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VOLTAGE TRIPLER

■ GENERAL DESCRIPTION

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

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

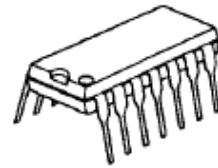
The application circuit of tripler requires three capacitors, and doubler requires only two capacitors.

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

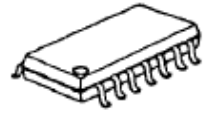
■ FEATURES

- 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

■ PACKAGE OUTLINE



NJU7670D

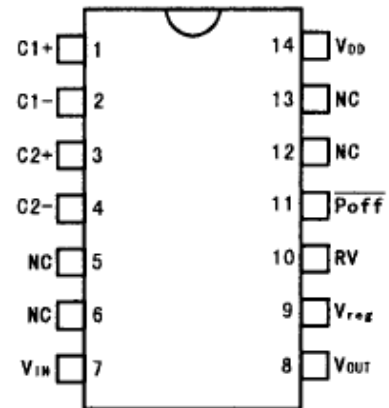


NJU7670M

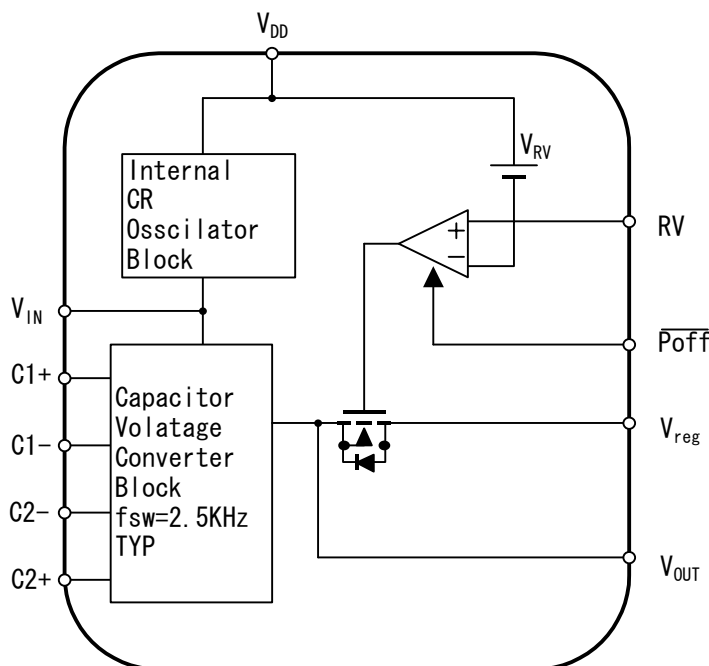


NJU7670V

■ PIN CONFIGURATION



■ BLOCK DIAGRAM



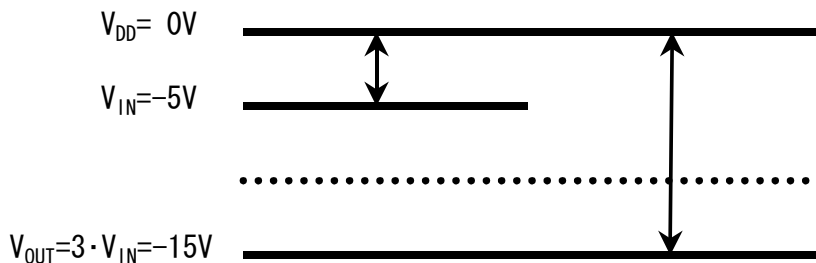
■ TERMINAL DESCRIPTION

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	$\overline{\text{Poff}}$	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

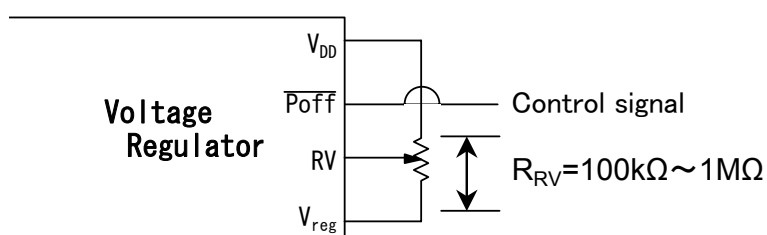
The voltage reference circuit is generating the reference voltage for a voltage regulator.

(3) Voltage Regulator

The voltage regulator 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 V_{reg} Terminal

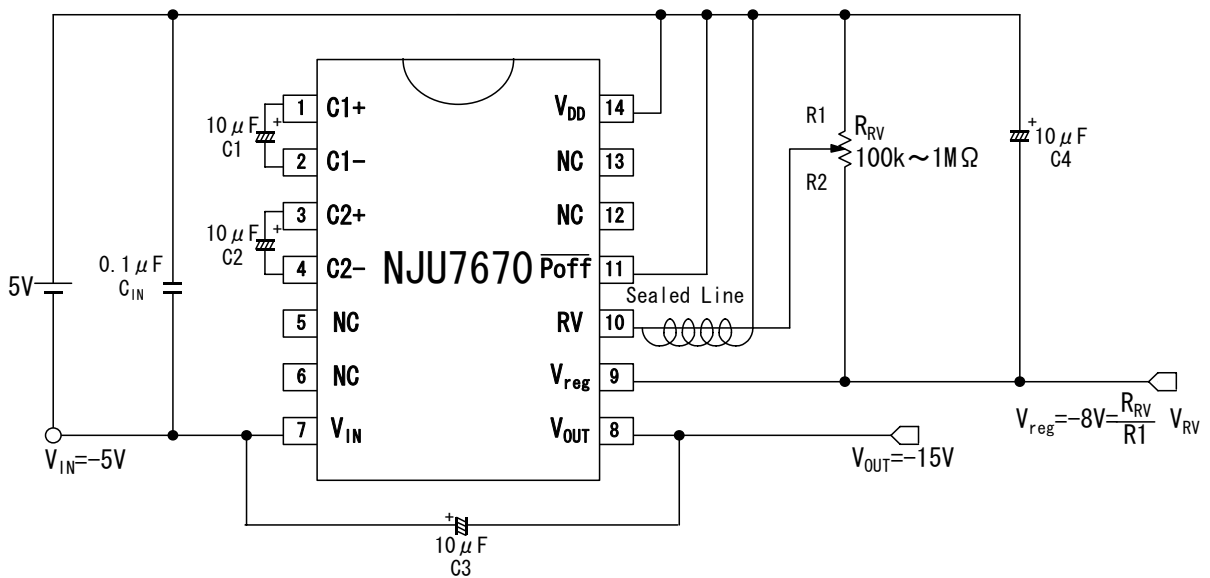
$\overline{\text{Poff}}$ Level	V _{reg} Output
"H" (Connect to V _{DD})	ON
"L" (Connect to V _{IN})	OFF

(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 Poff terminal

Note2): Apply to RV terminal

■ ELECTRICAL CHARACTERISTICS

($V_{DD}=0V$, $V_{IN}=-5V$, $C_{IN}=0.1\mu F$, $T_a=25^\circ C$) Note3)

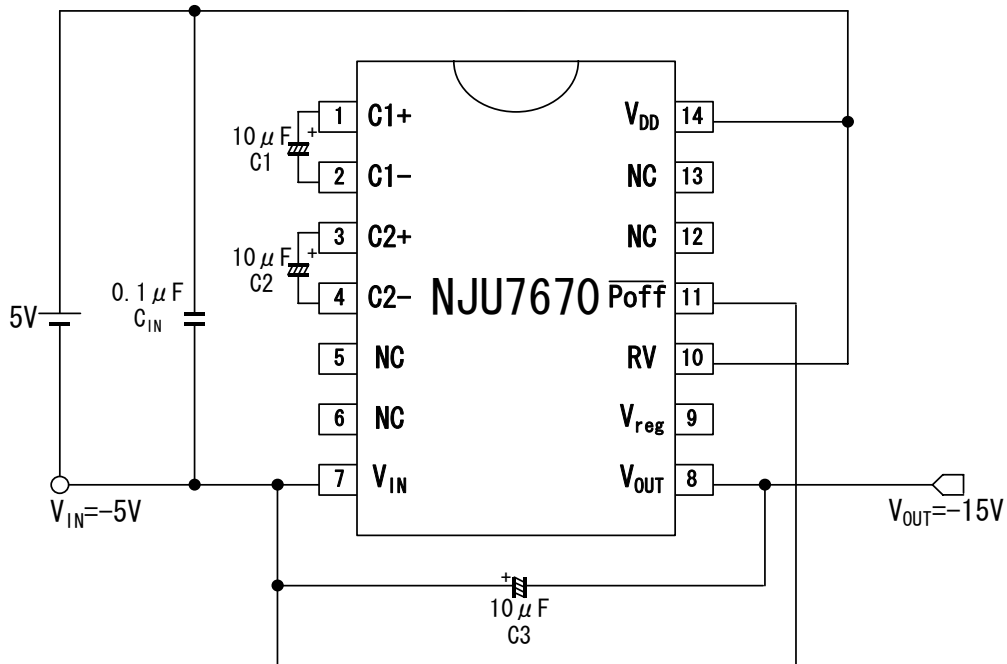
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{IN}		-6.0	-	-2.6	V
Output Voltage	V_{OUT}		-18.0	-	-	V
	V_{reg}	$R_L = \infty$, $R_{RV} = 1M\Omega$, $V_{OUT} = -18V$	-18.0	-	-2.6	
Regulator Operating Voltage	$V_{(OUT)}$		-18.0	-	-8.0	V
Current Consumption 1	I_{DD1}	Poff="H" note4) $R_L = \infty$, $R_{RV} = 1M\Omega$, $V_{reg} = -2.6V$	-	75	120	μA
Current Consumption 2	I_{DD2}	Poff="L" note4) $R_L = \infty$, $R_{RV} = 1M\Omega$	-	60	100	μA
Output Impedance	R_{OUT}	$I_{OUT} = 20mA$, $C1 = C2 = C3 = 10\mu A$	-	150	200	Ω
Power Conversion Rate	P_{eff}	$I_{OUT} = 5mA$, $C1 = C2 = C3 = 10\mu A$	90	95	-	%
Line Regulation	$\frac{\Delta V_{reg}}{\Delta V_{OUT} \cdot V_{reg}}$	$-18V < V_{OUT} < -8V$ $V_{reg} = -8V$, $R_L = \infty$	-	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}	$R_{SAT} = \Delta (V_{reg} - V_{OUT}) / \Delta I_{reg}$ $0 < I_{reg} < 20mA$, $R_V = V_{DD}$	-	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}	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)

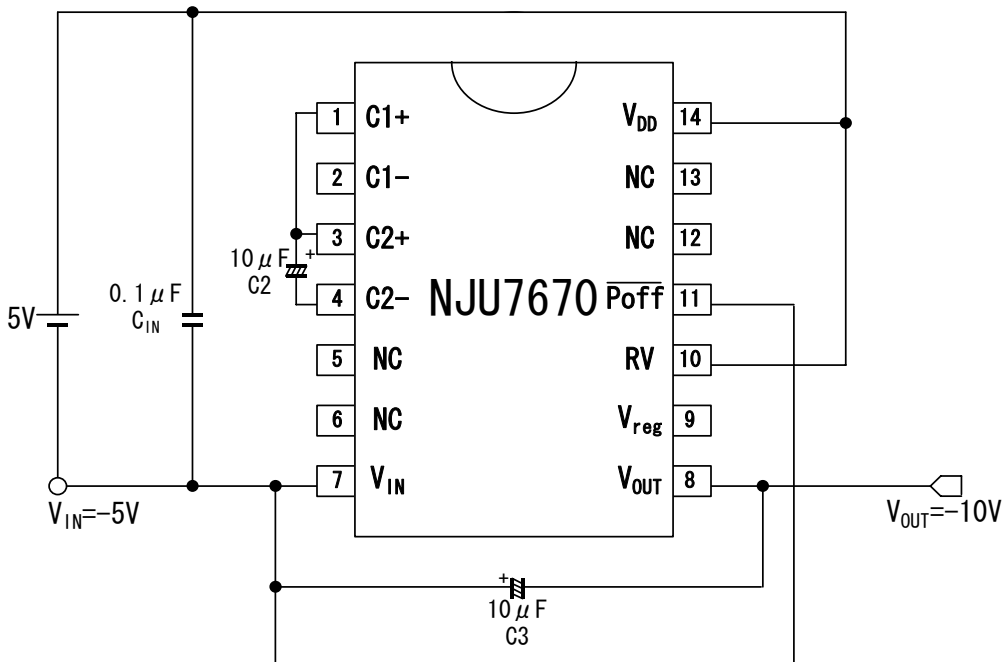
(1-1) Tripler Operation



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

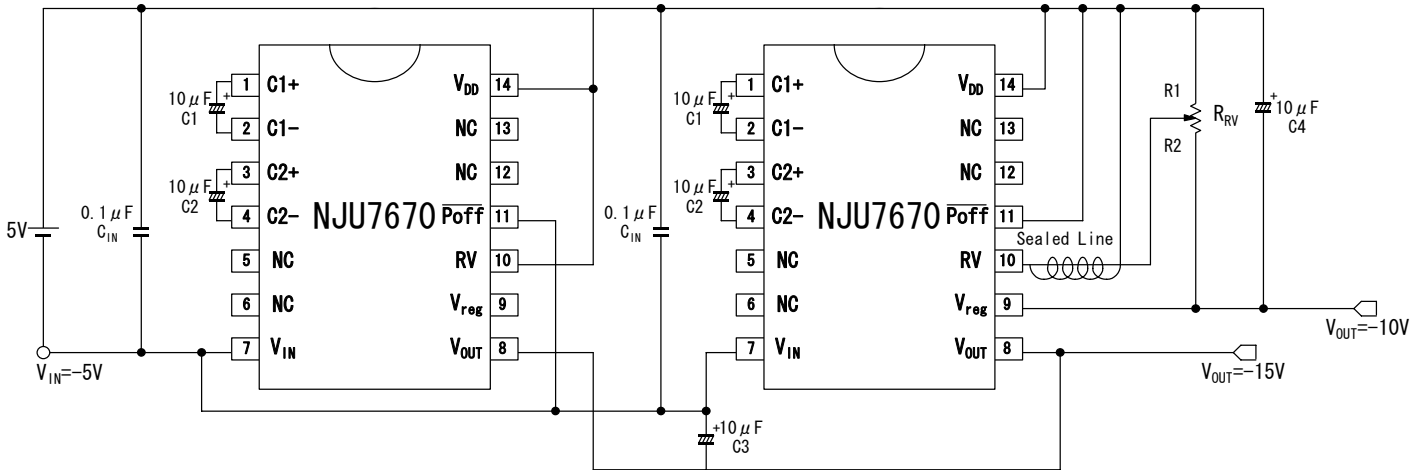


The IC may have a possibility not to operate properly with unstable supply voltage due to large transient current when the capacitor is charged or discharged.

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

■ APPLICATION CIRCUITS (2)

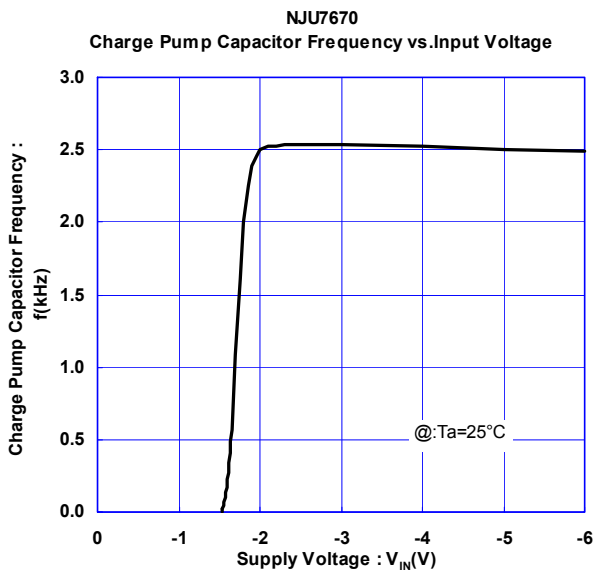
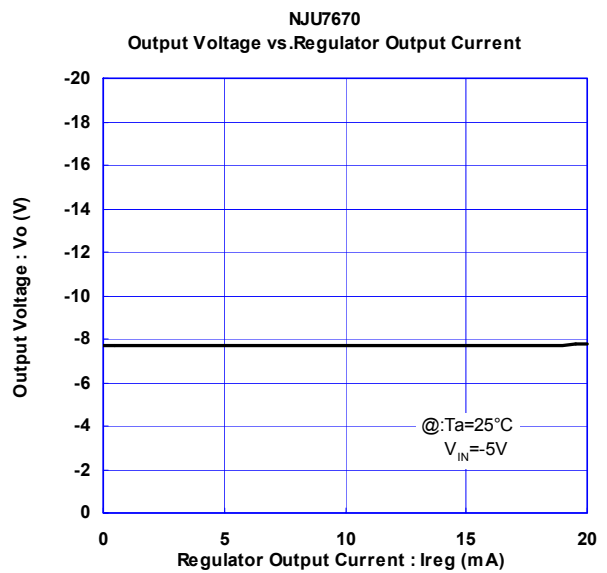
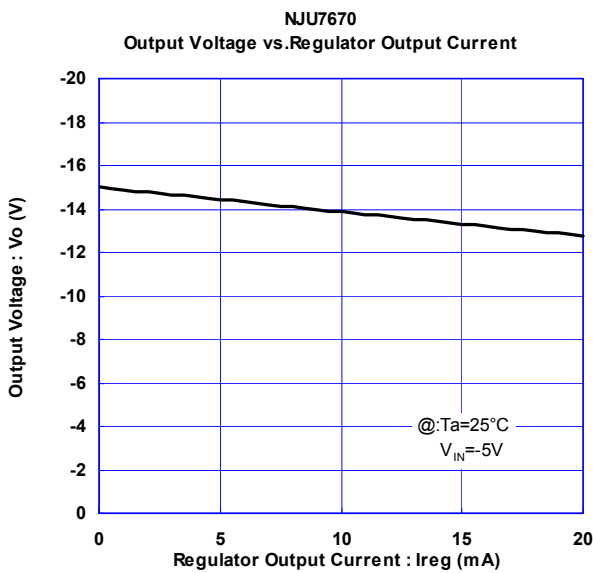
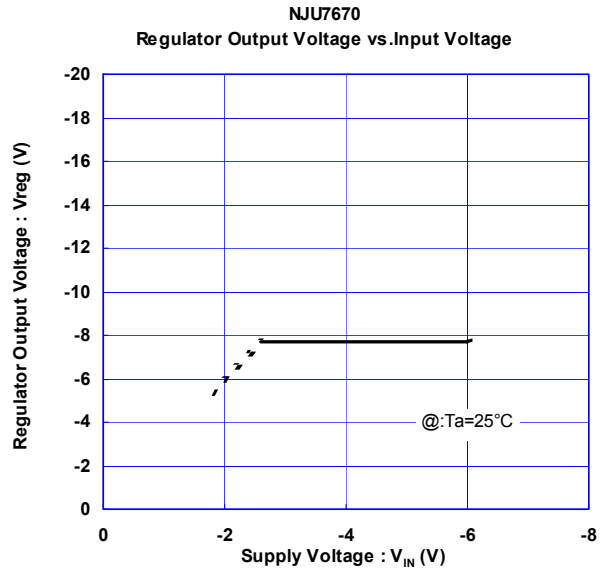
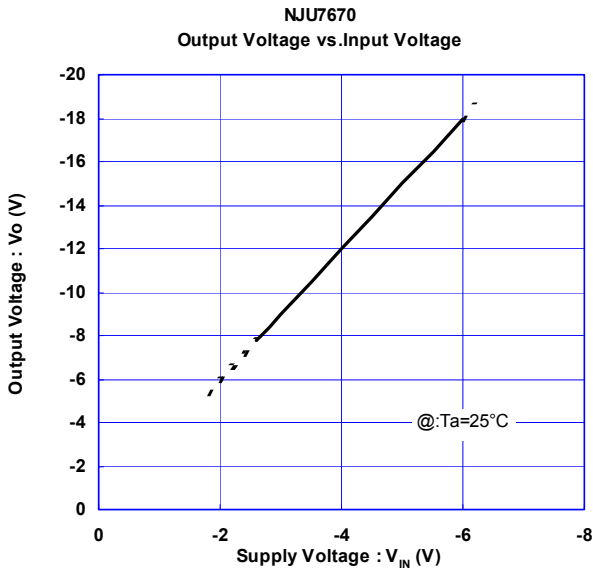
(2) Parallel Connection



- * The output impedance R_{OUT} can be reduced by parallel connection.
- * C_3 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)



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