NEGATIVE FIXED VOLTAGE REGULATOR

DESCRIPTION

The SG120 series of negative regulators offer self-contained, fixed-voltage capability with up to 1.5A of load current. With a variety of output voltages and four package options this regulator series is an optimum complement to the SG7800A/ 7800/120 line of three terminal regulators.

All protective features of thermal shutdown, current limiting, and safe-area control have been designed into these units and since these regulators require only a single output capacitor or a capacitor and 5mA minimum load for satisfactory performance, ease of application is assured.

Although designed as fixed-voltage regulators, the output voltage can be increased through the use of a simple voltage divider. The low quiescent drain current of the device insures good regulation when this method is used, especially for the SG120 series. Utilizing an improved Bandgap reference design, problems have been eliminated that are normally associated with the zener diode references, such as drift in output voltage and large changes in the line and load regulation

These devices are available in TO-257 (hermetically sealed TO-220), both isolated and non-isolated), TO-3, TO-39 and TO-66 power packages.

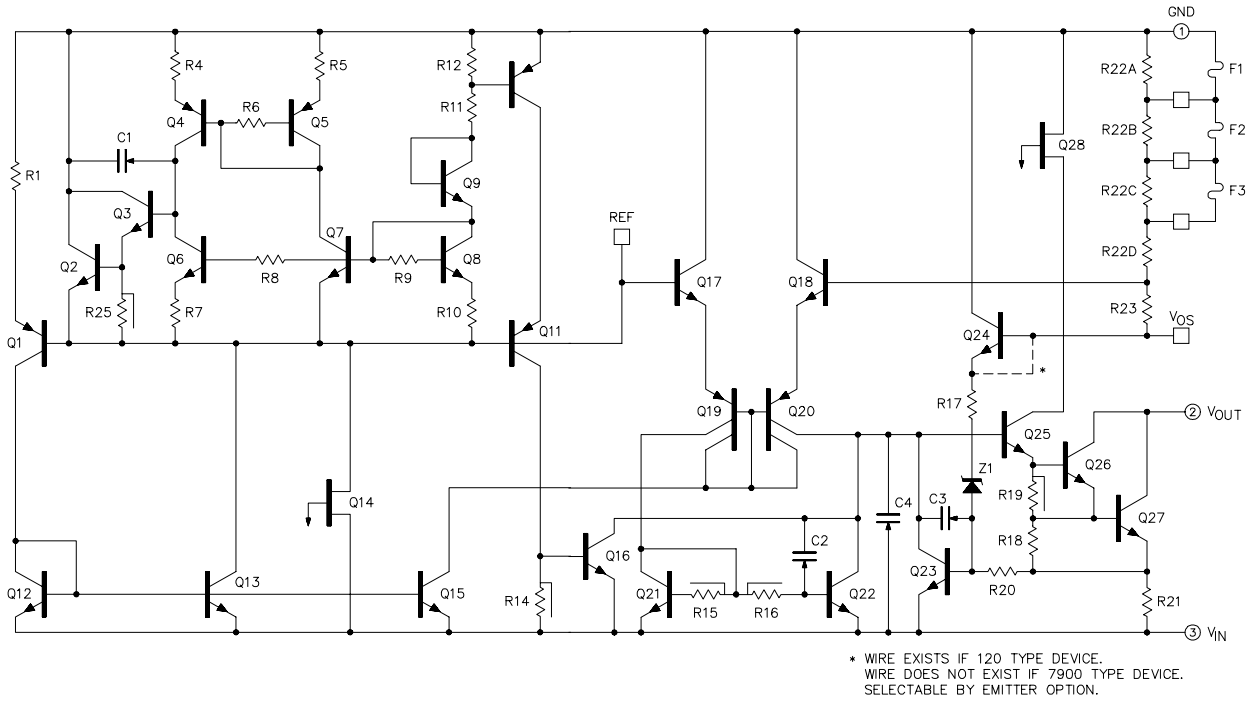
FEATURES

- **Output current to 1.5A**
- **Excellent line and load regulation**
- **Foldback current limiting**
- **Thermal overload protection**
- **Voltages available: -5V, -12V, -15V**
- **Voltages Not Recommended For New Designs: -5.2V, -8V, -18V, -20V**
- **Contact factory for other voltage options**

HIGH RELIABILITY FEATURES - SG120

- **Available to MIL-STD - 883**
- **Radiation data available**
- **LMI level "S" processing available**

SCHEMATIC DIAGRAM



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ABSOLUTE MAXIMUM RATINGS (Note 1)

Device Output Voltage	Input Voltage	Input Voltage Differential (Output shorted to ground)
-5V	-35V	35V
-5.2V	-35V	35V
-8V	-35V	35V
-12V	-35V	35V
-15V	-40V	35V
-18V	-40V	35V
-20V	-40V	35V

Operating Junction Temperature
Hermetic (K, R, IG - Packages) ..... 150°C

Storage Temperature Range ..... -65°C to 150°C
Lead Temperature (Soldering, 10 Seconds) ..... 300°C

Note 1. Values beyond which damage may occur.

THERMAL DATA

K Package:
Thermal Resistance-Junction to Case, θ_{JC} ..... 3.0°C/W
Thermal Resistance-Junction to Ambient, θ_{JA} ..... 35°C/W
R Package:
Thermal Resistance-Junction to Case, θ_{JC} ..... 5.0°C/W
Thermal Resistance-Junction to Ambient, θ_{JA} ..... 40°C/W
T Package:
Thermal Resistance-Junction to Case, θ_{JC} ..... 15°C/W
Thermal Resistance-Junction to Ambient, θ_{JA} ..... 120°C/W
IG Package:
Thermal Resistance-Junction to Case, θ_{JC} ..... 3.5°C/W
Thermal Resistance-Junction to Ambient, θ_{JA} ..... 42°C/W
L Package:
Thermal Resistance-Junction to Case, θ_{JC} ..... 35°C/W
Thermal Resistance-Junction to Ambient, θ_{JA} ..... 120°C/W

Note A. Junction Temperature Calculation: $T_J = T_A + (P_D \times \theta_{JA})$.
Note B. The above numbers for θ_{JC} are maximums for the limiting thermal resistance of the package in a standard mounting configuration. The θ_{JA} numbers are meant to be guidelines for the thermal performance of the device/pc-board system. All of the above assume no ambient airflow.

RECOMMENDED OPERATING CONDITIONS (Note 2)

Operating Junction Temperature Range:
SG120 ..... -55°C to 150°C

Note 2. Range over which the device is functional.

CHARACTERISTIC CURVES

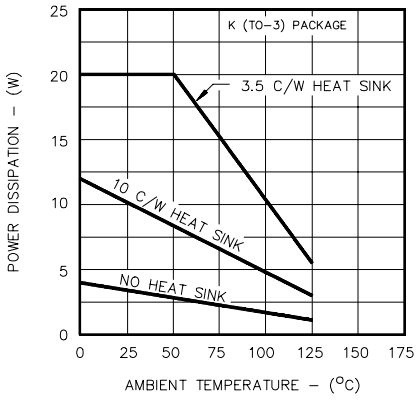

FIGURE 1.
MAXIMUM AVERAGE POWER DISSIPATION

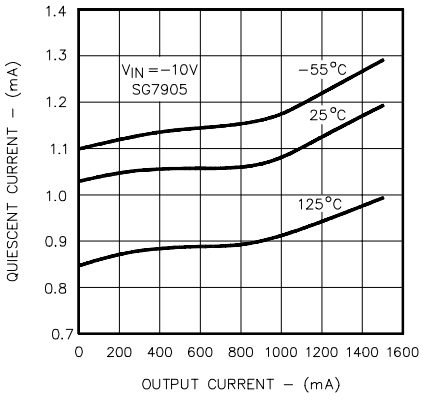

FIGURE 2.
QUIESCENT CURRENT VS. LOAD

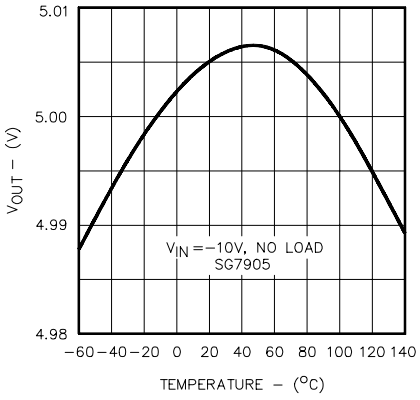

FIGURE 3.
TEMPERATURE COEFFICIENT

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CHARACTERISTIC CURVES (continued)

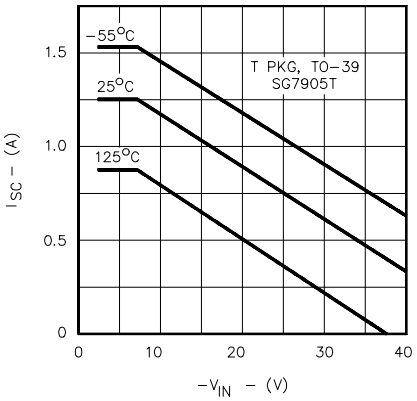

FIGURE 4.
SHORTCIRCUIT CURRENT VS. V_{IN}

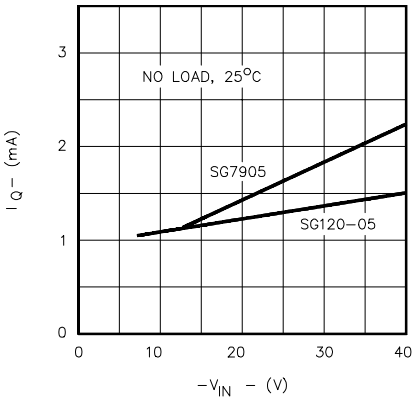

FIGURE 5.
QUIESCENT CURRENT VS. V_{IN}

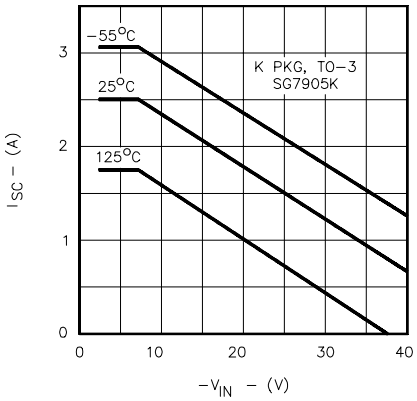

FIGURE 6.
SHORT CIRCUIT CURRENT VS. V_{IN}

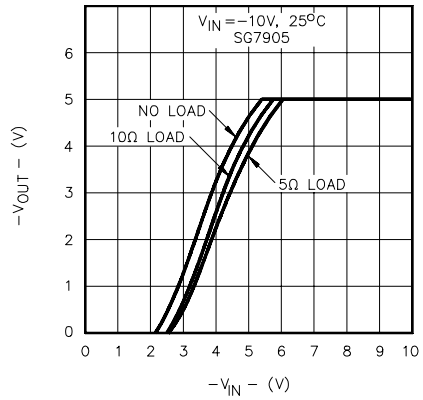

FIGURE 7.
DROPOUT CHARACTERISTICS

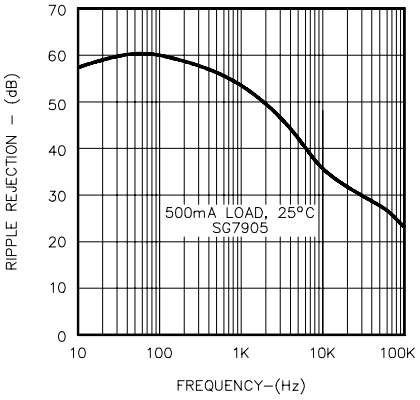

FIGURE 8.
RIPPLE REJECTION VS. FREQUENCY

APPLICATIONS

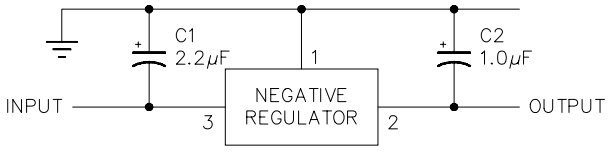

FIGURE 9 - FIXED OUTPUT REGULATOR

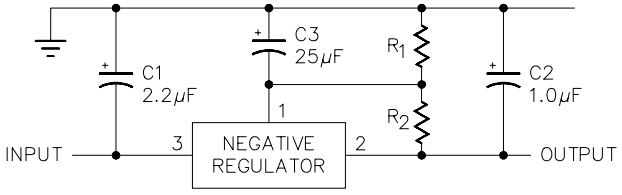

FIGURE 10 - CIRCUIT FOR INCREASING OUTPUT VOLTAGE

NOTE: 1. C1 is required only if regulator is separated from rectifier filter.
2. Both C1 and C2 should be low E.S.R. types such as solid tantalum. If aluminum electrolitics are used, at least 10 times values shown should be selected.
3. If large output capacities are used, the regulators must be protected from momentary input shorts. A high current diode from output to input will suffice.

NOTE: C3 optional for improved transient response and ripple rejection.

$$V_{OUT} = V\,(REGULATOR)\frac{R_1 + R_2}{R_1} \qquad R_2 = \frac{V(REG)}{15mA}$$

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ELECTRICAL CHARACTERISTICS (Note 1)

SG120-05

(Unless otherwise specified, these specifications apply over full operating ambient temperatures for SG120-05 with -55°C ≤ T_A ≤ 150°C, and V_{IN} = -10V, I_O = 5mA, C_{IN} = 2mF, C_{OUT} = 1.0mF. Low duty cycle pulse testing techniques are used which maintains junction and case temperature equal to the ambient temperature.)

Parameter	Test Conditions	SG120-05			Units
		Min.	Typ.	Max.	
Output Voltage	T_J = 25°C	-4.9	-5.0	-5.1	V
Line Regulation (Note 1)	V_{IN} = -7V to -25V, T_J = 25°C		10	25	mV
Load Regulation (Note 1)	Power Pkgs: I_O = 5mA to 1.5A, T_J = 25°C		50	75	mV
	T - Pkg: I_O = 5mA to 500mA, T_J = 25°C		30	50	mV
Total Output Voltage	V_{IN} = -7.5V to -25V				
Tolerance	Power Pkgs: I_O = 5mA to 1.5A, P ≤ 20W	-4.8	-5.0	-5.2	V
	T - Pkg: I_O = 5mA to 500mA, P ≤ 2W	-4.8	-5.0	-5.2	V
Quiescent Current	V_{IN} = -7V to -25V			2	mA
Quiescent Current Change	With Line: V_{IN} = -7V to -25V, T_J = 25°C			0.4	mA
	With Load: T_J = 25°C				
	Power Pkgs: I_O = 5mA to 1.5A			0.4	mA
	T - Pkg: I_O = 5mA to 500mA			0.4	mA
Dropout Voltage	ΔV_O = 100mV, T_J = 25°C				
	Power Pkgs: I_O = 1.0A, T - Pkg: I_O = 500mA		1.1	2.3	V
Peak Output Current	Power Pkgs: T_J = 25°C	1.5		3.3	A
	T - Pkg: T_J = 25°C	0.5		1.4	A
Short Circuit Current	Power Pkgs: V_{IN} = -35V, T_J = 25°C			1.2	A
	T - Pkg: V_{IN} = -35V, T_J = 25°C			0.6	A
Ripple Rejection	ΔV_{IN} = 10V, f = 120Hz, T_J = 25°C	54			dB
Output Noise Voltage (rms)	f = 10Hz to 100KHz (Note 2)		25	80	µV/V
Long Term Stability	1000hrs. at T_J = 125°C		20		mV
Thermal Shutdown	I_O = 5mA		175		°C

SG120-5.2

(Unless otherwise specified, these specifications apply over full operating ambient temperatures for SG120-5.2 with -55°C ≤ T_A ≤ 150°C, and V_{IN} = -10V, I_O = 5mA, C_{IN} = 2mF, C_{OUT} = 1.0mF. Low duty cycle pulse testing techniques are used which maintains junction and case temperature equal to the ambient temperature.)

Parameter	Test Conditions	SG120-5.2			Units
		Min.	Typ.	Max.	
Output Voltage	T_J = 25°C	-5.1	-5.2	-5.3	V
Line Regulation (Note 1)	V_{IN} = -7.2V to -25V, T_J = 25°C		15	25	mV
Load Regulation (Note 1)	Power Pkgs: I_O = 5mA to 1.5A, T_J = 25°C		50	75	mV
	T - Pkg: I_O = 5mA to 500mA, T_J = 25°C		30	50	mV
Total Output Voltage	V_{IN} = -7.7V to -25V				
Tolerance	Power Pkgs: I_O = 5mA to 1.5A, P ≤ 20W	-5.0	-5.2	-5.4	V
	T - Pkg: I_O = 5mA to 500mA, P ≤ 2W	-5.0	-5.2	-5.4	V
Quiescent Current	V_{IN} = -7.2V to -25V			2	mA
Quiescent Current Change	With Line: V_{IN} = -7.2V to -25V, T_J = 25°C			0.4	mA
	With Load: T_J = 25°C				
	Power Pkgs: I_O = 5mA to 1.5A			0.4	mA
	T - Pkg: I_O = 5mA to 500mA			0.4	mA
Dropout Voltage	ΔV_O = 100mV, T_J = 25°C				
	Power Pkgs: I_O = 1.5A, T - Pkg: I_O = 500mA		1.1	2.3	V
Peak Output Current	Power Pkgs: T_J = 25°C	1.5		3.3	A
	T - Pkg: T_J = 25°C	0.5		1.4	A
Short Circuit Current	Power Pkgs: V_{IN} = -35V, T_J = 25°C			1.2	A
	T - Pkg: V_{IN} = -35V, T_J = 25°C			0.6	A
Ripple Rejection	ΔV_{IN} = 10V, f = 120Hz, T_J = 25°C	54			dB
Output Noise Voltage (rms)	f = 10Hz to 100KHz (Note 2)		25	80	µV/V
Long Term Stability	1000hrs. at T_J = 125°C		20		mV
Thermal Shutdown	I_O = 5mA		175		°C

Note 1. All regulation tests are made at constant junction temperature with low duty cycle testing.
2. This test is guaranteed but is not tested in production.

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ELECTRICAL CHARACTERISTICS (Note 1)

SG120-08

(Unless otherwise specified, these specifications apply over full operating ambient temperatures for SG120-08 with -55°C ≤ T_A ≤ 150°C, and V_{IN} = -14V, I_O = 5mA, C_{IN} = 1.0mF, C_{OUT} = 1.0mF. Low duty cycle pulse testing techniques are used which maintains junction and case temperature equal to the ambient temperature.)

Parameter	Test Conditions	SG120-8			Units
		Min.	Typ.	Max.	
Output Voltage	T_J = 25°C	-7.8	-8.0	-8.2	V
Line Regulation (Note 1)	V_{IN} = -10.5V to -25V, T_J = 25°C		10	25	mV
Load Regulation (Note 1)	Power Pkgs: I_O = 5mA to 1.5A, T_J = 25°C		20	80	mV
	T - Pkg: I_O = 5mA to 500mA, T_J = 25°C		10	25	mV
Total Output Voltage	V_{IN} = -10.5V to -25V				
Tolerance	Power Pkgs: I_O = 5mA to 1.5A, P ≤ 20W	-7.65	-8.00	-8.35	V
	T - Pkg: I_O = 5mA to 500mA, P ≤ 2W	-7.65	-8.00	-8.35	V
Quiescent Current	V_{IN} = -10.5V to -25V			2	mA
Quiescent Current Change	With Line: V_{IN} = -10.5V to -25V, T_J = 25°C			0.4	mA
	With Load: T_J = 25°C				
	Power Pkgs: I_O = 5mA to 1.5A			0.4	mA
	T - Pkg: I_O = 5mA to 500mA			0.4	mA
Dropout Voltage	ΔV_O = 100mV, T_J = 25°C				
	Power Pkgs: I_O = 1.0A, T - Pkg: I_O = 500mA		1.1	2.3	V
Peak Output Current	Power Pkgs: T_J = 25°C	1.5		3.3	A
	T - Pkg: T_J = 25°C	0.5		1.4	A
Short Circuit Current	Power Pkgs: V_{IN} = -35V, T_J = 25°C			1.2	A
	T - Pkg: V_{IN} = -35V, T_J = 25°C			0.6	A
Ripple Rejection	ΔV_{IN} = 10V, f = 120Hz, T_J = 25°C	54			dB
Output Noise Voltage (rms)	f = 10Hz to 100KHz (Note 2)		25	80	µV/V
Long Term Stability	1000hrs. at T_J = 125°C		32		mV
Thermal Shutdown	I_O = 5mA		175		°C

SG120-12

(Unless otherwise specified, these specifications apply over full operating ambient temperatures for SG120-12 with -55°C ≤ T_A ≤ 150°C, and V_{IN} = -17V, I_O = 5mA, C_{IN} = 2.0mF, C_{OUT} = 1.0mF. Low duty cycle pulse testing techniques are used which maintains junction and case temperature equal to the ambient temperature.)

Parameter	Test Conditions	SG120-12			Units
		Min.	Typ.	Max.	
Output Voltage	T_J = 25°C	-11.7	-12.0	-12.3	V
Line Regulation (Note 1)	V_{IN} = -14V to -32V, T_J = 25°C		4	10	mV
Load Regulation (Note 1)	Power Pkgs: I_O = 5mA to 1.0A, T_J = 25°C		30	80	mV
	T - Pkg: I_O = 5mA to 500mA, T_J = 25°C		10	25	mV
Total Output Voltage	V_{IN} = -14.5V to -32V				
Tolerance	Power Pkgs: I_O = 5mA to 1.0A, P ≤ 20W	-11.5	-12.0	-12.5	V
	T - Pkg: I_O = 5mA to 500mA, P ≤ 2W	-11.5	-12.0	-12.5	V
Quiescent Current	V_{IN} = -14V to -32V		2	4	mA
Quiescent Current Change	With Line: V_{IN} = -14V to -32V, T_J = 25°C			0.4	mA
	With Load: T_J = 25°C				
	Power Pkgs: I_O = 5mA to 1.0A			0.4	mA
	T - Pkg: I_O = 5mA to 500mA			0.4	mA
Dropout Voltage	ΔV_O = 100mV, T_J = 25°C				
	Power Pkgs: I_O = 1.0A, T - Pkg: I_O = 500mA		1.1	2.3	V
Peak Output Current	Power Pkgs: T_J = 25°C	1.5		3.3	A
	T - Pkg: T_J = 25°C	0.5		1.4	A
Short Circuit Current	Power Pkgs: V_{IN} = -35V, T_J = 25°C			1.2	A
	T - Pkg: V_{IN} = -35V, T_J = 25°C			0.6	A
Ripple Rejection	ΔV_{IN} = 10V, f = 120Hz, T_J = 25°C	56			dB
Output Noise Voltage (rms)	f = 10Hz to 100KHz (Note 2)		25	80	µV/V
Long Term Stability	1000hrs. at T_J = 125°C		48		mV
Thermal Shutdown	I_O = 5mA		175		°C

Note 1. All regulation tests are made at constant junction temperature with low duty cycle testing.
2. This test is guaranteed but is not tested in production.

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ELECTRICAL CHARTACTERISTICS (Note 1)

SG120-15

(Unless otherwise specified, these specifications apply over full operating ambient temperatures for SG120-15 with -55°C ≤ T_A ≤ 150°C, and V_{IN} = -20V, I_O = 5mA, C_{IN} = 2.0mF, C_{OUT} = 1.0mF. Low duty cycle pulse testing techniques are used which maintains junction and case temperature equal to the ambient temperature.)

Parameter	Test Conditions	SG120-15			Units
		Min.	Typ.	Max.	
Output Voltage	T_J = 25°C	-14.7	-15.0	-15.3	V
Line Regulation (Note 1)	V_{IN} = -17V to -35V, T_J = 25°C		5	10	mV
Load Regulation (Note 1)	Power Pkgs: I_O = 5mA to 1.0A, T_J = 25°C		30	80	mV
	T - Pkg: I_O = 5mA to 500mA, T_J = 25°C		10	25	mV
Total Output Voltage	V_{IN} = -17.5V to -35V				
Tolerance	Power Pkgs: I_O = 5mA to 1.0A, P ≤ 20W	-14.5	-15.0	-15.5	V
	T - Pkg: I_O = 5mA to 500mA, P ≤ 2W	-14.5	-15.0	-15.5	V
Quiescent Current	V_{IN} = -17V to -35V		2	4	mA
Quiescent Current Change	With Line: V_{IN} = -17V to -35V, T_J = 25°C			0.4	mA
	With Load: T_J = 25°C				
	Power Pkgs: I_O = 5mA to 1.0A			0.4	mA
	T - Pkg: I_O = 5mA to 500mA			0.4	mA
Dropout Voltage	ΔV_O = 100mV, T_J = 25°C				
	Power Pkgs: I_O = 1.0A, T - Pkg: I_O = 500mA		1.1	2.3	V
Peak Output Current	Power Pkgs: T_J = 25°C	1.5		3.3	A
	T - Pkg: T_J = 25°C	0.5		1.4	A
Short Circuit Current	Power Pkgs: V_{IN} = -35V, T_J = 25°C			1.2	A
	T - Pkg: V_{IN} = -35V, T_J = 25°C			0.6	A
Ripple Rejection	ΔV_{IN} = 10V, f = 120Hz, T_J = 25°C	56			dB
Output Noise Voltage (rms)	f = 10Hz to 100KHz (Note 2)		25	80	µV/V
Long Term Stability	1000hrs. at T_J = 125°C		60		mV
Thermal Shutdown	I_O = 5mA		175		°C

SG120-18

(Unless otherwise specified, these specifications apply over full operating ambient temperatures for SG120-18 with -55°C ≤ T_A ≤ 150°C, and V_{IN} = -27V, I_O = 5mA, C_{IN} = 2.0mF, C_{OUT} = 1.0mF. Low duty cycle pulse testing techniques are used which maintains junction and case temperature equal to the ambient temperature.)

Parameter	Test Conditions	SG120-18			Units
		Min.	Typ.	Max.	
Output Voltage	T_J = 25°C	-17.6	-18.0	-18.4	V
Line Regulation (Note 1)	V_{IN} = -21V to -33V, T_J = 25°C		5	10	mV
Load Regulation (Note 1)	Power Pkgs: I_O = 5mA to 1.0A, T_J = 25°C		30	80	mV
	T - Pkg: I_O = 5mA to 500mA, T_J = 25°C		10	25	mV
Total Output Voltage	V_{IN} = -22V to -33V				
Tolerance	Power Pkgs: I_O = 5mA to 1.0A, P ≤ 20W	-17.4	-18.0	-18.6	V
	T - Pkg: I_O = 5mA to 500mA, P ≤ 2W	-17.4	-18.0	-18.6	V
Quiescent Current	V_{IN} = -21V to -33V		2	4	mA
Quiescent Current Change	With Line: V_{IN} = -21V to -33V, T_J = 25°C			0.4	mA
	With Load: T_J = 25°C				
	Power Pkgs: I_O = 5mA to 1.0A			0.4	mA
	T - Pkg: I_O = 5mA to 500mA			0.4	mA
Dropout Voltage	ΔV_O = 100mV, T_J = 25°C				
	Power Pkgs: I_O = 1.0A, T - Pkg: I_O = 500mA		1.1	2.3	V
Peak Output Current	Power Pkgs: T_J = 25°C	1.5		3.3	A
	T - Pkg: T_J = 25°C	0.5		1.4	A
Short Circuit Current	Power Pkgs: V_{IN} = -35V, T_J = 25°C			1.2	A
	T - Pkg: V_{IN} = -35V, T_J = 25°C			0.6	A
Ripple Rejection	ΔV_{IN} = 10V, f = 120Hz, T_J = 25°C	56			dB
Output Noise Voltage (rms)	f = 10Hz to 100KHz (Note 2)		25		µV/V
Long Term Stability	1000hrs. at T_J = 125°C		72		mV
Thermal Shutdown	I_O = 5mA		175		°C

Note 1. All regulation tests are made at constant junction temperature with low duty cycle testing.
2. This test is guaranteed but is not tested in production.

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ELECTRICAL CHATRACTERISTICS (Note 1)

SG120-20

(Unless otherwise specified, these specifications apply over full operating ambient temperatures for SG120-20 with -55°C ≤ T_A ≤ 150°C, and V_{IN} = -29V, I_O = 5mA, C_{IN} = 2.0mF, C_{OUT} = 1.0mF. Low duty cycle pulse testing techniques are used which maintains junction and case temperature equal to the ambient temperature.)

Parameter	Test Conditions	SG120-20			Units
		Min.	Typ.	Max.	
Output Voltage	T_J = 25°C	-19.5	-20.0	-20.5	V
Line Regulation (Note 1)	V_{IN} = -23V to -35V, T_J = 25°C		5	10	mV
Load Regulation (Note 1)	Power Pkgs: I_O = 5mA to 1.0A, T_J = 25°C		30	80	mV
	T - Pkg: I_O = 5mA to 500mA, T_J = 25°C		10	25	mV
Total Output Voltage	V_{IN} = -24V to -35V				
Tolerance	Power Pkgs: I_O = 5mA to 1.0A, P ≤ 20W	-19.3	-20.0	-20.7	V
	T - Pkg: I_O = 5mA to 500mA, P ≤ 2W	-19.3	-20.0	-20.7	V
Quiescent Current	V_{IN} = -23V to -35V		2	4	mA
Quiescent Current Change	With Line: V_{IN} = -23V to -35V, T_J = 25°C			0.4	mA
	With Load: T_J = 25°C				
	Power Pkgs: I_O = 5mA to 1.0A			0.4	mA
	T - Pkg: I_O = 5mA to 500mA			0.4	mA
Dropout Voltage	ΔV_O = 100mV, T_J = 25°C				
	Power Pkgs: I_O = 1.0A, T - Pkg: I_O = 500mA		1.1	2.3	V
Peak Output Current	Power Pkgs: T_J = 25°C	1.5		3.3	A
	T - Pkg: T_J = 25°C	0.5		1.4	A
Short Circuit Current	Power Pkgs: V_{IN} = -35V, T_J = 25°C			1.2	A
	T - Pkg: V_{IN} = -35V, T_J = 25°C			0.6	A
Ripple Rejection	ΔV_{IN} = 10V, f = 120Hz, T_J = 25°C	56			dB
Output Noise Voltage (rms)	f = 10Hz to 100KHz (Note 2)		25	80	µV/V
Long Term Stability	1000hrs. at T_J = 125°C		80		mV
Thermal Shutdown	I_O = 5mA		175		°C

Note 1. All regulation tests are made at constant junction temperature with low duty cycle testing.
2. This test is guaranteed but is not tested in production.

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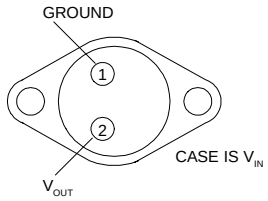
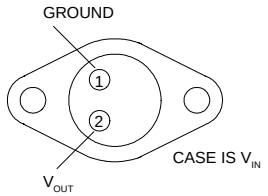
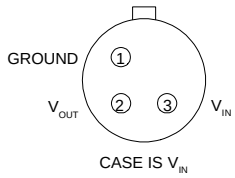
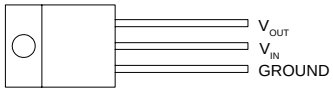
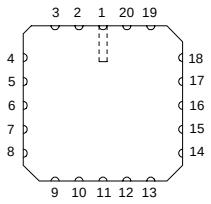
CONNECTION DIAGRAMS & ORDERING INFORMATION (See Notes Below)

Package	Part No.	Ambient Temperature Range	Connection Diagram
3-TERMINAL TO-3 METAL CAN K-PACKAGE	SG120-XXK/883B SG120-XXK	-55°C to 125°C -55°C to 125°C	
3-TERMINAL TO-66 METAL CAN R-PACKAGE	SG120-XXR/883B SG120-XXR	-55°C to 125°C -55°C to 125°C	
3-PIN TO-39 METAL CAN T-PACKAGE	SG120-XXT/883B SG120-XXT	-55°C to 125°C -55°C to 125°C	
3-PIN HERMETIC TO-257 IG-PACKAGE (Isolated)	SG120-XXIG/883B SG120-XXIG	-55°C to 125°C -55°C to 125°C	
20-PIN CERAMIC (LCC) LEADLESS CHIP CARRIER L- PACKAGE	SG120-XXL/883B SG120-XXL	-55°C to 125°C -55°C to 125°C	(Note 4) 1. N.C. 2. V_{IN} 3. N.C. 4. V_{OUT} 5. V_{OUT} 6. N.C. 7. V_{OUT} SENSE 8. N.C. 9. N.C. 10. N.C.  11. N.C. 12. N.C. 13. N.C. 14. N.C. 15. GND 16. N.C. 17. GND 18. N.C. 19. N.C. 20. V_{IN}

Note 1. Contact factory for JAN and DESC product availability.
2. All parts are viewed from the top.
3. "XX" to be replaced by output voltage of specific fixed regulator.
4. Some products will be available in leadless chip carrier (LCC) and hermetic flat pack (F). Consult factory for price and availability

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