M62216FP/GP

Low Voltage Operation STEP-UP DC/DC Converter

REJ03D0845-0201
Rev.2.01
Nov 14, 2007

Description

The M62216FP is designed as low voltage operation STEP-UP DC/DC converter.

This IC can operate very low input voltage (over 0.9 V) and low power dissipation. (circuit current is less than 850 µA)

So, this IC suitable for power supply of portable system that using low voltage battery. (DRY battery, rechargeable battery)

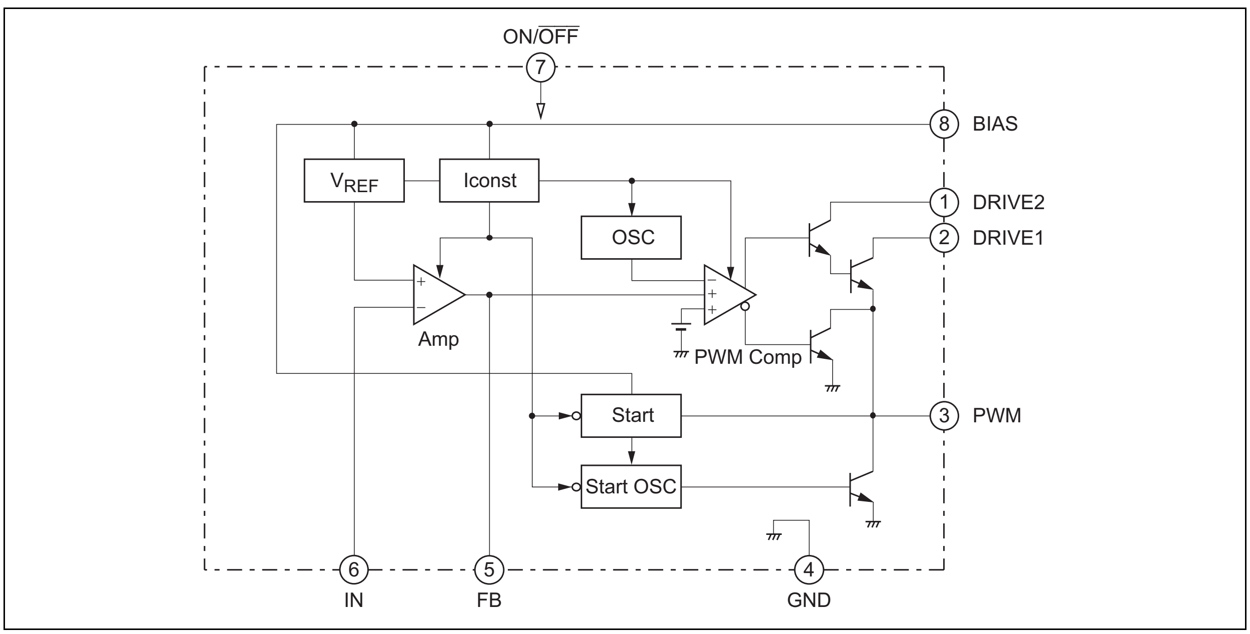
Features

- Pre-drive type PWM output (Pre-drive only)
- Low voltage operation……….. V_{IN} = 0.9 V min.
- Low current dissipation……… I_B = 850 µA typ.
- Pre-drive output current can be adjusted
- Built-in ON/OFF Function…..... $I_{B\ (OFF)}$ = 35 µA typ.
- Application for STEP-DOWN Converter can be used

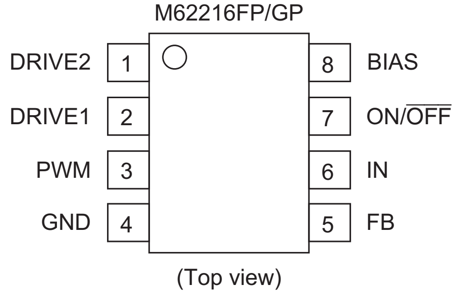
Application

DC/DC Converter for portable sets of battery used

Block Diagram



Pin Arrangement



Outline: PRSP0008DA-A (8P2S-A) [FP]
8P2X-A [GP]

Absolute Maximum Ratings

(Ta = 25°C, unless otherwise noted)

Item	Symbol	Ratings	Units	Conditions
Input voltage	V_{IN}	15.5	V	
Bias terminal supply voltage	V_{BIAS}	15.5	V	
Drive1 terminal supply voltage	V_{DRIVE1}	15.5	V	
Drive2 terminal supply voltage	V_{DRIVE2}	15.5	V	
Drive1 terminal input current	I_{DRIVE1}	100	mA	
Drive2 terminal Input current	I_{DRIVE2}	10	mA	
Power dissipation	Pd	440 (FP) 250 (GP)	mW	Ta = 25°C
Operating temperature	Topr	–20 to +85	°C	
Storage temperature	Tstg	–40 to +150	°C	

Electrical Characteristics

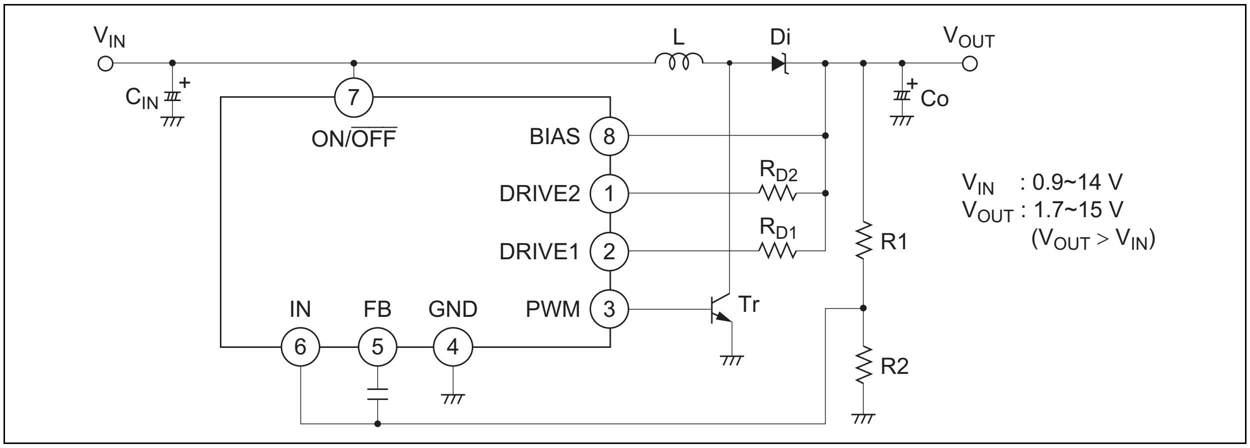
(Ta = 25°C, V_{IN} = 1.7 V, V_{OUT} = V_{BIAS} = 3.0 V, unless otherwise noted)

Block	Item	Symbol	Limits Min	Limits Typ	Limits Max	Units	Test Condition
All device	Input voltage range	V_{IN}	0.9	—	15	V	
	BIAS voltage setting range*[1]	V_{BIAS}	1.7	—	15	V	
	BIAS current	I_B	—	850	1200	µA	
	BIAS current at off mode	$I_{B (OFF)}$	—	35	47	µA	
Voltage reference	Reference voltage	V_{REF}	1.20	1.26	1.32	V	Use internal amp as Buffer-amp
	BIAS voltage regulation of VREF	ΔV_{REF}	—	10	30	mV	V_{BIAS} = 1.7 to 15 V
Error Amp.	Input current	I_{IN}	—	20	—	nA	IN = 1 V/IM
	Open loop voltage gain	A_V	—	70	—	dB	f_{IN} = 100 Hz, null amp operation
	FB terminal sink current	$I_{FB}+$	260	800	—	µA	IN = 1.4 V, FB = 1.25 V/IM
	FB terminal source current	$I_{FB}–$	30	45	60	µA	IN = 1.1 V, FB = 1.25 V/IM
Osc.	Oscillation frequency	f_{OSC}	95	125	155	kHz	PWM terminal monitored
	Maximum on duty	$DUTY_{max}$	82	87	92	%	PWM terminal monitored, IN = 1.1 V
Output	Saturation voltage between PWM Term. and DRIVE1 Term.	V_{sat1}	—	0.25	0.5	V	I_{DRIVE1} = 50 mA, I_{DRIVE2} = 5 mA
	Saturation voltage between PWM Term. and DRIVE2 Term.	V_{sat2}	—	1.0	1.2	V	
	Leak current of DRIVE1 terminal	I_{L1}	–1	—	1	µA	IN = 1.4 V
	Leak current of DRIVE2 terminal	I_{L2}	–1	—	1	µA	IN = 1.4 V
	Output low voltage of PWM terminal	$V_{PWM (L)}$	—	0.03	0.3	V	I_{PWM} = 1 mA
ON/OFF	Input current of ON/$\overline{OFF}$ terminal at on status	I_{ON}	—	2	3	µA	
	Threshold voltage of ON/$\overline{OFF}$ terminal	$V_{TH (ON)}$	—	0.65	0.75	V	

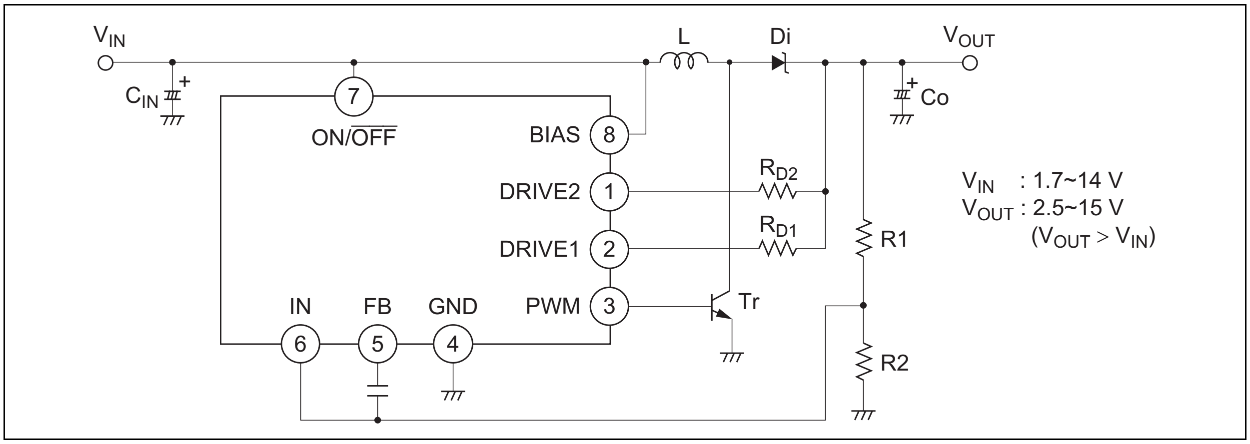
Note: 1. Setting range of BIAS voltage as same as setting range of output voltage.

Application Circuit

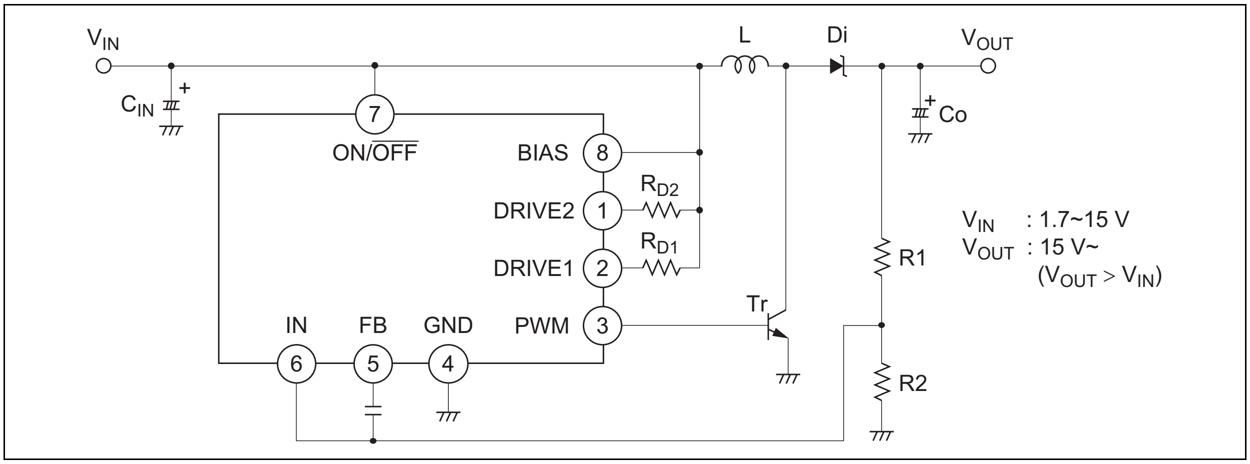
(1) Standard application circuit



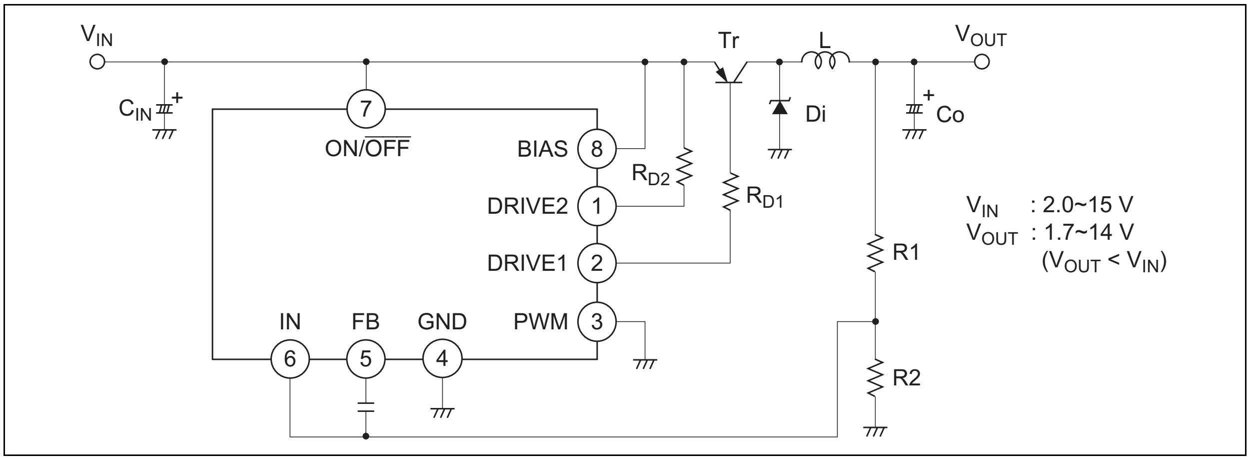
(2) Application circuit 1 ($V_{IN} \geq 1.7$ V)



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

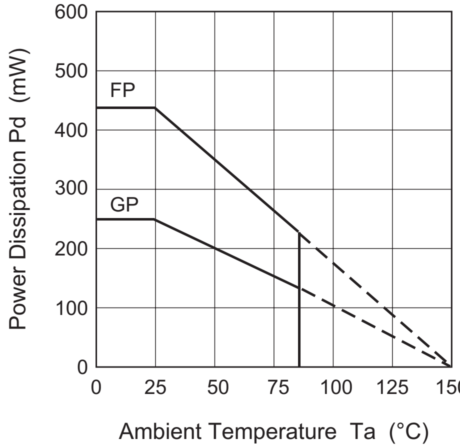


(4) Application circuit for STEP-DOWN circuit

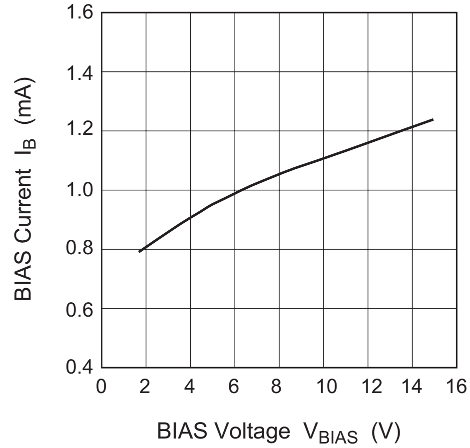


Typical Characteristics

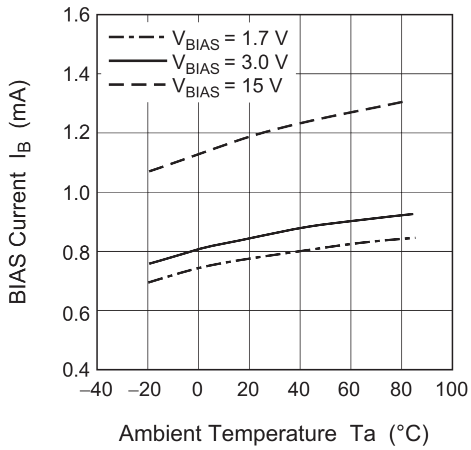
Thermal Derating
(Absolute Maximum Rating)



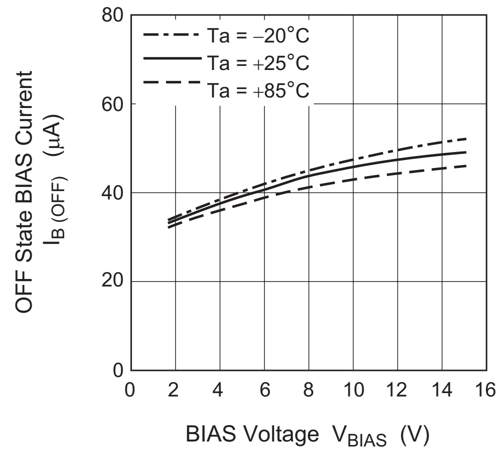
BIAS Current vs. BIAS Voltage
(Ta = 25°C)



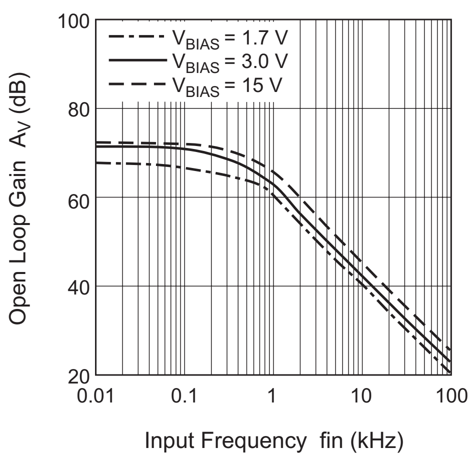
BIAS Current vs.
Ambient Temperature



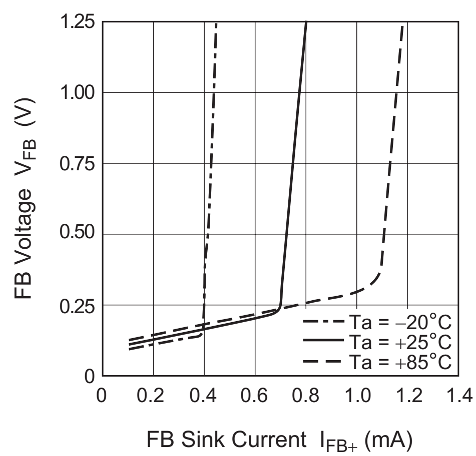
OFF State BIAS Current vs.
BIAS Voltage (ON/OFF = GND)



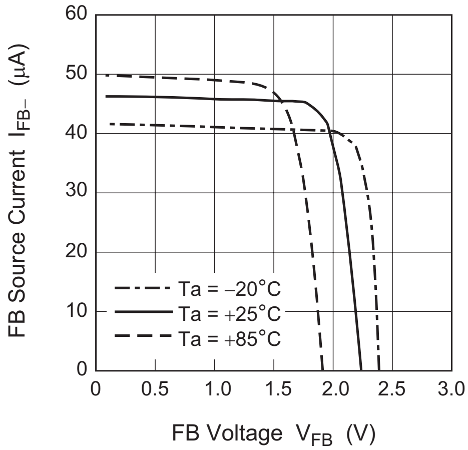
Open Loop Gain vs. Input Frequency
(Vin = 0.1 Vrms, Null Amp, Ta = 25°C)



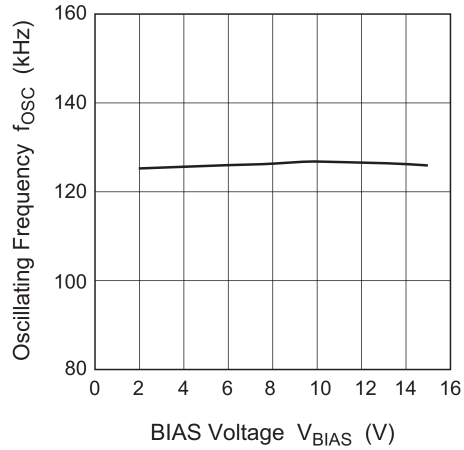
FB Voltage vs. FB Sink Current
(V_{BIAS} = 3.0 V, IN = 1.4 V)



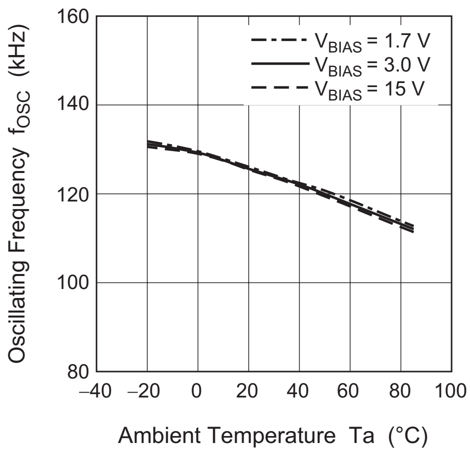
FB Source Current vs. FB Voltage
(V_{BIAS} = 3.0 V, IN = 1.1 V)



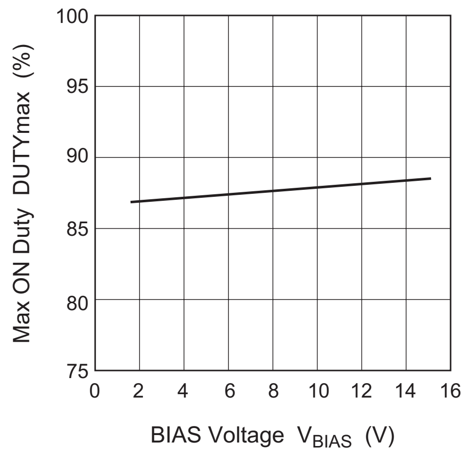
Oscillating Frequency vs.
BIAS Voltage
(PWM Terminal Monitored, Ta = 25°C)



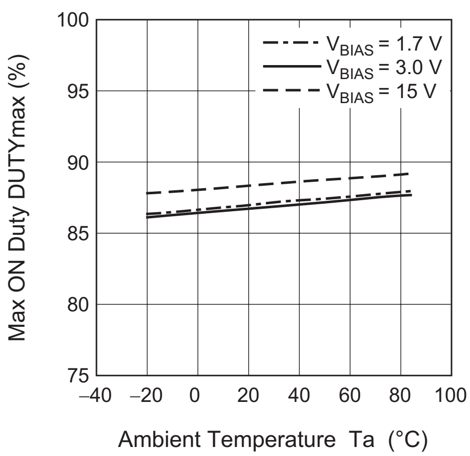
Oscillating Frequency vs.
Ambient Temperature
(PWM Terminal Monitored, IN = 1.1 V)



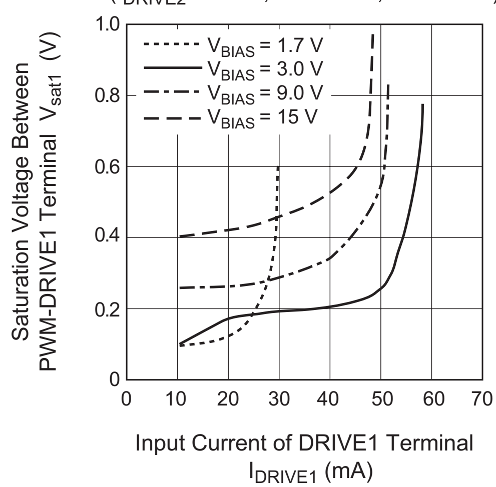
Max ON Duty vs. BIAS Voltage
(PWM Terminal Monitored, IN = 1.1 V, Ta = 25°C)



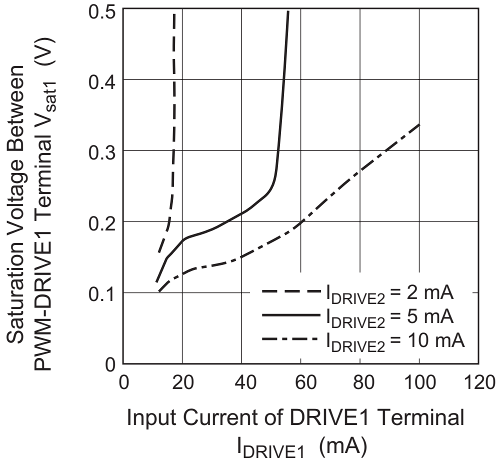
Max ON Duty vs. Ambient Temperature
(PWM Terminal Monitored, IN = 1.1 V)



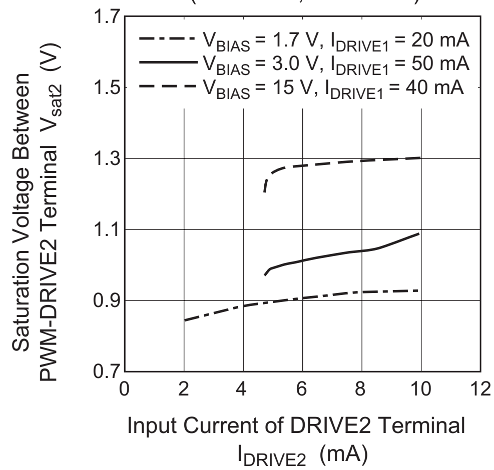
Saturation Voltage Between PWM-DRIVE1
Terminal vs. Input Current of DRIVE1 Terminal
(I_{DRIVE2} = 5 mA, IN = 1.1 V, Ta = 25°C)



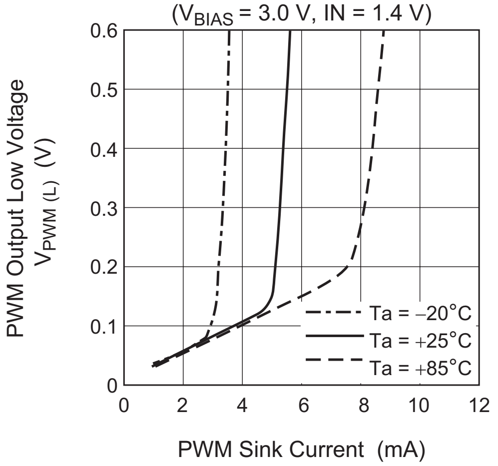
Saturation Voltage Between PWM-DRIVE1 Terminal vs. Input Current of DRIVE1 Terminal (V_{BIAS} = 3.0 V, IN = 1.1 V, Ta = 25°C)



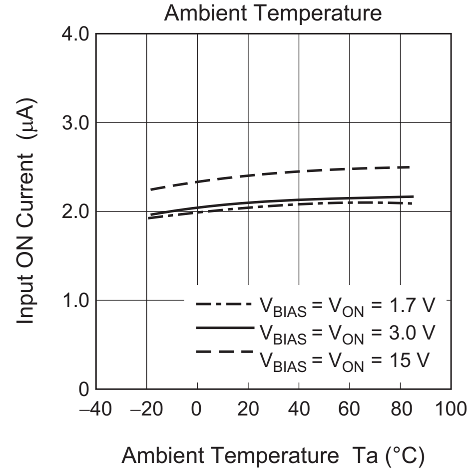
Saturation Voltage Between PWM-DRIVE2 Terminal vs. Input Current of DRIVE2 Terminal (IN = 1.1 V, Ta = 25°C)



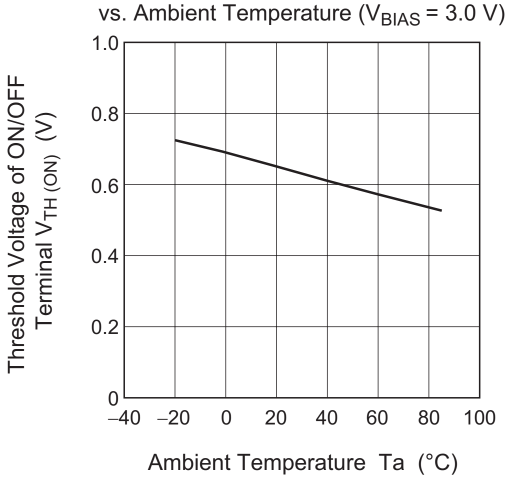
PWM Output Low Voltage vs. PWM Sink Current (V_{BIAS} = 3.0 V, IN = 1.4 V)



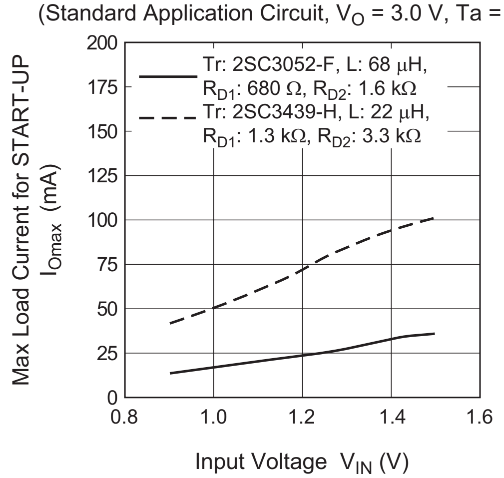
Input ON Current vs. Ambient Temperature



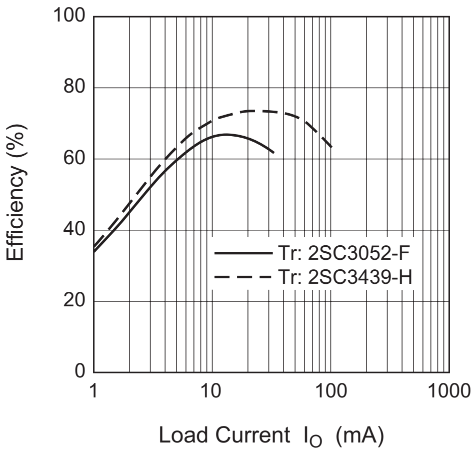
Threshold Voltage of ON/OFF Terminal vs. Ambient Temperature (V_{BIAS} = 3.0 V)



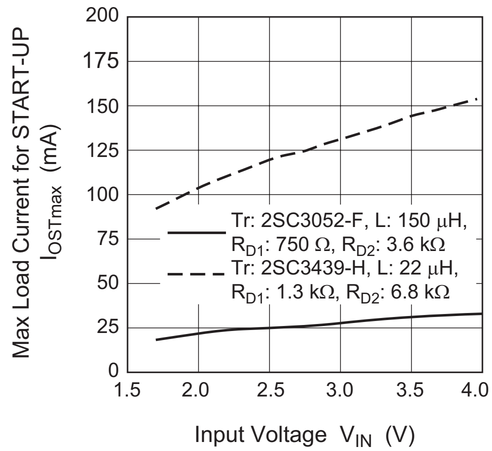
Max Load Current for START-UP(*1) vs. Input Voltage (Standard Application Circuit, V_O = 3.0 V, Ta = 25°C)



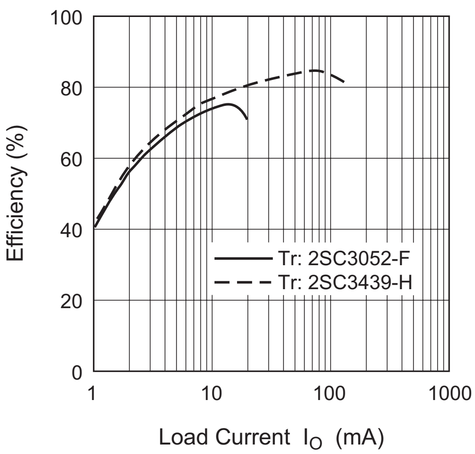
Efficiency vs. Load Current
(Standard Application circuit:
V_{IN} = 1.5 V, V_O = 3.0 V, Ta = 25°C)



Max Load Current for START-UP (*2)
vs. Input Voltage
(Application circuit1: V_O = 5.0 V, Ta = 25°C)



Efficiency vs. Load Current
(Application circuit1:
V_{IN} = 3.0 V, V_O = 5.0 V, Ta = 25°C)



note: 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: h_{FE} = 250 to 500, 2SC3439-H: h_{FE} = 600 to 1200)

Equation for Constants Calculation

Constants	Standard Application Circuit	Application Circuit 1	Application Circuit 2
$\frac{T_{ON}}{T_{OFF}}$	$\frac{V_O + V_F - V_{IN}}{V_{IN} - V_{CE\,(sat)}}$	$\frac{V_O + V_F - V_{IN}}{V_{IN} - V_{CE\,(sat)}}$	$\frac{V_O + V_F - V_{IN}}{V_{IN} - V_{CE\,(sat)}}$
$T_{ON} + T_{OFF}$	$\frac{1}{f_{OSC}}$	$\frac{1}{f_{OSC}}$	$\frac{1}{f_{OSC}}$
$T_{OFF\,(MIN)}$	$\frac{T_{ON} + T_{OFF}}{1 + \frac{T_{ON}}{T_{OFF}}}$	$\frac{T_{ON} + T_{OFF}}{1 + \frac{T_{ON}}{T_{OFF}}}$	$\frac{T_{ON} + T_{OFF}}{1 + \frac{T_{ON}}{T_{OFF}}}$
$T_{ON\,(MAX)}$	$\frac{1}{f_{OSC}} - T_{OFF\,(MIN)}$	$\frac{1}{f_{OSC}} - T_{OFF\,(MIN)}$	$\frac{1}{f_{OSC}} - T_{OFF\,(MIN)}$
Ipk	$2 \times \left(1 + \frac{T_{ON}}{T_{OFF}}\right) \times (I_O + I_B)$	$2 \times \left(1 + \frac{T_{ON}}{T_{OFF}}\right) \times I_O$	$2 \times \left(1 + \frac{T_{ON}}{T_{OFF}}\right) \times I_O$
$L_{(MIN)}$	$\frac{(V_{IN} - V_{CE\,(sat)})^2 \times T_{ON\,(MAX)}{}^2 \times f_{OSC}}{2 \times V_O \times (I_O + I_B)}$	$\frac{(V_{IN} - V_{CE\,(sat)})^2 \times T_{ON\,(MAX)}{}^2 \times f_{OSC}}{2 \times V_O \times I_O}$	$\frac{(V_{IN} - V_{CE\,(sat)})^2 \times T_{ON\,(MAX)}{}^2 \times f_{OSC}}{2 \times V_O \times I_O}$
R1	$\left(\frac{V_O}{V_{REF}} - 1\right) \times R2$	$\left(\frac{V_O}{V_{REF}} - 1\right) \times R2$	$\left(\frac{V_O}{V_{REF}} - 1\right) \times R2$
R_{D1}	$\frac{V_O - (V_{BE} + V_{sat1})}{(Ipk/h_{FE}) \times A1}$	$\frac{V_O - (V_{BE} + V_{sat1})}{(Ipk/h_{FE}) \times A1}$	$\frac{V_{IN} - (V_{BE} + V_{sat1})}{(Ipk/h_{FE}) \times A1}$
R_{D2}	$\frac{V_O - (V_{BE} + V_{sat2})}{(Ipk/h_{FE}) \times A2}$	$\frac{V_O - (V_{BE} + V_{sat2})}{(Ipk/h_{FE}) \times A2}$	$\frac{V_{IN} - (V_{BE} + V_{sat2})}{(Ipk/h_{FE}) \times A2}$

Constants	STEP-DOWN Circuit
$\frac{T_{ON}}{T_{OFF}}$	$\frac{V_O + V_F}{V_{IN} - V_{CE\,(sat)} - V_O}$
$T_{ON} + T_{OFF}$	$\frac{1}{f_{OSC}}$
$T_{OFF\,(MIN)}$	$\frac{T_{ON} + T_{OFF}}{1 + \frac{T_{ON}}{T_{OFF}}}$
$T_{ON\,(MAX)}$	$\frac{1}{f_{OSC}} - T_{OFF\,(MIN)}$
Ipk	$2 \times I_O$
$L_{(MIN)}$	$\frac{(V_{IN} - V_{CE\,(sat)} - V_O) \times T_{ON\,(MAX)}}{\Delta I_O}$
R1	$\left(\frac{V_O}{V_{REF}} - 1\right) \times R2$
R_{D1}	$\frac{V_O - V_{BE} - V_{sat1}}{Ipk/h_{FE}}$
R_{D2}	$\frac{V_{IN} - V_{sat2}}{(Ipk/h_{FE}) \times A3}$

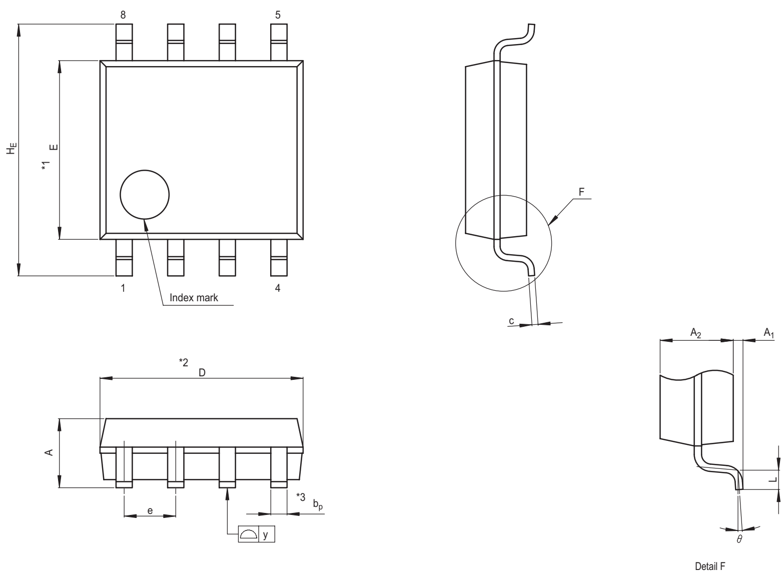
Note:

V_F: Forward voltage of external diode.
$V_{CE\,(sat)}$: Saturation voltage of external transistor.
V_{BE}: Voltage between Base - Emitter of external transistor.
h_{FE}: h_{FE} 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 kΩ ~ several 10ths kΩ.
- Set current into DRIVE2 terminal more than 100 μA.
  $(Ipk / h_{FE}) \times A2 \geq 100$ μA, $(Ipk / h_{FE}) \times A3 \geq 100$ μA
- Set ΔI_O 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 Ipk.

Package Dimensions

JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-SOP8-4.4x5-1.27	PRSP0008DA-A	8P2S-A	0.07g



NOTE)
1. DIMENSIONS "*1" AND "*2" DO NOT INCLUDE MOLD FLASH.
2. DIMENSION "*3" DOES NOT INCLUDE TRIM OFFSET.

Reference Symbol	Dimension in Millimeters		
	Min	Nom	Max
D	4.8	5.0	5.2
E	4.2	4.4	4.6
A_2	—	1.5	—
A_1	0.05	—	—
A	—	—	1.9
b_p	0.35	0.4	0.5
c	0.13	0.15	0.2
θ	0°	—	10°
H_E	5.9	6.2	6.5
e	1.12	1.27	1.42
y	—	—	0.1
L	0.2	0.4	0.6

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Colophon .7.0