

3-TERMINAL 0.1A POSITIVE VOLTAGE REGULATOR

LM78LXX

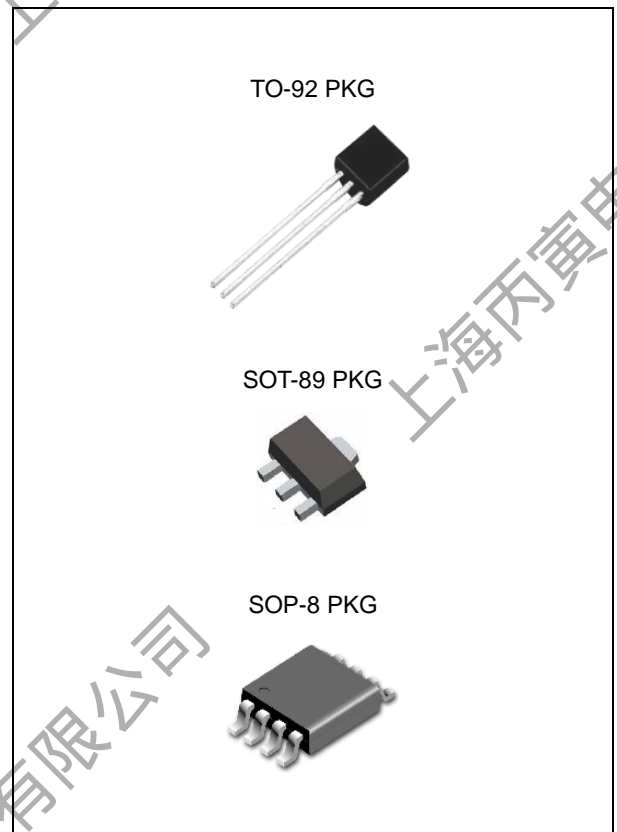
FEATURES

- Output Current Up to 100mA
- No External Components
- Internal Thermal Overload Protection
- Internal Short-Circuit Limiting
- Output Voltage of 5V, 6V, 8V, 9V, 10V, 12V, 15V, 18V and 24V
- Moisture Sensitivity Level 3

DESCRIPTION

This series of fixed-voltage monolithic integrated-circuit voltage regulators is designed for a wide range of applications. These applications include on-card regulation for elimination of noise and distribution problems associated with single-point regulation. In addition, they can be used with power-pass elements to make high current voltage regulators.

Each of these regulators can deliver up to 100mA of output current. The internal limiting and thermal shutdown features of these regulators make them essentially immune to overload. Current limiting is include to limit the peak output current(250mA ~ 300mA) to a safe value. When used as a replacement for a zener diode-resistor combination, an effective improvement in output impedance can be obtained together with lower-bias current.



ORDERING INFORMATION

Device	Package
LM78LXX	TO-92 (Bulk)
LM78LXXTA	TO-92 (Taping)
LM78LXXF	SOT-89
LM78LXXD	SOP-8

XX : Output Voltage = 05, 06, 08, 09, 10, 12, 15, 18, 24

Absolute Maximum Ratings

CHARACTERISTIC		SYMBOL	MIN.	MAX.	UNIT
Input Voltage	LM78L05 ~ LM78L10	V_{IN}	-	30	V
	LM78L12 ~ LM78L18		-	35	
	LM78L24		-	40	
Maximum Power Dissipation at $T_A = 25^\circ\text{C}$ / TO-92		P_{DMax}	-	0.770	W
Thermal Resistance Junction-To-Ambient / TO-92		θ_{JA}	-	162	$^\circ\text{C}/\text{W}$
Lead Temperature (Soldering, 10 sec)		T_{SOL}	-	260	$^\circ\text{C}$
Storage Temperature Range		T_{STG}	-65	150	$^\circ\text{C}$
Operating Junction Temperature Range		T_{JOPR}	-40	150	$^\circ\text{C}$

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Recommended Operating Conditions

CHARACTERISTIC		SYMBOL	MIN.	MAX.	UNIT
Input Voltage	LM78L05 / A	V_{IN}	7	20	V
	LM78L06		8	20	
	LM78L08		10.5	23	
	LM78L09		11.5	24	
	LM78L10		12.5	25	
	LM78L12		14.5	27	
	LM78L15		17.5	30	
	LM78L18		20.5	33	
	LM78L24		26.5	39	
Output Current		I_o	100	100	mA
Operating Virtual Junction Temperature		T_J	-40	125	°C

Ordering Information

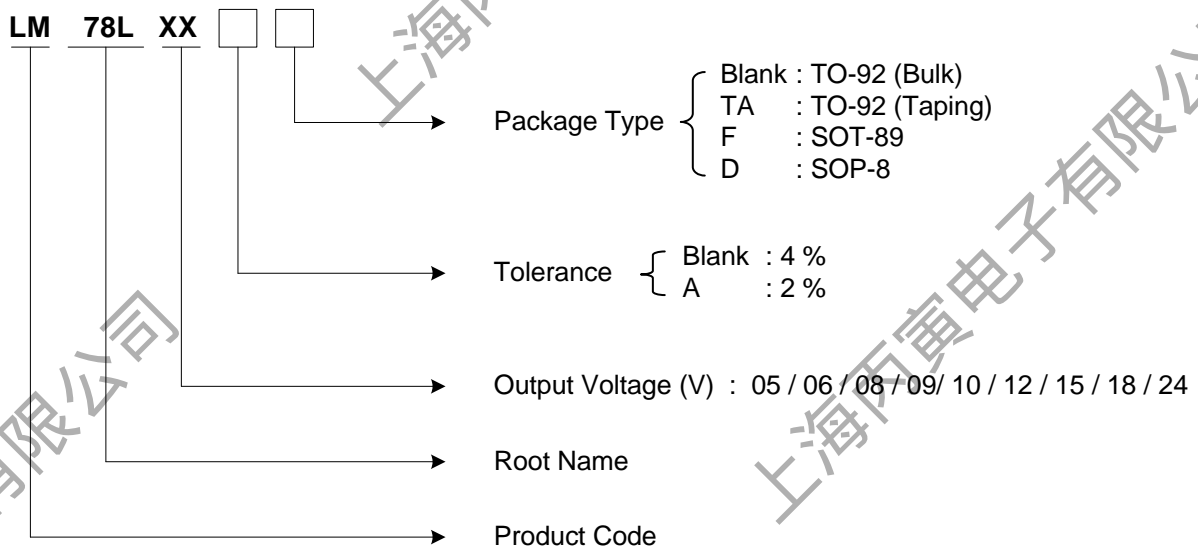
V_{OUT}	Package	Order No.	Description	Supplied As	Status
5.0V	TO-92	LM78L05	0.1A, Positive	Bulk	Active
		LM78L05A	0.1A, Positive	Bulk	Active
		LM78L05TA	0.1A, Positive	Taping	Active
		LM78L05ATA	0.1A, Positive	Taping	Active
	SOT-89	LM78L05F	0.1A, Positive	Reel	Active
	SOP-8	LM78L05D	0.1A, Positive	Reel	Active
6.0V	TO-92	LM78L06	0.1A, Positive	Bulk	Active
		LM78L06TA	0.1A, Positive	Taping	Active
	SOT-89	LM78L06F	0.1A, Positive	Reel	Active
8.0V	TO-92	LM78L08	0.1A, Positive	Bulk	Active
		LM78L08TA	0.1A, Positive	Taping	Active
	SOT-89	LM78L08F	0.1A, Positive	Reel	Active
9.0V	TO-92	LM78L09	0.1A, Positive	Bulk	Active
		LM78L09TA	0.1A, Positive	Taping	Active
	SOT-89	LM78L09F	0.1A, Positive	Reel	Active

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Ordering Information (Continued)

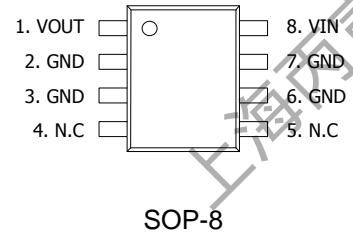
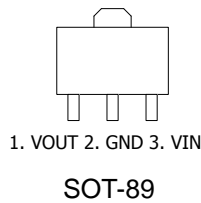
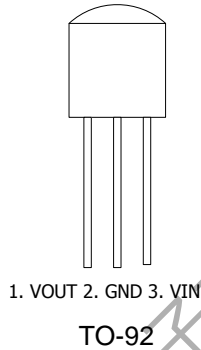
V _{OUT}	Package	Order No.	Description	Supplied As	Status
10V	TO-92	LM78L10	0.1A, Positive	Bulk	Active
		LM78L10TA	0.1A, Positive	Taping	Active
	SOT-89	LM78L10F	0.1A, Positive	Reel	Active
12V	TO-92	LM78L12	0.1A, Positive	Bulk	Active
		LM78L12TA	0.1A, Positive	Taping	Active
	SOT-89	LM78L12F	0.1A, Positive	Reel	Active
15V	TO-92	LM78L15	0.1A, Positive	Bulk	Active
		LM78L15TA	0.1A, Positive	Taping	Active
	SOT-89	LM78L15F	0.1A, Positive	Reel	Active
18V	TO-92	LM78L18	0.1A, Positive	Bulk	Active
		LM78L18TA	0.1A, Positive	Taping	Active
	SOT-89	LM78L18F	0.1A, Positive	Reel	Active
24V	TO-92	LM78L24	0.1A, Positive	Bulk	Active
		LM78L24TA	0.1A, Positive	Taping	Active
	SOT-89	LM78L24F	0.1A, Positive	Reel	Active



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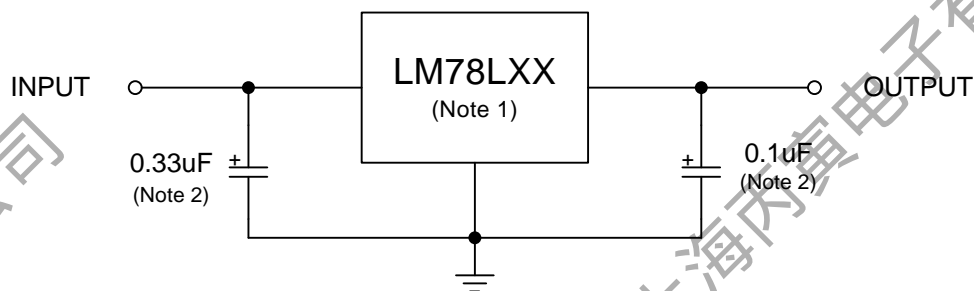
PIN CONFIGURATION



PIN DESCRIPTION

Pin No.	TO-92 / SOT-89 3 LEAD		SOP-8 8 LEAD	
	Name	Function	Name	Function
1	V _{OUT}	Output Voltage	V _{OUT}	Output Voltage
2	GND	Ground	GND	Ground
3	V _{IN}	Input Voltage	GND	Ground
4 / 5	-	-	N.C	Not Connected
6 / 7	-	-	GND	Ground
8	-	-	V _{IN}	Input Voltage

TYPICAL APPLICATION



Note)

1. To specify an output voltage, substitute voltage for "XX".
2. Bypass capacitors are recommended for optimum stability and transient response and should be located as close as possible to the regulators.

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ELECTRICAL CHARACTERISTICS

LM78L05 (At specified virtual junction temperature, $V_{IN} = 10V$, $I_o = 40mA$ (Unless otherwise noted))

PARAMETER	SYMBOL	TEST CONDITION ^(Note 1)		MIN.	TYP.	MAX.	UNIT
Output Voltage ^(Note 2)	V_{OUT}		25°C	4.8	5	5.2	V
		$1mA \leq I_o \leq 40mA$ $7V \leq V_{IN} \leq 20V$	-30°C ~ 125°C	4.75	5	5.25	
		$1mA \leq I_o \leq 70mA$		4.75	5	5.25	
Line Regulation	ΔV_{LINE}	$7V \leq V_{IN} \leq 20V$	25°C		32	150	mV
		$8V \leq V_{IN} \leq 20V$			26	100	
Load Regulation	ΔV_{LOAD}	$1mA \leq I_o \leq 100mA$	25°C		15	60	mV
		$1mA \leq I_o \leq 40mA$			8	30	
Bias Current	I_B		25°C		3.8	6	mA
			125°C			5.5	
Bias Current Change	ΔI_B	$9V \leq V_{IN} \leq 20V$	-30°C ~ 125°C			1.5	mA
		$1mA \leq I_o \leq 40mA$				0.1	
Output Noise Voltage	V_N	$10Hz \leq f \leq 100kHz$	25°C		42		uV
Ripple Rejection	RR	$8V \leq V_{IN} \leq 18V$, $f=120Hz$	25°C	41	49		dB
Dropout Voltage	V_D		25°C		1.7		V

LM78L05A (At specified virtual junction temperature, $V_{IN} = 10V$, $I_o = 40mA$ (Unless otherwise noted))

PARAMETER	SYMBOL	TEST CONDITION ^(Note 1)		MIN.	TYP.	MAX.	UNIT
Output Voltage ^(Note 2)	V_{OUT}		25°C	4.9	5	5.1	V
		$1mA \leq I_o \leq 40mA$ $7V \leq V_{IN} \leq 20V$	-30°C ~ 125°C	4.875	5	5.125	
		$1mA \leq I_o \leq 70mA$		4.875	5	5.125	
Line Regulation	ΔV_{LINE}	$7V \leq V_{IN} \leq 20V$	25°C		32	150	mV
		$8V \leq V_{IN} \leq 20V$			26	100	
Load Regulation	ΔV_{LOAD}	$1mA \leq I_o \leq 100mA$	25°C		15	60	mV
		$1mA \leq I_o \leq 40mA$			8	30	
Bias Current	I_B		25°C		3.8	6	mA
			125°C			5.5	
Bias Current Change	ΔI_B	$9V \leq V_{IN} \leq 20V$	-30°C ~ 125°C			1.5	mA
		$1mA \leq I_o \leq 40mA$				0.1	
Output Noise Voltage	V_N	$10Hz \leq f \leq 100kHz$	25°C		42		uV
Ripple Rejection	RR	$8V \leq V_{IN} \leq 18V$, $f=120Hz$	25°C	41	49		dB
Dropout Voltage	V_D		25°C		1.7		V

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LM78L06 (At specified virtual junction temperature, $V_{IN} = 11V$, $I_o = 40mA$ (Unless otherwise noted))

PARAMETER	SYMBOL	TEST CONDITION ^(Note 1)		MIN.	TYP.	MAX.	UNIT
Output Voltage ^(Note 2)	V_{OUT}		25°C	5.75	6	6.25	V
		$1mA \leq I_o \leq 40mA$ $8V \leq V_{IN} \leq 20V$	-30°C ~ 125°C	5.7	6	6.3	
		$1mA \leq I_o \leq 70mA$		5.7	6	6.3	
Line Regulation	ΔV_{LINE}	$8V \leq V_{IN} \leq 20V$	25°C		35	175	mV
		$9V \leq V_{IN} \leq 20V$			29	125	
Load Regulation	ΔV_{LOAD}	$1mA \leq I_o \leq 100mA$	25°C		16	80	mV
		$1mA \leq I_o \leq 40mA$			9	40	
Bias Current	I_B		25°C		3.9	6	mA
			125°C			5.5	
Bias Current Change	ΔI_B	$9V \leq V_{IN} \leq 20V$	-30°C ~ 125°C			1.5	mA
		$1mA \leq I_o \leq 40mA$				0.1	
Output Noise Voltage	V_N	$10Hz \leq f \leq 100kHz$	25°C		46		uV
Ripple Rejection	RR	$8V \leq V_{IN} \leq 18V$, $f=120Hz$	25°C	40	48		dB
Dropout Voltage	V_D		25°C		1.7		V

LM78L08 (At specified virtual junction temperature, $V_{IN} = 14V$, $I_o = 40mA$ (Unless otherwise noted))

PARAMETER	SYMBOL	TEST CONDITION ^(Note 1)		MIN.	TYP.	MAX.	UNIT
Output Voltage ^(Note 2)	V_{OUT}		25°C	7.7	8	8.3	V
		$1mA \leq I_o \leq 40mA$ $10.5V \leq V_{IN} \leq 23V$	-30°C ~ 125°C	7.6	8	8.4	
		$1mA \leq I_o \leq 70mA$		7.6	8	8.4	
Line Regulation	ΔV_{LINE}	$10.5V \leq V_{IN} \leq 23V$	25°C		42	175	mV
		$11V \leq V_{IN} \leq 23V$			36	125	
Load Regulation	ΔV_{LOAD}	$1mA \leq I_o \leq 100mA$	25°C		13	80	mV
		$1mA \leq I_o \leq 40mA$			10	40	
Bias Current	I_B		25°C		4	6	mA
			125°C			5.5	
Bias Current Change	ΔI_B	$11V \leq V_{IN} \leq 23V$	-30°C ~ 125°C			1.5	mA
		$1mA \leq I_o \leq 40mA$				0.1	
Output Noise Voltage	V_N	$10Hz \leq f \leq 100kHz$	25°C		54		uV
Ripple Rejection	RR	$13V \leq V_{IN} \leq 23V$, $f=120Hz$	25°C	37	46		dB
Dropout Voltage	V_D		25°C		1.7		V

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LM78L09 (At specified virtual junction temperature, $V_{IN} = 16V$, $I_o = 40mA$ (Unless otherwise noted))

PARAMETER	SYMBOL	TEST CONDITION ^(Note 1)		MIN.	TYP.	MAX.	UNIT
Output Voltage ^(Note 2)	V_{OUT}		25°C	8.6	9	9.4	V
		$1mA \leq I_o \leq 40mA$ $12V \leq V_{IN} \leq 24V$	-30°C ~ 125°C	8.55	9	9.45	
		$1mA \leq I_o \leq 70mA$		8.55	9	9.45	
Line Regulation	ΔV_{LINE}	$12V \leq V_{IN} \leq 24V$	25°C		45	175	mV
		$13V \leq V_{IN} \leq 24V$			40	125	
Load Regulation	ΔV_{LOAD}	$1mA \leq I_o \leq 100mA$	25°C		19	90	mV
		$1mA \leq I_o \leq 40mA$			11	40	
Bias Current	I_B		25°C		4.1	6	mA
			125°C			5.5	
Bias Current Change	ΔI_B	$13V \leq V_{IN} \leq 24V$	-30°C ~ 125°C			1.5	mA
		$1mA \leq I_o \leq 40mA$				0.1	
Output Noise Voltage	V_N	$10Hz \leq f \leq 100kHz$	25°C		58		µV
Ripple Rejection	RR	$15V \leq V_{IN} \leq 25V$, $f=120Hz$	25°C	38	45		dB
Dropout Voltage	V_D		25°C		1.7		V

LM78L10 (At specified virtual junction temperature, $V_{IN} = 17V$, $I_o = 40mA$ (Unless otherwise noted))

PARAMETER	SYMBOL	TEST CONDITION ^(Note 1)		MIN.	TYP.	MAX.	UNIT
Output Voltage ^(Note 2)	V_{OUT}		25°C	9.6	10	10.4	V
		$1mA \leq I_o \leq 40mA$ $13V \leq V_{IN} \leq 25V$	-30°C ~ 125°C	9.5	10	10.5	
		$1mA \leq I_o \leq 70mA$		9.5	10	10.5	
Line Regulation	ΔV_{LINE}	$13V \leq V_{IN} \leq 25V$	25°C		51	175	mV
		$14V \leq V_{IN} \leq 25V$			42	125	
Load Regulation	ΔV_{LOAD}	$1mA \leq I_o \leq 100mA$	25°C		20	90	mV
		$1mA \leq I_o \leq 40mA$			11	40	
Bias Current	I_B		25°C		4.2	6	mA
			125°C			5.5	
Bias Current Change	ΔI_B	$14V \leq V_{IN} \leq 25V$	-30°C ~ 125°C			1.5	mA
		$1mA \leq I_o \leq 40mA$				0.1	
Output Noise Voltage	V_N	$10Hz \leq f \leq 100kHz$	25°C		62		µV
Ripple Rejection	RR	$15V \leq V_{IN} \leq 25V$, $f=120Hz$	25°C	37	44		dB
Dropout Voltage	V_D		25°C		1.7		V

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LM78L12 (At specified virtual junction temperature, $V_{IN} = 19V$, $I_o = 40mA$ (Unless otherwise noted))

PARAMETER	SYMBOL	TEST CONDITION ^(Note 1)		MIN.	TYP.	MAX.	UNIT
Output Voltage ^(Note 2)	V_{OUT}		25°C	11.5	12	12.5	V
		$1mA \leq I_o \leq 40mA$ $14V \leq V_{IN} \leq 27V$	-30°C ~ 125°C	11.4	12	12.6	
		$1mA \leq I_o \leq 70mA$		11.4	12	12.6	
Line Regulation	ΔV_{LINE}	$14.5V \leq V_{IN} \leq 27V$	25°C		55	250	mV
		$16V \leq V_{IN} \leq 27V$			49	200	
Load Regulation	ΔV_{LOAD}	$1mA \leq I_o \leq 100mA$	25°C		22	100	mV
		$1mA \leq I_o \leq 40mA$			13	50	
Bias Current	I_B		25°C		4.3	6.5	mA
			125°C			6	
Bias Current Change	ΔI_B	$16V \leq V_{IN} \leq 27V$	-30°C ~ 125°C			1.5	mA
		$1mA \leq I_o \leq 40mA$				0.1	
Output Noise Voltage	V_N	$10Hz \leq f \leq 100kHz$	25°C		70		uV
Ripple Rejection	RR	$15V \leq V_{IN} \leq 25V$, $f=120Hz$	25°C	37	42		dB
Dropout Voltage	V_D		25°C		1.7		V

LM78L15 (At specified virtual junction temperature, $V_{IN} = 23V$, $I_o = 40mA$ (Unless otherwise noted))

PARAMETER	SYMBOL	TEST CONDITION ^(Note 1)		MIN.	TYP.	MAX.	UNIT
Output Voltage ^(Note 2)	V_{OUT}		25°C	14.4	15	15.6	V
		$1mA \leq I_o \leq 40mA$ $17.5V \leq V_{IN} \leq 30V$	-30°C ~ 125°C	14.25	15	15.75	
		$1mA \leq I_o \leq 70mA$		14.25	15	15.75	
Line Regulation	ΔV_{LINE}	$17.5V \leq V_{IN} \leq 30V$	25°C		65	300	mV
		$19V \leq V_{IN} \leq 30V$			58	250	
Load Regulation	ΔV_{LOAD}	$1mA \leq I_o \leq 100mA$	25°C		25	150	mV
		$1mA \leq I_o \leq 40mA$			15	75	
Bias Current	I_B		25°C		4.2	6.5	mA
			125°C			6	
Bias Current Change	ΔI_B	$19V \leq V_{IN} \leq 30V$	-30°C ~ 125°C			1.5	mA
		$1mA \leq I_o \leq 40mA$				0.1	
Output Noise Voltage	V_N	$10Hz \leq f \leq 100kHz$	25°C		82		uV
Ripple Rejection	RR	$18.5V \leq V_{IN} \leq 28.5V$, $f=120Hz$	25°C	37	44		dB
Dropout Voltage	V_D		25°C		1.7		V

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LM78L18 (At specified virtual junction temperature, $V_{IN} = 26V$, $I_o = 40mA$ (Unless otherwise noted))

PARAMETER	SYMBOL	TEST CONDITION ^(Note 1)		MIN.	TYP.	MAX.	UNIT
Output Voltage ^(Note 2)	V_{OUT}		25°C	17.3	18	18.7	V
		$1mA \leq I_o \leq 40mA$ $20.5V \leq V_{IN} \leq 33V$	-30°C ~ 125°C	17.1	18	18.9	
		$1mA \leq I_o \leq 70mA$		17.1	18	18.9	
Line Regulation	ΔV_{LINE}	$20.5V \leq V_{IN} \leq 33V$	25°C		70	360	mV
		$22V \leq V_{IN} \leq 33V$			64	300	
Load Regulation	ΔV_{LOAD}	$1mA \leq I_o \leq 100mA$	25°C		27	180	mV
		$1mA \leq I_o \leq 40mA$			19	90	
Bias Current	I_B		25°C		4.7	6.5	mA
			125°C			6	
Bias Current Change	ΔI_B	$22V \leq V_{IN} \leq 33V$	-30°C ~ 125°C			1.5	mA
		$1mA \leq I_o \leq 40mA$				0.1	
Output Noise Voltage	V_N	$10Hz \leq f \leq 100kHz$	25°C		82		uV
Ripple Rejection	RR	$21.5V \leq V_{IN} \leq 31.5V$, $f=120Hz$	25°C	32	36		dB
Dropout Voltage	V_D		25°C		1.7		V

LM78L24 (At specified virtual junction temperature, $V_{IN} = 32V$, $I_o = 40mA$ (Unless otherwise noted))

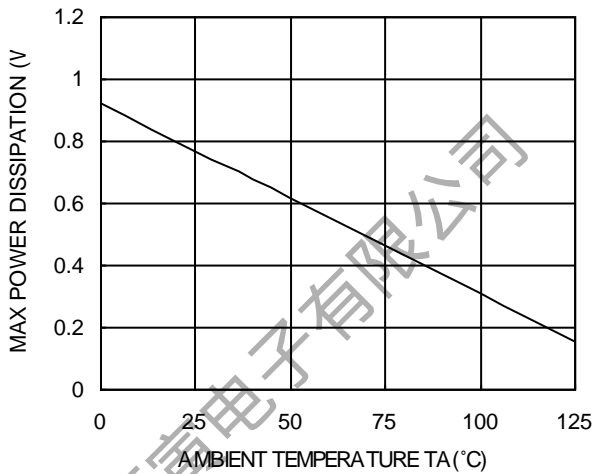
PARAMETER	SYMBOL	TEST CONDITION ^(Note 1)		MIN.	TYP.	MAX.	UNIT
Output Voltage ^(Note 2)	V_{OUT}		25°C	23	24	25	V
		$1mA \leq I_o \leq 40mA$ $26.5V \leq V_{IN} \leq 39V$	-30°C ~ 125°C	22.8	24	25.2	
		$1mA \leq I_o \leq 70mA$		22.8	24	25.2	
Line Regulation	ΔV_{LINE}	$26.5V \leq V_{IN} \leq 39V$	25°C		95	480	mV
		$29V \leq V_{IN} \leq 39V$			78	400	
Load Regulation	ΔV_{LOAD}	$1mA \leq I_o \leq 100mA$	25°C		41	240	mV
		$1mA \leq I_o \leq 40mA$			28	120	
Bias Current	I_B		25°C		4.8	6.5	mA
			125°C			6	
Bias Current Change	ΔI_B	$28V \leq V_{IN} \leq 39V$	-30°C ~ 125°C			1.5	mA
		$1mA \leq I_o \leq 40mA$				0.1	
Output Noise Voltage	V_N	$10Hz \leq f \leq 100kHz$	25°C		82		uV
Ripple Rejection	RR	$27.5V \leq V_{IN} \leq 37.5V$, $f=120Hz$	25°C	30	33		dB
Dropout Voltage	V_D		25°C		1.7		V

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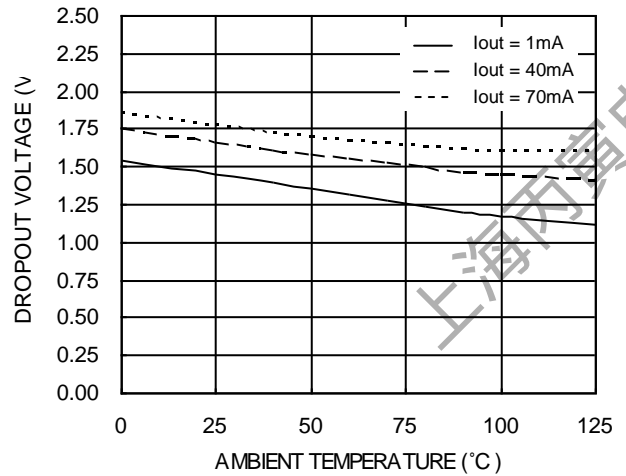
LM78LXX

- Note 1. Pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately.
All characteristics are measured with a 0.33 μ F capacitor across the input and a 0.1 μ F capacitor across the output.
- Note 2. This specification applies only for DC power dissipation permitted by absolute maximum ratings.

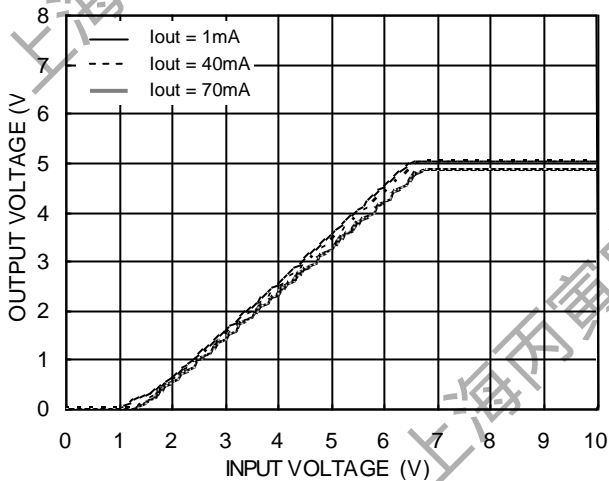
TYPICAL OPERATING CHARACTERISTICS



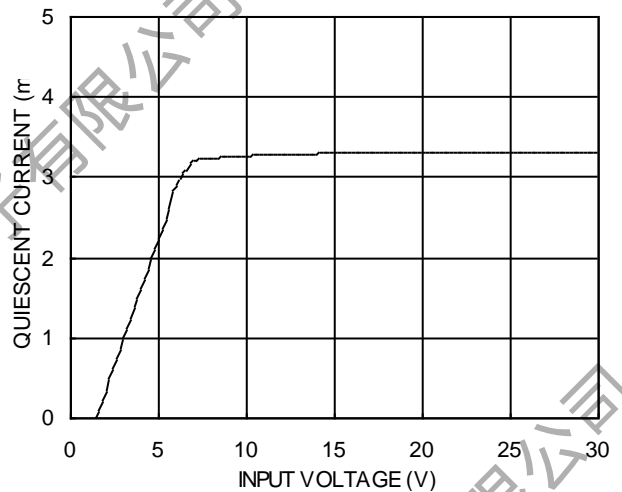
Power Dissipation vs. Ambient Temperature, TO-92



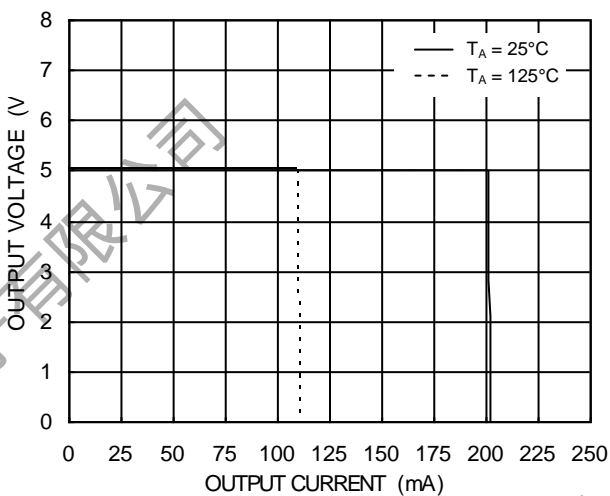
Dropout Voltage vs. Ambient Temperature



Output Voltage vs. Input Voltage



Quiescent Current vs. Input Voltage



Output Voltage vs. Output Current