钍地半导体
Tudi Semiconductor

Product Specification

TUDI-LM331/231

Precision Voltage-to-Frequency Converters

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semiconductor device manufacturer

- Design
- research and development
- production
- and sales

Applications

- Voltage to Frequency Conversions
- Frequency to Voltage Conversions
- Remote-Sensor Monitoring
- Tachometers

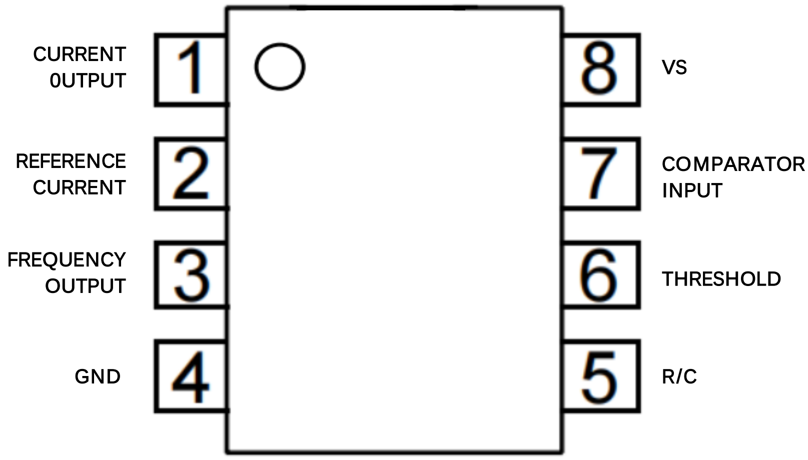


Figure 1. SOP8/DIP8 Pin Diagram

Features

- Ensured Linearity 0.01% Maximum
- Split or Single-Supply Operation
- Operates on Single 5-V Supply
- Low-Cost
- Low Power Consumption: 15 mW Typical at 5 V
- Improved Performance in Existing Voltage-to-Frequency Conversion Applications
- Pulse Output Compatible With All Logic Forms
- Excellent Temperature Stability: ±50 ppm/°C Maximum
- Wide Dynamic Range, 100 dB Minimum at 10-kHz Full Scale Frequency
- Wide Range of Full Scale Frequency: 1 Hz to 100 kHz

Description

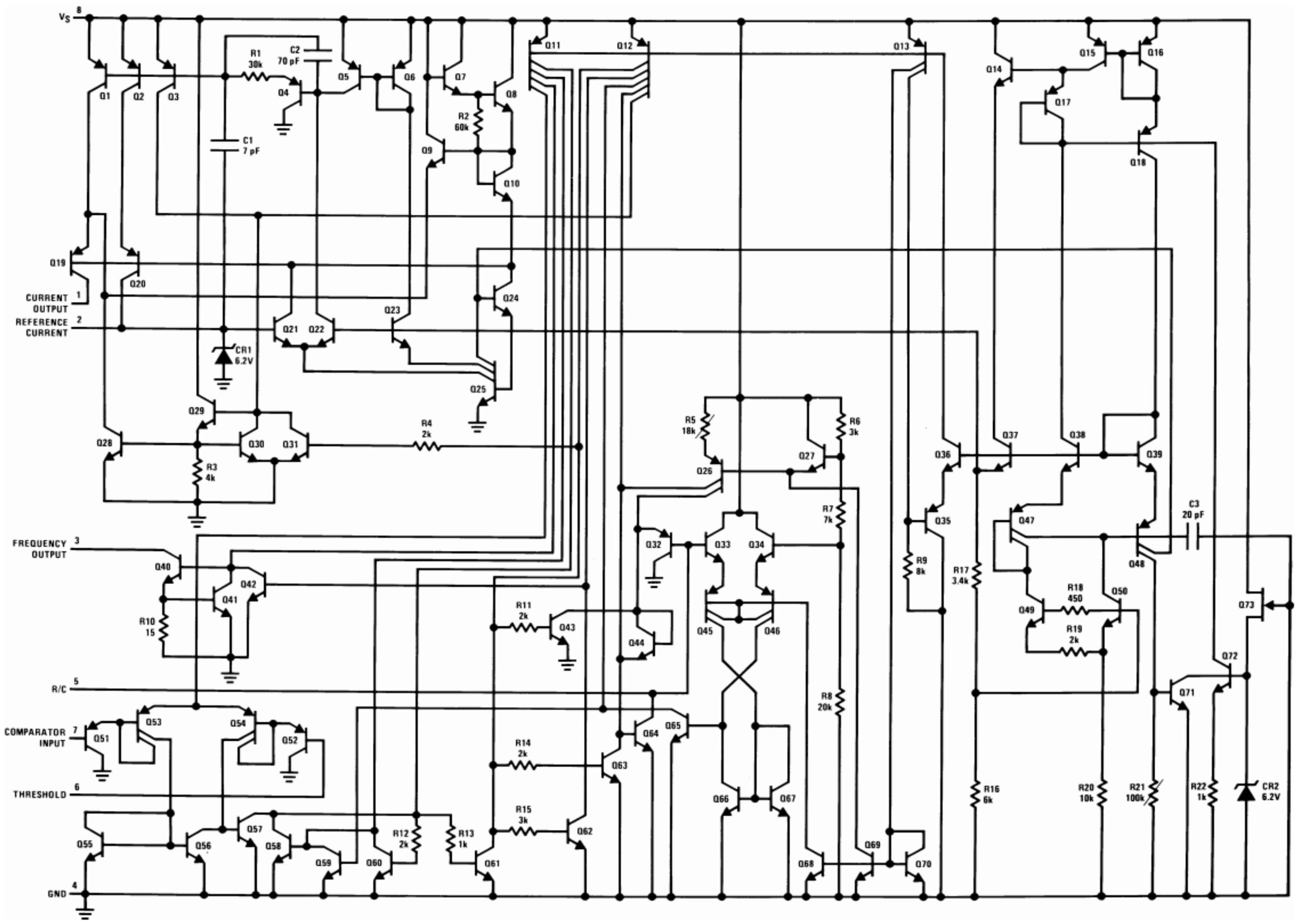
The LM231/LM331 family of voltage-to-frequency converters are ideally suited for use in simple low- cost circuits for analog-to-digital conversion, precision frequency-to-voltage conversion, long-term integration, linear frequency modulation or demodulation, and many other functions. The output when used as a voltage-to-frequency converter is a pulse train at a frequency precisely proportional to the applied input voltage. Thus, it provides all the inherent advantages of the voltage-to-frequency conversion techniques, and is easy to apply in all standard voltage-to-frequency converter applications. Further, the LM231A/LM331A attain a new high level of accuracy versus temperature which could only be attained with expensive voltage-to-frequency modules. Additionally the LM231/331 are ideally suited for use in digital systems at low power supply voltages and can provide low-cost analog-to-digital conversion in microprocessor-controlled systems. And, the frequency from a battery powered voltageto-frequency converter can be easily channeled through a simple photo isolator to provide isolation against high common mode levels.

The LM231/LM331 utilize a new temperaturecompensated band-gap reference circuit, to provide excellent accuracy over the full operating temperature range, at power supplies as low as 4.0V. The precision timer circuit has low bias currents without degrading the quick response necessary for 100 kHz voltage-to-frequency conversion. And the output are capable of driving 3 TTL loads, or a high voltage output up to 40V, yet is short-circuit-proof against V_{CC}.

Pin description

Pin		I/O	Description
No.	Name		
1	IOUT	O	Current Output
2	IREF	I	Reference Current
3	FOUT	O	Frequency Output.This output is an open-collector output and requires a pullup resistor
4	GND	G	Ground
5	RC		R-C filter input
6	THRESH	I	Threshold input
7	COMPIN	I	Comparator Input
8	VS	P	Supply Voltage

Schematic Diagram



Absolute Maximum Ratings

		MIN	MAX	UNIT
Supply Voltage,Vs			40	V
Output Short Circuit to Ground		Continuous		
Output Short Circuit to Vcc		Continuous		
Input Voltage		-0.2	+Vs	V
Lead Temperature (Soldering,10 sec.)	PDIP		260	℃

Note:
(1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) All voltages are measured with respect to GND = 0 V, unless otherwise noted.
(3) If Military/Aerospace specified devices are required, please contact the TI Sales Office/Distributors for availability and specifications.

ESD Ratings

		VALUE	UNIT
$V_{(ESD)}$ Electrostatic discharge	Human body model (HBM),per ANSIESDAJEDEC JS-001	±500	V

Note:
(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
(2) Human body model, 100 pF discharged through a 1.5-kΩ resistor.

Recommended Operating Conditions

		MIN	MAX	UNIT
Operating Ambient Temperature	LM231,LM231A	-25	85	℃
	LM331,LM331A	0	70	℃
Supply Voltage,Vs(1)		4	40	V

All voltages are measured with respect to GND = 0 V, unless otherwise noted.

Thermal Information

THERMAL METRIC		LM231,LM331	UNIT
$R_{θJA}$	Junction-to-ambient thermal resistance	100	CN

Functional Block Diagram

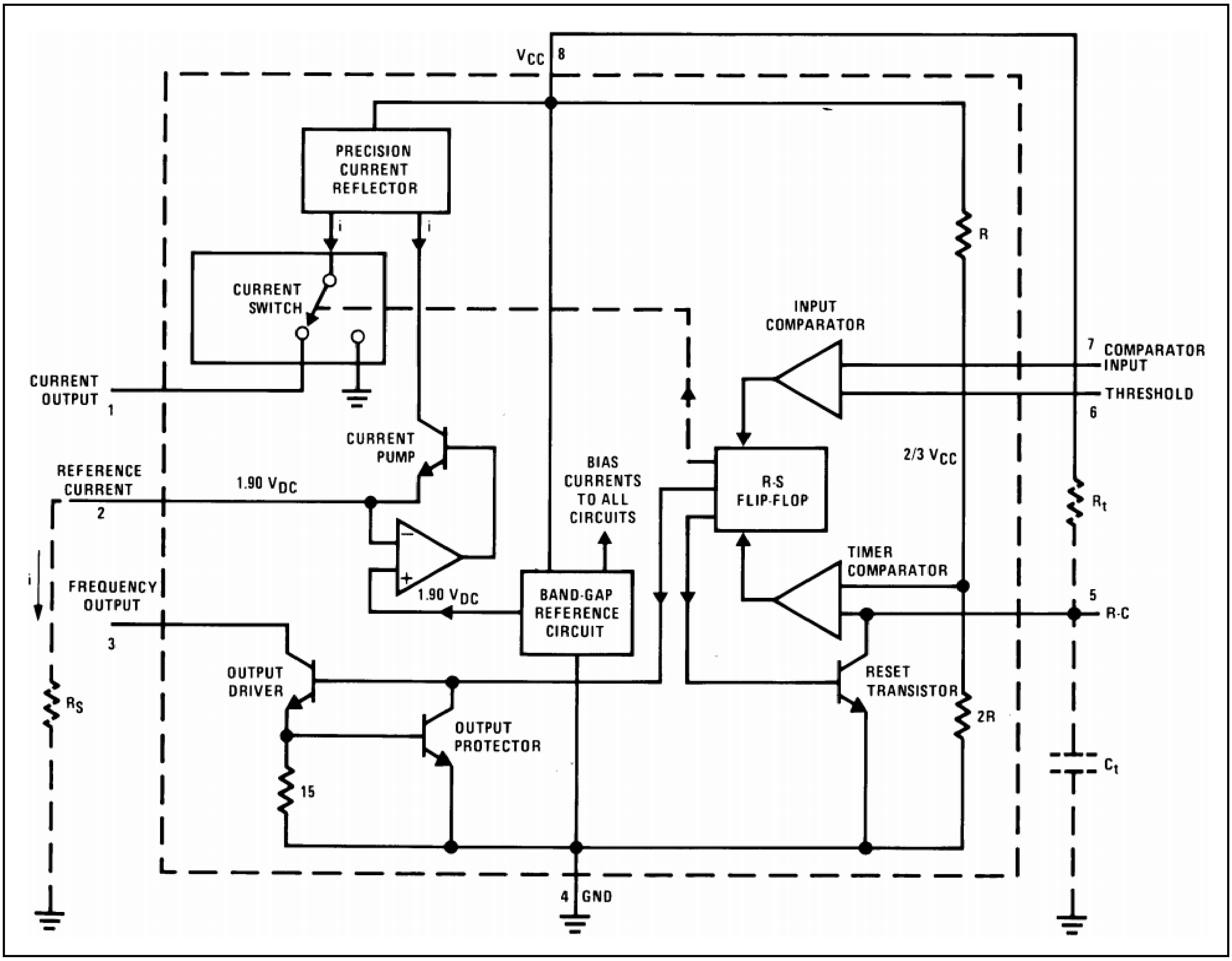


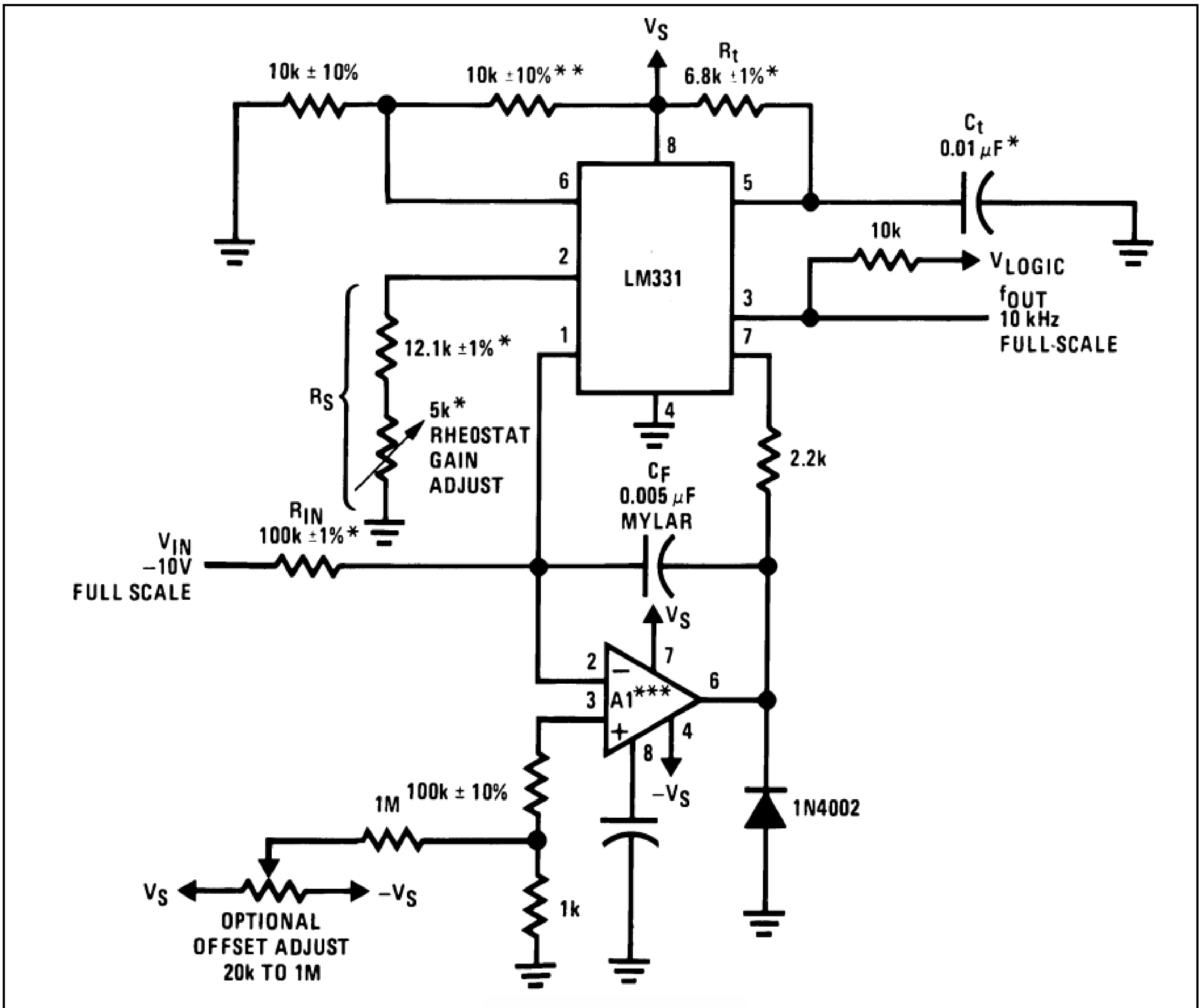
Figure 2. **Functional Block Diagram**

Dissipation Ratings

	VALUE	UNIT
Package Dissipation at 25℃	1.25	W

The absolute maximum junction temperature ($T_J$max) for this device is 150°C. The maximum allowable power dissipation is dictated by $T_J$max, the junction-to-ambient thermal resistance (θ_{JA}), and the ambient temperature T_A, and can be calculated using the formula $P_D$max = ($T_J$max - T_A) / θ_{JA}. The values for maximum power dissipation will be reached only when the device is operated in a severe fault condition (e.g., when input or output pins are driven beyond the power supply voltages, or the power supply polarity is reversed). Obviously, such conditions should always be avoided.

Standard Test Circuit and Applications Circuit, Precision Voltage -to-Frequency Converter



$$f_{OUT} = \frac{-V_{IN}}{2.09\ V} \cdot \frac{R_S}{R_{IN}} \cdot \frac{1}{R_t C_t}$$

Figure 3. Standard Test Circuit and Applications Circuit, Precision Voltage-to-Frequency Converter

*Use stable components with low temperature coefficients.
**This resistor can be 5 kΩ or 10 kΩ for Vs = 8 V to 22 V, but must be 10 kΩ for Vs = 4.5 V to 8 V.
***Use low offset voltage and low offset current op-amps for A1: recommended type LF411A

Electrical Characteristics

All specifications apply in the circuit of Figure 3, with 4.0 V VS 40 V, TA = 25°C, unless otherwise specified.

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
VFC Non-Linearity(1)		4.5V≤Vs≤20V		±0.003	±0.01	%Full-Scale
		TMIN≤TA≤TMAX		±0.006	±0.02	%Full-Scale
VFC Non-Linearity		Vs=15V,f=10 Hz to 11 kHz		±0.024	±0.14	%Full-Scale
Conversion Accuracy Scale Factor(Gain)	LM231,LM231A	VIn=-10V,Rs=14kΩ	0.95	1	1.05	kHzN
	LM331,LM331A		0.9	1	1.1	kHzN
Temperature Stability of Gain	LMx31	TMIN≤TA≤TMAX 4.5V≤Vs≤20V		±30	±150	ppm/℃
	LMx31A			±20	±50	ppm/℃
Change of Gain with Vs		4.5V≤Vs≤10V		0.01	0.1	%/N
		10V≤Vs≤40V		0.006	0.06	%N
Rated Ful-Scale Frequency		VIn=-10V	10.0			kHz
Gain Stability vs.Time(1000 Hours)		TMIN≤TA≤TMAX		±0.02		%Full-Scale
Over Range(Beyond Full-Scale)Frequency		VIN=-11V	10%			
INPUT COMPARATOR						
Offset Voltage				±3	±10	mV
LM231/LM331		TMIN≤TA≤TMAX		±4	±14	mV
LM231A/LM331A		TMIN≤TA≤TMAX		±3	±10	mV
Bias Current				-80	-300	nA
Offset Current				±8	±100	nA
Common-Mode Range		TMIN≤TA≤TMAX	-0.2		Vcc-2	V
TIMER						
Timer Threshold Voltage,Pin 5			0.63×Vs	0.667×Vs	0.7×Vs	
Input Bias Current,Pin 5		Vs=15V				
All Devices		OV≤VPIN 5≤9.9V		±10	±100	nA
LM231/LM331		VPIN 5=10V		200	1000	nA
LM231A/LM331A		VPIN 5=10V		200	500	nA
VSAT PIN 5(Reset)		I=5mA		0.22	0.5	V
SUPPLY CURRENT						
LM231,LM231A		Vs=5V	2	3	4	mA
		Vs=40V	2.5	4	6	mA
LM331,LM331A		Vs=5V	1.5	3	6	mA
		Vs=40V	2	4	8	mA

Non-linearity is defined as the deviation of f_{OUT} from V_{IN} × (10 kHz/-10 V_{DC}) when the circuit has been trimmed for zero error at 10 Hz and at 10 kHz, over the frequency range 1 Hz to 11 kHz. For the timing capacitor, C_T, use NPO ceramic, Teflon®, or polystyrene.

Electrical Characteristics

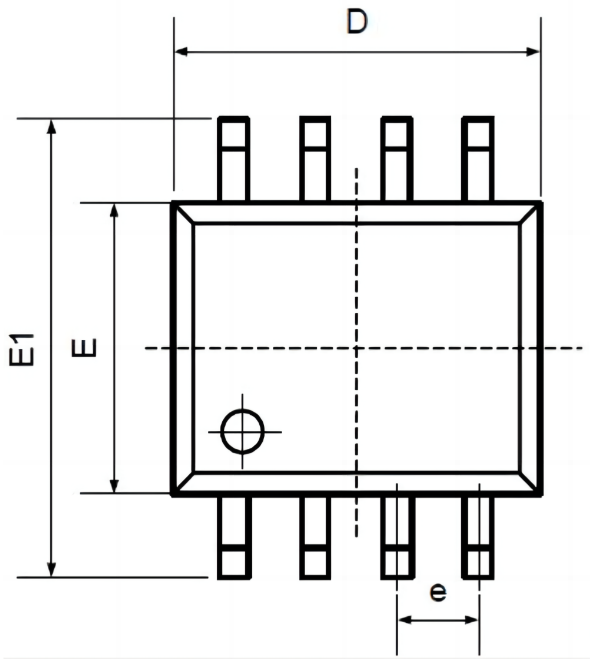
All specifications apply in the circuit of Figure 3, with 4.0 V VS 40 V, TA = 25°C, unless otherwise specified.

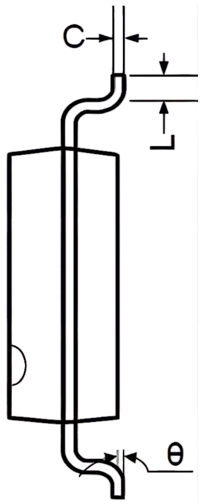
PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
CURRENT SOURCE(PIN 1)						
Output Current	LM231,LM231A	Rs=14kΩ,VPIN 1=0	126	135	144	μA
	LM331,LM331A		116	136	156	μA
Change with Voltage		OV≤VPIN 1≤10V		0.2	1	μA
Current Source OFF Leakage	LM231,LM231A, LM331,LM331A			0.02	10	nA
	All Devices	TA=TMAX		2	50	nA
Operating Range of Current(Typical)				(10 to 500)		μA
REFERENCE VOLTAGE(PIN 2)						
LM231,LM231A			1.76	1.89	2.02	V_{DC}
LM331,LM331A			1.7	1.89	2.08	V_{DC}
Stability vs.Temperature				±60		ppm/°°C
Stability vs.Time,1000 Hours				±0.1%		
LOGIC OUTPUT(PIN 3)						
VsAT		I=5mA		0.15	0.5	V
		I=3.2 mA (2 TTL Loads), TMIN≤TA≤TMAX		0.1	0.4	V
OFF Leakage				±0.05	1	μA

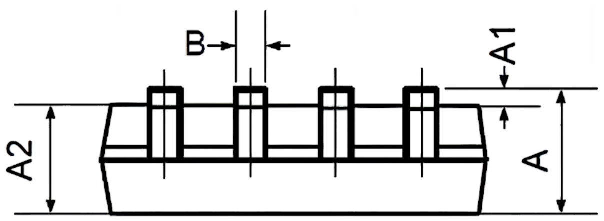
Order information

Order Number	Package	Package Quantity	Marking On The park	Temperature
LM331MX/NOPB-TUDI	SOP8	Tape,Reel,2500	LM331M	0℃ to 70℃
LM331N/NOPB-TUDI	DIP8	Tube,50,A box of 2000	LM331N	
LM331AMX/NOPB-TUDI	SOP8	Tape,Reel,2500	LM331AM	
LM331AN/NOPB-TUDI	DIP8	Tube,50,A box of 2000	LM331AN	
LM231MX/NOPB-TUDI	SOP8	Tape,Reel,2500	LM231M	-25℃ to 85℃
LM231N/NOPB-TUDI	DIP8	Tube,50,A box of 2000	LM231N	
LM231AMX/NOPB-TUDI	SOP8	Tape,Reel,2500	LM231AM	
LM231AN/NOPB-TUDI	DIP8	Tube,50,A box of 2000	LM231AN	

Package SOP8

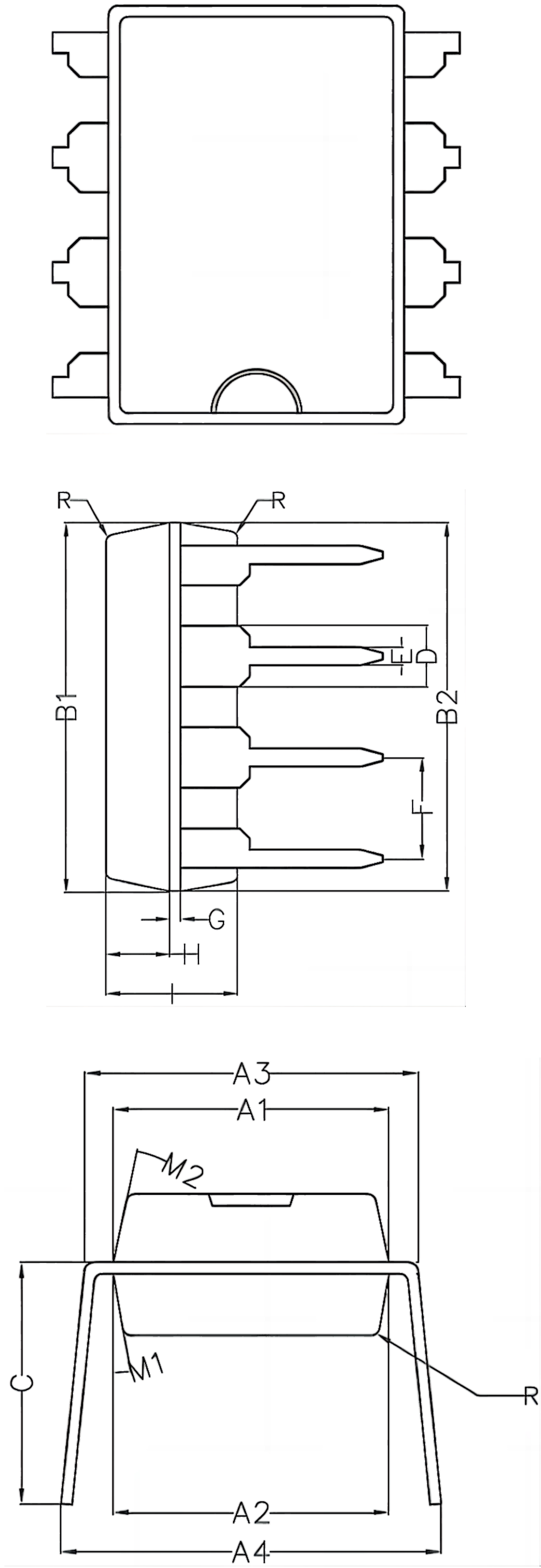






Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
B	0.330	0.510	0.013	0.020
C	0.190	0.250	0.007	0.010
D	4.780	5.000	0.188	0.197
E	3.800	4.000	0.150	0.157
E1	5.800	6.300	0.228	0.248
e	1.270TYP		0.050TYP	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

Package DIP8



Symbol	Min	Non	Max
A1	6.28	6.33	6.38
A2	6.33	6.38	6.43
A3	7.52	7.62	7.72
A4	7.80	8.40	9.00
B1	9.15	9.20	9.25
B2	9.20	9.25	9.30
C		5.57	
D		1.52	
E	0.43	0.45	0.47
F		2.54	
G		0.25	
H	1.54	1.59	1.64
工	3.22	3.27	3.32
R		0.20	
M1	9°	10°	11°
M2	11°	12°	13°

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