MIC5253

100 mA Low Noise μCap LDO

Features

- Input Voltage Range: 2.7V to 5.5V
- 5-Lead SC-70 Package
- Ultra-Low Output Noise: 30 μ$V_{(RMS)}$
- 100 mA Continuous Output Current, 150 mA Peak Current
- Stable with Ceramic Output Capacitors
- Ultra-Low Dropout: 165 mV @ 100 mA
- High Output Accuracy:
  - 1.5% Initial Accuracy
  - 3.0% over Temperature
- Low Ground Current: 95 μA
- TTL Logic Controlled Enable Input
- “Zero” Off-Mode Current
- Thermal Shutdown and Current Limit Protection

Applications

- Cellular Phones and Pagers
- Cellular Accessories
- Battery-Powered Equipment
- Laptop, Notebook, and Palmtop Computers
- Consumer/Personal Electronics

General Description

The MIC5253 is an efficient, CMOS voltage regulator optimized for ultra low noise applications. It offers 1.5% initial accuracy, extremely low dropout voltage (165 mV at 100 mA), and low ground current (typically 95 μA at full load). The MIC5253 provides a very low noise output, ideal for RF applications where a clean voltage source is required. A noise bypass pin is also available for further reduction of output noise.

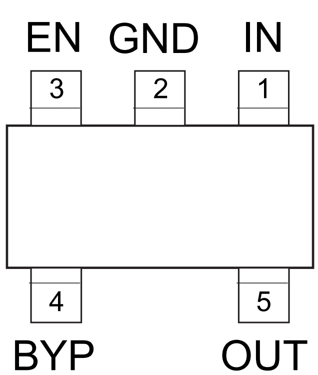
Designed specifically for handheld and battery-powered devices, the MIC5253 provides a TTL logic compatible enable pin. When disabled, power consumption drops nearly to zero.

The MIC5253 also works with low-ESR ceramic capacitors, reducing the amount of board space necessary for power applications, which is critical in handheld wireless devices.

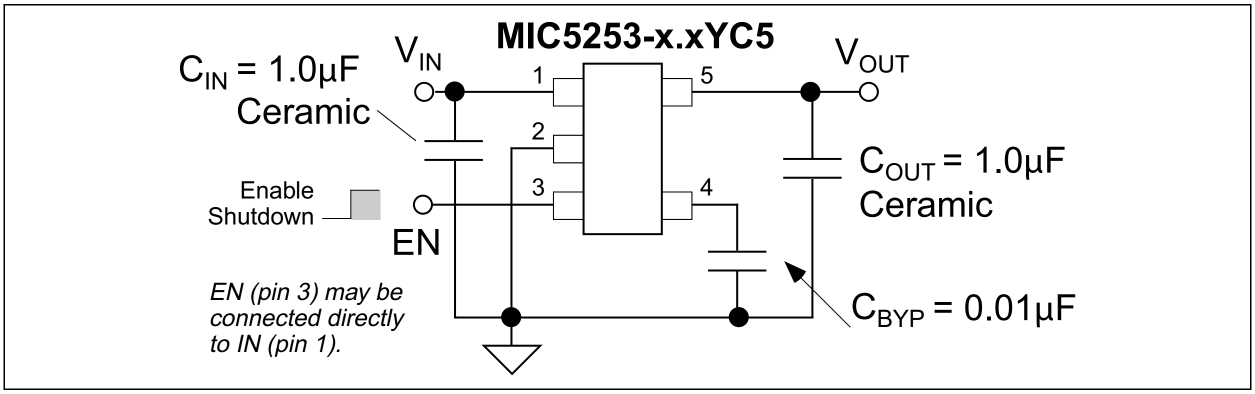
Available in a 5-lead SC-70 package, the MIC5253 offers a wide range of output voltages. Key features include current limit, thermal shutdown, faster transient response, and an active clamp to speed up device turn-off.

Package Type

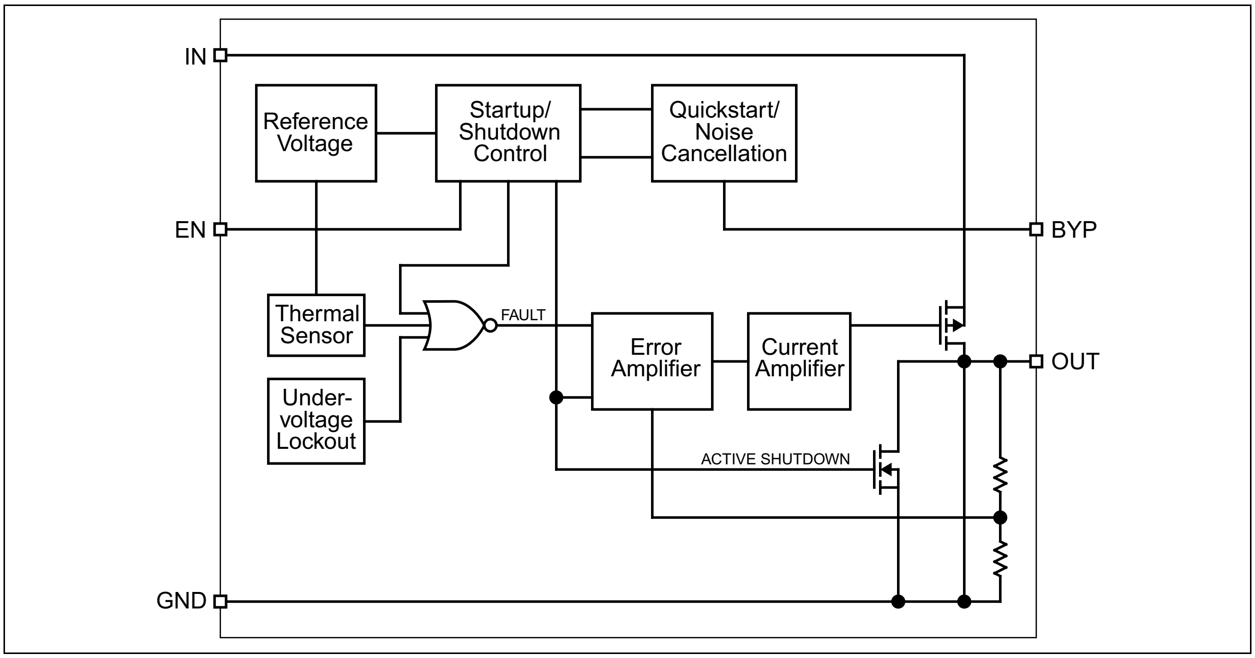
MIC5253
5-Lead SC-70 (C5)
(Top View)



Typical Application Circuit



Functional Block Diagram



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

Input Supply Voltage (V_{IN}) .... 0V to +7V
Enable Input Voltage (V_{EN}) .... 0V to +7V
Power Dissipation (Note 1) .... Internally Limited
ESD Rating (Note 2) .... 2 kV

Operating Ratings ‡

Input Voltage (V_{IN}) .... +2.7V to +5.5V
Enable Input Voltage (V_{EN}) .... 0V to V_{IN}

† Notice: Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational sections of this specification is not intended. Exposure to maximum rating conditions for extended periods may affect device reliability.

‡ Notice: The device is not guaranteed to function outside its operating ratings.

Note 1: The maximum allowable power dissipation of any T_A (ambient temperature) is $P_{D(MAX)} = (T_{J(MAX)} – T_A)/\theta_{JA}$. Exceeding the maximum allowable power dissipation will result in excessive die temperature, and the regulator will go into thermal shutdown. The θ_{JA} of the MIC5253-x.xYC5 (all versions) is 400°C/W on a PC board (see the Thermal Considerations section for further details).

2: Devices are ESD sensitive. Handling precautions recommended.

ELECTRICAL CHARACTERISTICS

Electrical Characteristics: $V_{IN} = V_{OUT} + 1V$, $V_{EN} = V_{IN}$; $I_{OUT} = 100$ µA; $T_J = +25°C$, **bold** values valid for –40°C ≤ T_J ≤ +125°C; unless otherwise noted. Note 1

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Output Voltage Accuracy	V_O	–1.5	—	1.5	%	I_{OUT} = 100 µA
		–3	—	**3**		
Line Regulation	$\Delta V_{OUT}/(V_{OUT} \times \Delta V_{IN})$	—	0.035	0.05	%/V	$V_{IN} = V_{OUT}$ + 1V to 6V
Load Regulation	$\Delta V_{OUT}/V_{OUT}$	—	1.5	2.5	%	I_{OUT} = 0.1 mA to 100 mA, Note 2
Dropout Voltage (Note 3)	$V_{IN} – V_{OUT}$	—	80	**150**	mV	I_{OUT} = 50 mA
		—	165	**300**		I_{OUT} = 100 mA
Quiescent Current	I_Q	—	0.2	**1**	µA	V_{EN} ≤ 0.4V (shutdown)
Ground Pin Current (Note 4)	I_{GND}	—	75	**100**	µA	I_{OUT} = 0 mA
		—	90	**150**		I_{OUT} = 100 mA
Ripple Rejection	PSRR	—	66	—	dB	f = 100 Hz, C_{OUT} = 1.0 µF, C_{BYP} = 0.1 µF
		—	70	—		f = 1 kHz, $V_{IN} = V_{OUT}$ + 1V, C_{BYP} = 0.1 µF
		—	65	—		f = 10 kHz, $V_{IN} = V_{OUT}$ + 1V, C_{BYP} = 0.1 µF
Turn-On Time	t_{ON}	—	30	**150**	µs	—
Current Limit	I_{LIM}	150	250	**450**	mA	V_{OUT} = 0V
Output Voltage Noise	e_n	—	30	—	$µV_{RMS}$	C_{OUT} = 1.0 µF, C_{BYP} = 0.01 µF, f = 10 Hz to 100 kHz

ELECTRICAL CHARACTERISTICS (CONTINUED)

Electrical Characteristics: $V_{IN} = V_{OUT} + 1V$, $V_{EN} = V_{IN}$; $I_{OUT} = 100\ \mu A$; $T_J = +25°C$, **bold** values valid for $–40°C \le T_J \le +125°C$; unless otherwise noted. Note 1

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Enable Input						
Enable Input Logic-Low Voltage	V_{IL}	—	—	**0.4**	V	V_{IN} = 2.7V to 5.5V, regulator shutdown
Enable Input Logic-High Voltage	V_{IH}	**1.6**	—	—	V	V_{IN} = 2.7V to 5.5V, regulator enabled
Enable Input Current	I_{EN}	—	0.01	—	µA	$V_{IL} \le 0.4V$, regulator shutdown
		—	0.01	—		$V_{IH} \ge 1.6V$, regulator enabled
Thermal Protection						
Thermal Shutdown Temperature	—	—	150	—	°C	—
Thermal Shutdown Hysteresis	—	—	10	—	°C	—

Note 1: Specification for packaged product only.

2: Regulation is measured at constant junction temperature using low duty cycle pulse testing. Parts are tested for load regulation in the load range from 0.1 mA to 100 mA. Changes in output voltage due to heating effects are covered by the thermal regulation specification.

3: Dropout voltage is defined as the input-to-output differential at which the output drops 2% below its nominal value measured at 1V differential. For outputs below 2.7V, dropout voltage is the input-to-output voltage differential with the minimum input voltage 2.7V. Minimum input operating voltage is 2.7V.

4: Ground pin current is the regulator quiescent current. The total current drawn from the supply is the sum of the load current plus the ground pin current.

TEMPERATURE SPECIFICATIONS

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Temperature Ranges						
Junction Temperature Range	T_J	–40	—	+125	°C	—
Storage Temperature	T_S	–65	—	+150	°C	—
Lead Temperature	T_{LEAD}	—	—	+260	°C	Soldering, 5 sec.
Package Thermal Resistances						
Thermal Resistance, SC-70 5-Ld	θ_{JA}	—	400	—	°C/W	—

2.0 TYPICAL PERFORMANCE CURVES

Note: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g., outside specified power supply range) and therefore outside the warranted range.

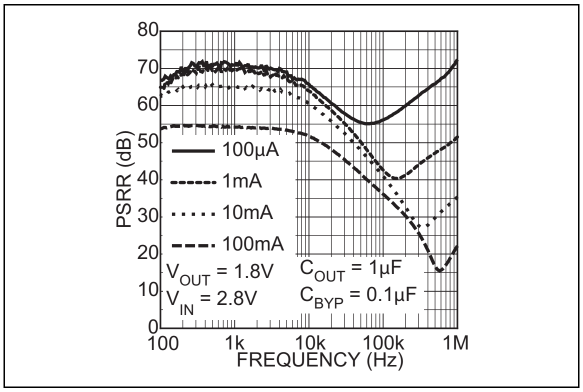


FIGURE 2-1: *Power Supply Rejection Ratio.*

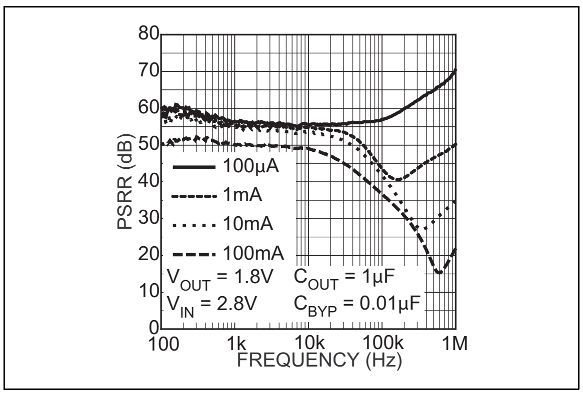


FIGURE 2-2: *Power Supply Rejection Ratio.*

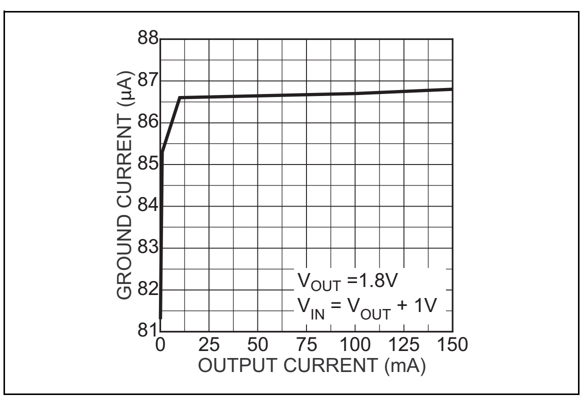


FIGURE 2-3: *Ground Pin Current.*

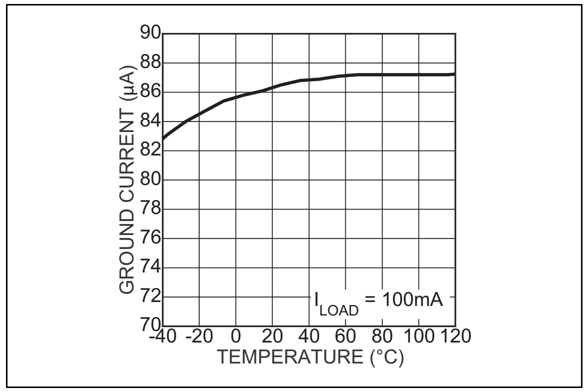


FIGURE 2-4: *Ground Pin Current.*

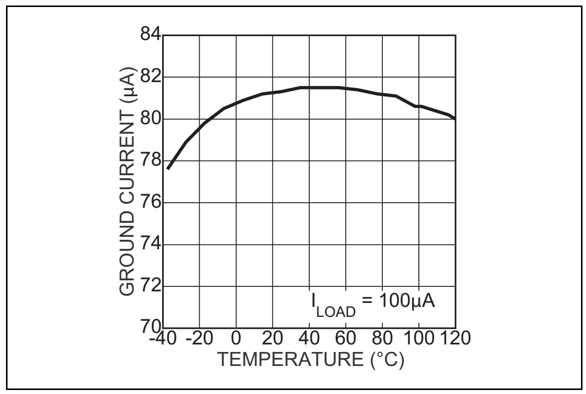


FIGURE 2-5: *Ground Pin Current.*

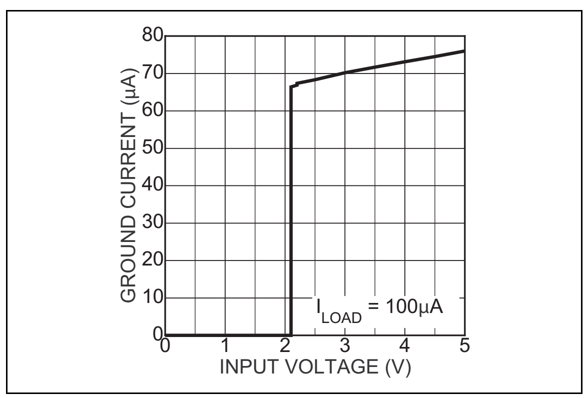


FIGURE 2-6: *Ground Pin Current.*

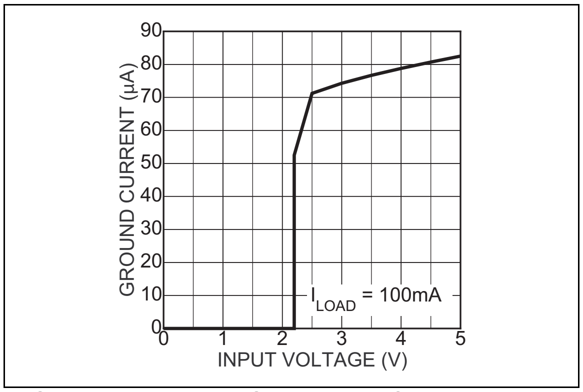


FIGURE 2-7: *Ground Pin Current.*

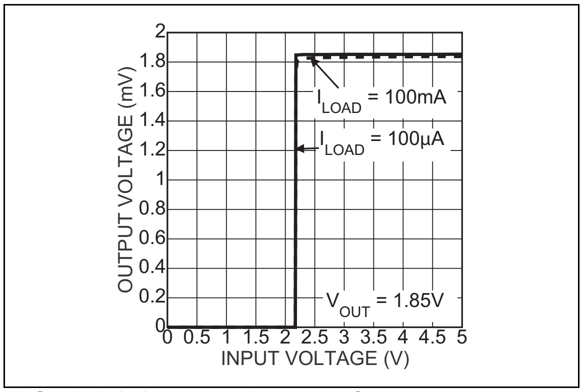


FIGURE 2-8: *Dropout Characteristics.*

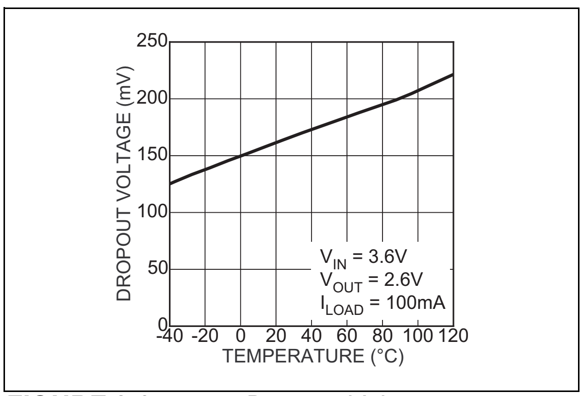


FIGURE 2-9: *Dropout Voltage.*

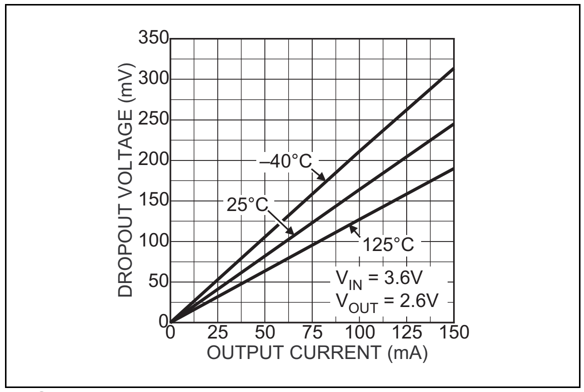


FIGURE 2-10: *Dropout Voltage.*

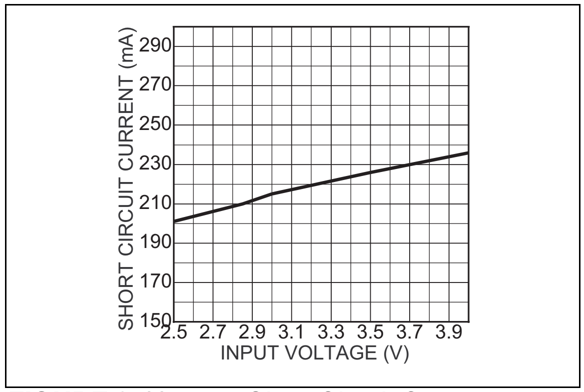


FIGURE 2-11: *Short Circuit Current.*

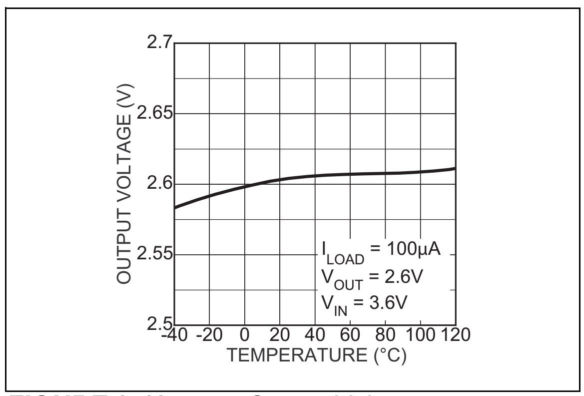


FIGURE 2-12: *Output Voltage vs. Temperature.*

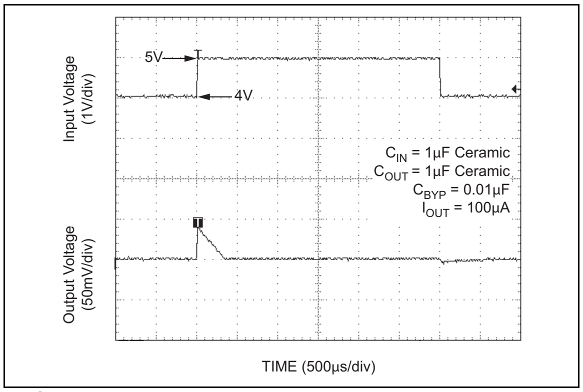


FIGURE 2-13: *Line Transient Response.*

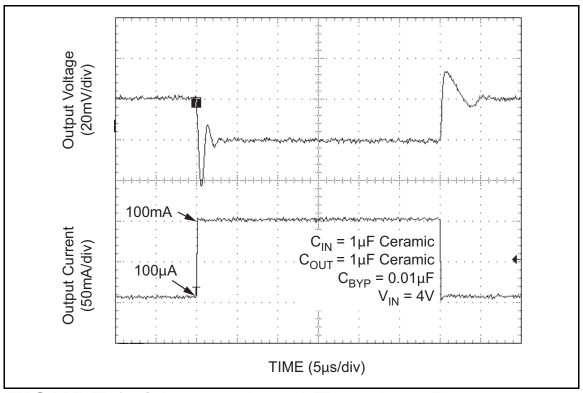


FIGURE 2-14: *Load Transient Response.*

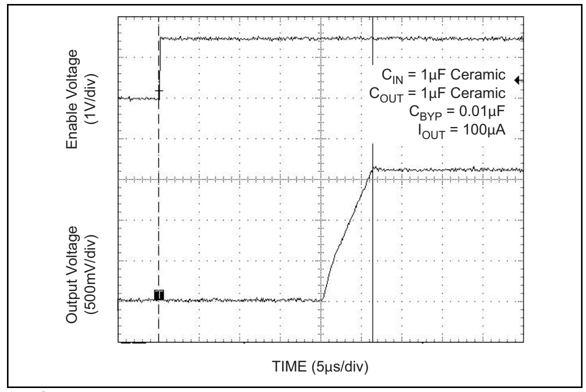


FIGURE 2-15: *Enable Pin Delay.*

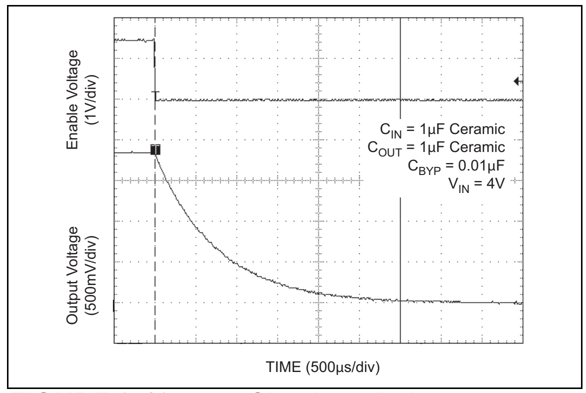


FIGURE 2-16: *Shutdown Delay.*

3.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in Table 3-1.

TABLE 3-1: PIN FUNCTION TABLE

Pin Number	Pin Name	Description
1	IN	Supply input.
2	GND	Ground.
3	EN	Enable/Shutdown (Input): CMOS compatible input. Logic high = enable; logic low = shutdown. Do not leave open.
4	BYP	Reference bypass: Connect external 0.01 µF ≤ C_{BYP} ≤ 1.0 µF capacitor to GND to reduce output noise. May be left open.
5	OUT	Regulator output.

4.0 APPLICATION INFORMATION

4.1 Enable/Shutdown

The MIC5253 comes with an active-high enable pin that allows the regulator to be disabled. Forcing the enable pin low disables the regulator and sends it into a "zero" off-mode current state. In this state, current consumed by the regulator goes nearly to zero. Forcing the enable pin high enables the output voltage. This part is CMOS and the enable pin cannot be left floating; a floating enable pin may cause an indeterminate state on the output.

4.2 Input Capacitor

The MIC5253 is a high performance, high bandwidth device. Therefore, it requires a well-bypassed input supply for optimal performance. A 1 µF capacitor is required from the input to ground to provide stability. Low-ESR ceramic capacitors provide optimal performance at a minimum of space. Additional high-frequency capacitors, such as small valued NPO dielectric type capacitors, help filter out high frequency noise and are good practice in any RF-based circuit.

4.3 Output Capacitor

The MIC5253 requires an output capacitor for stability. The design requires 1 µF or greater on the output to maintain stability. The design is optimized for use with low-ESR ceramic chip capacitors. High ESR capacitors may cause high frequency oscillation. The maximum recommended ESR is 300 mΩ. The output capacitor can be increased, but performance has been optimized for a 1 µF ceramic output capacitor and does not improve significantly with larger capacitance.

X7R/X5R dielectric-type ceramic capacitors are recommended because of their temperature performance. X7R type capacitors change capacitance by 15% over their operating temperature range and are the most stable type of ceramic capacitors. Z5U and Y5V dielectric capacitors change value by as much as 50% and 60%, respectively, over their operating temperature ranges. To use a ceramic chip capacitor with Y5V dielectric, the value must be much higher than an X7R ceramic capacitor to ensure the same minimum capacitance over the equivalent operating temperature range.

4.4 Bypass Capacitor

A capacitor can be placed from the noise bypass pin to ground to reduce output voltage noise. The capacitor bypasses the internal reference. A 0.01 µF capacitor is recommended for applications that require low-noise outputs. The bypass capacitor can be increased, further reducing noise and improving PSRR. Turn-on time increases slightly with respect to bypass capacitance. A unique quick-start circuit allows the MIC5253 to drive a large capacitor on the bypass pin without significantly slowing turn-on time. Refer to the Typical Performance Curves section for performance with different bypass capacitors.

4.5 Active Shutdown

The MIC5253 also features an active shutdown clamp, which is an N-channel MOSFET that turns on when the device is disabled. This allows the output capacitor and load to discharge, de-energizing the load.

4.6 No-Load Stability

The MIC5253 will remain stable and in regulation with no load unlike many other voltage regulators. This is especially important in CMOS RAM keep-alive applications.

4.7 Thermal Considerations

The MIC5253 is designed to provide 100 mA of continuous current in a very small package. Maximum ambient operating temperature can be calculated based on the output current and the voltage drop across the part. Given that the input voltage is 5.0V, the output voltage is 2.9V, and the output current equals 100 mA.

The actual power dissipation of the regulator circuit can be determined using the following equation:

EQUATION 4-1:

$$P_D = (V_{IN} - V_{OUT}) \times I_{OUT} + V_{IN} \times I_{GND}$$

Because this device is CMOS and the ground current is typically <100 µA over the load range, the power dissipation contributed by the ground current is <1% and can be ignored for this calculation.

EQUATION 4-2:

$$P_D = (5.0V - 2.9V) \times 100mA$$

$$P_D = 0.21W$$

To determine the maximum ambient operating temperature of the package, use the junction-to-ambient thermal resistance of the device and the following basic equation:

EQUATION 4-3:

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

Where:

$T_{J(MAX)}$ = 125°C, the max. junction temp. of the die.

θ_{JA} = Thermal resistance of 400°C/W.

Table 4-1 shows junction-to-ambient thermal resistance for the MIC5253 in the SC-70 package.

TABLE 4-1: THERMAL RESISTANCE FOR SC-70 PACKAGE

θ_{JA} Rec. Min. Footprint	θ_{JA} 1” Sq. Copper Clad	θ_{JC}
400°C/W	325°C	250°C/W

Substituting P_D for $P_{D(MAX)}$ and solving for the ambient operating temperature will give the maximum operating conditions for the regulator circuit. The junction-to-ambient thermal resistance for the minimum footprint is 400°C/W, from Table 4-1. The maximum power dissipation must not be exceeded for proper operation.

For example, when operating the MIC5253-2.9YC5 at an input voltage of 5.0V and 100 mA load with a minimum footprint layout, the maximum ambient operating temperature T_A can be determined as follows:

EQUATION 4-4:

$$0.21W = \frac{125°C - T_A}{400°C/W}$$

$$T_A = 41°C$$

Therefore, a 2.9V application at 100mA of output current can accept an ambient operating temperature of 41°C in a SC-70 package. For a full discussion of heat sinking and thermal effects on voltage regulators, refer to the “Regulator Thermals” section of the Designing with Low-Dropout Voltage Regulators handbook.

5.0 PACKAGING INFORMATION

5.1 Package Marking Information

5-Lead SC-70* (Front)	Example
XXX	72J

5-Lead SC-70* (Back)	Example
NNN	KS2

Note: The marking code for the 2.85V option is shown above. The other codes and voltage options are shown below.

TABLE 5-1: MARKING CODES

Part Number	Marking	Part Number	Marking
MIC5253-1.5YC5	715	MIC5253-2.8YC5	728
MIC5253-1.8YC5	718	MIC5253-2.9YC5	729
MIC5253-1.85YC5	71J	MIC5253-3.0YC5	730
MIC5253-2.5YC5	725	MIC5253-3.1YC5	731
MIC5253-2.6YC5	726	MIC5253-3.2YC5	732
MIC5253-2.7YC5	727	MIC5253-3.3YC5	733

Legend:
- XX...X Product code or customer-specific information
- Y Year code (last digit of calendar year)
- YY Year code (last 2 digits of calendar year)
- WW Week code (week of January 1 is week '01')
- NNN Alphanumeric traceability code
- (e3) Pb-free JEDEC® designator for Matte Tin (Sn)
- * This package is Pb-free. The Pb-free JEDEC designator ((e3)) can be found on the outer packaging for this package.
- ●, ▲, ▼ Pin one index is identified by a dot, delta up, or delta down (triangle mark).

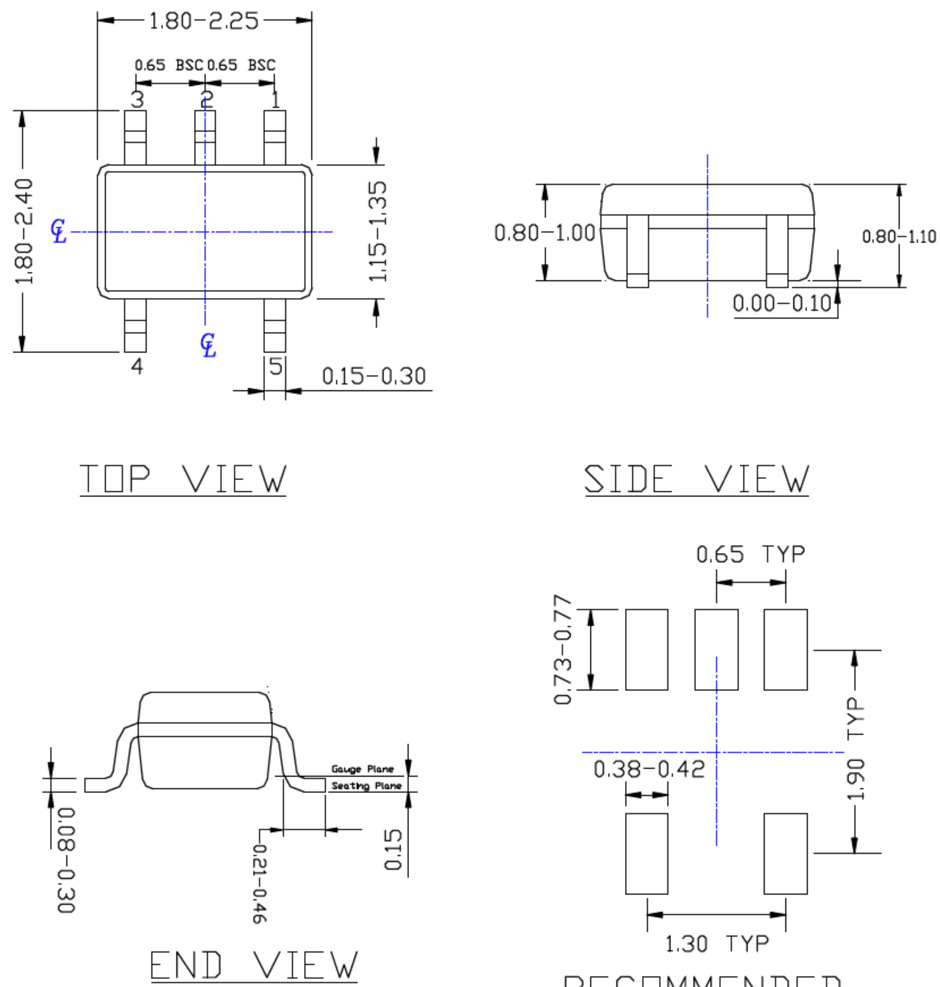
Note: In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information. Package may or may not include the corporate logo.

Underbar (_) symbol may not be to scale.

Note: If the full seven-character YYWWNNN code cannot fit on the package, the following truncated codes are used based on the available marking space:
6 Characters = YWWNNN; 5 Characters = WWNNN; 4 Characters = WNNN; 3 Characters = NNN;
2 Characters = NN; 1 Character = N

TITLE
5 LEAD SC70 PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

DRAWING #	SC70-5LD-PL-1	**UNIT**	MM



RECOMMENDED LAND PATTERN

NOTE:

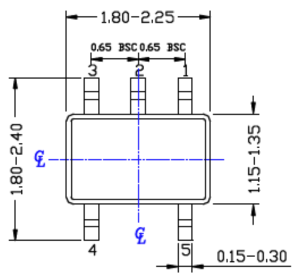
1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSIONS ARE INCLUSIVE OF PLATING.
3. DIMENSIONS ARE EXCLUSIVE OF MOLD FLASH & METAL BURR.

Note:	For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging.

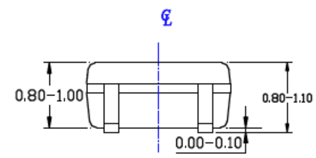
TITLE

5 LEAD SC70 PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

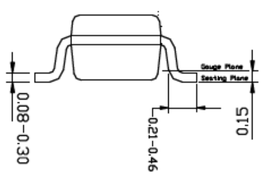
DRAWING #	SC70-5LD-PL-2	**UNIT**	MM



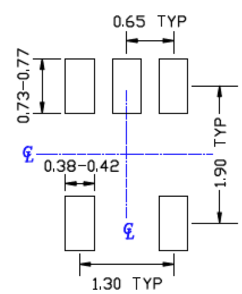
TOP VIEW



SIDE VIEW



END VIEW



RECOMMENDED LAND PATTERN

NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSIONS ARE INCLUSIVE OF PLATING.
3. DIMENSIONS ARE EXCLUSIVE OF MOLD FLASH & METAL BURR.

Note:	For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging.

NOTES:

APPENDIX A: REVISION HISTORY

Revision A (August 2022)

- Converted Micrel document MIC5253 to Microchip data sheet DS20006713A.
- Minor text changes throughout.

NOTES:

PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, contact your local Microchip representative or sales office.

Part Number	-X.X	X	XX	-XX
Device	Output Voltage	Temp. Range	Package	Media Type

Device:	MIC5253:	100 mA Low Noise µCap LDO
Output Voltage:	1.5 =	1.5V
	1.8 =	1.8V
	1.85 =	1.85V
	2.5 =	2.5V
	2.6 =	2.6V
	2.7 =	2.7V
	2.8 =	2.8V
	2.85 =	2.85V
	2.9 =	2.9V
	3.0 =	3.0V
	3.1 =	3.1V
	3.2 =	3.2V
	3.3 =	3.3V
Temperature Range:	Y =	–40°C to +125°C
Package:	C5 =	5-Lead SC-70
Media Type:	TR =	3,000/Reel
	TX =	3,000/Reel Reverse (2.5V option only)

Examples:

a) MIC5253-1.5YC5-TR: MIC5253, 1.5V Output Voltage, –40°C to +125°C Temp. Range, 5-Lead SC-70, 3,000/Reel

b) MIC5253-1.8YC5-TR: MIC5253, 1.8V Output Voltage, –40°C to +125°C Temp. Range, 5-Lead SC-70, 3,000/Reel

c) MIC5253-2.5YC5-TX: MIC5253, 2.5V Output Voltage, –40°C to +125°C Temp. Range, 5-Lead SC-70, 3,000/Reel Rev.

d) MIC5253-2.85YC5-TR: MIC5253, 2.85V Output Voltage, –40°C to +125°C Temp. Range, 5-Lead SC-70, 3,000/Reel

e) MIC5253-3.0YC5-TR: MIC5253, 3.0V Output Voltage, –40°C to +125°C Temp. Range, 5-Lead SC-70, 3,000/Reel

f) MIC5253-3.1YC5-TR: MIC5253, 3.1V Output Voltage, –40°C to +125°C Temp. Range, 5-Lead SC-70, 3,000/Reel

g) MIC5253-3.3YC5-TR: MIC5253, 3.3V Output Voltage, –40°C to +125°C Temp. Range, 5-Lead SC-70, 3,000/Reel

Note 1: Tape and Reel identifier only appears in the catalog part number description. This identifier is used for ordering purposes and is not printed on the device package. Check with your Microchip Sales Office for package availability with the Tape and Reel option.

NOTES:

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