

■ Description

The FA7616P(N) is a bipolar control IC having two channels of PWM-type switching regulator control circuits. With this IC, a DC-to-DC converter can be easily implemented for a minimum input voltage of 1.4V.

■ Features

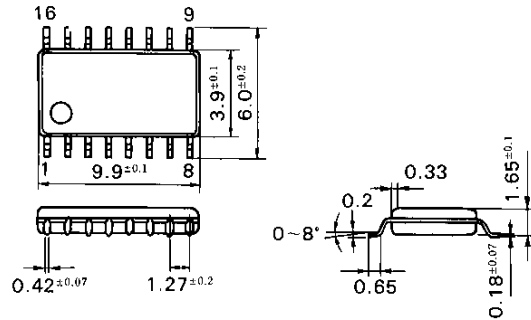
- Input voltage from 1.4V ($V_{CC} = 1.4$ to 12V)
- Open-collector output
- Wide operating frequency range (fosc: 10 to 500kHz)
- Output ON/OFF control function
- Not many external discrete components are needed

■ Applications

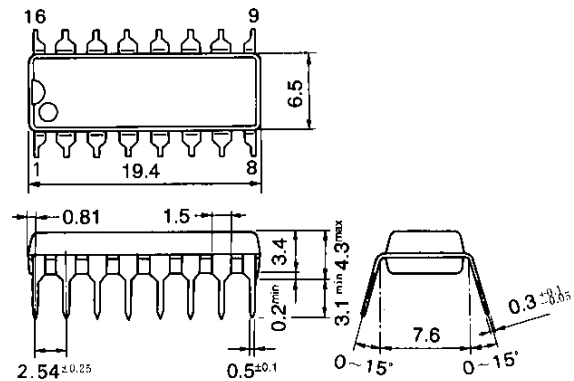
- Battery power supply (two, 1.5V batteries) for portable equipment

■ Dimensions, mm

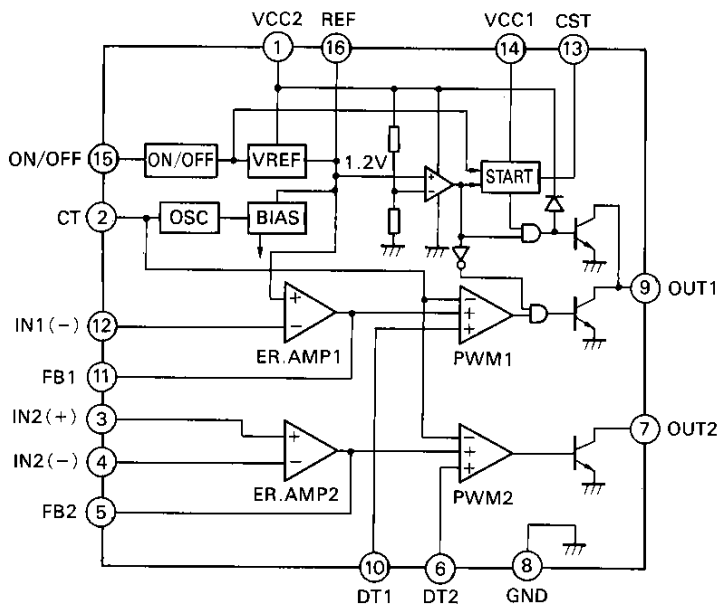
● SOP-16



● DIP-16



■ Block diagram



Pin No.	Pin symbol	Description
1	VCC2	IC main power supply
2	CT	Oscillator timing capacitor
3	IN2 (+)	Non-inverting input to error amplifier
4	IN2 (-)	Inverting input to error amplifier
5	FB2	Error amplifier output
6	DT2	Dead time adjustment
7	OUT2	CH. 2 Output
8	GND	Ground
9	OUT1	CH. 1 Output
10	DT1	Dead time adjustment
11	FB1	Error amplifier output
12	IN1 (-)	Inverting input to error amplifier
13	CST	Start-up circuit timing capacitor
14	VCC1	Start-up circuit power supply
15	ON/OFF	Output ON/OFF control
16	REF	Reference voltage output (1.20V)

■ Absolute maximum ratings

Item	Symbol	Rating	Unit
Supply voltage	V _{CC}	12	V
Reference voltage output current	I _{OR}	5	mA
Output sink current	I _O	10	mA
Total power dissipation	P _d	300	mW
Operating temperature	T _{opr}	-20 to +85	°C
Storage temperature	T _{stg}	-40 to +150	°C

■ Recommended operating conditions

Item	Symbol	Min.	Max.	Unit
Supply voltage 1	V _{CC1}	1.4	12	V
Supply voltage 2	V _{CC2}	2.5	12	V
Output sink current (at start-up)	I _{SINK}		3	mA
Output sink current (at steady state)	I _{SINK}		5	mA
Oscillation frequency	f _{osc}	10	500	kHz
Oscillator timing capacitor (start-up circuit)	C _{ST}	47	10,000	pF
Oscillator timing capacitor	C _T	220	10,000	pF
Oscillator timing resistance	R _T	4.7	47	kΩ
Feedback resistance	R _{NF}	100		kΩ

■ Electrical characteristics (T_a = 25°C, V_{CC1} = 1.6V, V_{CC2} = 3V, V₁₅ = 2V, C_T = 1000pF, R_T = 10kΩ)

Reference voltage section

Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Output voltage	V _{REF}	I _{OR} = 0.1mA	1.14	1.20	1.26	V
Line regulation	LINE	V _{CC} = 2.5 to 12V, V ₁₅ = 2V fixed		1	8	mV
Load regulation	LOAD	I _{OR} = 0.1 to 1mA		1	8	mV
Output voltage variation due to temperature change	V _{TC1}	T _a = -20 to +25°C I _{OR} = 0.1mA	-2	-0.3	1	%
	V _{TC2}	T _a = +25 to +85°C I _{OR} = 0.1mA	-2	-0.6	1	%

Oscillator unit

Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Oscillation frequency	f _{osc}	C _T = 1000pF, R _T = 10kΩ	80	92	110	kHz
Frequency variation 1 (due to supply voltage change)	f _{dV}	V _{CC} = 2.5 to 12V		1	3	%
Frequency variation 2 (due to temperature change)	f _{dT}	T _a = -20 to +85°C		2		%

Error amplifier section

Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Input offset voltage	V _{IO}			2	10	mV
Input bias current	I _B				1	μA
Common-mode input voltage	V _{CM}		0		V _{CC2} -1.7	V
Open-loop voltage gain	A _v		70			dB
Unity-gain bandwidth	G _B			1.0		MHz
Maximum output voltage	V _{OM+}	R _{NF} = 100kΩ	V _{CC2} -0.5			V
	V _{OM-}	R _{NF} = 100kΩ			200	mV
Output source current	I _{OM+}	V _{OM} = 1V	40	85	170	μA

PWM comparator section

Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Input threshold voltage	V _{TH0}	Duty cycle = 0%		0.80		V
Input threshold voltage	V _{TH100}	Duty cycle = 100%		1.45		V

Dead time adjustment circuit section

Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Input threshold voltage	$V_{TH\ DT0}$	Duty cycle = 0%	0.08	0.15		V
Input threshold voltage	$V_{TH\ DT100}$	Duty cycle = 100%		0.80	0.95	V

Output ON/OFF circuit section

Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
OFF-to-ON threshold voltage	$V_{TH\ ON}$		0.5	0.9	1.2	V
Input current	$I_{i\ ON}$	Pin 15 = 2V		650	850	μA

Start-up circuit

Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Oscillation frequency	fsc	$C_{ST} = 1000pF, V_{CC2} = 0.5V$	70	95	115	kHz
ON duty cycle	DST	$C_{ST} = 1000pF, V_{CC2} = 0.5V$	40	50	60	%
Threshold voltage to stop	$V_{CC2\ TH}$	ON-to-OFF threshold voltage at start-up circuit	2.15	2.30	2.45	V

Output section

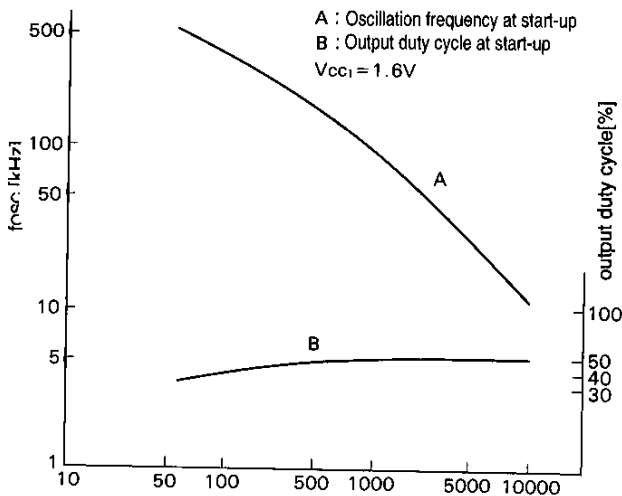
Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Output leakage current	I_{LEAK}	$V_O = 12V$			5	μA
L-level output voltage	V_{OL}	Output sink current = 5mA		0.25	0.55	V

Overall device

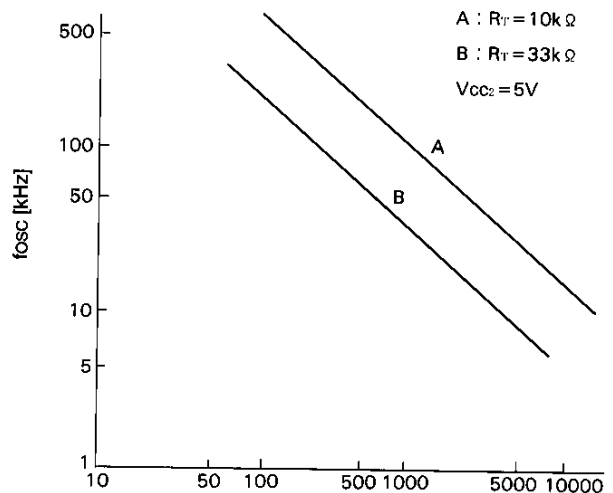
Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Standby current 1	$I_{CC\ ST1}$	Pin 15 = 0V or $V_{CC2} > 2.45V$		0.1	10	μA
Standby current	$I_{CC\ STAR}$	Pin 15 = 2V, $V_{CC2} < 2.15V$		400	800	μA
Standby current 2	$I_{CC\ ST2}$	Pin 15 = 0V, $V_{CC2} = 3V$		0.4	0.7	mA
Operating-state supply current	$I_{CC\ AV}$	Pin 15 = 2V, $V_{CC2} = 3V$		2.2	3.2	mA

■ Characteristic curves (Ta = 25°C)

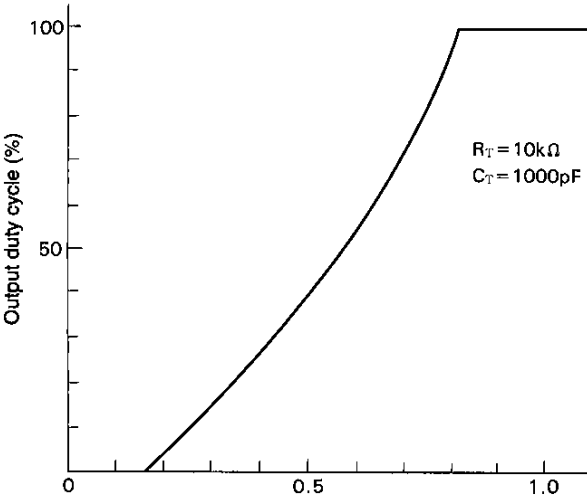
Oscillation frequency (fosc) vs. timing capacitor capacitance and output duty cycle
At start-up state



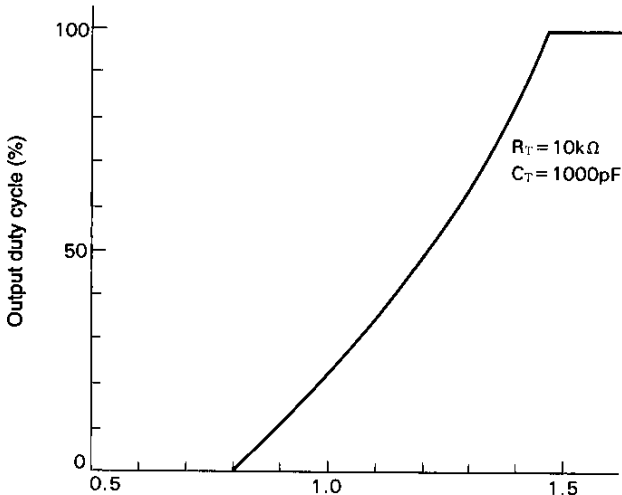
Oscillation frequency (fosc) vs. timing capacitor capacitance
At steady state



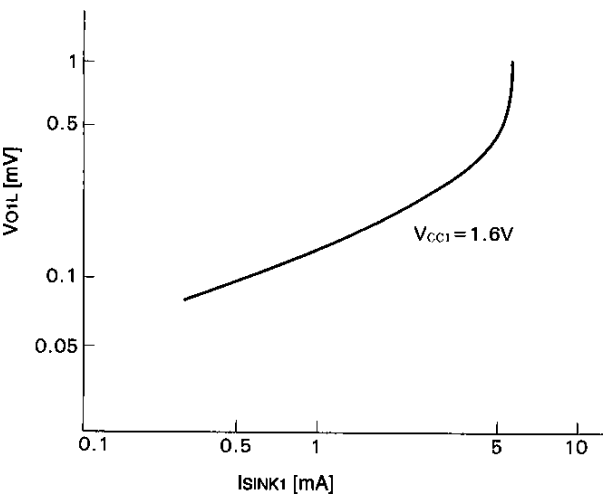
Output duty cycle vs. DT terminal voltage (VDT)



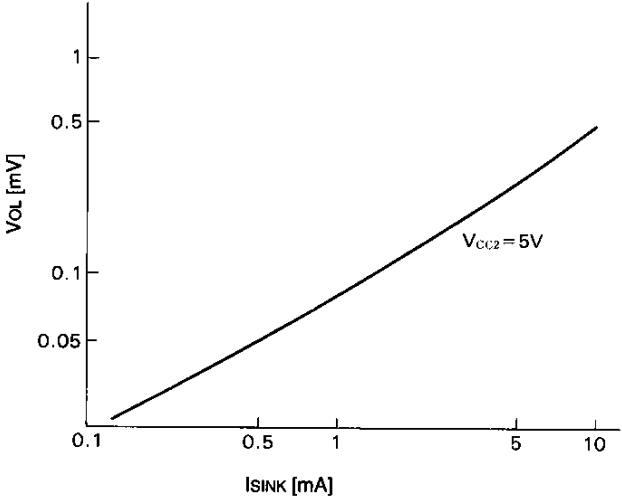
Output duty cycle vs. FB terminal voltage (VFB)



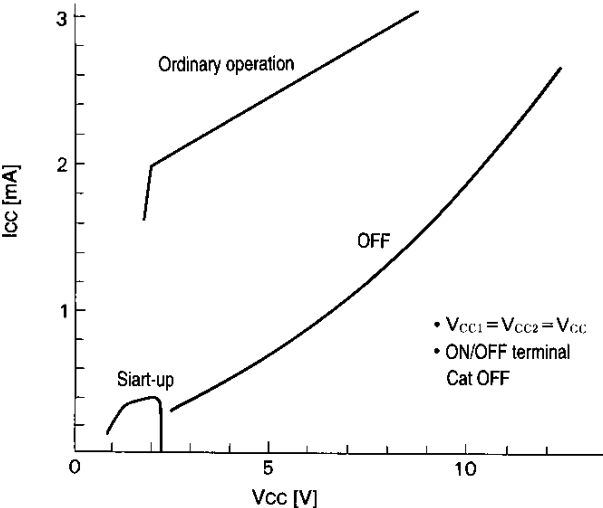
L-level output voltage (VO1L) vs. CH. 1 output sink current (ISINK1) At start-up state



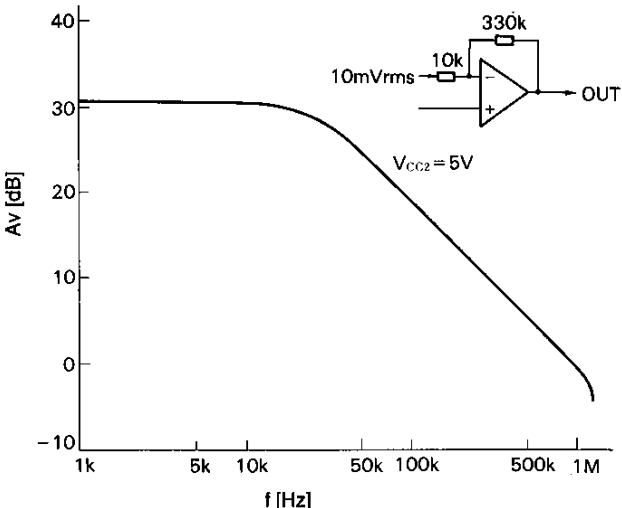
L-level output voltage (VOL) vs. output sink current (ISINK) At steady state



Supply current (Icc) vs. supply voltage (Vcc)

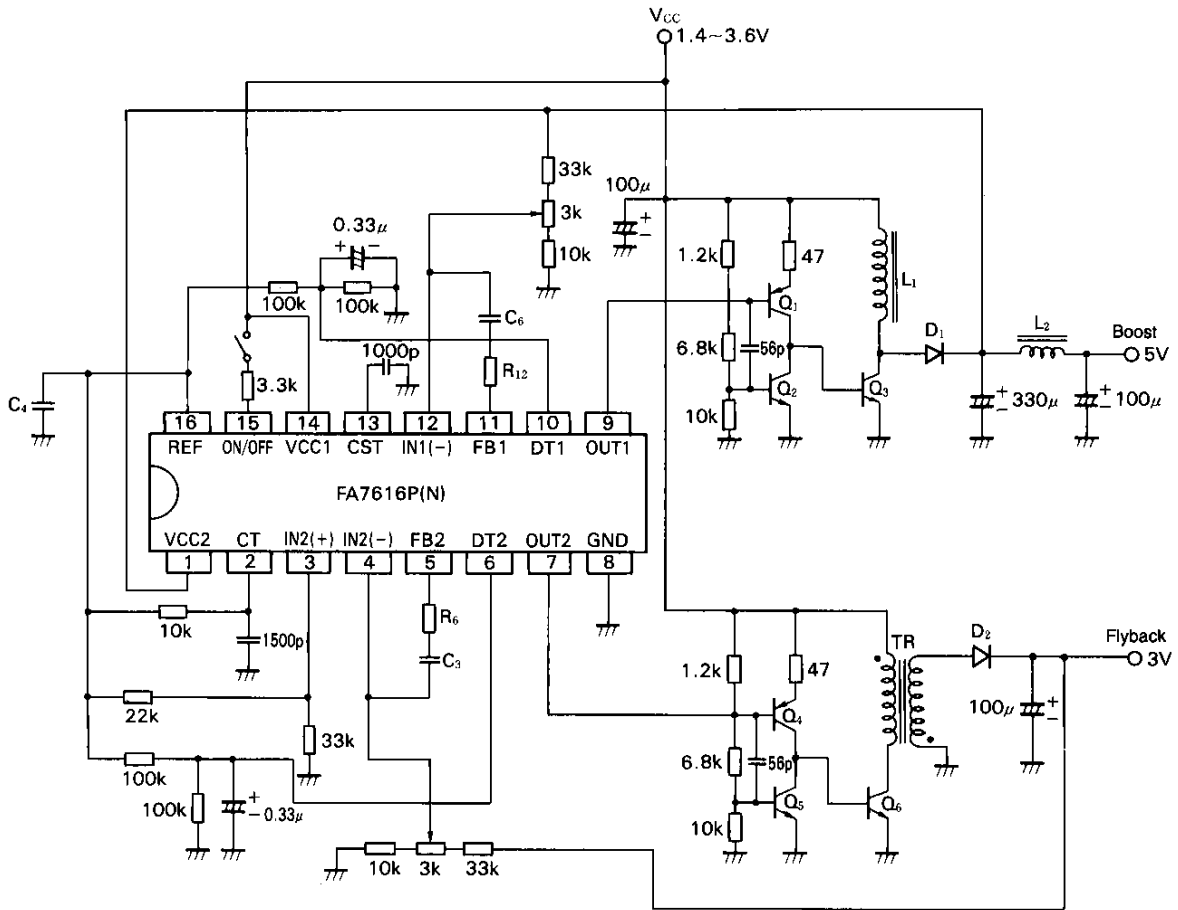


Error amplifier frequency (f) vs. voltage gain (Av)



■ Application circuit

- Flyback-transformer type and chopper type boost converter circuit



Parts tolerances characteristics are not defined in the circuit design sample shown above. When designing an actual circuit for a product, you must determine parts tolerances and characteristics for safe and economical operation.

CAUTION

1. This Data Book contains the product specifications, characteristics, data, materials, and structures as of July 1995. The contents are subject to change without notice for specification changes or other reasons. When using a product listed in this Data Book, be sure to obtain the latest specifications.
2. All applications described in this Data Book exemplify the use of Fuji's products for your reference only. No right or license, either express or implied, under any patent, copyright, trade secret or other intellectual property right owned by Fuji Electric Co., Ltd. is (or shall be deemed) granted. Fuji makes no representation or warranty, whether express or implied, relating to the infringement or alleged infringement of other's intellectual property rights which may arise from the use of the applications described herein.
3. Although Fuji Electric is enhancing product quality and reliability, a small percentage of semiconductor products may become faulty. When using Fuji Electric semiconductor products in your equipment, you are requested to take adequate safety measures to prevent the equipment from causing a physical injury, fire, or other problem if any of the products become faulty. It is recommended to make your design fail-safe, flame retardant, and free of malfunction.
4. The products introduced in this Data Book are intended for use in the following electronic and electrical equipment which has normal reliability requirements.
 - Computers • OA equipment • Communications equipment (terminal devices) • Measurement equipment
 - Machine tools • Audiovisual equipment • Electrical home appliances • Personal equipment • Industrial robots etc.
5. If you need to use a product in this Data Book for equipment requiring higher reliability than normal, such as for the equipment listed below, it is imperative to contact Fuji Electric to obtain prior approval. When using these products for such equipment, take adequate measures such as a backup system to prevent the equipment from malfunctioning even if a Fuji's product incorporated in the equipment becomes faulty.
 - Transportation equipment (mounted on cars and ships) • Trunk communications equipment
 - Traffic-signal control equipment • Gas leakage detectors with an auto-shut-off feature
 - Emergency equipment for responding to disasters and anti-burglary devices • Safety devices
6. Do not use products in this Data Book for the equipment requiring strict reliability such as (without limitation)
 - Space equipment • Aeronautic equipment • Atomic control equipment
 - Submarine repeater equipment • Medical equipment
7. Copyright ©1995 by Fuji Electric Co., Ltd. All rights reserved.
No part of this Data Book may be reproduced in any form or by any means without the express permission of Fuji Electric.
8. If you have any question about any portion in this Data Book, ask Fuji Electric or its sales agents before using the product. Neither Fuji nor its agents shall be liable for any injury caused by any use of the products not in accordance with instructions set forth herein.