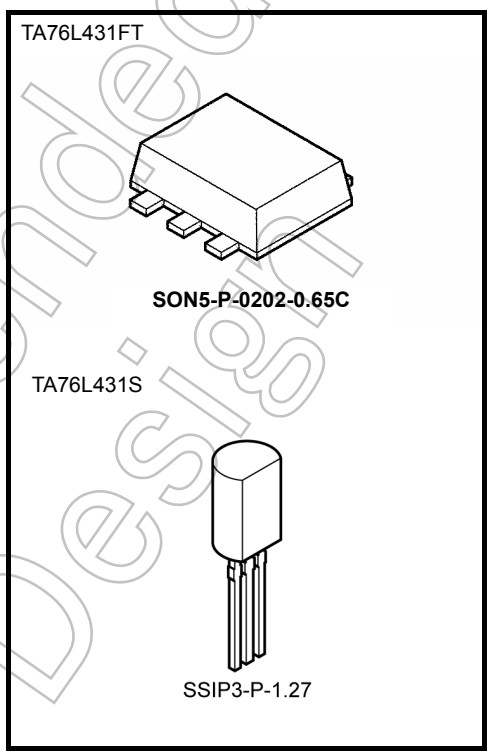
TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

TA76L431FT,TA76L431S

2.49V Adjustable High-Precision Shunt Regulators

These devices are adjustable high-precision shunt regulators whose output voltage (V_{KA}) can be set arbitrarily using two external resistors.
The devices have a precise internal reference voltage of 2.49 V, enabling them to operate at low voltage. In addition, they can be used as zener diodes to perform temperature compensation.



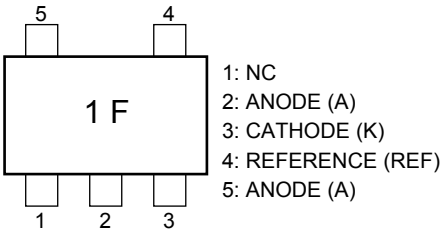
Weight
SON5-P-0202-0.65C : 0.007 g (typ.)
SSIP3-P-1.27 : 0.36 g (typ.)

Features

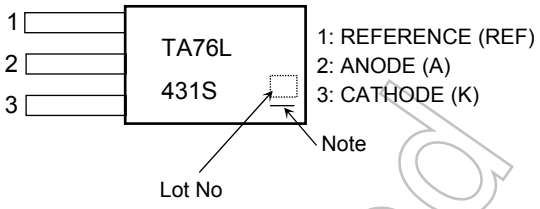
- Precision reference voltage
  : V_{REF} = 2.49V ± 1.0% (Ta = 25°C)
- Adjustable output voltage
  : $V_{REF} \leq V_{OUT} \leq 19$ V
- Minimum cathode current for regulation
  :I_{kmin} = 0.5 mA (max.)
- Operating temperature: Ta = −40 to 85°C
- The TA76L431FT is housed in an ultra-thin UFV package. (thickness: 0.7 mm typ.)
- Packages: UFV (TA76L431FT), LSTM (TA76L431S)

Pin Assignment/Marking

TA76L431FT



TA76L431S



Note: A line under a Lot No. identifies the indication of product Labels.
Not underlined: [[Pb]]/INCLUDES > MCV
Underlined: [[G]]/RoHS COMPATIBLE or [[G]]/RoHS [[Pb]]

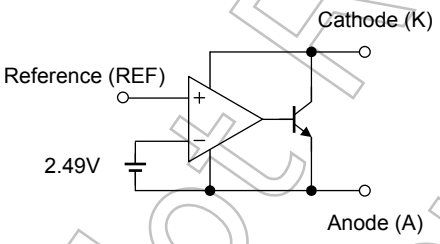
Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product. The RoHS is the Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

How to Order

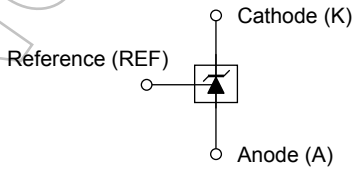
Product No.	Package Type	Packing Type and Capacity
TA76L431FT (TE85L,F	UFV (surface-mount type)	Embossed tape: 3000 pcs/reel
TA76L431S(Q)	LSTM (lead type)	Loose in bag: 200 pcs/bag
TA76L431S (TPE6,Q)		Radial tape: 2000 pcs/pack

Note: The lead pitch for the TA76L431S(Q) and TA76L431S(TPE6,Q) may vary.

Functional Block Diagram

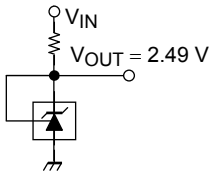


Circuit Symbol

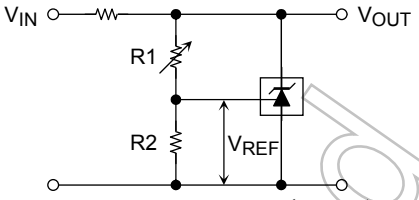


Typical Application Circuits

(1) 2.49 V Reference ($V_{KA} = V_{REF}$)



(2) Shunt regulator ($V_{KA} > V_{REF}$)



$$V_{OUT} = V_{REF}\left(1+\frac{R_1}{R_2}\right)+I_{REF}\cdot R1$$

Usage Precautions

1. TA76L431FT, TA76L431S

   These products contain MOS elements. Please take care to avoid generating static electricity when handling these devices.

2. TA76L431FT, TA76L431S

   The oscillation frequency of these devices is determined by the value of the capacitor connected between the anode and the cathode.

   When establishing maximum operating condition parameters, please derate the absolute maximum rating values specified in these datasheets so as to allow an operational safety margin.

   Use of a laminated ceramic capacitor is recommended

3. Precautions when handling anode pin of TA76L431FT

   Pin 2 and pin 5 should normally be shorted together. If only pin 5 is used, pin 2 should either be left open or always kept at a lower potential than pin 5. Do not leave pin 5 open and use pin 2 only.

Absolute Maximum Ratings (Ta = 25°C)

Characteristics		Symbol	Rating	Unit
Cathode voltage		V_{KA}	20	V
Cathode current		I_K	50	mA
Cathode-anode reverse current		$-I_K$	50	mA
Reference voltage		V_{REF}	7	V
Reference current		I_{REF}	50	μA
Reference-anode reverse current		$-I_{REF}$	10	mA
Power dissipation	TA76L431FT	P_D	0.45 (Note 1)	W
	TA76L431S		0.8	
Thermal resistance	TA76L431FT	R_{th}	277 (Note 1)	°C/W
	TA76L431S		156	
Operating temperature		T_{opr}	−40 to 85	°C
Junction temperature		T_j	150	°C
Storage temperature		T_{stg}	−55 to 150	°C

Note 1: Glass epoxy substrate mounting: 30 mm × 30 mm × 0.8 mmt (Cu pad area 35 mm^2)

Note 2: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook (“Handling Precautions”/“Derating Concept and Methods”) and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

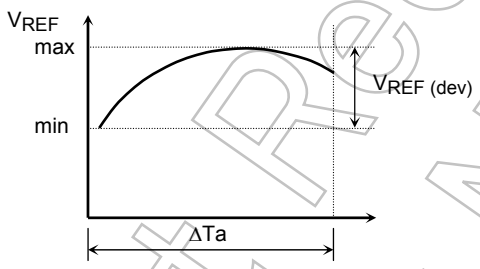
Operating Ranges

Characteristics	Symbol	Min	Typ.	Max	Unit
Cathode voltage	V_{KA}	V_{REF}	—	19	V
Cathode current	I_K	0.5	—	40	mA
Operating temperature	T_{opr}	−40	—	85	°C

Electrical Characteristics (Unless otherwise specified, Ta = 25°C, I_K = 10 mA)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Reference voltage	V_{REF}	$V_{KA} = V_{REF}$	2.465	2.49	2.515	V
Deviation of reference input voltage over temperature	$V_{REF\ (dev)}$	0°C ≦ Ta ≦ 70°C, $V_{KA} = V_{REF}$	—	5	15	mV
Ratio of change in reference input voltage to the change in cathode voltage	$\Delta V_{REF}/\Delta V$	$V_{REF} \leqq V_{KA} \leqq 10$ V	—	0.8	2.4	mV/V
		10V ≦ V_{KA} ≦ 19 V	—	0.8	2.0	
Reference Input current	I_{REF}	$V_{KA} = V_{REF}$	—	0.6	3	μA
Deviation of reference input current over temperature	$I_{REF\ (dev)}$	0°C ≦ Ta ≦ 70°C, $V_{KA} = V_{REF}$, R_1 = 10 kΩ, $R_2 = \infty$	—	0.3	1.2	μA
Minimum cathode current for regulation	I_{Kmin}	$V_{KA} = V_{REF}$	—	0.2	0.5	mA
Off-State cathode current	I_{Koff}	V_{KA} = 19 V, V_{REF} = 0 V	—	—	1.0	μA
Dynamic impedance	$\lvert Z_{KA} \rvert$	$V_{KA} = V_{REF}$, f ≦ 1 kHz, 0.5 mA ≦ I_K ≦ 40 mA	—	0.2	0.5	Ω

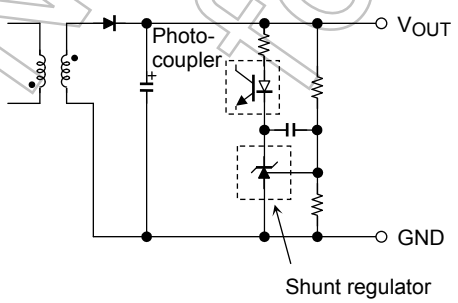
The deviation parameters $V_{REF\ (dev)}$ and $I_{REF\ (dev)}$ are defined as the maximum variation of the V_{REF} and I_{REF} over the rated temperature range(Ta=0 to 70ºC).
The average temperature coefficient of the V_{REF} is defined as:



$$\lvert \alpha V_{REF} \rvert = \frac{\left(\frac{V_{REF\ (dev)} \times 10^6}{V_{REF}\ @25°C} \right)}{\Delta Ta} \ (ppm/°C)$$

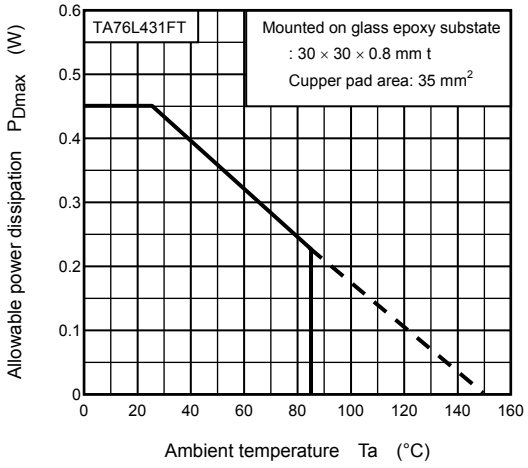
Application Circuit Example

Error amplification circuit for switching power supply

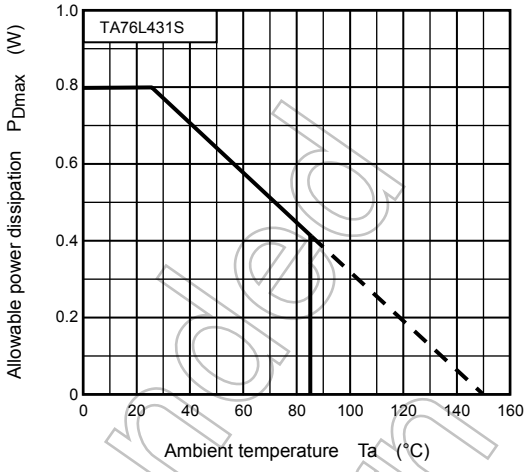


This circuit amplifies the difference between the switching power supply's secondary output voltage and the shunt regulator's reference voltage. It then feeds the amplified voltage back to the primary input voltage via the photocoupler.

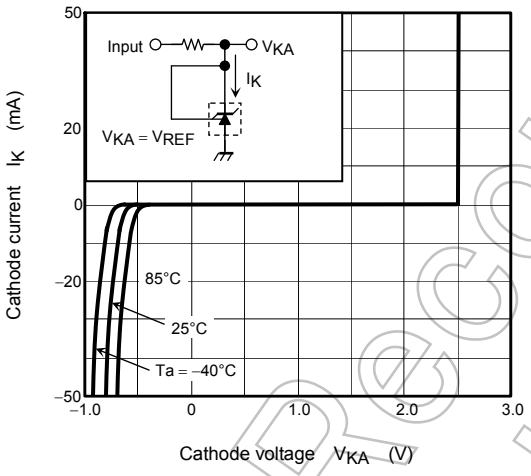
P_{Dmax} – Ta



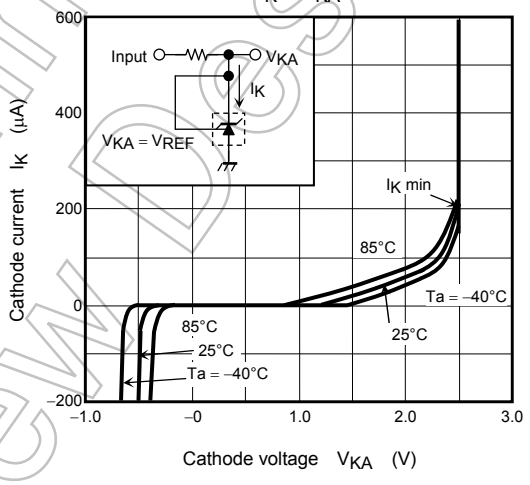
P_{Dmax} – Ta



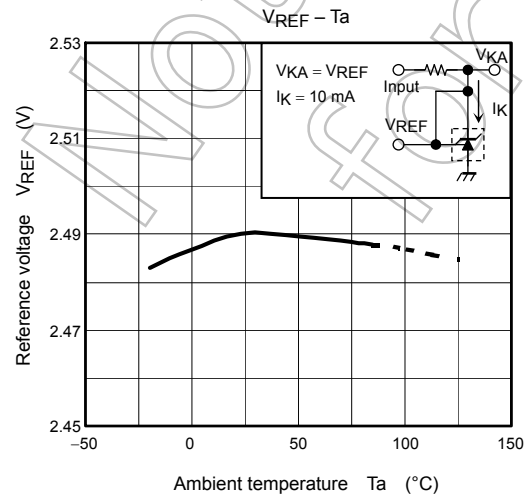
I_K – V_{KA}



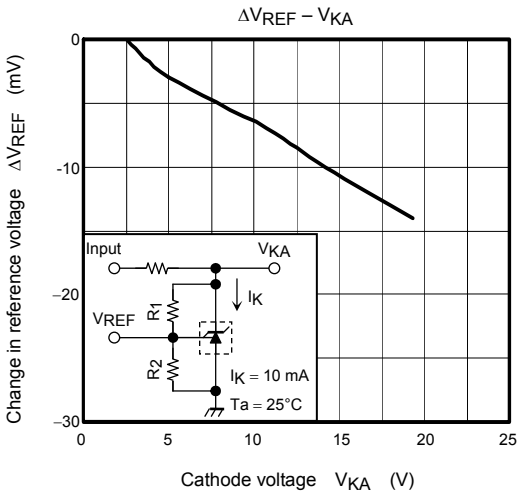
I_K – V_{KA}



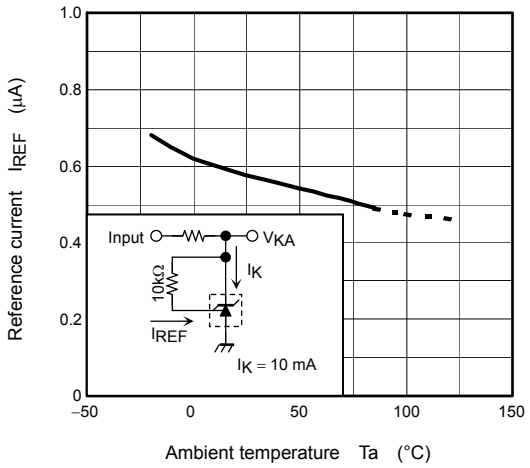
V_{REF} – Ta



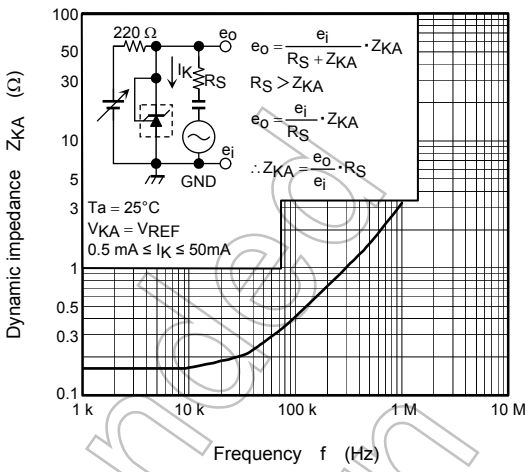
ΔV_{REF} – V_{KA}



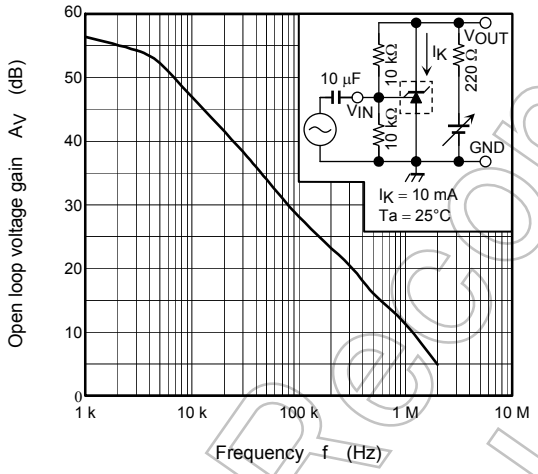
I_{REF} – Ta



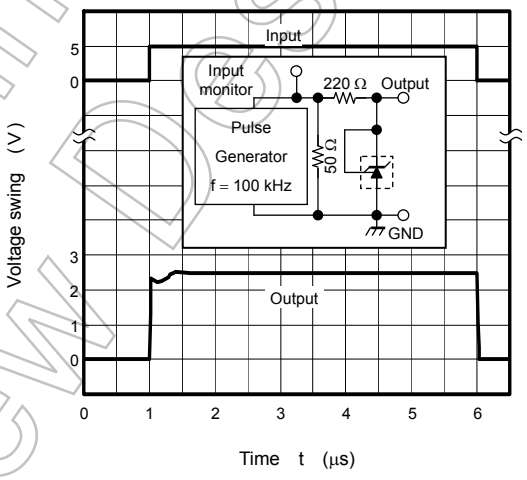
Z_{KA} – f



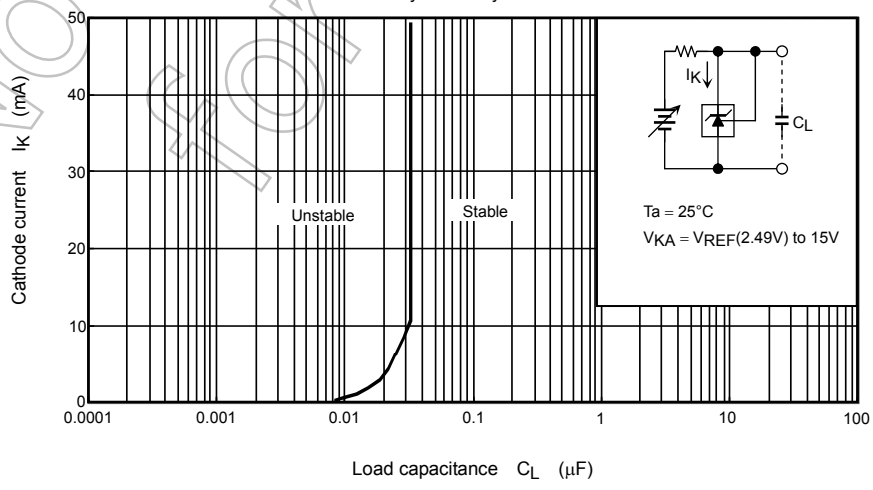
A_V – f



Pulse response

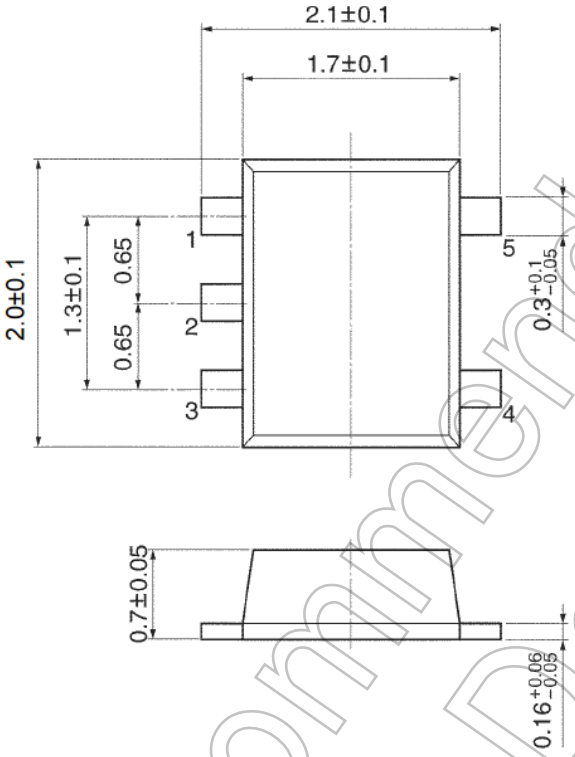


Stability boundaty conditions



Package Dimensions

SON5-P-0202-0.65C Unit: mm



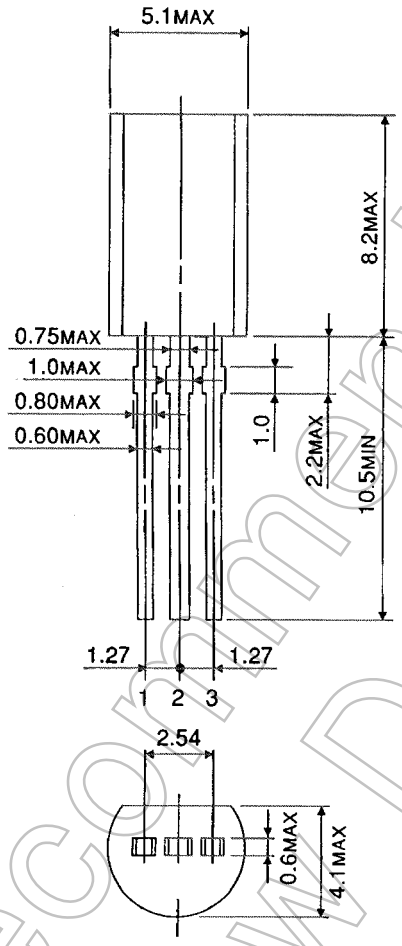
TA76L431FT (UFV)

Weight: 0.007 g (typ.)

Package Dimensions

Unit : mm

SSIP3-P-1.27



TA76L431S (LSTM)

Weight: 0.36 g (typ.)

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