Micropower Voltage Reference

ISL21010

The ISL21010 is a precision, low dropout micropower bandgap voltage reference in a space-saving SOT-23 package. It operates from a single 2.2V to 5.5V supply (minimum voltage is dependent on voltage option) and provides a ±0.2% accurate reference.

The ISL21010 provides up to 25mA output current sourcing with low 150mV dropout voltage. Output voltage options include 1.024V, 1.2V, 1.5V, 2.048V, 2.5V, 3.0V, 3.3V and 4.096V. The low supply current and low dropout voltage combined with high accuracy make the ISL21010 ideal for precision battery powered applications.

Applications

- Battery Management/Monitoring
- Low Power Standby Voltages
- Portable Instrumentation
- Consumer/Medical Electronics
- Lower Cost Industrial and Instrumentation
- Power Regulation Circuits
- Control Loops and Compensation Networks
- LED/Diode Supply

Features

- Reference Output Voltages 1.024V, 1.25V, 1.5V, 2.048V, 2.5V, 3.0V, 3.3V, 4.096V
- Precision 0.2% Initial Accuracy
- Input Voltage Range:
  - ISL21010-10, -12, -15 (Coming Soon) . . . . . . 2.2V to 5.5V
  - ISL21010-20. . . . . 2.2V to 5.5V
  - ISL21010-25 (Coming Soon) . . . . 2.6V to 5.5V
  - ISL21010-30. . . . . 3.1V to 5.5V
  - ISL21010-33. . . . . 3.4V to 5.5V
  - ISL21010-40 (Coming Soon) . . . . 4.2V to 5.5V
- Output Current Source Capability 25mA
- Operating Temperature Range. . . . .-40°C to +125°C
- Output Voltage Noise (V_{OUT} = 2.048V) . . . . .58µV_{P-P} (0.1Hz to 10Hz)
- Supply Current . . . . 48µA (Typ)
- Tempco . . . . 50ppm/°C
- Package . . . . 3 Ld SOT-23
- Pb-Free (RoHS compliant)

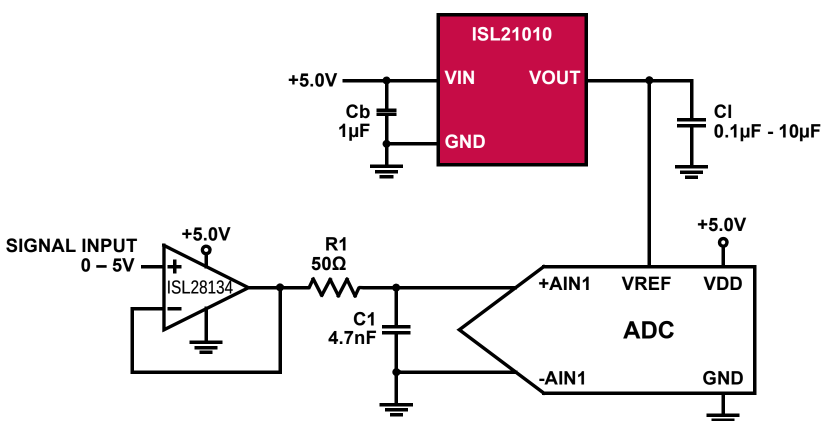
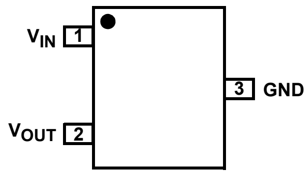


FIGURE 1. TYPICAL APPLICATION DIAGRAM

Pin Configuration

ISL21010
(3 LD SOT-23)
TOP VIEW



Pin Descriptions

PIN NUMBER	PIN NAME	DESCRIPTION
1	V_{IN}	Input Voltage Connection
2	V_{OUT}	Voltage Reference Output
3	GND	Ground Connection

Ordering Information

PART NUMBER (Notes 1, 2, 3, 4)	PART MARKING	V_{OUT} OPTION (V)	INITIAL ACCURACY (%)	TEMP. RANGE (°C)	PACKAGE TAPE & REEL (Pb-Free)	PKG. DWG. #
ISL21010CFH320Z-TK	BDSA	2.048	±0.2	-40 to +125	3 Ld SOT-23	P3.064
ISL21010CFH330Z-TK	BDVA	3.0	±0.2	-40 to +125	3 Ld SOT-23	P3.064
ISL21010CFH333Z-TK	BDWA	3.3	±0.2	-40 to +125	3 Ld SOT-23	P3.064

NOTES:

1. Please refer to TB347 for details on reel specifications.
2. These Intersil Pb-free plastic packaged products employ special Pb-free material sets, molding compounds/die attach materials, and 100% matte tin plate plus anneal (e3 termination finish, which is RoHS compliant and compatible with both SnPb and Pb-free soldering operations). Intersil Pb-free products are MSL classified at Pb-free peak reflow temperatures that meet or exceed the Pb-free requirements of IPC/JEDEC J STD-020.
3. For Moisture Sensitivity Level (MSL), please see device information page for ISL21010. For more information on MSL please see Tech Brief TB363.
4. The part marking is located on the bottom of the part.

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Absolute Maximum Ratings

Max Voltage
- V_{IN} to GND . . . . -0.5V to +6.5V
- V_{OUT}(pin) to GND (10s) . . . . -0.5V to V_{IN} +0.5V

Input Voltage Slew Rate (Max) 1V/µs
Temperature Range (Industrial) . . . . -40°C to +125°C
ESD Rating
- Human Body Model 5500V
- Machine Model 300V
- Charged Device Model 2kV

Thermal Information

Thermal Resistance (Typical)	θ_{JA} (°C/W)	θ_{JC}(°C/W)
3 Ld SOT-23 Package (Notes 5, 6)	275	110

Continuous Power Dissipation (T_A = +125°C) 99mW
Storage Temperature Range . . . . -65°C to +150°C
Pb-Free Reflow Profile (Note 7) . . . . see link below
http://www.intersil.com/pbfree/Pb-FreeReflow.asp

Recommended Operating Conditions

Temperature . . . . -40°C to +125°C
Supply Voltage
- V_{OUT} = 2.048V . . . . 2.2V to 5.5V
- V_{OUT} = 3.0V . . . . 3.1V to 5.5V
- V_{OUT} = 3.3V . . . . 3.4V to 5.5V

CAUTION: Do not operate at or near the maximum ratings listed for extended periods of time. Exposure to such conditions may adversely impact product reliability and result in failures not covered by warranty.

NOTES:

5. θ_{JA} is measured with the component mounted on a high effective thermal conductivity test board in free air. See Tech Brief TB379 for details.
6. For θ_{JC}, the "case temp" location is taken at the package top center.
7. Post-reflow drift for the ISL21010 devices may shift up to 4.0mV based on simulated reflow at 260°C peak temperature, three passes. The system design engineer must take this into account when considering the reference voltage after assembly.

Electrical Specifications (ISL21010-20, V_{OUT} = 2.048V)

V_{IN} = 3.0V, T_A = +25°C, I_{OUT} = 0A, unless otherwise specified. **Boldface limits apply over the operating temperature range, -40°C to +125°C.**

PARAMETER	DESCRIPTION	CONDITIONS	MIN (Note 8)	TYP	MAX (Note 8)	UNIT
V_{OUT}	Output Voltage			2.048		V
V_{OA}	V_{OUT} Accuracy @ T_A = +25°C (Note 7)		-0.2		+0.2	%
TC V_{OUT}	Output Voltage Temperature Coefficient (Note 9)			15	**50**	ppm/°C
V_{IN}	Input Voltage Range		**2.2**		**5.5**	V
I_{IN}	Supply Current	T_A = +25°C		46	80	µA
		T_A = -40°C to +125°C			**100**	µA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	2.2 V ≤ V_{IN} ≤ 5.5V		37	**130**	µV/V
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	Sourcing: 0mA ≤ I_{OUT} ≤ 25mA		18	**110**	µV/mA
		Sinking: -1mA ≤ I_{OUT} ≤ 0mA		10		µV/mA
I_{SC}	Short Circuit Current	T_A = +25°C, V_{OUT} tied to GND		118		mA
t_R	Turn-on Settling Time	V_{OUT} = ±0.1%, C_{OUT} = 1µF		300		µs
	Ripple Rejection	f = 120Hz		66		dB
e_N	Output Voltage Noise	0.1Hz ≤ f ≤ 10Hz		58		$µV_{P-P}$
V_N	Broadband Voltage Noise	10Hz ≤ f ≤ 1kHz		26		$µV_{RMS}$
$\Delta V_{OUT}/\Delta T_A$	Thermal Hysteresis (Note 11)	ΔT_A = +165°C		50		ppm
$\Delta V_{OUT}/\Delta t$	Long Term Stability	1000 hours, T_A = +25°C		50		ppm

Electrical Specifications (ISL21010-30, V_{OUT} = 3.0V)

V_{IN} = 5.0V, T_A = +25°C, I_{OUT} = 0A, unless otherwise specified. **Boldface limits apply over the operating temperature range, -40°C to +125°C.**

PARAMETER	DESCRIPTION	CONDITIONS	MIN (Note 8)	TYP	MAX (Note 8)	UNIT
V_{OUT}	Output Voltage			3.0		V
V_{OA}	V_{OUT} Accuracy @ T_A = +25°C (Note 7)		-0.2		+0.2	%
TC V_{OUT}	Output Voltage Temperature Coefficient (Note 9)			15	**50**	ppm/°C
V_{IN}	Input Voltage Range		**3.1**		**5.5**	V

Electrical Specifications (ISL21010-30, V_{OUT} = 3.0V)

V_{IN} = 5.0V, T_A = +25°C, I_{OUT} = 0A, unless otherwise specified. **Boldface limits apply over the operating temperature range, -40°C to +125°C. (Continued)**

PARAMETER	DESCRIPTION	CONDITIONS	MIN (Note 8)	TYP	MAX (Note 8)	UNIT
I_{IN}	Supply Current	T_A = +25°C		48	80	µA
		T_A = -40°C to +125°C			**100**	µA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	3.1 V ≤ V_{IN} ≤ 5.5V		73	**230**	µV/V
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	Sourcing: 0mA ≤ I_{OUT} ≤ 25mA		48	**110**	µV/mA
		Sinking: -1mA ≤ I_{OUT} ≤ 0mA		10		µV/mA
V_{INDO}	Dropout Voltage (Note 10)	I_{OUT} = 10mA		60	**150**	mV
I_{SC}	Short Circuit Current	T_A = +25°C, V_{OUT} tied to GND		126		mA
t_R	Turn-on Settling Time	V_{OUT} = ±0.1%, C_{OUT} =1µF		300		µs
	Ripple Rejection	f = 120Hz		62		dB
e_N	Output Voltage Noise	0.1Hz ≤ f ≤ 10Hz		86		$µV_{P-P}$
V_N	Broadband Voltage Noise	10Hz ≤ f ≤ 1kHz		36		$µV_{RMS}$
$\Delta V_{OUT}/\Delta T_A$	Thermal Hysteresis (Note 11)	ΔT_A = +165°C		50		ppm
$\Delta V_{OUT}/\Delta t$	Long Term Stability	1000 hours, T_A = +25°C		50		ppm

Electrical Specifications (ISL21010-33, V_{OUT} = 3.3V)

V_{IN} = 5.0V, T_A = +25°C, I_{OUT} = 0A, unless otherwise specified. **Boldface limits apply over the operating temperature range, -40°C to +125°C.**

PARAMETER	DESCRIPTION	CONDITIONS	MIN (Note 8)	TYP	MAX (Note 8)	UNIT
V_{OUT}	Output Voltage			3.3		V
V_{OA}	V_{OUT} Accuracy @ T_A = +25°C (Note 7)		-0.2		+0.2	%
TC V_{OUT}	Output Voltage Temperature Coefficient (Note 9)			15	**50**	ppm/°C
V_{IN}	Input Voltage Range		**3.4**		**5.5**	V
I_{IN}	Supply Current	T_A = +25°C		48	80	µA
		T_A = -40°C to +125°C			**100**	µA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	3.4 V ≤ V_{IN} ≤ 5.5V		80	**320**	µV/V
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	Sourcing: 0mA ≤ I_{OUT} ≤ 25mA		45	**110**	µV/mA
		Sinking: -1mA ≤ I_{OUT} ≤ 0mA		10		µV/mA
V_{INDO}	Dropout Voltage (Note 10)	I_{OUT} = 10mA		60	**150**	mV
I_{SC}	Short Circuit Current	T_A = +25°C, V_{OUT} tied to GND		126		mA
t_R	Turn-on Settling Time	V_{OUT} = ±0.1%, C_{OUT} = 1µF		300		µs
	Ripple Rejection	f = 120Hz		61		dB
e_N	Output Voltage Noise	0.1Hz ≤ f ≤ 10Hz		95		$µV_{P-P}$
V_N	Broadband Voltage Noise	10Hz ≤ f ≤ 1kHz		40		$µV_{RMS}$
$\Delta V_{OUT}/\Delta T_A$	Thermal Hysteresis (Note 11)	ΔT_A = +165°C		50		ppm
$\Delta V_{OUT}/\Delta t$	Long Term Stability	1000 hours, T_A = +25°C		50		ppm

NOTES:

8. Compliance to datasheet limits is assured by one or more methods: production test, characterization and/or design.
9. Over the specified temperature range. Temperature coefficient is measured by the box method whereby the change in V_{OUT} is divided by the temperature range; in this case, -40°C to +125°C = +165°C.
10. Dropout Voltage is the minimum V_{IN} - V_{OUT} differential voltage measured at the point where V_{OUT} drops 1mV from V_{IN} = 5.0V at T_A = +25°C.
11. Thermal Hysteresis is the change of V_{OUT} measured @ T_A = +25°C after temperature cycling over a specified range, ΔT_A. V_{OUT} is read initially at T_A = +25°C for the device under test. The device is temperature cycled and a second V_{OUT} measurement is taken at +25°C. The difference between the initial V_{OUT} reading and the second V_{OUT} reading is then expressed in ppm. For ΔT_A = +165°C, the device under test is cycled from +25°C to -40°C to +125°C to +25°C.

Typical Performance Characteristics Curves (V_{OUT} = 2.048V)

V_{IN} = 3.0V, I_{OUT} = 0mA, T_A = +25°C unless otherwise specified.

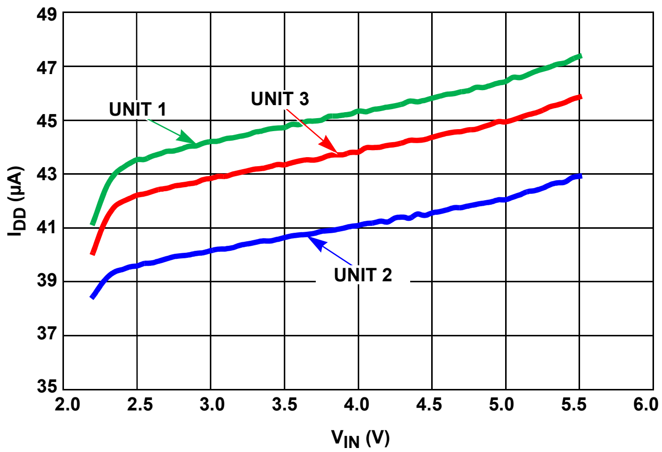


FIGURE 2. I_{IN} vs V_{IN}, THREE UNITS

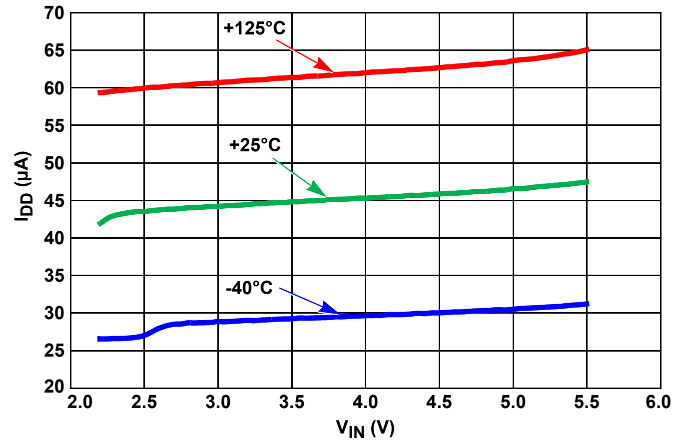


FIGURE 3. I_{IN} vs V_{IN}, OVER-TEMPERATURE

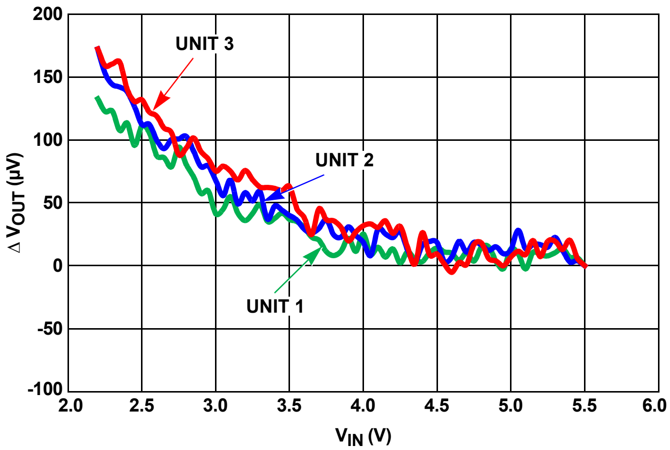


FIGURE 4. LINE REGULATION, THREE UNITS

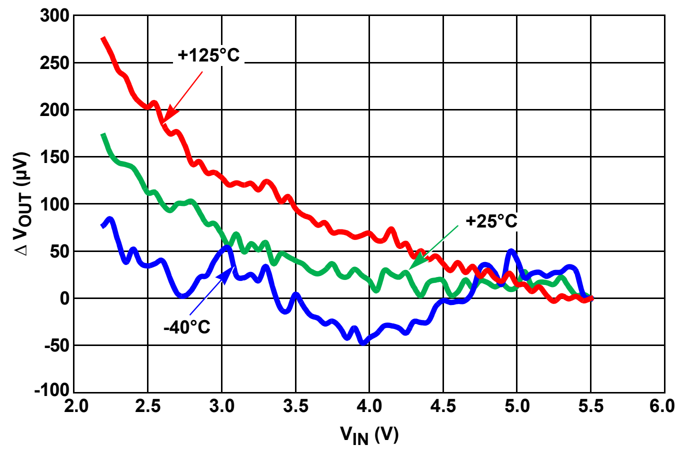


FIGURE 5. LINE REGULATION OVER-TEMPERATURE

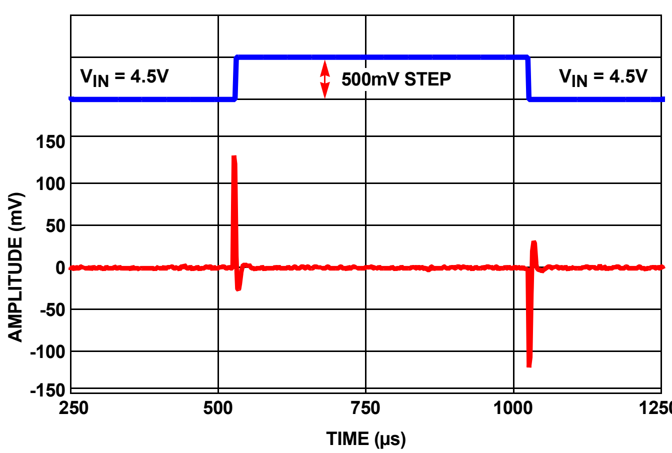


FIGURE 6. LINE TRANSIENT RESPONSE WITH 0.1µF LOAD

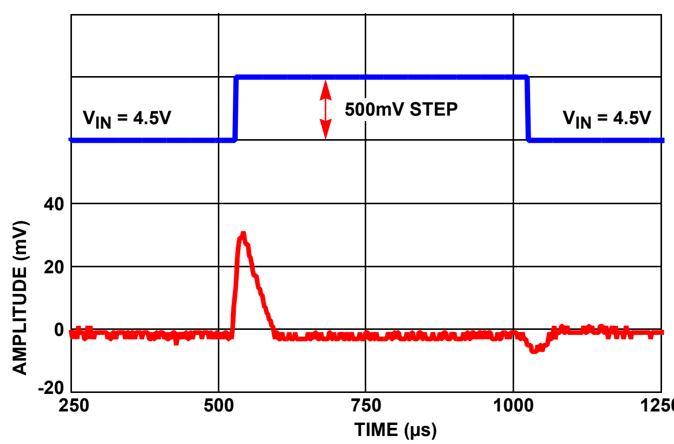


FIGURE 7. LINE TRANSIENT RESPONSE WITH 10µF LOAD

Typical Performance Characteristics Curves (V_{OUT} = 2.048V)

V_{IN} = 3.0V, I_{OUT} = 0mA, T_A = +25°C unless otherwise specified. **(Continued)**

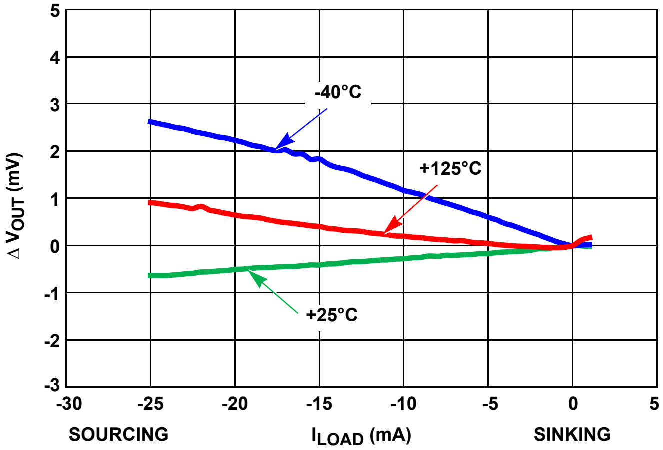


FIGURE 8. LOAD REGULATION OVER-TEMPERATURE

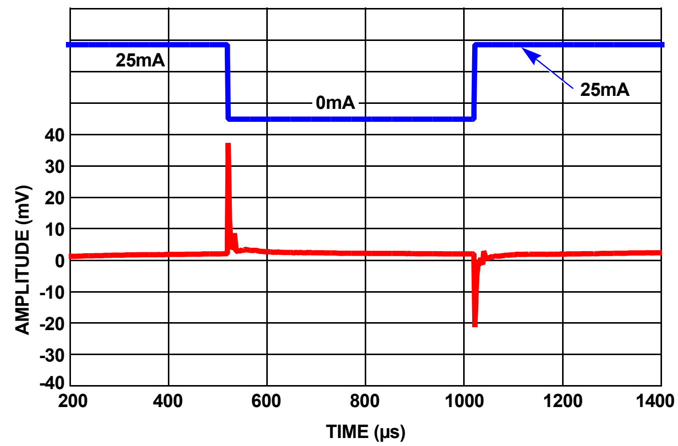


FIGURE 9. LOAD TRANSIENT RESPONSE, AT 25mA LOAD

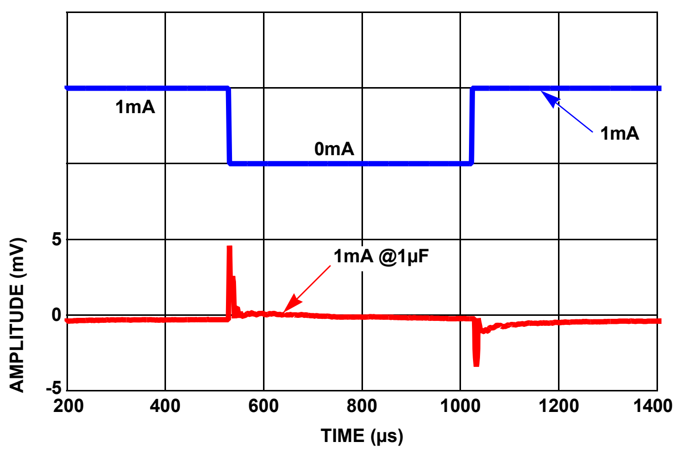


FIGURE 10. LOAD TRANSIENT RESPONSE AT 1mA LOAD

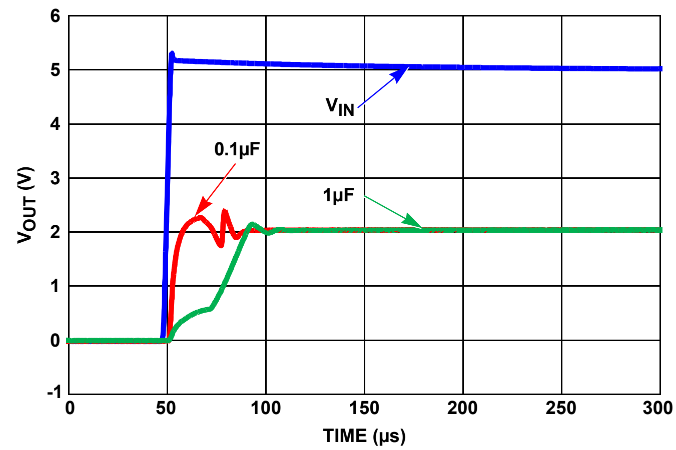


FIGURE 11. TURN-ON TIME

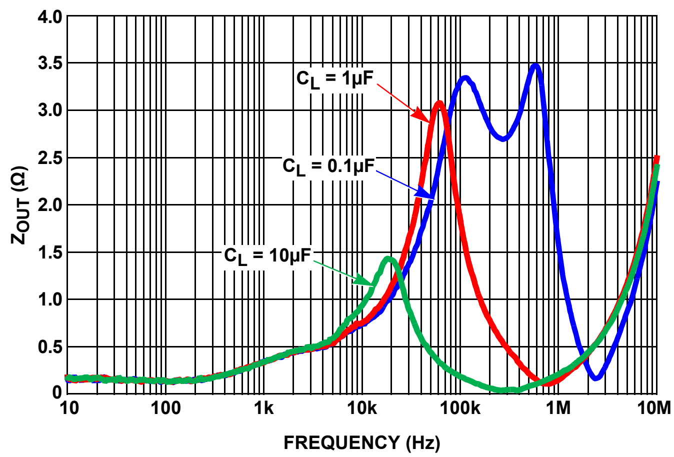


FIGURE 12. Z_{OUT} vs FREQUENCY

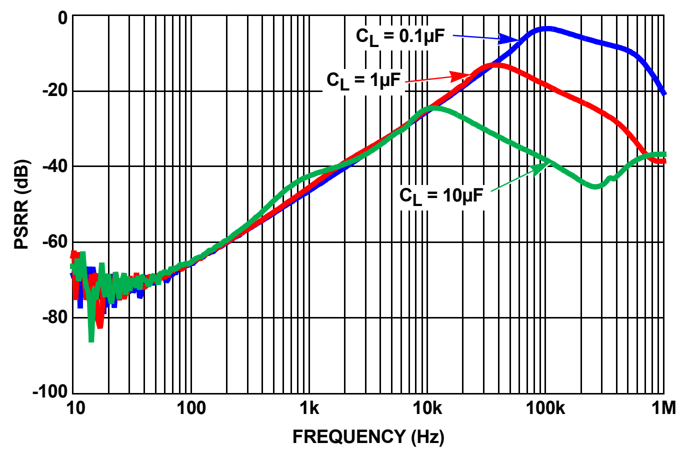


FIGURE 13. RIPPLE REJECTION AT DIFFERENT CAPACITIVE LOADS

Typical Performance Characteristics Curves (V_{OUT} = 2.048V)

V_{IN} = 3.0V, I_{OUT} = 0mA, T_A = +25°C unless otherwise specified. **(Continued)**

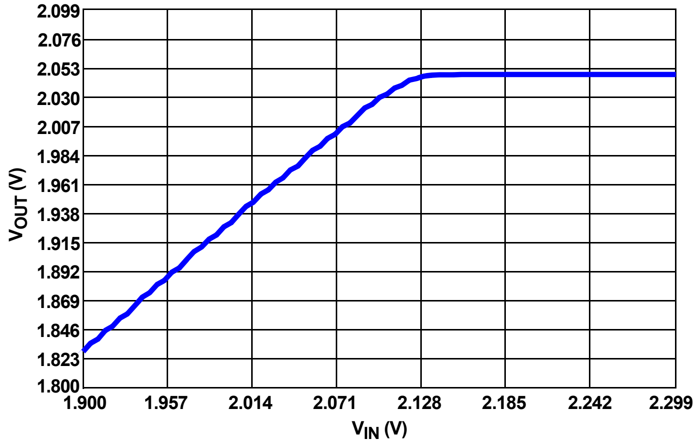


FIGURE 14. DROPOUT (10mA SOURCED LOAD)

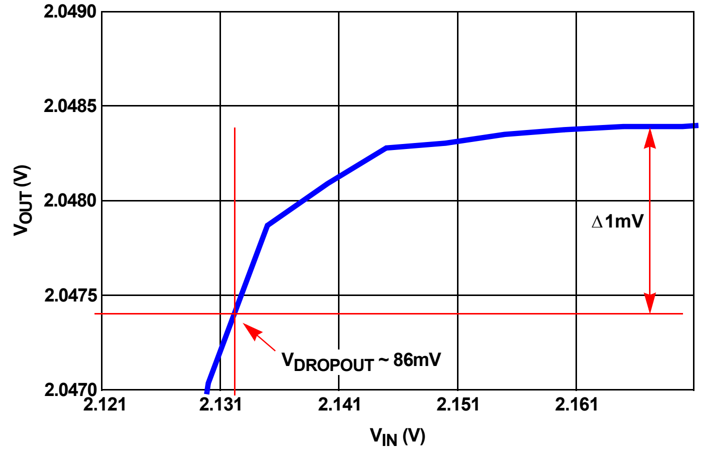


FIGURE 15. DROPOUT ZOOMED (10mA SOURCED LOAD)

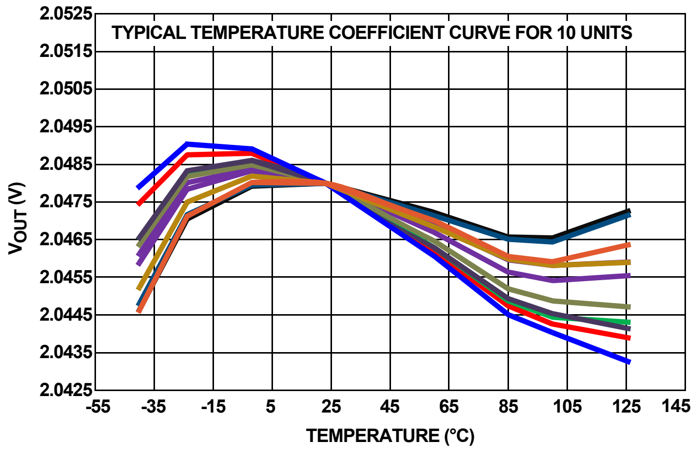


FIGURE 16. V_{OUT} vs TEMPERATURE

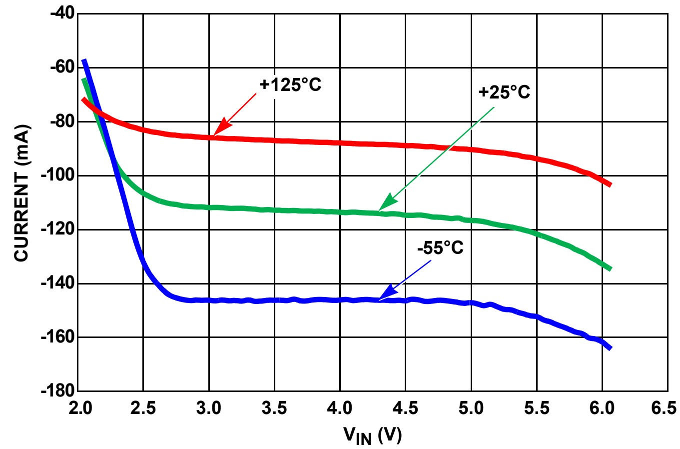


FIGURE 17. SHORT CIRCUIT TO GND

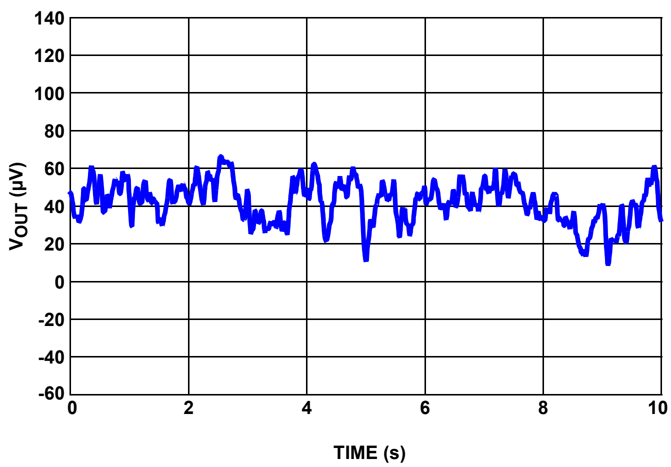


FIGURE 18. V_{OUT} vs NOISE, 0.1Hz TO 10Hz

Typical Performance Characteristics Curves (V_{OUT} = 3.0V)

V_{IN} = 5.0V, I_{OUT} = 0mA, T_A = +25°C unless otherwise specified.

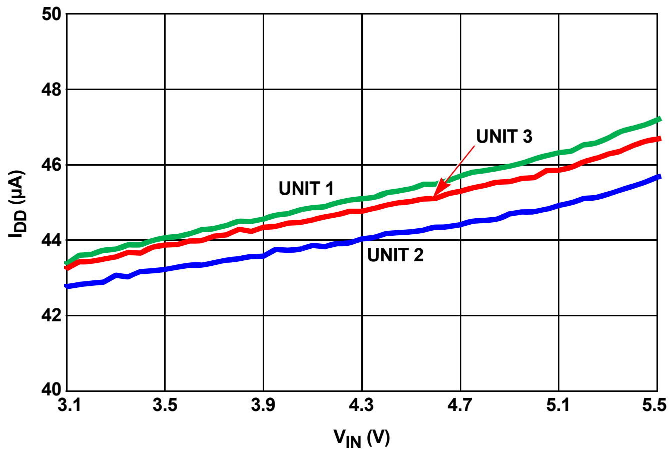


FIGURE 19. I_{IN} vs V_{IN}, THREE UNITS

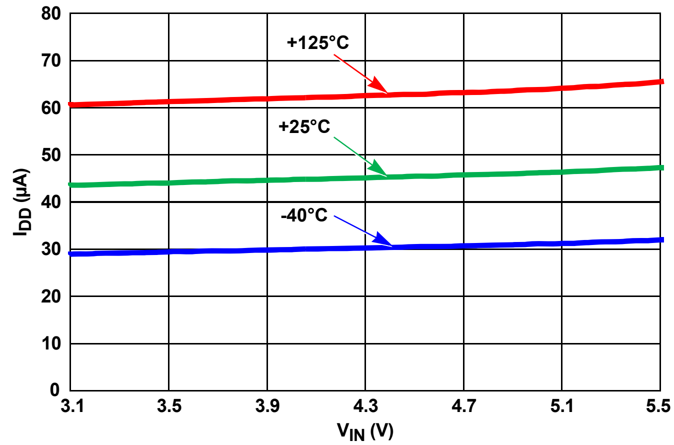


FIGURE 20. I_{IN} vs V_{IN}, OVER-TEMPERATURE

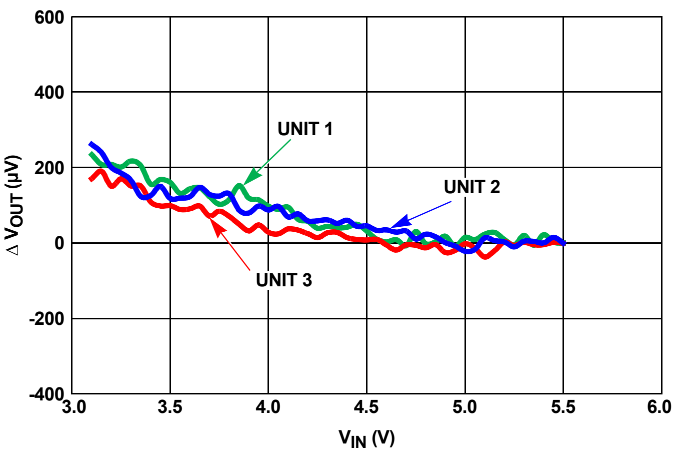


FIGURE 21. LINE REGULATION, THREE UNITS

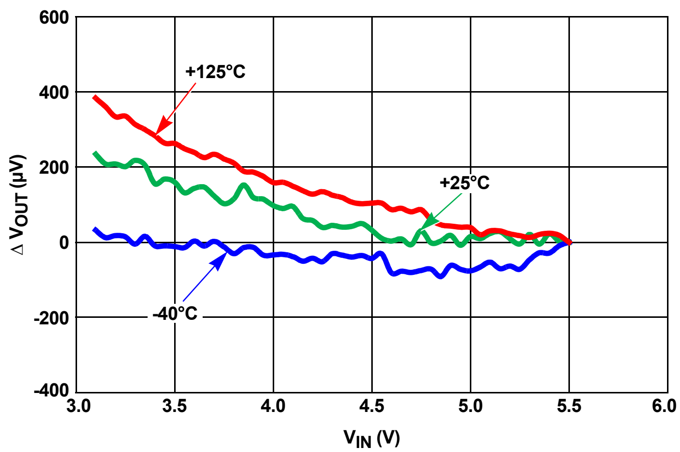


FIGURE 22. LINE REGULATION OVER-TEMPERATURE

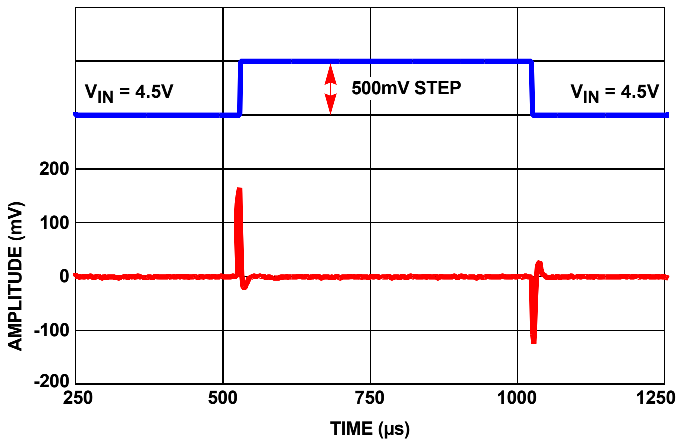


FIGURE 23. LINE TRANSIENT WITH 0.1µF LOAD

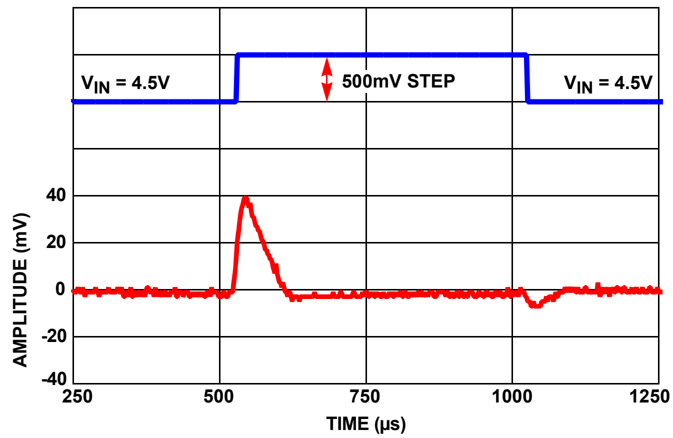


FIGURE 24. LINE TRANSIENT RESPONSE WITH 10µF LOAD

Typical Performance Characteristics Curves (V_{OUT} = 3.0V)

V_{IN} = 5.0V, I_{OUT} = 0mA, T_A = +25°C unless otherwise specified. **(Continued)**

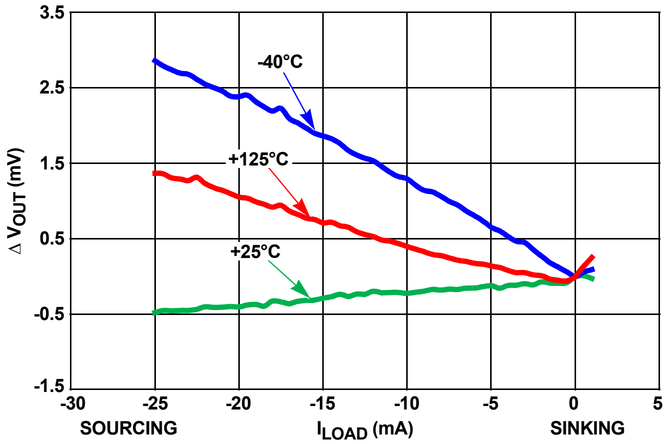


FIGURE 25. LOAD REGULATION OVER-TEMPERATURE

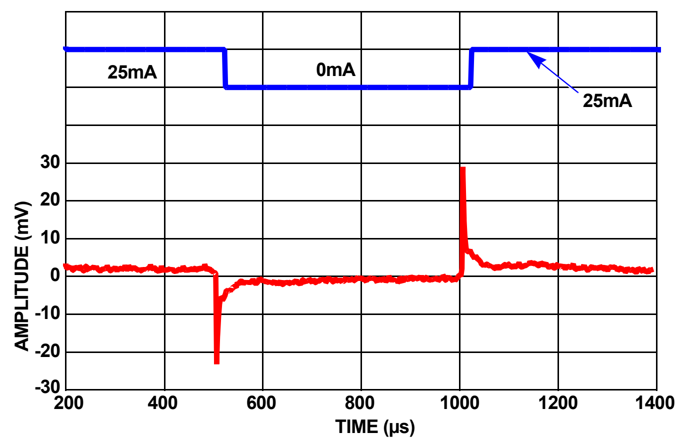


FIGURE 26. LOAD REGULATION OVER-TEMPERATURE

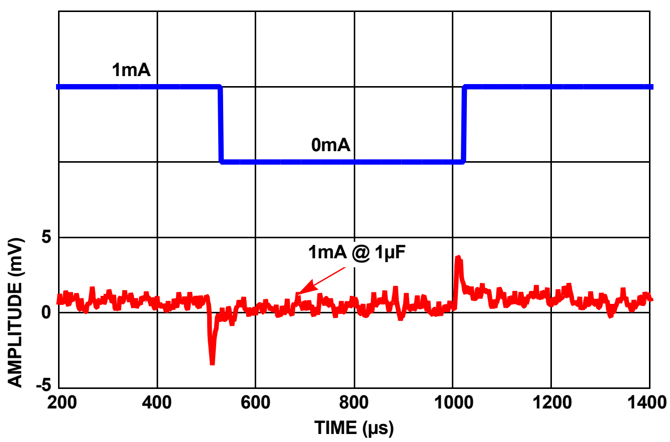


FIGURE 27. LOAD TRANSIENT RESPONSE

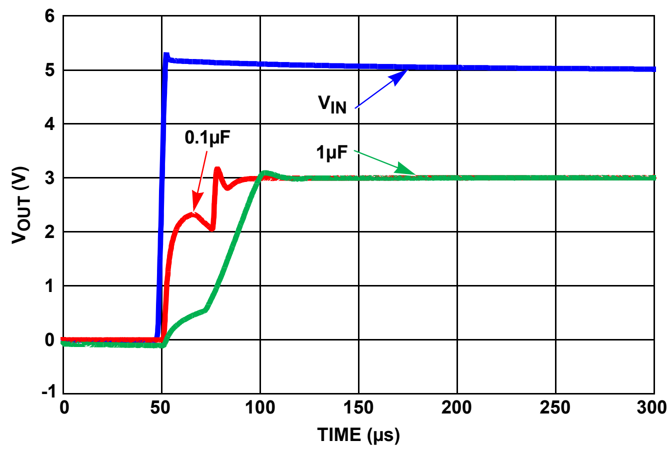


FIGURE 28. TURN-ON TIME

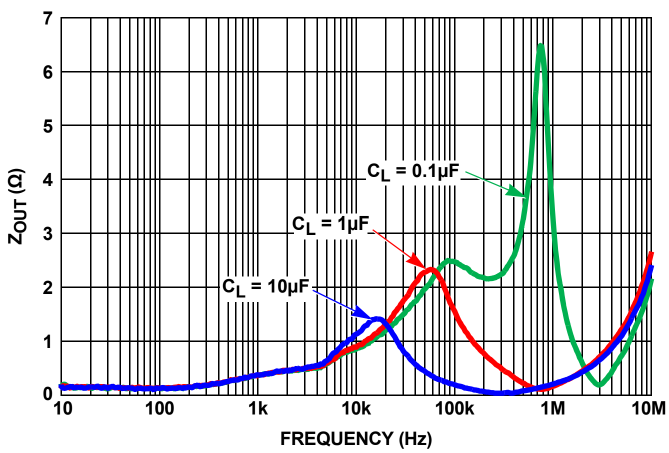


FIGURE 29. Z_{OUT} vs FREQUENCY

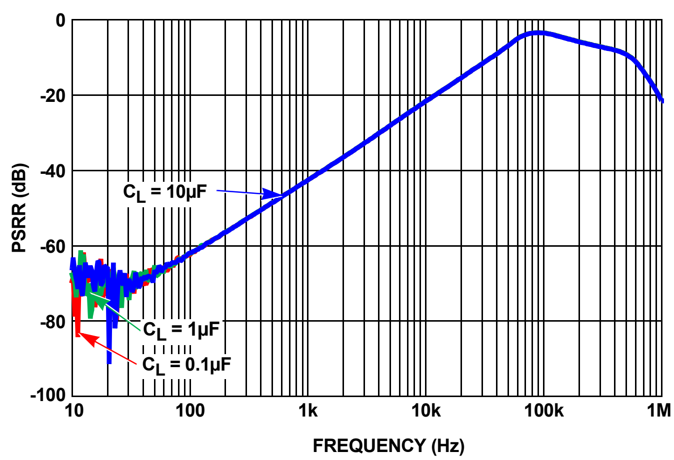


FIGURE 30. RIPPLE REJECTION AT DIFFERENT CAPACITIVE LOADS

Typical Performance Characteristics Curves (V_{OUT} = 3.0V)

V_{IN} = 5.0V, I_{OUT} = 0mA, T_A = +25°C unless otherwise specified. **(Continued)**

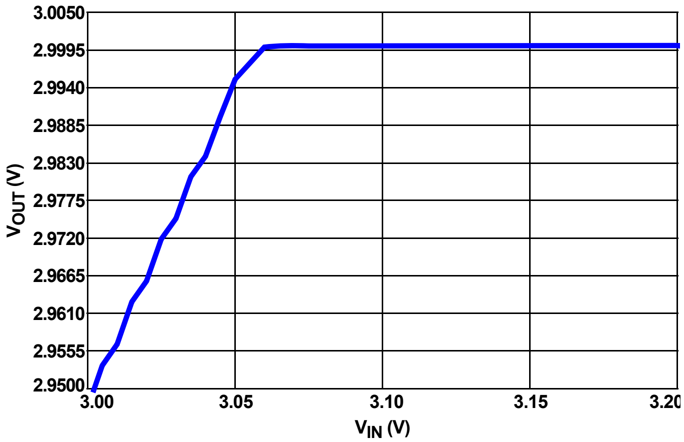


FIGURE 31. DROPOUT (1mA SOURCED LOAD)

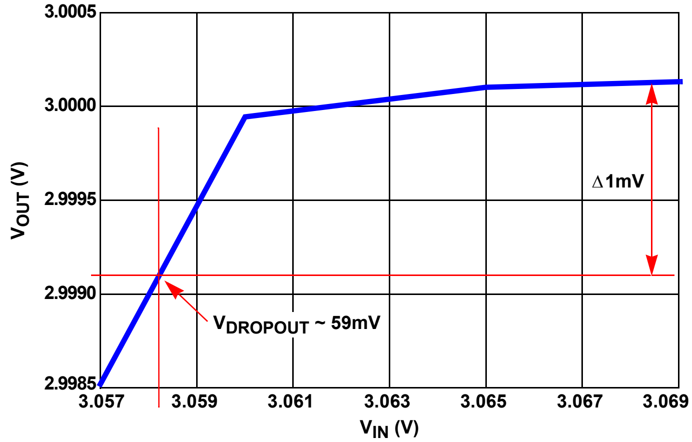


FIGURE 32. DROPOUT ZOOMED (10mA SOURCED LOAD)

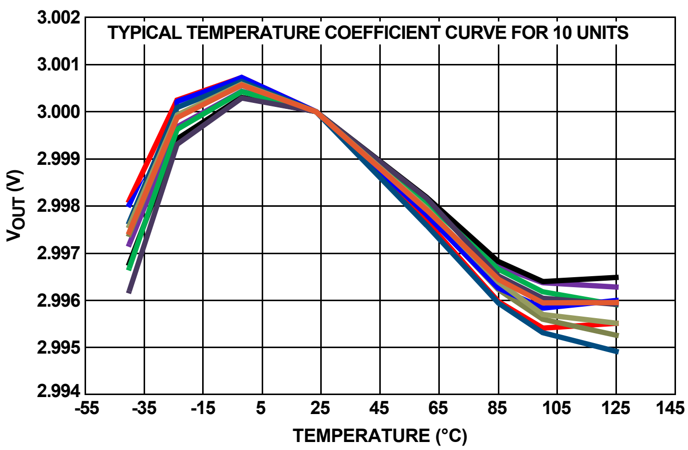


FIGURE 33. V_{OUT} vs TEMPERATURE

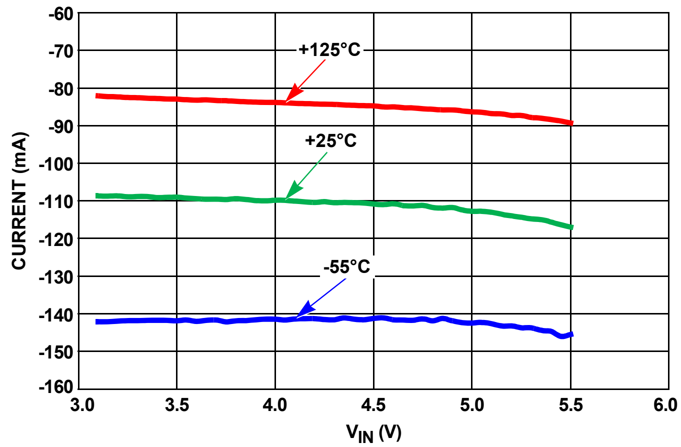


FIGURE 34. SHORT CIRCUIT TO GND

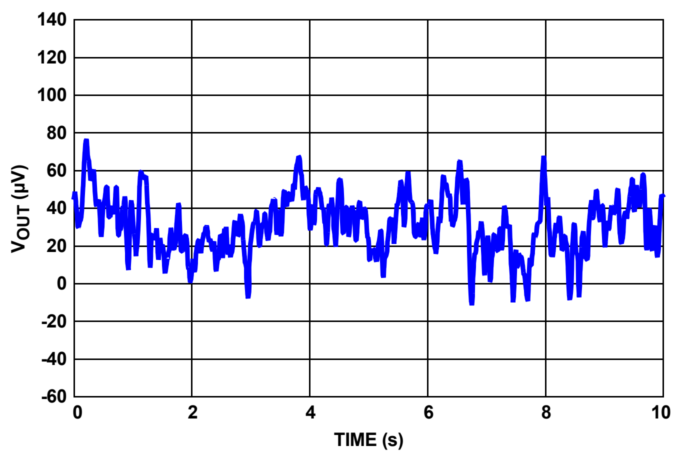


FIGURE 35. V_{OUT} vs NOISE, 0.1Hz TO 10Hz

Typical Performance Characteristics Curves (V_{OUT} = 3.3V)

V_{IN} = 5.0V, I_{OUT} = 0mA, T_A = +25°C unless otherwise specified.

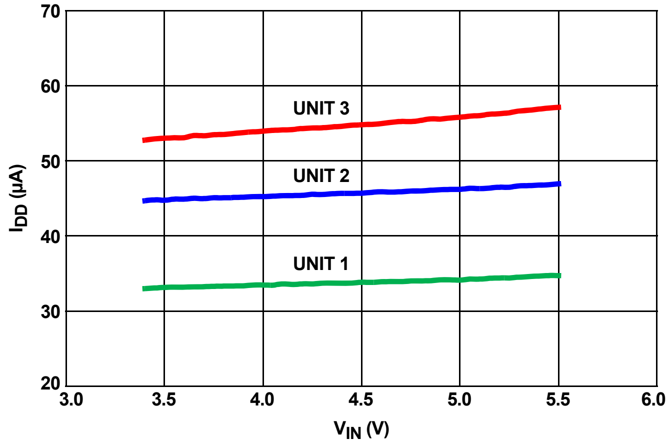


FIGURE 36. I_{IN} vs V_{IN}, THREE UNITS

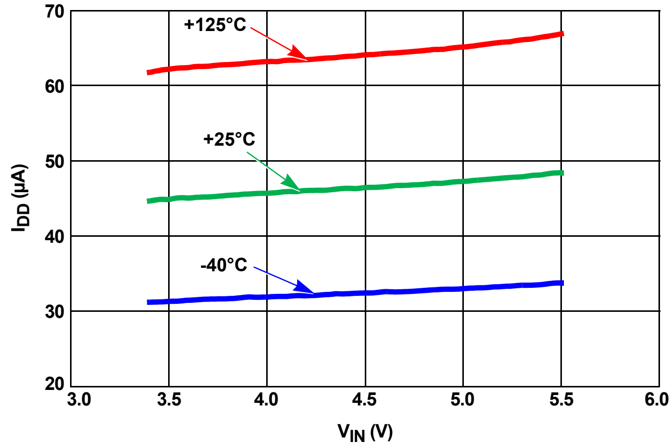


FIGURE 37. I_{IN} vs V_{IN}, OVER-TEMPERATURE

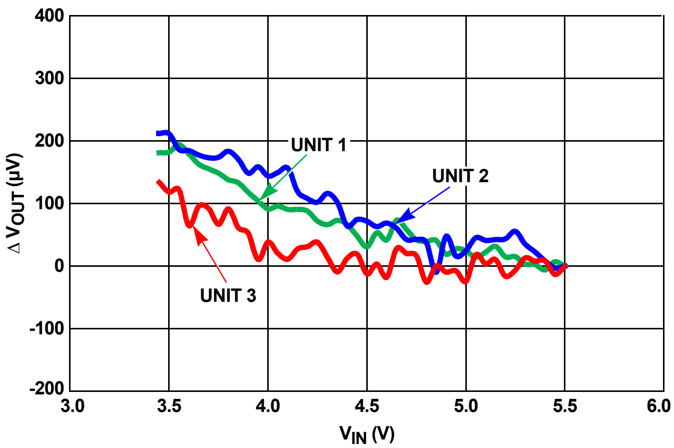


FIGURE 38. LINE REGULATION, THREE UNITS

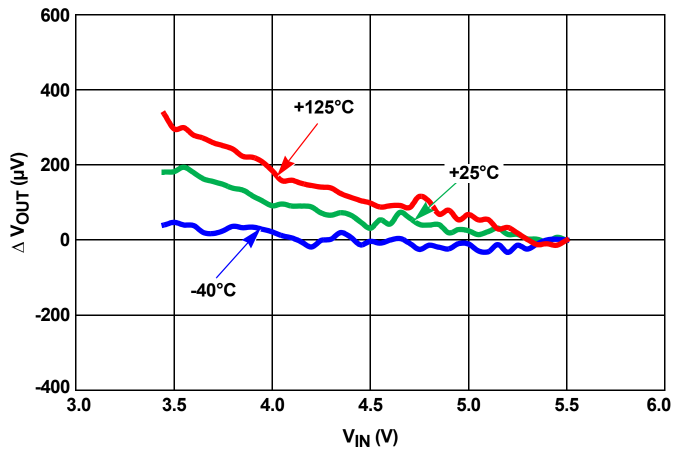


FIGURE 39. LINE REGULATION OVER-TEMPERATURE

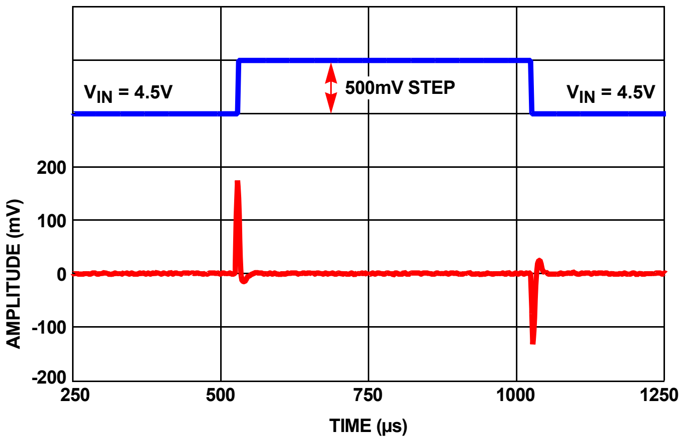


FIGURE 40. LINE TRANSIENT WITH 0.1µF LOAD

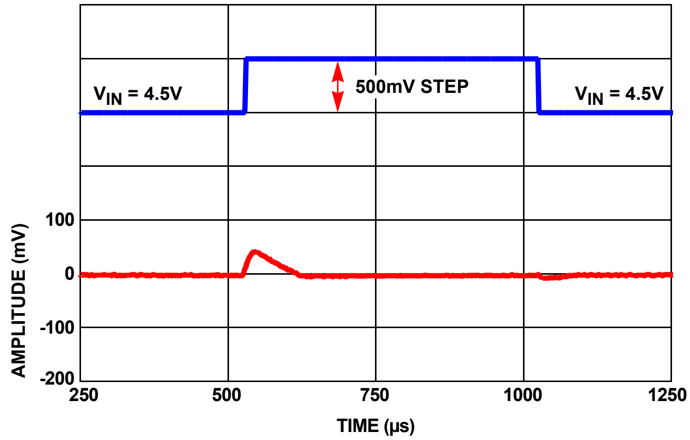


FIGURE 41. LINE TRANSIENT RESPONSE WITH 10µF LOAD

Typical Performance Characteristics Curves (V_{OUT} = 3.3V)

V_{IN} = 5.0V, I_{OUT} = 0mA, T_A = +25°C unless otherwise specified. **(Continued)**

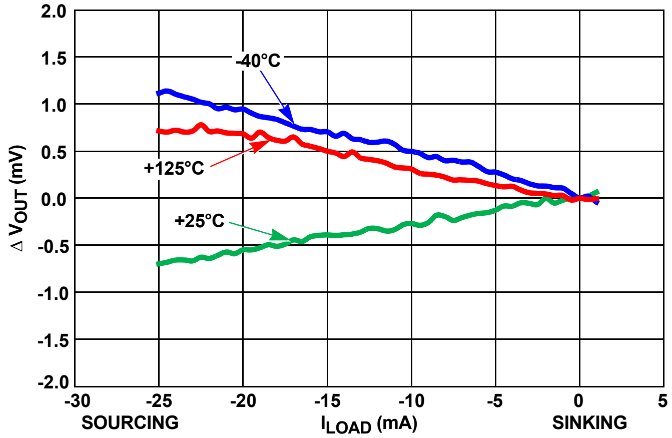


FIGURE 42. LOAD REGULATION OVER-TEMPERATURE

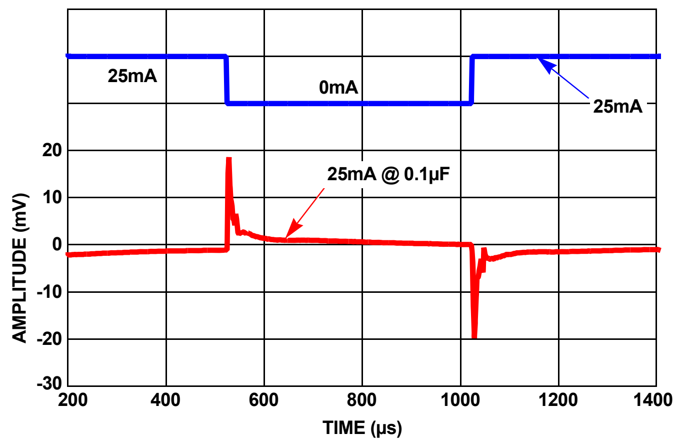


FIGURE 43. LOAD REGULATION OVER-TEMPERATURE

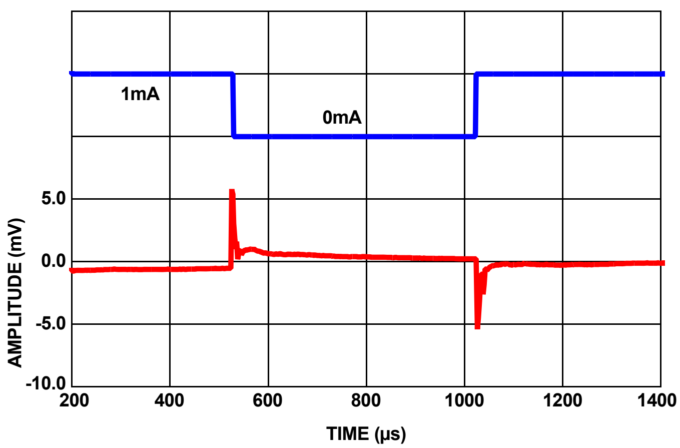


FIGURE 44. LOAD TRANSIENT RESPONSE

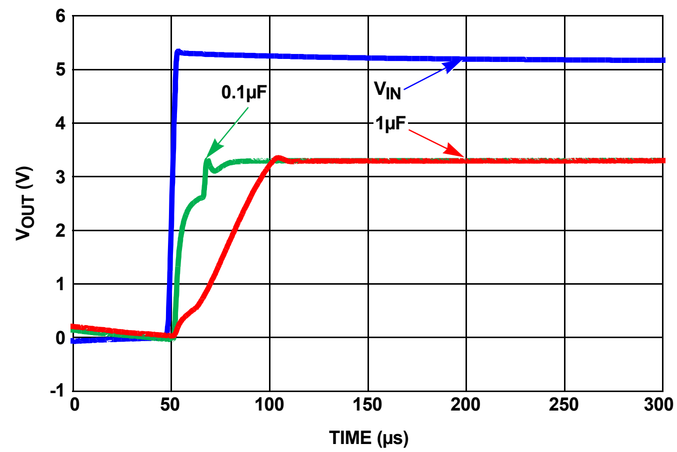


FIGURE 45. TURN-ON TIME

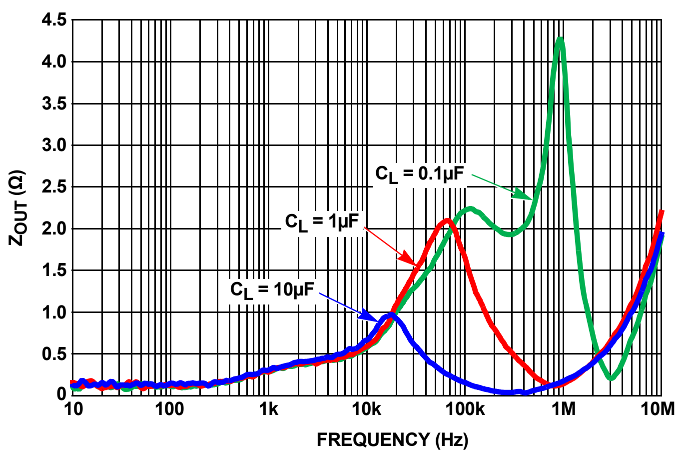


FIGURE 46. Z_{OUT} vs FREQUENCY

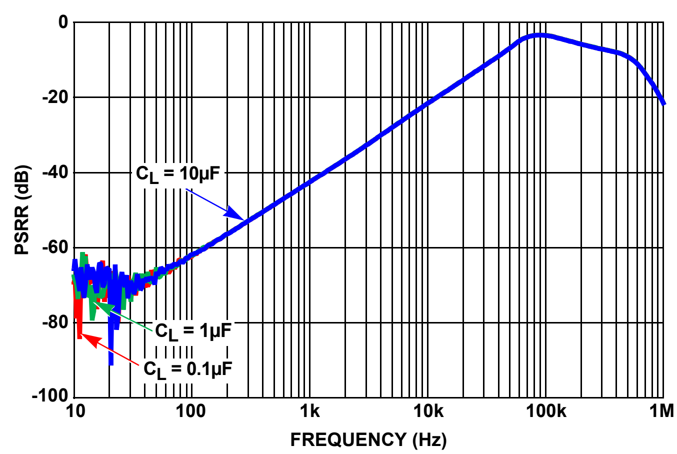


FIGURE 47. RIPPLE REJECTION AT DIFFERENT CAPACITIVE LOADS

Typical Performance Characteristics Curves (V_{OUT} = 3.3V)

V_{IN} = 5.0V, I_{OUT} = 0mA, T_A = +25°C unless otherwise specified. **(Continued)**

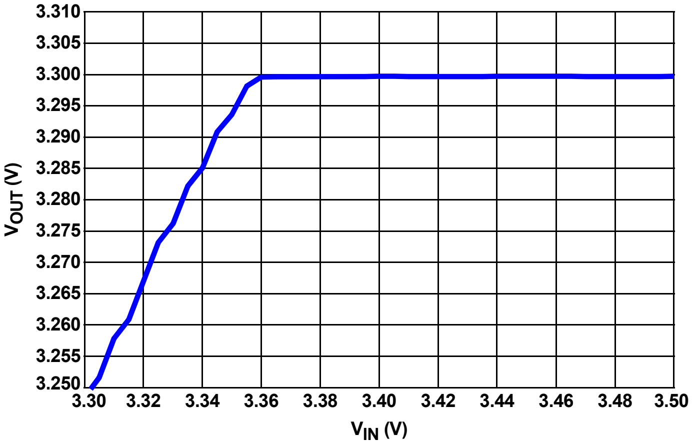


FIGURE 48. DROPOUT (1mA SOURCED LOAD)

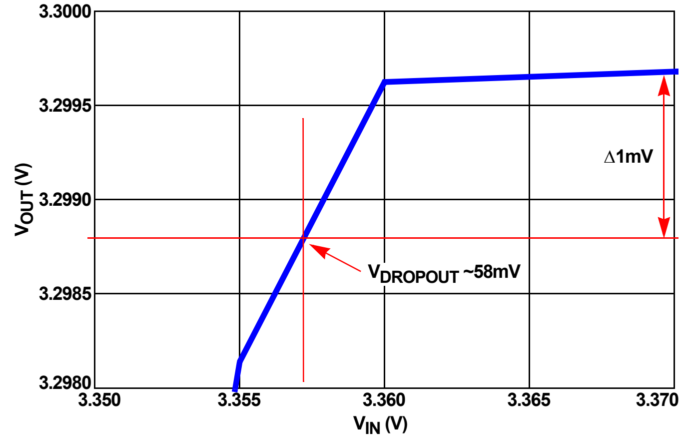


FIGURE 49. DROPOUT ZOOMED (10mA SOURCED LOAD)

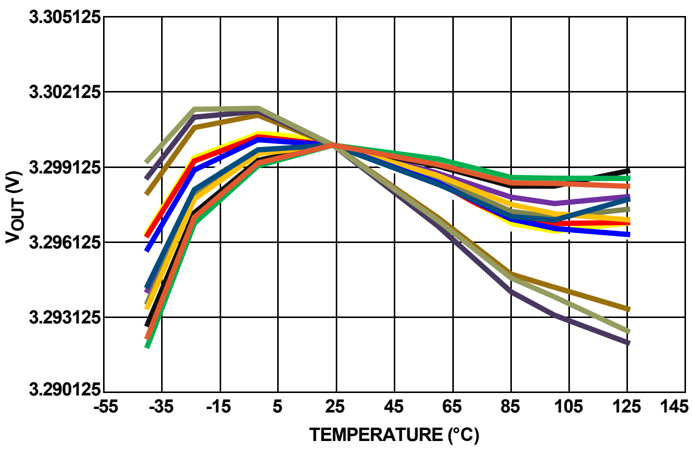


FIGURE 50. V_{OUT} vs TEMPERATURE

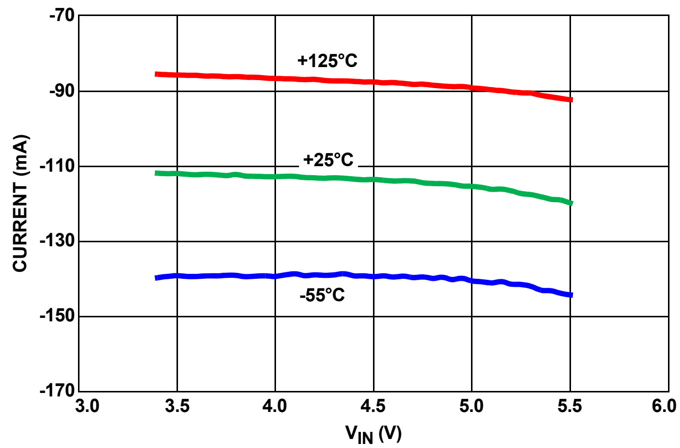


FIGURE 51. SHORT CIRCUIT TO GND

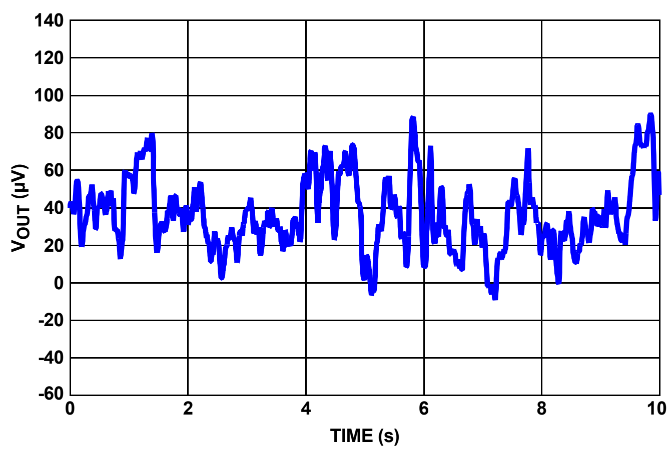


FIGURE 52. V_{OUT} vs NOISE, 0.1Hz TO 10Hz

Applications Information

Micropower Operation

The ISL21010 consumes very low supply current due to the proprietary bandgap technology. Low noise performance is achieved using optimized biasing techniques. Supply current is typically 48µA and noise in the 0.1Hz to 10Hz bandwidth is 58µV_{P-P} to 100µV_{P-P} (V_{OUT} = 2.048V, 3.0V, and 3.3V) benefitting precision, low noise portable applications such as handheld meters and instruments.

Data Converters in particular can utilize the ISL21010 as an external voltage reference. Low power DAC and ADC circuits will realize maximum resolution with lowest noise. The device Maintains output voltage during conversion cycles with fast response, although it is helpful to add an output capacitor, typically 1µF.

Board Mounting Considerations

For applications requiring the highest accuracy, board mounting location should be reviewed. The device uses a plastic SOIC package, which will subject the die to mild stresses when the Printed Circuit (PC) board is heated and cooled, slightly changing the shape. Placing the device in areas subject to slight twisting can cause degradation of the accuracy of the reference voltage due to these die stresses. It is normally best to place the device near the edge of a board, or the shortest side, as the axis of bending is most limited at that location. Mounting the device in a cutout also minimizes flex. Obviously mounting the device on flexprint or extremely thin PC material will likewise cause loss of reference accuracy.

Board Assembly Considerations

Bandgap references provide high accuracy and low temperature drift but some PC board assembly precautions are necessary. Normal Output voltage shifts of 100µV to 4mV can be expected with Pb-free reflow profiles or wave solder on multi-layer FR4 PC boards. Precautions should be taken to avoid excessive heat or extended exposure to high reflow or wave solder temperatures, this may reduce device initial accuracy.

Noise Performance and Reduction

The recommended capacitive load range for the ISL21010 is from 0.1µF to 10.0µF to ensure stability and best transient performance. Parallel 0.1µF and 10µF capacitors can be used to optimize performance as well. The noise specification stated in the Electrical Specification tables (starting on page 4) is for 0.1µF capacitive load, and larger values will reduce the output noise level.

Typical Application Circuit

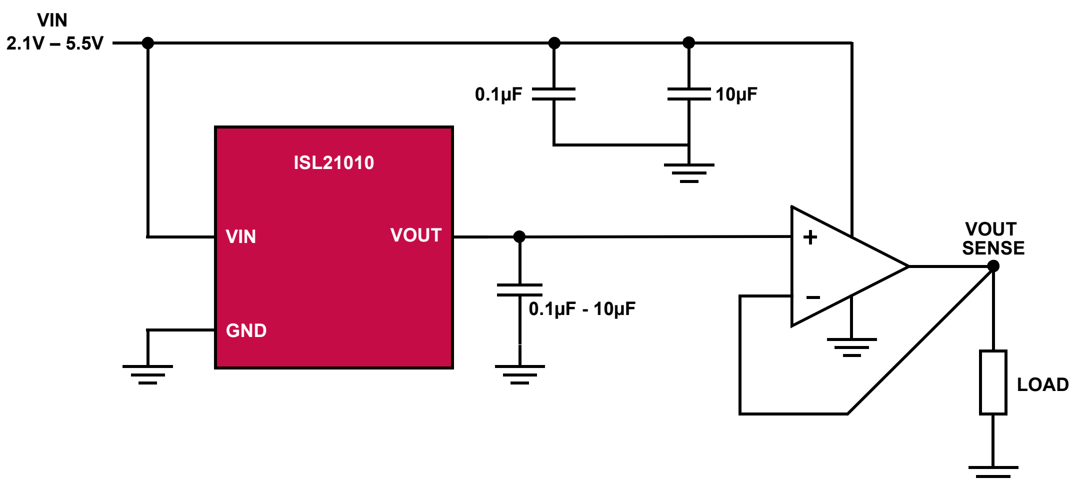


FIGURE 53. KELVIN SENSED LOAD

Revision History

The revision history provided is for informational purposes only and is believed to be accurate, but not warranted. Please go to web to make sure you have the latest Rev.

DATE	REVISION	CHANGE
8/9/11	FN7896.0	Initial Release

Products

Intersil Corporation is a leader in the design and manufacture of high-performance analog semiconductors. The Company's products address some of the industry's fastest growing markets, such as, flat panel displays, cell phones, handheld products, and notebooks. Intersil's product families address power management and analog signal processing functions. Go to www.intersil.com/products for a complete list of Intersil product families.

For a complete listing of Applications, Related Documentation and Related Parts, please see the respective device information page on intersil.com: ISL21010

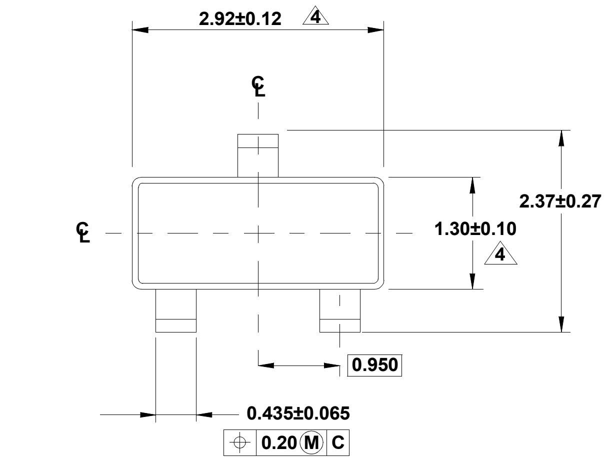
To report errors or suggestions for this datasheet, please go to www.intersil.com/askourstaff

FITs are available from our website at http://rel.intersil.com/reports/search.php

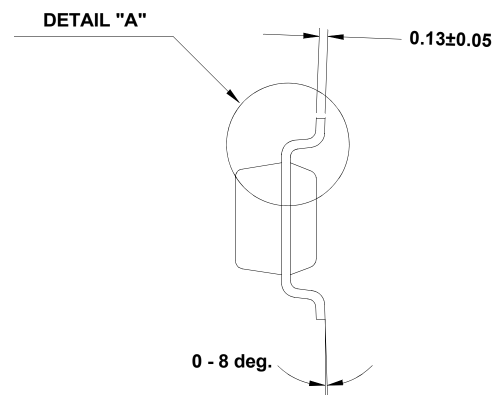
Package Outline Drawing

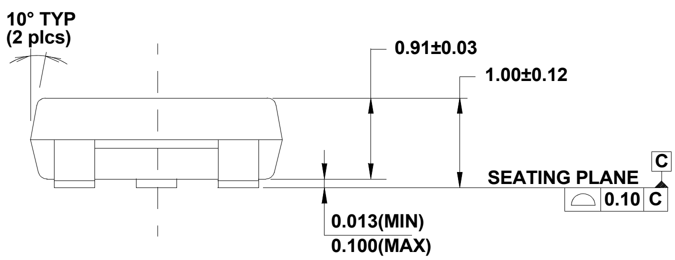
P3.064

3 LEAD SMALL OUTLINE TRANSISTOR PLASTIC PACKAGE (SOT23-3)
Rev 2, 9/09

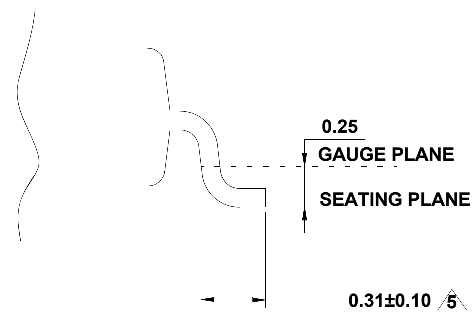


TOP VIEW

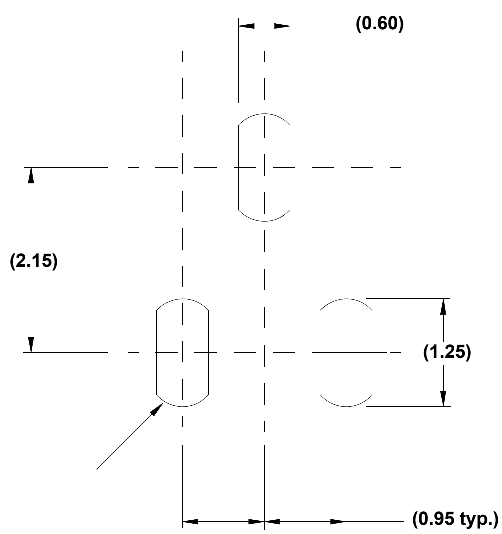




SIDE VIEW



DETAIL "A"



TYPICAL RECOMMENDED LAND PATTERN

NOTES:

1. Dimensions are in millimeters.
   Dimensions in ( ) for Reference Only.
2. Dimensioning and tolerancing conform to AMSEY14.5m-1994.
3. Reference JEDEC TO-236.
4. Dimension does not include interlead flash or protrusions.
   Interlead flash or protrusions shall not exceed 0.25mm per side.
5. Footlength is measured at reference to gauge plane.