

STANDARD  
LINEAR  
PRODUCTS



## COMPANY OVERVIEW

Diodes Incorporated is a leading global provider of Discrete and Analog semiconductors.

Its global footprint includes sales offices in 5 countries and manufacturing locations in China, Europe and the USA.

A focus on product innovation, cost reduction, acquisitions and customer service has made Diodes Incorporated an industry leader.

Combining leading silicon and packaging technologies, Diodes provides a broad portfolio of discrete semiconductors comprising Bipolar Transistors, MOSFETs, Schottky diodes, SBR, switching diodes and functional specific arrays to enable our customers' next generation designs.

The Diodes' Analog IC portfolio consists of 6 main areas: Power Management ICs, Standard Linear, Lighting, Sensors, Direct Broadcast by Satellite and Applications Specific Standard Products.



## DIODES MEANS STANDARD LINEAR

Diodes' acquisition of Zetex semiconductors expanded both companies' Analog product lines.

The best Analog ICs provide circuit designers with the most advantageous combination of efficiency, functionality, and package size.

Diodes Incorporated offers a portfolio of devices that meet the requirements of a wide range of electronic applications by addressing these competing design criteria to produce elegant and practical solutions.

The breadth of Diodes' standard linear portfolio provides designers with cost-effective industry standard replacements to high performance devices for the most demanding industrial and automotive applications.

The Diodes' portfolio is well suited to meeting the circuit requirements of:

- Performance consumer
- Portable consumer
- Communications
- Computer
- Automotive

Diodes' Standard Linear product line extends the performance of many industry standard parts. Offered in a choice of space-saving packages, they provide the opportunity to reduce power consumption and increase operating temperature.

With its knowledge, packaging, and technology leadership, Diodes has created the range of competitive Standard Linear ICs presented here.



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# STANDARD LINEAR Operational Amplifiers

Part Number	Minimum Supply Voltage	Maximum Supply Voltage	Supply Current @5V	Input Offset Voltage	Input Bias Current	Minimum Common Mode Input Voltage	Maximum Common Mode Input Voltage	Rail-rail Input	Rail-rail Output	Open Loop Gain	CMRR	PSRR	Gain Bandwidth	Slew Rate	Number of Channels	Operating Ambient Temp Range	Available Packages
	V	V	mA	mV	nA	V	V			V/mV	dB	dB	MHz	V/ $\mu$ s		$^{\circ}$ C	
AP358	3	32	0.5	2	45	0	$V_+ - 1.5$	-	-	100	85	100	1	0.6	2	0 to +70	SO-8 PDIP-8
APX321	2.5	5.5	0.11	1.7	15	$V_- + 0.2$	$V_+ - 0.2$	X	X	100	65	60	1	1	1	-40 to +85	SOT353 SOT25
APX358	2.5	5.5	0.19	1.7	15	$V_- + 0.2$	$V_+ - 0.2$	X	X	100	65	60	1	1	2	-40 to +85	MSOP-8 SO-8
APX324	2.5	5.5	0.34	1.7	15	$V_- + 0.2$	$V_+ - 0.2$	X	X	100	65	60	1	1	4	-40 to +85	TSSOP-14
LMV321	2.5	5.5	0.11	1.7	15	$V_-$	$V_+ - 1$	-	X	100	65	60	1	1	1	-40 to +85	SOT353 SOT25
LMV358	2.5	5.5	0.19	1.7	15	$V_-$	$V_+ - 1$	-	X	100	65	60	1	1	2	-40 to +85	MSOP-8 SO-8
LMV324	2.5	5.5	0.34	1.7	15	$V_-$	$V_+ - 1$	-	X	100	65	60	1	1	4	-40 to +85	TSSOP-14
TL072	10	30	2.8	3	0.065	$V_- + 4$	$V_+ - 4$	-	-	200	100	100	3	10	2	-40 to +85	SO-8
TL082	10	30	2.8	3	0.08	$V_- + 4$	$V_+ - 4$	-	-	200	86	86	3	10	2	-40 to +85	SO-8

## THE DIODES ADVANTAGE

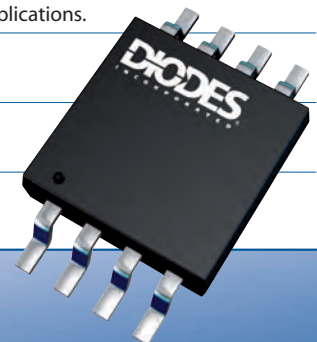
Diodes' LMV321/LMV358/ LMV324 has been designed to effectively reduce cost and save space at low voltage levels.



### Product benefits

Industry standard op amps for general purpose amplifier applications.

- **Pin-pin compatible with LMV321/358/324**  
Offers a lower cost solution versus other standard LMV321/358/324 devices.
- **-40 to 85 $^{\circ}$ C temperature range**  
Suitable for consumer and industrial applications.
- **Rail-rail output swing**  
Maximizes available dynamic range.
- **Wide range of packages**  
Industry standard drop-in devices.



# Comparators

Part Number	Minimum Supply Voltage	Maximum Supply Voltage	Supply Current @5V	Input Offset Voltage	Input Offset Current	Input Bias Current	Minimum Common Mode Input Voltage	Maximum Common Mode Input Voltage	Rail-rail Input	Output Type	Voltage Gain	Output Current Sink	Number of Channels	Operating Ambient Temp Range	Available Packages
	V	V	mA	mV	nA	nA	V	V			V/mV	mA		°C	
AP311	2	36	0.4	4	70	150	0	V+ -1.5	-	Open Collector	200 @ 15kΩ	16	1	0 to +70	SOT25
AP331A	2	36	0.4	4	70	150	0	V+ -1.5	-	Open Collector	200 @ 15kΩ	16	1	0 to +70	SOT25
AP393	2	36	0.4	1	5	25	0	V+ -2	-	Open Collector	200 @ 15kΩ	16	2	0 to +70	SO-8 PDIP-8
AP393A	2	36	0.4	4	70	150	0	V+ -1.5	-	Open Collector	200 @ 15kΩ	16	2	0 to +70	MSOP-8
APX393	2.5	5.5	0.15	1.7	2	25	0.2	V+ -0.2	X	Open Drain	50 @ 5.1kΩ	60	2	-40 to +85	MSOP-8 SO-8
APX339	2.5	5.5	0.24	1.7	2	25	0.2	V+ -0.2	X	Open Drain	50 @ 5.1kΩ	60	4	-40 to +85	TSSOP-14

THE DIODES ADVANTAGE

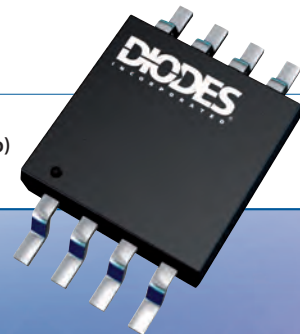
Diodes' cost-effective comparators for cost-sensitive applications.



## Product benefits

Industry standard comparators for everyday applications.

- **Pin-pin compatible with LMV393/339**  
Provides a low cost solution for 3V and 5V systems.
- **Pin-pin compatible with TL331/LM393**  
Offers customers a lower cost solution to other manufacturers.
- **Open drain/collector outputs**  
Enables simple level shifting and wire-ORing of multiple comparators.
- **Wide range of packages in green molding compound (No Br/Sb)**  
Environmentally friendly packaging.



# Current Monitors – Programmable Voltage gain

Part Number	Description	Min Supply Voltage	Max Supply Voltage	Min S+ Common-mode Sense Voltage	Max S+ Common-mode Sense Voltage	Max Output Voltage	Max Sense Voltage	Output Impedance	Accuracy @ $V_{sense} = 100mV$	Quiescent Current	Gain	Bandwidth	Ambient Temp Range	AEC-Q100	Available Packages
		V	V	V	V	V	V	$\Omega$	%	$\mu A$	mA/V	MHz	$^{\circ}C$		
ZXCT1008	AEC-Q100 High-Side Current Monitors	-	-	2.5	20	$V_{S-} - 1$	0.5	-	2.5	4	10	2	-40 to +125	X	SOT23
ZXCT1009	Micro-Power High Side Current Monitor for portable equipment	-	-	2.5	20	$V_{S-} - 1$	2.5	-	2.5	4	10	2	-40 to +85	-	SM8 SOT23
ZXCT1010	Micro-Power High-side Current Monitor with improved offset	-	-	2.5	20	$V_{S-} - 1$	2.5	-	2.5	3.5	10	2	-40 to +85	-	SOT25
ZXCT1011	Micro-Power High-side Current Monitor with improved Temperature drift	2.5	20	$V_B$	$V_B$	$V_{S-} - 1$	2.5	-	2.5	4	10	1.5	-40 to +125	-	SOT25
ZXCT1012	ZXCT1010 with low profile package	-	-	2.5	20	$V_{S-} - 1$	2.5	-	2.5	3.5	10	2	-40 to +85	-	TSOT25
ZXCT1020	Low offset Current Monitor	2.7	20	$V_B$	$V_B$	$V_{S-} - 1$	1.5	-	2	25	Prog	3	-40 to +125	-	SOT25
ZXCT1050	Input range includes 0V with separate $V_{CC}$ pin	2.7	20	0	$V_{CC} - 2$	$V_{CC} - 2$	0.5	-	3	50	Prog	0.8	-40 to +125	-	SOT25
ZXCT1082	Precision 60V wide common mode range Current Monitor	2.7	60	2.7	60	$V_{S-} - 1$	0.5	-	2	25	Prog	0.5	-40 to +125	X	SOT25
ZXCT1083	Precision 40V wide common mode range Current Monitor	2.7	40	2.7	40	$V_{S-} - 1$	0.5	-	2	25	Prog	0.5	-40 to +125	X	SOT25

THE DIODES ADVANTAGE

ZXCT current monitors convert a high-side current measurement to a ground referenced output signal, greatly simplifying high-sided current measurement.



## Product benefits

The devices enable gain to be set by a single external resistor, for increased versatility while minimizing component count.

- High-side current sensing**  
 Does not disturb ground plane.
- Current output format allows externally set gain**  
 Versatility allows 1 device used at different gains.
- Up to 2.5V sense voltage**  
 Measures larger transient currents while keeping accuracy at lower currents.
- <1% typical accuracy**  
 Meets accuracy requirements of demanding applications.



## Current Mirror

Current monitor using a two PNP and two NPN transistor combination that enables simple current measurement

Part Number	$V_{IN}$	Maximum collector currents	Maximum $V_{E1} - V_{E2}$	Maximum zero offset voltage (R1=R3=R4=100 $\Omega$ )	$P_D$	Package
	V	A	V	mV	W	
ZDS1009	2.5 - 30	1	10	4	2	SM8

# Current Monitors – Fixed gain

Part Number	Description	Min Supply Voltage	Max Supply Voltage	Min S+ Common-mode Sense Voltage	Max S+ Common-mode Sense Voltage	Max Output Voltage	Max Sense Voltage	R <sub>OUT</sub> Output impedance	Accuracy @ V <sub>sense</sub> = 100mV	Quiescent Current	Gain	Bandwidth	Ambient Temp Range	AEC-Q100	Available Packages
		V	V	V	V	V	V	Ω	%	μA	V/V	MHz	°C		
ZXCT1021	20V improved accuracy	-	-	2.5	20	V <sub>S</sub> -1	1.5	15k	2	25	10	1	-40 to +85	-	SOT25
ZXCT1022	20V improved accuracy	-	-	2.5	20	V <sub>S</sub> -1	0.18	15k	3	25	100	1	-40 to +85	-	SOT25
ZXCT1023	Voltage Output	-	-	2.5	20	V <sub>S</sub> -1	0.38	15k	3	3.5	25	1	-40 to +85	-	TDFN1218-4
ZXCT1030	Voltage Output with Internal reference and comparator	2.2	20	2.2	V <sub>CC</sub>	V <sub>S</sub> -1	0.5	1.5k	3	270	10	6	-40 to +85	-	SO-8
ZXCT1032	High-side inrush current limit controller	-	-	9.5	21	V <sub>S</sub> -1	0.25	-	-	1600	10	-	-40 to +85	-	SO-8
ZXCT1041	Bi-directional voltage output with flag	-	-	2.7	20	V <sub>S</sub> -1	±0.8	15k	3	35	10	0.3	-40 to +85	-	SOT25
ZXCT1051	Input range includes 0V with separate V <sub>CC</sub> pin	2.5	20	0	V <sub>CC</sub> -2	V <sub>CC</sub> -2	0.3	3.75k	3	50	10	2	-40 to +125	-	SOT25
ZXCT1080	AEC-Q100 High Voltage Current Monitor	4.5	12	3	60	1.5	0.15	-	3	30	10	0.5	-40 to +125	X	SOT25
ZXCT1081	High Voltage Current Monitor	4.5	12	3	40	1.5	0.15	-	3	30	10	0.5	-40 to +125	-	SOT25
ZXCT1084	Precision 60V wide common mode range Current Monitor	2.7	60	2.7	60	V <sub>S</sub> -1	0.5	125	2	0.6	25	0.5	-40 to +125	X	SOT25
ZXCT1085	Precision 40V wide common mode range Current Monitor	2.7	40	2.7	40	V <sub>S</sub> -1	0.5	125	2	0.6	25	0.5	-40 to +125	X	SOT25
ZXCT1086	Precision 60V wide common mode range Current Monitor	2.7	60	2.7	60	V <sub>S</sub> -1	0.5	125	2	0.6	50	0.2	-40 to +125	X	SOT25
ZXCT1087	Precision 40V wide common mode range Current Monitor	2.7	40	2.7	40	V <sub>S</sub> -1	0.5	125	2	0.6	50	0.2	-40 to +125	X	SOT25

THE DIODES ADVANTAGE

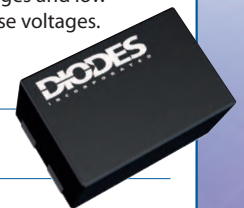
ZXCT current monitors with voltage output convert a high-side current measurement to a ground referenced voltage output, greatly simplifying high-sided current measurements.



## Product benefits

The devices offer an internally set gain with low offset voltages and low temperature drift, which optimizes performance at low sense voltages.

- **High-side current sensing**  
Does not disturb ground plane.
- **Output voltage scaling**  
One external component - reduces PCB area.
- **Up to 0.8V sense voltage**  
Measures larger transient currents while keeping accuracy at lower currents.
- **2.5V - 60V supply range**  
ZXCT108x works directly off power rails saving cost and PCB area.
- **<1% typical accuracy**  
Meets accuracy requirements of demanding applications.

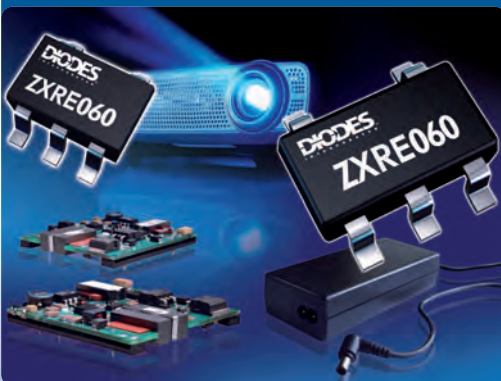


# Shunt Regulators

Part Number	Reference Voltage	Accuracy	Max Input Voltage	Sink Current	Minimum Cathode Current for Regulation	Typical Temperature Coefficient	Maximum Slope Resistance	Operating Ambient Temp Range	AEC-Q100	Available Packages
	V	%	V	mA	$\mu\text{A}$	ppm/ $^{\circ}\text{C}$	$\Omega$	$^{\circ}\text{C}$		
ZXRE060	0.6	0.5, 1	18	10	-	-	-	-40 to +85	-	SOT23/SOT363
AP432	1.24	0.5, 1	20	250	150	30	0.5	-20 to +85	-	TO92/SO-8/SOT23/SOT89/SC59/SOT25
TLV431	1.24	0.5, 1	18	15	100	50	0.4	-40 to +125	X	SOT23/SOT363/SOT25
ZR431L	1.24	1, 2.5	10	-	100	55	2	-40 to +85	-	SOT23
AP431	2.495	0.5, 1	36	250	190	30	0.5	-20 to +85	-	TO92/SO-8/SOT23/SOT89/SC59/SOT25
TL431	2.495	0.5, 1	36	100	400	50	0.5	-40 to +125	-	TO92/SOT23/SOT25
ZHT431	2.5	1, 2	20	150	50	55	0.75	-55 to +125	-	SOT23
ZR431	2.5	0.5, 1, 2	20	100	50	55	0.75	-40 to +85	-	SOT223/SOT23
ZTL431	2.5	0.5, 1	20	100	400	50	0.5	-40 to +125	X	SOT23/SOT363/SOT25
ZTL432	2.5	0.5, 1	20	100	400	50	0.5	-40 to +125	X	SOT23

## THE DIODES ADVANTAGE

The ZXRE060 simplifies the design of isolated low voltage DC-DC regulators. Its low 0.6V reference voltage makes it ideal for state of the art  $\mu\text{P}/\text{DSP}/\text{PLD}$  core voltage POL converters.



### Product benefits

Diodes' shunt regulators provide cost-effective solutions to a variety of consumer, power supply, industrial, and automotive applications.

- Wide temperature ranges, some to -40 to 125 $^{\circ}\text{C}$**   
 Best cost fit to application need.
- Very low minimum operating current: ZR/ZHT431 only 55 $\mu\text{A}$**   
 Suitable for current sensitive applications.
- AP431/2 cost-effective shunt regulators in industry standard packages**  
 Simplifies and reduces BOM cost.
- ZTL431/2 and TLV431 qualified to AEC-Q100**  
 Suitable for automotive applications.
- 0.5% and 1% variants in all package options**  
 Provides a large range of package size/power dissipation options to address a wide variety of system needs.

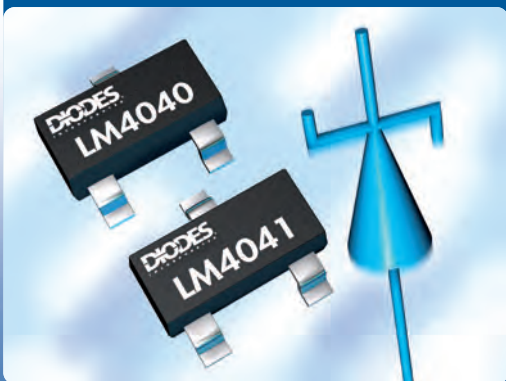


# Shunt References

Part Number	Reference Voltage	Accuracy	Max Input Voltage	Sink Current	Minimum Cathode Current for Regulation	Typical Temperature Coefficient	Maximum Slope Resistance	Noise Voltage	Operating Ambient Temp Range	AEC-Q100	Available Packages
	V	%	V	mA	$\mu$ A	ppm/ $^{\circ}$ C	$\Omega$	$\mu$ V/ $^{\circ}$ C	$^{\circ}$ C		
ZXRE1004	1.22	1	-	20	8	20	0.6	60	-40 to +85	-	SOT23
ZXRE125	1.22	0.5, 1, 2	-	20	8	20	0.6	60	-40 to +85	-	SOT23
LM4041	1.225	0.5, 1	-	12	30	15	0.6	20	-40 to +125	X	SOT23/SOT353
ZXRE4041	1.225	0.5, 1, 2	-	12	30	20	-	60	-40 to +85	-	SOT23
LM4041-ADJ	1.233	1	10	12	30	15	0.6	20	-40 to +125	X	SOT23/SOT353
LM4040-2.5	2.5	0.2, 0.5, 1	-	15	60	15	0.9	35	-40 to +125	X	SOT23/SOT353
ZR4040-2.5	2.5	0.5, 1, 2	-	20	50	30	2	45	-40 to +85	-	SOT23
ZRC250	2.5	1, 2	-	5	20	30	1	60	-40 to +85	-	SOT23
LM4040-3.0	3	0.2, 0.5, 1	-	15	62	15	0.9	35	-40 to +85	X	SOT23/SOT353
ZRC330	3.3	1, 2	-	5	20	15	2	75	-40 to +85	-	SOT23
ZR4040-4.1	4.096	1	-	20	50	20	2	90	-40 to +85	-	SOT23
ZRC400	4.096	1	-	5	23	30	2	90	-40 to +85	-	SOT23
LM4040-5.0	5	0.2, 0.5, 1	-	15	60	15	1.1	80	-40 to +125	X	SOT23/SOT353
ZR4040-5	5	1	-	20	50	20	1.5	105	-40 to +85	-	SOT23
ZRB500	5	1, 2	-	15	50	15	1.5	105	-40 to +85	-	SOT23
ZRC500	5	1	-	5	25	30	2	105	-40 to +85	-	SOT23

## THE DIODES ADVANTAGE

Diodes' voltage references are cost-effective form, fit and function industry-standard shunt references.



### Product benefits

Diodes voltage references are cost effective industry standard pin out shunt references providing excellent temperature stability.

- **Wide temperature ranges, some to -40 to 125°C**  
Simplifies component choice and stocking.
- **0.2%, 0.5% and 1% tolerance references**  
Matches needs of a wide range of applications.
- **ZRx references provide very low minimum operating currents**  
Suitable for portable/battery powered applications.
- **LM4040/1 qualified to AEC-Q100**  
Suitable for automotive applications.
- **Available in SOT23 and SOT353**  
Small, cost-effective surface mount options.



# Reset Generators

Part Number	Detect Voltages	Minimum Input Voltage	Maximum Input Voltage	Quiescent Current	Typical Time Delay	Watchdog Timeout Period	Active-High Reset Output	Active-Low Reset Output	Manual Reset Input	Watchdog Input	Watchdog Output	PFI (Power Fail Input)	PFO (Power Fail Output)	Reset Output Topology*	Ambient Temperature Range	Available Packages	
	V	V	V	µA	ms	s									°C		
APX803	2.25 2.63 2.93 3.08 4.00 4.38 4.63	1	5.5	20	200	-	-	Y	-	-	-	-	-	OD	-40 to +85	SOT23	
APX809		1	5.5	20	200	-	-	Y	-	-	-	-	-	PP	-40 to +85	SOT23	
APX810		1	5.5	20	200	-	-	Y	-	-	-	-	-	PP	-40 to +85	SOT23	
APX811		1	5.5	20	200	-	-	-	Y	Y	-	-	-	PP	-40 to +85	SOT143	
APX812		1	5.5	20	200	-	-	Y	-	Y	-	-	-	PP	-40 to +85	SOT143	
APX823		1	5.5	25	200	1.6	-	-	Y	Y	Y	-	-	PP	-40 to +85	SOT25	
APX824		1	5.5	25	200	1.6	Y	Y	-	Y	-	-	-	PP	-40 to +85	SOT25	
APX825A		1	5.5	25	200	1.6	Y	Y	Y	Y	-	-	-	PP	-40 to +85	SOT26	
AP1701		1	5.5	20	200	-	-	-	Y	-	-	-	-	PP	-40 to +85	SC59	
AP1702		1	5.5	20	200	-	-	Y	-	-	-	-	-	PP	-40 to +85	SC59	
AP1703		1	5.5	20	200	-	-	-	Y	-	-	-	-	PP	-40 to +85	SC59	
AP1704		1	5.5	20	200	-	-	Y	-	-	-	-	-	PP	-40 to +85	SC59	
ZM33164-3		2.68	1	10	190	0	-	-	Y	-	-	-	-	-	OC	-40 to +85	SOT223
ZSM560		4.6	1	6.5	200	0	-	-	Y	-	-	-	-	-	OC	-40 to +85	SOT223

\*OD stands for Open Drain, PP stands for Push Pull, OC stands for Open Collector

## THE DIODES ADVANTAGE

APX8xx µC/µP supervisors provide a simple cost-effective solution for µP/µC power supply supervision.



### Product benefits

- **µP supervisor monitors 2.5V, 3.0V, 3.3V and 5V power supplies**  
Improves circuit reliability at low cost.
- **Wide range of thresholds to meet the needs of 2.5V, 3.0V, 3.3V and 5V power supplies**  
The right threshold can be chosen to meet the needs of the system.
- **Small footprint SOT23/143 green packages**  
Small PCB area and halogen free.
- **Watchdog function**  
Hardware watchdog prevents µP software lock-up, improving reliability.
- **Manual reset (MR) input**  
Hardwire reset function to create manual reset or simple way of coupling multiple supervisors together.
- **No external components required**  
Reduces PCB area and cost.



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