TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT   SILICON MONOLITHIC

T A 8 2 1 4 K

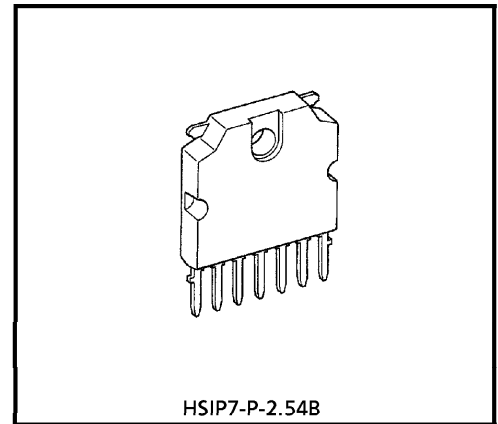## MULTI OUTPUT VOLTAGE REGULATOR (8.3V OUTPUT)

The TA8214K is voltage regulator IC, designed for car audio use, has built-in 4 outputs. (Fixed 1 output and changed 3 outputs.)
The input-output differential voltage : V_{DIF} is very small. ($V_{DIF} = 0.3V$ (Typ.))
Because each outputs consist of PNP Transistor. In addition, protection of over voltage, output short and thermal shut down are involved.

HSIP7-P-2.54B

Weight : 2.19g (Typ.)

FEATURES

● 4 Channel Outputs
   OUT1 : 8.3V (Typ.) / 100mA (Max.) .... Fixed Output
   OUT2 : 8.3V (Typ.) / 100mA (Max.) ⎫
   OUT3 : 8.3V (Typ.) / 300mA (Max.) ⎬ Switchable Output
   OUT4 : 8.3V (Typ.) / 100mA (Max.) ⎭

● Very Small Input-Output Differential Voltage
   $V_{DIF} = 0.3V$ (Typ.)

● Built-in Various Protection Circuits
   Over Voltage, Output Short, Thermal Shut Down

● Input Operating Voltage
   $V_{IN (opr)} = 9.3 \sim 18V$

BLOCK DIAGRAM
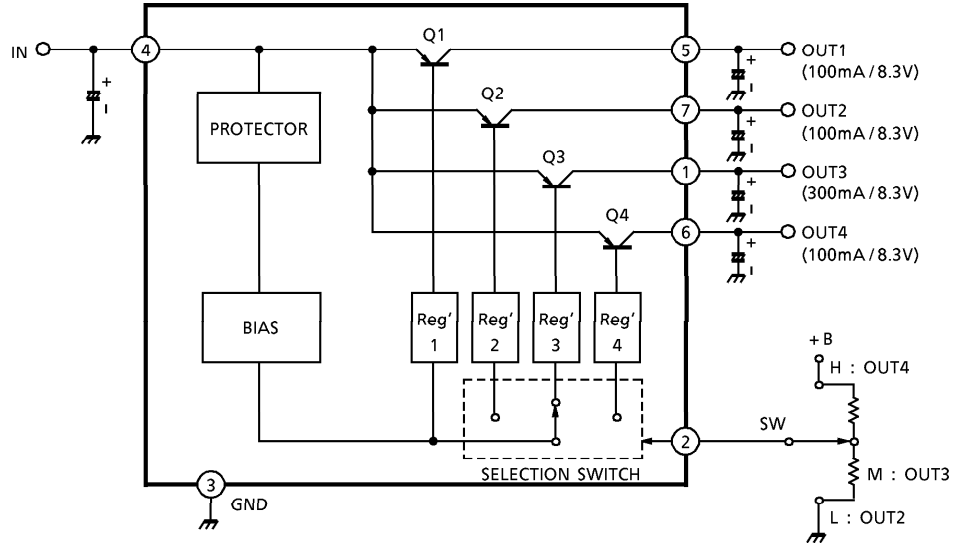
CAUTION FOR USE AND METHOD OF APPLICATION

(1) IC protective diode in $V_{IN} < V_{OUT}$ mode : D

When surge voltage is applied to the input/output terminals of IC or V_{OUT} becomes larger than V_{IN} ($V_{IN} < V_{OUT}$) at the time of power ON/OFF, insert a high speed switching diode : D.

(2) Power limiting register : R_{SD}

If V_{IN} is too high, insert a power limiting register : R_{SD} to reduce power dissipation of IC.

(3) Input surge protective Zener diode : ZD

Though an over voltage protective circuit (For positive surge) is built in, if excessive surge is input, insert a surge protective Zener diode : ZD.
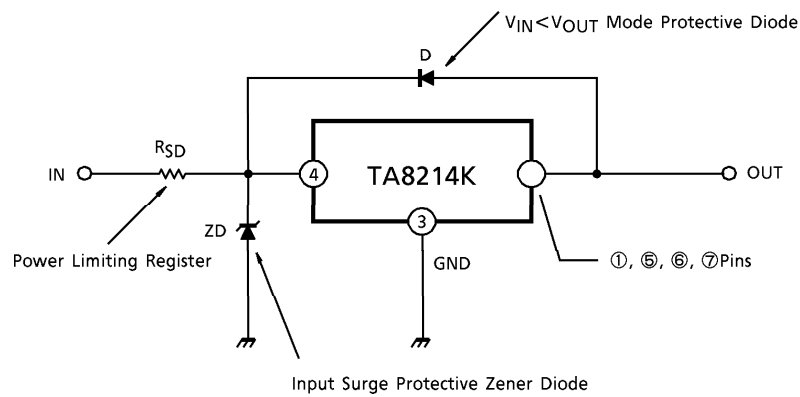
(Fig.1)

(4) Design of heat sink

Thermal resistance : $\theta_{j\text{-}T}$ of the package of this IC can be obtained from (Fig.2) according to the following expression :

$$\theta_{j\text{-}T} = \frac{150°C - 75°C}{15W} = 5°C/W$$

(Terminal from the junction to the TAB)···Expression ①

Thermal resistance : θ_{HS} of the heat sink attached to this IC is decided by the following expression :

$$\theta_{HS} = \frac{T_j\ MAX - Ta}{P_D\ MAX} - \theta_{j\text{-}T} \cdots \text{Expression } ②$$

Where, P_D MAX expresses maximum power dissipation in this IC.

P_D MAX =
$(V_{IN}$ (MAX) $- V_{OUT}$ (MIN)$) \times ($I1, I6, I7 + I5 + I_B (MAX)$)$
$\cdots$ Expression ③

For instance, if this IC is used under the conditions of V_{IN} (MAX) = 16V, I1 = 300mA, I5 = 100mA and Ta = up to 85°C from Expression ③,

P_D – Ta

① INFINITE HEAT SINK
② 64cm² × 2mm Aℓ HEAT SINK (7°C / W)
③ 25cm² × 2mm Aℓ HEAT SINK (12°C / W)
④ NO HEAT SINK

ALLOWABLE POWER DISSIPATION P_D (W)
AMBIENT TEMPERATURE Ta (°C)
(Fig.2)

P_D MAX = (16V – 8V) × (300mA + 100mA + 35mA) = 3.48W Substituting P_D MAX = 3.48W into Expression ②, above, θ_{HS} is obtained as follows :

$$\theta_{HS} = \frac{150°C - 85°C}{3.48W} - 5°C / W = 13.7°C / W$$

Accordingly, a heat sink having θ_{HS} = 13.7°C / W becomes necessary and referring to (Fig.3), it can be set to be an aluminum plate 2mm in thickness and about 270m² in area.
However, when a heat sink is actually mounted to IC, the contact resistance is generated on its contacting surface and heat generated on its contacting surface and heat conduction becomes worse.
Therefore, a heat sink shall be designed with a sufficient margin of heat sink given.

THERMAL RESISTANCE (°C / W)

1mm Fe PLATE
2mm Fe PLATE
1mm Aℓ PLATE
1mm STEEL PLATE
2mm Aℓ PLATE

HEAT SINK AREA (cm²)
HEAT SINK AREA vs THERMAL RESISTANCE
(Fig.3)

Further, the TAB shall be grounded or kept open when the IC is used.

(5) Output capacitor for preventing the oscillation.

Type and capacity of a capacitor to be used between the output and GND shall be decided after thoroughly examining print pattern, route of connection, at high / low temperature, etc.
In particular, if inductor component is connected to the output, it is necessary to make the capacity larger than the recommended value.
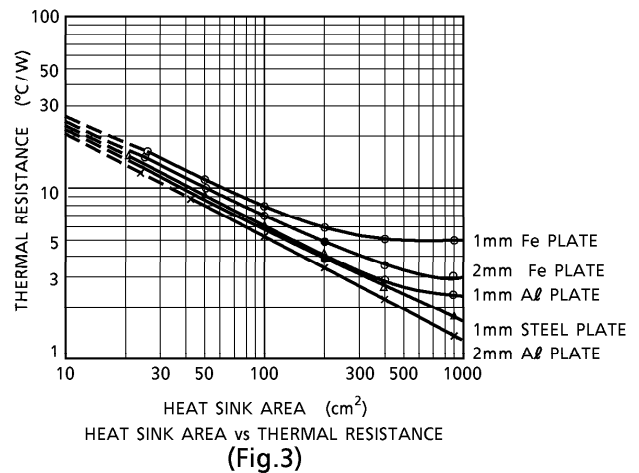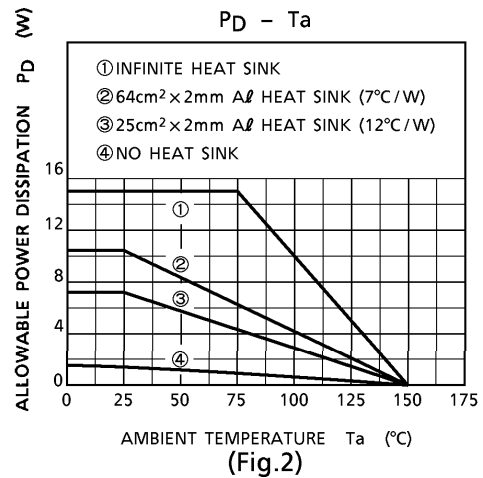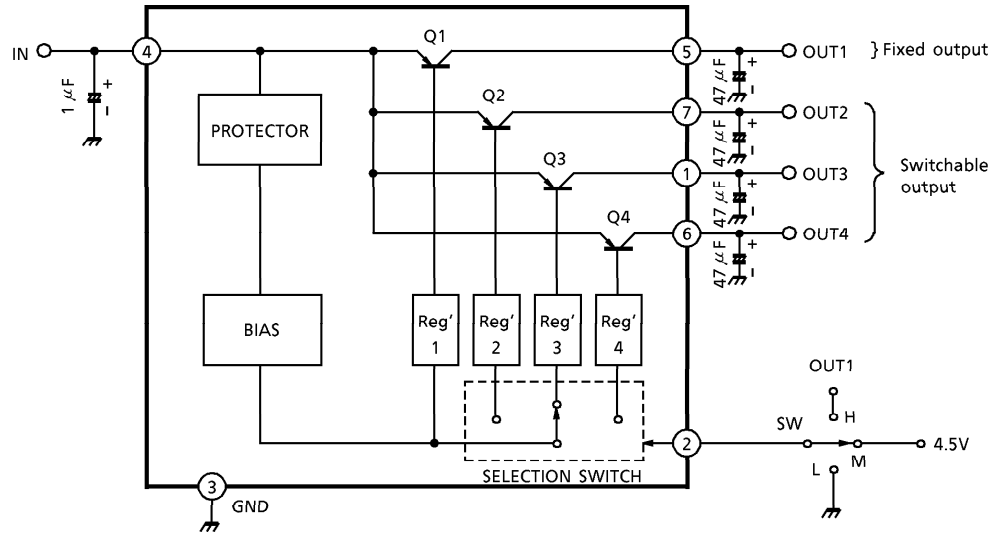
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Peak Input Voltage (0.2s)	$V_{IN (surge)}$	50	V
DC Input Voltage	$V_{IN (DC)}$	25	V
Operating Input Voltage	$V_{IN (opr)}$	18	V
Power Dissipation	P_D	15	W
Operating Temperature	T_{opr}	$-30 \sim 85$	°C
Storage Temperature	T_{stg}	$-55 \sim 150$	°C

ELECTRICAL CHARACTERISTICS (Unless otherwise specified, V_{IN} = 13.2V, Ta = 25°C)

CHARACTERISTIC		SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	OUT1	V5	—	I5 = 100mA		8.0	8.3	8.6	V
	OUT2	V7	—	I7 = 100mA		8.0	8.3	8.6	
	OUT3	V1	—	I1 = 300mA		8.0	8.3	8.6	
	OUT4	V6	—	I6 = 100mA		8.0	8.3	8.6	
Bias Current		I_B	—	I5, 7, 1, 6 = 0		—	12	35	mA
Input Variation		ΔV_{o1}	—	V_{IN} = 9.3~18V I5, 7, 6 = 100mA, I1 = 300mA		—	—	±50	mV
Load Variation		ΔV_{o2}	—	I5, 7, 6 = 0~100mA I1 = 0~300mA		—	—	±50	mV
Input-Output Voltage Difference		V_{DIF}	—	I5, 7, 6 = 100mA, I1 = 300mA		—	0.3	0.6	V
Ripple Rejection Ratio		R.R.	—	f = 100Hz, V_{ripple} = 0.775V_{rms} (0dBm) I5, 7, 6 = 100mA, I1 = 300mA		50	65	—	dB
Max. Output Current	OUT 1, 2, 4	$I_{MAX\ 5, 7, 6}$	—	—		100	—	—	mA
	OUT3	$I_{MAX\ 1}$	—	—		300	—	—	
Output Voltage Temperature Coefficient		TC_{VO}	—	I5, 7, 6 = 100mA, I1 = 300mA		—	+1	—	mV/ deg
Control Terminal Input Resistance		R_{CONT}	—	—		6	10	—	kΩ
Control Voltage		V_H	—	V6 (OUT4) : ON	Ta = −30 ~80°C	7.0	—	V_{IN}	V
		V_M	—	V1 (OUT3) : ON		2.8	—	5.5	
		V_L	—	V7 (OUT2) : ON		0	—	1.2	

TEST CIRCUIT

(Note 1) Heat sink must be used with its fin grounded or in "open" status.
(Note 2) When inductor element is connected to output, increase the capacity value of oscillation stop capacitor between output and GND.
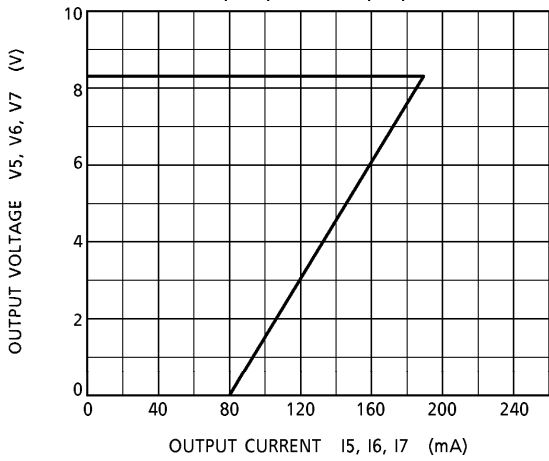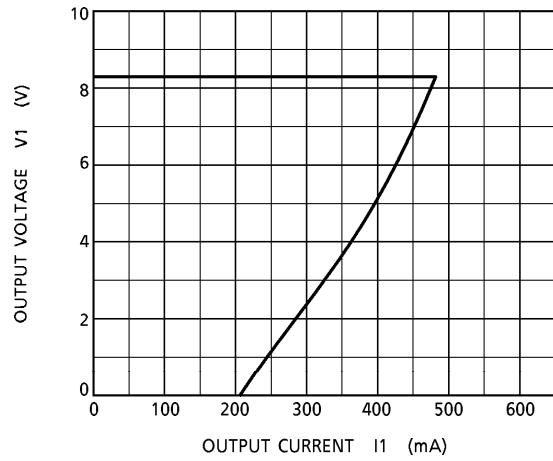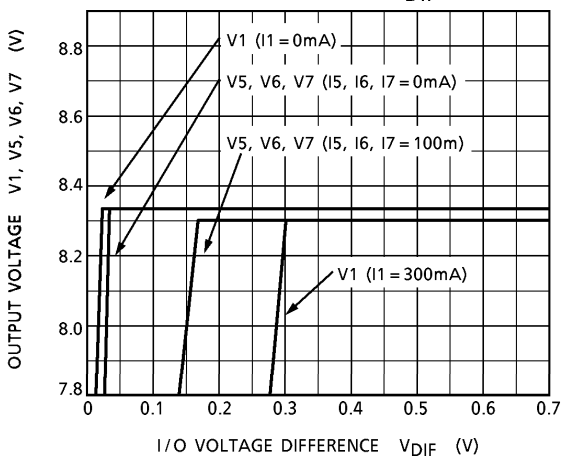
V5, V6, V7 − V$_{IN}$
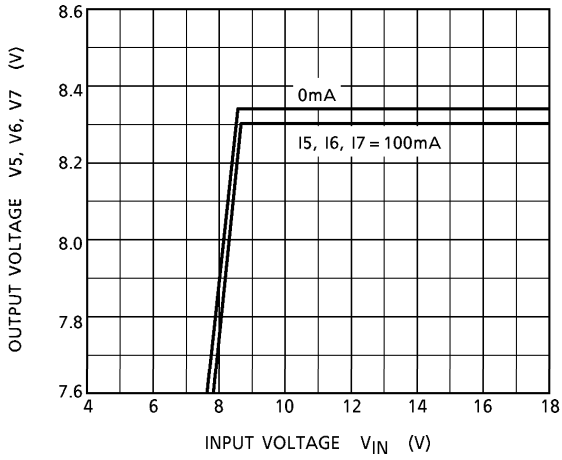
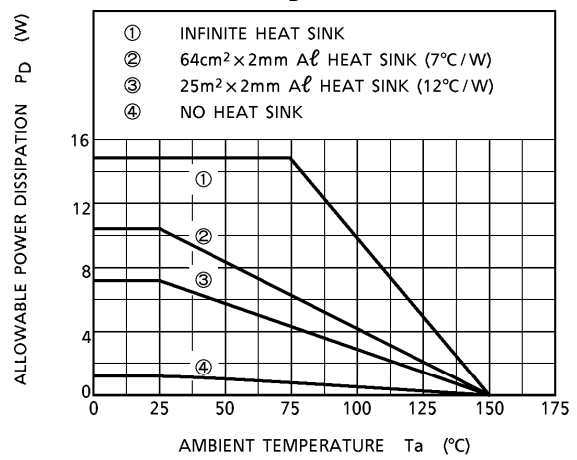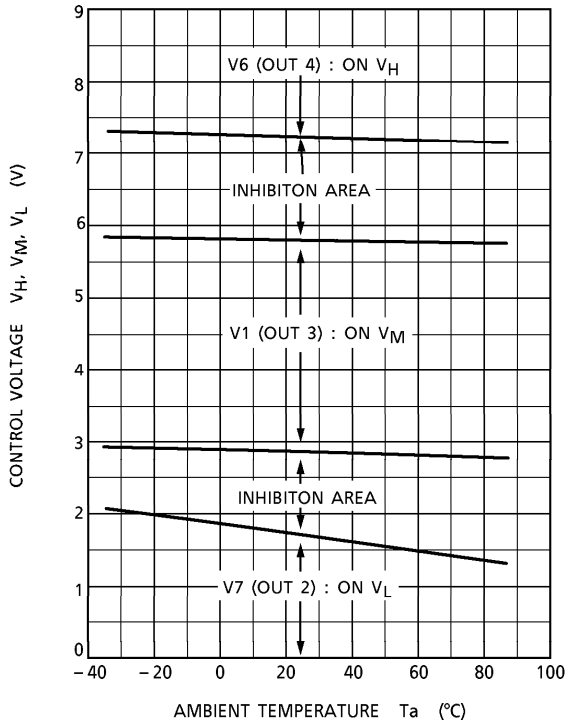V1 − V$_{IN}$
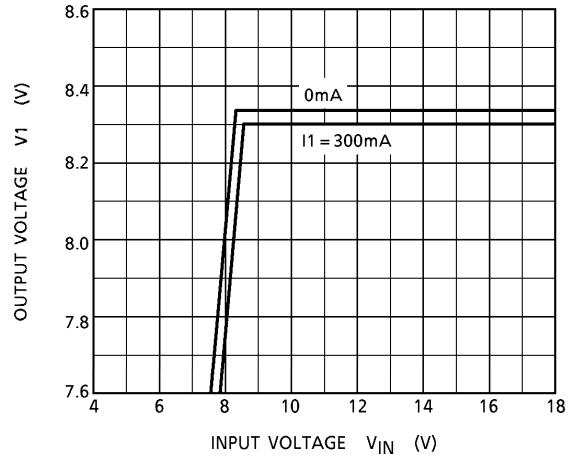
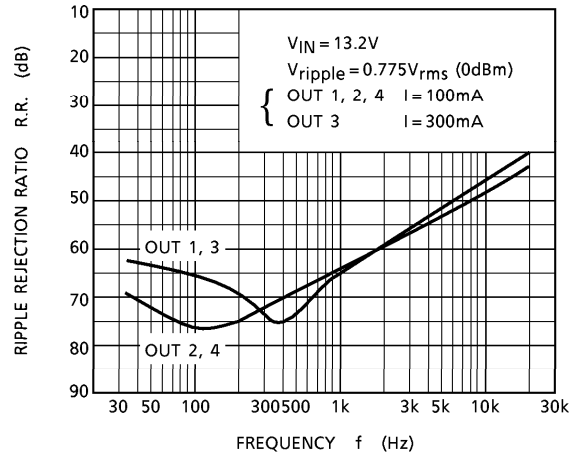V5, V6, V7 − I5, I6, I7

V1 − I1

V1, V5, V6, V7 − V$_{DIF}$

P$_D$ − Ta

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② 64cm² × 2mm Aℓ HEAT SINK (7°C / W)
③ 25m² × 2mm Aℓ HEAT SINK (12°C / W)
④ NO HEAT SINK

V_H, V_M, V_L — Ta

CONTROL VOLTAGE V_H, V_M, V_L (V)

AMBIENT TEMPERATURE Ta (°C)

V6 (OUT 4) : ON V_H

INHIBITON AREA

V1 (OUT 3) : ON V_M

INHIBITON AREA

V7 (OUT 2) : ON V_L

R. R. — f

RIPPLE REJECTION RATIO R.R. (dB)

FREQUENCY f (Hz)

$V_{IN} = 13.2V$
$V_{ripple} = 0.775V_{rms}$ (0dBm)
OUT 1, 2, 4   I = 100mA
OUT 3   I = 300mA

OUT 1, 3

OUT 2, 4

APPLICATION CIRCUIT
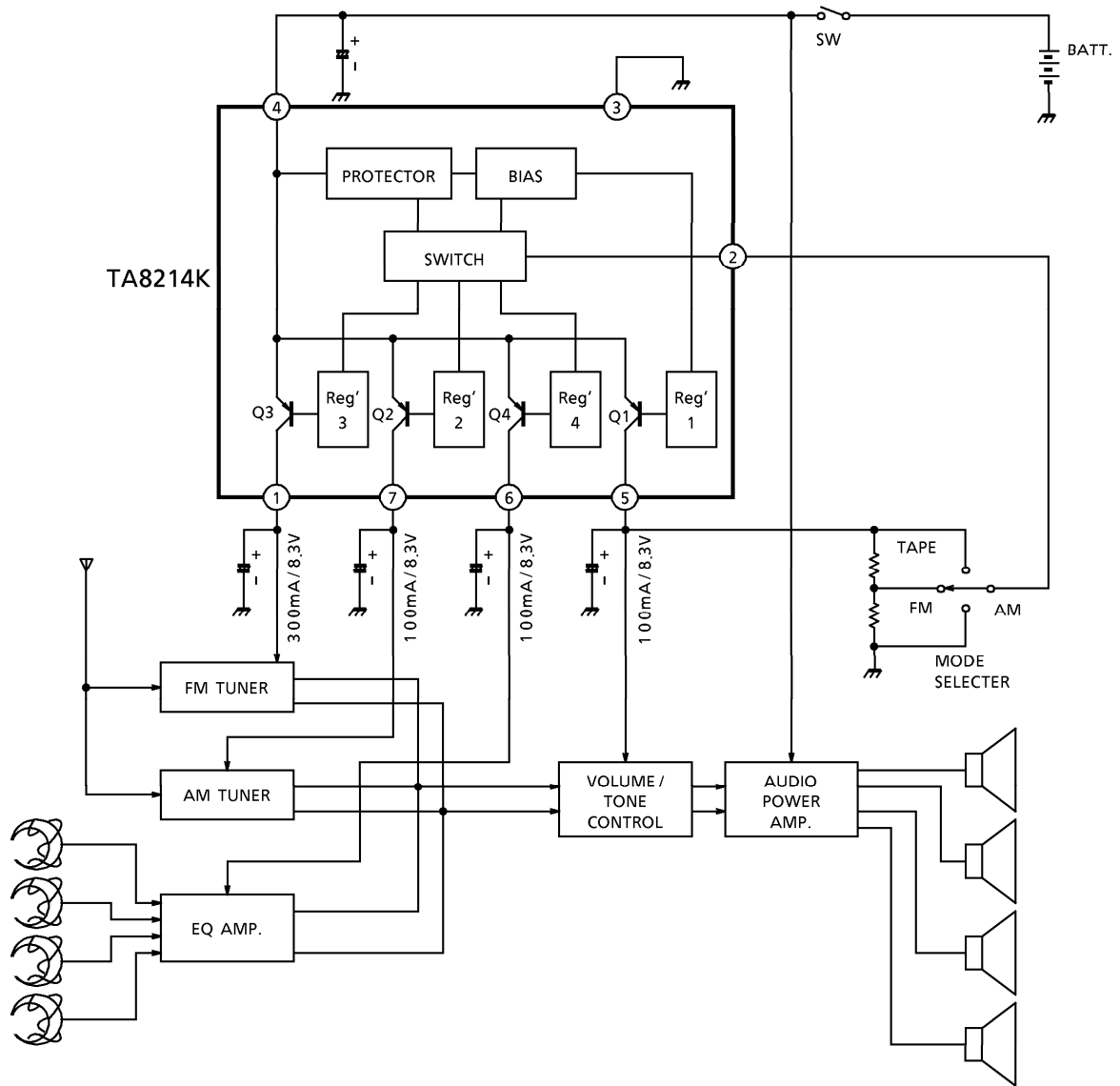
PACKAGE DIMENSIONS

HSIP7-P-2.54B

Unit : mm
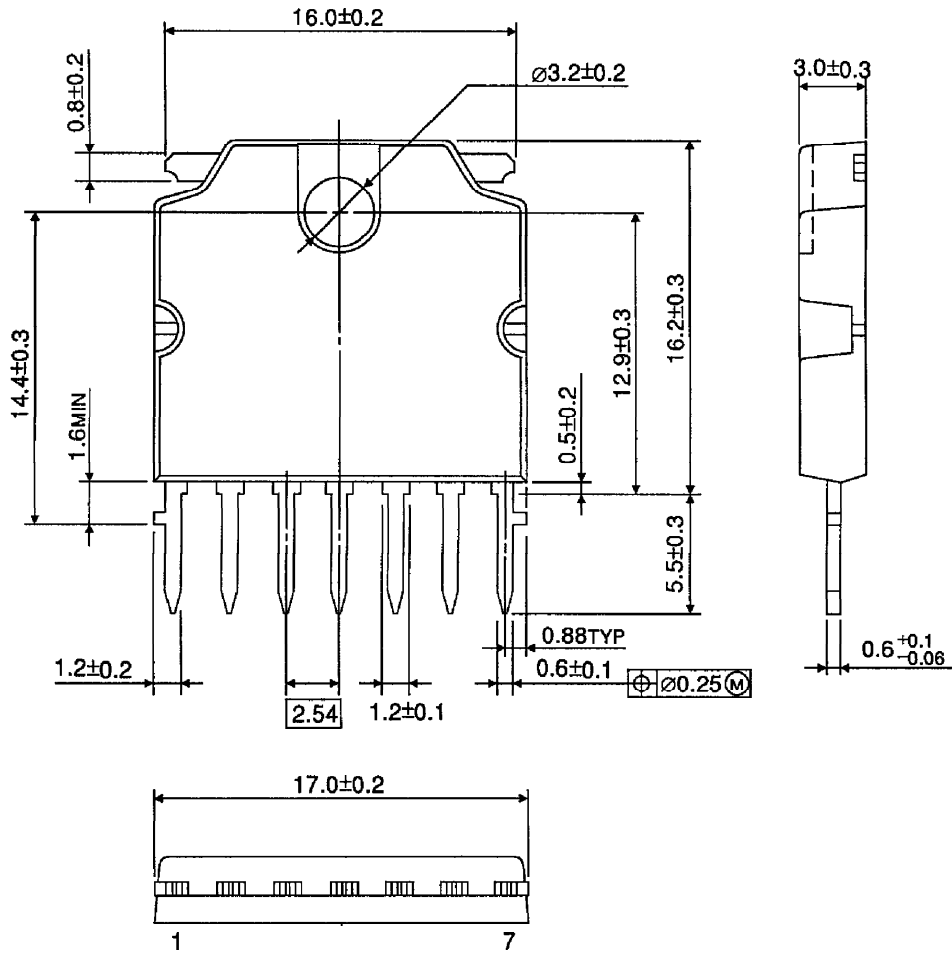
Weight : 2.19g (Typ.)

RESTRICTIONS ON PRODUCT USE

2001-06-25