

S1F76620

Technical Manual

NOTICE

No part of this material may be reproduced or duplicated in any form or by any means without the written permission of Seiko Epson. Seiko Epson reserves the right to make changes to this material without notice. Seiko Epson does not assume any liability of any kind arising out of any inaccuracies contained in this material or due to its application or use in any product or circuit and, further, there is no representation that this material is applicable to products requiring high level reliability, such as, medical products. Moreover, no license to any intellectual property rights is granted by implication or otherwise, and there is no representation or warranty that anything made in accordance with this material will be free from any patent or copyright infringement of a third party. This material or portions thereof may contain technology or the subject relating to strategic products under the control of the Foreign Exchange and Foreign Trade Law of Japan and may require an export license from the Ministry of Economy, Trade and Industry or other approval from another government agency.

All other product names mentioned herein are trademarks and/or registered trademarks of their respective companies.

Configuration of product number

●DEVICES

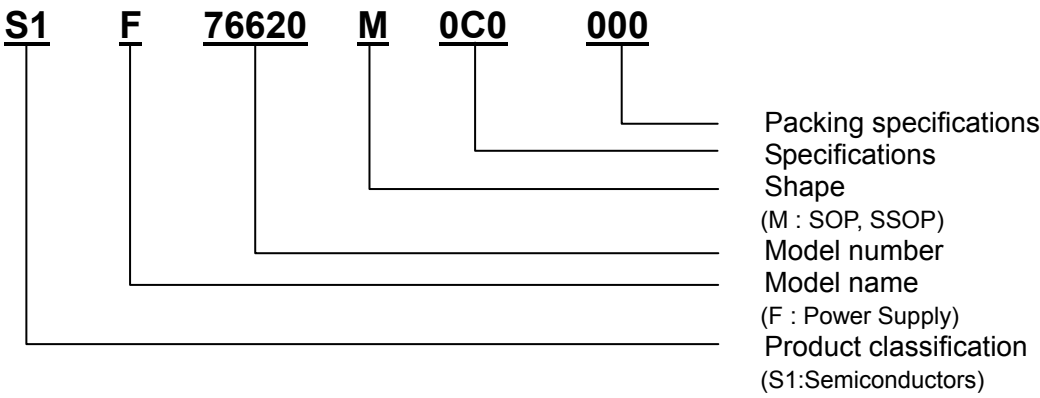


Table of Contents

1. DESCRIPTION	1
2. FEATURES.....	1
3. BLOCK DIAGRAM	1
4. PIN DESCRIPTION	2
4.1 Pin Assignment.....	2
4.2 Pin Function	2
4.3 Outline Dimensional Drawing	3
5. FUNCTIONAL DESCRIPTION	4
5.1 CR Oscillation Circuit.....	4
5.2 Voltage Converter	4
6. ELECTRICAL CHARACTERISTICS	5
6.1 Absolute Maximum Ratings	5
6.2 Recommended Operating Conditions.....	6
6.3 Electrical Characteristics	7
6.4 Measuring Circuit.....	7
6.5 Characteristic Data Sheets.....	8
7. EXTERNAL CONNECTION SAMPLES	12

1. DESCRIPTION

The S1F76620 is a highly efficient and low power consuming CMOS DC-DC converter.

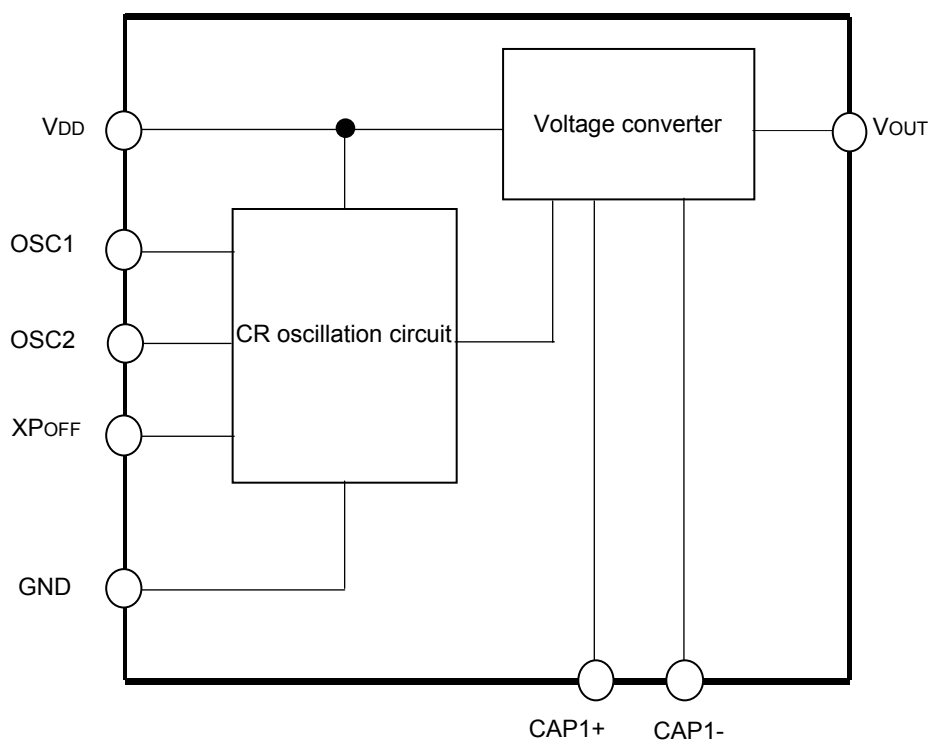
It assures double boosting output (3 to 16V) for input voltage (1.5 to 8V).

The S1F76620 enables you to drive an IC (liquid crystal driver, analog IC, etc.) that would usually require another power supply in addition to the logic main power, using a single power supply. Therefore, it is suitable for supplying micro-power to mobile handset such as PDA.

2. FEATURES

- (1) Highly efficient and low power consuming CMOS DC-DC converter
- (2) Easy conversion from input voltage V_{DD} (5V) to positive or negative voltage
Output $2V_{DD}$ (10V), $-V_{DD}$ (-5V) from input V_{DD} (5V)
- (3) Output current: Max. 30mA ($V_{DD} = 5V$)
- (4) Power conversion efficiency: Typ. 95%
- (5) Serial connection enabled ($V_{DD} = 5V$, $V_{OUT} = 15V$ using two ICs)
- (6) Low voltage operation: Appropriate for battery drive
- (7) Built-in CR oscillation circuit
- (8) SOP3B-8PIN

3. BLOCK DIAGRAM



4. PIN DESCRIPTION

4. PIN DESCRIPTION

4.1 Pin Assignment

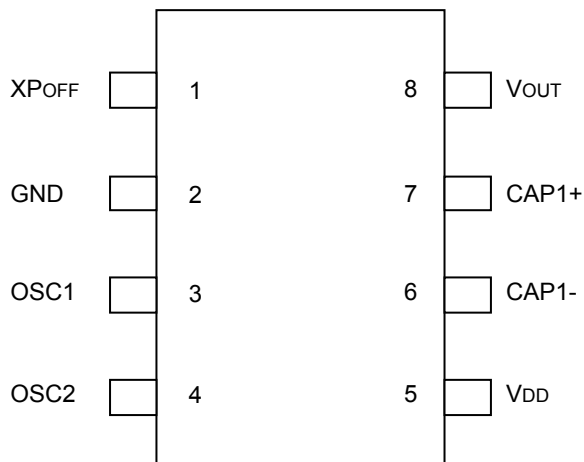


Fig.4.1 SOP3B - 8 Pins Pin Assignment

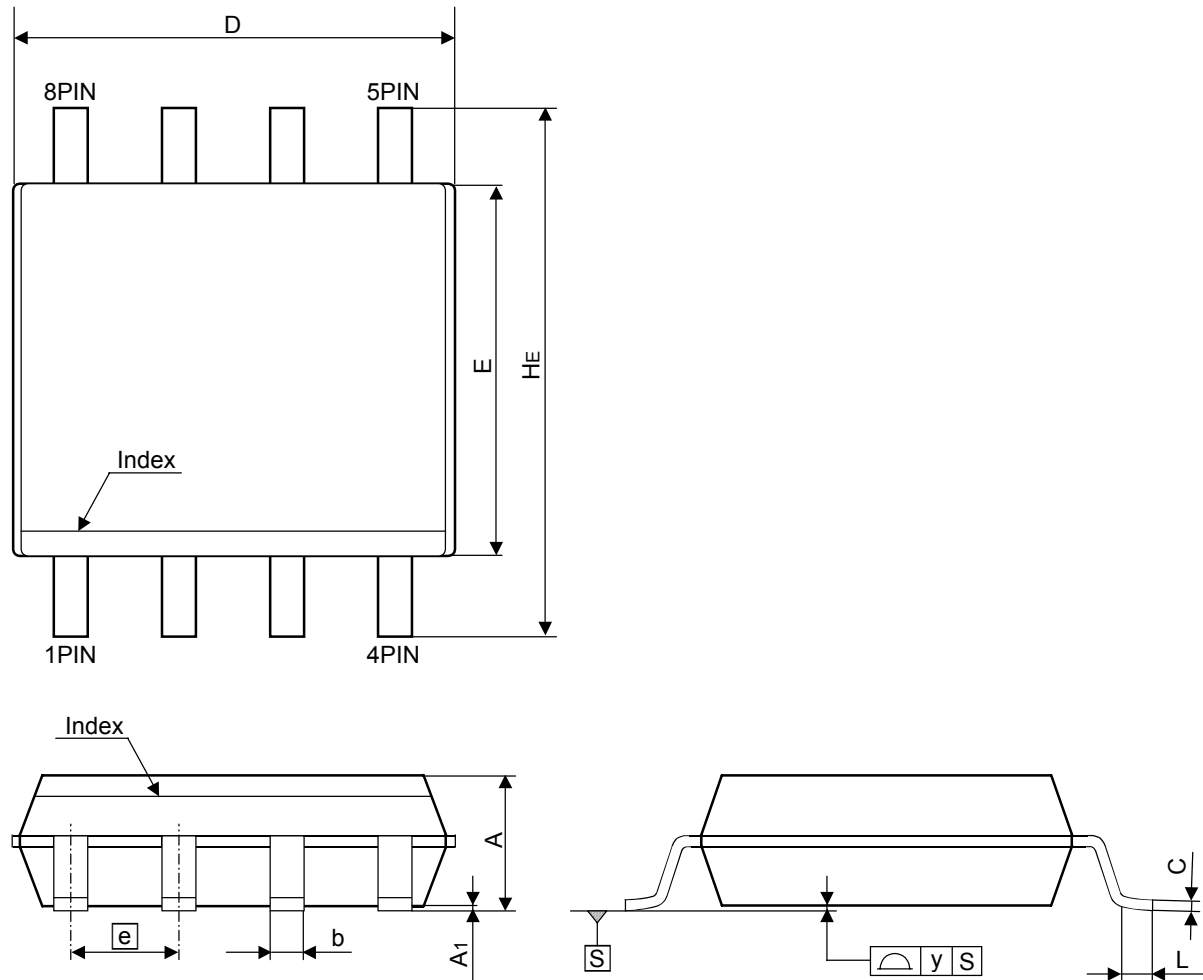
4.2 Pin Function

Pin No.	Pin Name	Function
1	XPOFF	Input pin for power off control VDD level: Internal clock operation mode VDD level: Internal clock operation stop mode, external clock Operation mode (For external clock input, input from OSC1 pin.)
2	GND(Vss)	Power supply pin (Negative side, system GND)
3	OSC1	Pin connected to oscillation resistor, functions as a clock input pin for external clock operation
4	OSC2	Pin connected to oscillation resistor; opened during external clock operation
5	VDD	Power supply pin (Positive side, system VCC)
6	CAP1-	Negative pin connected to pump-up capacitor for double boosting
7	CAP1+	Positive pin connected to pump-up capacitor for 3rd boosting
8	VOUT	Output pin for double boosting

4.3 Outline Dimensional Drawing

Reference

S1F76620M0C SOP3B-8PIN



Symbol	Dimension in Milimeter		
	Min.	Typ.	Max.
D		4.90	
E		3.90	
A			1.75
A1			0.25
b	0.30		0.45
c	0.15		0.27
e		1.27	
L	0.40		0.80
He		6.00	
γ			0.15

1 = 1mm

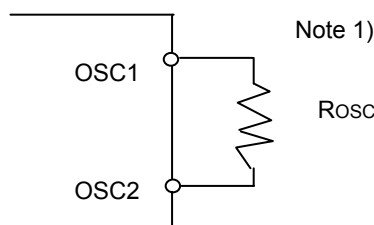
Note: The drawing is subject to change for improvement without prior notice.

5. FUNCTIONAL DESCRIPTION

5. FUNCTIONAL DESCRIPTION

5.1 CR Oscillation Circuit

The S1F76620 incorporates a CR oscillation circuit as an internal oscillation circuit, connecting the external resistor ROSC for oscillation between the OSC1 and OSC2 pins.



Note 1: Since the oscillation frequency varies depending on the wiring capacity, install the shortest possible wiring between OSC1, OSC2, and ROSC.

To set the external resistor ROSC, seek ROSC that corresponds to the oscillation frequency fOSC which provides maximum efficiency from Figures 7.9, 7.10 and 7.11.

The relationship between ROSC and fOSC in Fig.7.1 can be expressed by the following equation, which is concerned with the straight portion (500kΩ < ROSC < 2MΩ) only.

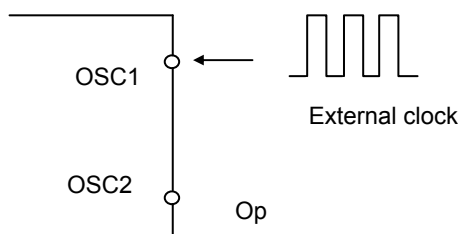
$$ROSC = A \cdot (1/f_{OSC})$$

(where A is a constant: GND=0V, VDD = 5V, $A \doteq 2.0 \times 10^{10} (\Omega \text{ Hz})$)

Therefore, the ROSC value can be obtained from the relational expression above.

(Recommended oscillation frequency: 10kHz to 30kHz (ROSC: 2MΩ to 680kΩ))

For external clock operation, open the OSC2 pin as shown below and input external clocks (duty 50%) from the OSC1 pin.

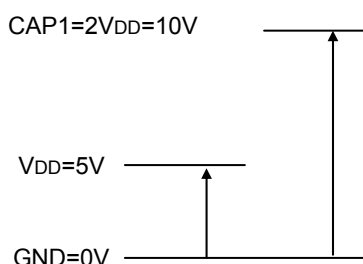


5.2 Voltage Converter

The voltage converter performs double boosting for input power voltage VDD using clocks generated in the CR oscillation circuit

For double boosting, the double input voltage (2VDD) is obtained from the VOUT pin by connecting a pump-up capacitor between CAP1+ and CAP2- and an external smoothing capacitor between VDD and VOUT.

The figure below shows the relationships between input and output voltages, using GND = 0V and VDD = 5V.



6. ELECTRICAL CHARACTERISTICS

6.1 Absolute Maximum Ratings

(Ta=-40 to +85°C)

Item	Symbol	Standard value		Unit	Remarks
		Min.	Max.		
Input power voltage	V _{DD}	-0.5	10.0	V	—
Input pin voltage	V _I	-0.5	V _{DD} +0.5	V	OSC1, OSC2
Output voltage	V _{OUT}	—	20	V	—
Output power voltage	V _{CAP+}	-0.5	V _{DD} +0.5	V	CAP+
Output pin voltage	V _{CAP-}	-0.5	V _{OUT} +0.5	V	CAP-
Allowable dissipation	P _d	—	150	mW	SOP3B-8pin
Operating temperature	T _{opr}	-40	85	°C	—
Storage temperature	T _{stg}	-65	150	°C	—

Note 1: The use under conditions exceeding the absolute maximum ratings above can cause permanent destruction of the IC.

Operation at the absolute maximum ratings for a long time can cause a significant reduction in reliability.

Note 2: All the voltages are based on GND = 0V.

6. ELECTRICAL CHARACTERISTICS

6.2 Recommended Operating Conditions

($T_a = -40$ to $+85^\circ\text{C}$)

Item	Symbol	Standard value		Unit	Remarks
		Min.	Max.		
Boosting start voltage	VSTA1	1.5	—	V	Rosc=1M Ω
	VSTA2	2.2	—	V	C2 $\geq 10\mu\text{F}$ Note 2: CL/C2 $\geq 1/20$
Boosting stop voltage	VSTP	—	1.5	V	Rosc=1M Ω
Output load resistance	RL	RLmin Note 3:	—	Ω	Rosc=1M Ω
Output load current	IOUT	—	30	mA	—
Oscillation frequency	fosc	10	30	kHz	—
External resistor for oscillation	Rosc	680	2000	k Ω	—
Boosting capacitor	C1,C2	3.3	—	μF	—

Note 1: All the voltages are based on GND = 0V.

Note 2: For low-voltage ($V_{DD} = 1.5$ to 2.2V) operation, the recommended circuit is as follows.

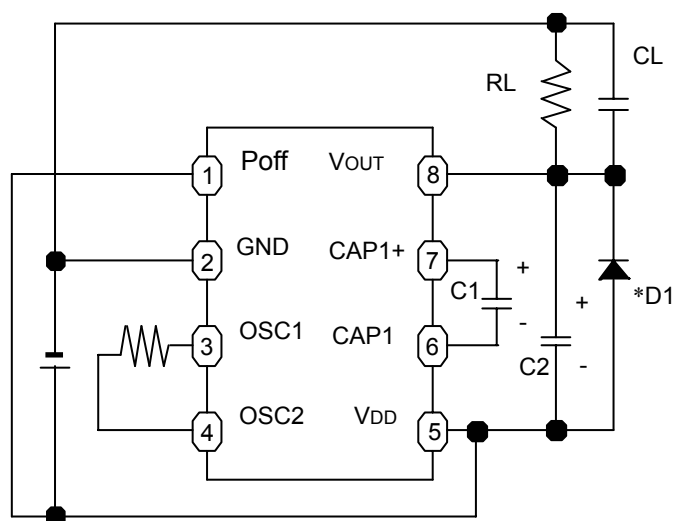


Fig.6.2.1 Recommended Circuit

Note 3: RLmin varies depending on the input voltage.

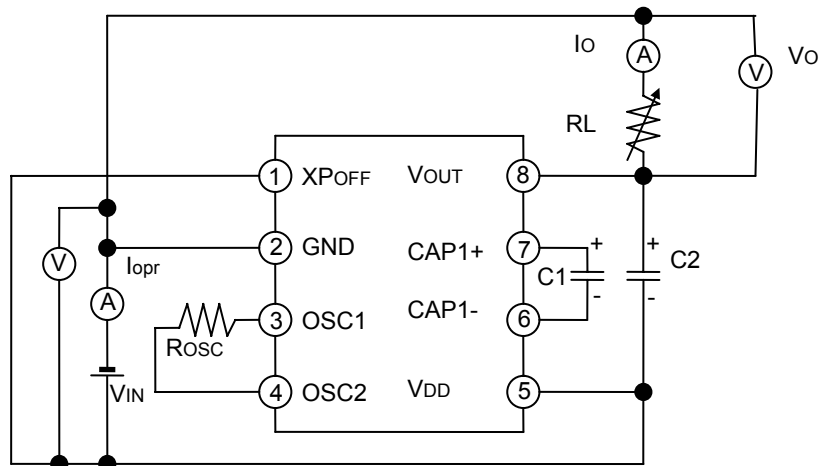
6.3 Electrical Characteristics

($V_{DD}=5V$, $T_a=-40$ to $+85^{\circ}C$)

Item	Symbol	Standard value			Unit	Remarks
		Min.	Typ.	Max.		
Input power voltage	V_{DD}	1.8	—	8.0	V	—
Output voltage	V_{OUT}	—	—	16.0	V	—
Booster current consumption	I_{OPR}	—	15	30	μA	$R_{OSC}=1M\Omega$
Static current	I_Q	—	—	2	μA	$V_{DD}=5V$
Oscillation frequency	f_{OSC}	14	17.5	21	kHz	$R_{OSC}=1M\Omega$
Output impedance	R_{OUT}	—	85	130	Ω	$I_{OUT}=10mA$
Boosting power conversion efficiency	P_{eff}	90	95	—	%	$I_{OUT}=5mA$
Input leak current	I_L	—	—	1.0	μA	OSC1 pin

Note 1: All the voltages are based on GND = 0V.

6.4 Measuring Circuit



6. ELECTRICAL CHARACTERISTICS

6.5 Characteristic Data Sheets

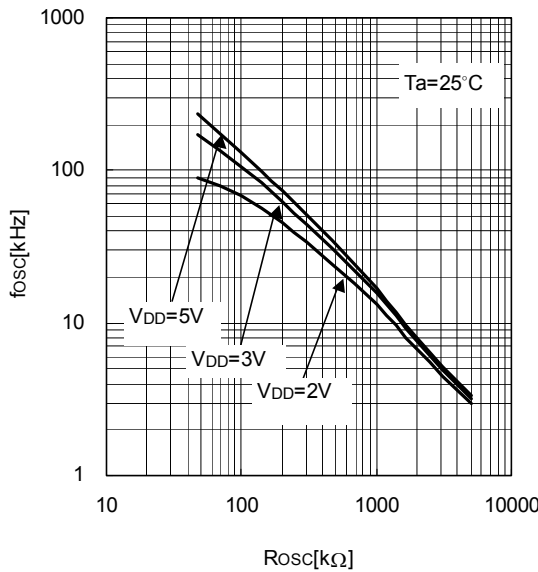


Fig.6.5.1 Oscillation frequency - External resistor for oscillation

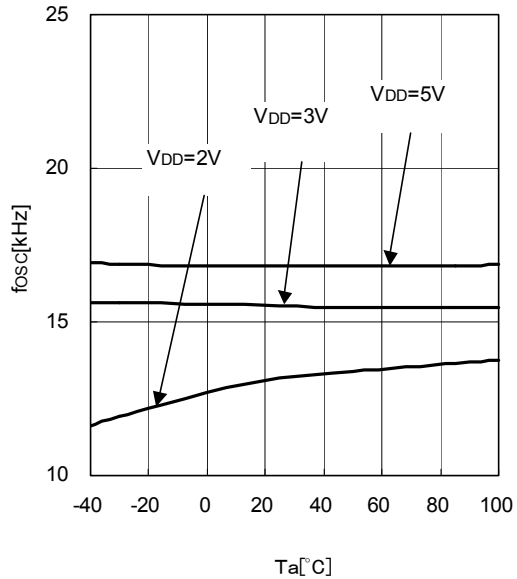


Fig.6.5.2 Oscillation frequency - Temperature

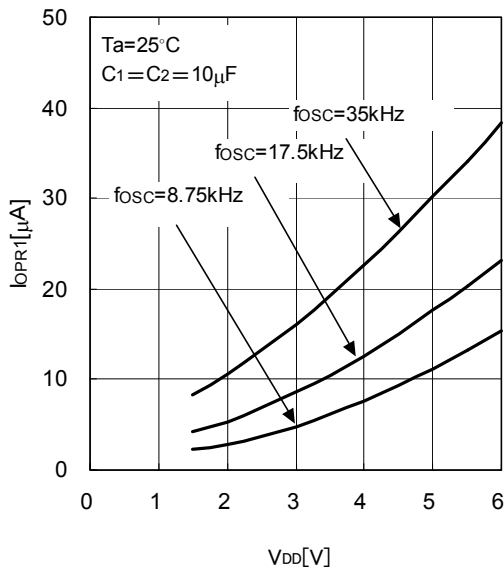


Fig.6.5.3 Booster current consumption - Input voltage

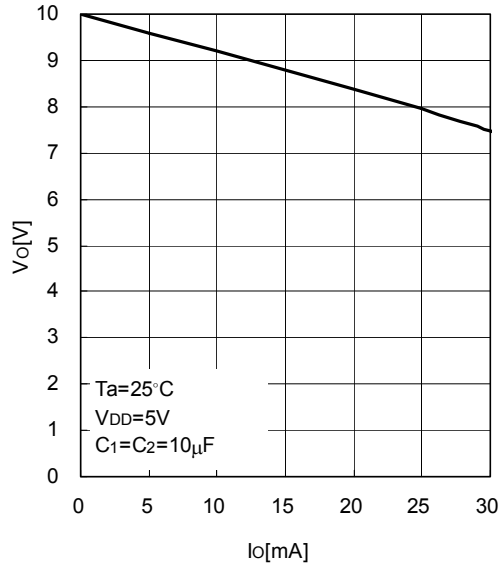


Fig.6.5.4 Output voltage (V_o) - Output current ①

6. ELECTRICAL CHARACTERISTICS

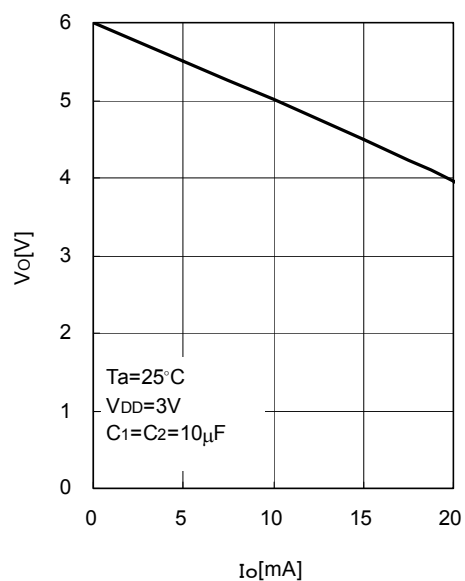


Fig.6.5.5 Output voltage (V_o) - Output current ②

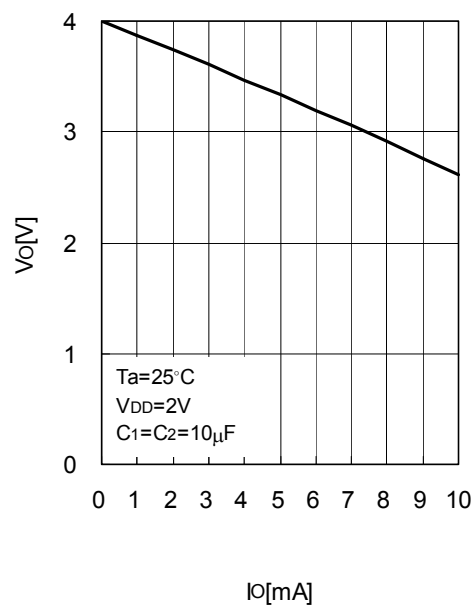


Fig.6.5.6 Output voltage (V_o) - Output current ③

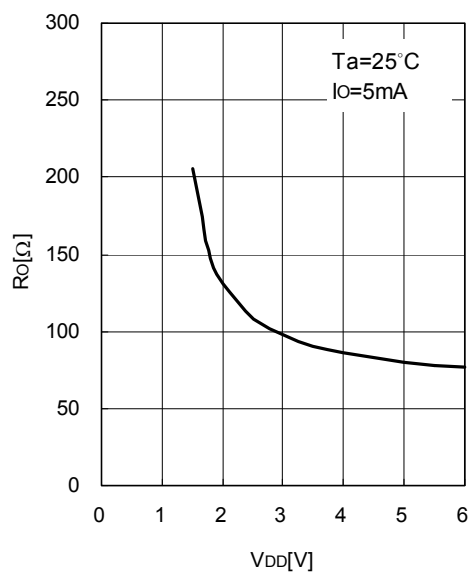


Fig.6.5.7 Output impedance - Input voltage ①

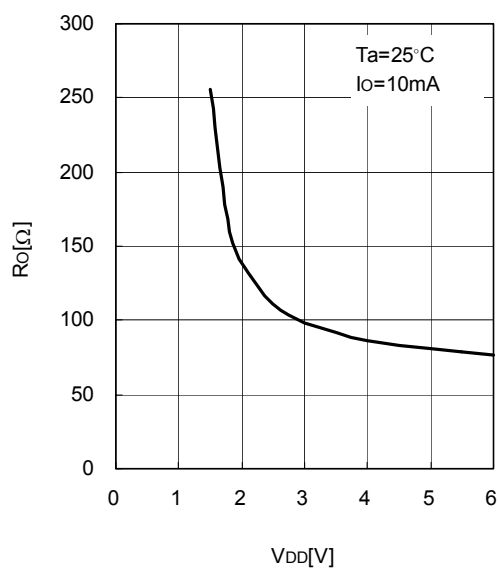


Fig.6.5.8 Output impedance - Input voltage ②

6. ELECTRICAL CHARACTERISTICS

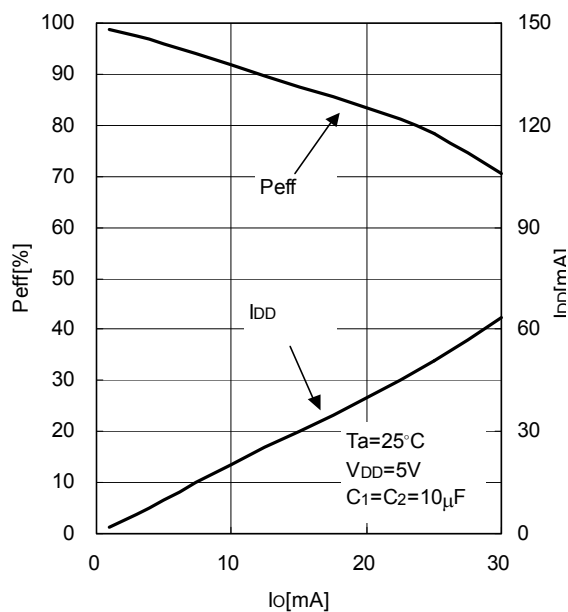


Fig.6.5.9 Boosting power conversion efficiency
- Output current ①
Input current - Output current ①

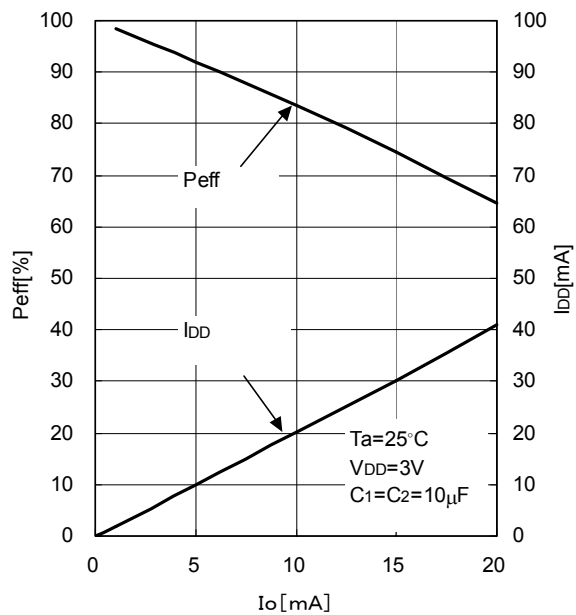


Fig.6.5.10 Boosting power conversion efficiency
- Output current ②
Input current - Output current ②

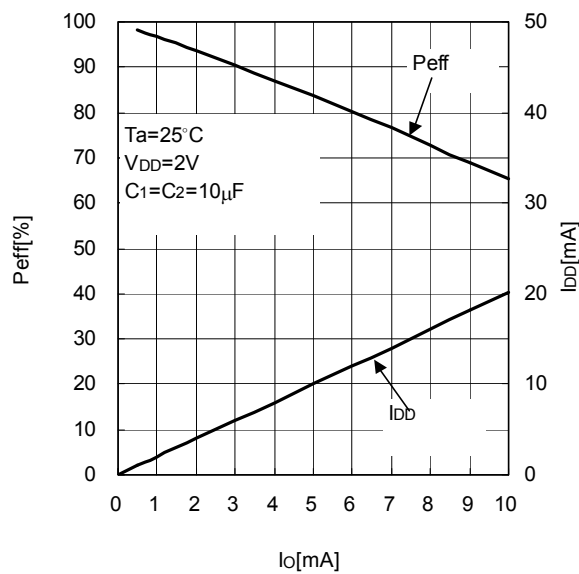


Fig.6.5.11 Boosting power conversion efficiency
- Output current ③
Input current - Output current ③

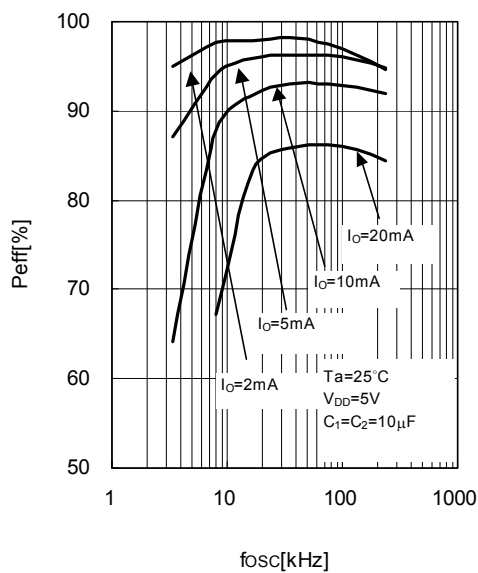


Fig.6.5.12 Boosting power conversion efficiency
- Oscillation frequency ①

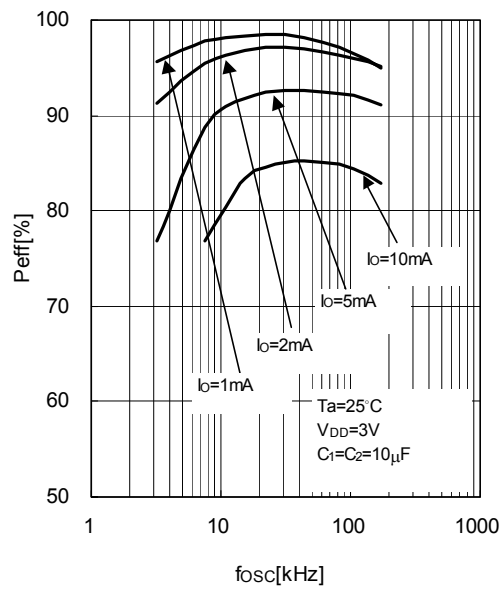


Fig.6.5.13 Boosting power conversion efficiency
- Oscillation frequency ②

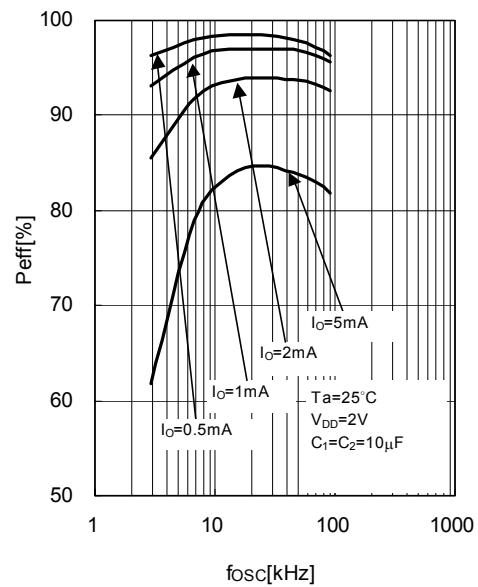


Fig.6.5.14 Boosting power conversion efficiency
- Oscillation frequency ③

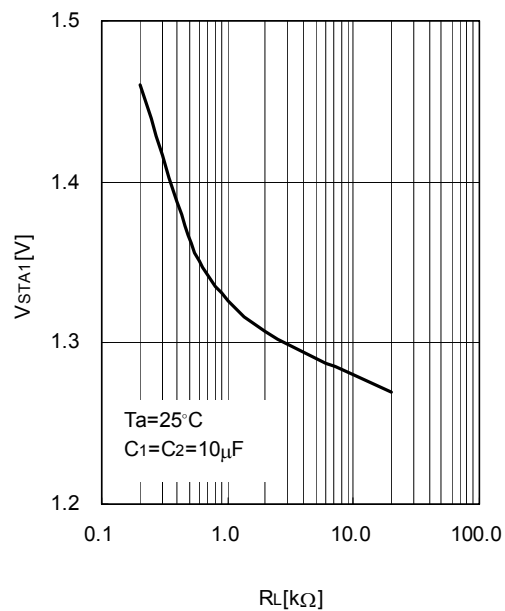


Fig.6.5.15 Boosting start voltage
- Load resistance

7. EXTERNAL CONNECTION SAMPLES

7. EXTERNAL CONNECTION SAMPLES

(1) Double boosting

The connection shown in Fig.7.1 enables double boosting output ($2 \times V_{DD}$) from V_{OUT} .

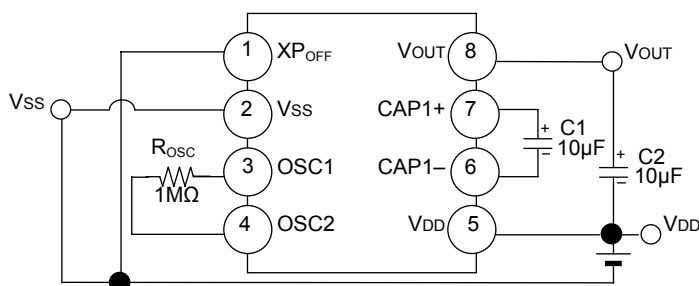


Fig.7.1 Double Boosting

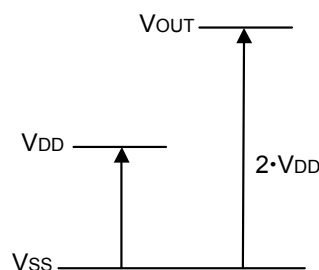


Fig.7.2 Diagram of Voltage Relations for Double Boosting

(2) Parallel Connection

As shown in Fig.7.1, multi-connection in parallel reduces output impedance R_{OUT} .

Therefore, n parallel connections lowers R_{OUT} to approximately $1/n$.

A single smoothing capacitor $C3$ can be shared among those connections.

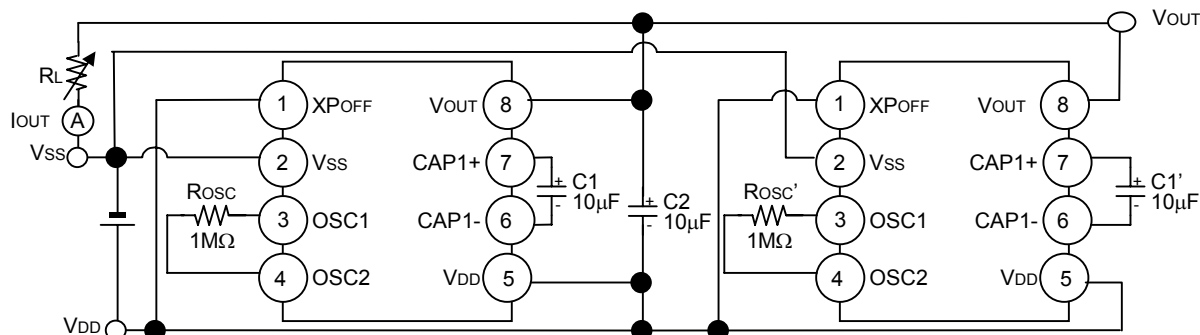


Fig.7.3 Parallel Connection

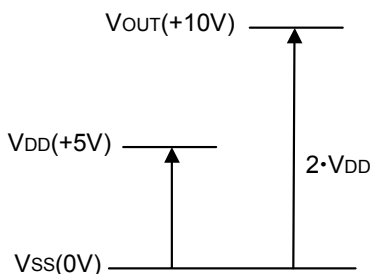


Fig.7.4 Diagram of Voltage Relations in Parallel Connection

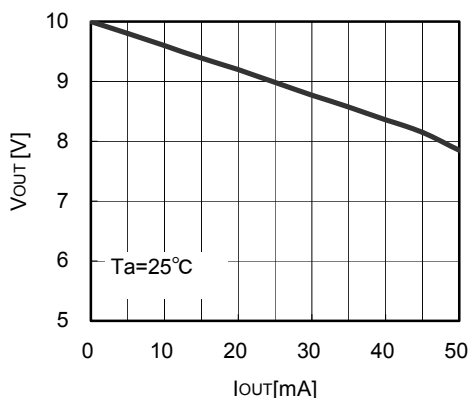


Fig.7.5 Output Voltage - Output Current

(3) Serial Connection

The serial connection in the S1F76620 (connecting V_{DD} and V_{OUT} in the pre-stage to V_{SS} and V_{DD} in the next stage respectively) further increases the output voltage.

However, the serial connection raises output impedance.

Fig.7.6 shows an example of serial connection for obtaining $V_{OUT}' = 15V$ from $V_{DD} = 5V$.

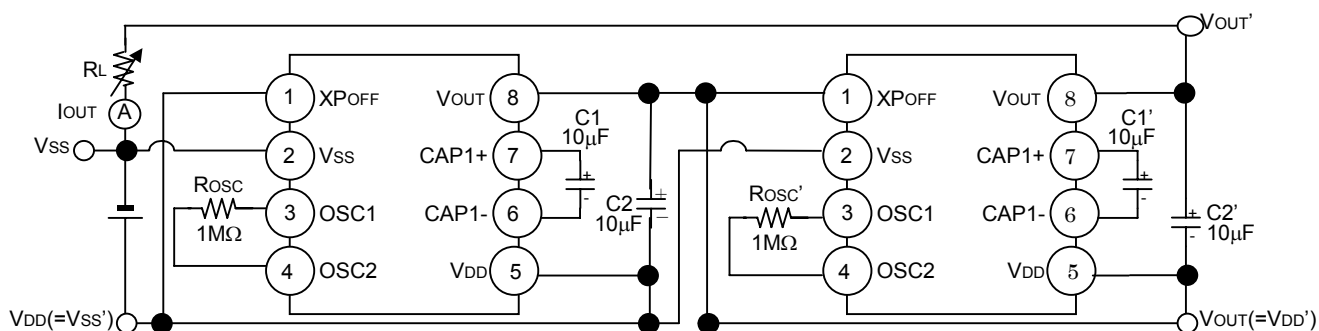


Fig.7.6 Serial Connection

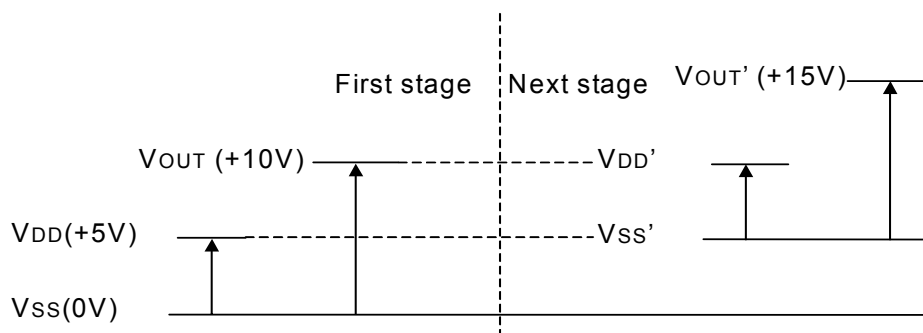


Fig.7.7 Diagram of Voltage Relations in Serial Connection

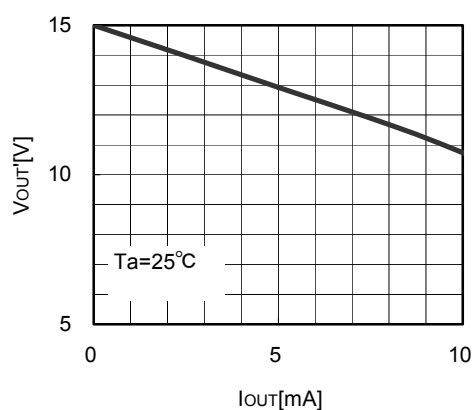


Fig.7.8 Output Voltage - Output Current

7. EXTERNAL CONNECTION SAMPLES

Note) In serial connection, if the next-stage input voltage is within the standard ($V_{DD}' - V_{SS}' \leq 10V$), the first-stage output ($V_{OUT} - V_{SS}$) can be used as the next-stage input ($V_{DD}' - V_{SS}'$).

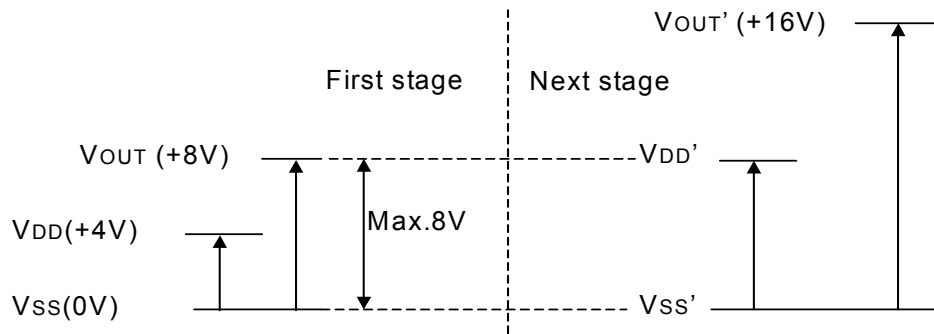


Fig.7.9 Diagram of Voltage Relations in Serial Connection (2)

(4) Negative Voltage Conversion

The S1F76620 converts input voltage to negative voltage for double boosting through the circuit shown in Fig.7.10. However, the output voltage rises by forward voltage V_F of the diode.

For example, as shown in Fig.7.10, $V_{SS} = 0V$, $V_{DD} = 5V$, and $V_F = 0.6V$ results in $V_{OUT} = -5V + 2 \times 0.6V = -3.8V$.

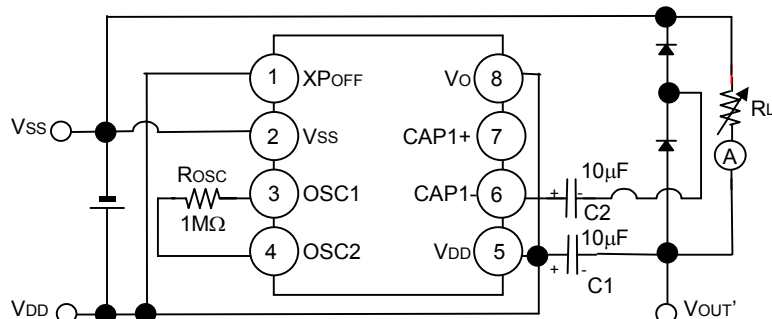


Fig.7.10 Negative-Voltage Conversion

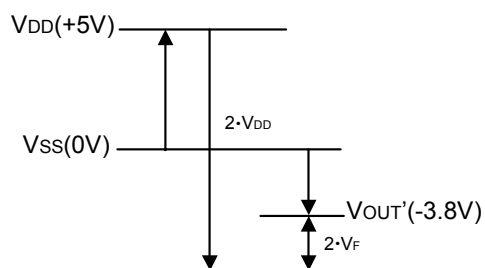


Fig.7.11 Diagram of Voltage Relations for Negative Voltage Conversion

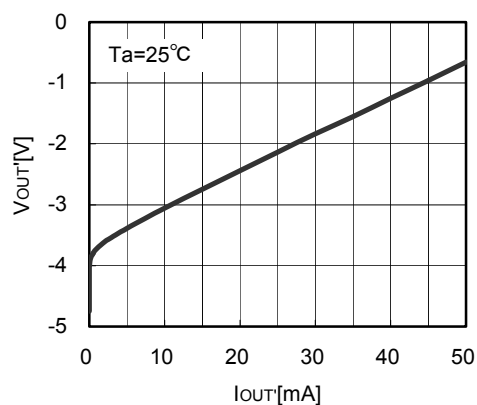


Fig.7.12 Output Voltage - Output Current

7. EXTERNAL CONNECTION SAMPLES

(5) Negative-Voltage Conversion + Positive-Voltage Conversion

Combining the double boosting (Fig.7.1) with the negative voltage conversion (Fig.7.10) generates the circuit shown in Fig.7.13, and outputs 10V and -3.8V from 5V input. In this case, the output impedance is higher than that for negative voltage conversion only or positive voltage conversion only.

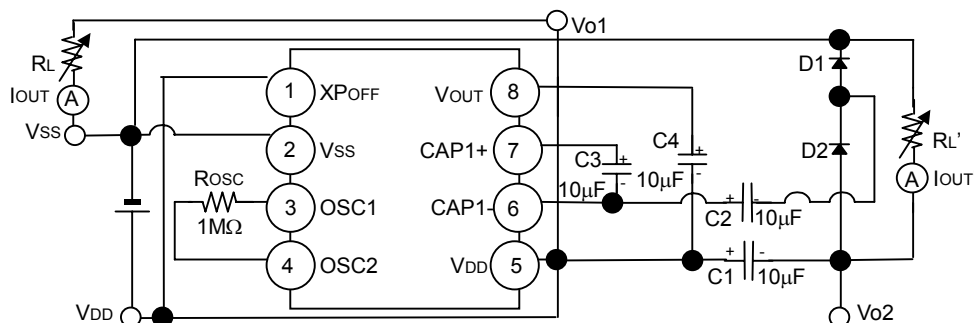


Fig.7.13 Negative-Voltage Conversion + Positive-Voltage Conversion

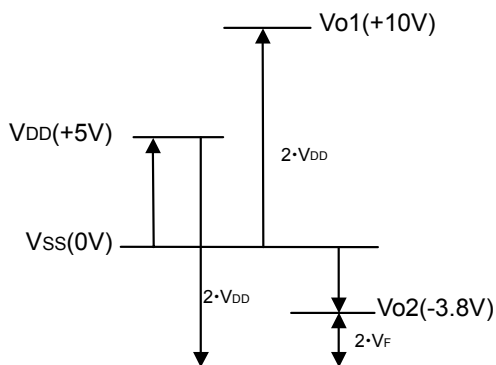


Fig.7.14 Diagram of Voltage Relations for Negative Voltage Conversion + Positive Voltage Conversion

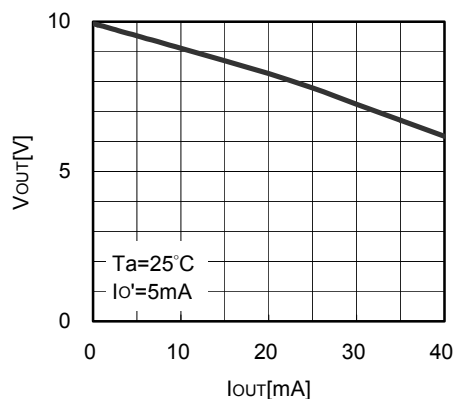


Fig.7.15 Output Voltage - Output Current

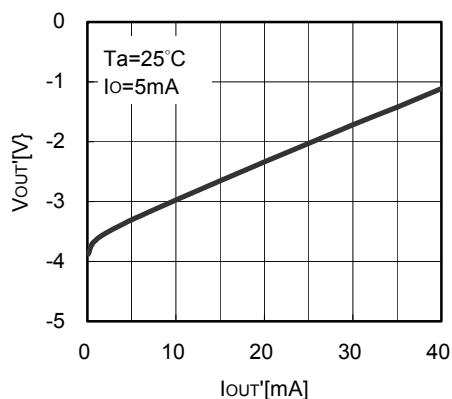


Fig.7.16 Output Voltage - Output Current

AMERICA

EPSON ELECTRONICS AMERICA, INC.**HEADQUARTERS**

2580 Orchard Parkway
San Jose, CA 95131, USA
Phone: +1-800-228-3964 FAX: +1-408-922-0238

SALES OFFICES**Northeast**

301 Edgewater Place, Suite 210
Wakefield, MA 01880, U.S.A.
Phone: +1-800-922-7667 FAX: +1-781-246-5443

EUROPE

EPSON EUROPE ELECTRONICS GmbH**HEADQUARTERS**

Riesstrasse 15
80992 Munich, GERMANY
Phone: +49-89-14005-0 FAX: +49-89-14005-110

ASIA

EPSON (CHINA) CO., LTD.

23F, Beijing Silver Tower 2# North RD DongSanHuan
ChaoYang District, Beijing, CHINA
Phone: +86-10-6410-6655 FAX: +86-10-6410-7320

SHANGHAI BRANCH

7F, High-Tech Bldg., 900, Yishan Road,
Shanghai 200233, CHINA
Phone: +86-21-5423-5522 FAX: +86-21-5423-5512

EPSON HONG KONG LTD.

20/F., Harbour Centre, 25 Harbour Road
Wanchai, Hong Kong
Phone: +852-2585-4600 FAX: +852-2827-4346
Telex: 65542 EPSCO HX

EPSON Electronic Technology Development (Shenzhen) LTD.

12/F, Dawning Mansion, Keji South 12th Road,
Hi-Tech Park, Shenzhen
Phone: +86-755-2699-3828 FAX: +86-755-2699-3838

EPSON TAIWAN TECHNOLOGY & TRADING LTD.

14F, No. 7, Song Ren Road,
Taipei 110
Phone: +886-2-8786-6688 FAX: +886-2-8786-6660

EPSON SINGAPORE PTE., LTD.

1 HarbourFront Place,
#03-02 HarbourFront Tower One, Singapore 098633
Phone: +65-6586-5500 FAX: +65-6271-3182

SEIKO EPSON CORPORATION**KOREA OFFICE**

50F, KLI 63 Bldg., 60 Yoido-dong
Youngdeungpo-Ku, Seoul, 150-763, KOREA
Phone: +82-2-784-6027 FAX: +82-2-767-3677

GUMI OFFICE

2F, Grand B/D, 457-4 Songjeong-dong,
Gumi-City, KOREA
Phone: +82-54-454-6027 FAX: +82-54-454-6093

SEIKO EPSON CORPORATION**SEMICONDUCTOR OPERATIONS DIVISION****IC Sales Dept.****IC International Sales Group**

421-8, Hino, Hino-shi, Tokyo 191-8501, JAPAN
Phone: +81-42-587-5814 FAX: +81-42-587-5117

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

Epson:

S1F76620M0C0