NEC

BIPOLAR ANALOG INTEGRATED CIRCUIT

μPC2400A Series

THREE TERMINAL LOW DROPOUT VOLTAGE REGULATOR

DESCRIPTION

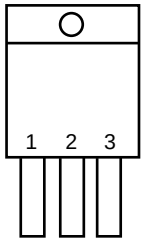
μPC2400A Series are low dropout regulators which have 1 A capable for the output current.
These ICs are built-in the saturation protection circuit of the output transistor.

FEATURES

- Built-in the saturation protection circuit of the output transistor.
- The capability of output current is 1 A
- High accuracy of output voltage.
  $|\Delta V_O| \leq \pm 2$ % (T_J = 25 ˚C)
  $|\Delta V_O| \leq \pm 3$ % (0 ˚C ≤ T_J ≤ 125 ˚C)
- Low dropout voltage.
  $V_{DIF} \leq 1$ V ($I_O \leq 1$ A, $T_J \leq 125$ ˚C)
- Built-in overcurrent protection circuit, thermal shut-down circuit.
- Built-in Safe Operating Area protection circuit.
- Compatible for μPC2400 Series.

CONNECTION DIAGRAM

(TOP VIEW)



1: INPUT
2: GND
3: OUTPUT

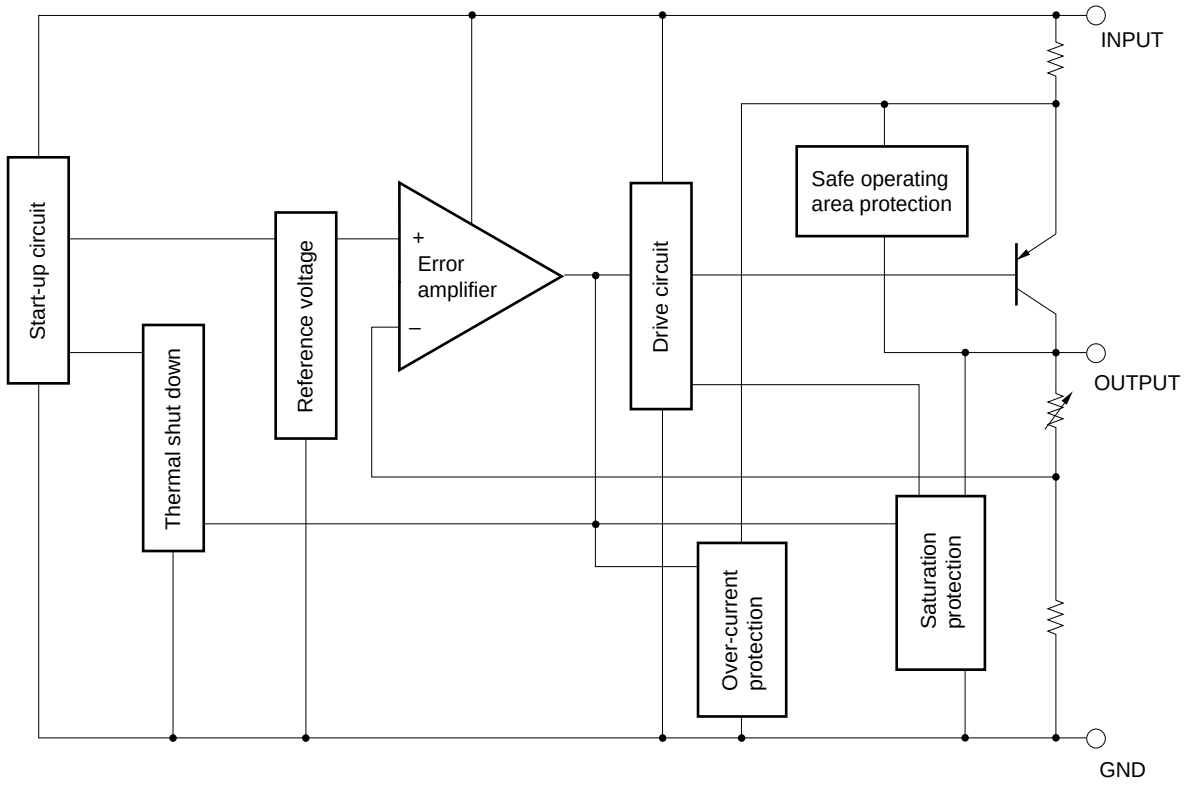
ORDERING INFORMATION

Output Voltage	Type Number	Package
5 V	μPC2405AHF	MP-45G (Isolated TO-220)
6 V	μPC2406AHF	
7 V	μPC2407AHF	
8 V	μPC2408AHF	
9 V	μPC2409AHF	
10 V	μPC2410AHF	
12 V	μPC2412AHF	
15 V	μPC2415AHF	
18 V	μPC2418AHF	

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BLOCK DIAGRAM

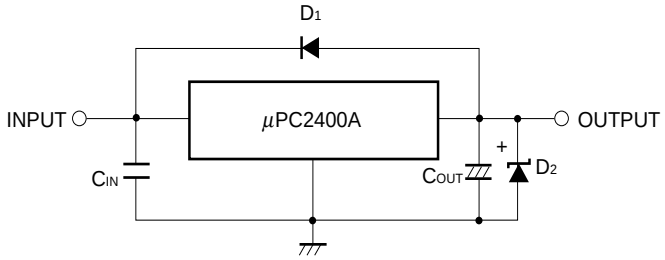


ABSOLUTE MAXIMUM RATINGS (T_A = 25 °C, Unless otherwise specified.)

PARAMETER	SYMBOL	RATING	UNIT
Input Voltage	V_{IN}	36	V
Internal Power Dissipation	$P_{T(T_C = 25\ °C)}$	15 **Note**	W
Operating Ambient Temperature Range	T_A	–20 to +85	°C
Operating Junction Temperature Range	T_J	–20 to +150	°C
Storage Temperature Range	T_{stg}	–55 to +150	°C
Thermal Resistance (Junction to Case)	$R_{th(J-C)}$	5.0	°C/W
Thermal Resistance (Junction to Ambient)	$R_{th(J-A)}$	65	°C/W

Note Internally limited

TYPICAL CONNECTION



C_{IN} : 0.1 to 0.47 μF.
C_{OUT} : More than 47 μF.
D_1 : Need for $V_O > V_{IN}$.
D_2 : Need for $V_O <$ GND.

RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	TYPE NUMBER	MIN.	TYP.	MAX.	UNIT
Input Voltage	V_{IN}	μPC2405AHF	6	9	20	V
		μPC2406AHF	7	10	21	
		μPC2407AHF	8	11	22	
		μPC2408AHF	9	13	23	
		μPC2409AHF	10	14	24	
		μPC2410AHF	11	15	25	
		μPC2412AHF	13	18	27	
		μPC2415AHF	16	22	27	
		μPC2418AHF	19	25	28	
Output Current	I_O	All	0		1	A
Operating Ambient Temperature Range	T_A	All	–20		+85	°C
Operating Junction Temperature Range	T_J	All	–20		+125	°C

ELECTRICAL CHARACTERISTICS

μPC2405A (V_{IN} = 9 V, I_O = 500 mA, T_J = 25 ˚C, Unless otherwise specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
Output Voltage	V_O	4.9	5.0	5.1	V	
		4.85		5.15		6 V ≤ V_{IN} ≤ 20 V, 5 mA ≤ I_O ≤ 500 mA, 0 ˚C ≤ T_J ≤ 125 ˚C
		4.85		5.15		5 mA ≤ I_O ≤ 1 A, 0 ˚C ≤ T_J ≤ 125 ˚C
Line Regulation	REG_{IN}		6	50	mV	6.5 V ≤ V_{IN} ≤ 20 V
Load Regulation	REG_L		3	50	mV	5 mA ≤ I_O ≤ 1 A
Quiescent Current	I_{BIAS}		2.3	3.2	mA	I_O = 0
			9	60		I_O = 1 A
Start-up Current	$I_{BIAS(S)}$			15	mA	V_{IN} = 4.5 V, I_O = 0 mA
				75		V_{IN} = 4.5 V, I_O = 1 A
Quiescent Current Change	ΔI_{BIAS}			20	mA	6.5 V ≤ V_{IN} ≤ 20 V, I_O = 1 A
Output Noise Voltage	V_n		90		μV_{rms}	10 Hz ≤ f ≤ 100 kHz
Ripple Rejection	R·R	59	64		dB	f = 120 Hz, 6.5 V ≤ V_{IN} ≤ 16.5 V
Dropout Voltage	V_{DIF}		0.5	1.0	V	I_O = 1 A, 0 ˚C ≤ T_J ≤ 125 ˚C
Short Circuit Current	I_{Oshort}		1.2		A	V_{IN} = 20 V
Peak Output Current	I_{Opeak}	1.65	2.2	3.1	A	
Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$		–0.4		mV/˚C	I_O = 5 mA, 0 ˚C ≤ T_J ≤ 125 ˚C

μPC2406A (V_{IN} = 10 V, I_O = 500 mA, T_J = 25 ˚C, Unless otherwise specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
Output Voltage	V_O	5.88	6.0	6.12	V	
		5.82		6.18		7 V ≤ V_{IN} ≤ 21 V, 5 mA ≤ I_O ≤ 500 mA, 0 ˚C ≤ T_J ≤ 125 ˚C
		5.82		6.18		5 mA ≤ I_O ≤ 1 A, 0 ˚C ≤ T_J ≤ 125 ˚C
Line Regulation	REG_{IN}		7	60	mV	7.5 V ≤ V_{IN} ≤ 21 V
Load Regulation	REG_L		4	60	mV	5 mA ≤ I_O ≤ 1A
Quiescent Current	I_{BIAS}		2.3	3.2	mA	I_O = 0
			9	60		I_O = 1 A
Start-up Current	$I_{BIAS(S)}$			15	mA	V_{IN} = 5.5 V, I_O = 0 mA
				75		V_{IN} = 5.5 V, I_O = 1 A
Quiescent Current Change	ΔI_{BIAS}			20	mA	7.5 V ≤ V_{IN} ≤ 21 V, I_O = 1 A
Output Noise Voltage	V_n		110		μV_{rms}	10 Hz ≤ f ≤ 100 kHz
Ripple Rejection	R·R	58	63		dB	f = 120 Hz, 7.5 V ≤ V_{IN} ≤ 17.5 V
Dropout Voltage	V_{DIF}		0.5	1.0	V	I_O = 1 A, 0 ˚C ≤ T_J ≤ 125 ˚C
Short Circuit Current	I_{Oshort}		1.2		A	V_{IN} = 21 V
Peak Output Current	I_{Opeak}	1.65	2.2	3.1	A	
Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$		0.4		mV/˚C	I_O = 5 mA, 0 ˚C ≤ T_J ≤ 125 ˚C

μPC2407A (V_{IN} = 11 V, I_O = 500 mA, T_J = 25 ˚C, Unless otherwise specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
Output Voltage	V_O	6.86	7.0	7.14	V	
		6.79		7.21		8 V ≤ V_{IN} ≤ 22 V, 5 mA ≤ I_O ≤ 500 mA, 0 ˚C ≤ T_J ≤ 125 ˚C
		6.79		7.21		5 mA ≤ I_O ≤ 1 A, 0 ˚C ≤ T_J ≤ 125 ˚C
Line Regulation	REG_{IN}		8	70	mV	8.5 V ≤ V_{IN} ≤ 22 V
Load Regulation	REG_L		4	70	mV	5 mA ≤ I_O ≤ 1 A
Quiescent Current	I_{BIAS}		2.3	3.2	mA	I_O = 0
			9	60		I_O = 1 A
Start-up Current	$I_{BIAS(S)}$			15	mA	V_{IN} = 6.5 V, I_O = 0 mA
				75		V_{IN} = 6.5 V, I_O = 1 A
Quiescent Current Change	ΔI_{BIAS}			20	mA	8.5 V ≤ V_{IN} ≤ 22 V, I_O = 1 A
Output Noise Voltage	V_n		130		μV_{rms}	10 Hz ≤ f ≤ 100 kHz
Ripple Rejection	R·R	57	62		dB	f = 120 Hz, 8.5 V ≤ V_{IN} ≤ 18.5 V
Dropout Voltage	V_{DIF}		0.5	1.0	V	I_O = 1 A, 0 ˚C ≤ T_J ≤ 125 ˚C
Short Circuit Current	I_{Oshort}		1.2		A	V_{IN} = 22 V
Peak Output Current	I_{Opeak}	1.65	2.2	3.1	A	
Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$		0.4		mV/˚C	I_O = 5 mA, 0 ˚C ≤ T_J ≤ 125 ˚C

μPC2408A (V_{IN} = 13 V, I_O = 500 mA, T_J = 25 ˚C, Unless otherwise specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
Output Voltage	V_O	7.85	8.0	8.15	V	
		7.75		8.25		9 V ≤ V_{IN} ≤ 23 V, 5 mA ≤ I_O ≤ 500 mA, 0 ˚C ≤ T_J ≤ 125 ˚C
		7.75		8.25		5 mA ≤ I_O ≤ 1 A, 0 ˚C ≤ T_J ≤ 125 ˚C
Line Regulation	REG_{IN}		9	80	mV	9.5 V ≤ V_{IN} ≤ 23 V
Load Regulation	REG_L		5	80	mV	5 mA ≤ I_O ≤ 1 A
Quiescent Current	I_{BIAS}		2.3	3.2	mA	I_O = 0
			9	60		I_O = 1 A
Start-up Current	$I_{BIAS(S)}$			15	mA	V_{IN} = 7.5 V, I_O = 0 mA
				75		V_{IN} = 7.5 V, I_O = 1 A
Quiescent Current Change	ΔI_{BIAS}			20	mA	9.5 V ≤ V_{IN} ≤ 23 V, I_O = 1 A
Output Noise Voltage	V_n		150		μV_{rms}	10 Hz ≤ f ≤ 100 kHz
Ripple Rejection	R·R	56	61		dB	f = 120 Hz, 9.5 V ≤ V_{IN} ≤ 19.5 V
Dropout Voltage	V_{DIF}		0.5	1.0	V	I_O = 1 A, 0 ˚C ≤ T_J ≤ 125 ˚C
Short Circuit Current	I_{Oshort}		1.2		A	V_{IN} = 23 V
Peak Output Current	I_{Opeak}	1.6	2.2	3.05	A	
Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$		0.5		mV/˚C	I_O = 5 mA, 0 ˚C ≤ T_J ≤ 125 ˚C

μPC2409A (V_{IN} = 14 V, I_O = 500 mA, T_J = 25 ˚C, Unless otherwise specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
Output Voltage	V_O	8.82	9.0	9.18	V	
		8.73		9.27		10 V ≤ V_{IN} ≤ 24 V, 5 mA ≤ I_O ≤ 500 mA, 0 ˚C ≤ T_J ≤ 125 ˚C
		8.73		9.27		5 mA ≤ I_O ≤ 1 A, 0 ˚C ≤ T_J ≤ 125 ˚C
Line Regulation	REG_{IN}		11	90	mV	10.5 V ≤ V_{IN} ≤ 24 V
Load Regulation	REG_L		5	90	mV	5 mA ≤ I_O ≤ 1 A
Quiescent Current	I_{BIAS}		2.4	3.2	mA	I_O = 0
			9	60		I_O = 1 A
Start-up Current	$I_{BIAS(S)}$			15	mA	V_{IN} = 8.5 V, I_O = 0 mA
				75		V_{IN} = 8.5 V, I_O = 1 A
Quiescent Current Change	ΔI_{BIAS}			20	mA	10.5 V ≤ V_{IN} ≤ 24 V, I_O = 1 A
Output Noise Voltage	V_n		170		μV_{rms}	10 Hz ≤ f ≤ 100 kHz
Ripple Rejection	R·R	55	60		dB	f = 120 Hz, 10.5 V ≤ V_{IN} ≤ 20.5 V
Dropout Voltage	V_{DIF}		0.5	1.0	V	I_O = 1 A, 0 ˚C ≤ T_J ≤ 125 ˚C
Short Circuit Current	I_{Oshort}		1.0		A	V_{IN} = 24 V
Peak Output Current	I_{Opeak}	1.6	2.2	3.05	A	
Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$		0.9		mV/˚C	I_O = 5 mA, 0 ˚C ≤ T_J ≤ 125 ˚C

μPC2410A (V_{IN} = 15 V, I_O = 500 mA, T_J = 25 ˚C, Unless otherwise specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
Output Voltage	V_O	9.8	10	10.2	V	
		9.7		10.3		11 V ≤ V_{IN} ≤ 25 V, 5 mA ≤ I_O ≤ 500 mA, 0 ˚C ≤ T_J ≤ 125 ˚C
		9.7		10.3		5 mA ≤ I_O ≤ 1 A, 0 ˚C ≤ T_J ≤ 125 ˚C
Line Regulation	REG_{IN}		12	100	mV	11.5 V ≤ V_{IN} ≤ 25 V
Load Regulation	REG_L		6	100	mV	5 mA ≤ I_O ≤ 1A
Quiescent Current	I_{BIAS}		2.4	3.2	mA	I_O = 0
			9	60		I_O = 1 A
Start-up Current	$I_{BIAS(S)}$			15	mA	V_{IN} = 9.5 V, I_O = 0 mA
				75		V_{IN} = 9.5 V, I_O = 1 A
Quiescent Current Change	ΔI_{BIAS}			20	mA	11.5 V ≤ V_{IN} ≤ 25 V, I_O = 1 A
Output Noise Voltage	V_n		190		μV_{rms}	10 Hz ≤ f ≤ 100 kHz
Ripple Rejection	R·R	54	59		dB	f = 120 Hz, 11.5 V ≤ V_{IN} ≤ 21.5 V
Dropout Voltage	V_{DIF}		0.5	1.0	V	I_O = 1 A, 0 ˚C ≤ T_J ≤ 125 ˚C
Short Circuit Current	I_{Oshort}		1.0		A	V_{IN} = 25 V
Peak Output Current	I_{Opeak}	1.6	2.2	3.05	A	
Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$		0.8		mV/˚C	I_O = 5 mA, 0 ˚C ≤ T_J ≤ 125 ˚C

μPC2412A (V_{IN} = 18 V, I_O = 500 mA, T_J = 25 ˚C, Unless otherwise specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
Output Voltage	V_O	11.75	12	12.25	V	
		11.65		12.35		13 V ≤ V_{IN} ≤ 27 V, 5 mA ≤ I_O ≤ 500 mA, 0 ˚C ≤ T_J ≤ 125 ˚C
		11.65		12.35		5 mA ≤ I_O ≤ 1 A, 0 ˚C ≤ T_J ≤ 125 ˚C
Line Regulation	REG_{IN}		14	120	mV	14 V ≤ V_{IN} ≤ 27 V
Load Regulation	REG_L		7	120	mV	5 mA ≤ I_O ≤ 1 A
Quiescent Current	I_{BIAS}		2.4	3.2	mA	I_O = 0
			10	60		I_O = 1 A
Start-up Current	$I_{BIAS(S)}$			15	mA	V_{IN} = 11.5 V, I_O = 0 mA
				75		V_{IN} = 11.5 V, I_O = 1 A
Quiescent Current Change	ΔI_{BIAS}			20	mA	14 V ≤ V_{IN} ≤ 27 V, I_O = 1 A
Output Noise Voltage	V_n		230		μV_{rms}	10 Hz ≤ f ≤ 100 kHz
Ripple Rejection	R·R	53	58		dB	f = 120 Hz, 14 V ≤ V_{IN} ≤ 24 V
Dropout Voltage	V_{DIF}		0.5	1.0	V	I_O = 1 A, 0 ˚C ≤ T_J ≤ 125 ˚C
Short Circuit Current	I_{Oshort}		0.8		A	V_{IN} = 27 V
Peak Output Current	I_{Opeak}	1.58	2.2	3.03	A	
Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$		0.8		mV/˚C	I_O = 5 mA, 0 ˚C ≤ T_J ≤ 125 ˚C

μPC2415A (V_{IN} = 22 V, I_O = 500 mA, T_J = 25 ˚C, Unless otherwise specified)

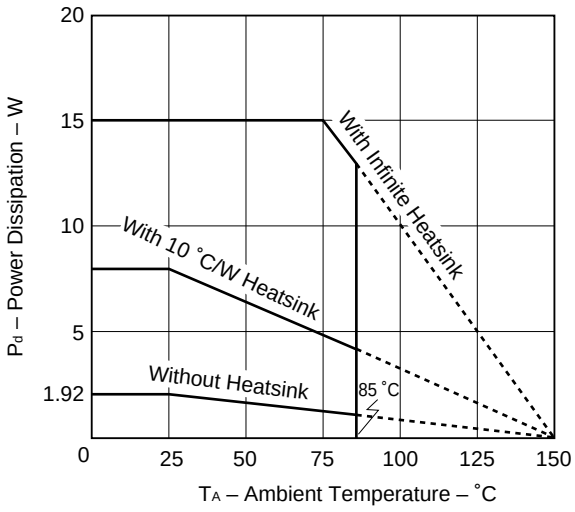
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
Output Voltage	V_O	14.7	15	15.3	V	
		14.55		15.45		16 V ≤ V_{IN} ≤ 27 V, 5 mA ≤ I_O ≤ 500 mA, 0 ˚C ≤ T_J ≤ 125 ˚C
		14.55		15.45		5 mA ≤ I_O ≤ 1 A, 0 ˚C ≤ T_J ≤ 125 ˚C
Line Regulation	REG_{IN}		18	150	mV	17 V ≤ V_{IN} ≤ 27 V
Load Regulation	REG_L		9	150	mV	5 mA ≤ I_O ≤ 1A
Quiescent Current	I_{BIAS}		2.5	3.2	mA	I_O = 0
			10	60		I_O = 1 A
Start-up Current	$I_{BIAS(S)}$			15	mA	V_{IN} = 14.5 V, I_O = 0 mA
				75		V_{IN} = 14.5 V, I_O = 1 A
Quiescent Current Change	ΔI_{BIAS}			20	mA	17 V ≤ V_{IN} ≤ 27 V, I_O = 1 A
Output Noise Voltage	V_n		290		μV_{rms}	10 Hz ≤ f ≤ 100 kHz
Ripple Rejection	R·R	51	56		dB	f = 120 Hz, 17 V ≤ V_{IN} ≤ 27 V
Dropout Voltage	V_{DIF}		0.5	1.0	V	I_O = 1 A, 0 ˚C ≤ T_J ≤ 125 ˚C
Short Circuit Current	I_{Oshort}		0.8		A	V_{IN} = 27 V
Peak Output Current	I_{Opeak}	1.55	2.2	3.0	A	
Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$		1.6		mV/˚C	I_O = 5 mA, 0 ˚C ≤ T_J ≤ 125 ˚C

μPC2418A (V_{IN} = 25 V, I_O = 500 mA, T_J = 25 ˚C, Unless otherwise specified)

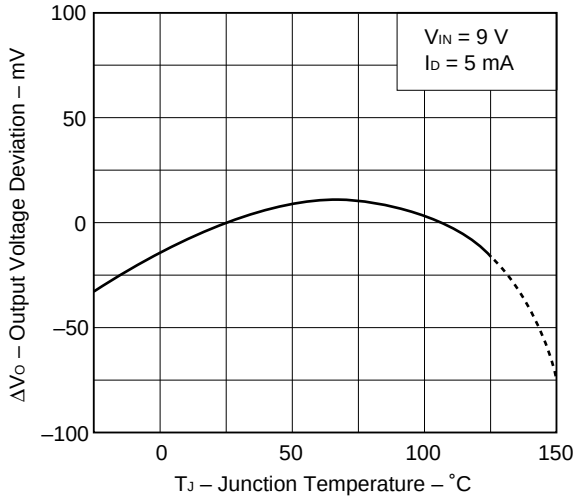
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
Output Voltage	V_O	17.64	18	18.36	V	
		17.46		18.54		19 V ≤ V_{IN} ≤ 28 V, 5 mA ≤ I_O ≤ 500 mA, 0 ˚C ≤ T_J ≤ 125 ˚C
		17.46		18.54		5 mA ≤ I_O ≤ 1 A, 0 ˚C ≤ T_J ≤ 125 ˚C
Line Regulation	REG_{IN}		22	180	mV	20 V ≤ V_{IN} ≤ 28 V
Load Regulation	REG_L		11	180	mV	5 mA ≤ I_O ≤ 1 A
Quiescent Current	I_{BIAS}		2.5	3.2	mA	I_O = 0
			10	60		I_O = 1 A
Start-up Current	$I_{BIAS(S)}$			15	mA	V_{IN} = 17.5 V, I_O = 0 mA
				75		V_{IN} = 17.5 V, I_O = 1 A
Quiescent Current Change	ΔI_{BIAS}			20	mA	20 V ≤ V_{IN} ≤ 28 V, I_O = 1 A
Output Noise Voltage	V_n		350		μV_{rms}	10 Hz ≤ f ≤ 100 kHz
Ripple Rejection	R·R	49	54		dB	f = 120 Hz, 20 V ≤ V_{IN} ≤ 28 V
Dropout Voltage	V_{DIF}		0.5	1.0	V	I_O = 1 A, 0 ˚C ≤ T_J ≤ 125 ˚C
Short Circuit Current	I_{Oshort}		0.8		A	V_{IN} = 28 V
Peak Output Current	I_{Opeak}	1.55	2.2	3.0	A	
Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T$		2.5		mV/˚C	I_O = 5 mA, 0 ˚C ≤ T_J ≤ 125 ˚C

TYPICAL CHARACTERISTICS

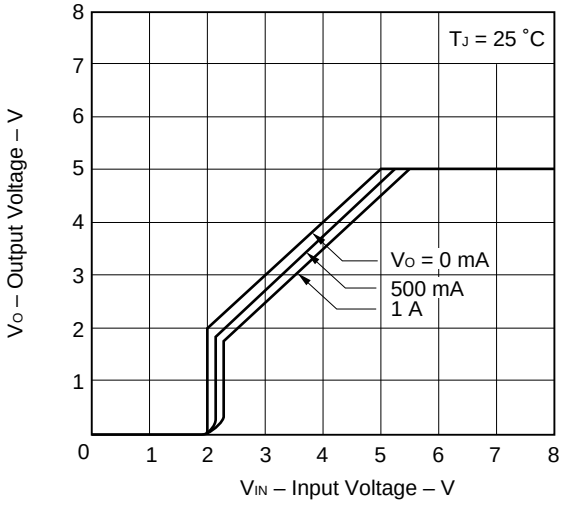
P_d - T_A



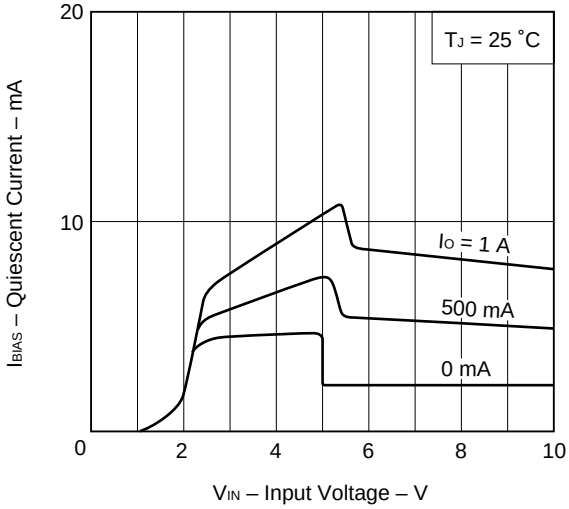
ΔVO - TJ (μPC2405A)



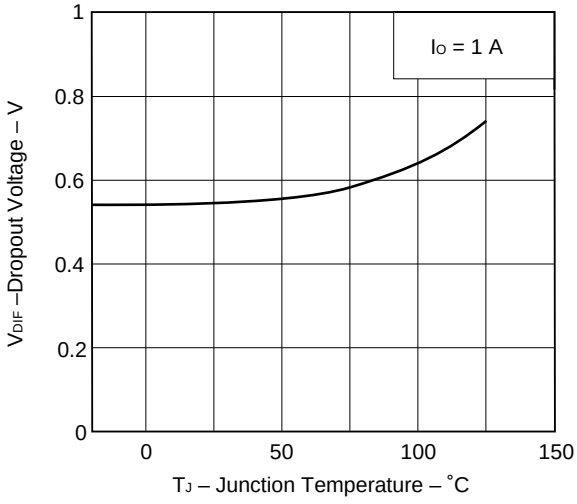
VO - VIN (μPC2405A)



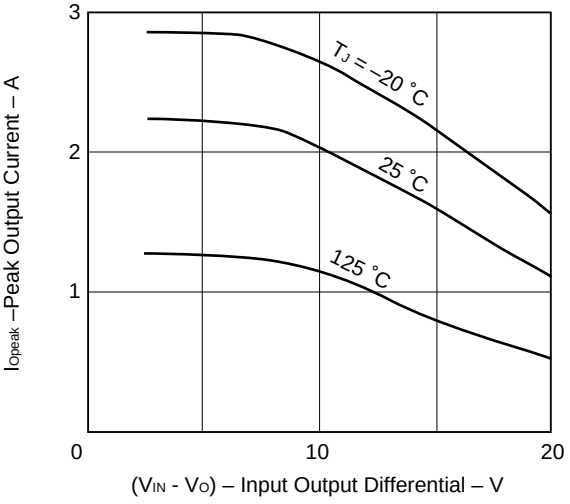
IBIAS (IBIAS(S)) - VIN (μPC2405A)



VDIF - TJ

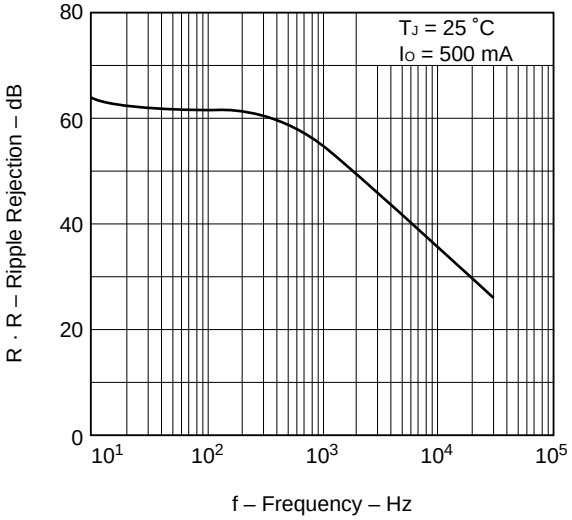


IOpeak - (VIN - VO)

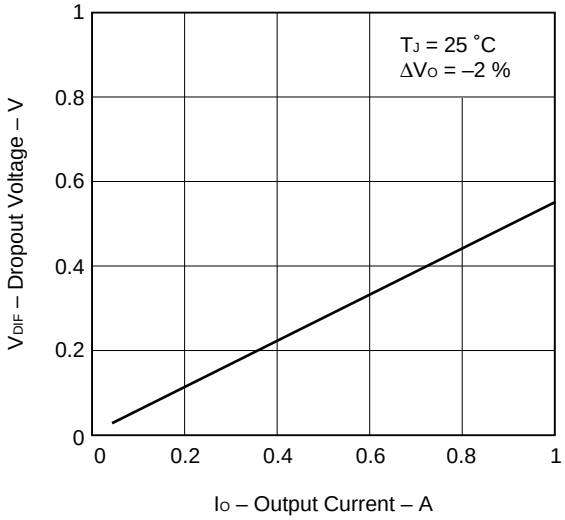


TYPICAL CHARACTERISTICS

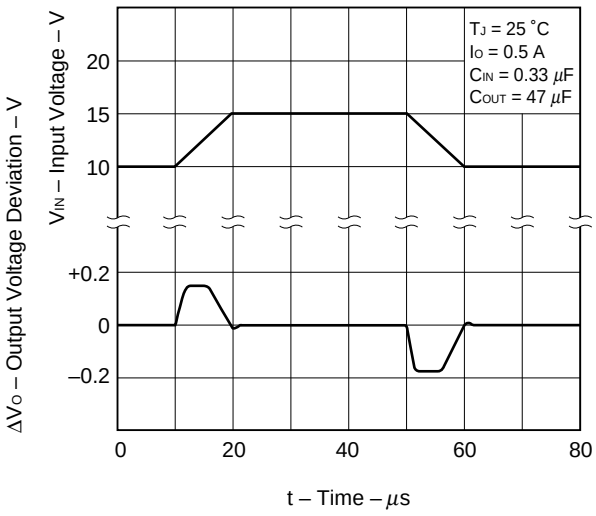
R · R - f (μPC2405A)



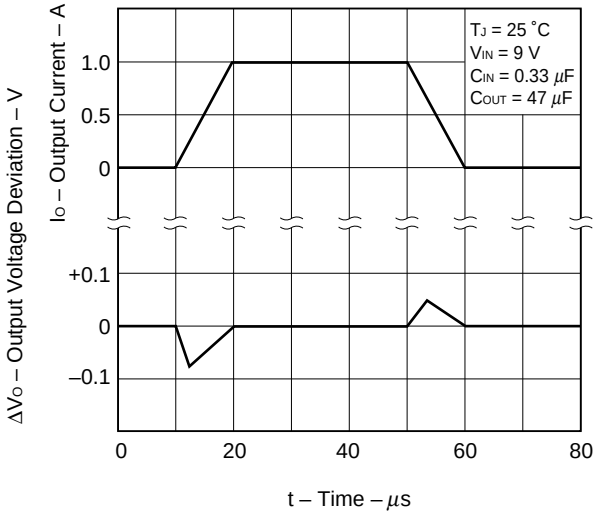
VDIF - IO



LINE TRANSIENT RESPONSE (μPC2405A)



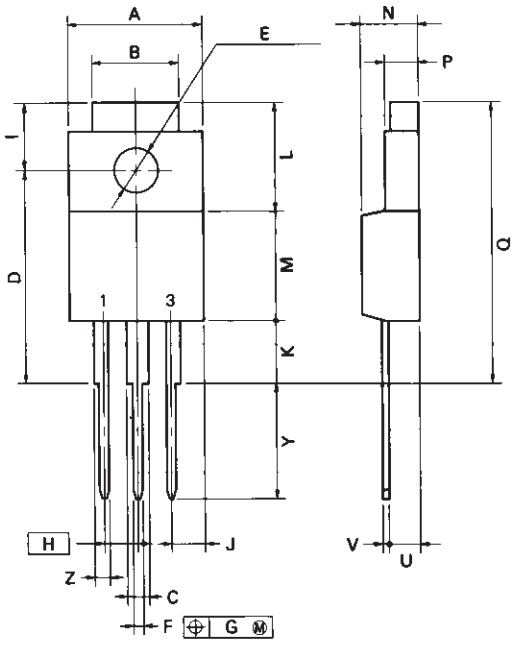
LOAD TRANSIENT RESPONSE (μPC2405A)



PACKAGE DIMENSIONS (Unit: mm)

μPC2400AHF Series

3PIN PLASTIC SIP (MP-45G)



P3HF-254B-1

NOTE

Each lead centerline is located within 0.25 mm (0.01 inch) of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS	INCHES
A	10.4 MAX.	0.410 MAX.
B	7.0	0.276
C	1.2 MIN.	0.047 MIN.
D	$17.0^{\pm 0.3}$	$0.669^{+0.013}_{-0.012}$
E	$\phi 3.3^{\pm 0.2}$	$\phi 0.130^{\pm 0.008}$
F	$0.75^{\pm 0.10}$	$0.030^{+0.004}_{-0.005}$
G	0.25	0.010
H	2.54 (T.P.)	0.100 (T.P.)
I	$5.0^{\pm 0.3}$	$0.197^{\pm 0.012}$
J	2.66 MAX.	0.105 MAX.
K	4.8 MIN.	0.188 MIN.
L	8.5	0.335
M	8.5	0.335
N	$4.5^{\pm 0.2}$	$0.177^{\pm 0.008}$
P	$2.8^{\pm 0.2}$	$0.110^{+0.009}_{-0.008}$
Q	22.4 MAX.	0.882 MAX.
U	$2.4^{\pm 0.5}$	$0.094^{+0.021}_{-0.020}$
V	$0.65^{\pm 0.10}$	$0.026^{+0.004}_{-0.005}$
Y	$8.9^{\pm 0.7}$	$0.350^{\pm 0.028}$
Z	1.0 MIN.	0.039 MIN.

RECOMMENDED SOLDERING CONDITIONS

The following conditions (see table below) must be met when soldering this product.

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

TYPES OF THROUGH HOLE MOUNT DEVICE

μPC2400AHF Series

Soldering Process	Soldering Conditions	Symbol
Wave soldering	Solder temperature: 260 °C or below. Flow Time: 10 seconds or below.	

REFERENCE

Document Name	Document No.
NEC semiconductor device reliability/quality control system.	IEI-1212
Quality grade on NEC semiconductor devices.	IEI-1209
Semiconductor device mounting technology manual.	IEI-1207
Semiconductor device package manual.	IEI-1213
Guide to quality assurance for semiconductor devices.	MEI-1202
Semiconductor selection guide.	MF-1134

[MEMO]

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NEC devices are classified into the following three quality grades:

"Standard", "Special", and "Specific". The Specific quality grade applies only to devices developed based on a customer designated "quality assurance program" for a specific application. The recommended applications of a device depend on its quality grade, as indicated below. Customers must check the quality grade of each device 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: Aircrafts, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems or medical equipment for life support, etc.

The quality grade of NEC devices in "Standard" unless otherwise specified in NEC's Data Sheets or Data Books. If customers intend to use NEC devices for applications other than those specified for Standard quality grade, they should contact NEC Sales Representative in advance.

Anti-radioactive design is not implemented in this product.

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