

KA331

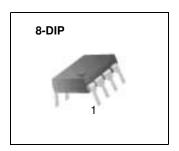
V-F Converter

Features

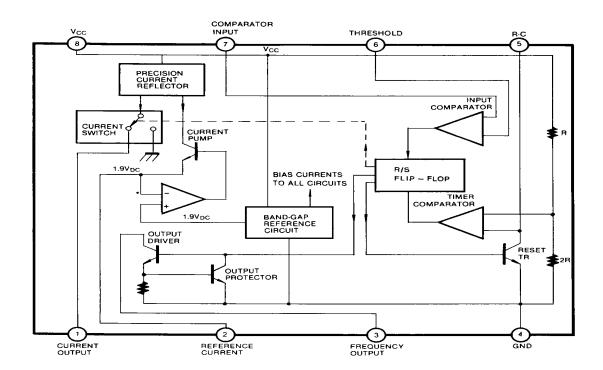
- Guaranteed linearity: 0.01% max.
- Low power dissipation: 15mW at 5V
- Wide range of full scale frequency: 1Hz to 100KHz
- Pulse output compatible with all logic forms
- Wide dynamic range: 100dB min at 10KHz full scale frequency

Description

This voltage to frequency converter provides the output pulse train at a frequency precisely proportional to the applied input voltage. The KA331 can operate at power supplies as low as 4.0V and be changed output frequency from 1Hz to 100KHz. It is ideally suited for use in simple low-cost circuit for analog-to digital conversion, long term integration, linear frequency modulation or demodulation, frequency-to-voltage conversion, and many other functions.



Internal Block Diagram



Absolute Maximum Ratings (T_A = 25°C)

Parameter	Symbol	Value	Unit
Supply Voltage	Vcc	40	V
Input Voltage	VI	-0.2 ~ + V _C C	V
Operating Temperature Range	TOPR	0 ~ +70	°C
Power Dissipation	PD	500	mW

Electrical Characteristics

Conversion Accuracy Scale Factor ACCUR $V_I = -10V$, Rs = 14KΩ 0.90 1.00 1.10 KHz/V Chang Of Gain With VCC VCCΔG/VCC $4.5V \le VCC \le 10V$ - 0.01 0.1 %/V Rated Full - Scale Frequency f VI = -10V 10.0 - - KHz INPUT COMPARATOR Offset Voltage VIO 0°C ≤ TA ≤ +70°C - ±3 ±10 mV Bias Current IBIAS - - -80 -300 nA Offset Current IIO - - ±8 ±100 nA Common-Mode Range VCM 0°C ≤ TA ≤ +70°C -0.2 - VCC-2.0 V TIMER (PIN 5) Timer Threshold Voltage VTH - 0.63 0.667 0.701 ×VCC	Parameter	Symbol	Conditions	Min.	Тур.	Max.	Unit	
Chang Of Gain With Vcc VccΔG/Vcc 4.5V ≤ Vcc ≤ 10V - 0.01 0.1 %/V Rated Full - Scale Frequency f V₁ = -10V 10.0 - - KHz INPUT COMPARATOR Offset Voltage VIO 0°C ≤ TA ≤ +70°C - ±3 ±10 mV Bias Current IBIAS - - -80 -300 nA Offset Current IIO - - ±8 ±100 nA Timer Threshold Voltage VTH - 0.63 0.667 0.701 ×Vcc Input Bias Current IBIAS VSAT I = 5mA -	VFC Non-Linearity	VFCNL	4.5 ≤ V _{CC} ≤ 20V	-	±0.003	±0.01	% Full-Scale	
Rated Full - Scale Frequency f V _I = -10V 10.0 c - C KHz	Conversion Accuracy Scale Factor	ACCUR	$V_I = -10V$, $R_S = 14K\Omega$	0.90	1.00	1.10	KHz/V	
Rated Full - Scale Frequency f V _I = -10V 10.0 - - KHz	Chang Of Gain With V _{CC}	Vcc∆G/Vcc	4.5V ≤ V _{CC} ≤ 10V	-	0.01	0.1	%/V	
NPUT COMPARATOR Offset Voltage VIO O°C ≤ TA ≤ +70°C - ±3 ±10 mV			10V ≤ VCC ≤ 40V	-	0.006	0.06		
Offset Voltage VIO 0°C ≤ TA ≤ +70°C - ±3 ±10 mV Bias Current IBIAS - - -80 -300 nA Offset Current IIO - - ±8 ±100 nA Common-Mode Range VCM 0°C ≤ TA ≤ +70°C -0.2 - VCC-2.0 V TIMER (PIN 5) Timer Threshold Voltage VTH - 0.63 0.667 0.701 ×VCC Input Bias Current IBIAS VCC = 15V, 0V ≤ V5 ≤ 9.9V - ±10 ±100 nA Saturation Voltage VSAT I = 5mA - 0.22 0.5 V CURRENT SOURCE (PIN 1) IO RS = 14KΩ, V1 = 0V 116 136 156 μA Change with Voltage ΔΙΟ/ΔV1 0V ≤ V1≤ 10V - 0.2 1.0 μA Current Source Off Leakage ILKG - - 0.02 10.0 nA Reference Voltage VREF -	Rated Full - Scale Frequency	f	V _I = -10V	10.0	-	-	KHz	
Bias Current	INPUT COMPARATOR							
Offset Current IIO - ±8 ±100 nA Common-Mode Range VCM 0°C ≤ TA ≤ +70°C -0.2 - VCC-2.0 V TIMER (PIN 5) Timer Threshold Voltage VTH - 0.63 0.667 0.701 ×VCC Input Bias Current IBIAS VCC = 15V, 0V ≤ V5 ≤ 9.9V - ±10 ±100 nA Saturation Voltage VSAT I = 5mA - 0.22 0.5 V CURRENT SOURCE (PIN 1) Output Current IO RS = 14KΩ, V1 = 0V 116 136 156 μA Change with Voltage ΔΙΟ/ΔV1 0V ≤ V1≤ 10V - 0.2 1.0 μA REFERENCE VOLTAGE (PIN 2) Reference Voltage VREF - 1.70 1.89 2.08 VDC Stability vs Temperature STT - ±60 - ppm/°C Stability vs Time, 1000Hours STT - ±60 - pm/°C	Offset Voltage	VIO	$0^{\circ}C \le T_A \le +70^{\circ}C$	-	±3	±10	mV	
Common-Mode Range V _{CM} 0°C ≤ T _A ≤ +70°C -0.2 - V _{CC-2.0} V TIMER (PIN 5) Timer Threshold Voltage VTH - 0.63 0.667 0.701 ×V _{CC} Input Bias Current IBIAS VCC = 15V, 0V ≤ V ₅ ≤ 9.9V - ±10 ±100 nA Saturation Voltage VSAT I = 5mA - 0.22 0.5 V CURRENT SOURCE (PIN 1) Output Current Io RS = 14KΩ, V1 = 0V 116 136 156 μA Change with Voltage ΔIO/ΔV1 0V ≤ V1≤ 10V - 0.2 1.0 μA Current Source Off Leakage ILKG - - 0.02 10.0 nA REFERENCE VOLTAGE (PIN 2) Reference Voltage VREF - 1.70 1.89 2.08 VDC Stability vs Time, 1000Hours STT - ±60 - ppm/°C Colspan="6">Saturation Voltage VSAT I = 5mA -	Bias Current	IBIAS	-	-	-80	-300	nA	
TIMER (PIN 5) Timer Threshold Voltage	Offset Current	lio	-	-	±8	±100	nA	
Timer Threshold Voltage VTH - 0.63 0.667 0.701 ×Vcc Input Bias Current IBIAS $VCC = 15V$, $0V \le V_5 \le 9.9V$ - ±10 ±100 nA Saturation Voltage VSAT I = 5mA - 200 1000 nA CURRENT SOURCE (PIN 1) Output Current Io RS = 14KΩ, V1 = 0V 116 136 156 μA Change with Voltage ΔIO/ΔV1 0V ≤ V1≤ 10V - 0.2 1.0 μA Current Source Off Leakage ILKG - - 0.02 10.0 nA REFERENCE VOLTAGE (PIN 2) Reference Voltage VREF - 1.70 1.89 2.08 VDC Stability vs Temperature STT - ±60 - ppm/°C Cstability vs Time, 1000Hours STT - ±0.1 - % LOGIC OUTPUT (Pin 3) Saturation Voltage ILKG - 0.15 0.50 <td>Common-Mode Range</td> <td>VcM</td> <td>$0^{\circ}C \le T_A \le +70^{\circ}C$</td> <td>-0.2</td> <td>-</td> <td>V_CC-2.0</td> <td>V</td>	Common-Mode Range	VcM	$0^{\circ}C \le T_A \le +70^{\circ}C$	-0.2	-	V _C C-2.0	V	
Input Bias Current IBIAS VCC = 15V, oV ≤ V5 ≤ 9.9V - ±10 ±100 nA Saturation Voltage VSAT I = 5mA - 0.22 0.5 V CURRENT SOURCE (PIN 1)	TIMER (PIN 5)			•				
IBIAS OV \leq V ₅ \leq 9.9V	Timer Threshold Voltage	VTH	-	0.63	0.667	0.701	×VCC	
Saturation Voltage VSAT I = 5mA - 0.22 0.5 V CURRENT SOURCE (PIN 1) Output Current IO RS = 14KΩ, V₁ = 0V 116 136 156 μA Change with Voltage ΔIO/ΔV1 0V ≤ V₁≤ 10V - 0.2 1.0 μA Current Source Off Leakage ILKG - - 0.02 10.0 nA REFERENCE VOLTAGE (PIN 2) Reference Voltage VREF - 1.70 1.89 2.08 VDC Stability vs Temperature STT - - ±60 - ppm/°C Stability vs Time, 1000Hours STT - - ±0.1 - % LOGIC OUTPUT (Pin 3) VSAT I = 5mA - 0.15 0.50 V Off Leakage ILKG - - ±0.05 1.0 μA Supply Current ICC VCC = 5V 1.5 3.0 6.0 mA <td>Input Bias Current</td> <td>IBIAS</td> <td></td> <td>-</td> <td>±10</td> <td>±100</td> <td>nA</td>	Input Bias Current	IBIAS		-	±10	±100	nA	
CURRENT SOURCE (PIN 1) Output Current IO Rs = 14KΩ, V1 = 0V 116 136 156 μA Change with Voltage ΔIO/ΔV1 0V ≤ V1≤ 10V - 0.2 1.0 μA Current Source Off Leakage ILKG - - 0.02 10.0 nA REFERENCE VOLTAGE (PIN 2) Reference Voltage VREF - 1.70 1.89 2.08 VDC Stability vs Temperature STT - - ±60 - ppm/°C Stability vs Time, 1000Hours STT - - ±0.1 - % LOGIC OUTPUT (Pin 3) VSAT I = 5mA - 0.15 0.50 V Off Leakage ILKG - ±0.05 1.0 μA Supply Current			V5 = 10V	-	200	1000	nA	
Output Current IO Rs = 14KΩ, V1 = 0V 116 136 156 μA Change with Voltage $\Delta IO/\Delta V1$ $0V \le V1 \le 10V$ - 0.2 1.0 μA Current Source Off Leakage ILKG - - 0.02 10.0 nA REFERENCE VOLTAGE (PIN 2) Reference Voltage VREF - 1.70 1.89 2.08 VDC Stability vs Temperature STT - - ±60 - ppm/°C Stability vs Time, 1000Hours STT - - ±0.1 - % LOGIC OUTPUT (Pin 3) VSAT I = 5mA - 0.15 0.50 V Off Leakage ILKG - - ±0.05 1.0 μA Supply Current ICC VCC = 5V 1.5 3.0 6.0 mA	Saturation Voltage	VSAT	I = 5mA	-	0.22	0.5	V	
Change with Voltage ΔIO/ΔV1 $0V \le V1 \le 10V$ - 0.2 1.0 μA Current Source Off Leakage ILKG - 0.02 10.0 nA REFERENCE VOLTAGE (PIN 2) Reference Voltage VREF - 1.70 1.89 2.08 VDC Stability vs Temperature STT - - ±60 - ppm/°C Stability vs Time, 1000Hours STT - - ±0.1 - % LOGIC OUTPUT (Pin 3) VSAT I = 5mA - 0.15 0.50 V Sturply Current ILKG - - ±0.05 1.0 μA Supply Current	CURRENT SOURCE (PIN 1)			•				
Current Source Off Leakage I _{LKG} - - 0.02 10.0 nA REFERENCE VOLTAGE (PIN 2) Reference Voltage VREF - 1.70 1.89 2.08 VDC Stability vs Temperature STT - ±60 - ppm/°C Stability vs Time, 1000Hours STT - ±0.1 - % LOGIC OUTPUT (Pin 3) Saturation Voltage VSAT I = 5mA - 0.15 0.50 V Off Leakage ILKG - - ±0.05 1.0 μA SUPPLY CURRENT VCC = 5V 1.5 3.0 6.0 mA	Output Current	lo	$R_S = 14K\Omega$, $V_1 = 0V$	116	136	156	μΑ	
Reference Voltage VREF - 1.70 1.89 2.08 VDC	Change with Voltage	ΔΙΟ/ΔV1	0V ≤ V1≤ 10V	-	0.2	1.0	μΑ	
Reference Voltage VREF - 1.70 1.89 2.08 VDC	Current Source Off Leakage	ILKG	-	-	0.02	10.0	nA	
Stability vs Temperature STT - ±60 - ppm/°C Stability vs Time, 1000Hours STT - ±0.1 - % LOGIC OUTPUT (Pin 3) Saturation Voltage VSAT I = 5mA - 0.15 0.50 V Off Leakage ILKG - - ±0.05 1.0 μA SUPPLY CURRENT Supply Current ICC VCC = 5V 1.5 3.0 6.0 mA	REFERENCE VOLTAGE (PIN 2)			•				
Stability vs Time, 1000Hours STT - ±0.1 - % LOGIC OUTPUT (Pin 3) VSAT I = 5mA - 0.15 0.50 V Saturation Voltage VSAT I = 3.2mA - 0.10 0.40 V Off Leakage ILKG - ±0.05 1.0 μA SUPPLY CURRENT Supply Current VCC = 5V 1.5 3.0 6.0 mA	Reference Voltage	VREF	-	1.70	1.89	2.08	VDC	
LOGIC OUTPUT (Pin 3) Saturation Voltage VSAT I = 5mA - 0.15 0.50 V I = 3.2mA - 0.10 0.40 V Off Leakage ILKG - - ±0.05 1.0 μA SUPPLY CURRENT VCC = 5V 1.5 3.0 6.0 mΔ	Stability vs Temperature	STT	-	-	±60	-	ppm/°C	
Saturation Voltage V_{SAT} $I = 5mA$ $-$ 0.15 0.50 V_{SAT} $I = 3.2mA$ $-$ 0.10 0.40 V_{SAT} $I = 3.2mA$ $-$ 0.10 0.40 I_{LKG} $ \pm 0.05$ 1.0 I_{LKG} I	Stability vs Time, 1000Hours	STT	-	-	±0.1	-	%	
Saturation Voltage VSAT I = 3.2mA - 0.10 0.40 V	LOGIC OUTPUT (Pin 3)							
I = 3.2mA	Saturation Voltage	Vsat	I = 5mA	-	0.15	0.50	- V	
SUPPLY CURRENT VCC = 5V 1.5 3.0 6.0 mΔ			I = 3.2mA	-	0.10	0.40		
Supply Current VCC = 5V 1.5 3.0 6.0 max	Off Leakage	ILKG	-	-	±0.05	1.0	μΑ	
Supply Current ICC MA	SUPPLY CURRENT							
V _{CC} = 40V 2.0 4.0 8.0	Supply Current	Icc	VCC = 5V	1.5	3.0	6.0	mA	
		100	V _{CC} = 40V	2.0	4.0	8.0		

Typical Applications

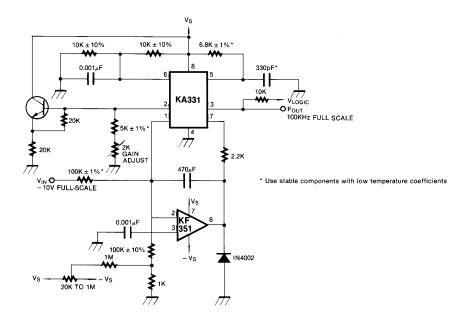


Figure 1. Precision Voltage-to-Frequency Converter, 100KHz Full-Scale

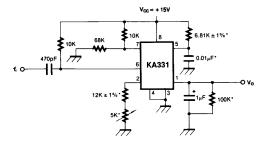


Figure 2. Simple Frequency-to-Voltage Converter, 10KHz Full-Scale

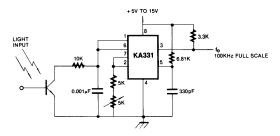
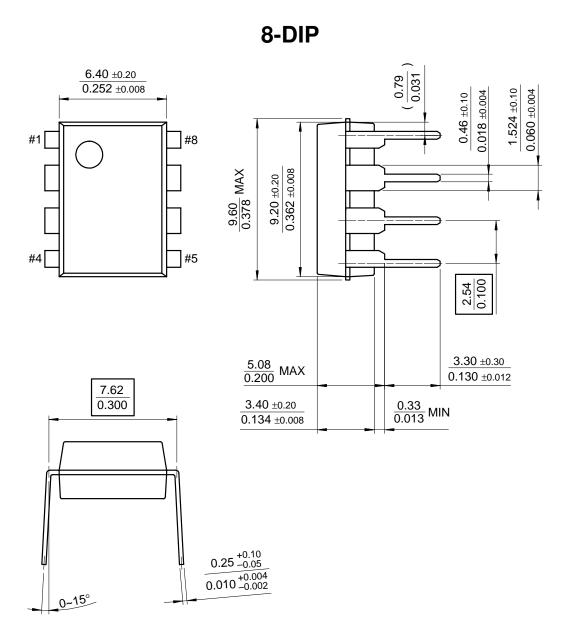


Figure 3. Light Intensity to Frequency Converter

Mechanical Dimensions

Package

Dimensions in millimeters



Ordering Information

Product Number	Package	Operating Temperature
KA331	8-DIP	0 ~ + 70°C

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