

To all our customers

Regarding the change of names mentioned in the document, such as Mitsubishi Electric and Mitsubishi XX, to Renesas Technology Corp.

The semiconductor operations of Hitachi and Mitsubishi Electric were transferred to Renesas Technology Corporation on April 1st 2003. These operations include microcomputer, logic, analog and discrete devices, and memory chips other than DRAMs (flash memory, SRAMs etc.) Accordingly, although Mitsubishi Electric, Mitsubishi Electric Corporation, Mitsubishi Semiconductors, and other Mitsubishi brand names are mentioned in the document, these names have in fact all been changed to Renesas Technology Corp. Thank you for your understanding. Except for our corporate trademark, logo and corporate statement, no changes whatsoever have been made to the contents of the document, and these changes do not constitute any alteration to the contents of the document itself.

Note : Mitsubishi Electric will continue the business operations of high frequency & optical devices and power devices.

Renesas Technology Corp.
Customer Support Dept.
April 1, 2003

M62212P/FP/GP

GENERAL PURPOSE DC-DC CONVERTER

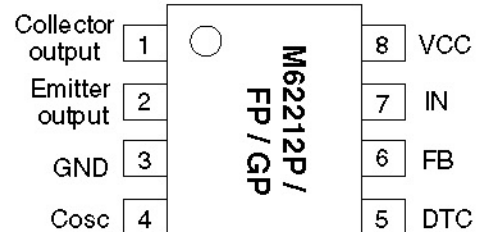
DESCRIPTION

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.

FEATURE

- Wide operation power supply voltage range2.5 ~ 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

PIN CONFIGURATION(TOP VIEW)

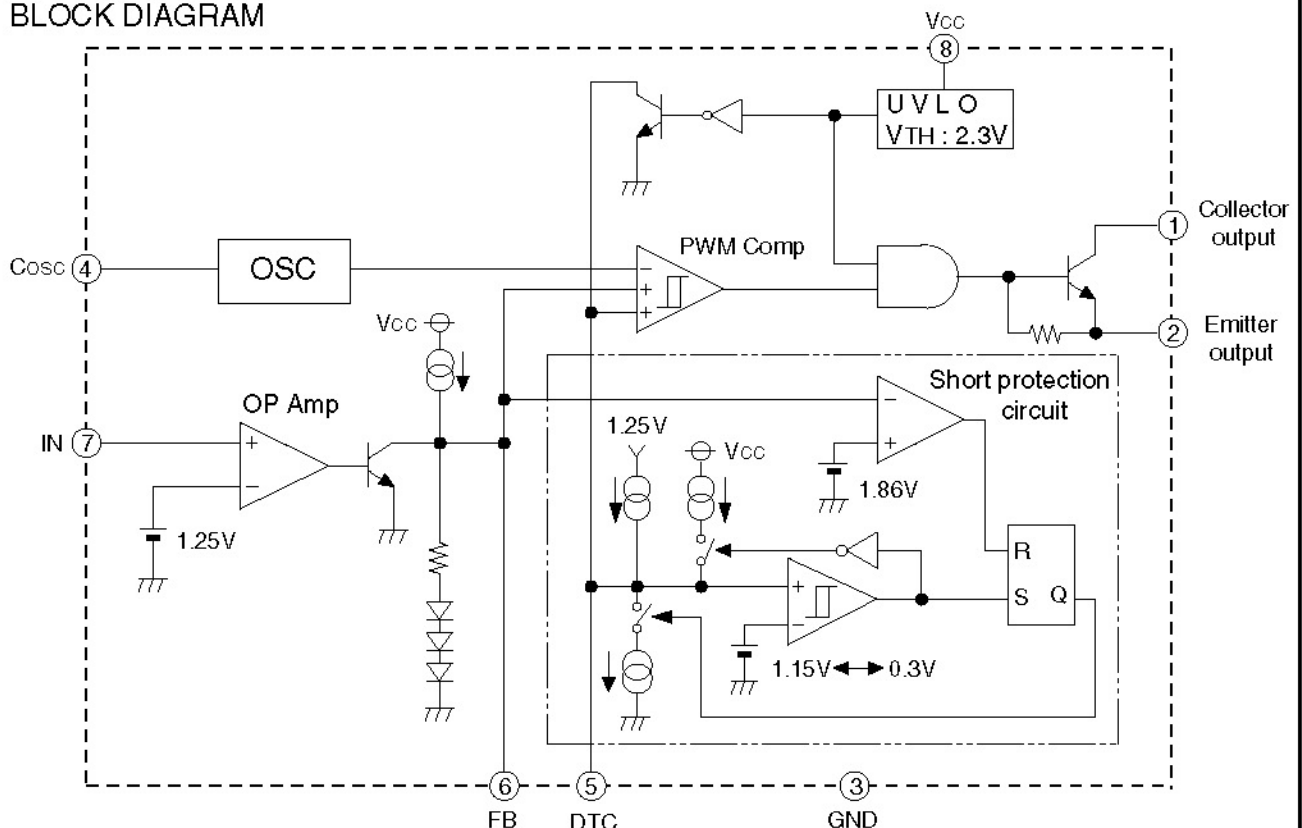


OUTLINE 8P2S-A (FP)
8P2X (GP)
8P4 (P)

APPLICATIONS

General electric products, DC-DC converter

BLOCK DIAGRAM



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GENERAL PURPOSE DC-DC CONVERTER

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

Symbols	Items	Conditions	Ratings	Units
V _{CC}	Power supply voltage		19	V
V _O	Output voltage		19	V
I _O	Output current		150	mA
P _d	Power dissipation	Ta=25°C	625 (P) 360(FP) 250(GP)	mW
K _{theta}	Thermal derating ratio	Ta>25°C	5.00 (P) 2.88 (FP) 2.00(GP)	mW/°C
T _{opr}	Operating ambient temperature		-20°C ~ +85	°C
T _{stg}	Storage temperature		-40°C ~ +125	°C

Electrical Characteristics (Ta=25°C, V_{CC}=12V, C_{osc}=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

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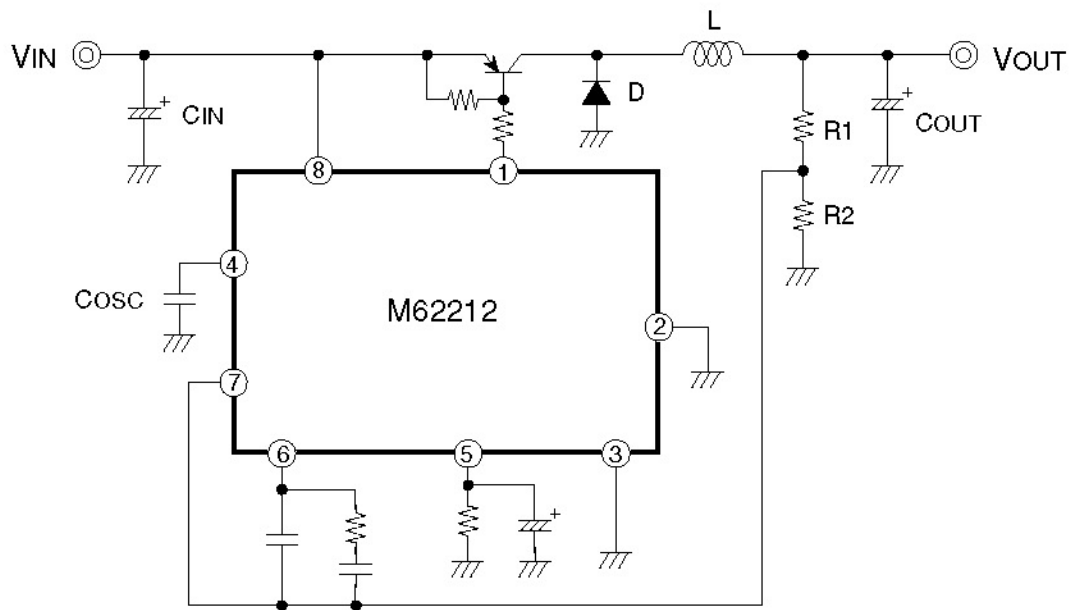
Electrical Characteristics ($T_a=25^{\circ}\text{C}$, $V_{CC}=12\text{V}$, $C_{OSC}=100\text{pF}$ unless otherwise noted)

Block	Symbol	Items	Test condition	Limits			Units
				Min	Typ	Max	
Short protection circuit	$V_{TH\text{ FB}}$	FB threshold voltage	$V_{IN}=1\text{V}, V_{DTC}=0.7\text{V}$		1.86		V
	$V_{TH\text{ DTC}}$	Latch mode "H" threshold voltage	$V_{IN}=1\text{V}, V_{FB}=2.11\text{V}$		1.15		V
	$V_{TL\text{ DTC}}$	Latch mode "L" threshold voltage	$V_{IN}=1\text{V}, V_{FB}=2.11\text{V}$		0.3		V
	I_{CH1}	DTC charge current when start-up	$V_{DTC}=0.7\text{V}, V_{FB}=2.11\text{V}$		-45		μA
	I_{DIS1}	DTC discharge current 1	$V_{DTC}=0.7\text{V}, V_{FB}=2.11\text{V}$		50		μA
	I_{CH2}	DTC charge current when stable state	$V_{DTC}=0.7\text{V}, V_{FB}=0.7\text{V}$		-10		μA
	I_{DIS2}	DTC discharge current 2	$V_{DTC}=0.2\text{V}, V_{FB}=2.11\text{V}$		15		μA
Output section	I_{CL}	Collector output leak current	$V_{CE}=18\text{V}, V_{CC}=18\text{V}$	-1		1	μA
	V_{SAT1}	Collector output saturation voltage 1	Emitter GND, $I_C=150\text{mA}, V_E=0\text{V}$		0.3	1.1	V
	V_{SAT2}	Collector output saturation voltage 2	Emitter follower, $I_E=50\text{mA}, V_C=12\text{V}$		1.6		V

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GENERAL PURPOSE DC-DC CONVERTER

1. Application Circuit (STEP-DOWN converter with current buffer transistor)



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GENERAL PURPOSE DC-DC CONVERTER

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 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 45 μ A.

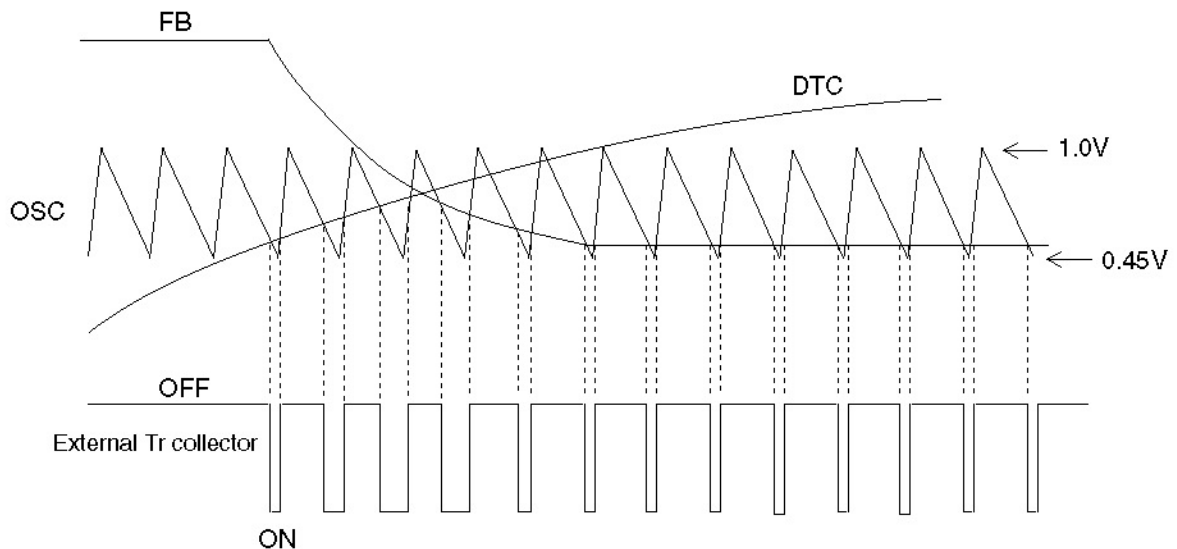


Fig.2

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 10 μ A. Therefore, R_{DTC} should be set to 40K Ω ~ 110K Ω .

(When the short protection circuit is not used)

At this time, the charge current for DTC is approximately 45 μ A. Therefore, R_{DTC} is set to 12K Ω ~ 25K Ω .

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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 45 μ A 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 50 μ A 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

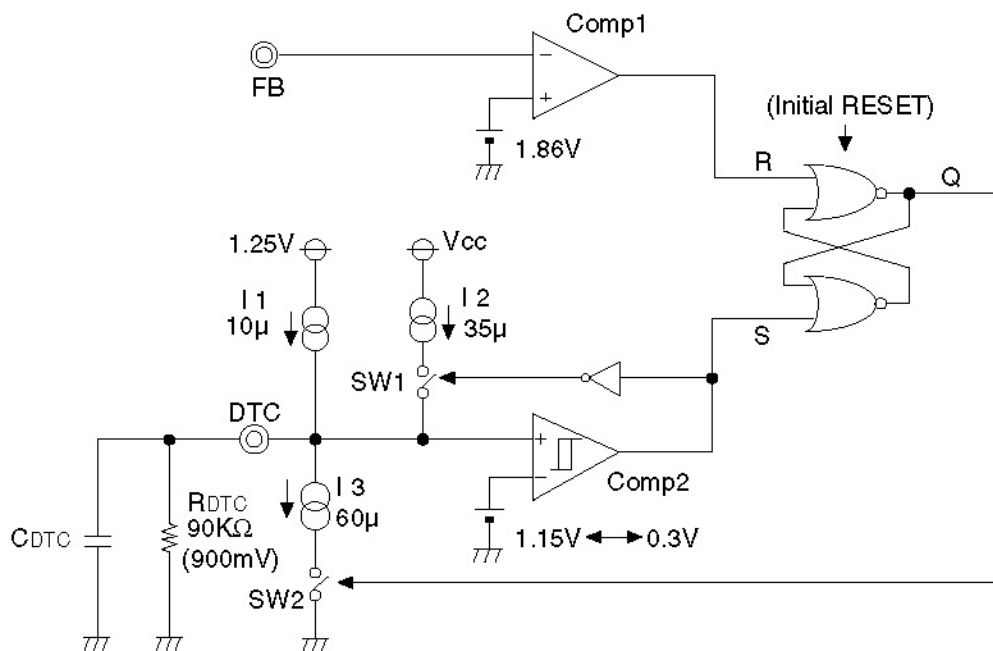
This mode turns off the output by forcing the DTC terminal to go down. (The system) returns as in the case of the activation.

[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.

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

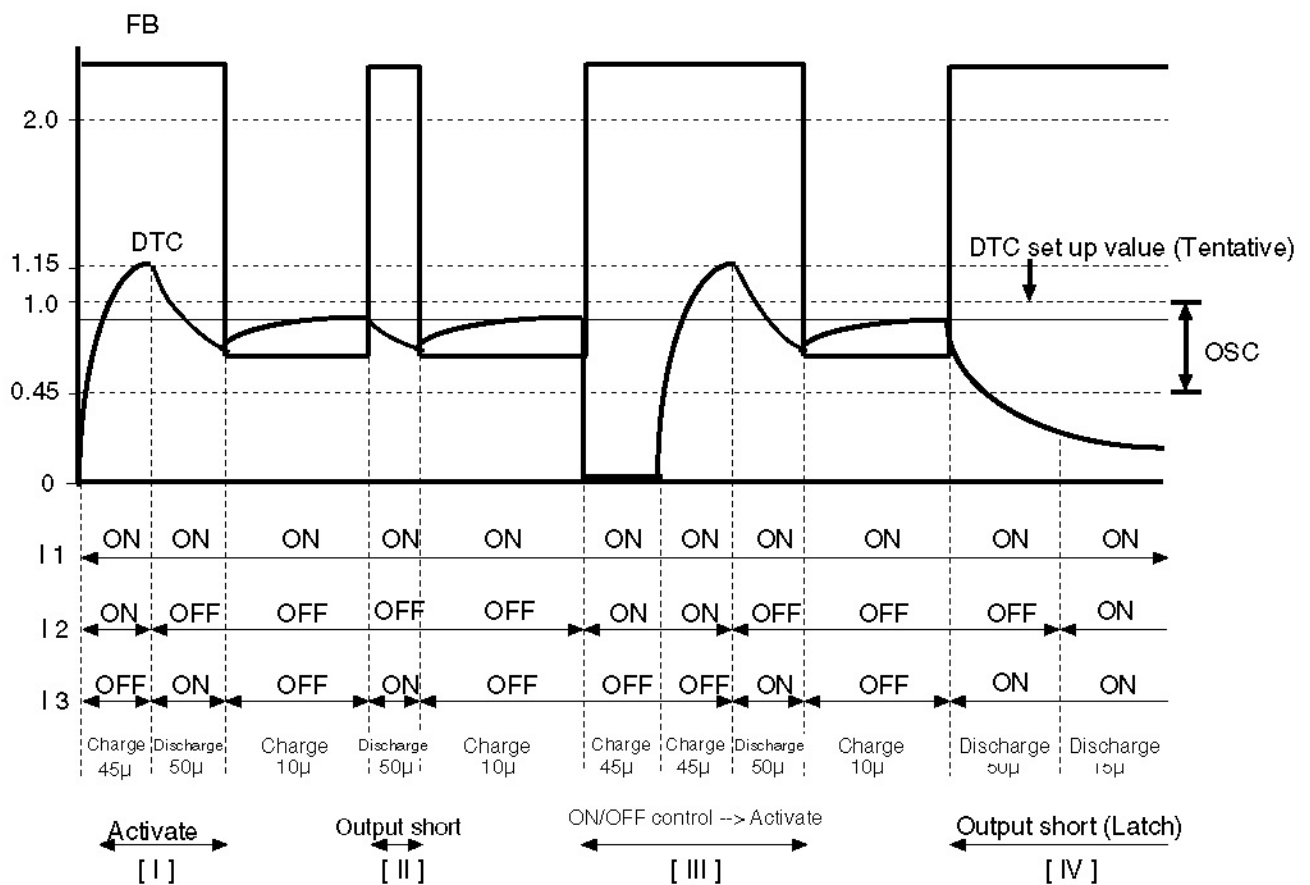


Fig.3 Short Protection Circuit and the Timing Chart of the Modes

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GENERAL PURPOSE DC-DC CONVERTER

3.CONSTANT DEFINITION

CONSTANT		Step-down converter	Step-up converter	Inverting converter
$\frac{T_{ON}}{T_{OFF}}$		$\frac{V_O + V_F}{V_{IN} - V_{CE(sat)} - V_O}$	$\frac{V_O + V_F - V_{IN}}{V_{IN} - V_{CE(sat)}}$	$\frac{ V_O + V_F}{V_{IN} - V_{CE(sat)}}$
$T_{ON} + T_{OFF}$		$\frac{1}{f_{OSC}}$	$\frac{1}{f_{OSC}}$	$\frac{1}{f_{OSC}}$
$T_{OFF} (MIN)$		$\frac{T_{ON} + T_{OFF}}{1 + \frac{T_{ON}}{T_{OFF}}}$	$\frac{T_{ON} + T_{OFF}}{1 + \frac{T_{ON}}{T_{OFF}}}$	$\frac{T_{ON} + T_{OFF}}{1 + \frac{T_{ON}}{T_{OFF}}}$
$T_{ON} (MAX)$		$\frac{1}{f_{OSC}} - T_{OFF}$	$\frac{1}{f_{OSC}} - T_{OFF}$	$\frac{1}{f_{OSC}} - T_{OFF}$
$D (MAX)$		$\frac{T_{ON(MAX)}}{T_{ON} + T_{OFF}}$	$\frac{T_{ON(MAX)}}{T_{ON} + T_{OFF}}$	$\frac{T_{ON(MAX)}}{T_{ON} + T_{OFF}}$
C_{OSC}		$\frac{1}{75 * 10^3 * f_{OSC}} - 16 * 10^{-12}$	$\frac{1}{75 * 10^3 * f_{OSC}} - 16 * 10^{-12}$	$\frac{1}{75 * 10^3 * f_{OSC}} - 16 * 10^{-12}$
$L (MIN) (*1)$		$\frac{(V_{IN} - V_{CE(sat)} - V_O) * T_{ON(MAX)}}{\Delta I_O}$	$\frac{(V_{IN} - V_{CE(sat)})^2 * T_{ON(MAX)}^2 * f_{OSC}}{2 * V_O * I_O}$	$\frac{(V_{IN} - V_{CE(sat)})^2 * T_{ON(MAX)}^2 * f_{OSC}}{2 * V_O * I_O}$
$R_1 (*1, *2)$		$\left(\frac{V_O}{V_{REF}} - 1 \right) * R_2$	$\left(\frac{V_O}{V_{REF}} - 1 \right) * R_2$	$\left(\frac{ V_O }{V_{REF}} - 1 \right) * R_2$
$R_{DTC} (*4)$	not use short protection	$\frac{V_{DTC(MAX)}}{ I_{CH1} }$	$\frac{V_{DTC(MAX)}}{ I_{CH1} }$	$\frac{V_{DTC(MAX)}}{ I_{CH1} }$
	use short protection	$\frac{V_{DTC(MAX)}}{ I_{CH2} }$	$\frac{V_{DTC(MAX)}}{ I_{CH2} }$	$\frac{V_{DTC(MAX)}}{ I_{CH2} }$
$C_{DTC} (*4)$	calicurate from start-up time	$\frac{ I_{CH1} * t_{start}}{V_{DTC(MAX)}}$	$\frac{ I_{CH1} * t_{start}}{V_{DTC(MAX)}}$	$\frac{ I_{CH1} * t_{start}}{V_{DTC(MAX)}}$
	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.

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

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

*2 : $|V_O| = \left(1 + \frac{R_1}{R_2} \right) * V_{REF}$

*3 : Please setting R_2 about few $K\Omega$ to score of $K\Omega$ 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 characteristics of $D(MAX) - V_{DTC(MAX)}$.

I_{CH1} means DTC charge current when start-up(-45 μ A typ), I_{CH2} means DTC charge current when stable state(-10 μ A typ), V_{OSCL} means lower limit vlage of oscillation waveform (0.45V typ), and I_{DIS1} means DTC discharge current 1(50 μ A typ).

t_{start} means time interval when terminal vlage 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.