AMC3202

1.5A 280kHz BOOST REGULATORS

DESCRIPTION

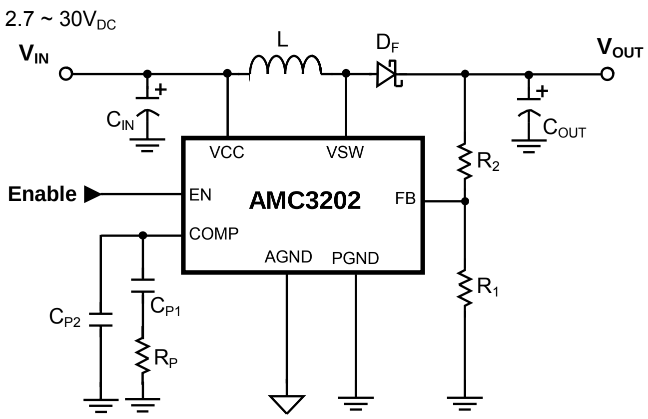
The AMC3202 is a 280kHz switching regulator with a high efficiency, 1.5A integrated switch. The part operates over a wide input voltage range, from 2.7V to 30V. The AMC3202 utilizes current mode architecture, which allows excellent load and line regulation, as well as a practical means for limiting current. Combining high frequency operation with a highly integrated regulator circuit results in an extremely compact power supply solution.

Build-in thermal protection to prevent the chip over heat damage.

FEATURES

- **Integrated Power Switch: 1.5A Guaranteed.**
- **Wide Input Range: 2.7V to 30V.**
- **40V Power Switch Input Voltage.**
- **High Frequency Allows for Small Components.**
- **Minimum External Components.**
- **Built in Over Current Protection.**

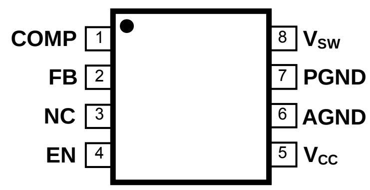
TYPICAL APPLICATION CIRCUIT



APPLICATIONS

- TFT-LCD Power Management
- LCD Monitor/TV LED Backlight Driver

PACKAGE PIN OUT



SO-8
(Top View)

ORDER INFORMATION

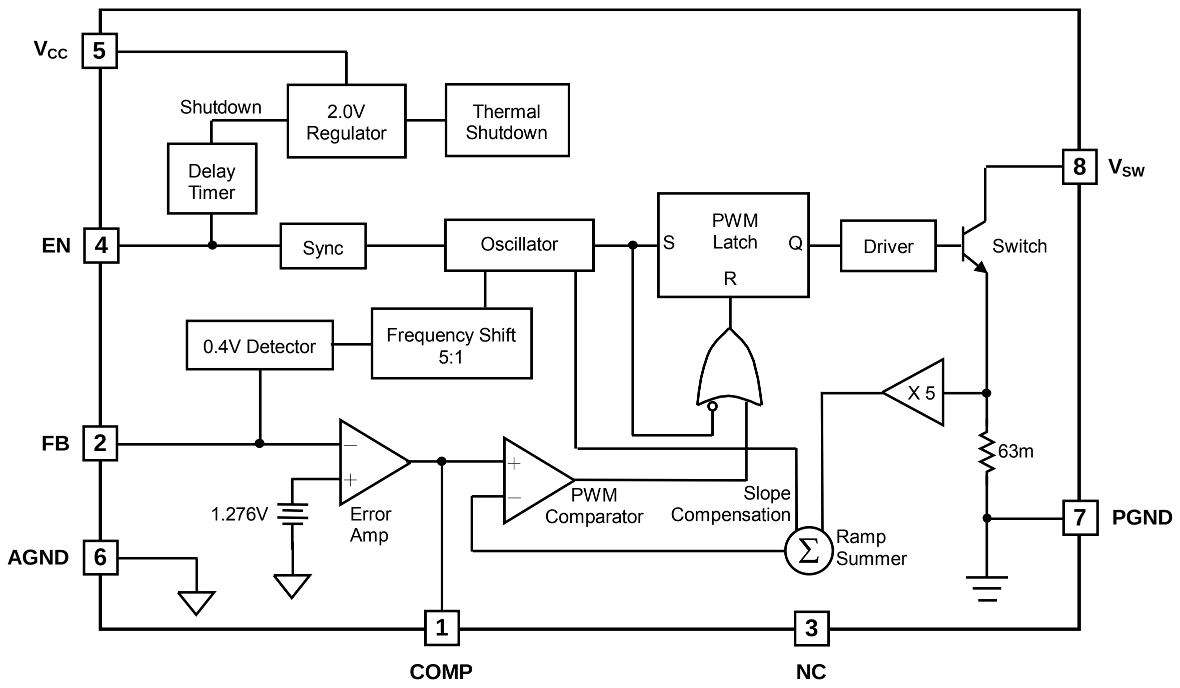
DM	SO
	8 pin
AMC3202DMF (Lead Free)	

Note: All surface-mount packages are available in Tape & Reel. Append the letter "T" to part number (i.e. AMC3202DMFT). The letter "F" is marked for Lead Free process.

ABSOLUTE MAXIMUM RATINGS (Note)	
Input Voltage, V_{CC}	30V
Switch Input Voltage, V_{SW}	40V
Maximum Operating Junction Temperature, T_J	150°C
Storage Temperature Range	-65°C to 150°C
Lead Temperature (Soldering, 10 seconds)	260°C

Note: Exceeding these ratings could cause damage to the device. All voltages are with respect to Ground.
Currents are positive into, negative out of the specified terminal.

BLOCK DIAGRAM



PIN DESCRIPTION	
Pin Name	Pin Function
COMP	Loop compensation pin. This pin is the output of the error amplifier and is used for loop compensation. Loop compensation can be implemented by a simple RC network.
FB	Feedback pin. Sense the output voltage and referenced to 1.276V. When the voltage at this pin falls below 0.4V, chip switching-frequency reduces to a much lower frequency.
NC	No connection. Keep floating.
EN	Enable pin. A TTL low will shut down the chip and high enable the chip. This pin may also be used to synchronize the part to nearly twice the base frequency. If synchronization is not used, this pin should be either tied high or left floating for normal operation.
VCC	Input power supply pin. Supply power to the IC and should have a bypass capacitor connected to AGND.
AGND	Analog ground. Provide a clean ground for the controller circuitry and should not be in the path of large currents. This pin is connected to the IC substrate.
PGND	Power ground. This pin is the ground connection for the emitter of the power switching transistor. Connection to a good ground plane is essential.
V_{SW}	High current switch pin. Connect to the collector of the internal power switch. The open voltage across the power switch can be as high as 40V. To minimize radiation, use a trace as short as practical.

THERMAL DATA	
Thermal Resistance from Junction to Ambient, θ_{JA}	165 ^{o}C /W

Junction Temperature Calculation: $T_J = T_A + (P_D \times \theta_{JA})$.
The θ_{JA} numbers are guidelines for the thermal performance of the device/pc-board system.
Connect the ground pin to ground using a large pad or ground plane for better heat dissipation.
All of the above assume no ambient airflow.

Maximum Power Calculation:

$$P_{D(MAX)} = \frac{T_{J(MAX)} - T_{A(MAX)}}{\theta_{JA}}$$

$T_J(^oC)$: Maximum recommended junction temperature

$T_A(^oC)$: Ambient temperature of the application

$\theta_{JA}(^oC/W)$: Junction-to-Ambient thermal resistance of the package, and other heat dissipating materials.

The maximum power dissipation for a single-output regulator is:

$$P_{D(MAX)} = [(V_{IN(MAX)} - V_{OUT(NOM)})] \times I_{OUT(NOM)} + V_{IN(MAX)} \times I_Q$$

Where: $V_{OUT(NOM)}$ = the nominal output voltage
$I_{OUT(NOM)}$ = the nominal output current, and
I_Q = the quiescent current the regulator consumes at $I_{OUT(MAX)}$
$V_{IN(MAX)}$ = the maximum input voltage

Then $\theta_{JA} = (+150\,^oC - T_A)/P_D$

DC ELECTRICAL CHARACTERISTICS

2.7V < V_{CC} < 30V, T_A=25°C, (Unless otherwise noted)

Parameter	Conditions	Min	Typ	Max	Unit
FB Reference Voltage	V_{COMP} tied to FB; Measure at FB	1.246	1.276	1.300	V
FB Input Current	FB=V_{REF}	-1.0	0.1	1.0	uA
FB Reference Voltage Line Regulation	V_{COMP}=FB, 2.7V < V_{CC} < 30V	-	0.01	0.03	%/V
Error Amp Transconductance	I_{VCOMP}=±25uA	300	550	800	uMho
Error Amp Gain	Note	200	500	-	V/V
V_{COMP} Source Current	FB=1.0V, V_{COMP}=1.25V	25	50	90	uA
V_{COMP} Sink Current	FB=1.5V, V_{COMP}=1.25V	200	625	1500	uA
V_{COMP} High Clamp Voltage	FB=1.0V, V_{COMP} sources 25uA	1.5	1.7	1.9	V
V_{COMP} Low Clamp Voltage	FB=1.5V, V_{COMP} sinks 25uA	0.25	0.50	0.65	V
V_{COMP} Threshold	Reduce V_{COMP} from 1.5V until switching stops	0.75	1.05	1.30	V
Base Operating Frequency	FB=1V	230	280	310	kHz
Reduced Operating Frequency	FB=0V	30	52	120	kHz
Maximum Duty Cycle		90	94	-	%
FB Frequency Shift Threshold	Frequency drops to reduced operating frequency	0.36	0.40	0.44	V
Synchronization Range		320	-	500	kHz
Synchronization Pulse Transition Threshold	Rise time=20ns	2.5	-	-	V
EN Bias Current	EN=0V EN=3.0V	-15 -	-3.0 3.0	- 8.0	uA
Shutdown Threshold		0.50	0.85	1.20	V
Shutdown Delay	2.7V≦V_{CC}≦12V 12V≦V_{CC}≦30V	12 12	80 36	350 200	uS
Switch Saturation Voltage	I_{SWITCH}=1.5A I_{SWITCH}=1.0A, 0°C≦T_J≦85°C I_{SWITCH}=1.0A, -40°C≦T_J≦0°C I_{SWITCH}=10mA	- - - -	0.8 0.55 0.75 0.09	1.4 - - 0.45	V
Switch Current Limit	50% duty cycle 80% duty cycle	1.6 1.5	1.9 1.7	2.4 2.2	A
Minimum Pulse Width	FB=0V, I_{SW}=1.0A	100	250	300	nS
Switch Leakage	V_{SW}=40V, V_{CC}=0V	-	2.0	100	uA

$\Delta I_{CC}/\Delta I_{Vsw}$	2.7V≦V_{CC}≦12V, 10mA≦I_{SW}≦1.0A 12V≦V_{CC}≦30V, 10mA≦I_{SW}≦1.0A 2.7V≦V_{CC}≦12V, 10mA≦I_{SW}≦1.5A 12V≦V_{CC}≦30V, 10mA≦I_{SW}≦1.5A	- - - -	10 - 17 -	30 100 30 100	mA/A
Operating Current	I_{SW}=0	-	5.5	8.0	mA
Shutdown Mode Current	V_{COMP}<0.8V, EN=0V, 2.7V≦V_{CC}≦12V V_{COMP}<0.8V, EN=0V, 12V≦V_{CC}≦30V	- -	12 -	60 100	uA
Minimum Operation Input Voltage	V_{SW} switching, maximum I_{SW}=10mA	-	2.45	2.70	V
Thermal Shutdown		150	180	210	°C
Thermal Hysteresis		-	25	-	°C

Note: Guaranteed by design, not 100% tested in production.

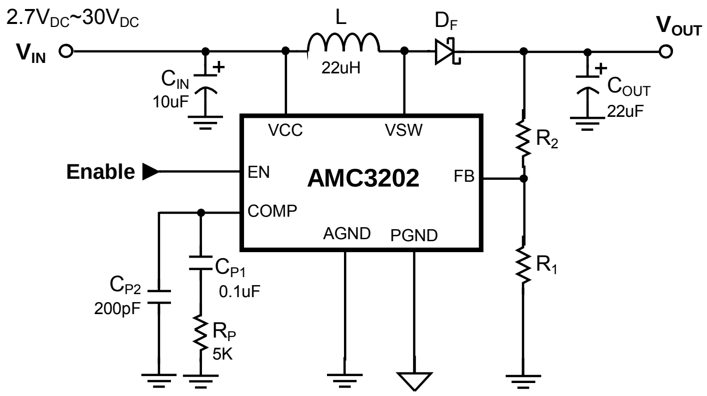
APPLICATION INFORMATION

Operation:

The AMC3202 incorporates a current mode control scheme, in which the duty cycle of the switch is directly controlled by switch current rather than by output voltage. The output of the oscillator turns on the power switch at a frequency of 280kHz as shown in the block diagram. The power switch is turned off by the output of the PWM comparator.

A TTL low voltage will shut down the chip and high voltage enable the chip through EN pin. This pin may also be used to synchronize the part to nearly twice the base oscillator frequency. In order to synchronize to a higher frequency, a positive transition turns on the power switch before the output of the oscillator goes high, thereby resetting the oscillator. The synchronization operation allows multiple power supplies to operate at the same frequency. If synchronization is not used, this pin should be either tied high or left floating for normal operation.

Component Selection:



The AMC3202 develops a 1.276V reference from the FB pin to ground. Output voltage is set by connecting the FB pin to an output resistor divider and the maximum output voltage is determined by the VSW pin maximum voltage minus the output diode forward voltage. Referring to typical application circuit, the output voltage is set by the below formula (1):

$$V_{OUT} = 1.276V\left(1 + \frac{R2}{R1}\right) \qquad 2.7V \leqq V_{OUT} \leqq 40V - V_F \qquad (1)$$

where, V_F is the output diode D_F forward voltage.

When choosing the inductor, one must consider factors such as peak current, core and ferrite material, output voltage ripple, EMI, temperature range, physical size, and cost. Lower values are chosen to reduce physical size of the inductor, and higher values reduce ripple voltage and core loss. In continuous conduction mode, the peak inductor current is equal to average current plus half of the ripple current, which should not cause inductor saturation. Based on the tolerance of the ripple current in the circuits, the following formula (2) can be referenced:

$$I_{Ripple} = \frac{V_{IN}(V_{OUT} - V_{IN})}{fLV_{OUT}} \qquad \text{where, } f = 280\text{kHz}. \qquad (2)$$

In Boost circuits, the inductor becomes part of the input filter. In continuous mode, the input current waveform is triangular and does not contain a large pulsed current. This reduces the requirements imposed on the input capacitor selection. Capacitors in the range of 10uF to 100uF with an ESR less than 0.3Ω work well up to full 1.5A switch current.

The V_{IN} ripple is determined by the product of the inductor current ripple and the ESR of input capacitor, and the V_{OUT} ripple comes from two major sources, namely ESR of output capacitor and the charging/discharging of the output capacitor. Ceramic capacitors have the lowest ESR, but too low ESR may cause loop stability problems. Aluminum Electrolytic capacitors exhibit the highest ESR, resulting in the poorest AC response. One option is to parallel a ceramic capacitor with an Aluminum Electrolytic capacitor.

Frequency Compensation

The goal of frequency compensation is to achieve desirable transient response and DC regulation while ensuring the stability of the system. A typical compensation network, as shown in the typical application circuit, provides a frequency response of two poles and one zero. The loop frequency compensation is performed on the output of the error amplifier (COMP pin) with a series RC network. The main pole is formed by the series capacitor and the output impedance of the error amplifier. The series resistor creates a zero, which improves loop stability and transient response. A second capacitor, is sometimes used to reduce the switching frequency ripple on the COMP pin.

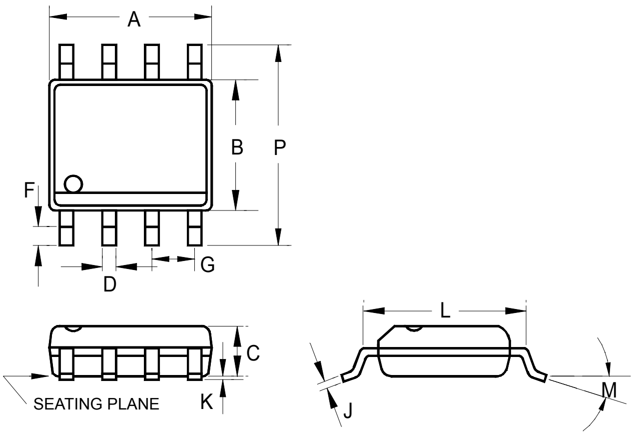
$$f_{P1} = \frac{1}{2\pi C_{P1} R_O}$$ where, R_O= error amplifier output resistance;

$$f_{Z1} = \frac{1}{2\pi C_{P1} R_P}$$

$$f_{P2} = \frac{1}{2\pi C_{P2} R_P}$$

PACKAGE

8-Pin Plastic S.O.I.C.



	INCHES			MILLIMETERS		
	MIN	TYP	MAX	MIN	TYP	MAX
A	0.183	-	0.202	4.65	-	5.13
B	0.144	-	0.163	3.66	-	4.14
C	0.068	-	0.074	1.35	-	1.88
D	0.010	-	0.020	0.25	-	0.51
F	0.015	-	0.035	0.38	-	0.89
G	0.050 BSC			1.27 BSC		
J	0.007	-	0.010	0.19	-	0.25
K	0.005	-	0.010	0.13	-	0.25
L	0.189	-	0.205	4.80	-	5.21
M	-	-	8º	-	-	8º
P	0.228	-	0.244	5.79	-	6.20