

LM7341 Rail-to-Rail Input/Output ±15V, 4.6 MHz GBW, Operational Amplifier in SOT-23 **Package**

Check for Samples: LM7341

FEATURES

- $(V_S = \pm 15V, T_A = 25^{\circ}C, Typical Values.)$
- Tiny 5-pin SOT-23 Package Saves Space
- Greater than Rail-to-Rail Input CMVR -15.3V to 15.3V
- Rail-to-Rail Output Swing -14.84V to 14.86V
- Supply Current 0.7 mA
- **Gain Bandwidth 4.6 MHz**
- Slew Rate 1.9 V/µs
- Wide Supply Range 2.7V to 32V
- High Power Supply Rejection Ratio 106 dB
- High Common Mode Rejection Ratio 115 dB
- Excellent Gain 106 dB
- Temperature Range -40°C to 125°C
- Tested at -40°C, 125°C and 25°C at 2.7V, ±5V and ±15V

APPLICATIONS

- **Automotive**
- **Industrial Robotics**
- **Sensor Output Buffers**
- **Multiple Voltage Power Supplies**
- **Reverse Biasing of Photodiodes**
- **Low Current Optocouplers**
- **High Side Sensing**
- Comparator
- **Battery Chargers**
- **Test Point Output Buffers**
- **Below Ground Current Sensing**

DESCRIPTION

The LM7341 is a rail-to-rail input and output amplifier in a small SOT-23 package with a wide supply voltage and temperature range. The LM7341 has a 4.6 MHz gain bandwidth and a 1.9 volt per microsecond slew rate, and draws 0.75 mA of supply current at no load.

The LM7341 is tested at -40°C, 125°C and 25°C with automatic test equipment. modern performance specifications at 2.7V, ±5V, and ±15V and over a wide temperature range make the LM7341 a good choice for automotive, industrial, and other demanding applications.

Greater than rail-to-rail input common mode range with a minimum 76 dB of common mode rejection at ±15V makes the LM7341 a good choice for both high and low side sensing applications.

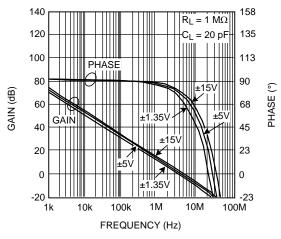
LM7341 performance is consistent over a wide voltage range, making the part useful for applications where the supply voltage can change, such as automotive electrical systems and battery powered electronics.

The LM7341 uses a small SOT23-5 package, which takes up little board space, and can be placed near signal sources to reduce noise pickup.

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Typical Performance Characteristics



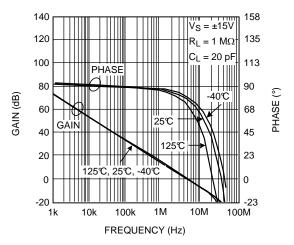


Figure 1. Open Loop Frequency Response

Figure 2. Open Loop Frequency Response



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

Absolute Maximum Ratings (1)(2)

ESD Tolerance ⁽³⁾	Human Body Model	2000V	
	Machine Model	200V	
	Charge-Device Model	1000V	
V _{IN} Differential		±15V	
Voltage at Input/Output Pin	$(V^+) + 0.3V, (V^-) -0.3V$		
Supply Voltage (V _S = V ⁺ - V ⁻)	35V		
Input Current	±10 mA		
Output Current ⁽⁴⁾		±20 mA	
Power Supply Current		25 mA	
Soldering Information	Infrared or Convection (20 sec)	235°C	
	Wave Soldering Lead Temp. (10 sec.)	260°C	
Storage Temperature Range		-65°C to 150°C	
Junction Temperature ⁽⁵⁾		150°C	

- (1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not ensured. For ensured specifications and the test conditions, see the Electrical Characteristics.
- (2) If Military/Aerospace specified devices are required, please contact the TI Sales Office/Distributors for availability and specifications.
- (3) Human Body Model, applicable std. MIL-STD-883, Method 3015.7. Machine Model, applicable std. JESD22-A115-A (ESD MM std. of JEDEC) Field-Induced Charge-Device Model, applicable std. JESD22-C101-C (ESD FICDM std. of JEDEC).
- (4) Applies to both single-supply and split-supply operation. Continuous short circuit operation at elevated ambient temperature can result in exceeding the maximum allowed junction temperature of 150°C.
- (5) The maximum power dissipation is a function of $T_{J(MAX)}$, θ_{JA} . The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(MAX)} T_A)/\theta_{JA}$. All numbers apply for packages soldered directly unto a PC board.

Operating Ratings⁽¹⁾

<u>, i </u>		
Supply Voltage $(V_S = V^+ - V^-)$		2.5V to 32V
Temperature Range ⁽²⁾		−40°C to 125°C
Package Thermal Resistance (θ _{JA})	5-Pin SOT-23	325°C/W

- (1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not ensured. For ensured specifications and the test conditions, see the Electrical Characteristics.
- (2) The maximum power dissipation is a function of $T_{J(MAX)}$, θ_{JA} . The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(MAX)} T_A)/\theta_{JA}$. All numbers apply for packages soldered directly unto a PC board.

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2.7V Electrical Characteristics

Unless otherwise specified, all limits ensured for $T_A = 25^{\circ}C$, $V^+ = 2.7V$, $V^- = 0V$, $V_{CM} = 0.5V$, $V_{OUT} = 1.35V$ and $R_L > 1$ M Ω to 1.35V. **Boldface** limits apply at the temperature extremes

Symbol	Parameter	Conditions	Min ⁽¹⁾	Typ ⁽²⁾	Max ⁽¹⁾	Units			
V _{OS}	Input Offset Voltage	$V_{CM} = 0.5V$ and $V_{CM} = 2.2V$	-4 -5	±0.2	+4 +5	mV			
TCV _{OS}	Input Offset Voltage Temperature Drift			±2		μV/°C			
I _B	Input Bias Current	V _{CM} = 0.5V	-180 -200	-90		- ^			
		$V_{CM} = 2.2V$		30	60 70	nA			
I _{OS}	Input Offset Current	$V_{CM} = 0.5V$ and $V_{CM} = 2.2V$		1	40 50	nA			
CMRR	Common Mode Rejection Ratio	$0V \le V_{CM} \le 1.0V$	82 80	106		٩D			
		$0V \le V_{CM} \le 2.7V$	62 60	80		dB			
PSRR	Power Supply Rejection Ratio	$2.7V \le V_S \le 30V$ $V_{CM} = 0.5V$	86 84	106		dB			
CMVR	Common Mode Voltage Range	CMRR > 60 dB		-0.3	0.0	V			
			2.7	3.0		V			
A _{VOL}	Open Loop Voltage Gain	$0.5V \le V_O \le 2.2V$ R _L = 10 k Ω to 1.35V	12 8	65		V/mV			
V _{OUT}	Output Voltage Swing High	$R_L = 10 \text{ k}\Omega \text{ to } 1.35 \text{V}$ $V_{ID} = 100 \text{ mV}$		50	120 150				
		$R_L = 2 k\Omega$ to 1.35V $V_{ID} = 100 \text{ mV}$		95	150 200	mV from either rail			
	Output Voltage Swing Low	$R_L = 10 \text{ k}\Omega \text{ to } 1.35 \text{V}$ $V_{ID} = -100 \text{ mV}$		55	120 150				
		$R_L = 2 k\Omega$ to 1.35V $V_{ID} = -100 \text{ mV}$		100	150 200				
I _{OUT}	Output Current	Sourcing, $V_{OUT} = 0V$ $V_{ID} = 200 \text{ mV}$	6 4	12		Λ			
		Sinking, $V_{OUT} = 0V$ $V_{ID} = -200 \text{ mV}$	5 3	10		mA			
I _S	Supply Current	$V_{CM} = 0.5V$ and $V_{CM} = 2.2V$		0.6	0.9 1.0	mA			
SR	Slew Rate	±1V Step		1.5		V/µs			
GBW	Gain Bandwidth	$f = 100 \text{ kHz}, R_L = 100 \text{ k}\Omega$		3.6		MHz			
e _n	Input Referred Voltage Noise Density	f = 1 kHz		35		nV/√ Hz			
i _n	Input Referred Voltage Noise Density	f = 1 kHz		0.28		pA/√Hz			
THD+N	Total Harmonic Distortion + Noise	f = 10 kHz		-66		dB			
t _{PD}	Propagation Delay	Overdrive = 50 mV ⁽³⁾		4					
		Overdrive = 1V ⁽³⁾		3		μs			
t _r	Rise Time	20% to 80% ⁽³⁾		1		μs			
t _f	Fall Time	80% to 20% ⁽³⁾		1		μs			

⁽¹⁾ All limits are specified by testing or statistical analysis.

Product Folder Links: LM7341

⁽²⁾ Typical values represent the most likely parametric norm as determined at the time of characterization. Actual typical values may vary over time and will also depend on the application and configuration. The typical values are not tested and are not ensured on shipped production material.

⁽³⁾ The maximum differential voltage between the input pins is V_{IN} Differential = ±15V.



±5V Electrical Characteristics

Unless otherwise specified, all limits ensured for $T_A = 25$ °C, $V^+ = +5V$, $V^- = -5V$, $V_{CM} = V_{OUT} = 0V$ and $R_L > 1$ M Ω to 0V. **Boldface** limits apply at the temperature extremes.

Symbol	Parameter	Conditions	Min ⁽¹⁾	Typ ⁽²⁾	Max ⁽¹⁾	Units	
Vos	Input Offset Voltage	$V_{CM} = -4.5V$ and $V_{CM} = 4.5V$	-4 -5	±0.2	+4 +5	mV	
TCV _{OS}	Input Offset Voltage Temperature Drift			±2		μV/°C	
I _B	Input Bias Current	V _{CM} = -4.5V	-200 -250	-95		m A	
		V _{CM} = 4.5V		35	70 80	- nA	
los	Input Offset Current	$V_{CM} = -4.5V$ and $V_{CM} = 4.5V$		1	40 50	nA	
CMRR	Common Mode Rejection Ratio	$-5V \le V_{CM} \le 3V$	84 82	112		– dB	
		$-5V \le V_{CM} \le 5V$	72 70	92		αБ	
PSRR	Power Supply Rejection Ratio	$2.7V \le V_S \le 30V, V_{CM} = -4.5V$	86 84	106		dB	
CMVR	Common Mode Voltage Range	CMRR ≥ 65 dB		-5.3	-5.0	V	
			5.0	5.3		V	
A _{VOL}	Open Loop Voltage Gain	$-4V \le V_O \le 4V$ R _L = 10 k Ω to 0V	20 12	110		V/mV	
V_{OUT}	Output Voltage Swing High Output Voltage Swing Low	$R_L = 10 \text{ k}\Omega \text{ to 0V},$ $V_{ID} = 100 \text{ mV}$		80	150 200		
		$R_L = 2 k\Omega$ to 0V, $V_{ID} = 100 \text{ mV}$		170	300 400	mV from	
		$R_L = 10 \text{ k}\Omega \text{ to 0V}$ $V_{ID} = -100 \text{ mV}$		90	150 200	either rail	
		$R_L = 2 k\Omega$ to 0V V _{ID} = -100 mV		210	300 400		
I _{OUT}	Output Current	Sourcing, $V_{OUT} = -5V$ $V_{ID} = 200 \text{ mV}$	6 4	11		^	
		Sinking, $V_{OUT} = 5V$ $V_{ID} = -200 \text{ mV}$	6 4	12		- mA	
I _S	Supply Current	$V_{CM} = -4.5V$ and $V_{CM} = 4.5V$		0.65	1.0 1.1	mA	
SR	Slew Rate	±4V Step		1.7		V/µs	
GBW	Gain Bandwidth	$f = 100 \text{ kHz}, R_L = 100 \text{ k}\Omega$		4.0		MHz	
e _n	Input Referred Voltage Noise Density	f = 1 kHz		33		nV/√ Hz	
i _n	Input Referred Voltage Noise Density	f = 1 kHz		0.26		pA/√Hz	
THD+N	Total Harmonic Distortion + Noise	f = 10 kHz		-66		dB	
t _{PD}	Propagation Delay	Overdrive = 50 mV ⁽³⁾		8			
		Overdrive = 1V ⁽³⁾	6			μs	
t _r	Rise Time	20% to 80% ⁽³⁾		5		μs	
t _f	Fall Time	80% to 20% ⁽³⁾		5		μs	

⁽¹⁾ All limits are specified by testing or statistical analysis.

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⁽²⁾ Typical values represent the most likely parametric norm as determined at the time of characterization. Actual typical values may vary over time and will also depend on the application and configuration. The typical values are not tested and are not ensured on shipped production material.

⁽³⁾ The maximum differential voltage between the input pins is V_{IN} Differential = ±15V.



±15V Electrical Characteristics

Unless otherwise specified, all limits ensured for $T_A = 25^{\circ}C$, $V^+ = 15V$, $V^- = -15V$, $V_{CM} = V_{OUT} = 0V$ and $R_L > 1$ M Ω to 0V. **Boldface** limits apply at the temperature extremes

Symbol	Parameter	Conditions	Min ⁽¹⁾	Typ ⁽²⁾	Max ⁽¹⁾	Units	
V _{OS}	Input Offset Voltage	$V_{CM} = -14.5V$ and $V_{CM} = 14.5V$	-4 -5	±0.2	+4 +5	mV	
TCV _{OS}	Input Offset Voltage Temperature Drift			±2		μV/°C	
I _B	Input Bias Current	V _{CM} = −14.5V	-250 -300	-110		4	
		V _{CM} = 14.5V		40	80 90	nA	
I _{OS}	Input Offset Current	$V_{CM} = -14.5V$ and $V_{CM} = 14.5V$		1	40 50	nA	
CMRR	Common Mode Rejection Ratio	-15V ≤ V _{CM} ≤12V	84 82	115		-10	
		-15V ≤ V _{CM} ≤ 15V	78 76	100		dB	
PSRR	Power Supply Rejection Ratio	$2.7V \le V_S \le 30V, V_{CM} = -14.5V$	86 84	106		dB	
CMVR	Common Mode Voltage Range	CMRR > 80 dB		-15.3	-15.0		
			15.0	15.3		V	
A _{VOL}	Open Loop Voltage Gain	$-13V \le V_0 \le 13V$ R _L = 10 k Ω to 0V	25 15	200		V/mV	
V _{OUT}	Output Voltage Swing High	$R_L = 10 \text{ k}\Omega \text{ to 0V}$ $V_{ID} = 100 \text{ mV}$		135	300 400	mV from	
	Output Voltage Swing Low	$R_L = 10 \text{ k}\Omega \text{ to 0V}$ $V_{\text{ID}} = -100 \text{ mV}$		160	300 400	either rail	
I _{OUT}	Output Current ⁽³⁾	Sourcing, V _{OUT} = −15V V _{ID} = 200 mV	5 3	10		^	
		Sinking, $V_{OUT} = 15V$ $V_{ID} = -200 \text{ mV}$	8 5	13		mA	
I _S	Supply Current	$V_{CM} = -14.5V$ and $V_{CM} = 14.5V$		0.7	1.2 1.3	mA	
SR	Slew Rate	±12V Step		1.9		V/µs	
GBW	Gain Bandwidth	$f = 100 \text{ kHz}, R_L = 100 \text{ k}\Omega$		4.6		MHz	
e _n	Input Referred Voltage Noise Density	f = 1 kHz		31		nV/√ Hz	
i _n	Input Referred Voltage Noise Density	f = 1 kHz		0.27		pA/√Hz	
THD+N	Total Harmonic Distortion + Noise	f = 10 kHz		-65		dB	
t _{PD}	Propagation Delay	Overdrive = 50 mV ⁽⁴⁾		17			
		Overdrive = 1V ⁽⁴⁾	12			μs	
t _r	Rise Time	20% to 80% ⁽⁴⁾		13		μs	
t _f	Fall Time	80% to 20% ⁽⁴⁾		13		μs	

⁽¹⁾ All limits are specified by testing or statistical analysis.

Product Folder Links: LM7341

Typical values represent the most likely parametric norm as determined at the time of characterization. Actual typical values may vary over time and will also depend on the application and configuration. The typical values are not tested and are not ensured on shipped production material.

The maximum differential voltage between the input pins is V_{IN} . The maximum allowable power dissipation at any ambient temperature is $V_{IN} = (T_{J(MAX)} - T_{A})/\theta_{JA}$. All numbers apply for packages soldered directly unto a PC board. The maximum differential voltage between the input pins is V_{IN} Differential = ±15V.



Connection Diagram

5-Pin SOT-23

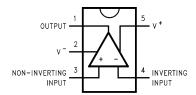


Figure 3. Top View



Typical Performance Characteristics

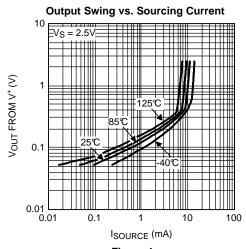


Figure 4.

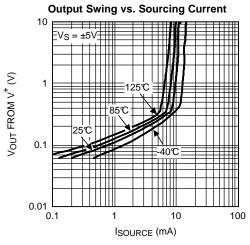
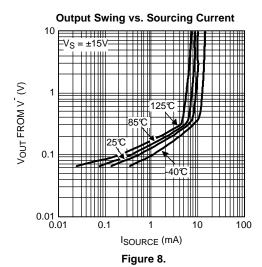
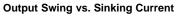


Figure 6.





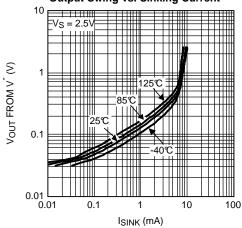


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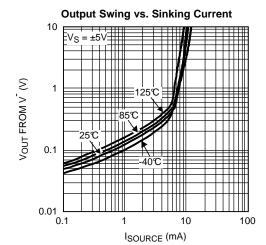


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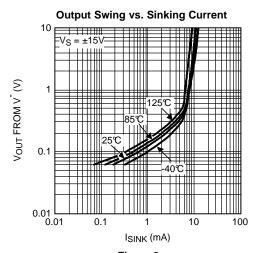


Figure 9.



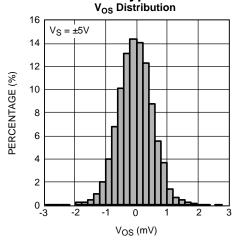


Figure 10.

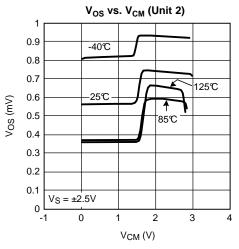
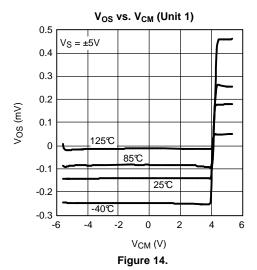


Figure 12.



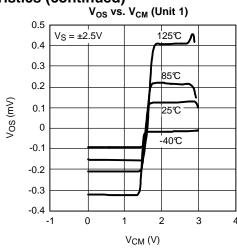


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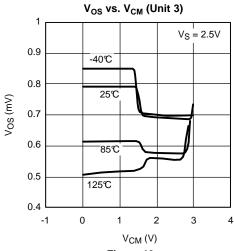


Figure 13.

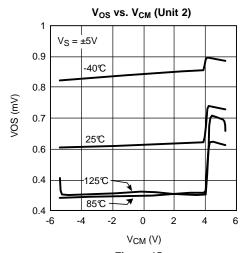


Figure 15.



Typical Performance Characteristics (continued) V_{OS} vs. V_{CM} (Unit 3) V_{OS} vs.

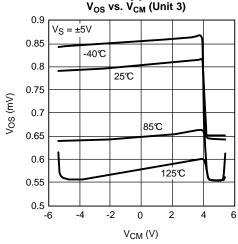
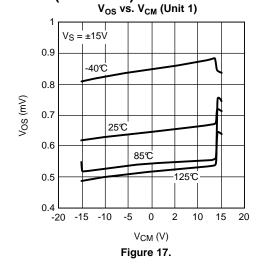


Figure 16.



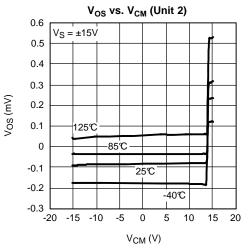


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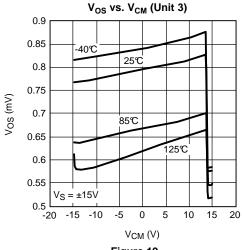


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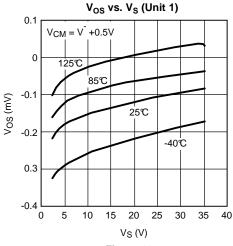


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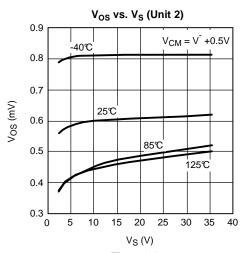
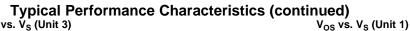


Figure 21.





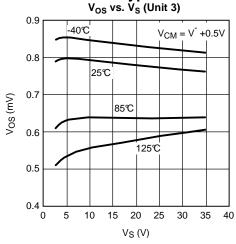
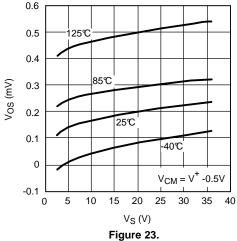


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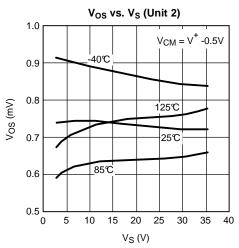


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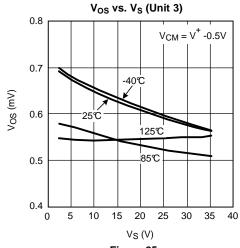


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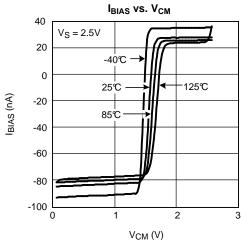


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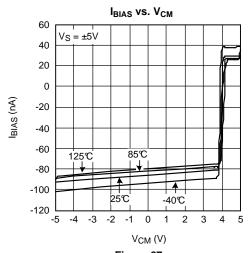


Figure 27.



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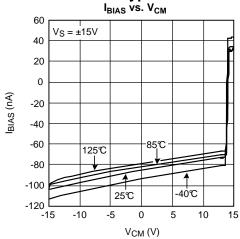


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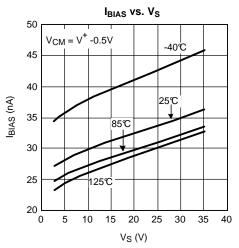
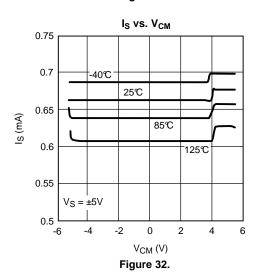


Figure 30.



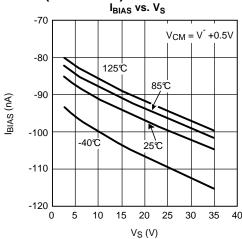


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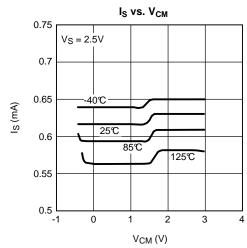


Figure 31.

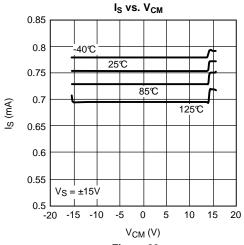


Figure 33.



Typical Performance Characteristics (continued)

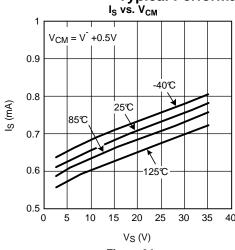


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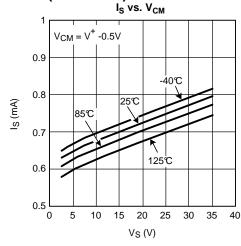


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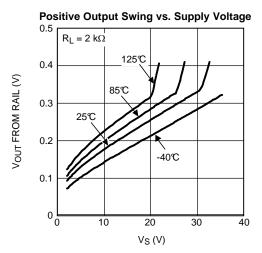


Figure 36.

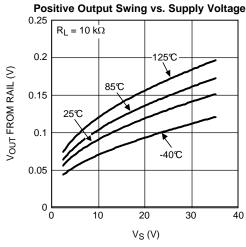
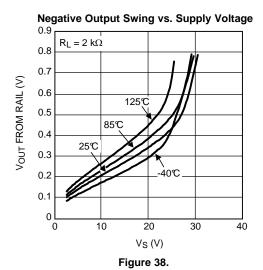


Figure 37.



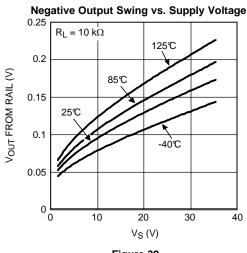
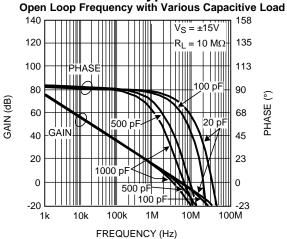
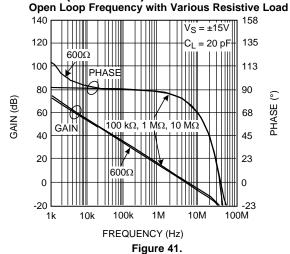


Figure 39.



Typical Performance Characteristics (continued)





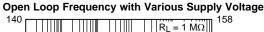
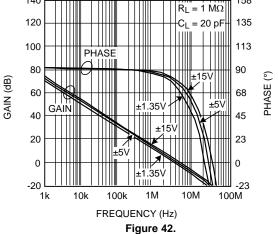
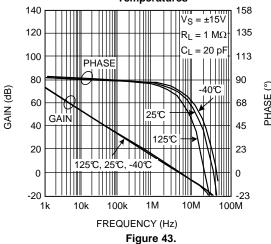
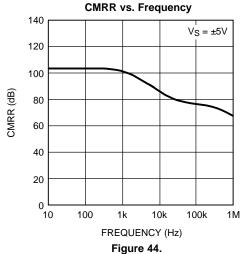


Figure 40.



Open Loop Frequency Response with Various Temperatures





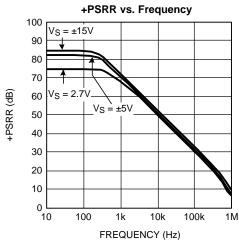


Figure 45.





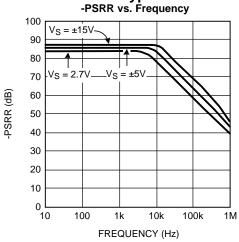


Figure 46.

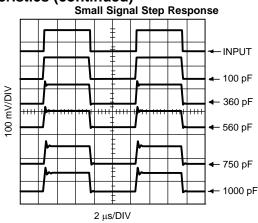


Figure 47.

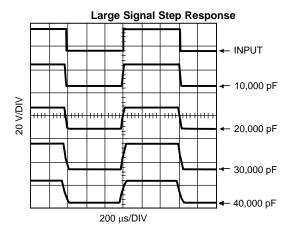
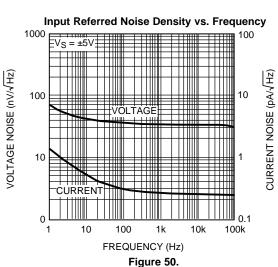
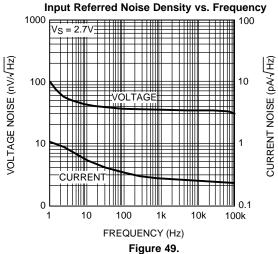
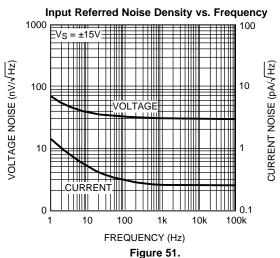


Figure 48.





J



rigure 51.



Typical Performance Characteristics (continued) THD+N vs. Frequency

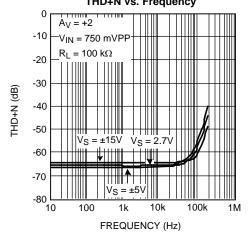


Figure 52.



APPLICATION INFORMATION

GENERAL INFORMATION

Low supply current and wide bandwidth, greater than rail-to-rail input range, full rail-to-rail output, good capacitive load driving ability, wide supply voltage and low distortion all make the LM7341 ideal for many diverse applications.

The high common-mode rejection ratio and full rail-to-rail input range provides precision performance when operated in non-inverting applications where the common-mode error is added directly to the other system errors.

CAPACITIVE LOAD DRIVING

The LM7341 has the ability to drive large capacitive loads. For example, 1000 pF only reduces the phase margin to about 30 degrees.

POWER DISSIPATION

Although the LM7341 has internal output current limiting, shorting the output to ground when operating on a +30V power supply will cause the op amp to dissipate about 350 mW. This is a worst-case example. In the 5-pin SOT-23 package, the higher thermal resistance will cause a calculated rise of 113°C. This can raise the junction temperature to above the absolute maximum temperature of 150°C.

Operating from split supplies greatly reduces the power dissipated when the output is shorted. Operating on ±15V supplies can only cause a temperature rise of 57°C in the 5-pin SOT-23 package, assuming the short is to ground.

WIDE SUPPLY RANGE

The high power-supply rejection ratio (PSRR) and common mode rejection ratio (CMRR) provide precision performance when operated on battery or other unregulated supplies. This advantage is further enhanced by the very wide supply range (2.5V–32V) offered by the LM7341. In situations where highly variable or unregulated supplies are present, the excellent PSRR and wide supply range of the LM7341 benefit the system designer with continued precision performance, even in such adverse supply conditions.

SPECIFIC ADVANTAGES OF 5-Pin SOT-23 (TinyPak)

The obvious advantage of the 5-pin SOT-23, TinyPak, is that it can save board space, a critical aspect of any portable or miniaturized system design. The need to decrease overall system size is inherent in any handheld, portable, or lightweight system application.

Furthermore, the low profile can help in height limited designs, such as consumer hand-held remote controls, sub-notebook computers, and PCMCIA cards.

An additional advantage of the tiny package is that it allows better system performance due to ease of package placement. Because the tiny package is so small, it can fit on the board right where the op amp needs to be placed for optimal performance, unconstrained by the usual space limitations. This optimal placement of the tiny package allows for many system enhancements, not easily achieved with the constraints of a larger package. For example, problems such as system noise due to undesired pickup of digital signals can be easily reduced or mitigated. This pick-up problem is often caused by long wires in the board layout going to or from an op amp. By placing the tiny package closer to the signal source and allowing the LM7341 output to drive the long wire, the signal becomes less sensitive to such pick-up. An overall reduction of system noise results.

Often times system designers try to save space by using dual or quad op amps in their board layouts. This causes a complicated board layout due to the requirement of routing several signals to and from the same place on the board. Using the tiny op amp eliminates this problem.

Additional space savings parts are available in tiny packages from Texas Instruments, including low power amplifiers, precision voltage references, and voltage regulators.

Product Folder Links: LM7341



LOW DISTORTION, HIGH OUTPUT DRIVE CAPABILITY

The LM7341 offers superior low-distortion performance, with a total-harmonic-distortion-plus-noise of −66 dB at f = 10 kHz. The advantage offered by the LM7341 is its low distortion levels, even at high output current and low load resistance.

Typical Applications

HANDHELD REMOTE CONTROLS

The LM7341 offers outstanding specifications for applications requiring good speed/power trade-off. In applications such as remote control operation, where high bandwidth and low power consumption are needed. The LM7341 performance can easily meet these requirements.

OPTICAL LINE ISOLATION FOR MODEMS

The combination of the low distortion and good load driving capabilities of the LM7341 make it an excellent choice for driving opto-coupler circuits to achieve line isolation for modems. This technique prevents telephone line noise from coupling onto the modem signal. Superior isolation is achieved by coupling the signal optically from the computer modem to the telephone lines; however, this also requires a low distortion at relatively high currents. Due to its low distortion at high output drive currents, the LM7341 fulfills this need, in this and in other telecom applications.

REMOTE MICROPHONE IN PERSONAL COMPUTERS

Remote microphones in Personal Computers often utilize a microphone at the top of the monitor which must drive a long cable in a high noise environment. One method often used to reduce the nose is to lower the signal impedance, which reduces the noise pickup. In this configuration, the amplifier usually requires 30 dB–40 dB of gain, at bandwidths higher than most low-power CMOS parts can achieve. The LM7341 offers the tiny package, higher bandwidths, and greater output drive capability than other rail-to-rail input/output parts can provide for this application.

LM7341 AS A COMPARATOR

The LM7341 can also be used as a comparator and provides quite reasonable performance. Note however that unlike a typical comparator an op amp has a maximum allowed differential voltage between the input pins. For the LM7341, as stated in the Absolute Maximum Ratings section, this maximum voltage is V_{IN} Differential = $\pm 15V$. Beyond this limit, even for a short time, damage to the device may occur.

As an inverting comparator at V_S = 30V and 1V of overdrive there is typically 12 μ s of propagation delay. At V_S = 30V and 50 mV of overdrive there is typically 17 μ s of propagation delay.

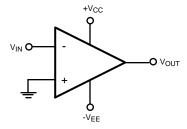


Figure 53. Inverting Comparator

Similarly a non-inverting comparator at $V_S = 30V$ and 1V of overdrive there is typically 12 μ s of propagation delay. At $V_S = 30V$ and 50 mV of overdrive there is typically 17 μ s of propagation delay.

Product Folder Links: LM7341

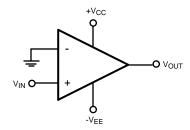


Figure 54. Non-Inverting Comparator

COMPARATOR WITH HYSTERESIS

The basic comparator configuration may oscillate or produce a noisy output if the applied differential input voltage is near the comparator's offset voltage. This usually happens when the input signal is moving very slowly across the comparator's switching threshold. This problem can be prevented by the addition of hysteresis or positive feedback.

INVERTING COMPARATOR WITH HYSTERESIS

The inverting comparator with hysteresis requires a three resistor network that is referenced to the supply voltage V_{CC} of the comparator, as shown in Figure 55. When V_{IN} at the inverting input is less than V_A , the voltage at the non-inverting node of the comparator $(V_{IN} < V_A)$, the output voltage is high (for simplicity assume V_{OUT} switches as high as V_{CC}). The three network resistors can be represented as $R_1||R_3$ in series with R_2 . The lower input trip voltage V_{A1} is defined as

$$V_{A1} = V_{CC}R_2 / ((R_1||R_3) + R_2)$$
 (1)

When V_{IN} is greater than V_A ($V_{IN} > V_A$), the output voltage is low, very close to ground. In this case the three network resistors can be presented as $R_2||R_3$ in series with R_1 . The upper trip voltage V_{A2} is defined as

$$V_{A2} = V_{CC} (R_2 || R_3) / ((R_1 + (R_2 || R_3))$$
 (2)

The total hysteresis provided by the network is defined as

$$Delta V_A = V_{A1} - V_{A2}$$
 (3)

For example to achieve 50 mV of hysteresis when V_{CC} = 30V set R_1 = 4.02 k Ω , R_2 = 4.02 k Ω , and R_3 = 1.21 M Ω . With these resistors selected the error due to input bias current is approximately 1 mV. To minimize this error it is best to use low resistor values on the inputs.



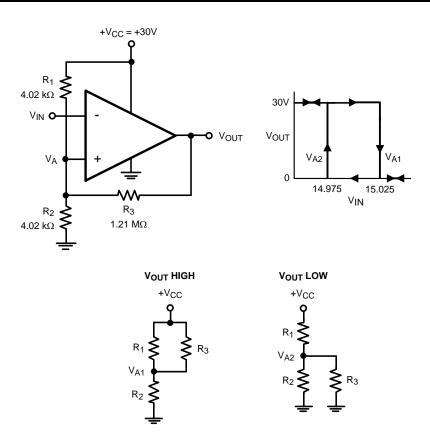


Figure 55. Inverting Comparator with Hysteresis

NON-INVERTING COMPARATOR WITH HYSTERESIS

A non-inverting comparator with hysteresis requires a two resistor network, and a voltage reference (V_{REF}) at the inverting input. When V_{IN} is low, the output is also low. For the output to switch from low to high, V_{IN} must rise up to V_{IN1} where V_{IN1} is calculated by

$$V_{IN1} = R_1^* (V_{REF}/R_2) + V_{REF}$$
 (4)

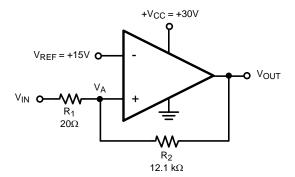
When V_{IN} is high, the output is also high, to make the comparator switch back to it's low state, V_{IN} must equal V_{REF} before V_A will again equal V_{REF} . V_{IN} can be calculated by

$$V_{IN2} = (V_{REF} (R_1 + R_2) - V_{CC}R_1)/R_2$$
 (5)

The hysteresis of this circuit is the difference between V_{IN1} and V_{IN2} .

Delta
$$V_{IN} = V_{CC}R_1/R_2$$
 (6)

For example to achieve 50 mV of hysteresis when V_{CC} = 30V set R_1 = 20 Ω and R_2 = 12.1 k Ω .



Product Folder Links: LM7341



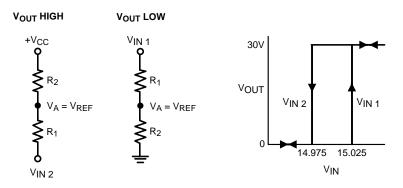


Figure 56. Non-Inverting Comparator with Hysteresis

OTHER SOT-23 AMPLIFIERS

The **LM7321** is a rail-to-rail input and output amplifier that can tolerate unlimited capacitive load. It works from 2.7V to ±15V and across the −40°C to 125°C temperature range. It has 20 MHz gain-bandwidth, and is available in both 5-Pin SOT-23 and 8-Pin SOIC packages.

The **LM6211** is a 20 MHz part with CMOS input, which runs on 5V to 24V single supplies. It has rail-to-rail output and low noise.

The **LMP7701** is a rail-to-rail input and output precision part with an input voltage offset under 220 microvolts and low noise. It has 2.5 MHz bandwidth and works on 2.7V to 12V supplies.

SMALLER SC70 AMPLIFIERS

The **LMV641** is a 10 MHz amplifier which uses only 140 micro amps of supply current. The input voltage offset is less than 0.5 mV.

The **LMV851** is an 8 MHz amplifier which uses only 0.4 mA supply current, and is available in the smaller SC70 package. The LMV851 also resists Electro Magnetic Interference (EMI) from mobile phones and similar high frequency sources. It works on 2.7V to 5.5 V supplies.

Detailed information on these and a wide range of other parts can be found at www.ti.com.





REVISION HISTORY

Changes from Revision A (March 2013) to Revision B				
•	Changed layout of National Data Sheet to TI format		20	

www.ti.com 31-Oct-2025

PACKAGING INFORMATION

Orderable part number	Status	Material type	Package Pins	Package qty Carrier	RoHS	Lead finish/	MSL rating/	Op temp (°C)	Part marking
	(1)	(2)			(3)	Ball material	Peak reflow		(6)
						(4)	(5)		
LM7341MF/NOPB	Obsolete	Production	SOT-23 (DBV) 5	-	-	Call TI	Call TI	-40 to 125	AV4A
LM7341MFE/NOPB	Obsolete	Production	SOT-23 (DBV) 5	-	-	Call TI	Call TI	-40 to 125	AV4A
LM7341MFX/NOPB	Active	Production	SOT-23 (DBV) 5	3000 LARGE T&R	Yes	NIPDAU SN	Level-1-260C-UNLIM	-40 to 125	AV4A
LM7341MFX/NOPB.A	Active	Production	SOT-23 (DBV) 5	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	AV4A

⁽¹⁾ Status: For more details on status, see our product life cycle.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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⁽²⁾ Material type: When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

⁽³⁾ RoHS values: Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

⁽⁴⁾ Lead finish/Ball material: Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

⁽⁵⁾ MSL rating/Peak reflow: The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

⁽⁶⁾ Part marking: There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

PACKAGE MATERIALS INFORMATION

www.ti.com 5-Sep-2025

TAPE AND REEL INFORMATION





A0	Dimension designed to accommodate the component width
В0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE

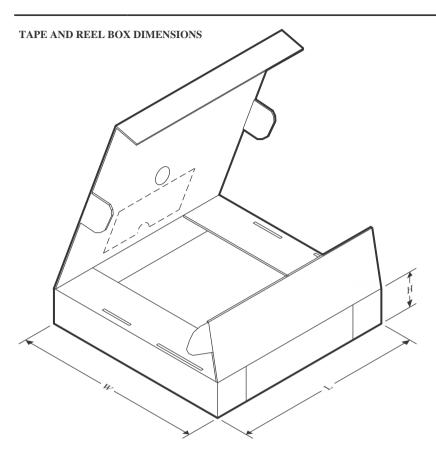


*All dimensions are nominal

Device	Package Type	Package Drawing		SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
LM7341MFX/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM7341MFX/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3

PACKAGE MATERIALS INFORMATION

www.ti.com 5-Sep-2025



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LM7341MFX/NOPB	SOT-23	DBV	5	3000	208.0	191.0	35.0
LM7341MFX/NOPB	SOT-23	DBV	5	3000	208.0	191.0	35.0



SMALL OUTLINE TRANSISTOR



NOTES:

- 1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
 2. This drawing is subject to change without notice.
 3. Reference JEDEC MO-178.

- 4. Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.25 mm per side.
- 5. Support pin may differ or may not be present.



SMALL OUTLINE TRANSISTOR



NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



SMALL OUTLINE TRANSISTOR



NOTES: (continued)

- 8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
- 9. Board assembly site may have different recommendations for stencil design.



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