

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

Preliminary Technical Data

AD8657

WWW.DZSC.COM **FEATURES PIN CONFIGURATIONS** 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 OUT 8 V OUT A 8 V+ Output drive: 10 mA AD8657 ADA865 7 OUT 7 OUT B IN A 2 2 -IN A **Unity Gain Stable** TOP VIEW (Not to Scale) 3 TOP VIEW 6 -IN B 5 -IN +IN A +IN 3 **APPLICATIONS** (Not to Scale) 5 +IN B v-5 +IN **Portable Operated Systems** 4-20mA loop drivers **Current monitors / sense Buffer / Level Shifting** Figure 2. 8-Lead MSOP **Multi-pole Filters** Figure 1. 8-Lead LFCSP **Remote / Wireless Sensors** Low Power Transimpedance Amps 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 1 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 (-40°C to +125°C) 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, $V_{CM}=V_{SY}/2,$ $T_{A}=25^{\circ}C,$ unless otherwise noted.

Table 1.

Parameter	Symbol	Conditions	Min	Тур	Max	Unit
INPUT CHARACTERISTICS	-					
Offset Voltage	Vos				300 TBD TBD	μV μV μV
Input Bias Current	I _B	-40°C ≤ T _A ≤ +85°C -40°C ≤ T _A ≤ +125°C		10	100 TBD TBD	pA nA nA
Input Offset Current	los	$-40^{\circ}C \le T_{A} \le +85^{\circ}C$ $-40^{\circ}C \le T_{A} \le +125^{\circ}C$		0.2	1 TBD TBD	pA nA nA
Common-Mode Rejection Ratio	CMRR	$V_{CM} = 0V \text{ to } 2.7V$ $V_{CM} = 0V \text{ to } 2.7V \text{ ; } -40^{\circ}\text{C} \le T_{A} \le +85^{\circ}\text{C}$ $V_{CM} = 0V \text{ to } 2.7 \text{ V ; } -40^{\circ}\text{C} \le T_{A} \le +125^{\circ}\text{C}$	0 80 TBD TBD	95	2.7	dB dB dB dB
Large-Signal Voltage Gain	Avo	$ \begin{split} R_L &= 100 \ k\Omega, \ V_0 = 0.5 \ V \ to \ 2.2 \ V \\ -40^\circ C &\leq T_A \leq +85^\circ C \\ -40^\circ C &\leq T_A \leq +125^\circ C \end{split} $	TBD TBD TBD	120		dB dB
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$			2		μV/°C
Input Resistance, Differential Mode	RINDM			TBD		MΩ
Input Resistance, Common Mode	RINCM			TBD		MΩ
Input Capacitance, Differential Mode	CINDM			TBD		pF
Input Capacitance, Common Mode	Сілсм			4		pF
OUTPUT CHARACTERISTICS						
Output Voltage High	V _{он}	$R_L = 1 M\Omega$ to V _{CM} -40°C ≤ T _A ≤ +125°C $R_I = 100 k\Omega$ to V _{CM}	TBD TBD TBD	TBD TBD		V V V
Output Voltage Low	Vol	$\begin{array}{l} -40^{\circ}C \leq T_{A} \leq +125^{\circ}C \\ R_{L} = 1 \ M\Omega \ to \ V_{CM} \\ -40^{\circ}C \leq T_{A} \leq +125^{\circ}C \\ R_{L} = 100 \ k\Omega \ to \ V_{CM} \\ -40^{\circ}C \leq T_{A} \leq +125^{\circ}C \end{array}$	TBD	TBD TBD	TBD TBD TBD TBD	V V V V
Short-Circuit Current	lsc	10 C = 1A = 1125 C		+20	100	mA
Closed-Loop Output Impedance	Zout	$f = 1 \text{ kHz}$. $A_{V} = 1$		120		0
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	$V_{SY} = 2.7 \text{ V to } 18 \text{ V}$ -40°C $\leq T_A \leq +85^{\circ}\text{C}$ -40°C $\leq T_A \leq +125^{\circ}\text{C}$	70 TBD TBD	95		dB dB
Supply Current per Amplifier	Isy	$ \begin{split} I_0 &= 0 \text{ mA} \\ -40^\circ\text{C} \leq T_\text{A} \leq +85^\circ\text{C} \\ -40^\circ\text{C} \leq T_\text{A} \leq +125^\circ\text{C} \end{split} $		20	TBD TBD TBD	μΑ μΑ μΑ
DYNAMIC PERFORMANCE						
Slew Rate	SR	$R_L = 1 M\Omega$, $C_L = 10 pF$, $Av = 1$		70		V/ms
Settling Time To 0.1%	ts	$V_{IN} = 1 \text{ V step}, R_L = 1 \text{ M}\Omega, C_L = 10 \text{ pF}$		TBD		μs
Gain Bandwidth Product	GBP	$R_L = 1 M\Omega$, $C_L = 10 pF$, $A_V = 1$		200		kHz
Phase Margin	Фм	$R_L = 1 M\Omega$, $C_L = 10 pF$, $A_V = 1$		60		Degrees
Channel Separation	CS	$f = 10 \text{ kHz}, R_L = 1 \text{ M}\Omega$		TBD		dB
NOISE PERFORMANCE						
Voltage Noise	en p-p	f = 0.1 Hz to 10 Hz		TBD		μV p-р
Voltage Noise Density	en	f = 1 kHz		50		nV/√Hz
		f = 10 kHz		TBD		nV/√Hz
Current Noise Density	İn	f = 1 kHz		0.1		pA/√Hz

ELECTRICAL CHARACTERISTICS

 $V_{SY} = 10 V$, $V_{CM} = V_{SY}/2$, $T_A = 25^{\circ}$ C, unless otherwise noted.

Table 2.

Parameter	Symbol	Conditions	Min	Тур	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	Vos	$V_{CM} = 0V$ to 10V			300	μV
		$V_{CM} = 0V$ to 10 V; $-40^{\circ}C \le T_A \le +85^{\circ}C$			TBD	μV
		$V_{CM} = 0V \text{ to } 10 \text{ V} ; -40^{\circ}\text{C} \le T_A \le +125^{\circ}\text{C}$			TBD	μV
Input Bias Current	IB			10	100	рА
		$-40^{\circ}C \le T_A \le +85^{\circ}C$			TBD	nA
		$-40^{\circ}C \le T_A \le +125^{\circ}C$			TBD	nA
Input Offset Current	los			0.2	1	рА
		$-40^{\circ}C \le T_{A} \le +85^{\circ}C$			TBD	nA
		$-40^{\circ}C \le T_A \le +125^{\circ}C$			TBD	nA
Input Voltage Range		$-40^{\circ}C \le T_A \le +125^{\circ}C$	0		10	V
Common-Mode Rejection Ratio	CMRR	$V_{CM} = 0V \text{ to } 10V$	80	TBD		dB
-		$V_{CM} = 0V$ to 10 V; $-40^{\circ}C \le T_A \le +85^{\circ}C$	TBD			dB
		$V_{CM} = 0V$ to 10 V; $-40^{\circ}C \le T_A \le +125^{\circ}C$	TBD			
Large-Signal Voltage Gain	Avo	$R_L = 100 \text{ k}\Omega$, $V_0 = 0.5 \text{ V}$ to 9.5 V	TBD	120		
		$-40^{\circ}C \le T_A \le +85^{\circ}C$	TBD			
		$-40^{\circ}C \le T_A \le +125^{\circ}C$	TBD			
Offset Voltage Drift	$\Delta V_{os}/\Delta T$			2		μV/°C
Input Resistance, Differential Mode	RINDM			TBD		ΤΩ
Input Resistance, Common Mode	RINCM			TBD		ТΩ
Input Capacitance, Differential Mode	CINDM			TBD		pF
Input Capacitance, Common Mode	CINCM			4		pF
OUTPUT CHARACTERISTICS						· ·
Output Voltage High	Vон	$R_L = 1 M\Omega$ to V_{CM}	TBD	TBD		V
		$-40^{\circ}C \le T_A \le +125^{\circ}C$	TBD			V
		$R_L = 100 \text{ k}\Omega \text{ to } V_{CM}$	TBD	TBD		V
		$-40^{\circ}C \le T_A \le +125^{\circ}C$	TBD			V
Output Voltage Low	V _{OL}	$R_L = 1 M\Omega$ to V_{CM}		TBD	TBD	V
		$-40^{\circ}C \le T_A \le +125^{\circ}C$			TBD	V
		$R_L = 100 \text{ k}\Omega \text{ to } V_{CM}$		TBD	TBD	V
		$-40^{\circ}C \le T_{A} \le +125^{\circ}C$			TBD	V
Short-Circuit Current	lsc			±50		mA
Closed-Loop Output Impedance	Zout	$f = 1 \text{ kHz}, A_V = 1$		100		Ω
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	$V_{SY} = 2.7 V \text{ to } 18 V$	70	TBD		dB
	_	$-40^{\circ}C \le T_{A} \le +125^{\circ}C$	TBD			dB
Supply Current per Amplifier	Isy	$I_0 = 0 \text{ mA}$		20	TBD	μΑ
		$-40^{\circ}\text{C} \le T_{\text{A}} \le +85^{\circ}\text{C}$			TBD	μΑ
		$-40^{\circ}C \le T_A \le +125^{\circ}C$			TBD	μΑ
DYNAMIC PERFORMANCE	CD					
Slew Rate	SR	$R_L = 1 M\Omega$, $C_L = 10 pF$, $Av = 1$		70		V/ms
Settling Time to 0.1%	ts	$V_{IN} = 5 \text{ V step}, R_L = 1 \text{ M}\Omega, C_L = 10 \text{ pF}$		IBD		μs
Gain Bandwidth Product	GBP	$R_L = 1 M\Omega$, $C_L = 10 pF$, $A_V = 1$		200		kHz
Phase Margin	Φ_{M}	$R_L = 1 M\Omega$, $C_L = 10 pF$, $A_V = 1$		60		Degrees
Channel Separation	CS	$f = 10 \text{ kHz}, \text{R}_{\text{L}} = 1 \text{ M}\Omega$		TBD		dB
NOISE PERFORMANCE				TDD		
Voltage Noise	en p-p	f = 0.1 Hz to 10 Hz		IBD		μV p-p
voitage Noise Density	en			50		nV/√Hz
		T = IU KHZ		IRD		nV/√Hz
Current Noise Density	In	т = I кHz		0.1		pA/√Hz

ELECTRICAL CHARACTERISTICS

 $V_{SY} = 18 V$, $V_{CM} = V_{SY}/2$, $T_A = 25^{\circ}$ C, unless otherwise noted.

Table 3.

Parameter	Symbol	Conditions	Min	Tvp	Max	Unit
	29.11201			.76	max	•
Offset Voltage	Vos	$V_{CM} = 0V \text{ to } 18V$ $V_{CM} = 0V \text{ to } 18V \text{ ; } -40^{\circ}\text{C} \le T_{A} \le +85^{\circ}\text{C}$ $V_{CM} = 0V \text{ to } 18V \text{ ; } -40^{\circ}\text{C} \le T_{A} \le +125^{\circ}\text{C}$			300 TBD TBD	μV μV μV
Input Bias Current	IB	$-40^{\circ}C \le T_{A} \le +85^{\circ}C$ $-40^{\circ}C \le T_{A} \le +125^{\circ}C$		10	100 TBD TBD	pA nA
Input Offset Current	los	$-40^{\circ}C \le T_{A} \le +85^{\circ}C$ $-40^{\circ}C \le T_{A} \le +125^{\circ}C$		0.2	1 TBD TBD	pA nA nA
Input Voltage Range Common-Mode Rejection Ratio	CMRR	$-40^{\circ}C \le T_A \le +125^{\circ}C$ $V_{CM} = 0V \text{ to } 18V$ $V_{CM} = 0V \text{ to } 18 \text{ V}; -40^{\circ}C \le T_A \le +85^{\circ}C$ $V_{CM} = 0V \text{ to } 18 \text{ V}; -40^{\circ}C \le T_A \le +125^{\circ}C$	0 80 TBD TBD	TBD	18	V dB dB
Large-Signal Voltage Gain	Avo	$\begin{array}{l} R_L = 100 \text{ k}\Omega, \text{ V}_0 = 0.5 \text{ V to } 17.5 \text{ V} \\ -40^\circ\text{C} \leq T_A \leq +85^\circ\text{C} \\ -40^\circ\text{C} \leq T_A \leq +125^\circ\text{C} \end{array}$	TBD TBD TBD	120		
Offset Voltage Drift	$\Delta V_{os}/\Delta T$			2		uV/°C
Input Resistance, Differential Mode	RINDM			TBD		ΤΩ
Input Resistance, Common Mode	RINCM			TBD		ΤΩ
Input Capacitance, Differential Mode	CINDM			TBD		рF
Input Capacitance, Common Mode	CINCM			4		pF
OUTPUT CHARACTERISTICS						
Output Voltage High	V _{OH}	$R_L = 1 M\Omega$ to V_{CM}	TBD	TBD		V
Output Voltage Low	Vol	$\begin{array}{l} -40^{\circ}\text{C} \leq \text{T}_{\text{A}} \leq +125^{\circ}\text{C} \\ \text{R}_{\text{L}} = 100 \text{ k}\Omega \text{ to } \text{V}_{\text{CM}} \\ -40^{\circ}\text{C} \leq \text{T}_{\text{A}} \leq +125^{\circ}\text{C} \\ \text{R}_{\text{L}} = 1 \text{ M}\Omega \text{ to } \text{V}_{\text{CM}} \\ -40^{\circ}\text{C} \leq \text{T}_{\text{A}} \leq +125^{\circ}\text{C} \\ \text{R}_{\text{L}} = 100 \text{ k}\Omega \text{ to } \text{V}_{\text{CM}} \\ -40^{\circ}\text{C} \leq \text{T}_{\text{A}} \leq +125^{\circ}\text{C} \end{array}$	TBD TBD TBD	TBD TBD TBD	TBD TBD TBD TBD	V V V V V V V
Short-Circuit Current	I _{SC}			±50		mA
Closed-Loop Output Impedance	Zout	$f = 1 \text{ kHz}, A_V = 1$		100		Ω
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	$V_{SY} = 2.7 \text{ V to } 18 \text{ V}$ -40°C ≤ $T_A \le +125$ °C	70 TBD	TBD		dB dB
Supply Current per Amplifier	Isy	$ \begin{split} I_0 &= 0 \text{ mA} \\ -40^\circ\text{C} &\leq T_\text{A} \leq +85^\circ\text{C} \\ -40^\circ\text{C} &\leq T_\text{A} \leq +125^\circ\text{C} \end{split} $		20	TBD TBD TBD	μΑ μΑ μΑ
DYNAMIC PERFORMANCE						
Slew Rate	SR	$R_L = 1 M\Omega$, $C_L=10pF$, $Av=1$		70		V/ms
Settling Time to 0.1%	ts	$V_{IN} = 5 \text{ V step}, R_L = 1 \text{ M}\Omega, C_L = 10 \text{ pF}$		TBD		μs
Gain Bandwidth Product	GBP	$R_L = 1 M\Omega$, $C_L = 10 pF$, $A_V = 1$		200		kHz
Phase Margin	Фм	$R_L = 1 M\Omega$, $C_L=10pF$, $A_V = 1$		60		Degrees
Channel Separation	CS	$f = 10 \text{ kHz}, R_L = 1 \text{ M}\Omega$		TBD		dB
NOISE PERFORMANCE						
Voltage Noise	en p-p	f = 0.1 Hz to 10 Hz		TBD		μV p-p
Voltage Noise Density	en	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 k Ω 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

 $^1\theta_{A}$ 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.