NEC

BIPOLAR ANALOG INTEGRATED CIRCUIT
μPC37M31,37M32

TWO-OUTPUT POSITIVE VOLTAGE REGULATORS

DESCRIPTION

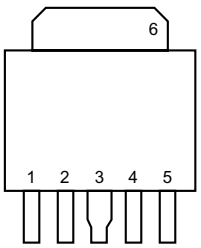
The μPC37M31 and 37M32 are series regulators with two outputs, $OUTPUT_1$: 1 A and $OUTPUT_2$: 0.5 A, built in a single package. $OUTPUT_1$ outputs 3.3 V and $OUTPUT_2$ outputs 1.8 V and 2.5 V. These regulators can be used to realize set miniaturization and component reduction due to the use of on MP-3 or MP-3Z package.

FEATURES

- Two outputs, 3.3 V and 1.8 V or 2.5 V, built in a single package
- Output voltage accuracy: ±2%
- Peak output current: $OUTPUT_1$: 1 A, $OUTPUT_2$: 0.5 A
- On-chip saturation protector at low input voltage
- On-chip overcurrent limiter
- On-chip thermal protection

PIN CONFIGURATION (Marking Side)

MP-3Z (5-pin), MP-3 (5-pin)



1: INPUT
2: NC
3: GND
4: $OUTPUT_1$
5: $OUTPUT_2$
6: GND (Fin)

ORDERING INFORMATION

Part Number	Package	Marking	Packing Type
μPC37MxxTJ	5-pin MP-3Z (SC-98)	37Mxx	• Bag stuffing
μPC37MxxTJ-E1	5-pin MP-3Z (SC-98)	37Mxx	• Embossed-type taping (16 mm tape) • Pin 1 on drawout side • 2000 pcs/reel
μPC37MxxTJ-E2	5-pin MP-3Z (SC-98)	37Mxx	• Embossed-type taping (16 mm tape) • Pin 1 on takeup side • 2000 pcs/reel
μPC37MxxHB	5-pin MP-3 (SC-99)	37Mxx	• Bag stuffing

"xx" in the part number and marking columns indicates the following.

Example

Output Voltage		Part Number	Marking
$OUTPUT_1$	$OUTPUT_2$		
3.3 V	1.8 V	μPC37M31TJ	37M31
3.3 V	2.5 V	μPC37M32TJ	37M32

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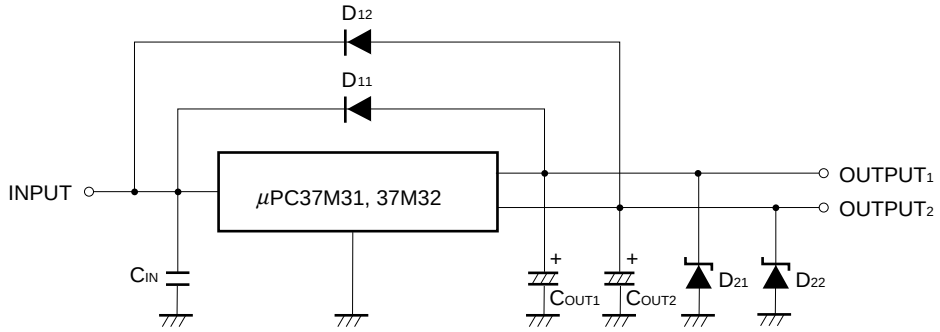
ABSOLUTE MAXIMUM RATINGS (T_A = 25°C, unless otherwise specified)

Parameter	Symbol	Rating	Unit
Input Voltage	V_{IN}	−0.3 to +8	V
Internal Power Dissipation (T_C = 25°C)	P_T	10 Note	W
Operating Ambient Temperature	T_A	−40 to +85	°C
Operating Junction Temperature	T_J	−40 to +150	°C
Storage Temperature	T_{stg}	−55 to +150	°C
Thermal Resistance (junction to case)	$R_{th(J-C)}$	12.5	°C/W
Thermal Resistance (junction to ambient)	$R_{th(J-A)}$	125	°C/W

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

Caution Product quality may suffer if the absolute maximum rating is exceeded even momentarily for any parameter. That is, the absolute maximum ratings are rated values at which the product is on the verge of suffering physical damage, and therefore the product must be used under conditions that ensure that the absolute maximum ratings are not exceeded.

TYPICAL 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_{OUT1}, C_{OUT2}: 10 μF or higher. Be sure to connect C_{OUT1} and C_{OUT2} to prevent oscillation and improve excessive load regulation. Place C_{IN}, C_{OUT1} and C_{OUT2} 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_{11}, D_{12}: If the $OUTPUT_1$ pin or $OUTPUT_2$ pin has a higher voltage than the INPUT pin, connect a diode.

D_{21}, D_{22}: If the $OUTPUT_1$ pin or $OUTPUT_2$ pin has a lower voltage than the GND pin, connect a Schottky barrier diode.

Caution Make sure that no voltage is applied to the $OUTPUT_1$ pin or $OUTPUT_2$ pin from external.

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Input Voltage	V_{IN}	4.5		6.0	V
Output Current 1	I_{O1}	0		0.5	A
Output Current 2	I_{O2}	0		0.3	A
Operating Ambient Temperature	T_A	–40		+85	°C
Operating Junction Temperature	T_J	–40		+125	°C

Caution Use of conditions other than the above-listed recommended operating conditions is not a problem as long as the absolute maximum ratings are not exceeded. However, since the use of such conditions diminishes the margin of safety, careful evaluation is required before such conditions are used. Moreover, using the MAX. value for all the recommended operating conditions is not guaranteed to be safe.

ELECTRICAL CHARACTERISTICS

μPC37M31 (T_J = 25°C, V_{IN} = 5 V, I_{O1} = 0.5 A, I_{O2} = 0.3 A, unless otherwise specified)

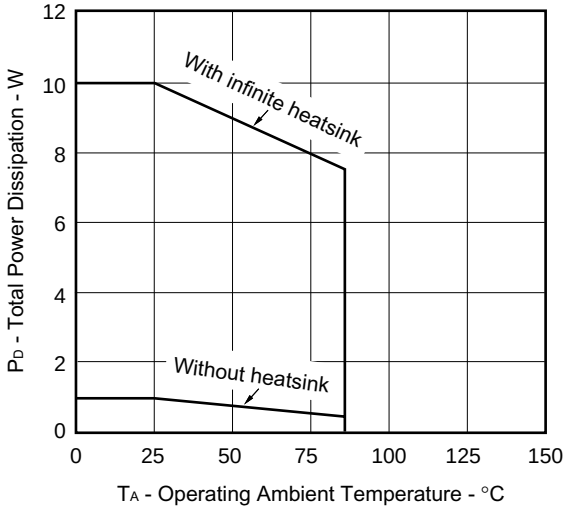
	Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
$OUTPUT_1$ (3.3 V)	Output Voltage 1	V_{O1}		3.234	3.3	3.366	V
	Line Regulation 1	REG_{IN1}	4.5 V ≤ V_{IN} ≤ 6.0 V	–	2	9	mV
	Load Regulation 1	REG_{L1}	5 mA ≤ I_O ≤ 1 A	–	20	66	mV
	Output Noise Voltage 1	V_{n1}	10 Hz ≤ I_O ≤ 100 kHz	–	76	–	μVr.m.s.
	Ripple Rejection 1	R•R_1	f = 120 Hz, 4.5 V ≤ V_{IN} ≤ 6.0 V	–	57	–	dB
	Short Circuit Current 1	$I_{Oshort1}$	V_{IN} = 6.0 V	–	0.5	–	A
	Peak Output Current 1	I_{Opeak1}	V_{IN} = 5.0 V	1.0	1.4	–	A
	Temperature Coefficient of Output Voltage 1	$\Delta V_{O1}/\Delta T$	I_O = 5 mA, 0°C ≤ T_J ≤ 125°C	–	–0.4	–	mV/°C
$OUTPUT_2$ (1.8 V)	Output Voltage 2	V_{O2}		1.764	1.8	1.836	V
	Line Regulation 2	REG_{IN2}	4.5 V ≤ V_{IN} ≤ 6.0 V	–	2	9	mV
	Load Regulation 2	REG_{L2}	5 mA ≤ I_O ≤ 0.5 A	–	17	50	mV
	Output Noise Voltage 2	V_{n2}	10 Hz ≤ I_O ≤ 100 kHz	–	60	–	μVr.m.s.
	Ripple Rejection 2	R•R_2	f = 120 Hz, 4.5 V ≤ V_{IN} ≤ 6.0 V	–	60	–	dB
	Short Circuit Current 2	$I_{Oshort2}$	V_{IN} = 6.0 V	–	0.3	–	A
	Peak Output Current 2	I_{Opeak2}	V_{IN} = 5.0 V	0.5	0.8	–	A
	Temperature Coefficient of Output Voltage 2	$\Delta V_{O2}/\Delta T$	I_O = 5 mA, 0°C ≤ T_J ≤ 125°C	–	–0.4	–	mV/°C
Total	Quiescent Current	I_{BIAS}	I_{O1} = 0 A, I_{O2} = 0 A	–	4	8	mA
	Startup Quiescent Current	$I_{BIAS\ (S)}$	V_{IN} = 1.7 V, I_{O1} = 0 A, I_{O2} = 0 A	–	7	40	mA
	Dropout Voltage (INPUT to $OUTPUT_1$)	V_{DIF1}	I_{O1} = 0.5 A	–	0.6	1.0	V

μPC37M32 (T_J = 25°C, V_{IN} = 5 V, I_{O1} = 0.5 A, I_{O2} = 0.3 A, unless otherwise specified)

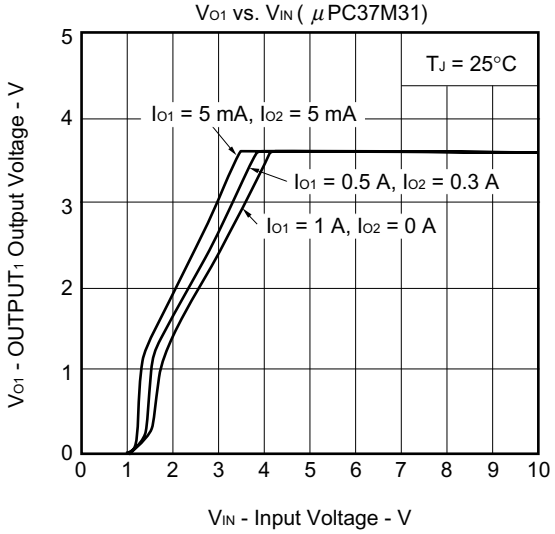
	Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
$OUTPUT_1$ (3.3 V)	Output Voltage 1	V_{O1}		3.234	3.3	3.366	V
	Line Regulation 1	REG_{IN1}	4.5 V ≤ V_{IN} ≤ 6.0 V	–	2	9	mV
	Load Regulation 1	REG_{L1}	5 mA ≤ I_O ≤ 1 A	–	20	66	mV
	Output Noise Voltage 1	V_{n1}	10 Hz ≤ I_O ≤ 100 kHz	–	76	–	μVr.m.s.
	Ripple Rejection 1	R•R_1	f = 120 Hz, 4.5 V ≤ V_{IN} ≤ 6.0 V	–	57	–	dB
	Short Circuit Current 1	$I_{Oshort1}$	V_{IN} = 6.0 V	–	0.5	–	A
	Peak Output Current 1	I_{Opeak1}	V_{IN} = 5.0 V	1.0	1.4	–	A
	Temperature Coefficient of Output Voltage 1	$\Delta V_{O1}/\Delta T$	I_O = 5 mA, 0°C ≤ T_J ≤ 125°C	–	−0.4	–	mV/°C
$OUTPUT_2$ (2.5 V)	Output Voltage 2	V_{O2}		2.45	2.5	2.55	V
	Line Regulation 2	REG_{IN2}	4.5 V ≤ V_{IN} ≤ 6.0 V	–	2	9	mV
	Load Regulation 2	REG_{L2}	5 mA ≤ I_O ≤ 0.5 A	–	17	50	mV
	Output Noise Voltage 2	V_{n2}	10 Hz ≤ I_O ≤ 100 kHz	–	60	–	μVr.m.s.
	Ripple Rejection 2	R•R_2	f = 120 Hz, 4.5 V ≤ V_{IN} ≤ 6.0 V	–	60	–	dB
	Short Circuit Current 2	$I_{Oshort2}$	V_{IN} = 6.0 V	–	0.3	–	A
	Peak Output Current 2	I_{Opeak2}	V_{IN} = 5.0 V	0.5	0.8	–	A
	Temperature Coefficient of Output Voltage 2	$\Delta V_{O2}/\Delta T$	I_O = 5 mA, 0°C ≤ T_J ≤ 125°C	–	−0.4	–	mV/°C
Total	Quiescent Current	I_{BIAS}	I_{O1} = 0 A, I_{O2} = 0 A	–	4	8	mA
	Startup Quiescent Current	$I_{BIAS\ (S)}$	V_{IN} = 2.4 V, I_{O1} = 0 A, I_{O2} = 0 A	–	7	40	mA
	Dropout Voltage (INPUT to $OUTPUT_1$)	V_{DIF1}	I_{O1} = 0.5 A	–	0.6	1.0	V

TYPICAL CHARACTERISTICS (Reference Values)

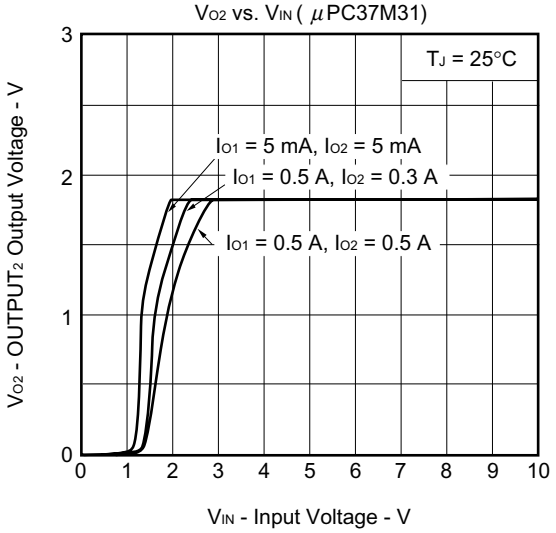
P_D vs. T_A



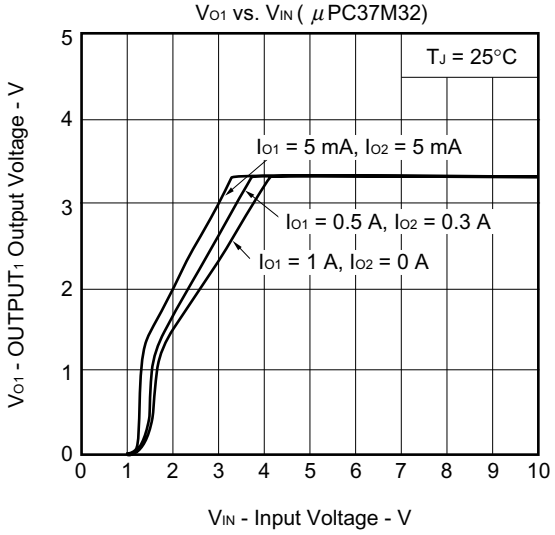
V_{O1} vs. V_{IN} (μPC37M31)



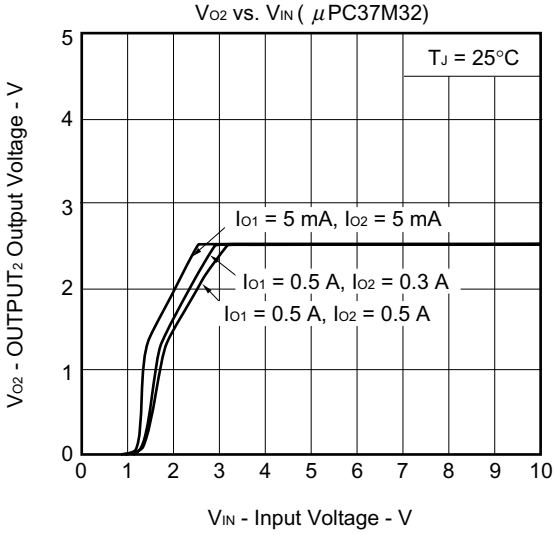
V_{O2} vs. V_{IN} (μPC37M31)



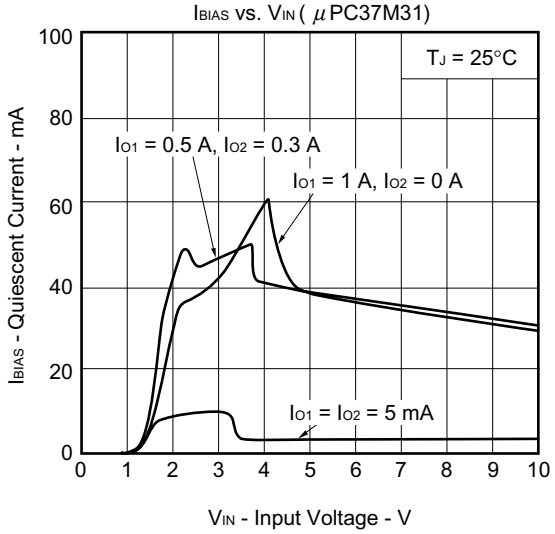
V_{O1} vs. V_{IN} (μPC37M32)

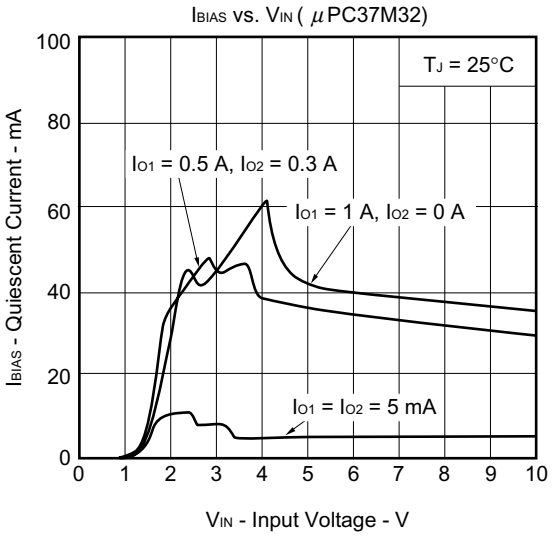


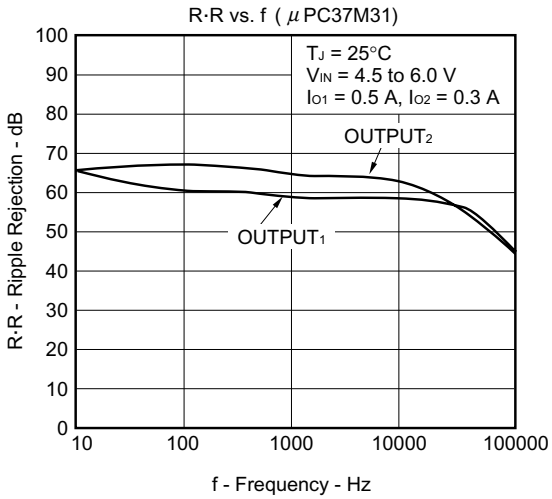
V_{O2} vs. V_{IN} (μPC37M32)

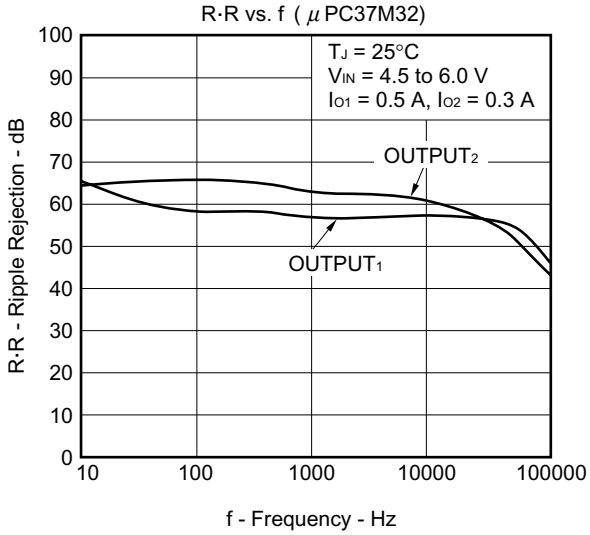


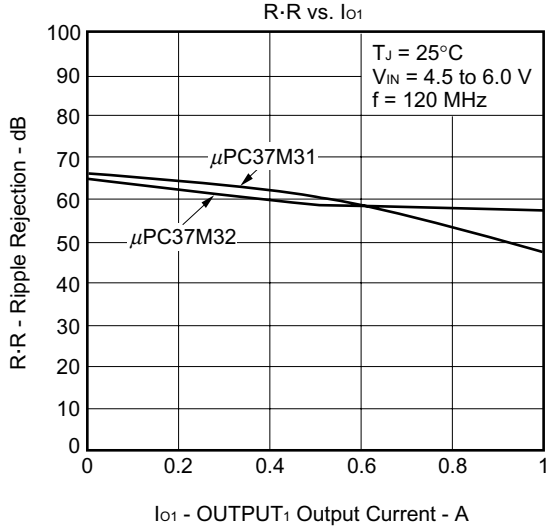
I_{BIAS} vs. V_{IN} (μPC37M31)

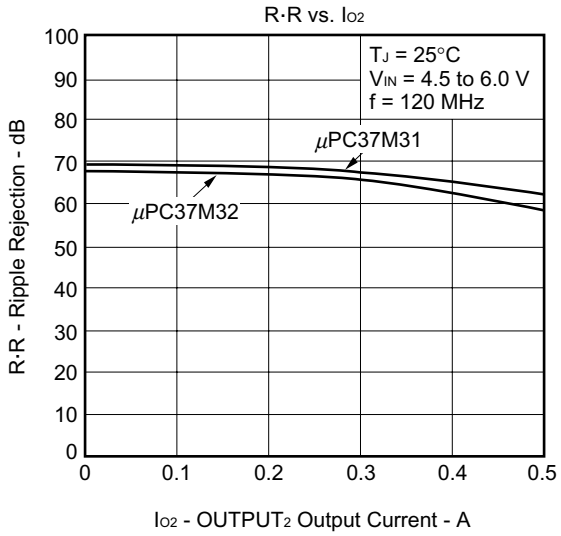


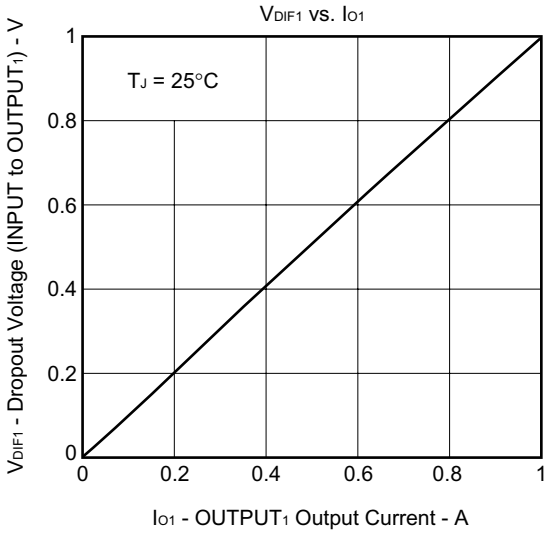

IBIAS vs. VIN (μPC37M32)
TJ = 25°C
IO1 = 0.5 A, IO2 = 0.3 A
IO1 = 1 A, IO2 = 0 A
IO1 = IO2 = 5 mA
IBIAS - Quiescent Current - mA
VIN - Input Voltage - V

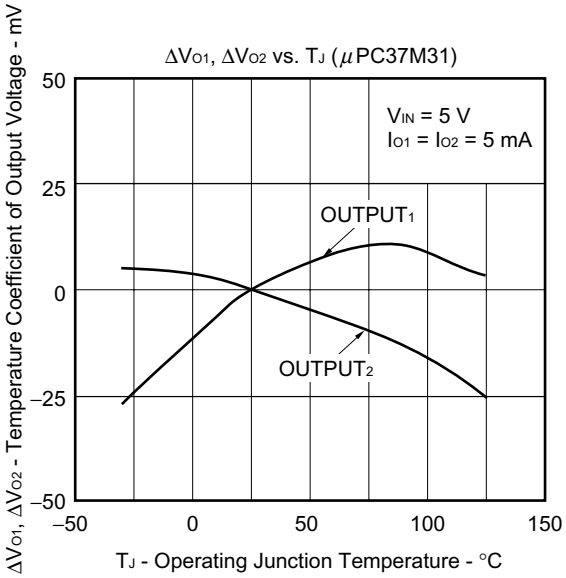

R·R vs. f (μPC37M31)
TJ = 25°C
VIN = 4.5 to 6.0 V
IO1 = 0.5 A, IO2 = 0.3 A
OUTPUT2
OUTPUT1
R·R - Ripple Rejection - dB
f - Frequency - Hz

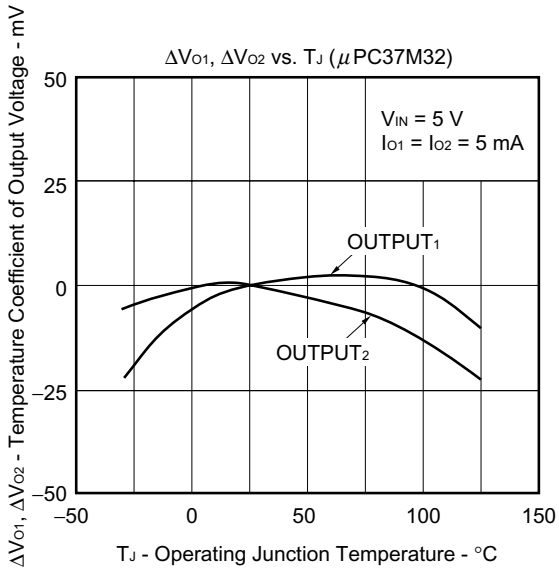

R·R vs. f (μPC37M32)
TJ = 25°C
VIN = 4.5 to 6.0 V
IO1 = 0.5 A, IO2 = 0.3 A
OUTPUT2
OUTPUT1
R·R - Ripple Rejection - dB
f - Frequency - Hz

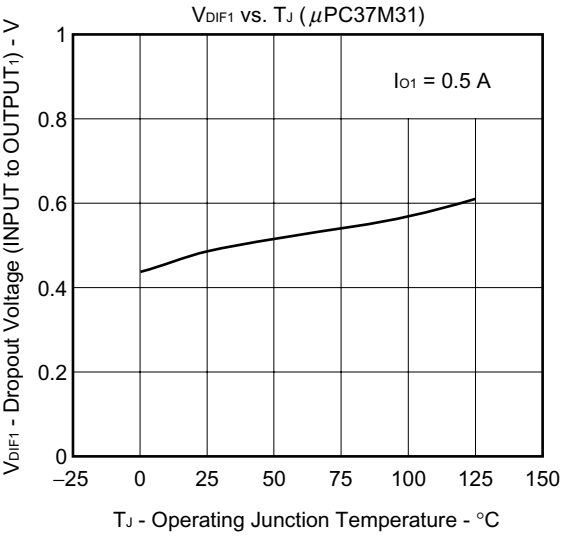

R·R vs. IO1
TJ = 25°C
VIN = 4.5 to 6.0 V
f = 120 MHz
μPC37M31
μPC37M32
R·R - Ripple Rejection - dB
IO1 - OUTPUT1 Output Current - A

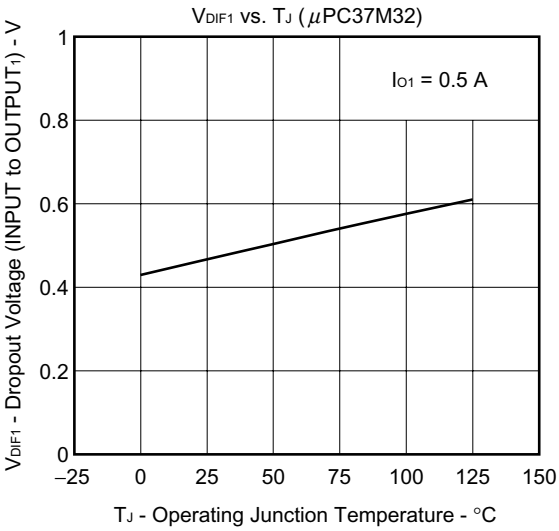

R·R vs. IO2
TJ = 25°C
VIN = 4.5 to 6.0 V
f = 120 MHz
μPC37M31
μPC37M32
R·R - Ripple Rejection - dB
IO2 - OUTPUT2 Output Current - A

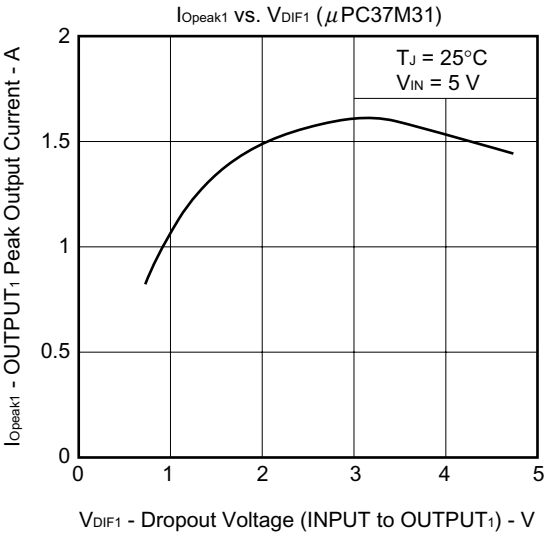

VDIF1 vs. IO1
TJ = 25°C
VDIF1 - Dropout Voltage (INPUT to OUTPUT1) - V
IO1 - OUTPUT1 Output Current - A

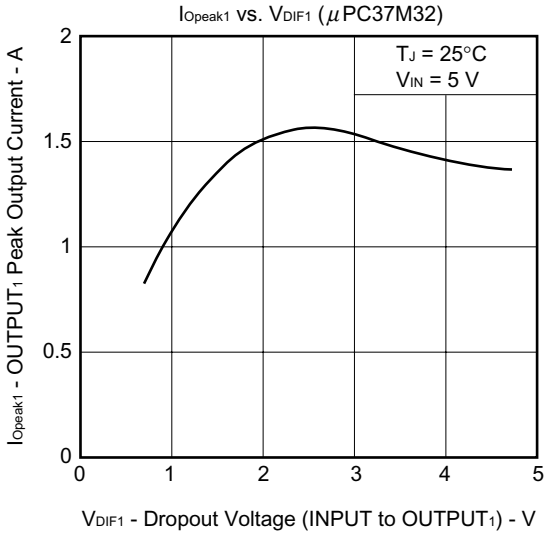

ΔVO1, ΔVO2 vs. TJ (μPC37M31)
VIN = 5 V
IO1 = IO2 = 5 mA
OUTPUT1
OUTPUT2
ΔVO1, ΔVO2 - Temperature Coefficient of Output Voltage - mV
TJ - Operating Junction Temperature - °C


ΔVO1, ΔVO2 vs. TJ (μPC37M32)
VIN = 5 V
IO1 = IO2 = 5 mA
OUTPUT1
OUTPUT2
ΔVO1, ΔVO2 - Temperature Coefficient of Output Voltage - mV
TJ - Operating Junction Temperature - °C


VDIF1 vs. TJ (μPC37M31)
IO1 = 0.5 A
VDIF1 - Dropout Voltage (INPUT to OUTPUT1) - V
TJ - Operating Junction Temperature - °C

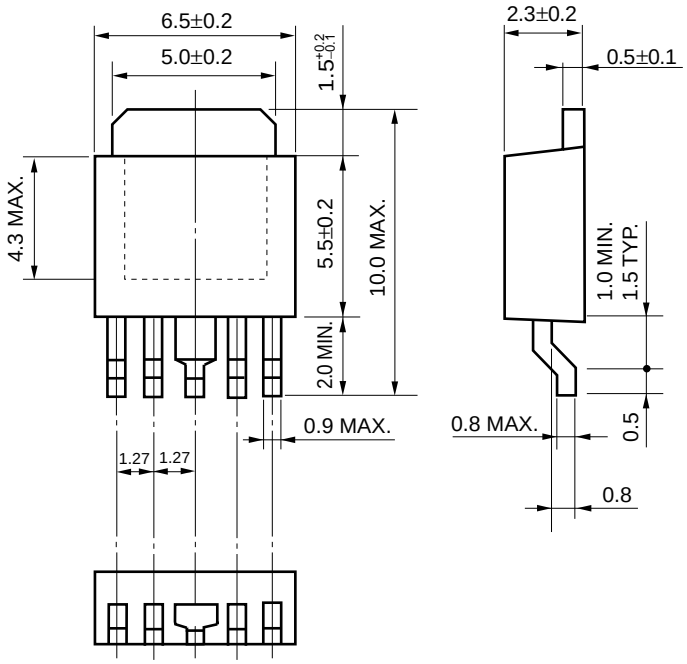

VDIF1 vs. TJ (μPC37M32)
IO1 = 0.5 A
VDIF1 - Dropout Voltage (INPUT to OUTPUT1) - V
TJ - Operating Junction Temperature - °C


IOpeak1 vs. VDIF1 (μPC37M31)
TJ = 25°C
VIN = 5 V
IOpeak1 - OUTPUT1 Peak Output Current - A
VDIF1 - Dropout Voltage (INPUT to OUTPUT1) - V

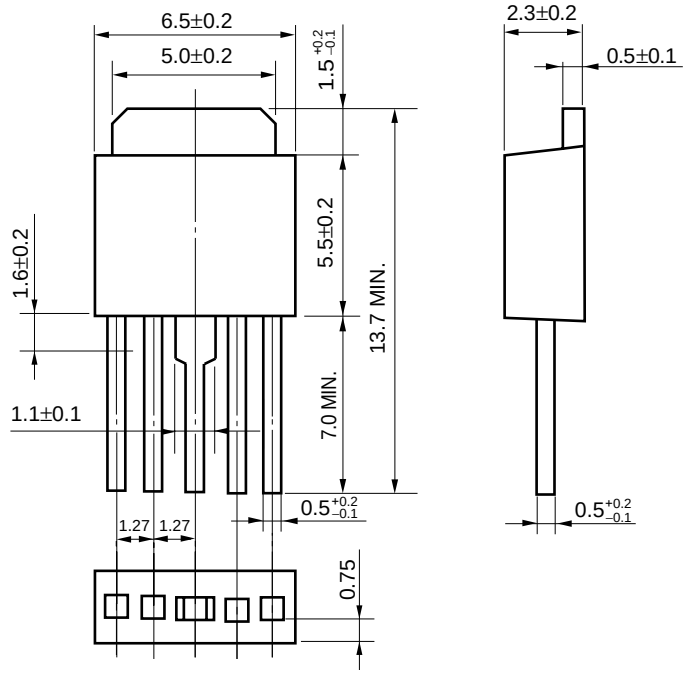

IOpeak1 vs. VDIF1 (μPC37M32)
TJ = 25°C
VIN = 5 V
IOpeak1 - OUTPUT1 Peak Output Current - A
VDIF1 - Dropout Voltage (INPUT to OUTPUT1) - V

PACKAGE DRAWINGS (Unit: mm)

MP-3Z (5-pin)



MP-3 (5-pin)



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RECOMMENDED MOUNTING CONDITIONS

The following conditions must be met for mounting conditions of the μPC37M31 and 37M32.

For more details, refer to the **Semiconductor Device Mounting Technology Manual (C10535E).**

Please consult with our sales offices in case other mounting process is used, or in case the mounting is done under different conditions.

Type of Surface Mount Device

μPC37M31TJ, μPC37M32TJ: MP-3Z (5-pin)

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 reflows processes: 3 times or less.	IR35-00-3
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 reflows processes: 3 times or less.	VP15-00-3
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.

Type of Through-hole Device

μPC37M31HB, μPC37M32HB: MP-3 (5-pin)

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.

CAUTION ON USE

When the μPC37M31 and 37M32 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 70 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.
Usage of Three-Terminal Regulators	User's Manual	G12702E
Voltage Regulator of SMD	Information	G11872E
Semiconductor Device Mounting Technology Manual	Information	C10535E
SEMICONDUCTOR SELECTION GUIDE - Products and Packages-		X13769X

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- While NEC Electronics endeavors to enhance the quality, reliability and safety of NEC Electronics products, customers agree and acknowledge that the possibility of defects thereof cannot be eliminated entirely. To minimize risks of damage to property or injury (including death) to persons arising from defects in NEC Electronics products, customers must incorporate sufficient safety measures in their design, such as redundancy, fire-containment and anti-failure features.
- NEC Electronics products are classified into the following three quality grades: "Standard", "Special" and "Specific".

  The "Specific" quality grade applies only to NEC Electronics products developed based on a customer-designated "quality assurance program" for a specific application. The recommended applications of NEC Electronics product depend on its quality grade, as indicated below. Customers must check the quality grade of each NEC Electronics product before using it in a particular application.

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

(Note)

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

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