EPSON
EXCEED YOUR VISION

S1F76620
Technical Manual

SEIKO EPSON CORPORATION

Rev.1.2

NOTICE

Configuration of product number

●DEVICES

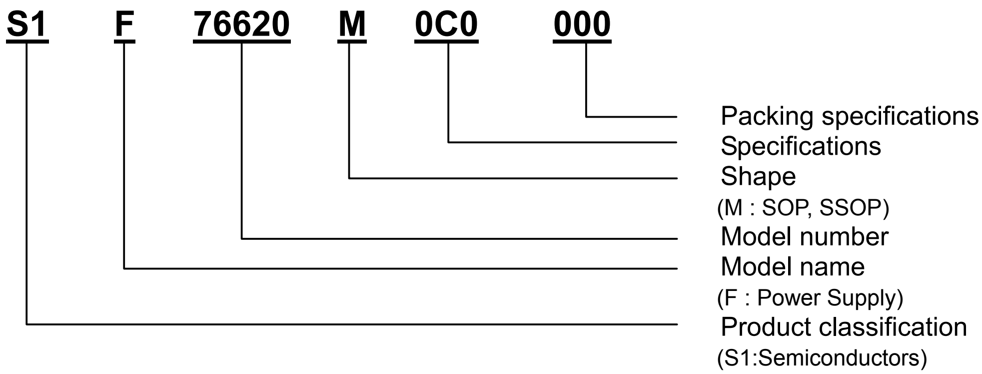


Table of Contents

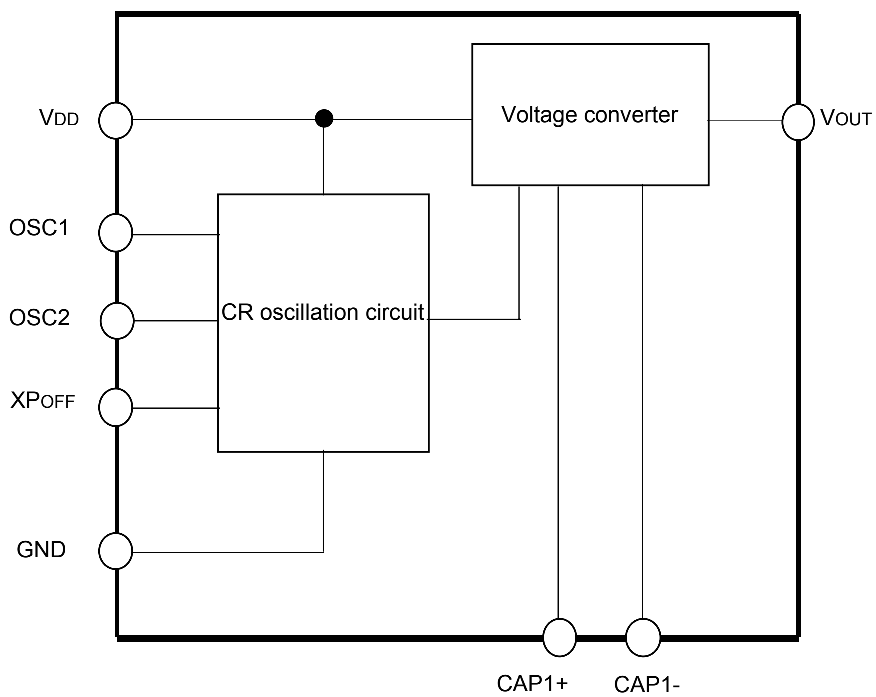
1. DESCRIPTION

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

4.1 Pin Assignment

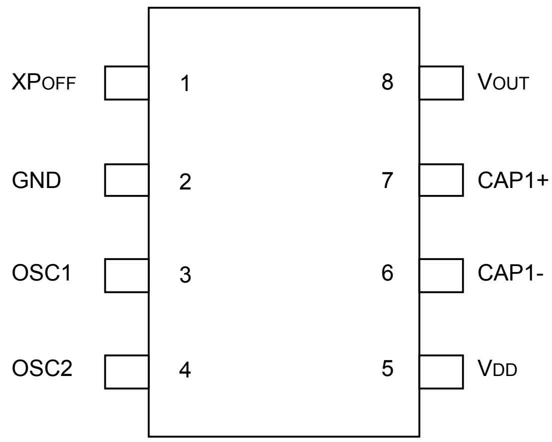


Fig.4.1 SOP3B - 8 Pins Pin Assignment

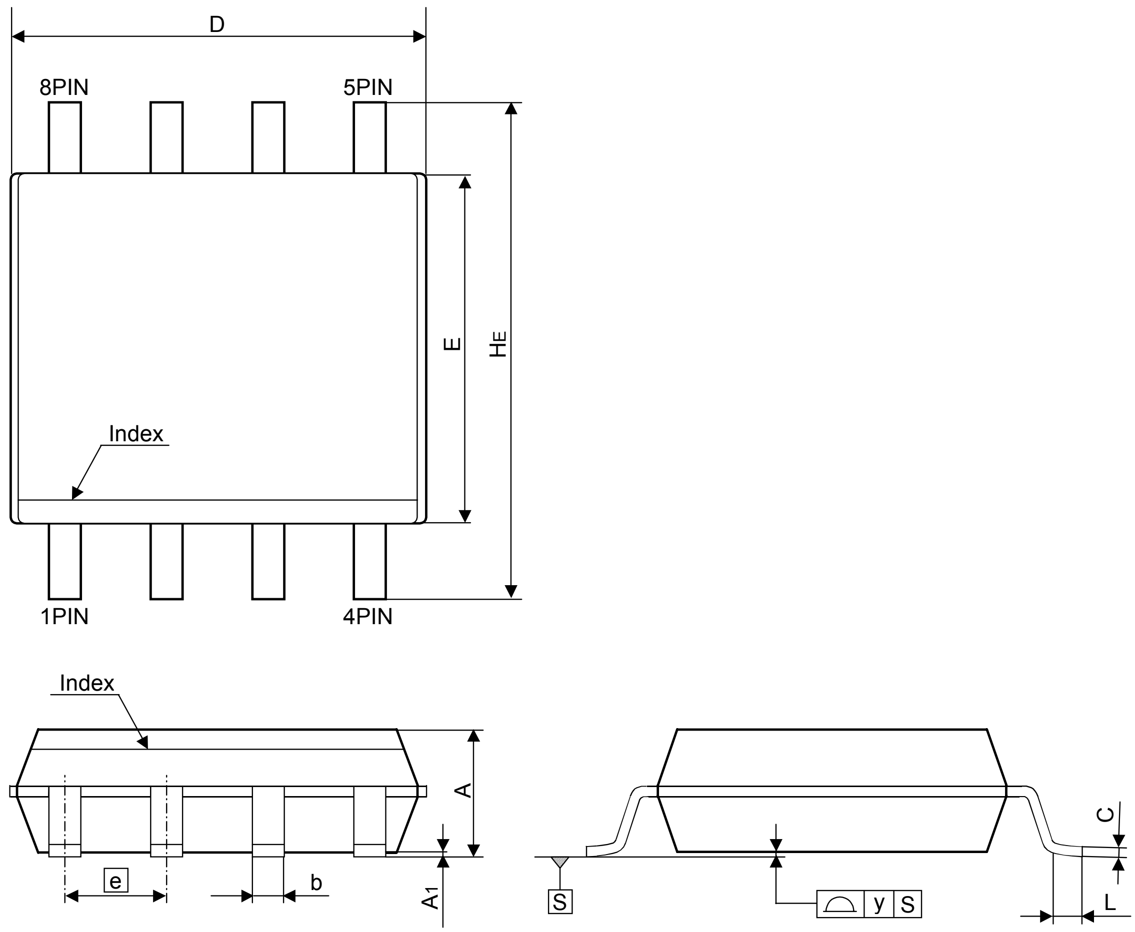
4.2 Pin Function

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
A_1			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

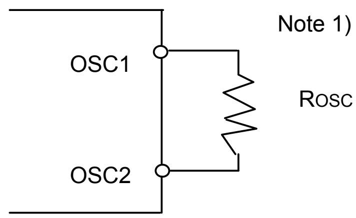
1 = 1mm

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

5. FUNCTIONAL DESCRIPTION

5.1 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.

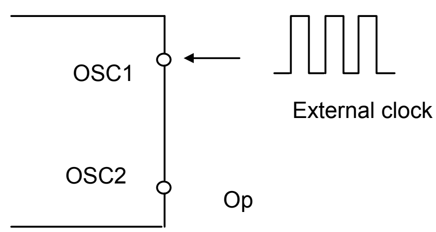
ROSC = A • (1/fOSC)

(where A is a constant: GND=0V, VDD = 5V, A ≒ 2.0 × 1010 (Ω 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.

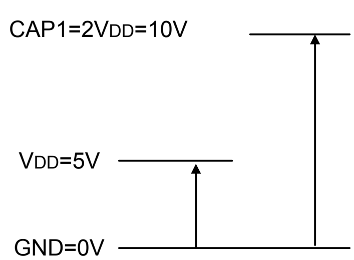


5.2 Voltage Converter

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

(T_a=-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	VCAP+	-0.5	V_{DD}+0.5	V	CAP+
Output pin voltage	VCAP-	-0.5	V_{OUT}+0.5	V	CAP-
Allowable dissipation	Pd	—	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.

6.2 Recommended Operating Conditions

(Ta=-40 to +85°C)

Item	Symbol	Standard value		Unit	Remarks
		Min.	Max.		
Boosting start voltage	VSTA1	1.5	—	V	ROSC=1MΩ
	VSTA2	2.2	—	V	C2≥10μF Note 2: CL/C2≥1/20
Boosting stop voltage	VSTP		1.5	V	ROSC=1MΩ
Output load resistance	RL	RLmin Note 3:	—	Ω	ROSC=1MΩ
Output load current	IOUT	—	30	mA	—
Oscillation frequency	fOSC	10	30	kHz	—
External resistor for oscillation	ROSC	680	2000	kΩ	—
Boosting capacitor	C1,C2	3.3	—	μF	—

Note 1: All the voltages are based on GND = 0V.
Note 2: For low-voltage (VDD = 1.5 to 2.2V) operation, the recommended circuit is as follows.

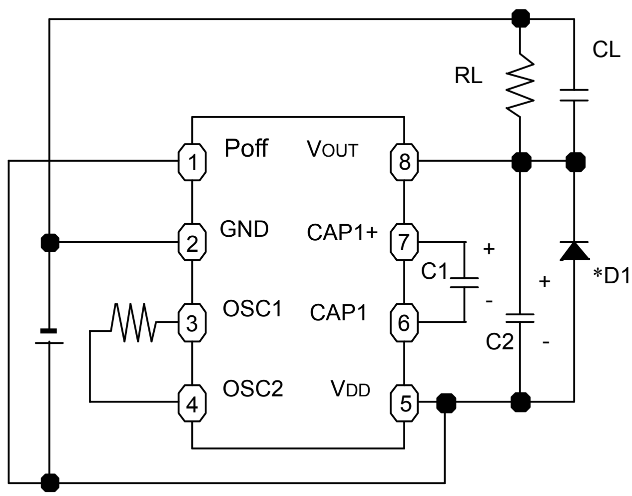


Fig.6.2.1 Recommended Circuit

Note 3: RLmin varies depending on the input voltage.

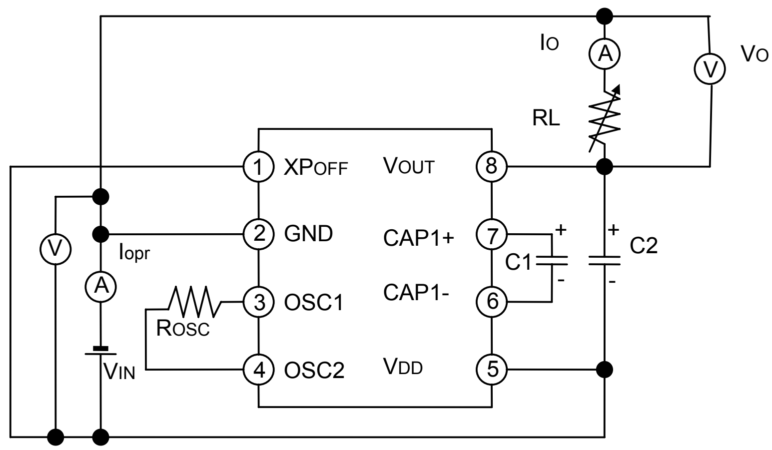
6.3 Electrical Characteristics

(V_{DD}=5V, Ta=-40 to +85°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}=1MΩ
Static current	IQ	—	—	2	μA	V_{DD}=5V
Oscillation frequency	f_{OSC}	14	17.5	21	kHz	R_{OSC}=1MΩ
Output impedance	R_{OUT}	—	85	130	Ω	I_{OUT}=10mA
Boosting power conversion efficiency	Peff	90	95	—	%	I_{OUT}=5mA
Input leak current	IL	—	—	1.0	μA	OSC1 pin

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

6.4 Measuring Circuit



6.5 Characteristic Data Sheets

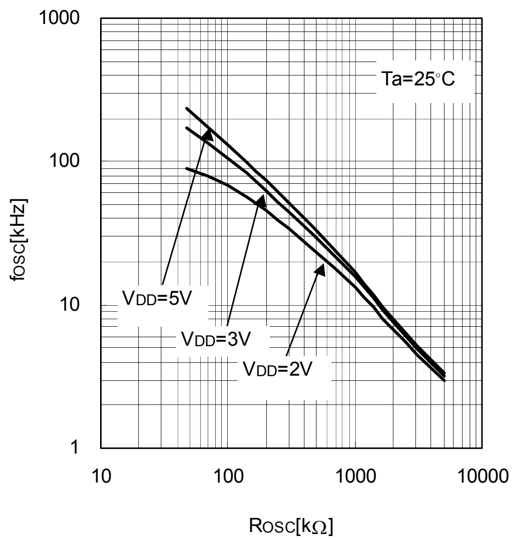


Fig.6.5.1 Oscillation frequency - External resistor for oscillation

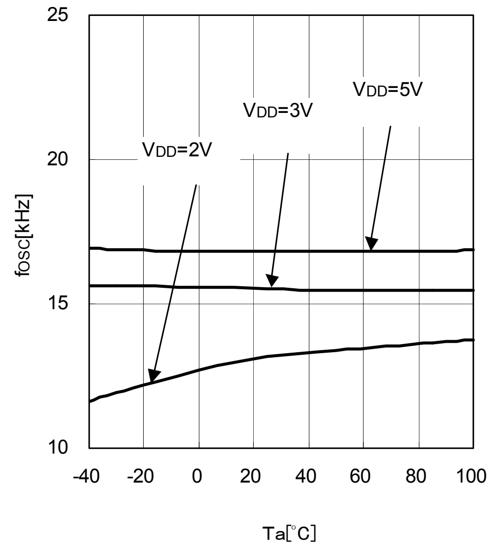


Fig.6.5.2 Oscillation frequency - Temperature

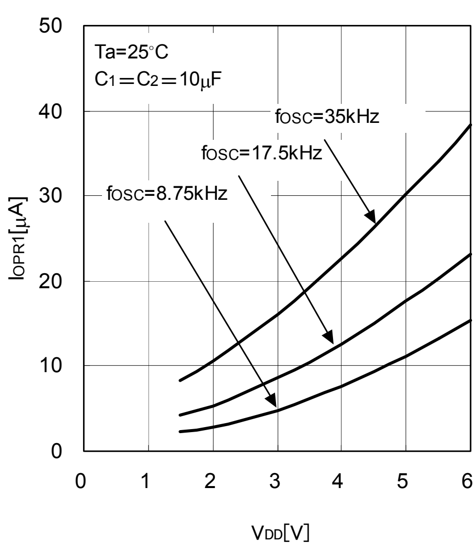


Fig.6.5.3 Booster current consumption - Input voltage

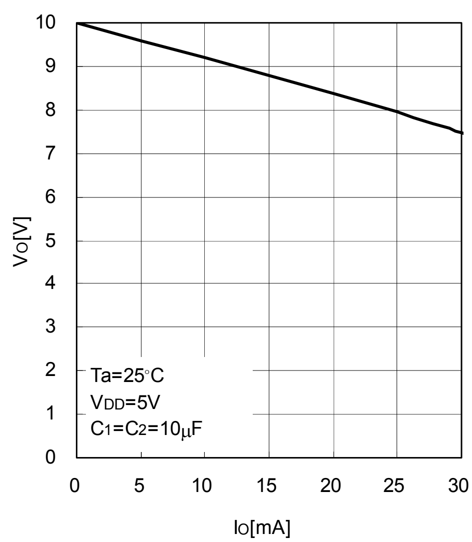


Fig.6.5.4 Output voltage (V_O) - Output current ①

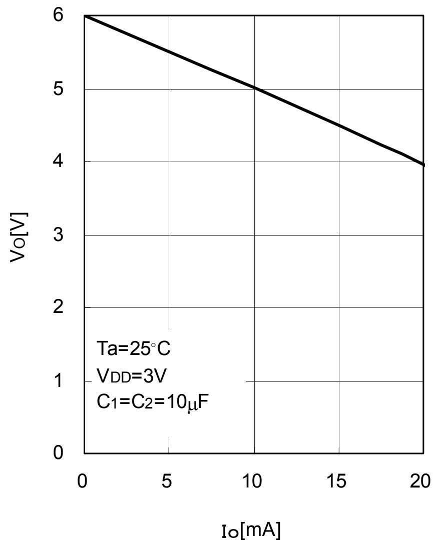


Fig.6.5.5 Output voltage (VO) - Output current ②

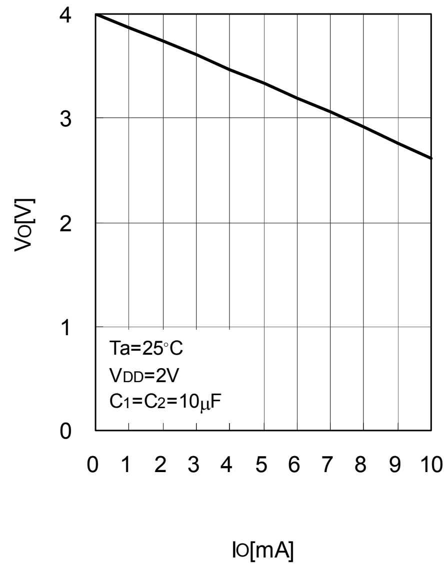


Fig.6.5.6 Output voltage (Vo) - Output current ③

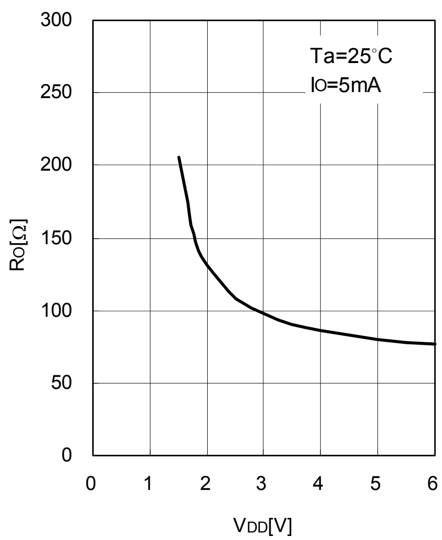


Fig.6.5.7 Output impedance - Input voltage ①

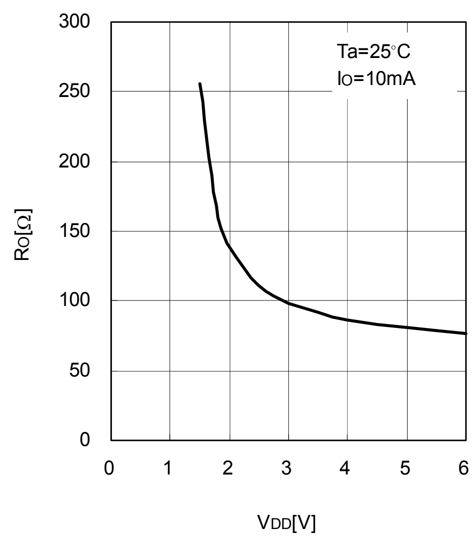


Fig.6.5.8 Output impedance - Input voltage ②

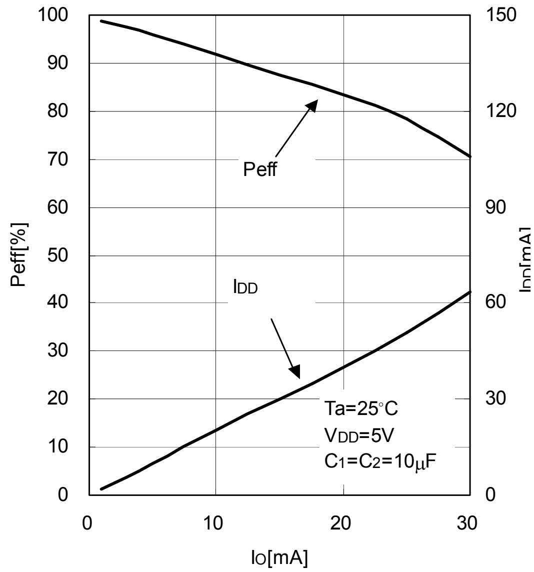


Fig.6.5.9 Boosting power conversion efficiency - Output current ①
Input current - Output current ①

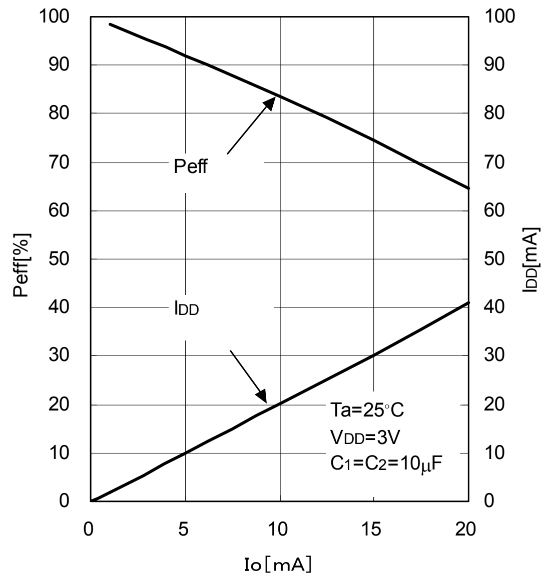


Fig.6.5.10 Boosting power conversion efficiency - Output current ②
Input current - Output current ②

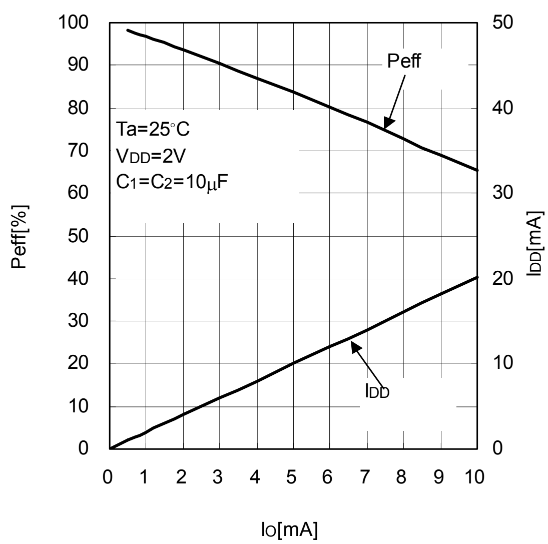


Fig.6.5.11 Boosting power conversion efficiency - Output current ③
Input current - Output current ③

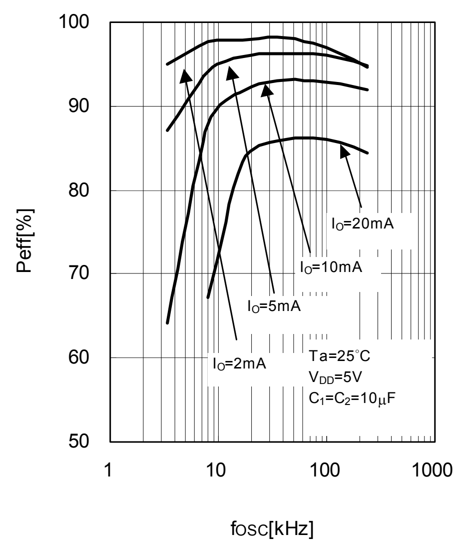


Fig.6.5.12 Boosting power conversion efficiency - Oscillation frequency ①

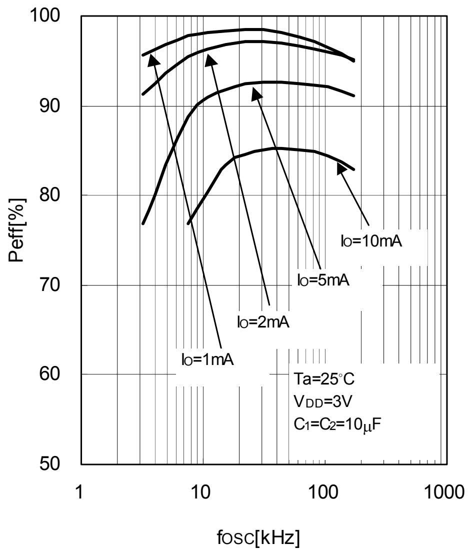


Fig.6.5.13 Boosting power conversion efficiency
- Oscillation frequency ②

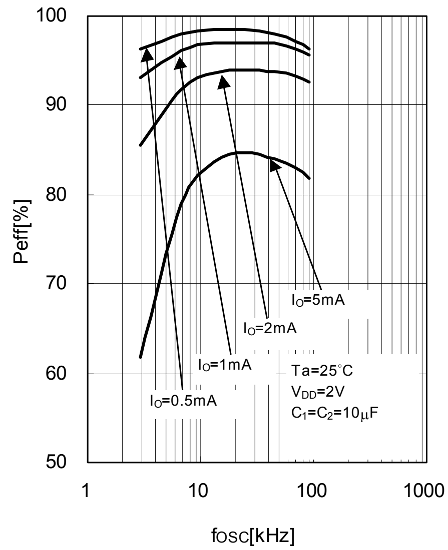


Fig.6.5.14 Boosting power conversion efficiency
- Oscillation frequency ③

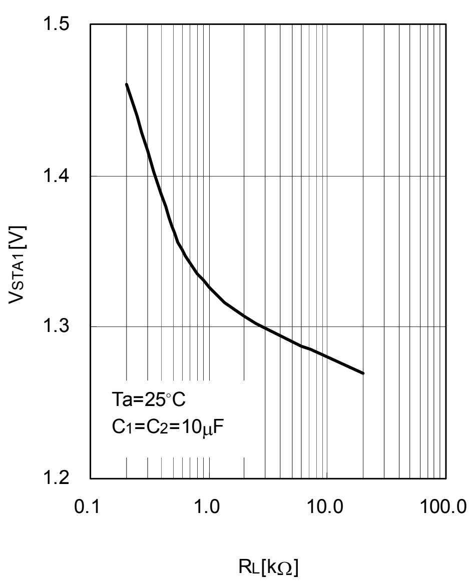


Fig.6.5.15 Boosting start voltage
- Load resistance

7. EXTERNAL CONNECTION SAMPLES

(1) Double boosting

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

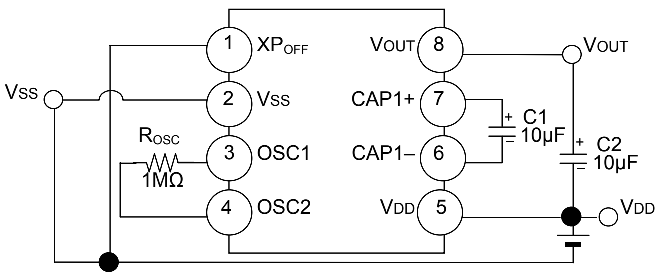


Fig.7.1 Double Boosting

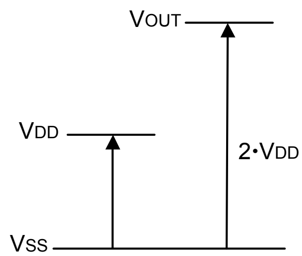


Fig.7.2 Diagram of Voltage Relations for Double Boosting

(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.

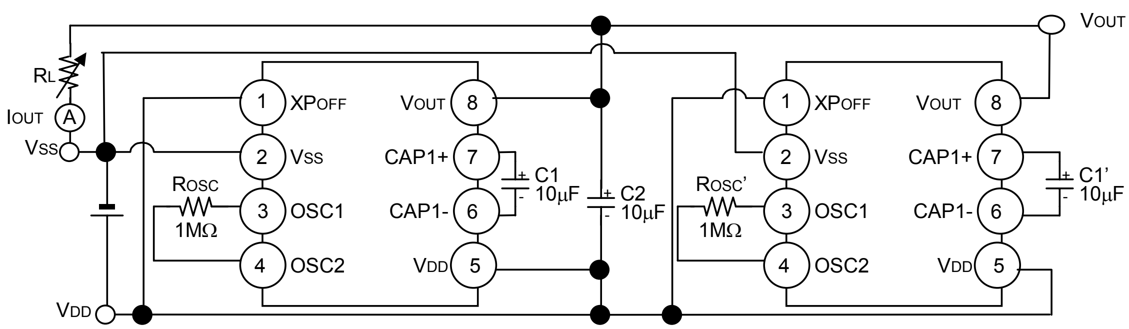


Fig.7.3 Parallel Connection

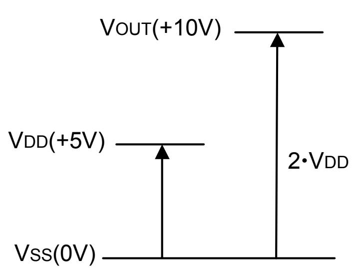


Fig.7.4 Diagram of Voltage Relations in Parallel Connection

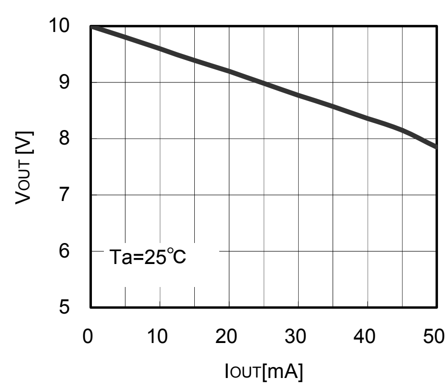


Fig.7.5 Output Voltage - Output Current

(3) Serial Connection

The serial connection in the S1F76620 (connecting VDD and VOUT in the pre-stage to VSS and VDD 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 VOUT' = 15V from VDD = 5V.

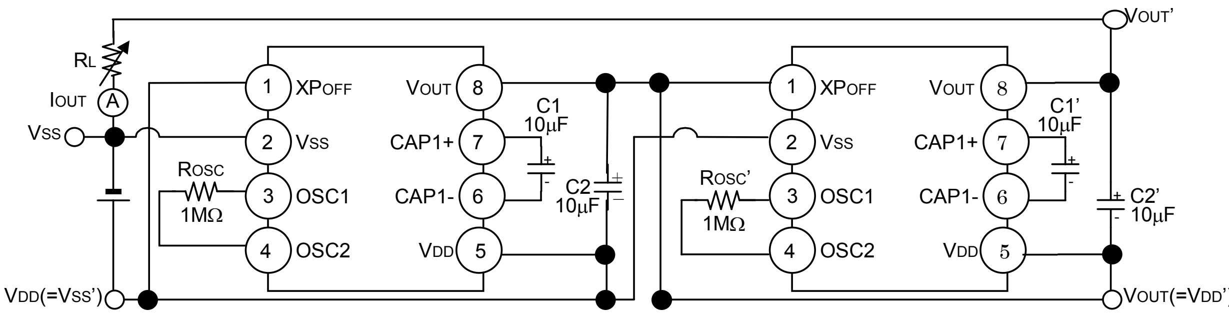


Fig.7.6 Serial Connection

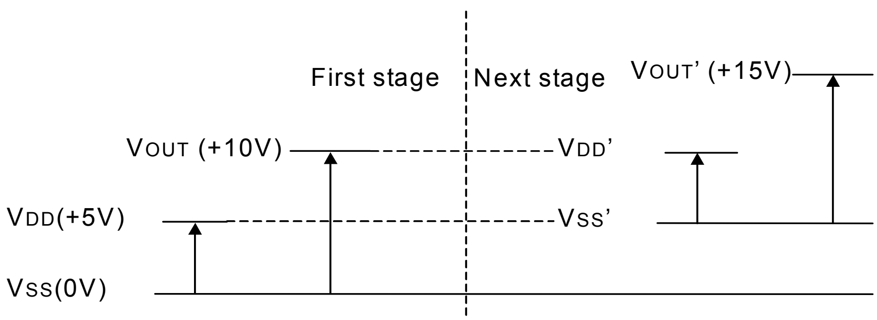


Fig.7.7 Diagram of Voltage Relations in Serial Connection

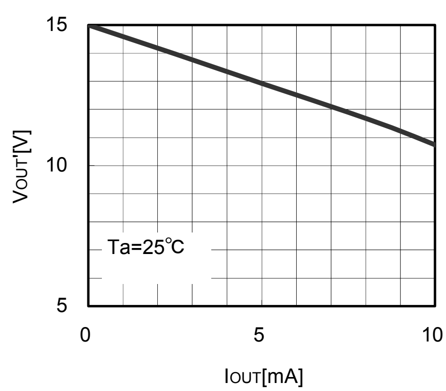


Fig.7.8 Output Voltage - Output Current

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

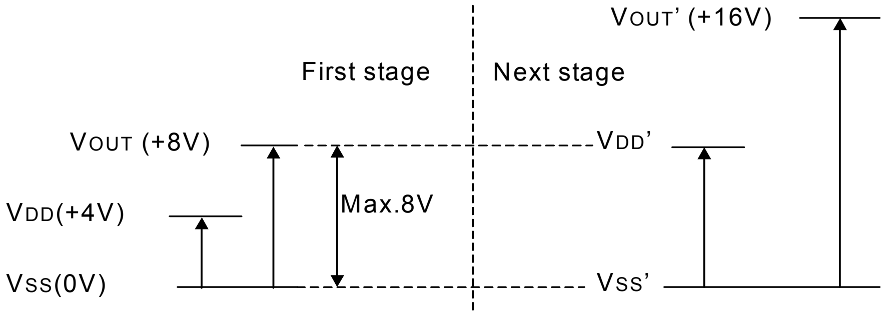


Fig.7.9 Diagram of Voltage Relations in Serial Connection (2)

(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 $V_{OUT} = -5V + 2 \times 0.6V = -3.8V$.

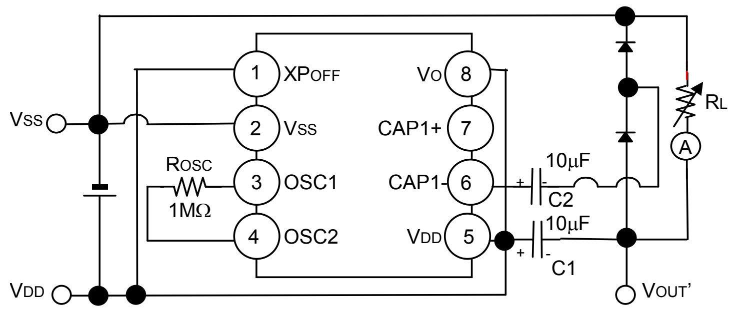


Fig.7.10 Negative-Voltage Conversion

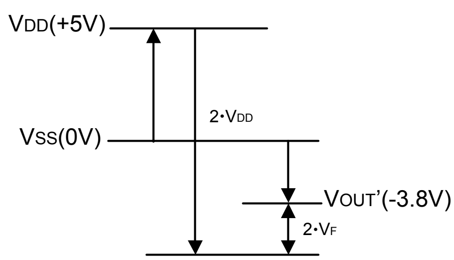


Fig.7.11 Diagram of Voltage Relations for Negative Voltage Conversion

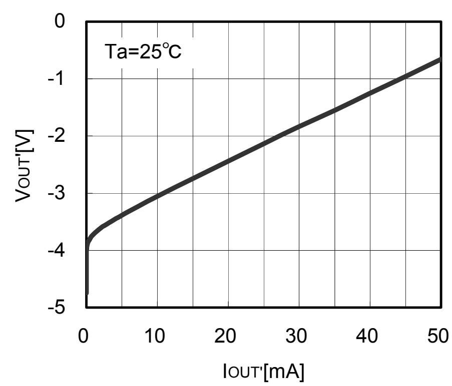


Fig.7.12 Output Voltage - Output Current

(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.

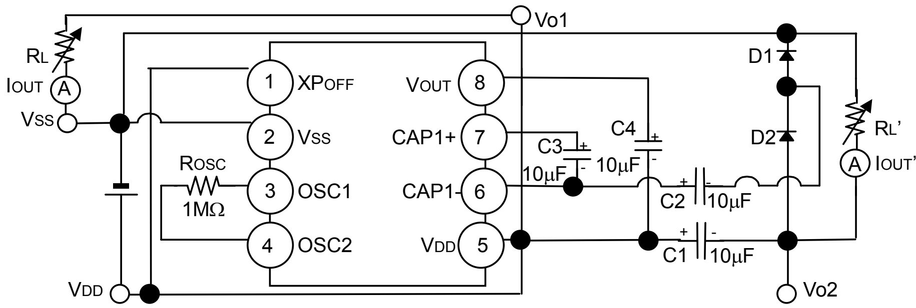


Fig.7.13 Negative-Voltage Conversion + Positive-Voltage Conversion

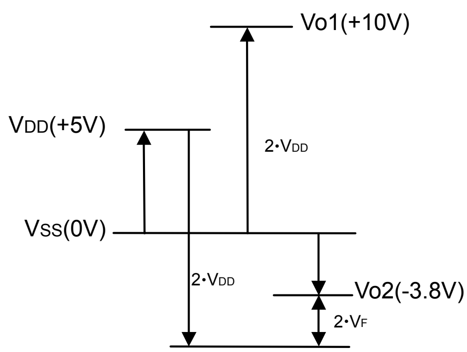


Fig.7.14 Diagram of Voltage Relations for Negative Voltage Conversion + Positive Voltage Conversion

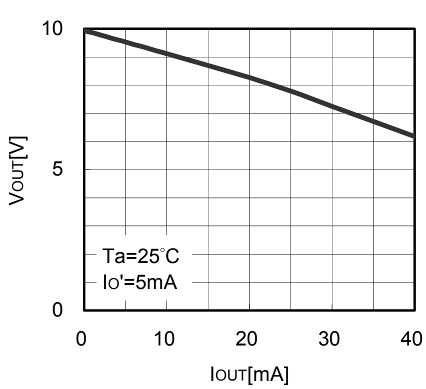


Fig.7.15 Output Voltage - Output Current

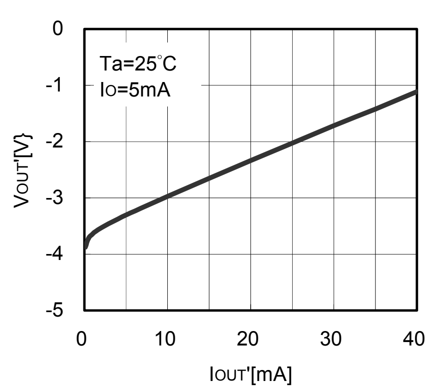


Fig.7.16 Output Voltage - Output Current

EPSON

International Sales Operations

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

Document Code: 410214201
First Issue December 2007
Printed in JAPAN Ⓗ