NEC

BIPOLAR ANALOG INTEGRATED CIRCUIT

μPC2933A, 2905A

THREE-TERMINAL LOW DROPOUT VOLTAGE REGULATOR

DESCRIPTION

The μPC2933A, 2905A of low dropout voltage three terminal positive regulators is constructed with PNP output transistor. The μPC2933A, 2905A feature the ability to source 1 A of output current with a low dropout voltage of typically 0.7 V.

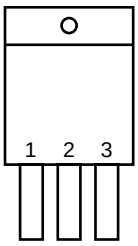
The power dissipation of the μPC2933A, 2905A can be drastically reduced compared with the conventional three terminal positive voltage regulators that is constructed with NPN output transistor. Also, this series corresponds to the low voltage output (3 V, 3.3 V) which is not in the conventional low dropout regulators (μPC2400A series).

FEATURES

- Output current in excess of 1.0 A
- Low dropout voltage V_{DIF} = 0.7 V TYP. (at I_O = 1 A)
- On-chip overcurrent and thermal protection circuit
- On-chip output transistor safe area protection circuit

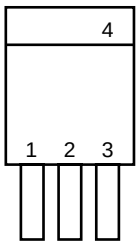
PIN CONFIGURATION (Marking Side)

μPC2933AHF, 2905AHF : MP-45G



1: INPUT
2: GND
3: OUTPUT

μPC2933AHB, 2905AHB : MP-3
μPC2933AT, 2905AT : MP-3Z



1: INPUT
2: GND
3: OUTPUT
4: GND (Fin)

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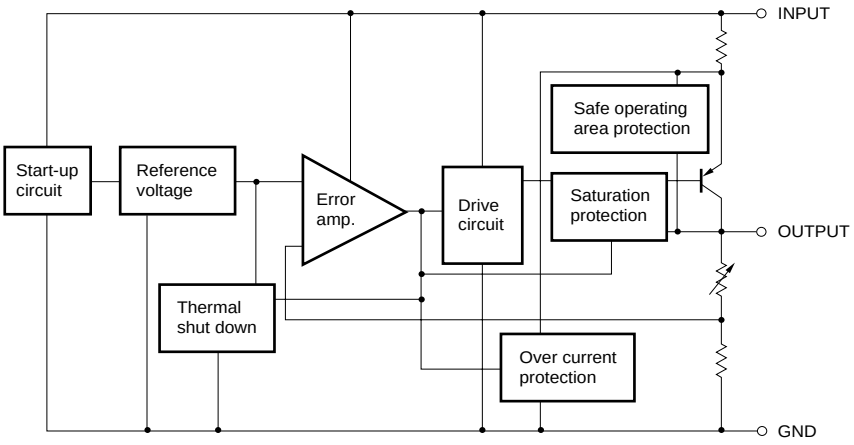
The mark ★ shows major revised points.

BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Output Voltage	Marking	Package Type
μPC2933AHF	MP-45G (Isolated TO-220)	3.3 V	2933A	• Packed in envelope
μPC2933AHB	MP-3 (SC-64)	3.3 V	2933A	• Packed in envelope
μPC2933AT	MP-3Z (SC-63)	3.3 V	2933A	• Packed in envelope
μPC2933AT-E1	MP-3Z (SC-63)	3.3 V	2933A	• 16 mm wide embossed taping • Pin 1 on drawout side • 2000 pcs/reel
μPC2933AT -E2	MP-3Z (SC-63)	3.3 V	2933A	• 16 mm width embossed taping • Pin 1 at takeup side • 2000 pcs/reel
μPC2933AT -T1	MP-3Z (SC-63)	3.3 V	2933A	• 32 mm wide adhesive taping • Pin 1 at drawout side • 1500 pcs/reel
μPC2933AT -T2	MP-3Z (SC-63)	3.3 V	2933A	• 32 mm wide adhesive taping • Pin 1 at takeup side • 1500 pcs/reel
μPC2905AHF	MP-45G (Isolated TO-220)	5.0 V	2905A	• Packed in envelope
μPC2905AHB	MP-3 (SC-64)	5.0 V	2905A	• Packed in envelope
μPC2905AT	MP-3Z (SC-63)	5.0 V	2905A	• Packed in envelope
μPC2905AT-E1	MP-3Z (SC-63)	5.0 V	2905A	• 16 mm wide embossed taping • Pin 1 at drawout side • 2000 pcs/reel
μPC2905AT-E2	MP-3Z (SC-63)	5.0 V	2905A	• 16 mm wide embossed taping • Pin 1 at takeup side • 2000 pcs/reel
μPC2905AT-T1	MP-3Z (SC-63)	5.0 V	2905A	• 32 mm wide adhesive taping • Pin 1 at drawout side • 1500 pcs/reel
μPC2905AT-T2	MP-3Z (SC-63)	5.0 V	2905A	• 32 mm wide adhesive taping • Pin 1 at takeup side • 1500 pcs/reel

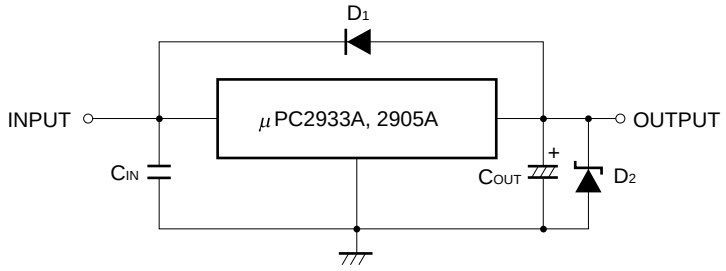
ABSOLUTE MAXIMUM RATINGS (T_A = 25°C unless otherwise specified)

Parameter	Symbol	Rating		Unit
		μPC2933AHF, 2905AHF	μPC2933AHB, 2905AHB μPC2933AT, 2905AT	
Input Voltage	V_{IN}	20		V
Internal Power Dissipation Note (T_C = 25°C)	P_T	15	10	W
Operating Ambient Temperature	T_A	–30 to +85		°C
Operating Junction Temperature	T_J	–30 to +150		°C
Storage Temperature	T_{stg}	–55 to +150		°C
Thermal Resistance (junction to case)	$R_{th(J-C)}$	7	12.5	°C/W
Thermal Resistance (junction to ambient)	$R_{th(J-A)}$	65	125	°C/W

Note Internally limited. When the operating junction temperature rises over 150°C, the internal circuit shuts down the output voltage.

Caution If the absolute maximum rating of any of the above parameters is exceeded even momentarily, the quality of the product may be degraded. In other words, absolute maximum ratings specify the values exceeding which the product may be physically damaged. Be sure to use the product with these ratings never exceeded.

STANDARD CONNECTION



C_{IN}: 0.1 μF or higher. Set this value according to the length of the line between the regulator and INPUT pin. Be sure to connect C_{IN} to prevent parasitic oscillation. Use of a film capacitor or other capacitor with excellent voltage and temperature characteristics is recommended. If using a laminated ceramic capacitor, it is necessary to ensure that C_{IN} is 0.1 μF or higher for the voltage and temperature range to be used.

★ C_{OUT}: 47 μF or higher. Be sure to connect C_{OUT} to prevent oscillation and improve excessive load regulation. Place C_{IN} and C_{OUT} as close as possible to the IC pins (within 2 cm). Also, use an electrolytic capacitor with low impedance characteristics if considering use at sub-zero temperatures.

D_1: If the OUTPUT pin has a higher voltage than the INPUT pin, connect a diode.

D_2: If the OUTPUT pin has a lower voltage than the GND pin, connect a Schottky barrier diode.

Caution Make sure that no voltage is applied to the OUTPUT pin from external.

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Type Number	MIN.	TYP.	MAX.	Unit
Input Voltage	V_{IN}	μPC2933A	4.3		16	V
		μPC2905A	6		16	
Output Current	I_O	All	0		1.0	A
Operating Ambient Temperature	T_A	All	–30		+85	°C
Operating Junction Temperature	T_J	All	–30		+125	°C

ELECTRICAL CHARACTERISTICS

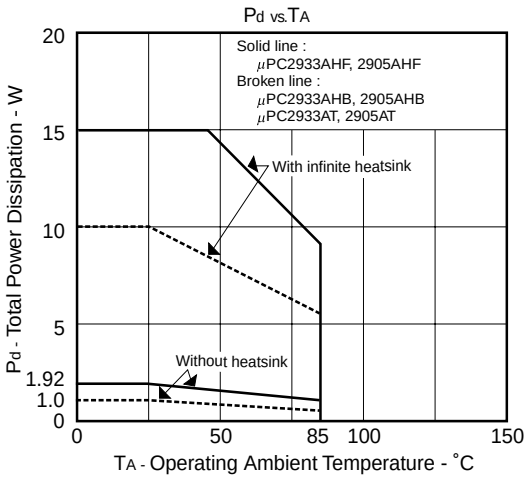
μPC2933A (T_J = 25°C, V_{IN} = 5 V, I_O = 500 mA, C_{IN} = 0.22 μF, C_{OUT} = 47 μF, unless otherwise specified)

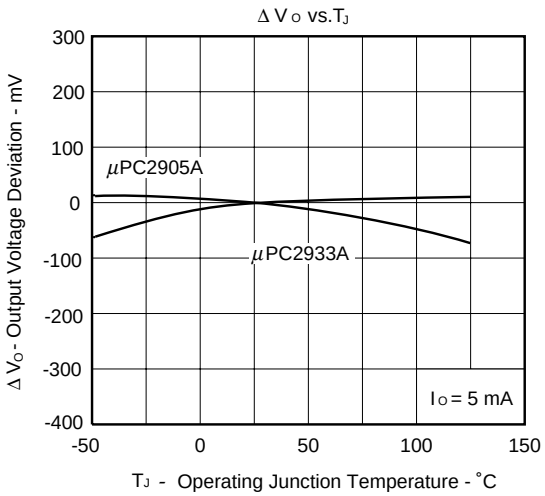
Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Output Voltage	V_O		3.18	3.3	3.42	V
		0°C ≤ T_J ≤ 125°C, 4.3 V ≤ V_{IN} ≤ 16 V, 0 A ≤ I_O ≤ 500 mA	3.14		3.46	
		0°C ≤ T_J ≤ 125°C, 0 A ≤ I_O ≤ 1 A				
Line Regulation	REG_{IN}	4.3 V ≤ V_{IN} ≤ 16 V		12	33	mV
Load Regulation	REG_L	0 A ≤ I_O ≤ 1 A		23	33	
Quiescent Current	I_{BIAS}	I_O = 0 A		2.0	3.0	mA
		I_O = 1 A		20	40	
Startup Quiescent Current	$I_{BIAS\ (s)}$	V_{IN} = 3.1 V, I_O = 0 A		10	30	mA
		V_{IN} = 3.1 V, I_O = 1 A			80	
Quiescent Current Change	ΔI_{BIAS}	0°C ≤ T_J ≤ 125°C, 4.3 V ≤ V_{IN} ≤ 16 V		3.0	15	mA
Output Noise Voltage	V_n	10 Hz ≤ f ≤ 100 kHz		55		$\mu V_{r.m.s.}$
Ripple Rejection	R•R	4.3 V ≤ V_{IN} ≤ 16 V, f = 120 Hz	48	64		dB
Dropout Voltage	V_{DIF}	0°C ≤ T_J ≤ 125°C, I_O = 1 A		0.7	1.0	V
Short Circuit Current	I_{Opeak}	V_{IN} = 4.5 V	1.2	1.6	3.0	A
		V_{IN} = 16 V		1.2		
Peak Output Current	I_{Opeak}	V_{IN} = 4.5 V	1.0	1.4	3.0	A
		V_{IN} = 16 V	1.3	1.7	2.8	
Temperature Coefficient of Output Voltage	$\Delta V_O / \Delta T$	0°C ≤ T_J ≤ 125°C, I_O = 5 mA		–0.4		mV/°C

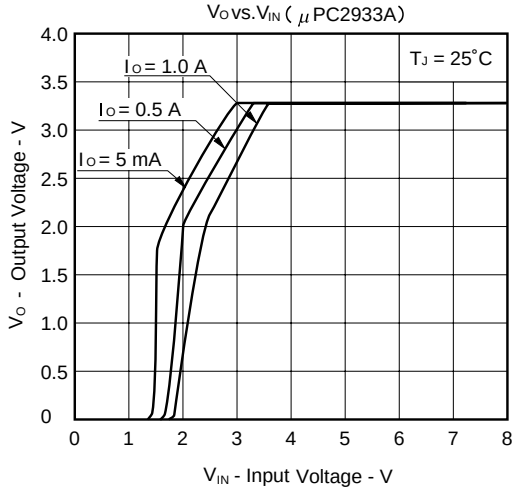
μPC2905A (T_J = 25°C, V_{IN} = 8 V, I_O = 500 mA, C_{IN} = 0.22 μF, C_{OUT} = 47 μF, unless otherwise specified)

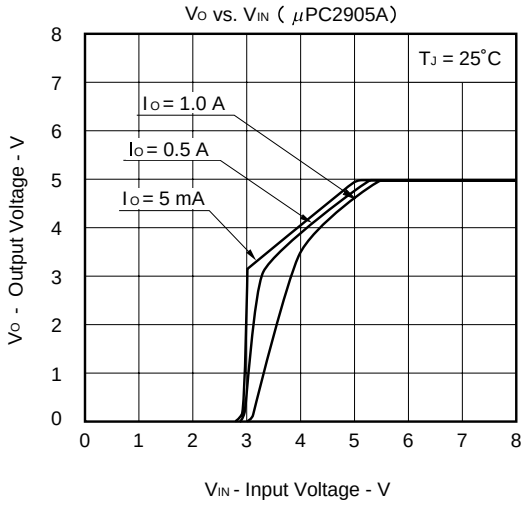
Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Output Voltage	V_O		4.83	5.0	5.18	V
		0°C ≤ T_J ≤ 125°C, 6 V ≤ V_{IN} ≤ 16 V, 0 A ≤ I_O ≤ 500 mA	4.75		5.25	
		0°C ≤ T_J ≤ 125°C, 0 A ≤ I_O ≤ 1 A				
Line Regulation	REG_{IN}	6 V ≤ V_{IN} ≤ 16 V		23	50	mV
Load Regulation	REG_L	0 A ≤ I_O ≤ 1 A		28	50	mV
Quiescent Current	I_{BIAS}	I_O = 0 A		2.2	3.5	mA
		I_O = 1 A		28	50	
Startup Quiescent Current	$I_{BIAS\ (s)}$	V_{IN} = 4.5 V, I_O = 0 A		10	30	mA
		V_{IN} = 4.5 V, I_O = 1 A			50	
Quiescent Current Change	ΔI_{BIAS}	0°C ≤ T_J ≤ 125°C, 6 V ≤ V_{IN} ≤ 16 V		2.9	15	mA
Output Noise Voltage	V_n	10 Hz ≤ f ≤ 100 kHz		90		$\mu V_{r.m.s.}$
Ripple Rejection	R•R	f = 120 Hz, 6 V ≤ V_{IN} ≤ 16 V	46	61		dB
Dropout Voltage	V_{DIF}	0°C ≤ T_J ≤ 125°C, I_O = 1 A		0.7	1.0	V
Short Circuit Current	I_{Opeak}	V_{IN} = 6.5 V	1.15	1.8	3.0	A
		V_{IN} = 16 V		1.1		
Peak Output Current	I_{Opeak}	V_{IN} = 6.5 V	1.1	1.5	3.0	A
		V_{IN} = 16 V	1.4	2.0	2.8	
Temperature Coefficient of Output Voltage	$\Delta V_O / \Delta T$	0°C ≤ T_J ≤ 125°C, I_O = 5 mA		0.6		mV/°C

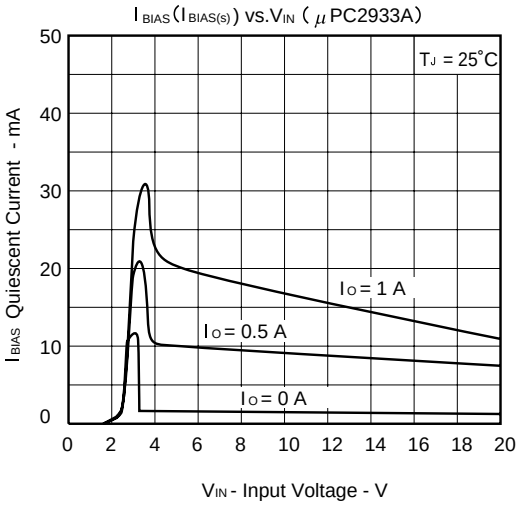
TYPICAL CHARACTERISTICS (Reference Values)

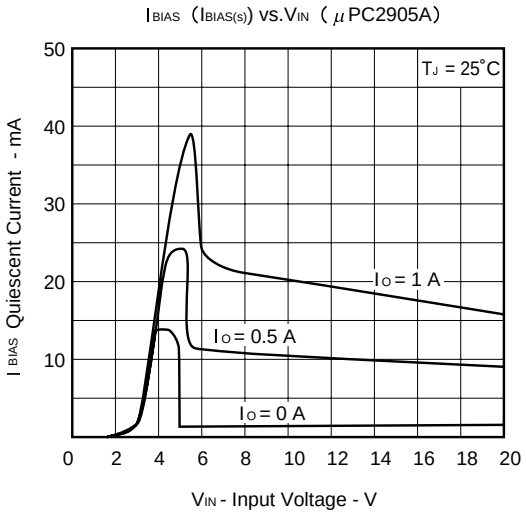


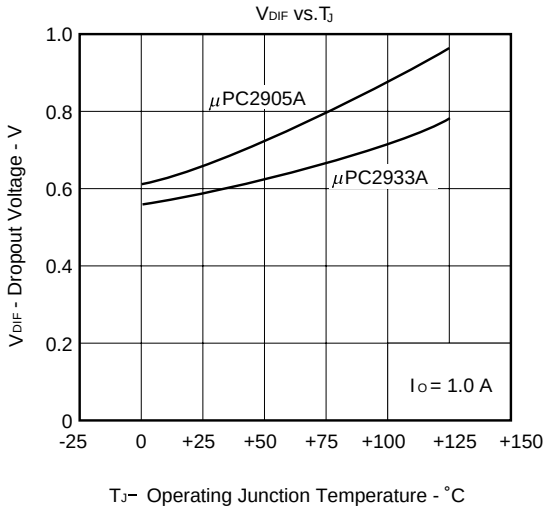


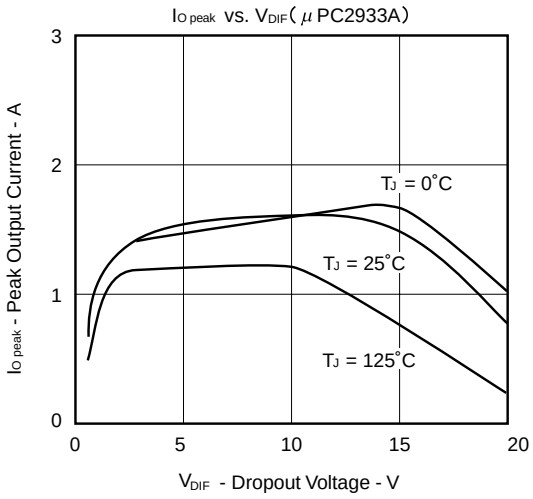


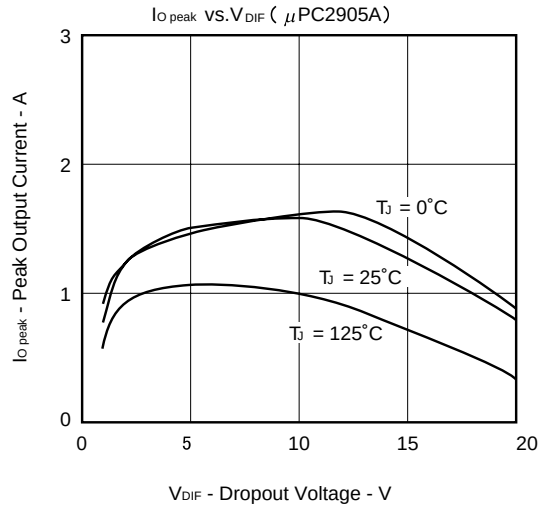


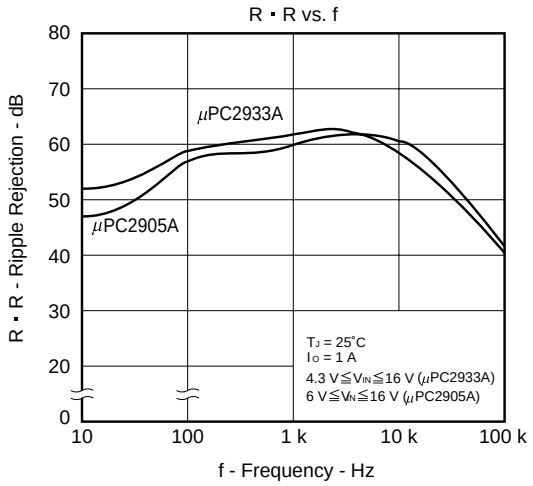


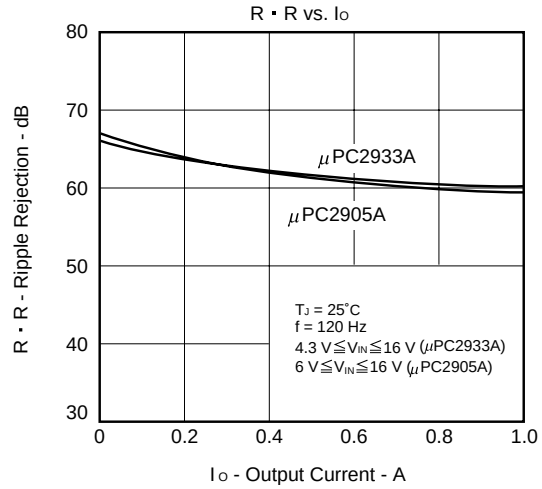


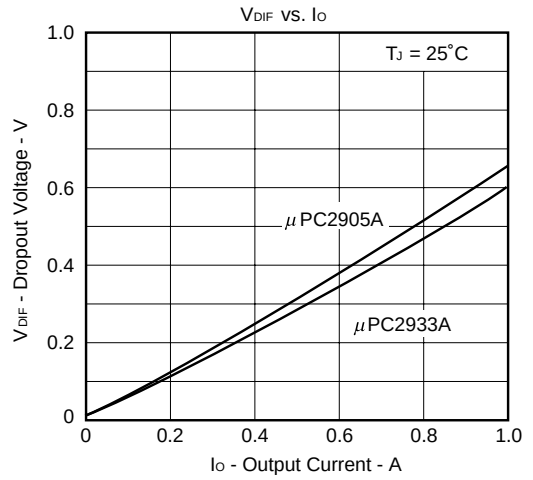

VDIF vs.TJ
VDIF - Dropout Voltage - V
μPC2905A
μPC2933A
IO = 1.0 A
TJ– Operating Junction Temperature - ˚C

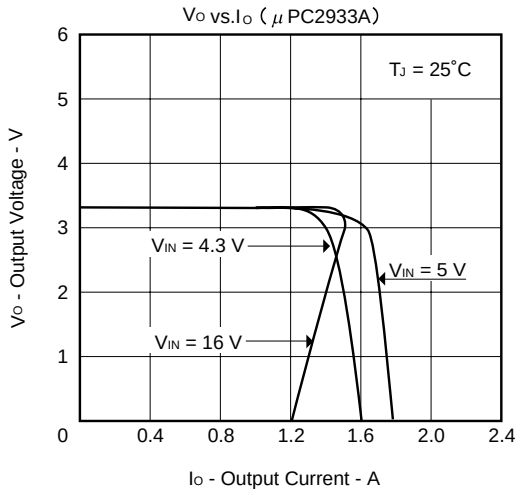

IO peak vs. VDIF (μPC2933A)
IO peak - Peak Output Current - A
TJ = 0˚C
TJ = 25˚C
TJ = 125˚C
VDIF - Dropout Voltage - V

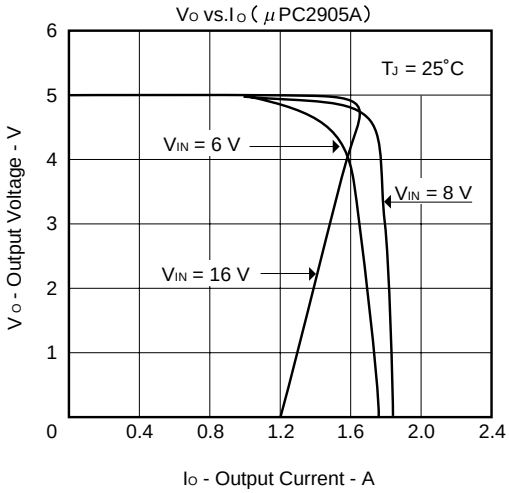

IO peak vs.VDIF (μPC2905A)
IO peak - Peak Output Current - A
TJ = 0˚C
TJ = 25˚C
TJ = 125˚C
VDIF - Dropout Voltage - V


R ▪ R vs. f
R ▪ R - Ripple Rejection - dB
μPC2933A
μPC2905A
TJ = 25˚C
IO = 1 A
4.3 V≦VIN≦16 V (μPC2933A)
6 V≦VIN≦16 V (μPC2905A)
f - Frequency - Hz


R ▪ R vs. IO
R ▪ R - Ripple Rejection - dB
μPC2933A
μPC2905A
TJ = 25˚C
f = 120 Hz
4.3 V≦VIN≦16 V (μPC2933A)
6 V≦VIN≦16 V (μPC2905A)
IO - Output Current - A


VDIF vs. IO
VDIF - Dropout Voltage - V
TJ = 25˚C
μPC2905A
μPC2933A
IO - Output Current - A

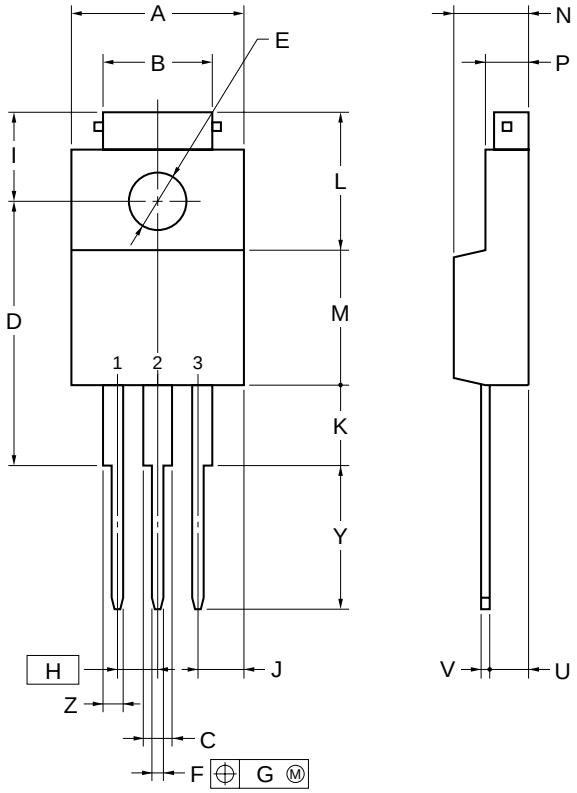

VO vs.IO (μPC2933A)
TJ = 25˚C
VIN = 4.3 V
VIN = 5 V
VIN = 16 V
VO - Output Voltage - V
IO - Output Current - A
0
1
2
3
4
5
6
0.4
0.8
1.2
1.6
2.0
2.4


VO vs.IO (μPC2905A)
TJ = 25˚C
VIN = 6 V
VIN = 8 V
VIN = 16 V
VO - Output Voltage - V
IO - Output Current - A
0
1
2
3
4
5
6
0.4
0.8
1.2
1.6
2.0
2.4

PACKAGE DRAWINGS

μPC2933AHF, 2905AHF

3PIN PLASTIC SIP (MP-45G)



NOTE

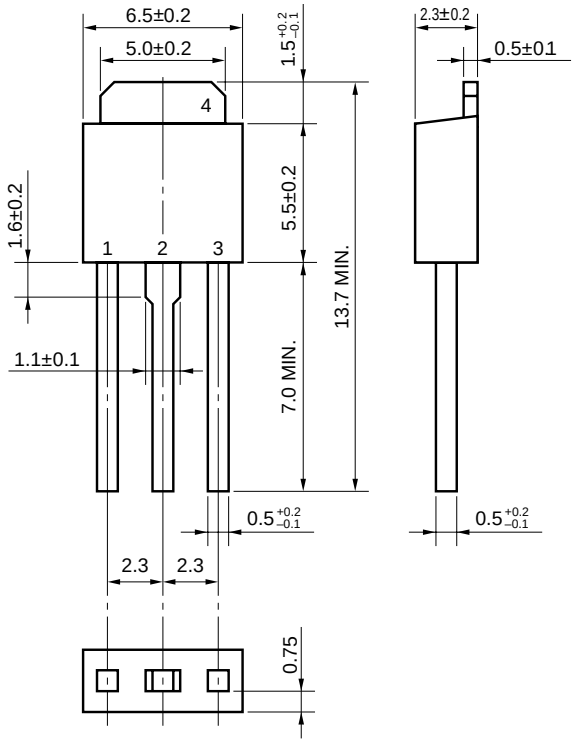
Each lead centerline is located within 0.25 mm of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS
A	10.0±0.2
B	7.0±0.2
C	1.50±0.2
D	17.0±0.3
E	φ3.3±0.2
F	0.75±0.10
G	0.25
H	2.54 (T.P.)
I	5.0±0.3
J	2.46±0.2
K	5.0±0.2
L	8.5±0.2
M	8.5±0.2
N	4.5±0.2
P	2.8±0.2
U	2.4±0.5
V	0.65±0.10
Y	8.9±0.7
Z	1.30±0.2

P3HF-254B-4

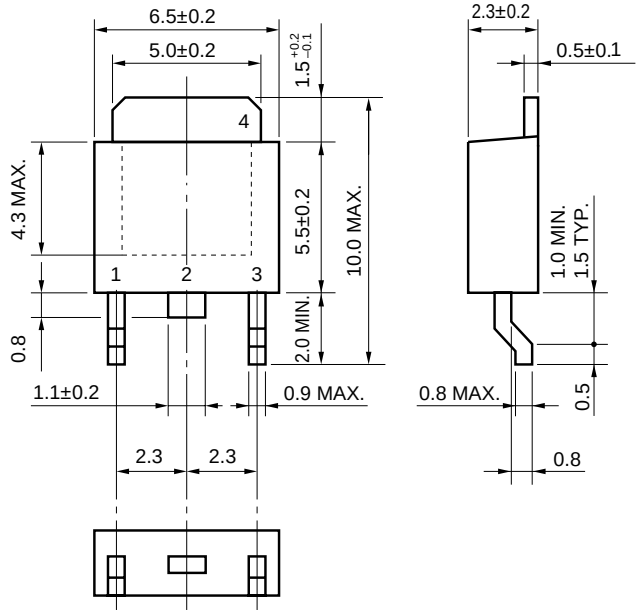
μPC2933AHB, 2905AHB

MP-3(SC-64) (Unit: mm)



μPC2933AT, 2905AT

MP-3Z (SC-63) (Unit: mm)



RECOMMENDED SOLDERING CONDITIONS

When soldering this product, it is highly recommended to observe the conditions as shown below. If other soldering processes are used, or if the soldering is perfomed under different condition, please make sure to consult with our sales offices.

For more details, refer to our document **"SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL" (C10535E)**.

Surface Mount Device

μPC2933AT, 2905AT: MP-3Z (SC-63)

Process	Conditions	Symbol
Infrared Ray Reflow	Peak temperature: 235°C or below (Package surface temperature), Reflow time: 30 seconds or less (at 210°C or higher), Maximum number of reflow processes: 2 times or less.	IR35-00-2
Vapor Phase Soldering	Peak temperature: 215°C or below (Package surface temperature), Reflow time: 40 seconds or less (at 200°C or higher), Maximum number of reflow processes: 2 times or less.	VP15-00-2
Wave Soldering	Solder temperature: 260°C or below, Flow time: 10 seconds or less, Maximum number of flow processes: 1 time, Pre-heating temperature: 120°C or below (Package surface temperature).	WS60-00-1
Partial Heating Method	Pin temperature: 300°C or below, Heat time: 3 seconds or less (Per each side of the device).	–

Caution Apply only one kind of soldering condition to a device, except for "partial heating method", or the device will be damaged by heat stress.

Through-hole devices

μPC2933AHF, 2905AHF: MP-45G
μPC2933AHB, 2905AHB: MP-3

Process	Conditions
Wave soldering (only to leads)	Solder temperature: 260°C or below, Flow time: 10 seconds or less.
Partial heating method	Pin temperature: 300°C or below, Heat time: 3 seconds or less (Per each pin).

Caution For through-hole device, the wave soldering process must be applied only to leads, and make sure that the package body does not get jet soldered.

NOTES ON USE

When the μPC2933A, 2905A are used with an input voltage that is lower than the value indicated in the recommended operating conditions, a large quiescent current flows through the device due to saturation of the transistor of the output stage. (Refer to the I_{BIAS} ($I_{BIAS(S)}$) vs. V_{IN} curves in **TYPICAL CHARACTERISTICS**).

These products have saturation protector, but a current of up to 80 mA MAX. may flow through the device. Thus the power supply on the input side must have sufficient capacity to allow this quiescent current to pass when the device starts up.

REFERENCE DOCUMENTS

Document Name	Document No.
QUALITY GRADES ON NEC SEMICONDUCTOR DEVICES	C11531E
SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL	C10535E
VOLTAGE REGULATOR OF SMD	G11872E
SEMICONDUCTOR SELECTION GUIDE – PRODUCTS AND PACKAGES	X13769E

[MEMO]

[MEMO]

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  "Standard": Computers, office equipment, communications equipment, test and measurement equipment, audio and visual equipment, home electronic appliances, machine tools, personal electronic equipment and industrial robots

  "Special": Transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, safety equipment and medical equipment (not specifically designed for life support)

  "Specific": Aircraft, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems and medical equipment for life support, etc.

  The quality grade of NEC semiconductor products is "Standard" unless otherwise expressly specified in NEC's data sheets or data books, etc. If customers wish to use NEC semiconductor products in applications not intended by NEC, they must contact an NEC sales representative in advance to determine NEC's willingness to support a given application.

  (Note)

  (1) "NEC" as used in this statement means NEC Corporation and also includes its majority-owned subsidiaries.

  (2) "NEC semiconductor products" means any semiconductor product developed or manufactured by or for NEC (as defined above).

M8E 00. 4