

# FEATURES

- 70 nanosecond settling to ±0.01%
- 1GHz gain bandwidth product
- 100dB open loop gain
- 80dB minimum CMRR
- -55 to +125°C operation
- Industry standard

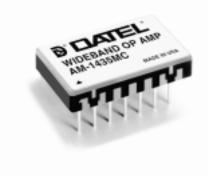
# **GENERAL DESCRIPTION**

DATEL's AM-1435 is an ultrafast settling, wideband operational amplifier. Utilizing precision thin-film hybrid construction and differential input operational amplifier design techniques, the AM-1435 achieves a settling time of only 70 nanoseconds for a 10V step to ±0.01% accuracy. High-speed performance is optimized with high open-loop gain, flat frequency response beyond 10kHz, and a roll-off of 6dB/ octave to beyond 100MHz. Typically, gain bandwidth product is 1GHz, and slew rate is ±300V/microsecond.

AM-1435's dc characteristics include a dc open loop gain of 100dB, 1M $\Omega$  input impedance, and an initial input offset voltage of only ±2mV. Input offset voltage drift is typically ±5 $\mu$ V/°C. Also featured is a minimum common mode rejection ratio of 80dB and full power frequency of 8MHz.

The AM-1435 is designed specifically for applications requiring high accuracy in the amplification of complex wideband waveforms. Such applications include radar and sonar signal processing, video instrumentation, ultrafast A/D and D/A converters and sample-hold amplifiers.

Power supply requirements are  $\pm 15V$  at 30mA maximum quiescent current. Models are specified for operation over the commercial (0 to  $\pm 70^{\circ}$ C) and military ( $\pm 55$  to  $\pm 125^{\circ}$ C) temperature ranges. A high-reliability version manufactured and screened to DATEL's QL screening program is also available. The package is a 14-pin ceramic DIP.



## **INPUT/OUTPUT CONNECTIONS**

PIN	FUNCTION
1	OPTIONAL BYPASS CAPACITOR
2	OUTPUT
3	COMPENSATION CAPACITOR
4	+15V SUPPLY (+V <sub>S</sub> )
5	OFFSET ADJUST
6	OFFSET ADJUST
7	–INPUT
8	+INPUT
9	N.C.
10	N.C.
11	N.C.
12	–15V SUPPLY (–V <sub>S</sub> )
13	OUTPUT CURRENT SINK
14	COMMON

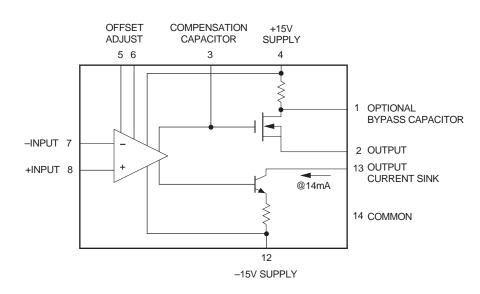


Figure 1. Functional Block Diagram

# **AM-1435** Ultra-Fast, Wideband Operational Amplifiers



# FUNCTIONAL SPECIFICATIONS

(Typical at +25°C and ±15V supplies, unless otherwise noted.)

INPUT	MIN.	TYP.	MAX.	UNITS
Differential Between Inputs			±4	Volts
Common Mode Voltage Range ①	±7	±8.5		Volts
Common Mode Rejection Ratio		_010		10110
1MHz	_	70	_	dB
DC	80	100	_	dB
50	00	100	_	UD
Input Impedance		1		
Common Mode	—	1  2	_	MΩ∥pF
Differential Mode	-	2.5 <b>   2</b>		kΩ∥pF
Input Bias Current	—	±20	40	μA
Input Offset Current		±0.3	—	μA
Input Offset Voltage ②	—	±2	±5	mV
PERFORMANCE	1	4	Į	1
DC Open Loop Gain 3	90	100	_	dB
Input Offset Voltage Drift	_	±5	±25	μV/°C
Input Bias Current Drift	_	±50	±100	nA/°C
Input Offset Current Drift	_	±2		nA/°C
Input Voltage Noise		<u> </u>		
0.01Hz to 10Hz		15		
			-	µVp-p
100Hz to 10kHz	-	1.6	-	μVrms
10Hz to 1MHz	-	5.2	_	μVrms
Input Current Noise ④				
0.01Hz to 10Hz	-	2.5	_	nAp-p
100Hz to 10kHz	-	2.5	—	nArms
10Hz to 1MHz	_	3.5	—	nArms
Power Supply Rejection Ratio	—	±0.15	—	mV/V
DYNAMIC CHARACTERIST	cs		L	•
Gain Bandwidth Product	700	1000	_	MHz
Unity Gain Bandwidth	_	150	_	MHz
Full Power Frequency (5)	8	10	_	MHz
Settling Time	0	10		IVII 12
10V to ±0.025% 6		60	75	nc
		1 00	75	ns
10V to ±0.01% 6	—	70	—	ns
10V to ±0.01% 5V to ±1.0%		70 25	-	ns
10V to ±0.01% ⑥ 5V to ±1.0% 5V to ±0.1%		70 25 40	— 60	ns ns
10V to ±0.01% 5V to ±1.0% 5V to ±0.1% 1V to ±1.0%	_ _ _ _	70 25 40 10	 60 	ns
10V to ±0.01% ⑥ 5V to ±1.0% 5V to ±0.1%	 	70 25 40	 60 	ns ns
10V to ±0.01% 5V to ±1.0% 5V to ±0.1% 1V to ±1.0%	   ±250	70 25 40 10	60 	ns ns ns
10V to ±0.01% 5V to ±1.0% 5V to ±0.1% 1V to ±1.0% 1V to ±0.1%	   ±250	70 25 40 10 20		ns ns ns ns
10V to ±0.01% 5V to ±1.0% 5V to ±0.1% 1V to ±1.0% 1V to ±0.1% Slew Rate \$	   ±250 	70 25 40 10 20 ±300		ns ns ns V/µs
10V to ±0.01% 5V to ±1.0% 5V to ±0.1% 1V to ±1.0% 1V to ±0.1% Slew Rate Overshoot Propagation Delay	   	70 25 40 10 20 ±300 1 5		ns ns ns V/µs % ns
10V to ±0.01% 5V to ±1.0% 5V to ±0.1% 1V to ±1.0% 1V to ±0.1% Slew Rate Overshoot	  ±250 	70 25 40 10 20 ±300 1		ns ns ns V/µs %
10V to ±0.01% 5V to ±1.0% 5V to ±0.1% 1V to ±1.0% 1V to ±0.1% Slew Rate Overshoot Propagation Delay Rise Time (10V step)	  ±250  	70 25 40 10 20 ±300 1 5 40		ns ns ns V/µs % ns ns
10V to ±0.01% 5V to ±1.0% 5V to ±0.1% 1V to ±1.0% 1V to ±0.1% Slew Rate Overshoot Propagation Delay Rise Time (10V step) Overload Recovery Time OUTPUT	 	70 25 40 10 20 ±300 1 5 40 50		ns ns ns V/µs % ns ns ns ns
10V to ±0.01% © 5V to ±1.0% 5V to ±0.1% 1V to ±1.0% 1V to ±0.1% Slew Rate © Overshoot Propagation Delay Rise Time (10V step) Overload Recovery Time OUTPUT Output Voltage ③		70 25 40 10 20 ±300 1 5 40 50 ±7		ns ns ns V/µs % ns ns ns ns Volts
10V to ±0.01% © 5V to ±1.0% 5V to ±0.1% 1V to ±1.0% 1V to ±0.1% Slew Rate © Overshoot Propagation Delay Rise Time (10V step) Overload Recovery Time OUTPUT Output Voltage ③ Output Current ③	 	70 25 40 10 20 ±300 1 5 40 50 ±7 ±14		ns ns ns V/µs % ns ns ns volts mA
10V to ±0.01% © 5V to ±1.0% 5V to ±0.1% 1V to ±1.0% 1V to ±0.1% Slew Rate © Overshoot Propagation Delay Rise Time (10V step) Overload Recovery Time OUTPUT Output Voltage ③ Output Current ③		70 25 40 10 20 ±300 1 5 40 50 ±7		ns ns ns V/µs % ns ns ns ns Volts
10V to ±0.01% © 5V to ±1.0% 5V to ±0.1% 1V to ±1.0% 1V to ±0.1% Slew Rate © Overshoot Propagation Delay Rise Time (10V step) Overload Recovery Time OUTPUT Output Voltage ③		70 25 40 10 20 ±300 1 5 40 50 ±7 ±14		ns ns ns V/µs % ns ns ns volts mA
10V to ±0.01% © 5V to ±1.0% 5V to ±0.1% 1V to ±1.0% 1V to ±0.1% Slew Rate © Overshoot Propagation Delay Rise Time (10V step) Overload Recovery Time OUTPUT Output Voltage ③ Output Voltage ③ Output Current ③ Stable Capacitative Load ⑦		70 25 40 10 20 ±300 1 5 40 50 ±7 ±14		ns ns ns V/µs % ns ns ns volts mA

#### Footnotes:

 Specified for dc linear operation. Common mode voltage range prior to fault condition is ±10V maximum.

- Adjustable to zero.
- $\Im R_L = 500 \Omega$
- Referred to input.
- ⑤ C1 = 0.5pF.
- 6 C1 = 1pF.
- $\bigcirc$  C1 = 3pF, noise gain >2.
- $\circledast$  Requires 18°C/W heat sink above +85°C.

### PHYSICAL/ENVIRONMENTAL

PARAMETERS	MIN.	TYP.	MAX.	UNITS
Operating Temp. Range, Case AM-1435MC	0	_	+70	0°
AM-1435MM, MM-QL ®	-55	_	+125	°C
Storage Temp. Range	-65	_	+150	°C
Package Type	14-р	in, metal-sea	aled, ceramic	DIP

## **TECHNICAL NOTES**

- The use of good high-frequency circuit board layout techniques is required for rated performance. The extensive use of a ground plane for all common connections is recommended. Lead lengths should be kept to a minimum with point-to-point connections wired directly to the amplifier pins. 1µF tantalum bypass capacitors should be used at the ±15V supply pins.
- Operation of the AM-1435MM and MM-QL over the +85 to +125°C temperature range requires additional thermal dissipation to achieve rated performance. Use of an 18°C/W heat sink is recommended.
- 3. No input protection is provided so as to maximize frequency response. As a result, several precautions must be observed. Do not apply the positive supply voltage before the negative supply. Do not apply signals to either input prior to power-up. If frequency response is not critical, installation of an external input-protection circuit is recommended.
- A 1µF bypass capacitor (C4) connected from OPTIONAL BYPASS CAPACITOR (pin 1) to COMMON (pin 14) may be required to inhibit output oscillation when driving capacitive loads.
- To ensure stable operation when the noise gain is less than 10, a 2pF compensation capacitor (C1) must be connected between pins 3 and 7. The value of the compensation capacitor may be application sensitive.
- 6. The AM-1435 is a prime choice as a current-to-voltage converter due to its excellent  $E_{OS}$  and  $I_{OS}$  temperature coefficient ratings. Input bias currents are easily compensated by adding a resistor from pin 8 to ground, which is equal to the parallel combination of the feedback resistor and input impedance.

ABSOLUTE MAXIMUM RATINGS, ALL MODELS	
Positive Supply, Pin 4	+18V
Negative Supply, Pin 12	–18V
Lead Temperature (soldering, 10s)	300°C
Load tomporatare (seraening, ros)	



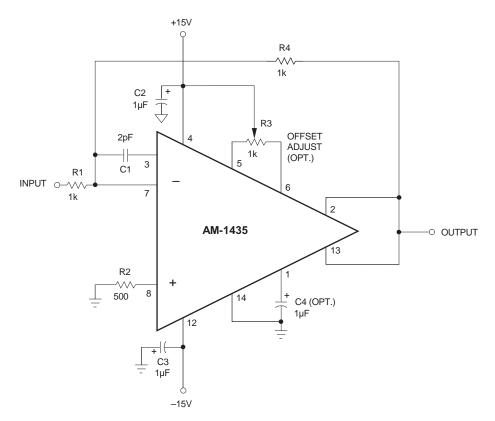


Figure 2. Typical Connection Diagram

## TYPICAL CONNECTION AND COMPENSATION

The typical connection diagram (above) shows the AM-1435 in a unity-gain inverting configuration. When used in any conventional operational-amplifier configuration, the AM-1435 (as a non-inverting amplifier) requires a noise gain of at least two (noise gain = 1 + R4/R1).

The 2pF compensation capacitor, C1, at pin 3 is required for stable operation when the noise gain is less than 10. Compensation for bias current is provided by R2 and its value is determined by the formula:

 $R2 = \frac{(R1) \times (R4)}{R1 + R4}$ 

The offset adjust potentiometer R3 and the compensation capacitor C4 are optional. Note, however, that C4 should be implemented when driving capacitive loads to prevent oscillation of the output stage.

Operation of the AM-1435 at low impedances requires careful attention to include the feedback resistor as a part of the total output load.

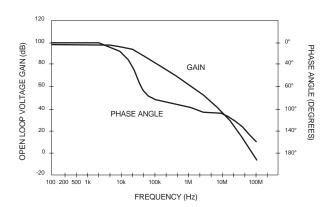


Figure 3. Gain and Phase vs. Frequency (Uncompensated)

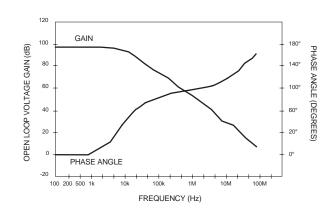


Figure 4. Gain and Phase vs. Frequency (Compensated 2pF)



# **PERFORMANCE CHARTS**

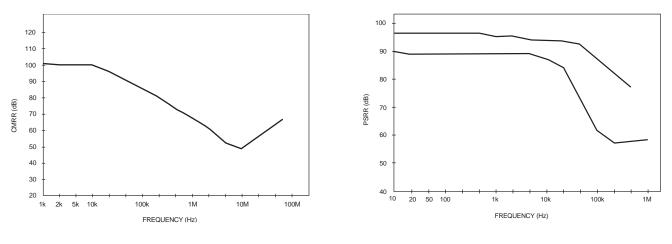
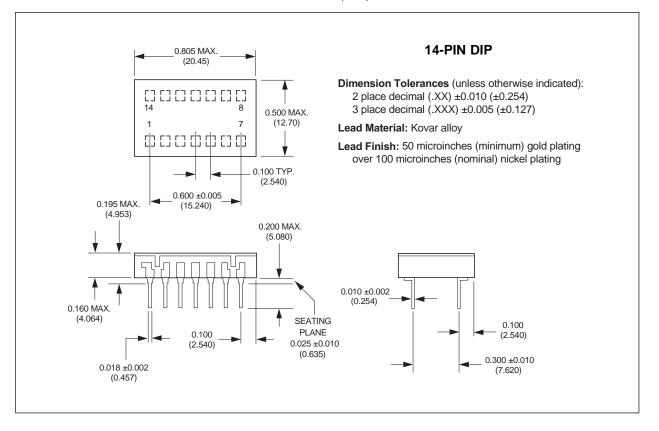


Figure 5. CMRR vs. Frequency

Figure 6. PSRR vs. Frequency





#### **ORDERING INFORMATION**

MODEL	OPERATING TEMP. RANGE
AM-1435MC	0 to +70°C
AM-1435MM	–55 to +125°C
AM-1435MM-QL	–55 to +125°C