NEC

BIPOLAR ANALOG INTEGRATED CIRCUIT

μPC24A00 Series

THREE TERMINAL LOW DROPOUT VOLTAGE REGULATOR

The μPC24A00 Series is a low dropout voltage three terminal regulator that has realized a minimum voltage differential between the I/O of no more than 1 V when the output current is 2 A through the employment of a PNP transistor at the output stage.

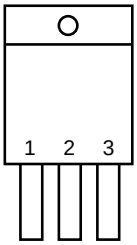
Due to its ability to achieve a greater reduction in the power loss compared with conventional three-terminal regulators, the μPC24A00 Series is ideal for use as the secondary side smoothing circuit of a power supply.

FEATURES

- Output current in excess of 2.0 A
- High accuracy of output voltage
  ΔV_O = ±2% MAX. (T_J = 25°C, I_O = 1 A)
- Low dropout voltage
  V_{DIF} = 1 V MAX. (I_O = 2 A)
- On-chip thermal shut down circuit, over-current protection circuit and safe operating area protection circuit

PIN CONFIGURATION (Marking Side)

3-pin plastic SIP (MP-45G)
μPC24A05HF, 24A12HF, 24A15HF



1: INPUT
2: GND
3: OUTPUT

ORDERING INFORMATION

Part Number	Package	Output Voltage
μPC24A05HF	3-pin plastic SIP (MP-45G) (isolated TO-220)	5 V
μPC24A12HF	3-pin plastic SIP (MP-45G) (isolated TO-220)	12 V
μPC24A15HF	3-pin plastic SIP (MP-45G) (isolated TO-220)	15 V

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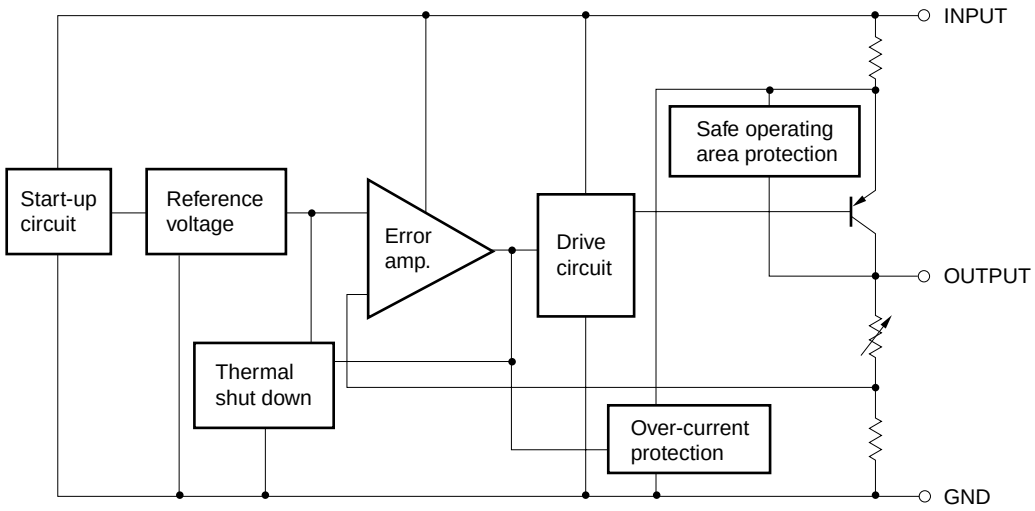
BLOCK DIAGRAM



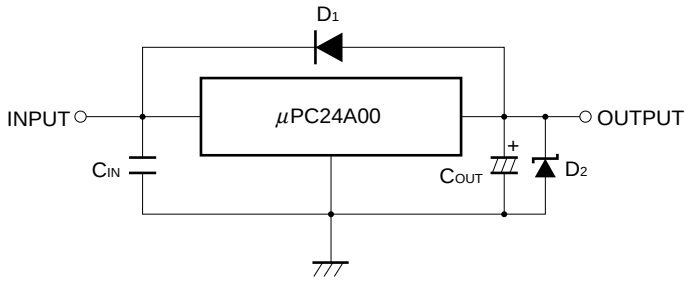
ABSOLUTE MAXIMUM RATINGS (T_A = 25°C, Unless Otherwise Specified)

Parameter	Symbol	Rating	Unit
Input voltage	V_{IN}	−0.3 to +36	V
Total power consumption	P_T	20[Note]	W
Operating ambient temperature	T_A	−20 to +85	°C
Storage temperature	T_{stg}	−55 to +150	°C
Operating junction temperature	T_J	−20 to +150	°C
Thermal resistance (junction to case)	$R_{th\ (J-C)}$	5	°C/W
Thermal resistance (junction to ambient)	$R_{th\ (J-A)}$	65	°C/W

Note Internally limited. When operating junction temperature rise up to 150°C, the internal circuit shutdown 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



CIN: 0.1 to 0.47 μF. Be sure to connect to prevent abnormal oscillation. When using capacitors, film capacitors with excellent voltage and temperature characteristics are recommended. Be aware that some monolithic ceramic capacitors have inferior temperature and voltage characteristics. When using a monolithic ceramic capacitor, CIN requires a capacitor that can secure this capacity within the voltage and temperature range used.

COUT: 10 μF or higher. Be sure to connect to prevent oscillation and to improve transient load stabilization.

Remark Connect CIN and COUT as close as possible to the IC pins (within 2 cm).

D1: VO > VIN required

D2: Shottky barrier diode required for when VO < GND.

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Input voltage	VIN	μPC24A05HF	6	9	15	V
		μPC24A12HF	13	18	22	V
		μPC24A15HF	16	22	25	V
Output current	IO	All	0		2	A
Operating junction temperature	TJ	All	−20		+125	°C

Caution The recommended operating range may be exceeded without causing any problems provided that the absolute maximum ratings are not exceeded. However, if the device is operated in a way that exceeds the recommended operating conditions, the margin between the actual conditions of use and the absolute maximum ratings is small, and therefore thorough evaluation is necessary. The recommended operating conditions do not imply that the device can be used with all values at their maximum values.

ELECTRICAL CHARACTERISTICS

μPC24A05 (T_J = 25°C, V_{IN} = 9 V, I_O = 1 A, Unless Otherwise Specified)

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Output voltage	V_O		4.9	5.0	5.1	V
		0°C ≤ T_J ≤ 125°C, 6 V ≤ V_{IN} ≤ 15 V, 5 mA ≤ I_O ≤ 2 A	4.85		5.15	V
Line regulation	REG_{IN}	6 V ≤ V_{IN} ≤ 15 V		6	50	mV
Load regulation	REG_L	5 mA ≤ I_O ≤ 2 A		3	50	mV
Quiescent current	I_{BIAS}	I_O = 0 A		3	5.0	mA
		I_O = 2 A		15	30	mA
Quiescent current change	ΔI_{BIAS}	6 V ≤ V_{IN} ≤ 15 V, I_O = 2 A			20	mA
Output noise voltage	V_n	10 Hz ≤ f ≤ 100 kHz		150		$\mu V_{r.m.s.}$
Ripple rejection	R·R	f = 120 Hz, 6.5 V ≤ V_{IN} ≤ 16.5 V	50	60		dB
Dropout voltage	V_{DIF}	0°C ≤ T_J ≤ 125°C, I_O = 2 A			1.0	V
Short circuit current	$I_{O\ short}$	V_{IN} = 15V		1.3		A
Peak output current	$I_{O\ peak}$	V_{IN} = 9 V	2.8	3.5	4.2	A
Temperature coefficient of output voltage	$\Delta V_O/\Delta T$	0°C ≤ T_J ≤ 125°C, I_O = 5 mA		0.5		mV/°C

μPC24A12 (T_J = 25°C, V_{IN} = 18 V, I_O = 1 A, Unless Otherwise Specified)

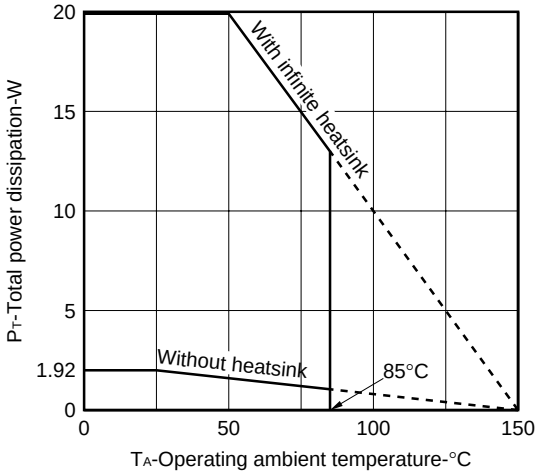
Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Output voltage	V_O		11.75	12.0	12.25	V
		0°C ≤ T_J ≤ 125°C, 13 V ≤ V_{IN} ≤ 22 V, 5 mA ≤ I_O ≤ 2 A	11.65		12.35	V
Line regulation	REG_{IN}	13 V ≤ V_{IN} ≤ 22 V		12	100	mV
Load regulation	REG_L	5 mA ≤ I_O ≤ 2 A		6	100	mV
Quiescent current	I_{BIAS}	I_O = 0 A		3	5.0	mA
		I_O = 2 A		15	30	mA
Quiescent current change	ΔI_{BIAS}	13 V ≤ V_{IN} ≤ 22 V, I_O = 2 A			20	mA
Output noise voltage	V_n	10 Hz ≤ f ≤ 100 kHz		220		$\mu V_{r.m.s.}$
Ripple rejection	R·R	f = 120 Hz, 13.5 V ≤ V_{IN} ≤ 23.5 V	43	50		dB
Dropout voltage	V_{DIF}	0°C ≤ T_J ≤ 125°C, I_O = 2 A			1.0	V
Short circuit current	$I_{O\ short}$	V_{IN} = 15 V		1.4		A
Peak output current	$I_{O\ peak}$	V_{IN} = 18 V	2.8	3.5	4.2	A
Temperature coefficient of output voltage	$\Delta V_O/\Delta T$	0°C ≤ T_J ≤ 125°C, I_O = 5 mA		1.0		mV/°C

μPC24A15 (T_J = 25°C, V_{IN} = 22 V, I_O = 1 A, Unless Otherwise Specified)

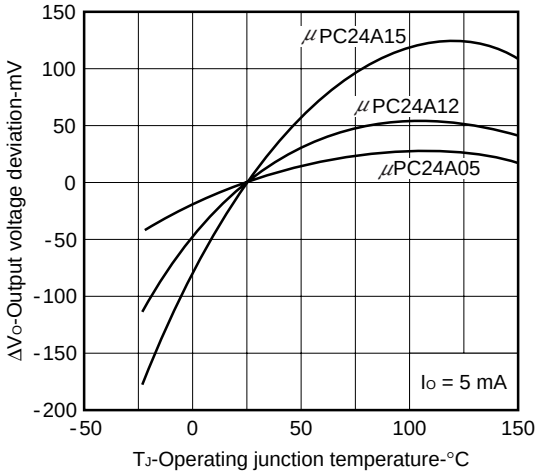
Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Output voltage	V_O		14.7	15.0	15.3	V
		0°C ≤ T_J ≤ 125°C, 16 V ≤ V_{IN} ≤ 25 V, 5 mA ≤ I_O ≤ 2 A	14.55		15.45	V
Line regulation	REG_{IN}	17 V ≤ V_{IN} ≤ 25 V		18	150	mV
Load regulation	REG_L	5 mA ≤ I_O ≤ 2 A		10	150	mV
Quiescent current	I_{BIAS}	I_O = 0 A		3	5.0	mA
		I_O = 2 A		15	30	mA
Quiescent current change	ΔI_{BIAS}	17 V ≤ V_{IN} ≤ 25 V, I_O = 2 A			20	mA
Output noise voltage	V_n	10 Hz ≤ f ≤ 100 kHz		260		$\mu V_{r.m.s.}$
Ripple rejection	R·R	f = 120 Hz, 17 V ≤ V_{IN} ≤ 27 V	40	48		dB
Dropout voltage	V_{DIF}	0°C ≤ T_J ≤ 125°C, I_O = 2 A			1.0	V
Short circuit current	$I_{O\ short}$	V_{IN} = 16 V		1.4		A
Peak output current	$I_{O\ peak}$	V_{IN} = 22 V	2.8	3.5	4.2	A
Temperature coefficient of output voltage	$\Delta V_O/\Delta T$	0°C ≤ T_J ≤ 125°C, I_O = 5 mA		1.6		mV/°C

TYPICAL CHARACTERISTICS (REFERENCE VALUES)

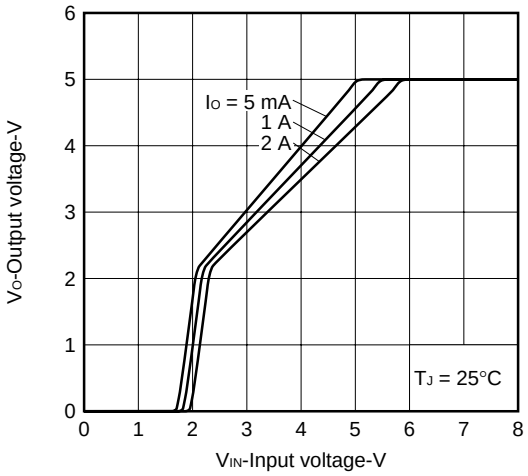
P_T vs T_A



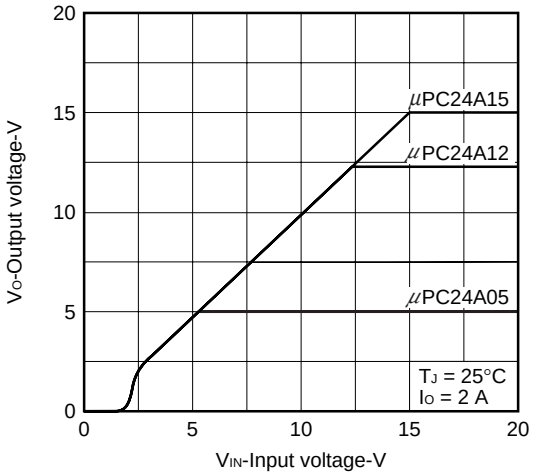
ΔV_O vs T_J



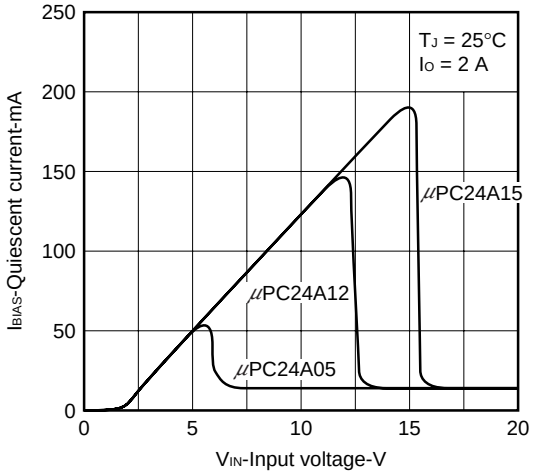
V_O vs V_{IN} (μPC24A05)



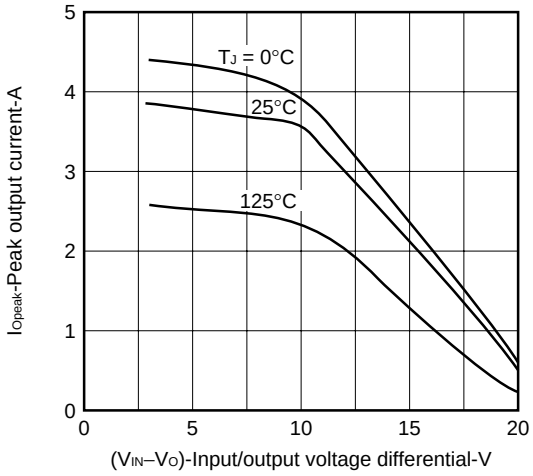
V_O vs V_{IN}



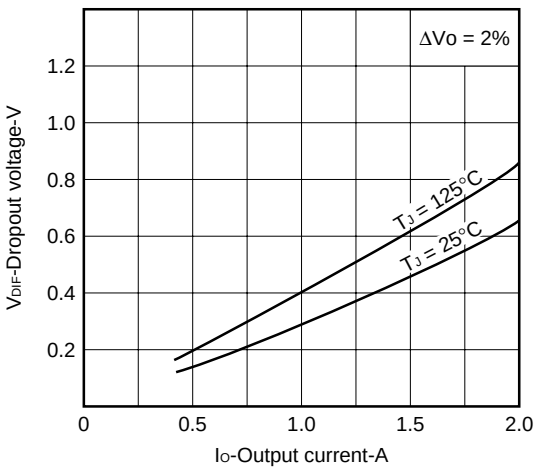
I_{BIAS} vs V_{IN}



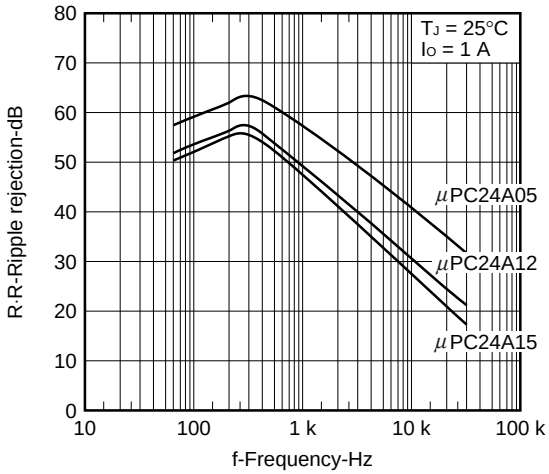
$I_{O\ peak}$ vs (V_{IN} - V_O)



V_{DIF} vs I_O

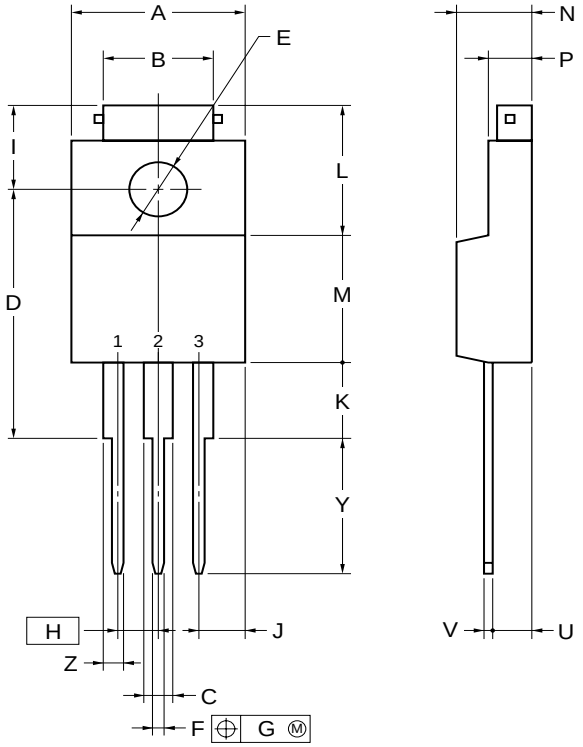


R·R vs f



PACKAGE DRAWINGS

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	ϕ 3.3±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

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RECOMMENDED SOLDERING CONDITIONS

The μPC2400 Series should be soldered and mounted under the following recommended conditions.

For the details of the recommended soldering conditions, refer to the document **SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL (C10535E)**.

For soldering methods and conditions other than those recommended below, contact your NEC sales representative.

Through-Hole Device

μPC24A05HF, 24A12HF, 24A15HF: 3-Pin Plastic SIP (MP-45G) (Isolated TO-220)

Process	Conditions
Wave soldering (only to leads)	Solder temperature: 260°C or below, Flow time: 10 seconds or less.

Caution Apply wave soldering only to the pins and be careful not to bring solder into direct contact with the package.

CAUTION ON USE

- In the μPC24A00 Series, if the output is short-circuited at $V_{IN} \geq 20$ V, the output may not be restored after the short-circuit is cancelled. In this case, restore the output by lowering and then reapplying V_{IN}.
- If a lower than recommended input voltage is used in the μPC24A00 Series, a large circuit current will flow due to the saturation of the output stage transistor (refer to the reference characteristic curve of the $I_{BIAS} - V_{IN}$ characteristics). The capacitance for the input side power supply therefore needs to be only enough to enable the current to flow in this circuit at startup. Note also that a resistor cannot be inserted at the GND pin to adjust the output voltage.

REFERENCE DOCUMENTS

QUALITY GRADES ON NEC SEMICONDUCTOR DEVICES	C11531E
SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL	C10535E
SEMICONDUCTORS SELECTION GUIDE	X10679E
SEMICONDUCTORS SELECTION GUIDE -Product and Packages- (CD-ROM)	X13769X

[MEMO]

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