falling threshold	$V_{EN\_FALLING}$		1.05	1.25	1.45	V
EN threshold hysteresis	V_{EN_HYS}			150		mV
EN input current	I_{EN}	V_{EN} = 2V		4	8	μA
		V_{EN} = 0		0	0.2	μA
V_{IN} under-voltage lockout threshold rising	$INUV_{RISING}$		3.3	3.5	3.7	V
V_{IN} under-voltage lockout threshold falling	$INUV_{FALLING}$		3.1	3.3	3.5	V
V_{IN} under-voltage lockout threshold hysteresis	$INUV_{HYS}$			200		mV
VCC regulator	V_{CC}	I_{CC} = 0mA	4.6	4.9	5.2	V
VCC load regulation		I_{CC} = 5mA		1.5	4	%
Soft-start period	t_{SS}	V_{OUT} from 10% to 90%	0.45	1.5	2.55	ms
Thermal shutdown (6)			150	170		°C
Thermal hysteresis (6)				30		°C
PG rising threshold	PG_{Vth_RISING}	as a percentage of V_{FB}	86	90	94	%
PG falling threshold	$PG_{Vth\_FALLING}$	as a percentage of V_{FB}	80	84	88	%

ELECTRICAL CHARACTERISTICS *(continued)*

V_{IN} = 12V, T_J = -40°C to +125°C [5], unless otherwise noted. Typical values are at T_J = +25°C.

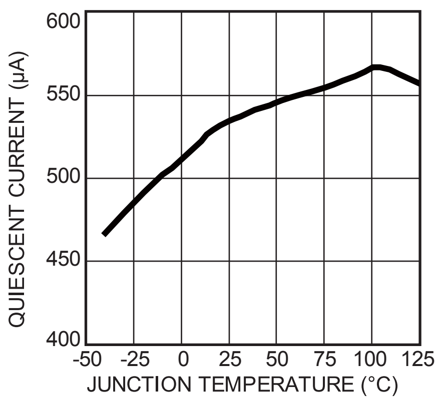
Parameter	Symbol	Condition	Min	Typ	Max	Units
PG threshold hysteresis	PG_{Vth_HYS}	as a percentage of V_{FB}		6		%
PG rising delay	PG_{Td_RISING}		40	90	160	μs
PG falling delay	$PG_{Td\_FALLING}$		30	55	95	μs
PG sink current capability	V_{PG}	Sink 4mA		0.1	0.3	V
PG leakage current	I_{LKG_PG}			10	100	nA

NOTES:
5) Not tested in production and guaranteed by over-temperature correlation.
6) Derived from bench characterization. Not tested in production.

TYPICAL CHARACTERISTICS

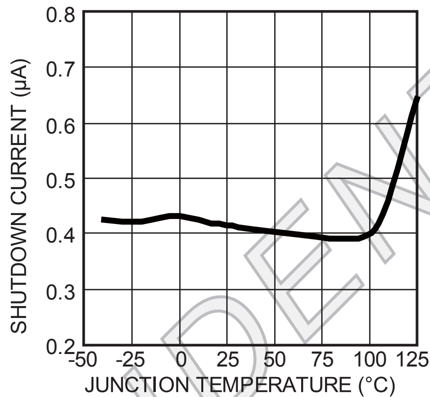
Quiescent Current vs. Junction Temperature

V_{IN}=12V



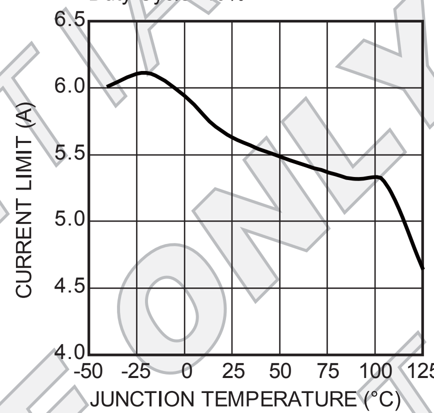
Shutdown Current vs. Junction Temperature

V_{IN}=12V



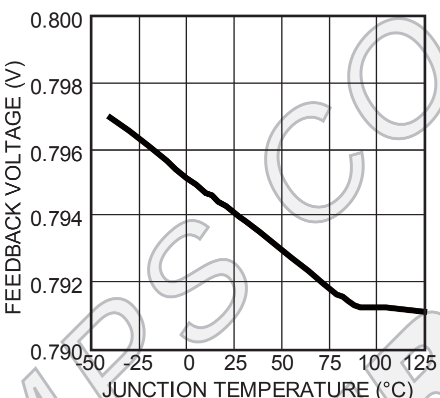
Current Limit vs. Junction Temperature

Duty Cycle=40%



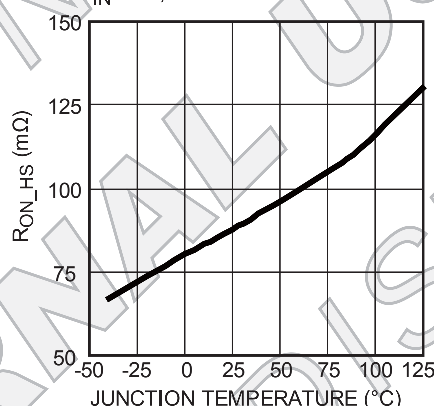
Feedback Voltage vs. Junction Temperature

V_{IN}=12V



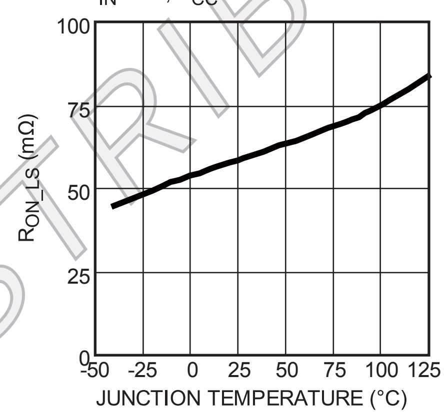
R_{ON_HS} vs. Junction Temperature

V_{IN}=12V, BST-SW=5V



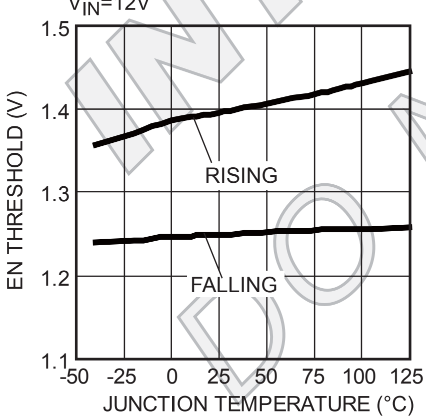
R_{ON_LS} vs. Junction Temperature

V_{IN}=12V, V_{CC}=5V

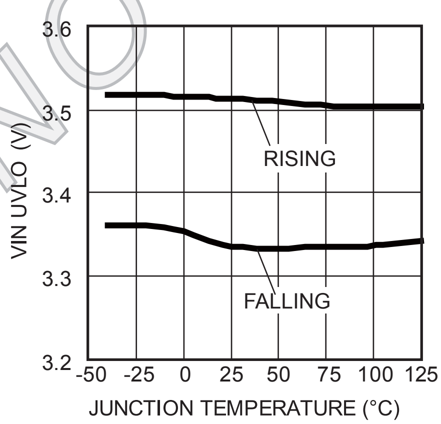


EN Threshold vs. Junction Temperature

V_{IN}=12V

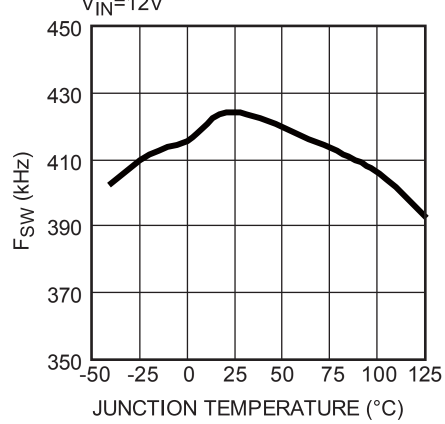


V_{IN} UVLO vs. Junction Temperature

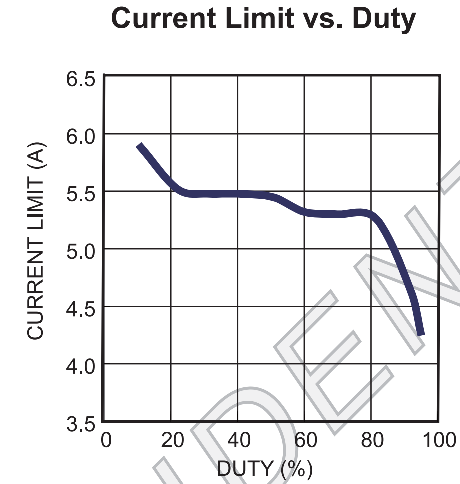


F_{SW} vs. Junction Temperature

V_{IN}=12V



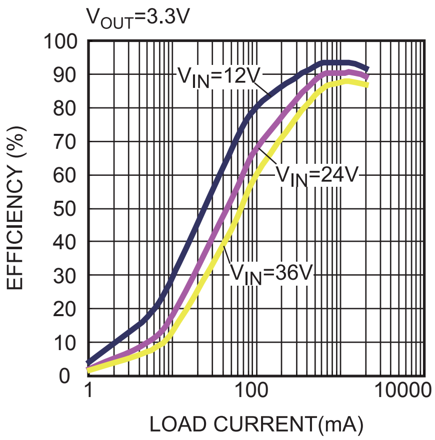
TYPICAL CHARACTERISTICS *(continued)*



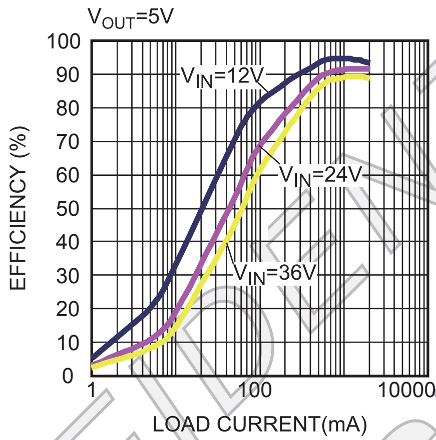
TYPICAL PERFORMANCE CHARACTERISTICS

V_{IN} = 12V, V_{OUT} = 3.3V, L = 10µH, R_{BST} = 20Ω, T_A = +25°C, unless otherwise noted.

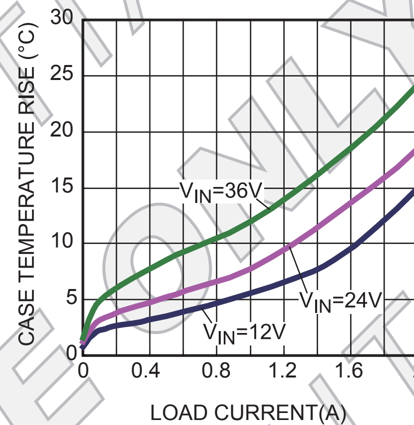
Efficiency vs. Load Current



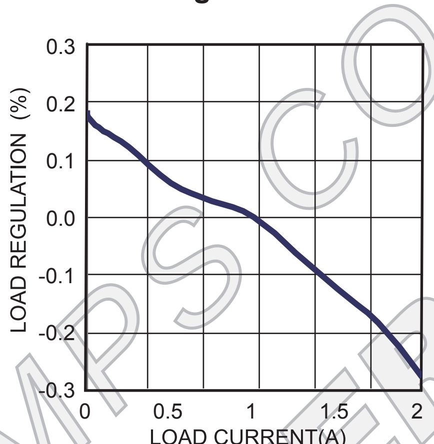
Efficiency vs. Load Current



Thermal Rise



Load Regulation



Line Regulation