NCP100

Advance Information

Sub 1V Precision Adjustable Shunt Regulator

The NCP100 is a programmable shunt regulator that provides accurate referencing for voltage levels of 1 volt and below. This device is targeted at low voltage applications where a 1.25 volt bandgap reference is not suitable. This device exhibits wide operating currents of 0.1 to 20 mA and has sufficient current for driving opto–couplers. Additional applications include feedback isolation for secondary side regulation of power supplies.

Features:

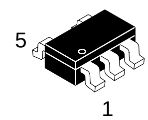
- Programmable Output Voltage Range of 0.9 to 6.0 V @ 25°C
- Tight Voltage Reference Tolerance of ±1%
- Low Dynamic Output Impedance, 0.2 Ω typical
- Sink Current Capability of 0.10 mA to 20 mA
- Equivalent Full–Range Temperature Coefficient of < 50 ppm/°C
- Operating Temperature Range of –40°C to 85°C
- Micro Miniature TSOP–5 Packaging

Applications:

- Laptop Computers
- Hand–Held Instrumentation
- Personal Data Loggers
- Cellular Phones
- Camcorders and Cameras
- Secondary Regulation of Power Supplies
- Reliable Reference for single cell Alkaline, NiCD and NiMH Battery Applications

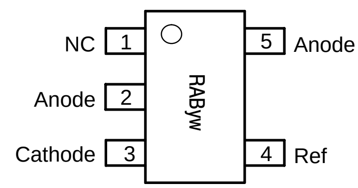
ON Semiconductor

http://onsemi.com



TSOP–5
SN SUFFIX
CASE 483

PIN CONNECTIONS AND MARKING DIAGRAM

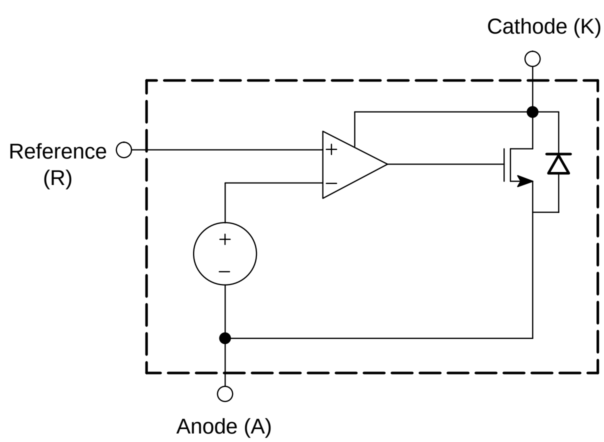


yw = Date Code
(Top View)

ORDERING INFORMATION

Device	Package	Shipping
NCP100SNT1	TSOP–5	3000 Units / 7″ Reel

Representative Block Diagram

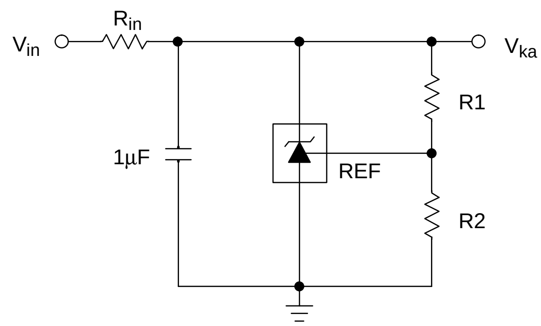


This document contains information on a new product. Specifications and information herein are subject to change without notice.

PIN DESCRIPTION

Pin No.	Name	Description
1	NC	No Connect
2	Anode	Anode – Typically Connected Directly to Ground
3	Cathode (K)	Reference Voltage Output
4	Reference	Input for Reference Voltage Adjustment Connection
5	Anode	Anode – Typically Connected Directly to Ground

Typical Application Circuit



Eq1: $V_{ka} = 0.700\ (1 + R1/R2) + I_{ref} * R1$

COMPONENT SELECTION

V_{ka} (nom)	R1	R2
0.90 V	10 kΩ	34.9 kΩ
1.19 V	10 kΩ	14.3 kΩ
6.00 V	10 kΩ	1.32 kΩ

MAXIMUM RATINGS (T_A = 25°C, unless otherwise noted.)

Rating	Symbol	Value	Unit
Cathode Voltage	V_{ka}	7.0	V
Operating Cathode Current	I_{ka}	25	mA
Anode–Cathode Forward Current	I_{ak}	2.0	mA
Reference Current	I_r	2.0	mA
Storage Temperature	T_{stg}	–55 to 125	°C
Thermal Resistance – Junction to Air	$R_{\theta JA}$	225	°C/W
Maximum Junction Temperature	T_J	125	°C
Lead Temperature (Soldering), 10 seconds	T_{solder}	260	°C

ELECTRICAL CHARACTERISTICS (C_L = 1μF, T_A = 25°C, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
Operating Voltage	V_{op}	0.9	–	6.0	V
Operating Current	I_{ka}	0.1	–	20	mA
Reference Voltage (V_{ka}(nom) = 1.19 V, I_{ka} = 10 mA) T_A = 25°C T_A = –40 to 85°C	V_{ref}	 0.693 0.689	 – –	 0.707 0.711	V
Temperature Coefficient (Note 2)		–	±25	–	ppm/°C
Reference Voltage (V_{ka}(nom) = 0.9 V, I_{ka} = 0.1 mA) (Figure 5) T_A = 25°C T_A = –40 to 85°C	$V_{ref\ (min)}$	 0.685 0.680	 – –	 0.707 0.711	V
Line Regulation (Ika = 10 mA) V_{ka} = 0.9 V to 1.19 V V_{ka} = 1.19 V to 6.0 V	 LR1 LR2	 –10 0	 – –	 10 10	mV
Reference Input Current (I_{ka} = 10 mA, V_{ka} = 1.19 V)	I_{ref}	–150	–	150	nA
Cathode Current in OFF State (V_{ref} = 0 V, V_{ka} = 6.0 V)	I_{off}	–	75	95	μA
Dynamic Output Impedance (I_{ka} = 1 mA to 20 mA, V_{ka}(nom) = 0.9 V, f < 1 kHz)	Z_{ka}	0	0.2	0.4	Ω

1. For V_{ka}(nom), a resistor divider is used, refer to the component selection table.
2. The average temperature coefficient of the reference input voltage, αV_{ref} is defined as:

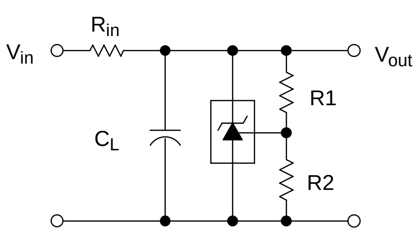
$$V_{ref}\ \frac{ppm}{^\circ C} = \frac{\left(\frac{\Delta V_{ref}}{V_{ref}\ @\ 25^\circ C}\right) X\ 10^6}{\Delta T_A} = \frac{\Delta V_{ref} \times 10^6}{\Delta T_A (V_{ref}\ @\ 25^\circ C)}$$

3. The dynamic impedance Z_{KA} is defined as $|Z_{KA}| = \frac{\Delta V_{KA}}{\Delta I_K}$

With two external resistors, R1 and R2, (refer to Figure 1) the total dynamic impedance of the circuit is given by:

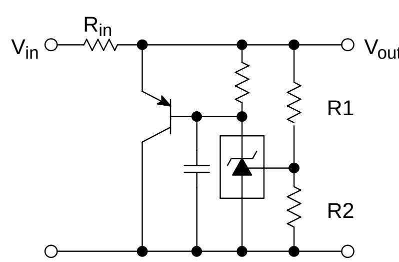
$$|Z_{KA}'| \approx |Z_{KA}| \left(1 + \frac{R1}{R2}\right)$$

TYPICAL APPLICATIONS



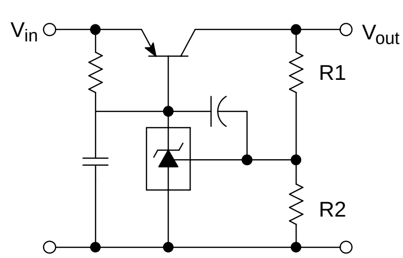
$$V_{out} = \left(1 + \frac{R1}{R2}\right) V_{ref}$$

Figure 1. Shunt Regulator



$$V_{out} = \left(1 + \frac{R1}{R2}\right) V_{ref}$$

Figure 2. High Current Shunt Regulator



$$V_{out} = \left(1 + \frac{R1}{R2}\right) V_{ref}$$

$$V_{out}\ min = 0.9\ V + V_{be}$$

Figure 3. Low Dropout Series Pass Regulator

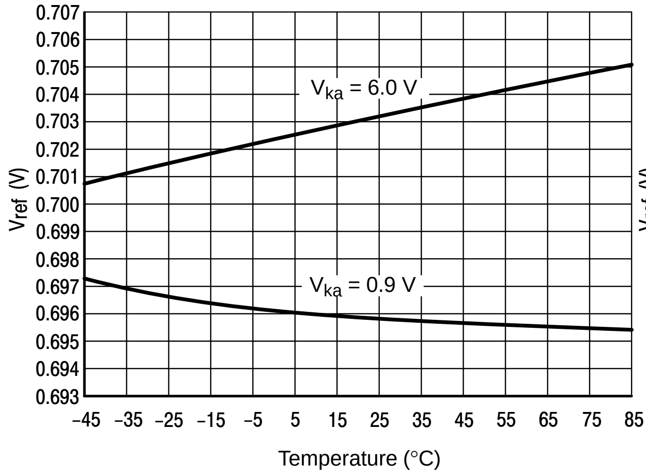


Figure 4. V_{ref} over Temperature for V_{ka} of 0.9 V and 6.0 V, I_{ka} = 10 mA

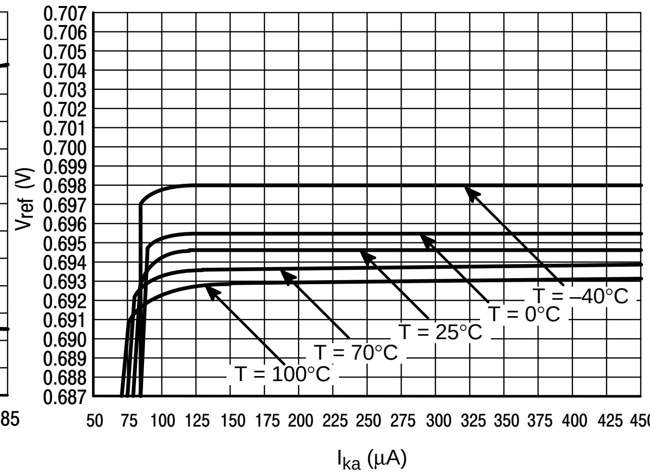


Figure 5. Minimum I_{ka} versus Temperature V_{ka} = 0.9 V (nom)

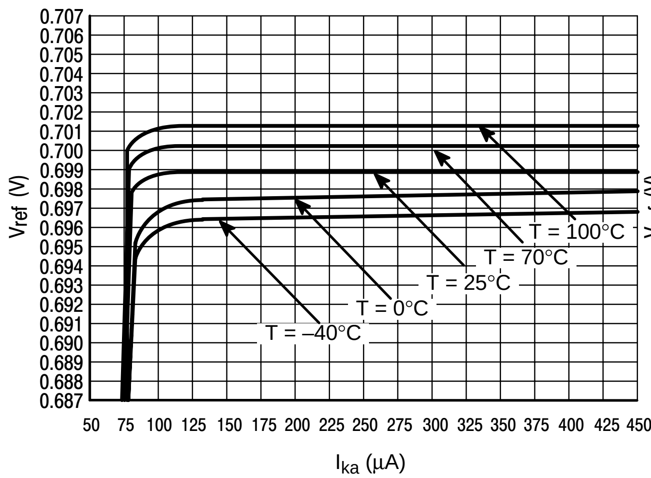


Figure 6. Minimum I_{ka} versus Temperature V_{ka} = 6.0 V (nom)

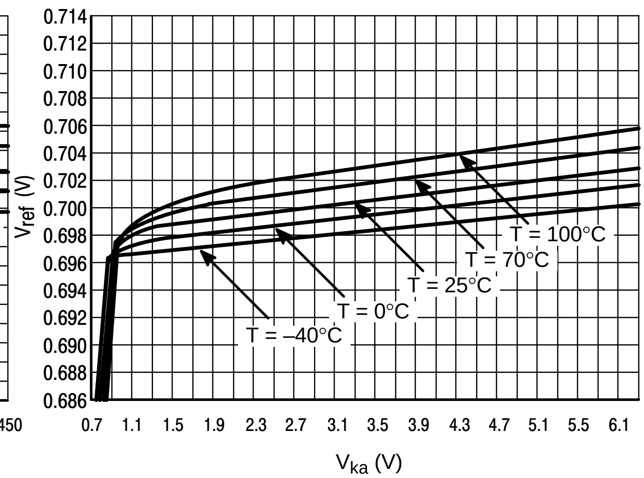


Figure 7. V_{ref} versus V_{ka} over Temperature I_{ka} = 10 mA

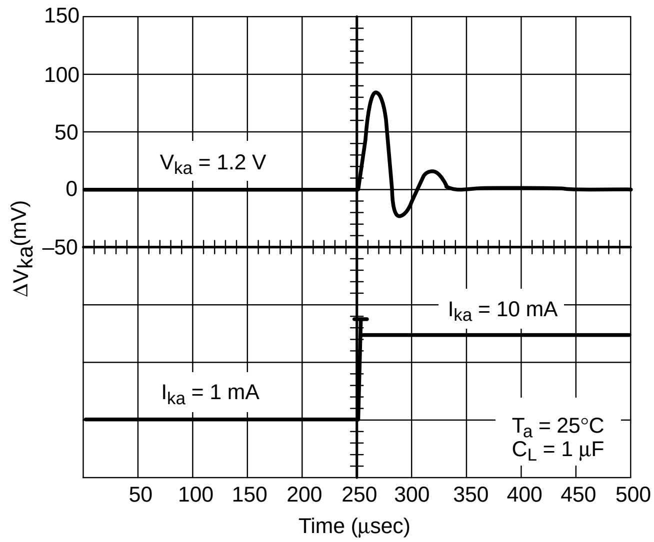


Figure 8. Transient Response of V_{ka} to a I_{ka} Step

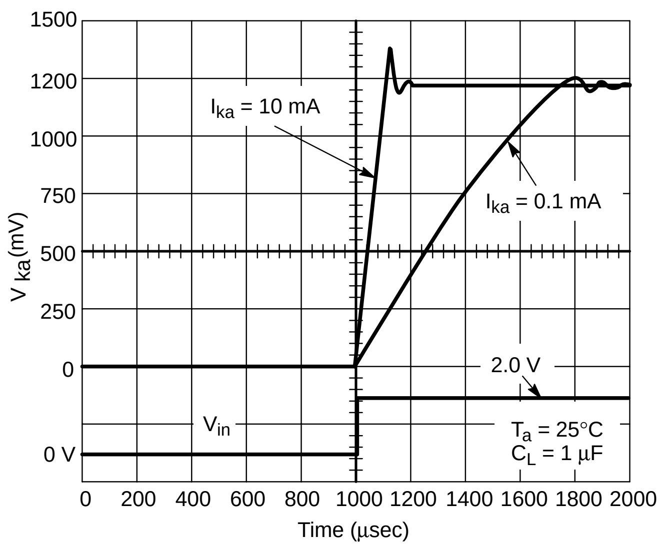


Figure 9. Turn–ON Time with V_{ka} = 1.2 V

APPLICATIONS INFORMATION

The NCP100 is a precision adjustable shut regulator similar to the industry standard 431–type shunt reference. The device has been designed using a CMOS process. Each device is laser trimmed during wafer probe to achieve very tight reference accuracy and low reference temperature shift.

The nominal value of the reference is 0.700 V. This lower voltage allows the device to be used in very low voltage applications where a traditional 1.25 V reference is not suitable. The device requires a minimum cathode to anode voltage of 0.9 V for proper operation. The typical configuration for this device is illustrated in Figure 1. The equation below can be used in calculating V_{ka}:

$$V_{ka} = 0.700\,(1 + R1/R2) + I_{ref} * R1 \qquad (1)$$

Because the error amplifier is a CMOS design the value of I_{ref} is extremely low so the error induced by this current can be neglected for most applications. Also because of the low I_{ref} current, the R1 and R2 resistors can be higher impedance to minimize power dissipation.

The NCP100 requires an output capacitor between the cathode and the anode. The minimum value for this component is 1 μF. Since some types of capacitors have a wide tolerance on the value and in some cases a significant temperature co–efficient, it is important to ensure that this capacitor is > 1 μF under all operating conditions.

In addition to calculating the values or R1 and R2, the input resistance, R_{in} must also set for proper operation. This is determined by calculating the current going into the minimum operating current I_{ka} plus the current through the R1/R2 resistor divider. In addition, the maximum current into the load must be determined. The sum of these three currents determines the current through R_{in}. This is reflected in equation 2:

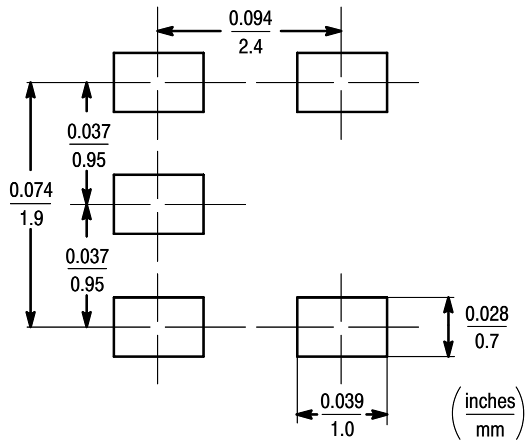
$$R_{in} = (V_{in} - V_{ka})/(I_{ka} + I_{R1/R2} + I_{load}) \qquad (2)$$

This value then should be reviewed to make sure that under worst case conditions, the minimum and maximum I_{ka} values are within specification.

INFORMATION FOR USING THE TSOP–5 SURFACE MOUNT PACKAGE

MINIMUM RECOMMENDED FOOTPRINT FOR SURFACE MOUNTED APPLICATIONS

Surface mount board layout is a critical portion of the total design. The footprint for the semiconductor packages must be the correct size to insure proper solder connection interface between the board and the package. With the correct pad geometry, the packages will self align when subjected to a solder reflow process.

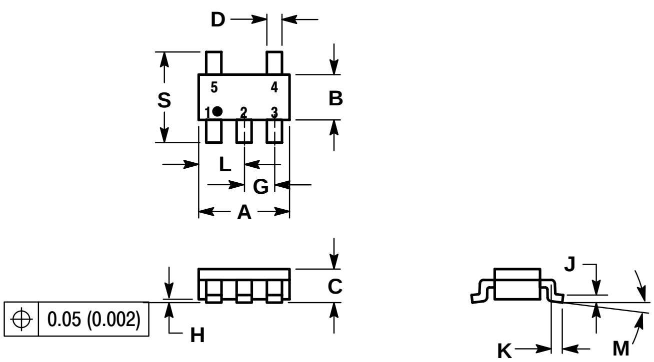


TSOP–5

(TSOP–5 is footprint compatible with SOT23–5)

PACKAGE DIMENSIONS

TSOP–5
SN SUFFIX
PLASTIC PACKAGE
CASE 483–01
ISSUE A



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	2.90	3.10	0.1142	0.1220
B	1.30	1.70	0.0512	0.0669
C	0.90	1.10	0.0354	0.0433
D	0.25	0.50	0.0098	0.0197
G	0.85	1.00	0.0335	0.0413
H	0.013	0.100	0.0005	0.0040
J	0.10	0.26	0.0040	0.0102
K	0.20	0.60	0.0079	0.0236
L	1.25	1.55	0.0493	0.0610
M	0°	10°	0°	10°
S	2.50	3.00	0.0985	0.1181

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