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Old Company Name in Catalogs and Other Documents

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Renesas Electronics website: <http://www.renesas.com>

April 1st, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (<http://www.renesas.com>)

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(Note 2) “Renesas Electronics product(s)” means any product developed or manufactured by or for Renesas Electronics.

THREE TERMINAL POSITIVE VOLTAGE REGULATORS

DESCRIPTION

μPC7800A series are monolithic three terminal positive regulators which employ internally current limiting, thermal shut down, output transistor safe operating area protection make them essentially indestructible.

They are improved for ripple rejection ratio, line regulation, load regulation and quiescent current, as comparison of conventional μPC7800 series.

FEATURES

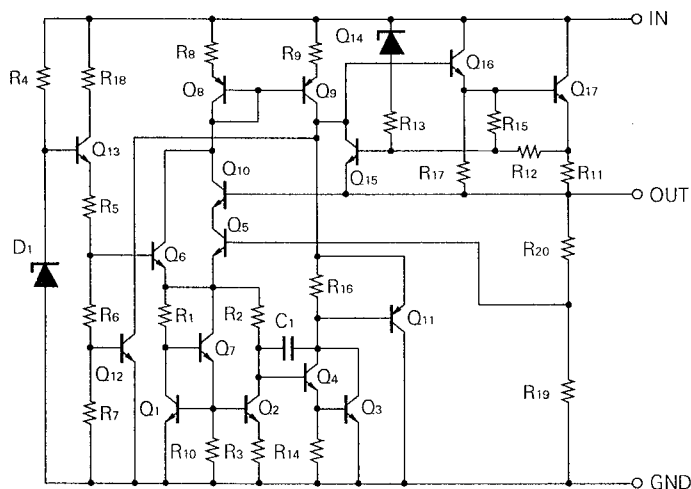
- Wide operation temperature range.
- High ripple rejection ratio.
- Good regulation (line, load).
- Low quiescent current.
- Built-in protection circuits.
(over current protection, SOA protection and thermal shut down)

ORDER INFORMATION

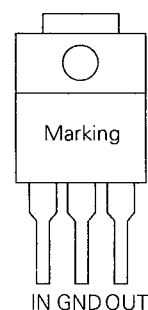
TYPE NUMBER	OUTPUT VOLTAGE	PACKAGE	QUALITY GRADE
μPC7805AHF	5 V	MP-45G (ISOLATED TO-220)	Standard
μPC7808AHF	8 V		
μPC7893AHF	9.3 V		
μPC7812AHF	12 V		
μPC7815AHF	15 V		
μPC7818AHF	18 V		
μPC7824AHF	24 V		

Please refer to "Quality grade on NEC Semiconductor Devices" (Document number IEI-1209) published by NEC Corporation to know the specification of quality grade on the devices and its recommended applications.

EQUIVALENT CIRCUIT



CONNECTION DIAGRAM



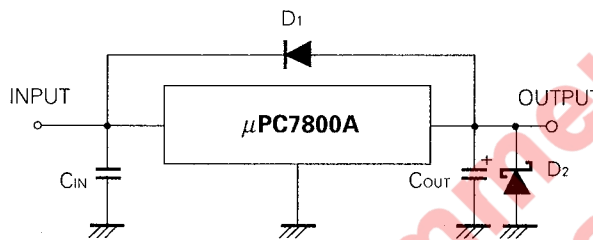
ABSOLUTE MAXIMUM RATINGS (T_a = 25 °C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Input Voltage	V _{IN}	35/40 (Note1)	V
Internal Power Dissipation	P _T	15 (Note2)	W
Operating Ambient Temperature Range	T _{opt}	- 30 to + 85	°C
Operating Junction Temperature Range	T _{opt(j)}	- 30 to + 150	°C
Storage Temperature Range	T _{stg}	- 55 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

(Note1) μPC7805A, 08A, 93A, 12A, 15A, 18A : 35 V, μPC7824A : 40 V

(Note2) Internally limited

TYPICAL CONNECTION



C₁: Required if regulator is located an appreciable distance from power supply filter.

C₂: More than 0.1 μF

D₁: Needed for V_{IN} < V_o

D₂: Needed for V_o < GND

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL		MIN.	TYP.	MAX.	UNIT
Input Voltage	V _{IN}	μPC7805AHF	7	10	25	V
		μPC7808AHF	10.5	14	25	
		μPC7893AHF	12	15	24.5	
		μPC7812AHF	14.5	19	30	
		μPC7815AHF	17.5	23	30	
		μPC7818AHF	21	27	33	
		μPC7824AHF	27	33	38	
Output Current	I _o	All	0.005	0.5	1	A
Operating Junction Temperature Range	T _{opt(j)}	All	- 30		+ 125	°C

ELECTRICAL CHARACTERISTICS μPC7805A

($V_{IN} = 10\text{ V}$, $I_o = 500\text{ mA}$, $0\text{ °C} \leq T_j \leq +125\text{ °C}$)

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_o	$T_j = 25\text{ °C}$	4.8	5.0	5.2	V
		$7\text{ V} \leq V_{IN} \leq 20\text{ V}$, $5\text{ mA} \leq I_o \leq 1\text{ A}$, $P_T \leq 15\text{ W}$	4.75		5.25	
		$-30\text{ °C} \leq T_j \leq +125\text{ °C}$	4.75		5.25	
Line Regulation	REG _{IN}	$T_j = 25\text{ °C}$, $7\text{ V} \leq V_{IN} \leq 25\text{ V}$		7	30	mV
		$T_j = 25\text{ °C}$, $8\text{ V} \leq V_{IN} \leq 12\text{ V}$		2	15	
Load Regulation	REG _L	$T_j = 25\text{ °C}$, $5\text{ mA} \leq I_o \leq 1.5\text{ A}$		4	30	mV
		$T_j = 25\text{ °C}$, $250\text{ mA} \leq I_o \leq 750\text{ mA}$		2	10	
Quiescent Current	I _{BIAS}	$T_j = 25\text{ °C}$		2.8	4.3	mA
Quiescent Current Change	ΔI_{BIAS}	$7\text{ V} \leq V_{IN} \leq 25\text{ V}$			1.0	mA
		$5\text{ mA} \leq I_o \leq 1.0\text{ A}$			0.5	
Output Noize Voltage	V_n	$T_j = 25\text{ °C}$, $10\text{ Hz} \leq f \leq 100\text{ kHz}$		40	200	μV _{r.m.s.}
Ripple Rejection	R•R	$T_j = 25\text{ °C}$, $f = 120\text{ Hz}$, $8\text{ V} \leq V_{IN} \leq 18\text{ V}$	70	76		dB
Dropout Voltage	V _{DIF}	$T_j = 25\text{ °C}$, $I_o = 1.0\text{ A}$		1.8		V
Short Circuit Current	I _{Oshort}	$T_j = 25\text{ °C}$, $V_{IN} = 25\text{ V}$		1.6		A
Peak Output Current	I _{Opeak}	$T_j = 25\text{ °C}$, $V_{IN} = 10\text{ V}$	1.7	2.2	2.8	A
Temperature Coefficient of Output Voltage	$\Delta V_o/\Delta T$	$I_o = 5\text{ mA}$, $0\text{ °C} \leq T_j \leq +125\text{ °C}$		-0.4		mV/°C

ELECTRICAL CHARACTERISTICS μPC7808A

($V_{IN} = 14\text{ V}$, $I_o = 500\text{ mA}$, $0\text{ °C} \leq T_j \leq +125\text{ °C}$)

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_o	$T_j = 25\text{ °C}$	7.7	8.0	8.3	V
		$10.5\text{ V} \leq V_{IN} \leq 23\text{ V}$, $5\text{ mA} \leq I_o \leq 1\text{ A}$, $P_T \leq 15\text{ W}$	7.6		8.4	
		$-30\text{ °C} \leq T_j \leq +125\text{ °C}$	7.6		8.4	
Line Regulation	REG _{IN}	$T_j = 25\text{ °C}$, $10.5\text{ V} \leq V_{IN} \leq 25\text{ V}$		8	35	mV
		$T_j = 25\text{ °C}$, $11\text{ V} \leq V_{IN} \leq 17\text{ V}$		3	25	
Load Regulation	REG _L	$T_j = 25\text{ °C}$, $5\text{ mA} \leq I_o \leq 1.5\text{ A}$		12	90	mV
		$T_j = 25\text{ °C}$, $250\text{ mA} \leq I_o \leq 750\text{ mA}$		4	20	
Quiescent Current	I _{BIAS}	$T_j = 25\text{ °C}$		3	4.4	mA
Quiescent Current Change	ΔI_{BIAS}	$10.5\text{ V} \leq V_{IN} \leq 25\text{ V}$			1.0	mA
		$5\text{ mA} \leq I_o \leq 1.0\text{ A}$			0.5	
Output Noize Voltage	V_n	$T_j = 25\text{ °C}$, $10\text{ Hz} \leq f \leq 100\text{ kHz}$		50	250	μV _{r.m.s.}
Ripple Rejection	R•R	$T_j = 25\text{ °C}$, $f = 120\text{ Hz}$, $11.5\text{ V} \leq V_{IN} \leq 21.5\text{ V}$	66	72		dB
Dropout Voltage	V _{DIF}	$T_j = 25\text{ °C}$, $I_o = 1.0\text{ A}$		1.8		V
Short Circuit Current	I _{Oshort}	$T_j = 25\text{ °C}$, $V_{IN} = 25\text{ V}$		1.6		A
Peak Output Current	I _{Opeak}	$T_j = 25\text{ °C}$, $V_{IN} = 14\text{ V}$	1.7	2.2	2.8	A
Temperature Coefficient of Output Voltage	$\Delta V_o/\Delta T$	$I_o = 5\text{ mA}$, $0\text{ °C} \leq T_j \leq +125\text{ °C}$		-0.6		mV/°C

ELECTRICAL CHARACTERISTICS μPC7812A

($V_{IN} = 19\text{ V}$, $I_o = 500\text{ mA}$, $0\text{ °C} \leq T_j \leq +125\text{ °C}$)

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_o	$T_j = 25\text{ °C}$	11.5	12.0	12.5	V
		$14.5\text{ V} \leq V_{IN} \leq 27\text{ V}$, $5\text{ mA} \leq I_o \leq 1\text{ A}$, $P_r \leq 15\text{ W}$	11.4		12.6	
		$-30\text{ °C} \leq T_j \leq +125\text{ °C}$	11.4		12.6	
Line Regulation	REG _{IN}	$T_j = 25\text{ °C}$, $14.5\text{ V} \leq V_{IN} \leq 30\text{ V}$		10	45	mV
		$T_j = 25\text{ °C}$, $16\text{ V} \leq V_{IN} \leq 22\text{ V}$		4	30	
Load Regulation	REG _L	$T_j = 25\text{ °C}$, $5\text{ mA} \leq I_o \leq 1.5\text{ A}$		17	130	mV
		$T_j = 25\text{ °C}$, $250\text{ mA} \leq I_o \leq 750\text{ mA}$		6	30	
Quiescent Current	I _{BIAS}	$T_j = 25\text{ °C}$		3.1	4.6	mA
Quiescent Current Change	ΔI_{BIAS}	$14.5\text{ V} \leq V_{IN} \leq 30\text{ V}$			1.0	mA
		$5\text{ mA} \leq I_o \leq 1.0\text{ A}$			0.5	
Output Noise Voltage	V_n	$T_j = 25\text{ °C}$, $10\text{ Hz} \leq f \leq 100\text{ kHz}$		70	300	μV _{r.m.s.}
Ripple Rejection	R•R	$T_j = 25\text{ °C}$, $f = 120\text{ Hz}$, $15\text{ V} \leq V_{IN} \leq 25\text{ V}$	62	68		dB
Dropout Voltage	V _{DIF}	$T_j = 25\text{ °C}$, $I_o = 1.0\text{ A}$		1.8		V
Short Circuit Current	I _{short}	$T_j = 25\text{ °C}$, $V_{IN} = 30\text{ V}$		1.3		A
Peak Output Current	I _{Opeak}	$T_j = 25\text{ °C}$, $V_{IN} = 19\text{ V}$	1.7	2.2	2.8	A
Temperature Coefficient of Output Voltage	$\Delta V_o/\Delta T$	$I_o = 5\text{ mA}$, $0\text{ °C} \leq T_j \leq +125\text{ °C}$		-0.8		mV/°C

ELECTRICAL CHARACTERISTICS μPC7815A

($V_{IN} = 23\text{ V}$, $I_o = 500\text{ mA}$, $0\text{ °C} \leq T_j \leq +125\text{ °C}$)

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_o	$T_j = 25\text{ °C}$	14.4	15.0	15.6	V
		$17.5\text{ V} \leq V_{IN} \leq 30\text{ V}$, $5\text{ mA} \leq I_o \leq 1\text{ A}$, $P_r \leq 15\text{ W}$	14.25		15.75	
		$-30\text{ °C} \leq T_j \leq +125\text{ °C}$	14.25		15.75	
Line Regulation	REG _{IN}	$T_j = 25\text{ °C}$, $17.5\text{ V} \leq V_{IN} \leq 30\text{ V}$		10	45	mV
		$T_j = 25\text{ °C}$, $20\text{ V} \leq V_{IN} \leq 26\text{ V}$		5	35	
Load Regulation	REG _L	$T_j = 25\text{ °C}$, $5\text{ mA} \leq I_o \leq 1.5\text{ A}$		25	190	mV
		$T_j = 25\text{ °C}$, $250\text{ mA} \leq I_o \leq 750\text{ mA}$		8	40	
Quiescent Current	I _{BIAS}	$T_j = 25\text{ °C}$		3.3	4.8	mA
Quiescent Current Change	ΔI_{BIAS}	$17.5\text{ V} \leq V_{IN} \leq 30\text{ V}$			1.0	mA
		$5\text{ mA} \leq I_o \leq 1.0\text{ A}$			0.5	
Output Noise Voltage	V_n	$T_j = 25\text{ °C}$, $10\text{ Hz} \leq f \leq 100\text{ kHz}$		85	400	μV _{r.m.s.}
Ripple Rejection	R•R	$T_j = 25\text{ °C}$, $f = 120\text{ Hz}$, $18.5\text{ V} \leq V_{IN} \leq 28.5\text{ V}$	60	66		dB
Dropout Voltage	V _{DIF}	$T_j = 25\text{ °C}$, $I_o = 1.0\text{ A}$		1.8		V
Short Circuit Current	I _{short}	$T_j = 25\text{ °C}$, $V_{IN} = 30\text{ V}$		1.3		A
Peak Output Current	I _{Opeak}	$T_j = 25\text{ °C}$, $V_{IN} = 23\text{ V}$	1.7	2.2	2.8	A
Temperature Coefficient of Output Voltage	$\Delta V_o/\Delta T$	$I_o = 5\text{ mA}$, $0\text{ °C} \leq T_j \leq +125\text{ °C}$		-1.1		mV/°C

ELECTRICAL CHARACTERISTICS μPC7818A

($V_{IN} = 27\text{ V}$, $I_o = 500\text{ mA}$, $0\text{ °C} \leq T_j \leq +125\text{ °C}$)

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_o	$T_j = 25\text{ °C}$	17.3	18.0	18.7	V
		$21\text{ V} \leq V_{IN} \leq 33\text{ V}$, $5\text{ mA} \leq I_o \leq 1\text{ A}$, $P_r \leq 15\text{ W}$	17.1		18.9	
		$-30\text{ °C} \leq T_j \leq +125\text{ °C}$	17.1		18.9	
Line Regulation	REG_{IN}	$T_j = 25\text{ °C}$, $21\text{ V} \leq V_{IN} \leq 33\text{ V}$		12	60	mV
		$T_j = 25\text{ °C}$, $24\text{ V} \leq V_{IN} \leq 30\text{ V}$		6	45	
Load Regulation	REG_L	$T_j = 25\text{ °C}$, $5\text{ mA} \leq I_o \leq 1.5\text{ A}$		32	110	mV
		$T_j = 25\text{ °C}$, $250\text{ mA} \leq I_o \leq 750\text{ mA}$		10	40	
Quiescent Current	I_{BIAS}	$T_j = 25\text{ °C}$		3.4	5.0	mA
Quiescent Current Change	ΔI_{BIAS}	$21\text{ V} \leq V_{IN} \leq 33\text{ V}$			1.0	mA
		$5\text{ mA} \leq I_o \leq 1.0\text{ A}$			0.5	
Output Noise Voltage	V_n	$T_j = 25\text{ °C}$, $10\text{ Hz} \leq f \leq 100\text{ kHz}$		95	450	$\mu\text{V}_{r.m.s.}$
Ripple Rejection	$R \cdot R$	$T_j = 25\text{ °C}$, $f = 120\text{ Hz}$, $22\text{ V} \leq V_{IN} \leq 32\text{ V}$	59	65		dB
Dropout Voltage	V_{DIF}	$T_j = 25\text{ °C}$, $I_o = 1.0\text{ A}$		1.8		V
Short Circuit Current	I_{Oshort}	$T_j = 25\text{ °C}$, $V_{IN} = 33\text{ V}$		1.2		A
Peak Output Current	I_{Opeak}	$T_j = 25\text{ °C}$, $V_{IN} = 27\text{ V}$	1.7	2.2	2.8	A
Temperature Coefficient of Output Voltage	$\Delta V_o / \Delta T$	$I_o = 5\text{ mA}$, $0\text{ °C} \leq T_j \leq +125\text{ °C}$		-1.3		mV/°C

ELECTRICAL CHARACTERISTICS μPC7824A

($V_{IN} = 33\text{ V}$, $I_o = 500\text{ mA}$, $0\text{ °C} \leq T_j \leq +125\text{ °C}$)

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_o	$T_j = 25\text{ °C}$	23.0	24.0	25.0	V
		$27\text{ V} \leq V_{IN} \leq 38\text{ V}$, $5\text{ mA} \leq I_o \leq 1\text{ A}$, $P_r \leq 15\text{ W}$	22.8		25.2	
		$-30\text{ °C} \leq T_j \leq +125\text{ °C}$	22.8		25.2	
Line Regulation	REG_{IN}	$T_j = 25\text{ °C}$, $27\text{ V} \leq V_{IN} \leq 38\text{ V}$		15	80	mV
		$T_j = 25\text{ °C}$, $30\text{ V} \leq V_{IN} \leq 36\text{ V}$		8	50	
Load Regulation	REG_L	$T_j = 25\text{ °C}$, $5\text{ mA} \leq I_o \leq 1.5\text{ A}$		44	150	mV
		$T_j = 25\text{ °C}$, $250\text{ mA} \leq I_o \leq 750\text{ mA}$		14	50	
Quiescent Current	I_{BIAS}	$T_j = 25\text{ °C}$		3.6	5.3	mA
Quiescent Current Change	ΔI_{BIAS}	$27\text{ V} \leq V_{IN} \leq 38\text{ V}$			1.0	mA
		$5\text{ mA} \leq I_o \leq 1.0\text{ A}$			0.5	
Output Noise Voltage	V_n	$T_j = 25\text{ °C}$, $10\text{ Hz} \leq f \leq 100\text{ kHz}$		120	500	$\mu\text{V}_{r.m.s.}$
Ripple Rejection	$R \cdot R$	$T_j = 25\text{ °C}$, $f = 120\text{ Hz}$, $28\text{ V} \leq V_{IN} \leq 38\text{ V}$	55	62		dB
Dropout Voltage	V_{DIF}	$T_j = 25\text{ °C}$, $I_o = 1.0\text{ A}$		2.0		V
Short Circuit Current	I_{Oshort}	$T_j = 25\text{ °C}$, $V_{IN} = 38\text{ V}$		1.0		A
Peak Output Current	I_{Opeak}	$T_j = 25\text{ °C}$, $V_{IN} = 33\text{ V}$	1.7	2.2	2.8	A
Temperature Coefficient of Output Voltage	$\Delta V_o / \Delta T$	$I_o = 5\text{ mA}$, $0\text{ °C} \leq T_j \leq +125\text{ °C}$		-1.7		mV/°C

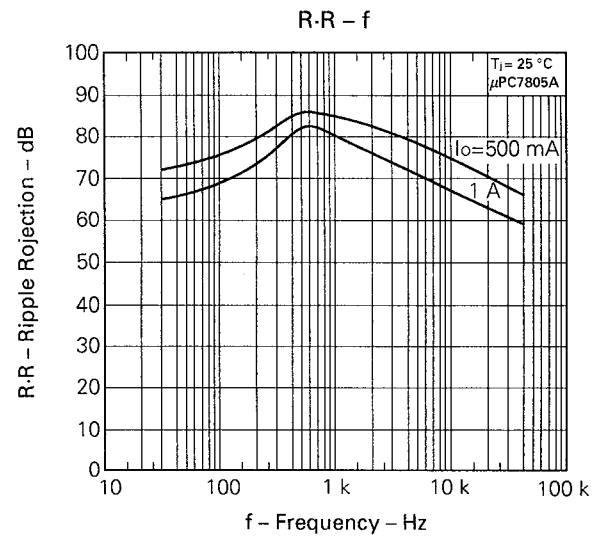
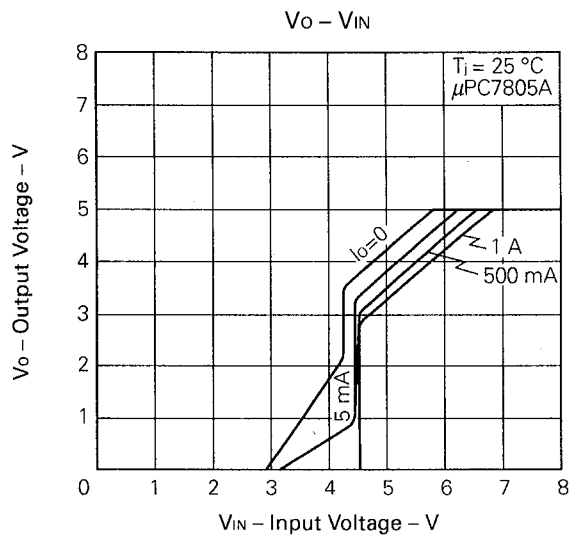
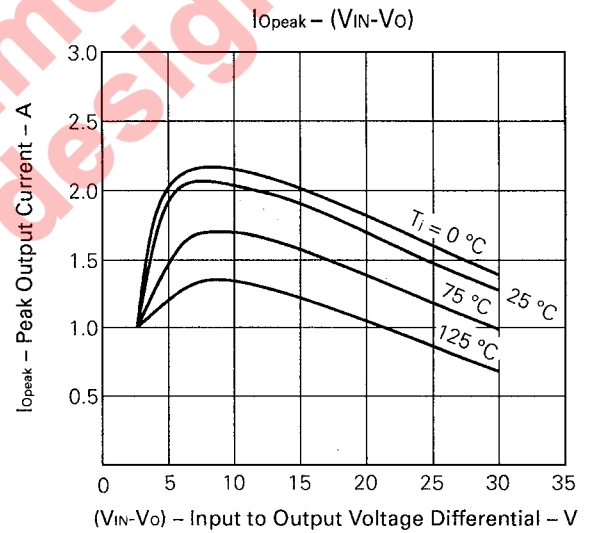
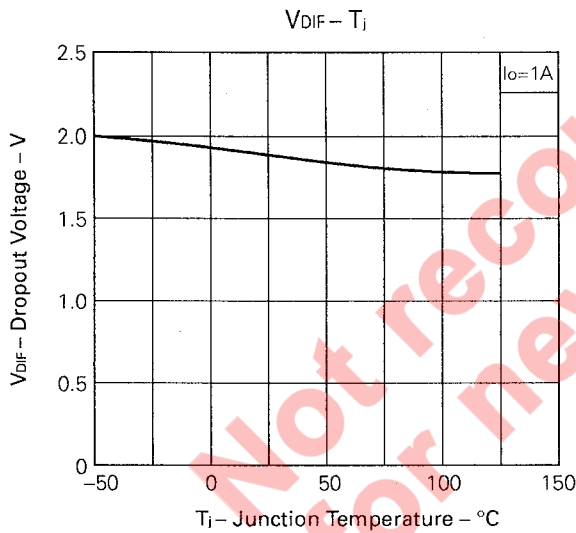
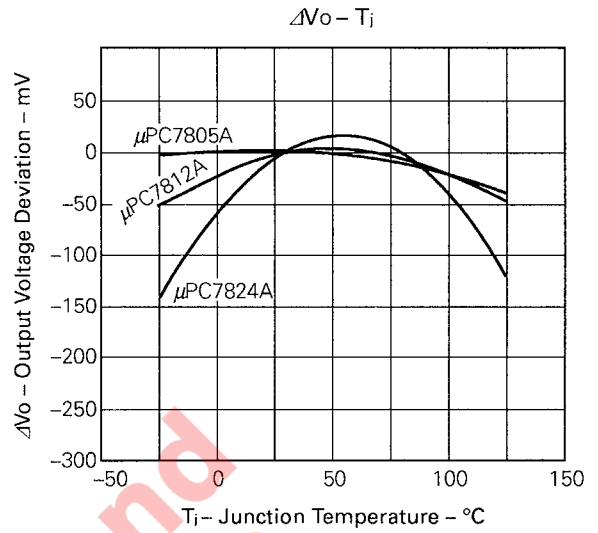
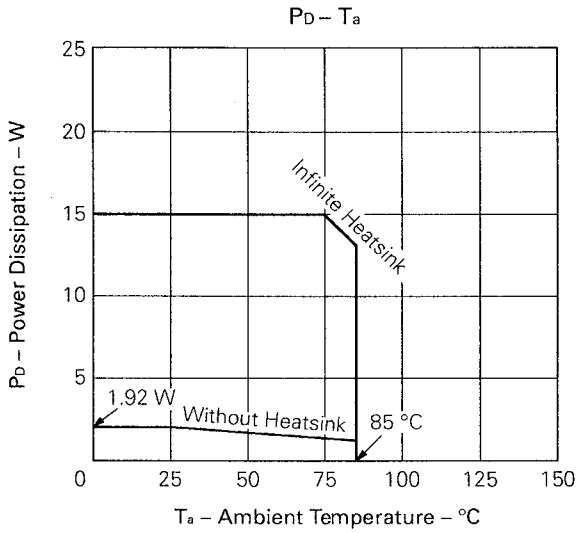
ELECTRICAL CHARACTERISTICS μPC7893A

($V_{IN} = 15\text{ V}$, $I_o = 500\text{ mA}$, $0\text{ °C} \leq T_j \leq +125\text{ °C}$)

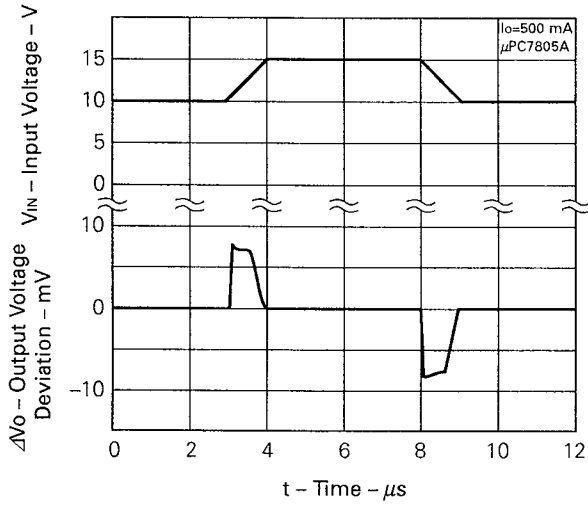
CHARACTERISTIC	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_o	$T_j = 25\text{ °C}$	9.0	9.3	9.5	V
		$12\text{ V} \leq V_{IN} \leq 24.5\text{ V}$, $5\text{ mA} \leq I_o \leq 1\text{ A}$, $P_r \leq 15\text{ W}$	8.9		9.7	
		$-30\text{ °C} \leq T_j \leq +125\text{ °C}$	8.9		9.7	
Line Regulation	REG_{IN}	$T_j = 25\text{ °C}$, $12\text{ V} \leq V_{IN} \leq 26.5\text{ V}$		9	40	mV
		$T_j = 25\text{ °C}$, $12.5\text{ V} \leq V_{IN} \leq 18.5\text{ V}$		4	30	
Load Regulation	REG_L	$T_j = 25\text{ °C}$, $5\text{ mA} \leq I_o \leq 1.5\text{ A}$		15	110	mV
		$T_j = 25\text{ °C}$, $250\text{ mA} \leq I_o \leq 750\text{ mA}$		5	25	
Quiescent Current	I_{BIAS}	$T_j = 25\text{ °C}$		3.1	4.5	mA
Quiescent Current Change	ΔI_{BIAS}	$12\text{ V} \leq V_{IN} \leq 26.5\text{ V}$			1.0	mA
		$5\text{ mA} \leq I_o \leq 1.0\text{ A}$			0.5	
Output Noise Voltage	V_n	$T_j = 25\text{ °C}$, $10\text{ Hz} \leq f \leq 100\text{ kHz}$		55	230	μV _{r.m.s.}
Ripple Rejection	$R \cdot R$	$T_j = 25\text{ °C}$, $f = 120\text{ Hz}$, $12.5\text{ V} \leq V_{IN} \leq 22.5\text{ V}$	64	70		dB
Dropout Voltage	V_{DIF}	$T_j = 25\text{ °C}$, $I_o = 1.0\text{ A}$		1.8		V
Short Circuit Current	I_{Oshort}	$T_j = 25\text{ °C}$, $V_{IN} = 26.5\text{ V}$		1.5		A
Peak Output Current	I_{Opeak}	$T_j = 25\text{ °C}$, $V_{IN} = 15\text{ V}$	1.7	2.2	2.8	A
Temperature Coefficient of Output Voltage	$\Delta V_o / \Delta T$	$I_o = 5\text{ mA}$, $0\text{ °C} \leq T_j \leq +125\text{ °C}$		-0.7		mV/°C

Not recommended for new design

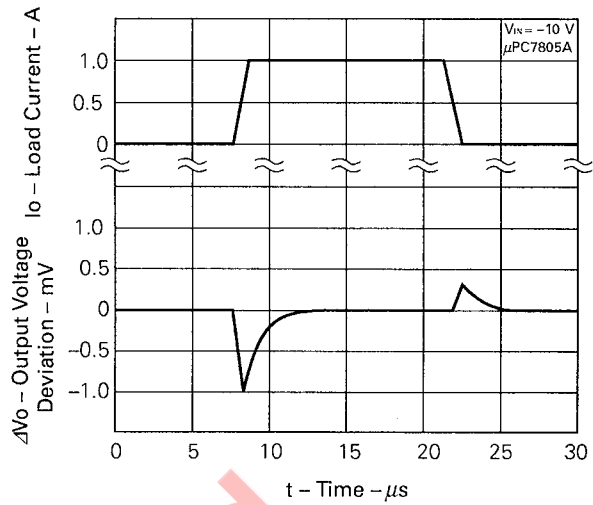
TYPICAL CHARACTERISTICS (T_a = 25 °C)



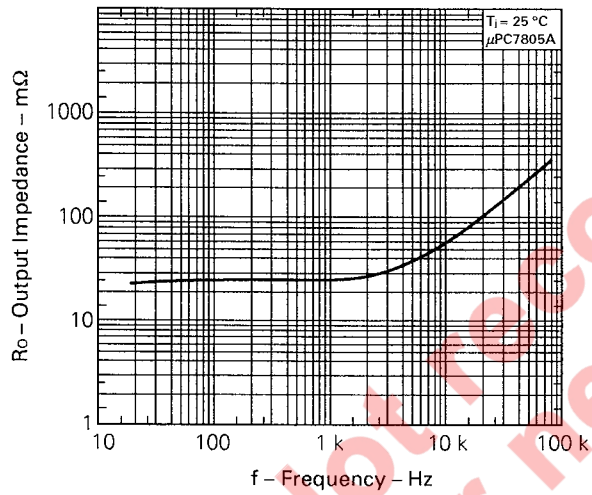
LINE TRANSIENT RESPONSE



LOAD TRANSIENT RESPONSE



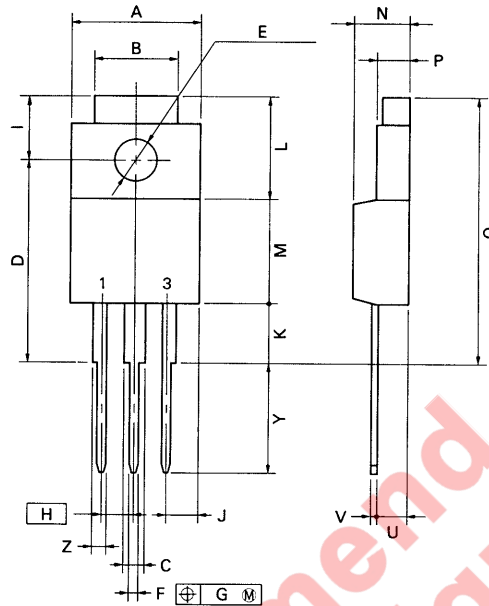
$R_o - f$



Not recommended for new design

PACKAGE DIMENSIONS

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.

Not recommended for new design

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 ^{±0.3}	0.669 ^{+0.013} _{-0.012}
E	φ3.3 ^{±0.2}	φ0.130 ^{±0.008}
F	0.75 ^{±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 ^{±0.3}	0.197 ^{±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 ^{±0.2}	0.177 ^{±0.008}
P	2.8 ^{±0.2}	0.110 ^{+0.009} _{-0.008}
Q	22.4 MAX.	0.882 MAX.
U	2.4 ^{±0.5}	0.094 ^{+0.021} _{-0.020}
V	0.65 ^{±0.10}	0.026 ^{+0.004} _{-0.005}
Y	8.9 ^{±0.7}	0.350 ^{±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

μPC7800AHF Series

Soldering process	Soldering conditions	Symbol
Wave soldering	Solder temperature : 260 °C or below. Flow time : 10 seconds or below.	

**Not recommend
for new design**

[MEMO]

**Not recommend
for new design**

[MEMO]

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Application examples recommended by NEC Corporation.

Standard: Computer, Office equipment, Communication equipment, Test and Measurement equipment, Machine tools, Industrial robots, Audio and Visual equipment, Other consumer products, etc.

Special: Automotive and Transportation equipment, Traffic control systems, Antidisaster systems, Anticrime systems, etc.