SERIES uA78M00
POSITIVE-VOLTAGE REGULATORS

BULLETIN NO. DL S 12403, JUNE 1976—REVISED SEPTEMBER 1977

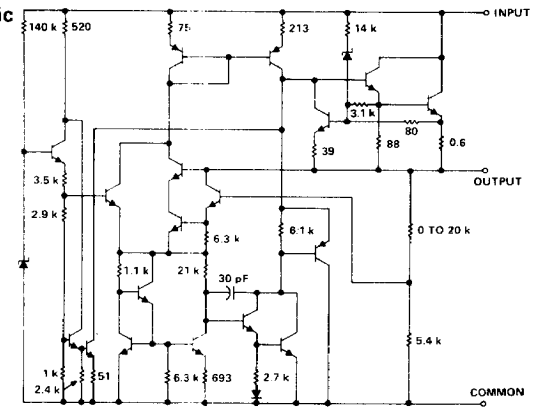
- 3-Terminal Regulators
- Output Current up to 500 mA
- No external components
- Internal Thermal Overload Protection
- Direct Replacements for Fairchild μA78M00 Series and National LM341 Series
- High Power Dissipation Capability
- Internal Short-Circuit Current Limiting
- Output Transistor Safe-Area Compensation

NOMINAL OUTPUT VOLTAGE	–55°C TO 150°C OPERATING TEMPERATURE RANGE	0°C TO 125°C OPERATING TEMPERATURE RANGE
5 V	uA78M05M	uA78M05C
6 V	uA78M06M	uA78M06C
8 V	uA78M08M	uA78M08C
12 V	uA78M12M	uA78M12C
15 V	uA78M15M	uA78M15C
20 V	uA78M20M	uA78M20C
22 V	uA78M22M	uA78M22C
24 V	uA78M24M	uA78M24C
PACKAGES	LA	KC, KD, and LA

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. One of these regulators can deliver up to 500 milliamperes of output current. The internal current limiting and thermal shutdown features of these regulators make them essentially immune to overlaod. In addition to use as fixed-voltage regulators, these devices can be used with external components to obtain adjustable output voltages and currents and also as the power pass element in precision regulators.

schematic



Resistor values shown are nominal and in ohms.

terminal assignments

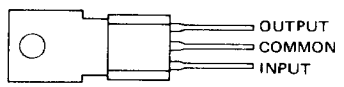
KC PACKAGE
(TOP VIEW)



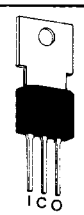
TO-220AB



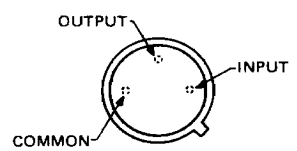
KD PACKAGE
(TOP VIEW)

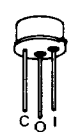


TO-202AB



LA PACKAGE
(TOP VIEW)





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absolute maximum ratings over operating temperature range (unless otherwise noted)

		uA78M05M THRU uA78M24M	uA78M05C THRU uA78M24C	UNIT
Input voltage	uA78M20 thru uA78M24	40	40	V
	All others	35	35	
Continuous total dissipation at 25°C free-air temperature (see Note 1)	KC (TO-220AB) package	2	2	W
	KD(TO-202AB) package	1.5	1.5	
	LA package	0.6	0.6	
Continuous total dissipation at (or below) 25°C case temperature (see Note 1)	KC and KD packages	7.5	7.5	W
	LA package	5	5	
Operating free-air, case, or virtual junction temperature range		−55 to 150	0 to 150	°C
Storage temperature range		−65 to 150	−65 to 150	°C
Lead temperature 1/16 inch from case for 10 seconds	KC and KD packages		260	°C
Lead temperature 1/16 inch from case for 60 seconds	LA package	300	300	°C

NOTE 1: For operation above 25°C free-air or case temperature, refer to Dissipation Derating Curves, Figures 1 through 4, page 188.

recommended operating conditions

		MIN	MAX	UNIT
Input voltage, V_I	uA78M05M, uA78M05C	7	25	V
	uA78M06M, uA78M06C	8	25	
	uA78M08M, uA78M08C	10.5	25	
	uA78M12M, uA78M12C	14.5	30	
	uA78M15M, uA78M15C	17.5	30	
	uA78M20M, uA78M20C	23	35	
	uA78M22M, uA78M22C	24	38	
	uA78M24M, uA78M24C	27	38	
Output current, I_O			500	mA
Operating virtual junction temperature, T_J	uA78M05M thru uA78M24M	−55	150	°C
	uA78M05C thru uA78M24C	0	125	

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uA78M05M, uA78M05C electrical characteristics at specified virtual junction temperature, V_I = 10 V, I_O = 350 mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS†			uA78M05M			uA78M05C			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
Output voltage	I_O = 5 mA to 350 mA	V_I = 8 V to 20 V	25°C	4.8	5	5.2	4.8	5	5.2	V
			–55° C to 150° C	4.7		5.3				
		V_I = 7 V to 20 V	0°C to 125°C				4.75		5.25	
Input regulation	I_O = 200 mA	V_I = 7 V to 25 V	25°C		3	50		3	100	mV
		V_I = 8 V to 20 V			1	25				
		V_I = 8 V to 25 V						1	50	
Ripple rejection	V_I = 8 V to 18 V, f = 120 Hz	I_O = 100 mA	–55°C to 150°C	62						dB
			0°C to 125C				62			
		I_O = 300 mA	25°C	62	80		62	80		
Output regulation	I_O = 5 mA to 500 mA		25°C		20	50		20	100	mV
	I_O = 5 mA to 200 mA				10	25		10	50	
Temperature coefficient of output voltage	I_O = 5 mA		–55°C to 150°C		–1					mV/°C
			0°C to 125°C					–1		
Output noise voltage	f = 10 Hz to 100 kHz		25°C		40			40		μV
Dropout voltage			25°C		2			2		V
Bias current			25°C		4.5	6		4.5	6	mA
Bias current change	I_O = 200 mA, V_I = 8 V to 25 V		–55°C to 150°C			0.8				mA
			0°C to 125°C						0.8	
	I_O = 5 mA to 350 mA		–55°C to 150°C			0.5				
			0°C to 125°C						0.5	
Short-circuit output current	V_I = 35 V		25°C		300			300		mA
Peak output current			25°C		700			700		A

†All characteristics are measured with a capacitor across the input of 0.33 μF and a capacitor across the output of 0.1 μF. All characteristics except noise voltage and ripple rejection ratio are measured using pulse techniques ($t_w \leq 10$ ms, duty cycle ≤ 5%). Output voltage changes due to changes in internal temperature must be taken into account separately.

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uA78M06M, uA78M06C electrical characteristics at specified virtual junction temperature, V_I = 11 V, I_O = 350 mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS†			uA78M06M			uA78M06C			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
Output voltage			25°C	5.75	6	6.25	5.75	6	6.25	V
	I_O = 5 mA to 350 mA	V_I = 9 V to 21 V	−55°C to 150°C	5.7		6.3				
		V_I = 8 V to 21 V	0°C to 125°C				5.7		6.3	
Input regulation	I_O = 200 mA	V_I = 8 V to 25 V	25°C		5	60		5	100	mV
		V_I = 9 V to 20 V			1.5	30				
		V_I = 9 V to 25 V						1.5	50	
Ripple rejection	V_I = 9 V to 19 V, f = 120 Hz	I_O = 100 mA	−55°C to 150°C	59						dB
			0°C to 125°C				59			
		I_O = 300 mA	25°C	59	80		59	80		
Output regulation	I_O = 5 mA to 500 mA		25°C		20	60		20	120	mV
	I_O = 5 mA to 200 mA				10	30		10	60	
Temperature coefficient of output voltage	I_O = 5 mA		−55°C to 150°C		−0.5					mV/°C
			0°C to 125°C					−0.5		
Output noise voltage	f = 10 Hz to 100 kHz		25°C		45			45		μV
Dropout voltage			25°C		2			2		V
Bias current			25°C		4.5	6		4.5	6	mA
Bias current change	I_O = 200 mA, V_I = 9 V to 25 V		−55°C to 150°C			0.8				mA
			0°C to 125°C						0.8	
	I_O = 5 mA to 350 mA		−55°C to 150°C			0.5				
			0°C to 125°C						0.5	
Short-circuit output current	V_I = 35 V		25°C		270			270		mA
Peak output current			25°C		700			700		A

†All characteristics are measured with a capacitor across the input of 0.33 μF and a capacitor across the output of 0.1 μF. All characteristics except noise voltage and ripple rejection ratio are measured using pulse techniques ($t_w \leq 10$ ms, duty cycle ≤ 5%). Output voltage changes due to changes in internal temperature must be taken into account separately.

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uA78M08M, uA78M08C electrical characteristics at specified virtual junction temperature, V_I = 14 V, I_O = 350 mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS†			uA78M08M			uA78M08C			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
Output voltage	I_O = 5 mA to 350 mA	V_I = 11.5 V to 23 V	25°C	7.7	8	8.3	7.7	8	8.3	V
			–55°C to 150°C	7.6		8.4				
		V_I = 10.5 V to 23 V	0°C to 125°C				7.6		8.4	
Input regulation	I_O = 200 mA	V_I = 10.5 V to 25 V	25°C		6	60		6	100	mV
		V_I = 11 V to 20 V			2	30				
		V_I = 11 V to 25 V						2	50	
Ripple rejection	V_I = 11.5 V to 21.5 V, f = 120 Hz	I_O = 100 mA	–55°C to 150°C	56						dB
			0°C to 125°C				56			
		I_O = 300 mA	25°C	56	80		56	80		
Output regulation	I_O = 5 mA to 500 mA		25°C		25	80		25	160	mV
	I_O = 5 mA to 200 mA				10	40		10	80	
Temperature coefficient of output voltage	I_O = 5 mA		–55°C to 150°C		–0.5					mV/°C
			0°C to 125°C					–0.5		
Output noise voltage	f = 10 Hz to 100 kHz		25°C		52			52		μV
Dropout voltage			25°C		2			2		V
Bias current			25°C		4.6	6		4.6	6	mA
Bias current change	I_O = 200 mA	V_I = 11.5 V to 25 V	–55°C to 150°C			0.8				mA
		V_I = 10.5 V to 25 V	0°C to 125°C						0.8	
	I_O = 5 mA to 350 mA		–55°C to 150°C			0.5				
			0°C to 125°C						0.5	
Short-circuit output current	V_I = 35 V		25°C		250			250		mA
Peak output current			25°C		700			700		A

† All characteristics are measured with a capacitor across the input of 0.33 μF and a capacitor across the output of 0.1 μF. All characteristics except noise voltage and ripple rejection ratio are measured using pulse techniques ($t_w \leq$ 10 ms, duty cycle ≤ 5%). Output voltage changes due to changes in internal temperature must be taken into account separately.

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uA78M12M, uA78M12C electrical characteristics at specified virtual junction temperature, V_I = 19 V, I_O = 350 mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS†			uA78M12M			uA78M12C			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
Output voltage	I_O = 5 mA to 350 mA	V_I = 15.5 V to 27 V	25°C	11.5	12	12.5	11.5	12	12.5	V
		V_I = 14.5 V to 27 V	−55° C to 150°C	11.4		12.6				
			0°C to 125°C				11.4		12.6	
Input regulation	I_O = 200 mA	V_I = 14.5 V to 30 V	25°C		8	60		8	100	mV
		V_I = 16 V to 25 V			2	30				
		V_I = 16 V to 30 V						2	50	
Ripple rejection	V_I = 15 V to 25 V, f = 120 Hz	I_O = 100 mA	−55°C to 150°C	55						dB
			0°C to 125° C				55			
		I_O = 300 mA	25°C	55	80		55	80		
Output regulation	I_O = 5 mA to 500 mA		25°C		25	120		25	240	mV
	I_O = 5 mA to 200 mA				10	60		10	120	
Temperature coefficient of output voltage	I_O = 5 mA		−55°C to 150°C		−1					mV/°C
			0°C to 125°C					−1		
Output noise voltage	f = 10 Hz to 100 kHz		25°C		75			75		μV
Dropout voltage			25°C		2			2		V
Bias current			25°C		4.8	6		4.8	6	mA
Bias current change	I_O = 200 mA	V_I = 15 V to 30 V	−55°C to 150°C			0.8				mA
		V_I = 14.5 V to 30 V	0°C to 125°C						0.8	
	I_O = 5 mA to 350 mA		−55°C to 150°C			0.5				
			0°C to 125°C						0.5	
Short-circuit output current	V_I = 35 V		25°C		240			240		mA
Peak output current			25°C		700			700		A

†All characteristics are measured with a capacitor across the input of 0.33 μF and a capacitor across the output of 0.1 μF. All characteristics except noise voltage and ripple rejection ratio are measured using pulse techniques ($t_w \leq 10$ ms, duty cycle ≤ 5%). Output voltage changes due to changes in internal temperature must be taken into account separately.

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uA78M15M, uA78M15C electrical characteristics at specified virtual junction temperature, V_I = 23 V, I_O = 350 mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS†			uA78M15M			uA78M15C			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
Output voltage			25°C	14.4	15	15.6	14.4	15	15.6	V
	I_O = 5 mA to 350 mA	V_I = 18.5 V to 30 V	–55° C to 150°C	14.25		15.75				
		V_I = 17.5 V to 30 V	0°C to 125°C				14.25		15.75	
Input regulation	I_O = 200 mA	V_I = 17.5 V to 30 V	25°C		10	60		10	100	mV
		V_I = 20 V to 30 V			3	30		3	50	
Ripple rejection	V_I = 18.5 V to 28.5 V, f = 120 Hz	I_O = 100 mA	–55°C to 150°C	54						dB
			0°C to 125°C				54			
		I_O = 300 mA	25°C	54	70		54	70		
Output regulation	I_O = 5 mA to 500 mA		25°C		25	150		25	300	mV
	I_O = 5 mA to 200 mA				10	75		10	150	
Temperature coefficient of output voltage	I_O = 5 mA		–55°C to 150°C		–1					mV/°C
			0°C to 125°C					–1		
Output noise voltage	f = 10 Hz to 100 kHz		25°C		90			90		μV
Dropout voltage			25°C		2			2		V
Bias current			25°C		4.8	6		4.8	6	mA
Bias current change	I_O = 200 mA	V_I = 18.5 V to 30 V	–55°C to 150°C			0.8				mA
		V_I = 17.5 V to 30 V	0°C to 125°C						0.8	
	I_O = 5 mA to 350 mA		–55°C to 150°C			0.5				
			0°C to 125°C						0.5	
Short-circuit output current	V_I = 35 V		25°C		240			240		mA
Peak output current			25°C		700			700		A

†All characteristics are measured with a capacitor across the input of 0.33 μF and a capacitor across the output of 0.1 μF. All characteristics except noise voltage and ripple rejection ratio are measured using pulse techniques ($t_w \leq 10$ ms, duty cycle ≤ 5%). Output voltage changes due to changes in internal temperature must be taken into account separately.

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uA78M20M, uA78M20C electrical characteristics at specified virtual junction temperature, V_I = 29 V, I_O = 350 mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS†			uA78M20M			uA78M20C			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
Output voltage			25°C	19.2	20	20.8	19.2	20	20.8	V
	I_O = 5 mA to 350 mA	V_I = 24 V to 35 V	–55° C to 150°C	19		21				
		V_I = 23 V to 35 V	0°C to 125°C				19		21	
Input regulation	I_O = 200 mA	V_I = 23 V to 35 V	25°C		10	60		10	100	mV
		V_I = 24 V to 35 V			5	30		5	50	
Ripple rejection	V_I = 24 V to 34 V, f = 120 Hz	I_O = 100 mA	–55°C to 150°C	53						dB
			0°C to 125°C				53			
		I_O = 300 mA	25°C	53	70		53	70		
Output regulation	I_O = 5 mA to 500 mA		25°C		30	200		30	400	mV
	I_O = 5 mA to 200 mA				10	100		10	200	
Temperature coefficient of output voltage	I_O = 5 mA		–55°C to 150°C		–1.1					mV/°C
			0°C to 125°C					–1.1		
Output noise voltage	f = 10 Hz to 100 kHz		25°C		110			110		μV
Dropout voltage			25°C		2			2		V
Bias current			25°C		4.9	6		4.9	6	mA
Bias current change	I_O = 200 mA	V_I = 24 V to 35 V	–55°C to 150°C			0.8				mA
		V_I = 23 V to 35 V	0°C to 125°C						0.8	
	I_O = 5 mA to 350 mA		–55°C to 150°C			0.5				
			0°C to 125°C						0.5	
Short-circuit output current	V_I = 35 V		25°C		240			240		mA
Peak output current			25°C		700			700		A

† All characteristics are measured with a capacitor across the input of 0.33 μF and a capacitor across the output of 0.1 μF. All characteristics except noise voltage and ripple rejection ratio are measured using pulse techniques ($t_w \leq$ 10 ms, duty cycle ≤ 5%). Output voltage changes due to changes in internal temperature must be taken into account separately.

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uA78M22M, uA78M22C electrical characteristics at specified virtual junction temperature, V_I = 31 V, I_O = 350 mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS†			uA78M22M			uA78M22C			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
Output voltage			25°C	21.1	22	22.9	21.1	22	22.9	V
	I_O = 5 mA to 350 mA	V_I = 26 V to 36 V	–55° C to 150°C	20.9		23.1				
		V_I = 25 V to 36 V	0°C to 125°C				20.9		23.1	
Input regulation	I_O = 200 mA	V_I = 25 V to 36 V	25°C		10	60		10	100	mV
		V_I = 26 V to 34 V			5	30		5	50	
Ripple rejection	V_I = 26 V to 36 V, f = 120 Hz	I_O = 100 mA	–55° C to 150°C	51						dB
			0°C to 125°C				51			
		I_O = 300 mA	25° C	51	70		51	70		
Output regulation	I_O = 5 mA to 500 mA		25° C		30	220		30	440	mV
	I_O = 5 mA to 200 mA				10	110		10	220	
Temperature coefficient of output voltage	I_O = 5 mA		–55° C to 150°C		–1.1					mV/°C
			0°C to 125°C					–1.1		
Output noise voltage	f = 10 Hz to 100 kHz		25°C		160			160		μV
Dropout voltage			25°C		2			2		V
Bias current			25°C		4.9	6		4.9	6	mA
Bias current change	I_O = 200 mA	V_I = 26 V to 36 V	–55°C to 150°C			0.8				mA
		V_I = 25 V to 36 V	0°C to 125°C						0.8	
	I_O = 5 mA to 350 mA		–55° C to 150°C			0.5				
			0°C to 125°C						0.5	
Short-circuit output current	V_I = 35 V		25°C		240			240		mA
Peak output current			25°C		700			700		A

† All characteristics are measured with a capacitor across the input of 0.33 μF and a capacitor across the output of 0.1 μF. All characteristics except noise voltage and ripple rejection ratio are measured using pulse techniques ($t_w \leq$ 10 ms, duty cycle ≤ 5%). Output voltage changes due to changes in internal temperature must be taken into account separately.

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uA78M24M, uA78M24C electrical characteristics at specified virtual junction temperature, V_I = 33 V, I_O = 350 mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS†			uA78M24M			uA78M24C			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
Output voltage			25°C	23	24	25	23	24	25	V
	I_O = 5 mA to 350 mA	V_I = 28 V to 38 V	–55° C to 150°C	22.8		25.2				
		V_I = 27 V to 38 V	0°C to 125°C				22.8		25.2	
Input regulation	I_O = 200 mA	V_I = 27 V to 38 V	25°C		10	60		10	100	mV
		V_I = 30 V to 36 V			5	30				
		V_I = 28 V to 38 V						5	50	
Ripple rejection	V_I = 28 V to 38 V, f = 120 Hz	I_O = 100 mA	–55°C to 150°C	50						dB
			0°C to 125°C				50			
		I_O = 300 mA	25°C	50	70		50	70		
Output regulation	I_O = 5 mA to 500 mA		25°C		30	240		30	480	mV
	I_O = 5 mA to 200 mA				10	120		10	240	
Temperature coefficient of output voltage	I_O = 5 mA		–55°C to 150°C		–1.2					mV/°C
			0°C to 125°C					–1.2		
Output noise voltage	f = 10 Hz to 100 kHz		25°C		170			170		μV
Dropout voltage			25°C		2			2		V
Bias current			25°C		5	6		5	6	mA
Bias current change	I_O = 200 mA	V_I = 28 V to 38 V	–55°C to 150°C			0.8				mA
		V_I = 27 V to 38 V	0°C to 125°C						0.8	
	I_O = 5 mA to 350 mA		–55°C to 150°C			0.5				
			0°C to 125°C						0.5	
Short-circuit output current	V_I = 35 V		25°C		240			240		mA
Peak output current			25°C		700			700		A

† All characteristics are measured with a capacitor across the input of 0.33 μF and a capacitor across the output of 0.1 μF. All characteristics except noise voltage and ripple rejection ratio are measured using pulse techniques ($t_w \leq 10$ ms, duty cycle ≤ 5%). Output voltage changes due to changes in internal temperature must be taken into account separately.

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