M62212FP

GENERAL PURPOSE DC-DC CONVERTER

DESCRIPTION

The M62212FP is designed as a general purpose DC-DC converter.

This small 8 pin package contains many functions allowing simpler peripheral circuits and compact set design.

The output transistor is open collector and emitter follower type. This makes the control STEP-UP, STEP-DOWN and INVERTING converter.

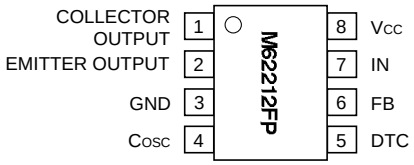
FEATURES

•Wide operation power supply voltage range..... 2.5 to 18V
•Low power dissipation..... 1.3mA (typ)
•High speed switching is possible. (300kHz)
•Output short protection circuit and ON/OFF control are used.
•The dead-time control and the soft-start operation are possible
•Small size 8-pin SOP package.

APPLICATION

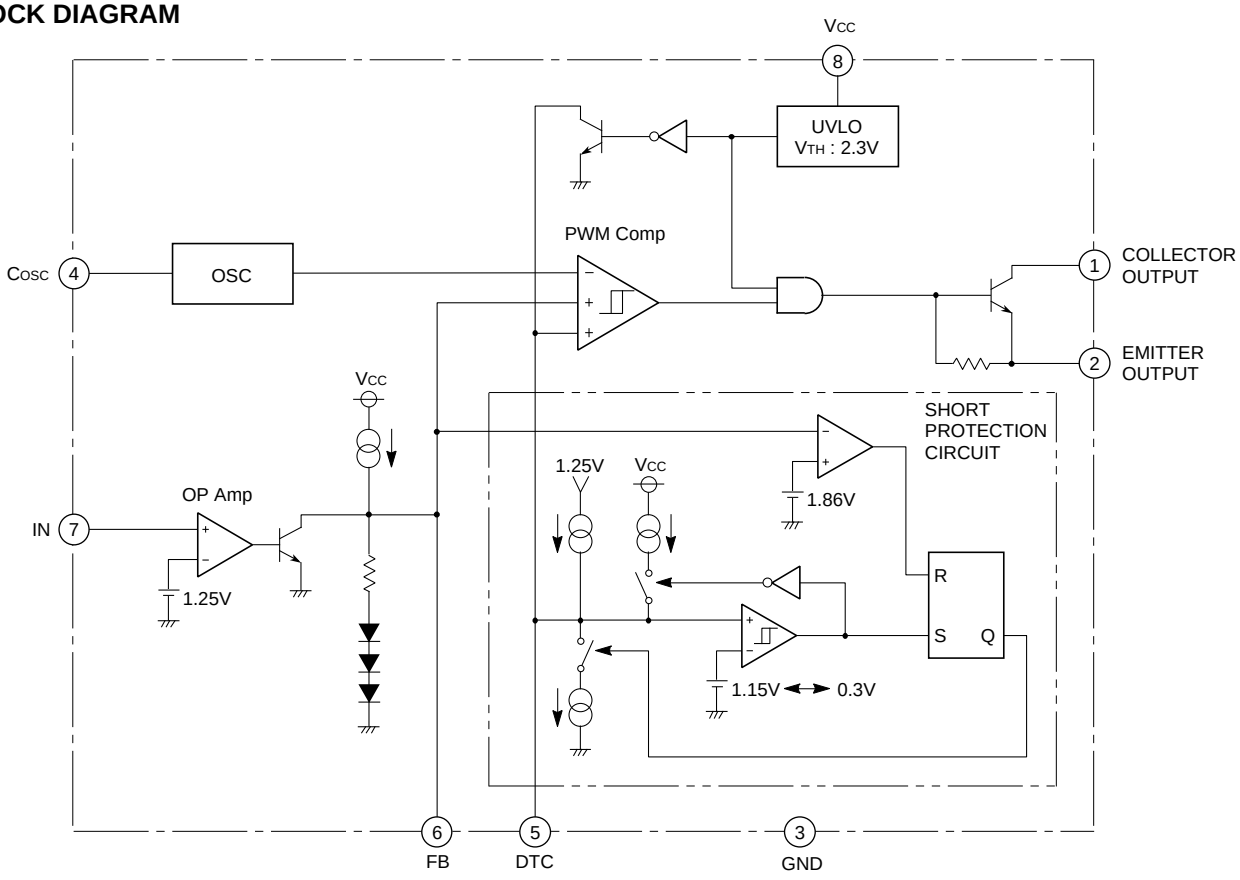
General electric products, DC-DC converter

PIN CONFIGURATION (TOP VIEW)



Outline 8P2S-A

BLOCK DIAGRAM



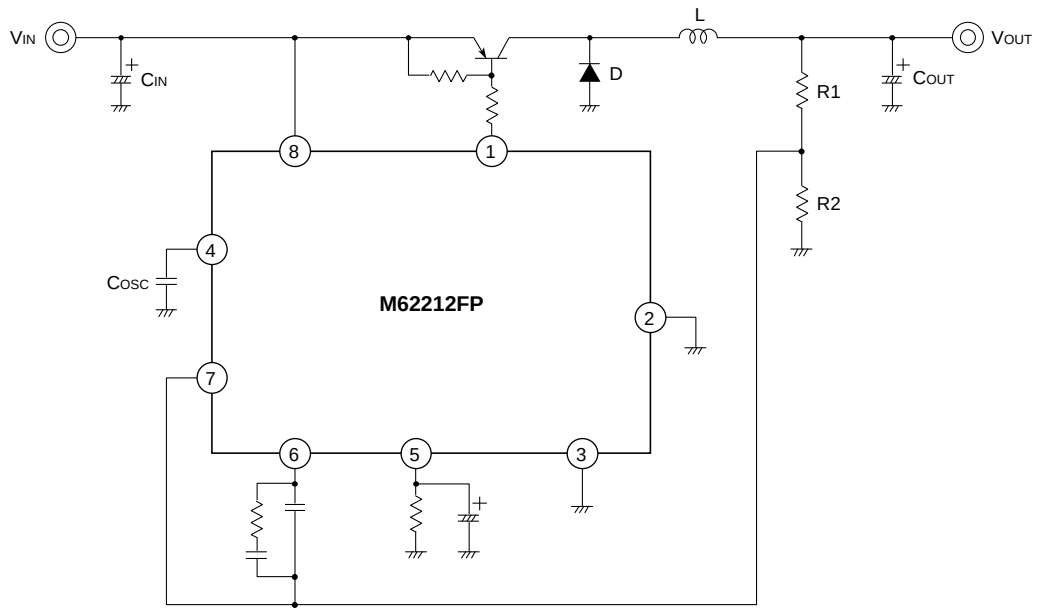
ABSOLUTE MAXIMUM RATINGS (Ta=25˚C, unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
V_{CC}	Supply voltage		19	V
V_O	Output voltage		19	V
I_O	Output current		150	mA
P_d	Power dissipation	Ta=25˚C	360	mW
K_Θ	Thermal derating	Ta>25˚C	2.88	mW/˚C
T_{opr}	Operating temperature		-20 to +85	˚C
T_{stg}	Storage temperature		-40 to +125	˚C

ELECTRICAL CHARACTERISTICS (Ta=25˚C, V_{CC}=12V, C_{OSC}=100pF, unless otherwise noted)

Block	Symbol	Parameter	Test conditions	Limits			Unit
				Min.	Typ.	Max.	
All device	V_{CC}	Range of power supply voltage		2.5		18	V
	$I_{CC\ ST}$	Standby current	Output "OFF" status		1.3	1.8	mA
Std. voltage section	V_{REF}	Standard voltage	Voltage follower	1.19	1.25	1.31	V
	L_{INE}	Line regulation	V_{CC}=2.5 to 18V		5	12	mV
Error amp. section	I_B	Input bias current				500	nA
	A_V	Open loop gain			80		dB
	G_B	Unity gain bandwidth			0.6		MHz
	V_{OM}^+	Output high voltage		1.82		2.62	V
	V_{OM}^-	Output low voltage				400	mV
	I_{OM}^+	Output sink current	V_{FB}=1.86V		6		mA
	I_{OM}^-	Output source current	V_{IN}=1V		-60	-30	µA
Oscillator section	f_{OSC}	Oscillation frequency			110		kHz
	V_{OSCH}	Upper limit voltage of oscillation waveform			1.0		V
	V_{OSCL}	Lower limit voltage of oscillation waveform			0.45		V
	$I_{OSC\ CH}$	Cosc charge current			-40		µA
	$I_{OSC\ DIS1}$	Cosc discharge current 1			10		µA
UVLO section	$V_{TH\ ON}$	Start-up threshold voltage	V_{IN}=1V	2.2	2.3	2.4	V
	$V_{TH\ OFF}$	Shut-down threshold voltage	V_{IN}=1V		2.25		V
	V_{HYS}	Hysteresis	V_{HYS}=V_{THON}-V_{THOFF}	20	50	80	mV
Short protection circuit	$V_{TH\ FB}$	FB threshold voltage	V_{IN}=1V, V_{DTC}=0.7V		1.86		V
	$V_{TH\ DTC}$	Latch mode "H" threshold voltage	V_{IN}=1V, V_{FB}=2.11V		1.15		V
	$V_{TL\ DTC}$	Latch mode "L" threshold voltage	V_{IN}=1V, V_{FB}=2.11V		0.3		V
	I_{CH1}	DTC charge current when start-up	V_{DTC}=0.7V, V_{FB}=2.11V		-45		µA
	I_{DIS1}	DTC discharge current 1	V_{DTC}=0.7V, V_{FB}=2.11V		50		µA
	I_{CH2}	DTC charge current when stable state	V_{DTC}=0.7V, V_{FB}=0.7V		-10		µA
	I_{DIS2}	DTC discharge current 2	V_{DTC}=0.2V, V_{FB}=2.11V		15		µA
Output section	I_{CL}	Collector output leak current	V_{CE}=18V , V_{CC}=18V	-1		1	µA
	V_{SAT1}	Collector output saturation voltage 1	Emitter GND, I_C=150mA, V_E=0V		0.3	1.1	V
	V_{SAT2}	Collector output saturation voltage 2	Emitter follower, I_E=50mA, V_C=12V		1.6		V

1. APPLICATION EXAMPLE (STEP-DOWN converter with current buffer transistor)



2. FUNCTION DESCRIPTION

1) Soft Start (The peripheral circuit is shown in Fig.1)

When the power is turned ON, input terminal IN is at 0V level. Therefore, the FB terminal is fixed to High level. The DTC terminal goes up gradually starting from 0V due to the internal charge current and the external CDTC.

When the level of DTC terminal reaches the lower limit of the triangular wave of the oscillator, PWM comparator and the output circuit go into operation causing the output voltage, "Vo" of the DC-DC converter to rise. The charge current is designed to be approximately 45μA.

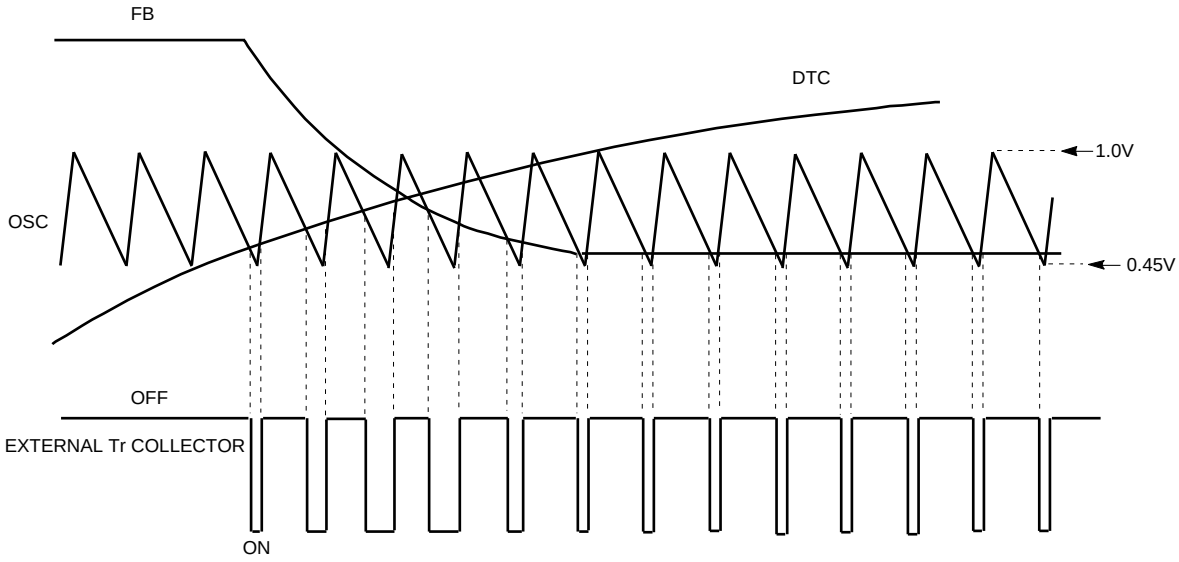


Fig. 1

2) DTC

The dead time control is set by installing a resistor between the DTC terminal and GND. However, the DTC terminal serves as the short protection circuit also. Therefore, its set up depends on whether the short protection circuit is used and not.

(When the short protection circuit is used)

At this time, the charge current for DTC is approximately 10μA . Therefore, R_{DTC} should be set to 40kΩ to 110kΩ.

(When the short protection circuit is not used)

At this time, the charge current for DTC is approximately 45μA. Therefore, R_{DTC} is set to 12kΩ to 25kΩ.

3) Short protection circuit

The short protection circuit used the timer latch system. It is determined by setting the capacity used for the soft start connected to the DTC terminal.

Fig.3 shows the short protection circuit and the timing chart for various modes.

When the power is turned on, the FB terminal goes high (approx. 2.3V) and the DTC terminal goes low (goes up slowly from 0V). Thus, approximately 45μA current will flow when SW1:ON and SW2:OFF. The potential, namely the potential of the FB terminal is in the amplitude of the triangular wave, SW1 will be OFF and SW2 will be ON and approximately 50μA will flow into the DTC terminal. This discharge current will cause the DTC terminal to drop from 1.15V.

At this time, if the potential of the FB terminal goes to the control potential before the potential at the DTC terminal goes lower than 0.45V which is the lower limit value of the triangular wave and if the potential of the FB terminal is lower than the potential of the DTC terminal, then the system is activated.

When the output is shorted, the system is either activated or latched depending on whether the time for the high potential of the FB terminal reaches the potential of the control state is long or short. (For detail, see [II] and [IV] of the Mode)

There are two ways to go back to operation after the latch to shut off output. Either method can restart with soft start.

1. Turning ON the Vcc.
2. Make the FB terminal to go to the low potential of 1.86V or less. Then, it is cancel led.

[Mode Explained]

[I] Mode .....Activation

This is used when the FB terminal goes down to the control state potential when the DTC terminal is in up slope. In order for the activation to occur when the DTC terminal is in down slope, the FB terminal potential must go below the DTC terminal before the DTC terminal goes to 0.45V.

[II] Mode.....Output short → Activation

The system is activated if the FB terminal potential goes below the DTC terminal potential before the DTC terminal goes to 0.45V. If there is not enough time, the output is turned OFF (Latched)

[III]Mode..... ON/OFF control → Activation

This mode turns off the output by forcing the DTC terminal to go down. (The system) returns as in the case of the activation.

[IV]Mode..... Output short (Latch)

The output is turned OFF when the FB terminal potential did not go down to the control state before the DTC terminal went down to 0.45V.

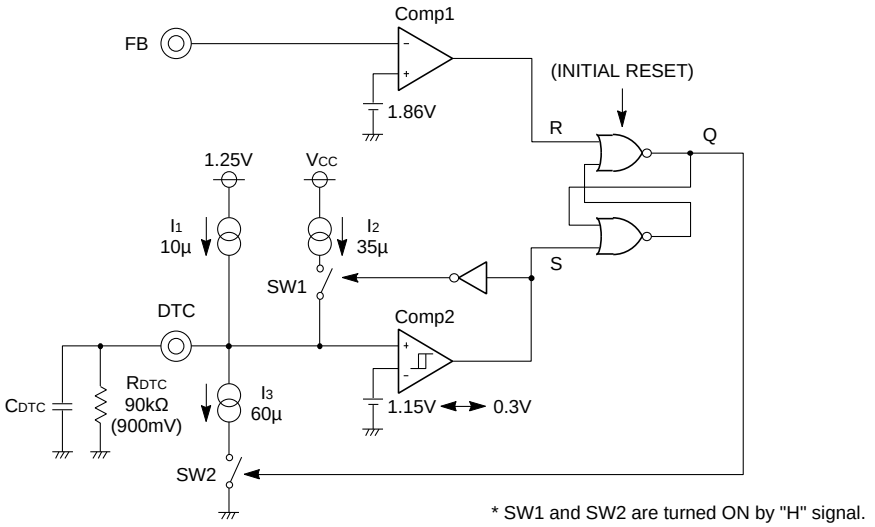


Fig. 2 Output short protection circuit

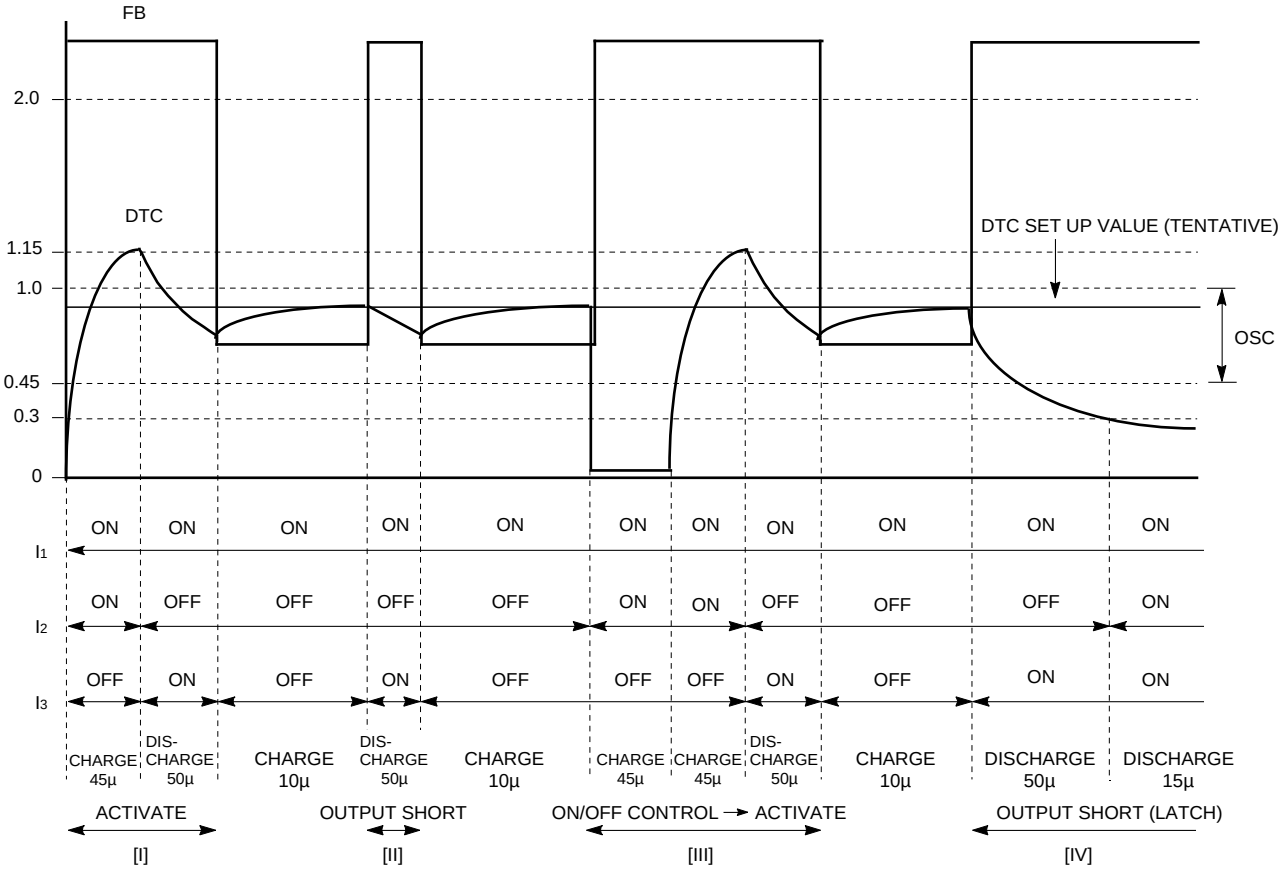


Fig. 3 Short protection circuit and the timing chart of the modes

CONSTANT DEFINITION

Constant		Step-down converter	Step-up converter	Inverting converter
$\frac{T_{ON}}{T_{OFF}}$		$\frac{V_O+V_F}{V_{IN}-V_{CE\,(sat)}-V_O}$	$\frac{V_O+V_F-V_{IN}}{V_{IN}-V_{CE\,(sat)}}$	$\frac{\lvert V_O\rvert+V_F}{V_{IN}-V_{CE\,(sat)}}$
$T_{ON}+T_{OFF}$		$\frac{1}{f_{OSC}}$	$\frac{1}{f_{OSC}}$	$\frac{1}{f_{OSC}}$
$T_{OFF\,(MIN)}$		$\frac{T_{ON}+T_{OFF}}{1+\frac{T_{ON}}{T_{OFF}}}$	$\frac{T_{ON}+T_{OFF}}{1+\frac{T_{ON}}{T_{OFF}}}$	$\frac{T_{ON}+T_{OFF}}{1+\frac{T_{ON}}{T_{OFF}}}$
$T_{ON\,(MAX)}$		$\frac{1}{f_{OSC}}-T_{OFF}$	$\frac{1}{f_{OSC}}-T_{OFF}$	$\frac{1}{f_{OSC}}-T_{OFF}$
$D_{(MAX)}$		$\frac{T_{ON\,(MAX)}}{T_{ON}+T_{OFF}}$	$\frac{T_{ON\,(MAX)}}{T_{ON}+T_{OFF}}$	$\frac{T_{ON\,(MAX)}}{T_{ON}+T_{OFF}}$
C_{OSC}		$\frac{1}{75X10^3Xf_{OSC}}-16X10^{-12}$	$\frac{1}{75X10^3Xf_{OSC}}-16X10^{-12}$	$\frac{1}{75X10^3Xf_{OSC}}-16X10^{-12}$
$L_{(MIN)}$	(Note1)	$\frac{(V_{IN}-V_{CE\,(sat)}-V_O)XT_{ON\,(MAX)}}{DI_O}$	$\frac{(V_{IN}-V_{CE\,(sat)})^2XT_{ON\,(MAX)}{}^2Xf_{OSC}}{2XV_OXI_O}$	$\frac{(V_{IN}-V_{CE\,(sat)})^2XT_{ON\,(MAX)}{}^2Xf_{OSC}}{2XV_OXI_O}$
R_1	(Note1, 2)	$\left(\frac{V_O}{V_{REF}}-1\right)XR_2$	$\left(\frac{V_O}{V_{REF}}-1\right)XR_2$	$\left(\frac{\lvert V_O\rvert}{V_{REF}}-1\right)XR_2$
R_{DTC} (Note4)	not use short protection	$\frac{V_{DTC(MAX)}}{\lvert I_{CH1}\rvert}$	$\frac{V_{DTC(MAX)}}{\lvert I_{CH1}\rvert}$	$\frac{V_{DTC(MAX)}}{\lvert I_{CH1}\rvert}$
	use short protection	$\frac{V_{DTC(MAX)}}{\lvert I_{CH2}\rvert}$	$\frac{V_{DTC(MAX)}}{\lvert I_{CH2}\rvert}$	$\frac{V_{DTC(MAX)}}{\lvert I_{CH2}\rvert}$
C_{DTC} (Note4)	calicurate from start-up time	$\frac{\lvert I_{CH1}\rvert Xt_{start}}{V_{DTC(MAX)}}$	$\frac{\lvert I_{CH1}\rvert Xt_{start}}{V_{DTC(MAX)}}$	$\frac{\lvert I_{CH1}\rvert Xt_{start}}{V_{DTC(MAX)}}$
	calicurate from shat down time	$\frac{I_{DIS1}Xt_{short}}{V_{DTC(MAX)}-V_{OSCL}}$	$\frac{I_{DIS1}Xt_{short}}{V_{DTC(MAX)}-V_{OSCL}}$	$\frac{I_{DIS1}Xt_{short}}{V_{DTC(MAX)}-V_{OSCL}}$

V_F:Forward Voltage of outer Diode.
$V_{CE\,(sat)}$:Saturation Voltage of M62212 or Saturation Voltage of Current buffer Transistor.
* Please setting the Oscillation frequency first and calicurate each constant value.

Note1. Please setting ΔI_O about 1/3 to 1/5 of maximum output current.

2. $\lvert V_O\rvert = (1+\frac{R_1}{R_2})XV_{REF}$

3. Please setting R2 about few kΩ to score of kΩ because output voltage don't undergo a influence of input current (Terminal 7).

4. Please setting $V_{DTC\,(MAX)}$ to satisfy $D_{(MAX)}$, fixed from characteristics of $D_{(MAX)}$-$V_{DTC\,(MAX)}$.
   I_{CH1} means DTC charge current when start-up (-45μA typ), I_{CH2} means DTC charge current when stable state (-10μA typ), V_{OSCL} means lower limit volage of oscillation waveform (0.45V typ), and I_{DIS1} means DTC discharge current 1 (50μA typ).
   t_{start} means time interval when terminal voltage of DTC increase to V_{OSCL} from lower voltage and to start switching at first.
   t_{short} means time interval when output is shut down after output is shorted.