

M62216FP/GP

Low Voltage Operation STEP-UP DC-DC Converter

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

Symbol	Parameter	Condition	Ratings	Unit
VIN	Input Voltage		15.5	V
VBIAS	Bias Terminal Supply Voltage		15.5	V
VDRIVE1	Drive1 Terminal Supply Voltage		15.5	V
VDRIVE2	Drive2 Terminal Supply Voltage		15.5	V
IDRIVE1	Drive1 Terminal Input Current		100	mA
IDRIVE2	Drive2 Terminal Input Current		10	mA
Pd	Power Dissipation	Ta=25°C	440 (FP) 250 (GP)	mW
Topr	Operating Temperature		-20 ~+85	°C
Tstg	Storage Temperature		-40 ~+150	°C

ELECTRICAL CHARACTERISTICS (Ta=25°C, VIN=1.7V, VOUT=VBIAS=3.0V, unless otherwise noted)

Block	Symbol	Parameter	Test Condition	Limits			Unit
				Min.	Typ.	Max.	
All Device	VIN	Input Voltage Range		0.9		15	V
	VBIAS	BIAS Voltage Setting Range *1		1.7		15	V
	IB	BIAS Current			850	1200	μA
	IB(OFF)	BIAS Current at OFF Mode			35	47	μA
Voltage Reference	VREF	Reference Voltage	Use internal amp as Buffer-amp	1.20	1.26	1.32	V
	VREF	BIAS Voltage Regulation of VREF	VBIAS=1.7~15V		10	30	mV
Error Amp.	IIN	Input Current	IN = 1V / IM		20		nA
	AV	Open Loop Voltage Gain	fIN = 100Hz , Null Amp Operation		70		dB
	IFB+	FB Terminal Sink Current	IN = 1.4V , FB = 1.25V / IM	260	800		μA
	IFB-	FB Terminal Source Current	IN = 1.1V , FB = 1.25V / IM	30	45	60	μA
Osc.	fosc	Oscillation Frequency	PWM Terminal Monitored	95	125	155	kHz
	DUTY _{max}	Maximum ON Duty	PWM Terminal Monitored , IN = 1.1 V	82	87	92	%
OUTPUT	Vsat1	Saturation Voltage between PWM Term. and DRIVE1 Term.	IDRIVE1=50mA, IDRIVE2=5mA		0.25	0.5	V
	Vsat2	Saturation Voltage between PWM Term. and DRIVE2 Term.			1.0	1.2	V
	IL1	Leak Current of DRIVE1 Terminal	IN = 1.4V	-1		1	μA
	IL2	Leak Current of DRIVE2 Terminal	IN = 1.4V	-1		1	μA
	VPWM(L)	Output Low Voltage of PWM Terminal	IPWM = 1mA		0.03	0.3	V
ON/OFF	ION	Input Current of ON/OFF Terminal At ON Status			2	3	μA
	VTH(ON)	Threshold Voltage of ON/OFF Terminal			0.65	0.75	V

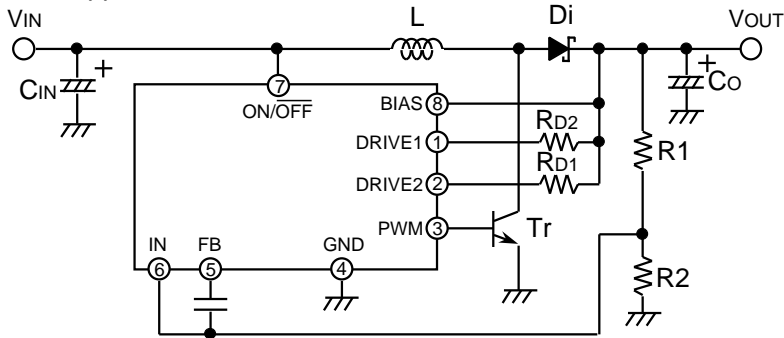
*1 : Setting range of BIAS voltage as same as setting range of output voltage .

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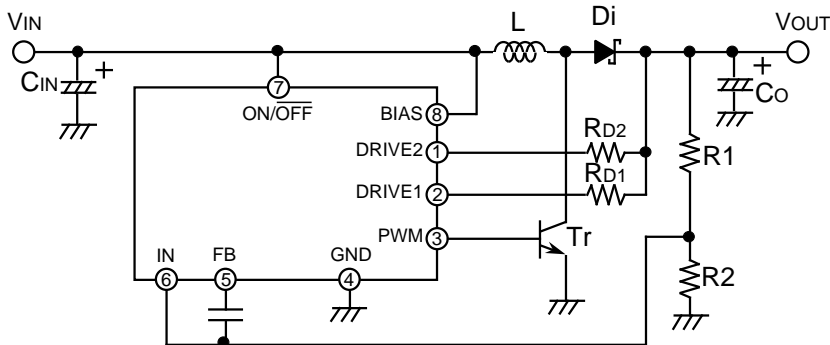
Application circuit

(1). Standard Application circuit



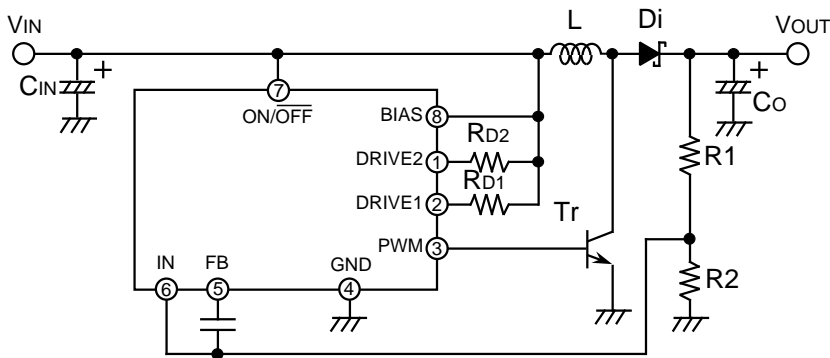
V_{IN} : 0.9 ~ 14V
 V_{OUT} : 1.7 ~ 15V
 ($V_{OUT} > V_{IN}$)

(2). Application circuit 1 (V_{IN} 1.7V)



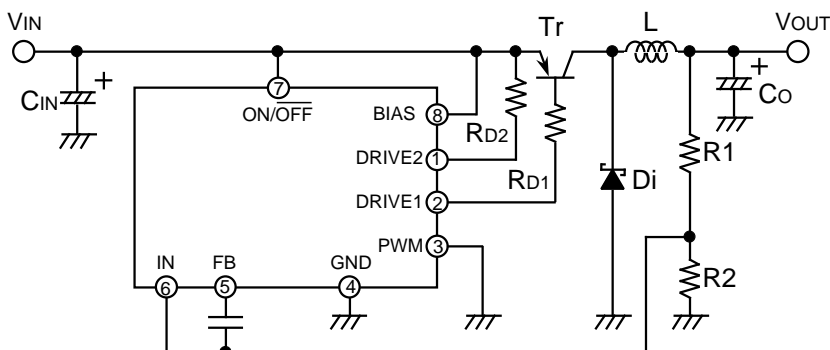
V_{IN} : 1.7 ~ 14V
 V_{OUT} : 2.5V ~ 15V
 ($V_{OUT} > V_{IN}$)

(3). Application circuit 2 ($V_{OUT} > 15V$)



V_{IN} : 1.7 ~ 15V
 V_{OUT} : 15V ~
 ($V_{OUT} > V_{IN}$)

(4). Application circuit for STEP-DOWN Circuit

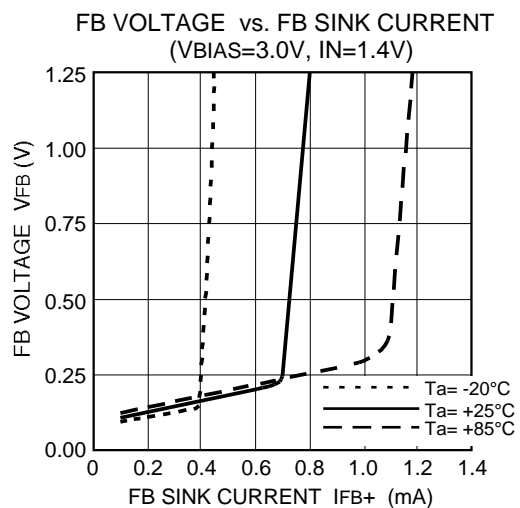
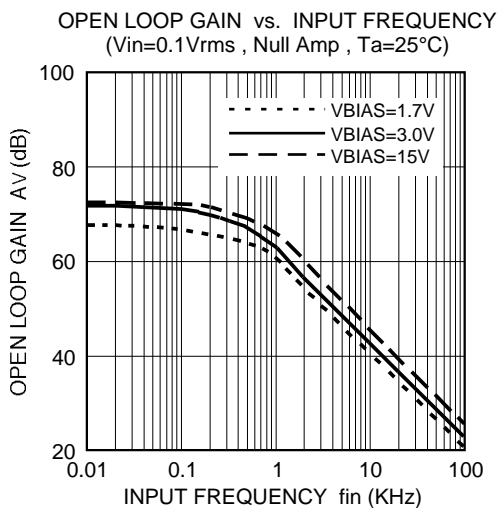
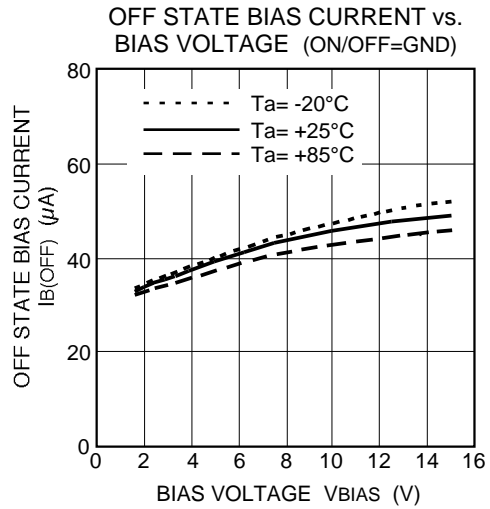
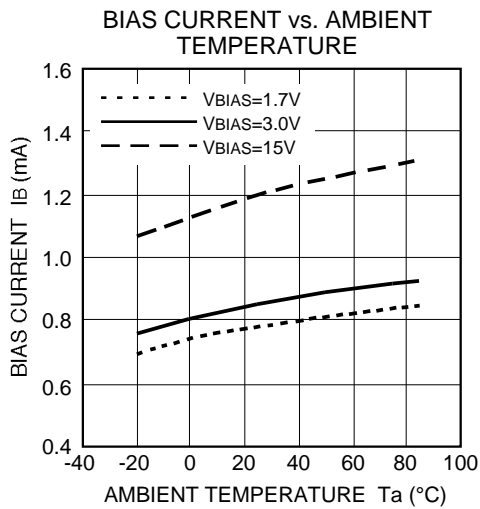
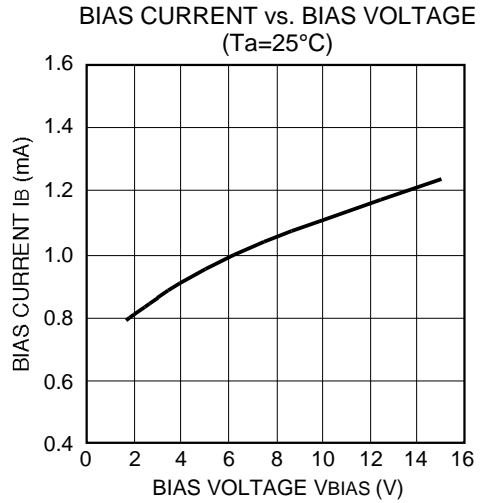
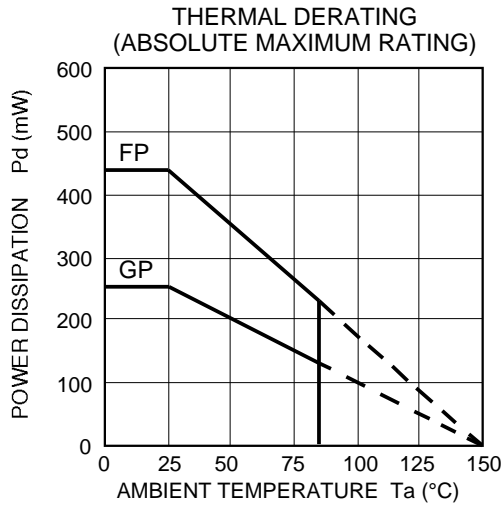


V_{IN} : 2.0 ~ 15V
 V_{OUT} : 1.7V ~ 14V
 ($V_{OUT} < V_{IN}$)

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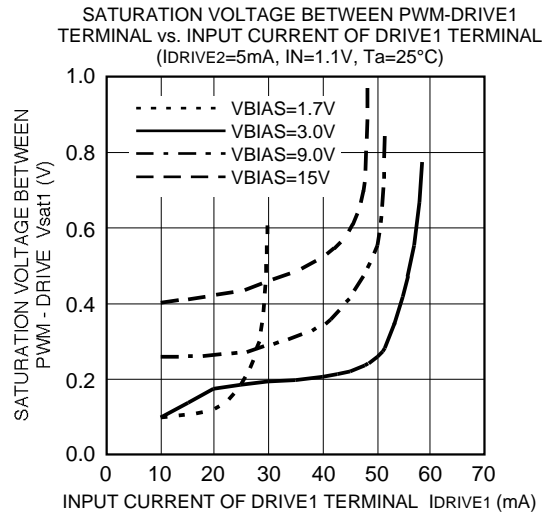
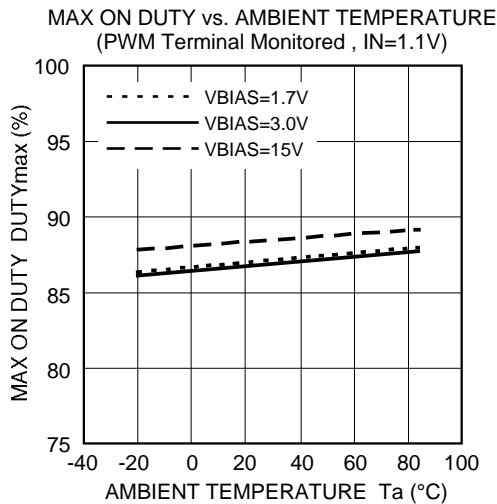
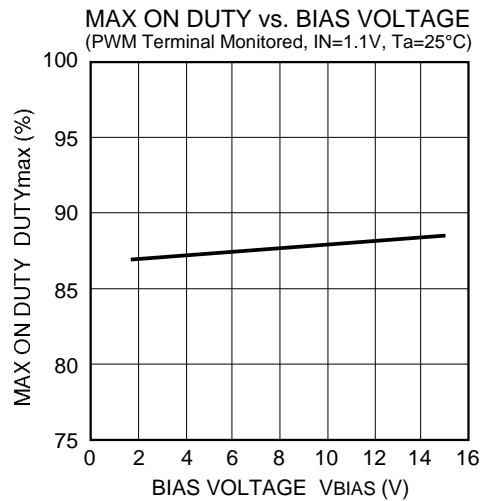
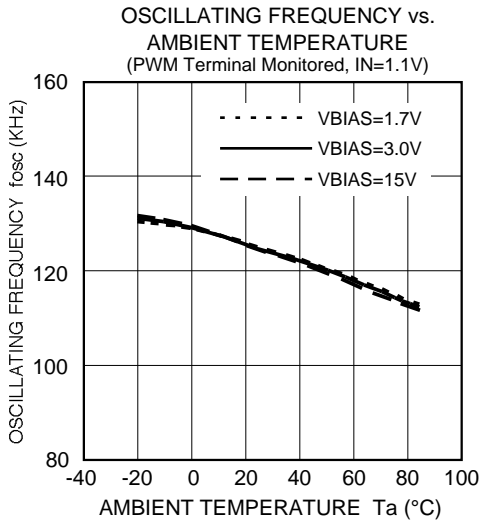
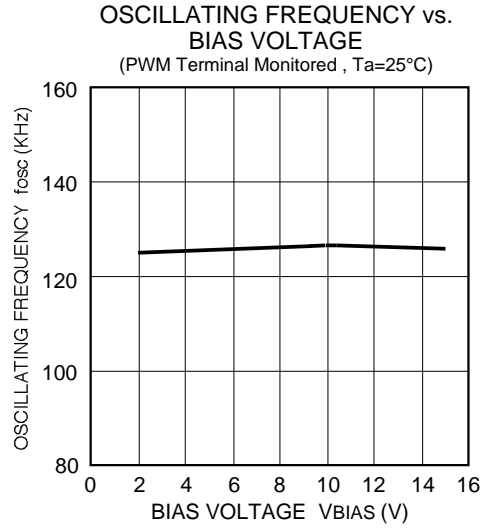
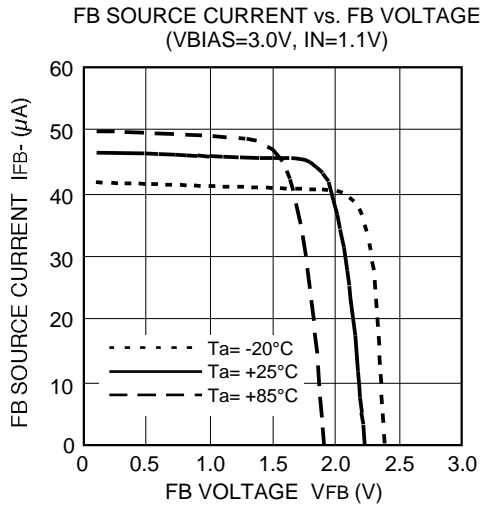
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TYPICAL CHARACTERISTICS



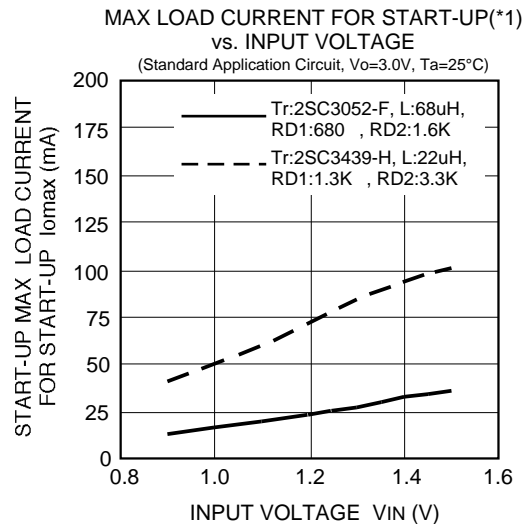
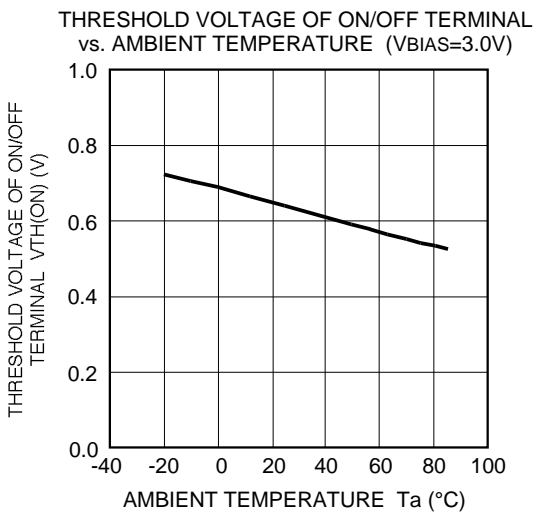
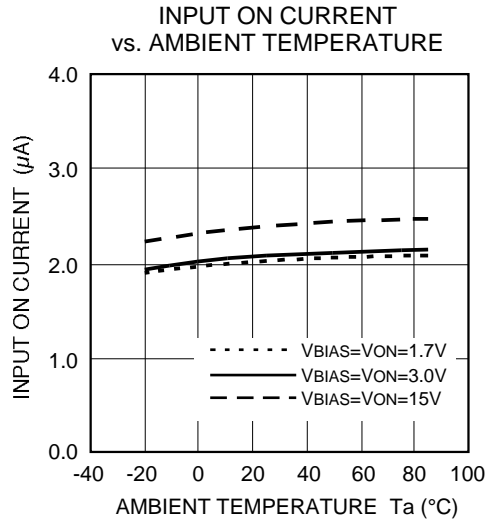
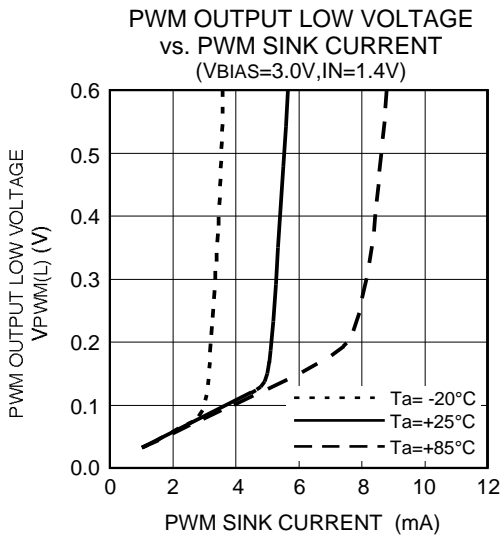
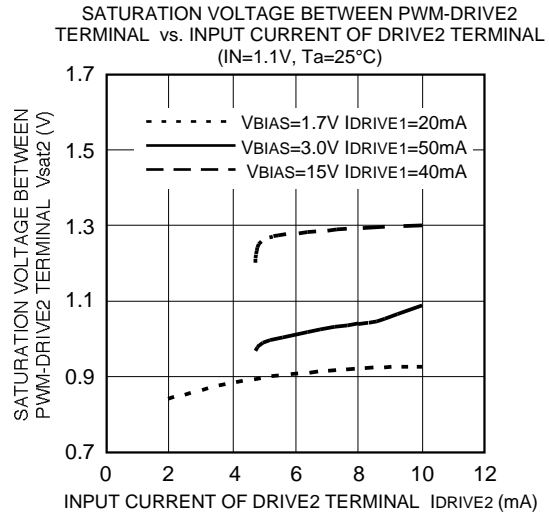
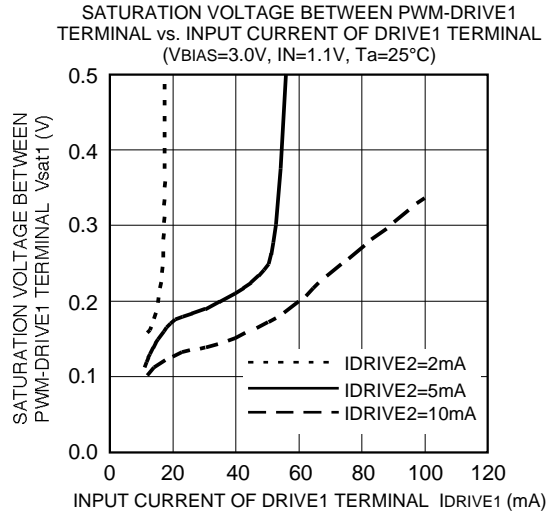
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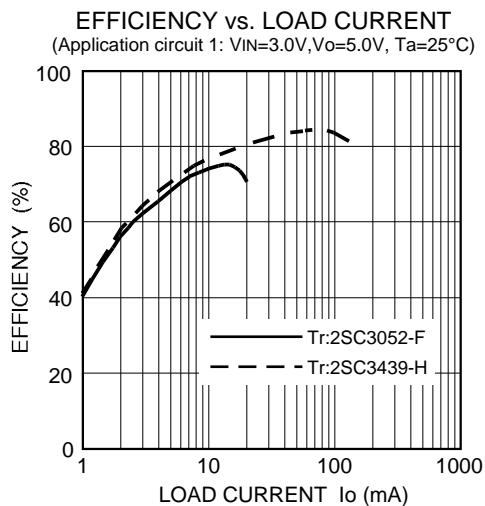
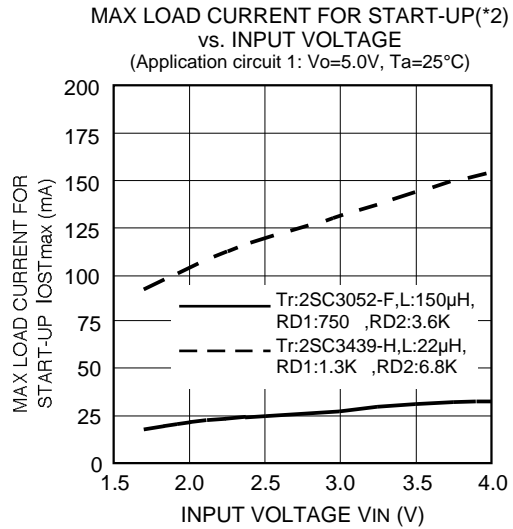
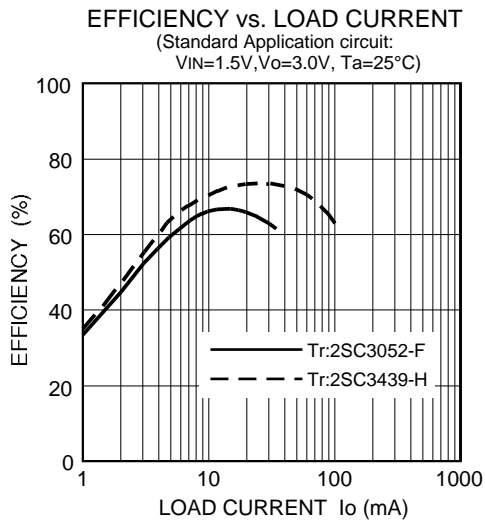
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*1, *2 : These characteristics show the maximum output load current when start-up.
Therefore, output voltage can grown-up to setting voltage less than a curve in the graph when using these external components value.
(• 2SC3052-F : hFE=250 ~ 500, 2SC3439-H : hFE=600 ~ 1200)

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Equation for Constants Calculation

Constants	Standard Application Circuit	Application Circuit 1	Application Circuit 2
$\frac{TON}{TOFF}$	$\frac{VO + VF - VIN}{VIN - VCE(sat)}$	$\frac{VO + VF - VIN}{VIN - VCE(sat)}$	$\frac{VO + VF - VIN}{VIN - VCE(sat)}$
TON+TOFF	$\frac{1}{fosc}$	$\frac{1}{fosc}$	$\frac{1}{fosc}$
TOFF(MIN)	$\frac{TON + TOFF}{1 + \frac{TON}{TOFF}}$	$\frac{TON + TOFF}{1 + \frac{TON}{TOFF}}$	$\frac{TON + TOFF}{1 + \frac{TON}{TOFF}}$
TON(MAX)	$\frac{1}{fosc} - TOFF(MIN)$	$\frac{1}{fosc} - TOFF(MIN)$	$\frac{1}{fosc} - TOFF(MIN)$
l _{pk}	$2 * \left(1 + \frac{TON}{TOFF}\right) * (Io + IB)$	$2 * \left(1 + \frac{TON}{TOFF}\right) * Io$	$2 * \left(1 + \frac{TON}{TOFF}\right) * Io$
L(MIN)	$\frac{(VIN - VCE(sat))^2 * TON(MAX)^2 * fosc}{2 * Vo * (Io + IB)}$	$\frac{(VIN - VCE(sat))^2 * TON(MAX)^2 * fosc}{2 * Vo * Io}$	$\frac{(VIN - VCE(sat))^2 * TON(MAX)^2 * fosc}{2 * Vo * Io}$
R1	$\left(\frac{Vo}{VREF} - 1\right) * R2$	$\left(\frac{Vo}{VREF} - 1\right) * R2$	$\left(\frac{Vo}{VREF} - 1\right) * R2$
RD1	$\frac{Vo - (VBE + Vsat1)}{(l_{pk} / hFE) * A1}$	$\frac{Vo - (VBE + Vsat1)}{(l_{pk} / hFE) * A1}$	$\frac{VIN - (VBE + Vsat1)}{(l_{pk} / hFE) * A1}$
RD2	$\frac{Vo - (VBE + Vsat2)}{(l_{pk} / hFE) * A2}$	$\frac{Vo - (VBE + Vsat2)}{(l_{pk} / hFE) * A2}$	$\frac{VIN - (VBE + Vsat2)}{(l_{pk} / hFE) * A2}$

Constants	STEP-DOWN Circuit
$\frac{TON}{TOFF}$	$\frac{VO + VF}{VIN - VCE(sat) - Vo}$
TON+TOFF	$\frac{1}{fosc}$
TOFF(MIN)	$\frac{TON + TOFF}{1 + \frac{TON}{TOFF}}$
TON(MAX)	$\frac{1}{fosc} - TOFF(MIN)$
l _{pk}	$2 * Io$
L(MIN)	$\frac{(VIN - VCE(sat) - Vo) * TON(MAX)}{Io}$
R1	$\left(\frac{Vo}{VREF} - 1\right) * R2$
RD1	$\frac{Vo - VBE - Vsat1}{l_{pk} / hFE}$
RD2	$\frac{VIN - Vsat2}{(l_{pk} / hFE) * A3}$

Notice)

- VF : Forward voltage of external diode.
- VCE(sat) : Saturation voltage of external transistor.
- VBE : Voltage between Base - Emitter of external transistor.
- hFE : hFE of external transistor at saturating.
- A1 : Ratio of current into DRIVE1 terminal.
(A1 = 0.8 ~ 0.9)
- A2 : Ratio of current into DRIVE2 terminal.
(A2 = 1 - A1)
- A3 : Ratio of current into DRIVE2 terminal.
(A3 = 0.1 ~ 0.2)
- Set R2 to several K ~ several 10ths k .
- Set current into DRIVE2 terminal more than 100μA.
(l_{pk} / hFE) * A2 100μA, (l_{pk} / hFE) * A3 100μA,.
- Set Io to 1/5 ~ 1/3 of maximum load current.
- The maximum rating of current of external parts (transistor, diode and inductor) are 1.5 to 2 times of l_{pk}.