

Power Supply IC
S1F78B20
Technical Manual

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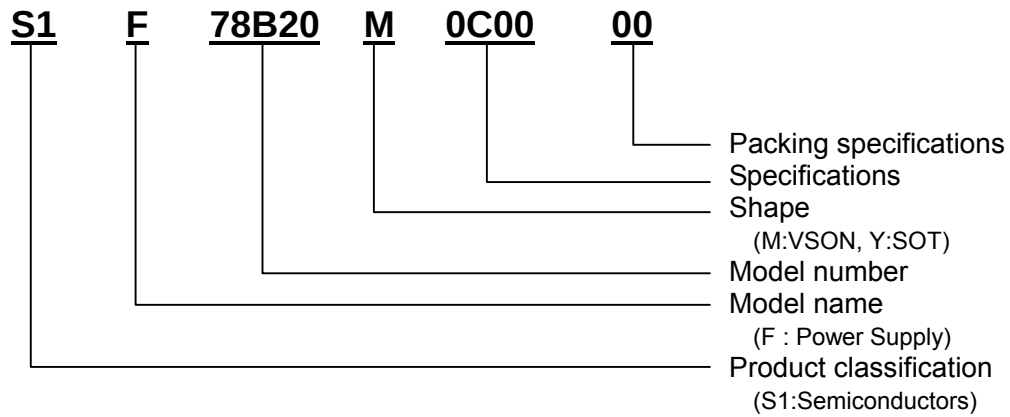
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Configuration of product number

●DEVICES



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1. DESCRIPTION

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

3. PACKAGE

VSON-6pin

SOT23-5pin

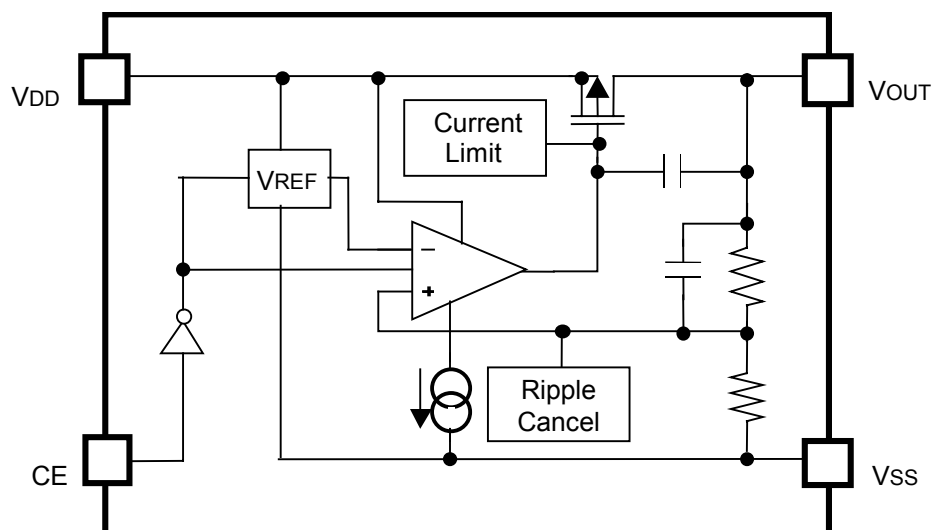
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4. APPLICATION

- 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

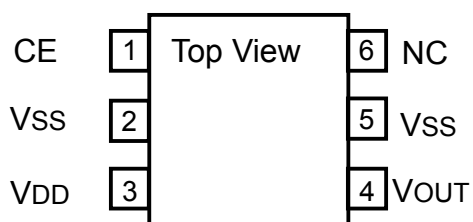
S1F78B20 ***00**
 a b c d e

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

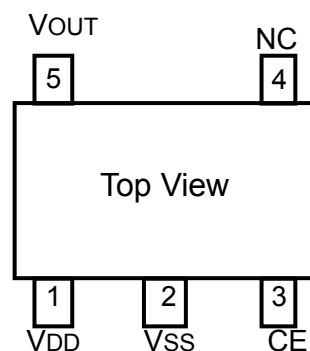
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7. PIN ASSIGNMENT

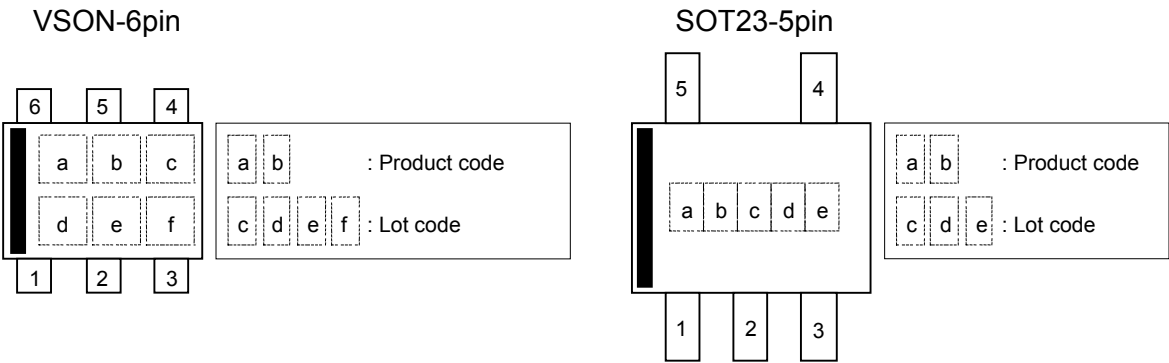
VSON-6pin



SOT23-5pin



8. MARKING



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°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
Operating ambient temperature	T _{opr}	-40 to +85	°C
Storage ambient temperature	T _{stg}	-55 to +125	°C

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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)+1.0V, I _{OUT} =50mA		V _{OUT} (S) ×0.98	—	V _{OUT} (S) ×1.02	V	Fig.1
Output current	I _{OUT}	V _{DD} =V _{CE} =V _{OUT} (S)+1.0V		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)+0.5V≤V _{DD} ≤5.5V, V _{CE} =V _{DD} I _{OUT} =50mA		—	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%	3.3V<V _{OUT} (S)<=4.0V	—	0.25	0.35	V	Fig.2
			2.4V<V _{OUT} (S)<=3.3V	—	0.30	0.45	V	
			1.8V<V _{OUT} (S)<=2.4V	—	0.40	0.55	V	
			V _{OUT} (S)=1.8V	—	0.50	0.65	V	
Load stability	$\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	V _{DD} =V _{CE} =V _{OUT} (S)+1.0V 1mA≤I _{OUT} ≤150mA		—	20	40	mV	Fig.1
Consumption current (With no load)	I _{SS1}	V _{DD} =V _{CE} =V _{OUT} (S)+1.0V, I _{OUT} =0mA		—	50	80	μA	Fig.3.1
Consumption current (Standby)	I _{SS0}	V _{DD} =V _{OUT} (S)+1.0V, V _{CE} =V _{SS}		—	—	0.1	μA	Fig.3.3
Limited current	I _{LIM}	V _{DD} =V _{CE} =V _{OUT} (S)+1.0V		—	350	—	mA	Fig.1
Short-circuit current	I _{SHORT}	V _{DD} =V _{CE} =V _{OUT} (S)+1.0V, V _{OUT} =V _{SS}		—	30	—	mA	Fig.1
Discharge Tr ON resistance	R _{DIST}	V _{DD} =4.0V, V _{CE} =V _{SS} , V _{OUT} =3.0V		80	110	140	Ω	Fig.7
CE HIGH level input voltage	V _{CEH}	V _{DD} =V _{OUT} (S)+1.0V		1.1	—	V _{DD}	V	Fig.6
CE LOW level input voltage	V _{CEL}	V _{DD} =V _{OUT} (S)+1.0V		V _{SS}	—	0.25	V	Fig.6
CE HIGH level input current	I _{CEH}	V _{DD} =V _{OUT} (S)+1.0V, V _{CE} =1.1V		-1.75	-1.25	-0.75	μA	Fig.6
CE LOW level input current	I _{CEL}	V _{DD} =V _{OUT} (S)+1.0V, 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	$\frac{\Delta V_{OUT}}{\Delta T_a}$	$V_{DD}=V_{CE}=V_{OUT(S)}+1.0V$ $-40^{\circ}C \leq T_a \leq 85^{\circ}C$, $I_{OUT}=50mA$	—	± 100	—	ppm/ $^{\circ}C$	Fig.1	
Ripple rejection	RR	$V_{DD}=V_{CE}=V_{OUT(S)}+1.0V$, $I_{OUT}=50mA$, $f=1kHz$, $V_{ripple}=0.2V_{p-pAC}$	$V_{OUT(S)}=3.3V$	—	80	—	dB	Fig.4
		$V_{OUT(S)}=2.7V$	—	70	—	dB		
		$V_{OUT(S)}=2.6V$	—	80	—	dB		
		$V_{OUT(S)}=1.8V$	—	70	—	dB		
Output noise	V_{on}	$V_{DD}=V_{CE}=V_{OUT(S)}+1.0V$, $I_{OUT}=50mA$	$V_{OUT(S)}=3.0V$	—	30	—	μV_{rms}	Fig.1

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

12. CHARACTERISTICS

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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 ± 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 ≤ V_{IN} ≤ 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.

12. CHARACTERISTICS

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:

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

<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 $V_{\text{OUT}}(\text{S})+1.0[\text{V}]$.

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: $I_{\text{OUT}}=50[\text{mA}]$

<Conditions>

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

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 $I_{\text{OUT}}=0[\text{mA}]$; the input voltage is set to $V_{\text{OUT}}(\text{S})+1.0[\text{V}]$.

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

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

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

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 $V_{\text{OUT}}+1.0[\text{V}]$ to $V_{\text{OUT}}+2.0[\text{V}]$ or from $V_{\text{OUT}}+2.0[\text{V}]$ to $V_{\text{OUT}}+1.0[\text{V}]$ at $5[\mu\text{s}]$. Output current $I_{\text{OUT}} = 50[\text{mA}]$

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

Change of the output voltage that is caused when the output current is changed at $500[\text{ns}]$.

<Conditions>

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

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

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

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 $V_{OUT}(S)+1.0[V]$ at 1[μs].

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

AC effective value in output voltage.

<Conditions>

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

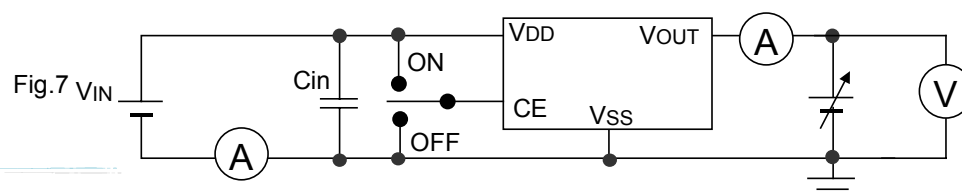
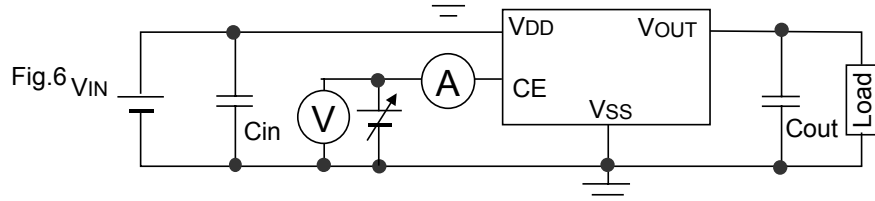
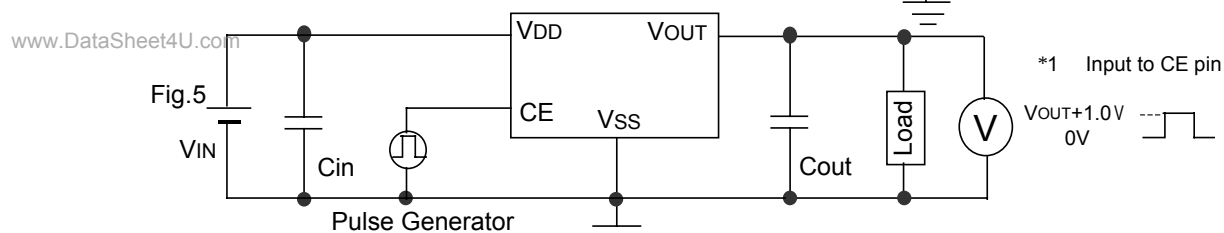
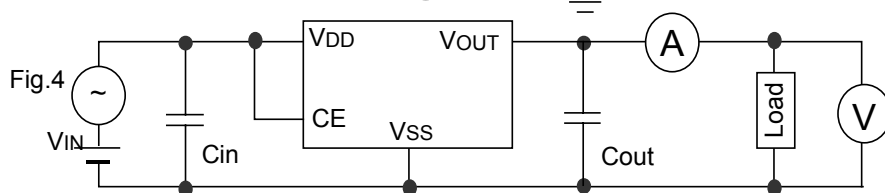
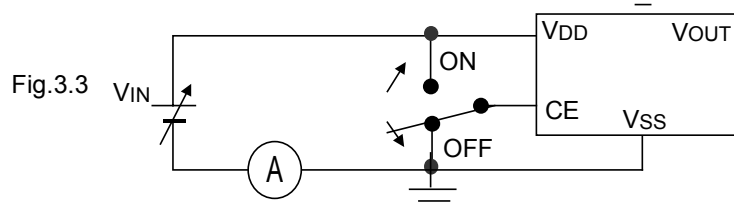
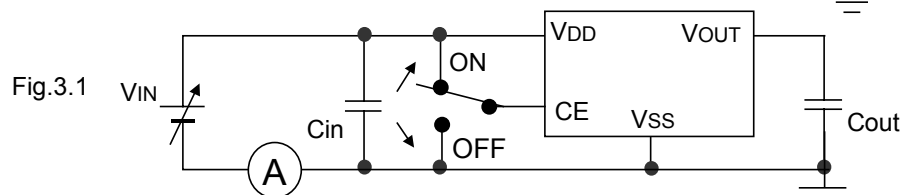
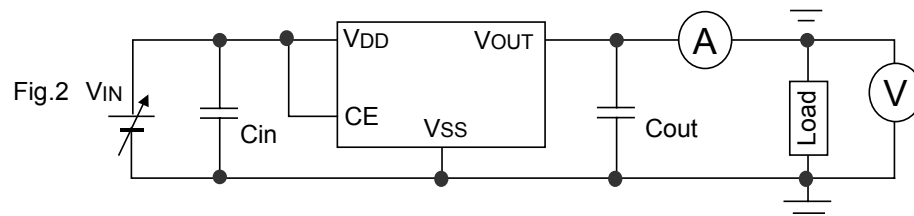
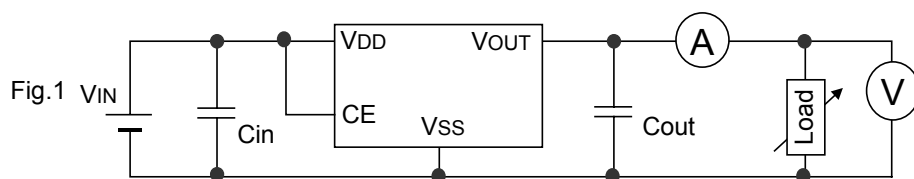
16. Discharge Tr ON Resistance (Measuring circuit, Fig.7)

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 $V_{OUT}=3V$.

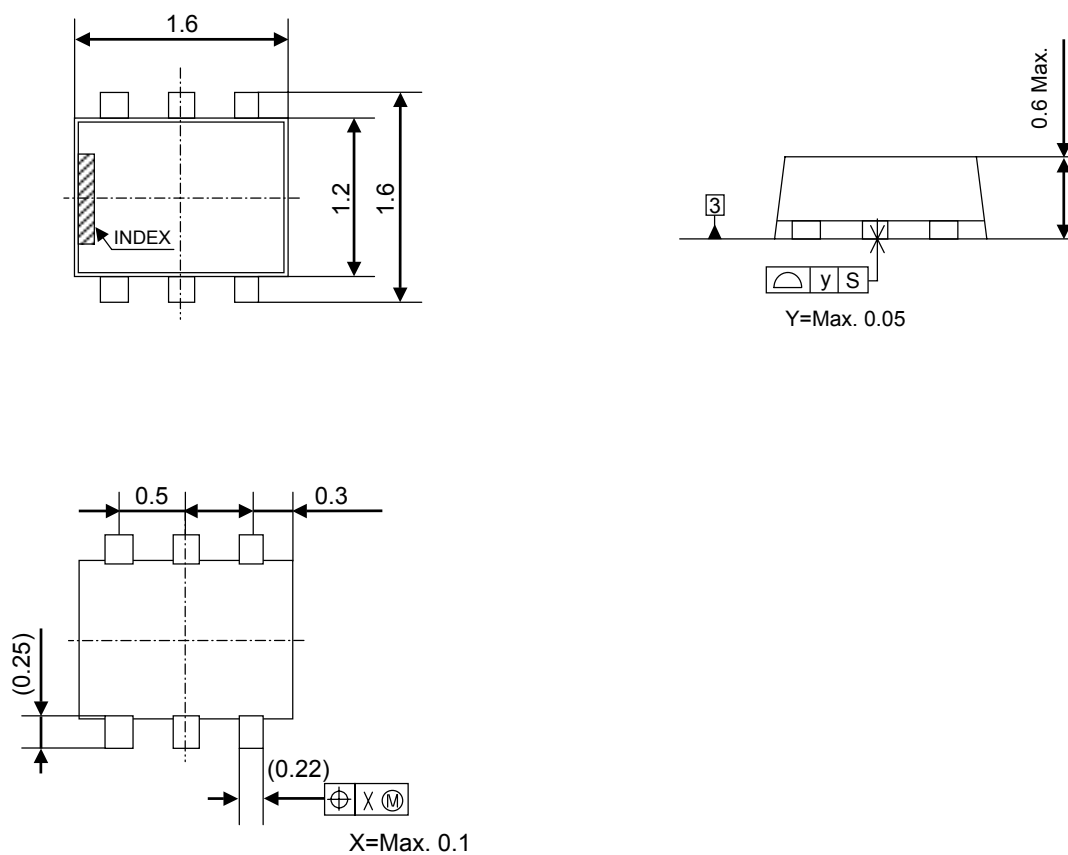
13. MEASURING CIRCUITS



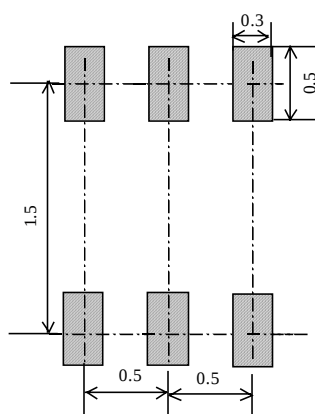
14. DIMENSIONS

14. DIMENSIONS

VSON-6

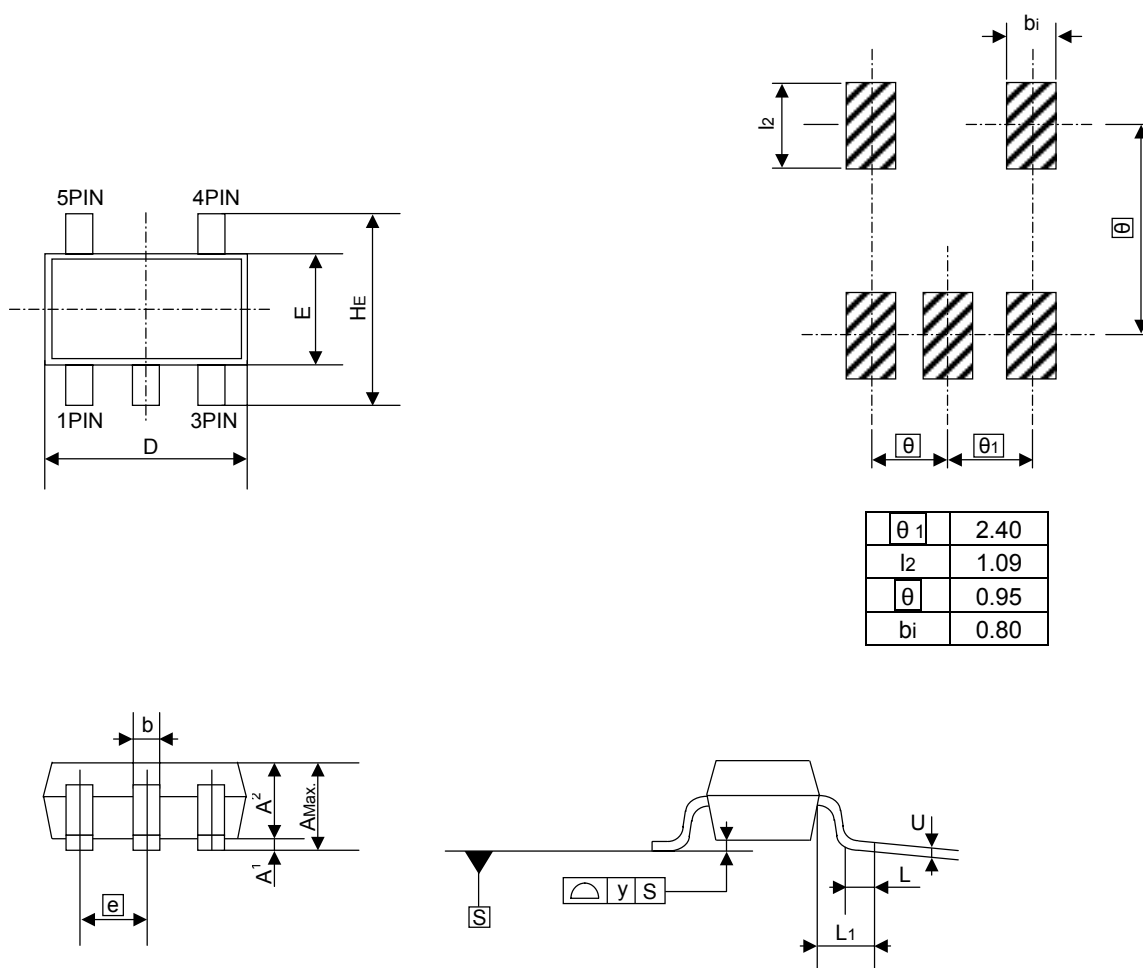


www.DataSheet4U.com Mount pad design example



14. DIMENSIONS

SOT23-5



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Symbol	Dimention In Millimeters		
	Min.	Nom.	Max.
D	—	2.9	—
E	—	1.6	—
AMax.	—	—	1.40
A ₁	0	—	0.15
A ₂	—	1.1	—
θ	—	0.95	—
lo	0.3	—	0.5
C	0.1	—	0.26
L	0.2	—	0.6
L ₁	—	0.6	—
HE	—	2.8	—
y	—	—	0.1

1 = 1mm

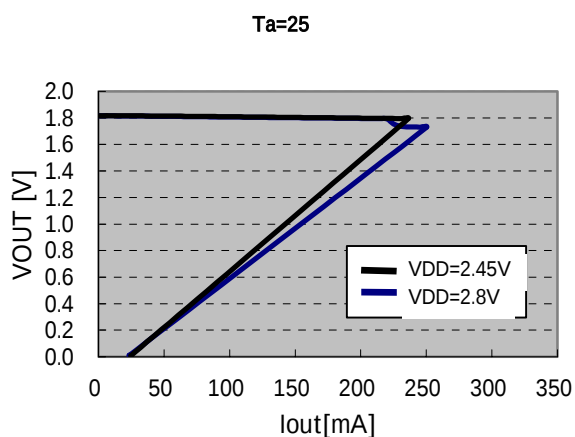
15. CHARACTERISTIC EXAMPLES

(1.8V OUTPUT PRODUCTS (S1F78B20Y18000R/S1F78B20Y18000R))

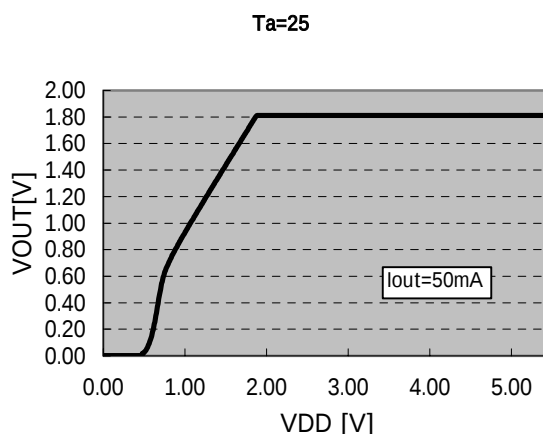
15. CHARACTERISTIC EXAMPLES

(1.8V OUTPUT PRODUCTS (S1F78B20Y18000R/S1F78B20Y18000R))

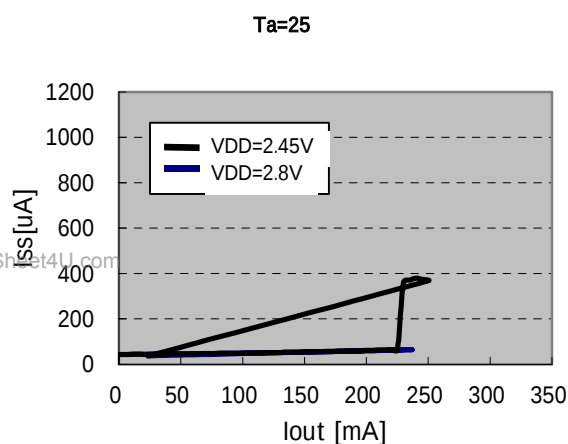
15.1 Characteristics between Output Voltage and Output Current



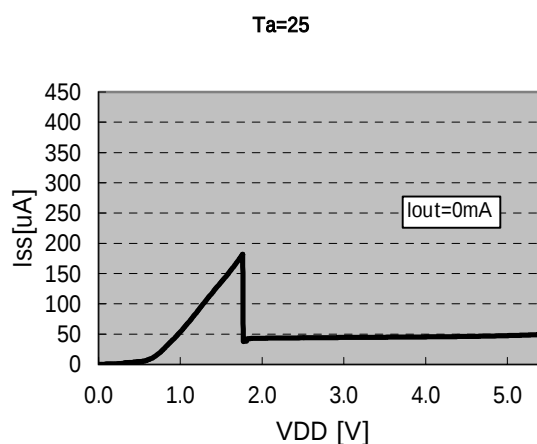
15.2 Characteristics between Output Voltage and Input Voltage



15.3 Characteristics between Consumption Current and Output Current

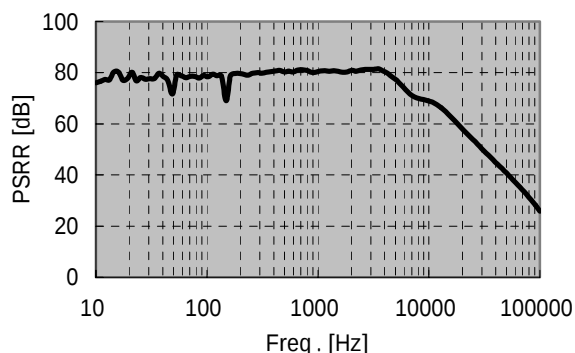


15.4 Characteristics between Consumption Current and Input Voltage



15.5 Characteristics between Ripple Rejection and Frequency

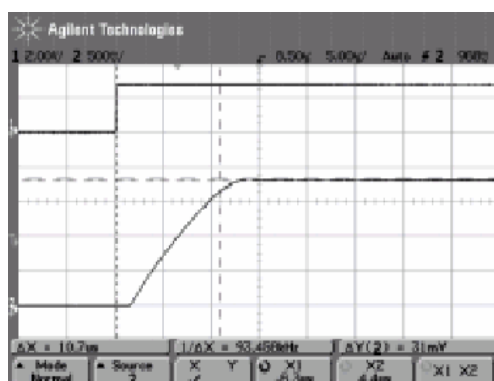
$V_{DD}=2.8V \pm 0.2V_{p-p}$
 $C_{in}=C_{out}=1\mu F$ $T_a=25$



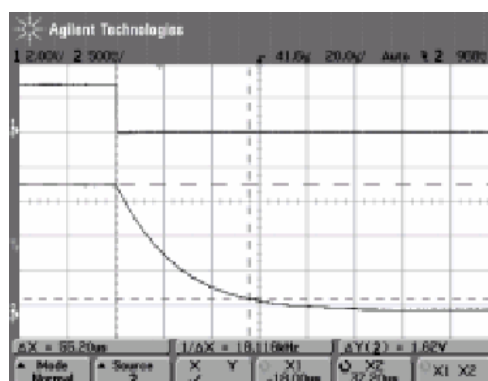
15. CHARACTERISTIC EXAMPLES

(1.8V OUTPUT PRODUCTS (S1F78B20Y18000R/S1F78B20Y18000R))

15.6 CE Transient Response $I_{OUT}=50mA$ $V_{CE}=0.0V$ $2.8V$ $C_{in}=C_{OUT}=1.0\mu F$ $V_{DD}=2.8V$ $T_a=25$

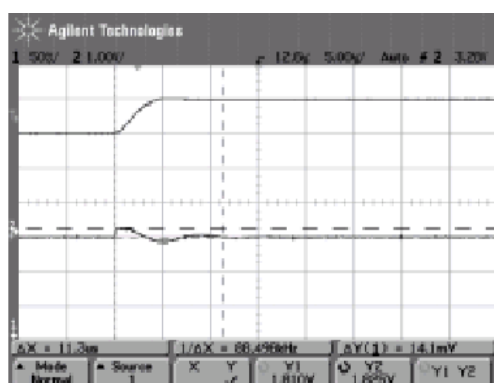


Upper:2.0V/div Lower:500mV/div Time:5μs/div

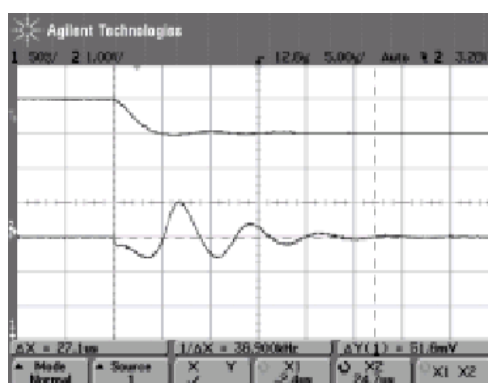


Upper:2.0V/div Lower:500mV/div Time:20μs/div

15.7 Input Transient Response $I_{OUT}=50mA$ $V_{DD}=2.8V$ $3.8V$ $C_{in}=C_{OUT}=1.0\mu F$ $T_a=25$



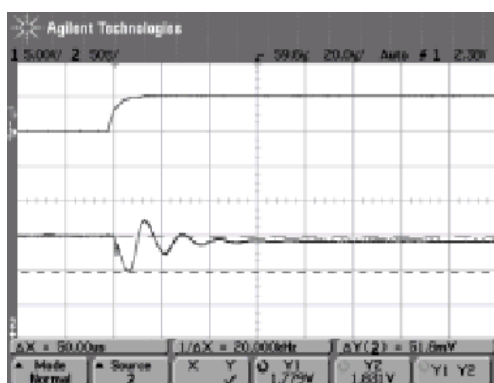
Upper:VDD Lower:VOUT Time:5μs/div



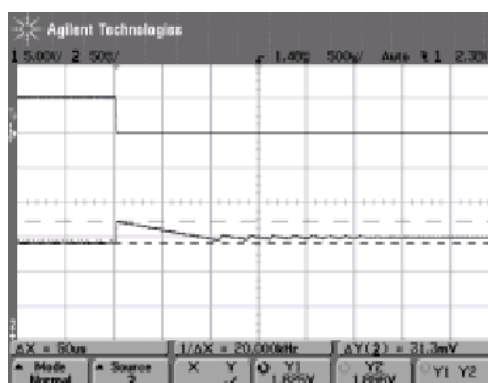
Upper:VDD Lower:VOUT Time:5μs/div

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15.8 Load Transient Response $V_{DD}=2.8V$ $I_{OUT}=0.1mA$ $50mA$ $C_{in}=1.0\mu F$ $C_{OUT}=4.7\mu F$ $T_a=25$



Upper:Iout Lower:VOUT Time:20μs/div



Upper:Iout Lower:VOUT Time:500μs/div

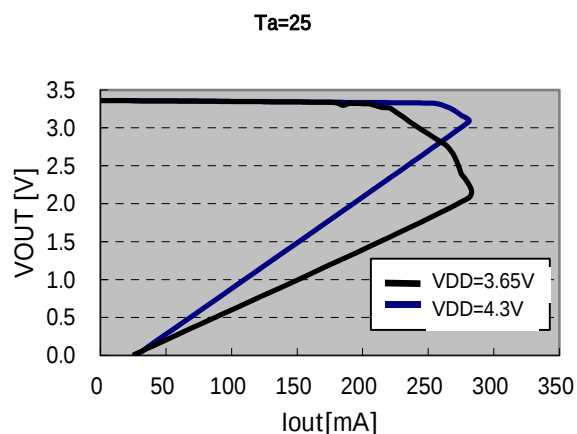
16. CHARACTERISTIC EXAMPLES

(3.3V OUTPUT PRODUCTS (S1F78B20Y33000R/S1F78B20Y33000R))

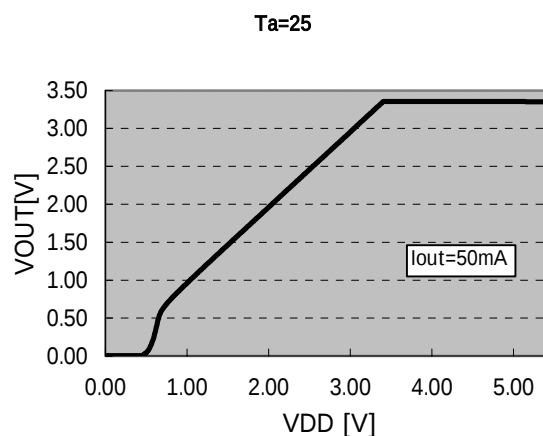
16. CHARACTERISTIC EXAMPLES

(3.3V OUTPUT PRODUCTS (S1F78B20Y33000R/S1F78B20Y33000R))

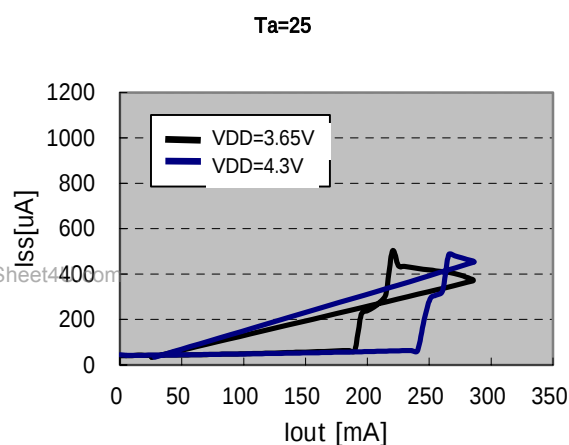
16.1 Characteristics between Output Voltage and Output Current



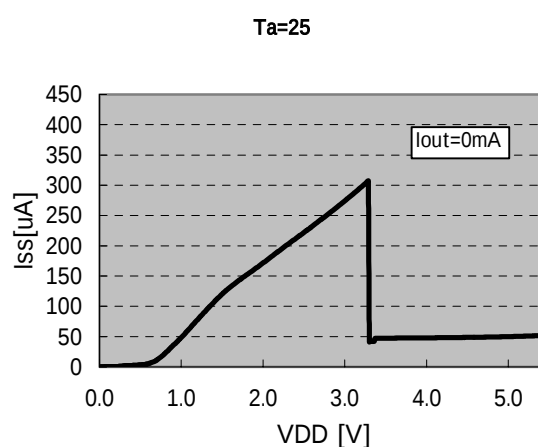
16.2 Characteristics between Output Voltage and Input Voltage



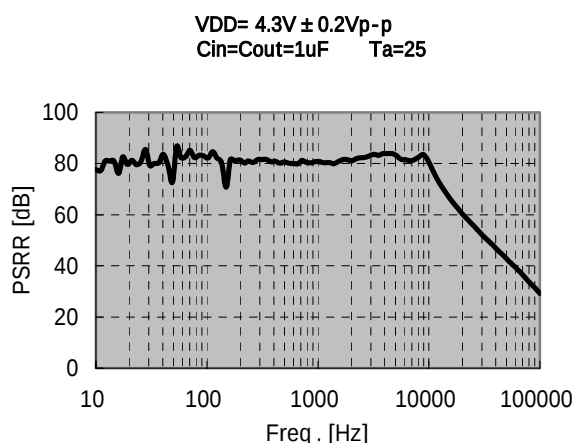
16.3 Characteristics between Consumption Current and Output Current



16.4 Characteristics between Consumption Current and Input Voltage



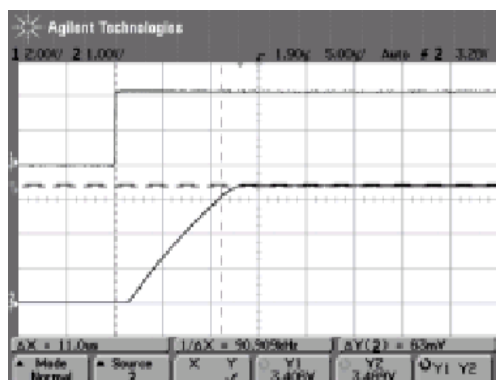
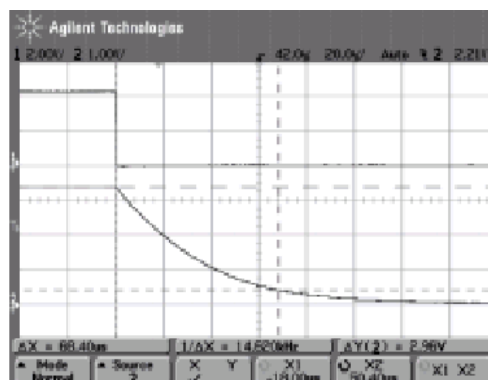
16.5 Characteristics between Ripple Rejection and Frequency



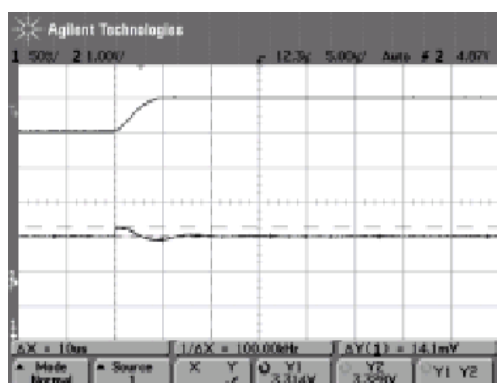
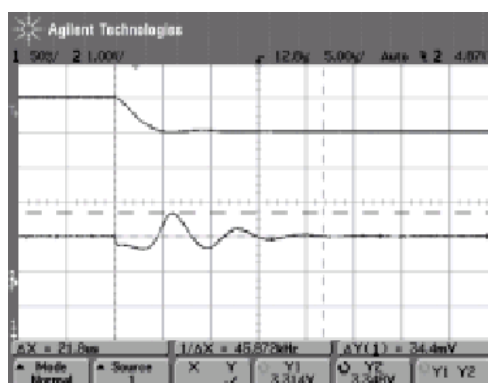
16. CHARACTERISTIC EXAMPLES

(3.3V OUTPUT PRODUCTS (S1F78B20Y33000R/S1F78B20Y33000R))

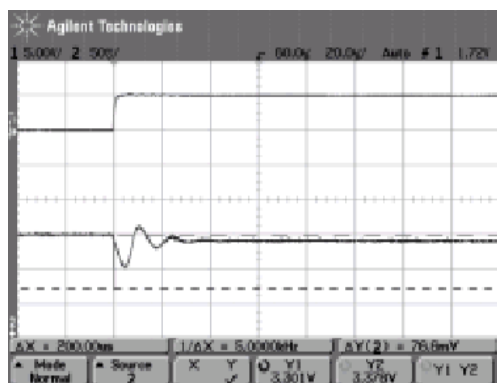
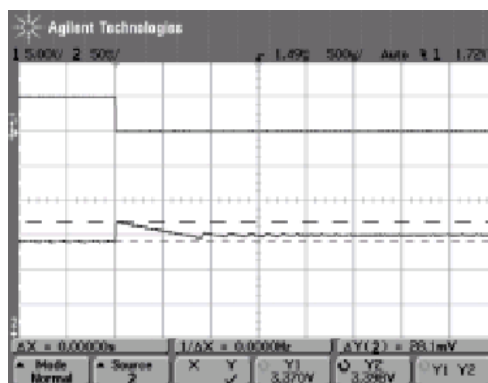
16.6 CE Transient Response $I_{OUT}=50mA$ $V_{CE}=0.0V$ 3.3V $C_{in}=C_{OUT}=1.0\mu F$ $V_{DD}=4.3V$ $T_a=25$

Upper:2.0V/div Lower:500mV/div Time:5 μ s/divUpper:2.0V/div Lower:500mV/div Time:20 μ s/div

16.7 Input Transient Response $I_{OUT}=50mA$ $V_{DD}=4.3V$ 5.3V $C_{in}=C_{OUT}=1.0\mu F$ $T_a=25$

Upper:VDD Lower:VOUT Time:5 μ s/divUpper:VDD Lower:VOUT Time:5 μ s/div

16.8 Load Transient Response $V_{DD}=4.3V$ $I_{OUT}=0.1mA$ 50mA $C_{in}=1.0\mu F$ $C_{OUT}=4.7\mu F$ $T_a=25$

Upper:Iout Lower:VOUT Time:20 μ s/divUpper:Iout Lower:VOUT Time:500 μ s/div

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