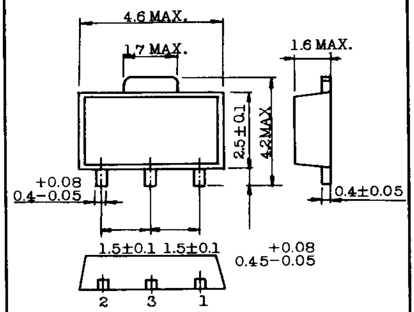
TA78L05F ~ TA78L15F

BIPOLAR LINEAR INTEGRATED CIRCUIT
SILICON MONOLITHIC

o 5V, 9V, 12V, 15V,
3-TERMINAL POSITIVE VOLTAGE REGULATORS

- Best suited to power supply for TTL/C² MOS.
- No external part needed.
- Built-in thermal protective circuit.
- Max. output current 150mA. (T_j = 25°C)
- Packaged in POWER MINI.

Unit in mm



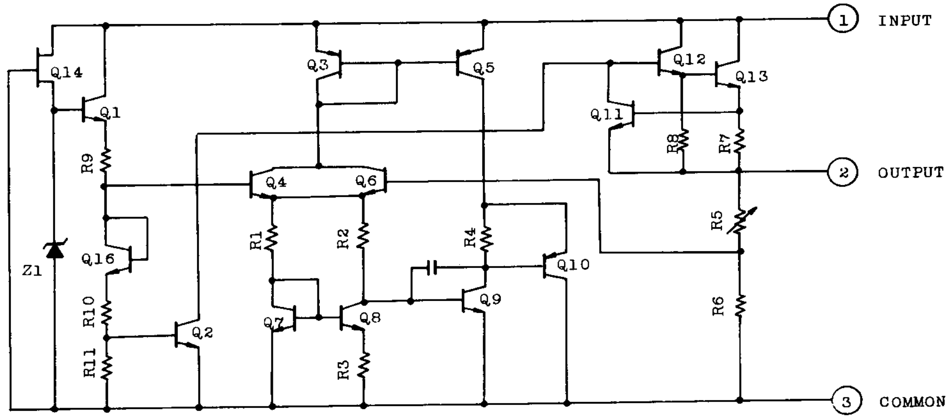
1. INPUT
2. OUTPUT
3. COMMON(CASE)

JEDEC	
EIAJ	−
TOSHIBA	S3A-P

MAXIMUM RATING (Ta = 25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Input Voltage	(5V∿15V)	V_{IN}	35	V
Power Dissipation		P_D	500	mW
Operating Temperature		T_{opr}	−30 ∿ 75	°C
Storage Temperature		T_{stg}	−55 ∿ 150	°C

EQUIVALENT CIRCUIT



ELECTRICAL CHARACTERISTICS

(V_{IN} = 10V, I_{OUT} = 40mA, C_{IN} = 0.33μF, C_{OUT} = 0.1μF, 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		4.75	5.0	5.25	V
Input Regulation	Reg Line	1	T_j=25°C	7.0V ≦ V_{IN} ≦ 20V	-	55	150	mV
				8.0V ≦ V_{IN} ≦ 20V	-	45	100	
Load Regulation	Reg Load	1	T_j=25°C	1.0mA ≦ I_{OUT} ≦ 100mA	-	11	60	mV
				1.0mA ≦ I_{OUT} ≦ 40mA	-	5.0	30	
Output Voltage	V_{OUT}	1	7.0V ≦ V_{IN} ≦ 20V, 1.0mA ≦ I_{OUT} ≦ 40mA		4.65	-	5.3	V
			V_{IN} = 10V, 1.0mA ≦ I_{OUT} ≦ 70mA		4.65	-	5.3	
Quiescent Current	I_B	1	T_j = 25°C		-	3.1	6.0	mA
			T_j = 125°C		-	-	5.5	
Quiescent Current Change	ΔI_B	1	8.0V ≦ V_{IN} ≦ 20V		-	-	1.5	mA
	ΔI_B	1	1.0mA ≦ I_{OUT} ≦ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz ≦ f ≦ 100kHz		-	40	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	12	-	mV/1.0kHrs
Ripple Rejection Ratio	RR	2	f = 120Hz, 8.0V ≦ V_{IN} ≦ 18V, T_j = 25°C		41	49	-	dB
Dropout Voltage	$\lvert V_{IN}-V_{OUT} \rvert$	1	T_j = 25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT} = 5mA		-	-0.6	-	mV/°C

ELECTRICAL CHARACTERISTICS

($V_{IN}=15V$, $I_{OUT}=40mA$, $C_{IN}=0.33\mu F$, $C_{OUT}=0.1\mu F$, $0°C<T_j<125°C$)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN	TYP	MAX	UNIT
Output Voltage	V_{OUT}	1	$T_j=25°C$		8.55	9.0	9.45	V
Input Regulation	Reg Line	1	$T_j=25°C$	$11.4V \leqq V_{IN} \leqq 24V$	-	80	200	mV
				$12V \leqq V_{IN} \leqq 24V$	-	20	160	
Load Regulation	Reg Load	1	$T_j=25°C$	$1.0mA \leqq I_{OUT} \leqq 100mA$	-	17	90	mV
				$1.0mA \leqq I_{OUT} \leqq 40mA$	-	8.0	45	
Output Voltage	V_{OUT}	1	$11.4V \leqq V_{IN} \leqq 24V$, $1.0mA \leqq I_{OUT} \leqq 40mA$		8.37	-	9.63	V
			$V_{IN}=15V$, $1.0mA \leqq I_{OUT} \leqq 70mA$		8.37	-	9.63	
Quiescent Current	I_B	1	$T_j=25°C$		-	3.2	6.5	mA
			$T_j=125°C$		-	-	6.0	
Quiescent Current Change	ΔI_B	1	$12V \leqq V_{IN} \leqq 24V$		-	-	1.5	mA
	ΔI_B	1	$1.0mA \leqq I_{OUT} \leqq 40mA$		-	-	0.1	
Output Noise Voltage	V_{NO}	1	$Ta=25°C$, $10Hz \leqq f \leqq 100kHz$		-	65	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	21	-	mV/1.0kHrs
Ripple Rejection Ratio	RR	2	$f=120Hz$, $12V \leqq V_{IN} \leqq 24V$, $T_j=25°C$		36	44	-	dB
Dropout Voltage	$\|V_{IN}-V_{OUT}\|$	1	$T_j=25°C$		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	$I_{OUT}=5mA$		-	-0.85	-	mV/°C

ELECTRICAL CHARACTERISTICS

(V_{IN} =19V, I_{OUT} =40mA, C_{IN} =0.33μF, C_{OUT} =0.1μF, 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		11.4	12	12.6	V
Input Regulation	Reg Line	1	T_j=25°C	14.5V ≦ V_{IN} ≦ 27V	–	120	250	mV
				16V ≦ V_{IN} ≦ 27V	–	100	200	
Load Regulation	Reg Load	1	T_j=25°C	1.0mA ≦ I_{OUT} ≦ 100mA	–	20	100	mV
				1.0mA ≦ I_{OUT} ≦ 40mA	–	10	50	
Output Voltage	V_{OUT}	1	14.5V ≦ V_{IN} ≦ 27V, 1.0mA ≦ I_{OUT} ≦ 40mA		11.16	–	12.84	V
			V_{IN} =19V, 1.0mA ≦ I_{OUT} ≦ 70mA		11.16	–	12.84	
Quiescent Current	I_B	1	T_j=25°C		–	3.2	6.5	mA
			T =125°C		–	–	6.0	
Quiescent Current Change	ΔI_B	1	16V ≦ V_{IN} ≦ 27V		–	–	1.5	mA
	ΔI_B	1	1.0mA ≦ I_{OUT} ≦ 40mA		–	–	0.1	
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz ≦ f ≦ 100kHz		–	80	–	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			–	24	–	mV/1.0kHrs
Ripple Rejection Ratio	RR	2	f =120Hz, 15V ≦ V_{IN} ≦ 25V, T_j =25°C		36	41	–	dB
Dropout Voltage	$\lvert V_{IN}-V_{OUT}\rvert$	1	T_j=25°C		–	1.7	–	V
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT} =5mA		–	-1.0	–	mV/°C

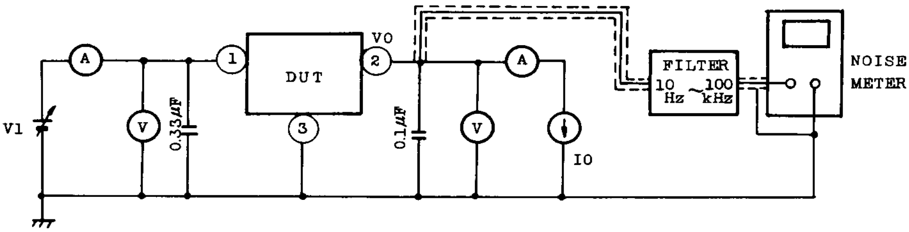
ELECTRICAL CHARACTERISTICS

(V_{IN} = 23V, I_{OUT} = 40mA, C_{IN} = 0.33μF, C_{OUT} = 0.1μF, 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		14.25	15	15.75	V
Input Regulation	Reg Line	1	Tj=25°C	17.5V ≦ V_{IN} ≦ 30V	–	130	300	mV
				20V ≦ V_{IN} ≦ 30V	–	110	250	
Load Regulation	Reg Load	1	T_j=25°C	1.0mA ≦ I_{OUT} ≦ 100mA	–	25	150	mV
				1.0mA ≦ I_{OUT} ≦ 40mA	–	12	75	
Output Voltage	V_{OUT}	1	17.5V ≦ V_{IN} ≦ 30V, 1.0mA = I_{OUT} = 40mA		13.95	-	16.05	V
			V_{IN} = 23V, 1.0mA ≦ I_{OUT} ≦ 70mA		13.95	-	16.05	
Quiescent Current	I_B	1	T_j = 25°C		–	3.3	6.5	mA
			T_j = 125°C		–	–	6.0	
Quiescent Current Change	ΔI_B	1	20V ≦ V_{IN} ≦ 30V		–	–	1.5	mA
	ΔI_B	1	1.0mA ≦ I_{OUT} ≦ 40mA		–	–	0.1	
Output Noise Voltage	V_{NO}	1	Ta = 25°C 10Hz ≦ f ≦ 100kHz		–	90	–	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			–	30	–	mV/1.0kHrs
Ripple Rejection Ratio	RR	2	f = 120Hz 18.5V ≦ V_{IN} ≦ 28.5V, T_j = 25°C		34	40	–	dB
Dropout Voltage	$\lvert V_{IN}-V_{OUT}\rvert$	1	T_j = 25°C		–	1.7	–	V
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT} = 5mA		–	-1.3	–	mV/°C

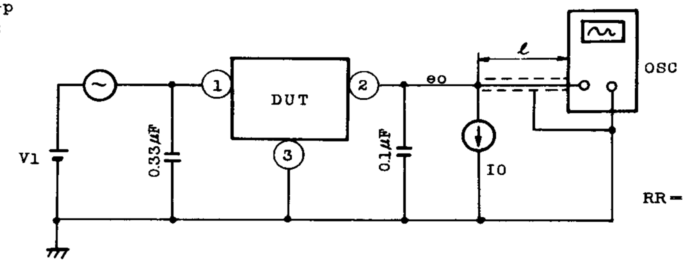
TEST CIRCUIT

1. V_{OUT}, Reg.line, Reg.load, V_{OUT}, I_B, ΔI_B, V_{NO}, $\Delta V_{OUT}/\Delta t$, $|V_{IN}-V_{OUT}|$, TC_{VO}

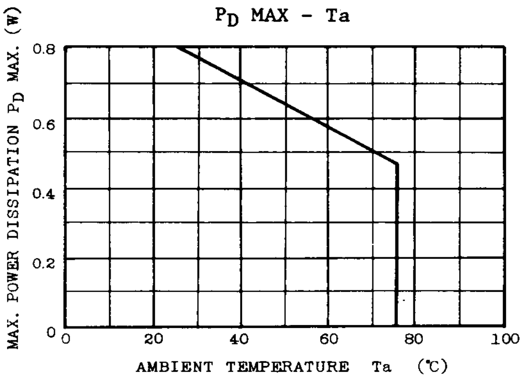


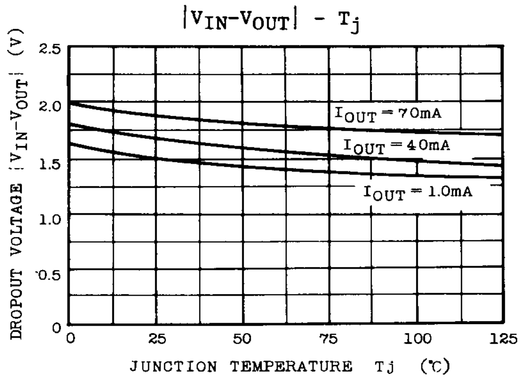
2. RR

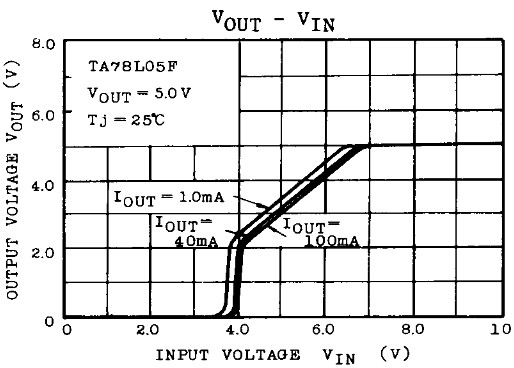
$ei = 1V_{p-p}$
$f = 120Hz$
$\ell \leqq 30cm$

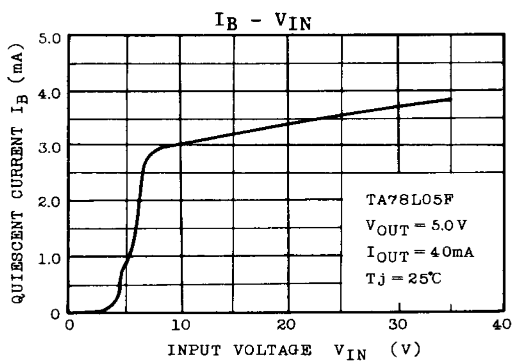


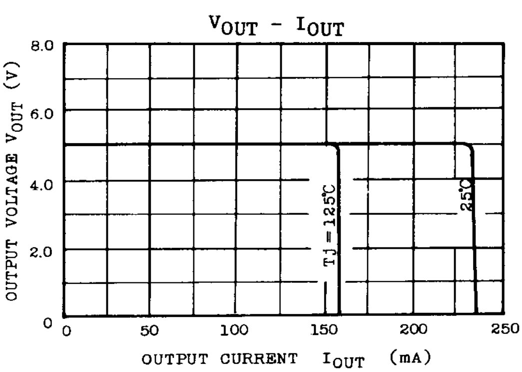
$$RR = 20 \log \frac{ei}{eo} \ (dB)$$


P_D MAX - Ta
MAX. POWER DISSIPATION P_D MAX. (W)
0.8
0.6
0.4
0.2
0
0
20
40
60
80
100
AMBIENT TEMPERATURE Ta (℃)


$|V_{IN}-V_{OUT}|$ - T_j
DROPOUT VOLTAGE $|V_{IN}-V_{OUT}|$ (V)
2.5
2.0
1.5
1.0
0.5
0
I_{OUT} = 70mA
I_{OUT} = 40mA
I_{OUT} = 1.0mA
0
25
50
75
100
125
JUNCTION TEMPERATURE Tj (℃)

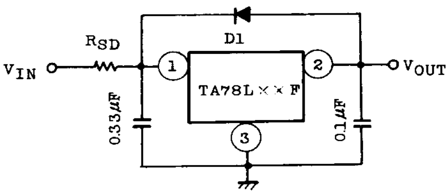

V_{OUT} - V_{IN}
TA78L05F
V_{OUT} = 5.0 V
Tj = 25℃
I_{OUT} = 1.0mA
I_{OUT} = 40mA
I_{OUT} = 100mA
OUTPUT VOLTAGE V_{OUT} (V)
8.0
6.0
4.0
2.0
0
0
2.0
4.0
6.0
8.0
10
INPUT VOLTAGE V_{IN} (V)


I_B - V_{IN}
QUIESCENT CURRENT I_B (mA)
5.0
4.0
3.0
2.0
1.0
0
TA78L05F
V_{OUT} = 5.0 V
I_{OUT} = 40mA
Tj = 25℃
0
10
20
30
40
INPUT VOLTAGE V_{IN} (V)


V_{OUT} - I_{OUT}
OUTPUT VOLTAGE V_{OUT} (V)
8.0
6.0
4.0
2.0
0
Tj = 125℃
25℃
0
50
100
150
200
250
OUTPUT CURRENT I_{OUT} (mA)

EXAMPLES OF TYPICAL CIRCUIT

(1) Example of Typical Circuit



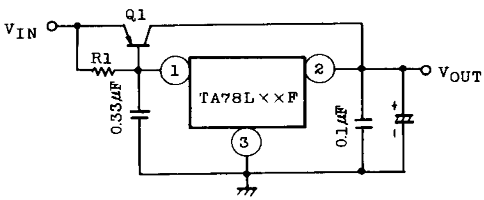
D_1 : IC protective diode

When surge voltage is applied to IC output terminal or $V_{IN} < V_{OUT}$ at time of power On/OFF, always connect the high speed switching diode D_1.

R_{SD}: Power limiting resistor

If V_{IN} is too high, always connect R_{SD} in order to reduce power consumption of IC.

(2) A. Current boosting circuit



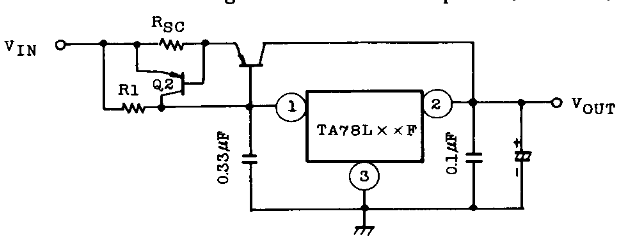
Use a required radiation plate for Q_1.

$$R_1 \leq \frac{V_{BE1}}{I_{B\ MAX}}$$

where, V_{BE1} : V_{BE} of external transistor Q_1

I_B MAX: Max. bias current of IC

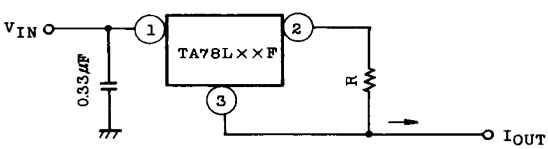
B. Current boosting circuit with output short-circuit protective circuit



$$R_{SC} = \frac{V_{BE2}}{I_{SC}}$$

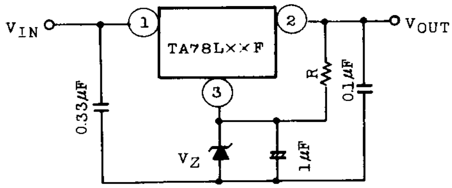
where, I_{SC}: Short-circuit current

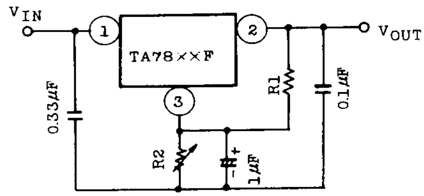
(3) Constant-current circuit



$$I_{OUT} = \frac{V_{OUT}}{R} + I_B$$

(4) Voltage boosting circuit



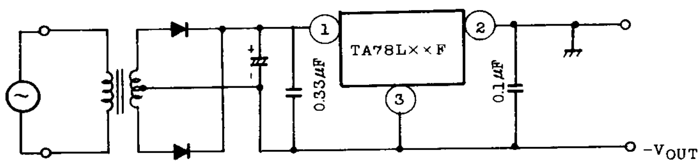


$V_{OUT} = V_Z + V_{OUT}$(of IC)

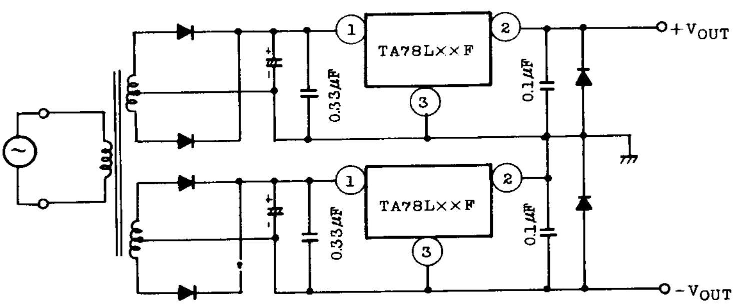
Apply current of several mA to R.

$$V_{OUT} = R_2\left(I_B + \frac{V_{OUT(of\,IC)}}{R_1}\right) + V_{OUT}(\text{of IC})$$

(5) Negative power supply



(6) Positive/negative power supply



PRECAUTIONS FOR USE

If high voltage in excess of output voltage (TYP.value) of IC is applied to its output terminal, IC may be destroyed. In this case, connect a zener diode between the output terminal and GND to prevent application of excessive voltage. In such a current boosting circuit as shown in Application Circuit Example (2), if input voltage is suddenly applied by stages and the load is light, then excessive voltage may be applied transiently to the output terminal of IC. In such a case as this, it may become necessary to increase capacity of output capacitor as appropriate, use a smaller R_I (resistor for bypassing IC bias current) or gradually raise the input voltage in addition to use of a zener diode as mentioned above.