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

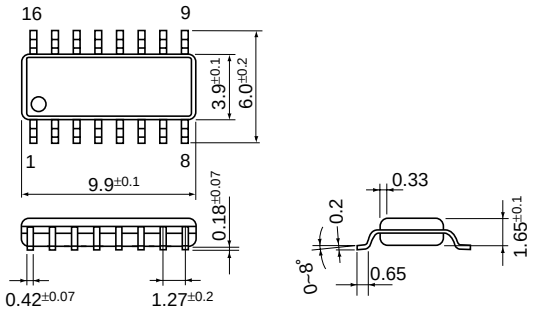
- External synchronization input terminal
- Wide supply voltage range (V_{CC} =7 to 22V)
- Open-collector output
- Soft-start from standby mode
- Double protection of output transistor by overcurrent limiting and cutoff functions
- Output ON/OFF control function
- Not many external discrete components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

■ Applications

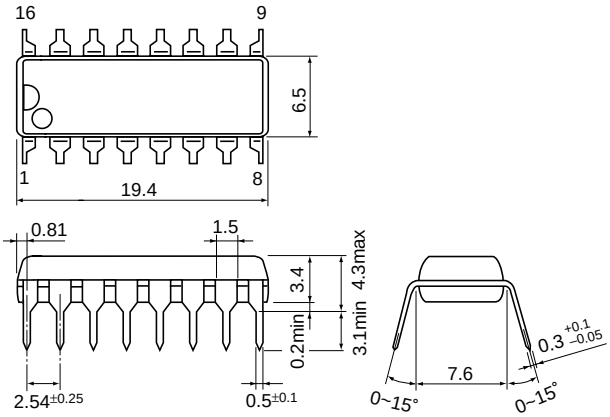
- Switching power supply for general equipment (Optimum for TV, display, and other monitor devices)

■ Dimensions, mm

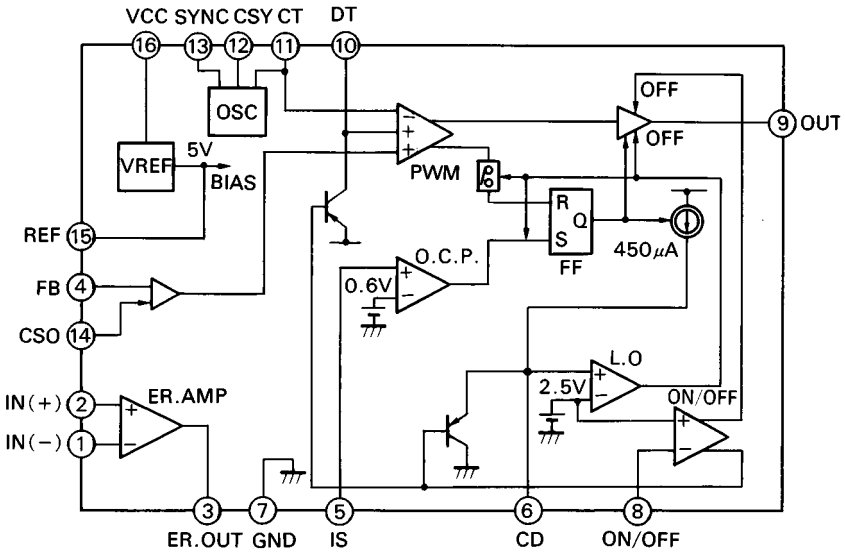
● SOP-16



● 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	CSY=OV	–35	–5	%
$\frac{f_{OSC} - f_{SYNC}}{f_{SYNC}}$ *3	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 $\frac{fosc - f_{SYNC}}{f_{SYNC}}$

■ 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	L_{INE}	V_{CC} = 8 to 20V		10	25	mV
Load current regulation	L_{OAD}	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

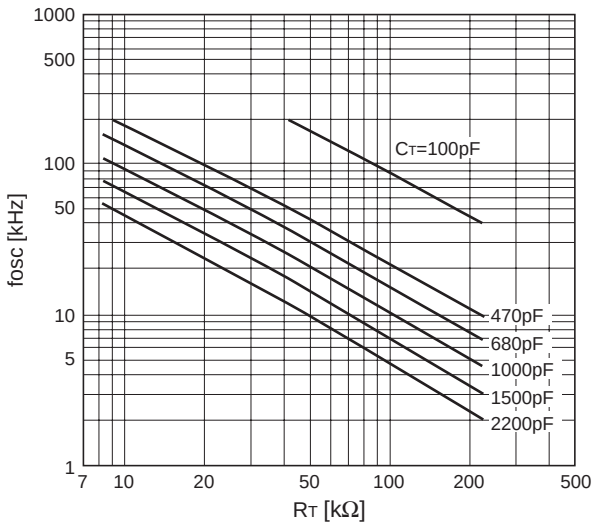
Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Input bias current (Pin 8)	I_{BON}	Pin 8 = 0V		–60	–300	μA
OFF-to-ON threshold voltage	$V_{TH\ ON}$	OFF→ON	2.13	2.50	2.87	V
ON-to-OFF threshold voltage	$V_{TH\ OFF}$	ON→OFF	1.96	2.30	2.64	V
Voltage hysteresis	V_{HYS}			0.2		V

Overall device

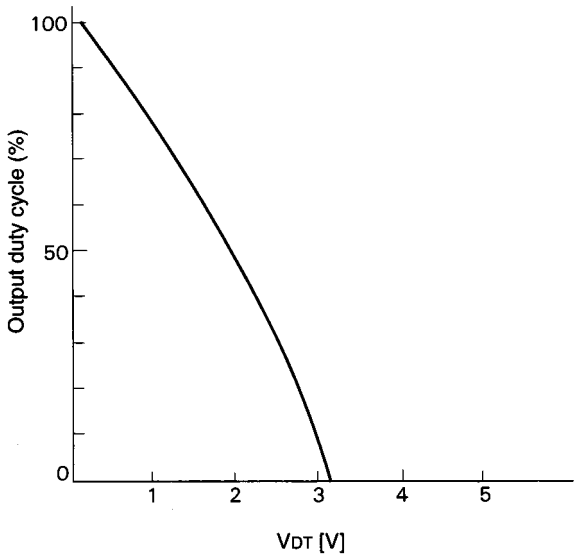
Item	Symbol	Test condition	Min.	Typ.	Max.	Unit
Supply current	$I_{CC\ LA}$	R_T = 47kΩ, latch mode		8.0	12.0	mA
Operating-state supply current	$I_{CC\ AV}$	R_T = 47kΩ, duty cycle = 50%		6.5	9.8	mA

■ Characteristic curves (Ta = 25°C)

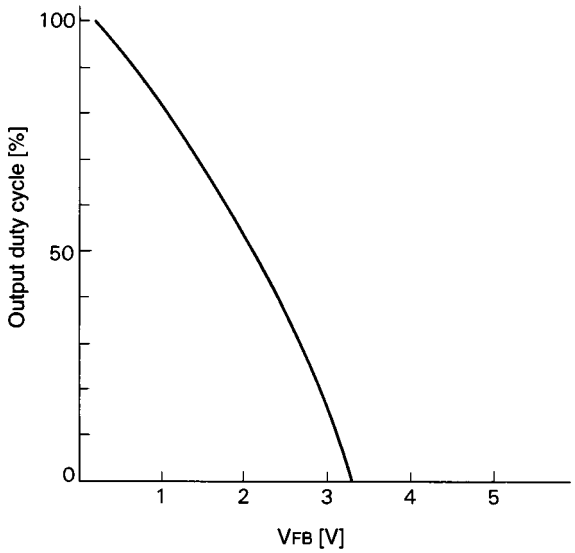
Oscillation frequency (fosc) vs. timing resistor resistance (RT)



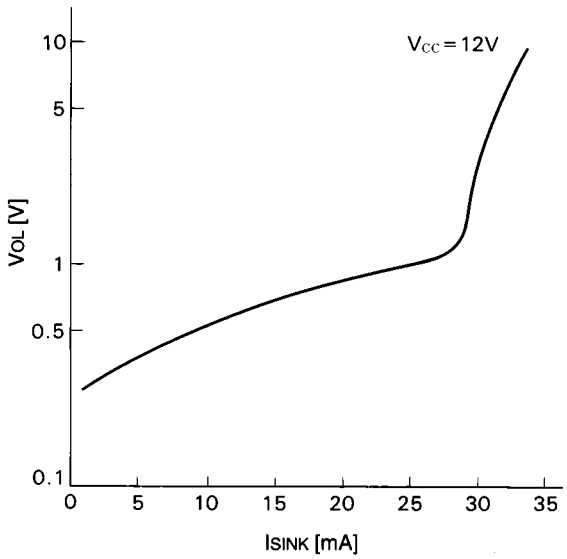
Output duty cycle vs. DT terminal voltage (VDT)



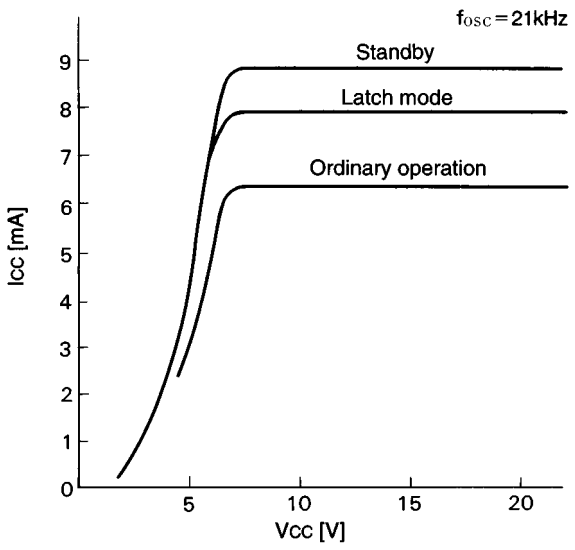
Output duty cycle vs. FB terminal voltage (VFB)



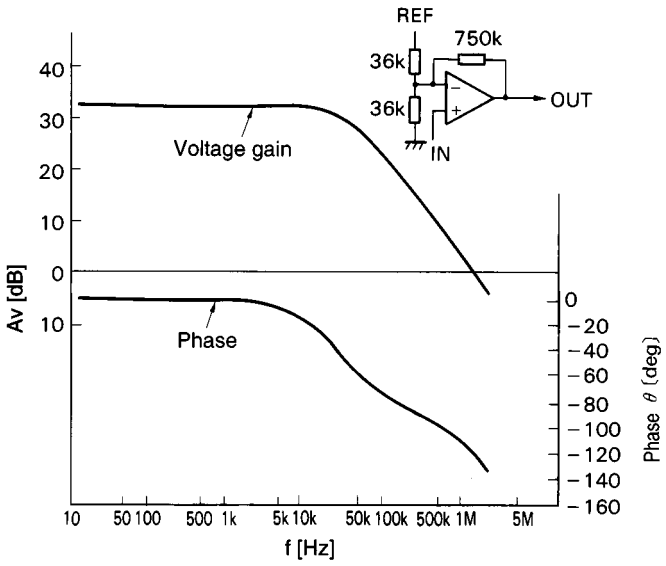
L-level output voltage vs. output sink current (ISINK)



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

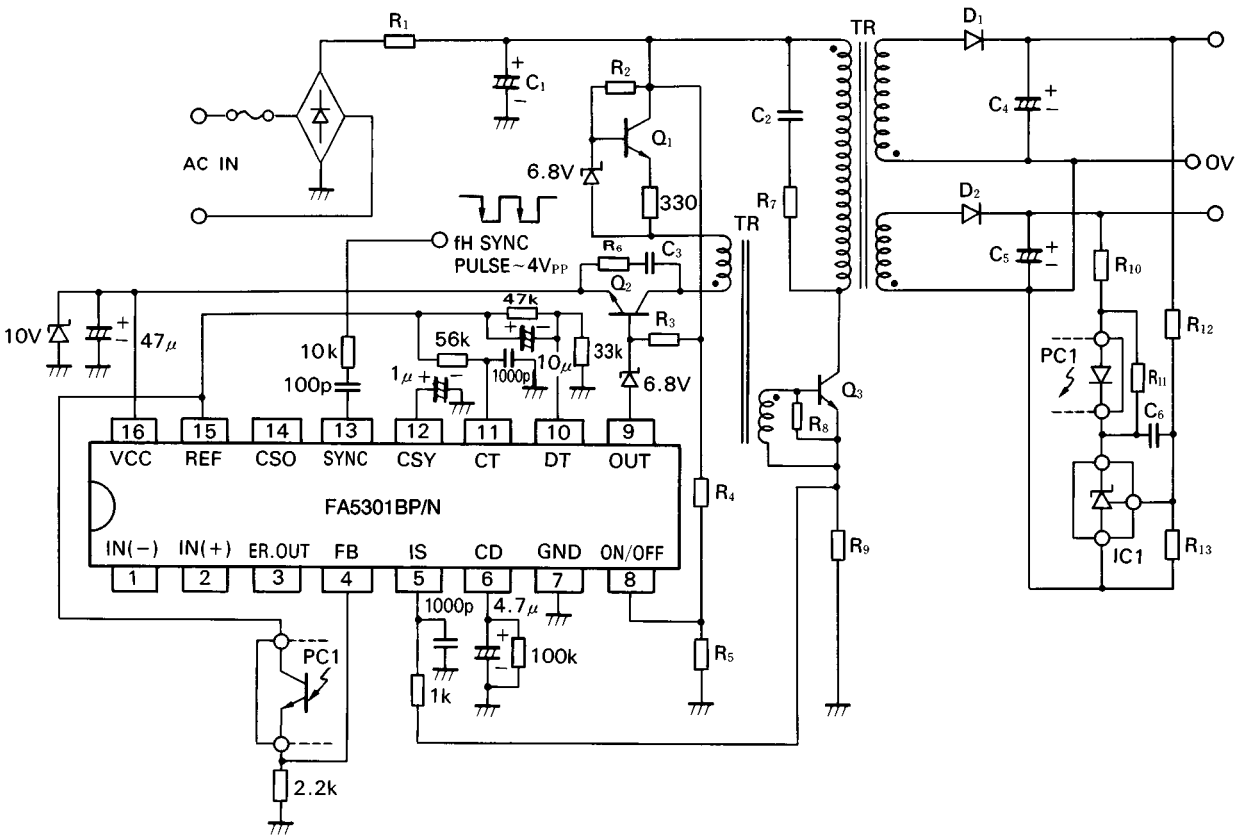


Error amplifier frequency (f) vs.voltage gain(Av)/ phase (θ)



■ 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.