



Power Supply IC

S1F78B20

Technical Manual

SEIKO EPSON CORPORATION

Rev.1.1

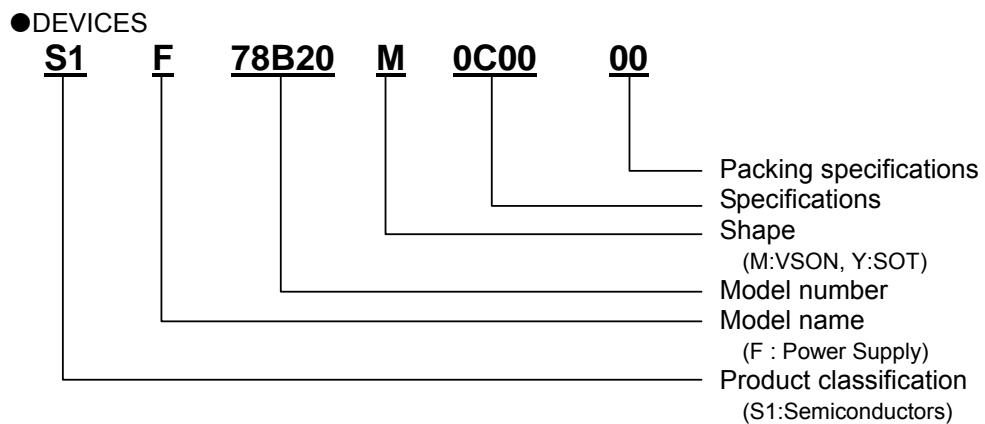
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Configuration of product number



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1. DESCRIPTION

The S1F78B20 is a positive voltage CMOS regulator IC. This IC provides the low output noise, high-speed load transient response, high-load stability, and high accuracy mechanisms, ensuring $50\mu A$, which is lower than the conventional consumption current.

The output voltage is fixed in the IC, and its allowable range is between 1.8 to 4.0V based on the laser trimming technique.

This IC consists of the reference voltage supply, output voltage setting resistor, overcurrent protection circuit, output voltage drop correction circuit, phase compensation circuit, chip enable circuit, pulse response circuit, and other components.

It is ideal for the power supply of the high-frequency circuit, realizing low output noises with low operating current.

2. FEATURES

- Low consumption current:
At operating: [Typ.] $50\mu A$ ($V_{OUT(S)}=3.0V$, at no-load),
In standby: [Max.] $0.1\mu A$
- Output noise voltage:
 $30\mu V_{rms}$ ($V_{OUT(S)} = 3.0V$, $C_{out}=1.0\mu F$, 10 to 100kHz)
- Output voltage:
1.8 to 4.0V DC (Can be set in 0.1V steps.)
- Output current:
 $150mA$ ($V_{DD}=V_{OUT(S)}+1.0V$)
 $\pm 2.0\%$ ($I_{out}=50mA$)
- Output voltage accuracy:
[Typ.] 0.30V ($V_{OUT(S)} = 3.0V$, $I_{out}=150 mA$)
- Input-output potential difference:
[Typ.] 80 dB ($V_{OUT(S)}=3.0V$, $V_{DD}=V_{OUT(S)}+1.0V$, $f=1kHz$,
 $V_{ripple}=0.2V_{p-pAC}$)
- Ripple rejection:
[Typ.] 350mA
- Overcurrent detection current:
[Typ.] 30mA
- Short-circuit holding current:
 $C_{in}=1.0$ to $10\mu F$, $C_{out}=1.0$ to $10\mu F$, $ESR=1m$ to 6.8Ω
- Range of capacitor:

3. PACKAGE

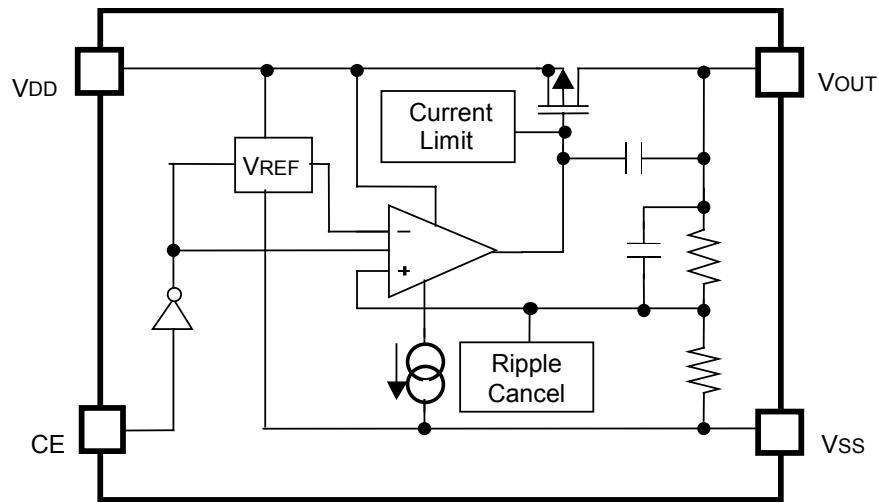
VSON-6pin
SOT23-5pin

4. APPLICATION

- Mobile communication equipment (Mobile-phone, cordless phone, radio communication equipment)
- Camera, video equipment
- Mobile AV equipment
- Portable game device
- Home appliance
- Battery equipment

5. BLOCK DIAGRAM

5. BLOCK DIAGRAM



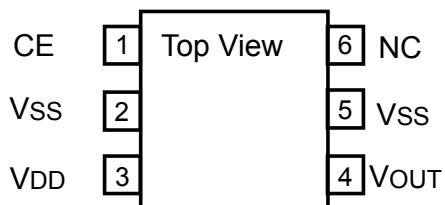
6. SELECTION GUIDE

S1F78B20 * * * 0 0 * *
a b c d e

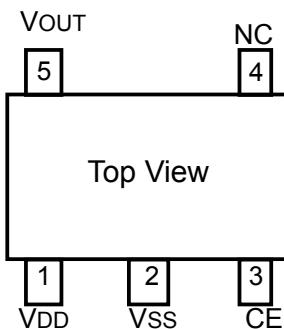
a	Package type M VSON-6pin Y SOT23-5pin
b	Indicates a 2-digit value that is ten times the output voltage value.
c	Fixed to "0" in this IC.
d	Fixed to "0" in this IC.
e	Taping form (See the Packing Specifications.) 0R TR type

7. PIN ASSIGNMENT

VSON-6pin

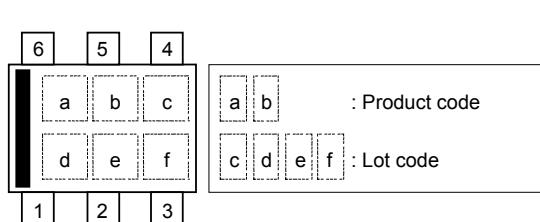


SOT23-5pin

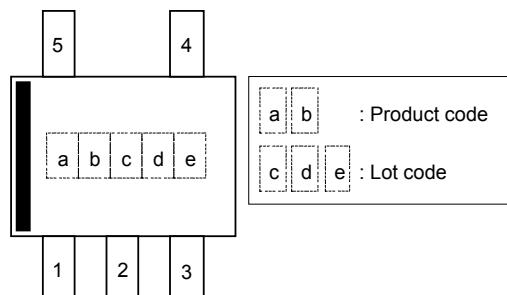


8. MARKING

VSON-6pin



SOT23-5pin



Vout option	a	b	Vout option	a	b	Vout option	a	b
—	—	—	2.6V	A	G	—	—	—
—	—	—	2.7V	A	H	—	—	—
—	—	—	2.8V	A	J	—	—	—
—	—	—	2.9V	A	K	—	—	—
—	—	—	3.0V	A	L	—	—	—
—	—	—	3.1V	A	M	—	—	—
—	—	—	3.2V	A	N	—	—	—
1.8V	A	8	3.3V	A	P	—	—	—
1.9V	A	9	3.4V	A	R	—	—	—
2.0V	A	A	3.5V	A	S	—	—	—
2.1V	A	B	3.6V	A	T	—	—	—
2.2V	A	C	3.7V	A	U	—	—	—
2.3V	A	D	3.8V	A	V	—	—	—
2.4V	A	E	3.9V	A	W	—	—	—
2.5V	A	F	4.0V	A	X	—	—	—

9. PIN DESCRIPTION

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For VSON-6pin

Pin No.	Pin Name	Function
1	CE	Chip enable pin (H:Enable / L:Disable)
2	Vss	GND pin
3	VDD	Power input pin
4	VOUT	Voltage output pin
5	Vss	GND pin
6	NC	No connection

For SOT23-5pin

Pin No.	Pin Name	Function
1	VDD	Power input pin
2	Vss	GND pin
3	CE	Chip enable pin (H:Enable / L:Disable)
4	NC	No connection
5	VOUT	Voltage output pin

10. ABSOLUTE MAXIMUM RATINGS

(Unless otherwise specified: $T_a=25^{\circ}\text{C}$)

Item	Symbol	Rating		Unit
Power voltage	VDD	Vss-0.3 to Vss+7.0		V
Output voltage	VOUT	Vss-0.3 to VDD+0.3		V
Output current	IOUT	150		mA
CE input voltage	VCE	Vss-0.3 to VDD+0.3		V
Allowable dissipation	PD	VSON SOT23	500 *1 300	mW
Operating ambient temperature	T _{opr}	-40 to +85		°C
Storage ambient temperature	T _{stg}	-55 to +125		°C

Note: To stabilize the IC, insert the decoupling capacitor between VDD and Vss.

*1) Installation conditions at measurement of VSON allowable dissipation (Board specifications)

Glass epoxy, 40 × 40 × 1.6, FR-4 (2-layer board), Wiring 50%, wind speed: 0m/s

11. ELECTRICAL CHARACTERISTICS

11. ELECTRICAL CHARACTERISTICS

● DC Characteristics

(Unless otherwise specified: $T_a=25^\circ\text{C}$, $C_{in}=C_{out}=1\mu\text{F/Ceramic}$)

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit	Measuring circuit
Output voltage	V_{OUT}	$V_{DD}=V_{CE}=V_{OUT}(S)+1.0\text{V}$, $I_{OUT}=50\text{mA}$	$V_{OUT}(S) \times 0.98$	—	$V_{OUT}(S) \times 1.02$	V	Fig.1
Output current	I_{OUT}	$V_{DD}=V_{CE}=V_{OUT}(S)+1.0\text{V}$	150	—	—	mA	Fig.1
Input voltage	V_{DD}		—	—	5.5	V	Fig.1
Input stability	$\frac{\Delta V_{OUT}}{\Delta V_{DD} \cdot V_{OUT}}$	$V_{OUT}(S)+0.5\text{V} \leq V_{DD} \leq 5.5\text{V}$, $V_{CE}=V_{DD}$, $I_{OUT}=50\text{mA}$	—	0.05	0.2	%/V	Fig.2
Input-output potential difference	V_{diff}	$V_{diff}=V_{DDA}-V_{OUT}$, *) V_{DDA} : V_{DD} value with V_{OUT} set to 98%	$3.3\text{V} < V_{OUT}(S) \leq 4.0\text{V}$	—	0.25	0.35	V
			$2.4\text{V} < V_{OUT}(S) \leq 3.3\text{V}$	—	0.30	0.45	V
			$1.8\text{V} < V_{OUT}(S) \leq 2.4\text{V}$	—	0.40	0.55	V
			$V_{OUT}(S)=1.8\text{V}$	—	0.50	0.65	V
Load stability	$\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	$V_{DD}=V_{CE}=V_{OUT}(S)+1.0\text{V}$, $1\text{mA} \leq I_{OUT} \leq 150\text{mA}$	—	20	40	mV	Fig.1
Consumption current (With no load)	I_{SS1}	$V_{DD}=V_{CE}=V_{OUT}(S)+1.0\text{V}$, $I_{OUT}=0\text{mA}$	—	50	80	μA	Fig.3.1
Consumption current (Standby)	I_{SS0}	$V_{DD}=V_{OUT}(S)+1.0\text{V}$, $V_{CE}=V_{SS}$	—	—	0.1	μA	Fig.3.3
Limited current	I_{LIM}	$V_{DD}=V_{CE}=V_{OUT}(S)+1.0\text{V}$	—	350	—	mA	Fig.1
Short-circuit current	I_{SHORT}	$V_{DD}=V_{CE}=V_{OUT}(S)+1.0\text{V}$, $V_{OUT}=V_{SS}$	—	30	—	mA	Fig.1
Discharge Tr ON resistance	R_{DIST}	$V_{DD}=4.0\text{V}$, $V_{CE}=V_{SS}$, $V_{OUT}=3.0\text{V}$	80	110	140	Ω	Fig.7
CE HIGH level input voltage	V_{CEH}	$V_{DD}=V_{OUT}(S)+1.0\text{V}$	1.1	—	V_{DD}	V	Fig.6
CE LOW level input voltage	V_{CEL}	$V_{DD}=V_{OUT}(S)+1.0\text{V}$	V_{SS}	—	0.25	V	Fig.6
CE HIGH level input current	I_{CEH}	$V_{DD}=V_{OUT}(S)+1.0\text{V}$, $V_{CE}=1.1\text{V}$	-1.75	-1.25	-0.75	μA	Fig.6
CE LOW level input current	I_{CEL}	$V_{DD}=V_{OUT}(S)+1.0\text{V}$, $V_{CE}=V_{SS}$	-0.1	—	0.1	μA	Fig.6

(Unless otherwise specified: $T_a=25^\circ\text{C}$, $C_{in}=C_{out}=1\mu\text{F/Ceramic}$)

Item	Symbol	Conditions	Min	Typ	Max	Unit	Measuring circuit
Output voltage temperature coefficient	$\frac{\Delta V_{OUT}}{\Delta T_a}$	$V_{DD}=V_{CE}=V_{OUT}(S)+1.0\text{V}$, $-40^\circ\text{C} \leq T_a \leq 85^\circ\text{C}$, $I_{OUT}=50\text{mA}$	—	± 100	—	ppm/ $^\circ\text{C}$	Fig.1
Ripple rejection	R_R	$V_{DD}=V_{CE}=V_{OUT}(S)+1.0\text{V}$, $I_{OUT}=50\text{mA}$, $f=1\text{kHz}$, $V_{ripple}=0.2\text{Vp-pAC}$	$V_{OUT}(S)=3.3\text{V}$	—	80	—	dB
			$V_{OUT}(S)=2.7\text{V}$	—	70	—	dB
			$V_{OUT}(S)=2.6\text{V}$	—	80	—	dB
			$V_{OUT}(S)=1.8\text{V}$	—	70	—	dB
Output noise	V_{ON}	$V_{DD}=V_{CE}=V_{OUT}(S)+1.0\text{V}$, $I_{OUT}=50\text{mA}$	$V_{OUT}(S)=3.0\text{V}$	—	30	—	μVrms

Note 1) V_{OUT} : Actual output voltage value
 $V_{OUT}(S)$: Rated output voltage value

12. CHARACTERISTICS

12. CHARACTERISTICS

1. Output Voltage (Measuring circuit, Fig.1)

Range of output voltage value when the input voltage is changed in the specified conditions such as the output current and temperature

V_{OUT}: Actual output voltage value

V_{OUT(S)}: Rated output voltage value

$$V_{OUT(S)} \cdot 0.98 \leq V_{OUT} \leq V_{OUT(S)} \cdot 1.02$$

The output voltage accuracy guarantees $\pm 2 [\%]$.

<Conditions>

Supply output current I_{OUT}=50[mA], and change the input voltage from V_{OUT(S)}+0.1[V] to 5.5[V].

2. Output Current (Measuring circuit, Fig.1)

Current that is stably output with normal operation

Minimum current value when the actual output voltage V_{OUT} became less than 96% of the rated output voltage V_{OUT(S)} by increasing the output current by degrees.

<Conditions>

Apply the input voltage of V_{OUT(S)} + 1.0 [V].

3. Input Stability (Measuring circuit, Fig.2)

Max. value in change of the output voltage that is caused when changing the input voltage while maintaining the output current

ΔV_{OUT1}: Changed output voltage

ΔV_{IN}: Changed input voltage (Rated output voltage + 0.5V \leq V_{IN} \leq Max. input voltage)

V_{OUT}: Rated output voltage

Obtained from the following formula:

$$\text{Input stability} = \frac{\Delta V_{OUT1}}{\Delta V_{IN} \cdot V_{OUT}}$$

<Conditions>

Supply output current I_{OUT}=50[mA], and apply the input voltage from V_{OUT(S)}+0.5[V] to rated input voltage 5.5[V].

4. Load Stability (Measuring circuit, Fig.1)

Max. value in change of the output voltage that is caused when changing the output current while maintaining the input voltage

<Conditions>

Max. value in change of the output voltage that is caused when changing the output current from 1[mA] to 200[mA] while setting the input voltage to V_{OUT(S)}+1.0[V]

5. Input-Output Potential Difference (Measuring circuit, Fig.2)

Potential difference between input and output voltages when changing the output current as a parameter.

Potential difference between input and output voltages when the output voltage lowers up to 98[%] by reducing the input voltage by degrees while maintaining the output current.

<Conditions>

Specify input-output potential differences Typ. and Max., using output current I_{OUT}=150[mA] as the reference.

6. Output Voltage Temperature Coefficient (Measuring circuit, Fig.1)

Rate in change of the output voltage that is caused when changing the ambient temperature while maintaining the output current

Obtained from the following formula:

$$\text{Output Voltage Temperature Coefficient[ppm/ }^\circ\text{C} \text{]} = \frac{\Delta V_{\text{OUT}}}{\Delta T_a} \text{ [ppm/ }^\circ\text{C]} = \frac{\Delta V_{\text{OUT}}}{\Delta T_a} [\text{mV/ }^\circ\text{C}] * \frac{1}{V_{\text{OUT(S)}} [\text{V}]} * 1000$$

<Conditions>

Rate in change of the output voltage that is caused when changing the ambient temperature in the rated range from -40°C to +85°C while setting the input voltage to V_{OUT(S)}+1.0[V].

7. Consumption Current (At Operation with No Load) (Measuring circuit, Fig.3.1)

CE pin = V_{DD} (IC active state), operating current at a specific input voltage and load current

ISS1: No load, ISS2: I_{OUT}=50[mA]

<Conditions>

Current value at CE=V_{DD} and I_{OUT}=0[mA]; the input voltage is set to V_{OUT(S)}+1.0[V].

8. Consumption Current (Standby) (Measuring circuit, Fig.3.3)

Input current value that is obtained when changing the input voltage while setting CE pin = V_{SS} and output open (no connection) state.

<Conditions>

Current value at CE=V_{SS} and I_{OUT}=0[mA]; the input voltage is set to V_{OUT(S)}+1.0[V].

9. Limited Current (Measuring circuit, Fig.1)

Output current value required to run the overcurrent protection circuit.

Max. current value when the output voltage drastically lowers by the overcurrent protection circuit that prevents overcurrent. (Max. IC output current)

<Conditions>

Set the input voltage to V_{OUT(S)}+1.0[V] and the CE pin voltage to V_{DD}.

10. Short-Circuit Current (Measuring circuit, Fig.1)

Value of the current that is supplied to the output when the output pin is short-circuited with V_{SS}. Output current value required to run the short-circuit current protection circuit.

<Conditions>

Set the input voltage to V_{OUT(S)}+1.0[V] and the CE pin voltage to V_{DD}, then connect the output pin to V_{SS}.

11. Ripple Rejection (Measuring circuit, Fig.4)

Indicates the ratio with which AC components included in the input voltage appear in the output voltage, by [dB].

<Conditions>

Input voltage = CE pin voltage = V_{OUT(S)}+1.0[V] Output current I_{OUT} = 50[mA]

Frequency obtained by superposing the sine wave of 0.2[Vp-pAC] with the input voltage: 10[Hz] to 100[kHz]

12. Input Transient Response (Measuring circuit, Fig.2)

Change of the output voltage that is caused when the input voltage is changed instantaneously.

<Conditions>

Change of the output voltage that is caused when the input voltage is changed from V_{OUT}+1.0[V] to V_{OUT}+2.0[V] or from V_{OUT}+2.0[V] to V_{OUT}+1.0[V] at 5[μs]. Output current I_{OUT} = 50[mA]

13. Load Transient Response (Measuring circuit, Fig.1)

Change of the output voltage that is caused when the output current is changed at 500[ns].

<Conditions>

1) Change of the output voltage that is caused when the output current is changed from 0.1[mA] to 50[mA] or 50[mA] to 0.1[mA]. Input voltage = V_{OUT(S)}+1.0[V], C_{out}=4.7[μF]

2) Change of the output voltage that is caused when the output current is changed from 0.1[mA] to 150[mA] or 150[mA] to 0.1[mA]. Input voltage = V_{OUT(S)}+1.0[V], C_{out}=4.7[μF]

12. CHARACTERISTICS

14. CE Pin Transient Response (Measuring circuit, Fig.5)

Time required until the output voltage reaches the specified value when the CE pin is switched from OFF to ON or ON to OFF.

<Conditions>

Output current: $I_{OUT}=50[\text{mA}]$, Input voltage: $V_{OUT(S)}+1.0[\text{V}]$

Time required until the output voltage reaches 90% of $V_{OUT(S)}$ when the CE pin voltage exceeds the H level voltage (1.1[V]), changing the CE pin voltage from 0[V] to $V_{OUT(S)}+1.0[\text{V}]$ at $1[\mu\text{s}]$.

15. Output Noise (Measuring circuit, Fig.1)

AC effective value in output voltage.

<Conditions>

Output current: $I_{OUT}=50[\text{mA}]$, Input voltage: $V_{OUT(S)}+1.0[\text{V}]$ Frequency: 10[Hz] to 100[kHz]

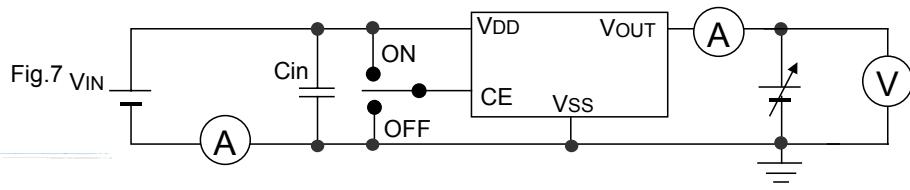
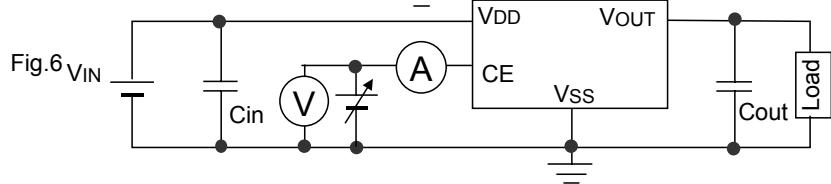
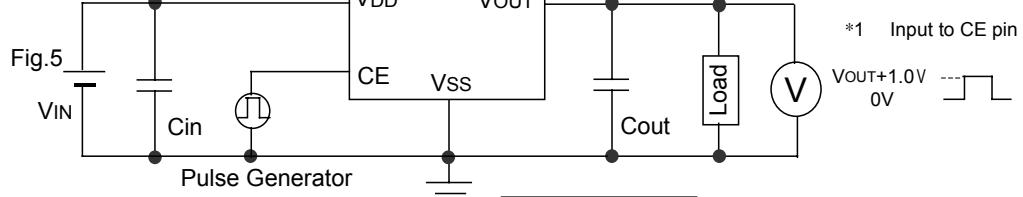
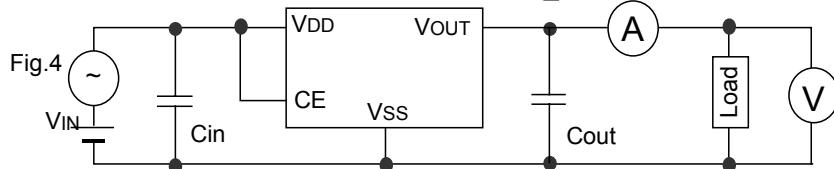
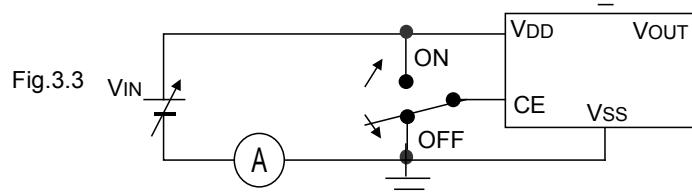
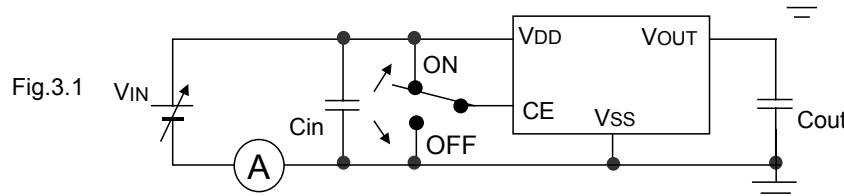
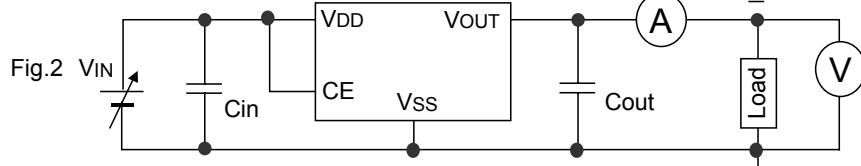
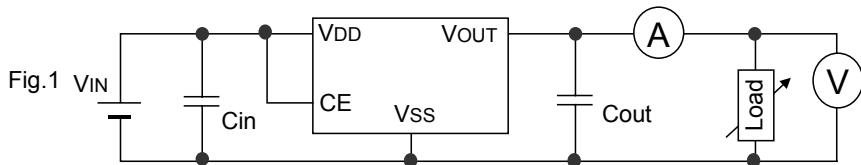
16. Discharge Tr ON Resistance (Measuring circuit, Fig.7)

ON resistance value of internal transistor that removes the C_{out} charge in the standby state.

<Conditions>

Obtained from the value of the current that is supplied to the V_{OUT} pin when the power is applied externally at input voltage = 4.0V, $CE=V_{SS}$, and $V_{OUT}=3V$.

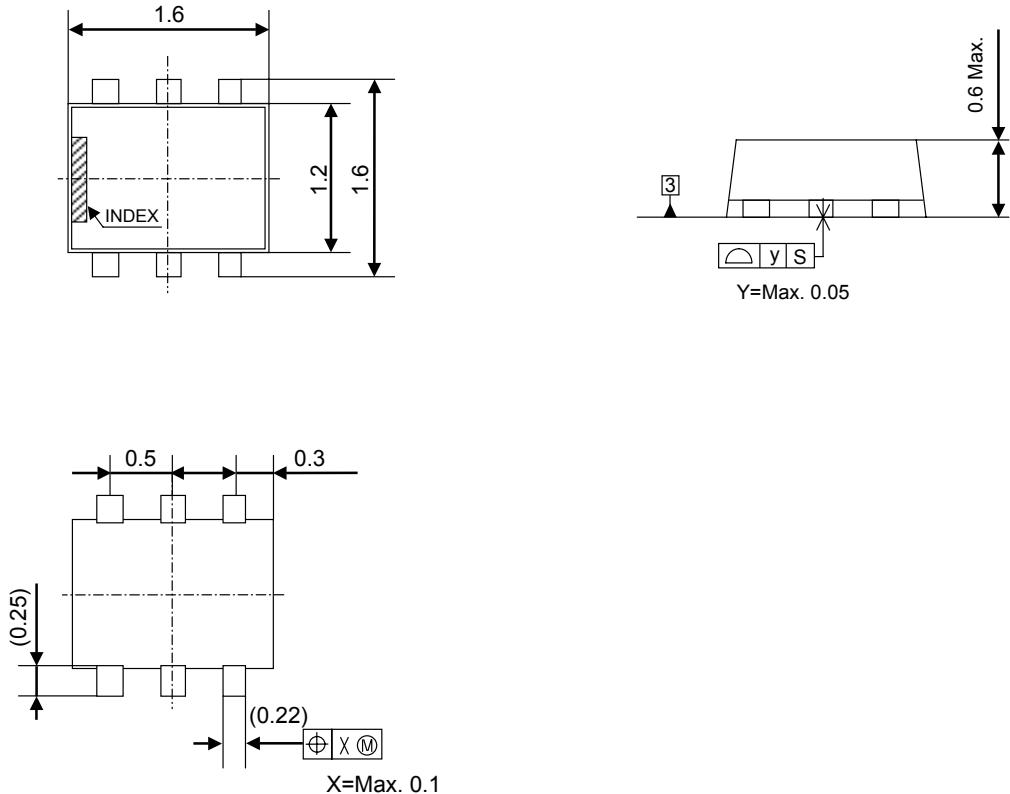
13. MEASURING CIRCUITS



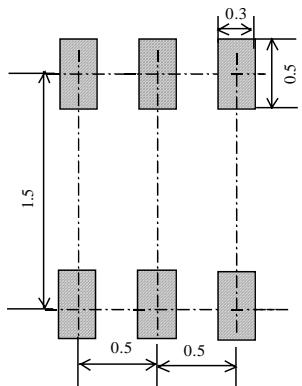
14. DIMENSIONS

14. DIMENSIONS

VSON-6

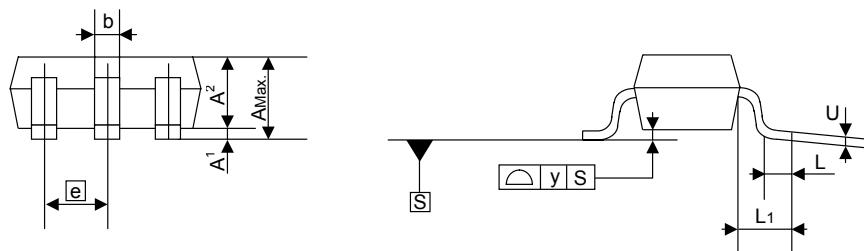
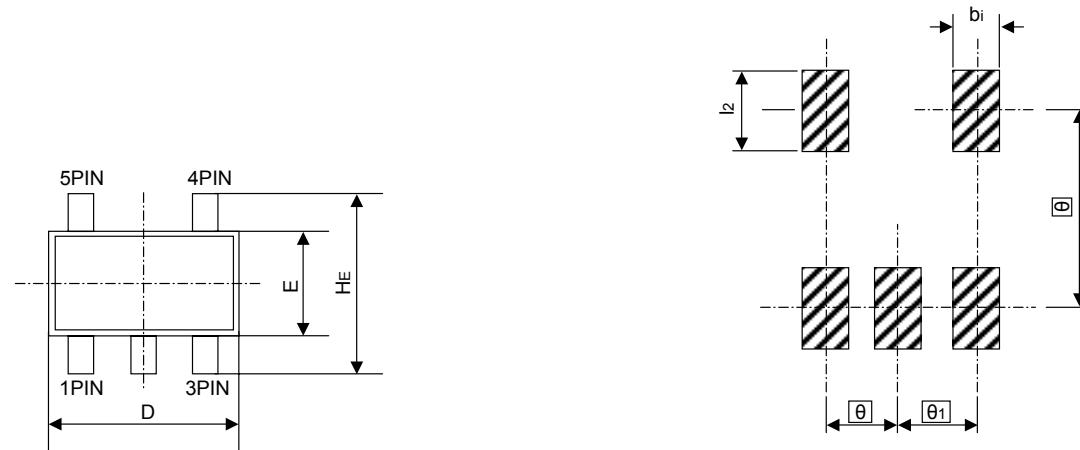


Mount pad design example



14. DIMENSIONS

SOT23-5

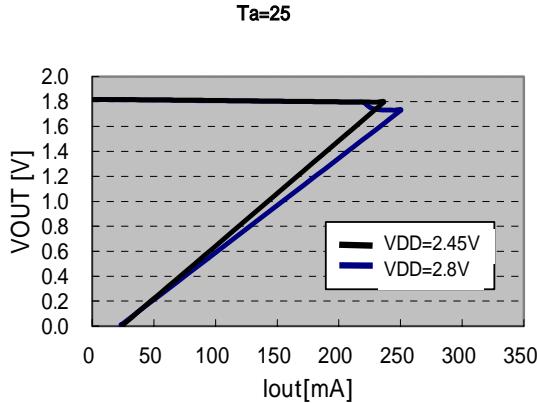


Symbol	Dimension In Millimeters		
	Min.	Nom.	Max.
D	—	2.9	—
E	—	1.6	—
AMax.	—	—	1.40
A1	0	—	0.15
A2	—	1.1	—
e	—	0.95	—
l_o	0.3	—	0.5
C	0.1	—	0.26
L	0.2	—	0.6
L1	—	0.6	—
HE	—	2.8	—
y	—	—	0.1

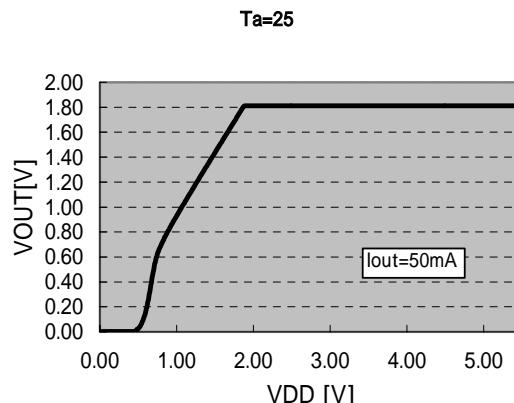
1 = 1mm

15. CHARACTERISTIC EXAMPLES (1.8V OUTPUT PRODUCTS (S1F78B20Y18000R/S1F78B20Y18000R))

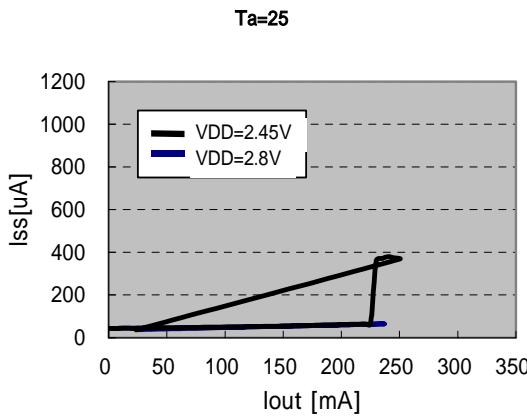
15.1 Characteristics between Output Voltage and Output Current



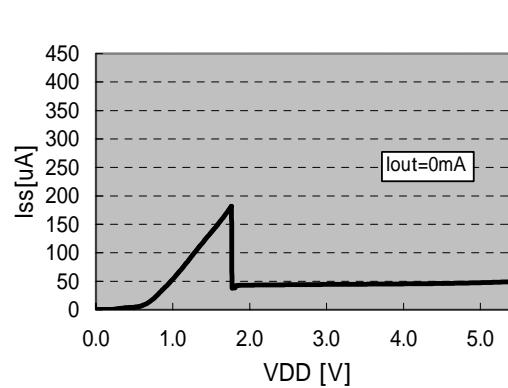
15.2 Characteristics between Output Voltage and Input Voltage



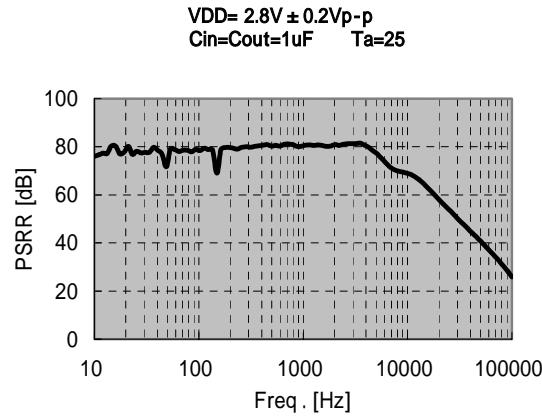
15.3 Characteristics between Consumption Current and Output Current



15.4 Characteristics between Consumption Current and Input Voltage

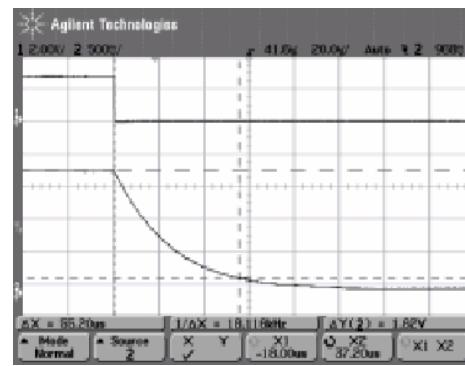
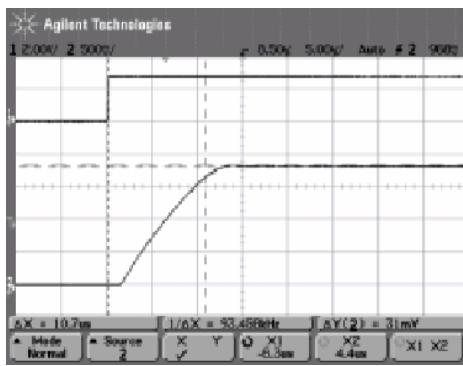


15.5 Characteristics between Ripple Rejection and Frequency

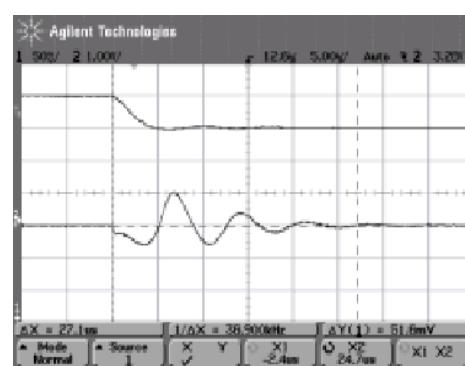
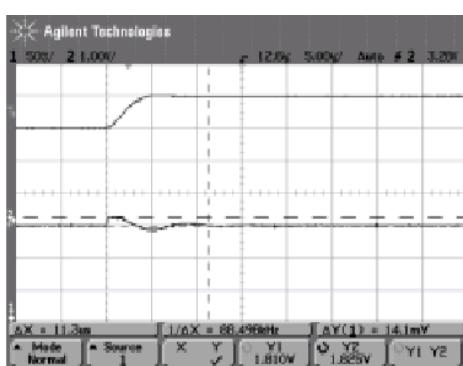


15. CHARACTERISTIC EXAMPLES (1.8V OUTPUT PRODUCTS (S1F78B20Y18000R/S1F78B20Y18000R))

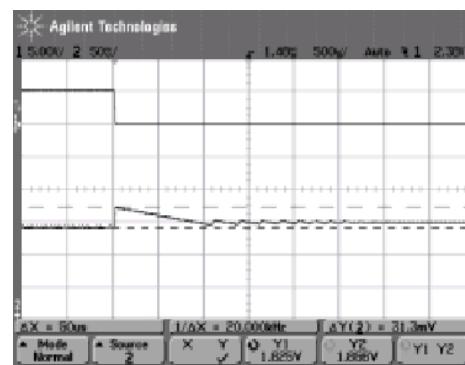
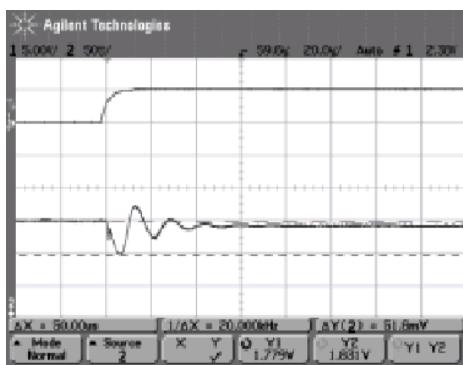
**15.6 CE Transient Response I_{OUT}=50mA V_{CES}=0.0V 2.8V C_{IN}=C_{OUT}=1.0μF
V_{DD}=2.8V Ta=25**



**15.7 Input Transient Response I_{OUT}=50mA V_{DD}=2.8V 3.8V
C_{IN}=C_{OUT}=1.0μF Ta=25**



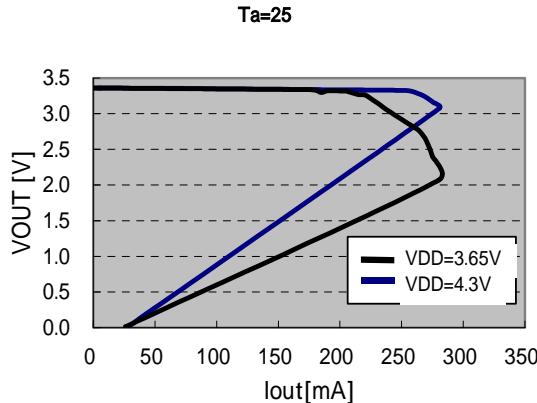
**15.8 Load Transient Response V_{DD}=2.8V I_{OUT}=0.1mA 50mA
C_{IN}=1.0μF C_{OUT}=4.7μF Ta=25**



16. CHARACTERISTIC EXAMPLES (3.3V OUTPUT PRODUCTS (S1F78B20Y33000R/S1F78B20Y33000R))

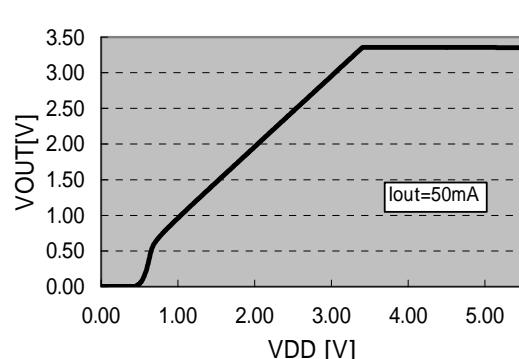
16.1 Characteristics between Output Voltage and Output Current

16.2 Characteristics between Output Voltage and Input Voltage

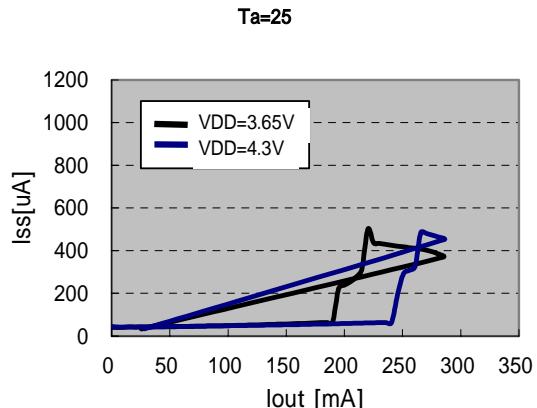


16.3 Characteristics between Consumption Current and Output Current

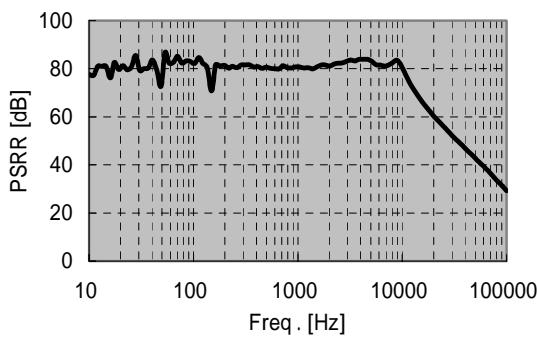
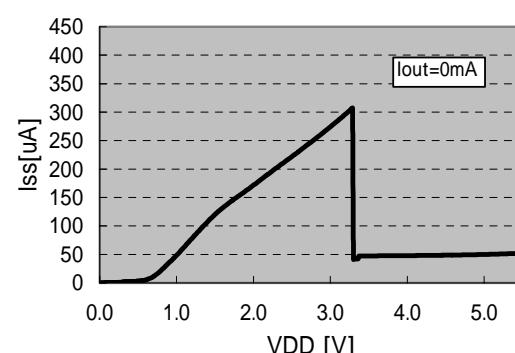
16.4 Characteristics between Consumption Current and Input Voltage



16.5 Characteristics between Ripple Rejection and Frequency

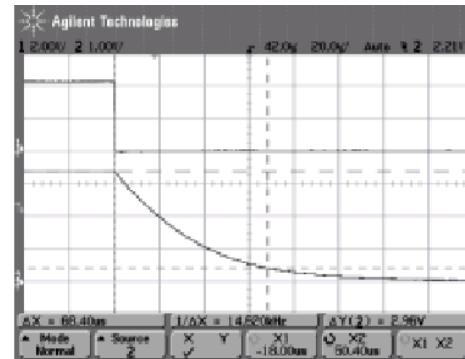
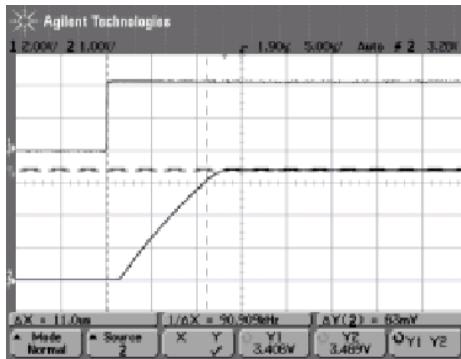


16.5 Characteristics between Ripple Rejection and Frequency

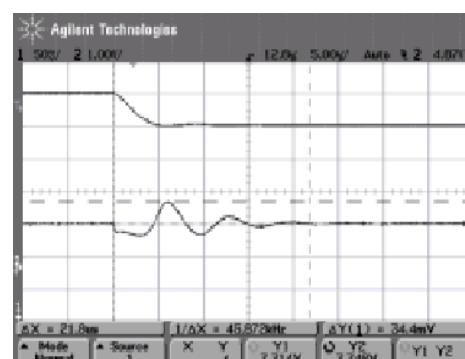
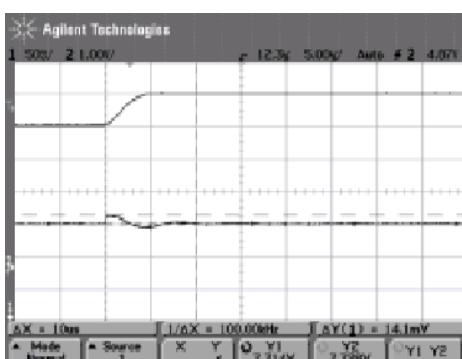


16. CHARACTERISTIC EXAMPLES (3.3V OUTPUT PRODUCTS (S1F78B20Y33000R/S1F78B20Y33000R))

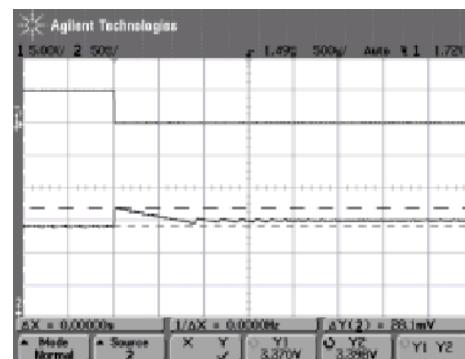
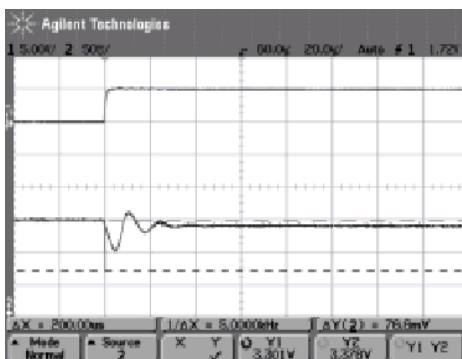
16.6 CE Transient Response I_{OUT}=50mA V_{CES}=0.0V 3.3V C_{in}=C_{out}=1.0μF V_{DD}=4.3V T_a=25



16.7 Input Transient Response I_{OUT}=50mA V_{DD}=4.3V 5.3V C_{in}=C_{out}=1.0μF T_a = 25



16.8 Load Transient Response V_{DD}=4.3V I_{OUT}=0.1mA 50mA C_{in}=1.0μF C_{out}=4.7μF T_a=25





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