

STRUCTURE Silicon Monolithic Integrated Circuit

TYPE Three-Terminal Regulator

PRODUCT SERIES **BA178MXXFP**

FEATURE Output current up to 0.5A

**ABSOLUTE MAXIMUM RATING (Ta=25°C)**

Parameter	Symbol	Limit	Unit
Input Voltage	Vin	35	V
Power Dissipation 1	Pd1	1 <sup>*1</sup>	W
Power Dissipation 2	Pd2	10 <sup>*2</sup>	W
Output Current	Iout	0.5 <sup>*3</sup>	A
Operating Temperature Range	Topr	-40~+85	°C
Storage Temperature Range	Tstg	-55~+150	°C
Maximum Junction Temperature	Tjmax	150	°C

\*1 Derating is done 8mW/°C for temperatures above Ta=25°C.

\*2 Derating is done 80mW/°C for temperatures above Ta=25°C, Mounted on infinity Aluminium heat sink.

\*3 Pd, ASO should not be exceeded.

**RECOMMENDED OPERATING CONDITIONS (Ta=-40~+85°C)**

Parameter	Symbol	Type	Min	Max	Unit
Input Voltage	Vin	BA178M05FP	7.5	25	V
		BA178M06FP	8.5	21	
		BA178M07FP	9.5	22	
		BA178M08FP	10.5	23	
		BA178M09FP	11.5	24	
		BA178M10FP	12.5	25	
		BA178M12FP	15	27	
		BA178M15FP	17.5	30	
		BA178M18FP	21	33	
		BA178M20FP	23	33	
		BA178M24FP	27	33	
Output Current	I <sub>o</sub>	Common	—	0.5 <sup>*3</sup>	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.

**Application example**

- ROHM cannot provide adequate confirmation of patents.
- The product described in this specification is designed to be used with ordinary electronic equipment or devices (such as audio-visual equipment, office-automation equipment, communications devices, electrical appliances, and electronic toys).  
Should you intend to use this product with equipment or devices which require an extremely high level of reliability and the malfunction of which would directly endanger human life (such as medical instruments, transportation equipment, aerospace machinery, nuclear-reactor controllers, fuel controllers and other safety devices), please be sure to consult with our sales representative in advance.
- ROHM assumes no responsibility for use of any circuits described herein, conveys no license under any patent or other right, and makes no representations that the circuits are free from patent infringement.

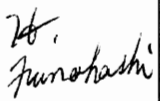
DESIGN

CHECK

APPROVAL

DATE: Apr/22/05

SPECIFICATION No. : TSZ02201-BA178MXXFP-1-2

REV. B

**ROHM CO., LTD.**

○ ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, Ta=25°C, 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	Io=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/°C	Io=5mA, Tj=0~125°C
		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°C
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		
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		
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	—		
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
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	—				

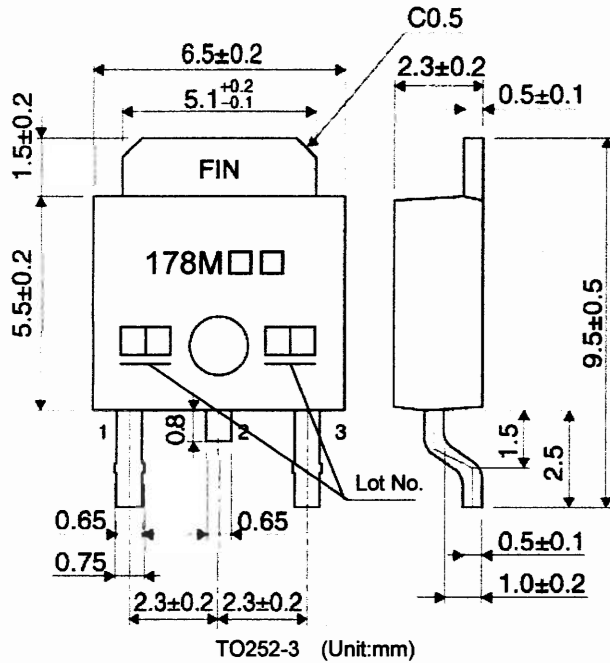
○ Output Voltage and Marking

Type	Marking	Output Voltage(V)
BA178M05FP	178M05	5
BA178M06FP	178M06	6
BA178M07FP	178M07	7
BA178M08FP	178M08	8

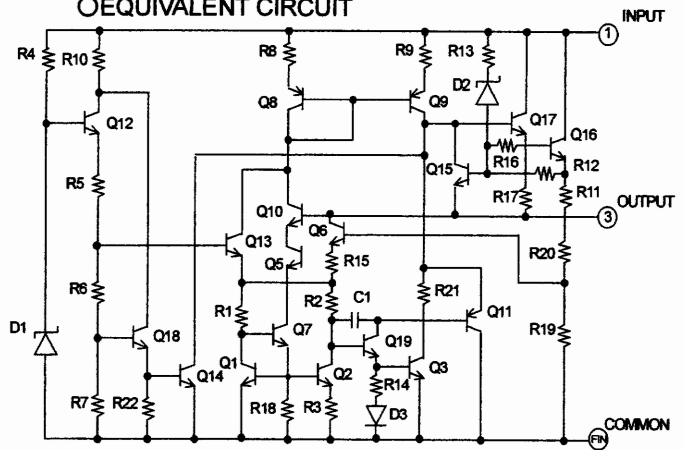
Type	Marking	Output Voltage(V)
BA178M09FP	178M09	9
BA178M10FP	178M10	10
BA178M12FP	178M12	12
BA178M15FP	178M15	15

Type	Marking	Output Voltage(V)
BA178M18FP	178M18	18
BA178M20FP	178M20	20
BA178M24FP	178M24	24

○ PHYSICAL DIMENTION



○ EQUIVALENT CIRCUIT



○ Pin number, Pin name

Pin number	Pin name
1	INPUT
2	N.C.
3	OUTPUT
FIN	COMMON

○ 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.

# Notice

## Precaution on using ROHM Products

- Our Products are designed and manufactured for application in ordinary electronic equipment (such as AV equipment, OA equipment, telecommunication equipment, home electronic appliances, amusement equipment, etc.). If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment <sup>(Note 1)</sup>, transport equipment, traffic equipment, aircraft/spacecraft, nuclear power controllers, fuel controllers, car equipment including car accessories, safety devices, etc.) and whose malfunction or failure may cause loss of human life, bodily injury or serious damage to property ("Specific Applications"), please consult with the ROHM sales representative in advance. Unless otherwise agreed in writing by ROHM in advance, ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of any ROHM's Products for Specific Applications.

(Note1) Medical Equipment Classification of the Specific Applications

JAPAN	USA	EU	CHINA
CLASS III	CLASS III	CLASS II b	CLASS III
CLASS IV		CLASS III	

- ROHM designs and manufactures its Products subject to strict quality control system. However, semiconductor products can fail or malfunction at a certain rate. Please be sure to implement, at your own responsibilities, adequate safety measures including but not limited to fail-safe design against the physical injury, damage to any property, which a failure or malfunction of our Products may cause. The following are examples of safety measures:
  - Installation of protection circuits or other protective devices to improve system safety
  - Installation of redundant circuits to reduce the impact of single or multiple circuit failure
- Our Products are designed and manufactured for use under standard conditions and not under any special or extraordinary environments or conditions, as exemplified below. Accordingly, ROHM shall not be in any way responsible or liable for any damages, expenses or losses arising from the use of any ROHM's Products under any special or extraordinary environments or conditions. If you intend to use our Products under any special or extraordinary environments or conditions (as exemplified below), your independent verification and confirmation of product performance, reliability, etc. prior to use, must be necessary:
  - Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
  - Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
  - Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, and NO<sub>2</sub>
  - Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
  - Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
  - Sealing or coating our Products with resin or other coating materials
  - Use of our Products without cleaning residue of flux (Exclude cases where no-clean type fluxes is used. However, recommend sufficiently about the residue.) ; or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
  - Use of the Products in places subject to dew condensation
- The Products are not subject to radiation-proof design.
- Please verify and confirm characteristics of the final or mounted products in using the Products.
- In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse. is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.
- De-rate Power Dissipation depending on ambient temperature. When used in sealed area, confirm that it is the use in the range that does not exceed the maximum junction temperature.
- Confirm that operation temperature is within the specified range described in the product specification.
- ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

## Precaution for Mounting / Circuit board design

- When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.
- In principle, the reflow soldering method must be used on a surface-mount products, the flow soldering method must be used on a through hole mount products. If the flow soldering method is preferred on a surface-mount products, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

**Precautions Regarding Application Examples and External Circuits**

1. If change is made to the constant of an external circuit, please allow a sufficient margin considering variations of the characteristics of the Products and external components, including transient characteristics, as well as static characteristics.
2. You agree that application notes, reference designs, and associated data and information contained in this document are presented only as guidance for Products use. Therefore, in case you use such information, you are solely responsible for it and you must exercise your own independent verification and judgment in the use of such information contained in this document. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of such information.

**Precaution for Electrostatic**

This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding the Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of Ionizer, friction prevention and temperature / humidity control).

**Precaution for Storage / Transportation**

1. Product performance and soldered connections may deteriorate if the Products are stored in the places where:
  - [a] the Products are exposed to sea winds or corrosive gases, including Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, and NO<sub>2</sub>
  - [b] the temperature or humidity exceeds those recommended by ROHM
  - [c] the Products are exposed to direct sunshine or condensation
  - [d] the Products are exposed to high Electrostatic
2. Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.
3. Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.
4. Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

**Precaution for Product Label**

A two-dimensional barcode printed on ROHM Products label is for ROHM's internal use only.

**Precaution for Disposition**

When disposing Products please dispose them properly using an authorized industry waste company.

**Precaution for Foreign Exchange and Foreign Trade act**

Since concerned goods might be fallen under listed items of export control prescribed by Foreign exchange and Foreign trade act, please consult with ROHM in case of export.

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