

HA178M00 Series

3-terminal Fixed Voltage Regulators

HITACHI

ADE-204-052 (Z)

Rev. 0

Dec. 2000

Features

- Output current less than 500 mA
- Various output voltages: 5, 6, 7, 8, 9, 12, 15, 18, 20, and 24 V
- No external compensation circuit required
- Built-in current control circuit protects elements from destruction by short circuit
- Building chip junction temperature limiting circuit protects elements from thermal destruction
- Building internal power dissipation limiting circuit protects transistors in output stage

Ordering Information

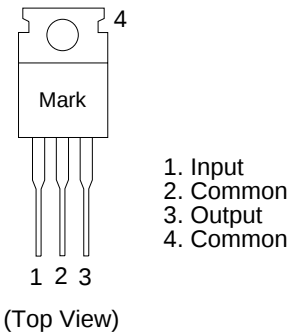
Type	Application	Package
HA178M00PJ Series	Automotive use	TO - 220AB
HA178M00P Series	Industrial use	
HA178M00 Series	Commercial use	

Output Voltage Accuracy Grade

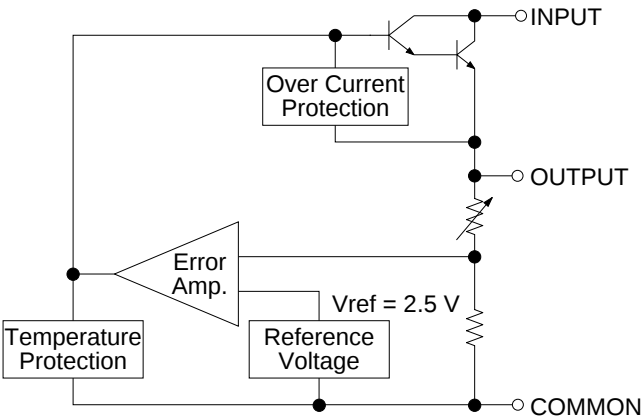
Type No.	Grade	Accuracy
HA178M05	None	± 4
HA178M12	A	± 2
	B	± 3
	C	+2, -4

HA178M00 Series

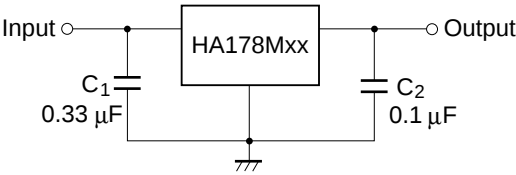
Pin Arrangement



Block Diagram



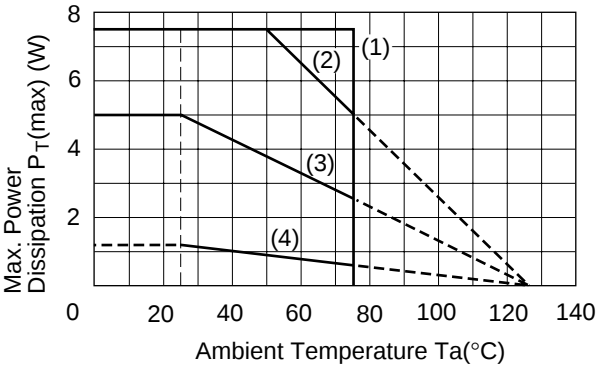
Standard Circuit



Absolute Maximum Ratings (Ta = 25°C)

Item	Symbol	Rating	Unit	Notes
Input voltage	V_{IN}	35	V	1
Input voltage	V_{IN}	40	V	2
Power dissipation	P_T	7.5	W	3
Operating temperature	T_{opr}	-20 to +75	°C	
Junction temperature	T_j	-20 to +125	°C	
Storage temperature	T_{stg}	-55 to +125	°C	

Notes: 1. For HA178M05P–HA178M18P, HA178M05–HA178M18
2. For HA178M20P, HA178M24P, HA178M20, HA178M24
3. Follow derating curve



(1) Infinite heat sink
(2) 5°C/W heat sink
(3) 15°C/W heat sink
(4) No heat sink

) Include fixed thermal resistance

Thermal resistance
 $\theta_{jc} = 3.0^\circ\text{C/W}$ (typ)
5.0°C/W (max)
 $\theta_{ja} = 62^\circ\text{C/W}$ (typ)
72°C/W (max)

HA178M05P/PJ, HA178M05 Electrical Characteristics (V_{IN} = 10 V, I_{OUT} = 350 mA, 0°C ≤ T_j ≤ 125°C, C_{IN} = 0.33 μF, C_{OUT} = 0.1 μF, unless otherwise specified)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Output voltage	V _{OUT}	4.8	5.0	5.2	V	T _j = 25°C
		4.75	—	5.25		7 V ≤ V _{IN} ≤ 20 V, 5 mA ≤ I _{OUT} ≤ 350 mA, P _T ≤ 7.5 W
Line regulation	δV _{O Line}	—	3	100	mV	T _j = 25°C 7 V ≤ V _{IN} ≤ 25 V, I _{OUT} = 200 mA
		—	1	50		8 V ≤ V _{IN} ≤ 25 V, I _{OUT} = 200 mA
Load regulation	δV _{O Load}	—	20	100	mV	T _j = 25°C 5 mA ≤ I _{OUT} ≤ 500 mA
		—	10	50		5 mA ≤ I _{OUT} ≤ 200 mA
Quiescent current	I _Q	—	4.5	6.0	mA	T _j = 25°C, I _{OUT} = 0
Quiescent current change	δI _Q	—	—	0.8	mA	8 V ≤ V _{IN} ≤ 25 V, I _{OUT} = 200 mA
		—	—	0.5		5 mA ≤ I _{OUT} ≤ 350 mA
Output noise voltage	V _n	—	40	—	μV	T _a = 25°C, 10 Hz ≤ f ≤ 100 kHz
Ripple rejection ratio	R _{REJ}	—	80	—	dB	f = 120 Hz I _{OUT} = 100 mA
		—	80	—		T _j = 25°C I _{OUT} = 300 mA
Dropout voltage	V _{drop}	—	2.0	—	V	I _{OUT} = 350 mA, T _j = 25°C
Output short-circuit current	I _{OS}	—	300	—	mA	T _j = 25°C, V _{IN} = 35 V
Peak output current	I _{o peak}	—	700	—	mA	T _j = 25°C
Temperature coefficient of output voltage	δV _{OUT} /δT _j	—	−1.0	—	mV/°C	I _{OUT} = 5 mA, 0°C ≤ T _j ≤ 125°C

HA178M06P/PJ, HA178M06 Electrical Characteristics ($V_{IN} = 11\text{ V}$, $I_{OUT} = 350\text{ mA}$, $0^{\circ}\text{C} \leq T_j \leq 125^{\circ}\text{C}$, $C_{IN} = 0.33\text{ }\mu\text{F}$, $C_{OUT} = 0.1\text{ }\mu\text{F}$, unless otherwise specified)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Output voltage	V_{OUT}	5.75	6.0	6.25	V	$T_j = 25^{\circ}\text{C}$
		5.7	—	6.3		$8\text{ V} \leq V_{IN} \leq 21\text{ V}$, $5\text{ mA} \leq I_{OUT} \leq 350\text{ mA}$, $P_T \leq 7.5\text{ W}$
Line regulation	$\delta V_{O\text{ Line}}$	—	5	120	mV	$T_j = 25^{\circ}\text{C}$ $8\text{ V} \leq V_{IN} \leq 25\text{ V}$, $I_{OUT} = 200\text{ mA}$
		—	1.5	60		$9\text{ V} \leq V_{IN} \leq 25\text{ V}$, $I_{OUT} = 200\text{ mA}$
Load regulation	$\delta V_{O\text{ Load}}$	—	20	120	mV	$T_j = 25^{\circ}\text{C}$ $5\text{ mA} \leq I_{OUT} \leq 500\text{ mA}$
		—	10	60		$5\text{ mA} \leq I_{OUT} \leq 200\text{ mA}$
Quiescent current	I_Q	—	4.5	6.0	mA	$T_j = 25^{\circ}\text{C}$, $I_{OUT} = 0$
Quiescent current change	δI_Q	—	—	0.8	mA	$9\text{ V} \leq V_{IN} \leq 25\text{ V}$, $I_{OUT} = 200\text{ mA}$
		—	—	0.5		$5\text{ mA} \leq I_{OUT} \leq 350\text{ mA}$
Output noise voltage	V_n	—	45	—	μV	$T_a = 25^{\circ}\text{C}$, $10\text{ Hz} \leq f \leq 100\text{ kHz}$
Ripple rejection ratio	R_{REJ}	—	80	—	dB	$f = 120\text{ Hz}$ $I_{OUT} = 100\text{ mA}$
		—	80	—		$T_j = 25^{\circ}\text{C}$ $I_{OUT} = 300\text{ mA}$
Dropout voltage	V_{drop}	—	2.0	—	V	$I_{OUT} = 350\text{ mA}$, $T_j = 25^{\circ}\text{C}$
Output short-circuit current	I_{OS}	—	270	—	mA	$T_j = 25^{\circ}\text{C}$, $V_{IN} = 35\text{ V}$
Peak output current	$I_{o\text{ peak}}$	—	700	—	mA	$T_j = 25^{\circ}\text{C}$
Temperature coefficient of output voltage	$\delta V_{OUT}/\delta V_j$	—	−0.5	—	mV/ $^{\circ}\text{C}$	$I_{OUT} = 5\text{ mA}$, $0^{\circ}\text{C} \leq T_j \leq 125^{\circ}\text{C}$

HA178M00 Series

HA178M07P/PJ, HA178M07 Electrical Characteristics (V_{IN} = 12.5 V, I_{OUT} = 350 mA, 0°C ≤ T_j ≤ 125°C, C_{IN} = 0.33 μF, C_{OUT} = 0.1 μF, unless otherwise specified)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Output voltage	V _{OUT}	6.72	7.0	7.28	V	T _j = 25°C
		6.65	—	7.35		9 V ≤ V _{IN} ≤ 22 V, 5 mA ≤ I _{OUT} ≤ 350 mA, P _T ≤ 7.5 W
Line regulation	δV _{O Line}	—	5.5	140	mV	T _j = 25°C 9 V ≤ V _{IN} ≤ 25 V, I _{OUT} = 200 mA
		—	1.7	70		10 V ≤ V _{IN} ≤ 25 V, I _{OUT} = 200 mA
Load regulation	δV _{O Load}	—	23	140	mV	T _j = 25°C 5 mA ≤ I _{OUT} ≤ 500 mA
		—	10	70		5 mA ≤ I _{OUT} ≤ 200 mA
Quiescent current	I _Q	—	4.6	6.0	mA	T _j = 25°C, I _{OUT} = 0
Quiescent current change	δI _Q	—	—	0.8	mA	10 V ≤ V _{IN} ≤ 25 V, I _{OUT} = 200 mA
		—	—	0.5		5 mA ≤ I _{OUT} ≤ 350 mA
Output noise voltage	V _n	—	48.5	—	μV	T _a = 25°C, 10 Hz ≤ f ≤ 100 kHz
Ripple rejection ratio	R _{REJ}	—	80	—	dB	f = 120 Hz I _{OUT} = 100 mA
		—	80	—		T _j = 25°C I _{OUT} = 300 mA
Dropout voltage	V _{drop}	—	2.0	—	V	I _{OUT} = 350 mA, T _j = 25°C
Output short-circuit current	I _{OS}	—	260	—	mA	T _j = 25°C, V _{IN} = 35 V
Peak output current	I _{o peak}	—	700	—	mA	T _j = 25°C
Temperature coefficient of output voltage	δV _{OUT} /δT _j	—	−0.5	—	mV/°C	I _{OUT} = 5 mA, 0°C ≤ T _j ≤ 125°C

HA178M08P/PJ, HA178M08 Electrical Characteristics ($V_{IN} = 14\text{ V}$, $I_{OUT} = 350\text{ mA}$, $0^{\circ}\text{C} \leq T_j \leq 125^{\circ}\text{C}$, $C_{IN} = 0.33\text{ }\mu\text{F}$, $C_{OUT} = 0.1\text{ }\mu\text{F}$, unless otherwise specified)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Output voltage	V_{OUT}	7.7	8.0	8.3	V	$T_j = 25^{\circ}\text{C}$
		7.6	—	8.4		$10.5\text{ V} \leq V_{IN} \leq 23\text{ V}$, $5\text{ mA} \leq I_{OUT} \leq 350\text{ mA}$, $P_T \leq 7.5\text{ W}$
Line regulation	$\delta V_{O\text{ Line}}$	—	6.0	160	mV	$T_j = 25^{\circ}\text{C}$ $10.5\text{ V} \leq V_{IN} \leq 25\text{ V}$, $I_{OUT} = 200\text{ mA}$
		—	2.0	80		$11\text{ V} \leq V_{IN} \leq 25\text{ V}$, $I_{OUT} = 200\text{ mA}$
Load regulation	$\delta V_{O\text{ Load}}$	—	25	160	mV	$T_j = 25^{\circ}\text{C}$ $5\text{ mA} \leq I_{OUT} \leq 500\text{ mA}$
		—	10	80		$5\text{ mA} \leq I_{OUT} \leq 200\text{ mA}$
Quiescent current	I_Q	—	4.6	6.0	mA	$T_j = 25^{\circ}\text{C}$, $I_{OUT} = 0$
Quiescent current change	δI_Q	—	—	0.8	mA	$10.5\text{ V} \leq V_{IN} \leq 25\text{ V}$, $I_{OUT} = 200\text{ mA}$
		—	—	0.5		$5\text{ mA} \leq I_{OUT} \leq 350\text{ mA}$
Output noise voltage	V_n	—	52	—	μV	$T_a = 25^{\circ}\text{C}$, $10\text{ Hz} \leq f \leq 100\text{ kHz}$
Ripple rejection ratio	R_{REJ}	—	80	—	dB	$f = 120\text{ Hz}$ $I_{OUT} = 100\text{ mA}$
		—	80	—		$T_j = 25^{\circ}\text{C}$ $I_{OUT} = 300\text{ mA}$
Dropout voltage	V_{drop}	—	2.0	—	V	$I_{OUT} = 350\text{ mA}$, $T_j = 25^{\circ}\text{C}$
Output short-circuit current	I_{OS}	—	250	—	mA	$T_j = 25^{\circ}\text{C}$, $V_{IN} = 35\text{ V}$
Peak output current	$I_{O\text{ peak}}$	—	700	—	mA	$T_j = 25^{\circ}\text{C}$
Temperature coefficient of output voltage	$\delta V_{OUT}/\delta T_j$	—	−0.5	—	mV/ $^{\circ}\text{C}$	$I_{OUT} = 5\text{ mA}$, $0^{\circ}\text{C} \leq T_j \leq 125^{\circ}\text{C}$

HA178M00 Series

HA178M09P/PJ, HA178M09 Electrical Characteristics (V_{IN} = 15 V, I_{OUT} = 350 mA, 0°C ≤ T_j ≤ 125°C, C_{IN} = 0.33 μF, C_{OUT} = 0.1 μF, unless otherwise specified)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Output voltage	V _{OUT}	8.64	9.0	9.36	V	T _j = 25°C
		8.55	—	9.45		11.5 V ≤ V _{IN} ≤ 24 V, 5 mA ≤ I _{OUT} ≤ 350 mA, P _T ≤ 7.5 W
Line regulation	δV _{O Line}	—	7.0	180	mV	T _j = 25°C 11.5 V ≤ V _{IN} ≤ 25 V, I _{OUT} = 200 mA
		—	2.5	90		12 V ≤ V _{IN} ≤ 25 V I _{OUT} = 200 mA
Load regulation	δV _{O Load}	—	25	200	mV	T _j = 25°C 5 mA ≤ I _{OUT} ≤ 500 mA
		—	10	100		5 mA ≤ I _{OUT} ≤ 200 mA
Quiescent current	I _Q	—	4.6	6.0	mA	T _j = 25°C, I _{OUT} = 0
Quiescent current change	δI _Q	—	—	0.8	mA	12 V ≤ V _{IN} ≤ 25 V, I _{OUT} = 200 mA
		—	—	0.5		5 mA ≤ I _{OUT} ≤ 350 mA
Output noise voltage	V _n	—	52	—	μV	T _a = 25°C, 10 Hz ≤ f ≤ 100 kHz
Ripple rejection ratio	R _{REJ}	—	80	—	dB	f = 120 Hz I _{OUT} = 100 mA
		—	80	—		T _j = 25°C I _{OUT} = 300 mA
Dropout voltage	V _{drop}	—	2.0	—	V	I _{OUT} = 350 mA, T _j = 25°C
Output short-circuit current	I _{OS}	—	250	—	mA	T _j = 25°C, V _{IN} = 35 V
Peak output current	I _{o peak}	—	700	—	mA	T _j = 25°C
Temperature coefficient of output voltage	δV _{OUT} /δT _j	—	−0.9	—	mV/°C	I _{OUT} = 5 mA, 0°C ≤ T _j ≤ 125°C

HA178M12P/PJ, HA178M12 Electrical Characteristics ($V_{IN} = 19\text{ V}$, $I_{OUT} = 350\text{ mA}$, $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$, $C_{IN} = 0.33\text{ }\mu\text{F}$, $C_{OUT} = 0.1\text{ }\mu\text{F}$, unless otherwise specified)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Output voltage	V_{OUT}	11.5	12.0	12.5	V	$T_j = 25^\circ\text{C}$
		11.4	—	12.6		$14.5\text{ V} \leq V_{IN} \leq 27\text{ V}$, $5\text{ mA} \leq I_{OUT} \leq 350\text{ mA}$, $PT \leq 7.5\text{ W}$
Line regulation	$\delta V_{O\text{ Line}}$	—	10	240	mV	$T_j = 25^\circ\text{C}$ $14.5\text{ V} \leq V_{IN} \leq 30\text{ V}$, $I_{OUT} = 200\text{ mA}$
		—	3.0	120		$16\text{ V} \leq V_{IN} \leq 30\text{ V}$, $I_{OUT} = 200\text{ mA}$
Load regulation	$\delta V_{O\text{ Load}}$	—	25	240	mV	$T_j = 25^\circ\text{C}$ $5\text{ mA} \leq I_{OUT} \leq 500\text{ mA}$
		—	10	120		$5\text{ mA} \leq I_{OUT} \leq 200\text{ mA}$
Quiescent current	I_Q	—	4.8	6.0	mA	$T_j = 25^\circ\text{C}$, $I_{OUT} = 0$
Quiescent current change	δI_Q	—	—	0.8	mA	$14.5\text{ V} \leq V_{IN} \leq 30\text{ V}$, $I_{OUT} = 200\text{ mA}$
		—	—	0.5		$5\text{ mA} \leq I_{OUT} \leq 350\text{ mA}$
Output noise voltage	V_n	—	75	—	μV	$T_a = 25^\circ\text{C}$, $10\text{ Hz} \leq f \leq 100\text{ kHz}$
Ripple rejection ratio	R_{REJ}	—	80	—	dB	$f = 120\text{ Hz}$ $I_{OUT} = 100\text{ mA}$
		—	80	—		$T_j = 25^\circ\text{C}$ $I_{OUT} = 300\text{ mA}$
Dropout voltage	V_{drop}	—	2.0	—	V	$I_{OUT} = 350\text{ mA}$, $T_j = 25^\circ\text{C}$
Output short-circuit current	I_{OS}	—	240	—	mA	$T_j = 25^\circ\text{C}$, $V_{IN} = 35\text{ V}$
Peak output current	$I_{O\text{ peak}}$	—	700	—	mA	$T_j = 25^\circ\text{C}$
Temperature coefficient of output voltage	$\delta V_{OUT}/\delta T_j$	—	−1.0	—	mV/°C	$I_{OUT} = 5\text{ mA}$, $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$

HA178M00 Series

HA178M15P/PJ, HA178M15 Electrical Characteristics (V_{IN} = 23 V, I_{OUT} = 350 mA, 0°C ≤ T_j ≤ 125°C, C_{IN} = 0.33 μF, C_{OUT} = 0.1 μF, unless otherwise specified)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Output voltage	V _{OUT}	14.4	15.0	15.6	V	T _j = 25°C
		14.25	—	15.75		17.5 V ≤ V _{IN} ≤ 30 V, 5 mA ≤ I _{OUT} ≤ 350 mA, P _T ≤ 7.5 W
Line regulation	δV _{O Line}	—	11	300	mV	T _j = 25°C 17.5 V ≤ V _{IN} ≤ 30 V, I _{OUT} = 200 mA
		—	3.0	150		20 V ≤ V _{IN} ≤ 30 V, I _{OUT} = 200 mA
Load regulation	δV _{O Load}	—	25	300	mV	T _j = 25°C 5 mA ≤ I _{OUT} ≤ 500 mA
		—	10	150		5 mA ≤ I _{OUT} ≤ 200 mA
Quiescent current	I _Q	—	4.8	6.0	mA	T _j = 25°C, I _{OUT} = 0
Quiescent current change	δI _Q	—	—	0.8	mA	17.5 V ≤ V _{IN} ≤ 30 V, I _{OUT} = 200 mA
		—	—	0.5		5 mA ≤ I _{OUT} ≤ 350 mA
Output noise voltage	V _n	—	90	—	μV	T _a = 25°C, 10 Hz ≤ f ≤ 100 kHz
Ripple rejection ratio	R _{REJ}	—	70	—	dB	f = 120 Hz I _{OUT} = 100 mA
		—	70	—		T _j = 25°C I _{OUT} = 300 mA
Dropout voltage	V _{drop}	—	2.0	—	V	I _{OUT} = 350 mA, T _j = 25°C
Output short-circuit current	I _{OS}	—	240	—	mA	T _j = 25°C, V _{IN} = 35 V
Peak output current	I _{o peak}	—	700	—	mA	T _j = 25°C
Temperature coefficient of output voltage	δV _{OUT} /δT _j	—	−1.0	—	mV/°C	I _{OUT} = 5 mA, 0°C ≤ T _j ≤ 125°C

HA178M18P/PJ, HA178M18 Electrical Characteristics ($V_{IN} = 27\text{ V}$, $I_{OUT} = 350\text{ mA}$, $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$, $C_{IN} = 0.33\text{ }\mu\text{F}$, $C_{OUT} = 0.1\text{ }\mu\text{F}$, unless otherwise specified)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Output voltage	V_{OUT}	17.3	18.0	18.7	V	$T_j = 25^\circ\text{C}$
		17.1	—	18.9		$21\text{ V} \leq V_{IN} \leq 33\text{ V}$, $5\text{ mA} \leq I_{OUT} \leq 350\text{ mA}$, $P_T \leq 7.5\text{ W}$
Line regulation	$dV_{O\text{ Line}}$	—	15	360	mV	$T_j = 25^\circ\text{C}$ $21\text{ V} \leq V_{IN} \leq 33\text{ V}$, $I_{OUT} = 200\text{ mA}$
		—	5.0	180		$24\text{ V} \leq V_{IN} \leq 33\text{ V}$, $I_{OUT} = 200\text{ mA}$
Load regulation	$\delta V_{O\text{ Load}}$	—	25	360	mV	$T_j = 25^\circ\text{C}$ $5\text{ mA} \leq I_{OUT} \leq 500\text{ mA}$
		—	10	180		$5\text{ mA} \leq I_{OUT} \leq 200\text{ mA}$
Quiescent current	I_Q	—	4.8	6.0	mA	$T_j = 25^\circ\text{C}$, $I_{OUT} = 0$
Quiescent current change	δI_Q	—	—	0.8	mA	$21\text{ V} \leq V_{IN} \leq 35\text{ V}$, $I_{OUT} = 200\text{ mA}$
		—	—	0.5		$5\text{ mA} \leq I_{OUT} \leq 350\text{ mA}$
Output noise voltage	V_n	—	110	—	μV	$T_a = 25^\circ\text{C}$, $10\text{ Hz} \leq f \leq 100\text{ kHz}$
Ripple rejection ratio	R_{REJ}	—	70	—	dB	$f = 120\text{ Hz}$ $I_{OUT} = 100\text{ mA}$
		—	70	—		$T_j = 25^\circ\text{C}$ $I_{OUT} = 300\text{ mA}$
Dropout voltage	V_{drop}	—	2.0	—	V	$I_{OUT} = 350\text{ mA}$, $T_j = 25^\circ\text{C}$
Output short-circuit current	I_{OS}	—	240	—	mA	$T_j = 25^\circ\text{C}$, $V_{IN} = 35\text{ V}$
Peak output current	$I_{o\text{ peak}}$	—	700	—	mA	$T_j = 25^\circ\text{C}$
Temperature coefficient of output voltage	$\delta V_{OUT}/\delta T_j$	—	−1.0	—	mV/°C	$I_{OUT} = 5\text{ mA}$, $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$

HA178M00 Series

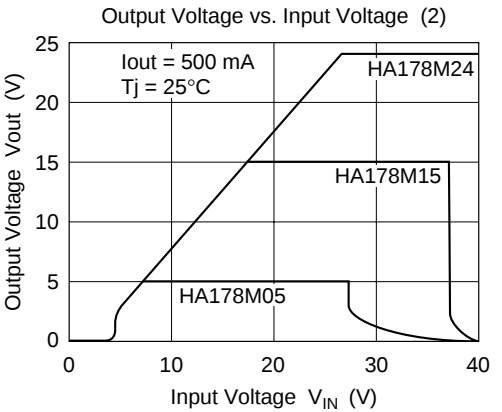
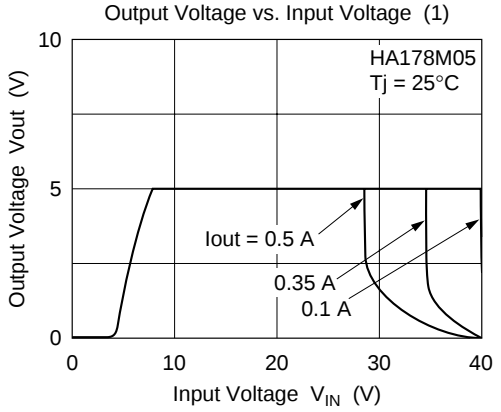
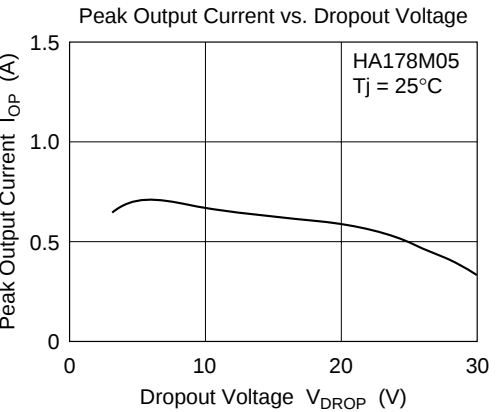
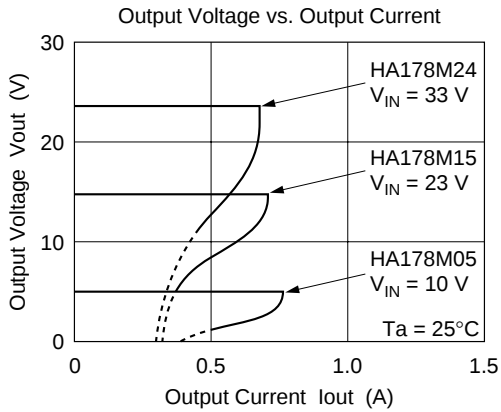
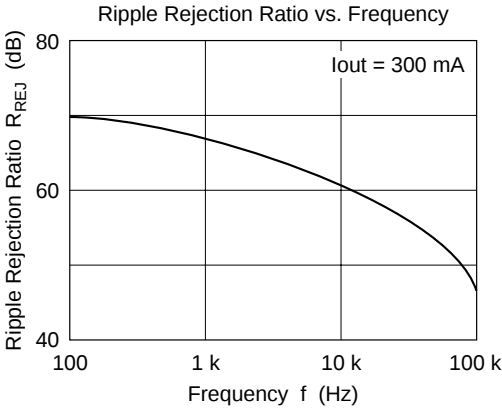
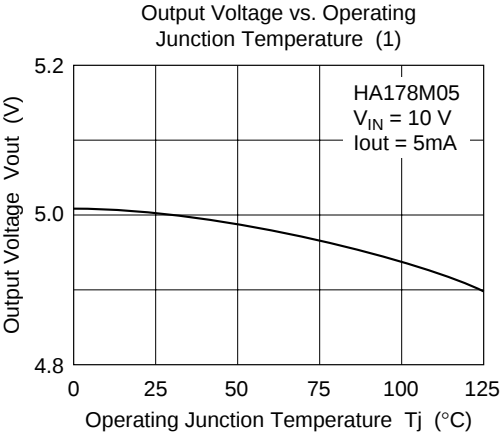
HA178M20P/PJ, HA178M20 Electrical Characteristics (V_{IN} = 29 V, I_{OUT} = 350 mA, 0°C ≤ T_j ≤ 125°C, C_{IN} = 0.33 μF, C_{OUT} = 0.1 μF, unless otherwise specified)

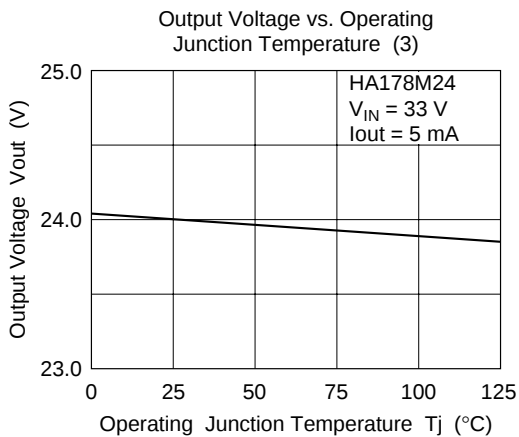
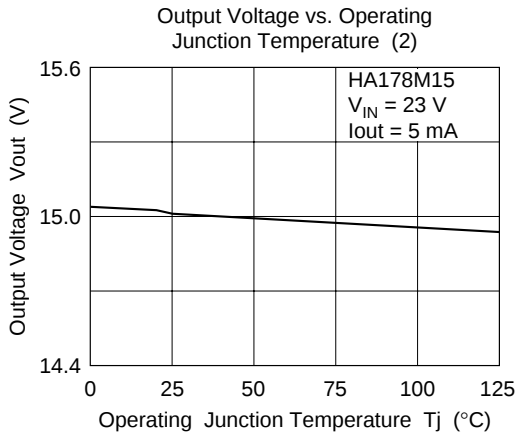
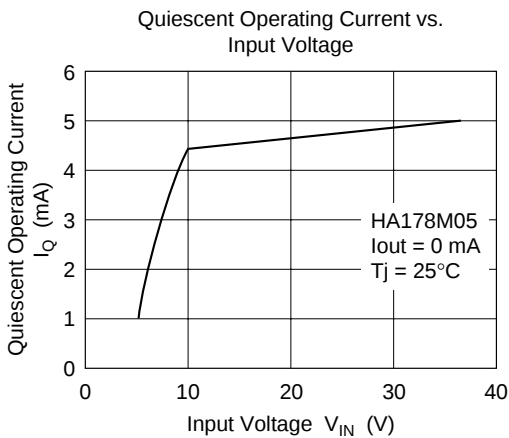
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Output voltage	V _{OUT}	19.2	20	20.8	V	T _j = 25°C
		19	—	21		23 V ≤ V _{IN} ≤ 35 V, 5 mA ≤ I _{OUT} ≤ 350 mA, P _T ≤ 7.5 W
Line regulation	δV _{O Line}	—	17	400	mV	T _j = 25°C 23 V ≤ V _{IN} ≤ 35 V, I _{OUT} = 200 mA
		—	6.0	200		24 V ≤ V _{IN} ≤ 35 V, I _{OUT} = 200 mA
Load regulation	δV _{O Load}	—	30	400	mV	T _j = 25°C 5 mA ≤ I _{OUT} ≤ 500 mA
		—	10	200		5 mA ≤ I _{OUT} ≤ 200 mA
Quiescent current	I _Q	—	4.9	6.0	mA	T _j = 25°C, I _{OUT} = 0
Quiescent current change	δI _Q	—	—	0.8	mA	23 V ≤ V _{IN} ≤ 35 V, I _{OUT} = 200 mA
		—	—	0.5		5 mA ≤ I _{OUT} ≤ 350 mA
Output noise voltage	V _n	—	110	—	μV	T _a = 25°C, 10 Hz ≤ f ≤ 100 kHz
Ripple rejection ratio	R _{REJ}	—	70	—	dB	f = 120 Hz I _{OUT} = 100 mA
		—	70	—		T _j = 25°C I _{OUT} = 300 mA
Dropout voltage	V _{drop}	—	2.0	—	V	I _{OUT} = 350 mA, T _j = 25°C
Output short-circuit current	I _{OS}	—	240	—	mA	T _j = 25°C, V _{IN} = 35 V
Peak output current	I _{o peak}	—	700	—	mA	T _j = 25°C
Temperature coefficient of output voltage	δV _{OUT} /δT _j	—	−1.1	—	mV/°C	I _{OUT} = 5 mA, 0°C ≤ T _j ≤ 125°C

HA178M24P/PJ, HA178M24 Electrical Characteristics ($V_{IN} = 33\text{ V}$, $I_{OUT} = 350\text{ mA}$, $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$, $C_{IN} = 0.33\text{ }\mu\text{F}$, $C_{OUT} = 0.1\text{ }\mu\text{F}$, unless otherwise specified)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Output voltage	V_{OUT}	23.0	24.0	25.0	V	$T_j = 25^\circ\text{C}$
		22.8	—	25.2		$27\text{ V} \leq V_{IN} \leq 38\text{ V}$,
						$5\text{ mA} \leq I_{OUT} \leq 350\text{ mA}$, $P_T \leq 7.5\text{ W}$
Line regulation	$\delta V_{O\text{ Line}}$	—	18	480	mV	$T_j = 25^\circ\text{C}$ $27\text{ V} \leq V_{IN} \leq 38\text{ V}$, $I_{OUT} = 200\text{ mA}$
		—	6.0	240		$28\text{ V} \leq V_{IN} \leq 38\text{ V}$, $I_{OUT} = 200\text{ mA}$
Load regulation	$\delta V_{O\text{ Load}}$	—	30	480	mV	$T_j = 25^\circ\text{C}$ $5\text{ mA} \leq I_{OUT} \leq 500\text{ mA}$
		—	10	240		$5\text{ mA} \leq I_{OUT} \leq 200\text{ mA}$
Quiescent current	I_Q	—	5.0	8.0	mA	$T_j = 25^\circ\text{C}$, $I_{OUT} = 0$
Quiescent current change	δI_Q	—	—	0.8	mA	$27\text{ V} \leq V_{IN} \leq 38\text{ V}$, $I_{OUT} = 200\text{ mA}$
		—	—	0.5		$5\text{ mA} \leq I_{OUT} \leq 350\text{ mA}$
Output noise voltage	V_n	—	170	—	μV	$T_a = 25^\circ\text{C}$, $10\text{ Hz} \leq f \leq 100\text{ kHz}$
Ripple rejection ratio	R_{REJ}	—	70	—	dB	$f = 120\text{ Hz}$ $I_{OUT} = 100\text{ mA}$
		—	70	—		$T_j = 25^\circ\text{C}$ $I_{OUT} = 300\text{ mA}$
Dropout voltage	V_{drop}	—	2.0	—	V	$I_{OUT} = 350\text{ mA}$, $T_j = 25^\circ\text{C}$
Output short-circuit current	I_{OS}	—	240	—	mA	$T_j = 25^\circ\text{C}$, $V_{IN} = 35\text{ V}$
Peak output current	$I_{o\text{ peak}}$	—	700	—	mA	$T_j = 25^\circ\text{C}$
Temperature coefficient of output voltage	$\delta V_{OUT}/\delta T_j$	—	−1.2	—	$\text{mV}/^\circ\text{C}$	$I_{OUT} = 5\text{ mA}$, $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$

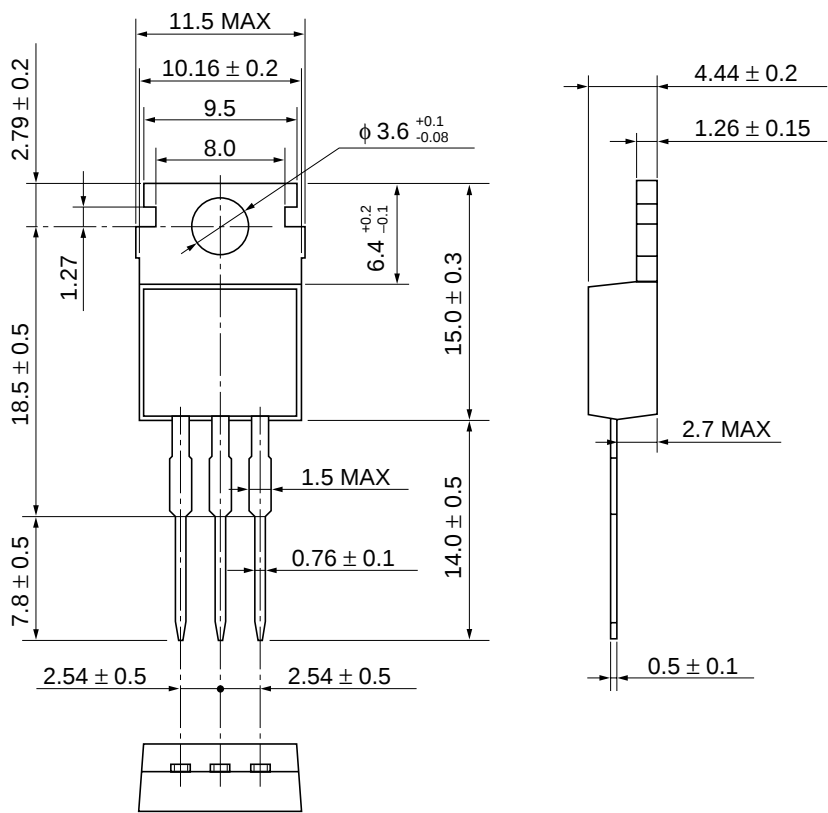
Characteristic Curves





Package Dimensions

Unit: mm



Hitachi Code	TO-220AB
JEDEC	Conforms
EIAJ	Conforms
Mass (reference value)	1.8 g

Cautions

1. Hitachi neither warrants nor grants licenses of any rights of Hitachi's or any third party's patent, copyright, trademark, or other intellectual property rights for information contained in this document. Hitachi bears no responsibility for problems that may arise with third party's rights, including intellectual property rights, in connection with use of the information contained in this document.
2. Products and product specifications may be subject to change without notice. Confirm that you have received the latest product standards or specifications before final design, purchase or use.
3. Hitachi makes every attempt to ensure that its products are of high quality and reliability. However, contact Hitachi's sales office before using the product in an application that demands especially high quality and reliability or where its failure or malfunction may directly threaten human life or cause risk of bodily injury, such as aerospace, aeronautics, nuclear power, combustion control, transportation, traffic, safety equipment or medical equipment for life support.
4. Design your application so that the product is used within the ranges guaranteed by Hitachi particularly for maximum rating, operating supply voltage range, heat radiation characteristics, installation conditions and other characteristics. Hitachi bears no responsibility for failure or damage when used beyond the guaranteed ranges. Even within the guaranteed ranges, consider normally foreseeable failure rates or failure modes in semiconductor devices and employ systemic measures such as fail-safes, so that the equipment incorporating Hitachi product does not cause bodily injury, fire or other consequential damage due to operation of the Hitachi product.
5. This product is not designed to be radiation resistant.
6. No one is permitted to reproduce or duplicate, in any form, the whole or part of this document without written approval from Hitachi.
7. Contact Hitachi's sales office for any questions regarding this document or Hitachi semiconductor products.

HITACHI

Hitachi, Ltd.

Semiconductor & Integrated Circuits.
Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan
Tel: Tokyo (03) 3270-2111 Fax: (03) 3270-5109

URL	North America	: http://semiconductor.hitachi.com/
	Europe	: http://www.hitachi-eu.com/hel/ecg
	Asia	: http://sicapac.hitachi-asia.com
	Japan	: http://www.hitachi.co.jp/Sicd/indx.htm

For further information write to:

Hitachi Semiconductor (America) Inc. 179 East Tasman Drive, San Jose, CA 95134 Tel: <1> (408) 433-1990 Fax: <1> (408) 433-0223	Hitachi Europe GmbH Electronic Components Group Dornacher Straße 3 D-85622 Feldkirchen, Munich Germany Tel: <49> (89) 9 9180-0 Fax: <49> (89) 9 29 30 00
	Hitachi Europe Ltd. Electronic Components Group. Whitebrook Park Lower Cookham Road Maidenhead Berkshire SL6 8YA, United Kingdom Tel: <44> (1628) 585000 Fax: <44> (1628) 585160

Hitachi Asia Ltd. Hitachi Tower 16 Collyer Quay #20-00, Singapore 049318 Tel: <65>-538-6533/538-8577 Fax: <65>-538-6933/538-3877 URL: http://www.hitachi.com.sg	Hitachi Asia Ltd. (Taipei Branch Office) 4/F, No. 167, Tun Hwa North Road, Hung-Kuo Building, Taipei (105), Taiwan Tel: <886>-(2)-2718-3666 Fax: <886>-(2)-2718-8180 Telex: 23222 HAS-TP URL: http://www.hitachi.com.tw
---	---

Hitachi Asia (Hong Kong) Ltd.
Group III (Electronic Components)
7/F., North Tower,
World Finance Centre,
Harbour City, Canton Road
Tsim Sha Tsui, Kowloon,
Hong Kong
Tel: <852>-(2)-735-9218
Fax: <852>-(2)-730-0281
URL: <http://www.hitachi.com.hk>

Copyright © Hitachi, Ltd., 2000. All rights reserved. Printed in Japan.
Colophon 2.0

HITACHI