

## Low Voltage Adjustable Precision Shunt Regulator

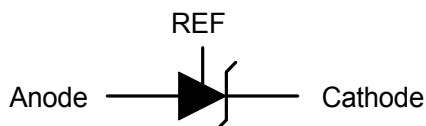
### Features

- Precise Reference Voltage to 1.24V
- Guaranteed 0.5% or 1% Reference Voltage Tolerance
- Sink Current Capability , 60mA to 100mA
- Quick Turn-on
- Adjustable Output Voltage ,  $V_O = V_{REF}$  to 20V
- Low Operational Cathode Current , 60mA Typical
- 0.1 $\Omega$  Typical Output Impedance
- SOT-23-5 Packages

### Applications

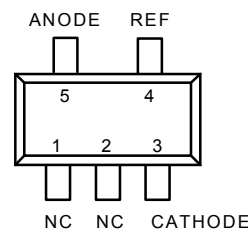
- Linear Regulators
- Adjustable Power Supply
- Switching Power Supply

### Symbol

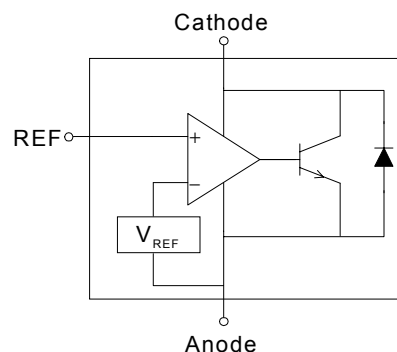


### General Description

The APL1431L is a 3-terminal low voltage adjustable precision reference with specified thermal stability over applicable commercial temperature ranges . Output voltage may be set to any value between  $V_{REF}$  (1.24 V) and 20 V with two external resistors (see Figure 2) . When used with an photocoupler , the APL1431L is an ideal voltage reference in isolated feedback circuits for 1.24V to 12V switching-mode power supplies . This device has a typical output impedance of 0.1 $\Omega$  . Active output circuitry provides a very sharp turn-on characteristic , making the APL1431L excellent replacements for zener diodes in many applications , including on-board regulation and adjustable power supplies .

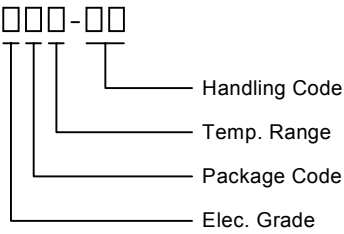


### Functional Diagram



ANPEC reserves the right to make changes to improve reliability or manufacturability without notice, and advise customers to obtain the latest version of relevant information to verify before placing orders.

## Ordering and Marking Information

<p>APL1431L <span style="border: 1px solid black; padding: 2px;">□□□-□□</span></p>  <p>Handling Code Temp. Range Package Code Elec. Grade</p>	<p>Elec. Grade A : 0.5% Reference Voltage Tolerance B : 1% Reference Voltage Tolerance</p> <p>Package Code B : SOT- 23 - 5</p> <p>Temp. Range C : 0 to 70 °C      I : -40 to 85 °C</p> <p>Handling Code PB : Plastic Bag      TB : Tape &amp; Box TR : Tape &amp; Reel</p>
<p>APL1431L B : <span style="border: 1px solid black; padding: 2px;">1431L</span></p>	

## Absolute Maximum Ratings

Symbol	Parameter	Rating	Unit
$V_{KA}$	Cathode Voltage	20	V
$I_K$	Continuous Cathode Current	100	mA
$I_{REF}$	Reference Current	3	mA
$\theta_{JA}$	Thermal Resistance from Junction to Ambient in Free Air SOT-23-5	357	°C/W
$T_J$	Operating Junction Temperature Range	-40 to 150	°C
$T_{STG}$	Storage Temperature Range	-65 to 150	°C
$T_{SOL}$	Lead Temperature Range, $T_s$ (Soldering, 10sec)	260	°C

## Electrical Characteristics $T_A = 25^\circ\text{C}$ ( unless otherwise noted)

Symbol	Parameter	Test Conditions	APL1431L			Unit	
			Min.	Typ.	Max.		
$V_{REF}$	Reference Voltage	$V_{KA} = V_{REF}$ , $I_K = 10\text{mA}$ $T_A = 25^\circ\text{C}$ , (Fig. 1)	APL1431LA	1.234	1.240	1.246	V
			APL1431LB	1.228	1.240	1.252	
		$T_A = \text{full range}$ (see Note 1), (Fig. 1)	APL1431LA	1.222	1.240	1.258	
			APL1431LB	1.215	1.240	1.265	
$V_{DEV}$	$V_{DEF}$ Temp Deviation	$T_A = \text{full range}$ (see Note 1), $V_{KA} = V_{REF}$ , $I_K = 10\text{mA}$ , (Fig. 1)		5	15	mV	
$\frac{\Delta V_{REF}}{\Delta V_{KA}}$	Ratio of Change in $V_{REF}$ to Change in Cathode Voltage	$I_K = 10\text{mA}$ , $\Delta V_{KA} = 16\text{V}$ to $V_{REF}$ (Fig. 2)		-0.2	-1.0	mV/V	
$I_{REF}$	Reference Input Current	$I_K = 10\text{mA}$ , $R_1 = 10\text{k}\Omega$ , $R_2 = \infty$ (Fig. 2)		0.15	0.5	$\mu\text{A}$	

## Electrical Characteristics $T_A = 25^\circ\text{C}$ ( unless otherwise noted)

Symbol	Parameter	Test Conditions	APL1431L			Unit
			Min.	Typ.	Max.	
$I_{REF(DEV)}$	$I_{REF}$ Temp Deviation	$T_A = \text{full range (see Note 1), } R_1 = 10\text{k}\Omega, R_2 = \infty, I_K = 10\text{mA}, \text{ (Fig. 2)}$		0.05	0.3	$\mu\text{A}$
$I_{K(off)}$	Off-state cathode current	$V_{REF} = 0\text{V}, \text{ (Fig. 3)}$	$V_K = 6\text{V}$	0.01	0.1	$\mu\text{A}$
			$V_K = 16\text{V}$	0.01	0.5	
$Z_{KA}$	Dynamic Output Impedance	$V_{KA} = V_{REF}, I_K = 100\mu\text{A to } 100\text{mA}, f < 1\text{kHz}, \text{ (Fig. 1)}$		0.1	0.3	$\Omega$
$I_{K(MIN)}$	Minimum Operating Current	$V_{KA} = V_{REF}, \text{ (Fig. 1)}$		60	80	$\mu\text{A}$

Note : 1. Full temperature range is  $0^\circ\text{C}$  to  $70^\circ\text{C}$  for APL1431LXXC, and  $-40^\circ\text{C}$  to  $85^\circ\text{C}$  for APL1431LXXI.

## Test Circuits

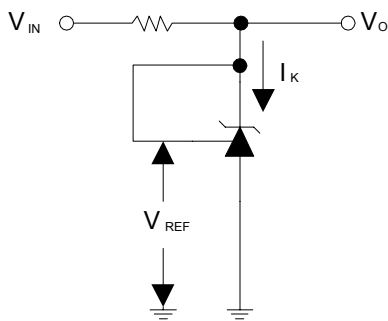


Figure 1. Test Circuit for  $V_{KA} = V_{REF}, V_O = V_{KA} = V_{REF}$

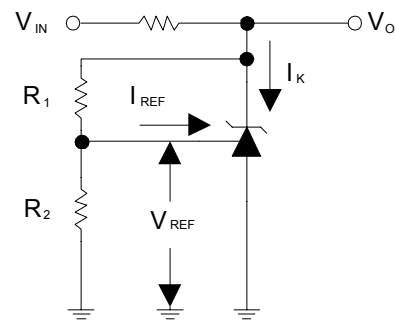


Figure 2. Test Circuit for  $V_{KA} > V_{REF}, V_O = V_{KA} = V_{REF} \times (1 + R_1/R_2) + I_{REF} \times R_1$

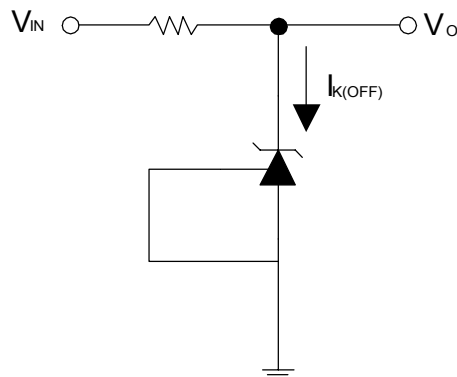
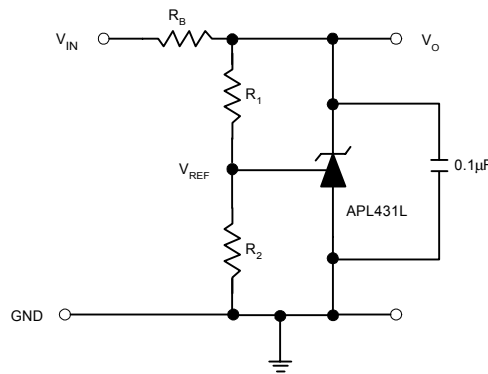
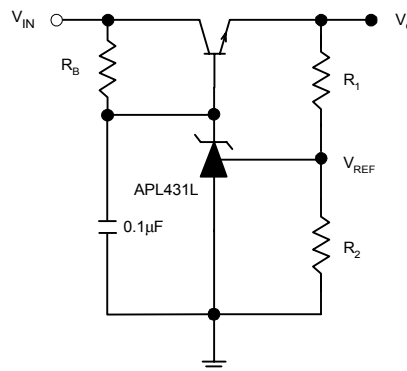


Figure 3. Test Circuit for  $I_{K(OFF)}$

## Application Schematic



Precision Voltage Reference



Precision Voltage Regulator

### Notes for Application Circuits:

1) To improve the stability of output voltage , a 0.1µF capacitor between cathode and anode of APL431L is strongly recommended.

2) Set  $V_O$  according to the following equation:

$$V_O = V_{REF} (1 + R_1 / R_2) + I_{REF} R_1$$

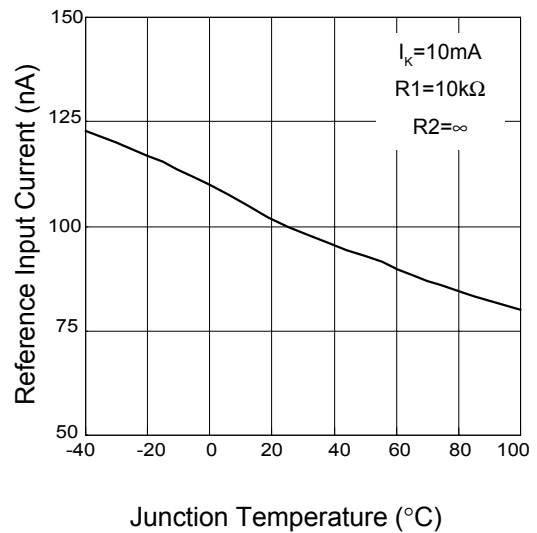
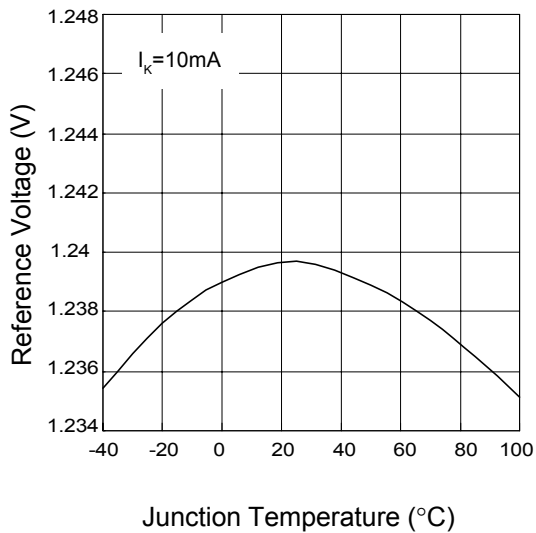
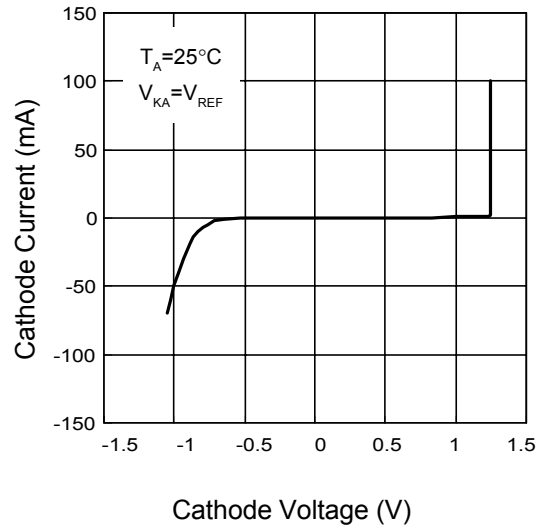
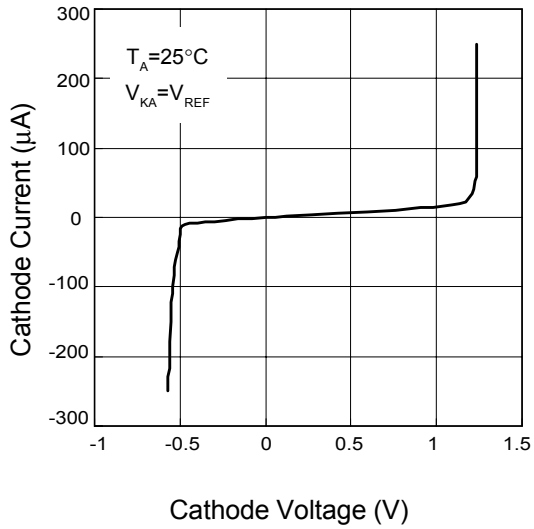
3) Choose the value for  $R_B$  as follows:

- The maximum limit for  $R_B$  should be such that the cathode current ( $I_K$ ) is greater than the minimum operating current (60µA) at  $V_{IN(MIN)}$  .
- The minimum limit for  $R_B$  should be such that the cathode current ( $I_K$ ) does not exceed 100mA under all load conditions, and the instantaneous turn-on value for  $I_K$  does not exceed 150mA . Both of the following conditions must be met :

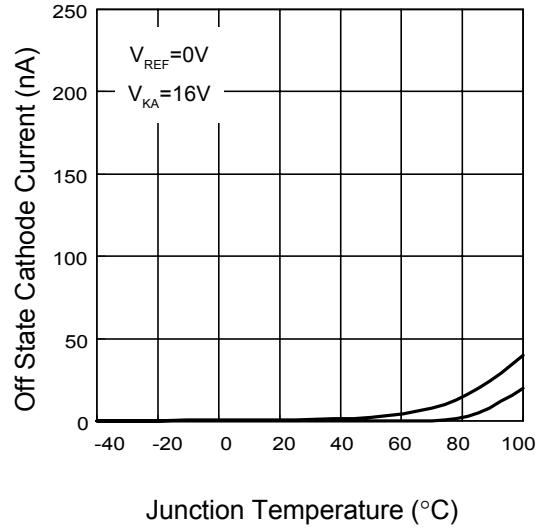
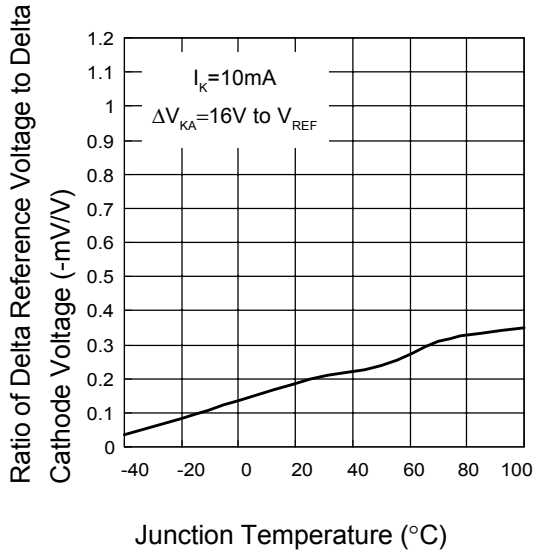
$$R_{B,MIN} \geq V_{IN(MAX)} / 150mA \text{ ( to limit instantaneous turn-on } I_K \text{ )}$$

$$R_{B,MIN} \geq V_{IN(MAX)} - V_O / I_{O(MIN)} + 100mA \text{ ( to limit } I_K \text{ under normal operating conditions )}$$

## Typical Characteristics

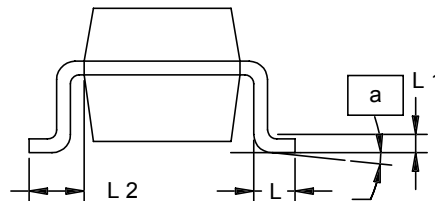
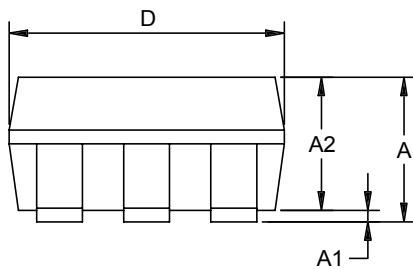
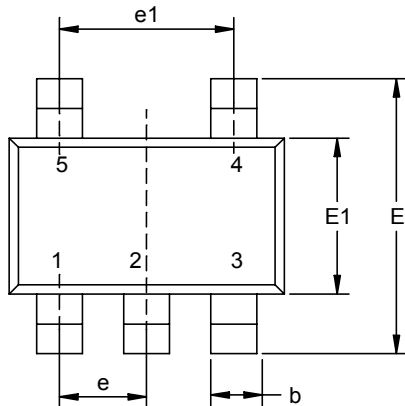


Typical Characteristics (Cont.)



## Packaging Information

SOT-23-5



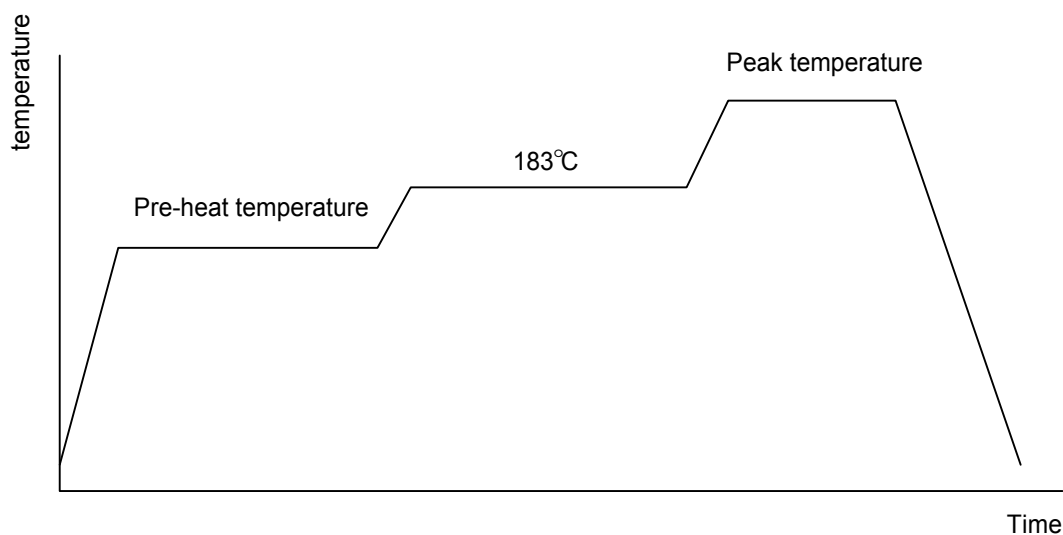
Dim	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	0.95	1.45	0.037	0.057
A1	0.05	0.15	0.002	0.006
A2	0.90	1.30	0.035	0.051
D	2.8	3.00	0.110	0.118
E	2.6	3.00	0.102	0.118
E1	1.5	1.70	0.059	0.067
L	0.35	0.55	0.014	0.022
L1	0.20 BSC		0.008 BSC	
L2	0.5	0.7	0.020	0.028
N	5		5	
$\alpha$	0°	10°	0°	10°

## Physical Specifications

Terminal Material	Solder-Plated Copper (Solder Material : 90/10 or 63/37 SnPb)
Lead Solderability	Meets EIA Specification RSI86-91, ANSI/J-STD-002 Category 3.

## Reflow Condition (IR/Convection or VPR Reflow)

Reference JEDEC Standard J-STD-020A APRIL 1999



## Classification Reflow Profiles

	Convection or IR/ Convection	VPR
Average ramp-up rate(183°C to Peak)	3°C/second max.	10 °C /second max.
Preheat temperature 125 ± 25°C)	120 seconds max	
Temperature maintained above 183°C	60 – 150 seconds	
Time within 5°C of actual peak temperature	10 –20 seconds	60 seconds
Peak temperature range	220 +5/-0°C or 235 +5/-0°C	215-219°C or 235 +5/-0°C
Ramp-down rate	6 °C /second max.	10 °C /second max.
Time 25°C to peak temperature	6 minutes max.	

## Package Reflow Conditions

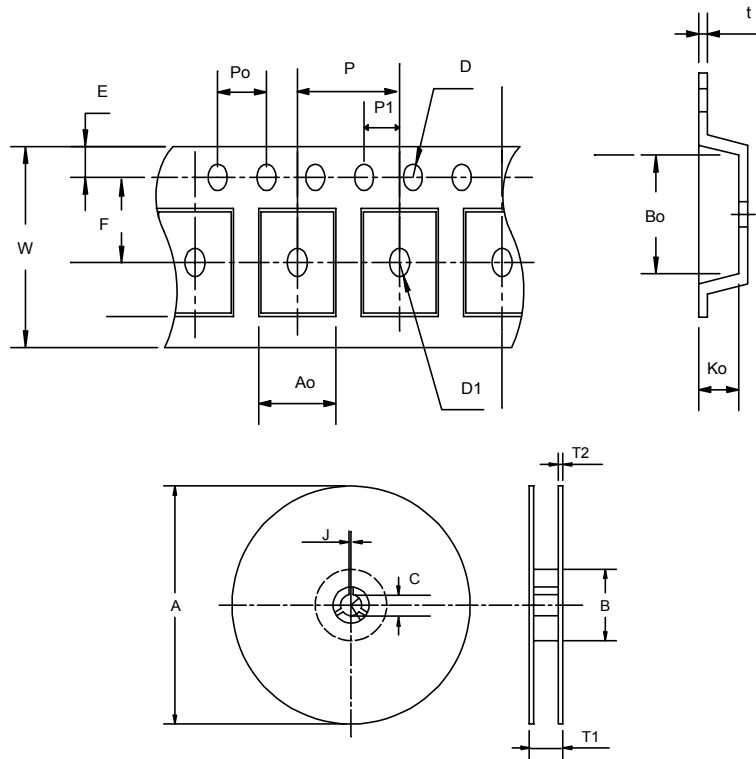
pkg. thickness ≥ 2.5mm and all bgas	pkg. thickness < 2.5mm and pkg. volume ≥ 350 mm <sup>3</sup>	pkg. thickness < 2.5mm and pkg. volume < 350mm <sup>3</sup>
Convection 220 +5/-0 °C		Convection 235 +5/-0 °C
VPR 215-219 °C		VPR 235 +5/-0 °C
IR/Convection 220 +5/-0 °C		IR/Convection 235 +5/-0 °C



## Reliability test program

Test item	Method	Description
SOLDERABILITY	MIL-STD-883D-2003	245°C , 5 SEC
HOLT	MIL-STD-883D-1005.7	1000 Hrs Bias @ 125 °C
PCT	JESD-22-B, A102	168 Hrs, 100 % RH , 121°C
TST	MIL-STD-883D-1011.9	-65°C ~ 150°C, 200 Cycles
ESD	MIL-STD-883D-3015.7	VHBM > 2KV, VMM > 200V
Latch-Up	JESD 78	10ms , I <sub>tr</sub> > 100mA

## Carrier Tape & Reel Dimensions



Application	A	B	C	J	T1	T2	W	P	E
SOT-23-5	178 ±1	72 ± 1.0	13.0 + 0.2	2.5 ± 0.15	8.4 ± 2	1.5 ± 0.3	8.0 ± 0.3	4 ± 0.1	1.75 ± 0.1
	F	D	D1	Po	P1	Ao	Bo	Ko	t
	3.5 ± 0.05	1.5 ± 0.1	1.5 ± 0.1	4.0 ± 0.1	2.0 ± 0.1	3.15 ± 0.1	3.2 ± 0.1	1.4 ± 0.1	0.2 ± 0.033

(mm)

## Cover Tape Dimensions

Application	Carrier Width	Cover Tape Width	Devices Per Reel
SOT- 23-5	8	5.3	3000

## Customer Service

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