



# SP6872

## Multi-Mode PWM Controller

### DESCRIPTION

SP6872 is a high performance flyback multi-mode PWM controller, optimized to achieve high efficiency and low standby power with effective system cost.

At full load IC operates in CCM mode with fixed frequency at low line input range and in QR mode at high line input range. At normal load conditions it operates in QR mode with internally limited frequency to 75kHz typ. to minimize switching loss. Controller gradually reduces frequency with loading at light load conditions to keep high efficiency and switches to extended burst mode at no-load conditions to minimize stand-by power loss. As a result, high conversion efficiency can be achieved with universal input range and within whole loading range.

The rich set of protection features such as VCC Under Voltage Lockout (UVLO), VCC Over Voltage Protection (VCC OVP) and clamp, load Over Voltage Protection (OVP), Over Load Protection (OLP) and on-chip Over Temperature Protection (OTP), the programmable Brown-in/out Protection is built-in. helps to build low component counts and high performance power supply.

The tone energy at below 23KHz is minimized in the design and audio noise is eliminated during operation. SP6872 is offered in space saving SOT23-6 package.

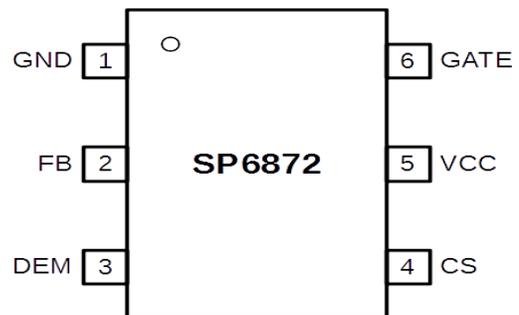
### FEATURES

- Internal soft start reducing MOSFET VDS stress
- Multi-mode operation for better efficiency
- Frequency shuffling for better EMI
- Extended burst mode for lower standby power loss
- The rich set of protection features:
  - VCC Under Voltage Lockout (UVLO) with hysteresis
  - VCC Over Voltage Protection (VCC OVP) and clamp
  - Cycle-by-cycle current limiting with line voltage compensation
  - Over Load Protection (OLP) with auto-recovery
  - Adjustable brown-out protection with auto-recovery
  - Adjustable load Over Voltage Protection (OVP) with latch.
  - Fixed on-chip and adjustable external over temperature protection (OTP) with auto-recovery

### APPLICATIONS

- AC/DC switching power adaptor
- Set-top box power supply
- Open-frame switching power supply
- NB Adaptor
- TV/Monitor Standby Power
- PC Peripherals

### PIN CONFIGURATION (SOT-23-6L) SOT23-6



### PART MARKING



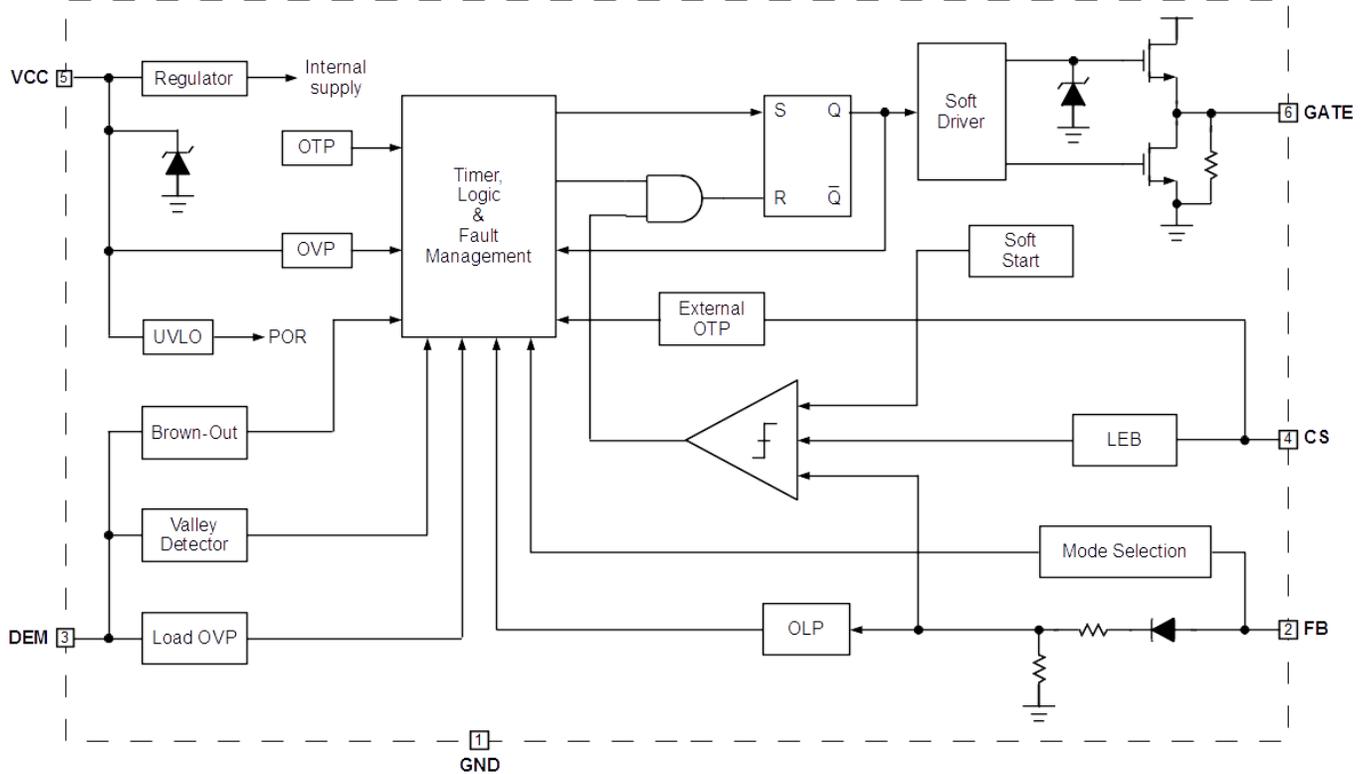
**Y : Year Code**  
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## BLOCK DIAGRAM



### ABSOLUTE MAXIMUM RATINGS ( $T_A=25^\circ\text{C}$ , unless otherwise specified)

The following ratings designate persistent limits beyond which damage to the device may occur.

Symbol	Parameter	Value	Unit
$V_{CC}$	Zener clamp voltage (@ 10mA)	31	V
$V_{FB}, V_{CS}, V_{DEM}$	FB, CS, DEM pin voltage	-0.3 ~ 7.0	V
$T_{OP}$	Operating ambient temperature	-40 ~ 85	$^\circ\text{C}$
$T_J$	Operating junction temperature	-40 ~ 150	$^\circ\text{C}$
$T_{STG}$	Storage temperature	-40 ~ 150	$^\circ\text{C}$
$T_{LEAD}$	Lead soldering temperature for 5 sec	260	$^\circ\text{C}$
Thermal Resistance			
Symbol	Parameter	Value	Unit
$R_{\theta JA}$	Thermal Resistance Junction –to Ambient (*1)	220	$^\circ\text{C}/\text{W}$
$R_{\theta JC}$	Thermal Resistance Junction –to Case (*2)	110	$^\circ\text{C}/\text{W}$

(\*1)  $\theta_{JA}$  is measured in natural convection (still air) at  $T_A = 25^\circ\text{C}$  with the component mounted on a low effective thermal conductivity test board of JEDEC 51-3 thermal measurement standard.

(\*2) The power dissipation and thermal resistance are evaluated under copper board mounted with free air conditions.



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### ELECTRICAL CHARACTERISTICS

( $T_A=25^{\circ}\text{C}$ ,  $V_{CC}=16\text{V}$ , unless otherwise specified)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Supply Voltage Section (VCC pin)</b>						
I <sub>st<sub>up</sub></sub>	Start-up current	$V_{CC}=\text{UVLO}(\text{OFF})-1.5\text{V}$		5	15	uA
I <sub>cc(op)</sub>	Operating current	$V_{FB}=3\text{V}$		2	4	mA
		$V_{FB}=3\text{V}$ , $C_L=1\text{nF}$		3	5	mA
I <sub>cc(burst)</sub>	Burst mode operating current	$V_{FB}=0.5\text{V}$ , $V_{CS}=0\text{V}$		0.6	0.8	mA
UVLO(ON)	VCC under voltage lockout enter			8		V
UVLO(OFF)	VCC under voltage lockout exit (Recovery)			18.5		V
OVP	VCC over voltage protection			28		V
V <sub>cc_clamp</sub>	Clamping voltage	$I_{CC}=10\text{mA}$		31		V
<b>Feedback Section (FB pin)</b>						
I <sub>FB(SC)</sub>	Short circuit current			250		uA
V <sub>FB_Open</sub>	Open loop voltage			5.3		V
V <sub>TH_BM_off</sub>	Burst mode exit threshold			0.8		V
V <sub>TH_BM_on</sub>	Burst mode enter threshold			0.7		V
V <sub>FB(OLP)</sub>	Over load protection threshold			4.4		V
T <sub>DEL(OLP)</sub>	Over load protection delay			80		ms
<b>Demagnetization Detection Section (DEM pin)</b>						
V <sub>DEM(TH)</sub>	Demagnetization threshold			75		mV
V <sub>DEM(H)</sub>	Upper clamp voltage			6		V
V <sub>DEM(L)</sub>	Lower clamp voltage			-0.7		V
T <sub>DEL(DEM)</sub>	Demagnetization propagation delay			250		ns
V <sub>DEM(OVP)</sub>	Load over voltage protection threshold			3.75		V
T <sub>DEL(OVP)</sub>	Number of subsequent cycles to trigger OVP			4		Cycle
I <sub>B(in)</sub>	Brown-in current threshold			100		uA
I <sub>B(out)</sub>	Brown-out current threshold			20		uA
T <sub>B(in)</sub>	Number of cycles to detect brown-in			4		Cycle
T <sub>B(out)</sub>	Brown-out De-bounce time			50		ms
<b>Current Sense Section (CS pin)</b>						
V <sub>CS(L)</sub>	CS threshold at zero duty cycle	$V_{FB}=3\text{V}$	0.415	0.45	0.485	V
V <sub>CS(H)</sub>	CS threshold at max duty cycle	$V_{FB}=3\text{V}$		0.8		V
V <sub>CS(BM)</sub>	CS threshold at burst mode	$V_{FB}=1\text{V}$		0.3		V
T <sub>LEB</sub>	Leading edge blanking time			300		ns
T <sub>DEL(CS)</sub>	Over current detection and control delay			80		ns
V <sub>TH(OTP)</sub>	External OTP threshold			0.25		V
T <sub>DEL(OTP)</sub>	External OTP De-bounce time			50		ms



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### ELECTRICAL CHARACTERISTICS (continued)

( $T_A=25^{\circ}\text{C}$ ,  $V_{CC}=16\text{V}$ , unless otherwise specified)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Soft Start Section</b>						
$T_{SS}$	Soft start time			4		ms
<b>Internal OTP</b>						
$T_{SD}$	Thermal shutdown threshold			150		$^{\circ}\text{C}$
$T_{SD\_HYS}$	Thermal shutdown hysteresis			30		$^{\circ}\text{C}$
<b>Oscillator</b>						
$F_{BURST}$	Burst mode switching frequency			22		KHz
$F_{QR(L)}$	Frequency low clamp in QR mode		47	52	57	KHz
$F_{QR(H)}$	Frequency high clamp in QR mode			75		KHz
$G\_PFM$	Frequency reduction ratio			60		KHz/V
$\Delta F_{(shuffle)}/F$	Frequency shuffling range		-4		+4	%
$T_{ON}$	Maximum ON time		10	12.5	15	us
$T_{OFF}$	Maximum OFF time		40	55	75	us
<b>Gate Driver Section (GATE pin)</b>						
$V_{O(L)}$	Output low voltage	$I_O=10\text{mA}$			1	V
$V_{O(H)}$	Output high voltage		11.5			V
$V_{O(CLAMP)}$	Output clamp voltage	$V_{CC}=20\text{V}$		16.5		V
tr	Voltage rise time	$C_L=1\text{nF}$		100		ns
tf	Voltage fall time	$C_L=1\text{nF}$		50		ns



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