

3.3V Power Supply Isolated Current Sensor with Common Mode Field Rejection

Description

The Senko Micro's SC813 provides economical and precise solutions for AC or DC current sensing in industrial, commercial, and communications systems. The device package allows for easy implementation by the customer.

The device consists of a precise, low-offset, linear Hall circuit with a copper conduction path located near the surface of the die. Applied current flowing through this copper conduction path generates a magnetic field which the Hall IC converts into a proportional voltage. A precise, proportional voltage is provided by the low-offset, chopper-stabilized Linear Hall IC, which is programmed for accuracy after packaging.

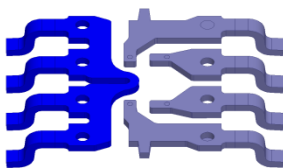
The terminals of the conductive path (from pin1 and 2 to pin 3 and 4) are electrically isolated from the signal leads (pins 5 through 8). This allows the SC813 to be used in applications requiring electrical isolation without the use of opto-isolators or other costly isolation techniques.

Package: 8-Lead SOP-SC

Top View:



Current Path:



Features

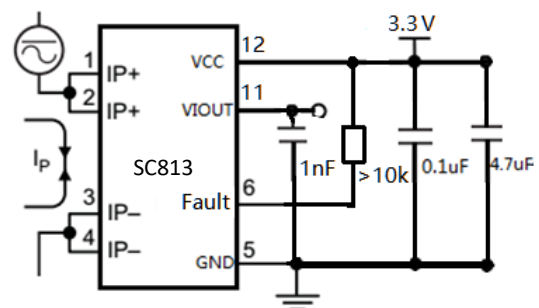
- Support 3.3v power supply
- Differential hall sensing rejects common mode fields
- Output voltage proportional to AC or DC currents
- Selected Bidirectional and unidirectional IP mode
- Total output error 0.5% @ $T_A = 25^\circ\text{C}$, 3% for full temperature range.
- 4 μs output rise time in response to step input current
- 1.2m Ω internal conductor resistance
- > 2 kV RMS minimum isolation voltage from pins 1-4 to pins 5-8
- Nearly zero magnetic hysteresis
- Small footprint, low-profile SOP8-SC package

Application Field

- Smart power meter
- Brushless DC motor commutation
- Load detection and management
- Switch mode power supplies

Typical Application

- Support 0 ~ $\pm 50\text{A}$, AC or DC



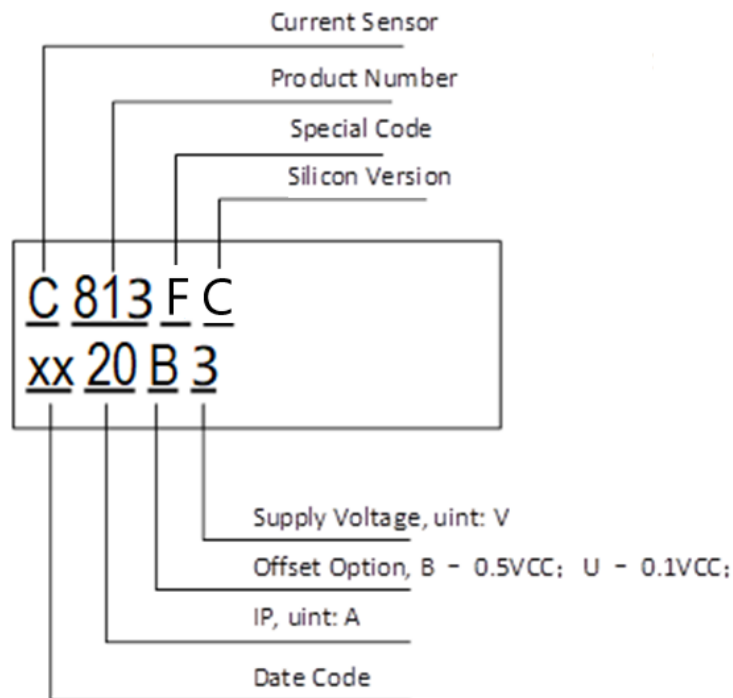
Note:

1. 4.7 μF bypass is **MUST** have to guarantee performance;
2. 0.1 μF bypass capacitor is optional for VCC;
3. Pin6 NC or to capacitor, cancel Fault function.

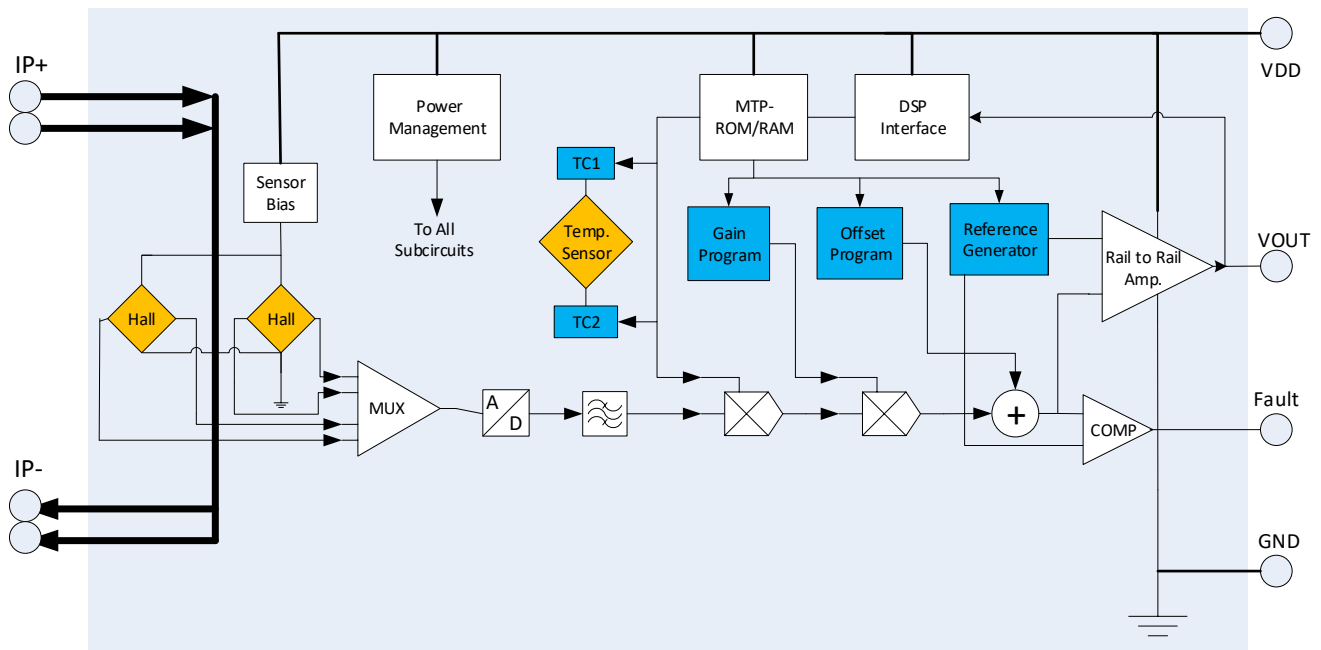
■ Order information

Part Number	Temp Range	Packaging	IP(A)	Vout @IP=0A	Sens @ VCC=3.3V (mV/A)
SC813FFT-05B3	F (-40~125°C)	T (3k Pieces/Reel)	±5	B3(0.5Vcc)	264
SC813FFT-10B3			±10	B3(0.5Vcc)	132
SC813FFT-12B3			±12.5	B3(0.5Vcc)	110
SC813FFT-20B3			±20	B3(0.5Vcc)	66
SC813FFT-25B3			±25	B3(0.5Vcc)	55
SC813FFT-30B3			±30	B3(0.5Vcc)	44
SC813FFT-40B3			±40	B3(0.5Vcc)	33
SC813FFT-50B3			±50	B3(0.5Vcc)	26.4
SC813FFT-10U3			10	U3(0.1Vcc)	264
SC813FFT-20U3			20	U3(0.1Vcc)	132
SC813FFT-30U3			30	U3(0.1Vcc)	88
SC813FFT-40U3			40	U3(0.1Vcc)	66

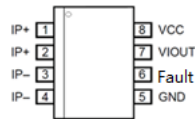
Mark Description



Functional Block Diagram



Pin Configuration



Number	Name	Description
1 and 2	IP+	Terminals for current being sampled; fused internally
3 and 4	IP-	Terminals for current being sampled; fused internally
5	GND	Signal Ground terminal
6	Fault	IP over current protection signal output, active low
7	VIOUT	Analog output signal
8	VCC	Device power supply terminal

Absolute Maximum Ratings

Absolute maximum ratings are limiting values to be applied individually, and beyond which the serviceability of the circuit may be impaired. Functional operability is not necessarily implied. Exposure to absolute maximum rating conditions for an extended period of time may affect device reliability.

Characteristic	Symbol	Notes	Rating	Unit
V _{CC}	Supply voltage		6.0	V
V _{RCC}	Reverse Supply Voltage		-0.1	V
V _{IOUT}	Output voltage		6.0	V
V _{RIOUT}	Reverse Output Voltage		-0.1	V
V _{ISO}	Dielectric Strength Test Voltage	Pins 1-4 and 5-8; 50 Hz, 1 minute, T _A =25°C	2400	V _{RMS}
V _{WVBI}	Working Voltage for Basic Isolation	Maximum working voltage according to UL60950-1	420	V _{peak}
I _P	Overcurrent Transient Tolerance	1 pulse, 100ms, 1% duty cycle	80	A
I _{IOUT(Source)}	Output Current Source		20	mA
I _{IOUT(Sink)}	Output Current Sink		20	mA
T _A	Nominal Operating Ambient Temperature	Range F	-40~125	°C
T _{J(max)}	Maximum Junction Temperature		165	°C
T _{stg}	Storage Temperature		-65~170	°C

Common operating Characteristics

Note: Over full range of T_A=-40°C ~ 125°C, C_{bypass}=4.7uF, C_{Load}=1.5nF, V_{CC}=3.3V, unless otherwise specified.

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Supply Voltage	V _{CC}	Operating	3.1	3.3	3.6	V
Supply Current	I _{CC}	V _{CC} = 5.0 V, output open		8	12	mA
Output Capacitance Load	C _{LOAD}	V _{IOUT} to GND		1.5	3	nF
Output Resistive Load	R _{LOAD}	V _{IOUT} to GND	0.17			kΩ
Primary Conductor Resistance	R _{PRIMARY}	T _A = 25°C		1.2	1.5	mΩ
Response Time	t _r	I _P = I _{P(max)} , T _A = 25°C, C _{OUT} = open		4.0	5	μS
Frequency Bandwidth	f	-3 Db, T _A =25°C; I _P =10 A peak-to-peak		120		kHz
Nonlinearity	E _{LIN}	Over full range of I _P		0.3	1	%
Symmetry	E _{SYM}	Over full range of I _P	99	100	101	%
Power-On Time	T _{PO}	Output reaches 90% of steady-state level, T _J = 25°C, 20 A present		100	300	μS
Magnetic Coupling		T _{J(max)} is not exceeded		12		G/A
Internal Filter Resistance	R _{F(INT)}			1.7		kΩ
Power supply bypass capacitor	C _{bypass}	Normal operating	2.2	4.7		μF
Pull up resistor	R _{fault}		10	20	100	kΩ

Common Thermal Characteristics

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Operating Internal Lead Frame Temperature	T _A	F range	-40		-125	°C
Junction-to-Lead Thermal Resistance	R _{θJL}				5	°C/W
Junction-to-Ambient Thermal Resistance	R _{θJA}				23	°C/W

X-05B Individual Performance Characteristics

Note: TJ(max) is not exceeded TA=-40°C ~ 125°C, C_{Bypass}=4.7uF, C_{Load}=1.5nF, VCC=3.3V, unless otherwise specified

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Optimized Accuracy Range	I _P		-5		5	A
VIOUT @ 0A	V _{OQ}	IP=0A, T _A =25°C		0.5Vcc		V
Sensitivity	Sens	Over full of T _A =25°C		264		mV/A
Zero Current Output Slope	ΔI _{OUT(Q)}	T _A = -40~25°C		±20		mV
		T _A = 25~125°C		±15		mV
Sensitivity Slope	ΔSens	T _A = -40~25°C		±1		%
		T _A = 25~125°C		±1.5		%
Total Output Error	E _{TOT}	I _P = ±5 A, T _A =25°C, output filtered		±0.8		%
		I _P = ±5 A, T _A =-40°C ~ 125°C, output filtered	-3		3	%

X-10B Individual Performance Characteristics

Note: TJ(max) is not exceeded TA=-40°C ~ 125°C, C_{Bypass}=4.7uF, C_{Load}=1.5nF, VCC=3.3V, unless otherwise specified

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Optimized Accuracy Range	I _P		-10		10	A
VIOUT @ 0A	V _{OQ}	IP=0A, T _A =25°C		0.5Vcc		V
Sensitivity	Sens	Over full of T _A =25°C		132		mV/A
Zero Current Output Slope	ΔI _{OUT(Q)}	T _A = -40~25°C		±20		mV
		T _A = 25~125°C		±15		mV
Sensitivity Slope	ΔSens	T _A = -40~25°C		±1		%
		T _A = 25~125°C		±1.5		%
Total Output Error	E _{TOT}	I _P = ±10 A, T _A =25°C, output filtered		±0.8		%
		I _P = ±10 A, T _A =-40°C ~ 125°C, output filtered	-3		3	%

X-12B Individual Performance Characteristics

Note: TJ(max) is not exceeded TA=-40°C ~ 125°C, C_{Bypass}=4.7uF, C_{Load}=1.5nF, VCC=3.3V, unless otherwise specified

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Optimized Accuracy Range	I _P		-12.5		12.5	A
VIOUT @ 0A	V _{OQ}	IP=0A, T _A =25°C		0.5Vcc		V
Sensitivity	Sens	Over full of T _A =25°C		110		mV/A
Zero Current Output Slope	ΔI _{OUT(Q)}	T _A = -40~25°C		±20		mV
		T _A = 25~125°C		±15		mV
Sensitivity Slope	ΔSens	T _A = -40~25°C		±1		%
		T _A = 25~125°C		±1.5		%
Total Output Error	E _{TOT}	I _P = ±12 A, T _A =25°C, output filtered		±0.5		%
		I _P = ±12 A, T _A =-40°C ~ 125°C, output filtered	-3		3	%

X-20B Individual Performance Characteristics

Note: TJ(max) is not exceeded TA=-40°C ~ 125°C, C_{Bypass}=4.7uF, C_{Load}=1.5nF, VCC=3.3V, unless otherwise specified

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Optimized Accuracy Range	I _P		-20		20	A
VIOUT @ 0A	V _{OQ}	IP=0A, T _A =25°C		0.5Vcc		V
Sensitivity	Sens	Over full of T _A =25°C		66		mV/A
Zero Current Output Slope	ΔI _{OUT(Q)}	T _A = -40~25°C		±15		mV
		T _A = 25~125°C		±12		mV
Sensitivity Slope	ΔSens	T _A = -40~25°C		±1		%
		T _A = 25~125°C		±1.5		%
Total Output Error	E _{TOT}	I _P = ±20 A, T _A =25°C, output filtered		±0.5		%
		I _P = ±20 A, T _A =-40°C ~ 125°C, output filtered	-3		3	%

X-25B Individual Performance Characteristics

Note: $T_J(\max)$ is not exceeded $T_A = -40^\circ\text{C} \sim 125^\circ\text{C}$, $C_{\text{Bypass}} = 4.7\mu\text{F}$, $C_{\text{Load}} = 1.5\text{nF}$, $V_{\text{CC}} = 3.3\text{V}$, unless otherwise specified

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Optimized Accuracy Range	I_P		-25		25	A
VIOUT @ 0A	V_{OQ}	$I_P = 0\text{A}$, $T_A = 25^\circ\text{C}$		0.5Vcc		V
Sensitivity	Sens	Over full of $T_A = 25^\circ\text{C}$		55		mV/A
Zero Current Output Slope	$\Delta I_{\text{OUT}(Q)}$	$T_A = -40 \sim 25^\circ\text{C}$		± 15		mV
		$T_A = 25 \sim 125^\circ\text{C}$		± 12		mV
Sensitivity Slope	ΔSens	$T_A = -40 \sim 25^\circ\text{C}$		± 1		%
		$T_A = 25 \sim 125^\circ\text{C}$		± 1.5		%
Total Output Error	E_{TOT}	$I_P = \pm 25\text{A}$, $T_A = 25^\circ\text{C}$, output filtered		± 0.5		%
		$I_P = \pm 25\text{A}$, $T_A = -40^\circ\text{C} \sim 125^\circ\text{C}$, output filtered	-3		3	%

X-30B Individual Performance Characteristics

Note: $T_J(\max)$ is not exceeded $T_A = -40^\circ\text{C} \sim 125^\circ\text{C}$, $C_{\text{Bypass}} = 4.7\mu\text{F}$, $C_{\text{Load}} = 1.5\text{nF}$, $V_{\text{CC}} = 3.3\text{V}$, unless otherwise specified

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Optimized Accuracy Range	I_P		-30		30	A
VIOUT @ 0A	V_{OQ}	$I_P = 0\text{A}$, $T_A = 25^\circ\text{C}$		0.5Vcc		V
Sensitivity	Sens	Over full of $T_A = 25^\circ\text{C}$		44		mV/A
Zero Current Output Slope	$\Delta I_{\text{OUT}(Q)}$	$T_A = -40 \sim 25^\circ\text{C}$		± 15		mV
		$T_A = 25 \sim 125^\circ\text{C}$		± 12		mV
Sensitivity Slope	ΔSens	$T_A = -40 \sim 25^\circ\text{C}$		± 1		%
		$T_A = 25 \sim 125^\circ\text{C}$		± 1.5		%
Total Output Error	E_{TOT}	$I_P = \pm 30\text{A}$, $T_A = 25^\circ\text{C}$, output filtered		± 0.5		%
		$I_P = \pm 30\text{A}$, $T_A = -40^\circ\text{C} \sim 125^\circ\text{C}$, output filtered	-3		3	%

X-40B Individual Performance Characteristics

Note: $T_J(\max)$ is not exceeded $T_A = -40^\circ\text{C} \sim 125^\circ\text{C}$, $C_{\text{Bypass}} = 4.7\mu\text{F}$, $C_{\text{Load}} = 1.5\text{nF}$, $V_{\text{CC}} = 3.3\text{V}$, unless otherwise specified

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Optimized Accuracy Range	I_P		-40		40	A
VIOUT @ 0A	V_{OQ}	$I_P = 0\text{A}$, $T_A = 25^\circ\text{C}$		0.5Vcc		V
Sensitivity	Sens	Over full of $T_A = 25^\circ\text{C}$		33		mV/A
Zero Current Output Slope	$\Delta I_{\text{OUT}(Q)}$	$T_A = -40 \sim 25^\circ\text{C}$		± 15		mV
		$T_A = 25 \sim 125^\circ\text{C}$		± 12		mV
Sensitivity Slope	ΔSens	$T_A = -40 \sim 25^\circ\text{C}$		± 1		%
		$T_A = 25 \sim 125^\circ\text{C}$		± 1.5		%
Total Output Error	E_{TOT}	$I_P = \pm 40\text{A}$, $T_A = 25^\circ\text{C}$, output filtered		± 0.5		%
		$I_P = \pm 40\text{A}$, $T_A = -40^\circ\text{C} \sim 125^\circ\text{C}$, output filtered	-3		3	%

X-50B Individual Performance Characteristics

Note: $T_J(\max)$ is not exceeded $T_A = -40^\circ\text{C} \sim 125^\circ\text{C}$, $C_{\text{Bypass}} = 4.7\mu\text{F}$, $C_{\text{Load}} = 1.5\text{nF}$, $V_{\text{CC}} = 3.3\text{V}$, unless otherwise specified

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Optimized Accuracy Range	I_P		-50		50	A
VIOUT @ 0A	V_{OQ}	$I_P = 0\text{A}$, $T_A = 25^\circ\text{C}$		0.5Vcc		V
Sensitivity	Sens	Over full of $T_A = 25^\circ\text{C}$		26.4		mV/A
Zero Current Output Slope	$\Delta I_{\text{OUT}(Q)}$	$T_A = -40 \sim 25^\circ\text{C}$		± 15		mV
		$T_A = 25 \sim 125^\circ\text{C}$		± 12		mV
Sensitivity Slope	ΔSens	$T_A = -40 \sim 25^\circ\text{C}$		± 1		%
		$T_A = 25 \sim 125^\circ\text{C}$		± 1.5		%
Total Output Error	E_{TOT}	$I_P = \pm 50\text{A}$, $T_A = 25^\circ\text{C}$, output filtered		± 0.5		%
		$I_P = \pm 50\text{A}$, $T_A = -40^\circ\text{C} \sim 125^\circ\text{C}$, output filtered	-3		3	%

X-10U Individual Performance Characteristics

Note: TJ(max) is not exceeded TA=-40°C ~ 125°C, C_{Bypass}=4.7uF, C_{Load}=1.5nF, VCC=3.3V, unless otherwise specified

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Optimized Accuracy Range	I _P		0		10	A
V _{IOUT @ 0A}	V _{OQ}	IP=0A, T _A =25°C		0.1Vcc		V
Sensitivity	Sens	Over full of T _A =25°C		264		mV/A
Zero Current Output Slope	ΔI _{OUT(Q)}	T _A = -40~25°C		±20		mV
		T _A = 25~125°C		±15		mV
Sensitivity Slope	ΔSens	T _A = -40~25°C		±1		%
		T _A = 25~125°C		±1.5		%
Total Output Error	E _{TOT}	I _P = 10 A, T _A =25°C, output filtered		±0.5		%
		I _P = 10 A, T _A =-40°C ~ 125°C, output filtered	-3		3	%

X-20U Individual Performance Characteristics

Note: TJ(max) is not exceeded TA=-40°C ~ 125°C, C_{Bypass}=4.7uF, C_{Load}=1.5nF, VCC=3.3V, unless otherwise specified

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Optimized Accuracy Range	I _P		0		20	A
V _{IOUT @ 0A}	V _{OQ}	IP=0A, T _A =25°C		0.1Vcc		V
Sensitivity	Sens	Over full of T _A =25°C		132		mV/A
Zero Current Output Slope	ΔI _{OUT(Q)}	T _A = -40~25°C		±20		mV
		T _A = 25~125°C		±15		mV
Sensitivity Slope	ΔSens	T _A = -40~25°C		±1		%
		T _A = 25~125°C		±1.5		%
Total Output Error	E _{TOT}	I _P = 20 A, T _A =25°C, output filtered		±0.5		%
		I _P = 20 A, T _A =-40°C ~ 125°C, output filtered	-3		3	%

X-30U Individual Performance Characteristics

Note: TJ(max) is not exceeded TA=-40°C ~ 125°C, C_{Bypass}=4.7uF, C_{Load}=1.5nF, VCC=3.3V, unless otherwise specified

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Optimized Accuracy Range	I _P		0		30	A
V _{IOUT @ 0A}	V _{OQ}	IP=0A, T _A =25°C		0.1Vcc		V
Sensitivity	Sens	Over full of T _A =25°C		88		mV/A
Zero Current Output Slope	ΔI _{OUT(Q)}	T _A = -40~25°C		±15		mV
		T _A = 25~125°C		±12		mV
Sensitivity Slope	ΔSens	T _A = -40~25°C		±1		%
		T _A = 25~125°C		±1.5		%
Total Output Error	E _{TOT}	I _P = 30 A, T _A =25°C, output filtered		±0.5		%
		I _P = 30 A, T _A =-40°C ~ 125°C, output filtered	-3		3	%

X-40U Individual Performance Characteristics

Note: TJ(max) is not exceeded TA=-40°C ~ 125°C, C_{Bypass}=4.7uF, C_{Load}=1.5nF, VCC=3.3V, unless otherwise specified

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Optimized Accuracy Range	I _P		0		40	A
V _{IOUT @ 0A}	V _{OQ}	IP=0A, T _A =25°C		0.1Vcc		V
Sensitivity	Sens	Over full of T _A =25°C		66		mV/A
Zero Current Output Slope	ΔI _{OUT(Q)}	T _A = -40~25°C		±15		mV
		T _A = 25~125°C		±12		mV
Sensitivity Slope	ΔSens	T _A = -40~25°C		±1		%
		T _A = 25~125°C		±1.5		%
Total Output Error	E _{TOT}	I _P = 40 A, T _A =25°C, output filtered		±0.5		%
		I _P = 40 A, T _A =-40°C ~ 125°C, output filtered	-3		3	%

Typical Performance Graphs

Note: Over full range of $T_A = -40^{\circ}\text{C} \sim 125^{\circ}\text{C}$, $C_{\text{Bypass}} = 4.7\mu\text{f}$, $C_{\text{Load}} = 1.5\text{nF}$, $V_{\text{CC}} = 3.3\text{V}$, $I_P = 20\text{mA}$, unless otherwise specified.

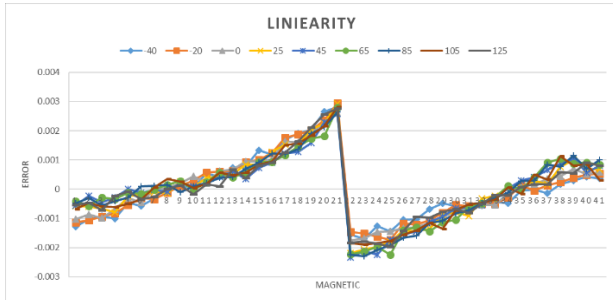


Figure 1. Linearity versus Ambient Temperature

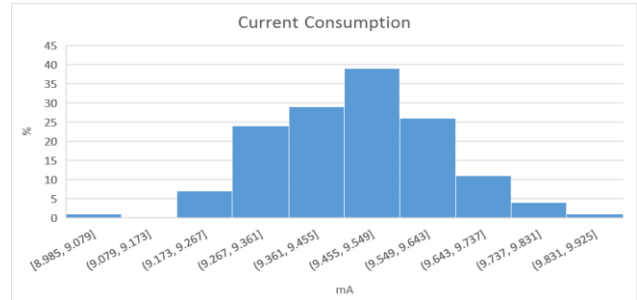


Figure 2. Current Consumption

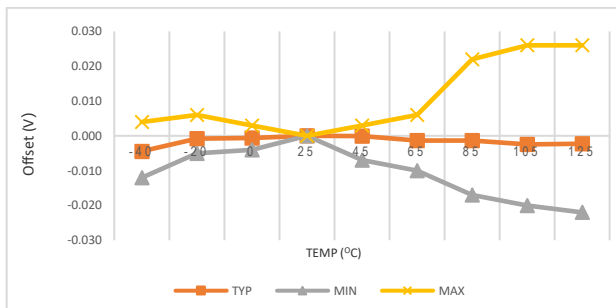


Figure 3. Zero Current Output versus Ambient Temperature

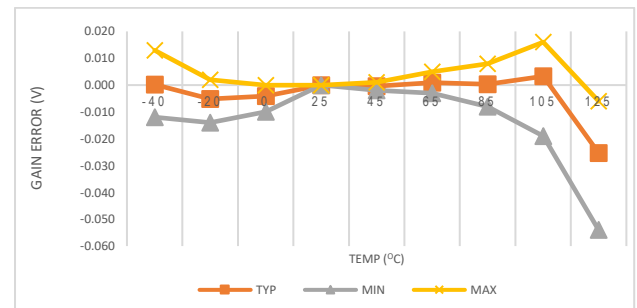


Figure 4. Sensitivity Error versus Ambient Temperature

Dynamic Performance

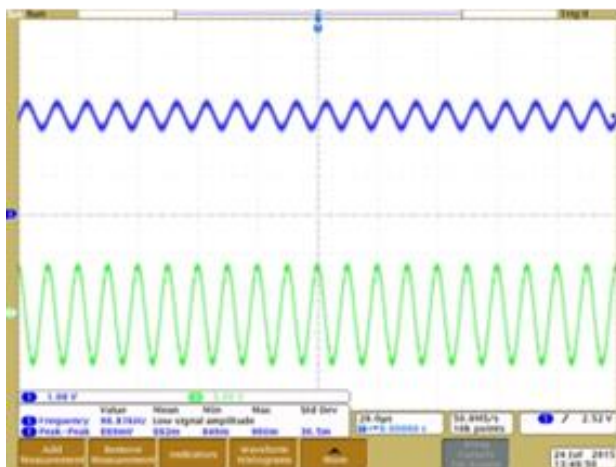


Figure 5. 100k 25A IP Frequency Response.

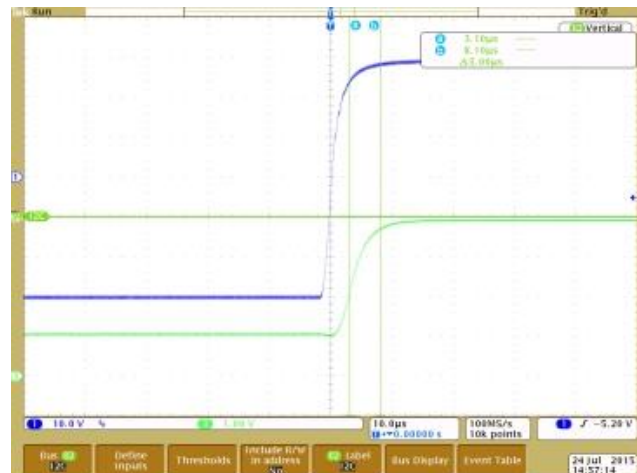
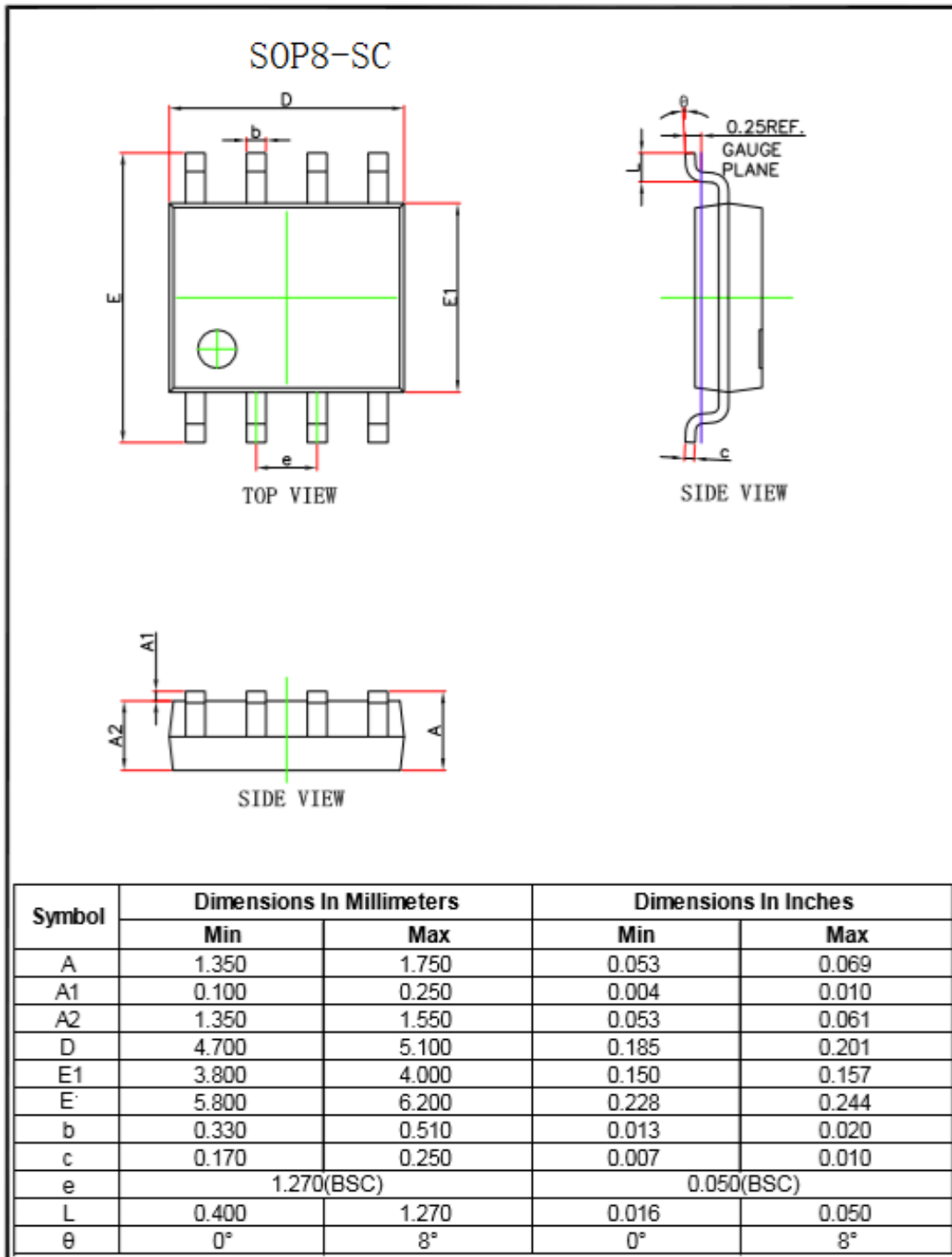


Figure 6. < 5uS Response Time

Package Information

Note: Package is SOP8-SC, all dimensions are in millimeters.



Important Notice

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Revision Table

Revision	Change	Page	Author	Date
1.0	Initial draft		Jon	2017.03
2.0	Add order info.		Jon	2018.08

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