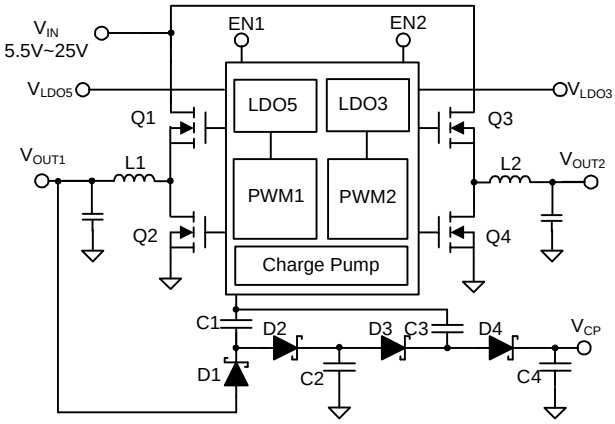
System Power PWM Controller with Economy Standby Mode

Features

- Wide Input voltage Range from 5.5V to 25V
- Provide 5 Independent Outputs with ±1.0% Accuracy Over-Temperature
  - PWM1 Controller with Adjustable (2V to 5.5V) Output
  - PWM2 Controller with Adjustable (2V to 5.5V) Output
  - 100mA Low Dropout Regulator (LDO5) with Fixed 5V Output
  - 100mA Low Dropout Regulator (LDO3) with Fixed 3.3V Output
  - 250kHz Clock Signal for 15V Charge Pump (Used PWM1 as Its Power Supply)
- Excellent Line/Load Regulations about ±1.5% over temperature range at PWM Channels
- Low Consumption in Standby Mode
- 2Cells Input Battery Support
- Built in POR Control Scheme Implemented
- Constant On-Time Control Scheme
- Built in Soft Start for PWM Outputs and Soft Stop for PWM Outputs and LDO Outputs
- Integrated Bootstrap Forward P-CH MOSFET
- High Efficiency over Light to Full Load Range (PWMs)
- Built in Power Good Indicators (PWMs)
- 60% Under-Voltage and 115% Over-Voltage Protections (PWM)
- Adjustable Current-Limit Protection (PWMs)
  - Using Sense Low-Side MOSFET's $R_{DS(ON)}$
- Over-Temperature Protection
- 3mmx3mm Thin QFN-20 (TQFN3x3-20) package
- Lead Free and Green Device Available (RoHS Compliant)

Simplified Application Circuit



General Description

The APW8823 integrates dual step-down, constant-on-time, synchronous PWM controllers (that drives dual N-channel MOSFETs for each channel) and two low dropout regulators as well as various protections into a chip. The PWM controllers step down high voltage of a battery to generate low-voltage for NB applications. The output of PWM1 and PWM2 can be adjusted from 2V to 5.5V by setting a resistive voltage-divider from VOUTx to GND. The linear regulators provide 5V and 3.3V output for standby power supply. The linear regulators provide up to 100mA output current. When the PWMx output voltage is higher than LDOx bypass threshold, the related LDOx regulator is shut off and its output is connected to VOUTx by internal switchover MOSFET. It can save power dissipation. The charge pump circuit with 250kHz clock driver uses VOUT1 as its power supply to generate approximately 15V DC voltage.

The APW8823 provides excellent transient response and accurate DC output voltage in either PFM or PWM Mode. In Pulse-Frequency Mode (PFM), the APW8823 provides very high efficiency over light to heavy loads with loading-modulated switching frequencies. The Forced-PWM Mode works nearly at constant frequency for low-noise requirements. The unique ultrasonic mode maintains the switching frequency above 25kHz, which eliminates noise in audio application.

General Description (Cont.)

The APW8823 has individual enable controls for each PWM channels. Pulling both EN1/2 pin of APW8823A/C/G low shuts down the all of outputs unless LDO3 output. The LDO3 and LDO5 of APW8823B/D/E/F/H are always on standby power.The APW8823 is available in a TQFN3x3-20 package.

Applications

- **Notebook and Sub-Notebook Computers**
- **Portable Devices**
- **DDR1, DDR2, and DDR3 Power Supplies**
- **3-Cell and 4-Cell Li+ Battery-Powered Devices**
- **Graphic Cards**
- **Game Consoles**
- **Telecommunications**

Ordering and Marking Information

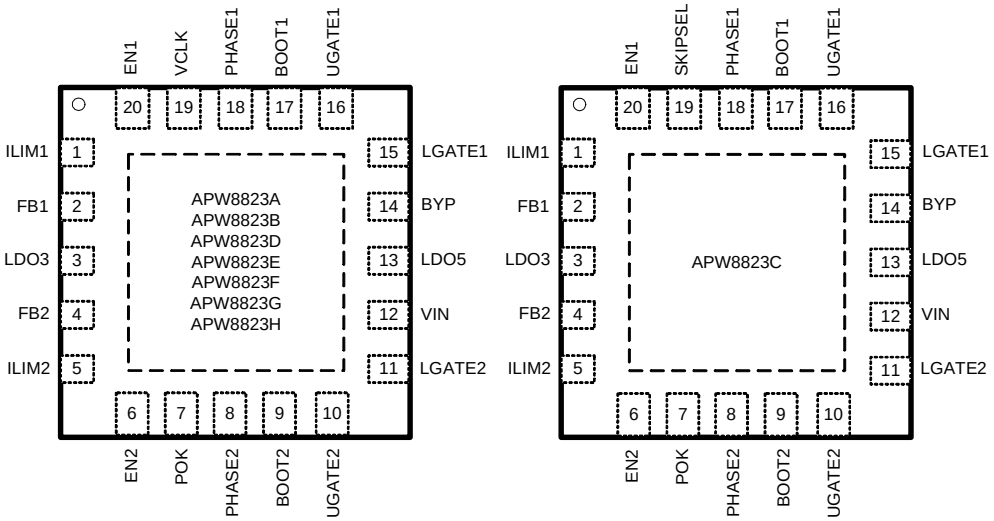
APW8823A APW8823B APW8823C APW8823D APW8823E APW8823F APW8823G APW8823H □□□-□□□ Assembly Material Handling Code Temperature Range Package Code	Package Code QB: TQFN3x3-20 Operating Ambient Temperature Range I : -40 to 85°C Handling Code TR : Tape & Reel Lead Free Code L : Lead Free Device G : Halogen and Lead Free Device

APW8823A QB :	APW 8823A XXXXX	XXXXX - Date Code
APW8823B QB :	APW 8823B XXXXX	XXXXX - Date Code
APW8823C QB :	APW 8823C XXXXX	XXXXX - Date Code
APW8823D QB :	APW 8823D XXXXX	XXXXX - Date Code
APW8823E QB :	APW 8823E XXXXX	XXXXX - Date Code
APW8823F QB :	APW 8823F XXXXX	XXXXX - Date Code
APW8823G QB :	APW 8823G XXXXX	XXXXX - Date Code
APW8823H QB :	APW 8823H XXXXX	XXXXX - Date Code

Device Number	VCLK Function	Switching Frequency	SKIP Mode	Always ON-LDO	Soft-Start Time	Current Limit (I_{LIM})
APW8823A	Enable by EN1	400KHz / 475KHz	Auto - Skip	LDO3	0.9ms	50uA
APW8823B	Enable by EN1	400KHz / 475KHz	Auto - Skip	LDO3 & LDO5	0.9ms	50uA
APW8823C	Without VCLK Replace SKIPSEL Pin	400KHz / 475KHz	Ultra-sonic / Auto Skip mode selection	LDO3	0.9ms	50uA
APW8823D	Enable by EN1	400KHz / 475KHz	Auto - Skip	LDO3 & LDO5	3.0ms	10uA
APW8823E	Enable by EN1	300KHz / 350KHz	Ultra-sonic mode	LDO3 & LDO5	3.0ms	10uA
APW8823F	Enable by EN1	300KHz / 350KHz	Auto - Skip	LDO3 & LDO5	0.9ms	10uA
APW8823G	Enable by EN1	300KHz / 350KHz	Auto - Skip	LDO3	0.9ms	10uA
APW8823H	Enable by EN1	300KHz / 350KHz	Ultra-sonic mode	LDO3 & LDO5	0.9ms	10uA

Note: ANPEC lead-free products contain molding compounds/die attach materials and 100% matte tin plate termination finish; which are fully compliant with RoHS. ANPEC lead-free products meet or exceed the lead-free requirements of IPC/JEDEC J-STD-020D for MSL classification at lead-free peak reflow temperature. ANPEC defines “Green” to mean lead-free (RoHS compliant) and halogen free (Br or Cl does not exceed 900ppm by weight in homogeneous material and total of Br and Cl does not exceed 1500ppm by weight).

Pin Configuration



TQFN 3X3-20
Top View

= GND and Thermal Pad (connected to GND plane for better heat dissipation)

Absolute Maximum Ratings (Note 1)

Symbol	Parameter	Rating	Unit
V_{IN}	Input Power Voltage (VIN to GND)	-0.3 ~ 28	V
V_{BOOT}	BOOT Supply Voltage (BOOT to PHASE)	-0.3 ~ 7	V
$V_{BOOT-GND}$	BOOT Supply Voltage (BOOT to GND)	-0.3 ~ 35	V
$V_{UG-PHASE}$	UGATE Voltage (UGATE to PHASE) <20ns pulse width >20ns pulse width	 -5 ~ V_{BOOT}+5 -0.3 ~ V_{BOOT}+0.3	V
V_{LG-GND}	LGATE Voltage (LGATE to GND) <20ns pulse width >20ns pulse width	 -5 ~ V_{LDO5} +5 -0.3 ~ V_{LDO5} +0.3	V
V_{PHASE}	PHASE Voltage (PHASE to GND) <20ns pulse width >20ns pulse width	 -5 ~ 35 -0.3 ~ 28	V
	All Other Pins (FBx, BYP, LDO5, LDO3, VCLK, ENx, ILIMx to GND)	-0.3 ~ 6	V
T_J	Maximum Junction Temperature	150	°C
T_{STG}	Storage Temperature	-65 ~ 150	°C
T_{SDR}	Maximum Lead Soldering Temperature, 10 Seconds	260	°C

Note1: Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Thermal Characteristics (Note 2)

Symbol	Parameter	Typical Value	Unit
θ_{JA}	Thermal Resistance -Junction to Ambient	65	°C/W
θ_{JC}	Thermal Resistance -Junction to Case	10	

Note 2: θ_{JA} and θ_{JC} are measured with the component mounted on a high effective the thermal conductivity test board in free air. The thermal pad of package is soldered directly on the PCB.

Recommended Operating Conditions

Symbol	Parameter	Range	Unit
V_{IN}	PWM1/2 Converter Input Voltage	5.5 ~ 25	V
V_{OUT1}	PWM1 Converter Output Voltage	2 ~ 5.5	V
V_{OUT2}	PWM2 Converter Output Voltage	2 ~ 5.5	V
V_{LIMx}	I_{LIMx} Adjustment Range ($V_{ILIMx-GND}$)	0.2~2	V
C_{IN}	PWM1/2 Converter Input Capacitor (MLCC)	10 ~	µF
C_{LDO}	LDO Output Capacitor (MLCC)	1.0~	µF
T_A	Ambient Temperature	-40 ~ 85	°C
T_J	Junction Temperature	-40 ~ 125	°C

Electrical Characteristics

Refer to the typical application circuits. These specifications apply over V_{IN}=12V and T_A= -40 ~ 85°C, unless otherwise specified. Typical values are at T_A=25°C.

Symbol	Parameter	Test Conditions	APW8823			Unit
			Min	Typ	Max	
INPUT SUPPLY POWER						
I_{VIN}	VIN Supply Current	Supply current1, BYP=0V, EN1=EN2=5V, V_{FB1} = V_{FB2} = 2.05V	-	280	400	µA
		Supply current2, BYP=5V, EN1=EN2=5V, V_{FB1} = V_{FB2} = 2.05V	-	10	-	µA
		Standby current1, BYP=0V, EN1=EN2=0V (For APW8823A/C/G)	-	20	-	
		Standby current2, BYP=0V, EN1=EN2=0V (For APW8823B/D/E/F/H)	-	40	-	
UNDER VOLTAGE LOCK OUT PROTECTION (UVLO)						
	LDO5 UVLO threshold	Rising Edge, PWM1/2 enable	4.2	4.3	4.4	V
		Hysteresis	-	0.1	-	V
	LDO3 UVLO threshold	Rising Edge	2.9	3.0	3.1	V
		Hysteresis	-	0.1	-	V
	VIN POR threshold	Rising threshold1, LDO3 enable (For APW8823A/C/G)	-	3.8	-	V
		Rising threshold2, LDO3 & LDO5 enable (For APW8823B/D/E/F/H)	-	3.8	-	V
		Falling threshold, LDOx shutdown with soft stop	-	3.7	-	V
PWM CONTROLLERS						
V_{FB}	FBx Reference Voltage	T_A = -40 °C to 85 °C	1.98	2.0	2.02	V
I_{FB}	FBx input current	V_{FBX}=2.0V, T_A=25 °C	-20	-	20	nA
T_{SS}	Soft-Start Time	ENx High to V_{OUT} 95% Regulation, LDO5=5V (For APW8823A/B/C/F/G/H)	-	0.9	-	ms
		V_{OUT} 0% to 95% Regulation, LDO5=5V(For APW8823D/E)	-	3.0	-	ms
	Soft-Stop Time	ENx low to V_{FBX}<0.1V	-	3.0	-	ms
F_{SW1}	PWM1 Switching Frequency (For APW8823A/B/C/D)	V_{IN}=20V, PWM1=5V	320	400	480	kHz
F_{SW2}	PWM2 Switching Frequency (For APW8823A/B/C/D)	V_{IN}=20V, PWM2=3.33V	380	475	570	
F_{SW1}	PWM1 Switching Frequency (For APW8823E/F/G/H)	V_{IN}=20V, PWM1=5V	240	300	360	kHz
F_{SW2}	PWM2 Switching Frequency (For APW8823E/F/G/H)	V_{IN}=20V, PWM2=3.33V	280	350	420	
	UGATEx Minimum Off-Time		200	300	400	ns