

FA5301BP(N)

Bipolar IC
For Switching Power Supply Control

■ Description

The FA5301BP(N) is a bipolar IC containing basic circuits necessary for PWM-type switching power supply control. This IC switches an external transistor according to external synchronizing pulses.

■ Features

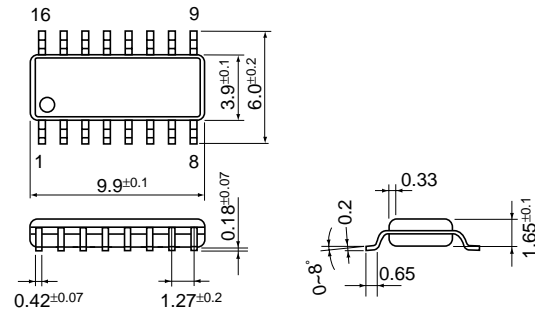
- External synchronization input terminal
- Wide supply voltage range ($V_{CC} = 7$ to $22V$)
- Open-collector output
- Soft-start from standby mode
- Double protection of output transistor by overcurrent limiting and cutoff functions
- Output ON/OFF control function
- Not many external discrete components needed

■ Applications

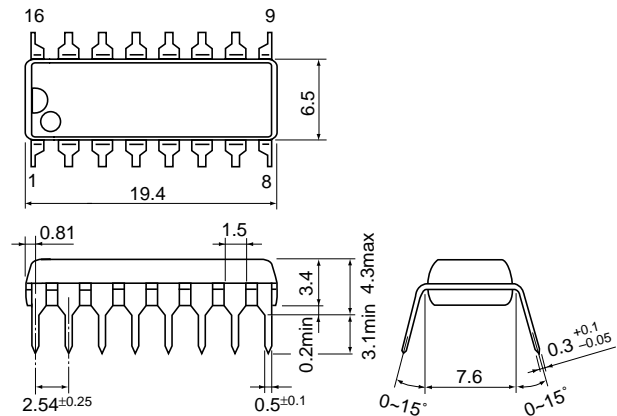
- Switching power supply for general equipment (Optimum for TV, display, and other monitor devices)

■ Dimensions, mm

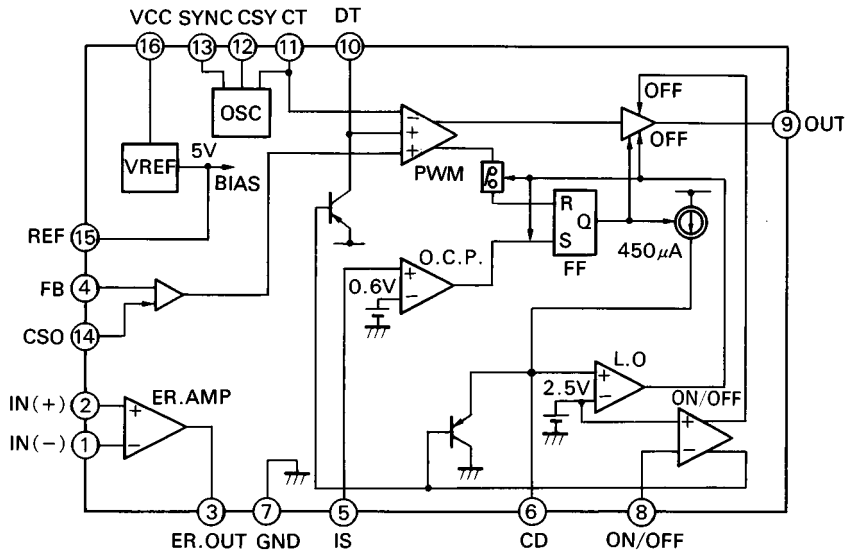
● SOP-16



● DIP-16



■ Block diagram



Pin No.	Pin symbol	Description
1	IN (-)	Inverting input to error amplifier
2	IN (+)	Non-inverting input to error amplifier
3	ER.OUT	Error amplifier output
4	FB	Feedback input
5	IS	Overcurrent detection
6	CD	Overcurrent cutoff delay capacitor
7	GND	Ground
8	ON/OFF	Output ON/OFF control
9	OUT	Output
10	DT	Dead time adjustment
11	CT	Oscillator timing capacitor
12	CSY	External synchronizing signal detection capacitor
13	SYNC	External synchronization input
14	CSO	PWM soft-start capacitor
15	REF	Reference voltage output (5V)
16	VCC	Power supply

■ Absolute maximum ratings

Item	Symbol	Rating	Unit
Supply voltage	V _{CC}	22	V
Output voltage	V _O	22	V
Error amplifier output current	I _{OM}	5	mA
Error amplifier input voltage	V _I	5	V
Overcurrent detection terminal input voltage	V _{IS}	20	V
Feedback terminal input voltage	V _{FB}	20	V
Output ON/OFF terminal input voltage	V _{ON/OFF}	6	V
Synchronizing terminal input voltage	V _{SYNC}	6	V
Total power dissipation	P _d	1000 (DIP-16) *1	mW
		400 (SOP-16) *2	
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	V _{CC}	7	20	V
Error amplifier input voltage	V _I	0	V _{REF-2}	V
Output current	I _O		20	mA
Error amplifier feedback resistor	R _{NF}	33		kΩ
Oscillator timing capacitor	C _T	100	10,000	pF
Oscillator timing resistor	R _T	8.2	220	kΩ
Free run oscillation frequency	f _{OSC}	1	200	kHz
Synchronized frequency	f _{SYNC}	1	200	kHz
Frequency ratio $\frac{f_{OSC} - f_{SYNC}}{f_{SYNC}} *3$	CSY=OV	-35	-5	%
	CSY: Capacitor is connected to GND	-30	+10	%

Notes:

*1 Derating factor Ta > 25°C : 10.0mW/°C (on PC board)

*2 Derating factor Ta > 25°C : 4.0mW/°C (on PC board)

*3 Consider the tolerance of $\frac{f_{OSC} - f_{SYNC}}{f_{SYNC}}$

■ Electrical characteristics (Ta = 25°C, V_{CC} = 9V, R_T = 47kΩ, C_T = 1000pF)

Reference voltage section

Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Output voltage	V _{REF}	I _{OR} = 1mA	4.75	5.00	5.25	V
Line regulation	LINE	V _{CC} = 8 to 20V		10	25	mV
Load current regulation	LOAD	I _{OR} = 0.1 to 2mA		10	25	mV
Output voltage variation by temperature fluctuation	V _{TC1}	Ta = -20 to +25°C		1		%
	V _{TC2}	Ta = +25 to +85°C		1		%
Output current at output short-circuit	I _{OS}			25		mA

Oscillator section

Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Oscillation frequency	f _{OSC}	C _T = 1,000pF, R _T = 47kΩ	20	21	22	kHz
Frequency variation by line voltage fluctuation	f _{dV}	V _{CC} = 8 to 20V			2	%
Frequency variation by temperature fluctuation	f _{dt1}	Ta = +25 to -20°C	-2		+2	%
	f _{dt2}	Ta = +25 to +85°C	-2		+2	%
Input current to synchronizing signal terminal	I _{SYNC1}	V _{SYNC} = 1V		300	600	μA
	I _{SYNC2}	V _{SYNC} = -0.5V		-60	-300	μA
Input current to synchronizing signal detection terminal	I _{CSY1}	Pin 12 = 0V, V _{SYNC} = -0.5V	-65	-130	-260	μA
	I _{CSY2}	Pin 12 = 1V, V _{SYNC} = 1V		200	400	μA
Threshold voltage of synchronizing signal detection terminal	V _{TH CSY}			0.7	1.0	V

Error amplifier section

Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Input offset voltage	V _{IO}		-10		10	mV
Input bias current	I _I				1	μA
Common-mode input voltage	V _{CM}		0		V _{REF-2}	V
Open-loop voltage gain	A _V		70	95		dB
Unity-gain bandwidth	G _B			0.8		MHz
Common-mode signal rejection ratio	CMRR			80		dB
Maximum output voltage	V _{OM+}	I _{OM} = -50μA		4		V
	V _{OM-}	I _{OM} = 50μA			0.5	V
Output sink current	I _{OM-}	V _{OM} = 1V	170	240		μA

PWM comparator section

Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Input bias current (Pin 4)	I _{BFB}	V _{FB} = 1V		-2.0	-10.0	μA
Input threshold voltage (Pin 4)	V _{TH0}	Duty cycle = 0%		3.3		V
	V _{TH100}	Duty cycle = 100%		0.2		V
Soft-start signal pin input current	I _{CSO}	Pin 14 = 3V, V _{FB} = 0V		2.0	10.0	μA

Dead time adjustment circuit section

Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Input bias current	I _{BDT}	Pin 10 = 1V		-0.5	-5	μA
Input threshold voltage	V _{TH DT0}	Duty cycle = 0%		3.2		V
	V _{TH DT100}	Duty cycle = 100%		0.1		V
Reset saturation voltage	V _{SAT RS}	Pin 10 = -100μA		0.25	0.8	V

Overcurrent limiting circuit section

Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Input bias current (Pin 5)	I _{BIS}	V _{IS} = 0.3V			-1	μA
Input threshold voltage (Pin 5)	V _{TH IS}		0.5	0.6	0.7	V
Source current of overcurrent cutoff terminal	I _{O CD}	Pin 6 = 0V, V _{IS} = 1V		-450	-700	μA
Latch-mode threshold voltage	V _{TH LA}		1.8	2.2	2.6	V
Reset saturation voltage (Pin 6)	V _{SAT RS}	Pin 6 = 100μA, V _{IS} = 0V		0.75	1.0	V

Output section

Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Output leakage current	I _{LEAK}	V _O = 22V, output OFF			10	μA
L-level output voltage	V _{OL}	I _O = 10mA		0.4	0.7	V
Output sink current limit	I _{SINK}	V _O = 3V	25	40	55	mA

Output ON/OFF control circuit section

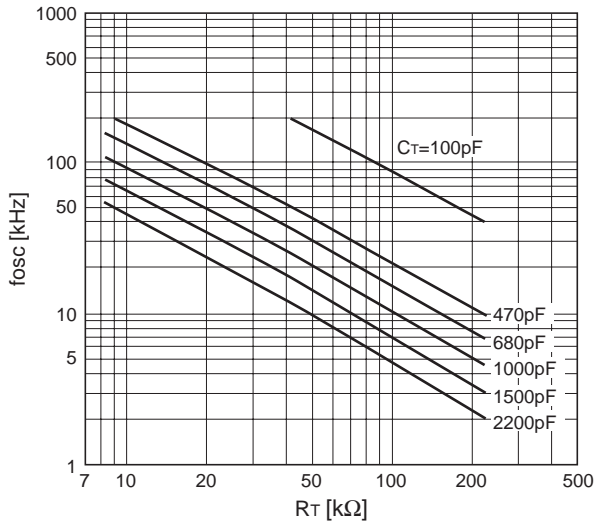
Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Input bias current (Pin 8)	I _{BON}	Pin 8 = 0V		-60	-300	μA
OFF-to-ON threshold voltage	V _{TH ON}	OFF→ON	2.13	2.50	2.87	V
ON-to-OFF threshold voltage	V _{TH OFF}	ON→OFF	1.96	2.30	2.64	V
Voltage hysteresis	V _{HYS}			0.2		V

Overall device

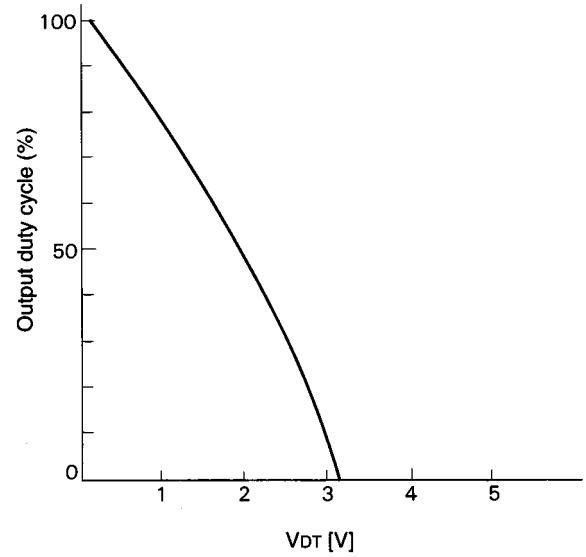
Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Supply current	I _{CC LA}	R _T = 47kΩ, latch mode		8.0	12.0	mA
Operating-state supply current	I _{CC AV}	R _T = 47kΩ, duty cycle = 50%		6.5	9.8	mA

■ Characteristic curves (Ta = 25°C)

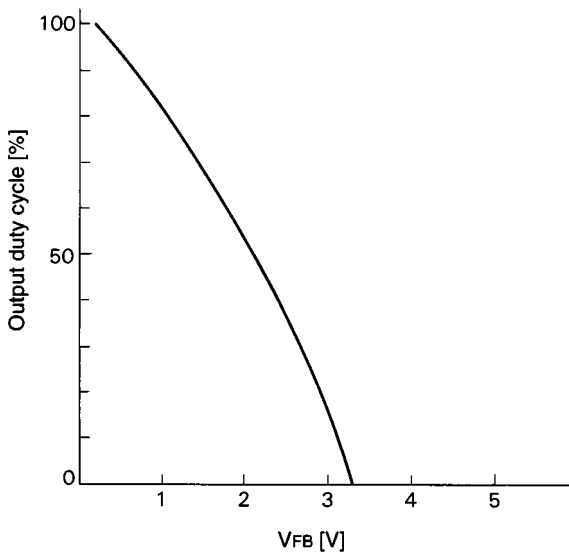
Oscillation frequency (fosc) vs. timing resistor resistance (RT)



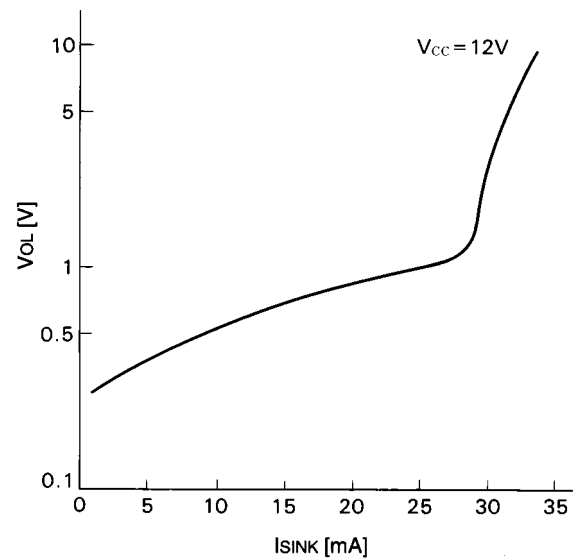
Output duty cycle vs. DT terminal voltage (VDT)



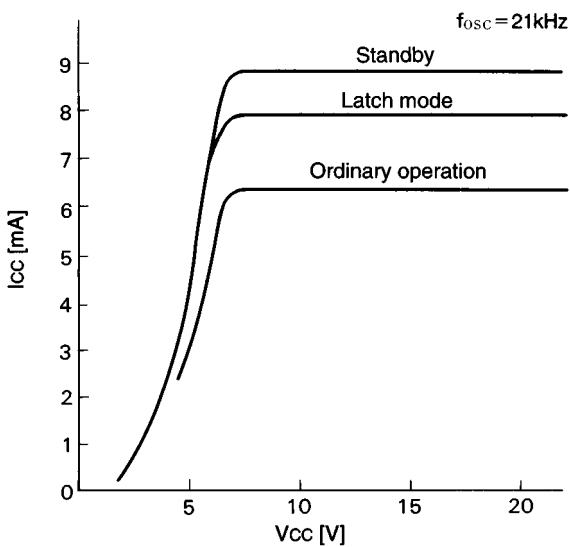
Output duty cycle vs. FB terminal voltage (VFB)



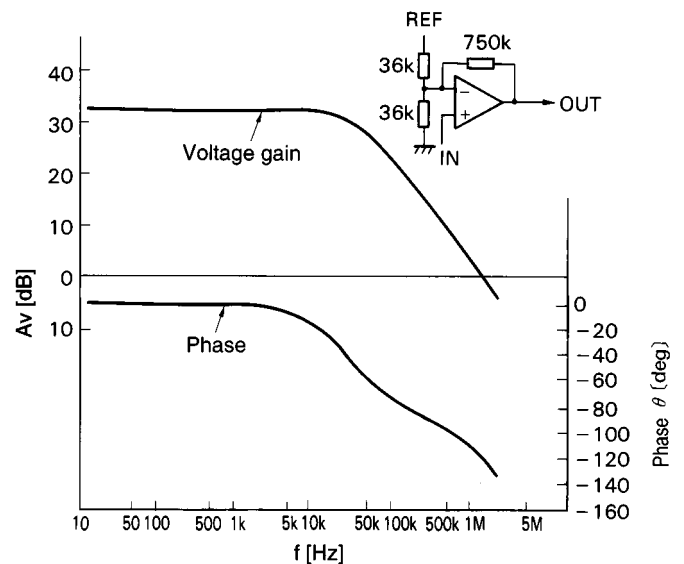
L-level output voltage vs. output sink current (ISINK)



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

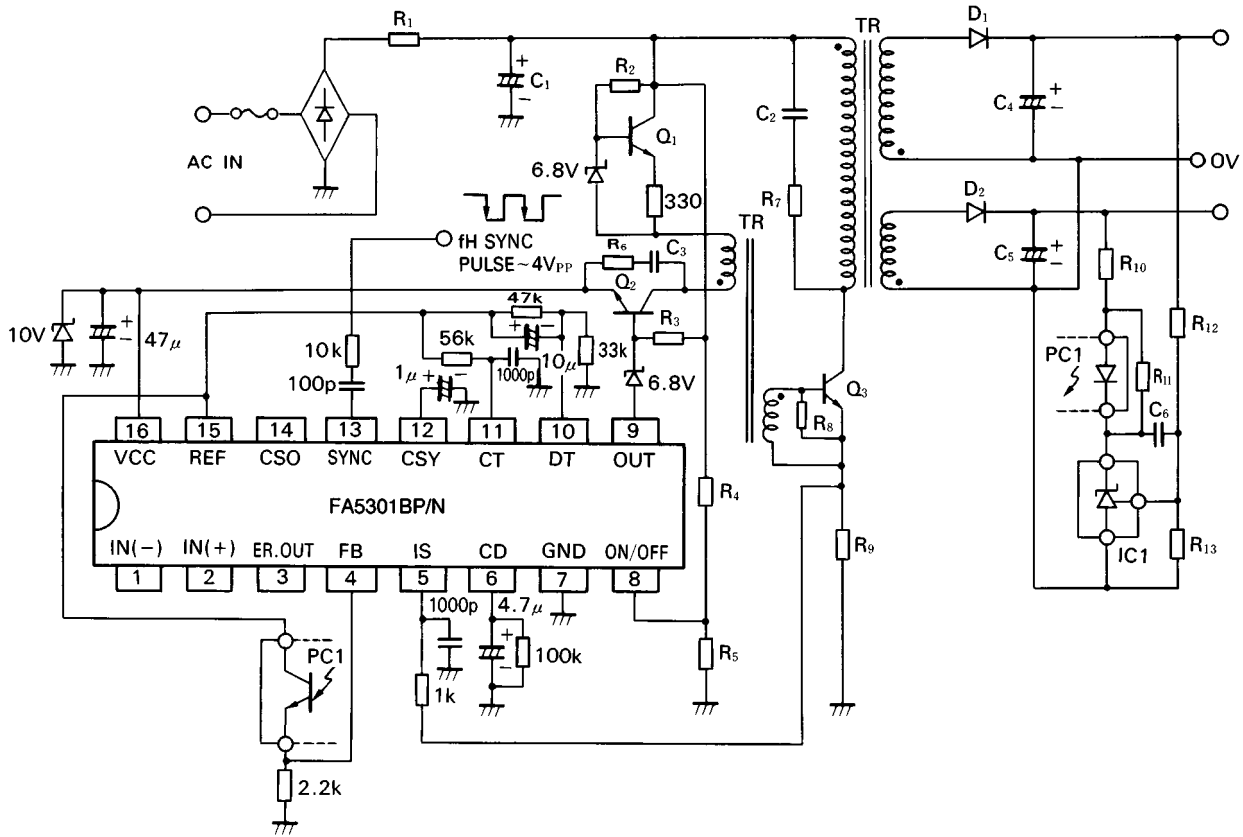


Error amplifier frequency (f) vs. voltage gain (Av) / phase (θ)



■ Application circuit

● Switching power supply (primary current control and insulated output type)



This circuit uses the following functions.

- Horizontal synchronizing function
- Overcurrent limiting function
- Overcurrent cutoff function
- Undervoltage input cutoff function
- Soft-start function

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.