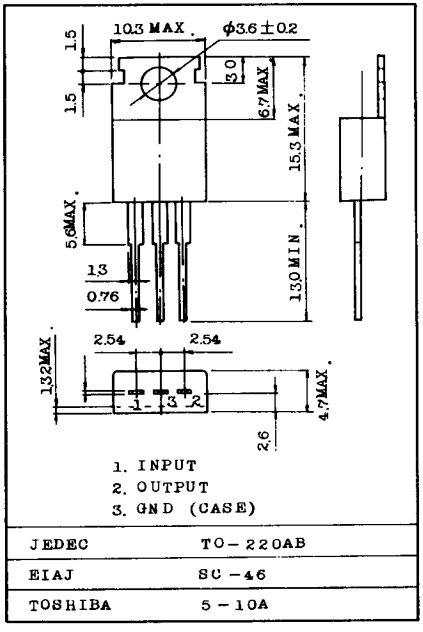
TA78005AP ~ TA78015AP

THREE TERMINAL POSITIVE VOLTAGE REGULATORS
5V, 9V, 12V, 15V,

- Suitable for C-MOS, TTL, the other Digital IC's Power Supply
- Internal Thermal Overload Protection
- Internal Short Circuit Current Limiting
- Output Current in excess of 1A

Unit in mm



1. INPUT
2. OUTPUT
3. GND (CASE)

JEDEC	TO-220AB
EIAJ	SC-46
TOSHIBA	5-10A

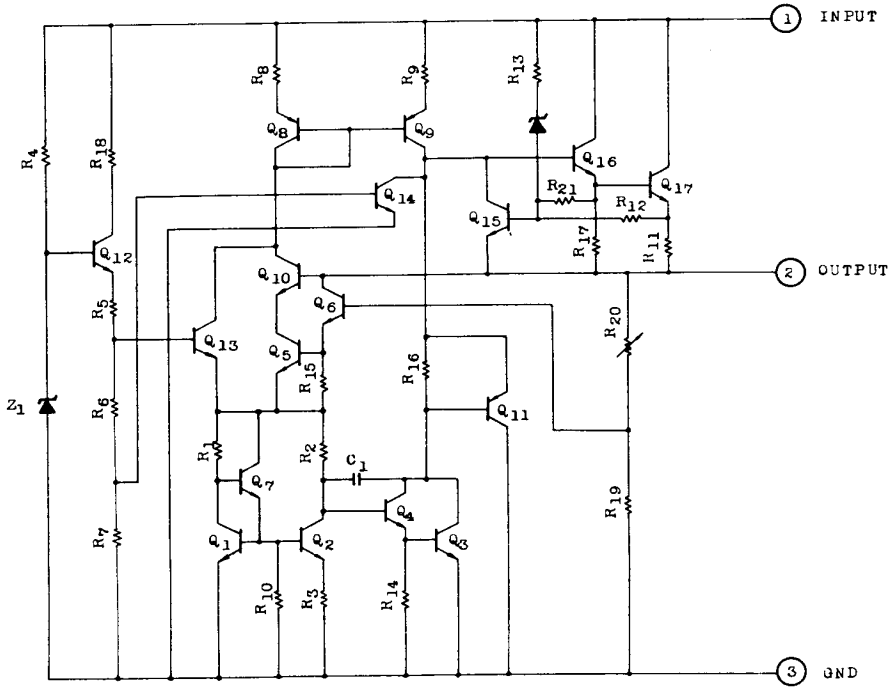
MOUNTING KIT No. AC75.

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Input Voltage	TA78005AP ~ TA78015AP	V_{IN}	35	V
Power Dissipation (Note)		P_D	20.8	W
Operating Temperature		T_{opr}	-30 ~ 75	°C
Storage Temperature		T_{stg}	-55 ~ 150	°C

Note : Tc=25°C

EQUIVALENT CIRCUIT



ELECTRICAL CHARACTERISTICS (V_{IN}=10V, I_{OUT}=500mA, 0°C≦T_j≦125°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	T_j=25°C, I_{OUT}=100mA		4.8	5.0	5.2	V
Input Regulation	Reg.line	1	T_j=25°C	7.0V≦V_{IN}≦2.5V	-	3	100	mV
				8.0V≦V_{IN}≦12V	-	1	50	
Load Regulation	Reg.load	1	T_j=25°C	5mA≦I_{OUT}≦1.4A	-	15	100	mV
				250mA≦I_{OUT}≦750mA	-	5	50	
Output Voltage	V_{OUT}	1	7.0V≦V_{IN}≦20V 5.0mA≦I_{OUT}≦1.0A, P_o≦15W		4.75	-	5.25	V
Quiescent Current	I_B	1	T_j=25°C, I_{OUT}=5mA		-	4.2	8.0	mA
Quiescent Current Change	ΔI_B	1	7.0V≦V_{IN}≦25V		-	-	1.3	mA
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz≦f≦100kHz I_{OUT}=50mA		-	50	-	μV
Ripple Rejection	RR	1	f=120Hz, 8.0V≦V_{IN}≦18V I_{OUT}=50mA, T_j=25°C		62	78	-	dB
Dropout Voltage	V_D	1	I_{OUT}=1.0A, T_j=25°C		-	2.0	-	V
Short Circuit Current Limit	I_{SC}	1	T_j=25°C		-	1.6	-	A
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT}=5mA, 0°C≦T_j≦125°C		-	-0.6	-	$mV/_{deg}$

ELECTRICAL CHARACTERISTICS (V_{IN}=15V, I_{OUT}=500mA, 0°C ≦ T_j ≦ 125°C)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	T_j=25°C, I_{OUT}=100mA		8.64	9.0	9.36	V
Input Regulation	Reg.line	1	T_j=25°C	11.5V ≦ V_{IN} ≦ 26V	-	7.0	180	mV
				13V ≦ V_{IN} ≦ 19V	-	2.5	90	
Load Regulation	Reg.load	1	T_j=25°C	5mA ≦ I_{OUT} ≦ 1.4A	-	12	180	mV
				250mA ≦ I_{OUT} ≦ 750mA	-	4.0	90	
Output Voltage	V_{OUT}	1	11.5V ≦ V_{IN} ≦ 2.6V 5.0mA ≦ I_{OUT} ≦ 1.0A, Po ≦ 15W		8.55	-	9.45	V
Quiescent Current	I_B	1	T_j=25°C, I_{OUT}=5mA		-	4.3	8.0	mA
Quiescent Current Change	ΔI_B	1	11.5V ≦ V_{IN} ≦ 26V		-	-	1.0	mA
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz ≦ f ≦ 100kHz I_{OUT}=50mA		-	75	-	μV
Ripple Rejection	RR	1	f=120Hz, 12.5V ≦ V_{IN} ≦ 22.5V I_{OUT}=50mA, T_j=25°C		56	72	-	dB
Dropout Voltage	V_D	1	I_{OUT}=1.0A, T_j=25°C		-	2.0	-	V
Short Circuit Current Limit	I_{SC}	1	T_j=25°C		-	1.0	-	A
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT}=5mA, 0°C ≦ T_j ≦ 125°C		-	-1.1	-	$mV/_{deg}$

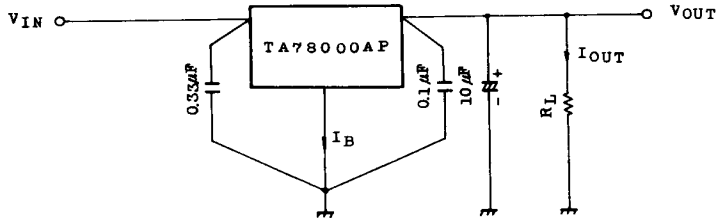
ELECTRICAL CHARACTERISTICS (V_{IN}=19V, I_{OUT}=500mA, 0°C≦T_j≦125°C)

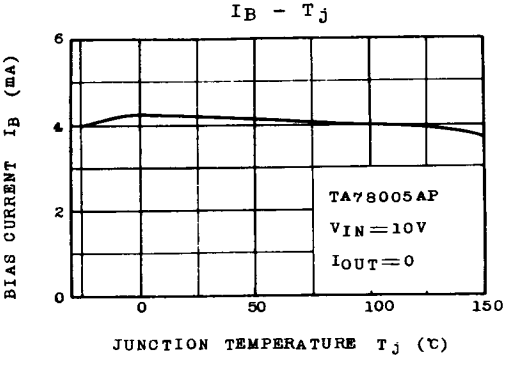
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	T_j=25°C, I_{OUT}=100mA		11.5	12.0	12.5	V
Input Regulation	Reg.line	1	T_j=25°C	14.5V≦V_{IN}≦30V	-	10	240	mV
				16V≦V_{IN}≦22V	-	3	1 20	
Load Regulation	Reg.load	1	T_j=25°C	5mA≦I_{OUT}≦1.4A	-	12	240	mV
				250mA≦I_{OUT}≦750mA	-	4	120	
Output Voltage	V_{OUT}	1	14.5V≦V_{IN}≦27V 5.0mA≦I_{OUT}≦1.0A, P_O≦15W		11.4	-	12.6	V
Quiescent Current	I_B	1	T_j=25°C, I_{OUT}=5mA		-	4.3	8.0	mA
Quiescent Current Change	ΔI_B	1	14.5V≦V_{IN}≦30V		-	-	1.0	mA
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz≦f≦100kHz I_{OUT}=50mA		-	90	-	μV
Repple Rejection	RR	1	f=120Hz, 15V≦V_{IN}≦25V I_{OUT}=50mA, T_j=25°C		55	71	-	dB
Dropout Voltage	V_D	1	I_{OUT}=1.0A, T_j=25°C		-	2.0	-	V
Short Circuit Current	I_{SC}	1	T_j=25°C		-	0.7	-	A
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT}=5mA, 0°C≦T_j≦125°C		-	-1.6	-	mV/deg

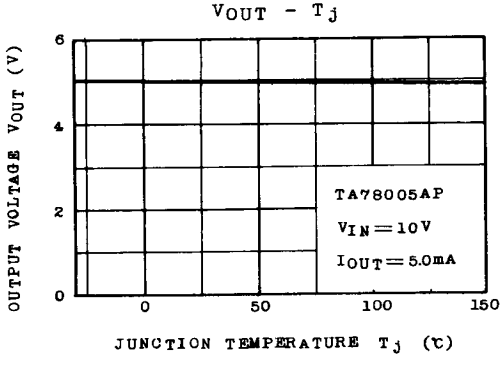
ELECTRICAL CHARACTERISTICS (V_{IN}=23V, I_{OUT}=500mA, 0°C≦T_j≦125°C)

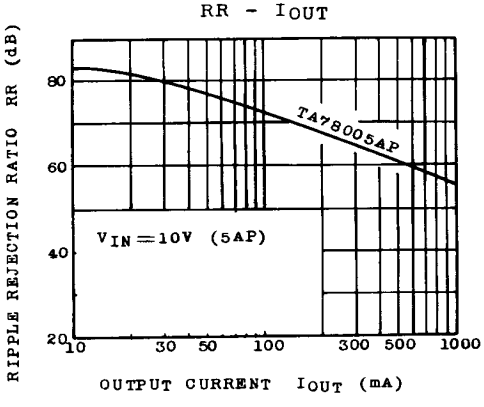
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	T_j=25°C, I_{OUT}=100mA		14.4	15.0	15.6	V
Input Regulation	Reg.line	1	T_j=25°C	17.5V≦V_{IN}≦30V	-	11	300	mV
				20V≦V_{IN}≦26V	-	3	150	
Load Regulation	Reg.load	1	T_j=25°C	5mA≦I_{OUT}≦1.4A	-	12	300	mV
				250mA≦I_{OUT}≦750mA	-	4	150	
Output Voltage	V_{OUT}	1	17.5V≦V_{IN}≦30V 5.0mA≦I_{OUT}≦1.0A, P_O≦15W		14.25	-	15.75	V
Quiescent Current	I_B	1	T_j=25°C, I_{OUT}=5mA		-	4.4	8.0	mA
Quiescent Current Change	ΔI_B	1	17.5V≦V_{IN}≦30V		-	-	1.0	mA
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz≦f≦100kHz I_{OUT}=50mA		-	110	-	μV
Repple Rejection	RR	1	f=120Hz, 18.5V≦V_{IN}≦28.5V I_{OUT}=50mA, T_j=25°C		54	70	-	dB
Dropout Voltage	V_D	1	I_{OUT}=1.0A, T_j=25°C		-	2.0	-	V
Short Circuit Current	I_{SC}	1	T_j=25°C		-	0.5	-	A
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT}=5mA, 0°C≦T_j≦125°C		-	-2.0	-	mV/deg

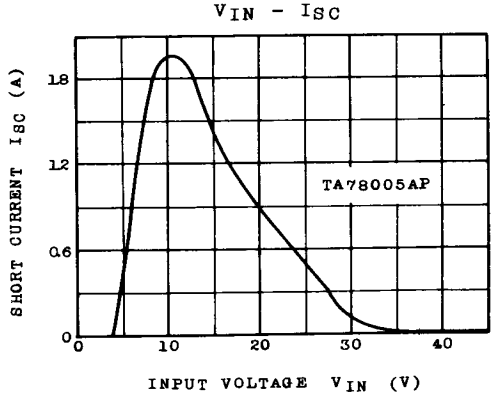
TEST CIRCUIT/STANDARD APPLICATION CIRCUIT



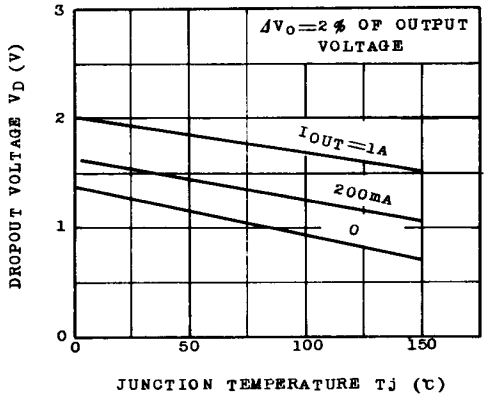




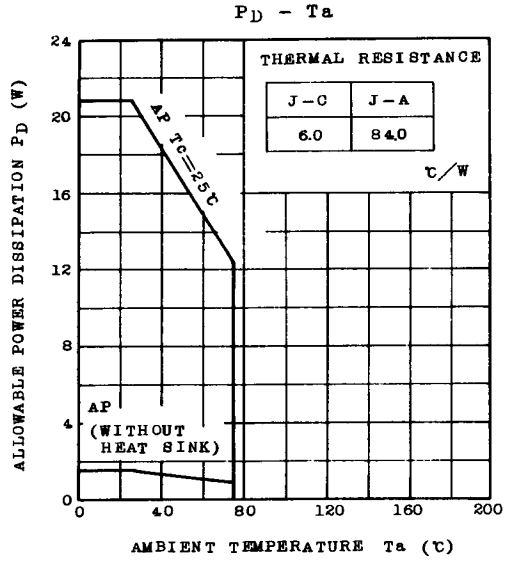




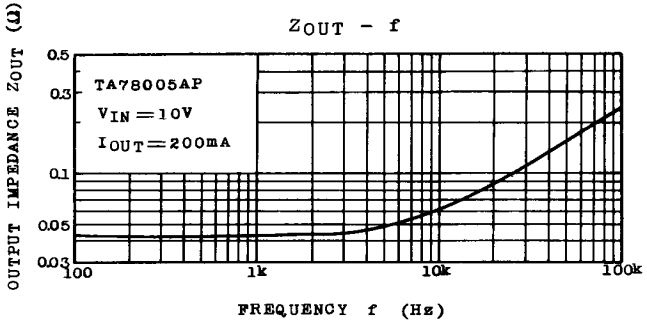
V_D - T_j



P_D - Ta



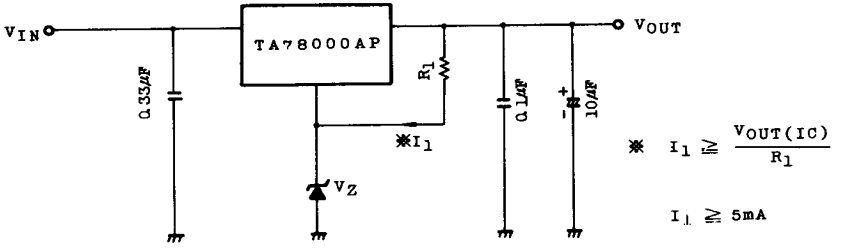
Z_{OUT} - f



APPLICATION CIRCUITS

(1) VOLTAGE BOOST REGULATOR

(a) Voltage boost by use of zener diode

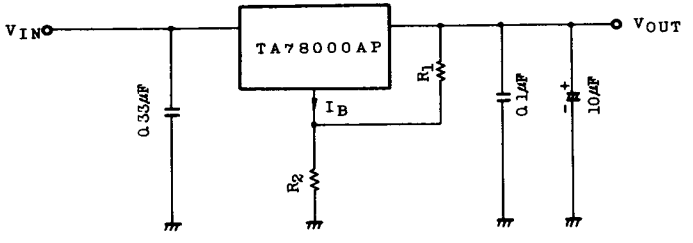


* $I_1 \geqq \frac{V_{OUT(IC)}}{R_1}$

$I_1 \geqq 5mA$

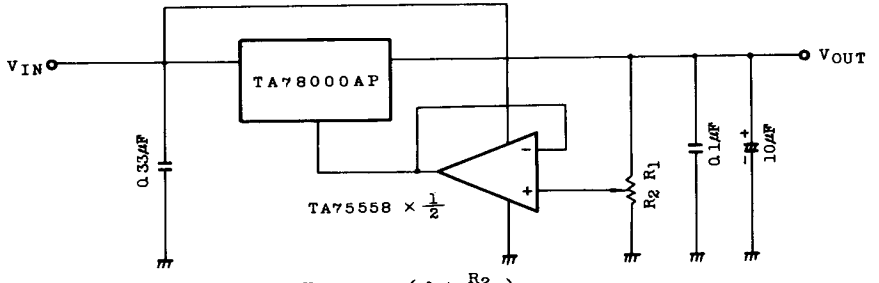
$V_{OUT} = V_{OUT(IC)} + V_Z$

(b) Voltage boost by use of resistor



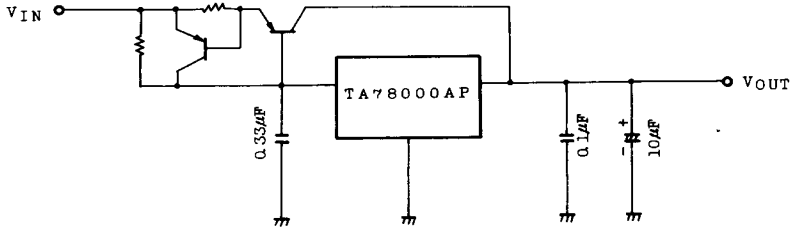
$$V_{OUT} = V_{OUT(IC)} \left(1 + \frac{R_2}{R_1}\right) + R_2 \cdot I_B$$

(c) Adjustable output regulator



$$V_{OUT} = V_{OUT(IC)} \left(1 + \frac{R_2}{R_1}\right)$$

(2) CURRENT BOOST REGULATOR



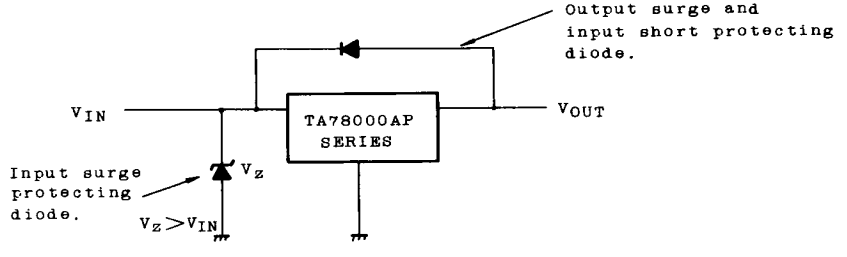
PRECAUTIONS ON APPLICATION

(1) In regard to GND, be careful not to apply a negative voltage to the input/output terminal. Special care is necessary in case of a voltage boost application.

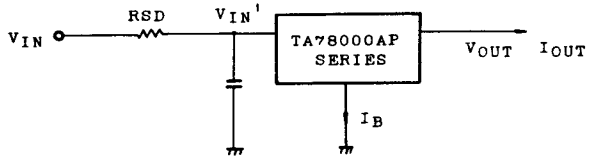
(2) When a surge voltage exceeding maximum rating is applied to the input terminal or when a voltage in excess of the input terminal voltage is applied to the output terminal, the circuit may be destroyed. In the latter case, great care is necessary.

If the input terminal shorts to GND in a state of normal operation, the output terminal voltage becomes higher than the input voltage (GND potential), and the electric charge of a chemical capacitor connected to the output terminal flows into the input side, which may cause the destruction of circuit.

In these cases, take such steps as a zener diode and a general silicon diode are connected to the circuit, as shown in the following figure.



(3) When the input voltage is too high, the power dissipation of three terminal regulator increases because of series regulator, so that the junction temperature rises. In such a case, it is recommended to reduce the power dissipation by inserting the power limiting resistor RSD in the input terminal, and to reduce the junction temperature as a result.



The power dissipation PD of IC is expressed in the following equation.

$$P_D = (V_{IN'} - V_{OUT}) \cdot I_{OUT} + V_{IN'} \cdot I_B$$

If VIN' is reduced below the lowest voltage necessary for the IC, the parasitic oscillation will be caused according to circumstances. In determining the resistance value of RSD, margin design should be made by making reference to the following equation.

$$R_{SD} < \frac{V_{IN} - V_{IN'}}{I_{OUT} + I_B}$$

(4) Connect the input terminal and GND, and the output terminal and GND, by capacitors respectively. The capacitances should be determined experimentally. In particular, adequate investigation should be made so that there is no problem even at the time of high or low temperature.

(5) Installation of IC for power supply

For obtaining high reliability on the heat sink design of the regulator IC, it is generally required to derate more than 20% of maximum junction temperature (Tj MAX.).

Full consideration should be given to the installation of IC to the heat sink.

(a) Heat sink design

The thermal resistance of IC itself is required from the viewpoint of the design of elements, but the thermal resistance from the IC package to the open air varies with the contact thermal resistance.
Table 1 shows how much the value of the contact thermal resistance (Q_C+ Q_S) is changed by insulating sheet (mica) and heat sink grease.

TABLE Unit: °C/W

PACKAGE	MODEL No.	TORQUE	MICA	$Q_C + Q_S$
TO-220AB	TA780×××AP	6kg.cm	Not Provided	0.3∿0.5(1.5∿2.0)
			Provided	2.0∿2.5(4.0∿6.0)

The figures given in parentheses denote the values at time of no grease.

The package of regulator IC serves as GND, therefore, usually use the value at time of "no mica."

(b) Silicon grease

When a circuit not exceeding maximum rating is designed, it is to be desired that the grease should be used if possible. If it is required that the contact thermal resistance is reduced from the viewpoint of the circuit design, it is recommended that the following methods be adopted.

A: Use Thercon (Fuji High Polymer Kogyo K.K.)

B: Use SC101 (Torei Silicon) or G-640 (GE), if grease is used.

(c) Torque

When installing IC on a heat sink or the like, tighten the IC with the torque of less than the rated value. If it is tightened with the torque in excess of the rated value, sometimes the internal elements of the IC are adversely affected. Therefore, great care should be given to the installing operation.
Further, if polycarbonate screws are used, the torque causes a change with the passage of time, which may lessen the effect of radiation.