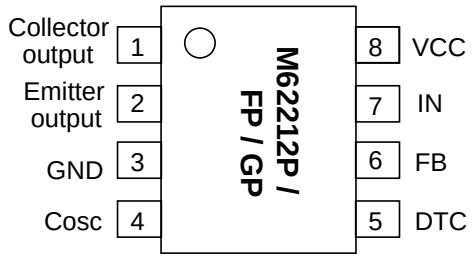
M62212P/FP/GP

GENERAL PURPOSE DC-DC CONVERTER

DESCRIPTION

M62212 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.

PIN CONFIGURATION(TOP VIEW)



OUTLINE 8P2S-A (FP)
8P2X (GP)
8P4 (P)

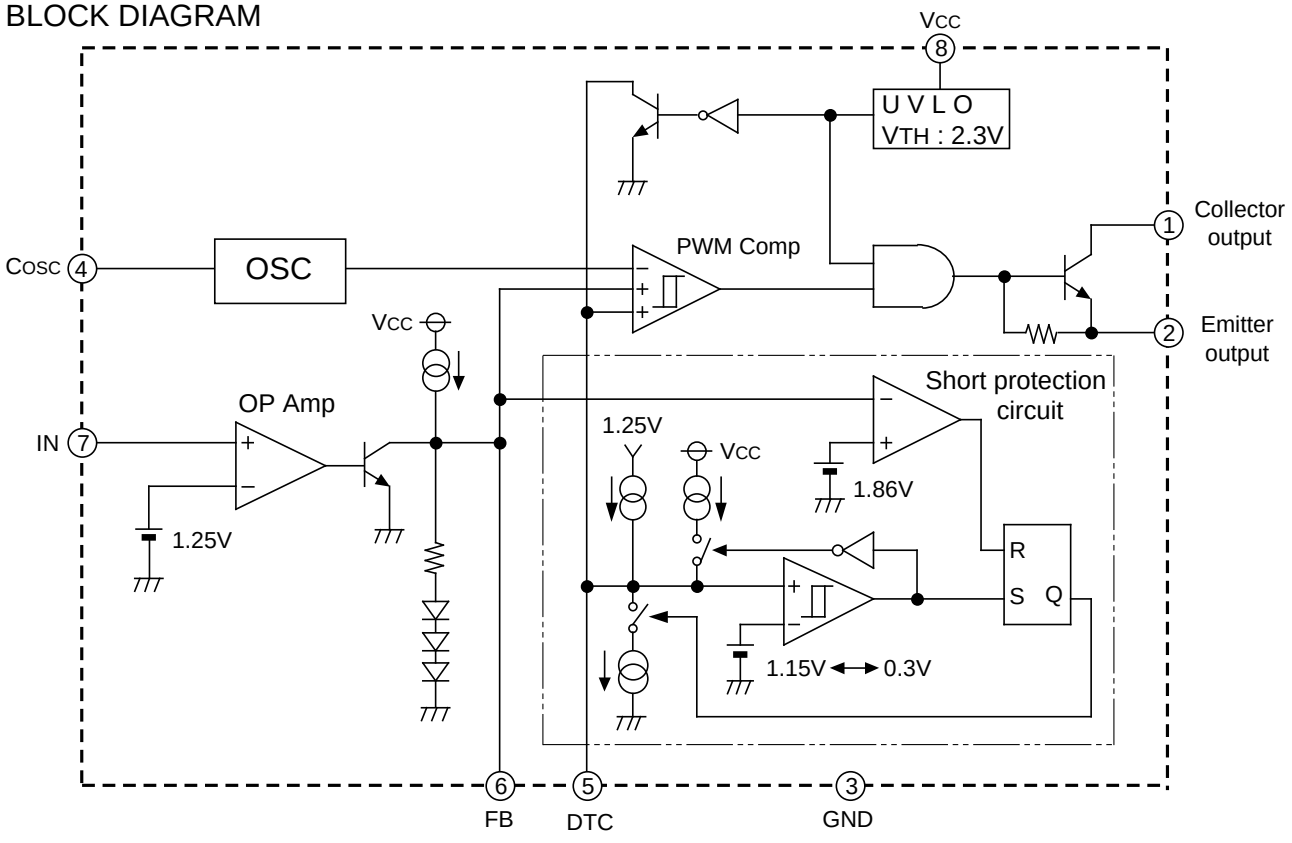
FEATURE

- Wide operation power supply voltage range •••••••2.5 ~ 18V
- Low power consumption••••••••••••••••••••••••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
- Package variation : 8pin DIP/SOP/SSOP8

APPLICATIONS

General electric products, DC-DC converter

BLOCK DIAGRAM



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

Symbols	Items	Conditions	Ratings	Units
Vcc	Power supply voltage		19	V
Vo	Output voltage		19	V
Io	Output current		150	mA
Pd	Power dissipation	Ta=25°C	625 (P) 360(FP) 250(GP)	mW
Ktheta	Thermal derating ratio	Ta>25°C	5.00 (P) 2.88 (FP) 2.00(GP)	mW/°C
Topr	Operating ambient temperature		-20°C ~ +85	°C
Tstg	Storage temperature		-40°C ~ +125	°C

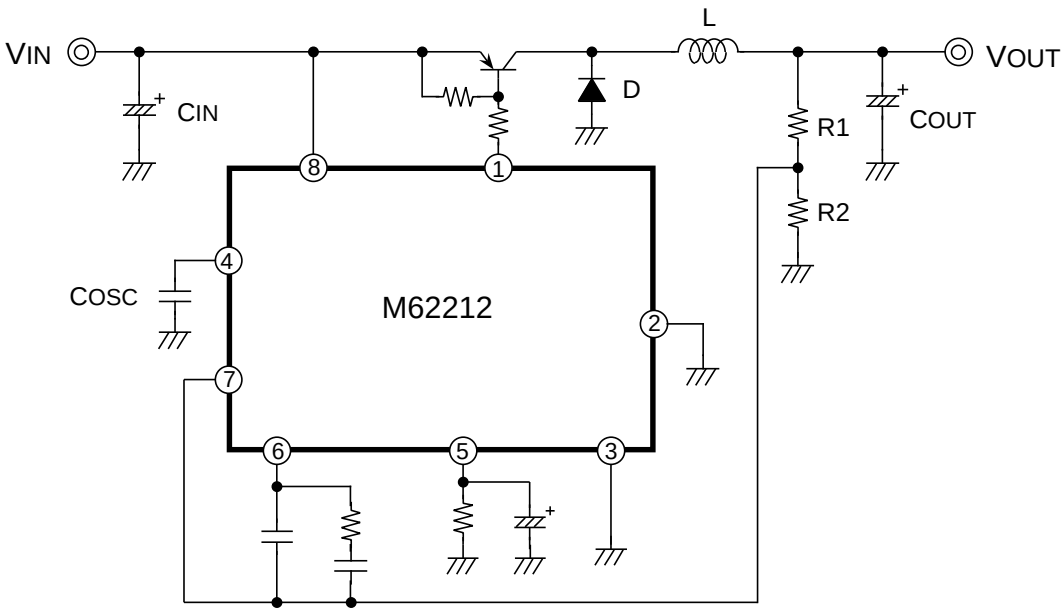
Electrical Characteristics (Ta=25°C, Vcc =12V, Cosc=100pF unless otherwise noted)

Block	Symbol	Items	Test condition	Limits			Units
				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 ~ 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	uA
Oscil-lator 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		uA
	$I_{OSC\ DIS1}$	Cosc discharge current 1			10		uA
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

Electrical Characteristics (Ta=25°C, Vcc =12V, Cosc=100pF unless otherwise noted)

Block	Symbol	Items	Test condition	Limits			Units
				Min	Typ	Max	
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 Circuit (STEP-DOWN converter with current buffer transistor)



2. FUNCTION DESCRIPION

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 C_{DTC}.

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.

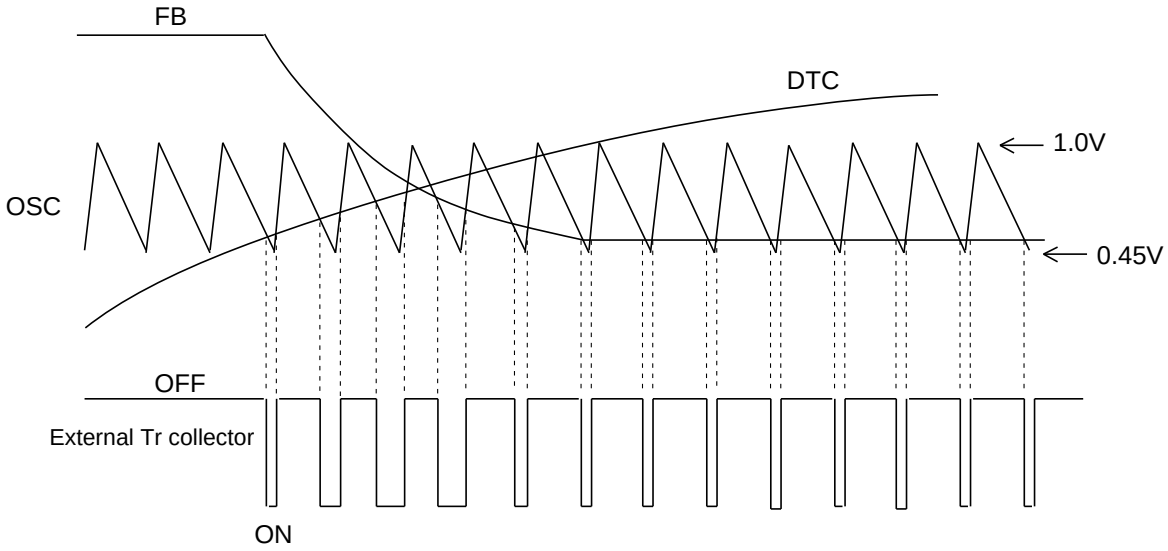


Fig.2

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 ~ 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 12KΩÅ`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

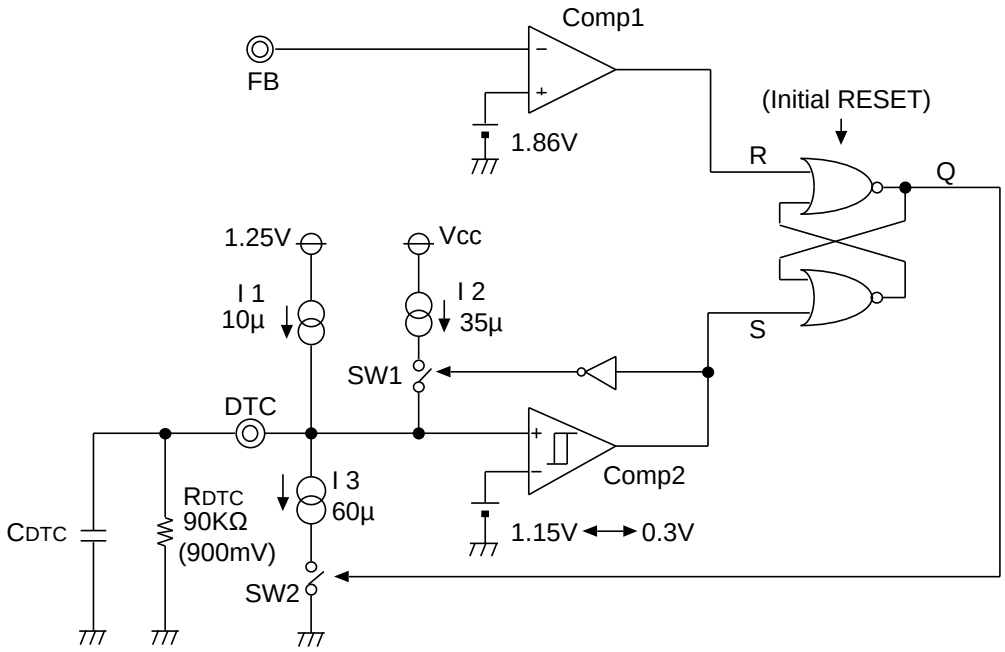
The system is activated if the FB terminal potential goes below the DTC terminal potential before the DTC terminal goes to 0.45V. If there is not enough time, the output is turned OFF (Latched)

[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.



* SW1 and SW2 are turned ON by "H" signal.

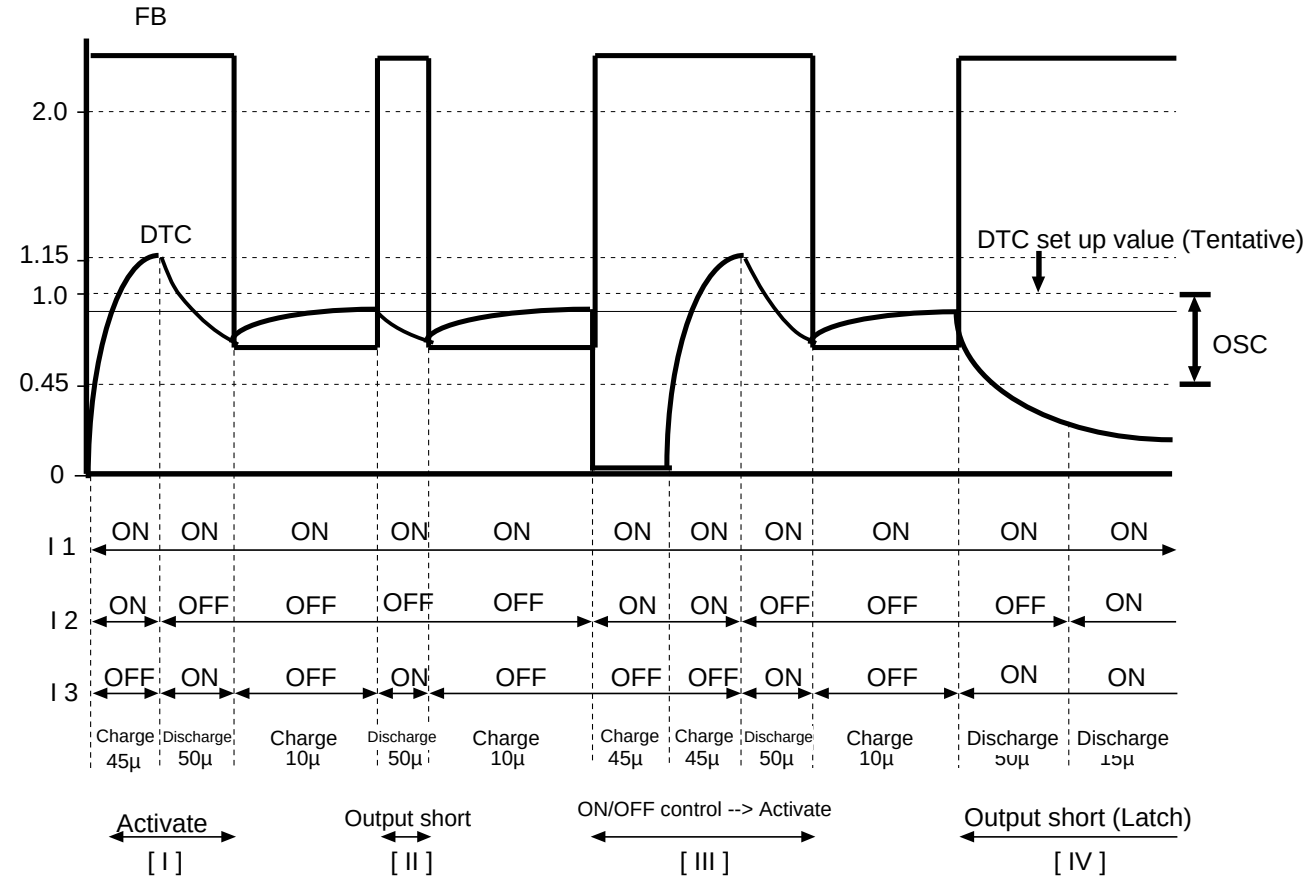


Fig.3 Short Protection Circuit and the Timing Chart of the Modes

3.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}		$\frac{1}{75 * 10^3 * fosc} - 16 * 10^{-12}$	$\frac{1}{75 * 10^3 * fosc} - 16 * 10^{-12}$	$\frac{1}{75 * 10^3 * fosc} - 16 * 10^{-12}$
L (MIN) (*1)		$\frac{(V_{IN} - V_{CE(sat)} - V_O) * T_{ON(MAX)}}{\Delta I_O}$	$\frac{(V_{IN} - V_{CE(sat)})^2 * T_{ON(MAX)}^2 * f_{OSC}}{2 * V_O * I_O}$	$\frac{(V_{IN} - V_{CE(sat)})^2 * T_{ON(MAX)}^2 * f_{OSC}}{2 * V_O * I_O}$
R_1 (*1,*2)		$\left(\frac{V_O}{V_{REF}} - 1\right) * R_2$	$\left(\frac{V_O}{V_{REF}} - 1\right) * R_2$	$\left(\frac{\lvert V_O \rvert}{V_{REF}} - 1\right) * R_2$
R_{DTC} (*4)	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} (*4)	calicurate from start-up time	$\frac{\lvert I_{CH1} \rvert * t_{start}}{V_{DTC(MAX)}}$	$\frac{\lvert I_{CH1} \rvert * t_{start}}{V_{DTC(MAX)}}$	$\frac{\lvert I_{CH1} \rvert * t_{start}}{V_{DTC(MAX)}}$
	calicurate from shat down time	$\frac{I_{DIS1} * t_{short}}{V_{DTC(MAX)} - V_{OSCL}}$	$\frac{I_{DIS1} * t_{short}}{V_{DTC(MAX)} - V_{OSCL}}$	$\frac{I_{DIS1} * t_{short}}{V_{DTC(MAX)} - V_{OSCL}}$

V_F : Forward Voltage of outer Diode.

$V_{CE(sat)}$: Saturation Voltage of M62212 or Saturation Voltage of Current buffer Transistor.

Åô Please setting the Oscillation frequency first and calicurate each constant value.

*1 : Please setting Å¢Io about 1/3 to 1/5 of maximum output current.

*2 : $|V_O| = (1 + \frac{R1}{R2}) * V_{REF}$

*3 : Please settng R2 about few KÉ∂ to score of KÉ∂ because output voltage don't undergo
a influence of input current (Terminla 7).

*4 : Please setting $V_{DTC(MAX)}$ to satisfy $D_{(MAX)}$, fixed from caracteristics 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 vlage of oscillation waveform (0.45V typ), and I_{DIS1} means DTC discharge current 1(50µA typ).

tstart means time internval when terminal vltage of DTC increase to V_{OSCL} from lower voltage and to start switching at first.

tshort means time interval when output is shut down after output is shorted.