



78LXXM

LINEAR INTEGRATED CIRCUIT

3-TERMINAL 0.2A POSITIVE VOLTAGE REGULATOR

DESCRIPTION

The UTC **78LXXM** family is monolithic fixed voltage regulator integrated circuit. They are suitable for applications that required supply current up to 200mA.

FEATURES

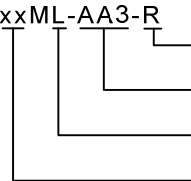
- *Output Current up to 200mA
- *Fixed Output Voltage of 5V, 6V, 8V, 9V, 10V, 12V, 15V, 18V and 24V Available
- *Thermal Overload Shutdown Protection
- *Short Circuit Current Limiting

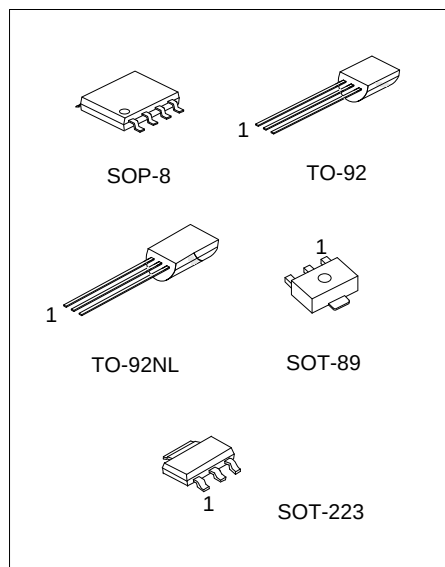
ORDERING INFORMATION

Ordering Number			Pin Assignment								Package	Packing
Normal	Lead Free	Halogen Free	1	2	3	4	5	6	7	8		
78LxxM-S08-R	78LxxML-S08-R	78LxxMG-S08-R	O	G	G	NC	NC	G	G	I	SOP-8	Tape Reel
78LxxM-AA3-R	78LxxML-AA3-R	78LxxMG-AA3-R	O	G	I	-	-	-	-	-	SOT-223	Tape Reel
78LxxM-AB3-R	78LxxML-AB3-R	78LxxMG-AB3-R	O	G	I	-	-	-	-	-	SOT-89	Tape Reel
78LxxM-T92-B	78LxxML-T92-B	78LxxMG-T92-B	O	G	I	-	-	-	-	-	TO-92	Tape Box
78LxxM-T92-K	78LxxML-T92-K	78LxxMG-T92-K	O	G	I	-	-	-	-	-	TO-92	Bulk
78LxxM-T92-R	78LxxML-T92-R	78LxxMG-T92-R	O	G	I	-	-	-	-	-	TO-92	Tape Reel
78LxxM-T9N-B	78LxxML-T9N-B	78LxxMG-T9N-B	O	G	I	-	-	-	-	-	TO-92NL	Tape Box
78LxxM-T9N-K	78LxxML-T9N-K	78LxxMG-T9N-K	O	G	I	-	-	-	-	-	TO-92NL	Bulk
78LxxM-T9N-R	78LxxML-T9N-R	78LxxMG-T9N-R	O	G	I	-	-	-	-	-	TO-92NL	Tape Reel

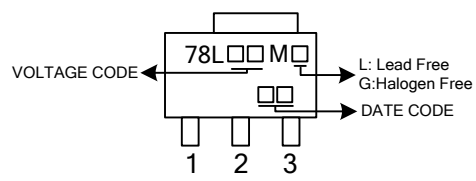
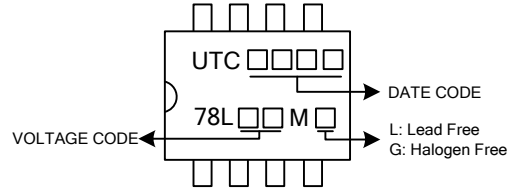
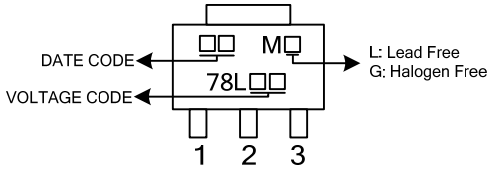
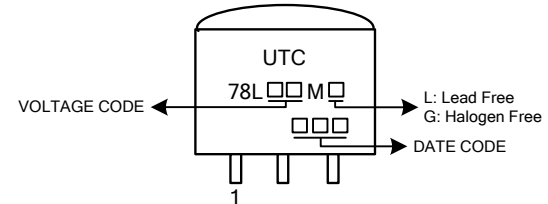
Note: 1. xx: Output Voltage, refer to Marking Information

2. O: Output G: GND I: Input

78LxxML-AA3-R 	(1) B: Tape Box, K: Bulk, R: Tape Reel (2) AA3: SOT-223, AB3: SOT-89, S08: SOP-8, T92: TO-92, T9N: TO-92NL (3) L: Lead Free, Blank: Pb/Sn, G: Halogen Free (4) xx: refer to Marking Information
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MARKING INFORMATION

PACKAGE	VOLTAGE CODE	MARKING
SOT-223	05:5.0V 06:6.0V 08:8.0V 09:9.0V 10:10V 12:12V 15:15V 18:18V 24:24V	 Diagram of SOT-223 package marking. The top surface shows the marking '78L□□M□'. Arrows point to the first two empty boxes as 'VOLTAGE CODE', the 'M' as 'L: Lead Free' and 'G: Halogen Free', and the last empty box as 'DATE CODE'. The package has three pins labeled 1, 2, and 3.
SOP-8		 Diagram of SOP-8 package marking. The top surface shows the marking 'UTC□□□□' and '78L□□M□'. Arrows point to the first two empty boxes of the second row as 'VOLTAGE CODE', the 'M' as 'L: Lead Free' and 'G: Halogen Free', and the last empty box as 'DATE CODE'. The package has eight pins.
SOT-89		 Diagram of SOT-89 package marking. The top surface shows the marking '□□M□' and '78L□□'. Arrows point to the first two empty boxes of the second row as 'DATE CODE', the 'M' as 'L: Lead Free' and 'G: Halogen Free', and the last empty box as 'VOLTAGE CODE'. The package has three pins labeled 1, 2, and 3.
TO-92/ TO-92NL		 Diagram of TO-92/TO-92NL package marking. The top surface shows the marking 'UTC' and '78L□□M□'. Arrows point to the first two empty boxes as 'VOLTAGE CODE', the 'M' as 'L: Lead Free' and 'G: Halogen Free', and the last empty box as 'DATE CODE'. The package has three pins, with the first pin labeled 1.

■ ABSOLUTE MAXIMUM RATINGS

(Operating temperature range applies unless otherwise specified.)

PARAMETER	SYMBOL	RATINGS	UNIT
Input Voltage	$V_{OUT}=5\sim 9V$	30	V
	$V_{OUT}=12\sim 24V$	35	V
Output Current	I_{OUT}	200	mA
Power Dissipation	SOP-8	500	mW
	TO-92	625	mW
	TO-92L	800	mW
	TO-92NL	800	mW
	SOT-89	500	mW
	SOT-223	750	mW
Ambient Operating Temperature	T_{OPR}	-40~+85	°C
Storage Temperature	T_{STG}	-55~+150	°C

Note Absolute maximum ratings are those values beyond which the device could be permanently damaged.

Absolute maximum ratings are stress ratings only and functional device operation is not implied.

■ ELECTRICAL CHARACTERISTICS

(0°C < T_J < 125°C, $C_1=0.33\mu F$, $C_o=0.1\mu F$, unless otherwise specified)(Note 1)

For UTC78L05M ($V_{IN}=10V$, $I_{OUT}=40mA$)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output Voltage	V_{OUT}	$T_J=25^\circ C$	4.80	5.0	5.20	V
		$7V \leq V_{IN} \leq 20V, I_{OUT}=1mA - 40mA$	4.75		5.25	V
		$7V \leq V_{IN} \leq V_{MAX}$	4.75		5.25	V (note 2)
		$I_{OUT}=1mA-200mA$				
Load Regulation	ΔV_{OUT}	$T_J=25^\circ C, I_{OUT}=1mA - 100mA$		11	60	mV
		$T_J=25^\circ C, I_{OUT}=1mA - 40mA$		5.0	30	mV
Line Regulation	ΔV_{OUT}	$7V \leq V_{IN} \leq 20V, T_J=25^\circ C$		8	150	mV
		$8V \leq V_{IN} \leq 20V, T_J=25^\circ C$		6	100	mV
Quiescent Current	I_Q			2.0	5.5	mA
Quiescent Current Change	ΔI_Q	$8V \leq V_{IN} \leq 20V$			1.5	mA
		$1mA \leq V_{IN} \leq 40mA$			0.1	mA
Output Noise Voltage	eN	$10Hz \leq f \leq 100kHz$		40		uV
Temperature Coefficient of V_{OUT}	$\Delta V_o/\Delta T$	$I_{OUT}=5mA$		-0.65		mV/°C
Ripple Rejection	RR	$8V \leq V_{IN} \leq 20V, f=120Hz, T_J=25^\circ C$	41	80		dB
Dropout Voltage	V_D	$T_J=25^\circ C$		1.7		V

For UTC78L06M ($V_{IN}=12V$, $I_{OUT}=40mA$)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output Voltage	V_{OUT}	$T_J=25^\circ C$	5.76	6.0	6.24	V
		$8.5V \leq V_{IN} \leq 20V, I_{OUT}=1mA - 40mA$	5.7		6.3	V
		$8.5V \leq V_{IN} \leq V_{MAX},$	5.7		6.3	V (note 2)
		$I_{OUT}=1mA - 200mA$				
Load Regulation	ΔV_{OUT}	$T_J=25^\circ C, I_{OUT}=1mA - 100mA$		12.8	80	mV
		$T_J=25^\circ C, I_{OUT}=1mA - 70mA$		5.8	40	mV
Line Regulation	ΔV_{OUT}	$8.5V \leq V_{IN} \leq 20V, T_J=25^\circ C$		64	175	mV
		$9V \leq V_{IN} \leq 20V, T_J=25^\circ C$		54	125	mV
Quiescent Current	I_Q			3.9	6.0	mA
Quiescent Current Change	ΔI_Q	$9V \leq V_{IN} \leq 20V$			1.5	mA
		$1mA \leq V_{IN} \leq 40mA$			0.1	mA
Output Noise Voltage	eN	$10Hz \leq f \leq 100kHz$		49		uV
Temperature Coefficient of V_{OUT}	$\Delta V_o/\Delta T$	$I_{OUT}=5mA$		0.75		mV/°C
Ripple Rejection	RR	$10V \leq V_{IN} \leq 20V, f=120Hz, T_J=25^\circ C$	40	46		dB
Dropout Voltage	V_D	$T_J=25^\circ C$		1.7		V

■ ELECTRICAL CHARACTERISTICS(Cont.)

For UTC78L08M ($V_{IN}=14V, I_{OUT}=40mA$)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output Voltage	V_{OUT}	$T_J=25^{\circ}C$	7.68	8.0	8.32	V
		$10.5V \leq V_{IN} \leq 23V, I_{OUT}=1mA - 40mA$	7.60		8.40	V
		$10.5V \leq V_{IN} \leq V_{MAX},$ $I_{OUT}=1mA - 200mA$	7.60		8.40	V (note 2)
Load Regulation	ΔV_{OUT}	$T_J=25^{\circ}C, I_{OUT}=1mA - 100mA$		15	80	mV
		$T_J=25^{\circ}C, I_{OUT}=1mA - 70mA$		8.0	40	mV
Line Regulation	ΔV_{OUT}	$10.5V \leq V_{IN} \leq 23V, T_J=25^{\circ}C$		10	175	mV
		$11V \leq V_{IN} \leq 23V, T_J=25^{\circ}C$		8	125	mV
Quiescent Current	I_Q			2.0	5.5	mA
Quiescent Current Change	ΔI_Q	$11V \leq V_{IN} \leq 23V$			1.5	mA
		$1mA \leq V_{IN} \leq 40mA$			0.1	mA
Output Noise Voltage	eN	$10Hz \leq f \leq 100kHz$		49		μV
Temperature Coefficient of V_{OUT}	$\Delta V_O/\Delta T$	$I_{OUT}=5mA$		0.75		mV/ $^{\circ}C$
Ripple Rejection	RR	$11V \leq V_{IN} \leq 23V, f=120Hz, T_J=25^{\circ}C$	39	70		dB
Dropout Voltage	V_D	$T_J=25^{\circ}C$		1.7		V

For UTC78L09M ($V_{IN}=15V, I_{OUT}=40mA$)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output Voltage	V_{OUT}	$T_J=25^{\circ}C$	8.64	9.0	9.36	V
		$11.5V \leq V_{IN} \leq 24V, I_{OUT}=1mA - 40mA$	8.55		9.45	V
		$11.5V \leq V_{IN} \leq V_{MAX},$ $I_{OUT}=1mA - 200mA$	8.55		9.45	V (note 2)
Load Regulation	ΔV_{OUT}	$T_J=25^{\circ}C, I_{OUT}=1mA - 100mA$		20	90	mV
		$T_J=25^{\circ}C, I_{OUT}=1mA - 40mA$		10	45	mV
Line Regulation	ΔV_{OUT}	$11.5V \leq V_{IN} \leq 24V, T_J=25^{\circ}C$		90	200	mV
		$13V \leq V_{IN} \leq 24V, T_J=25^{\circ}C$		100	150	mV
Quiescent Current	I_Q			2.0	6.0	mA
Quiescent Current Change	ΔI_Q	$13V \leq V_{IN} \leq 24V$			1.5	mA
		$1mA \leq V_{IN} \leq 40mA$			0.1	mA
Output Noise Voltage	eN	$10Hz \leq f \leq 100kHz$		49		μV
Temperature Coefficient of V_{OUT}	$\Delta V_O/\Delta T$	$I_{OUT}=5mA$		0.75		mV/ $^{\circ}C$
Ripple Rejection	RR	$12V \leq V_{IN} \leq 23V, f=120Hz, T_J=25^{\circ}C$	38	44		dB
Dropout Voltage	V_D	$T_J=25^{\circ}C$		1.7		V

■ ELECTRICAL CHARACTERISTICS(Cont.)

For UTC78L10M ($V_{IN}=16V$, $I_{OUT}=40mA$)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output Voltage	V_{OUT}	$T_J=25^{\circ}C$	9.6	10.0	10.4	V
		$12.5V \leq V_{IN} \leq 23V, I_{OUT}=1mA - 40mA$	9.5		10.5	V
		$12.5V \leq V_{IN} \leq V_{MAX}, I_{OUT}=1mA - 200mA$	9.5		10.5	V (note 2)
Load Regulation	ΔV_{OUT}	$T_J=25^{\circ}C, I_{OUT}=1mA - 100mA$		20	94	mV
		$T_J=25^{\circ}C, I_{OUT}=1mA - 70mA$		10	47	mV
Line Regulation	ΔV_{OUT}	$12.5V \leq V_{IN} \leq 23V, T_J=25^{\circ}C$		100	220	mV
		$14V \leq V_{IN} \leq 23V, T_J=25^{\circ}C$		200	170	mV
Quiescent Current	I_Q			4.2	6.5	mA
Quiescent Current Change	ΔI_Q	$12.5V \leq V_{IN} \leq 23V$			1.5	mA
		$1mA \leq V_{IN} \leq 40mA$			0.1	mA
Output Noise Voltage	eN	$10Hz \leq f \leq 100kHz$		74		μV
Temperature Coefficient of V_{OUT}	$\Delta V_o/\Delta T$	$I_{OUT}=5mA$		0.95		mV/ $^{\circ}C$
Ripple Rejection	RR	$15V \leq V_{IN} \leq 23V, f=120Hz, T_J=25^{\circ}C$	38	43		dB
Dropout Voltage	V_D	$T_J=25^{\circ}C$		1.7		V

For UTC78L12M ($V_{IN}=19V$, $I_{OUT}=40mA$)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output Voltage	V_{OUT}	$T_J=25^{\circ}C$	11.52	12	12.48	V
		$14.5V \leq V_{IN} \leq 27V, I_{OUT}=1mA - 40mA$	11.40		12.60	V
		$14.5V \leq V_{IN} \leq V_{MAX}, I_{OUT}=1mA - 200mA$	11.40		12.60	V (note 2)
Load Regulation	ΔV_{OUT}	$T_J=25^{\circ}C, I_{OUT}=1mA - 100mA$		25	150	mV
		$T_J=25^{\circ}C, I_{OUT}=1mA - 40mA$		12	75	mV
Line Regulation	ΔV_{OUT}	$14.5V \leq V_{IN} \leq 27V, T_J=25^{\circ}C$		25	300	mV
		$16V \leq V_{IN} \leq 27V, T_J=25^{\circ}C$		20	250	mV
Quiescent Current	I_Q			2.0	6.0	mA
Quiescent Current Change	ΔI_Q	$16V \leq V_{IN} \leq 27V$			1.5	mA
		$1mA \leq V_{IN} \leq 40mA$			0.1	mA
Output Noise Voltage	eN	$10Hz \leq f \leq 100kHz$		80		μV
Temperature Coefficient of V_{OUT}	$\Delta V_o/\Delta T$	$I_{OUT}=5mA$		-1.0		mV/ $^{\circ}C$
Ripple Rejection	RR	$15V \leq V_{IN} \leq 25V, f=120Hz, T_J=25^{\circ}C$	37	65		dB
Dropout Voltage	V_D	$T_J=25^{\circ}C$		1.7		V

■ ELECTRICAL CHARACTERISTICS(Cont.)

For UTC78L15M ($V_{IN}=23V$, $I_{OUT}=40mA$)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output Voltage	V_{OUT}	$T_J=25^{\circ}C$	14.40	15	15.60	V
		$17.5V \leq V_{IN} \leq 30V, I_{OUT}=1mA - 40mA$	14.25		15.75	V
		$17.5V \leq V_{IN} \leq V_{MAX}, I_{OUT}=1mA - 200mA$	14.25		15.75	V (note 2)
Load Regulation	ΔV_{OUT}	$T_J=25^{\circ}C, I_{OUT}=1mA - 100mA$		20	150	mV
		$T_J=25^{\circ}C, I_{OUT}=1mA - 70mA$		25	150	mV
Line Regulation	ΔV_{OUT}	$17.5V \leq V_{IN} \leq 30V, T_J=25^{\circ}C$		25	150	mV
		$20V \leq V_{IN} \leq 30V, T_J=25^{\circ}C$		15	75	mV
Quiescent Current	I_Q			2.2	6.5	mA
Quiescent Current Change	ΔI_Q	$20V \leq V_{IN} \leq 30V$			1.5	mA
		$1mA \leq V_{IN} \leq 40mA$			0.1	mA
Output Noise Voltage	eN	$10Hz \leq f \leq 100kHz$		90		uV
Temperature Coefficient of V_{OUT}	$\Delta V_o/\Delta T$	$I_{OUT}=5mA$		-1.3		mV/ $^{\circ}C$
Ripple Rejection	RR	$18.5V \leq V_{IN} \leq 28.5V, f=120Hz, T_J=25^{\circ}C$	34	63		dB
Dropout Voltage	V_D	$T_J=25^{\circ}C$		1.7		V

For UTC78L18M ($V_{IN}=27V$, $I_{OUT}=40mA$)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output Voltage	V_{OUT}	$T_J=25^{\circ}C$	17.28	18	18.72	V
		$21V \leq V_{IN} \leq 33V, I_{OUT}=1mA - 40mA$	17.10		18.90	V
		$21V \leq V_{IN} \leq V_{MAX}, I_{OUT}=1mA - 200mA$	17.10		18.90	V (note 2)
Load Regulation	ΔV_{OUT}	$T_J=25^{\circ}C, I_{OUT}=1mA - 100mA$		30	170	mV
		$T_J=25^{\circ}C, I_{OUT}=1mA - 40mA$		15	85	mV
Line Regulation	ΔV_{OUT}	$21V \leq V_{IN} \leq 33V, T_J=25^{\circ}C$		145	300	mV
		$22V \leq V_{IN} \leq 33V, T_J=25^{\circ}C$		135	250	mV
Quiescent Current	I_Q			2.0	6.0	mA
Quiescent Current Change	ΔI_Q	$21V \leq V_{IN} \leq 33V$			1.5	mA
		$1mA \leq V_{IN} \leq 40mA$			0.1	mA
Output Noise Voltage	eN	$10Hz \leq f \leq 100kHz$		150		uV
Temperature Coefficient of V_{OUT}	$\Delta V_o/\Delta T$	$I_{OUT}=5mA$		-1.8		mV/ $^{\circ}C$
Ripple Rejection	RR	$23V \leq V_{IN} \leq 33V, f=120Hz, T_J=25^{\circ}C$	34	48		dB
Dropout Voltage	V_D	$T_J=25^{\circ}C$		1.7		V

■ ELECTRICAL CHARACTERISTICS(Cont.)

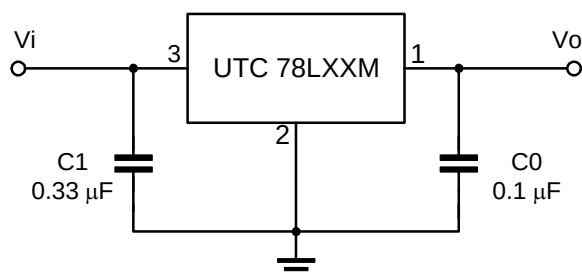
For UTC78L24M ($V_{IN}=33V$, $I_{OUT}=40mA$)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output Voltage	V_{OUT}	$T_J=25^{\circ}C$	23.04	24	24.96	V
		$27V \leq V_{IN} \leq 38V, I_{OUT}=1mA - 40mA$	22.80		25.20	V
		$27V \leq V_{IN} \leq V_{MAX}, I_{OUT}=1mA - 200mA$	22.80		25.20	V (note 2)
Load Regulation	ΔV_{OUT}	$T_J=25^{\circ}C, I_{OUT}=1mA - 100mA$		40	200	mV
		$T_J=25^{\circ}C, I_{OUT}=1mA - 40mA$		20	100	mV
Line Regulation	ΔV_{OUT}	$27V \leq V_{IN} \leq 38V, T_J=25^{\circ}C$		160	300	mV
		$28V \leq V_{IN} \leq 38V, T_J=25^{\circ}C$		150	250	mV
Quiescent Current	I_Q			2.2	6.0	mA
Quiescent Current Change	ΔI_Q	$27V \leq V_{IN} \leq 38V$			1.5	mA
		$1mA \leq V_{IN} \leq 40mA$			0.1	mA
Output Noise Voltage	eN	$10Hz \leq f \leq 100kHz$		200		μV
Temperature Coefficient of V_{OUT}	$\Delta V_o/\Delta T$	$I_{OUT}=5mA$		-2.0		mV/ $^{\circ}C$
Ripple Rejection	RR	$27V \leq V_{IN} \leq 38V, f=120Hz, T_J=25^{\circ}C$	34	45		dB
Dropout Voltage	V_D	$T_J=25^{\circ}C$		1.7		V

Note 1: The Maximum steady state usable output current are dependent on input voltage, heat sinking, lead length of the package and copper pattern of PCB. The data above represent pulse test conditions with junction temperatures specified at the initiation of test.

Note 2: Power dissipation<0.5W

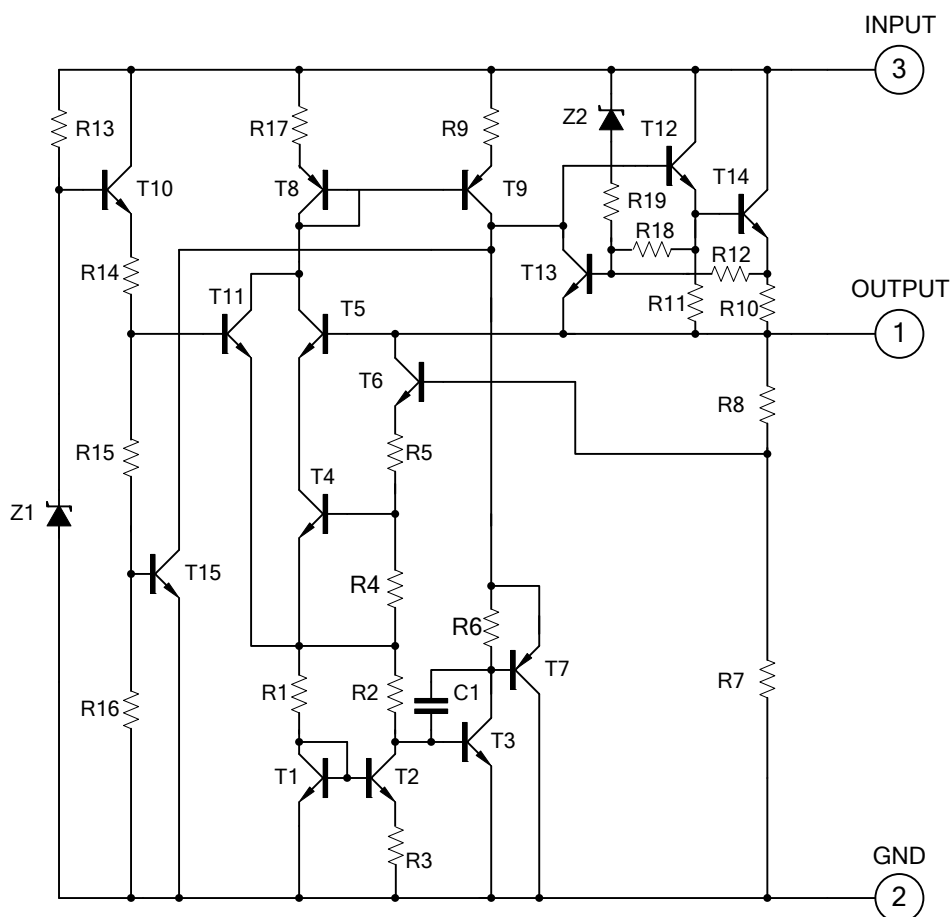
■ APPLICATION CIRCUIT



Note 1: To specify an output voltage, substitute voltage value for "XXM".

Note 2: Bypass capacitors are recommended for optimum stability and transient response and should be located as close as possible to the regulators.

■ TEST CIRCUIT



■ TYPICAL CHARACTERISTICS

Fig.1 Ambient Temperature vs. Power Dissipation

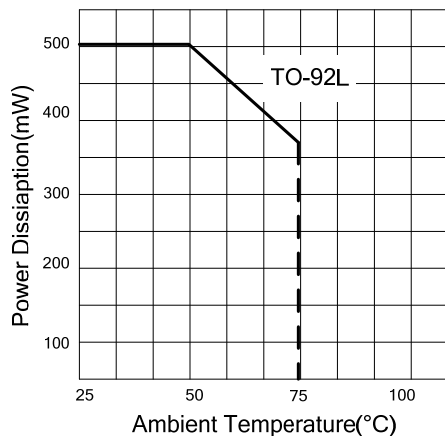


Fig.2 UTC78L05M Output Voltage vs. Ambient Temperature

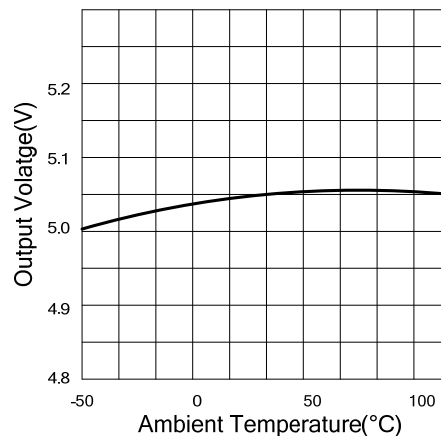


Fig.3 UTC78L12M Power Dissipation vs. Ambient Temperature

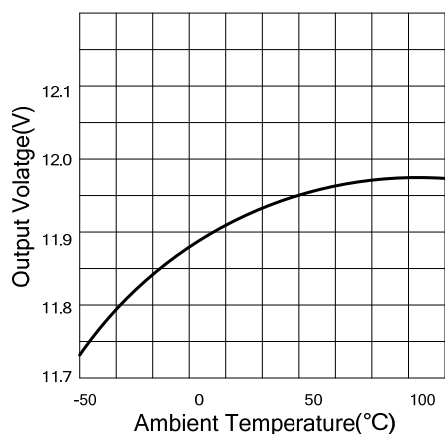


Fig.4 Output Characteristics ($I_{OUT}=0mA, T_J=25^\circ C$)

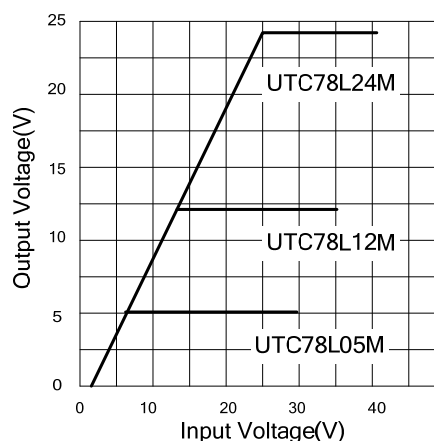


Fig.5 UTC78L05M Dropout Characteristics ($T_J=25^\circ C$)

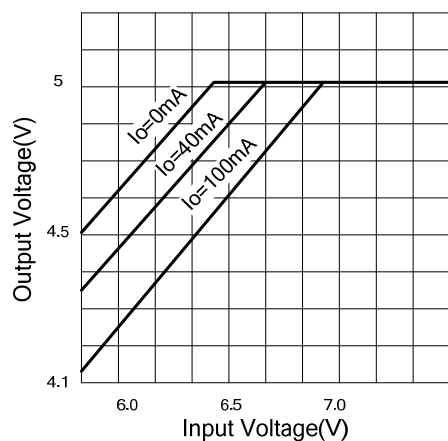
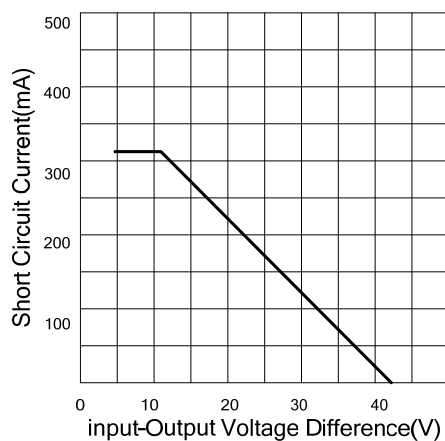


Fig.6 Short Circuit Output Current ($T_J=25^\circ C$)



■ TYPICAL CHARACTERISTICS(Cont.)

Fig.7 UTC78L12/24M Quiescent Current vs Output Current ($T_J=25^\circ\text{C}$)

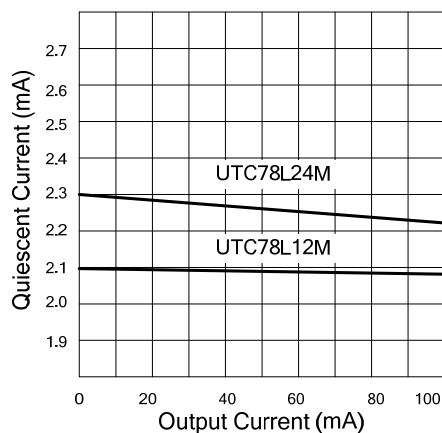


Fig.8 UTC78L05M Quiescent Current vs. Input Voltage ($I_{OUT}=0\text{mA}$, $T_J=25^\circ\text{C}$)

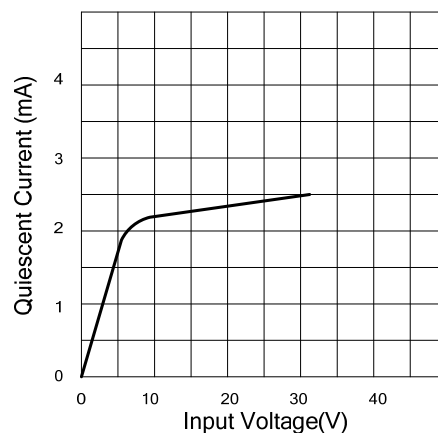
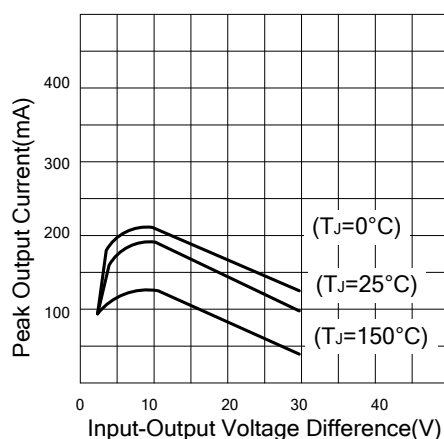


Fig.9 Peak Output Current vs Dropout Voltage Difference



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