VOLTAGE TRIPLER

■ GENERAL DESCRIPTION

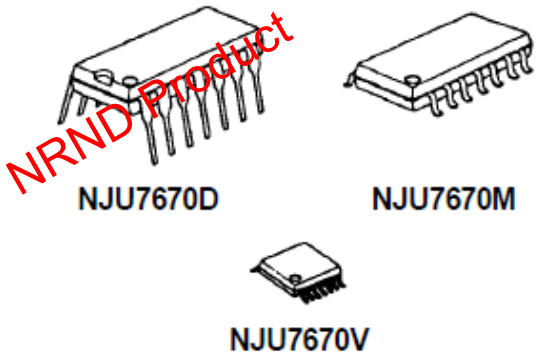
The **NJU7670** is a voltage tripler incorporated CR oscillator, voltage converter, reference voltage circuit and voltage regulator.

It can generates triple or double negative voltage of an operating voltage ranging from -2.6V to -6V.

The application circuit of tripler requires three capacitors, and doubler requires only two capacitors.

Furthermore, any kind of output voltage is available by the internal voltage regulator.

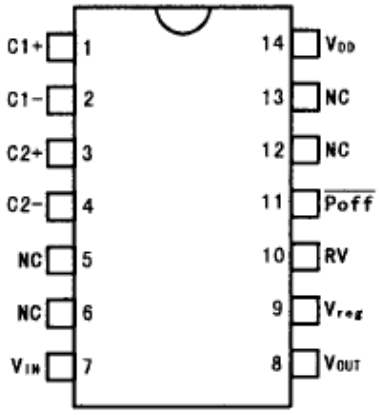
■ PACKAGE OUTLINE



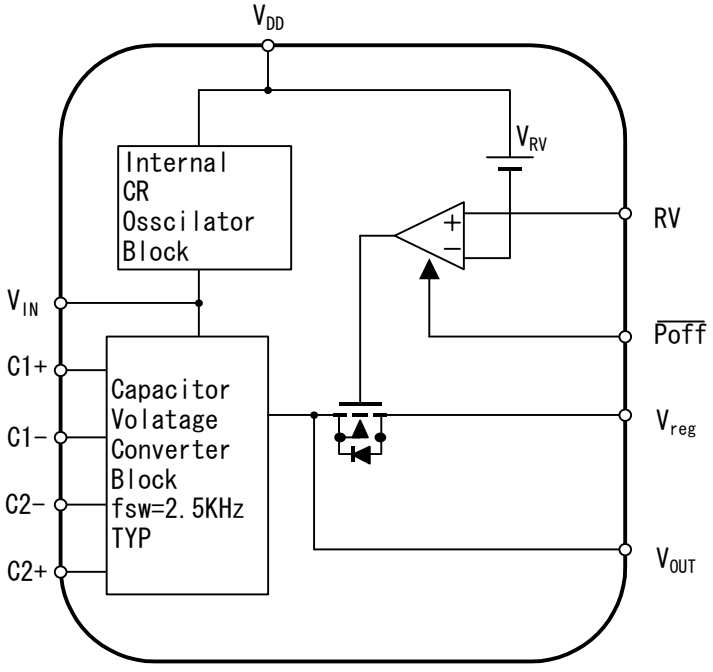
■ FEATURES

- Triple / Double Voltage Output
- Operating Voltage --- -2.6V to -6.0V
- High-efficiency Voltage Conversion Rate
  --- 95% (I_{OUT} = 5mA)
- High Output Current --- MAX 20mA (V_{IN} = -5V)
- CR Oscillator ON-Chip
- Output - OFF Function By External Signal
  --- ON / OFF of V_{reg}
- C-MOS Technology
- Package Outline DIP/DMP/SSOP 14

■ PIN CONFIGURATION



■ BLOCK DIAGRAM



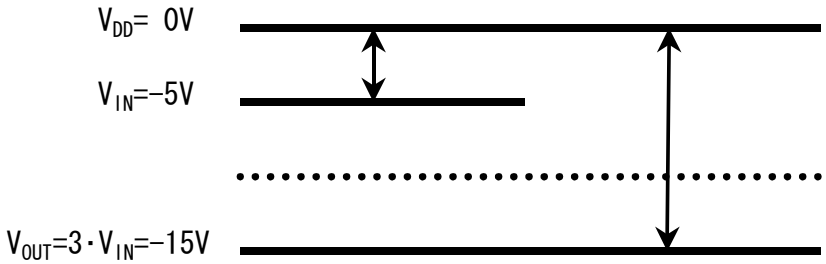
■ TERMINAL DESCRIPTION

No.	SYMBOL	FUNCTION
1	C1+	Charge Pump Capacitor 1(+) Connecting Terminal
2	C1-	Charge Pump Capacitor 1(-) Connecting Terminal
3	C2+	Charge Pump Capacitor 2(+) Connecting Terminal
4	C2-	Charge Pump Capacitor 2(-) Connecting Terminal
5	NC	Non Connection
6	NC	Non Connection
7	V_{IN}	Power Supply Terminal (-)
8	V_{OUT}	Voltage Output Terminal
9	V_{reg}	Voltage Regulator Output Terminal
10	RV	Voltage Regulator Adjustment Terminal
11	$\overline{Poff}$	V_{reg} Output ON/OFF Control Terminal
12	NC	Non Connection
13	NC	Non Connection
14	V_{DD}	Power Supply Terminal (+)

■ FUNCTIONAL DESCRIPTION

(1) Voltage Converter

The voltage converter generates double or triple voltage against V_{IN}.



(2) Voltage Reference Circuit

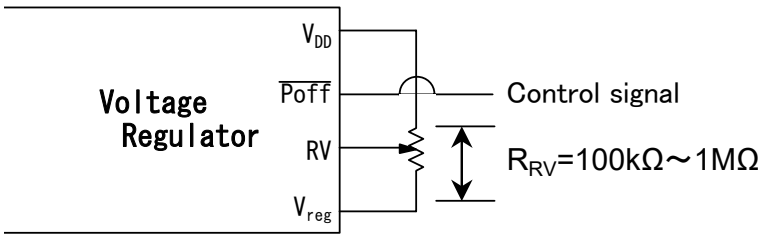
The voltage reference circuit is generating the reference voltage for a voltage regulator.

(3) Voltage Regulator

The voltage regurator output stabilized voltage which regulated by using the external resistor against double or triple voltage of the input voltage.

(3-1) Output-OFF Function

As this circuit incorporated output-off function, the voltage regulator output (ON/OFF) is performed by the signal come from system.



- ON/OFF Control for Vreg Terminal

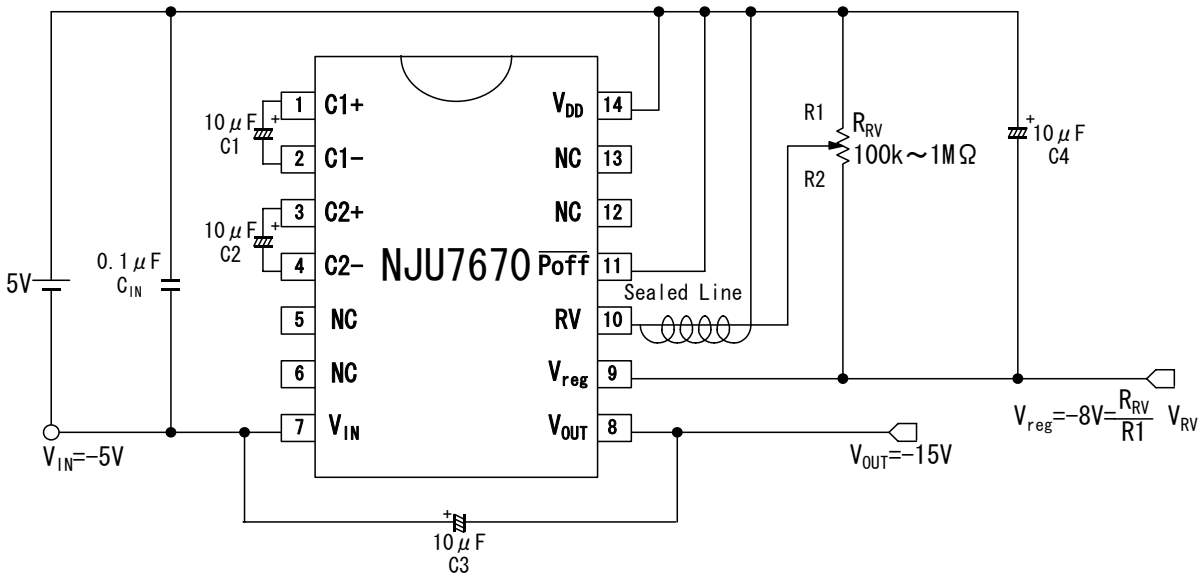
$\overline{Poff}$ Level	Vreg Output
"H" (Connect to V_{DD})	ON
"L" (Connect to V_{IN})	OFF

(3-2) Example of the Voltage Regulation

The voltage regulator has a output terminal which can be adjusted the output voltage to any kind of voltage by resistance R_{RV}.

As the RV terminal input impedance is high. Therefore special care against noise is required. (Use a sealed line or others noise-proof method)

Tripler Operation + Voltage Regulator Operation



The IC may have a possibility not to operate properly with unstable supply voltage due to large transient current when the capacitor is charged or discharged.

The decoupling capacitor (C_{IN}) connect as close as possible to the IC.

■ ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

PARAMETER	SYMBOL	RATINGS		UNIT
Supply Voltage	V_{IN}	$\|V_{DD} - V_{DD}\| \leq 20$		V
Input Voltage	V_{I1}	V_{IN} -0.5 to +0.5 Note1)		V
	V_{I2}	V_{OUT} -0.5 to +0.5 Note2)		
Output Voltage	V_{OUT}	-20.0		V
Power Dissipation	P_D	700	DIP	mW
		300	DMP	
		250	SSOP	
Operating Temperature Range	Topr	-20 to +75		°C
Storage Temperature	Tstg	-40 to +125		°C

Note1): Apply to $\overline{Poff}$ terminal

Note2): Apply to RV terminal

■ ELECTRICAL CHARACTERISTICS

(V_{DD}=0V, V_{IN}=−5V, C_{IN}=0.1μF, Ta=25°C) Note3)

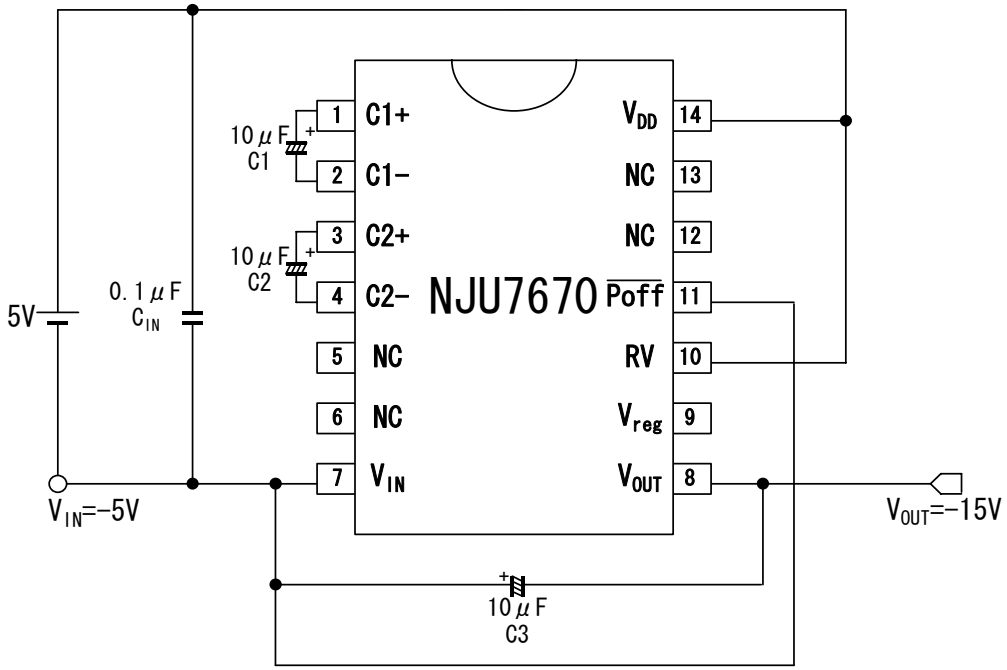
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{IN}		-6.0	–	-2.6	V
Output Voltage	V_{OUT}		-18.0	–	–	V
	V_{reg}	RL = ∞, R_{RV} = 1MΩ, V_{OUT} = -18V	-18.0	–	-2.6	
Regulator Operating Voltage	$V_{(OUT}$		-18.0	–	-8.0	V
Current Consumption 1	I_{DD1}	$\overline{Poff}$="H" note4) RL = ∞, R_{RV} = 1MΩ, V_{reg} = -2.6V	–	75	120	μA
Current Consumption 2	I_{DD2}	$\overline{Poff}$="L" note4) RL = ∞, R_{RV} = 1MΩ	–	60	100	μA
Output Impedance	R_{OUT}	I_{OUT} = 20mA,C1 = C2 = C3 = 10μA	–	150	200	Ω
Power Conversion Rate	P_{eff}	I_{OUT} = 5mA,C1 = C2 = C3 = 10μA	90	95	–	%
Line Regulation	$\frac{\Delta V_{reg}}{\Delta V_{OUT} \cdot V_{reg}}$	-18V < V_{OUT} < -8V V_{reg} = -8V, RL = ∞	–	0.2	–	%/V
Load Regulation	$\frac{\Delta V_{reg}}{\Delta I_{reg}}$	V_{OUT} = -15V, V_{reg} = -8V 0 < I_{reg} < 20mA	–	5.0	–	Ω
Output Saturation Resistance	R_{SAT}	$R_{SAT} = \Delta (V_{reg} - V_{OUT}) / \Delta I_{reg}$ 0 < I_{reg} < 20mA, RV = V_{DD}	–	8.0	–	Ω
Reference Voltage	V_{RV}		–2.3	-1.5	-1.0	V
Input Current 1	I_{IN1}	RV Terminal	–	–	1.0	μA
Input Current 2	I_{IN2}	$\overline{Poff}$ Terminal	–	–	2.0	μA
Switching Frequency	f_{sw}		–	2.5	–	kHz

Note3): To achieve the best operation, select the input capacitor (C_{IN}) with enough margin according to the stability of supply voltage.

Note4): Excluding input current on R_{RV}

■ APPLICATION CIRCUITS (1)

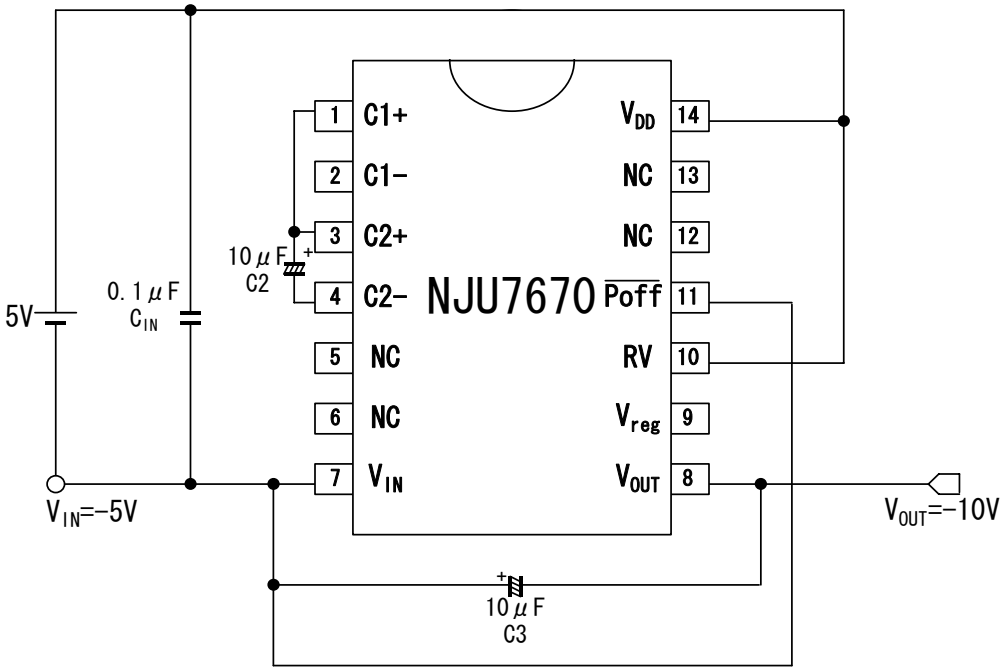
(1-1) Tripler Operation



The IC may have a possibility not to operate properly with unstable supply voltage due to large transient current when the capacitor is charged or discharged.

The decoupling capacitor (C_{IN}) connect as close as possible to the IC.

(1-2) Doubler Operation

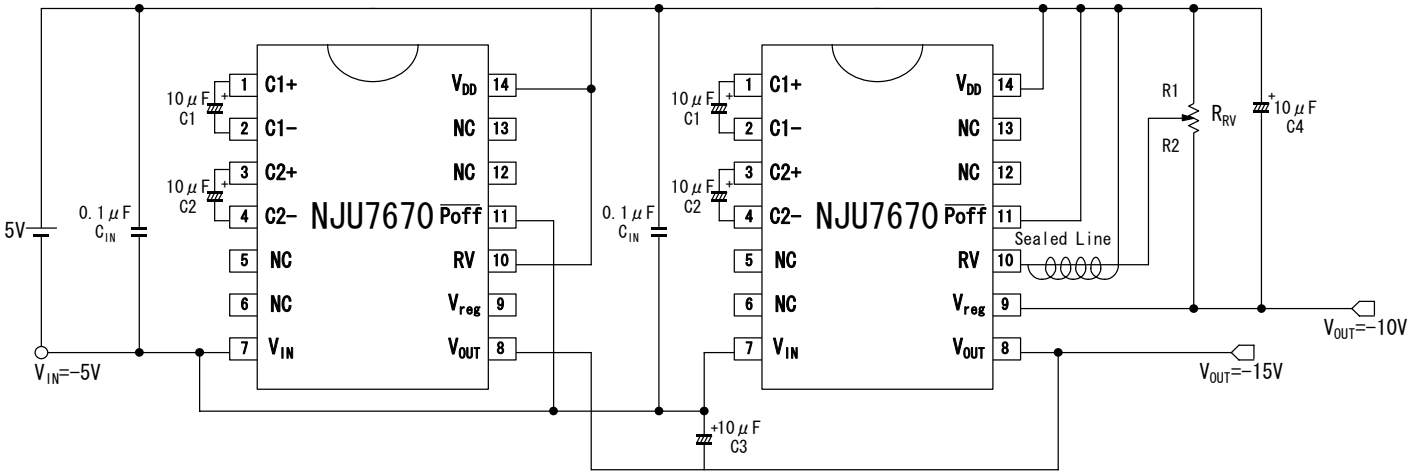


The IC may have a possibility not to operate properly with unstable supply voltage due to large transient current when the capacitor is charged or discharged.

The decoupling capacitor (C_{IN}) connect as close as possible to the IC.

■ APPLICATION CIRCUITS (2)

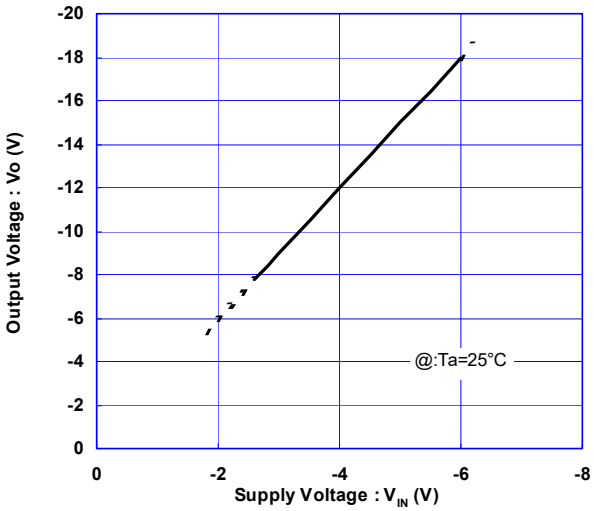
(2) Parallel Connection



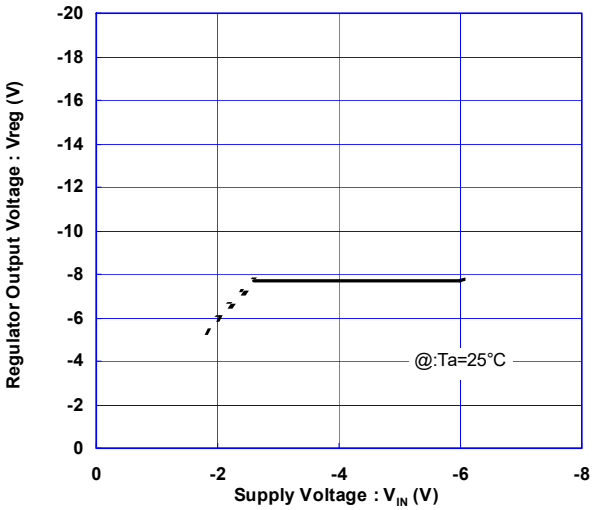
* The output impedance ROUT can be reduced by parallel connection.
* C3 is a stabilizing capacitor output for stabilized voltage.
* In the parallel connection, one stabilizing capacitor using is better way.
* The IC may have a possibility not to operate properly with unstable supply voltage due to large transient current when the capacitor is charged or discharged.
  The decoupling capacitor (C_{IN}) connect as close as possible to the IC.

■ TYPICAL CHARACTERISTICS (CIRCUITS CONDITION : Tripler Operation + Voltage Regulator Operation)

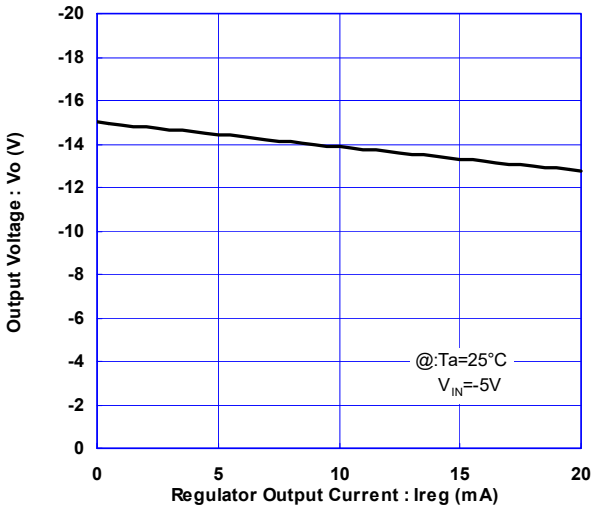
NJU7670
Output Voltage vs.Input Voltage



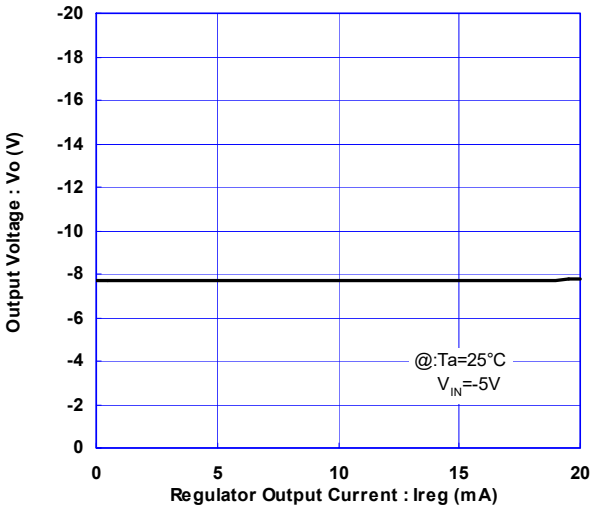
NJU7670
Regulator Output Voltage vs.Input Voltage



NJU7670
Output Voltage vs.Regulator Output Current



NJU7670
Output Voltage vs.Regulator Output Current



NJU7670
Charge Pump Capacitor Frequency vs.Input Voltage