NEC

BIPOLAR ANALOG INTEGRATED CIRCUIT
μPC37Mxx Series

TWO-OUTPUT POSITIVE VOLTAGE REGULATORS

★ DESCRIPTION

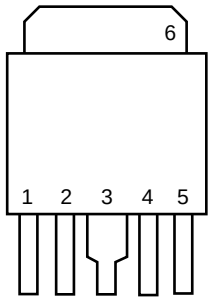
The μPC37Mxx series is a series regulator with two outputs, $OUTPUT_1$: 1 A and $OUTPUT_2$: 0.5 A, built in a single package. $OUTPUT_1$ outputs 3.3 V or 2.5 V, and $OUTPUT_2$ outputs 1.8 V or 2.5 V. This series can be used to realize set miniaturization and component reduction due to the use of on MP-3 or MP-3Z package.

FEATURES

★ • Two-output series regulator 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	SC-98 (5-pin MP-3Z)	37Mxx	• Bag stuffing
μPC37MxxTJ-E1	SC-98 (5-pin MP-3Z)	37Mxx	• Embossed-type taping (16 mm tape) • Pin 1 on drawout side • 2000 pcs/reel
μPC37MxxTJ-E2	SC-98 (5-pin MP-3Z)	37Mxx	• Embossed-type taping (16 mm tape) • Pin 1 on takeup side • 2000 pcs/reel
μPC37MxxHB	SC-99 (5-pin MP-3)	37Mxx	• Bag stuffing

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

Example

Output Voltage		Part Number	Marking
$OUTPUT_1$	$OUTPUT_2$		
2.5 V	1.8 V	μPC37M21TJ	37M21
3.3 V	1.8 V	μPC37M31TJ	37M31
3.3 V	2.5 V	μPC37M32TJ	37M32

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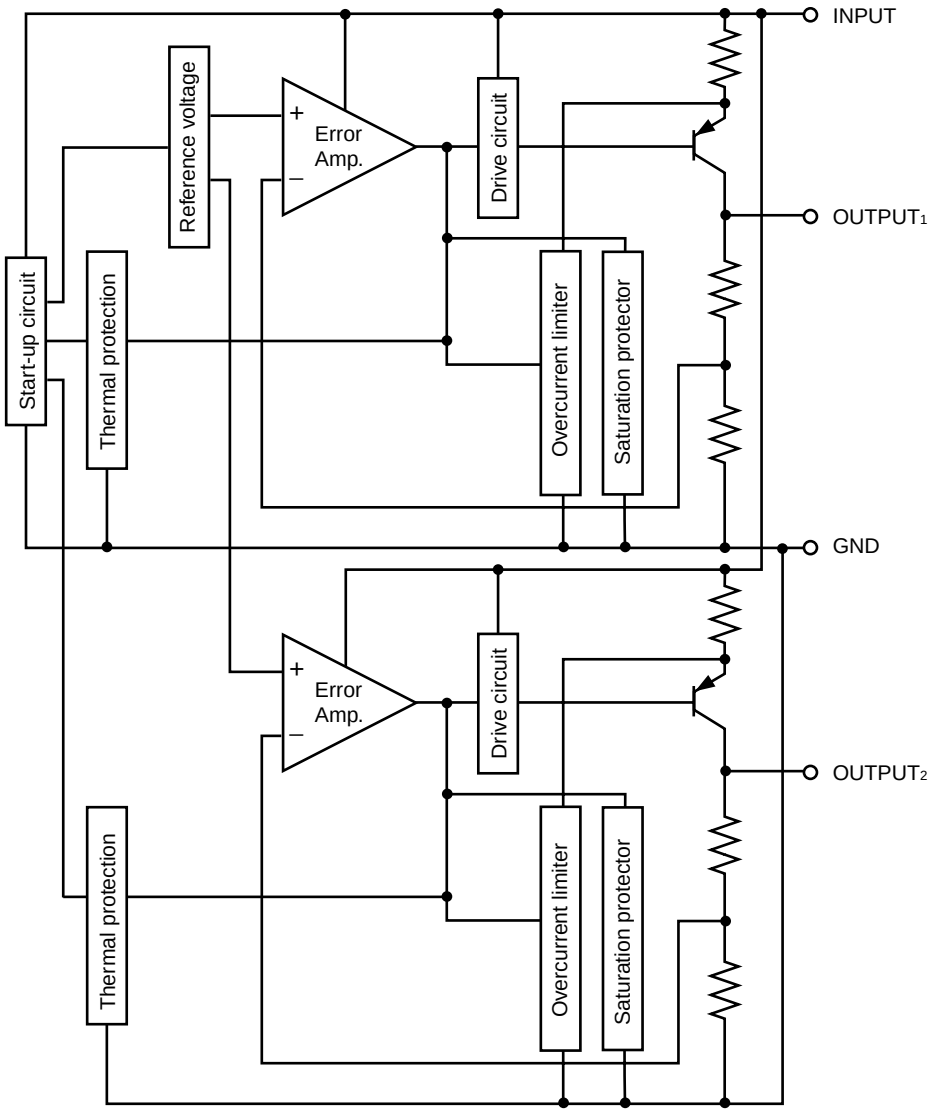
The mark ★ shows major revised points.

★ BLOCK DIAGRAM



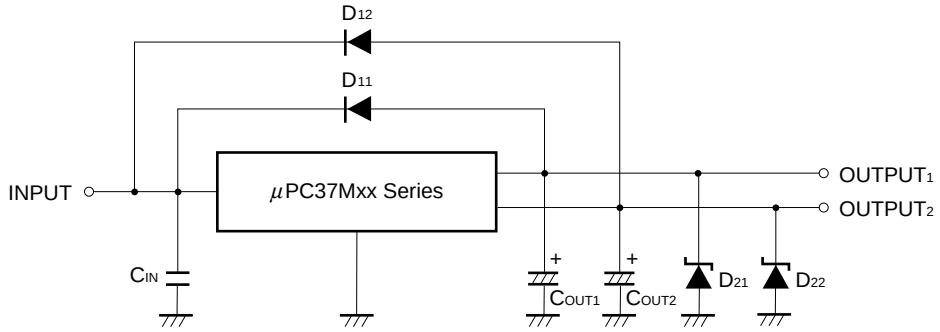
ABSOLUTE MAXIMUM RATINGS (T_A = 25°C, unless otherwise specified.)

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	Type Number	MIN.	TYP.	MAX.	Unit
Input Voltage	V_{IN}	μPC37M21	3.2		5.0	V
		μPC37M31	4.5		6.0	
		μPC37M32	4.5		6.0	
Output Current 1	I_{O1}	μPC37M21	0		0.3	A
		μPC37M31	0		0.5	
		μPC37M32	0		0.5	
Output Current 2	I_{O2}	All	0		0.3	A
Operating Ambient Temperature	T_A	All	−40		+85	°C
Operating Junction Temperature	T_J	All	−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

μPC37M21 (T_J = 25°C, V_{IN} = 3.3 V, I_{O1} = 0.3 A, I_{O2} = 0.3 A, unless otherwise specified.)

	Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
$OUTPUT_1$	Output Voltage 1	V_{O1}		2.45	2.5	2.55	V
(2.5 V)	Line Regulation 1	REG_{IN1}	3.2 V ≤ V_{IN} ≤ 5.0 V	–	2	9	mV
	Load Regulation 11	REG_{L11}	5 mA ≤ I_{O1} ≤ 0.5 A	–	17	50	mV
	Load Regulation 12	REG_{L12}	V_{IN} = 5.0 V, 5 mA ≤ I_{O1} ≤ 1 A	–	20	66	mV
	Output Noise Voltage 1	V_{n1}	10 Hz ≤ f ≤ 100 kHz	–	60	–	μVr.m.s.
	Ripple Rejection 1	R•R_1	f = 120 Hz, 3.2 V ≤ V_{IN} ≤ 5.0 V	–	60	–	dB
	Short Circuit Current 1	$I_{Oshort1}$	V_{IN} = 5.0 V	–	0.5	–	A
	Peak Output Current 11	$I_{Opeak11}$	V_{IN} = 3.3 V	0.5	0.8	–	A
	Peak Output Current 12	$I_{Opeak12}$	V_{IN} = 5.0 V	1.0	1.4	–	A
	Temperature Coefficient of Output Voltage 1	$\Delta V_{O1}/\Delta T$	I_{O1} = 5 mA, 0°C ≤ T_J ≤ 125°C	–	−0.4	–	mV/°C
$OUTPUT_2$	Output Voltage 2	V_{O2}		1.764	1.8	1.836	V
(1.8 V)	Line Regulation 2	REG_{IN2}	3.2 V ≤ V_{IN} ≤ 5.0 V	–	2	9	mV
	Load Regulation 2	REG_{L2}	5 mA ≤ I_{O2} ≤ 0.5 A	–	17	50	mV
	Output Noise Voltage 2	V_{n2}	10 Hz ≤ f ≤ 100 kHz	–	60	–	μVr.m.s.
	Ripple Rejection 2	R•R_2	f = 120 Hz, 3.2 V ≤ V_{IN} ≤ 5.0 V	–	60	–	dB
	Short Circuit Current 2	$I_{Oshort2}$	V_{IN} = 5.0 V	–	0.3	–	A
	Peak Output Current 21	$I_{Opeak21}$	V_{IN} = 3.3 V	0.5	0.6	–	A
	Peak Output Current 22	$I_{Opeak22}$	V_{IN} = 5.0 V	0.5	0.8	–	A
	Temperature Coefficient of Output Voltage 2	$\Delta V_{O2}/\Delta T$	I_{O2} = 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	V

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

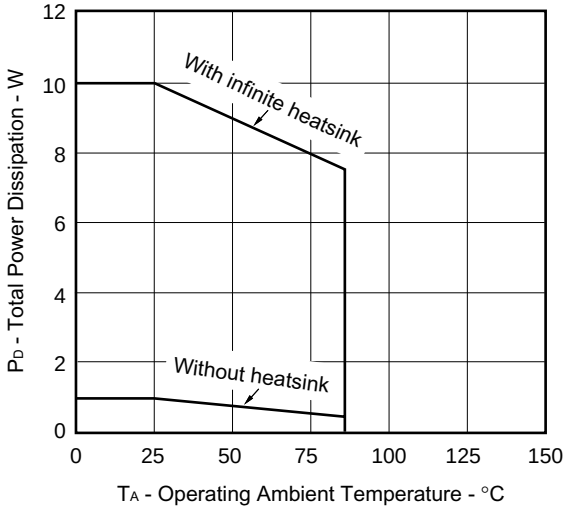
	Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
$OUTPUT_1$ (3.3 V)	Output Voltage 1	V_{O1}		3.234	3.3	3.366	V
	Line Regulation 1	REG_{IN1}	4.5 V ≤ V_{IN} ≤ 6.0 V	–	2	9	mV
	Load Regulation 1	REG_{L1}	5 mA ≤ I_{O1} ≤ 1 A	–	20	66	mV
	Output Noise Voltage 1	V_{n1}	10 Hz ≤ f ≤ 100 kHz	–	76	–	μVr.m.s.
	Ripple 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_{O1} = 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_{O2} ≤ 0.5 A	–	17	50	mV
	Output Noise Voltage 2	V_{n2}	10 Hz ≤ f ≤ 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_{O2} = 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.)

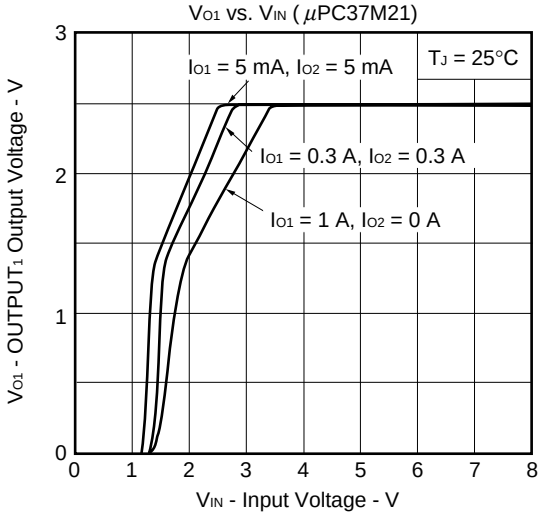
	Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
$OUTPUT_1$ (3.3 V)	Output Voltage 1	V_{O1}		3.234	3.3	3.366	V
	Line Regulation 1	REG_{IN1}	4.5 V ≤ V_{IN} ≤ 6.0 V	–	2	9	mV
	Load Regulation 1	REG_{L1}	5 mA ≤ I_{O1} ≤ 1 A	–	20	66	mV
	Output Noise Voltage 1	V_{n1}	10 Hz ≤ f ≤ 100 kHz	–	76	–	μVr.m.s.
	Ripple 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_{O1} = 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_{O2} ≤ 0.5 A	–	17	50	mV
	Output Noise Voltage 2	V_{n2}	10 Hz ≤ f ≤ 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_{O2} = 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)

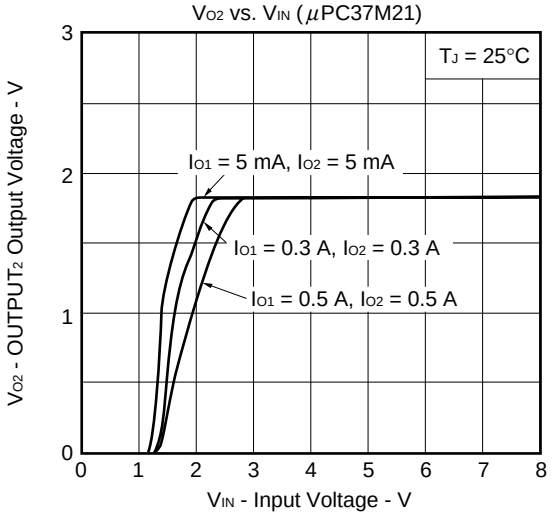
P_D vs. T_A



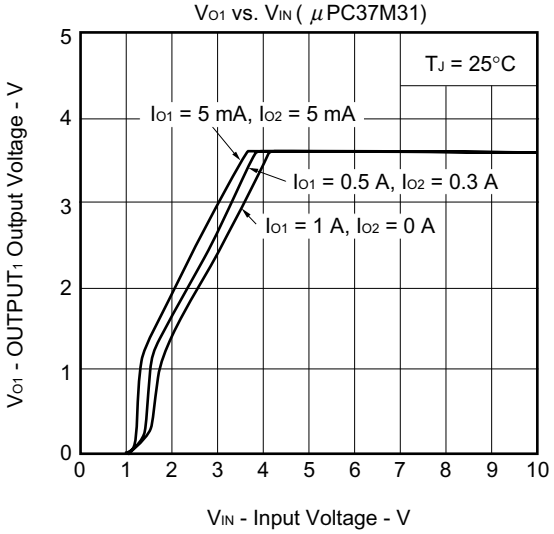
V_{O1} vs. V_{IN} (μPC37M21)



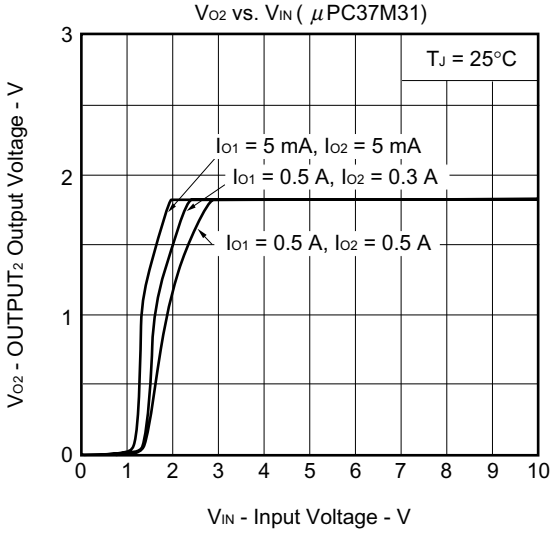
V_{O2} vs. V_{IN} (μPC37M21)



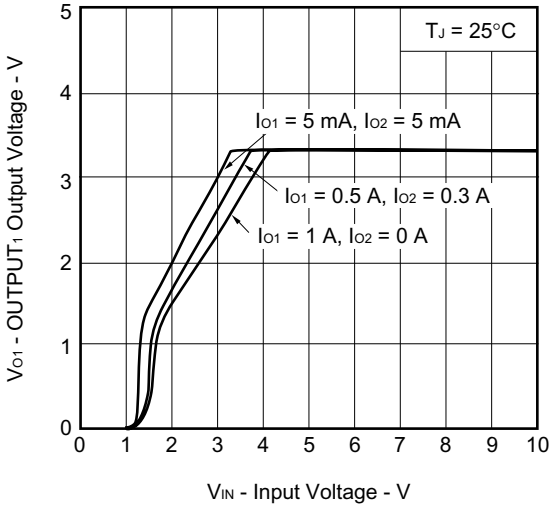
V_{O1} vs. V_{IN} (μPC37M31)



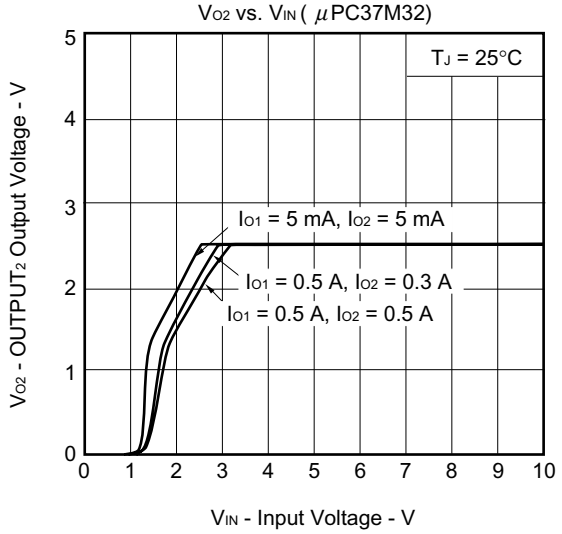
V_{O2} vs. V_{IN} (μPC37M31)



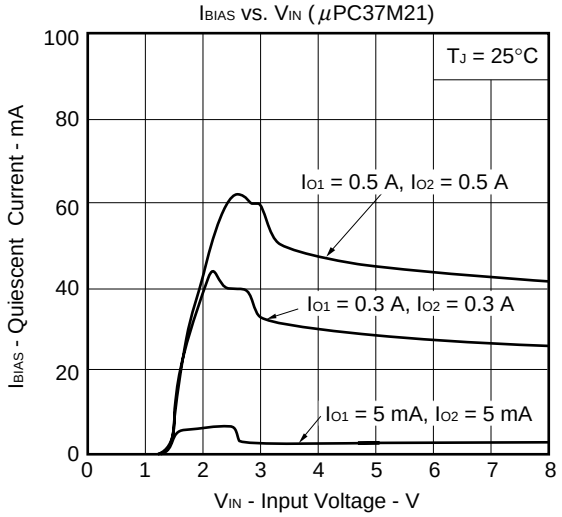
V_{O1} vs. V_{IN} (μPC37M32)



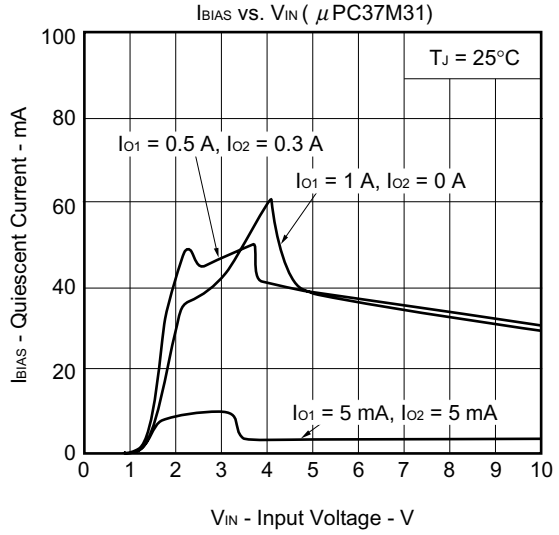
V_{O2} vs. V_{IN} (μPC37M32)



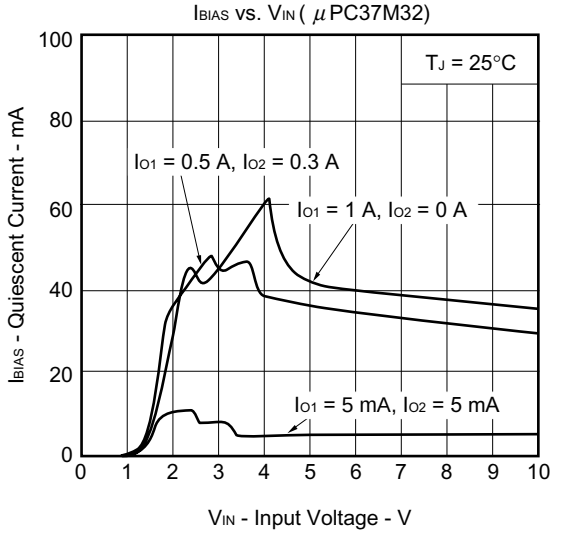
I_{BIAS} vs. V_{IN} (μPC37M21)



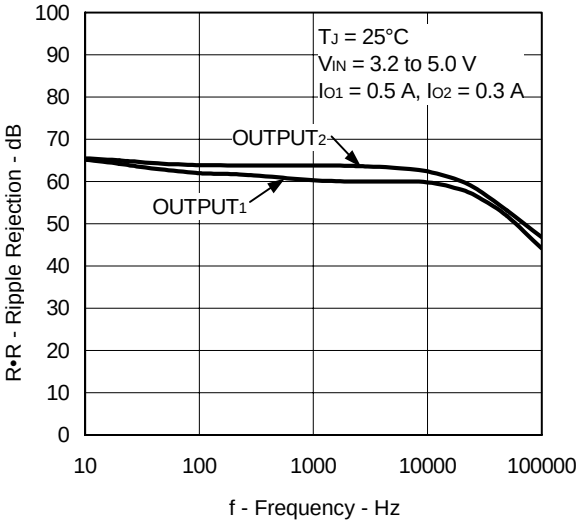
I_{BIAS} vs. V_{IN} (μPC37M31)



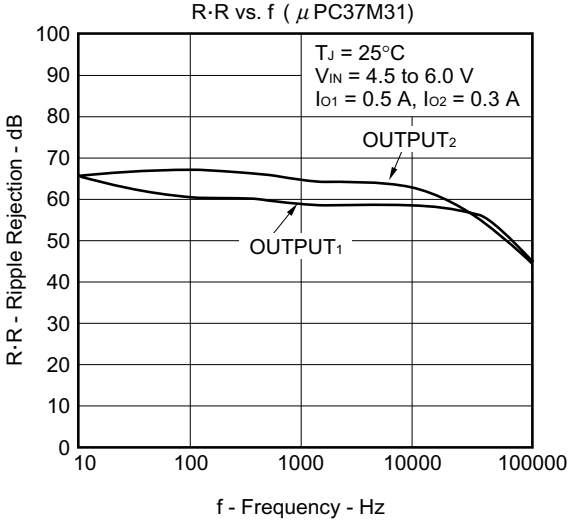
I_{BIAS} vs. V_{IN} (μPC37M32)



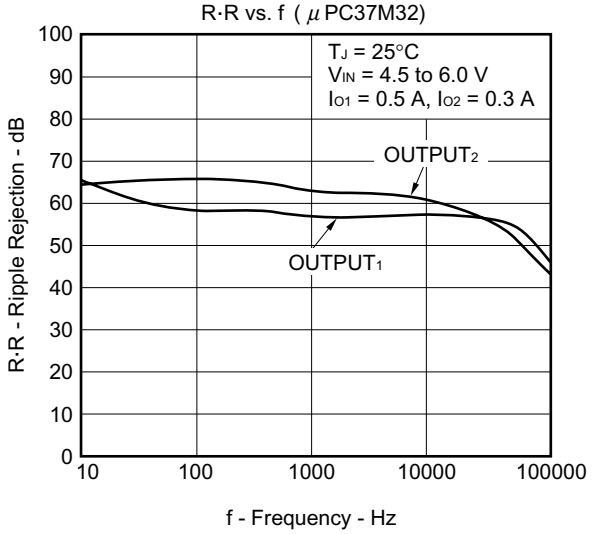
R•R vs. f (μPC37M21)



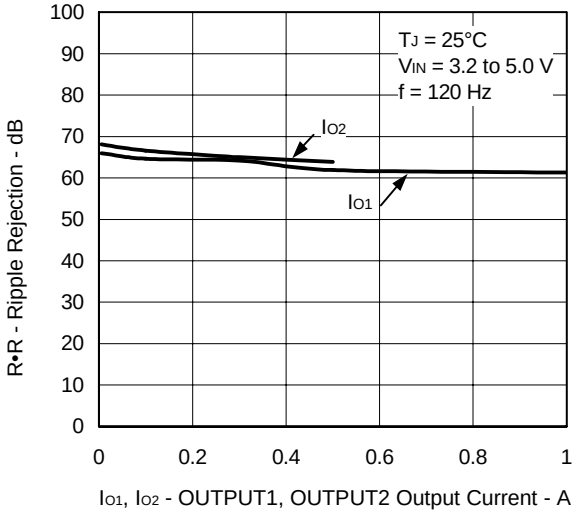
R·R vs. f (μPC37M31)



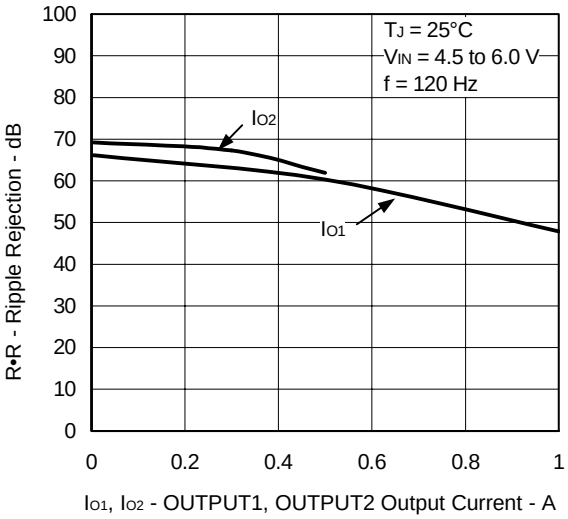
R·R vs. f (μPC37M32)



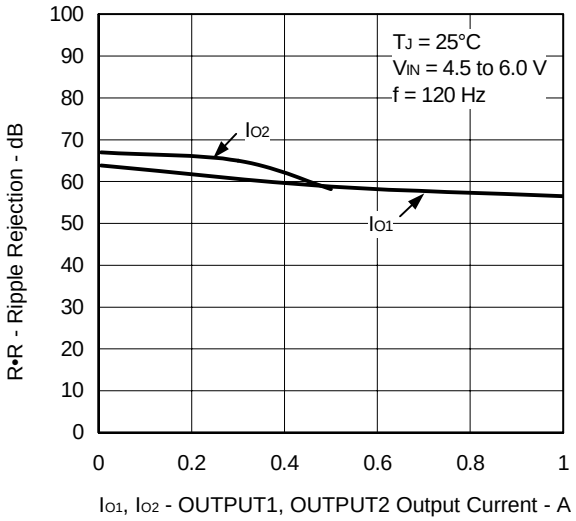
R•R vs. IO1, IO2 (μPC37M21)



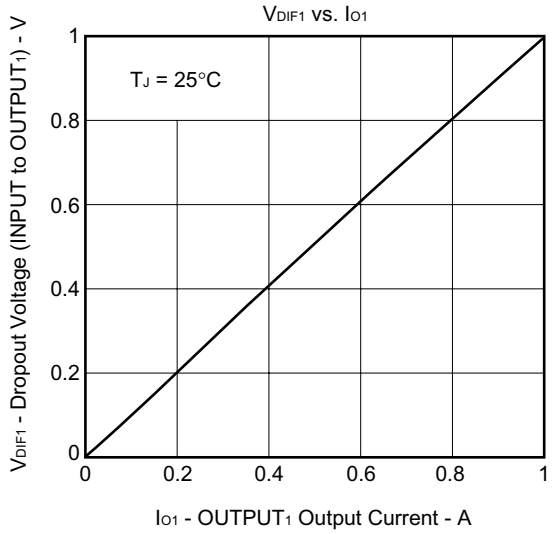
R•R vs. IO1, IO2 (μPC37M31)



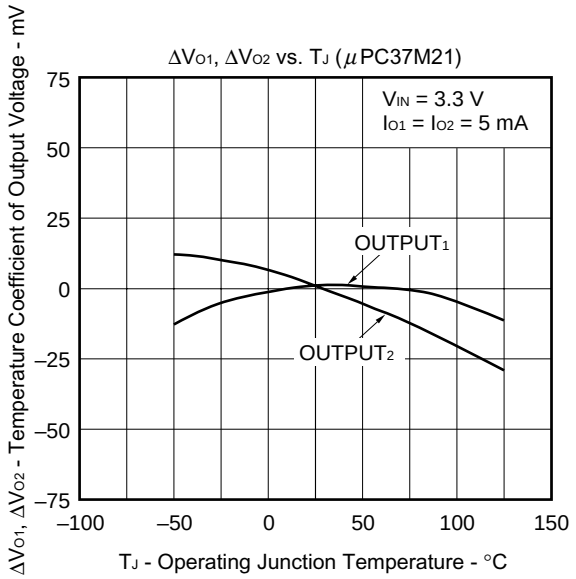
R•R vs. IO1, IO2 (μPC37M32)

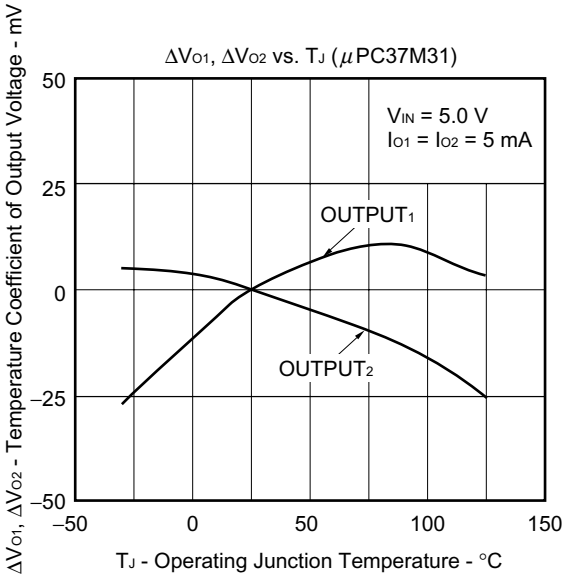


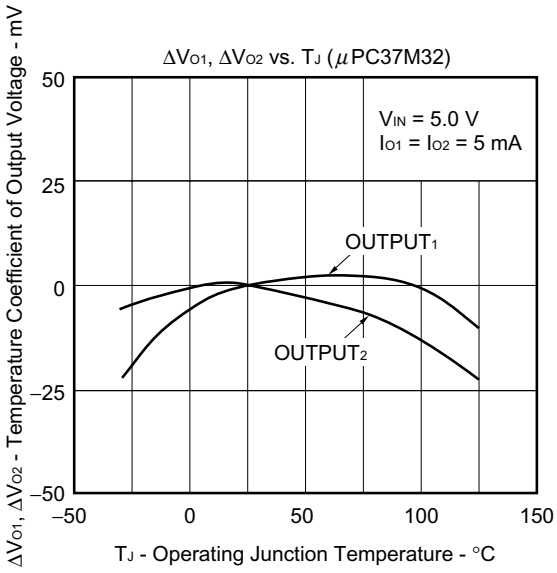
VDIF1 vs. IO1

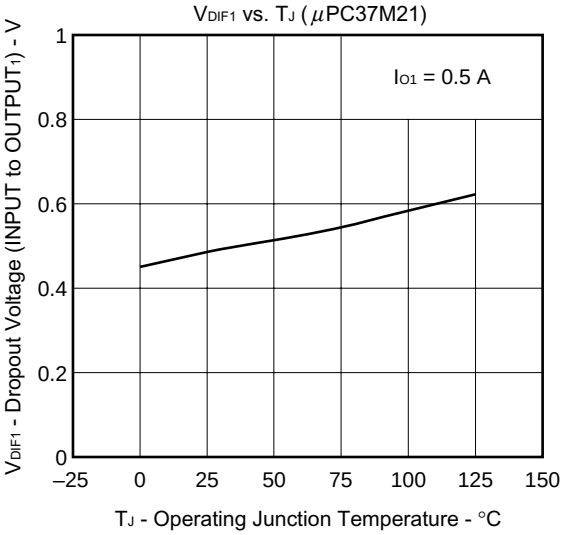


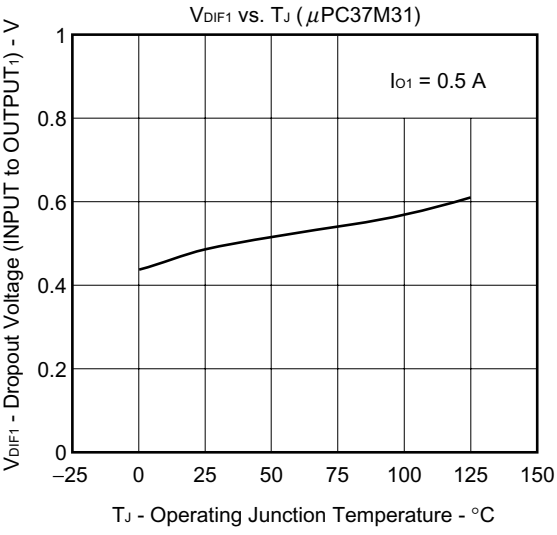
ΔVO1, ΔVO2 vs. TJ (μPC37M21)

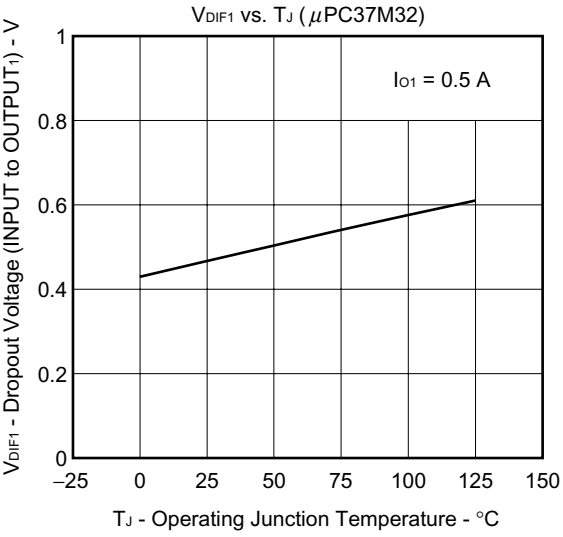


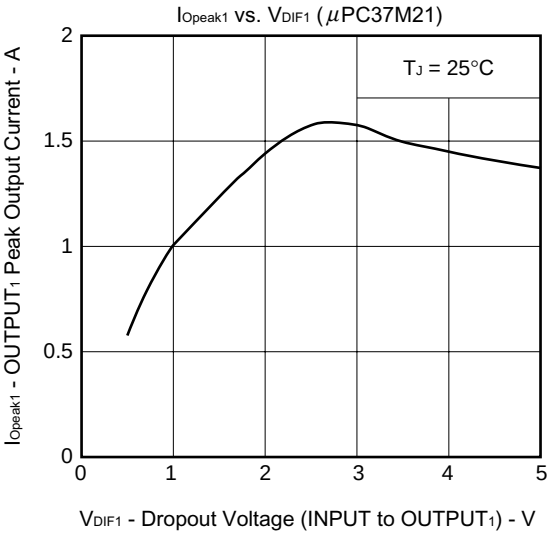

ΔVO1, ΔVO2 vs. TJ (μPC37M31)
VIN = 5.0 V
IO1 = IO2 = 5 mA
OUTPUT1
OUTPUT2
ΔVO1, ΔVO2 - Temperature Coefficient of Output Voltage - mV
TJ - Operating Junction Temperature - °C

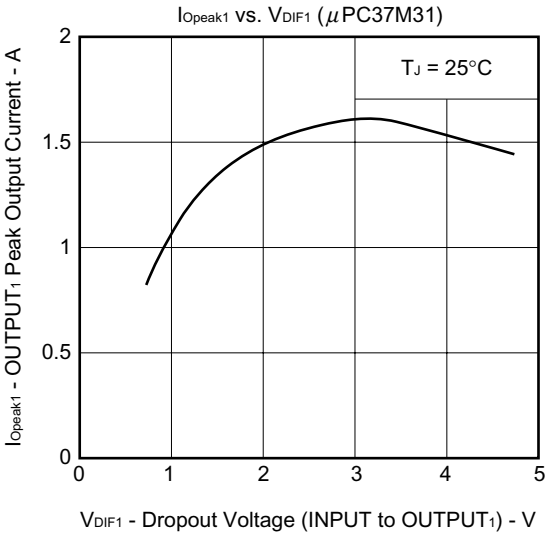

ΔVO1, ΔVO2 vs. TJ (μPC37M32)
VIN = 5.0 V
IO1 = IO2 = 5 mA
OUTPUT1
OUTPUT2
ΔVO1, ΔVO2 - Temperature Coefficient of Output Voltage - mV
TJ - Operating Junction Temperature - °C

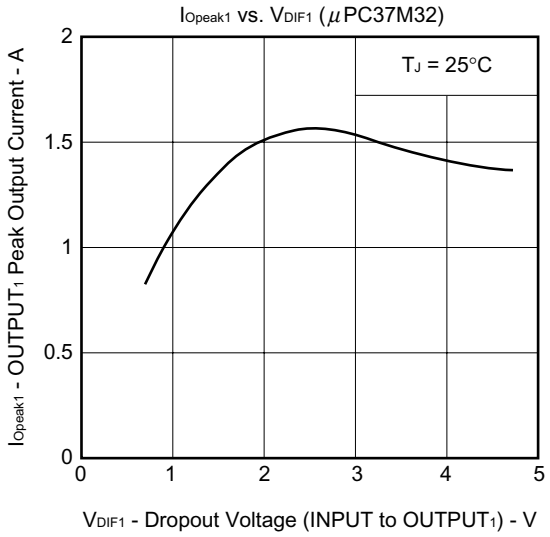

VDIF1 vs. TJ (μPC37M21)
IO1 = 0.5 A
VDIF1 - Dropout Voltage (INPUT to OUTPUT1) - V
TJ - Operating Junction Temperature - °C


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

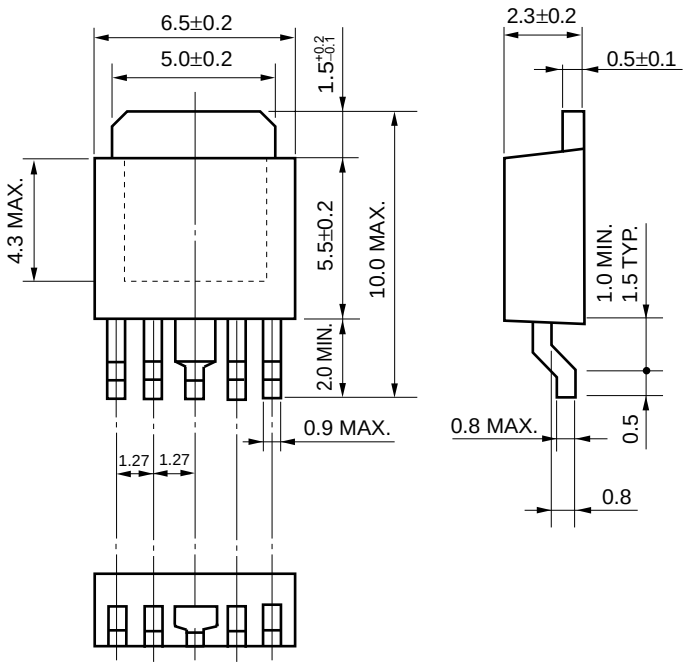

IOpeak1 vs. VDIF1 (μPC37M21)
TJ = 25°C
IOpeak1 - OUTPUT1 Peak Output Current - A
VDIF1 - Dropout Voltage (INPUT to OUTPUT1) - V


IOpeak1 vs. VDIF1 (μPC37M31)
TJ = 25°C
IOpeak1 - OUTPUT1 Peak Output Current - A
VDIF1 - Dropout Voltage (INPUT to OUTPUT1) - V
0
0.5
1
1.5
2
0
1
2
3
4
5

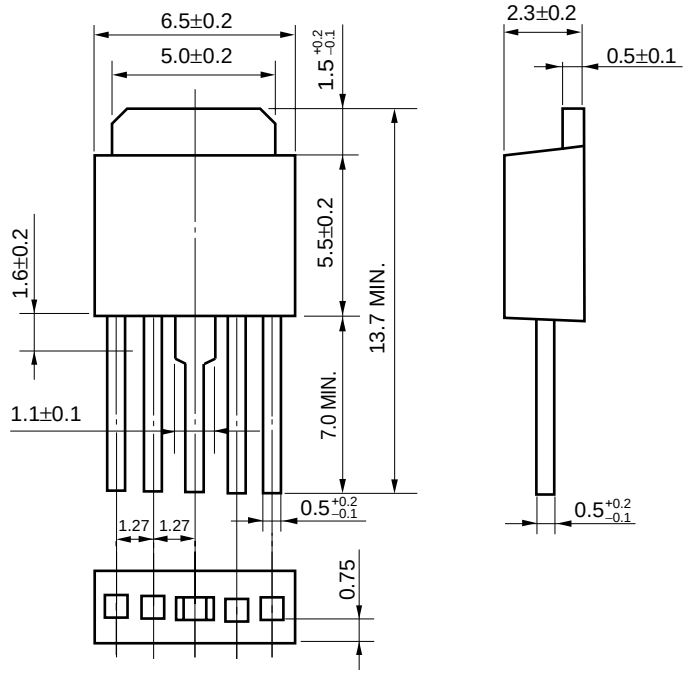

IOpeak1 vs. VDIF1 (μPC37M32)
TJ = 25°C
IOpeak1 - OUTPUT1 Peak Output Current - A
VDIF1 - Dropout Voltage (INPUT to OUTPUT1) - V
0
0.5
1
1.5
2
0
1
2
3
4
5

★ **PACKAGE DRAWINGS (Unit: mm)**

SC-98 (5-pin MP-3Z)



SC-99 (5-pin MP-3)



★ RECOMMENDED MOUNTING CONDITIONS

The following conditions must be met for mounting conditions of the μPC37Mxx series.

For more details, refer to the **Semiconductor Device Mount Manual (http://www.necel.com/pkg/en/mount/index.html).**

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

μPC37MxxTJ: SC-98 (5-pin MP-3Z)

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

μPC37MxxHB: SC-99 (5-pin 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.

★ CAUTION ON USE

When the μPC37Mxx series is 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 40 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 Mount Manual	Information	http://www.necel.com/pkg/en/mount/index.html
SEMICONDUCTOR SELECTION GUIDE - Products and Packages-		X13769X

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