MPQ8632D-6, MPQ8632D-12

High Efficiency, 6A/12A, 18V Synchronous Step-down Converter

The Future of Analog IC Technology

DESCRIPTION

The MPQ8632D-6/MPQ8632D-12 is a fully integrated high frequency synchronous rectified step-down switch mode converter. It offers a very compact solution to achieve 6A/12A output current over a wide input supply range with excellent load and line regulation. The MPQ8632D-6/MPQ8632D-12 operates at high efficiency over a wide output current load range.

The MPQ8632D-6/MPQ8632D-12 uses Constant-On-Time (COT) control mode to provide fast transient response and ease loop stabilization.

An external resistor programs the operating frequency from 200kHz to 1MHz and the frequency keeps nearly constant as input supply varies with the feedforward compensation.

The default under voltage lockout threshold is internally set at 4.1V, but a resistor network on the enable pin can increase this threshold. An open drain power good signal indicates that the output is within nominal voltage range.

The MPQ8632D-6/MPQ8632D-12 employs a programmable soft start and shut-down scheme. With the soft shut-down feature, it discharges the output voltage smoothly when the enable signal is deserted.

It has fully integrated protection features that include over-current protection, over-voltage protection and thermal shutdown.

The MPQ8632D-6/MPQ8632D-12 requires a minimal number of readily available standard external components and is available in a 3mm×4mm package.

FEATURES

- 2.5V to 18V Operating Input Range with External 5V Bias
- 4.5V to 18V Operating Input Range with Internal Bias
- 6A/12A Output Current
- Low R_{DS}(ON) Internal Power MOSFETs
- Proprietary Switching Loss Reduction Technique
- Adaptive COT for Ultrafast Transient Response
- 0.5% Reference Voltage Over 0°C to 70°C Junction Temperature Range
- Programmable Soft Start and Shut-down Time
- Pre-Bias Start up
- Programmable Switching Frequency from 200kHz to 1MHz
- Non-latch OCP, OVP and Thermal Shutdown
- Output Adjustable from 0.611V to 13V

APPLICATIONS

- Telecom and Networking Systems
- Base Stations
- Servers
- Personal Video Recorders
- Flat Panel Television and Monitors
- Distributed Power Systems

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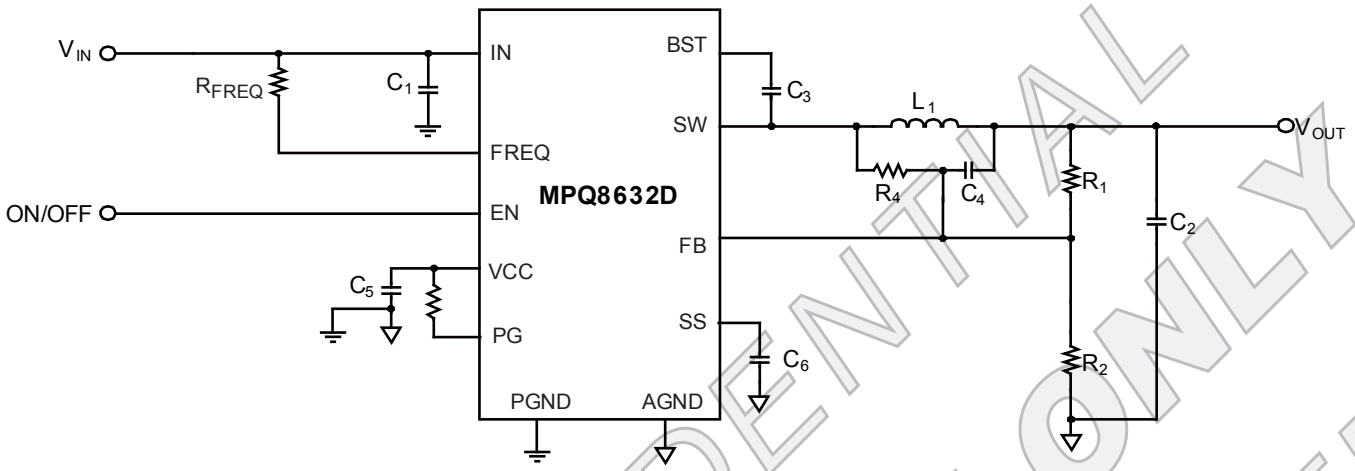
TYPICAL APPLICATION



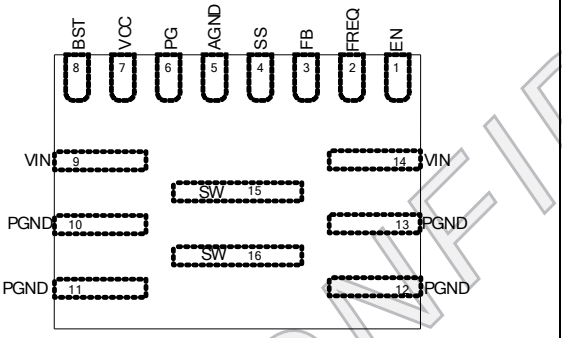
ORDERING INFORMATION

Part Number	Package	Top Marking
MPQ8632DGLE-6*	QFN(3X4mm)	MP8632D 6
MPQ8632DGLE-12	QFN(3X4mm)	MP8632D 12

* For Tape & Reel, add suffix –Z (e.g. MPQ8632DGLE–6–Z)

PACKAGE REFERENCE

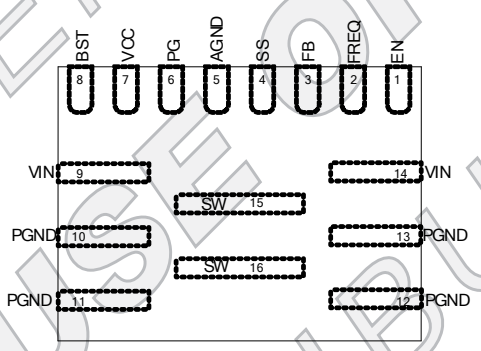
TOP VIEW



Part Number*	Package
MPQ8632DGLE-6	QFN (3x4mm)
Junction Temperature	**Top Marking**
–40°C to +125°C	MP8632D 6

* For Tape & Reel, add suffix –Z (eg. MPQ8632DGLE-6–Z)

TOP VIEW



Part Number*	Package
MPQ8632DGLE-12	QFN (3x4mm)
Junction Temperature	**Top Marking**
–40°C to +125°C	MP8632D 12

* For Tape & Reel, add suffix –Z (eg. MPQ8632DGLE-12–Z)

ABSOLUTE MAXIMUM RATINGS (1)

Supply Voltage V_{IN} 21V
V_{SW} ..... -0.3V to V_{IN} + 0.3V
V_{SW} (30ns) ..... -3V to V_{IN} + 3V
V_{BST} ..... V_{SW} + 6V
Enable Current I_{EN} (2) 2.5mA
All Other Pins ..... –0.3V to +6V
Continuous Power Dissipation (T_A=+25°) (3)
QFN3X4 ..... 2.7W
Junction Temperature ..... 150°C
Lead Temperature ..... 260°C
Storage Temperature ..... -65°C to +150°C

Recommended Operating Conditions (4)

Supply Voltage V_{IN} ..... 4.5V to 18V
Output Voltage V_{OUT} ..... 0.611V to 13V
Enable Current I_{EN} 1mA
Operating Junction Temp. (T_J). -40°C to +125°C

Thermal Resistance (5)

	θ_{JA}	θ_{JC}
QFN (3x4mm)	46	9 °C/W

Notes:

1) Exceeding these ratings may damage the device.
2) Refer to the section “Configuring the EN Control”.
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 will cause excessive die temperature, and the regulator will go into thermal shutdown. Internal thermal shutdown circuitry protects the device from permanent damage.
4) The device is not guaranteed to function outside of its operating conditions.
5) Measured on JESD51-7, 4-layer PCB.

ELECTRICAL CHARACTERISTICS

V_{IN} = 12V, T_J = -40°C to +125°C, unless otherwise noted.

Parameters	Symbol	Condition	Min	Typ	Max	Units
Supply Current						
Supply Current (Shutdown)	I_{IN}	V_{EN} = 0V		0	1	μA
Supply Current (Quiescent)	I_{IN}	V_{EN} = 2V, V_{FB} = 1V	700	860	1000	μA
MOSFET						
High-side Switch On Resistance	HS_{RDS-ON}	MPQ8632DGLE-6 T_J =25°C		28		mΩ
		MPQ8632DGLE-12 T_J =25°C		19.6		mΩ
Low-side Switch On Resistance	LS_{RDS-ON}	MPQ8632DGLE-6, T_J =25°C		15.8		mΩ
		MPQ8632DGLE-12,T_J=25°C		5.2		
Switch Leakage	SW_{LKG}	V_{EN} = 0V, V_{SW} = 0V or 12V		0	10	μA
Current Limit						
Low-side Valley Current Limit[6]	I_{LIMIT_VALLEY}	MPQ8632DGLE-6	6.5	7.5	8.5	A
		MPQ8632DGLE-12	12	15	18	
Low-side Negative Current Limit[6]	$I_{LIMIT\_NEGATIVE}$		-4	-2.5	-1	A
Timer						
One-Shot On Time	T_{ON}	R_{FREQ}=453kΩ, V_{OUT}=1.2V		250		ns
Minimum On Time[6]	T_{ON_MIN}		20	30	40	ns
Minimum Off Time[6]	T_{OFF_MIN}		200	360	420	ns
Under-voltage Protection						
UVP Threshold[6]	V_{UVP}		47%	50%	53%	V_{FB}
Reference And Soft Start/Shut-down						
Reference Voltage	V_{REF}	T_J = 0°C to +70°C	608	611	614	mV
		T_J = 0°C to +125°C	605	611	617	mV
		T_J = -40°C to +125°C	602	611	620	mV
Feedback Current	I_{FB}	V_{FB} = 611mV		50	100	nA
Soft Start Charging Current	I_{SS}	V_{SS}=0V	16	20	25	μA
Soft Shut-down Discharging Current	I_{SD}	V_{SS}=0V	6	10	15	μA

ELECTRICAL CHARACTERISTICS *(continued)*

V_{IN} = 12V, T_J = -40°C to +125°C, unless otherwise noted.

Parameters	Symbol	Condition	Min	Typ	Max	Units
Enable And UVLO						
Enable Input Low Voltage	VIL_{EN}		1.1	1.3	1.5	V
Enable Hysteresis	V_{EN-HYS}			250		mV
Enable Input Current	I_{EN}	V_{EN} = 2V		0		µA
		V_{EN} = 0V		0		
VCC Regulator						
VCC Under Voltage Lockout Threshold Rising	VCC_{Vth}			3.8		V
VCC Under Voltage Lockout Threshold Hysteresis	VCC_{HYS}			500		mV
VCC Regulator	V_{CC}			4.8		V
VCC Load Regulation		Icc=5mA		0.5		%
Power Good						
Power Good High Threshold	$PG_{Vth-Hi-Rise}$	FB from low to high	86%	90%	94%	V_{FB}
	$PG_{Vth-Hi-Fall}$	FB from high to low		109%		V_{FB}
Power Good Low Threshold	$PG_{Vth-Lo-Rise}$	FB from low to high	116%	120%	124%	V_{FB}
	$PG_{Vth-Lo-Fall}$	FB from high to low		85%		V_{FB}
Power Good Lower to High Delay	PG_{Td}			2.5		ms
Power Good Sink Current Capability	I_{OL}	V_{OL}=600mV			12	mA
Power Good Leakage Current	I_{PG_LEAK}	V_{PG} = 3.3V		10		nA
Thermal Protection (6)						
Thermal Shutdown	T_{SD}		150			°C
Thermal Shutdown Hysteresis				25		°C

Note:

6) Guaranteed by design.

PIN FUNCTIONS

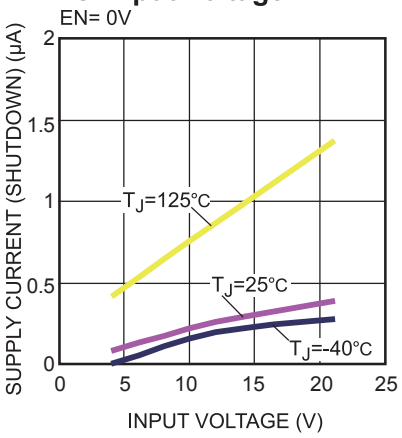
MPQ8632D-6/MPQ8632D-12

PIN #	Name	Description
1	EN	Enable. Digital input that turns the regulator on or off. Drive EN high to turn on the regulator, drive it low to turn it off. Connect EN to IN through a pull-up resistor or a resistive voltage divider for automatic startup. Do not float this pin.
2	FREQ	Frequency Set. Require a resistor connected between FREQ and IN to set the switching frequency. The input voltage and the resistor connected to the FREQ pin determine the ON time. The connection to the IN pin provides line feed-forward and stabilizes the frequency during input voltage's variation.
3	FB	Feedback. Connect to the tap of an external resistor divider from the output to GND to set the output voltage. FB is also configured to realize over-voltage protection (OVP) by monitoring output voltage. MPQ8632D-6 and MPQ8632D-12 provide non-latch OVP mode. Please refer to the section "Over-Voltage-Protection (OVP)". Place the resistor divider as close to FB pin as possible. Avoid using vias on the FB traces.
4	SS	Soft Start/Shut-Down. Connect an external capacitor to program the soft start/shut-down time for the switch mode regulator. The soft start time is the half of the soft shut-down time.
5	AGND	Analog ground. The control circuit reference.
6	PG	Power Good. The output is an open drain signal. Require a 100kΩ typical pull-up resistor to a DC voltage to indicate high if the output voltage exceeds 90% of the nominal voltage. Recommend a 10nF capacitor from PG to GND when the PG pull up resistor is <100kΩ. There is a delay from FB ≥ 90% to PG goes high.
7	VCC	Internal 4.8V LDO Output. Power the driver and control circuits. 5V external bias can disable the internal LDO. Decouple with a ≥ 1μF ceramic capacitor as close to the pin as possible. For best results, use X7R or X5R dielectric ceramic capacitors for their stable temperature characteristics.
8	BST	Bootstrap. Require a capacitor connected between SW and BST pins to form a floating supply across the high-side switch driver.
9, 14	IN	Supply Voltage. Supply power to the internal MOSFET and regulator. The MPQ8632D-6/MPQ8632D-12 operates from a +2.5V to +18V input rail with 5V external bias and a +4.5V to +18V input rail with internal bias. Require an input decoupling capacitor. Connect using wide PCB traces and multiple vias.
10, 11, 12, 13	PGND	System Ground. Reference ground of the regulated output voltage. PCB layout requires extra care. Connect using wide PCB traces.
15, 16	SW	Switch Output. Connect to the inductor and bootstrap capacitor. The high-side switch drives the pin up to the V_{IN} during the PWM duty cycle's ON time. The inductor current drives the SW pin negative during the OFF-time. The low-side switch's ON-resistance and the internal Schottky diode clamp the negative voltage. Connect using wide PCB traces.

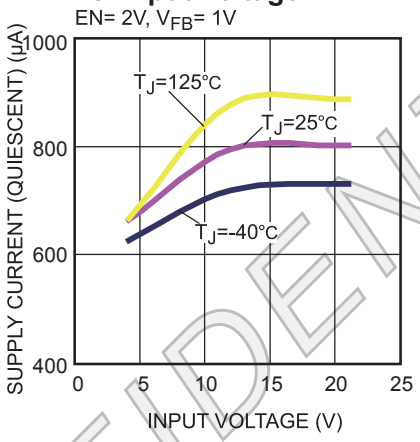
TYPICAL CHARACTERISTICS

MPQ8632DGLE-12, VIN = 12V, V_{OUT} = 1V, L = 1µH, T_A = 25ºC, unless otherwise noted.

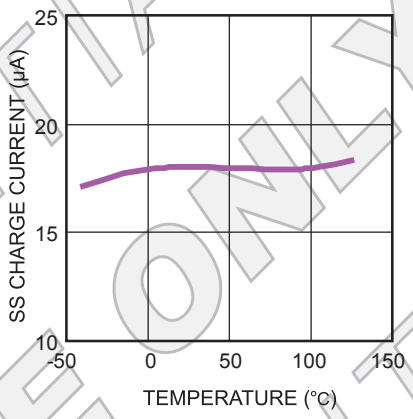
Supply Current (Shutdown) vs. Input Voltage



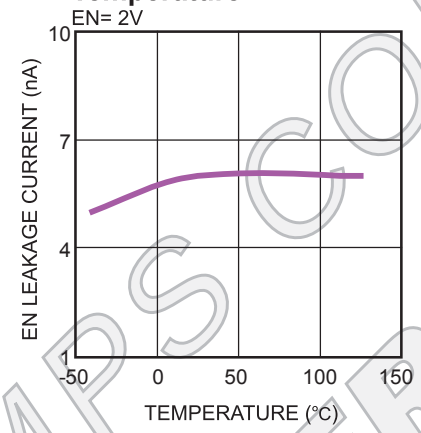
Supply Current (Quiescent) vs. Input Voltage



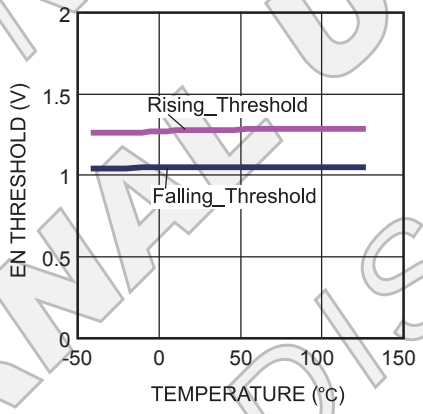
SS Charge Current vs. Temperature



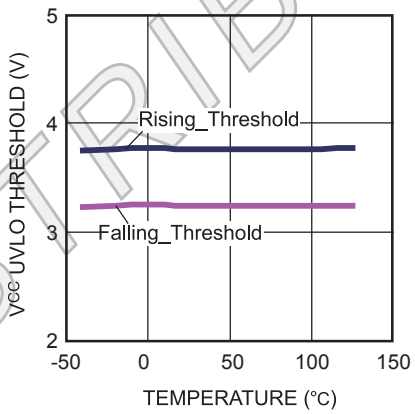
EN Leakage Current vs. Temperature



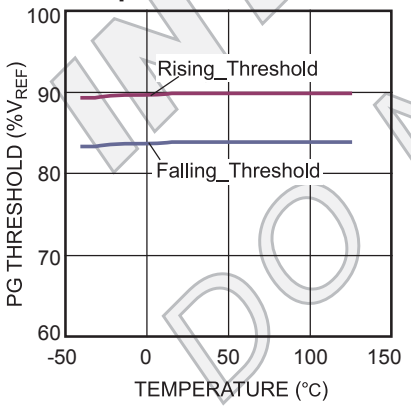
EN Threshold vs. Temperature



V_{CC} UVLO Threshold vs. Temperature



PG Threshold vs. Temperature



PG Rising Delay vs. Temperature