To all our customers

Regarding the change of names mentioned in the document, such as Mitsubishi Electric and Mitsubishi XX, to Renesas Technology Corp.

The semiconductor operations of Hitachi and Mitsubishi Electric were transferred to Renesas Technology Corporation on April 1st 2003. These operations include microcomputer, logic, analog and discrete devices, and memory chips other than DRAMs (flash memory, SRAMs etc.) Accordingly, although Mitsubishi Electric, Mitsubishi Electric Corporation, Mitsubishi Semiconductors, and other Mitsubishi brand names are mentioned in the document, these names have in fact all been changed to Renesas Technology Corp. Thank you for your understanding. Except for our corporate trademark, logo and corporate statement, no changes whatsoever have been made to the contents of the document, and these changes do not constitute any alteration to the contents of the document itself.

Note : Mitsubishi Electric will continue the business operations of high frequency & optical devices and power devices.

Renesas Technology Corp.
Customer Support Dept.
April 1, 2003

M5278LXX, M5278LXXM

(5V, 5.6V, 8V, 9V, 10V, 12V, 15V) 3-TERMINAL FIXED POSITIVE OUTPUT VOLTAGE REGULATOR (WITH FOLD-BACK PROTECTION CIRCUIT)

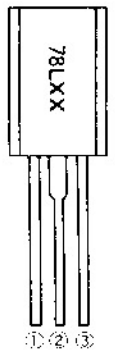
DESCRIPTION

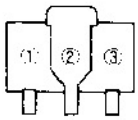
The M5278L series consists of monolithic integrated circuits, each a three-terminal regulator with maximum load capabilities of 100mA and featuring output voltages of 5, 5.6, 8, 9, 10, 12, or 15V. The high-performance, fixed-positive output power supply ICs are packaged in 3-pin packages featuring fold-back protective circuits for limiting current when load short. They are especially appropriate for use in personal computers and general power supplies of electrical appliances.

FEATURES

- Interchangeable with other brand 78L series
  ..... I_{Lmax}=100mA
- Internal fold-back protection circuit limits current due to shorted loads.
  M5278L05 ····16.5mA(typ.)(1/10 that of other brands)
- High ripple division factor
  M5278L05 ·····73dB(typ.)
- Low output voltage tolerancee ·····±5%(max.)
- High level of permissible internal heat dissipation
  ..... 900mW(max.) 3P5
  ..... 500mW(max.) 3P2

PIN CONFIGURATION





Outline EIAJ:TO-92L **Outline SOT-89**

ELECTRODE CONNECTION
① : OUTPUT
② : GND
③ : INPUT

ELECTRODE CONNECTION
① : INPUT
② : GND
③ : OUTPUT

APPLICATION

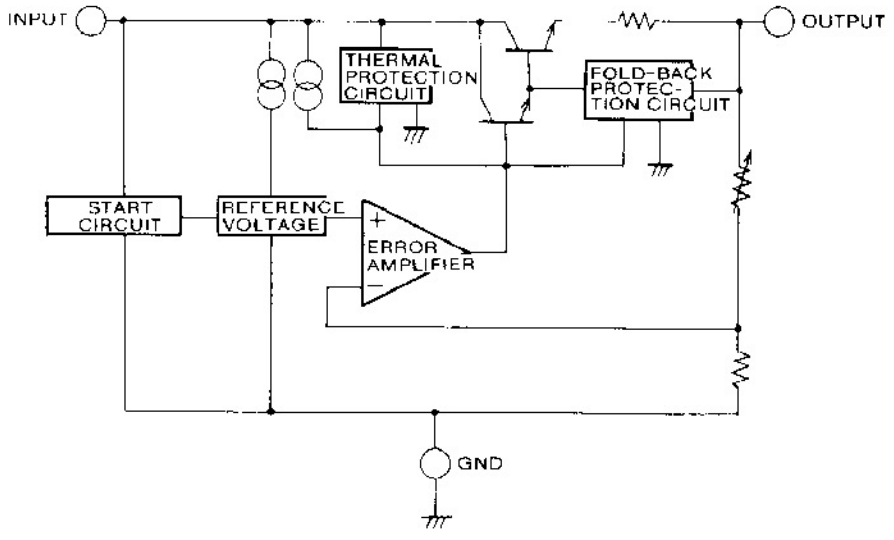
Power supply for microcomputer in VTR equipment, general power supply for electronic equipment of tape decks, car stereo equipment and radio cassette recorder.

M5278LXX □ — blank···3P5 pkg.
M ·····3P2 pkg.
OUTPUT VOLTAGE VALUE

Type	Marking		Output voltage
	3P5	3P2	
M5278L05	78L05	MA	5V
M5278L56	78L56	MB	5.6V
M5278L10	78L10	MF	10V
M5278L12	78L12	MG	12V

Type	Marking		Output voltage
	3P5	3P2	
M5278L08	78L08	MD	8V
M5278L09	78L09	ME	9V
M5278L15	78L15	MH	15V

BLOCK DIAGRAM

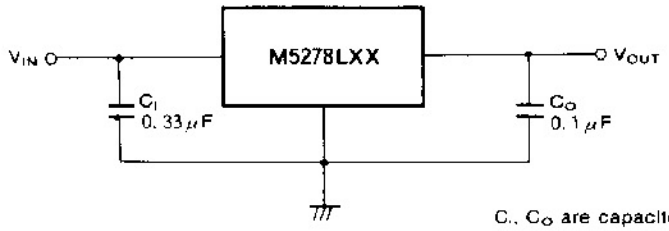


(5V,5.6V,8V,9V,10V,12V,15V) 3-TERMINAL FIXED POSITIVE OUTPUT VOLTAGE REGULATOR (WITH FOLD-BACK PROTECTION CIRCUIT)

ABSOLUTE MAXIMUM RATINGS (T_a=25℃)

Symbol	Parameter	Ratings	Unit
V_I	Input voltage	36	V
I_L	Load current	100	mA
P_d	Power dissipation	900(3P5)/500(3P2)	mW
T_{opr}	Operating temperature	−20~+75	℃
T_{stg}	Sotrage temperature	−55~+150	℃

STANDARD CONNECTION



C_I, C_O are capacitors to prevent oscillation. Make connections as close to the IC as possible.

ELECTRICAL CHARACTERISTICS

M5278L05 (V_I=10V, I_L=40mA, T_a=25℃, C_I=0.33μF, C_O=0.1μF, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_O	Output voltage		4.75	5.0	5.25	V
$R_{eg\cdot in}$	Input regulation	7.5V≦V_I≦20V		50	200	mV
		8V≦V_I≦20V		30	150	
$R_{eg\cdot L}$	Load regulation	1mA≦I_L≦100mA		10	60	mV
		1mA≦I_L≦40mA		5	30	
V_O	Output voltage	7.5V≦V_I≦20V, 1mA≦I_L≦40mA	4.7	5.0	5.3	V
		V_I=10V, 1mA≦I_L≦70mA	4.7	5.0	5.3	
I_B	Bias current	I_L=0		4.8	6.7	mA
ΔI_B	Bias current variability	8V≦V_I≦20V, I_L=40mA		0.1	1.5	mA
		V_I=10V, 1mA≦I_L≦40mA			0.2	
V_{NO}	Output noise voltage	BW: 10Hz~100kHz		49		μVrms
RR	Ripple rejection ratio	f=120Hz, V_{in}=0dBm	63	73		dB
V_I-V_O	Minimum input-output voltage difference			2.0		V
I_{LP}	Peak load current			130		mA
I_{OS}	Output short holding current			16.5		mA
TC_{VO}	Temperature coefficient of output voltage	I_L=5mA		−0.6		mV/℃

(5V,5.6V,8V,9V,10V,12V,15V) 3-TERMINAL FIXED POSITIVE OUTPUT VOLTAGE REGULATOR (WITH FOLD-BACK PROTECTION CIRCUIT)

M5278L56 (V_I=11V, I_L=40mA, T_a=25℃, C_I=0.33μF, C_O=0.1μF, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_O	Output voltage		5.32	5.6	5.88	V
$R_{eg\text{-}in}$	Input regulation	8.5V≦V_I≦21V		50	200	mV
		9V≦V_I≦21V		30	150	
$R_{eg\text{-}L}$	Load regulation	1mA≦I_L≦100mA		10	60	mV
		1mA≦I_L≦40mA		5	30	
V_O	Output voltage	8.5V≦V≦21V, 1mA≦I_L≦40mA	5.27	5.6	5.93	V
		V_I=11V, 1mA≦I_L≦70mA	5.27	5.6	5.93	
I_B	Bias current	I_L=0		4.8	6.7	mA
ΔI_B	Bias current differential	9V≦V_I≦21V, I_L=40mA		0.1	1.5	mA
		V_I=11V, 1mA≦I_L≦40mA			0.2	
V_{NO}	Output noise voltage	BW: 10Hz~100kHz		55		μVrms
RR	Ripple rejection ratio	f=120Hz, V_{in}=0dBm	63	73		dB
V_I-V_O	Minimum input-output voltage difference			2.0		V
I_{LP}	Peak load current			150		mA
I_{OS}	Output short circuit sustain current			16.5		mA
TC_{VO}	Temperature coefficient of output voltage	I_L=5mA		−0.65		mV/℃

M5278L08 (V_I=14V, I_L=40mA, T_a=25℃, C_I=0.33μF, C_O=0.1μF, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_O	Output voltage		7.6	8.0	8.4	V
$R_{eg\text{-}in}$	Input regulation	10.5V≦V_I≦23V		60	200	mV
		11V≦V_I≦23V		40	150	
$R_{eg\text{-}L}$	Load regulation	1mA≦I_L≦100mA		10	80	mV
		1mA≦I_L≦40mA		5	40	
V_O	Output voltage	10.5V≦V_I≦23V, 1mA≦I_L≦40mA	7.52	8.0	8.48	V
		V_I=14V, 1mA≦I_L≦70mA	7.52	8.0	8.48	
I_B	Bias current	I_L=0		4.8	6.7	mA
ΔI_B	Bias current differential	10.5V≦V_I≦23V, I_L=40mA		0.1	1.5	mA
		V_I=14V, 1mA≦I_L≦40mA			0.2	
V_{NO}	Output noise voltage	BW: 10Hz~100kHz		80		μVrms
RR	Ripple rejection ratio	f=120Hz, V_{in}=0dBm		56		dB
V_I-V_O	Minimum input-output voltage difference			2.0		V
I_{LP}	Peak load current			150		mA
I_{OS}	Output short circuit sustain current			12.5		mA
TC_{VO}	Temperature coefficient of output voltage	I_L=5mA		−0.9		mV/℃

M5278LXX, M5278LXXM

(5V, 5.6V, 8V, 9V, 10V, 12V, 15V) 3-TERMINAL FIXED POSITIVE OUTPUT VOLTAGE REGULATOR (WITH FOLD-BACK PROTECTION CIRCUIT)

M5278L09 (V_I=16V, I_L=40mA, T_a=25℃, C_I=0.33μF, C_O=0.1μF, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_O	Output voltage		8.55	9.0	9.45	V
$R_{eg\cdot in}$	Input regulation	12V≦V_I≦24V		60	225	mV
		13V≦V_I≦24V		40	170	
$R_{eg\cdot L}$	Load regulation	1mA≦I_L≦100mA		10	90	mV
		1mA≦I_L≦40mA		5	40	
V_O	Output voltage	12V≦V_I≦24V, 1mA≦I_L≦40mA	8.46	9.0	9.54	V
		V_I=16V, 1mA≦I_L≦70mA	8.46	9.0	9.54	
I_B	Bias current	I_L=0		4.8	6.7	mA
ΔI_B	Bias current differential	13V≦V_I≦24V, I_L=40mA		0.1	1.5	mA
		V_I=16V, 1mA≦I_L≦40mA			0.2	
V_{NO}	Output noise voltage	BW: 10Hz~100kHz		90		μVrms
RR	Ripple rejection ratio	f=120Hz, V_{in}=0dBm		60		dB
V_I-V_O	Minumum input-output voltage difference			2.0		V
I_{LP}	Peak load current			150		mA
I_{OS}	Output short circuit sustain current			12.5		mA
TC_{VO}	Temperature coefficient of output voltage	I_L=5mA		−0.65		mV/℃

M5278L10 (V_I=17V, I_L=40mA, T_a=25℃, C_I=0.33μF, C_O=0.1μF, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_O	Output voltage		9.5	10.0	10.5	V
$R_{eg\cdot in}$	Input regulation	12.5V≦V_I≦25V		70	230	mV
		13V≦V_I≦25V		50	170	
$R_{eg\cdot L}$	Load regulation	1mA≦I_L≦100mA		10	90	mV
		1mA≦I_L≦40mA		5	45	
V_O	Output voltage	12.5V≦V_I≦25V, 1mA≦I_L≦40mA	9.4	10.0	10.6	V
		V_I=17V, 1mA≦I_L≦70mA	9.4	10.0	10.6	
I_B	Bias current	I_L=0		4.8	6.7	mA
ΔI_B	Bias current differential	13V≦V_I≦25V, I_L=40mA		0.1	1.5	mA
		V_I=17V, 1mA≦I_L≦40mA			0.2	
V_{NO}	Output noise voltage	BW: 10Hz~100kHz		100		μVrms
RR	Ripple rejection ratio	f=120Hz, V_{in}=0dBm	52	59		dB
V_I-V_O	Minumum input-output voltage difference			2.0		V
I_{LP}	Peak load current			130		mA
I_{OS}	Output short circuit sustain current			12.5		mA
TC_{VO}	Temperature coefficient of output voltage	I_L=5mA		−0.9		mV/℃

(5V, 5.6V, 8V, 9V, 10V, 12V, 15V) 3-TERMINAL FIXED POSITIVE OUTPUT VOLTAGE REGULATOR (WITH FOLD-BACK PROTECTION CIRCUIT)

M5278L12 (V_I=19V, I_L=40mA, T_a=25°C, C_I=0.33μF, C_O=0.1μF, unless otherwise noted)

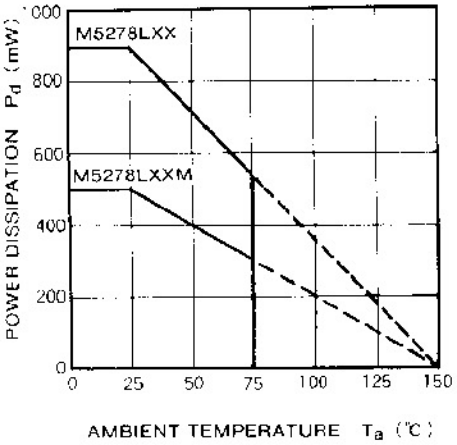
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_O	Output voltage		11.4	12.0	12.6	V
$R_{eg\cdot in}$	Input regulation	14.5V≦V_I≦27V		70	250	mV
		16V≦V≦27V		50	200	
$R_{eg\cdot L}$	Load regulation	1mA≦I_L≦100mA		10	100	mV
		1mA≦I_L≦40mA		5	50	
V_O	Output voltage	14.5V≦V_I≦27V, 1mA≦I_L≦40mA	11.3	12.0	12.7	V
		V_I=19V, 1mA≦I_L≦70mA	11.3	12.0	12.7	
I_B	Bias current	I_L=0		4.8	6.7	mA
ΔI_B	Bias current differential	16V≦V_I≦27V, I_L=40mA		0.1	1.5	mA
		V_I=19V, 1mA≦I_L≦40mA			0.2	
V_{NO}	Output noise voltage	BW: 10Hz~100kHz		110		μVrms
RR	Ripple rejection ratio	f=120Hz, V_{in}=0dBm	50	56		dB
V_I-V_O	Minimum input-output voltage difference			2.0		V
I_{LP}	Peak load current			150		mA
I_{OS}	Output short circuit sustain current			12.5		mA
TC_{VO}	Temperature coefficient of output voltage	I_L=5mA		−1.0		mV/°C

M5278L15 (V_I=23V, I_L=40mA, T_a=25°C, C_I=0.33μF, C_O=0.1μF, unless otherwise noted)

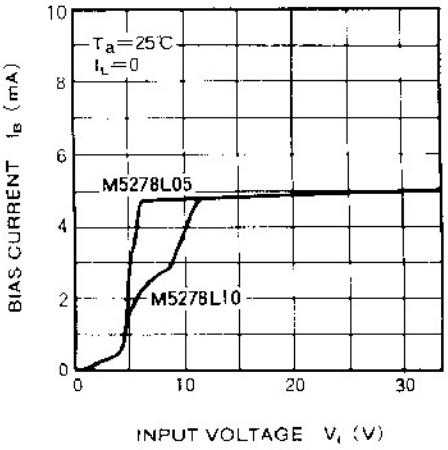
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_O	Output voltage		14.25	15.0	15.75	V
$R_{eg\cdot in}$	Input regulation	17.5V≦V_I≦30V		80	300	mV
		20V≦V_I≦30V		60	250	
$R_{eg\cdot L}$	Load regulation	1mA≦I_L≦100mA		10	150	mV
		1mA≦I_L≦40mA		5	75	
V_O	Output voltage	17.5V≦V_I≦30V, 1mA≦I_L≦40mA	14.1	15.0	15.9	V
		V_I=23V, 1mA≦I_L≦70mA	14.1	15.0	15.9	
I_B	Bias current	I_L=0		4.8	6.7	mA
ΔI_B	Bias current differential	23V≦V_I≦30V, I_L=40mA		0.1	1.5	mA
		V_I=23V, 1mA≦I_L≦40mA			0.2	
V_{NO}	Output noise voltage	BW: 10Hz~100kHz		140		μVrms
RR	Ripple rejection ratio	f=120Hz, V_{in}=0dBm	40	45		dB
V_I-V_O	Minimum input-output voltage difference			2.0		V
I_{LP}	Peak load current			150		mA
I_{OS}	Output short circuit sustain current			12.5		mA
TC_{VO}	Temperature coefficient of output voltage	I_L=5mA		−0.9		mV/°C

TYPICAL CHARCTERISTICS

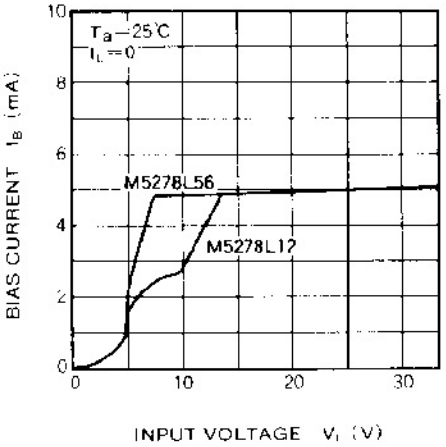
THERMAL DERATING (MAXIMUM RATING)



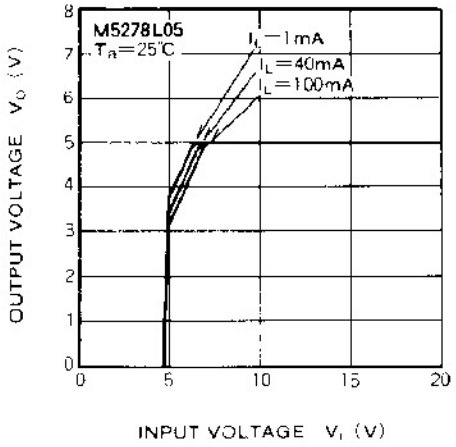
BIAS CURRENT VS. INPUT VOLTAGE



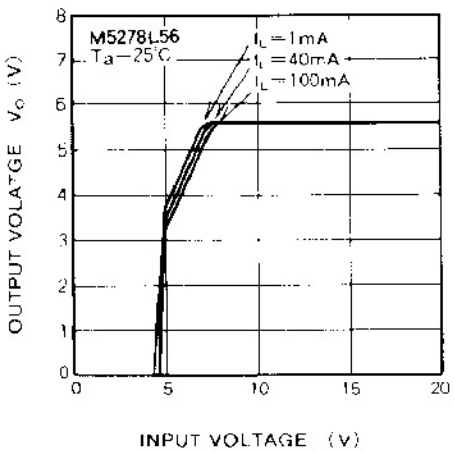
BIAS CURRENT VS. INPUT VOTAGE



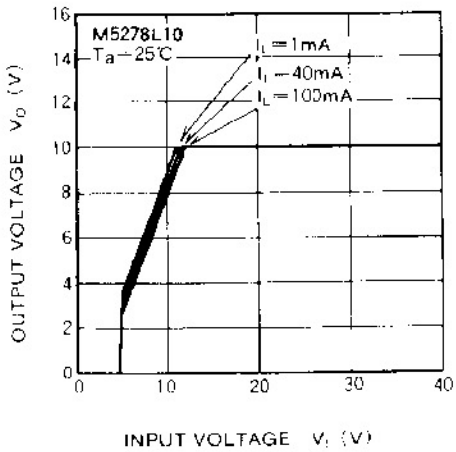
OUTPUT VOLTAGE VS. INPUT VOLTAGE



OUTPUT VOLTAGE VS. INPUT VOLTAGE

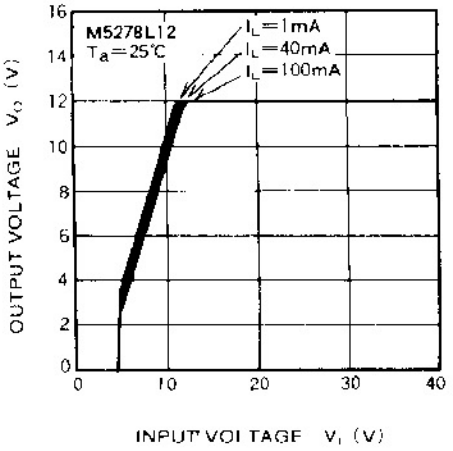


OUTPUT VOLTAGE VS. INPUT VOLTAGE

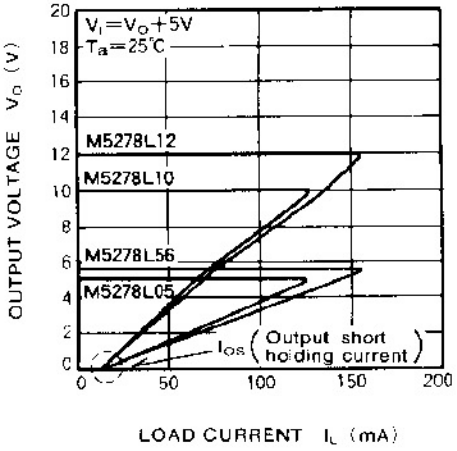


(5V, 5.6V, 8V, 9V, 10V, 12V, 15V) 3-TERMINAL FIXED POSITIVE OUTPUT VOLTAGE REGULATOR (WITH FOLD-BACK PROTECTION CIRCUIT)

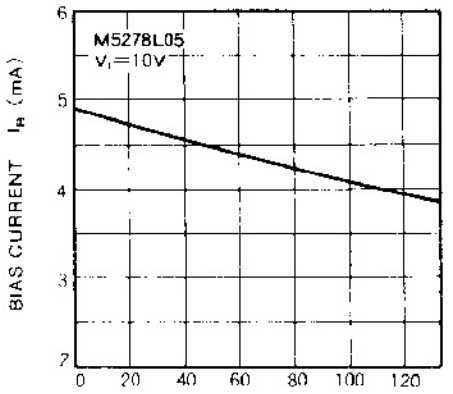
OUTPUT VOLTAGE VS. INPUT VOLTAGE



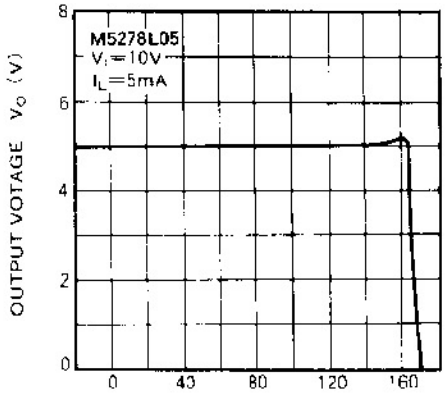
OUTPUT VOLTAGE VS. LOAD CURRENT



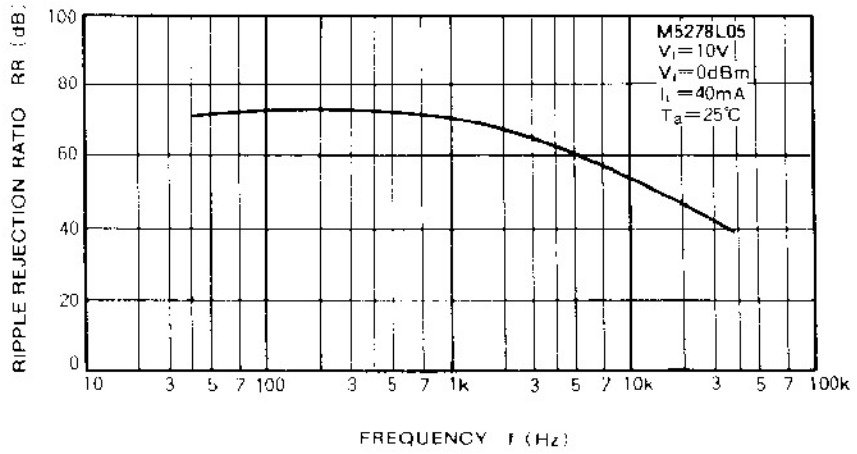
BIAS CURRENT VS. AMBIENT TEMPERATURE



OUTPUT VOLTAGE VS. AMBIENT TEMPERATURE

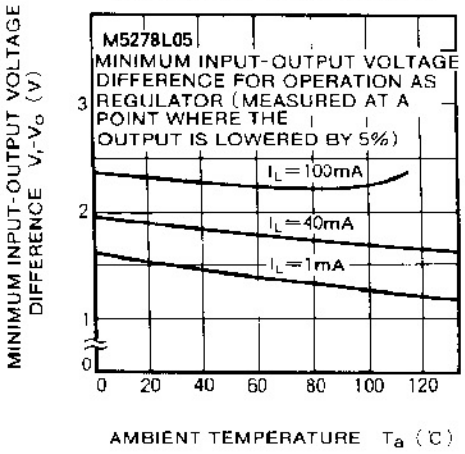


RIPPLE REJECTION VS. FREQUENCY



(5V, 5.6V, 8V, 9V, 10V, 12V, 15V) 3-TERMINAL FIXED POSITIVE OUTPUT VOLTAGE REGULATOR (WITH FOLD-BACK PROTECTION CIRCUIT)

MINIMUM INPUT-OUTPUT VOLTAGE DIFFERENCE VS. AMBIENT TEMPERATURE



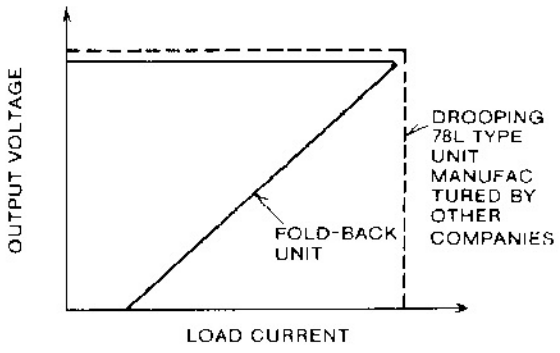
FOLD-BACK PROTECTION CIRCUIT

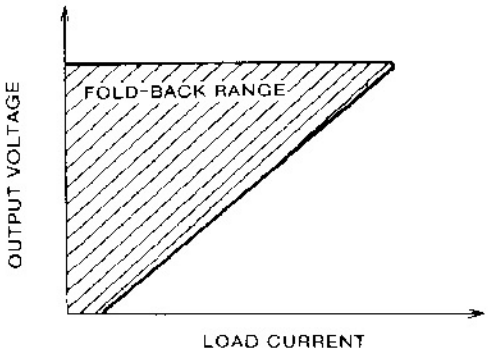
The M5278L series has been designed to be complete with three-pin, 78L type regulators manufactured by other companies for applications with loading currents in the 100mA class. They additionally have an internalized fold-back protection circuit for protection against shorted loads.

Other 78L units do have an internalized protection circuit known as a drooping type circuit that are rether simple, merely limiting maximum loading current. When large current begins to flow in these units due to a short circuit, abnormal temperatures are generated leading to breakdown and effective setting reliability.

As shown in the diagram, the fold-back protection circuit employed in the M5278L decreases immediately excessive current caused by a short in the load. This not only improves set reliability but permits the elimination of such protection circuits as fuses in the protection circuit.

OUTPUT VOLTAGE VS. LOAD CURRENT





PRECAUTIONS FOR USE

The current-control circuit requires that, as an IC power supply, this device be operated within the fold-back operating range shown in the accompanying chart.