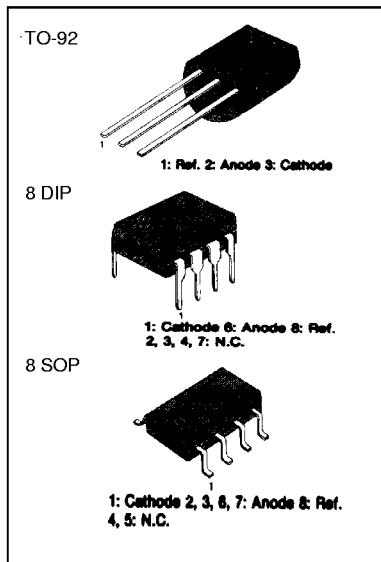


PROGRAMMABLE SHUNT REGULATOR

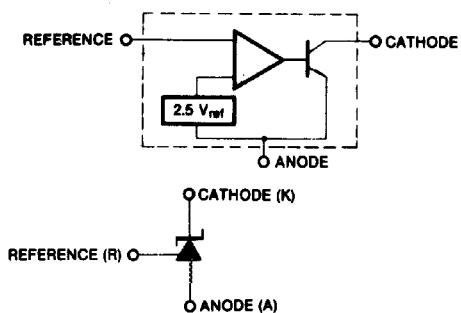
The TL431/A/L are three-terminal adjustable regulator series with a guaranteed thermal stability over applicable temperature ranges. The output voltage may be set to any value between V_{REF} (approximately 2.5 volts) and 36 volts with two external resistors. These devices have a typical dynamic output impedance of 0.2Ω . Active output circuitry provides a very sharp turn-on characteristic, making these devices excel lent replacement for zener diodes in many applications.

FEATURES

- Programmable output voltage to 36 volts
- Low dynamic output impedance 0.2Ω typical
- Sink current capability of 1.0 to 100mA
- Equivalent full-range temperature coefficient of $50\text{ppm}/^\circ\text{C}$ typical
- Temperature compensated for operation over full rated operating temperature range
- Low output noise voltage
- Fast turn-on response



BLOCK DIAGRAM



ORDERING INFORMATION

Device	Operating Temperature	Package
TL431CLP	$-25 \sim +85^\circ\text{C}$	TO-92
TL431N	$-25 \sim +85^\circ\text{C}$	8 DIP
TL431M	$-25 \sim +85^\circ\text{C}$	8 SOP
TL431ACLP	$-25 \sim +85^\circ\text{C}$	TO-92
TL431AM	$-25 \sim +85^\circ\text{C}$	8 SOP
TL431LCLP	$-25 \sim +85^\circ\text{C}$	TO-92

ABSOLUTE MAXIMUM RATINGS

(Operating temperature range applies unless otherwise specified.)

Characteristic	Symbol	Value	Unit
Cathode Voltage	V_{KA}	37	V
Cathode current Range (Continuous)	I_{KA}	-100 ~ + 150	mA
Reference Input Current Range	I_{REF}	0.05 ~ + 10	mA
Power Dissipation	P_D		
D, Z Suffix Package		770	mW
N Suffix Package		1000	mW
Operating Temperature Range	T_{OPR}	-25 ~ + 85	°C
Storage Temperature Range	T_{STG}	-65 ~ + 150	°C

RECOMMENDED OPERATING CONDITIONS

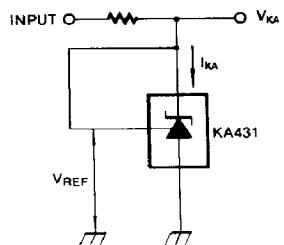
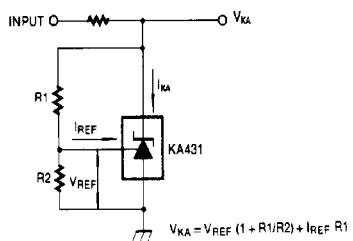
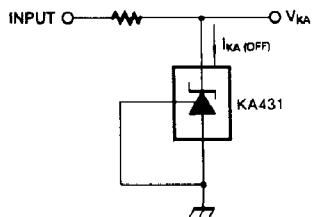
Characteristic	Symbol	Min	Typ	Max	Unit
Cathode Voltage	V_{KA}	V_{REF}		36	V
Cathode Current	I_{KA}	1.0		100	mA

ELECTRICAL CHARACTERISTICS ($T_A = +25^\circ\text{C}$, unless otherwise specified)

Characteristic	Symbol	Test Conditions	TL431			TL431A			TL431L			Unit
			Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Reference Input Voltage	V_{REF}	$V_{KA}=V_{REF}, I_{KA}=10\text{mA}$	2.440	2.495	2.550	2.470	2.495	2.520	2.482	2.495	2.508	V
Deviation of Reference Input Voltage Over-Temperature (Note 1)	DV_{REF}/DT	$V_{KA}=V_{REF}, I_{KA}=10\text{mA}$ $T_{MIN} \leq T_A \leq T_{MAX}$		4.5	17		4.5	17		4.5	17	mV
Ratio of Change in Reference Input Voltage to the Change in Cathode Voltage	DV_{REF}/D_{KA}	$I_{KA}=10\text{mA}$	$DV_{KA}=10\text{V}-V_{REF}$	-10	-2.7		-1.0	-2.7		-1.0	-2.7	mV/W
			$DV_{KA}=36\text{V}-10\text{V}$	-0.5	-2.0		-0.5	-2.0		-0.5	-2.0	
Reference Input Current	I_{REF}	$I_{KA}=10\text{mA}, R_1=10\text{K}\Omega, R_2=\infty$		1.5	4		1.5	4		1.5	4	μA
Deviation of Reference Input Current Over Full Temperature Range	D_{REF}/DT	$I_{KA}=10\text{mA}, R_1=10\text{K}\Omega, R_2=\infty$ $T_A=\text{Full Range}$		0.4	1.2		0.4	1.2		0.4	1.2	μA
Minimum Cathode Current for Regulation	$I_{KA(MIN)}$	$V_{KA}=V_{REF}$		0.45	1.0		0.45	1.0		0.45	1.0	mA
Off - Stage Cathode Current	$I_{KA(OFF)}$	$V_{KA}=36\text{V}, V_{REF}=0$		0.05	1.0		0.05	1.0		0.05	1.0	μA
Dynamic Impedance (Note 2)	Z_{KA}	$V_{KA}=V_{REF}, I_{KA}=1 \text{ to } 100\text{mA}$ $f=1.0\text{K}\Omega$		0.15	0.5		0.15	0.5		0.15	0.5	Ω

 $T_{MIN} = -25^\circ\text{C}$, $T_{MAX} = +85^\circ\text{C}$

TEST CIRCUITS

Fig. 1 Test Circuit for $V_{KA}=V_{REF}$ Fig. 2 Test Circuit for $V_{KA} \geq V_{REF}$ Fig. 3 Test Circuit for $I_{KA(OFF)}$ 

TYPICAL PERFORMANCE CHARACTERISTICS

Fig. 4 Cathode Current vs. Cathode Voltage

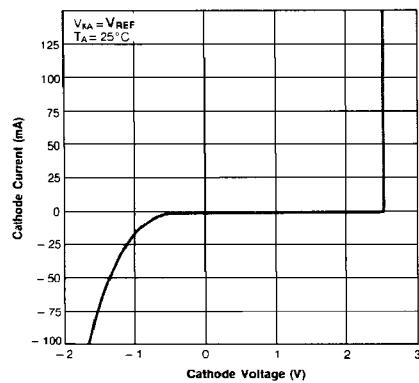


Fig. 5 Cathode Current vs. Cathode Voltage

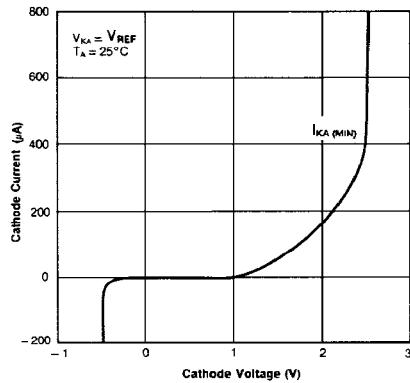


Fig. 6 Change In Reference Input Voltage vs. Cathode Voltage

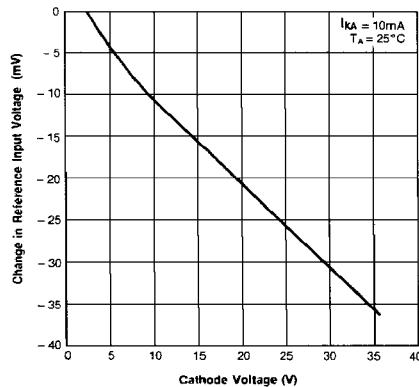


Fig. 7 Dynamic Impedance Frequency

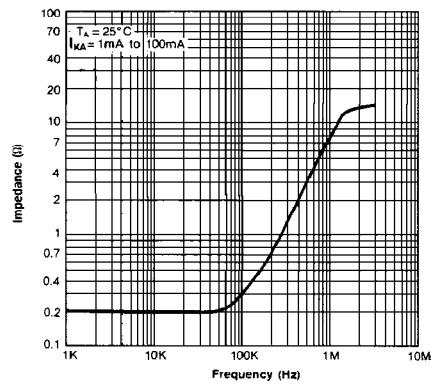


Fig. 8 Small Signal Voltage Amplification vs. Frequency

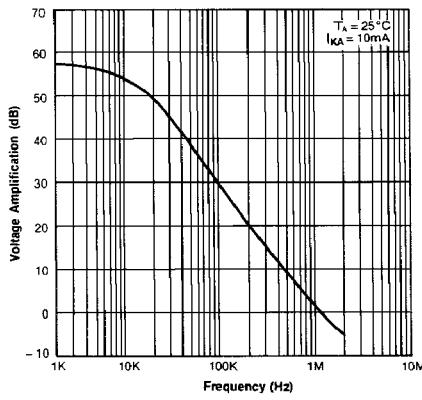
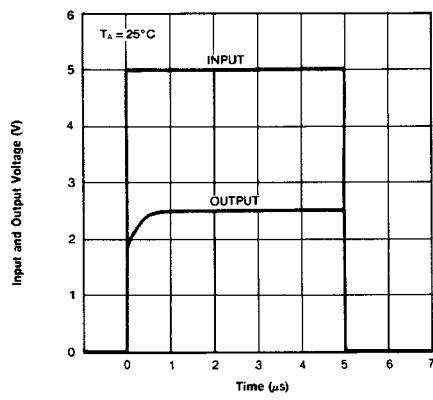
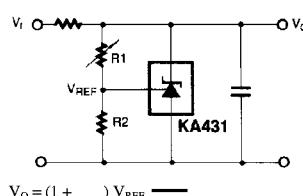


Fig. 9 Pulse Response

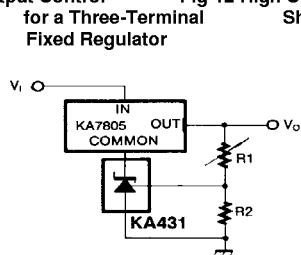


TYPICAL APPLICATIONS

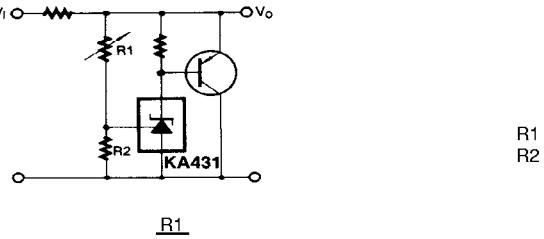
Fig. 10 Shunt Regulator



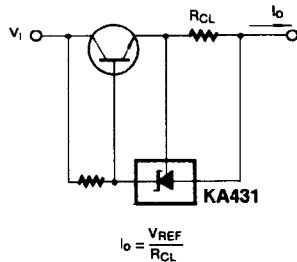
$$V_0 = V_{REF} (1 + \frac{R1}{R2})$$

Fig.11 Output Control
for a Three-Terminal
Fixed Regulator

$$V_0 = (1 + \frac{R1}{R2}) V_{REF}$$

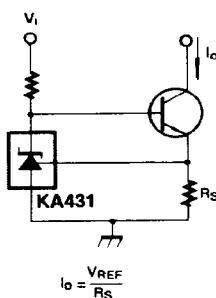
Fig-12 High Current
Shunt Regulator

$$\frac{R1}{R2}$$

Fig. 13 Current Limit or
Current Source

$$I_0 = \frac{V_{REF}}{R_{CL}}$$

Fig. 14 Constant-Current Sink



$$I_0 = \frac{V_{REF}}{R_S}$$

TRADEMARKS

The following are registered and unregistered trademarks Fairchild Semiconductor owns or is authorized to use and is not intended to be an exhaustive list of all such trademarks.

ACETM
CoolFETTM
CROSSVOLTTM
E²CMOSTM
FACTTM
FACT Quiet SeriesTM
FAST[®]
FASTRTM
GTOTM
HiSeCTM

ISOPLANARTM
MICROWIRETM
POPTM
PowerTrenchTM
QSTM
Quiet SeriesTM
SuperSOTTM-3
SuperSOTTM-6
SuperSOTTM-8
TinyLogicTM

DISCLAIMER

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION OR DESIGN. FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS.

LIFE SUPPORT POLICY

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF FAIRCHILD SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, or (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

PRODUCT STATUS DEFINITIONS

Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	This datasheet contains preliminary data, and supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
No Identification Needed	Full Production	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
Obsolete	Not In Production	This datasheet contains specifications on a product that has been discontinued by Fairchild semiconductor. The datasheet is printed for reference information only.