19-1781; Rev 0; 7/00

MAXIM

Single/Dual/Quad High-Side Current-Sense Amplifiers with Internal Gain

General Description

The MAX4376/MAX4377/MAX4378 single, dual, and quad precision high-side current-sense amplifiers are available in space-saving packages. They feature buffered voltage outputs that eliminate the need for gain-setting resistors and are ideal for today's notebook computers, cell phones, and other systems where current monitoring is critical. These precision devices are offered in three fixed-gain versions of 20, 50, and 100:

GAIN	SUFFIX
20	T
50	F
100	H

For example, MAX4376TAUK is a single high-side amplifier with a gain of 20.

High-side current monitoring is especially useful in battery-powered systems since it does not interfere with the ground path of the battery charger. The input common-mode range of 0 to +28V is independent of the supply voltage and ensures that the current-sense feedback remains viable even when connected to a battery pack in deep discharge.

The full-scale current reading can be set by choosing the appropriate voltage gain and external-sense resistor. This capability offers a high level of integration and flexibility, resulting in a simple and compact current-sense solution.

The MAX4376/MAX4377/MAX4378 operate over a supply voltage range of +3V to +28V, draw 1mA of supply current per amplifier, and operate over the full automotive temperature range of -40°C to +125°C. These devices have a wide bandwidth of 2MHz, making them suitable for use inside battery-charger control loops. The buffered outputs drive up to 2mA of output current into a ground-referenced load.

The MAX4376 is available in a tiny 5-pin SOT23 package. The MAX4377/MAX4378 are available in space-saving 8-pin µMAX and 14-pin TSSOP packages, respectively.

Applications

Notebook Computers

Current-Limited Power Supplies

Fuel Gauges in PC

General-System/Board-Level Current Monitoring

Battery Chargers

Portable/Battery-Powered Systems

Cell Phones

Smart Battery Packages

Automotive Current Detect

Power Management Systems

PA Bias Control

Features

- **Low-Cost Single/Dual/Quad High-Side Current-Sense Amplifiers**
- **±0.5% Typical Full-Scale Accuracy**
- **+3V to +28V Supply Operation**
- **Adjustable Current-Sense Capability with External Sense Resistor**
- **Buffered Output Voltage with 2mA Drive**
- **1mA (typ) Supply Current**
- **2.0MHz Bandwidth (Gain = +20V/V)**
- **Automotive Temperature Range (-40°C to +125°C)**
- **Full 0 to 28V Common-Mode Range, Independent of Supply Voltage**
- **Three Gain Versions Available**
  +20V/V (MAX437_T)
  +50V/V (MAX437_F)
  +100V/V (MAX437_H)
- **Available in Space-Saving 5-pin SOT23 (Single), 8-pin µMAX (Dual), and 14-pin TSSOP (Quad)**

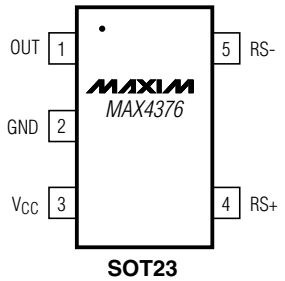
Ordering Information

PART	GAIN (+V/+V)	TEMP. RANGE	PIN-PACKAGE	TOP MARK
MAX4376TAUK-T	20	-40°C to +125°C	5 SOT23-5	ADOG
MAX4376FAUK-T	50	-40°C to +125°C	5 SOT23-5	ADOH
MAX4376HAUK-T	100	-40°C to +125°C	5 SOT23-5	ADOI
MAX4376TASA	20	-40°C to +125°C	8 SO	—
MAX4376FASA	50	-40°C to +125°C	8 SO	—
MAX4376HASA	100	-40°C to +125°C	8 SO	—

Ordering Information continued at end of data sheet.

Pin Configurations

TOP VIEW



SOT23

Pin Configurations continued at end of data sheet.

Single/Dual/Quad High-Side Current-Sense Amplifiers with Internal Gain

ABSOLUTE MAXIMUM RATINGS

V_{CC}, RS+, RS- to GND .....-0.3V to +30V
OUT to GND .....-0.3V to (V_{CC} + 0.3V)
Differential Input Voltage (V_{RS+} - V_{RS-}).....±8V
Output Short Circuit to V_{CC} .....Continuous
Output Short Circuit to GND 1s
Current into Any Pin.....±20mA
Continuous Power Dissipation (T_A = +70°C)
5-pin SOT23 (derate 7.1mW/°C above +70°C).....571mW
8-pin µMAX (derate 4.5mW/°C above +70°C) 362mW
8-pin SO (derate 5.88mW/°C above +70°C).....471mW
14-pin SO (derate 8.33mW/°C above +70°C).....667mW
14-pin TSSOP (derate 9.1mW/°C above +70°C) 727mW
Operating Temperature Range .....-40°C to +125°C
Junction Temperature.....+150°C
Storage Temperature Range .....-65°C to +150°C
Lead Temperature (soldering, 10s) .....+300°C

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

ELECTRICAL CHARACTERISTICS

(V_{RS+} = 0 to 28V, V_{SENSE} = (V_{RS+} - V_{RS-}) = 0, V_{CC} = +3.0V to +28V, R_L = ∞, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = 25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Operating Voltage Range	V_{CC}	Guaranteed by PSR test		3		28	V
Common-Mode Input Range	V_{CM}	Guaranteed by total OUT voltage error test		0		28	V
Common-Mode Rejection	CMR	2V ≤ V_{RS+} ≤ 28V, V_{SENSE} = 100mV			90		dB
Supply Current per Amplifier	I_{CC}	V_{SENSE} = 5mV, V_{RS+} > 2.0V, V_{CC} = 12V			1	2.2	mA
Leakage Current	I_{RS+}, I_{RS-}	V_{CC} = 0, V_{RS+} = 28V				8	µA
Input Bias Current	I_{RS+}	V_{RS+} > 2.0V		0		60	µA
		V_{RS+} ≤ 2.0V		-400		60	
	I_{RS-}	V_{RS+} > 2.0V		0		120	
		V_{RS+} ≤ 2.0V		-800		120	
Full-Scale Sense Voltage	V_{SENSE}				150		mV
Total OUT Voltage Error (Note 2)		I_{OUT} ≤2mA	V_{SENSE} = 100mV, V_{CC} = 12V, V_{RS+} = 12V			±6.75	%
			V_{SENSE} = 100mV, V_{CC} = 12V, T_A = +25°C		±0.5	±3.25	
			V_{SENSE} = 100mV, V_{CC} = 28V, V_{RS+} = 28V			±11	
			V_{SENSE} = 100mV, V_{CC} = 28V, V_{RS+} = 28V, T_A = +25°C		±0.5	±5	
			V_{SENSE} = 100mV, V_{CC} = 12V, V_{RS+} = 0.1V		±9	±32	
			V_{SENSE} = 6.25mV, V_{CC} = 12V, V_{RS+} = 12V (Note 3)		±7		
OUT High Voltage (Note 4)	(V_{CC} - V_{OUT})	V_{CC} = 3V, I_{OUT} = 2mA			0.9	1.2	V
OUT Low Voltage	V_{OL}	I_{OUT} = 200µA, V_{CC} = 3V, V_{SENSE} = 0			30		mV