SQ52131

High- and Low-Side, Bidirectional, Zero-Drift, Current-Sense Amplifier With Enhanced PWM Rejection

Advanced Design Specification

General Description

The SQ52131 is a voltage-output, current-sense amplifier with enhanced PWM rejection that can sense drops across shunt resistors over a wide common-mode voltage range from –4V to 80V, independent of the supply voltage. The negative common-mode voltage allows the device to operate below ground, accommodating the flyback period of typical solenoid applications. Enhanced PWM rejection provides high levels of suppression for large common-mode transients (ΔV/Δt) in systems that use pulse width modulation (PWM) signals (such as motor drives and solenoid control systems). This feature allows for accurate current measurements without large transients and associated recovery ripple on the output voltage.

This device operates from a single 2.7V to 5.5V power supply, drawing a typical value of 1.8mA of supply current. A fixed Gain= 50V/V. The low offset of the zero-drift architecture enables current sensing with maximum drops across the shunt as low as 10mV full-scale. All versions are specified over the extended operating temperature range (–40°C to +125°C), and are offered in a TSSOP8 and SOP8 packages.

Ordering Information

SQ52131 □(□□□)

Package Code

Optional Spec Code

Ordering Number	Package type	Note
SQ52131HMP	TSSOP8	
SQ52131FAP	SOP8	

Features

- Enhanced PWM Rejection
- Excellent CMRR:
  - 132dB DC CMRR
  - 84dB AC CMRR at 50 kHz
- Wide Common-Mode Range: –4V to 80V
- Accuracy:
  - Gain Error: 0.05% (Typ.)
  - Gain Drift: 0.5ppm/°C (Typ.)
  - Offset Voltage: ±5μV (Typ.)
  - Offset Drift: 50nV/°C (Typ.)
- Fixed Gain: 50V/V
- Quiescent Current: 1.8mA (Typ.)
- Package: TSSOP8/ SOP8

Applications

- Motor Controls
- Solenoid and Valve Controls
- Power Management
- Actuator Controls
- Pressure Regulators
- Telecom Equipment

Typical Application and Function Block

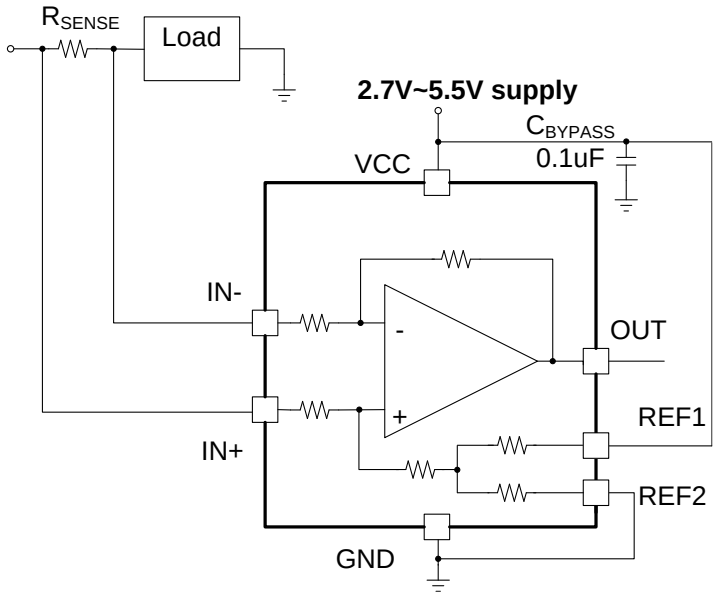
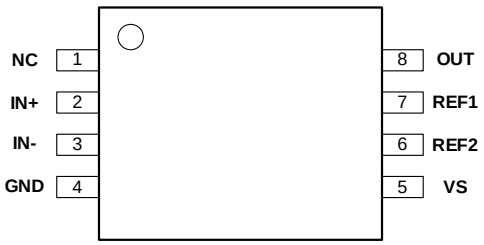
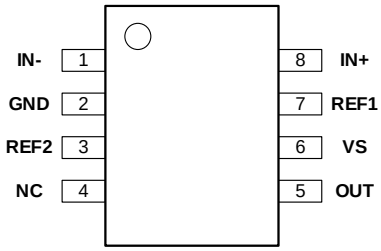


Figure1. Typical Application Circuit

Pin out (Top View)



(TSSOP8)



(SOP8)

Part Number	Package type	Top Mark①
SQ52131HMP	TSSOP8	**EAT*xyz***
SQ52131FAP	SOP8	**GFG*xyz***

Note①： ***x=year code, y=week code, z= lot number code.***

Pin Name	Pin No.		Function Description
	TSSOP8	SOP8	
GND	4	2	Ground
IN-	3	1	Connect to load side of shunt resistor
IN+	2	8	Connect to supply side of shunt resistor
NC	1	4	Reserved. Connect to ground
OUT	8	5	Output voltage
REF1	7	7	Reference 1 voltage. Connect to 0 V to VS
REF2	6	3	Reference 2 voltage. Connect to 0 V to VS
VS	5	6	Power supply, 2.7 V to 5.5 V

Absolute Maximum Ratings (Note 1)

V_S ---------- 6V
Differential V_{IN+} - V_{IN-} ---------- -80V~80V
Common mode, V_{IN+}, V_{IN-} ---------- -6V~90V
Output ---------- GND-0.3V~V_S+0.3V
R_{EF1}, R_{EF2}, NC Input voltage ---------- GND-0.3V~V_S+0.3V
Operating free-air Temperature ---------- -55℃~150℃
Maximum Junction Temperature ---------- 150℃
Storage Temperature Range ---------- -65℃ ~ 150℃

Recommended Operating Conditions

V_S ---------- 2.7V~5.5V
Common mode, V_{IN+}, V_{IN-} ---------- -4V~80V
Operating free-air Temperature ---------- -40℃~125℃

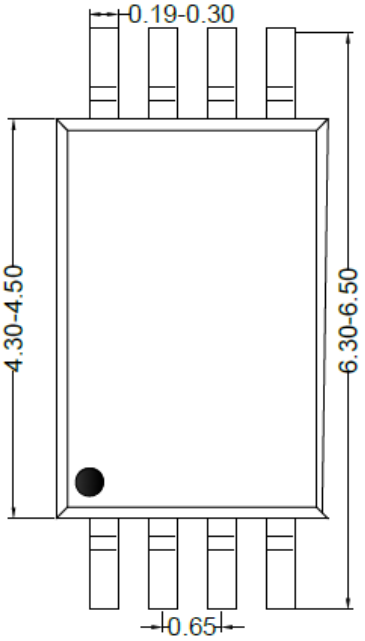
Electrical Characteristics

T_A=25°C, V_S=5V, V_{SENSE}=V_{IN+}–V_{IN-}, V_{CM}=12V, and V_{REF1}=V_{REF2}=V_S/2, unless otherwise noted.

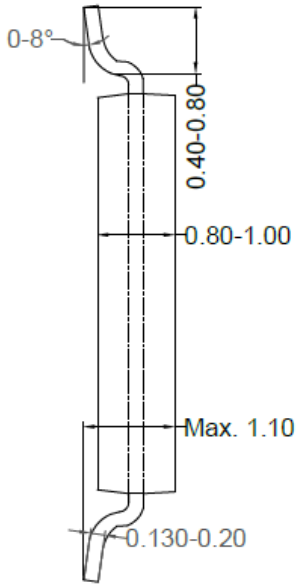
Parameter	Symbol	Conditions	Min	Typ	Max	Units
INPUT						
Common mode Input Voltage	V_{CM}		-4		80	V
Common-mode Rejection Ratio	CMRR	V_{IN+}= -4V to 80V, V_{SENSE}=0mV T_A= –40°C to 125°C		132		dB
		f = 50 kHz		84		
Offset Voltage, Input-Referred	V_{OS}	V_{SENSE}=0mV		±5		μV
Offset Voltage Drift	dV_{OS}/dT	V_{SENSE}=0mV, T_A= –40°C to 125°C		±50		nV/°C
Power-supply Rejection Ratio	PSRR	V_S=2.7V to 5.5V, V_{SENSE}=0mV, T_A= –40°C to 125°C		±1		μV/V
Input Bias Current	I_B	I_{B+}, I_{B-}, V_{SENSE}=0mV		90		μA
Reference Input Range			0		V_S	V
OUTPUT						
Gain	G			50		V/V
Gain Error		GND + 50mV≤V_{OUT}≤V_S–200mV		±0.05%		
		T_A=–40°C to 125°C		±0.5		ppm/°C
Non-Linearity Error		GND + 10mV≤V_{OUT}≤V_S–200mV		±0.01%		
Reference Divider Accuracy		V_{OUT}=|(V_{REF1}–V_{REF2})|/2 at V_{SENSE}=0mV, T_A=–40°C to 125°C		0.02%		
Reference Voltage Rejection Ratio (Input-Referred)	RVRR			2		μV/V
Maximum Capacitive Load		No sustained oscillation		1		nF
VOLTAGE OUTPUT						
Swing to V_S Power-supply Rail		R_L=10kΩ to GND, T_A = –40°C to 125°C		V_S–0.05		V
Swing to GND		R_L=10kΩ to GND, V_{SENSE}=0mV V_{REF1}=V_{REF2}=0V, T_A= –40°C to 125°C		V_{GND}+1		mV
FREQUENCY RESPONSE						
Bandwidth	BW	–3-dB bandwidth		400		kHz
		2% THD+N		100		
Settling Time		output settles to 0.5% of final value		9.6		μs
Slew Rate	SR			2		V/μs
NOISE (INPUT REFERRED)						
Voltage Noise Density				40		nV/√Hz
POWER SUPPLY						
Operating Voltage Range	V_S	T_A= –40°C to 125°C	2.7		5.5	V
Quiescent Current	I_Q	V_{SENSE}=0mV		1.8		mA
		I_Q vs temperature, T_A= –40°C to 125°C			TBD	
TEMPERATURE RANGE						
Specified Range			-40		125	°C

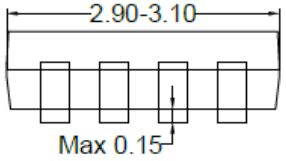
Note 1: Stresses beyond the "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

TSSOP8 Package Outline Drawing



Top View



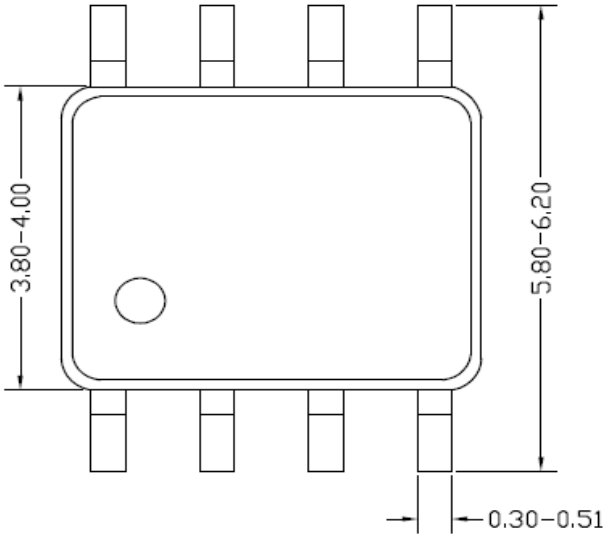


Front View

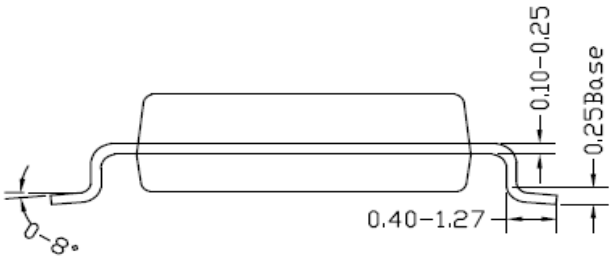
Recommended PCB layout

Notes: 1, All dimension in millimeter and exclude mold flash & metal burr;

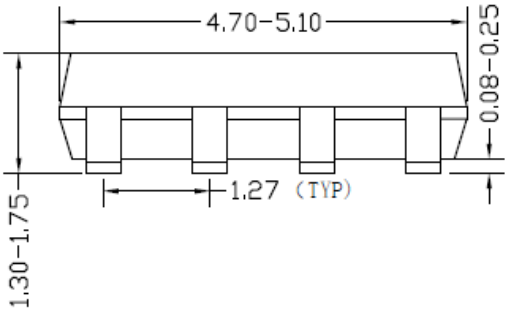
SOP8 Package outline & PCB layout design



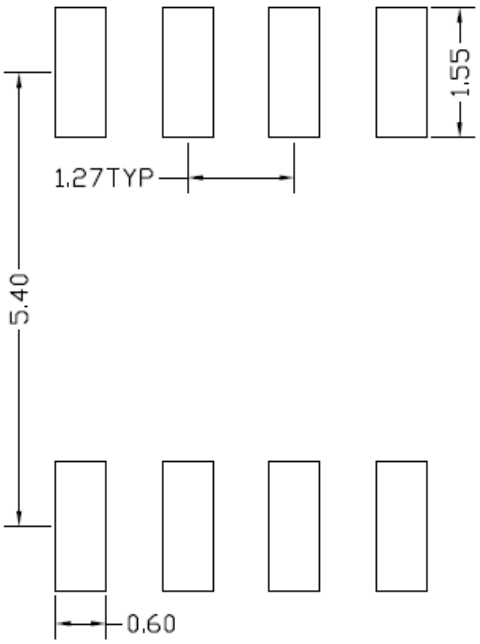
Top view



Side view



Front view



Recommended Pad Layout (Reference only)

Notes: **All dimension in millimeter and exclude mold flash & metal burr.**