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

TO-92 PKG

SOT-89 PKG

SOP-8 PKG

DESCRIPSION

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°C / TO-92		P_{DMax}	-	0.770	W
Thermal Resistance Junction-To-Ambient / TO-92		θ_{JA}	-	162	℃/W
Lead Temperature (Soldering, 10 sec)		T_{SOL}	-	260	℃
Storage Temperature Range		T_{STG}	-65	150	℃
Operating Junction Temperature Range		T_{JOPR}	-40	150	℃

Recommended Operating Conditions

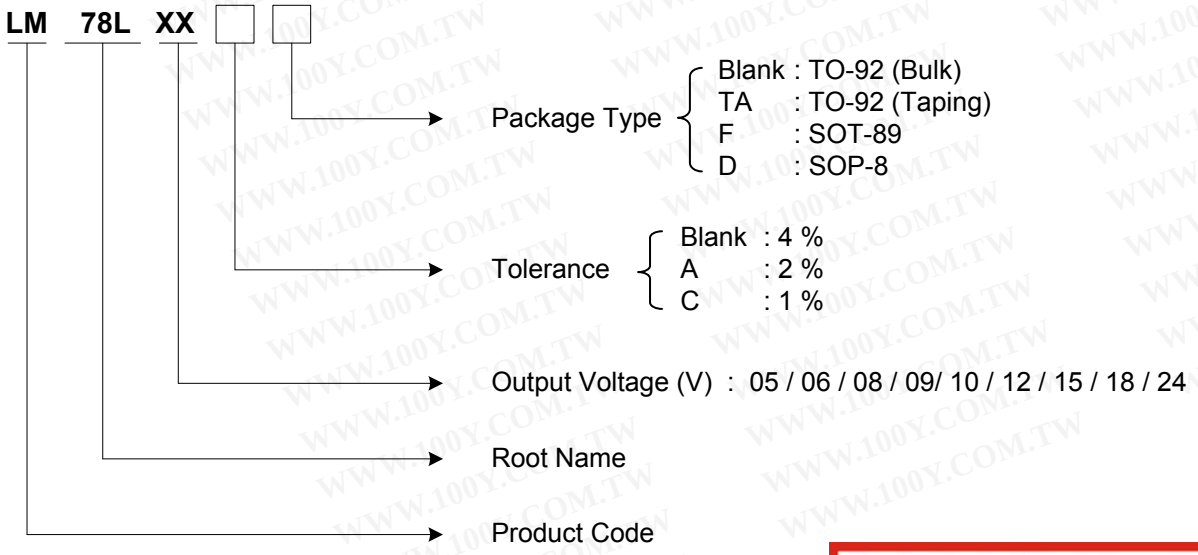
CHARACTERISTIC		SYMBOL	MIN.	MAX.	UNIT
Input Voltage	LM78L05 / A / C	V_{IN}	7	20	V
	LM78L06		8	20	
	LM78L08		10.5	23	
	LM78L09		11.5	24	
	LM78L10		12.5	25	
	LM78L12		14.5	27	
	LM78L15		17.5	30	
	LM78L18		20.5	33	
	LM78L24		26.5	39	
Output Current		Io	100	100	mA
Operating Virtual Junction Temperature	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

Ordering Information

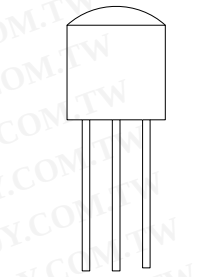
V_{OUT}	Package	Order No.	Description	Supplied As	Status
5.0V	TO-92	LM78L05	0.1A, Positive	Bulk	Active
		LM78L05A	0.1A, Positive	Bulk	Active
		LM78L05C	0.1A, Positive	Bulk	Active
		LM78L05TA	0.1A, Positive	Taping	Active
		LM78L05ATA	0.1A, Positive	Taping	Active
		LM78L05CTA	0.1A, Positive	Taping	Active
	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

Ordering Information (Continued)

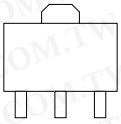
V_{OUT}	Package	Order No.	Description	Supplied As	Status
10V	TO-92	LM78L10	0.1A, Positive	Bulk	Active
		LM78L10TA	0.1A, Positive	Taping	Active
	SOT-89	LM78L10F	0.1A, Positive	Reel	Active
12V	TO-92	LM78L12	0.1A, Positive	Bulk	Active
		LM78L12TA	0.1A, Positive	Taping	Active
	SOT-89	LM78L12F	0.1A, Positive	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



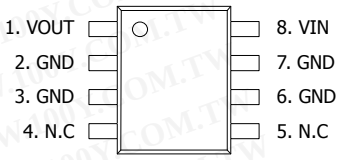
PIN CONFIGURATION



TO-92



SOT-89

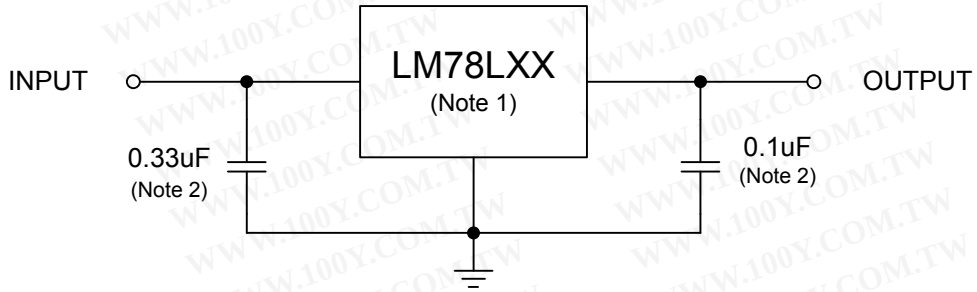


SOP-8

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.

ELECTRICAL CHARACTERISTICS

LM78L05 (At specified virtual junction temperature, VIN = 10V, Io = 40mA (Unless otherwise noted)

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

LM78L05A (At specified virtual junction temperature, VIN = 10V, Io = 40mA (Unless otherwise noted)

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

LM78L05C (At specified virtual junction temperature, VIN = 10V, Io = 40mA (Unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITION(Note 1)		MIN.	TYP.	MAX.	UNIT
Output Voltage(Note 2)	V_{OUT}		25℃	4.95	5	5.05	V
		1mA ≤ Io ≤ 40mA 7V ≤ V_{IN} ≤ 20V	-30℃ ~ 125℃	4.925	5	5.063	
		1mA ≤ Io ≤ 70mA		4.925	5	5.063	
Line Regulation	ΔV_{LINE}	7V ≤ V_{IN} ≤ 20V	25℃		32	150	mV
		8V ≤ V_{IN} ≤ 20V			26	100	
Load Regulation	ΔV_{LOAD}	1mA ≤ Io ≤ 100mA	25℃		15	60	mV
		1mA ≤ Io ≤ 40mA			8	30	
Bias Current	I_B		25℃		3.8	6	mA
			125℃			5.5	
Bias Current Change	ΔI_B	9V ≤ V_{IN} ≤ 20V	-30℃ ~ 125℃			1.5	mA
		1mA ≤ Io ≤ 40mA				0.1	
Output Noise Voltage	V_N	10Hz ≤ f ≤ 100kHz	25℃		42		uV
Ripple Rejection	RR	8V ≤ V_{IN} ≤ 18V, f=120Hz	25℃	41	49		dB
Dropout Voltage	V_D		25℃		1.7		V

LM78L06 (At specified virtual junction temperature, VIN = 11V, Io = 40mA (Unless otherwise noted)

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

LM78L08 (At specified virtual junction temperature, VIN = 14V, Io = 40mA (Unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITION(Note 1)		MIN.	TYP.	MAX.	UNIT
Output Voltage(Note 2)	V_{OUT}		25℃	7.7	8	8.3	V
		1mA ≤ Io ≤ 40mA 10.5V ≤ V_{IN} ≤ 23V	-30℃ ~ 125℃	7.6	8	8.4	
		1mA ≤ Io ≤ 70mA		7.6	8	8.4	
Line Regulation	ΔV_{LINE}	10.5V ≤ V_{IN} ≤ 23V	25℃		42	175	mV
		11V ≤ V_{IN} ≤ 23V			36	125	
Load Regulation	ΔV_{LOAD}	1mA ≤ Io ≤ 100mA	25℃		18	80	mV
		1mA ≤ Io ≤ 40mA			10	40	
Bias Current	I_B		25℃		4	6	mA
			125℃			5.5	
Bias Current Change	ΔI_B	11V ≤ V_{IN} ≤ 23V	-30℃ ~ 125℃			1.5	mA
		1mA ≤ Io ≤ 40mA				0.1	
Output Noise Voltage	V_N	10Hz ≤ f ≤ 100kHz	25℃		54		uV
Ripple Rejection	RR	13V ≤ V_{IN} ≤ 23V, f=120Hz	25℃	37	46		dB
Dropout Voltage	V_D		25℃		1.7		V

LM78L09 (At specified virtual junction temperature, VIN = 16V, Io = 40mA (Unless otherwise noted)

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

LM78L10 (At specified virtual junction temperature, VIN = 17V, Io = 40mA (Unless otherwise noted)

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

LM78L12 (At specified virtual junction temperature, VIN = 19V, Io = 40mA (Unless otherwise noted)

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

LM78L15 (At specified virtual junction temperature, VIN = 23V, Io = 40mA (Unless otherwise noted)

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

LM78L18 (At specified virtual junction temperature, VIN = 26V, Io = 40mA (Unless otherwise noted)

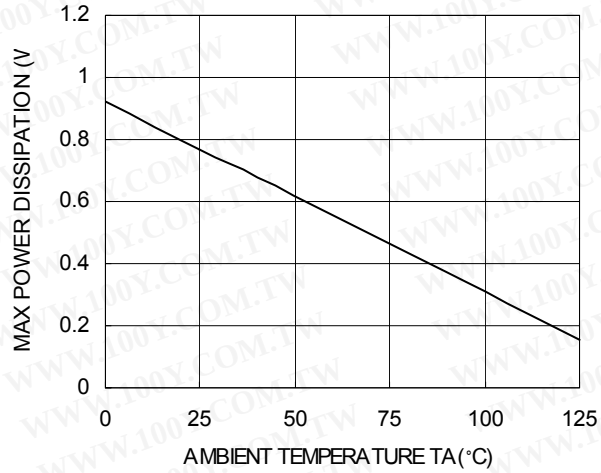
PARAMETER	SYMBOL	TEST CONDITION(Note 1)		MIN.	TYP.	MAX.	UNIT
Output Voltage(Note 2)	V_{OUT}		25℃	17.3	18	18.7	V
		1mA ≤ Io ≤ 40mA 20.5V ≤ V_{IN} ≤ 33V	-30℃ ~ 125℃	17.1	18	18.9	
		1mA ≤ Io ≤ 70mA		17.1	18	18.9	
Line Regulation	ΔV_{LINE}	20.5V ≤ V_{IN} ≤ 33V	25℃		70	360	mV
		22V ≤ V_{IN} ≤ 33V			64	300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

LM78L24 (At specified virtual junction temperature, VIN = 32V, Io = 40mA (Unless otherwise noted)

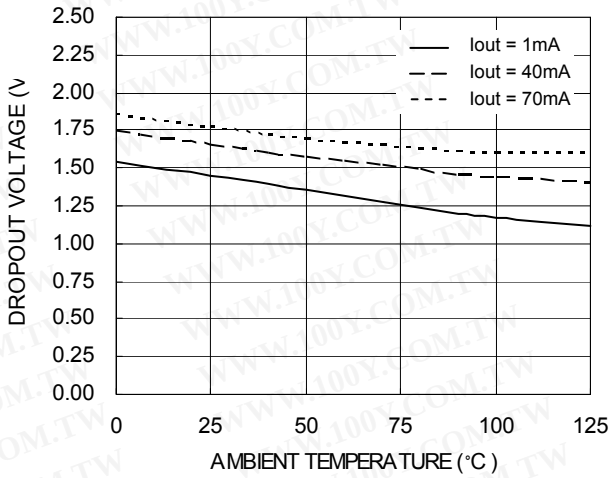
PARAMETER	SYMBOL	TEST CONDITION(Note 1)		MIN.	TYP.	MAX.	UNIT
Output Voltage(Note 2)	V_{OUT}		25℃	23	24	25	V
		1mA ≤ Io ≤ 40mA 26.5V ≤ V_{IN} ≤ 39V	-30℃ ~ 125℃	22.8	24	25.2	
		1mA ≤ Io ≤ 70mA		22.8	24	25.2	
Line Regulation	ΔV_{LINE}	26.5V ≤ V_{IN} ≤ 39V	25℃		95	480	mV
		29V ≤ V_{IN} ≤ 39V			78	400	
Load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

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 0.33uF capacitor across the input and a 0.1uF capacitor across the output.
Note 2. This specification applies only for DC power dissipation permitted by absolute maximum ratings.

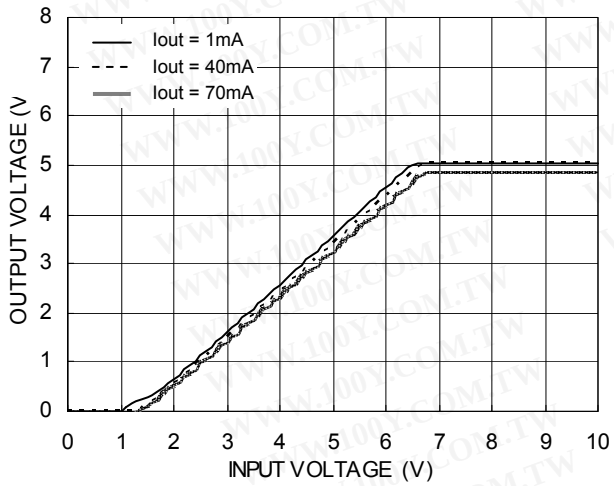
TYPICAL OPERATING CHARACTERISTICS



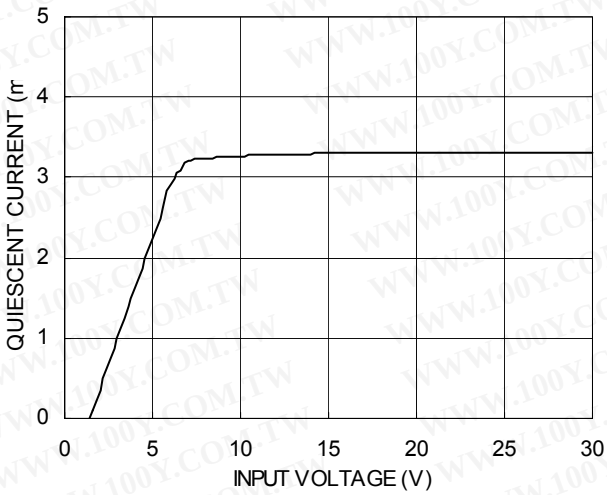
Power Dissipation vs. Ambient Temperature, TO-92



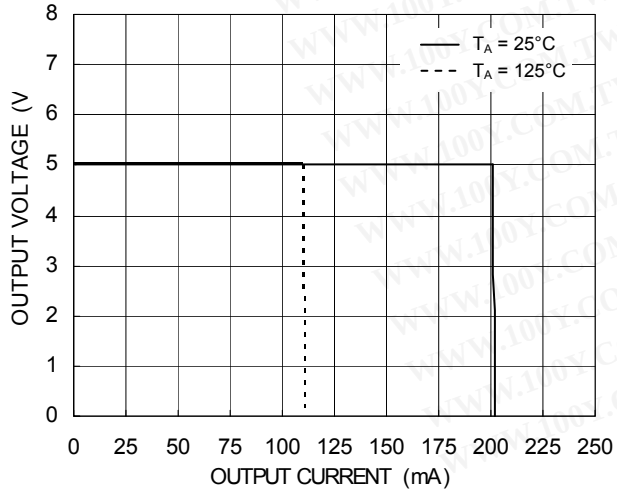
Dropout Voltage vs. Ambient Temperature



Output Voltage vs. Input Voltage



Quiescent Current vs. Input Voltage



Output Voltage vs. Output Current