ANALOG DEVICES

18V, 20μA, 200kHz CMOS Rail-to-Rail Input/Output Operational Amplifier

Preliminary Technical Data

AD8657

FEATURES
MicroPower at High voltage (18V): 20 μA typ
Gain Bandwidth: 200 kHz
Offset Voltage: 300 μV
Single-Supply Operation: 2.7 to 18 Volts
Dual-Supply Operation: +/-1.35 to +/-9 Volts
Output drive: 10 mA
Unity Gain Stable

APPLICATIONS
Portable Operated Systems
4-20mA loop drivers
Current monitors / sense
Buffer / Level Shifting
Multi-pole Filters
Remote / Wireless Sensors
Low Power Transimpedance Amps

PIN CONFIGURATIONS

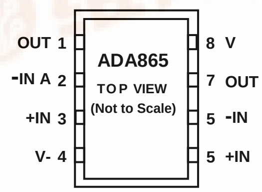

Figure 1. 8-Lead LFCSP

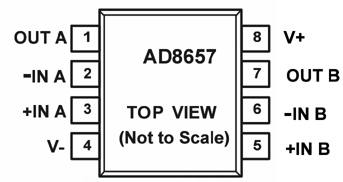

Figure 2. 8-Lead MSOP

GENERAL DESCRIPTION
The AD8657 is a dual, micropower, precision, rail-to-rail input/output amplifier optimized for low power and wide operating supply voltage range applications.

The AD8657 operates from 2.7V up to 18 V with a quiescent supply current of 20 uA.

The combination of low supply current, low offset voltage, very low input bias current, wide supply range and rail-to-rail inputs and output make the AD8657 ideal for current monitoring and current loops in process and motor control. The combination of precision specifications makes this devices ideal l for DC gain and buffering of sensor front-ends or high impedance input sources in wireless or remote sensors or transmitters.

AD8657 is specified over the extended industrial temperature range (-40ºC to +125ºC) and available in 8-lead MSOP and 8-lead 3x3x0.75 LFCSP packages.

REV. PrA

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SPECIFICATIONS

ELECTRICAL CHARACTERISTICS

V_{SY} = 2.7 V, V_{CM} = V_{SY}/2, T_A = 25°C, unless otherwise noted.

Table 1.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}	V_{CM} = 0 V to 2.7 V			300	µV
		V_{CM} = 0 V to 2.7 V ; −40°C ≤ T_A ≤ +85°C			TBD	µV
		V_{CM} = 0 V to 2.7 V ; −40°C ≤ T_A ≤ +125°C			TBD	µV
Input Bias Current	I_B			10	100	pA
		−40°C ≤ T_A ≤ +85°C			TBD	nA
		−40°C ≤ T_A ≤ +125°C			TBD	nA
Input Offset Current	I_{OS}			0.2	1	pA
		−40°C ≤ T_A ≤ +85°C			TBD	nA
		−40°C ≤ T_A ≤ +125°C			TBD	nA
Input Voltage Range			0		2.7	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = 0V to 2.7V	80	95		dB
		V_{CM} = 0V to 2.7 V ; −40°C ≤ T_A ≤ +85°C	TBD			dB
		V_{CM} = 0V to 2.7 V ; −40°C ≤ T_A ≤ +125°C	TBD			dB
Large-Signal Voltage Gain	A_{VO}	R_L = 100 kΩ, V_O = 0.5 V to 2.2 V	TBD	120		dB
		−40°C ≤ T_A ≤ +85°C	TBD			dB
		−40°C ≤ T_A ≤ +125°C	TBD			
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$			2		µV/°C
Input Resistance, Differential Mode	R_{INDM}			TBD		MΩ
Input Resistance, Common Mode	R_{INCM}			TBD		MΩ
Input Capacitance, Differential Mode	C_{INDM}			TBD		pF
Input Capacitance, Common Mode	C_{INCM}			4		pF
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	R_L = 1 MΩ to V_{CM}	TBD	TBD		V
		−40°C ≤ T_A ≤ +125°C	TBD			V
		R_L = 100 kΩ to V_{CM}	TBD	TBD		V
		−40°C ≤ T_A ≤ +125°C	TBD			V
Output Voltage Low	V_{OL}	R_L = 1 MΩ to V_{CM}		TBD	TBD	V
		−40°C ≤ T_A ≤ +125°C			TBD	V
		R_L = 100 kΩ to V_{CM}		TBD	TBD	V
		−40°C ≤ T_A ≤ +125°C			TBD	V
Short-Circuit Current	I_{SC}			±20		mA
Closed-Loop Output Impedance	Z_{OUT}	f = 1 kHz, A_V = 1		120		Ω
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_{SY} = 2.7 V to 18 V	70	95		dB
		−40°C ≤ T_A ≤ +85°C	TBD			dB
		−40°C ≤ T_A ≤ +125°C	TBD			
Supply Current per Amplifier	I_{SY}	I_O = 0 mA		20	TBD	µA
		−40°C ≤ T_A ≤ +85°C			TBD	µA
		−40°C ≤ T_A ≤ +125°C			TBD	µA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 1 MΩ, C_L=10pF, Av=1		70		V/ms
Settling Time To 0.1%	t_S	V_{IN} = 1 V step, R_L = 1 MΩ, C_L=10pF		TBD		µs
Gain Bandwidth Product	GBP	R_L = 1 MΩ, C_L=10pF, A_V = 1		200		kHz
Phase Margin	Φ_M	R_L = 1 MΩ, C_L=10pF, A_V = 1		60		Degrees
Channel Separation	CS	f = 10 kHz, R_L = 1 MΩ		TBD		dB
NOISE PERFORMANCE						
Voltage Noise	e_n p-p	f = 0.1 Hz to 10 Hz		TBD		µV p-p
Voltage Noise Density	e_n	f = 1 kHz		50		nV/√Hz
		f = 10 kHz		TBD		nV/√Hz
Current Noise Density	i_n	f = 1 kHz		0.1		pA/√Hz

ELECTRICAL CHARACTERISTICS

V_{SY} = 10 V, V_{CM} = V_{SY}/2, T_A = 25°C, unless otherwise noted.

Table 2.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}	V_{CM} = 0V to 10V			300	µV
		V_{CM} = 0V to 10 V ; −40°C ≤ T_A ≤ +85°C			TBD	µV
		V_{CM} = 0V to 10 V ; −40°C ≤ T_A ≤ +125°C			TBD	µV
Input Bias Current	I_B			10	100	pA
		−40°C ≤ T_A ≤ +85°C			TBD	nA
		−40°C ≤ T_A ≤ +125°C			TBD	nA
Input Offset Current	I_{OS}			0.2	1	pA
		−40°C ≤ T_A ≤ +85°C			TBD	nA
		−40°C ≤ T_A ≤ +125°C			TBD	nA
Input Voltage Range		−40°C ≤ T_A ≤ +125°C	0		10	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = 0V to 10V	80	TBD		dB
		V_{CM} = 0V to 10 V ; −40°C ≤ T_A ≤ +85°C	TBD			dB
		V_{CM} = 0V to 10 V ; −40°C ≤ T_A ≤ +125°C	TBD			
Large-Signal Voltage Gain	A_{VO}	R_L = 100 kΩ, V_O = 0.5 V to 9.5 V	TBD	120		
		−40°C ≤ T_A ≤ +85°C	TBD			
		−40°C ≤ T_A ≤ +125°C	TBD			
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$			2		µV/°C
Input Resistance, Differential Mode	R_{INDM}			TBD		TΩ
Input Resistance, Common Mode	R_{INCM}			TBD		TΩ
Input Capacitance, Differential Mode	C_{INDM}			TBD		pF
Input Capacitance, Common Mode	C_{INCM}			4		pF
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	R_L = 1 MΩ to V_{CM}	TBD	TBD		V
		−40°C ≤ T_A ≤ +125°C	TBD			V
		R_L = 100 kΩ to V_{CM}	TBD	TBD		V
		−40°C ≤ T_A ≤ +125°C	TBD			V
Output Voltage Low	V_{OL}	R_L = 1 MΩ to V_{CM}		TBD	TBD	V
		−40°C ≤ T_A ≤ +125°C			TBD	V
		R_L = 100 kΩ to V_{CM}		TBD	TBD	V
		−40°C ≤ T_A ≤ +125°C			TBD	V
Short-Circuit Current	I_{SC}			±50		mA
Closed-Loop Output Impedance	Z_{OUT}	f = 1 kHz, A_V = 1		100		Ω
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_{SY} = 2.7 V to 18 V	70	TBD		dB
		−40°C ≤ T_A ≤ +125°C	TBD			dB
Supply Current per Amplifier	I_{SY}	I_O = 0 mA		20	TBD	µA
		−40°C ≤ T_A ≤ +85°C			TBD	µA
		−40°C ≤ T_A ≤ +125°C			TBD	µA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 1 MΩ, C_L=10pF, Av=1		70		V/ms
Settling Time to 0.1%	t_S	V_{IN} = 5 V step, R_L = 1 MΩ, C_L=10pF		TBD		µs
Gain Bandwidth Product	GBP	R_L = 1 MΩ, C_L=10pF, A_V = 1		200		kHz
Phase Margin	Φ_M	R_L = 1 MΩ, C_L=10pF, A_V = 1		60		Degrees
Channel Separation	CS	f = 10 kHz, R_L = 1 MΩ		TBD		dB
NOISE PERFORMANCE						
Voltage Noise	e_n p-p	f = 0.1 Hz to 10 Hz		TBD		µV p-p
Voltage Noise Density	e_n	f = 1 kHz		50		nV/√Hz
		f = 10 kHz		TBD		nV/√Hz
Current Noise Density	i_n	f = 1 kHz		0.1		pA/√Hz

ELECTRICAL CHARACTERISTICS

V_{SY} = 18 V, V_{CM} = V_{SY}/2, T_A = 25°C, unless otherwise noted.

Table 3.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}	V_{CM} = 0V to 18V			300	µV
		V_{CM} = 0V to 18 V ; −40°C ≤ T_A ≤ +85°C			TBD	µV
		V_{CM} = 0V to 18 V ; −40°C ≤ T_A ≤ +125°C			TBD	µV
Input Bias Current	I_B			10	100	pA
		−40°C ≤ T_A ≤ +85°C			TBD	nA
		−40°C ≤ T_A ≤ +125°C			TBD	nA
Input Offset Current	I_{OS}			0.2	1	pA
		−40°C ≤ T_A ≤ +85°C			TBD	nA
		−40°C ≤ T_A ≤ +125°C			TBD	nA
Input Voltage Range		−40°C ≤ T_A ≤ +125°C	0		18	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = 0V to 18V	80	TBD		dB
		V_{CM} = 0V to 18 V ; −40°C ≤ T_A ≤ +85°C	TBD			dB
		V_{CM} = 0V to 18 V ; −40°C ≤ T_A ≤ +125°C	TBD			
Large-Signal Voltage Gain	A_{VO}	R_L = 100 kΩ, V_O = 0.5 V to 17.5 V	TBD	120		
		−40°C ≤ T_A ≤ +85°C	TBD			
		−40°C ≤ T_A ≤ +125°C	TBD			
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$			2		µV/°C
Input Resistance, Differential Mode	R_{INDM}			TBD		TΩ
Input Resistance, Common Mode	R_{INCM}			TBD		TΩ
Input Capacitance, Differential Mode	C_{INDM}			TBD		pF
Input Capacitance, Common Mode	C_{INCM}			4		pF
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	R_L = 1 MΩ to V_{CM}	TBD	TBD		V
		−40°C ≤ T_A ≤ +125°C	TBD			V
		R_L = 100 kΩ to V_{CM}	TBD	TBD		V
		−40°C ≤ T_A ≤ +125°C	TBD			V
Output Voltage Low	V_{OL}	R_L = 1 MΩ to V_{CM}		TBD	TBD	V
		−40°C ≤ T_A ≤ +125°C			TBD	V
		R_L = 100 kΩ to V_{CM}		TBD	TBD	V
		−40°C ≤ T_A ≤ +125°C			TBD	V
Short-Circuit Current	I_{SC}			±50		mA
Closed-Loop Output Impedance	Z_{OUT}	f = 1 kHz, A_V = 1		100		Ω
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_{SY} = 2.7 V to 18 V	70	TBD		dB
		−40°C ≤ T_A ≤ +125°C	TBD			dB
Supply Current per Amplifier	I_{SY}	I_O = 0 mA		20	TBD	µA
		−40°C ≤ T_A ≤ +85°C			TBD	µA
		−40°C ≤ T_A ≤ +125°C			TBD	µA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 1 MΩ, C_L=10pF, Av=1		70		V/ms
Settling Time to 0.1%	t_S	V_{IN} = 5 V step, R_L = 1 MΩ, C_L=10pF		TBD		µs
Gain Bandwidth Product	GBP	R_L = 1 MΩ, C_L=10pF, A_V = 1		200		kHz
Phase Margin	Φ_M	R_L = 1 MΩ, C_L=10pF, A_V = 1		60		Degrees
Channel Separation	CS	f = 10 kHz, R_L = 1 MΩ		TBD		dB
NOISE PERFORMANCE						
Voltage Noise	e_n p-p	f = 0.1 Hz to 10 Hz		TBD		µV p-p
Voltage Noise Density	e_n	f = 1 kHz		50		nV/√Hz
		f = 10 kHz		TBD		nV/√Hz
Current Noise Density	i_n	f = 1 kHz		0.1		pA/√Hz

Absolute Maximum Ratings

Table 4.

Parameter	Rating
Supply Voltage	TBD
Input Voltage	TBD
Input Current[1]	TBD
Differential Input Voltage[2]	$\pm V_{SY}$
Output Short-Circuit Duration to GND	Indefinite
Storage Temperature Range	−65°C to +150°C
Operating Temperature Range	−40°C to +125°C
Junction Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 60 sec)	300°C

[1] Input pins have clamp diodes to the supply pins. Input current should be limited to 10 mA or less whenever input signals exceed either power supply rail by 0.3 V.
[2] Inputs are protected against high differential voltages by internal 1 kΩ series resistors and back-to-back diode-connected N-MOSFETs (with a typical V_T of 1.25 V for V_{CM} of 0 V).

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Thermal Resistance

Table 5. Thermal Resistance

Package Type	θ_{JA}[1]	θ_{JC}	Unit
8-Lead MSOP (RM-8)	TBD	TBD	°C/W
8-Lead LFCSP (CP-8)	TBD	TBD	°C/W

[1] θ_{JA} is specified for the worst-case conditions, that is, a device soldered in a circuit board for surface-mount packages. This was measured using a standard two-layer board.
[2] Exposed pad is soldered to the application board.

ESD Caution

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.