NEC

BIPOLAR ANALOG INTEGRATED CIRCUIT
μPC78N00 SERIES

THREE TERMINAL POSITIVE VOLTAGE REGULATOR

DESCRIPTION

μPC78N00 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 intended as fixed voltage regulators in a wide range of application including local on card regulation for elimination of distribution problems associated wide single point regulation.

FEATURES

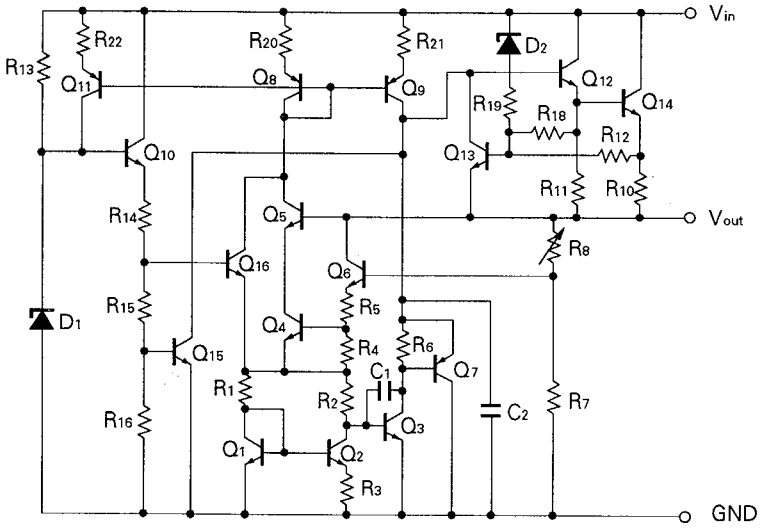
- Output current in excess of 300 mA.
- Built-in some protection circuits.
  (over current protection, SOA protection and thermal shut down)
- Small package, TO-126

ORDER INFORMATION

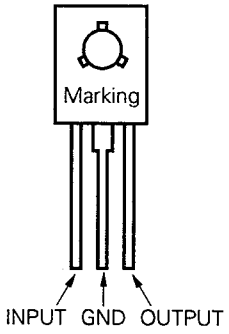
Type Number	Output Voltage	Package	Quality Grade
μPC78N05H	5 V	TO-126	Standard
μPC78N08H	8 V		
μPC78N10H	10 V		
μPC78N12H	12 V		
μPC78N15H	15 V		
μPC78N18H	18 V		
μPC78N24H	24 V		

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



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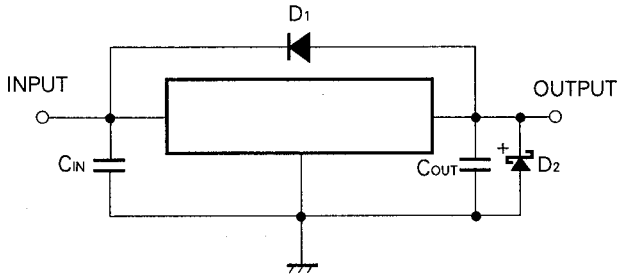
ABSOLUTE MAXIMUM RATINGS (T_a = 25 °C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Input Voltage	V_{IN}	35/40 (Note1)	V
Internal Power Dissipation	P_T	12.5 (Note2)	W
Operating Ambient Temperature Range	T_{opt}	−20 to +85	°C
Operating Junction Temperature Range	$T_{opt\ (j)}$	−20 to +150	°C
Storage Temperature Range	T_{stg}	−55 to +150	°C
Thermal Resistance (junction to case)	$R_{th\ (j-c)}$	10	°C/W
Thermal Resistance (junction to ambient)	$R_{th\ (j-a)}$	110	°C/W

(Note 1) μPC78N05, 08, 10, 12, 15, 18 : 35 V, μPC78N24 : 40 V
(Note 2) Internally limited

TYPICAL CONNECTION



C_1: Required if regulator is located an appreciable distance from power supply filter
C_2: More than 0.1 μF
D_1: Needed for $V_{IN} < V_O$
D_2: Needed for $V_O < GND$

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	TYPE NUMBER	MIN.	TYP.	MAX.	UNIT
Input Voltage	V_{IN}	μPC78N05H	7	10	25	V
		μPC78N08H	10.5	14	25	
		μPC78N10H	12.5	17	30	
		μPC78N12H	14.5	19	30	
		μPC78N15H	17.5	23	30	
		μPC78N18H	21	27	33	
		μPC78N24H	27	33	38	
Output Current	I_O	All	0		300	mA
Operating Temperature Range	T_{opt}	All	−20		+85	°C
Operating Junction Temperature Range	$T_{opt\ (j)}$	All	−20		+125	°C

ELECTRICAL CHARACTERISTICS μPC78N05

(V_{IN} = 10 V, I_O = 200 mA, 0 °C ≦ T_j ≦ + 125 °C, C_{IN} = 0.33 μF, C_{OUT} = 0.1 μF)

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_O	T_j = 25 °C	4.8	5.0	5.2	V
		7 V ≦ V_{IN} ≦ 20 V, 5 mA ≦ I_O ≦ 200 mA	4.75		5.25	
Line Regulation	REG_{IN}	T_j = 25 °C, 7 V ≦ V_{IN} ≦ 25 V		15	50	mV
		T_j = 25 °C, 8 V ≦ V_{IN} ≦ 20 V		10	25	
Load Regulation	REG_L	T_j = 25 °C, 1 mA ≦ I_O ≦ 300 mA		6	100	mV
		T_j = 25 °C, 5 mA ≦ I_O ≦ 200 mA		4	50	
Quiescent Current	I_{BIAS}	T_j = 25 °C		3.5	5.0	mA
Quiescent Current Change	ΔI_{BIAS}	7 V ≦ V_{IN} ≦ 25 V			0.8	mA
		1 mA ≦ I_O ≦ 300 mA			0.5	
Output Noise Voltage	V_n	T_j = 25 °C, 10 Hz ≦ f ≦ 100 kHz		50	120	$\mu V_{r.m.s.}$
Ripple Rejection	R · R	T_j = 25 °C, f = 120 Hz, 8 V ≦ V_{IN} ≦ 18 V	62	70		dB
Dropout Voltage	V_{DIF}	T_j = 25 °C		1.7		V
Short Circuit Current	I_{Oshort}	T_j = 25 °C, V_{IN} = 25 V		170		mA
Peak Output Current	I_{Opeak}	T_j = 25 °C	360	500	640	mA
Temperature coefficient of Output Voltage	$\Delta V_O/\Delta T$	I_O = 5 mA		0.1		mV/°C

ELECTRICAL CHARACTERISTICS μPC78N08

(V_{IN} = 14 V, I_O = 200 mA, 0 °C ≦ T_j ≦ + 125 °C, C_{IN} = 0.33 μF, C_{OUT} = 0.1 μF)

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_O	T_j = 25 °C	7.7	8.0	8.3	V
		10.5 V ≦ V_{IN} ≦ 23 V, 5 mA ≦ I_O ≦ 200 mA	7.6		8.4	
Line Regulation	REG_{IN}	T_j = 25 °C, 10.5 V ≦ V_{IN} ≦ 25 V		18	80	mV
		T_j = 25 °C, 12 V ≦ V_{IN} ≦ 23 V		13	40	
Load Regulation	REG_L	T_j = 25 °C, 1 mA ≦ I_O ≦ 300 mA		8	160	mV
		T_j = 25 °C, 5 mA ≦ I_O ≦ 200 mA		6	80	
Quiescent Current	I_{BIAS}	T_j = 25 °C		3.5	5.0	mA
Quiescent Current Change	ΔI_{BIAS}	10.5 V ≦ V_{IN} ≦ 25 V			0.8	mA
		1 mA ≦ I_O ≦ 300 mA			0.5	
Output Noise Voltage	V_n	T_j = 25 °C, 10 Hz ≦ f ≦ 100 kHz		65	190	$\mu V_{r.m.s.}$
Ripple Rejection	R · R	T_j = 25 °C, f = 120 Hz, 11 V ≦ V_{IN} ≦ 21 V	56	68		dB
Dropout Voltage	V_{DIF}	T_j = 25 °C		1.7		V
Short Circuit Current	I_{Oshort}	T_j = 25 °C, V_{IN} = 25 V		170		mA
Peak Output Current	I_{Opeak}	T_j = 25 °C	360	490	640	mA
Temperature coefficient of Output Voltage	$\Delta V_O/\Delta T$	I_O = 5 mA		0.2		mV/°C

ELECTRICAL CHARACTERISTICS μPC78N10

(V_{IN} = 17 V, I_O = 200 mA, 0 °C ≦ T_j ≦ + 125 °C, C_{IN} = 0.33 μF, C_{OUT} = 0.1 μF)

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_O	T_j = 25 °C	9.6	10	10.4	V
		12.5 V ≦ V_{IN} ≦ 25 V, 5 mA ≦ I_O ≦ 200 mA	9.5		10.5	
Line Regulation	REG_{IN}	T_j = 25 °C, 12.5 V ≦ V_{IN} ≦ 30 V		25	100	mV
		T_j = 25 °C, 13 V ≦ V_{IN} ≦ 25 V		17	50	
Load Regulation	REG_L	T_j = 25 °C, 1 mA ≦ I_O ≦ 300 mA		12	200	mV
		T_j = 25 °C, 5 mA ≦ I_O ≦ 200 mA		8	100	
Quiescent Current	I_{BIAS}	T_j = 25 °C		3.6	5.0	mA
Quiescent Current Change	ΔI_{BIAS}	13 V ≦ V_{IN} ≦ 30 V			0.8	mA
		1 mA ≦ I_O ≦ 300 mA			0.5	
Output Noise Voltage	V_n	T_j = 25 °C, 10 Hz ≦ f ≦ 100 kHz		80	230	$\mu V_{r.m.s.}$
Ripple Rejection	R · R	T_j = 25 °C, f = 120 Hz, 13 V ≦ V_{IN} ≦ 23 V	56	66		dB
Dropout Voltage	V_{DIF}	T_j = 25 °C		1.7		V
Short Circuit Current	I_{Oshort}	T_j = 25 °C, V_{IN} = 30 V		100		mA
Peak Output Current	I_{Opeak}	T_j = 25 °C	360	480	640	mA
Temperature coefficient of Output Voltage	$\Delta V_O/\Delta T$	I_O = 5 mA		0.2		mV/°C

ELECTRICAL CHARACTERISTICS μPC78N12

(V_{IN} = 19 V, I_O = 200 mA, 0 °C ≦ T_j ≦ + 125 °C, C_{IN} = 0.33 μF, C_{OUT} = 0.1 μF)

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_O	T_j = 25 °C	11.5	12	12.5	V
		14.5 V ≦ V_{IN} ≦ 27 V, 5 mA ≦ I_O ≦ 200 mA	11.4		12.6	
Line Regulation	REG_{IN}	T_j = 25 °C, 14.5 V ≦ V_{IN} ≦ 30 V		30	100	mV
		T_j = 25 °C, 16 V ≦ V_{IN} ≦ 27 V		20	50	
Load Regulation	REG_L	T_j = 25 °C, 1 mA ≦ I_O ≦ 300 mA		18	240	mV
		T_j = 25 °C, 5 mA ≦ I_O ≦ 200 mA		12	120	
Quiescent Current	I_{BIAS}	T_j = 25 °C		3.6	5.0	mA
Quiescent Current Change	ΔI_{BIAS}	14.5 V ≦ V_{IN} ≦ 30 V			0.8	mA
		1 mA ≦ I_O ≦ 300 mA			0.5	
Output Noise Voltage	V_n	T_j = 25 °C, 10 Hz ≦ f ≦ 100 kHz		90	280	$\mu V_{r.m.s.}$
Ripple Rejection	R · R	T_j = 25 °C, f = 120 Hz, 15 V ≦ V_{IN} ≦ 25 V	55	64		dB
Dropout Voltage	V_{DIF}	T_j = 25 °C		1.7		V
Short Circuit Current	I_{Oshort}	T_j = 25 °C, V_{IN} = 30 V		100		mA
Peak Output Current	I_{Opeak}	T_j = 25 °C	360	480	640	mA
Temperature coefficient of Output Voltage	$\Delta V_O/\Delta T$	I_O = 5 mA		0.3		mV/°C

ELECTRICAL CHARACTERISTICS μPC78N15

(V_{IN} = 23 V, I_O = 200 mA, 0 °C ≦ T_j ≦ + 125 °C, C_{IN} = 0.33 μF, C_{OUT} = 0.1 μF)

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_O	T_j = 25 °C	14.4	15	15.6	V
		17.5 V ≦ V_{IN} ≦ 30 V, 5 mA ≦ I_O ≦ 200 mA	14.25		15.75	
Line Regulation	REG_{IN}	T_j = 25 °C, 17.5 V ≦ V_{IN} ≦ 30 V		32	100	mV
		T_j = 25 °C, 20 V ≦ V_{IN} ≦ 30 V		25	50	
Load Regulation	REG_L	T_j = 25 °C, 1 mA ≦ I_O ≦ 300 mA		25	300	mV
		T_j = 25 °C, 5 mA ≦ I_O ≦ 200 mA		16	150	
Quiescent Current	I_{BIAS}	T_j = 25 °C		3.7	5.0	mA
Quiescent Current Change	ΔI_{BIAS}	17.5 V ≦ V_{IN} ≦ 30 V			0.8	mA
		1 mA ≦ I_O ≦ 300 mA			0.5	
Output Noise Voltage	V_n	T_j = 25 °C, 10 Hz ≦ f ≦ 100 kHz		100	350	$\mu V_{r.m.s.}$
Ripple Rejection	R · R	T_j = 25 °C, f = 120 Hz, 18.5 V ≦ V_{IN} ≦ 28.5 V	54	62		dB
Dropout Voltage	V_{DIF}	T_j = 25 °C		1.7		V
Short Circuit Current	I_{Oshort}	T_j = 25 °C, V_{IN} = 30 V		100		mA
Peak Output Current	I_{Opeak}	T_j = 25 °C	360	470	640	mA
Temperature coefficient of Output Voltage	$\Delta V_O/\Delta T$	I_O = 5 mA		0.5		mV/°C

ELECTRICAL CHARACTERISTICS μPC78N18

(V_{IN} = 27 V, I_O = 200 mA, 0 °C ≦ T_j ≦ + 125 °C, C_{IN} = 0.33 μF, C_{OUT} = 0.1 μF)

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_O	T_j = 25 °C	17.3	18	18.7	V
		21 V ≦ V_{IN} ≦ 33 V, 5 mA ≦ I_O ≦ 200 mA	17.1		18.9	
Line Regulation	REG_{IN}	T_j = 25 °C, 21 V ≦ V_{IN} ≦ 33 V		32	100	mV
		T_j = 25 °C, 22 V ≦ V_{IN} ≦ 33 V		25	50	
Load Regulation	REG_L	T_j = 25 °C, 1 mA ≦ I_O ≦ 300 mA		30	360	mV
		T_j = 25 °C, 5 mA ≦ I_O ≦ 200 mA		20	180	
Quiescent Current	I_{BIAS}	T_j = 25 °C		3.7	5.0	mA
Quiescent Current Change	ΔI_{BIAS}	21 V ≦ V_{IN} ≦ 33 V			0.8	mA
		1 mA ≦ I_O ≦ 300 mA			0.5	
Output Noise Voltage	V_n	T_j = 25 °C, 10 Hz ≦ f ≦ 100 kHz		115	420	$\mu V_{r.m.s.}$
Ripple Rejection	R · R	T_j = 25 °C, f = 120 Hz, 22 V ≦ V_{IN} ≦ 32 V	53	60		dB
Dropout Voltage	V_{DIF}	T_j = 25 °C		1.7		V
Short Circuit Current	I_{Oshort}	T_j = 25 °C, V_{IN} = 33 V		60		mA
Peak Output Current	I_{Opeak}	T_j = 25 °C	360	460	640	mA
Temperature coefficient of Output Voltage	$\Delta V_O/\Delta T$	I_O = 5 mA		0.5		mV/°C

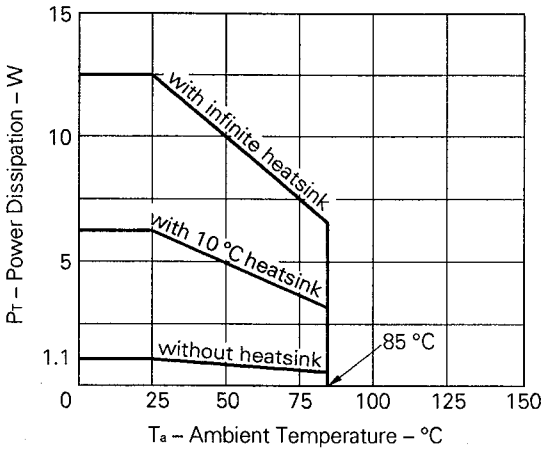
ELECTRICAL CHARACTERISTICS μPC78N24

(V_{IN} = 33 V, I_O = 200 mA, 0 °C ≦ T_j ≦ + 125 °C, C_{IN} = 0.33 μF, C_{OUT} = 0.1 μF)

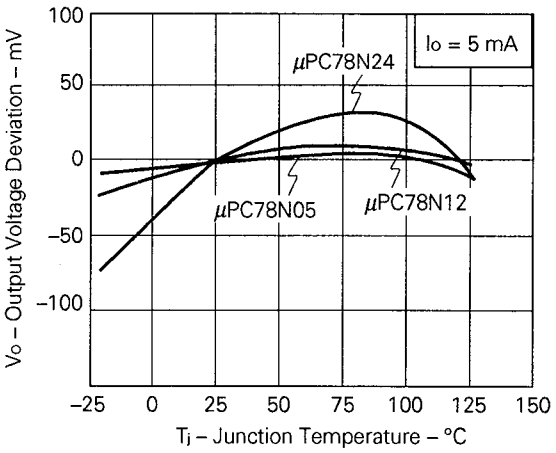
CHARACTERISTIC	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_O	T_j = 25 °C	23	24	25	V
		27 V ≦ V_{IN} ≦ 38 V, 5 mA ≦ I_O ≦ 200 mA	22.8		25.2	
Line Regulation	REG_{IN}	T_j = 25 °C, 27 V ≦ V_{IN} ≦ 38 V		40	100	mV
		T_j = 25 °C, 28 V ≦ V_{IN} ≦ 38 V		30	50	
Load Regulation	REG_L	T_j = 25 °C, 1 mA ≦ I_O ≦ 300 mA		35	480	mV
		T_j = 25 °C, 5 mA ≦ I_O ≦ 200 mA		23	240	
Quiescent Current	I_{BIAS}	T_j = 25 °C		3.7	5.0	mA
Quiescent Current Change	ΔI_{BIAS}	27 V ≦ V_{IN} ≦ 38 V			0.8	mA
		1 mA ≦ I_O ≦ 300 mA			0.5	
Output Noise Voltage	V_n	T_j = 25 °C, 10 Hz ≦ f ≦ 100 kHz		135	560	$\mu V_{r.m.s.}$
Ripple Rejection	R · R	T_j = 25 °C, f = 120 Hz, 28 V ≦ V_{IN} ≦ 38 V	50	57		dB
Dropout Voltage	V_{DIF}	T_j = 25 °C		1.7		V
Short Circuit Current	I_{Oshort}	T_j = 25 °C, V_{IN} = 38 V		5		mA
Peak Output Current	I_{Opeak}	T_j = 25 °C	360	460	640	mA
Temperature coefficient of Output Voltage	$\Delta V_O/\Delta T$	I_O = 5 mA		0.7		mV/°C

TYPICAL CHARACTERISTICS (T_a = 25 °C)

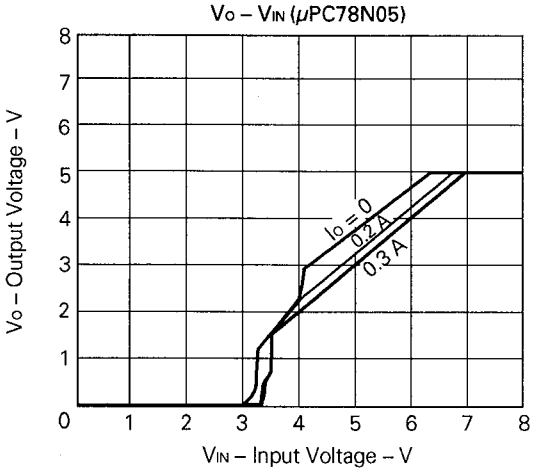
P_T – T_a



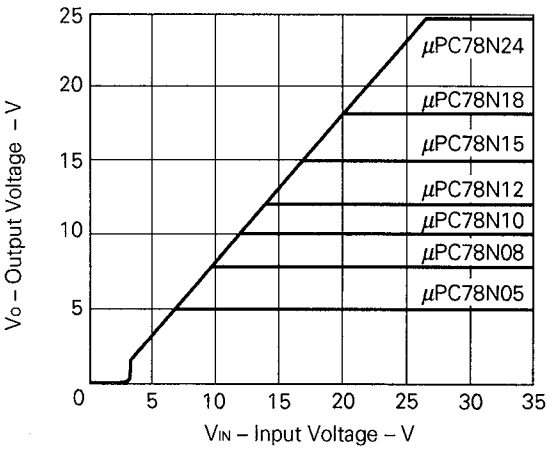
ΔV_O – T_j



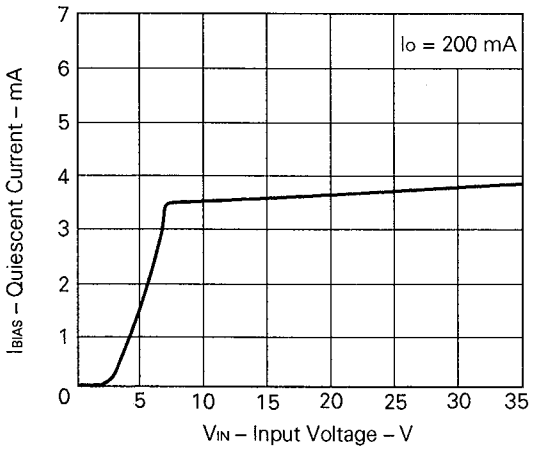
V_O – V_{IN} (μPC78N05)



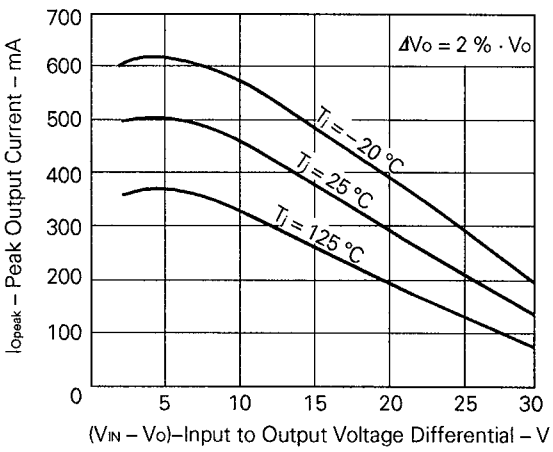
V_O – V_{IN}



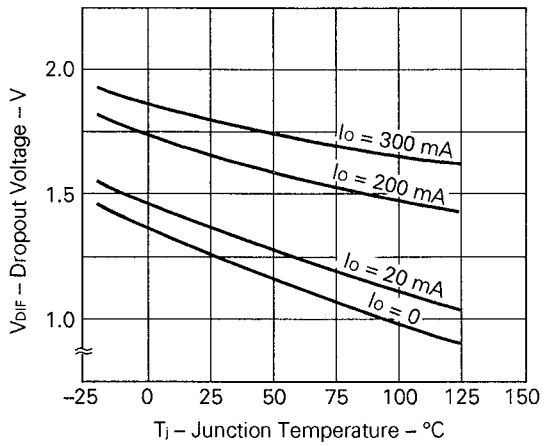
I_{BIAS} – V_{IN} (μPC78N05)



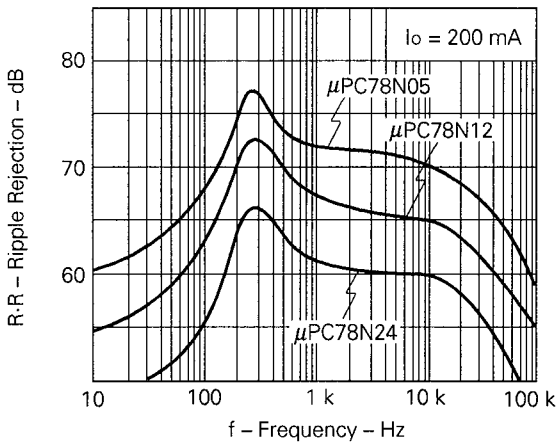
$I_{O\,peak}$ – (V_{IN} – V_O)



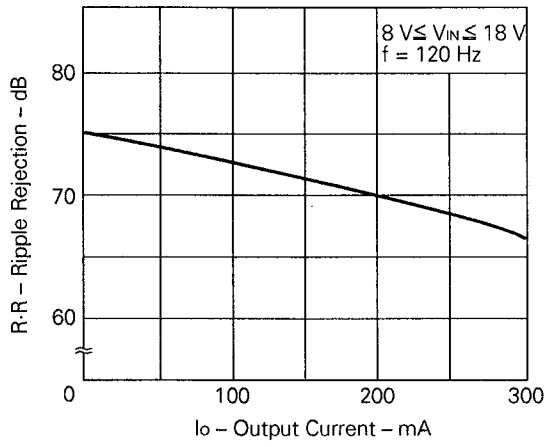
V_{DIF} – T_j



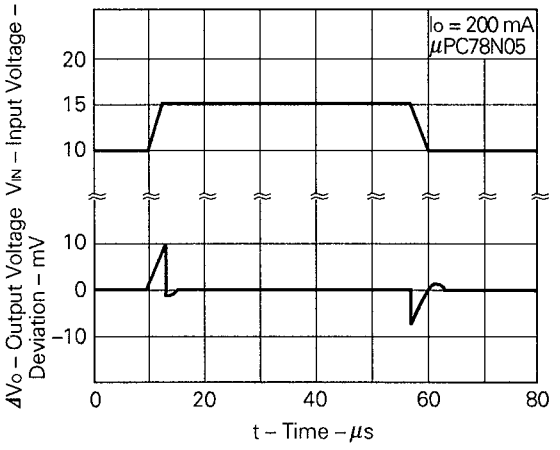
R·R – f



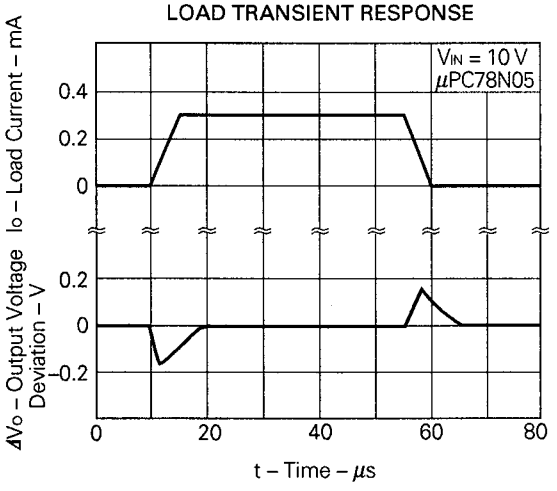
R·R – Io (μPC78N05)



LINE TRANSIENT RESPONSE



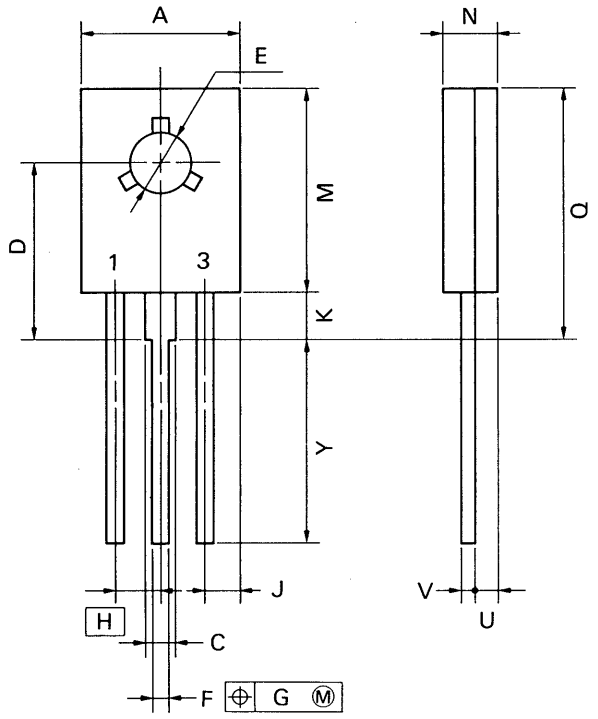
LOAD TRANSIENT RESPONSE



PACKAGE DIMENSIONS (Unit: mm)

μPC78N00H Series

3 PIN PLASTIC SIP (TO-126)



P3HP-230B

NOTE

Each lead centerline is located within 0.23 mm (0.009 inch) of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS	INCHES
A	8.5 MAX.	0.335 MAX.
C	1.1 MIN.	0.043 MIN.
D	$9.7^{\pm 0.3}$	$0.382^{\pm 0.012}$
E	$\phi 3.2^{\pm 0.1}$	$\phi 0.126^{\pm 0.004}$
F	$0.80^{\pm 0.1}$	$0.031^{+0.005}_{-0.004}$
G	0.23	0.009
H	2.3	0.091
J	1.95 MAX.	0.077 MAX.
K	2.3 MIN.	0.09 MIN.
M	11.5 MAX.	0.453 MAX.
N	$2.7^{\pm 0.2}$	$0.106^{+0.009}_{-0.008}$
Q	14.5 MAX.	0.571 MAX.
U	1.7 MAX.	0.067 MAX.
V	$0.55^{\pm 0.1}$	$0.022^{+0.004}_{-0.005}$
Y	$13.5^{\pm 0.7}$	$0.531^{+0.029}_{-0.028}$

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>

[μPC78N00H Series]

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

Reference

Application note name	No.
Quality control of NEC semiconductor devices	TEI-1202
Quality control guide of semiconductors devices	MEI-1202
Assembly manual of semiconductors devices	IEI-1207
NEC semiconductor device reliability/quality control system	IEI-1212

[MEMO]

M4 92.6