

Switching Regulator Control Circuit

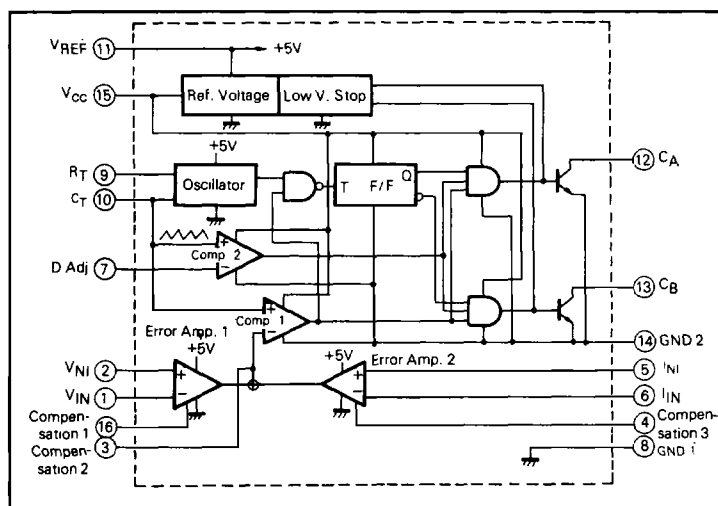
GENERAL DESCRIPTION

The μ PC1042 is an inverter control unit which provides all the control circuitry for PWM type switching regulators. The voltage reference, dual error amplifiers, oscillator, voltage comparator for pulse width modulation, pulse steering flip-flop, dual alternating output switches, and dead time adjustment are all included in this device. It can be used for fixed-frequency switching regulators such as forward type and push-pull type SMPS.

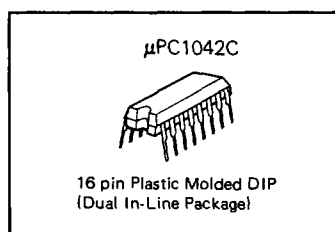
FEATURES

- Internal Oscillator has symmetrical triangular waveform
- Adjustable dead time (0 ~ 100%)
- Includes a Mis-Operation preventing circuit at low input voltage
- No double pulsing of each outputs, C_A and C_B
- Error Amp. II can operate 0 V input voltage level

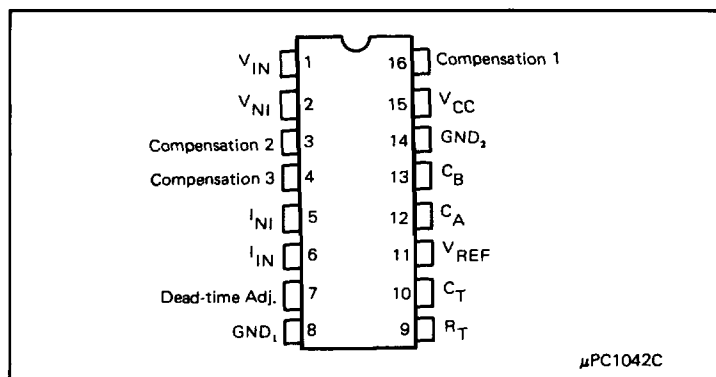
EQUIVALENT CIRCUIT



ORDERING INFORMATION



CONNECTION DIAGRAM (Top View)



ABSOLUTE MAXIMUM RATINGS (Ta = 25°C)

PARAMETER	SYMBOL	μPC1042C	UNIT
Supply Voltage	V _{CC}	30	V
Output Voltage	V _{CER}	40	V
Output Current (each output)	I _C	100	mA
Reference Output Current	I _{REF}	40	mA
Total Power Dissipation (Ta = 25°C)	P _T	800	mW
Operating Temperature Range	T _{opt}	−20 to +85	°C
Storage Temperature Range	T _{stg}	−40 to +125	°C

RECOMMENDED OPERATING CONDITIONS

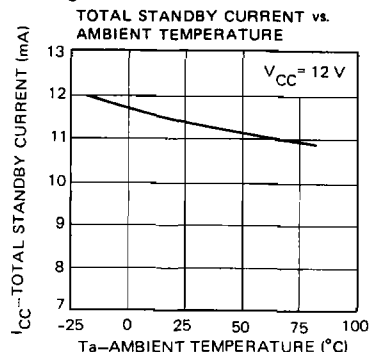
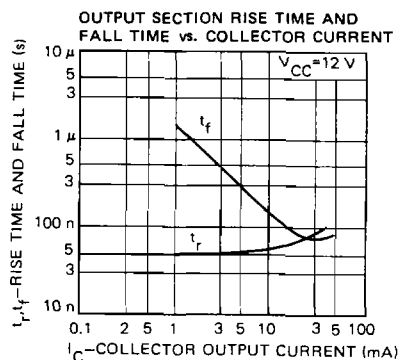
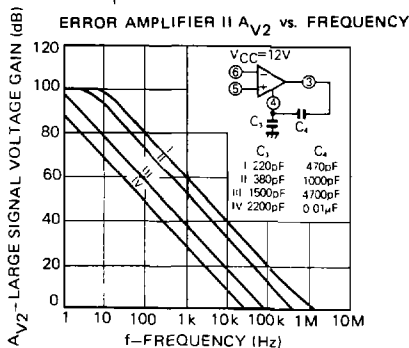
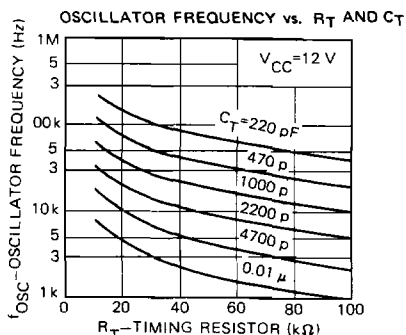
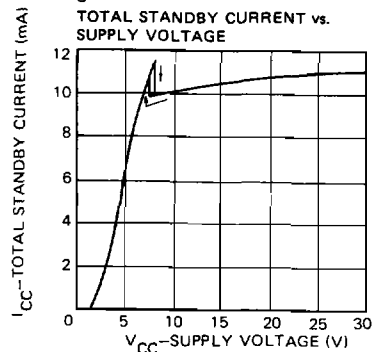
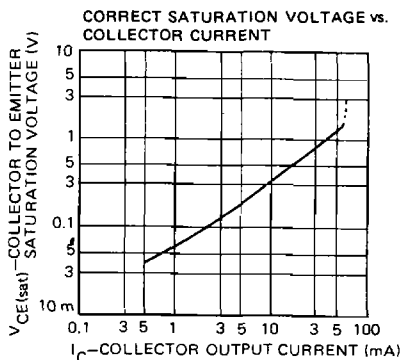
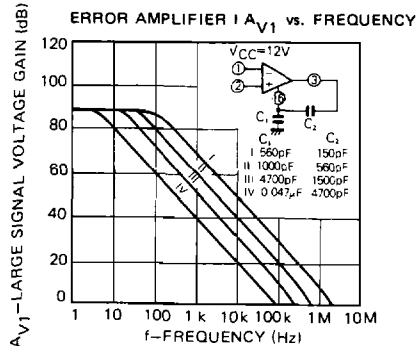
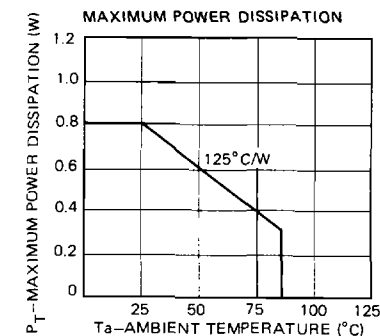
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V _{CC}	8	12	16	V
Output Voltage	V _{CER}		24	32	V
Output Current	I _C	5	20	40	mA
Reference Output Current	I _{REF}	0	3	5	mA
Oscillation Frequency	f _{OSC}	20	40	100	kHz

ELECTRICAL CHARACTERISTICS (V_{CC} = 12 V, Ta = 25°C unless otherwise noted)

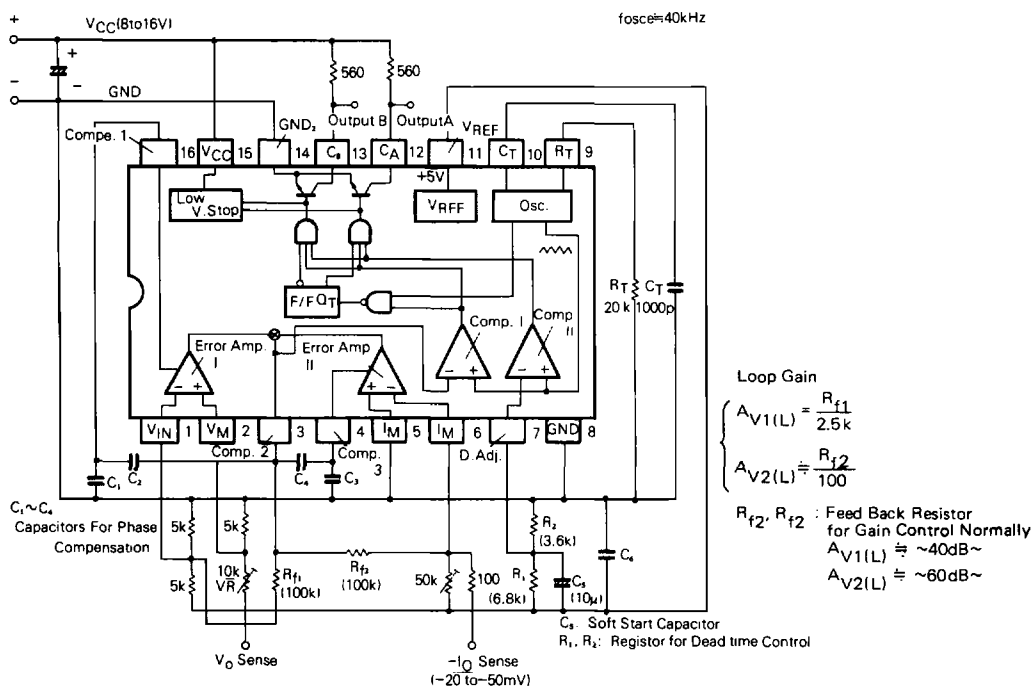
BLOCK	CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
Reference Section	Output Voltage	V _{REF}	4.6	5.0	5.4	V	I _{REF} =0
	Line Regulation	REG _{IN}		13	35	mV	8V<V _{CC} <20V, I _{REF} =0
	Load Regulation	REG _L		−2.5	−10	mV	0<I _{REF} <20mA
	Ripple Rejection			60		dB	f=120 Hz
	Temperature Coefficient	ΔV _{REF} /ΔT		200	750	μV/°C	−20°C<T _{opt} <+85°C
Low Voltage Stop Sec.	Start-up Voltage	V _{CC} (L to H)		7.5		V	0<V _{CC} <12 V
	Hysteresis Voltage	V _H		0.5		V	0<V _{CC} <12 V
Oscillator Section	Maximum Oscillation Frequency	f _{max}	100			kHz	
	Initial Accuracy			±5	±10	%	R _T , C _T constant
	Temperature Stability			−6	−10	%	−20°C<T _{opt} <+85°C
	Output Voltage (Hight)	V _O (H)		4		V	
	Output Voltage (Low)	V _O (L)		2		V	
	Line Frequency Stability			±1	±2	%	8 V<V _{CC} <20 V

BLOCK	CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
Error Amp. 1 Section	Input Offset Voltage	$V_{IO(1)}$		±2	±10	mV	
	$V_{IO(1)}$ Temperature Coefficient	$\Delta V_{IO(1)}/\Delta T$		±4	±10	μV/°C	-20°C ≤ T _{opt} ≤ +85°C
	Input Bias Current	I_{B1}		+1.3	+10	μA	
	Large Signal Voltage Gain	A_{V1}	72	87		dB	
	Common Mode Input Voltage		1.2		4.0	V	
	Common Mode Rejection Ratio	CMR ₁		70		dB	
	Small Signal Bandwidth	f_{01}		2		MHz	$A_{V1}=0$ dB, $C_1=560$ pF, $C_2=150$ pF
Error Amp. 2 Section	Input Offset Voltage	$V_{IO(2)}$		±3	±10	mV	
	$V_{IO(2)}$ Temperature Coefficient	$\Delta V_{IO(2)}/\Delta T$		±3	±10	μV/°C	-20°C ≤ T _{opt} ≤ +85°C
	Input Bias Current	I_{B2}		-1.5	-10	μA	
	Large Signal Voltage Gain	A_{V2}	72	100		dB	
	Common Mode Input Voltage		0		3	V	
	Common Mode Rejection Ratio	CMR ₂		70		dB	
	Small Signal Bandwidth	f_{02}		1.2		MHz	$A_{V2}=0$ dB, $C_3=220$ pF, $C_4=470$ pF
Dead time Adj. Section	Maximum Output Current	$I_{O(AMP)}$			1.0	mA	
	Input Bias Current	I_{B3}		-4.5		μA	
	Input Voltage (0% duty)	$V_{D(0)}$		1.35		V	
Output Section	Input Voltage (100% duty)	$V_{D(100)}$		3.3		V	
	Collector to Emitter Voltage	V_{CER}	40			V	$I_C=1$ mA
	Collector to Emitter Cutoff Current	I_{CER}			10	μA	$V_{CE}=40$ V
	Collector Saturation Voltage	$V_{CE(sat)}$		0.55	0.7	V	$I_C=20$ mA
	Rise Time	t_r		80		ns	$I_C=20$ mA
	Fall Time	t_f		70		ns	$V_{CC}=12$ V, $R_L \approx 560 \Omega$
Total Standby Current		I_{CC}		12	15	mA	$V_{CC}=20$ V, $I_{REF}=0$

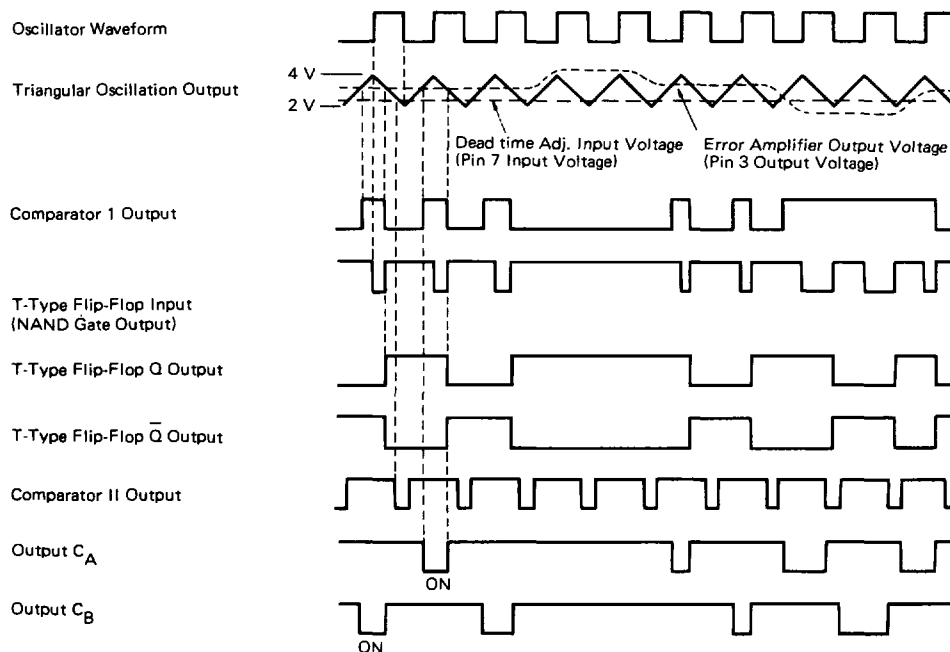
TYPICAL PERFORMANCE CHARACTERISTICS ($T_a = 25 \pm 2^\circ\text{C}$)



APPLICATION



INTERNAL WAVEFORMS (TIMING CHARTS)



PRECAUTIONS FOR OPERATION**1. Common Mode Input Voltage Range of Error Amp. I**

C.M. voltage range of the Error Amp. I is from 1.2 V to 4.0 V.

Input terminals of the Error Amp. I (pin 1 or 2) must be given bias voltage in this range even if the Error Amp. I is not in use. (When the bias voltage is not given to them, the oscillator stops.)

2. Dead-time Adjustment Terminal (pin 7)

If dead-time adjust terminal is not in use, it must be connected to GND1 (pin 8).

3. Phase Compensation of Error Amplifiers.

Error Amp. I and II do not have internal phase compensation. So, when these Amps are used, external capacitors ($C_1 \sim C_4$) are necessary. (Without them, the Amp. will cause high frequency oscillation.)