DATA SHEET

NEC

BIPOLAR ANALOG INTEGRATED CIRCUIT

μPC78L00 SERIES

THREE TERMINAL POSITIVE VOLTAGE REGULATORS

DESCRIPTION

The μPC78L00 series are monolithic three terminal positive regulators which employ internally current limiting, thermal shut down, output transistor safe 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

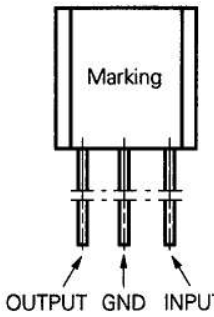
- Output current in excess of 100 mA.
- Low noise.
- High Ripple Rejection.
- Internal output transistor safe area protection.
- Internal thermal overload protection.
- Internal short circuit current limiting.

ORDER INFORMATION

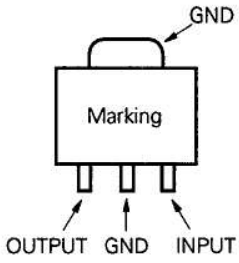
Type Number	Output Voltage	Package	Quality Grade
μPC78L05J	5 V	TO-92	Standard
μPC78L05T		SOT-89	
μPC78L06J	6 V	TO-92	
μPC78L06T		SOT-89	
μPC78L07J	7 V	TO-92	
μPC78L07T		SOT-89	
μPC78L08J	8 V	TO-92	
μPC78L08T		SOT-89	
μPC78L10J	10 V	TO-92	
μPC78L10T		SOT-89	
μPC78L12J	12 V	TO-92	
μPC78L12T		SOT-89	
μPC78L15J	15 V	TO-92	
μPC78L15T		SOT-89	

CONNECTION DIAGRAM

μPC78L00J Series



μPC78L00T Series



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.

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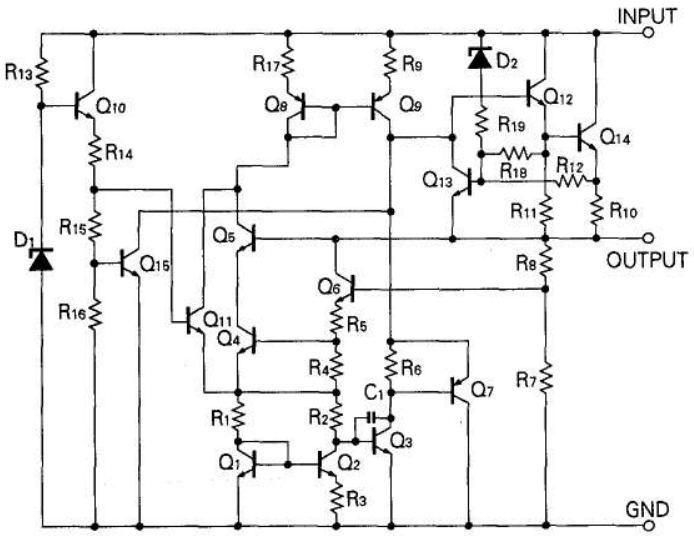
EQUIVALENT CIRCUIT

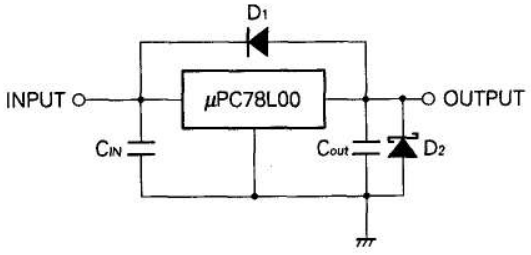


ABSOLUTE MAXIMUM RATINGS (T_a = 25 °C)

PARAMETER	SYMBOL	RATINGS		UNIT
		μPC78L00J Series	μPC78L00T Series	
Input Voltage	V_{IN}	30/35 (Note1)		V
Internal Power Dissipation	P_T	700	400/2000 (Note2)	mW
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 ambient)	$R_{th\ (j-a)}$	180	315/62.5 (Note2)	°C/W

(Note 1) μPC78L05, 06, 07, 08 : 30 V, μPC78L10, 12, 15 : 35 V
(Note 2) with 2.5 cm^2 × 0.7 mm ceramic substrate

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} < Vo
D_2: Needed for Vo < GND

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	TYPE NUMBER	MIN.	TYP.	MAX.	UNIT
Input Voltage	V_{IN}	μPC78L05	7	10	20	V
		μPC78L06	8.5	11	21	
		μPC78L07	9.5	12	22	
		μPC78L08	10.5	14	23	
		μPC78L10	12.5	17	25	
		μPC78L12	14.5	19	27	
		μPC78L15	17.5	23	30	
Output Current	I_O	All	0	40	70	mA
Operating Temperature Range	T_{opt}	All	−20		+85	°C
Operating Junction Temperature Range	$T_{opt\ (j)}$	All	−20		+125	°C

ELECTRICAL CHARACTERISTICS μPC78L05

(V_{IN} = 10 V, I_O = 40 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, 1 mA ≦ I_O ≦ 40 mA	4.75		5.25	
		V_{IN} = 10 V, 1 mA ≦ I_O ≦ 70 mA	4.75		5.25	
Line Regulation	REG_{IN}	T_j = 25 °C, 7 V ≦ V_{IN} ≦ 20 V		6	150	mV
		T_j = 25 °C, 8 V ≦ V_{IN} ≦ 20 V		4	100	
Load Regulation	REG_L	T_j = 25 °C, 1 mA ≦ I_O ≦ 100 mA		9	60	mV
		T_j = 25 °C, 1 mA ≦ I_O ≦ 40 mA		4	30	
Quiescent Current	I_{BIAS}	T_j = 25 °C		2.3	5.5	mA
Quiescent Current Change	ΔI_{BIAS}	8 V ≦ V_{IN} ≦ 20 V, I_O = 40 mA			1.5	mA
		V_{IN} = 10 V, 1 mA ≦ I_O ≦ 40 mA			0.1	
Output Noise Voltage	V_n	T_j = 25 °C, 10 Hz ≦ f ≦ 100 kHz		45	120	$\mu V_{r.m.s.}$
Ripple Rejection	R · R	T_j = 25 °C, f = 120 Hz, 8 V ≦ V_{IN} ≦ 18 V	55	75		dB
Dropout Voltage	V_{DIF}	T_j = 25 °C		1.7		V
Short Circuit Current	I_{Oshort}	T_j = 25 °C, V_{IN} = 20 V		88		mA
Peak Output Current	I_{Opeak}	T_j = 25 °C	125	160	205	mA
Temperature coefficient of Output Voltage	$\Delta V_O/\Delta T$	I_O = 5 mA		0.4		mV/°C

ELECTRICAL CHARACTERISTICS μPC78L06

(V_{IN} = 11 V, I_O = 40 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	5.76	6.0	6.24	V
		8.5 V ≦ V_{IN} ≦ 21 V, 1 mA ≦ I_O ≦ 40 mA	5.70		6.30	
		V_{IN} = 11 V, 1 mA ≦ I_O ≦ 70 mA	5.70		6.30	
Line Regulation	REG_{IN}	T_j = 25 °C, 8.5 V ≦ V_{IN} ≦ 21 V		6	155	mV
		T_j = 25 °C, 9 V ≦ V_{IN} ≦ 21 V		4	105	
Load Regulation	REG_L	T_j = 25 °C, 1 mA ≦ I_O ≦ 100 mA		10	65	mV
		T_j = 25 °C, 1 mA ≦ I_O ≦ 40 mA		4	35	
Quiescent Current	I_{BIAS}	T_j = 25 °C		2.3	5.5	mA
Quiescent Current Change	ΔI_{BIAS}	9 V ≦ V_{IN} ≦ 21 V, I_O = 40 mA			1.5	mA
		V_{IN} = 11 V, 1 mA ≦ I_O ≦ 40 mA			0.1	
Output Noise Voltage	V_n	T_j = 25 °C, 10 Hz ≦ f ≦ 100 kHz		55	145	$\mu V_{r.m.s.}$
Ripple Rejection	R · R	T_j = 25 °C, f = 120 Hz, 9 V ≦ V_{IN} ≦ 19 V	54	75		dB
Dropout Voltage	V_{DIF}	T_j = 25 °C		1.7		V
Short Circuit Current	I_{Oshort}	T_j = 25 °C, V_{IN} = 21 V		85		mA
Peak Output Current	I_{Opeak}	T_j = 25 °C	125	160	205	mA
Temperature coefficient of Output Voltage	$\Delta V_O/\Delta T$	I_O = 5 mA		0.5		mV/°C

ELECTRICAL CHARACTERISTICS μPC78L07

(V_{IN} = 12 V, I_O = 40 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	6.72	7.0	7.28	V
		9.5 V ≦ V_{IN} ≦ 22 V, 1 mA ≦ I_O ≦ 40 mA	6.65		7.35	
		V_{IN} = 12 V, 1 mA ≦ I_O ≦ 70 mA	6.65		7.35	
Line Regulation	REG_{IN}	T_j = 25 °C, 9.5 V ≦ V_{IN} ≦ 22 V		8	165	mV
		T_j = 25 °C, 10 V ≦ V_{IN} ≦ 22 V		5	115	
Load Regulation	REG_L	T_j = 25 °C, 1 mA ≦ I_O ≦ 100 mA		12	75	mV
		T_j = 25 °C, 1 mA ≦ I_O ≦ 40 mA		5	35	
Quiescent Current	I_{BIAS}	T_j = 25 °C		2.3	5.5	mA
Quiescent Current Change	ΔI_{BIAS}	10 V ≦ V_{IN} ≦ 22 V, I_O = 40 mA			1.5	mA
		V_{IN} = 12 V, 1 mA ≦ I_O ≦ 40 mA			0.1	
Output Noise Voltage	V_n	T_j = 25 °C, 10 Hz ≦ f ≦ 100 kHz		70	180	$\mu V_{r.m.s.}$
Ripple Rejection	R · R	T_j = 25 °C, f = 120 Hz, 10 V ≦ V_{IN} ≦ 20 V	52	74		dB
Dropout Voltage	V_{DIF}	T_j = 25 °C		1.7		V
Short Circuit Current	I_{Oshort}	T_j = 25 °C, V_{IN} = 22 V		83		mA
Peak Output Current	I_{Opeak}	T_j = 25 °C	125	160	205	mA
Temperature coefficient of Output Voltage	$\Delta V_O/\Delta T$	I_O = 5 mA		0.6		mV/°C

ELECTRICAL CHARACTERISTICS μPC78L08

(V_{IN} = 14 V, I_O = 40 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, 1 mA ≦ I_O ≦ 40 mA	7.6		8.4	
		V_{IN} = 14 V, 1 mA ≦ I_O ≦ 70 mA	7.6		8.4	
Line Regulation	REG_{IN}	T_j = 25 °C, 10.5 V ≦ V_{IN} ≦ 23 V		10	175	mV
		T_j = 25 °C, 11 V ≦ V_{IN} ≦ 23 V		6	125	
Load Regulation	REG_L	T_j = 25 °C, 1 mA ≦ I_O ≦ 100 mA		14	80	mV
		T_j = 25 °C, 1 mA ≦ I_O ≦ 40 mA		6	40	
Quiescent Current	I_{BIAS}	T_j = 25 °C		2.4	5.5	mA
Quiescent Current Change	ΔI_{BIAS}	12 V ≦ V_{IN} ≦ 23 V, I_O = 40 mA			1.5	mA
		V_{IN} = 14 V, 1 mA ≦ I_O ≦ 40 mA			0.1	
Output Noise Voltage	V_n	T_j = 25 °C, 10 Hz ≦ f ≦ 100 kHz		85	190	$\mu V_{r.m.s.}$
Ripple Rejection	R · R	T_j = 25 °C, f = 120 Hz, 12 V ≦ V_{IN} ≦ 22 V	51	73		dB
Dropout Voltage	V_{DIF}	T_j = 25 °C		1.7		V
Short Circuit Current	I_{Oshort}	T_j = 25 °C, V_{IN} = 23 V		80		mA
Peak Output Current	I_{Opeak}	T_j = 25 °C	125	160	205	mA
Temperature coefficient of Output Voltage	$\Delta V_O/\Delta T$	I_O = 5 mA		0.6		mV/°C

ELECTRICAL CHARACTERISTICS μPC78L10

(V_{IN} = 17 V, I_O = 40 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, 1 mA ≦ I_O ≦ 40 mA	9.5		10.5	
		V_{IN} = 17 V, 1 mA ≦ I_O ≦ 70 mA	9.5		10.5	
Line Regulation	REG_{IN}	T_j = 25 °C, 12.5 V ≦ V_{IN} ≦ 25 V		12	200	mV
		T_j = 25 °C, 13 V ≦ V_{IN} ≦ 25 V		8	150	
Load Regulation	REG_L	T_j = 25 °C, 1 mA ≦ I_O ≦ 100 mA		18	90	mV
		T_j = 25 °C, 1 mA ≦ I_O ≦ 40 mA		8	45	
Quiescent Current	I_{BIAS}	T_j = 25 °C		2.5	5.5	mA
Quiescent Current Change	ΔI_{BIAS}	13 V ≦ V_{IN} ≦ 25 V, I_O = 40 mA			1.5	mA
		V_{IN} = 17 V, 1 mA ≦ I_O ≦ 40 mA			0.1	
Output Noise Voltage	V_n	T_j = 25 °C, 10 Hz ≦ f ≦ 100 kHz		100	230	$\mu V_{r.m.s.}$
Ripple Rejection	R · R	T_j = 25 °C, f = 120 Hz, 14 V ≦ V_{IN} ≦ 24 V	49	69		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		70		mA
Peak Output Current	I_{Opeak}	T_j = 25 °C	125	160	205	mA
Temperature coefficient of Output Voltage	$\Delta V_O/\Delta T$	I_O = 5 mA		0.8		mV/°C

ELECTRICAL CHARACTERISTICS μPC78L12

(V_{IN} = 19 V, I_O = 40 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 V ≦ V_{IN} ≦ 27 V, 1 mA ≦ I_O ≦ 40 mA	11.4		12.6	
		V_{IN} = 19 V, 1 mA ≦ I_O ≦ 70 mA	11.4		12.6	
Line Regulation	REG_{IN}	T_j = 25 °C, 14.5 V ≦ V_{IN} ≦ 27 V		14	250	mV
		T_j = 25 °C, 16 V ≦ V_{IN} ≦ 27 V		10	200	
Load Regulation	REG_L	T_j = 25 °C, 1 mA ≦ I_O ≦ 100 mA		20	100	mV
		T_j = 25 °C, 1 mA ≦ I_O ≦ 40 mA		10	50	
Quiescent Current	I_{BIAS}	T_j = 25 °C		2.6	5.5	mA
Quiescent Current Change	ΔI_{BIAS}	16 V ≦ V_{IN} ≦ 27 V, I_O = 40 mA			1.5	mA
		V_{IN} = 19 V, 1 mA ≦ I_O ≦ 40 mA			0.1	
Output Noise Voltage	V_n	T_j = 25 °C, 10 Hz ≦ f ≦ 100 kHz		115	280	$\mu V_{r.m.s.}$
Ripple Rejection	R · R	T_j = 25 °C, f = 120 Hz, 15 V ≦ V_{IN} ≦ 25 V	47	66		dB
Dropout Voltage	V_{DIF}	T_j = 25 °C		1.7		V
Short Circuit Current	I_{Oshort}	T_j = 25 °C, V_{IN} = 27 V		64		mA
Peak Output Current	I_{Opeak}	T_j = 25 °C	125	160	205	mA
Temperature coefficient of Output Voltage	$\Delta V_O/\Delta T$	I_O = 5 mA		1.1		mV/°C

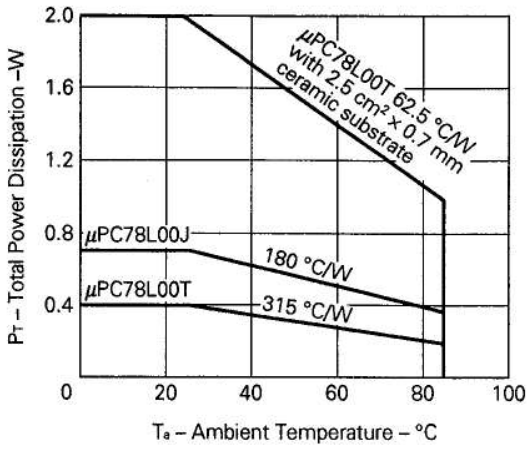
ELECTRICAL CHARACTERISTICS μPC78L15

(V_{IN} = 23 V, I_O = 40 mA, 0 °C ≦ T_j ≦ + 125 °C, C_{IN} = 0.33 μF, C_{OUT} = 0.1 μF)

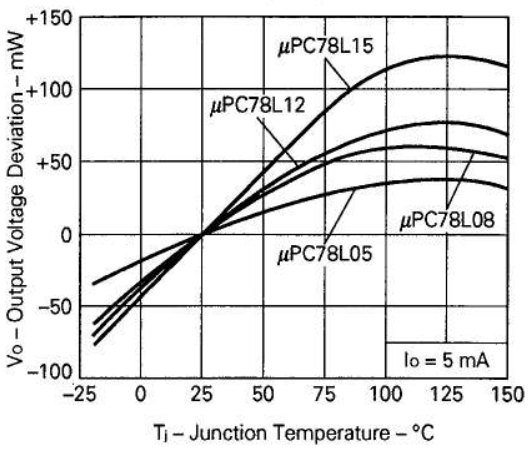
CHARACTERISTIC	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_O	T_j = 25 °C	14.4	15	15.6	V
		17.5 V ≦ V_{IN} ≦ 30 V, 1 mA ≦ I_O ≦ 40 mA	14.25		15.75	
		V_{IN} = 23 V, 1 mA ≦ I_O ≦ 70 mA	14.25		15.75	
Line Regulation	REG_{IN}	T_j = 25 °C, 17.5 V ≦ V_{IN} ≦ 30 V		18	300	mV
		T_j = 25 °C, 20 V ≦ V_{IN} ≦ 30 V		13	250	
Load Regulation	REG_L	T_j = 25 °C, 1 mA ≦ I_O ≦ 100 mA		25	150	mV
		T_j = 25 °C, 1 mA ≦ I_O ≦ 40 mA		12	75	
Quiescent Current	I_{BIAS}	T_j = 25 °C		2.7	5.5	mA
Quiescent Current Change	ΔI_{BIAS}	20 V ≦ V_{IN} ≦ 30 V, I_O = 40 mA			1.5	mA
		V_{IN} = 23 V, 1 mA ≦ I_O ≦ 40 mA			0.1	
Output Noise Voltage	V_n	T_j = 25 °C, 10 Hz ≦ f ≦ 100 kHz		135	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	45	61		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		53		mA
Peak Output Current	I_{Opeak}	T_j = 25 °C	125	160	205	mA
Temperature coefficient of Output Voltage	$\Delta V_O/\Delta T$	I_O = 5 mA		1.4		mV/°C

TYPICAL CHARACTERISTICS (T_a = 25 °C)

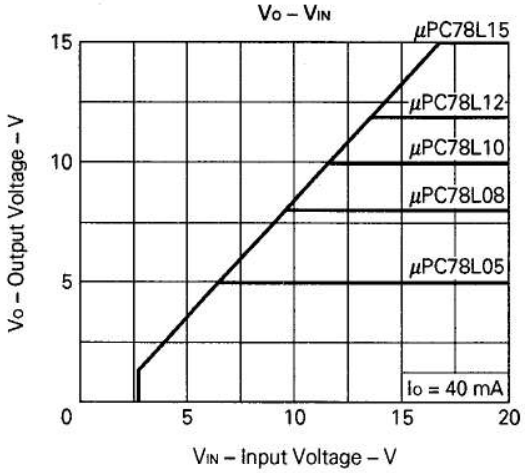
P_T – T_a



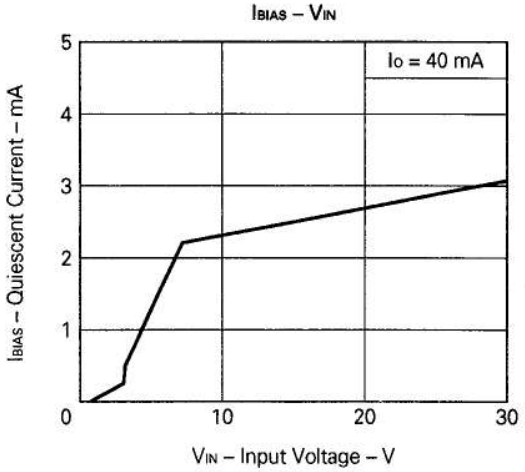
ΔVo – T_a



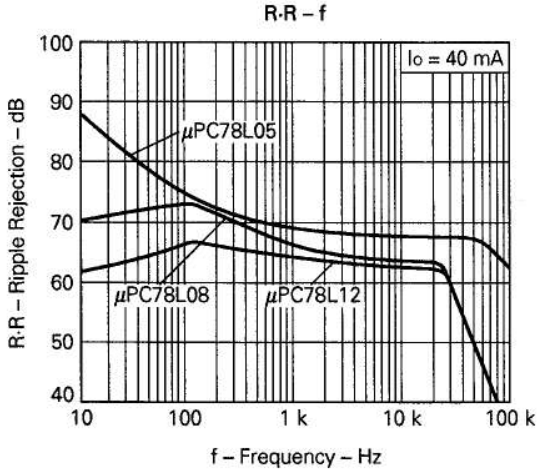
Vo – V_{IN}



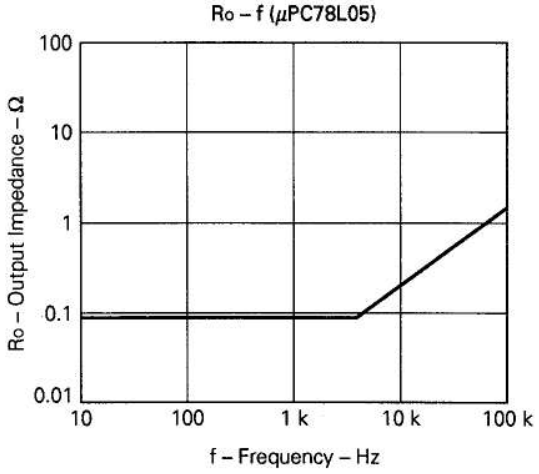
I_{BIAS} – V_{IN}



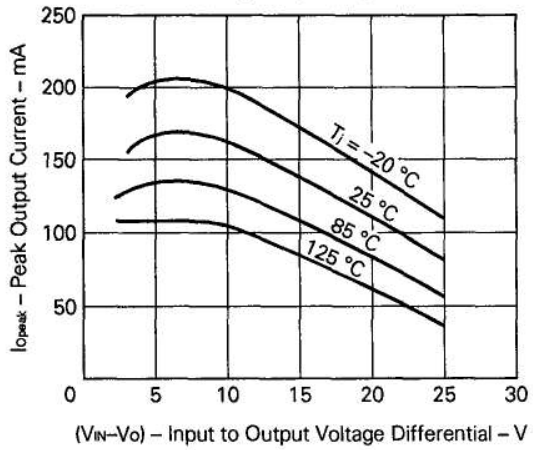
R·R – f



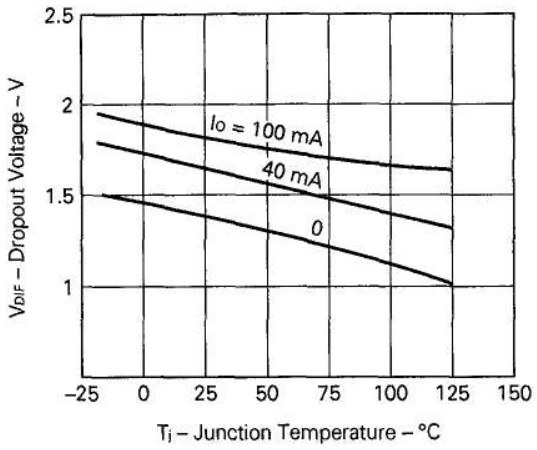
Ro – f (μPC78L05)



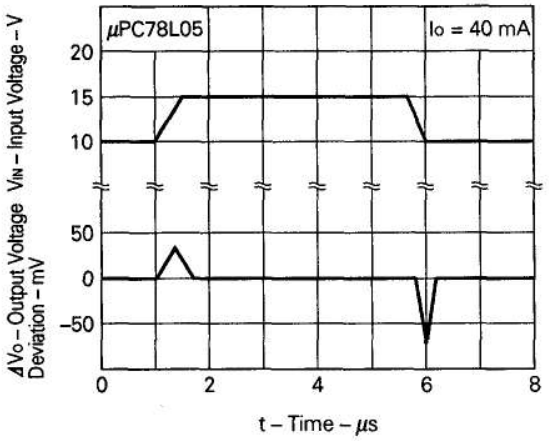
I_{opeak} – $(V_{IN}–V_O)$



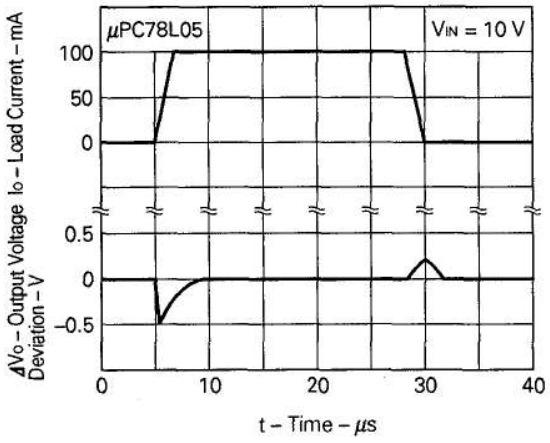
V_{DIF} – T_j



LINE TRANSIENT RESPONSE



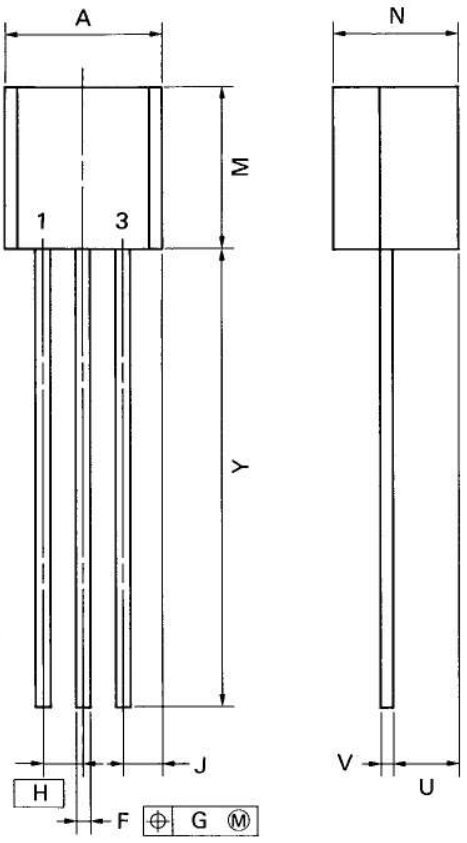
LOAD TRANSIENT RESPONSE



PACKAGE DIMENSIONS (Unit: mm)

μPC78L00J Series

3 PIN PLASTIC SIP (TO-92)



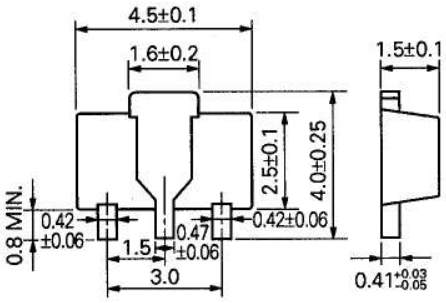
P3J-127B

NOTE

Each lead centerline is located within 0.12 mm (0.005 inch) of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS	INCHES
A	5.2 MAX.	0.205 MAX.
F	$0.5^{+0.3}_{-0.1}$	$0.02^{+0.012}_{-0.005}$
G	0.12	0.005
H	1.27	0.05
J	1.33 MAX.	0.053 MAX.
M	5.5 MAX.	0.217 MAX.
N	4.2 MAX.	0.166 MAX.
U	2.8 MAX.	0.111 MAX.
V	$0.5^{\pm0.1}$	$0.02^{+0.004}_{-0.005}$
Y	$15.0^{\pm0.7}$	$0.591^{+0.028}_{-0.029}$

μPC78L00T Series



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 SURFACE MOUNT DEVICE>

For more details, refer to our document "SMT MANUAL" (IEI–1207).

[μPC78L00T Series]

Soldering process	Soldering condition	Symbol
Infrared ray reflow	Peak package's surface temperature: 230 °C or below, Reflow time: 30 seconds or below (210 °C or higher), Number of reflow process: 1, Exposure limit*: None	IR30-00
VPS	Peak package's surface temperature: 215 °C or below, Reflow time: 40 seconds or below (200 °C or higher), Number of reflow process: 1, Exposure limit*: None	VP15-00

*: Exposure limit before soldering after dry-pack package is opened. Storage conditions: 25 °C and relative humidity at 65% or less.

Note: Do not apply more than a single process at once, except for "Partial heating method".

<TYPES OF THROUGH HOLE MOUNT DEVICE>

[μPC78L00J 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 semiconductor devices	MEI-1202
Assembly manual of semiconductor devices	IEI-1207
NEC semiconductor device reliability/quality control system	IEI-1212

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