

## SWITCHING REGULATOR CONTROL CIRCUIT FOR 500 kHz OPERATION

$\mu$ PC1099 is a control IC for the high performance switching power supply equipped with high speed/high sensitivity protection circuit. Control ICs for the high performance switching power supply have 3 series of  $\mu$ PC1099, 1905, 1906. The features of  $\mu$ PC1099 are as follows:

Low voltage start up (11 V TYP.) → Suited for flyback mode converter, DC-DC converter, etc.

### CONTROL IC FAMILY FOR THE HIGH PERFORMANCE SWITCHING POWER SUPPLY

PART NUMBER	SUPPLY VOLTAGE	START-UP THRESHOLD VOLTAGE	THRESHOLD HYSTERESIS	OVER CURRENT LATCH PROTECTION MODE
$\mu$ PC1099	26 V	11 V	3 V	Pulse by pulse current limiting
$\mu$ PC1905	31 V	16.5 V	6.5 V	Pulse by pulse current limiting
$\mu$ PC1906	31 V	16.5 V	6.5 V	Shut down and $V_{CC}$ reset

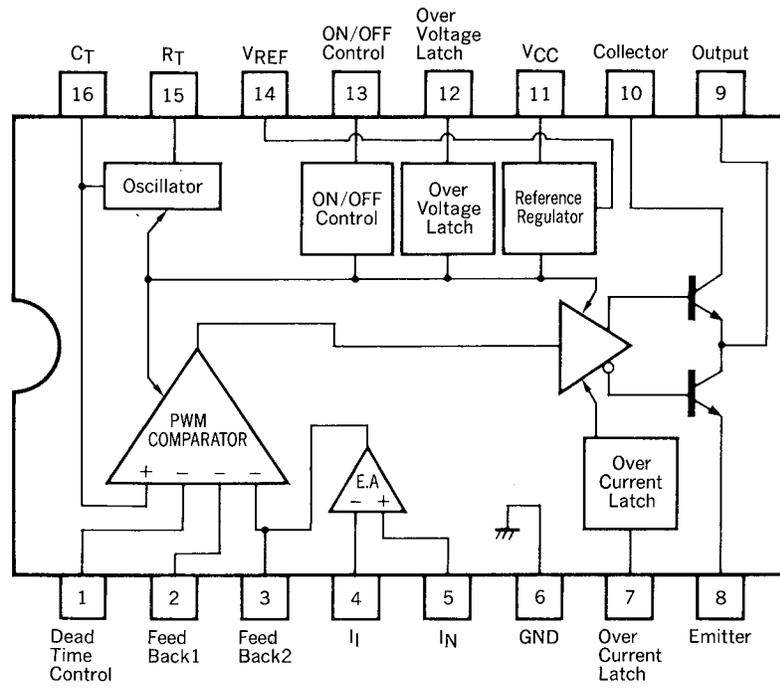
### FEATURES

- Directly drive power MOS FET (totem pole circuit adopted)
- Pulse by pulse over current latch circuit incorporated
- Over voltage latch circuit incorporated
- Under voltage lockout circuit incorporated
- Remote control circuit incorporated
- Error amplifier incorporated

PART NUMBER	PACKAGE	QUALITY GRADE
$\mu$ PC1099CX	16 pin plastic DIP (300 mil)	Standard
$\mu$ PC1099GS	16 pin plastic SOP (300 mil)	

Please refer to "Quality grade on NEC Semiconductor Devices" (Document number IEI-1209) published by NEC Corporation to know the specification of quality grade on the devices and its recommended applications.

PIN CONNECTION DIAGRAM (Top View)



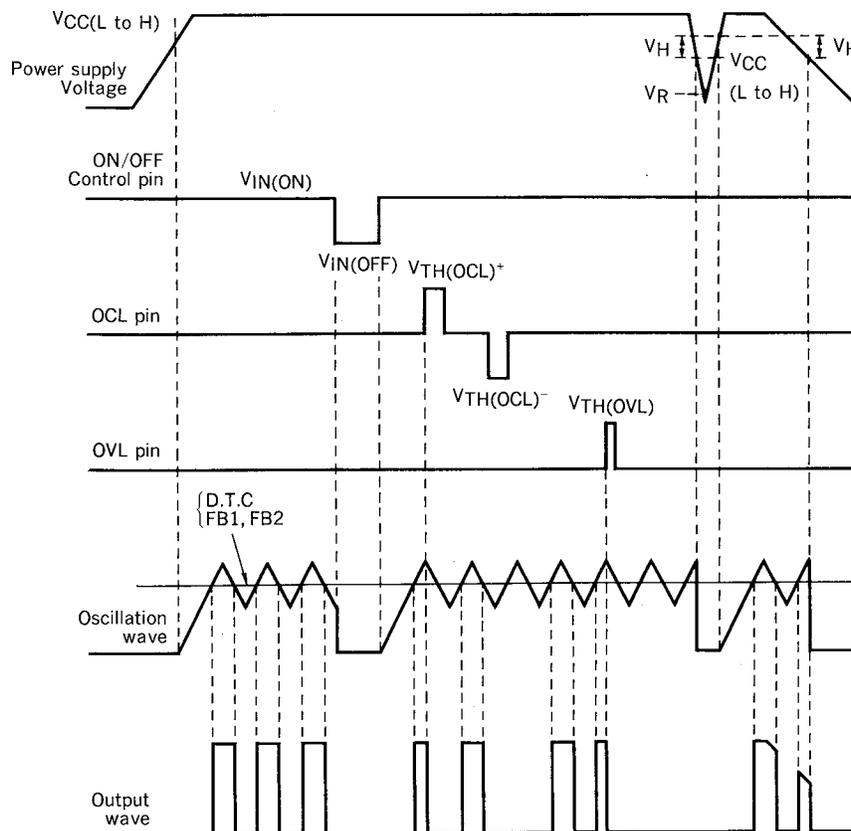
ABSOLUTE MAXIMUM RATING (T<sub>a</sub> = 25 °C)

PARAMETER		SYMBOL	RATING	UNIT
Supply Voltage		V <sub>CC</sub>	26	V
Output Voltage		V <sub>C</sub>	26	V
Output Current		I <sub>C(DC)</sub>	100	mA
Peak Output Current		I <sub>C(peak)</sub>	1.2	A
Total Power Dissipation	μPC1099CX	P <sub>T</sub> (T <sub>a</sub> = 25 °C)	1 000	mW
	μPC1099GS	P <sub>T</sub> (T <sub>a</sub> = 25 °C)	694	mW
Operation Temperature		T <sub>opt</sub>	-20 to +85	°C
Storage Temperature		T <sub>stg</sub>	-55 to +150	°C

RECOMMENDED OPERATION REQUIREMENTS

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V <sub>CC</sub>	11.5	15	24	V
Oscillation Frequency	f <sub>OSC</sub>	50	200	500	kHz
Output Load Capacitance	C <sub>L</sub>	—	2 200	3 000	pF

OPERATION WAVES

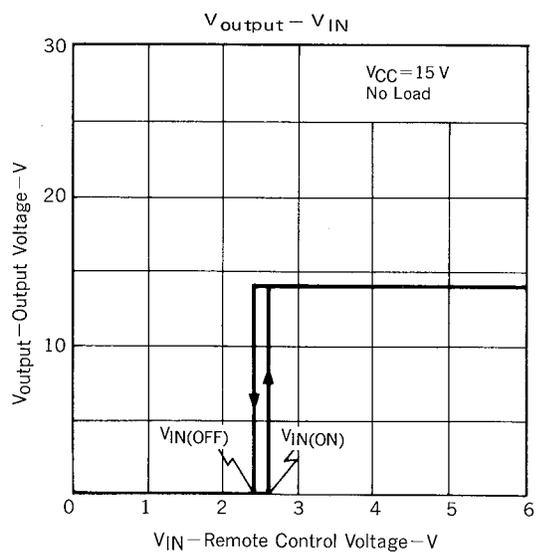
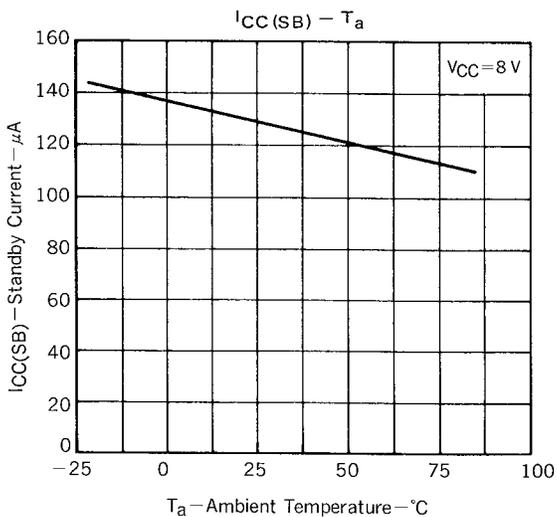
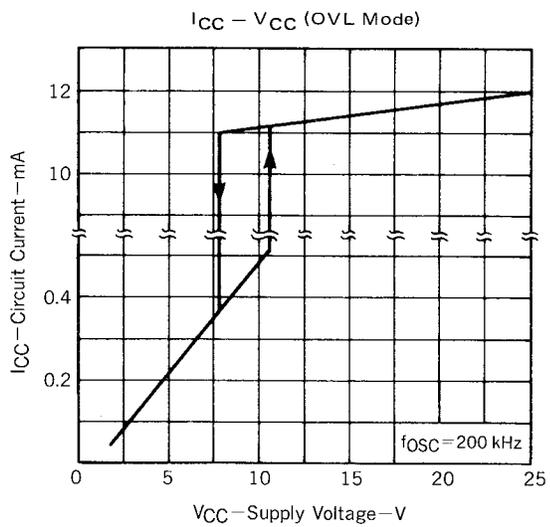
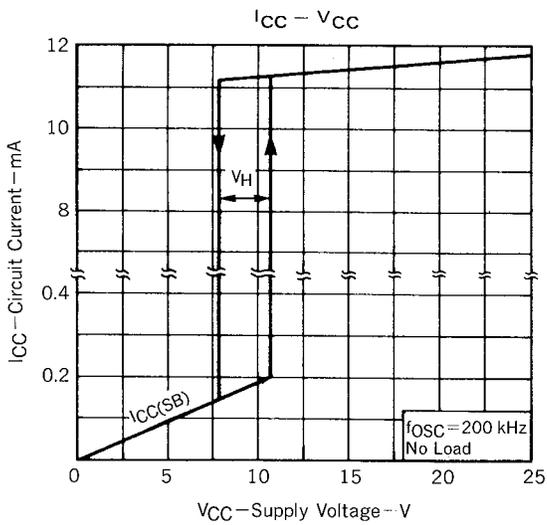
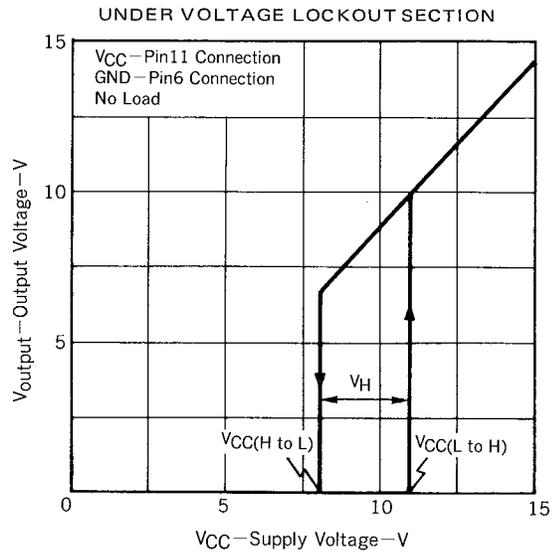
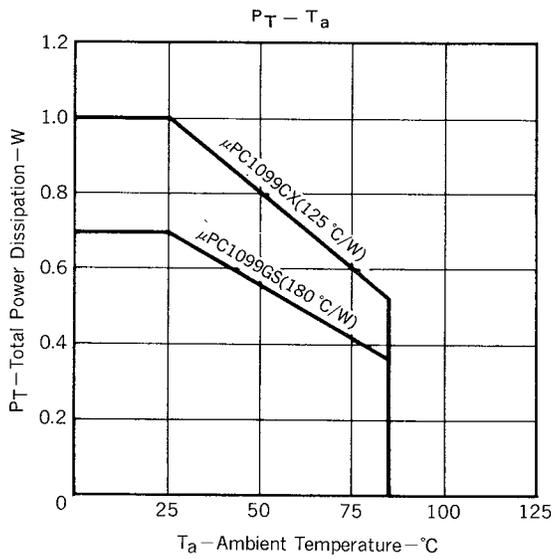


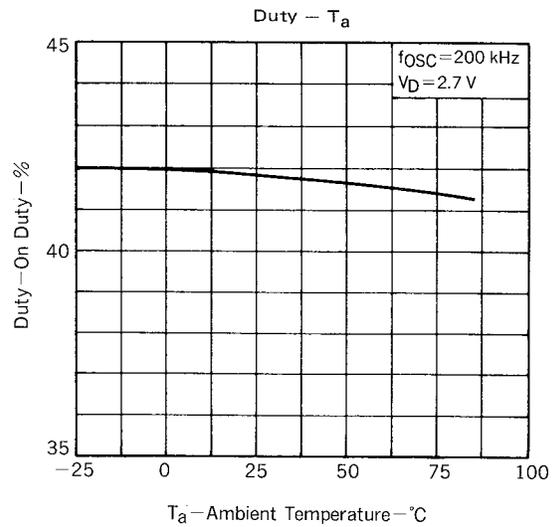
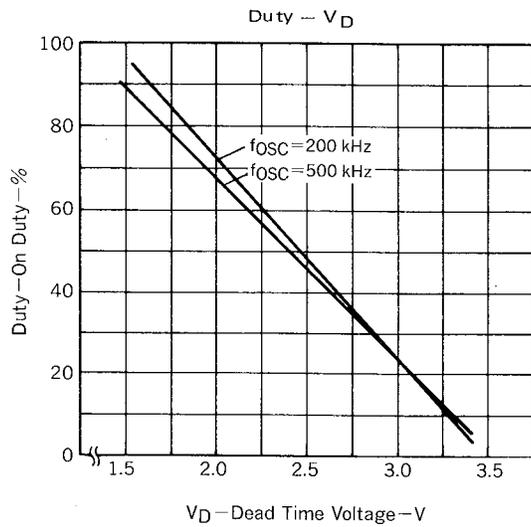
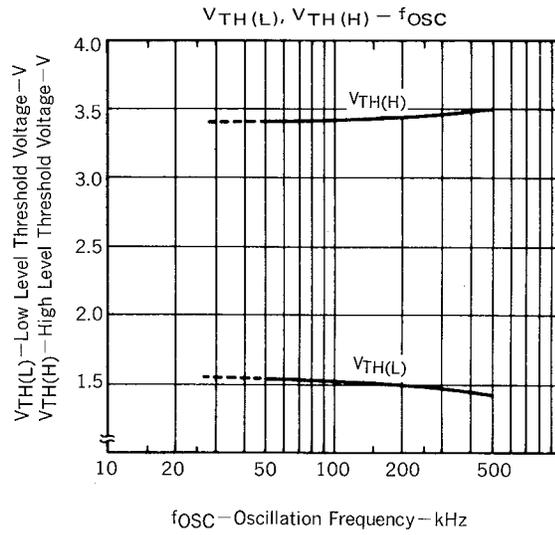
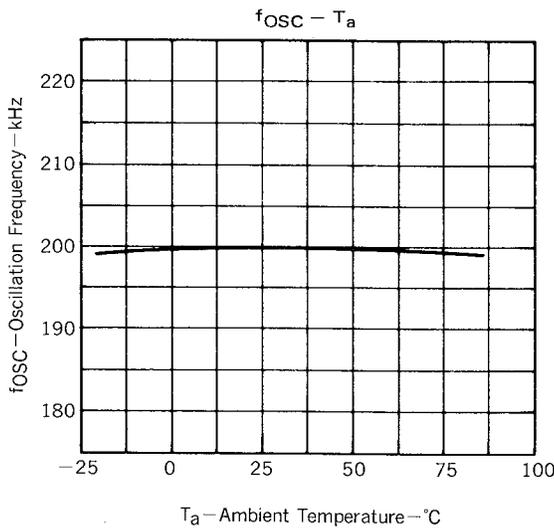
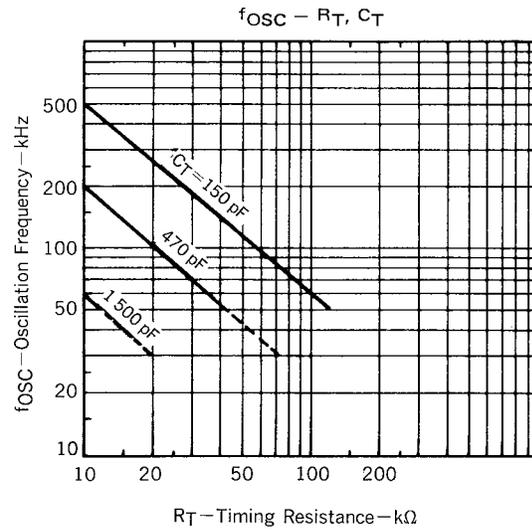
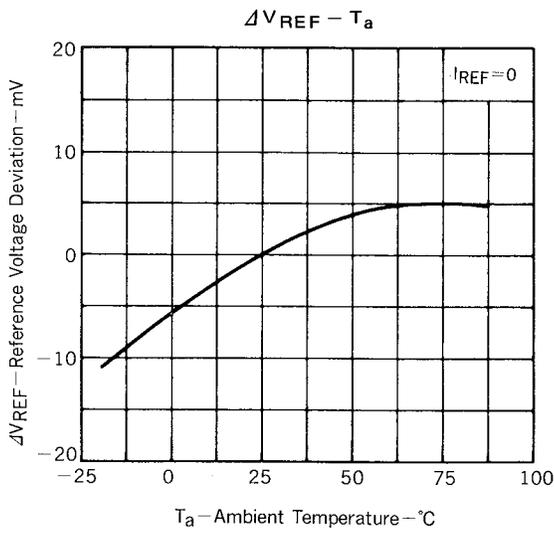
ELECTRICAL CHARACTERISTICS ( $T_a = 25^\circ\text{C}$ ,  $V_{CC} = 15\text{V}$ ,  $C_T = 470\text{pF}$ ,  $R_T \cong 10\text{k}\Omega$ ,  $f_{OSC} = 200\text{kHz}$ )

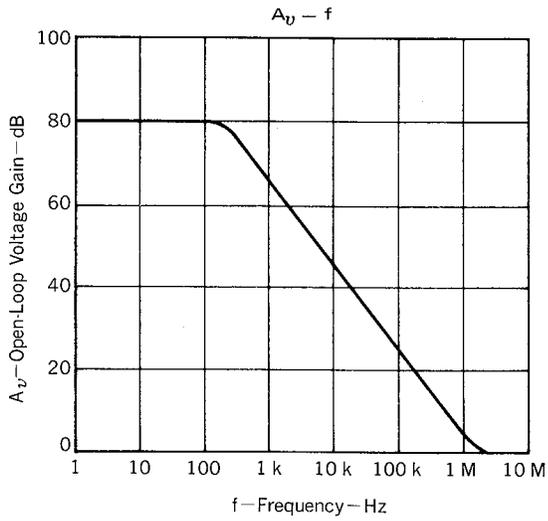
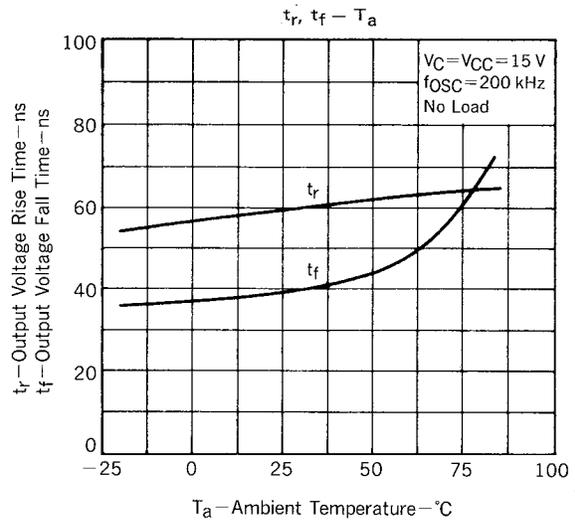
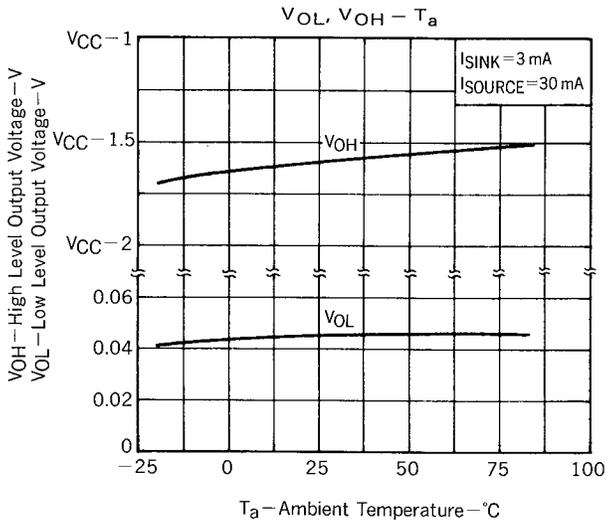
BLOCK	PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITIONS
Total	Standby Current	$I_{CC(SB)}$	0.05	0.1	0.2	mA	$V_{CC} = 8\text{V}$ , $-10^\circ\text{C} \leq T_a \leq 85^\circ\text{C}$
	Circuit Current at OVL Operation Mode	$I_{CC(OVL)}$		10		mA	
	Circuit Current at Off Mode	$I_{CC(OFF)}$		10		mA	
	Circuit Current	$I_{CC}$		10	15	mA	$V_{CC} = V_C = 24\text{V}$ , $V_D = 2.7\text{V}$ , no load
Under Voltage Lockout Section	Start-Up Threshold Voltage	$V_{CC(L\text{ to }H)}$	10.5	11	11.5	V	
	Threshold Hysteresis	$V_H$	2.8	3	3.2	V	
Reference Voltage Section	Output Voltage	$V_{REF}$	4.8	5	5.2	V	$I_{REF} = 0$
	Line Regulation	$REG_{IN}$		1	10	mV	$11.5\text{V} \leq V_{CC} \leq 20\text{V}$ , $I_{REF} = 0$
	Load Regulation	$REG_L$		6.5	12	mV	$0 \leq I_{REF} \leq 3\text{mA}$
	Output Voltage Temperature Coefficient	$V_{REF}/\Delta T$		400	700	$\mu\text{V}/^\circ\text{C}$	$I_{REF} = 0$ , $-10^\circ\text{C} \leq T_a \leq +85^\circ\text{C}$
	Short Circuit Current	$I_{O\text{ short}}$		13		mA	$V_{REF} = 0$
PWM Section	Input Bias Current	$I_B$			10	$\mu\text{A}$	
	Low Level Threshold Voltage	$V_{TH(L)}$		1.5		V	
	High Level Threshold Voltage	$V_{TH(H)}$		3.5		V	
	Dead Time Temperature Coefficient	$\Delta DT/\Delta T$		3		%	$V_D = 0.54 V_{REF}$ , $-10^\circ\text{C} \leq T_a \leq +85^\circ\text{C}$
Oscillator Section	Oscillation Frequency	$f_{OSC}$	180	200	220	kHz	
	Frequency Line Regulation	$\Delta f/\Delta V_{CC}$		1		%	$11.5\text{V} \leq V_{CC} \leq 24\text{V}$
	Frequency Temperature Coefficient	$\Delta f/\Delta T$		2	5	%	$-10^\circ\text{C} \leq T_a \leq +85^\circ\text{C}$
Output Section	Low Level Output Voltage	$V_{OL}$			0.5	V	$I_{SINK} = 3\text{mA}$ , $V_{CC} = V_C$
	High Level Output Voltage	$V_{OH}$		$V_{CC}-1.6$		V	$I_{SOURCE} = 30\text{mA}$ , $V_{CC} = V_C$
	Output Voltage Rise Time	$t_r$		60		ns	$R_L = 15\Omega$ , $C_L = 2\text{200pF}$
	Output Voltage Fall Time	$t_f$		40		ns	$V_{CC} = V_C$
Remote Control Section	Input Voltage at Output ON	$V_{IN(ON)}$	2.4	2.6	2.8	V	
	Input Voltage at Output OFF	$V_{IN(OFF)}$	2.2	2.4	2.6	V	
	Hysteresis Width	$V_H$	0.1	0.2	0.3	V	
Over Voltage Latch Section	Over Voltage Threshold Voltage	$V_{TH(OVL)}$	2.0	2.4	2.8	V	$-10^\circ\text{C} \leq T_a \leq +85^\circ\text{C}$
	Input Bias Current	$I_B(OVL)$			4	$\mu\text{A}$	OVL pin voltage = $V_{TH(OVL)}$
	OVL Reset Voltage	$V_R(OVL)$		2		V	
	Delay to Output	$t_d(OVL)$		750		ns	
Over Current Latch Section	Over Current Threshold Voltage	$V_{TH(OCL)}^+$	200	220	240	mV	$-10^\circ\text{C} \leq T_a \leq +85^\circ\text{C}$
	Over Current Threshold Voltage	$V_{TH(OCL)}^-$	-230	-210	-190	mV	$-10^\circ\text{C} \leq T_a \leq +85^\circ\text{C}$
	OCL Pin Output Current	$I_B(OCL)$		250		$\mu\text{A}$	
	Delay to Output	$t_d(OCL)^+$		120		ns	
	Delay to Output	$t_d(OCL)^-$		160		ns	

BLOCK	PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITIONS
Error Amplifier Section	Input Bias Current	$I_B$ (AMP)			1	μA	$V_{IN} = 2.5 V$
	Open-Loop Voltage Gain	$A_v$	60	80		dB	$V_{FB} = 2.9 V$
	Unit Gain Bandwidth	$f_{unity}$	1	1.6		MHz	
	High Level Output Voltage	$V_{om}^+$	3.0			V	
	Low Level Output Voltage	$V_{om}^-$			1.0	V	
	Common Mode Input Voltage Range	$V_{ICM}^+$	3			V	$11.5 V \leq V_{CC} \leq 24 V,$
	Common Mode Input Voltage Range	$V_{ICM}^-$			-0.3	V	$-10^\circ C \leq T_a \leq +85^\circ C$

TYPICAL CHARACTERISTICS ( $T_a = 25^\circ\text{C}$ ,  $V_{CC} = 15\text{ V}$ )

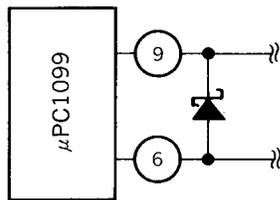






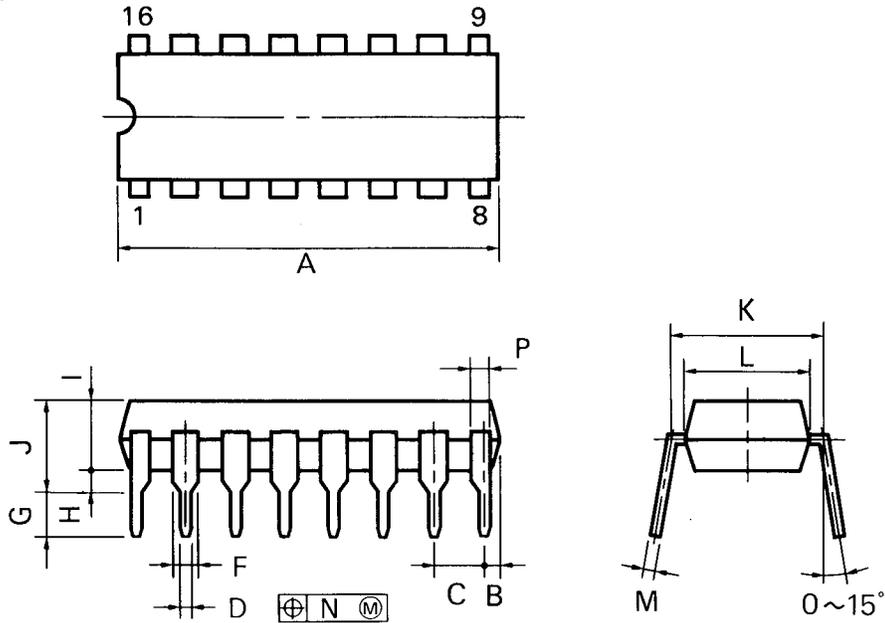
**NOTE:** When under-shoot voltage at pin 9 occurs, it must be cramped to prevent from wrong operation. See Fig. 1.

Fig. 1



16PIN PLASTIC DIP (300 mil)

μPC1099CX



P16C-100-300B

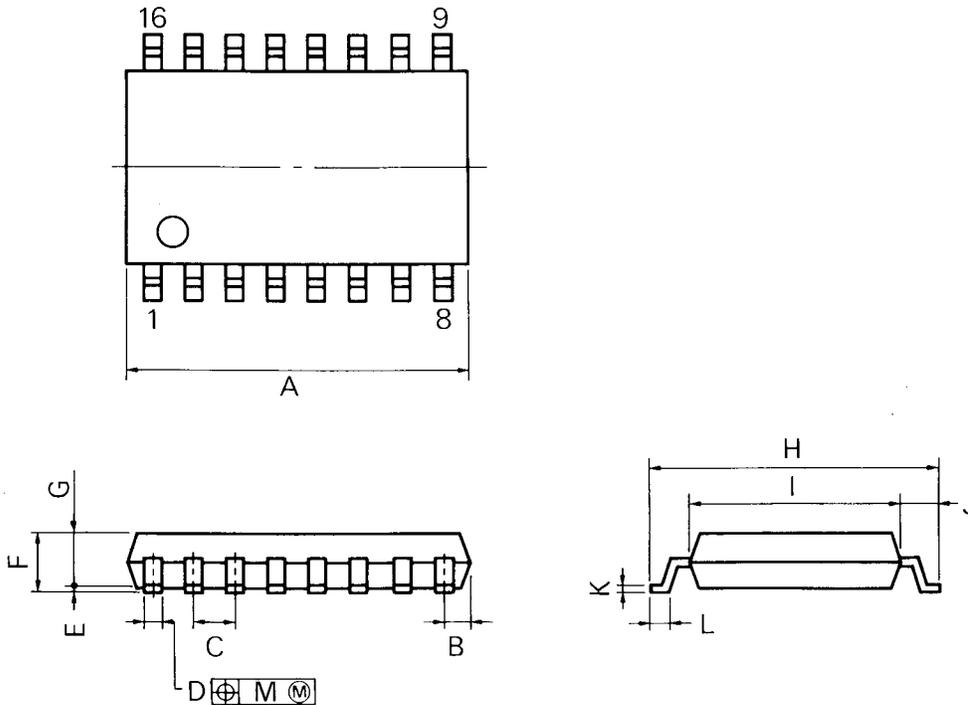
NOTES

- 1) Each lead centerline is located within 0.25 mm (0.01 inch) of its true position (T.P.) at maximum material condition.
- 2) Item "K" to center of leads when formed parallel.

ITEM	MILLIMETERS	INCHES
A	20.32 MAX.	0.800 MAX.
B	1.27 MAX.	0.050 MAX.
C	2.54 (T.P.)	0.100 (T.P.)
D	0.50 <sup>+0.10</sup>	0.020 <sup>+0.004</sup> <sub>-0.005</sub>
F	1.1 MIN.	0.043 MIN.
G	3.5 <sup>+0.3</sup>	0.138 <sup>+0.012</sup>
H	0.51 MIN.	0.020 MIN.
I	4.31 MAX.	0.170 MAX.
J	5.08 MAX.	0.200 MAX.
K	7.62 (T.P.)	0.300 (T.P.)
L	6.5	0.256
M	0.25 <sup>+0.10</sup> <sub>-0.05</sub>	0.010 <sup>+0.004</sup> <sub>-0.003</sub>
N	0.25	0.01
P	1.1 MIN.	0.043 MIN.

16PIN PLASTIC SOP (300 mil)

μPC1099GS



P16GM-50-300B-1

NOTE

Each lead centerline is located within 0.12 mm (0.005 inch) of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS	INCHES
A	10.46 MAX.	0.412 MAX.
B	0.78 MAX.	0.031 MAX.
C	1.27 (T.P.)	0.050 (T.P.)
D	0.40 <sup>+0.10</sup> <sub>-0.05</sub>	0.016 <sup>+0.004</sup> <sub>-0.003</sub>
E	0.1 <sup>±0.1</sup>	0.004 <sup>±0.004</sup>
F	1.8 MAX.	0.071 MAX.
G	1.55	0.061
H	7.7 <sup>±0.3</sup>	0.303 <sup>±0.012</sup>
I	5.6	0.220
J	1.1	0.043
K	0.20 <sup>+0.10</sup> <sub>-0.05</sub>	0.008 <sup>+0.004</sup> <sub>-0.002</sub>
L	0.6 <sup>±0.2</sup>	0.024 <sup>+0.008</sup> <sub>-0.009</sub>
M	0.12	0.005

**RECOMMENDED SOLDERING CONDITIONS**

The following conditions (see table below) must be set when soldering this product.

Please consult with our sales offices in case other soldering process is used, or in case soldering is done under different conditions.

**TYPES OF SURFACE MOUNT DEVICE**

For more details, refer to our document "SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL" (IEI-1207).

μPC1099GS

Soldering process	Soldering conditions	Symbol
Infrared ray reflow	Peak package's surface temperature : 230 °C or below, Reflow time : 30 seconds or below (210 °C or higher), Number of reflow process : 1, Exposure limit* : None	IR30-00-1
VPS	Peak package's surface temperature : 215 °C or below, Reflow time : 40 seconds or below (200 °C or higher), Number of reflow process : 1, Exposure limit* : None	VP15-00-1

\* : Exposure limit before soldering after dry-pack package is opened.  
Storage conditions : 25 °C and relative humidity at 65 % or less.

**Note:** Do not apply more than a single process at once, except for "Partial heating method".

**TYPES OF THROUGH HOLE MOUNT DEVICE**

μPC1099CX

Soldering process	Soldering conditions	Symbol
Wave soldering	Solder temperature : 260 °C or below, Flow time : 10 seconds or below	

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The devices listed in this document are not suitable for use in the field where very high reliability is required including, but not limited to, aerospace equipment, submarine cables, nuclear reactor control systems and life support systems. If customers intend to use NEC devices for above applications or those intend to use "Standard" quality grade NEC devices for the application not intended by NEC, please contact our sales people in advance.

Application examples recommended by NEC Corporation

Standard: Computer, Office equipment, Communication equipment, Test and Measurement equipment, Machine tools, Industrial robots, Audio and Visual equipment, Other consumer products, etc.

Special: Automotive and Transportation equipment, Traffic control systems, Antidisaster systems, Anti-crime systems, etc.