

High-Precision, Low-Temperature Drift, Low-Noise Voltage Reference

GENERAL DESCRIPTION

The CLREF06 offer a very low noise and low-drift voltage reference in a small 6-pin SOT23 package. These devices provide a $1/f$ noise voltage of only $4.8\mu\text{Vp-p}$ at an output voltage of 2.5V , with a temperature drift of $10\text{ppm}/^\circ\text{C}$ (typical). The devices operate with an input voltage from 2.7V to 5.5V . The CLREF06 consume $270\mu\text{A}$ of supply current and can sink and source up to 10mA of load current. The low-drift and low noise specifications enable enhanced system accuracy, making these devices ideal for high precision industrial applications. The CLREF06 offers a noise filter option for wideband applications. The MAX6070/MAX6071 provide output voltages of 1.25V , 1.8V , 2.048V , 2.5V , 3.0V , 3.3V , 4.096V , and 5.0V . The devices are available in a 6-pin SOT23 package and specified over the extended industrial temperature range of -40°C to $+125^\circ\text{C}$.

FEATURES

- $10\text{ppm}/^\circ\text{C}$ (Typical) Temperature Drift
- $4.8\mu\text{Vpp}$ Low Noise ($0.1\text{Hz}\sim 10\text{Hz}$) @ 2.5V
- $270\mu\text{A}$ Low Supply Current
- 10mA Source/Sink Current
- Low 200mV Dropout Voltage
- Noise Filter Option
- High 76dB Ripple Rejection
- Small 6-Pin SOT23 Package
- Voltage Output Options: 1.25V , 1.8V , 2.048V , 2.5V , 3.0V , 3.3V , 4.096V and 5.0V
- $0.1\mu\text{F}\sim 10\mu\text{F}$ Capacitive-Load Stability Range

Application

- High-Accuracy Industrial and Process Control
- Precision Instrumentation
- High-Resolution ADC and DAC
- Precision Current Sources

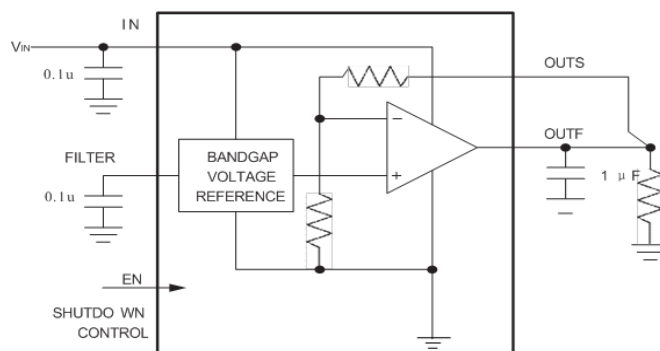


Figure1 Typical Application Schematic

Catalogue

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Revision History

October 31, 2021: Rev 0.5

August 18, 2022 : Rev 1.5

Electrical Characteristics

$V_{IN} = +5.0V$, $V_{OUT}=1.25$, $I_{OUT} = 0mA$, $C_{OUT} = 0.1\mu F$, $C_{FILTER} = 0.1\mu F$, $T_A = -40^{\circ}C$ to $+125^{\circ}C$, Typical values are at $T_A = +25^{\circ}C$, unless otherwise noted.

Figure 1 suitable for CLREF0612, unless otherwise noted.

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output Voltage Accuracy	$T_A=25^{\circ}C$	-0.1		0.1	%
Noise Voltage	1/f noise, 0.1Hz to 10Hz		2.2		μV_{p-p}
	thermal noise, 10Hz ~ 10kHz		3		μV_{RMS}
Temperature Drift			15	25	ppm/ $^{\circ}C$
Line Regulation	Overall V_{IN} range		145	200	$\mu V/V$
Load Regulation	$0m < I_{sink} < 10mA$		80	160	$\mu V/mA$
Output Current		-10		10	mA
Short-Circuit Current	Sourcing to ground		25	27	mA
Long-Term Stability	1000 hours at $T_A = +25^{\circ}C$		40		ppm
Thermal Hysteresis			85		ppm
Ripple Rejection	60Hz		82		dB
	1KHz		57		dB
Supply Voltage		2.7		5.5	V
Operating Temperature Range		-40		125	$^{\circ}C$
Turn-On Settling Time	Settling to 0.01%, $C_{OUT}=0.1\mu F$		30		μs
Enable Settling Time	Settling to 0.01%, $C_{OUT}=0.1\mu F$		75		μs
Quiescent Supply Current			270		μA
Shutdown Supply Current	EN Low Voltage			2	μA

$V_{IN} = +5.0V, V_{OUT}=1.8, I_{OUT} = 0mA, C_{OUT} = 0.1\mu F, C_{FILTER} = 0.1\mu F, T_A = -40^{\circ}C$ to $+125^{\circ}C$, unless otherwise noted.

Typical values are at $T_A = +25^{\circ}C$.

Figure 2 Figure 2 suitable for CLREF0618, unless otherwise noted.

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output Voltage Accuracy	$T_A=25^{\circ}C$	-0.1		0.1	%
Noise Voltage	1/f noise, 0.1Hz to 10Hz		2.3		μV_{p-p}
	thermal noise, 10Hz ~ 10kHz		3.3		μV_{RMS}
Temperature Drift			10	15	ppm/ $^{\circ}C$
Line Regulation	Overall V_{IN} range		125	200	$\mu V/V$
Load Regulation	$0mA < I_{sink} < 10mA$		100	160	$\mu V/mA$
Output Current		-10		10	mA
Short-Circuit Current	Sourcing to ground		25	27	mA
Long-Term Stability	1000 hours at $T_A = +25^{\circ}C$		40		ppm
Thermal Hysteresis			85		ppm
Ripple Rejection	60Hz		79		dB
	1KHz		53		dB
Supply Voltage		2.7		5.5	V
Operating Temperature Range		-40		125	$^{\circ}C$
Turn-On Settling Time	Settling to 0.01%, $C_{OUT}=0.1\mu F$		30		μs
Enable Settling Time	Settling to 0.01%, $C_{OUT}=0.1\mu F$		75		μs
Quiescent Supply Current			260		μA
Shutdown Supply Current	EN Low Voltage			2	μA

$V_{IN} = +5.0V, V_{OUT}=2.048, I_{OUT} = 0mA, C_{OUT} = 0.1\mu F, C_{FILTER} = 0.1\mu F, T_A = -40^{\circ}C$ to $+125^{\circ}C$, unless otherwise noted. Typical values are at $T_A = +25^{\circ}C$.

Figure 3 suitable for CLREF0620, unless otherwise noted.

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output Voltage Accuracy	$T_A=25^{\circ}C$	-0.1		0.1	%
Noise Voltage	1/f noise, 0.1Hz to 10Hz		2.4		μV_{p-p}
	thermal noise, 10Hz ~ 10kHz		3.5		μV_{RMS}
Temperature Drift			10	15	ppm/ $^{\circ}C$
Line Regulation	Overall V_{IN} range		130	200	$\mu V/V$
Load Regulation	$0m < I_{sink} < 10mA$		100	160	$\mu V/mA$
Output Current		-10		10	mA
Short-Circuit Current	Sourcing to ground		25	27	mA
Long-Term Stability	1000 hours at $T_A = +25^{\circ}C$		40		ppm
Thermal Hysteresis			85		ppm
Ripple Rejection	60Hz		78		dB
	1KHz		51		dB
Supply Voltage		2.7		5.5	V
Operating Temperature Range		-40		125	$^{\circ}C$
Turn-On Settling Time	Settling to 0.01%, $C_{OUT}=0.1\mu F$		30		μs
Enable Settling Time	Settling to 0.01%, $C_{OUT}=0.1\mu F$		75		μs
Quiescent Supply Current			260		μA
Shutdown Supply Current	EN Low Voltage			2	μA

$V_{IN} = +5.0V, V_{OUT}=2.5, I_{OUT} = 0mA, C_{OUT} = 0.1\mu F, C_{FILTER} = 0.1\mu F, T_A = -40^{\circ}C$ to $+125^{\circ}C$, unless otherwise noted.

Typical values are at $T_A = +25^{\circ}C$.

Figure 4 suitable for CLREF0625, unless otherwise noted.

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output Voltage Accuracy	$T_A=25^{\circ}C$	-0.1		0.1	%
Noise Voltage	1/f noise, 0.1Hz to 10Hz		4.8		μV_{p-p}
	thermal noise, 10Hz ~ 10kHz		9		μV_{RMS}
Temperature Drift	CLREF06XX ($-20^{\circ}C \sim 90^{\circ}C$)		10	15	ppm/ $^{\circ}C$
Line Regulation	Overall V_{IN} range		100	200	$\mu V/V$
Load Regulation	$0m < I_{sink} < 10mA$		120	160	$\mu V/mA$
Output Current		-10		10	mA
Short-Circuit Current	Sourcing to ground		25	27	mA
Long-Term Stability	1000 hours at $T_A = +25^{\circ}C$		40		ppm
Thermal Hysteresis			85		ppm
Ripple Rejection	60Hz		76		dB
	1KHz		50		dB
Supply Voltage		2.8		5.5	V
Operating Temperature Range		-40		125	$^{\circ}C$
Turn-On Settling Time	Settling to 0.01%, $C_{OUT}=0.1\mu F$		30		μs
Enable Settling Time	Settling to 0.01%, $C_{OUT}=0.1\mu F$		75		μs
Quiescent Supply Current	$T_A=25^{\circ}C$		270		μA
Shutdown Supply Current	EN Low Voltage			2	μA

$V_{IN} = +5.0V, V_{OUT}=3, I_{OUT} = 0mA, C_{OUT} = 0.1\mu F, C_{FILTER} = 0.1\mu F, T_A = -40^{\circ}C$ to $+125^{\circ}C$, unless otherwise noted.

Typical values are at $T_A = +25^{\circ}C$.

Figure 5 suitable for CLREF0630, unless otherwise noted

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output Voltage Accuracy	$T_A=25^{\circ}C$	-0.1		0.1	%
Noise Voltage	1/f noise, 0.1Hz to 10Hz		5.2		μV_{p-p}
	thermal noise, 10Hz ~ 10kHz		11.5		μV_{RMS}
Temperature Drift	CLREF06XX ($-20^{\circ}C \sim 90^{\circ}C$)		10	15	ppm/ $^{\circ}C$
Line Regulation	Overall V_{IN} range		150	220	$\mu V/V$
Load Regulation	$0m < I_{sink} < 10mA$		120	160	$\mu V/mA$
Output Current		-10		10	mA
Short-Circuit Current	Sourcing to ground		25	27	mA
Long-Term Stability	1000 hours at $T_A = +25^{\circ}C$		40		ppm
Thermal Hysteresis			85		ppm
Ripple Rejection	60Hz		74		dB
	1KHz		48		dB
Supply Voltage		3.2		5.5	V
Operating Temperature Range		-40		125	$^{\circ}C$
Turn-On Settling Time	Settling to 0.01%, $C_{OUT}=0.1\mu F$		30		μs
Enable Settling Time	Settling to 0.01%, $C_{OUT}=0.1\mu F$		75		μs
Quiescent Supply Current	$T_A=25^{\circ}C$		270		μA
Shutdown Supply Current	EN Low Voltage			2	μA

$V_{IN} = +5.0V, V_{OUT}=3.3, I_{OUT} = 0mA, C_{OUT} = 0.1\mu F, C_{FILTER} = 0.1\mu F, T_A = -40^{\circ}C$ to $+125^{\circ}C$, unless otherwise noted.

Typical values are at $T_A = +25^{\circ}C$.

Figure 6 suitable for CLREF0633, unless otherwise noted

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output Voltage Accuracy	$T_A=25^{\circ}C$	-0.1		0.1	%
Noise Voltage	1/f noise, 0.1Hz to 10Hz		5.4		μV_{p-p}
	thermal noise, 10Hz ~ 10kHz		14		μV_{RMS}
Temperature Drift	CLREF06XX ($-20^{\circ}C \sim 90^{\circ}C$)		10	15	ppm/ $^{\circ}C$
Line Regulation	Overall V_{IN} range		165	300	$\mu V/V$
Load Regulation	$0m < I_{sink} < 10mA$		130	170	$\mu V/mA$
Output Current		-10		10	mA
Short-Circuit Current	Sourcing to ground		25	27	mA
Long-Term Stability	1000 hours at $T_A = +25^{\circ}C$		40		ppm
Thermal Hysteresis			85		ppm
Ripple Rejection	60Hz		73		dB
	1KHz		47		dB
Supply Voltage		3.5		5.5	V
Operating Temperature Range		-40		125	$^{\circ}C$
Turn-On Settling Time	Settling to 0.01%, $C_{OUT}=0.1\mu F$		30		μs
Enable Settling Time	Settling to 0.01%, $C_{OUT}=0.1\mu F$		75		μs
Quiescent Supply Current	$T_A=25^{\circ}C$		280		μA
Shutdown Supply Current	EN Low Voltage			2	μA

$V_{IN} = +5V, V_{OUT}=4.096, I_{OUT} = 0mA, C_{OUT} = 0.1\mu F, C_{FILTER} = 0.1\mu F, T_A = -40^{\circ}C$ to $+125^{\circ}C$, unless otherwise noted.

Typical values are at $T_A = +25^{\circ}C$.

Figure 7 suitable for CLREF0640, unless otherwise noted

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output Voltage Accuracy	$T_A=25^{\circ}C$	-0.1		0.1	%
Noise Voltage	1/f noise, 0.1Hz to 10Hz		6		μV_{p-p}
	thermal noise, 10Hz ~ 10kHz		16		μV_{RMS}
Temperature Drift	CLREF06XX ($-20^{\circ}C \sim 90^{\circ}C$)		10		ppm/ $^{\circ}C$
Line Regulation	Overall V_{IN} range		220	300	$\mu V/V$
Load Regulation	$0m < I_{sink} < 10mA$		220	300	$\mu V/mA$
Output Current		-10		10	mA
Short-Circuit Current	Sourcing to ground		25	27	mA
Long-Term Stability	1000 hours at $T_A = +25^{\circ}C$		40		ppm
Thermal Hysteresis			85		ppm
Ripple Rejection	60Hz		72		dB
	1KHz		45		dB
Supply Voltage		4.3		5.5	V
Operating Temperature Range		-40		125	$^{\circ}C$
Turn-On Settling Time	Settling to 0.01%, $C_{OUT}=0.1\mu F$		30		μs
Enable Settling Time	Settling to 0.01%, $C_{OUT}=0.1\mu F$		75		μs
Quiescent Supply Current	$T_A=25^{\circ}C$		280		μA
Shutdown Supply Current	EN Low Voltage			2	μA

$V_{IN} = +5.5V, V_{OUT}=5, I_{OUT} = 0mA, C_{OUT} = 0.1\mu F, C_{FILTER} = 0.1\mu F, T_A = -40^{\circ}C$ to $+125^{\circ}C$, unless otherwise noted.

Typical values are at $T_A = +25^{\circ}C$.

Figure 7 suitable for CLREF0640, unless otherwise noted

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output Voltage Accuracy	$T_A=25^{\circ}C$	-0.1		0.1	%
Noise Voltage	1/f noise, 0.1Hz to 10Hz		7		μV_{p-p}
	thermal noise, 10Hz ~ 10kHz		17		μV_{RMS}
Temperature Drift	CLREF06XX ($-20^{\circ}C \sim 90^{\circ}C$)		10	15	ppm/ $^{\circ}C$
Line Regulation	Overall V_{IN} range		320	450	$\mu V/V$
Load Regulation	$0m < I_{sink} < 10mA$		220	400	$\mu V/mA$
Output Current		-10		10	mA
Short-Circuit Current	Sourcing to ground		25	27	mA
Long-Term Stability	1000 hours at $T_A = +25^{\circ}C$		40		ppm
Thermal Hysteresis			85		ppm
Ripple Rejection	60Hz		70		dB
	1KHz		43		dB
Supply Voltage		5.2		5.5	V
Operating Temperature Range		-40		125	$^{\circ}C$
Turn-On Settling Time	Settling to 0.01%, $C_{OUT}=0.1\mu F$		30		μs
Enable Settling Time	Settling to 0.01%, $C_{OUT}=0.1\mu F$		75		μs
Quiescent Supply Current	$T_A=25^{\circ}C$		300		μA
Shutdown Supply Current	EN Low Voltage			2	μA

Pin Configurations and Pin Description

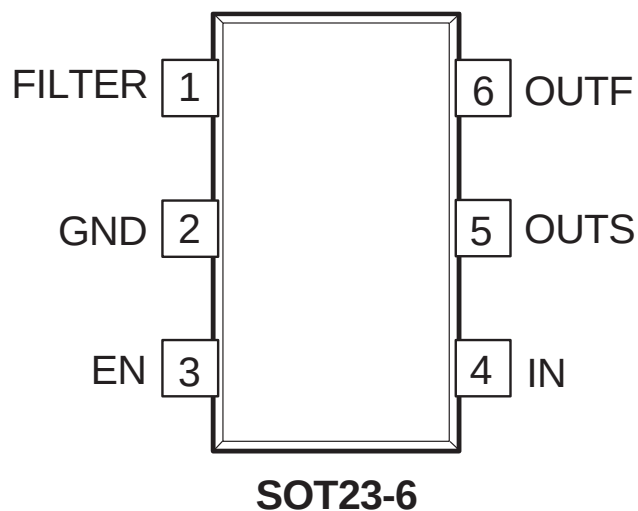


图 2 引脚图

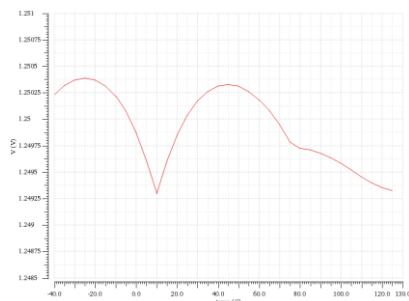
Figure 9

PIN	NAME	
1	FILTER	Filter Input. Connect a 0.1μF capacitor from FILTER to ground to provide high-frequency bypass. Leave unconnected, if not used.
2	GND	Ground
3	EN	Enable. Drive high to enable the device. Drive low to disable the device.
4	IN	Supply Input
5	OUTS	Voltage Reference Sense Output
6	OUTF	Voltage Reference Output Sense. Connect OUTF and OUTS as close as possible to the load.

Typical Operating Characteristics

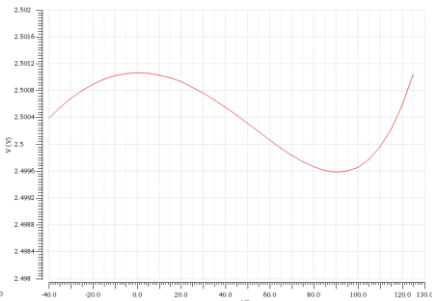
CLREF0612 OUTPUT

VOLTAGE TEMPERATURE DFIFT

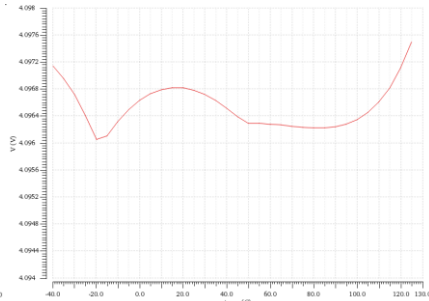


CLREF0625 OUTPUT CLREF0640 OUTPUT

VOLTAGE TEMPERATURE DFIFT

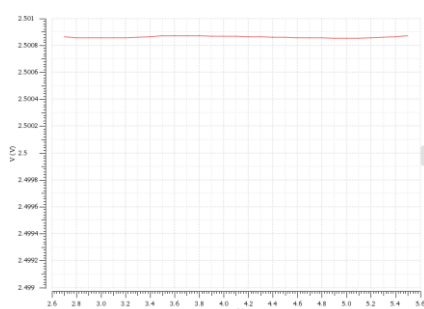


VOLTAGE TEMPERATURE DFIFT



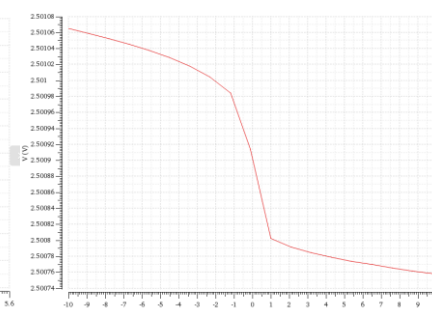
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LINE REGULATION



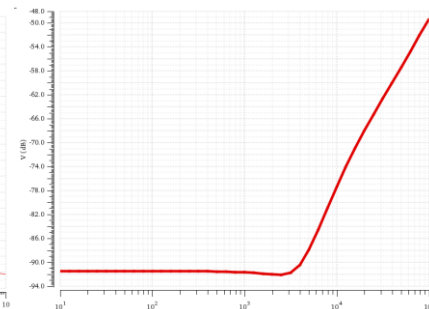
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LOAD REGULATION



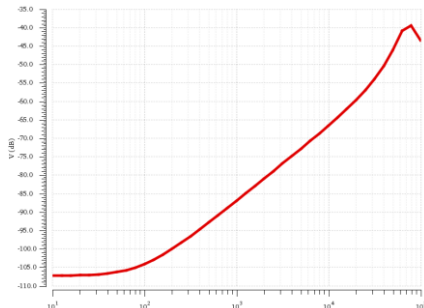
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PSRR vs. FREQUENCY



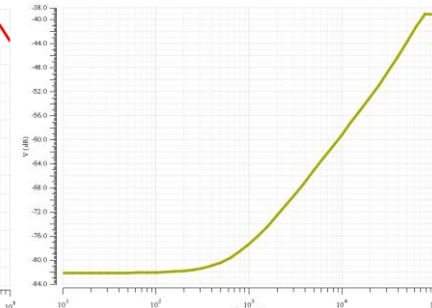
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PSRR vs. FREQUENCY



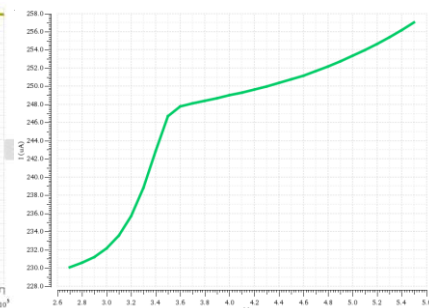
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PSRR vs. FREQUENCY



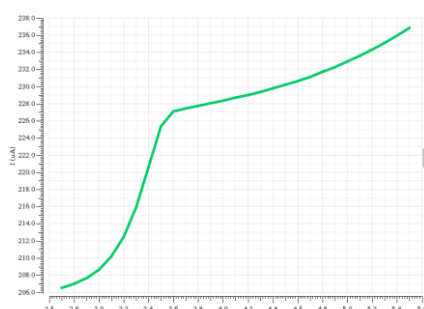
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SUPPLY CURRENT vs. INPUT VOLTAGE



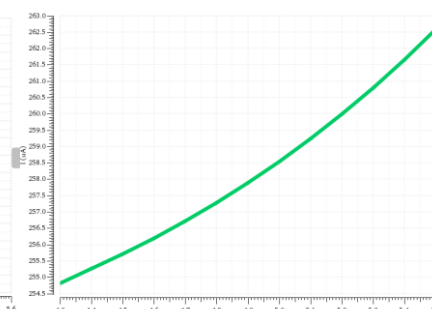
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SUPPLY CURRENT vs. INPUT VOLTAGE

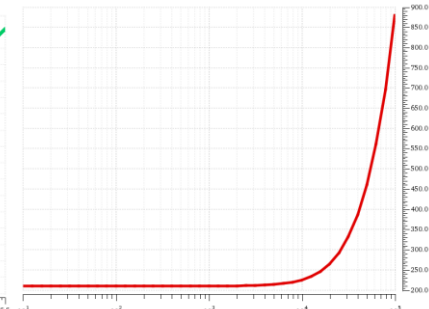


CLREF0640 OUTPUT CLREF0612 OUTPUT

SUPPLY CURRENT vs. INPUT VOLTAGE

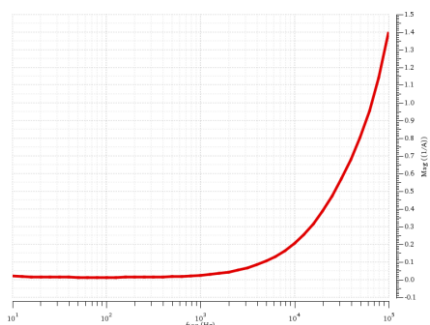


ROUT vs. FREQUENCY



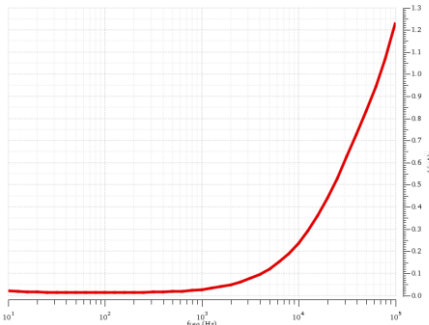
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ROUT vs. FREQUENCY



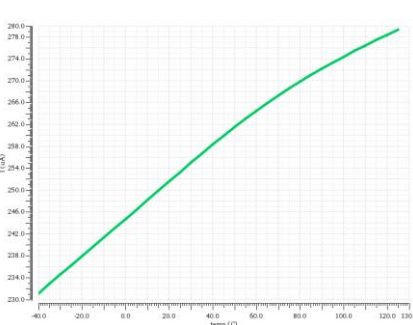
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ROUT vs. FREQUENCY



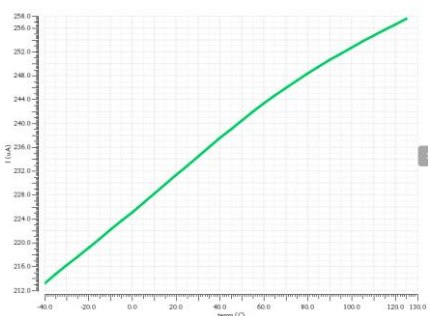
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SUPPLY CURRENT vs. TEMPERATURE



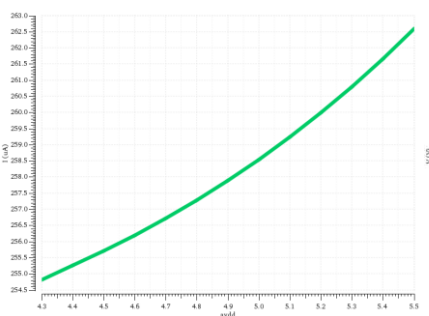
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SUPPLY CURRENT vs. TEMPERATURE



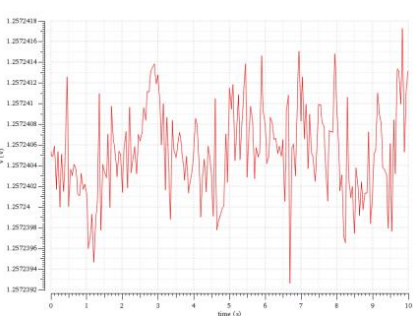
CLREF0640 OUTPUT

SUPPLY CURRENT vs. TEMPERATURE



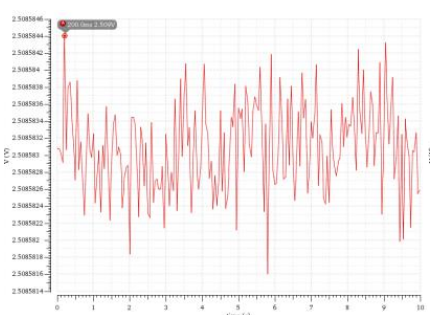
CLREF0612 OUTPUT NOISE

(0.1Hz to 10Hz)



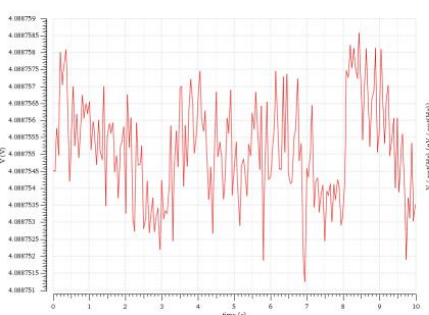
CLREF0625 OUTPUT NOISE

(0.1Hz to 10Hz)



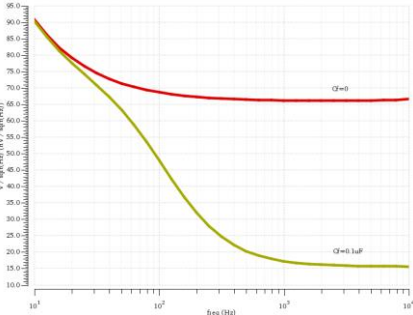
CLREF0640 OUTPUT NOISE

(0.1Hz to 10Hz)



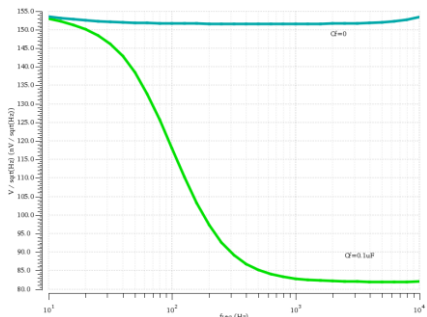
CLREF0612 OUTPUT

OUTPUT NOISE DENSITY



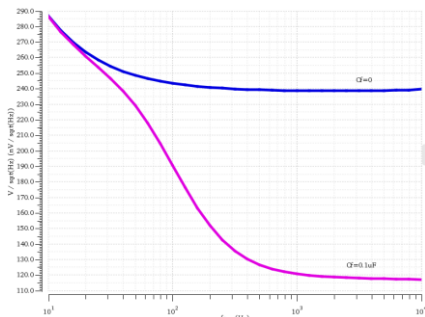
CLREF0625 OUTPUT

OUTPUT NOISE DENSITY



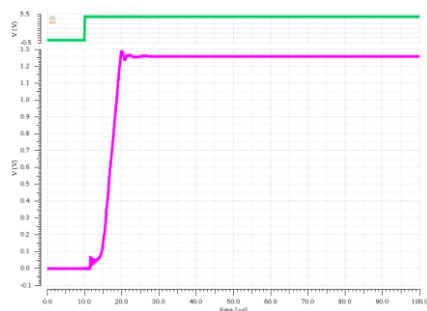
CLREF0640 OUTPUT

OUTPUT NOISE DENSITY

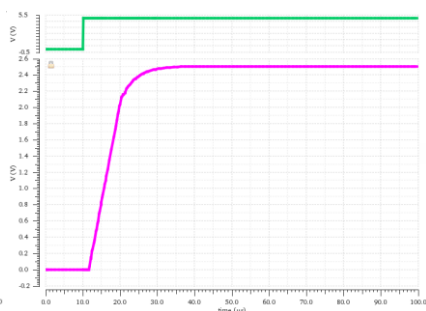


CLREF0612 TURN-ON TRAN

(CFILTER=0uF) (CFILTER=0uF)

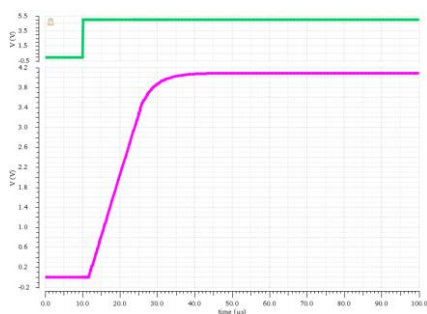


CLREF0625 TURN-ON TRAN

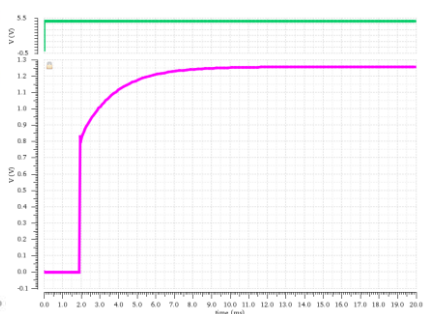


CLREF0640 TURN-ON TRAN

(CFILTER=0uF) (CFILTER=0.1uF)

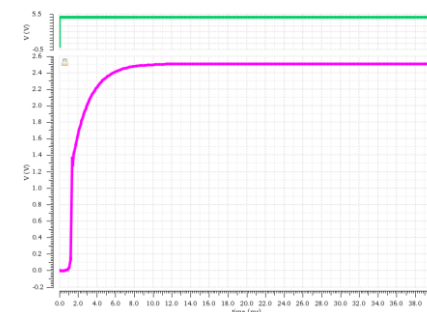


CLREF0612 TURN-ON TRAN

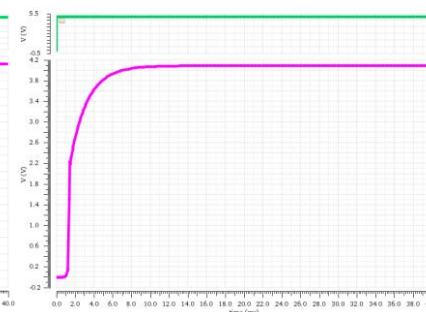


CLREF0625 TURN-ON TRAN

(CFILTER=0uF) (CFILTER=0.1uF)

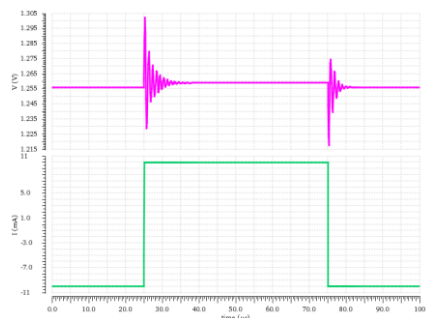


CLREF0640 TURN-ON TRAN



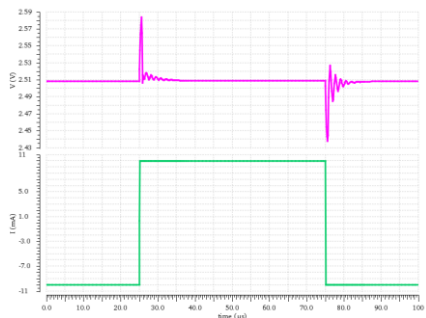
CLREF0612 +-10mA LOAD TRAN

(Cout=0.1uF)

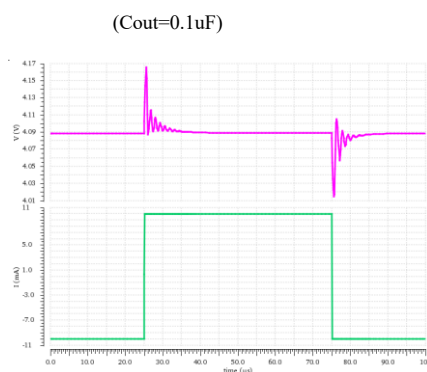


CLREF0625 +-10mA LOAD TRAN

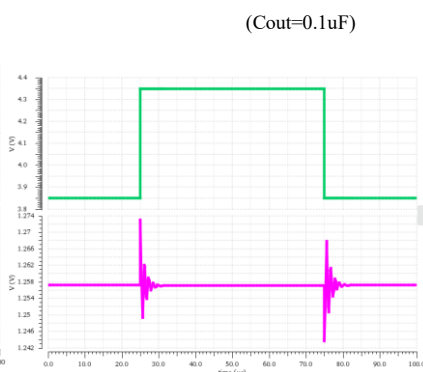
(Cout=0.1uF)



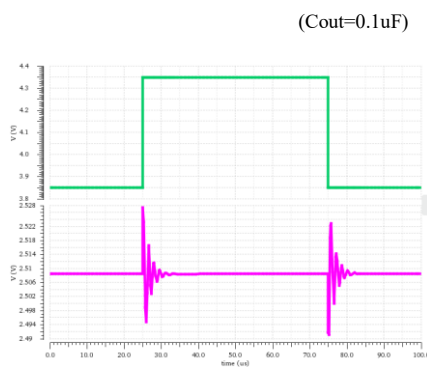
CLREF0640 +-10mA LOAD TRAN



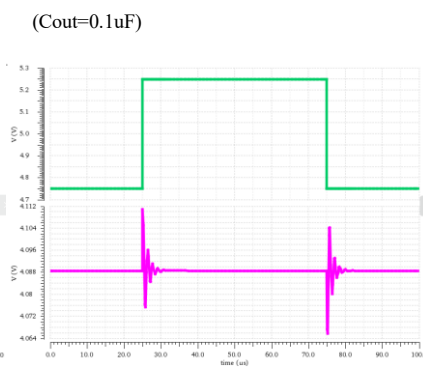
CLREF0612 LINE TRAN



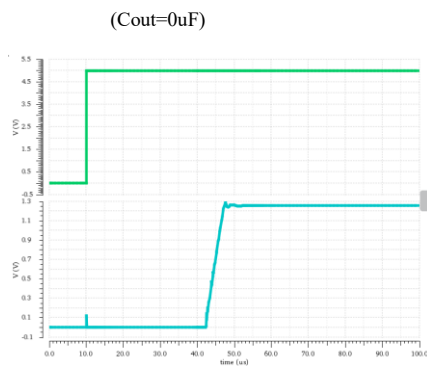
CLREF0625LINE TRAN



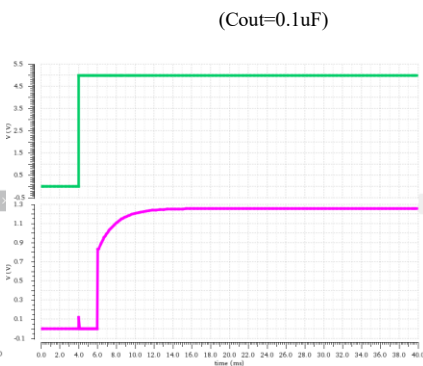
CLREF0640 LINE TRAN



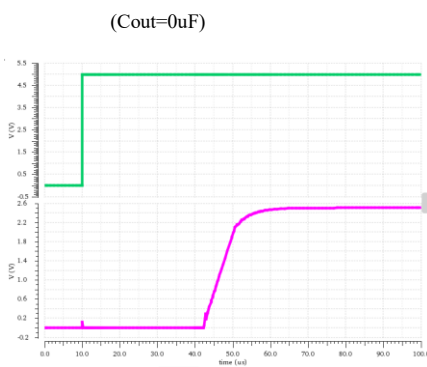
CLREF0612 ENABLE TRAN



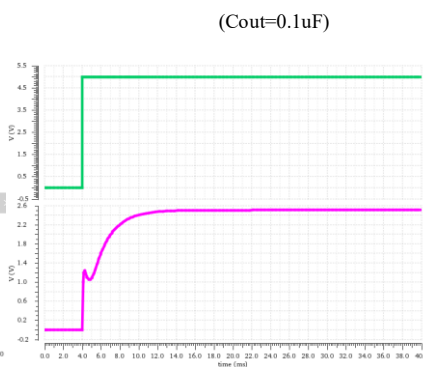
CLREF0612 ENABLE TRAN



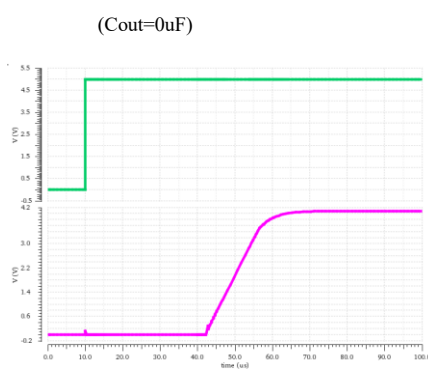
CLREF0625 ENABLE TRAN



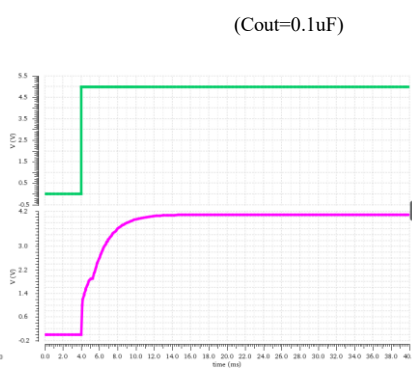
CLREF0625 ENABLE TRAN



CLREF0640 ENABLE TRAN



CLREF0640 ENABLE TRAN



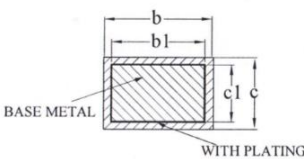
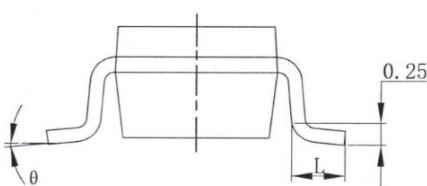
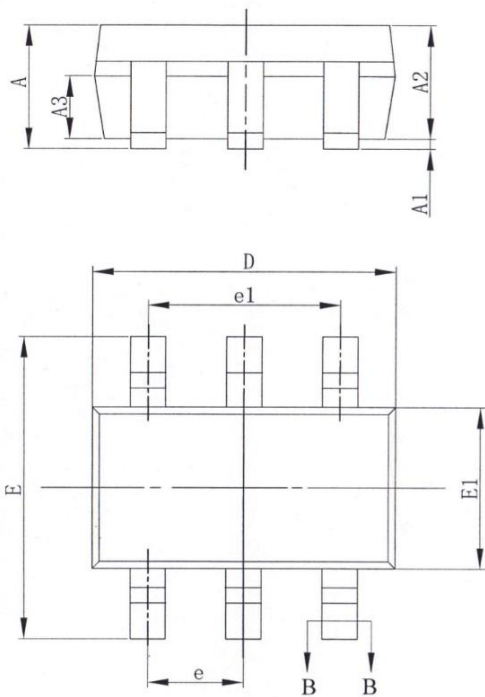
Ordering Information

Figure 10 CLREF06XX

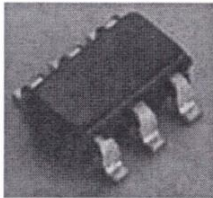
PART NUMBER	Vout (V)	Pakage Type	Package	Temperature drift (Typ)	Operating Temperature Range (°C)
CLREF0612AR	1.25	SOT23-6	Reel	15ppm	-40 to 125
CLREF0618AR	1.8	SOT23-6	Reel	10ppm	-40 to 125
CLREF0620AR	2.048	SOT23-6	Reel	10ppm	-40 to 125
CLREF0625AR	2.5	SOT23-6	Reel	10ppm	-40 to 125
CLREF0630AR	3.0	SOT23-6	Reel	10ppm	-40 to 125
CLREF0633AR	3.3	SOT23-6	Reel	10ppm	-40 to 125
CLREF0640AR	4.096	SOT23-6	Reel	10ppm	-40 to 125
CLREF0650AR	5.0	SOT23-6	Reel	10ppm	-40 to 125
CLREF0612BR	1.25	SOT23-6	Reel	15ppm	-40 to 125
CLREF0618BR	1.8	SOT23-6	Reel	10ppm	-40 to 125
CLREF0620BR	2.048	SOT23-6	Reel	10ppm	-40 to 125
CLREF0625BR	2.5	SOT23-6	Reel	10ppm	-40 to 125
CLREF0630BR	3.0	SOT23-6	Reel	10ppm	-40 to 125
CLREF0633BR	3.3	SOT23-6	Reel	10ppm	-40 to 125
CLREF0640BR	4.096	SOT23-6	Reel	10ppm	-40 to 125
CLREF0650BR	5.0	SOT23-6	Reel	10ppm	-40 to 125

*OrderingQuantity: 3000pcs/Reel

Package Information



SECTION B-B



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.25
A1	0.04	—	0.10
A2	1.00	1.10	1.20
A3	0.55	0.65	0.75
b	0.38	—	0.48
b1	0.37	0.40	0.43
c	0.11	—	0.21
c1	0.10	0.13	0.16
D	2.72	2.92	3.12
E	2.60	2.80	3.00
E1	1.40	1.60	1.80
e	0.95BSC		
e1	1.90BSC		
L	0.30	—	0.60
θ	0	—	8°