共模 GONGMO

Ultra-low noise, ultra-high PSRR linear regulated power supply

Data Sheet

GM1200

Features Ultra-low

RMS noise: 0.8µVRMS Ultra-low spot
noise: 2.8nV/ÿHz (at 10kHz) Ultra-high PSRR: 70dB (at 1MHz)
Output current: 200mA Wide input voltage
range: 2.6V to 20V Single SET
pin capacitor improves noise and PSRR 100µA SET pin
current: ±1% initial accuracy Single SET pin resistor sets
output voltage Programmable current limit Low dropout voltage:
233mV Output voltage range: 1.5V to 15V Programmable
power good fast start
capability High-precision enable/
undervoltage lockout Multiple devices can be
paralleled to reduce noise
and provide higher
current Second protection function:
internal current limit Minimum output capacitance: 4.7µF (ceramic) 10-lead MSOP
and 3mmx3mm DFN packages are fully compatible with
LT3042 Pass AEC-Q100 automotive qualification

Post-regulator for switching power supplies

Typical Applications

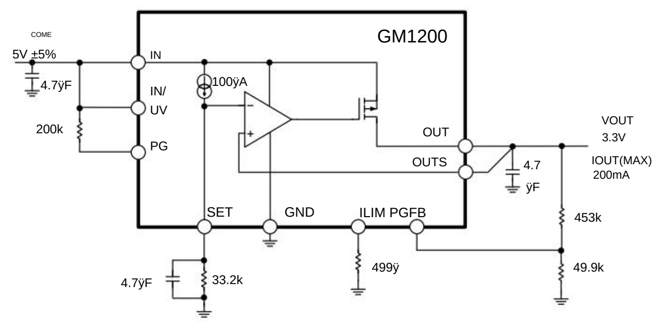

Figure Typical Application 1

application

RF power supplies, PLLs, VCOs, mixers, low noise amplifiers (LNAs) Ultra-low noise
instruments High-speed/
high-precision data converters Medical
imaging, diagnostics Infrared
sensing and automotive driver assistance
High-precision power supplies

Overview

The GM1200 is a high performance low dropout linear regulated power supply that uses an ultra-low noise and ultra-high power supply rejection ratio (PSRR) architecture to power noise sensitive signal acquisition and wireless communication applications. The GM1200 is designed as a high performance current reference followed by a high performance voltage buffer, which can be easily paralleled to further reduce noise, increase output current and improve heat dissipation on the PCB.

The GM1200 can deliver 200mA at a typical dropout voltage of 233mV. The typical quiescent current is 1.9mA in normal operation and less than 1µA in shutdown mode. The device adjusts the output voltage through off-chip resistors and can maintain unity gain operation over a wide output voltage range (1.5V to 15V), providing nearly constant

The output noise, PSRR, bandwidth and load regulation are all independent of the output voltage. In addition, the regulated power supply has programmable current limit, fast startup and a programmable power good signal to indicate output voltage regulation.

The GM1200 is stable with a 4.7µF (minimum) ceramic output capacitor. Built-in protection circuits include internal current limiting and over-temperature protection. The GM1200 is available in thermally enhanced 10-pin MSOP and 3mm x 3mm DFN packages, with the DFN package operating over the -55°C to +125°C temperature range and AEC-Q100 automotive qualified.

Manbasemi Technology (Suzhou) Co., Ltd. A1605, Phase 4,
International Science Park, Suzhou Industrial Park, Suzhou, Jiangsu Province, China. Technical
support and document feedback: tech@manbasemi.com, manbasemi.com

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Revision History

8/2021—Revision 0: First draft

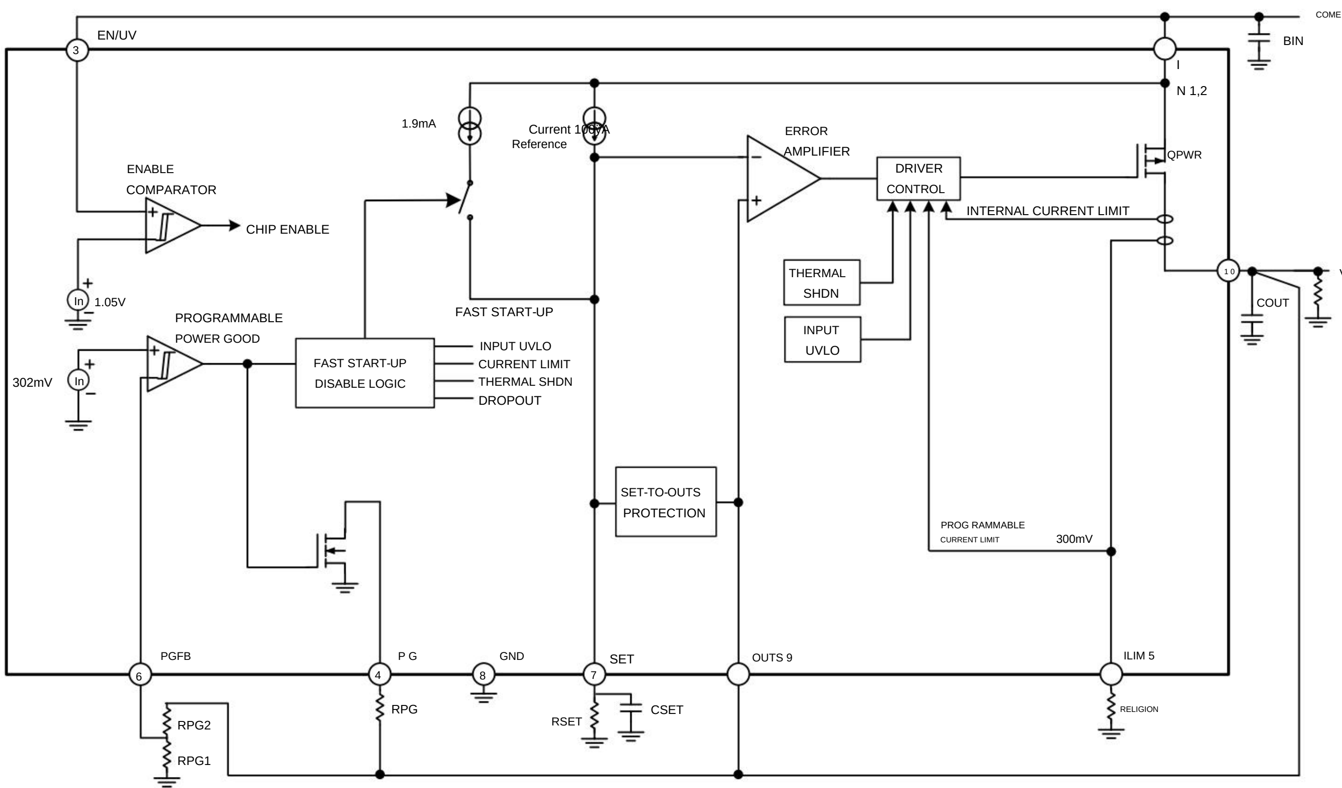
11/2022—Revision A: Added MSOP package

12/2022—Revision B: Added -55ÿ model, updated electrical characteristics and typical performance parameters

11/2023—Revision C: Added GM1200WCPZ vehicle model, updated electrical characteristics

02/2024—Revision D: Updated electrical characteristics and typical performance parameters

Functional Block Diagram



Pin Configuration

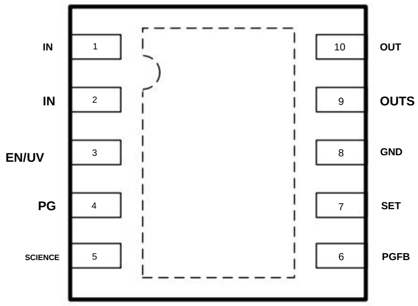


Figure 2. DFN pin configuration (top view)

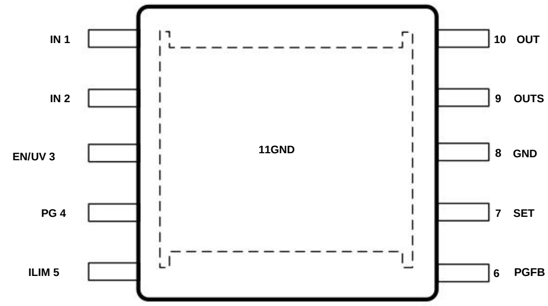


Figure 3. MSOP pin configuration (top view)

Table 1 Function

Pin No.	Pin Name	Description
IN	1, 2	Input. Regulator supply pins. The GM1200 requires a typical 4.7ÿF bypass capacitor on the IN pin. Applications with large load transients may require more input capacitance to prevent input supply droop. Enable/
EN/UV	3	UVLO. Pulling the GM1200's EN/UV pin low puts the device into shutdown mode. Quiescent current in shutdown mode is less than 1ÿA, and the output voltage is cut off. Alternatively, the EN/UV pin can be used to set an input supply undervoltage lockout (UVLO) threshold using a resistor divider between IN, EN/UV, and GND. The GM1200 turns on when the EN/UV pin voltage exceeds 1.07V on its rising edge, with 100mV hysteresis on its falling edge. Normal operation is maintained with the EN/UV pin voltage above the input voltage. Connect EN/UV to IN when not used alone. Do not leave the EN/UV pin floating. Power
PG	4	Good. PG is an open-drain flag that indicates output voltage regulation. If PGFB is above 302mV, PG is pulled high. If the power-good indication feature is not required, leave the PG pin floating.
SCIENCE	5	Current Limit Programming Pin. Connect a resistor between ILIM and GND to set the current limit. For best accuracy, connect the resistor directly to the GND pin of the GM1200 using a Kelvin connection. The nominal value of the programmed scale factor is 128mA·kÿ. The ILIM pin also acts as a current monitor pin with a range of 0V to 300mV. If the programmable current limit feature is not required, connect ILIM to GND. Power
PGFB	6	Good Feedback. Pull the PG pin high if PGFB exceeds 302mV on its rising edge with 60mV hysteresis on its falling edge. By connecting an external resistor divider between the OUT, PGFB, and GND pins, the programmable power-good threshold can be set using the following equation: 0.305V(1 + RPG2/RPG1). PGFB is also responsible for activating the fast-start circuit. If the power-good and fast-start features are not required, connect
SET	7	PGFB to IN. Voltage Setting. This pin is the inverting input of the error amplifier and the regulation set point of the GM1200. The SET pin provides a precise 100ÿA current that flows through an external resistor connected between SET and GND. The output voltage of the GM1200 is determined by VSET = ISETÿRSET . The output voltage range is 1.5V to 15V. Adding a capacitor between SET and GND imp PSRR and transient response are improved at the expense of slightly increased start-up time. For optimum load regulation, the ground side of the SET pin resistor should be connected directly to the load using a Kelvin connection.
GND	8, 11	Ground. The exposed back side is an electrical connection to GND. To ensure proper electrical and thermal performance, the exposed back side should be soldered to PCB ground and connect it directly to the GND pin.
OUTS	9	Output Sense. This pin is the noninverting input to the error amplifier. For best transient performance and load regulation, connect OUTS directly to the output capacitor and the load using a Kelvin connection. Also, connect the GND connections of the output capacitor and the SET pin capacitor directly together. Also, place the input and output capacitors (and their GND connections)
OUT	10	very close together. Output. This pin supplies power to the load. For stability, use a 4.7ÿF (minimum) output capacitor with an ESR of less than 50mÿ and an ESL of less than 2nH. Large load transients require a larger output capacitor to limit the peak voltage transient. See the Application Information section for more information on output capacitors.

Absolute Maximum Ratings

Table 2:

parameter	Rating
IN, EN/UV, PG, PGFB to GND Voltage	ÿ0.3 V to +22 V
ILIM to GND voltage	ÿ0.3 V to +1 V
SET to GND voltage	ÿ0.3 V to +16 V
OUT to GND voltage	ÿ0.3 V to +16 V
OUTS to GND voltage	ÿ0.3V to +16V
SET Pin Current Storage	-10mA to +10mA
Temperature Range Operating	ÿ65°C to +150°C
Junction Temperature	ÿ55°C to +125°C
Soldering Conditions	JEDEC J-STD-020

Stresses above those listed under Maximum Ratings may cause permanent damage to the product.

The normal operating range of the product should not exceed the specifications shown in the Technical Specifications section.

Stresses above those listed under Maximum Ratings may affect product reliability.

Thermal resistance

ÿJA is for the worst case condition, where the device is soldered on a circuit board for surface mount packaging.

Pack.

Table 3:

Package Type	ÿJA	ÿJC Unit	
DFN-10	34	5.5	°C/W
MSOP-10	33	8	°C/W

Electrical Characteristics

Unless otherwise noted, VIN = max(VOUT + 1V, 2.7 V), IOUT=10mA, CIN=COUT=4.7µF, TJ = -55°C to +125°C (for min/max specifications), TA = 25°C (for typical specifications).

Table 4:

parameter	condition	Min Typ Max	Unit		
Minimum IN pin voltage V	ILOAD = 10mA, VIN UVLO rises		2.41	2.5	In
	VIN UVLO Hysteresis		80		mV
SET Pin Current (ISET)	VIN = 4V, ILOAD = 1mA, VOUT = 3V	99	100	101	ÿA
	2.7V < VIN < 20Vÿ1.5V < VOUT < 15Vÿ1mA < ILOAD < 200mA(ÿ 1)	98	100	102	ÿA
Fast Start SET pin current VPGFB = 289mV,	VIN = 4V, VSET = 3V		2		m.a.
Output offset voltage VOS(VOUT – VSET)(2)	VIN = 4V, ILOAD = 1mA, VOUT = 3V	-2.4		3.5 mV	
	2.7V < VIN < 20Vÿ1.5V < VOUT < 15Vÿ1mA < ILOAD < 200mA(ÿ 1)	-3.5		4.8 mV	
Voltage Regulation: ÿISET	VIN = 2.7V to 20V, ILOAD = 1mA, VOUT = 1.8V		1.5	8	nA/V
Voltage Regulation: ÿVOS	VIN = 2.7V to 20V, ILOAD = 1mA, VOUT = 1.8V (Note 2)		4	21	ÿV/V
Load Regulation: ÿISET	ILOAD = 1mA to 200mA, VIN = 4V, VOUT = 3V		0.8	5	nA/mA
Load Regulation: ÿVOS	ILOAD = 1mA to 200mA, VIN = 4V, VOUT = 3V (Note 2)		0.1	1.6 mV	
ISET changes with VSET	VSET = 1.5V to 15V, VIN = 16V, ILOAD = 1mA		100		nA
Variation of VOS with VSET	VSET = 1.5V to 15V, VIN = 16V, ILOAD = 1mA (Note 2)		0.7	1.6 mV	
GND pin current VIN = VOUT(NOMINAL)	ILOAD = 10ÿA		1.9	2.5 mA	
	ILOAD = 1mA		2.0	2.6 mA	
	ILOAD = 50mA		2.5	3.2 mA	
	ILOAD = 100mA		2.9	3.5 mA	
	ILOAD = 200mA		3.5	4.5 mA	
Dropout voltage	ILOAD = 1mA		228	300 mV	
	ILOAD = 50mA		230	306 mV	
	ILOAD = 100mA (Note 3)		231	315 mV	
	ILOAD = 200mA (Note 3)		233	328 mV	
Output noise spectrum Density (Note 2, 4)	ILOAD = 200mA, Frequency = 10Hz, COUT = 4.7ÿF, CSET = 4.7ÿF, 1.5V ÿ VOUT ÿ 15V		112		nV/ÿHz
	ILOAD = 200mA, Frequency = 10kHz, COUT = 4.7ÿF, CSET = 4.7ÿF, 1.5V ÿ VOUT ÿ 15V		2.8		nV/ÿHz
Output RMS Noise (Note 2, 4)	ILOAD = 200mA, BW = 10Hz to 100kHz, COUT = 4.7ÿF, CSET = 0.47ÿF		2.0		ÿVRMS
	ILOAD = 200mAÿBW = 10Hz ÿ 100kHzÿCOUT = 4.7ÿFÿCSET = 4.7ÿF VRIPPLE = 500mVP-		0.8		ÿVRMS
Supply voltage ripple rejection 1.5V ÿ VOUT ÿ 15V (Note 2, 4)	PÿfRIPPLE = 120HzÿILOAD = 200mAÿCOUT = 4.7ÿFÿCSET = 4.7ÿF VRIPPLE = 150mVP-PÿfRIPPLE =		87		dB
	10kHzÿILOAD = 200mAÿCOUT = 4.7ÿFÿCSET = 4.7ÿF		92		dB
EN/UV Pin Threshold	EN/UV Threshold Rising (Turn On), VIN = 4V	1.04	1.07	1.1	In
EN/UV Pin Hysteresis	EN/UV Threshold Hysteresis, VIN = 4V		100		mV
EN/UV Pin Current	VEN/UV = 0VÿVIN = 20V			1.5	ÿA

parameter	condition	Min	Typ	Max	Unit
	VEN/UV = 1.24VÿVIN = 20V		0.1	2	ÿA
	VEN/UV = 20VÿVIN = 0V		0.01	0.4	ÿA
Quiescent current in shutdown mode (VEN/UV = 0V)	VIN = 4V		0.4	0.6	ÿA
				10	ÿA
Internal Current Limit	VIN = 4VÿVOUT = 0V	256	340	440	mA
Programmable Current Limit	Programming Scale Factor: 2.6V < VIN < 20V (Note 6)		128		mAÿkÿ
	VIN = 4VÿVOUT = 0VÿRILIM = 649ÿ		197		m.a.
	VIN = 4VÿVOUT = 0VÿRILIM = 2.55kÿ		50		m.a.
PGFB Threshold	PGFB Threshold Rising	292	305	318	mV
PGFB Hysteresis	PGFB Threshold Hysteresis		43		mV
PGFB Pin Current	VIN = 4VÿVGFB = 300mV		3		nA
PG output low voltage	IPG = 100ÿA		16	70	mV
PG leakage current	VPG = 20V			0.5	ÿA
Thermal shutdown	TJ Rise		160		°C
	Hysteresis		15		°C
Startup time	VOUT = 5VÿILOAD = 200mAÿCSET = 0.47ÿFÿVIN = 6VÿVPGFB = 6V		55		ms
	VOUT = 5VÿILOAD = 200mAÿCSET = 4.7ÿFÿVIN = 6VÿVPGFB = 6V		550		ms
	VOUT = 5VÿILOAD = 200mAÿCSET = 4.7ÿFÿVIN = 6VÿRPG1 = 50kÿÿ		10		ms

Note 1: Maximum junction temperature limits the operating conditions. Regulated output voltage specifications do not apply for all possible input voltage and output current combinations. If the maximum output current If the input voltage is within the maximum input voltage range, If the output current is limited, the

Note 2: OUTS is directly connected to OUT.

Note 3: The dropout voltage is the voltage required to maintain the voltage regulation under the specified output current conditions. The minimum input-to-output voltage difference. The dropout voltage is 1% out of regulation at the output Compared to the hard voltage drop measured at VIN=VOUT(NOMINAL), this definition A higher dropout voltage will be generated. Due to production test limitations caused by (Kelvin) detection, 100mA and Maximum dropout voltage specification at 200mA current.

Note 4: Adding a capacitor across the SET pin resistor can reduce the output voltage Adding this capacitor bypasses the thermal noise of the SET pin resistor and the base The output noise is then equal to the error amplifier noise. A SET pin bypass capacitor also increases the startup time.

Typical performance parameters

Unless otherwise noted, VIN = max(VOUT + 1V, 2.7 V), IOUT = 10mA, CIN = COUT = 4.7μF, RSET = 4.7μF.

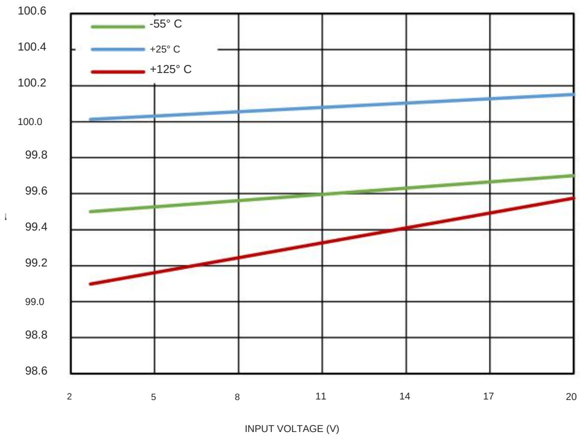


Figure 4. Relationship between SET pin current and input voltage

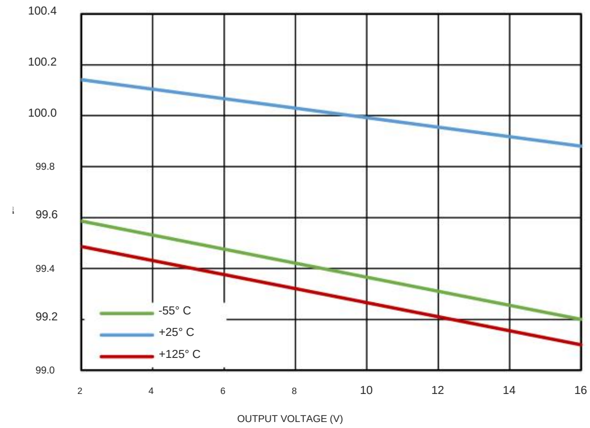


Figure 5. Relationship between SET pin current and output voltage

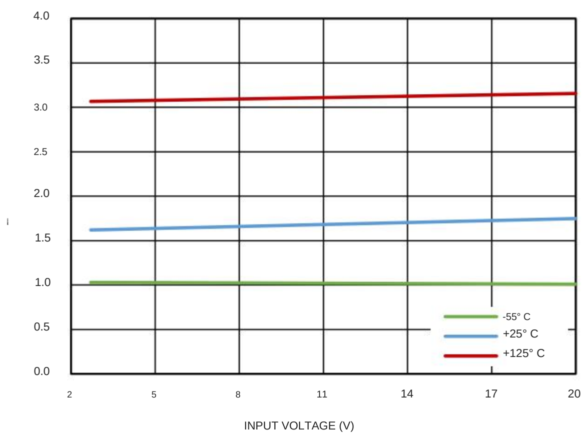


Figure 6. |VOUT-VSET| vs. input voltage, VOUT=3.0V

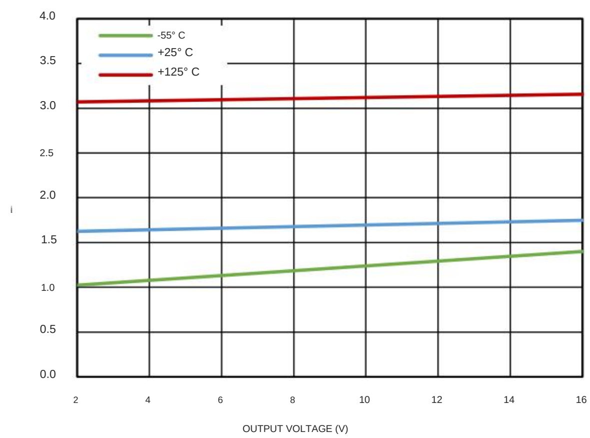


Figure 7. Relationship between |VOUT-VSET| and output voltage

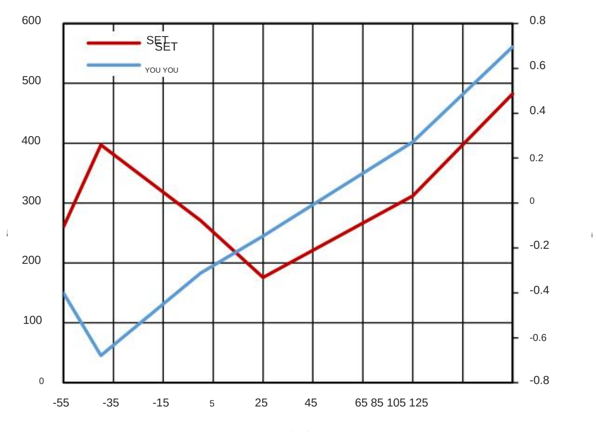


Figure 8. Relationship between SET pin current, |VOUT-VSET| and temperature.

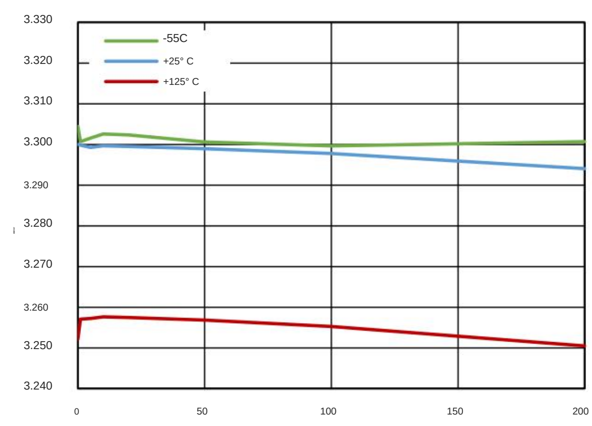


Figure 9. Load regulation when VOUT=3.3V

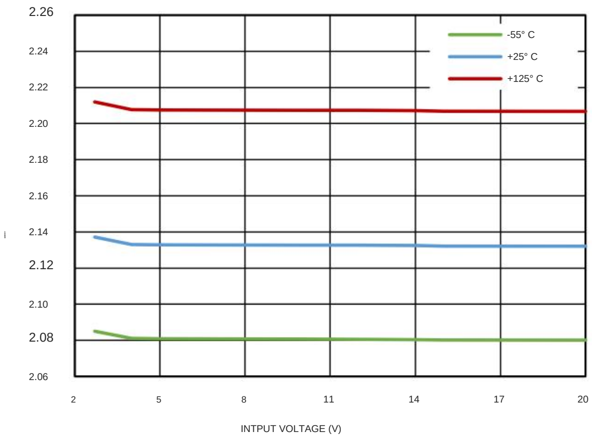


Figure 10. Quiescent current vs. input voltage, IOUT = 1mA

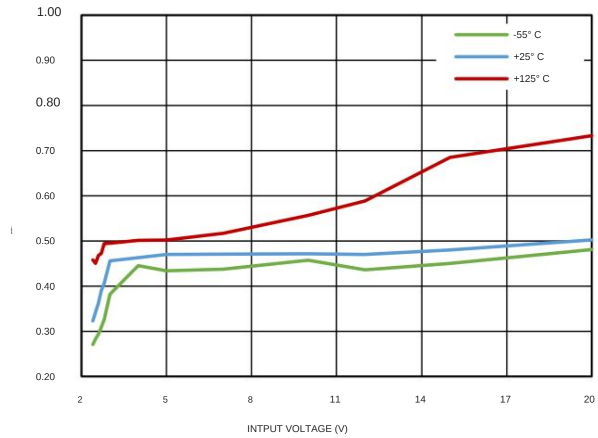


Figure 11. Shutdown Quiescent Current vs. Input Voltage

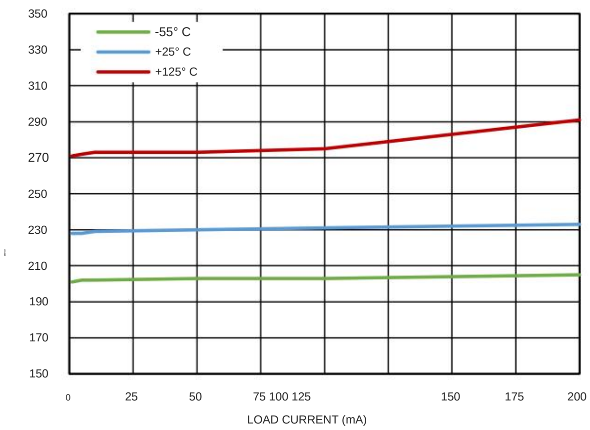


Figure 12. Dropout voltage vs. load current, VOUT = 3.3V

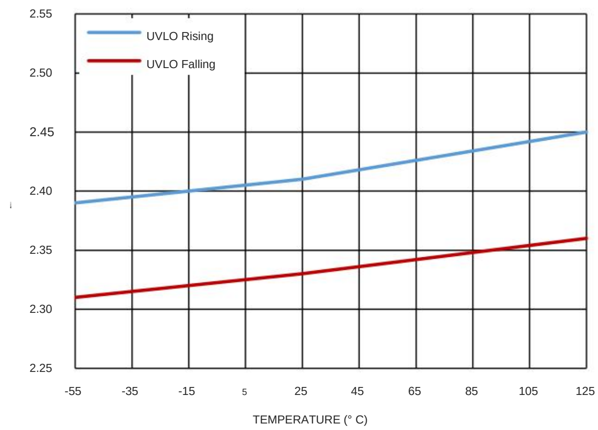


Figure 13. UVLO threshold

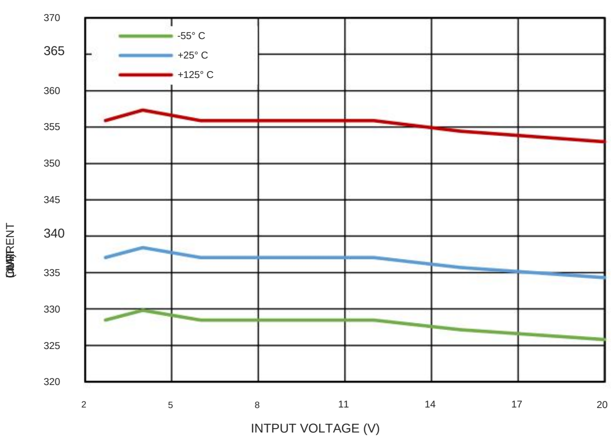


Figure 14. Output current limit vs. input voltage

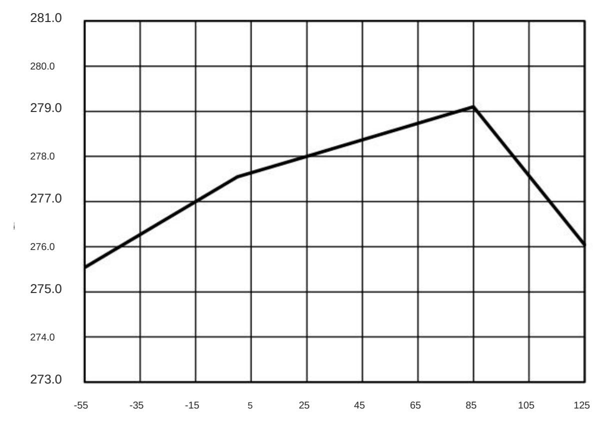


Figure 15. Output Current Limit Programming Factors

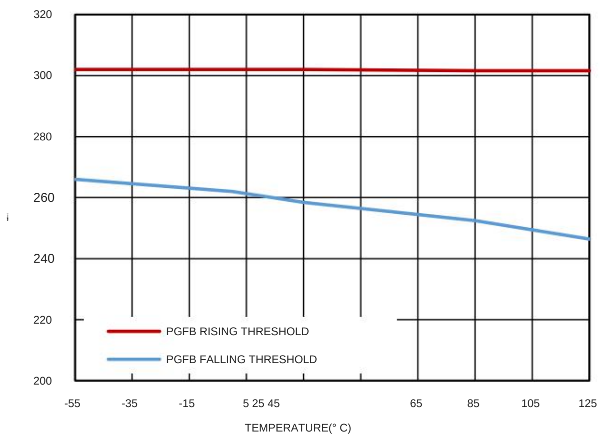


Figure 16. PGFB pin threshold

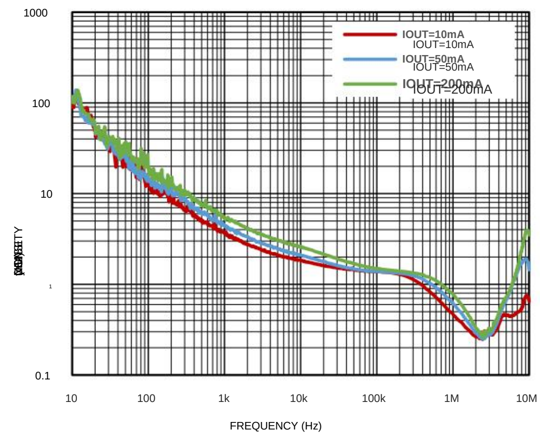


Figure 17. Output Noise Spectral Density, VIN=5V, VOUT=3.3V

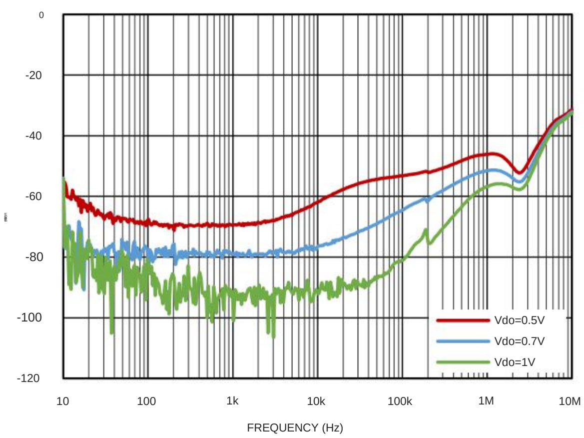


Figure 18. Relationship between power supply voltage ripple rejection ratio and voltage dropout, IOUT=200mA

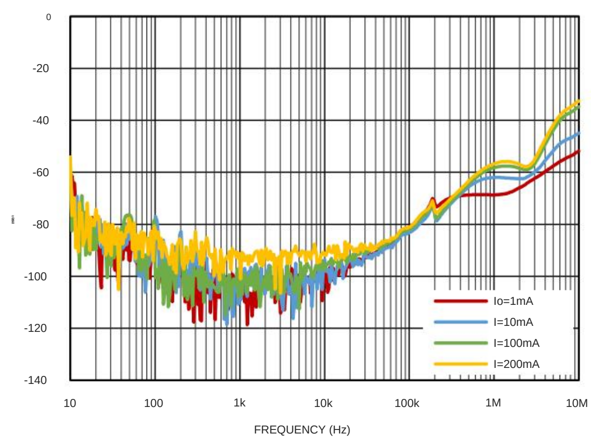


Figure 19. Supply voltage ripple rejection ratio, VIN=4.3V, VOUT=3.3V

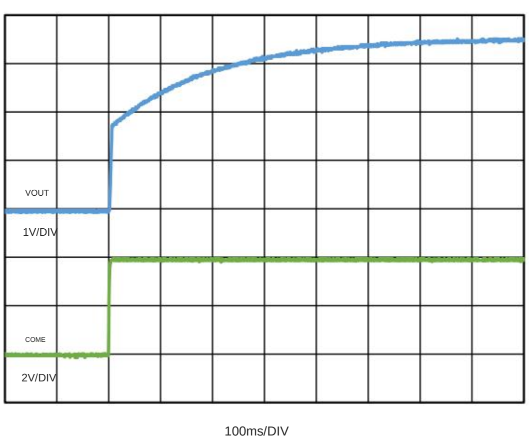


Figure 20. Soft start, VIN=4V, VOUT=3.3V, IOUT=200mA

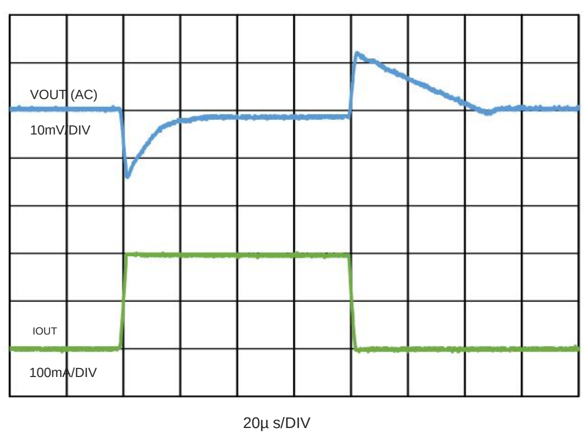


Figure 21. Load transient response, VIN=4V, VOUT=3.3V, IOUT=1mA to 200mA

Application Information

The GM1200 is a high-performance low-dropout linear regulator that uses an ultra-low noise (2.8nV/Hz at 10kHz) and ultra-high PSRR (70dB at 1MHz) architecture to power noise-sensitive applications. The GM1200 has a built-in high-precision current source followed by a high-performance rail-to-rail voltage buffer that can be paralleled to further reduce noise, increase output current, and spread heat on the PCB. In addition, the regulator also has programmable current limit, fast startup capability, and a programmable power good signal.

The GM1200 is easy to use and has the protection features needed in a high-performance regulator. This includes short-circuit protection and thermal

shutdown with

hysteresis. The output voltage GM1200 has a built-in high-precision 100µA current source from the SET pin, which is also connected to the inverting input of the error amplifier. As shown in Figure 22 , connecting a resistor between the SET pin and ground can generate a reference voltage for the error amplifier. The reference voltage is the product of the SET pin current and the SET pin resistance. The unity-gain configuration of the error amplifier can generate a low-impedance version of this voltage at its non-inverting input (i.e., the OUTS pin, which is connected to the OUT pin outside the device).

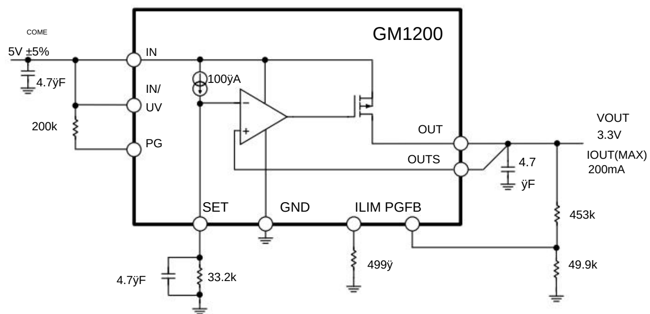


Figure 22 Typical

Applications The GM1200's rail-to-rail error amplifier and current reference provide a wide output voltage range, from 1.5V (with a 15kÿ resistor) to the VIN– dropout voltage (up to 15V). Read the "Electrical Characteristics" table for details on parameters such as error amplifier input-to-offset voltage, SET pin current, output noise, and PSRR variation. Table 5 lists commonly used output voltages and their corresponding 1% RSET resistors.

Table 5 1% resistors for common output voltages

VOUT(V)	RSET(k)
2.5	24.9
3.3	33.2
5	49.9
7	69.8
12	121

The benefit of using a current reference over a traditional regulator that uses a voltage reference is that the regulator always operates in a unity-gain configuration, which allows the GM1200 to have loop gain, frequency response, and bandwidth that are independent of the output voltage. Therefore, noise, PSRR, and transient performance do not vary with output voltage. Also, since no error amplifier gain is required to amplify the SET pin voltage to a higher output voltage, output voltage regulation can be tighter.

The grid is limited to a range of several hundred microvolts, rather than a fixed percentage of the output

voltage. Because the zero-temperature drift current source is highly accurate, only a single high-precision resistor is required on the SET pin to achieve high accuracy. Additionally, any leakage path to or from the SET pin will cause errors in the output voltage. If necessary, use high-quality insulation (e.g., Teflon, PTFE); in addition, all insulating surfaces may need to be cleaned to remove solder flux and other residues. In high humidity environments, it may be necessary to provide a moisture barrier on the SET pin. Board leakage can be minimized by

surrounding the SET pin with a guard ring that operates close to its own potential (ideally connected to the OUT pin). It is recommended to add protective rings to both sides of the circuit board. The reduction in bulk leakage depends on the width of the guard ring. Leakage currents as small as 100nA (into or out of the SET pin) will produce a 0.1% error in the reference voltage. Adding other leakage sources can cause significant errors in the output voltage, especially over a wide operating temperature range. Since the SET pin is a very high impedance node,

interference signals may couple to the SET pin and cause unstable operation. This phenomenon is more prominent when the load current is large and the output capacitance is small. Bypassing the SET pin to ground with a small capacitor (10nF is sufficient) solves this problem. Bypassing the SET pin is particularly important when using the guard ring method because it virtually eliminates the stray capacitance of the SET pin. For applications requiring high accuracy or an adjustable output voltage, the SET pin can be actively driven from an external voltage source capable of sinking 100µA. Connecting a high-precision voltage reference to the SET pin eliminates any errors caused by the reference current and the SET pin resistance. Output Sense The OUTS pin of the GM1200 provides a Kelvin sense connection to the output.

The GND

terminal of the SET pin resistor provides a Kelvin connection to the GND terminal of the load. In addition, the OUTS pin should be directly connected to the output capacitor (COUT), the GND terminal of the SET pin capacitor (CSET) should be directly connected to the GND terminal of COUT , and the input capacitor (CIN) and the GND terminal of COUT should be close to each other. Together, these initiatives are important to achieving stability. Stability and Output Capacitor The GM1200

requires an output capacitor for

stability. Due to their high bandwidth (approximately 1MHz), low ESR and ESL ceramic capacitors are recommended. To ensure stability, a 4.7µF (minimum) output capacitor with an ESR below 50mÿ and an ESL below 2nH is required. In order to minimize the impact of circuit board inductance on the dynamic performance of the GM1200, the OUTS pin should be directly connected to the output capacitor using a Kelvin connection, and the GND terminal of the SET pin capacitor (CSET) should be directly connected to the output using a Kelvin connection. GND terminal of the capacitor. In addition, the GND connection of the input capacitor should be connected as close as possible to the GND connection of the output capacitor.

Whereas the high PSRR and low noise performance is achieved with a single 4.7µF ceramic output capacitor, using a larger value of the output capacitor only improves performance slightly because the regulator bandwidth decreases with increasing output capacitance. Therefore, the benefit from using an output capacitor greater than 4.7µF (minimum) will be minimal. Nonetheless, larger output capacitor values do reduce load transients peak output deviation during the period. Note that bypass capacitors used to decouple individual components powered by the GM1200 increase the effective output capacitance. Additional consideration needs to be given to the type of ceramic output capacitor used. These capacitors are manufactured from a variety of dielectrics with different operating characteristics at different temperatures and applied voltages. The most commonly used dielectrics are designated using the EIA temperature signature codes Z5U, Y5V, X5R, and X7R. Z5U, Y5V dielectrics are suitable for providing high capacitance in small packages, but they tend to have strong voltage and temperature coefficients. When used with a 5V regulator, for the applied DC bias voltage, a 16V/10µF Y5V The capacitor exhibits an effective value as low as 1µF to 2µF over the entire operating temperature range.

X5R and X7R dielectrics produce more stable characteristics and are therefore more suitable for the GM1200. X7R dielectrics have better stability over temperature, while X5R dielectrics are less expensive and available in higher values. Nevertheless, caution must be exercised when using X5R and X7R capacitors. The X5R and X7R codes only specify the operating temperature range and the maximum capacitance change over

temperature. Stability and Input

Capacitance The GM1200 is stable with a minimum IN pin capacitance of 4.7µF, and low ESR ceramic capacitors are recommended.

When the input and ground terminals of the GM1200 are connected, the use of low-value input capacitors combined with large load currents can cause instability due to the LC resonance formed by the wire inductance and the input capacitor. The self-inductance (i.e., isolation inductance) of the wire is proportional to its length, but the diameter of the wire has a smaller effect on its self-inductance.

If the GM1200 is powered from a nearby battery, a 4.7µF input capacitor is sufficient for stability. If the GM1200 is powered from a remote source, a larger input capacitor is required. A rough guideline is to add 1µF of capacitance for every 20cm of wire length beyond the 4.7µF minimum. The minimum input capacitance required for application circuit stability also varies with output capacitance and load current. Placing additional capacitance at the output of the GM1200 can help. However, this requires much more capacitance than adding input bypassing. For example, use a higher ESR tantalum or electrolytic capacitor in parallel with a 4.7µF ceramic capacitor at the input of the GM1200. Output Noise The GM1200 offers many advantages in terms of noise performance. Traditional linear regulators have several sources

of noise. The

most critical noise sources for a traditional regulator are its voltage reference, error amplifier, the noise of the resistor divider network used to set the output voltage, and the noise gain created by the resistor network. Many low-noise regulators have their voltage reference pinned out to reduce noise by bypassing the reference voltage. Unlike most linear regulators, the GM1200 uses a 100µA low-noise current reference. The resulting voltage noise is equal to the current noise multiplied by the resistor value, which is then RMS summed with the error amplifier noise and the resistor's own noise of 4kTR (where k = Boltzmann's constant 1.38•10–23J/K and T is absolute temperature).

One problem with traditional linear regulators is that the resistor divider network that sets the output voltage adds reference noise. In contrast, the unity-gain follower architecture of the GM1200 provides no gain from the SET pin to the output. Therefore, if a capacitor bypasses the SET pin resistor, the output noise will be independent of the programmed output voltage. Thus, with a 4.7µF SET pin capacitor, the resulting output noise is set only by the error amplifier noise, typically 2.8nV/Hz (in a 10kHz to 1MHz bandwidth) and 0.8µVRMS (in 10Hz to 100kHz bandwidth). Paralleling multiple GM1200s can further reduce the noise by a factor of ÿ ($\overline{\text{N}}$ is the number of paralleled regulators). See the Typical Performance Characteristics section for noise spectral density and RMS integrated noise for various load currents and SET pin capacitances.

SET Pin Capacitor: Noise, PSRR, Transient Response, and Soft-Start In addition to reducing output noise, using a SET pin bypass capacitor improves PSRR and transient performance. Note that any bypass capacitor leakage will impair the DC regulation performance of the GM1200. Even 100nA of capacitor leakage will produce a 0.1% DC error. Therefore, it is recommended to use a high-quality low-leakage ceramic capacitor. In addition, using a SET pin bypass capacitor can also achieve soft-start of the output and limit inrush current. The RC time constant formed by the SET pin resistor and capacitor is used to control the soft-start time. The ramp rate from 0% to 90% of the nominal VOUT is:

$$= 2.3 \times \qquad \times$$

Fast Startup For ultra-low noise applications that require low 1/f noise (for example, in the frequency band below 100Hz), a larger value of the SET pin capacitor (up to 4.7µF) will be required, which will significantly increase the regulator's Start time. However, GM1200 has a built-in fast startup circuit for increasing the SET pin current to approximately 1.9mA during

startup. As shown in the Functional Block Diagram, the 1.9mA current source continues to operate when PGFB is below 302mV unless the regulator is in current limit, dropout, thermal shutdown, or the input voltage is below

minimum VIN. If the quick start function is not used, PGFB should be connected to IN or OUT. Note that doing so will also disable the power good indicator.

Filtering Out High-

Frequency Spikes For applications where the GM1200 is used to post-regulate a switching converter, the device's high PSRR effectively suppresses any "noise" present at the switching frequency of the switching power supply (typically 100kHz to 4MHz). However, the very high frequency (up to several hundred MHz) "spikes" (outside the bandwidth of the GM1200) associated with the power switching transition times of the switching power supply will pass almost directly through the GM1200. Although the output capacitor is designed in part to absorb these spikes, the ESL at these frequencies will limit its ability to absorb. A ferrite bead or the inductance caused by a short (for example: 1cm) PCB trace between the output of the switching power supply and the input of the GM1200 can act as

an LC filter and

suppress these high frequency spikes. Enable/UVLO The EN/UV pin is used to place the regulator into a mic

The GM1200 has an accurate 1.07V turn-on threshold and 100mV hysteresis on the EN/UV pin. This threshold is used with a resistor divider from the input supply to set the accurate undervoltage lockout (UVLO) threshold for the regulator. When calculating the resistor divider network, consider the EN/UV pin current (IEN) at this threshold given in the Electrical Characteristics table:

$$(\quad) = 1.07 \times (1 + \frac{\quad_2}{\quad_1}) + \times \quad_2$$

If REN1 is less than 100k, the EN/UV pin current (IEN) can be ignored. Connect the EN/UV pin to IN when not in use .

Programmable Power Good

As shown in the "Functional Block Diagram", the Power Good threshold is user programmable using two external resistors (RPG2 and RPG1):

$$(\_ \quad) = 0.305 \times (1 + \frac{{}_{2}}{{}_{1}}) + \quad \times \quad {}_{2}$$

If the PGFB pin voltage increases above 302mV, the open-drain PG pin is deasserted and becomes high impedance. The power good comparator has 60mV hysteresis and 5µs deglitch time. The PGFB pin current (IPGFB) given in the "Electrical Characteristics" table must be considered when determining the resistor divider network. If RPG1 is less than 30k, the PGFB pin current (IPGFB) can be ignored. If the power good flag function is not used, the PG pin can be

left floating. Externally Programmable Current Limit

The current limit threshold of the ILIM pin is 300mV. Connecting a resistor from ILIM to GND sets the maximum current out of the ILIM pin and also sets the current limit of the GM1200. The programmed scale factor is 128mA•kÿ. For example, a 1kÿ resistor sets the current limit to 128mA, while a 2kÿ resistor sets the current limit to 64mA. For good accuracy, the resistor should be connected to the GND pin of the GM1200 using a Kelvin connection. As shown in

the Functional Block Diagram, the ILIM pin provides a current proportional to the output current; therefore, it also acts as a current monitoring pin with a range of 0V to 300mV. If external current limiting or current monitoring is not used, connect ILIM to GND.

Output Overshoot

Recovery During a transition from full load to no load (or light load), the output voltage overshoot occurs before the regulator responds by shutting down the power transistor. Assuming there is no load (or a light load) on the output, it will take a long

time to discharge the output capacitor. By adding a dummy load to the output, or using a smaller PGFB divider resistor, the output capacitor can be discharged when OUTS is higher

than SET. This current is typically

about 0.7mA. Parallel Operation Provides Higher Current Higher currents can be obtained by paralleling multiple GM1200s. Connect all SET pins together and all IN pins together. Use a small section of PCB trace (used as a ballast resistor) to connect the OUT pins together to balance the current in the GM1200s.

The worst-case offset of each paralleled GM1200 is small (4.8mV), thus minimizing the required ballast resistor value.

50mÿ PCB trace ballast resistors provide better than 52% output current sharing at full load. At 400mA maximum current, two 50mÿ external resistors add only 10mV to the output regulation voltage drop. For a 3.3V output, this adds only 0.3% regulation accuracy and connects the OUTS pin directly to the output capacitor. Connecting more than two GM1200s in parallel

can provide higher output current and reduce output noise. In addition, connecting multiple GM1200s in parallel also helps spread heat on the PCB. For applications with high input-output voltage differentials, series resistors or resistors in parallel with the GM1200 can also be used to spread the heat. Thermal Considerations The GM1200

has internal

power limiting and thermal limiting circuits to protect the device in overload conditions. The thermal shutdown temperature is nominally 160°C with approximately 10°C hysteresis. For continuous normal load conditions, do not exceed the maximum junction temperature of 125°C. It is important to consider all sources of thermal resistance from junction to ambient. This includes junction to case, case to heat sink interface, heat sink resistance, or board to ambient, as dictated by the application. In addition, all heat sources in close proximity to the GM1200 should also be considered.

The bottom surface of the DFN package has exposed metal from the lead frame to the die mount. Both packages allow heat to transfer directly from the die junction to the PCB metal to limit the maximum operating junction temperature. On the top side (component side) of the PCB, the dual in-line pin configuration allows the metal to extend beyond the end faces of the package.

For surface mount packages, heat dissipation is achieved by utilizing the heat spreading capabilities of the PCB and its copper traces. In addition, copper board stiffeners and plated through holes can also be used to spread the heat generated by the

regulator. Protection Features

The GM1200 has built-in high-precision current limiting and thermal overprotection, providing protection against overload and fault conditions on the device output. For normal operation, do not allow the junction temperature to exceed 125°C. To protect the GM1200's low-noise error amplifier, the SET to OUTS protection clamp limits the maximum voltage between SET and OUTS to 15V (the maximum DC current flowing through the clamp is 10mA). Therefore, for applications where the SET is actively driven by a voltage source, the voltage source current must be limited to 10mA or less. Also, to limit the transient current flowing through these clamps during transient fault conditions, the SET pin capacitance (CSET) should be limited to a maximum value of 22µF.

Package Description

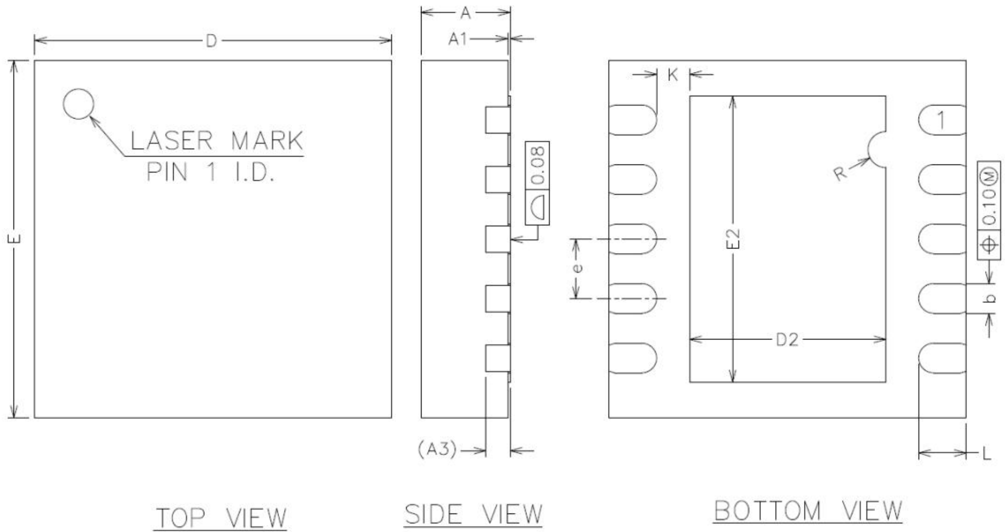
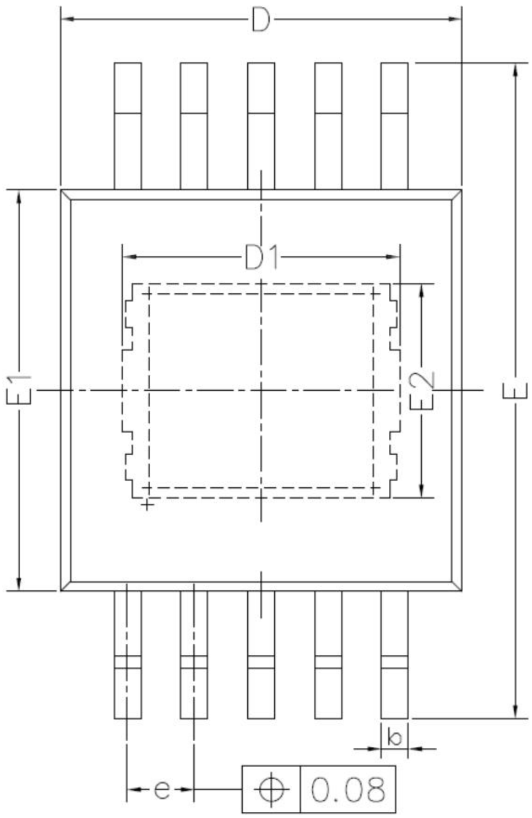
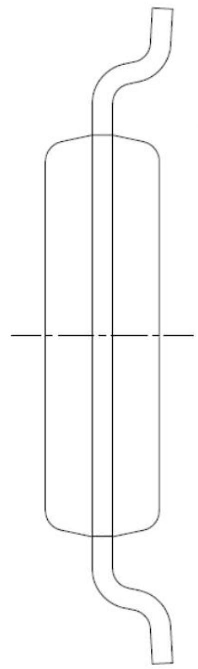


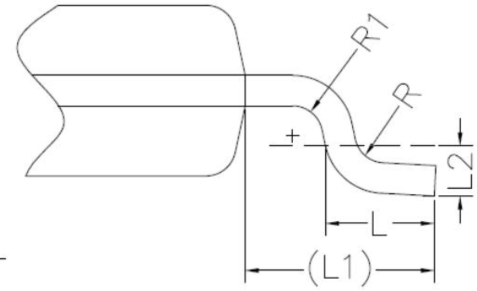
Figure 23 DFN package (3mmx3mm)

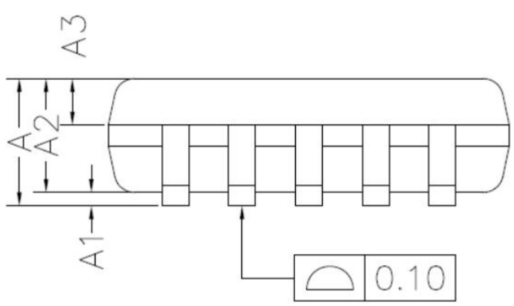
COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
A3	0.20REF		
b	0.20	0.25	0.30
D	2.90	3.00	3.10
E	2.90	3.00	3.10
D2	1.60	1.65	1.80
E2	2.30	2.40	2.50
e	0.45	0.50	0.55
K	0.175	0.275	0.375
L	0.30	0.40	0.50
R	0.15REF		









COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	–	–	1.10
A1	0.05	0.10	0.15
A2	0.75	0.85	0.95
A3	0.30	0.35	0.40
b	0.18	–	0.27
D	2.90	3.00	3.10
D1	1.92	2.07	2.22
E	4.75	4.90	5.05
E1	2.90	3.00	3.10
E2	1.45	1.60	1.75
e	0.40	0.50	0.60
L	0.40	0.55	0.70
L1		0.95REF	
L2		0.25BSC	
R	0.07	–	–
R1	0.07	–	–

Figure 24 MSOP package

Ordering Guide

model	Temperature range	Package Description	Top label
GM1200ACPZ	ÿ40°C to +125°C	DFN-10	GM1200
GM1200MCPZ	ÿ55°C to +125°C	DFN-10	GM1200
GM1200WACPZ	ÿ40°C to +125°C	DFN-10	GM1200W
GM1200ARMZ-R7	ÿ40°C to +125°C	MSOP-10	GM1200

Z = RoHS Compliant Part