PRELIMINARY | Data Sheet | January 11, 2005 | FN7455.1

Micropower Single Supply Rail-to-Rail Input-Output Op Amp

The EL8186 is a micropower operational amplifier optimized for single supply operation at 5V and can operate down to 2.4V.

The EL8186 draws minimal supply current while meeting excellent DC-accuracy noise and output drive specifications. Competing devices seriously degrade these parameters to achieve micropower supply current. Offset current, voltage and current noise, slew rate, and gain-bandwidth product are all two to ten times better than on previous micropower op amps.

The 1/f corner of the voltage noise spectrum is at 1kHz. This results in low frequency noise performance which can only be found on devices with an order of magnitude higher supply current.

The EL8186 can be operated from one lithium cell or two Ni-Cd batteries. The input range includes both positive and negative rail. The output swings to both rails.

Ordering Information

PART NUMBER	PACKAGE	TAPE & REEL	PKG. DWG. #
EL8186IW-T7	6-Pin SOT-23	7” (3K pcs)	MDP0038
EL8186IW-T7A	6-Pin SOT-23	7” (250 pcs)	MDP0038
EL8286IY (Note)	10-Pin MSOP	-	MDP0043
EL8286IL (Note)	10-Pin DFN	-	MDP0047

NOTE: Contact factory for availability

Features

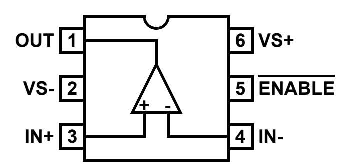
- 55μA supply current
- 400μV typical offset voltage
- 500pA input bias current
- 700kHz gain-bandwidth product
- 0.13V/μs slew rate
- Single supply operation down to 2.4V
- Rail-to-rail input and output
- Output sources and sinks 26mA load current

Applications

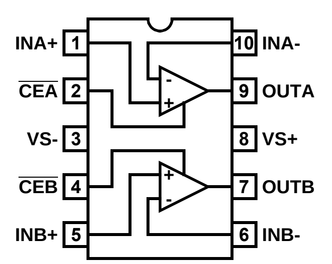
- Battery- or solar-powered systems
- 4mA to 25mA current loops
- Handheld consumer products
- Medical devices
- Thermocouple amplifiers
- Photodiode pre amps
- pH probe amplifiers

Pinouts

EL8186
(6-PIN SOT-23)
TOP VIEW



EL8286*
(10-PIN MSOP, DFN)
TOP VIEW



***COMING SOON**

Absolute Maximum Ratings (T_A = 25°C)

Supply Voltage 5.5V
Differential Input Voltage 0.5V
Input Voltage . . . . -0.5V to V_S + 0.5V
Output Short-Circuit Duration . . . . .Indefinite
Ambient Operating Temperature Range . . . . -40°C to +85°C
Storage Temperature Range . . . . -65°C to +150°C

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

IMPORTANT NOTE: All parameters having Min/Max specifications are guaranteed. Typical values are for information purposes only. Unless otherwise noted, all tests are at the specified temperature and are pulsed tests, therefore: $T_J = T_C = T_A$

Electrical Specifications V_S = 5V, 0V, V_{CM} = 0.1V, V_O = 1.4V, T_A = 25°C unless otherwise specified.

PARAMETER	DESCRIPTION	CONDITIONS	MIN	TYP	MAX	UNIT
V_{OS}	Input Offset Voltage			0.4	1	mV
$\frac{\Delta V_{OS}}{\Delta Time}$	Long Term Input Offset Voltage Stability			TBD		µV/Mo
$\frac{\Delta V_{OS}}{\Delta T}$	Input Offset Drift vs Temperature			1.5		µV/°C
I_{OS}	Input Offset Current			0.4	1.2	nA
I_B	Input Bias Current			0.5	2	nA
e_N	Input Noise Voltage Density	f_O = 1KHz		25		nV/√Hz
i_N	Input Noise Current Density	f_O = 1KHz		0.1		pA/√Hz
CMIR	Input Voltage Range	Guaranteed by CMRR test	0		5	V
CMRR	Common-Mode Rejection Ratio	V_{CM} = 0V to 5V	90	110		dB
PSRR	Power Supply Rejection Ratio	V_S = 2.4V to 5V	90	110		dB
A_{VOL}	Large Signal Voltage Gain	V_O = 0.5V to 4.5V, R_L = 100kΩ	200	500		V/mV
		V_O = 0.5V to 4.5V, R_L = 1kΩ		25		V/mV
V_{OUT}	Maximum Output Voltage Swing	Output low, R_L = 100kΩ		3	6	mV
		Output low, R_L = 1kΩ		130	200	mV
		Output high, R_L = 100kΩ	4.994	4.997		V
		Output high, R_L = 1kΩ	4.8	4.88		V
SR	Slew Rate		0.07	0.13	0.16	V/µs
GBW	Gain Bandwidth Product	A_V = 1		700		kHz
$I_{S,ON}$	Supply Current, Enabled		40	55	75	µA
$I_{S,OFF}$	Supply Current, Disabled			3	10	µA
I_O+	Short Circuit Output Current	R_L = 10Ω	18	31		mA
I_O-	Short Circuit Output Current	R_L = 10Ω	17	26		mA
V_S	Minimum Supply Voltage			2.2	2.4	V
V_{INH}	Enable Pin High Level				2	V
V_{INL}	Enable Pin Low Level		0.8			V
I_{ENH}	Enable Pin Input Current	V_{EN} = 5V	0.25	0.7	2	µA
I_{ENL}	Enable Pin Input Current	V_{EN} = 0V	-0.5	0	+0.5	µA

Typical Performance Curves

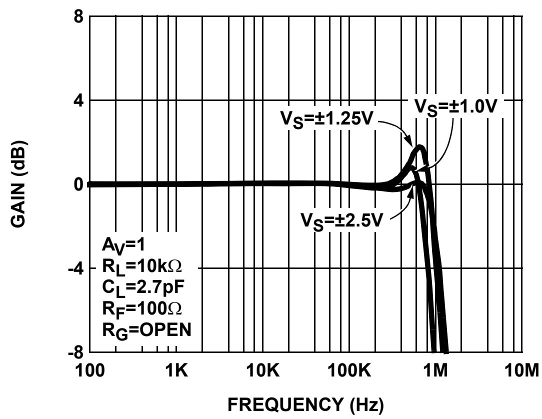


FIGURE 1. FREQUENCY RESPONSE vs SUPPLY VOLTAGE

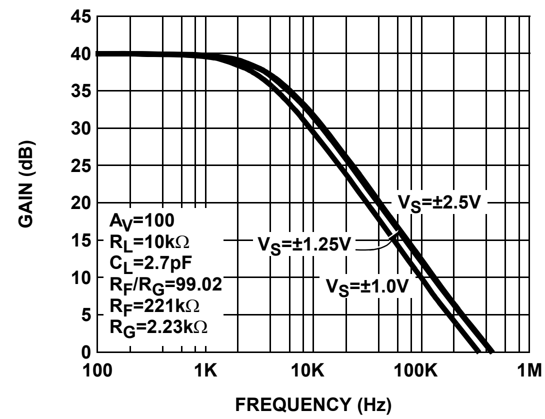


FIGURE 2. FREQUENCY RESPONSE vs SUPPLY VOLTAGE

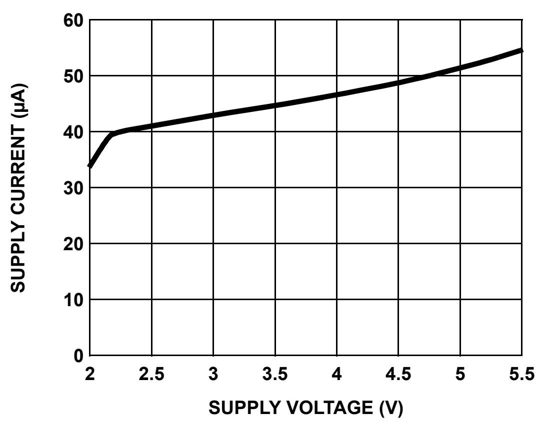


FIGURE 3. SUPPLY CURRENT vs SUPPLY VOLTAGE

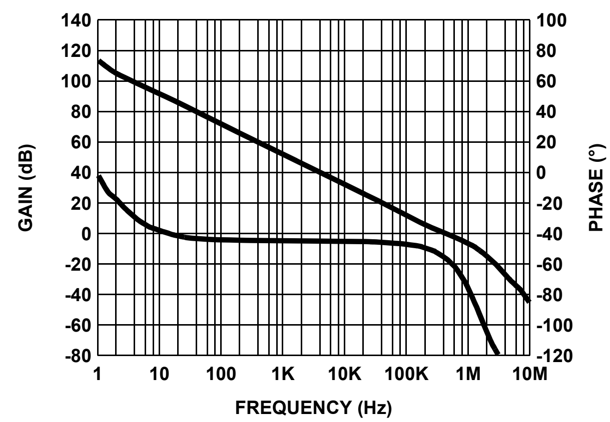


FIGURE 4. OPEN LOOP GAIN + PHASE vs FREQUENCY

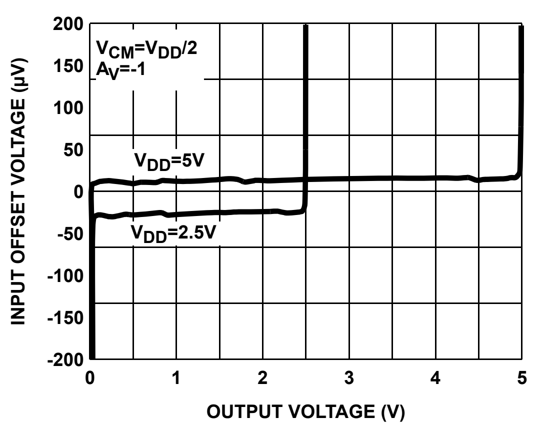


FIGURE 5. INPUT OFFSET VOLTAGE vs OUTPUT VOLTAGE

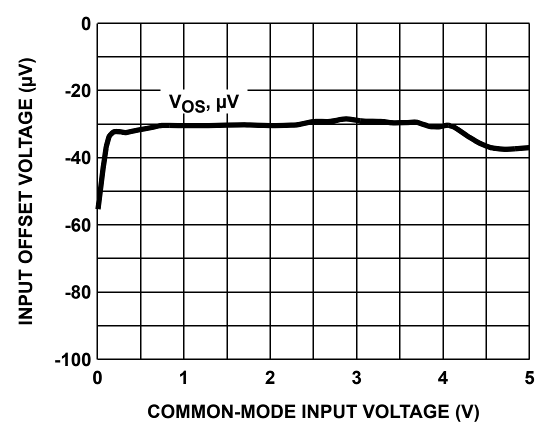


FIGURE 6. INPUT OFFSET VOLTAGE vs COMMON-MODE INPUT VOLTAGE

Typical Performance Curves

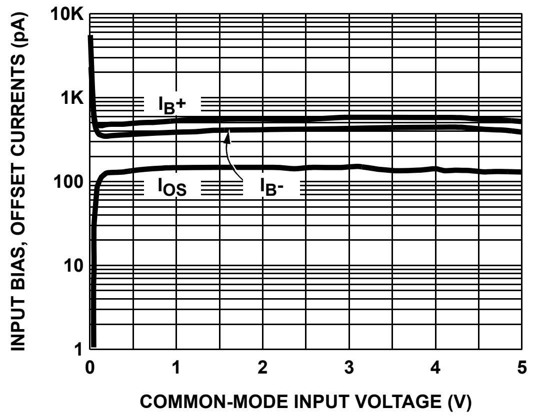


FIGURE 7. INPUT BIAS + OFFSET CURRENTS vs COMMON-MODE INPUT VOLTAGE

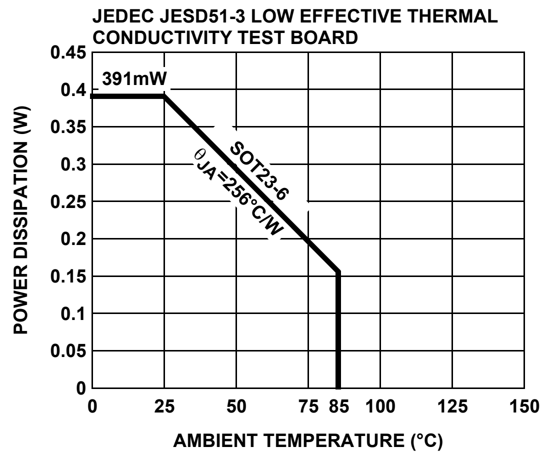


FIGURE 8. PACKAGE POWER DISSIPATION vs AMBIENT TEMPERATURE

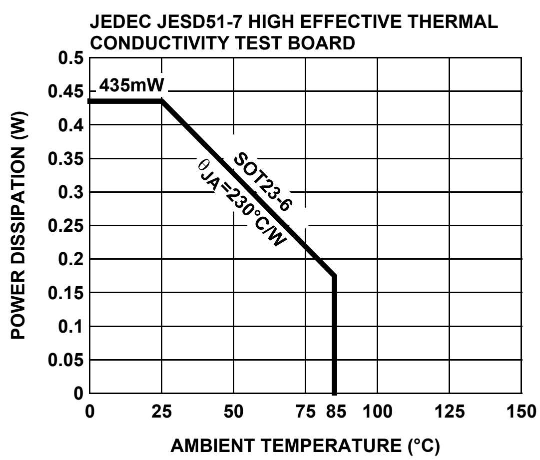


FIGURE 9. PACKAGE POWER DISSIPATION vs AMBIENT TEMPERATURE

Applications Information

Introduction

The EL8186 is a rail-to-rail micropower operational amplifier. The device eliminates concerns introduced by traditional rail-to-rail I/O operation making it ideal for portable and single-supply design.

Rail-to-Rail Input Stage

The EL8186 achieves rail-to-rail input operation without introducing errors or degrading performance. The EL8186 has a single differential-pair bipolar PNP input stage (ground-sensing amplifier) aided by a charge pump to increase upper common-mode range amplification up to the positive rail. The PNP differential pair remains active throughout the entire input common-mode voltage range eliminating a drastic shift in offset voltage and offset current as the common-mode approaches either rail. Since there is no common-mode threshold crossover, unlike a conventional paralleled PNP and NPN rail-to-rail input stage amplifier, the EL8186's offset voltage, and input offset current exhibit an undistorted and smooth behavior over the common-mode input range.

In general, bipolar amplifiers have higher bias currents if intended for high-speed operation. The bipolar PNP input bias currents of the EL8186 are decimated down to a typical of 500pA while maintaining an excellent bandwidth for a micropower operational amplifier. Inside the EL8186 is an input bias cancelling circuit. The transistors are still biased with an adequate current for speed but the cancelling circuit sinks most of the base current, leaving a small fraction for input bias current.

The EL8186's ground-sensing input amplifier takes advantage of many slew-rate-enhancing techniques that cannot be implemented to an amplifier with a dual pair rail-to-rail input. Hence, compared to other operational amplifiers with a dual pair rail-to-rail input with comparable supply currents, the EL8186 slew rates are several times faster.

Charge Pump

The EL8186 has a built-in charge pump to increase the input range up to the positive supply rail. The charge pump provides an internal supply voltage to bias the input stage enabling a ground-sensing configuration to swing from ground to V_{DD}.

The charge pump, operating at around 3MHz, is transparent to the user. The EL8186 is adequately bypassed inside the chip and will perform quietly. There is no need for a dedicated external bypass capacitor, minimizing components.

Enable/Disable Feature

The EL8186 offers an $\overline{EN}$ pin. The active low enable pin disables the device when pulled up to at least 2.2V. Upon disable the part consumes typically 3µA, while the output is in a high impedance state. The $\overline{EN}$ also has an internal pull down. If left open, the $\overline{EN}$ will pull to negative rail and the device will be enabled by default.

Rail-to-Rail Output Stage

A pair of complementary MOSFET devices achieves rail-to-rail output swing. The NMOS sinks current to swing the output in the negative direction. The PMOS sources current to swing the output in the positive direction. The EL8186 with a 100kΩ load will swing to within 3mV of the supply rails.