STRUCTURE Silicon Monolithic Integrated Circuit

TYPE Three-Terminal Regulator

PRODUCT SERIES **BA178MXXT**

FEATURE Output current up to 0.5A

○ABSOLUTE MAXIMUM RATING (Ta=25℃)

Parameter	Symbol	Limit	Unit
Input Voltage	Vin	35	V
Power Dissipation 1	Pd1	2*1	W
Power Dissipation 2	Pd2	22*2	W
Output Current	Iout	0.5*3	A
Operating Temperature Range	Topr	-40～+85	℃
Storage Temperature Range	Tstg	-55～+150	℃
Maximum Junction Temperature	Tjmax	150	℃

*1 Derating in done 16mW/℃ for temperatures above Ta=25℃
*2 Derating in done 176mW/℃ for temperatures above Ta=25℃, Mounted on infinity Alminium heat sink.
*3 Pd, ASO should not be exceeded.

○RECOMMENDED OPERATING CONDITIONS (Ta=-40～+85℃)

Parameter	Symbol	Type	Min	Max	Unit
Input Voltage	Vin	BA178M05T	7.5	25	V
		BA178M06T	8.5	21	
		BA178M07T	9.5	22	
		BA178M08T	10.5	23	
		BA178M09T	11.5	24	
		BA178M10T	12.5	25	
		BA178M12T	15	27	
		BA178M15T	17.5	30	
		BA178M18T	21	33	
		BA178M20T	23	33	
		BA178M24T	27	33	
Output Current	Io	Common	—	0.5*3	A

The product described in this specification is a strategic product (and/or Service) subject to COCOM regulations.
It should not be exported without Authorization from the appropriate government.
This product is not designed for protection against radioactive rays.

Status of this document
The Japanese version of this document is the formal specification. A customer may use this translation version only for a reference to help reading the formal version. If there are any differences in translation version of this document, formal version takes priority.

○ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, Ta=25℃,Vin=10V(05),11V(06),13V(07),14V(08),15V(09),16V(10),19V(12),23V(15),27V(18),29V(20),33V(24), Io=350mA)

Parameter	Symbol	Type	Limit			Unit	Condition
			Min.	Typ.	Max.		
Output Voltage1	Vo1	05	4.8	5.0	5.2	V	I o=350mA
		06	5.75	6.0	6.25		
		07	6.7	7.0	7.3		
		08	7.7	8.0	8.3		
		09	8.6	9.0	9.4		
		10	9.6	10.0	10.4		
		12	11.5	12.0	12.5		
		15	14.4	15.0	15.6		
		18	17.3	18.0	18.7		
		20	19.2	20.0	20.8		
		24	23.0	24.0	25.0		
Output Voltage2	Vo2	05	4.75	—	5.25	V	Vin=7.5～20V, Io=5mA～350mA
		06	5.7	—	6.3		Vin=8.5～21V, Io=5mA～350mA
		07	6.65	—	7.35		Vin=9.5～22V, Io=5mA～350mA
		08	7.6	—	8.4		Vin=10.5～23V, Io=5mA～350mA
		09	8.55	—	9.45		Vin=11.5～24V, Io=5mA～350mA
		10	9.5	—	10.5		Vin=12.5～25V, Io=5mA～350mA
		12	11.4	—	12.6		Vin=15～27V, Io=5mA～350mA
		15	14.25	—	15.75		Vin=17.5～30V, Io=5mA～350mA
		18	17.1	—	18.9		Vin=21～33V, Io=5mA～350mA
		20	19.0	—	21.0		Vin=23～33V, Io=5mA～350mA
		24	22.8	—	25.2		Vin=27～33V, Io=5mA～350mA
Line Regulation1	Reg.I1	05	—	3	100	mV	Vin=7～25V, Io=200mA
		06	—	3	100		Vin=8～25V, Io=200mA
		07	—	4	100		Vin=9～25V, Io=200mA
		08	—	4	100		Vin=10.5～25V, Io=200mA
		09	—	4	100		Vin=11.5～26V, Io=200mA
		10	—	5	100		Vin=12.5～28V, Io=200mA
		12	—	5	100		Vin=14.5～30V, Io=200mA
		15	—	6	100		Vin=17.5～30V, Io=200mA
		18	—	7	100		Vin=21～33V, Io=200mA
		20	—	8	100		Vin=23～33V, Io=200mA
		24	—	10	100		Vin=27～33V, Io=200mA
Line Regulation2	Reg.I2	05	—	1	50	mV	Vin=8～12V, Io=200mA
		06	—	1	50		Vin=9～25V, Io=200mA
		07	—	1	50		Vin=10～25V, Io=200mA
		08	—	1	50		Vin=11～25V, Io=200mA
		09	—	2	50		Vin=12～25V, Io=200mA
		10	—	2	50		Vin=14～26V, Io=200mA
		12	—	3	50		Vin=16～30V, Io=200mA
		15	—	3	50		Vin=20～30V, Io=200mA
		18	—	3	50		Vin=24～33V, Io=200mA
		20	—	4	50		Vin=24～33V, Io=200mA
		24	—	5	50		Vin=28～33V, Io=200mA
Ripple Rejection	R.R.	05	62	78	—	dB	ein=1Vrms, f=120Hz, Io=100mA
		06	60	74	—		
		07	57	71	—		
		08	56	69	—		
		09	56	67	—		
		10	56	66	—		
		12	55	63	—		
		15	54	60	—		
		18	53	58	—		
		20	53	58	—		
		24	50	55	—		
Temperature Coefficient of Output Voltage	Tcvo	05	—	-1.0	—	mV/℃	Io=5mA, Tj=0～125℃
		06/07/08/09/10/12	—	-0.5	—		
		15/18	—	-0.6	—		
		20/24	—	-0.7	—		
Peak Output Current	Io-p	Common	—	875	—	mA	Tj=25℃
Dropout Voltage	Vd	Common	—	2.0	—	V	Io=500mA

Parameter	Symbol	Type	Limit			Unit	Condition
			Min.	Typ.	Max.		
Load Regulation1	Reg.L1	05	—	20	100	mV	Io=5mA~500mA
		06	—	20	120		
		07	—	20	140		
		08	—	20	160		
		09	—	20	180		
		10	—	20	200		
		12	—	20	240		
		15	—	20	300		
		18	—	20	360		
		20	—	20	400		
		24	—	20	480		
Load Regulation2	Reg.L2	05	—	10	50	mV	Io=5mA~200mA
		06	—	10	60		
		07	—	10	70		
		08	—	10	80		
		09	—	10	90		
		10	—	10	100		
		12	—	10	120		
		15	—	10	150		
		18	—	10	180		
		20	—	10	200		
		24	—	10	240		
Output Noise Voltage	Vn	05	—	40	—	μV	f=10Hz~100kHz
		06	—	60	—		
		07	—	70	—		
		08	—	80	—		
		09	—	90	—		
		10	—	100	—		
		12	—	110	—		
		15	—	130	—		
		18	—	140	—		
		20	—	150	—		
		24	—	170	—		
Bias Current	Ib	Common	—	4.5	6.0	mA	Io=0mA
Bias Current Change 1	Ib1	Common	—	—	0.5	mA	Io=5mA~350mA
Bias Current Change 2	Ib2	05	—	—	0.8	mA	Vin:8~25V, Io=200mA
		06	—	—	0.8		Vin:9~25V, Io=200mA
		07	—	—	0.8		Vin:10~25V, Io=200mA
		08	—	—	0.8		Vin:10.5~25V, Io=200mA
		09	—	—	0.8		Vin:12~25V, Io=200mA
		10	—	—	0.8		Vin:13~25V, Io=200mA
		12	—	—	0.8		Vin:14.5~30V, Io=200mA
		15	—	—	0.8		Vin:17.5~30V, Io=200mA
		18	—	—	0.8		Vin:21~33V, Io=200mA
		20	—	—	0.8		Vin:23~33V, Io=200mA
		24	—	—	0.8		Vin:27~33V, Io=200mA
Short-Circuit Output Current	Ios	05/06/07/08	—	0.4	—	A	Vin=25V
		09/10/12/15/18/20/24	—	0.17	—		Vin=30V
Output Resistance	Ro	05	—	9	—	mΩ	f=1kHz
		06	—	10	—		
		07	—	11	—		
		08	—	12	—		
		09	—	13	—		
		10	—	14	—		
		12	—	16	—		
		15	—	19	—		
		18	—	22	—		
		20	—	25	—		
		24	—	37	—		

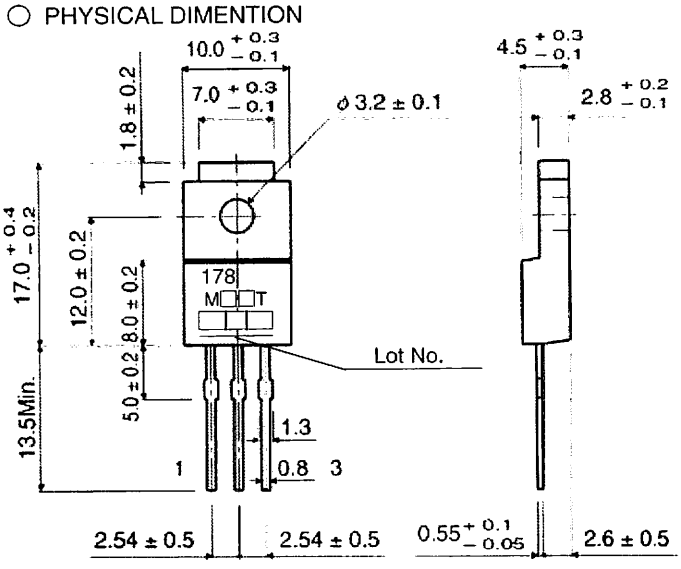
○ Output Voltage and Marking

Type	Marking	Output Voltage(V)
BA178M05T	178M05T	5
BA178M06T	178M06T	6
BA178M07T	178M07T	7
BA178M08T	178M08T	8

Type	Marking	Output Voltage(V)
BA178M09T	178M09T	9
BA178M10T	178M10T	10
BA178M12T	178M12T	12
BA178M15T	178M15T	15

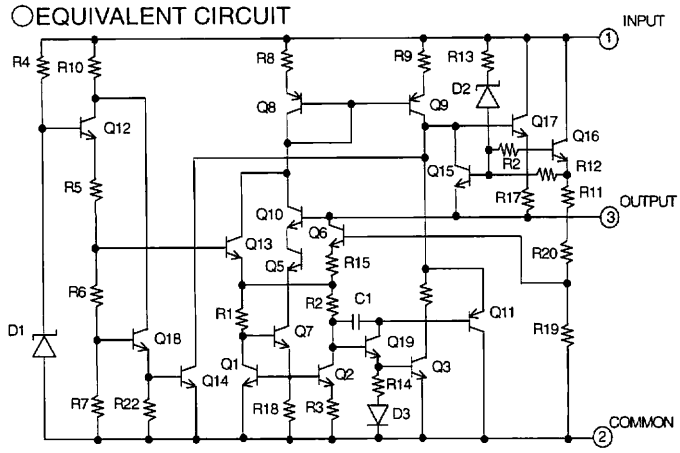
Type	Marking	Output Voltage(V)
BA178M18T	178M18T	18
BA178M20T	178M20T	20
BA178M24T	178M24T	24

○ PHYSICAL DIMENTION



TO220FP-3 (Unit:mm)

○EQUIVALENT CIRCUIT



○Pin number, Pin name

Pin number	Pin name
1	INPUT
2	COMMON
3	OUTPUT

○NOTES FOR USE

(1) Absolute maximum range
We are careful enough for quality control about this IC. So, there is no problem under normal operation, excluding that it exceeds the absolute maximum ratings. However, Absolute Maximum Ratings are those values beyond which the life of a device may be destroyed we cannot be defined the failure mode, such as short mode or open mode. Therefore physical security countermeasure, like fuse, is to be given when a specific mode to be beyond absolute maximum ratings is considered.

(2) Ground voltage
Make setting of the potential of the GND terminal so that it will be maintained at the minimum in any operating state. Furthermore, check to be sure no terminals are at a potential lower than the GND voltage including an actual electric transient.

(3) Thermal design
When you do the kind of use which exceeds Pd, It may be happened to deteriorating IC original quality such as decrease of electric current ability with chip temperature rise. Do not exceed the power dissipation (Pd) of the package specification rating under actual operation, and please design enough temperature margins.

(4) Short circuit mode between terminals and wrong mounting
Do not mount the IC in the wrong direction and be careful about the reverse-connection of the power connector.
Moreover, this IC might be destroyed when the dust short the terminals between them or GND.

(5) Operation in the strong electromagnetic field
Malfunction may be happened when the device is used in the strong electromagnetic field.

(6) ASO
Do not exceed the maximum ASO and the absolute maximum ratings of the output transistor.

(7) Thermal shutdown circuit
The thermal shutdown circuit (TSD circuit) is built in this product. When IC chip temperature become higher, the thermal shutdown circuit operates and turns output off. The thermal shutdown circuit, which is aimed at isolating the LSI from thermal runaway as much as possible, is not aimed at the protection or guarantee of the LSI. Therefore, do not continuously use the LSI with this circuit operating or use the LSI assuming its operation.

(8) GND wiring pattern
Use separate ground lines for control signals and high current power driver outputs. Because these high current outputs that flows to the wire impedance changes the GND voltage for control signal. Therefore, each ground terminal of IC must be connected at the one point on the set circuit board. As for GND of external parts, it is similar to the above-mentioned.

(9) Internal circuits could be damaged if there are modes in which the electric potential of the application's input and GND are the opposite of the electric potential of the various outputs. Use of a diode or other such bypass is recommended.

(10) We recommend to put Diode for protection purpose in case of output pin connected with large load of impedance or reserve current occurred at initial and output off.

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