XINLUDA®
WWW.XINLUDA.COM 信路达

XD331 DIP-8 / XL331 SOP8 / XD231 DIP-8

1 Features

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

2 Applications

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

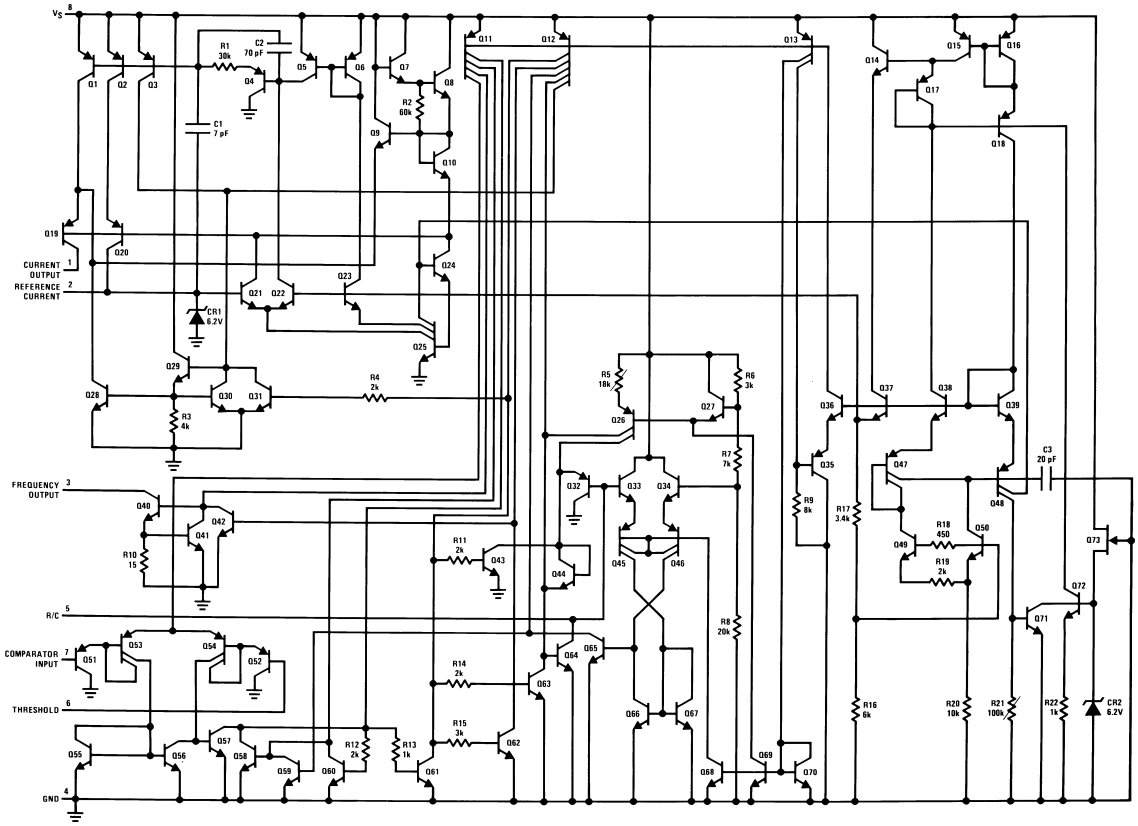
3 Description

The XDx31 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.

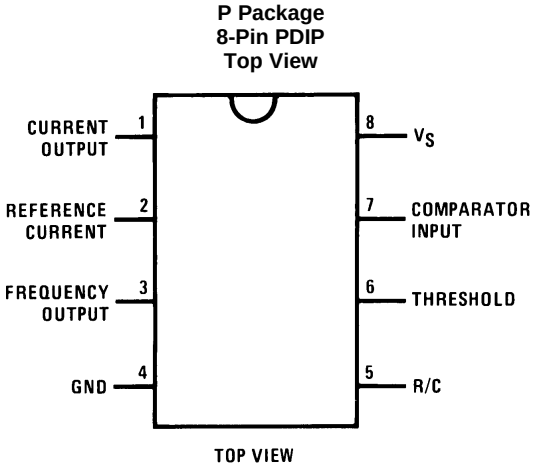
4 Device Information(1)

PART NUMBER	PACKAGE
XD331-231	DIP8
XL331	SOP8

Schematic Diagram



5 Pin Configuration and Functions



Pin Functions

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

6 Specifications

6.1 Absolute Maximum Ratings[1][2][3]

		MIN	MAX	UNIT
Supply Voltage, V_S			40	V
Output Short Circuit to Ground		Continuous		
Output Short Circuit to V_{CC}		Continuous		
Input Voltage		−0.2	$+V_S$	V
Lead Temperature (Soldering, 10 sec.)	PDIP		260	°C

(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.

6.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001[1][2]	±500	V

(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.

6.3 Recommended Operating Conditions

		MIN	MAX	UNIT
Operating Ambient Temperature	XD231	−25	85	°C
	XD331 XL331	0	70	°C
Supply Voltage, V_S (1)		4	40	V

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

6.4 Thermal Information

THERMAL METRIC (1)		XD331 XL331 P (PDIP) 8 PINS	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance	100	°C/W

(1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application report, SPRA953.

6.5 Electrical Characteristics

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
VFC Non-Linearity (1)		4.5 V ≤ V_S ≤ 20 V		±0.003	±0.01	% Full-Scale
		T_{MIN} ≤ T_A ≤ T_{MAX}		±0.006	±0.02	% Full-Scale
VFC Non-Linearity in Circuit of Figure 14		V_S = 15 V, f = 10 Hz to 11 kHz		±0.024	±0.14	%Full-Scale
Conversion Accuracy Scale Factor (Gain)	XD231	V_{IN} = −10 V, R_S = 14 kΩ	0.95	1	1.05	kHz/V
	XD331, XL331		0.9	1	1.1	kHz/V
Temperature Stability of Gain	XDx31	T_{MIN} ≤ T_A ≤ T_{MAX} 4.5 V ≤ V_S ≤ 20 V		±30	±150	ppm/°C
	XDx31			±20	±50	ppm/°C
Change of Gain with V_S		4.5 V ≤ V_S ≤ 10 V		0.01	0.1	%/V
		10 V ≤ V_S ≤ 40 V		0.006	0.06	%/V
Rated Full-Scale Frequency		V_{IN} = −10 V	10.0			kHz
Gain Stability vs. Time (1000 Hours)		T_{MIN} ≤ T_A ≤ T_{MAX}		±0.02		% Full-Scale
Over Range (Beyond Full-Scale) Frequency		V_{IN} = −11 V	10%			
INPUT COMPARATOR						
Offset Voltage				±3	±10	mV
XD231		T_{MIN} ≤ T_A ≤ T_{MAX}		±4	±14	mV
XD331/XL331		T_{MIN} ≤ T_A ≤ T_{MAX}		±3	±10	mV
Bias Current				−80	−300	nA
Offset Current				±8	±100	nA
Common-Mode Range		T_{MIN} ≤ T_A ≤ T_{MAX}	−0.2		V_{CC} − 2	V
TIMER						
Timer Threshold Voltage, Pin 5			0.63 × V_S	0.667 × V_S	0.7 × V_S	
Input Bias Current, Pin 5		V_S = 15 V				
All Devices		0V ≤ $V_{PIN\ 5}$ ≤ 9.9 V		±10	±100	nA
XD231		$V_{PIN\ 5}$ = 10 V		200	1000	nA
XD331/XL331		$V_{PIN\ 5}$ = 10 V		200	500	nA
$V_{SAT\ PIN\ 5}$ (Reset)		I = 5 mA		0.22	0.5	V

(1) 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 (continued)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
CURRENT SOURCE (PIN 1)						
Output Current	XD231	R_S = 14 kΩ, $V_{PIN\ 1}$ = 0	126	135	144	µA
	XD331, XL331		116	136	156	µA
Change with Voltage		0V ≤ $V_{PIN\ 1}$ ≤ 10 V		0.2	1	µA
Current Source OFF Leakage	XD231 XD331 XL331			0.02	10	nA
	All Devices	$T_A = T_{MAX}$		2	50	nA
Operating Range of Current (Typical)				(10 to 500)		µA
REFERENCE VOLTAGE (PIN 2)						
XD231			1.76	1.89	2.02	V_{DC}
XD331, XL331			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)						
V_{SAT}		I = 5 mA		0.15	0.5	V
		I = 3.2 mA (2 TTL Loads), $T_{MIN} \le T_A \le T_{MAX}$		0.1	0.4	V
OFF Leakage				±0.05	1	µA
SUPPLY CURRENT						
XD231		V_S = 5 V	2	3	4	mA
		V_S = 40 V	2.5	4	6	mA
XD331, XL331		V_S = 5 V	1.5	3	6	mA
		V_S = 40 V	2	4	8	mA

6.6 Dissipation Ratings

	VALUE	UNIT
Package Dissipation at 25°C(1)	1.25	W

(1) 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.

6.7 Typical Characteristics

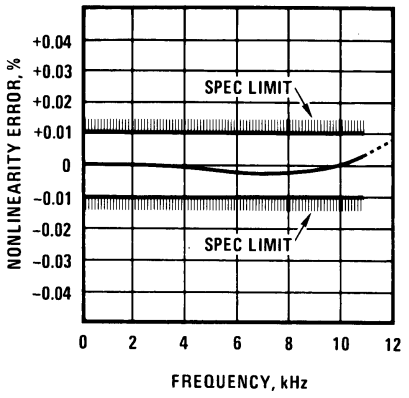


Figure 1. Non-Linearity Error as Precision V-to-F Converter

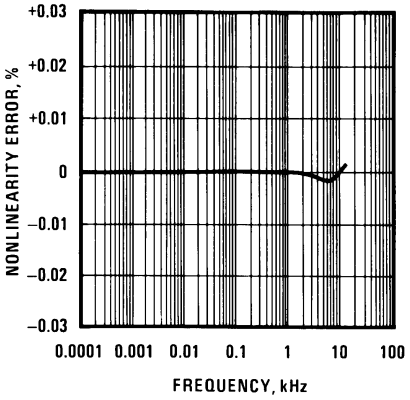


Figure 2. Non-Linearity Error

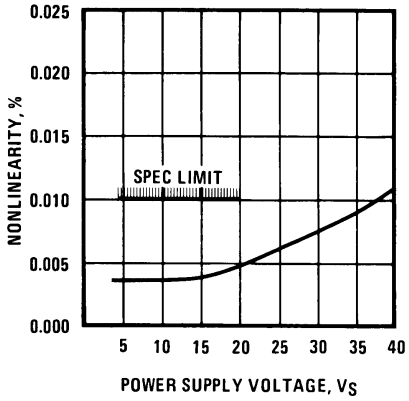


Figure 3. Non-Linearity Error vs. Power Supply Voltage

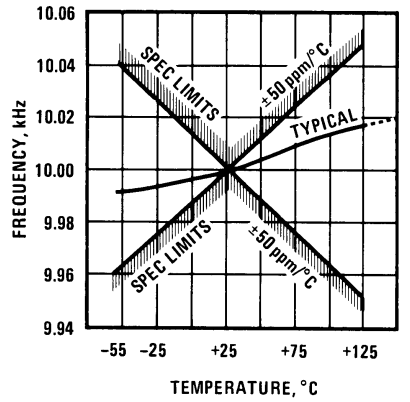


Figure 4. Frequency vs. Temperature

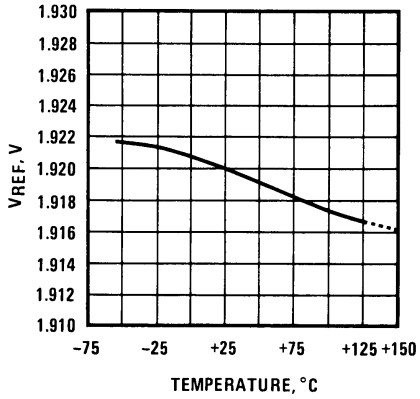


Figure 5. V_{REF} vs. Temperature

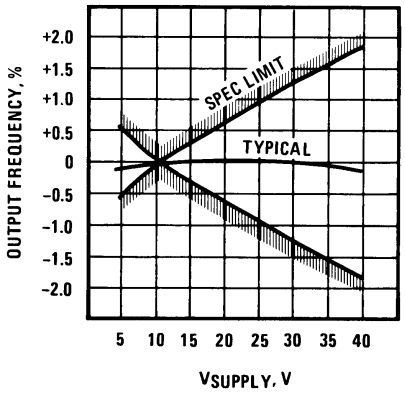


Figure 6. Output Frequency vs. V_{SUPPLY}

Typical Characteristics (continued)

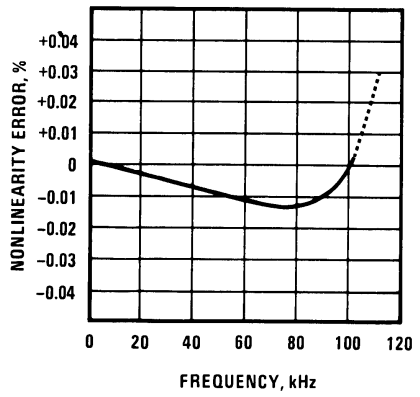


Figure 7. 100 kHz Non-Linearity Error

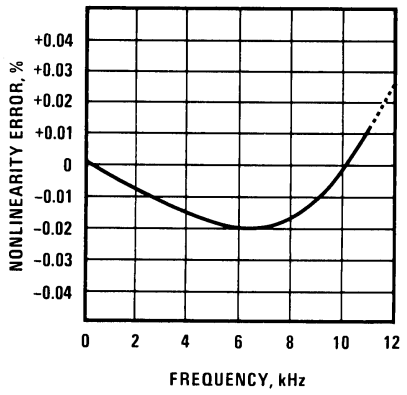


Figure 8. Non-Linearity Error (Figure 14)

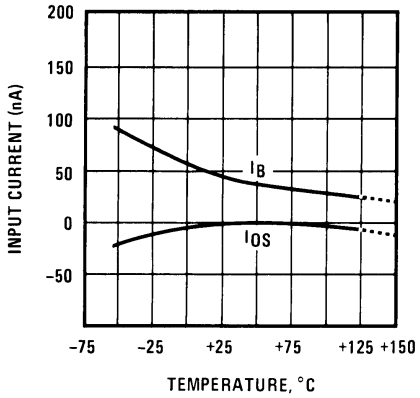


Figure 9. Input Current (Pins 6,7) vs. Temperature

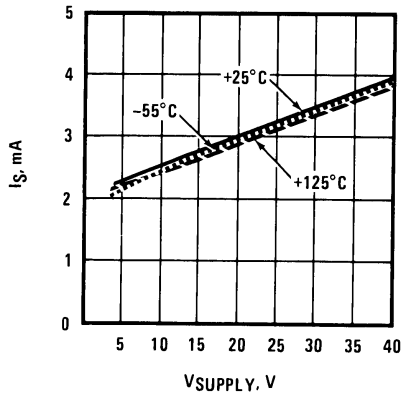


Figure 10. Power Drain vs. V_{SUPPLY}

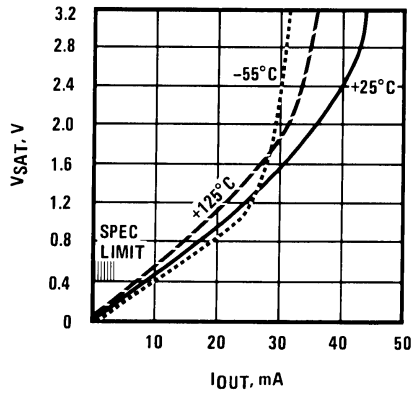


Figure 11. Output Saturation Voltage vs. I_{OUT} (Pin 3)

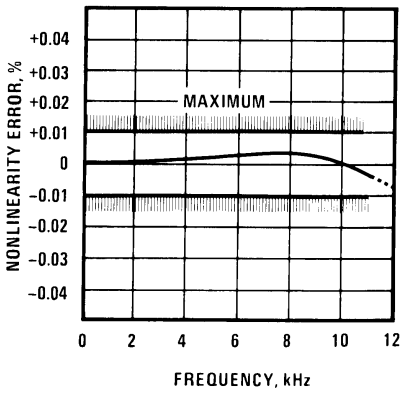


Figure 12. Non-Linearity Error, Precision F-to-V Converter

7 Detailed Description

7.1 Overview

7.1.1 Detail of Operation, Functional Block Diagram

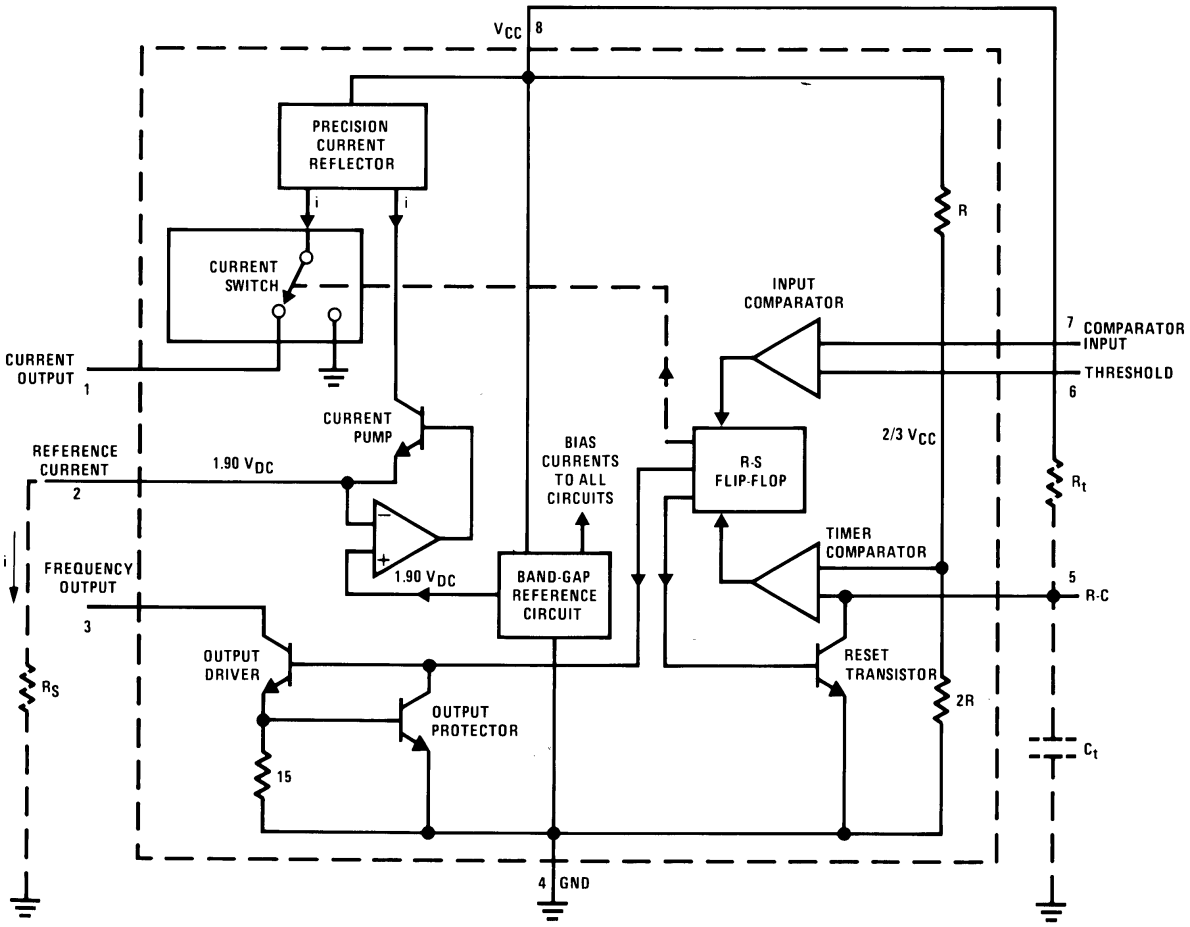
The *Functional Block Diagram* shows a band gap reference which provides a stable 1.9-V_{DC} output. This 1.9 V_{DC} is well regulated over a V_S range of 3.9 V to 40 V. It also has a flat, low temperature coefficient, and typically changes less than ½% over a 100°C temperature change.

The current pump circuit forces the voltage at pin 2 to be at 1.9 V, and causes a current i = 1.90 V/R_S to flow. For R_S=14 k, i=135 µA. The precision current reflector provides a current equal to i to the current switch. The current switch switches the current to pin 1 or to ground, depending upon the state of the R-S flip-flop.

The timing function consists of an R-S flip-flop and a timer comparator connected to the external R_tC_t network. When the input comparator detects a voltage at pin 7 higher than pin 6, it sets the R-S flip-flop which turns ON the current switch and the output driver transistor. When the voltage at pin 5 rises to ⅔ V_{CC}, the timer comparator causes the R-S flip-flop to reset. The reset transistor is then turned ON and the current switch is turned OFF.

However, if the input comparator still detects the voltage on pin 7 as higher than pin 6 when pin 5 crosses ⅔ V_{CC}, the flip-flop will not be reset, and the current at pin 1 will continue to flow, trying to make the voltage at pin 6 higher than pin 7. This condition will usually apply under start-up conditions or in the case of an overload voltage at signal input. During this sort of overload the output frequency will be 0. As soon as the signal is restored to the working range, the output frequency will be resumed.

7.2 Functional Block Diagram



8 Application and Implementation

8.1 Application Information

8.1.1 Simplified Voltage-to-Frequency Converter

The operation of these blocks is best understood by going through the operating cycle of the basic V-to-F converter, Figure 13, which consists of the simplified block diagram of the XDx31 and the various resistors and capacitors connected to it.

The voltage comparator compares a positive input voltage, V1, at pin 7 to the voltage, V_x, at pin 6. If V1 is greater, the comparator will trigger the 1-shot timer. The output of the timer will turn ON both the frequency output transistor and the switched current source for a period t = 1.1 R_tC_t. During this period, the current i will flow out of the switched current source and provide a fixed amount of charge, Q = i × t, into the capacitor, C_L. This will normally charge V_x up to a higher level than V1. At the end of the timing period, the current i will turn OFF, and the timer will reset itself.

Now there is no current flowing from pin 1, and the capacitor C_L will be gradually discharged by R_L until V_x falls to the level of V1. Then the comparator will trigger the timer and start another cycle.

The current flowing into C_L is exactly I_{AVE} = i × (1.1×R_tC_t) × f, and the current flowing out of C_L is exactly $V_x/R_L \simeq V_{IN}/R_L$. If V_{IN} is doubled, the frequency will double to maintain this balance. Even a simple V-to-F converter can provide a frequency precisely proportional to its input voltage over a wide range of frequencies.

9.1.2 Principles of Operation

The XDx31 are monolithic circuits designed for accuracy and versatile operation when applied as voltage-to-frequency (V-to-F) converters or as frequency-to-voltage (F-to-V) converters. A simplified block diagram of the XDx31 is shown in Figure 13 and consists of a switched current source, input comparator, and 1-shot timer.

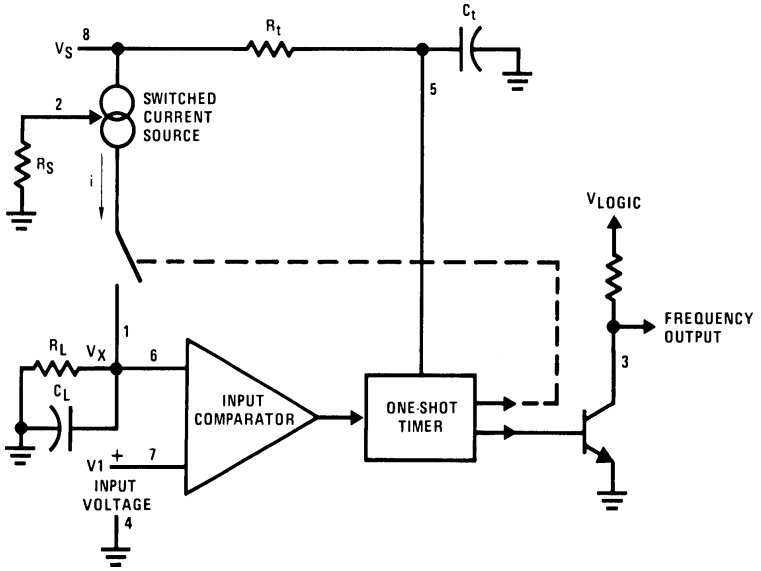
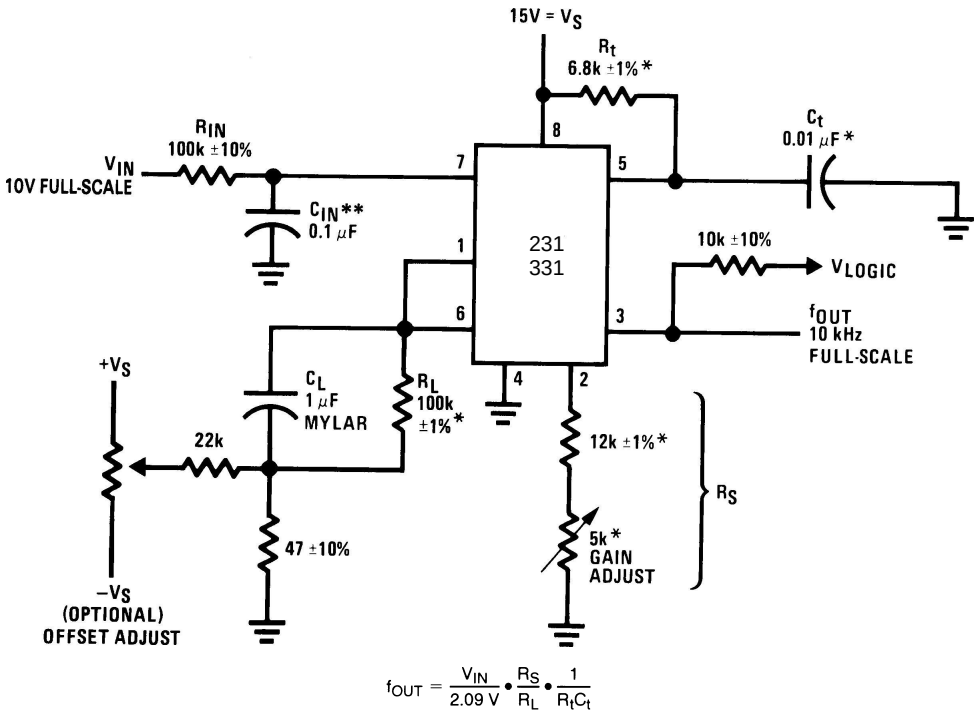


Figure 13. Simplified Block Diagram of Stand-Alone Voltage-to-Frequency Converter and External Components

8.2 Typical Applications

8.2.1 Basic Voltage-to-Frequency Converter

The simple stand-alone V-to-F converter shown in Figure 14 includes all the basic circuitry of Figure 13 plus a few components for improved performance.



*Use stable components with low temperature coefficients. See *Application Information*.
**0.1 µF or 1 µF, See *Typical Applications*.

Figure 14. Simple Stand-Alone V-to-F Converter with ±0.03% Typical Linearity (f = 10 Hz to 11 kHz)

8.2.1.1 *Design Requirements*

For this example, the system requirements are 0.05% linearity over an output frequency range of 10 Hz to 4 kHz with an input voltage range of 25 mV to 12.5 V. The available supply voltage is 15.0 V.

8.2.1.2 *Detailed Design Procedure*

A capacitor C_{IN} is added from pin 7 to ground to act as a filter for V_{IN}, use of a 0.1 µF is appropriate for this application. A value of 0.01 µF to 0.1 µF will be adequate in most cases; however, in cases where better filtering is required, a 1-µF capacitor can be used. When the RC time constants are matched at pin 6 and pin 7, a voltage step at V_{IN} will cause a step change in f_{OUT}. If C_{IN} is much less than C_L, a step at V_{IN} may cause f_{OUT} to stop momentarily.

Next, we cancel the comparator bias current by setting R_{IN} to 100 kΩ to match R_L. This will help to minimize any frequency offset.

For best results, all the components should be stable low-temperature-coefficient components, such as metal-film resistors. The capacitor should have low dielectric absorption; depending on the temperature characteristics desired, NPO ceramic, polystyrene, Teflon or polypropylene are best suited.

The resistance R_S at pin 2 is made up of a 12-kΩ fixed resistor plus a 5-kΩ (cermet, preferably) gain adjust rheostat. The function of this adjustment is to trim out the gain tolerance of the XDx31, and the tolerance of R_t, R_L and C_t.

X-ON Electronics

Largest Supplier of Electrical and Electronic Components

Click to view similar products for Analog to Digital Converters - ADC ***category:***

Click to view products by XINLUDA ***manufacturer:***

Other Similar products are found below :

017539FB 020296DB ADC0820CNEN AD7916BRMZ-RL7 AD9257TCPZ-65-EP ADC0804LCD ADC0808 MCP37211-200I/TE 512761G AD9695BCPZ-625 AD9695BCPZ-1300 MX574AKEQI MAX15511TGTL+ MAX11156ETC+T MAX1111EEE/V+ AD7175-8BCPZ-RL7 AD9530BCPZ MAX1436BECQ+D MAX16924GGM/VY+ MAX11108AVB+T MAX11647EUA+T MCP33141-10T-E/MS MCP33141D-05T-E/MS MCP33151D-05T-E/MS MCP3202T-CI/MS MAX11137ATI+T MAX11136ATI+T MAX11612EUA+T MAX11212AEUB+T MAX11101EUB+T AD4001BCPZ-RL7 MAX14002AAP+T MCP33141-05T-E/MS MAX11636EEE+T MCP33141D-10T-E/MS MCP33151-05T-E/MS MCP33151-10T-E/MS MCP33151D-10T-E/MS MAX11259AWX+T AD7091R-5BRUZ-RL7 ADE1201ACCZ ADE1202ACCZ LTC1864CS8#PBF LTC2418CGNPBF LTC2433-1IMS#PBF LTC2442CGPBF LTC2400CS8#PBF LTC2414CGNPBF TC7109ACKW TC7109CLW