Ultra Low Output Voltage Linear N-FET Controller AP2160

General Description

The AP2160 is an ultra low output voltage N-FET linear regulator controller. The output voltage can be adjusted down to 0.5V. A Power-On-Reset (POR) circuit monitors supply voltage to prevent wrong operations. A POK pin indicates the output status. It can control other converters for power sequence. The AP2160 can be enabled by other power systems.

The AP2160 integrates a 0.5V reference voltage with 1% accuracy to provide tight regulation to the output voltage. The regulator also features enable control, open drain power good signal, under-voltage protection and soft start.

The AP2160 is available in 6-pin SOT-23-6 standard package.

Features

- 0.5V Reference Voltage with 1% Accuracy
- Adjustable Output Voltage down to 0.5V
- Low ESR Output Capacitor (MLCC and POSCAP) Applicable
- Enable Control for the Output Voltage and Low Shutdown Current
- Under-voltage Short Circuit Protection
- Fast Transient Response
- Power Good Monitoring and Signaling for the Output
- Drive N-Channel MOSFETs

Applications

- Notebook PC Computers
- Desktop Computers
- Battery Powered Devices
- Portable Instruments

SOT-23-6

Figure 1. Package Type of AP2160

Pin Configuration

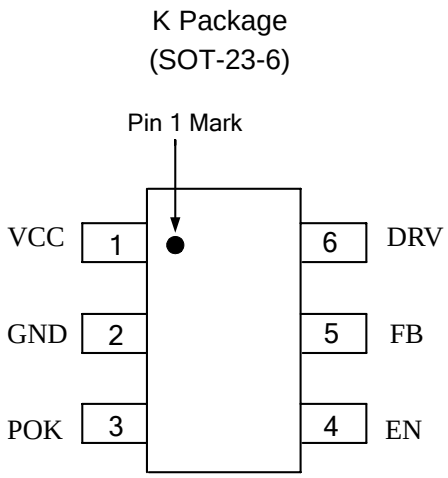

Figure 2. Pin Configuration of AP2160 (Top View)

Pin Description

Pin Number	Pin Name	Function
1	VCC	Input voltage
2	GND	Common ground pin
3	POK	Power OK output pin
4	EN	H: Normal operation; L: Shutdown
5	FB	Output voltage feedback pin
6	DRV	Gate drive to N-FET

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Functional Block Diagram

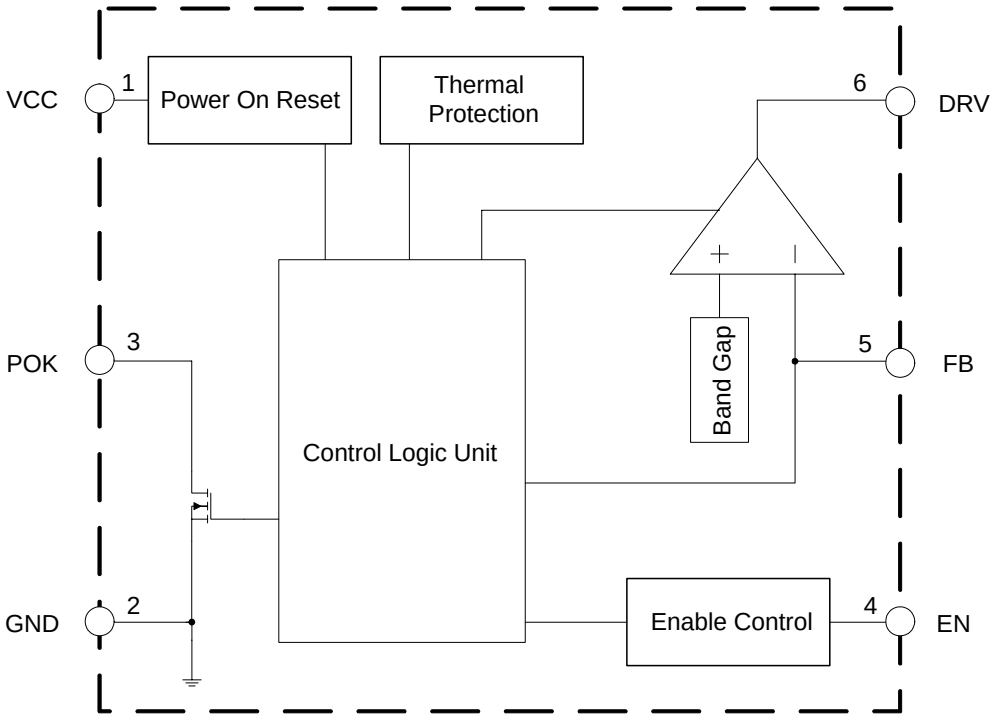
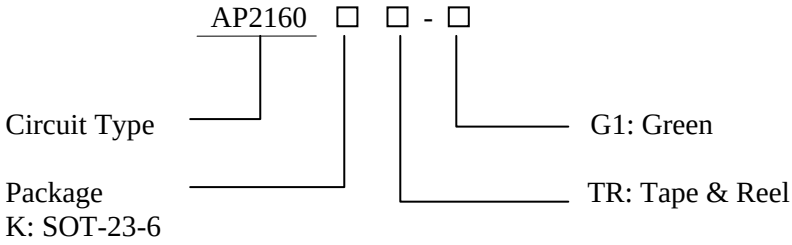


Figure 3. Functional Block Diagram of AP2160

Ordering Information



Package	Temperature Range	Part Number	Marking ID	Packing Type
SOT-23-6	-40 to 85°C	AP2160KTR-G1	GJC	Tape & Reel

BCD Semiconductor's Pb-free products, as designated with "G1" suffix in the part number, are RoHS compliant and green.

Absolute Maximum Ratings (Note 1)

Parameter	Symbol	Value	Unit
VCC to GND	V_{CC}	-0.3 to 7	V
DRV to GND	V_{DRV}	-0.3 to V_{CC}+0.3	V
POK to GND	V_{POK}	-0.3 to V_{CC}+0.3	V
FB to GND	V_{FB}	-0.3 to V_{CC}+0.3	V
EN to GND	V_{EN}	-0.3 to V_{CC}+0.3	V
Operating Junction Temperature	T_J	150	ºC
Power Dissipation (25ºC)	P_D	0.4	W
Operating Temperature Range	T_{OPR}	-40 to 85	ºC
Storage Temperature Range	T_{STG}	-65 to 150	ºC
Lead Temperature (Soldering, 10 Seconds)	T_{LEAD}	260	ºC
ESD (Machine Model)		200	V
ESD (Human Body Model)		2000	V

Note 1: Stresses greater than 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 Ratings” for extended periods may affect device reliability.

Recommended Operating Conditions

Parameter	Symbol	Min	Max	Unit
Supply Voltage (between VCC and GND)	V_{CC}	4.5	5.5	V
System Input Voltage (between VIN and GND)	V_{IN}	0.5	5.5	V
Ambient Operating Temperature Range	T_A	-40	85	°C

Electrical Characteristics

V_{IN} =1.5V, V_{OUT}=1.05V, V_{EN}=V_{CC}, T_A=25°C, C_{IN}=4.7μF, C_{OUT}=22μF, unless otherwise specified.

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Supply Voltage Range	V_{CC}		4.5		5.5	V
Input Voltage UVLO Threshold	V_{UVLO}	V_{FB}=0.48V, V_{CC} rising		3.70		V
Input Voltage UVLO Hysteresis	V_{HYST}	V_{FB}=0.48V, V_{CC} falling		0.25		V
Supply Current	I_{CC}	V_{EN}=V_{CC}=5V		0.42	0.6	mA
Shutdown Current	I_{SD}	V_{EN}=0V	-1		1	μA
Feedback Voltage	V_{FB}	V_{EN}=V_{CC}=5V	0.495	0.5	0.505	V
Feedback Pin Input Current	I_{FB}	V_{FB}=0.5V	-100		100	nA
EN Pin Logic High Threshold Voltage	V_{EN-H}	V_{CC}=5V, V_{EN} rising	1.3			V
	V_{EN-L}	V_{CC}=5V, V_{EN} falling			0.5	
EN Pin Input Current	I_{EN}	I_{OUT}=0mA, V_{IN}=5V	-1		1	μA
Output Voltage UVLO Threshold	$V_{TH(UV)}$	V_{FB} Falling	0.2	0.25	0.3	V
DRV Output Current	$I_{DRV(SS)}$	Sourcing, V_{FB}=0V		20		μA
	$I_{DRV(SRC)}$	Sourcing, V_{FB}=0.48V		2.2		mA
	$I_{DRV(SINK)}$	Sinking, V_{FB}=0.52V		9.0		
DRV Pin Output Voltage	V_{DRV}	V_{FB}=0.48V, V_{EN}=V_{CC}=5V	4.9		5.0	V
		V_{FB}=0.52V, V_{EN}=V_{CC}=5V	0.8	1.15	1.5	
POK Threshold Voltage for Power not OK	V_{PNOK}	V_{FB} falling	84%	88%	91%	V_{FB}
POK Low Voltage		POK sinks 1mA		200	250	mV
POK Delay Time	t_{DELAY}		0.8	2	10	ms
Thermal Shutdown Temperature	T_{SD}			150		°C
Thermal Shutdown Hysteresis				40		°C

Typical Performance Characteristics

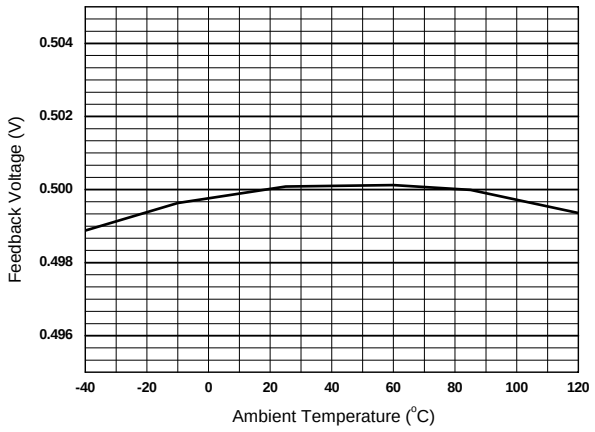


Figure 4. Feedback Voltage vs. Ambient Temperature

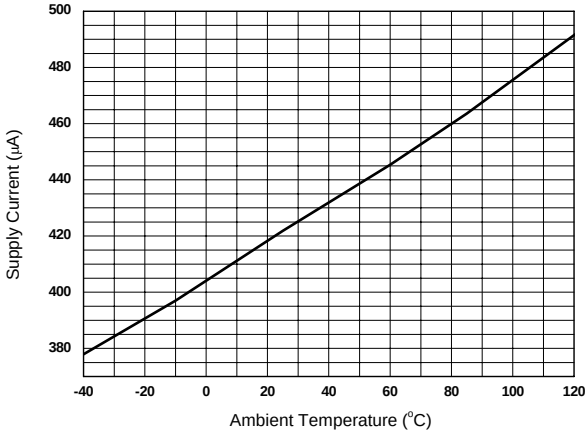


Figure 5. Supply Current vs. Ambient Temperature

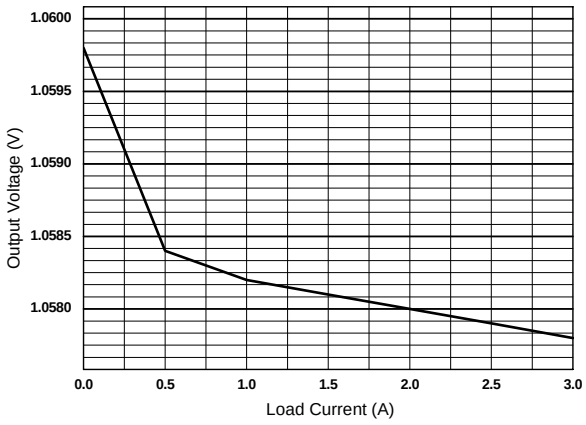


Figure 6. Output Voltage vs. Load Current

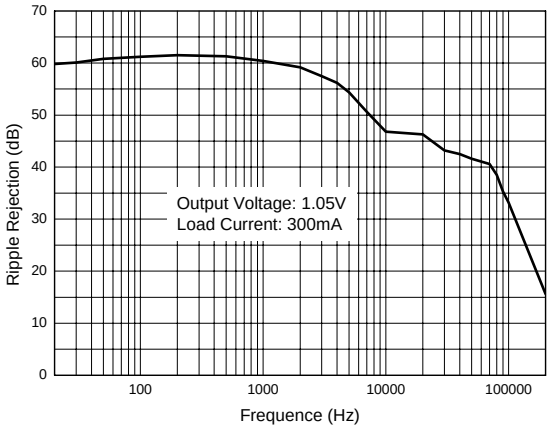


Figure 7. Ripple Rejection vs. Frequency

Function Description

1. Power-On-Reset

A Power-On-Reset (POR) circuit monitors input voltages at VCC pin to prevent wrong logic controls. The POR function initiates a soft-start process after the supply voltages exceed input voltage UVLO threshold during powering on. The POR function also pulls low the POK pin regardless of the output voltage when the VCC voltage falls below the input voltage UVLO threshold minus input voltage UVLO hysteresis.

2. Output Voltage Regulation

An error amplifier working with a temperature compensated 0.5V reference and an output NMOS regulates output to the preset voltage. The error amplifier designed with high bandwidth and DC gain provides very fast transient response and excellent load regulation.

3. Under-Voltage Protection (UVP)

AP2160 monitors the voltage on FB pin after soft-start process finishing. Therefore the UVP is disabled during soft-start. When the voltage on FB pin falls below the output voltage UVLO Threshold, the UVP circuit shuts down the output immediately.

4. Thermal Shutdown

A thermal shutdown circuit limits the junction temperature of AP2160. When the junction temperature exceeds 150°C, a thermal sensor turns off the output NMOS, allowing the device to cool down. The regulator regulates the output again through initiation of a new soft-start cycle after the junction temperature drops by 40°C.

Typical Application

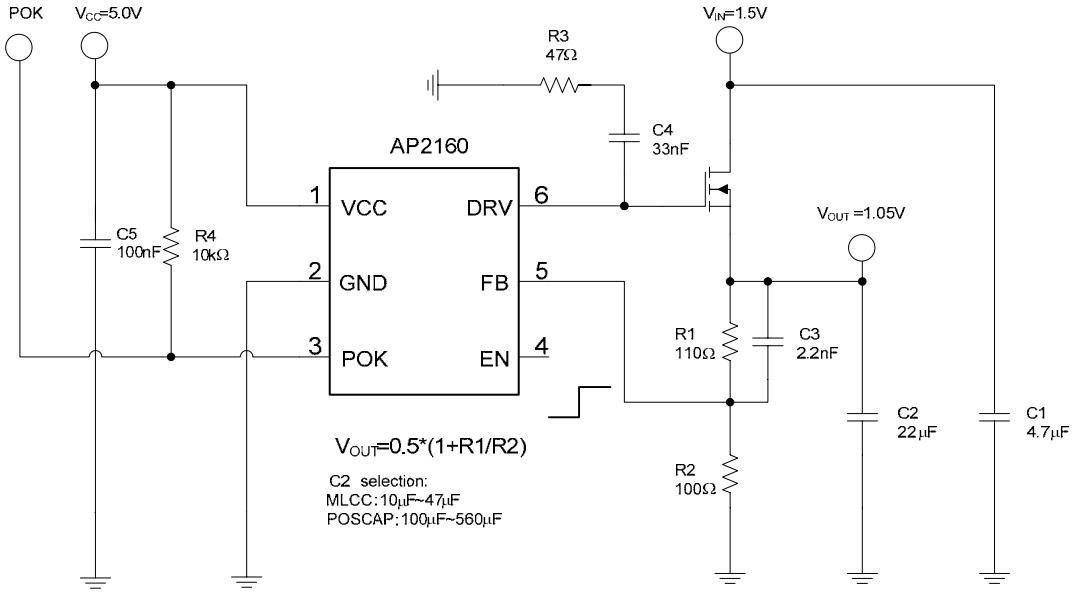
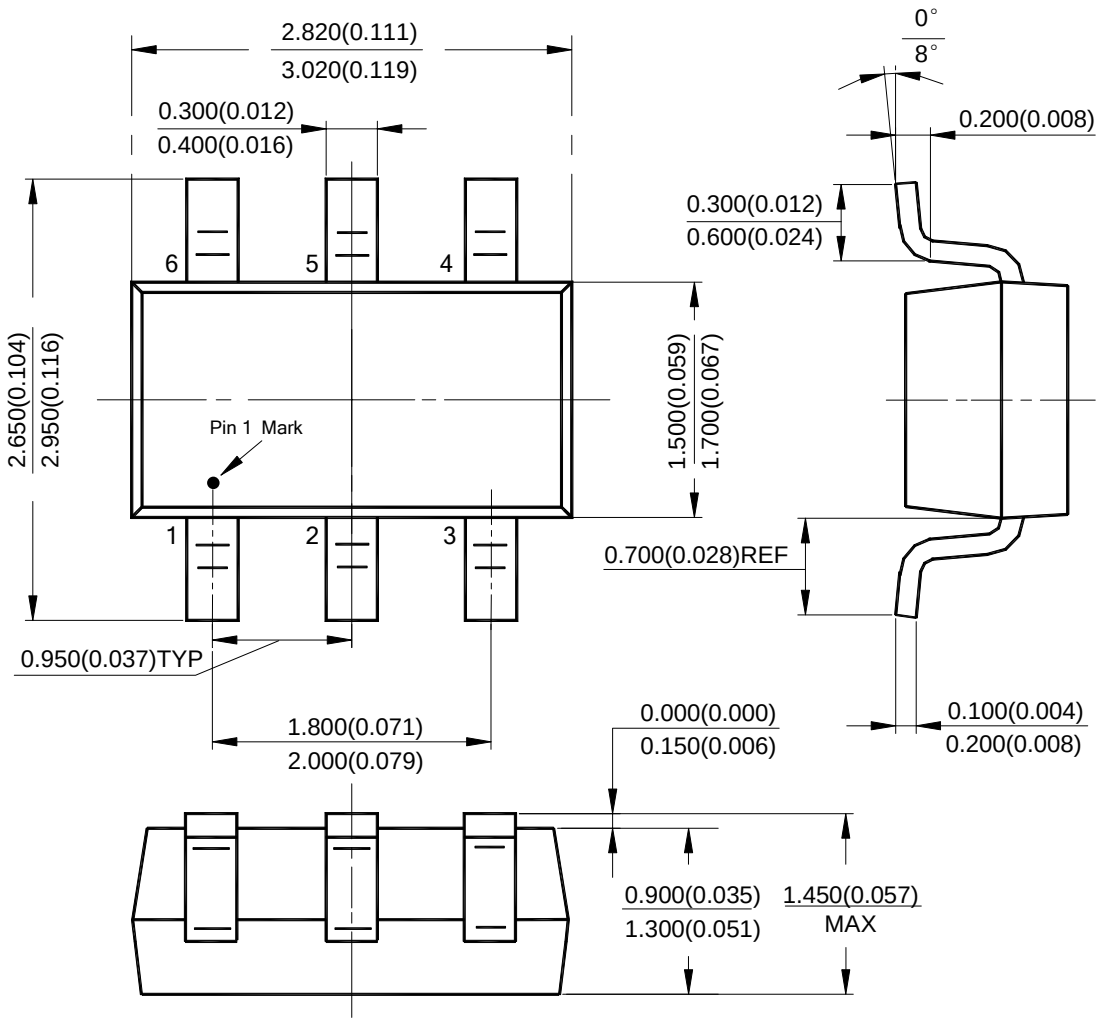


Figure 8. Typical Application Circuit of AP2160

Mechanical Dimensions

SOT-23-6 **Unit: mm(inch)**



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