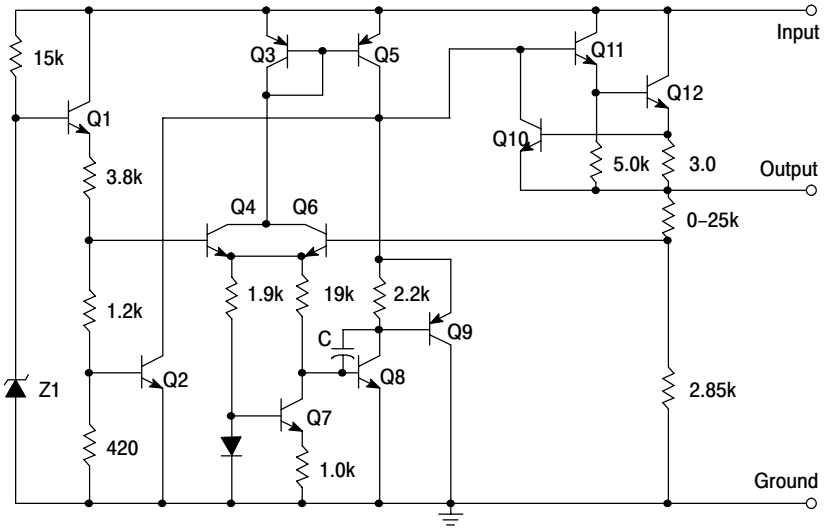
PLASTIC-ENCAPSULATE VOLTAGE REGULATORS

FEATURES

- Maximum Output Current I_O: 0.1 A
- Output Voltage V_O:3.3; 5; 6; 8; 9; 10; 12; 15; 18; 20; 24V
- Thermal Overload Protection
- Short Circuit Protection
- No External Components Are Required
- Continuous Total Dissipation
  P_D: 0.60 W (Ta= 25 ℃)

TO-92

SCHEMATIC DIAGRAM



MECHANICAL DATA

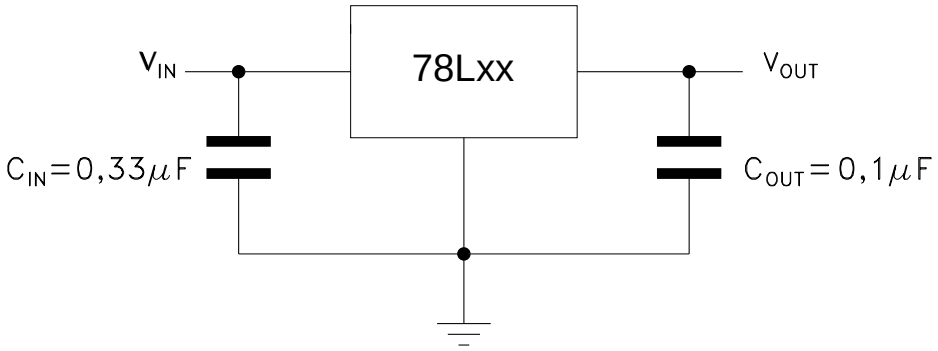
- Case: TO -92
- Case Material: Molded Plastic. UL flammability
- Classification Rating: 94V-0
- Weight: 0.055 grams (approximate)

MAXIMUM RATINGS (Operating temperature range applies unless otherwise specified)

Parameter		Symbol	Value	Unit
Input Voltage	V_O=3.3V to 9V	V_i	30	V
	V_O=12V to 15V		35	V
	V_O=18V to 24V		40	V
Power Dissipation		P_D	600	mW
Thermal Resistance from Junction to Ambient		$R_{\theta JA}$	160	°C/W
Operating Temperature		T_{opr}	-40~+125	°C
Storage Temperature Range		T_{STG}	-55 ~+150	°C

PLASTIC-ENCAPSULATE VOLTAGE REGULATORS

TEST CIRCUIT



Note: Bypass capacitors are recommended for optimum stability and transient response and should be located as close as Possible to the regulators.

ELECTRICAL CHARACTERISTICS OF 78L05 AT SPECIFIED VIRTUAL JUNCTION TEMPERATURE (Vi=10V,Io=40mA,Ci=0.33uF,,Co=0.1uF, unless otherwise specified)

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Output voltage	V_O	4.80	5.0	5.20	V	T_J=+25°C
		4.75	5.0	5.25	V	7V≤V_i≤20V,I_O=1mA~40mA, 0°C≤T_J≤+125°C
		4.75	5.0	5.25	V	7V≤V_i≤20V,I_O=1mA~70mA, 0°C≤T_J≤+125°C
Load Regulation	ΔV_O		15	60	mV	I_O=1mA~100mA,T_J=+25°C
			8	30	mV	I_O=1mA~40mA,T_J=+25°C
Line regulation	ΔV_O		32	150	mV	7V≤V_i≤20V
			26	100	mV	8V≤V_i≤20V,T_J=+25°C
Quiescent Current	I_q		3.8	6	mA	T_J=+25°C
Quiescent Current Change	ΔI_q			1.5	mA	8V≤V_i≤20V,-25°C≤T_J≤+125°C
				0.1	mA	1mA≤I_i≤40mA,-25°C≤T_J≤+125°C
Output Noise Voltage	V_N		42		μV/V_O	10Hz≤f≤100kHz,T_J=+25°C
Ripple Rejection	RR	41	49		dB	8V≤V_i≤20V,f=120Hz, -25°C≤T_J≤+125°C
Dropout Voltage	V_d		1.7		V	T_J=+25°C

*Pulse Test

PLASTIC-ENCAPSULATE VOLTAGE REGULATORS

ELECTRICAL CHARACTERISTICS OF 78L06 AT SPECIFIED VIRTUAL JUNCTION TEMPERATURE (Vi=10V,Io=40mA,Ci=0.33uF,,Co=0.1uF, unless otherwise specified)

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Output voltage	V_O	5.75	6.0	6.25	V	T_J=+25°C
		5.7	6.0	6.3	V	8V≤V_i≤20V,I_O=1mA~40mA, 0°C≤T_J≤+125°C
		5.7	6.0	6.3	V	8V≤V_i≤20V,I_O=1mA~70mA, 0°C≤T_J≤+125°C
Load Regulation	ΔV_O		16	80	mV	I_O=1mA~100mA,T_J=+25°C
			9	40	mV	I_O=1mA~40mA,T_J=+25°C
Line regulation	ΔV_O		35	175	mV	8V≤V_i≤20V
			29	125	mV	9V≤V_i≤20V,T_J=+25°C
Quiescent Current	I_q		3.9	6	mA	T_J=+25°C
Quiescent Current Change	ΔI_q			1.5	mA	9V≤V_i≤20V,0°C≤T_J≤+125°C
				0.1	mA	1mA≤I_i≤40mA,0°C≤T_J≤+125°C
Output Noise Voltage	V_N		46		μV/V_O	10Hz≤f≤100kHz,T_J=+25°C
Ripple Rejection	RR	40	48		dB	9V≤V_i≤19V,f=120Hz, 0°C≤T_J≤+125°C
Dropout Voltage	V_d		1.7		V	T_J=+25°C

*Pulse Test

ELECTRICAL CHARACTERISTICS OF 78L08 AT SPECIFIED VIRTUAL JUNCTION TEMPERATURE (Vi=10V,Io=40mA,Ci=0.33uF,,Co=0.1uF, unless otherwise specified)

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Output voltage	V_O	7.7	8.0	8.3	V	T_J=+25°C
		7.6	8.0	8.4	V	10.5V≤V_i≤23V,I_O=1mA~40mA, 0°C≤T_J≤+125°C
		7.6	8.0	8.4	V	10.5V≤V_i≤23V,I_O=1mA~70mA, 0°C≤T_J≤+125°C
Load Regulation	ΔV_O		18	80	mV	I_O=1mA~100mA,T_J=+25°C
			10	40	mV	I_O=1mA~40mA,T_J=+25°C
Line regulation	ΔV_O		42	175	mV	10.5V≤V_i≤23V
			36	125	mV	11V≤V_i≤23V,T_J=+25°C
Quiescent Current	I_q		4	6	mA	T_J=+25°C
Quiescent Current Change	ΔI_q			1.5	mA	11V≤V_i≤23V,0°C≤T_J≤+125°C
				0.1	mA	1mA≤I_O≤40mA,0°C≤T_J≤+125°C
Output Noise Voltage	V_N		54		μV/V_O	10Hz≤f≤100kHz,T_J=+25°C
Ripple Rejection	RR	37	46		dB	13V≤V_i≤23V,f=120Hz, 0°C≤T_J≤+125°C
Dropout Voltage	V_d		1.7		V	T_J=+25°C

*Pulse Test

PLASTIC-ENCAPSULATE VOLTAGE REGULATORS

ELECTRICAL CHARACTERISTICS OF 78L09 AT SPECIFIED VIRTUAL JUNCTION TEMPERATURE (Vi=16V,Io=40mA,Ci=0.33uF,,Co=0.1uF, unless otherwise specified)

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Output voltage	V_O	8.64	9.0	9.36	V	T_J=+25°C
		8.55	9.0	9.45	V	12V≤V_i≤24V,I_O=1mA~40mA, 0°C≤T_J≤+125°C
		8.55	9.0	9.45	V	12V≤V_i≤24V,I_O=1mA~70mA, 0°C≤T_J≤+125°C
Load Regulation	ΔV_O		19	90	mV	I_O=1mA~100mA,T_J=+25°C
			11	40	mV	I_O=1mA~40mA,T_J=+25°C
Line regulation	ΔV_O		45	175	mV	12V≤V_i≤24V
			40	125	mV	13V≤V_i≤24V,T_J=+25°C
Quiescent Current	I_q		4.1	6.0	mA	T_J=+25°C
Quiescent Current Change	ΔI_q			1.5	mA	13V≤V_i≤24V,0°C≤T_J≤+125°C
				0.1	mA	1mA≤I_O≤40mA,0°C≤T_J≤+125°C
Output Noise Voltage	V_N	58			μV/V_O	10Hz≤f≤100kHz,T_J=+25°C
Ripple Rejection	RR		45		dB	15V≤V_i≤25V,f=120Hz, 0°C≤T_J≤+125°C
Dropout Voltage	V_d		1.7		V	T_J=+25°C

*Pulse Test

ELECTRICAL CHARACTERISTICS OF 78L10 AT SPECIFIED VIRTUAL JUNCTION TEMPERATURE (Vi=16V,Io=40mA,Ci=0.33uF,,Co=0.1uF, unless otherwise specified)

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Output voltage	V_O	9.2	10	10.8	V	T_J=+25°C
		9	10	11	V	12.5V≤V_i≤23V,I_O=1mA~40mA, 0°C≤T_J≤+125°C
		9	10	11	V	V_i=16V,I_O=1mA~70mA, 0°C≤T_J≤+125°C
Load Regulation	ΔV_O		21	80	mV	I_O=1mA~100mA,T_J=+25°C
			12	40	mV	I_O=1mA~40mA,T_J=+25°C
Line regulation	ΔV_O		50	230	mV	12.5V≤V_i≤23V,T_J=+25°C
			45	170	mV	13V≤V_i≤23V,T_J=+25°C
Quiescent Current	I_q		4.1	6.0	mA	T_J=+25°C
Quiescent Current Change	ΔI_q			1.5	mA	13V≤V_i≤23V,0°C≤T_J≤+125°C
				0.1	mA	1mA≤I_O≤40mA,0°C≤T_J≤+125°C
Output Noise Voltage	V_N		60		μV/V_O	10Hz≤f≤100kHz,T_J=+25°C
Ripple Rejection	RR	37	45		dB	14V≤V_i≤23V,f=120Hz, 0°C≤T_J≤+125°C
Dropout Voltage	V_d		1.7		V	T_J=+25°C

*Pulse Test

PLASTIC-ENCAPSULATE VOLTAGE REGULATORS

ELECTRICAL CHARACTERISTICS OF 78L12 AT SPECIFIED VIRTUAL JUNCTION TEMPERATURE (Vi=19V,Io=40mA,Ci=0.33uF,,Co=0.1uF, unless otherwise specified)

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Output voltage	V_O	11.5	12	12.5	V	T_J=+25°C
		11.4	12	12.6	V	14V≤V_i≤27V,I_O=1mA~40mA, 0°C≤T_J≤+125°C
		11.4	12	12.6	V	14V≤V_i≤27V,I_O=1mA~70mA, 0°C≤T_J≤+125°C
Load Regulation	ΔV_O		22	100	mV	I_O=1mA~100mA,T_J=+25°C
			13	50	mV	I_O=1mA~40mA,T_J=+25°C
Line regulation	ΔV_O		55	250	mV	14.5V≤V_i≤27V
			49	200	mV	16V≤V_i≤27V,T_J=+25°C
Quiescent Current	I_q		4.3	6.5	mA	T_J=+25°C
Quiescent Current Change	ΔI_q			1.5	mA	16V≤V_i≤27V,0°C≤T_J≤+125°C
				0.1	mA	1mA≤I_O≤40mA,0°C≤T_J≤+125°C
Output Noise Voltage	V_N		70		μV/V_O	10Hz≤f≤100kHz,T_J=+25°C
Ripple Rejection	RR	37	42		dB	15V≤V_i≤25V,f=120Hz, 0°C≤T_J≤+125°C
Dropout Voltage	V_d		1.7		V	T_J=+25°C

*Pulse Test

ELECTRICAL CHARACTERISTICS OF 78L15 AT SPECIFIED VIRTUAL JUNCTION TEMPERATURE (Vi=23V,Io=40mA,Ci=0.33uF,,Co=0.1uF, unless otherwise specified)

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Output voltage	V_O	14.4	15	15.6	V	T_J=+25°C
		14.25	15	15.75	V	17.5V≤V_i≤30V,I_O=1mA~40mA, 0°C≤T_J≤+125°C
		14.25	15	15.75	V	V_i=23V,I_O=1mA~70mA, 0°C≤T_J≤+125°C
Load Regulation	ΔV_O		25	150	mV	V_i=23V,I_O=1mA~100mA,T_J=25°C
			15	75	mV	V_i=23V,I_O=1mA~40mA,T_J=25°C
Line regulation	ΔV_O		65	300	mV	17.5V≤V_i≤30V,I_O=40mA,T_J=25°C
			58	250	mV	19V≤V_i≤30V,I_O=40mA,T_J=25°C
Quiescent Current	I_q		4.6	6.5	mA	T_J=+25°C
Quiescent Current Change	ΔI_q			1.5	mA	19V≤V_i≤30V,I_O=40mA, 0°C≤T_J≤+125°C
				0.1	mA	1mA≤I_O≤40mA,V_i=23V, 0°C≤T_J≤+125°C
Output Noise Voltage	V_N		82		μV/V_O	10Hz≤f≤100kHz,T_J=+25°C
Ripple Rejection	RR	34	39		dB	18.5V≤V_i≤28.5V,f=120Hz, 0°C≤T_J≤+125°C
Dropout Voltage	V_d		1.7		V	T_J=+25°C

*Pulse Test

PLASTIC-ENCAPSULATE VOLTAGE REGULATORS

ELECTRICAL CHARACTERISTICS OF 78L18 AT SPECIFIED VIRTUAL JUNCTION TEMPERATURE (Vi=26V,Io=40mA,Ci=0.33uF,,Co=0.1uF, unless otherwise specified)

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Output voltage	V_O	17.3	18	18.7	V	T_J=+25°C
		17.1	18	18.9	V	20.5V≤V_i≤33V,I_O=1mA~40mA, 0°C≤T_J≤+125°C
		17.1	18	18.9	V	V_i=26V,I_O=1mA~70mA, 0°C≤T_J≤+125°C
Load Regulation	ΔV_O		27	180	mV	V_i=26V,I_O=1mA~100mA,T_J=25°C
			19	90	mV	V_i=26V,I_O=1mA~40mA,T_J=25°C
Line regulation	ΔV_O		70	360	mV	20.5V≤V_i≤33V,I_O=40mA,T_J=25°C
			64	300	mV	22V≤V_i≤33V,I_O=40mA,T_J=25°C
Quiescent Current	I_q		4.7	6.5	mA	T_J=+25°C
Quiescent Current Change	ΔI_q			1.5	mA	22V≤V_i≤33V,I_O=40mA, 0°C≤T_J≤+125°C
				0.1	mA	1mA≤I_O≤40mA,V_i=26V, 0°C≤T_J≤+125°C
Output Noise Voltage	V_N		89		μV/V_O	10Hz≤f≤100kHz,T_J=+25°C
Ripple Rejection	RR	32	36		dB	21.5V≤V_i≤31.5V,f=120Hz, 0°C≤T_J≤+125°C
Dropout Voltage	V_d		1.7		V	T_J=+25°C

*Pulse Test

ELECTRICAL CHARACTERISTICS OF 78L20 AT SPECIFIED VIRTUAL JUNCTION TEMPERATURE (Vi=29V,Io=40mA,Ci=0.33uF,,Co=0.1uF, unless otherwise specified)

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Output voltage	V_O	18.4	20	21.6	V	T_J=+25°C
		18	20	22	V	24V≤V_i≤33V,I_O=1mA~40mA, 0°C≤T_J≤+125°C
		18	20	22	V	V_i=29V,I_O=1mA~70mA, 0°C≤T_J≤+125°C
Load Regulation	ΔV_O		29	180	mV	V_i=29V,I_O=1mA~100mA,T_J=25°C
			17	90	mV	V_i=29V,I_O=1mA~40mA,T_J=25°C
Line regulation	ΔV_O		75	330	mV	22.5V≤V_i≤34V,I_O=40mA,T_J=25°C
			70	280	mV	24V≤V_i≤34V,I_O=40mA,T_J=25°C
Quiescent Current	I_q		4.7	6.5	mA	T_J=+25°C
Quiescent Current Change	ΔI_q			1.5	mA	25V≤V_i≤33V,I_O=40mA, 0°C≤T_J≤+125°C
				0.2	mA	1mA≤I_O≤40mA,V_i=26V, 0°C≤T_J≤+125°C
Output Noise Voltage	V_N		120		μV/V_O	10Hz≤f≤100kHz,T_J=+25°C
Ripple Rejection	RR	31	38		dB	25V≤V_i≤35V,f=120Hz, 0°C≤T_J≤+125°C
Dropout Voltage	V_d		1.7		V	T_J=+25°C

*Pulse Test

PLASTIC-ENCAPSULATE VOLTAGE REGULATORS

ELECTRICAL CHARACTERISTICS OF 78L24 AT SPECIFIED VIRTUAL JUNCTION TEMPERATURE (Vi=33V,Io=40mA,Ci=0.33uF,,Co=0.1uF, unless otherwise specified)

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Output voltage	V_O	22.1	24	25.9	V	T_J=+25°C
		21.6	24	26.4	V	27V≤V_i≤38V,I_O=1mA~40mA, 0°C≤T_J≤+125°C
		21.6	24	26.4	V	V_i=33V,I_O=1mA~70mA, 0°C≤T_J≤+125°C
Load Regulation	ΔV_O		29	200	mV	V_i=33V,I_O=1mA~100mA,T_J=25°C
			21	100	mV	V_i=33V,I_O=1mA~40mA,T_J=25°C
Line regulation	ΔV_O		75	350	mV	27V≤V_i≤38V,I_O=40mA,T_J=25°C
			70	300	mV	28V≤V_i≤38V,I_O=40mA,T_J=25°C
Quiescent Current	I_q		4.7	6.5	mA	T_J=+25°C
Quiescent Current Change	ΔI_q			1.5	mA	28V≤V_i≤38V,I_O=40mA, 0°C≤T_J≤+125°C
				0.2	mA	1mA≤I_O≤40mA,V_i=33V, 0°C≤T_J≤+125°C
Output Noise Voltage	V_N		200		μV/V_O	10Hz≤f≤100kHz,T_J=+25°C
Ripple Rejection	RR	30	37		dB	29V≤V_i≤35V,f=120Hz,I_O=40mA, 0°C≤T_J≤+125°C
Dropout Voltage	V_d		1.7		V	T_J=+25°C

*Pulse Test

ELECTRICAL CHARACTERISTICS OF 78L33 AT SPECIFIED VIRTUAL JUNCTION TEMPERATURE (Vi=8.3V,Io=40mA,Ci=0.33uF,,Co=0.1uF, unless otherwise specified)

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Output voltage	V_O	3.168	3.3	3.432	V	T_J=+25°C
		3.135	3.3	3.465	V	5.3V≤V_i≤20V,I_O=1mA~40mA, -40°C≤T_J≤+125°C
		3.135	3.3	3.465	V	V_i=8.3V,I_O=1mA~70mA, -40°C≤T_J≤+125°C
Load Regulation	ΔV_O			60	mV	V_i=8.3V,I_O=1mA~100mA,T_J=25°C
				30	mV	V_i=8.3V,I_O=1mA~40mA,T_J=25°C
Line regulation	ΔV_O			150	mV	5.3V≤V_i≤20V,I_O=40mA,T_J=25°C
				100	mV	6.3V≤V_i≤20V,I_O=40mA,T_J=25°C
Quiescent Current	I_q			6	mA	T_J=+25°C
Quiescent Current Change	ΔI_q			1.5	mA	6.3V≤V_i≤20V,I_O=40mA, -40°C≤T_J≤+125°C
				0.1	mA	1mA≤I_O≤40mA,V_i=8.3V, -40°C≤T_J≤+125°C
Output Noise Voltage	V_N		40		μV/V_O	10Hz≤f≤100kHz,T_J=+25°C
Ripple Rejection	RR	41	49		dB	6.3V≤V_i≤16.3V,f=120Hz,I_O=40mA -40°C≤T_J≤+125°C
Dropout Voltage	V_d		1.7		V	T_J=+25°C

*Pulse Test

PLASTIC-ENCAPSULATE VOLTAGE REGULATORS

Typical Characteristics

Figure 1 : 78L05/12 Output Voltage vs Ambient Temperature

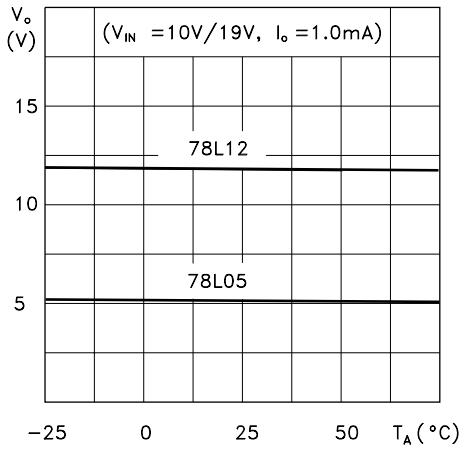


Figure 2 : 78L05/12/24 Load Characteristics

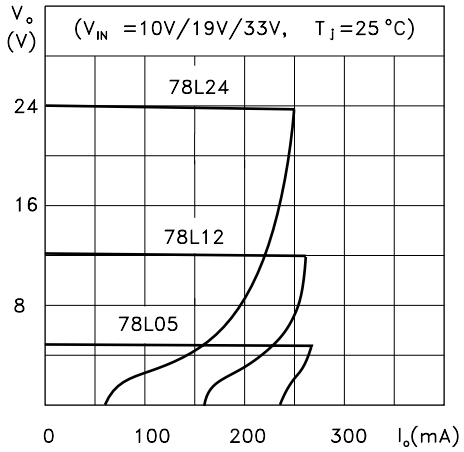


Figure 3 : 78L05/12/24 Thermal Shutdown

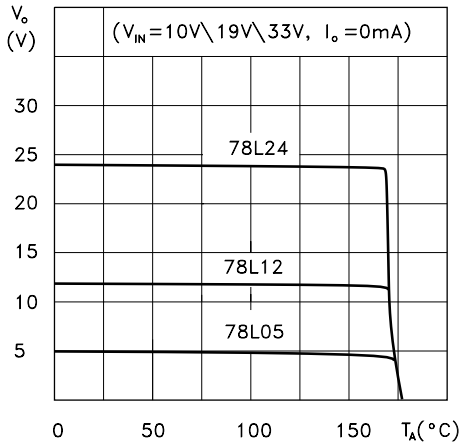


Figure 4 : 78L05/12 Quiescent Current vs Output Current

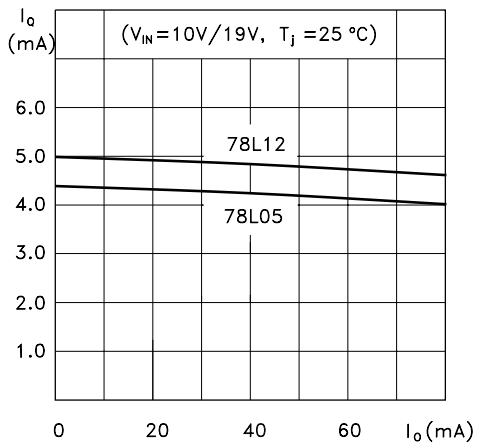


Figure 5 : 78L05 Quiescent Current vs Input Voltage

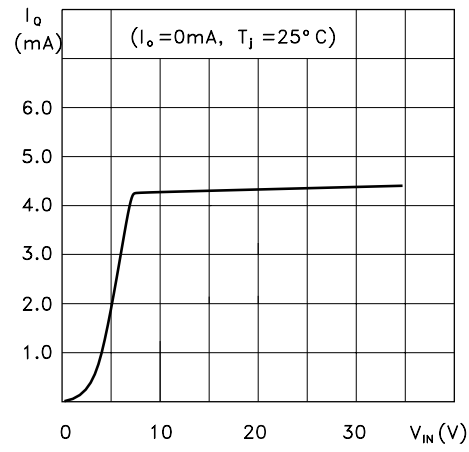
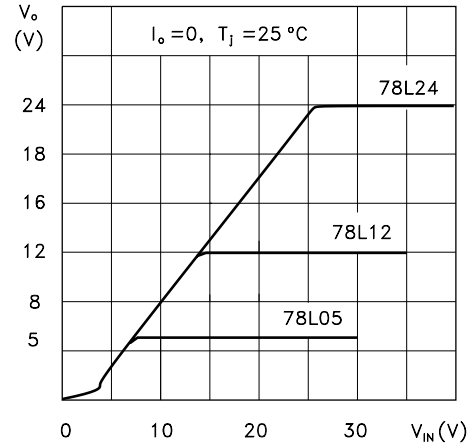


Figure 6 : 78L05/12/24 Output Characteristics



PLASTIC-ENCAPSULATE VOLTAGE REGULATORS

Figure 7 : 78L05/12/24 Ripple Rejection

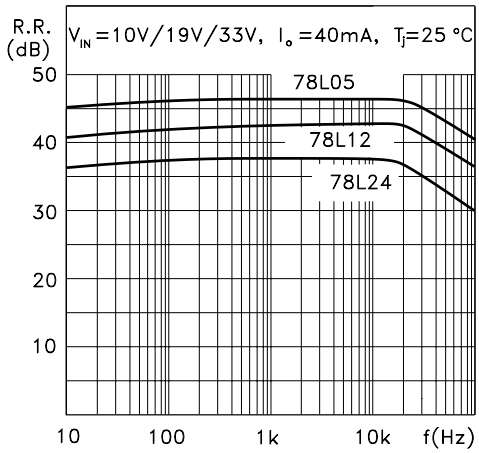


Figure 8 : 78L05 Dropout Characteristics

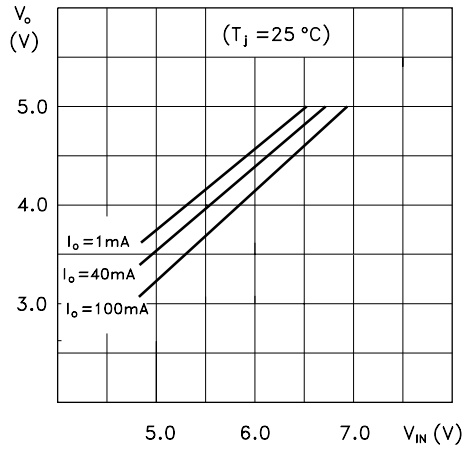
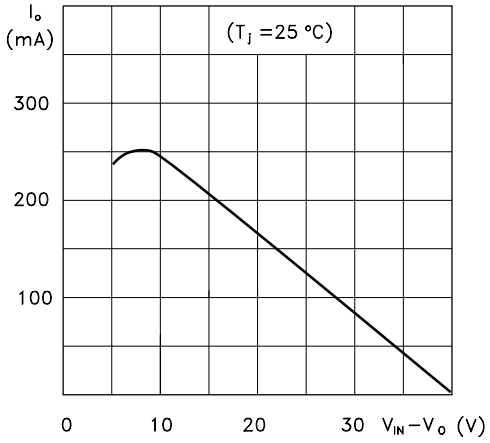


Figure 9 : 78L00 Series Short Circuit Output Current



PLASTIC-ENCAPSULATE VOLTAGE REGULATORS

TYPICAL APPLICATION

Table 10 : High Output Current Short Circuit Protected

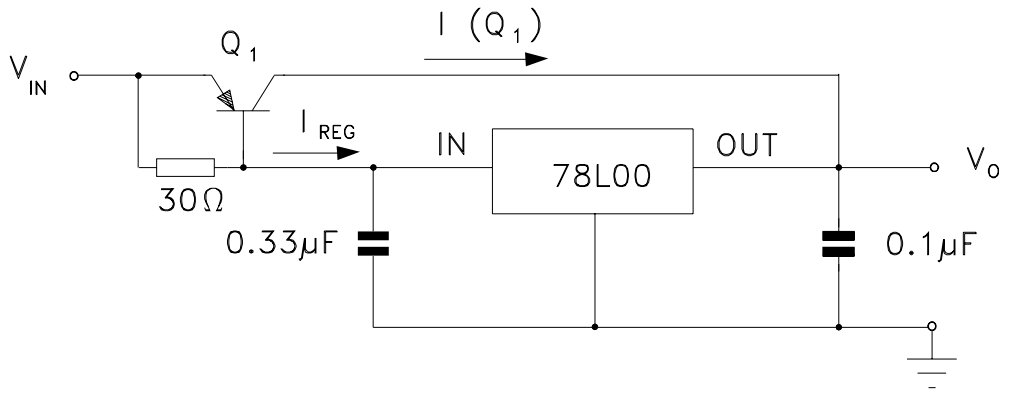


Figure 11 : Edit Boost Circuit

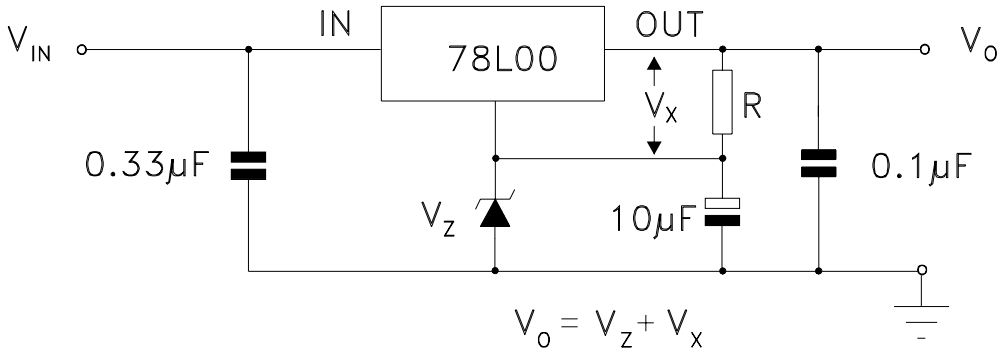


Figure 12 : Current Regulator

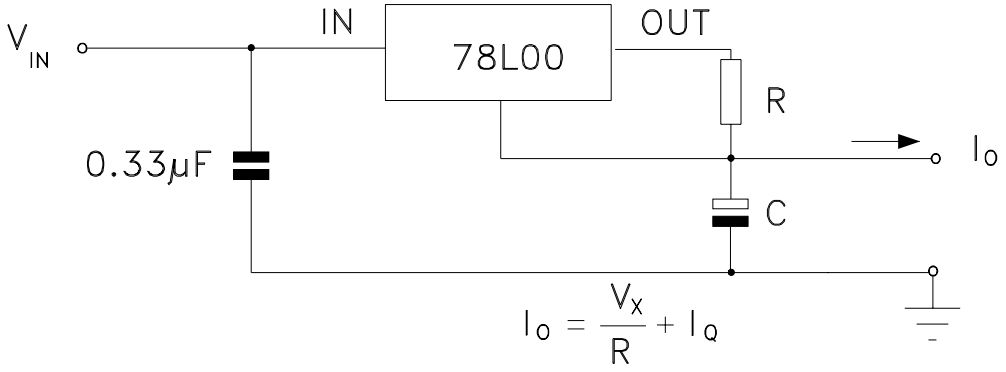
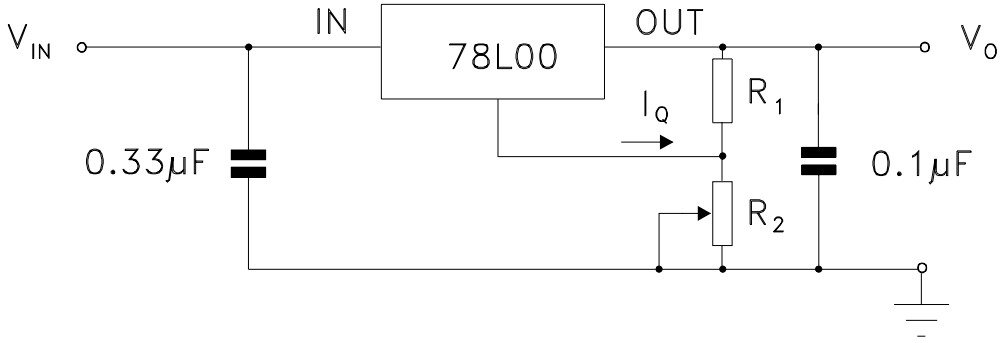
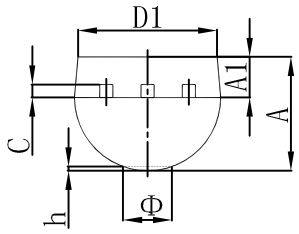


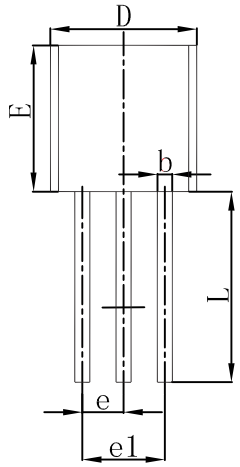
Figure 13 : Adjustable Output Regulator



PLASTIC-ENCAPSULATE VOLTAGE REGULATORS

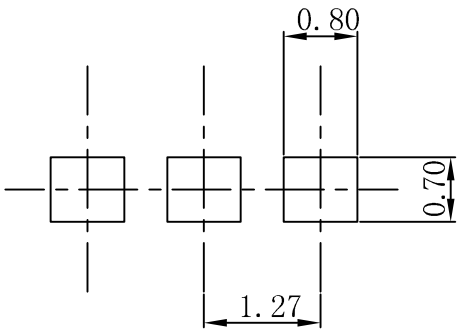
TO-92 Package Outline Dimensions





Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	3.300	3.700	0.130	0.146
A1	1.100	1.400	0.043	0.055
b	0.380	0.550	0.015	0.022
c	0.360	0.510	0.014	0.020
D	4.300	4.700	0.169	0.185
D1	3.430		0.135	
E	4.300	4.700	0.169	0.185
e	1.270 TYP		0.050 TYP	
e1	2.440	2.640	0.096	0.104
L	14.100	14.500	0.555	0.571
Φ		1.600		0.063
h	0.000	0.380	0.000	0.015

TO-92 Suggested Pad Layout



Note:

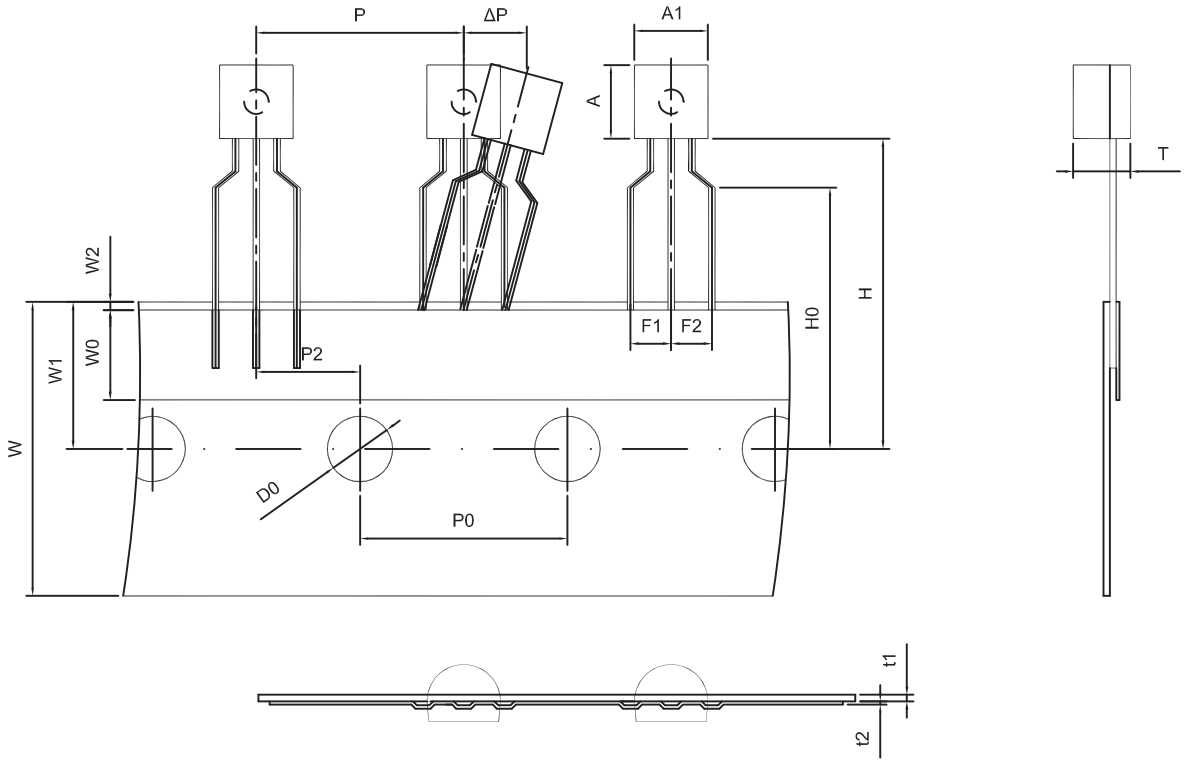
1.Controlling dimension: in millimeters

2.General tolerance: ±0.05mm

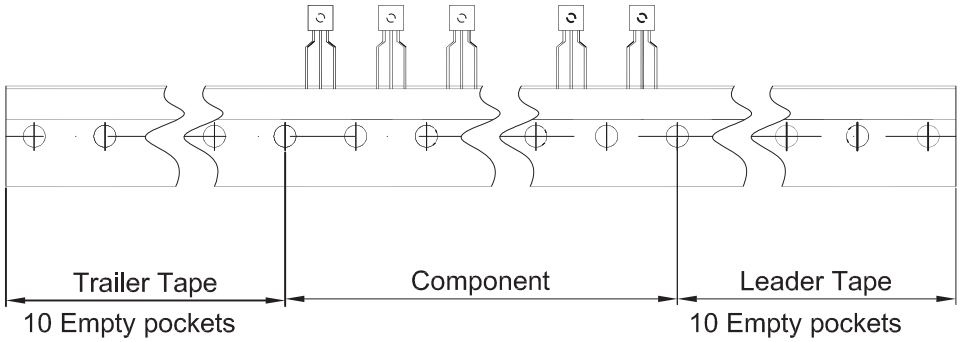
3.The pad layout is for reference purposes only

PLASTIC-ENCAPSULATE VOLTAGE REGULATORS

TO-92 Package Tapeing Dimensions



Dimiensions are in millimeter								
A1	A	T	P	P0	P2	F1	F2	W
4.5	4.5	3.5	12.7	12.7	6.35	2.5	2.5	18.0
W0	W1	W2	H	H0	D0	t1	t2	ΔP
6.0	9.0	1.0 MAX.	19.0	16.0	4.0	0.4	0.2	0



Package	Box	Box Size(mm)	Carton	Carton Size(mm)
TO-92	2000 pcs	333×162×43	20,000 pcs	350×340×250