

SWITCHING REGULATOR CONTROL IC

The μ PC1909 is a switching regulator control IC ideal for primary side control of active-clamp type^{Note} DC/DC converters. This IC has 2 outputs employing a totem-pole circuit with peak output current 1.2 A, and is capable of directly driving a power MOS-FET. As a result, it has been possible to realize primary side control of an active-clamp type converter on a single chip.

Note It is necessary to obtain license from Vicor Corporation before using the μ PC1909 in an active-clamp type circuit.

FEATURES

- 2 on-chip outputs; for Q and \bar{Q}
- Capable of directly driving a power MOS-FET
- Drive supply voltage range: 7 V to 24 V
- On-chip remote control circuit
- On-chip pulse-by-pulse overcurrent protection circuit
- On-chip overvoltage latch circuit

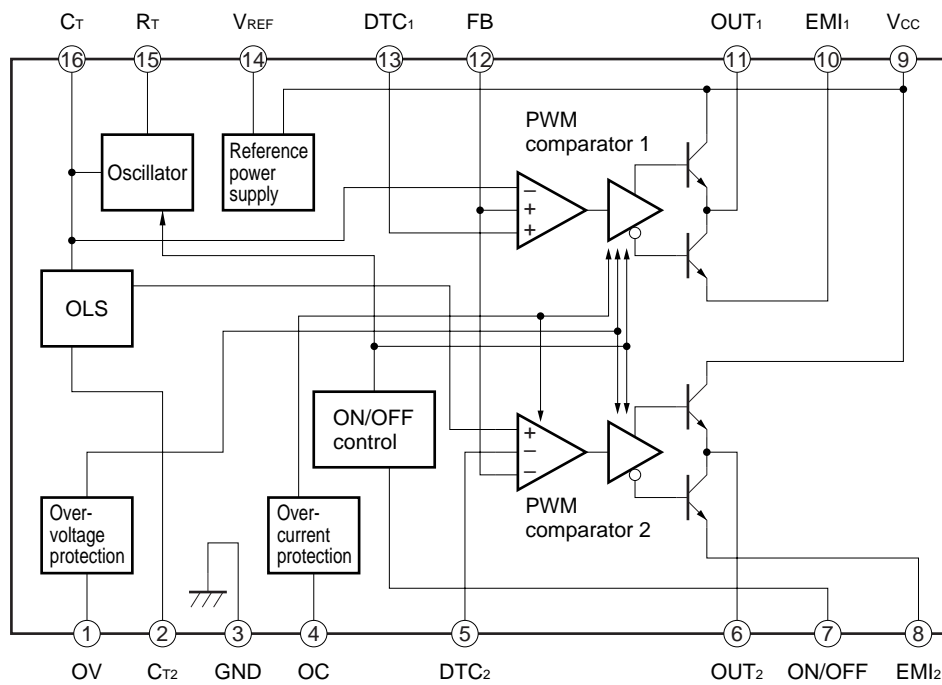
ORDERING INFORMATION

Part Number	Package
μ PC1909CX	16-pin plastic DIP (300 mils)
μ PC1909GS	16-pin plastic SOP (300 mils)

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Not all devices/types available in every country. Please check with local NEC representative for availability and additional information.

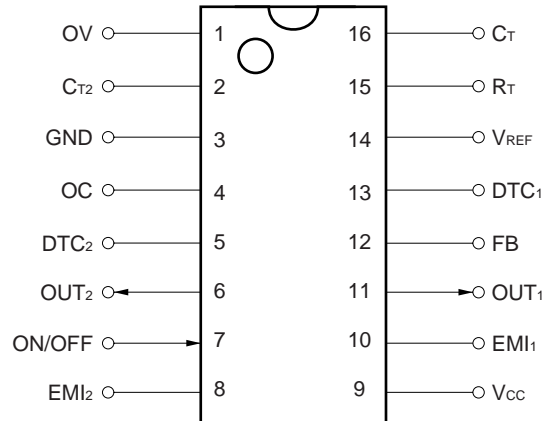
BLOCK DIAGRAM



PIN CONFIGURATION (TOP VIEW)

16-pin plastic DIP (300 mils)
μPC1909CX

16-pin plastic SOP (300 mils)
μPC1909GS



PIN FUNCTION LIST

Pin Number	Pin Name	Function	Pin Number	Pin Name	Function
1	OV	Overvoltage protection	9	V _{CC}	Power supply
2	C _{T2}	OLS shift setting	10	EMI ₁	OUT ₁ emitter
3	GND	Ground	11	OUT ₁	OUT ₁ output
4	OC	Overcurrent protection	12	FB	Feedback input
5	DTC ₂	OUT ₂ dead-time setting	13	DTC ₁	OUT ₁ dead-time setting
6	OUT ₂	OUT ₂ output	14	V _{REF}	Reference voltage output
7	ON/OFF	ON/OFF control	15	R _T	Timing resistance
8	EMI ₂	OUT ₂ emitter	16	C _T	Timing capacitance

ELECTRICAL SPECIFICATIONS

Absolute Maximum Ratings (Unless otherwise specified, T_A = 25°C)

Parameter	Symbol	μPC1909CX	μPC1909GS	Unit
Supply Voltage	V _{CC}	26		V
Output Current (DC, per output)	I _{C (DC)}	100		mA
Output Current (peak, per output)	I _{C (peak)}	1.2		A
Total Power Dissipation	P _T	1000	694	mW
Operating Ambient Temperature	T _A	-20 to +85		°C
Operating Junction Temperature	T _J	-20 to +150		°C
Storage Temperature	T _{stg}	-55 to +150		°C

Caution Product quality may suffer if the absolute maximum rating is exceeded even momentarily for any parameter. That is, the absolute maximum ratings are rated values at which the product is on the verge of suffering physical damage, and therefore the product must be used under conditions that ensure that the absolute maximum ratings are not exceeded.

Recommended Operating Conditions

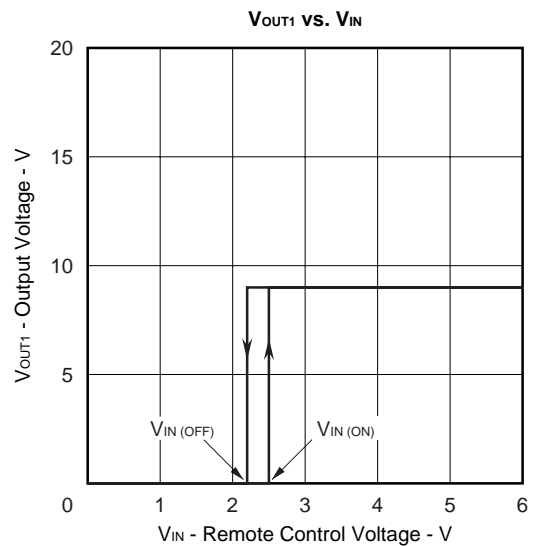
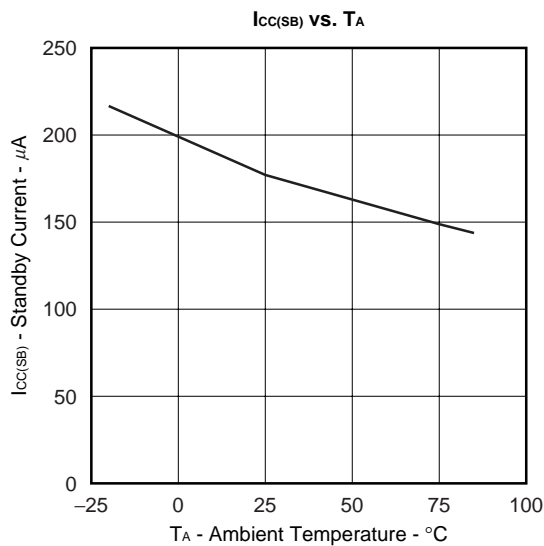
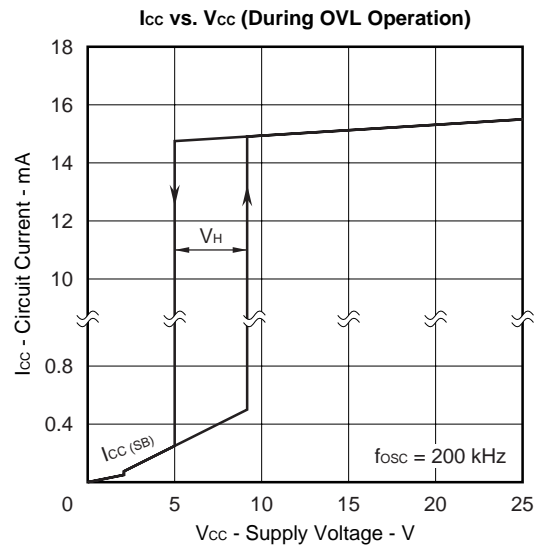
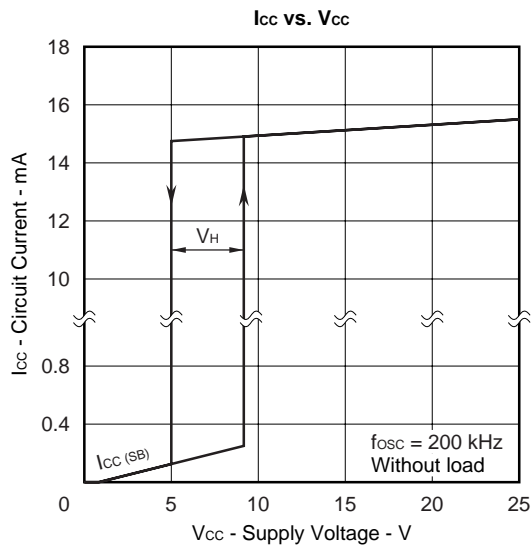
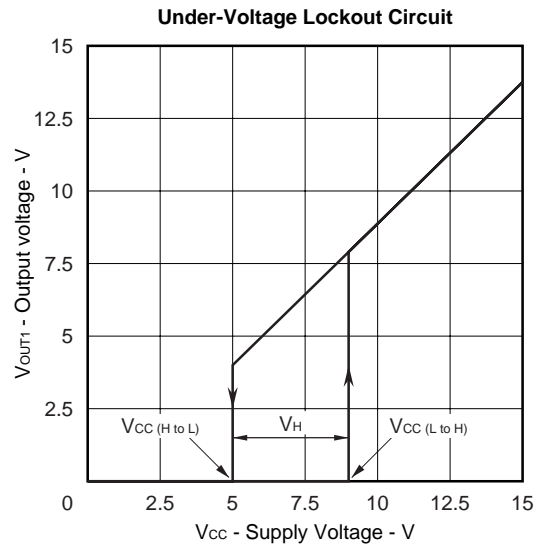
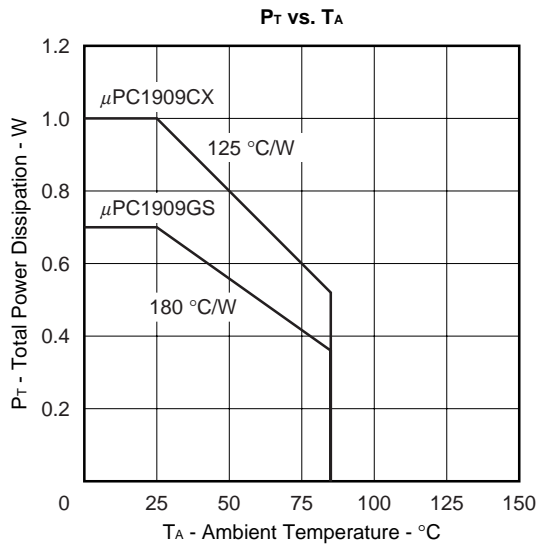
Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage	V _{CC}	7	10	24	V
Oscillation Frequency	f _{osc}	50	200	500	kHz
Output Load Capacitance	C _L		2200	3000	pF
Output Load Resistance	R _L	10			kΩ
Operating Junction Temperature	T _J	-20		+100	°C

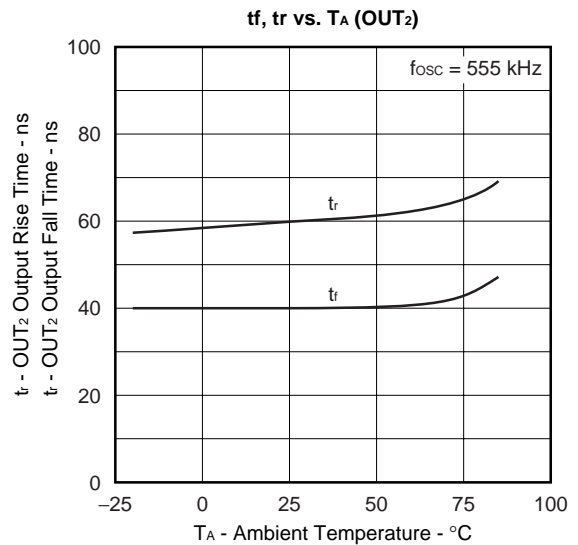
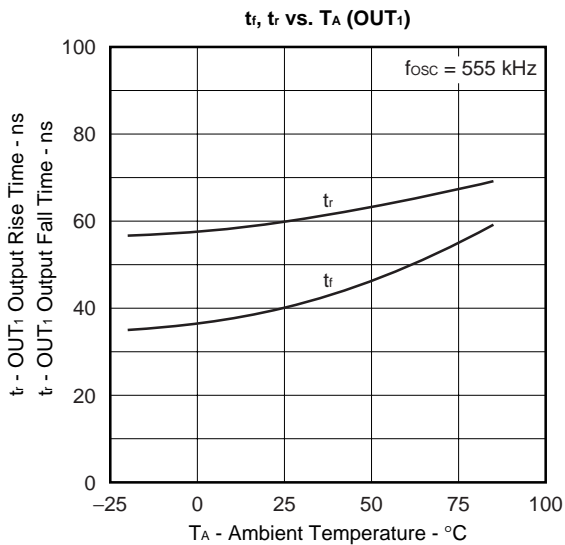
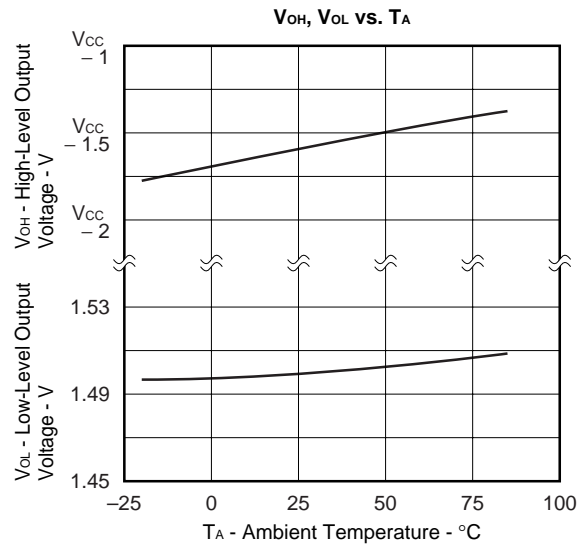
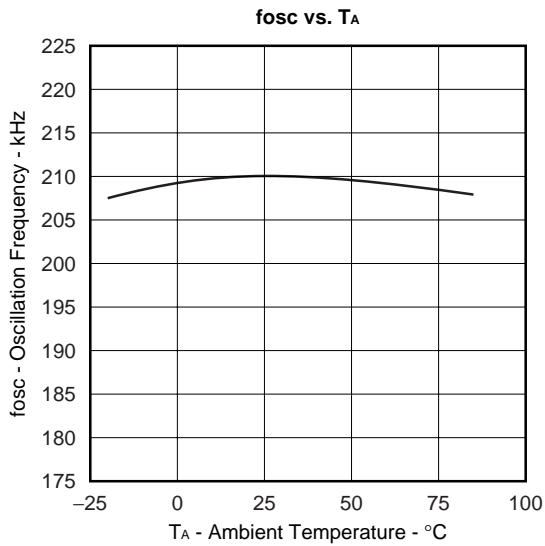
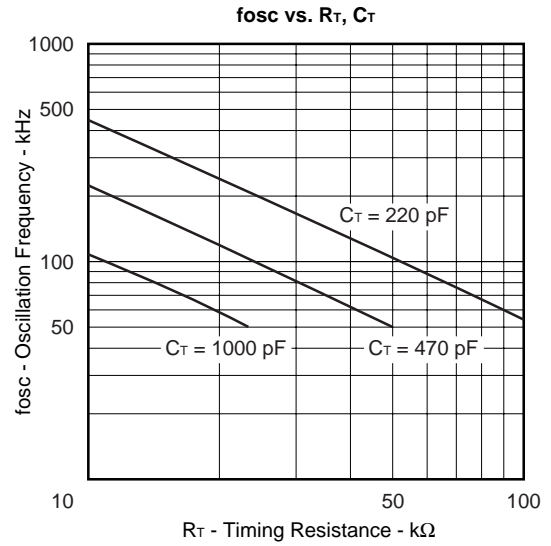
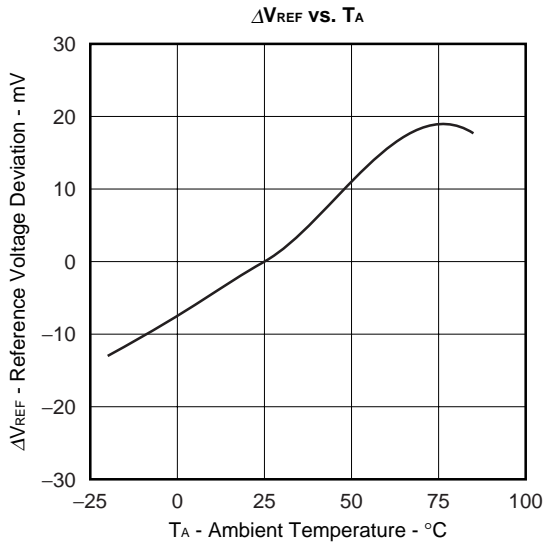
Electrical Characteristics (Unless otherwise specified, T_A = 25°C, V_{CC} = 10 V, R_T = 10 kΩ, f_{osc} = 200 kHz)

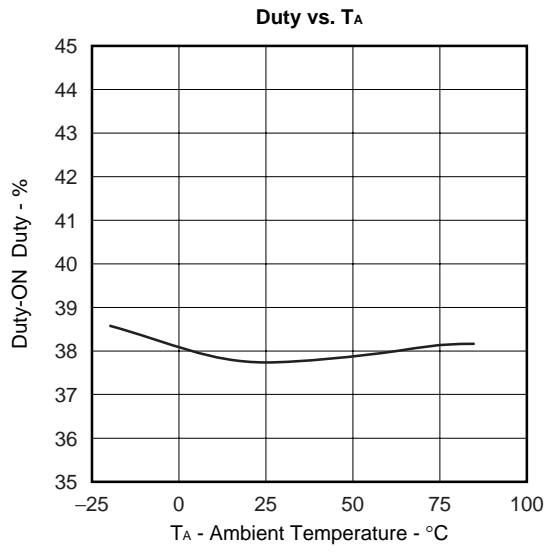
Block	Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Total	Standby Current	I _{CC(SB)}	V _{CC} = 7 V		0.1		mA
	Circuit Current	I _{CC}	Without load	6	12	18	mA
Under-Voltage Lockout Circuit	Start-Up Threshold Voltage	V _{CC(L to H)}		8	9	10	V
	Operating Voltage Hysteresis Width	V _H		3	4	5	V
Reference Voltage	Output Voltage	V _{REF}	I _{REF} = 0 A	4.7	4.9	5.1	V
	Line Regulation	REG _{IN}	8 V ≤ V _{CC} ≤ 15 V, I _{REF} = 0 A		1	10	mV
	Load Regulation	REG _L	1 mA ≤ I _{REF} ≤ 4 mA		6	12	mV
	Output Voltage Temperature Coefficient	ΔV _{REF} /ΔT	-10°C ≤ T _A ≤ +85°C, I _{REF} = 0 A		400	(700)	μV/°C
	Short Circuit Current	I _{O short}	I _{REF} = 0 A		15		mA
Oscillation	Oscillation Frequency	f _{osc}		180	200	220	kHz
	Frequency Line Regulation	Δf/ΔV	8 V ≤ V _{CC} ≤ 15 V		1		%
	Frequency Temperature Coefficient	Δf/ΔT	-10°C ≤ T _A ≤ +85°C		2	(5)	%
PWM Comparator	Input Bias Current	I _{B(COMP1)}	V _{COMP1} = V _{REF}			10	μA
		I _{B(COMP2)}	V _{COMP2} = V _{REF}			10	μA
	Low-level Threshold Voltage	V _{TH(L)}			1.5		V
	High-level Threshold Voltage	V _{TH(H)}			3.5		V
	Dead-time Temperature Coefficient	ΔDT/ΔT	-10°C ≤ T _A ≤ +85°C, V _D = 0.46 V _{REF}		3		%
Output	Low-level Output Voltage	V _{OL}	I _{SINK} = 3 mA			0.5	V
	High-level Output Voltage	V _{OH}	I _{SOURCE} = 30 mA		V _{CC} - 1.6		V
	Rise Time	t _r	R _L = 15 Ω, C _L = 2200 pF		60		ns
	Fall Time	t _f	R _L = 15 Ω, C _L = 2200 pF		40		ns
Remote Control	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
Overcurrent Latch	Overcurrent Threshold Voltage	V _{TH(OC)}		190	210	230	mV
	Input Bias Current	I _{B(OC)}	V _{CC} = 0 V		200		μA
	Delay to Output	t _{d(OC)}			150		ns
Overvoltage Latch	Overvoltage Threshold Voltage	V _{TH(OV)}		2	2.4	2.8	V
	Input Bias Current	I _{B(OV)}	V _{OV} = V _{REF}			4	μA
	OVL Reset Voltage	V _{R(OV)}			2		V
	Delay to Output	t _{d(OV)}			750		ns

Remark Values in parentheses () represent reference values.

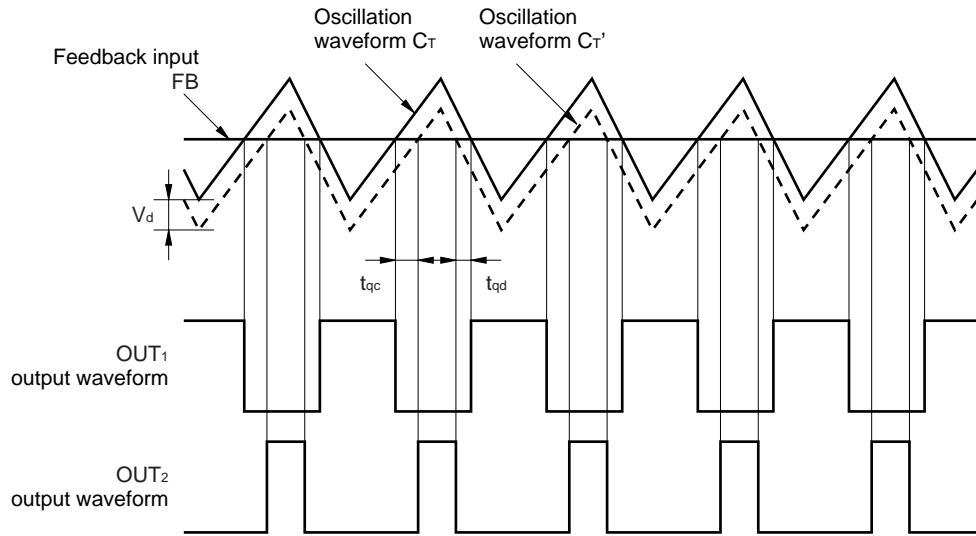
TYPICAL CHARACTERISTICS CURVES (UNLESS OTHERWISE SPECIFIED, $T_A = 25^\circ\text{C}$, $V_{CC} = 10\text{ V}$, REFERENCE VALUES)







TIMING CHART



(1) Oscillation waveform (C_T)

This waveform is determined by the external capacitor connected to the C_T pin (pin 16) and the external resistor connected to the R_T pin (pin 15). It is usually a 1.5-V to 3.5-V triangle waveform (the rise and fall times are the same).

(2) Output waveform (OUT₁)

Whichever is the lower of the DTC₁ pin (pin 13) and FB pin (pin 12) voltages is compared with the triangle wave of the C_T pin (pin 16). The OUT₁ pin (pin 11) is high level while the triangle wave is low.

(3) Output waveform (OUT₂)

Whichever is the higher of the DTC₂ pin (pin 5) and FB pin (pin 12) voltages is compared with the level-shifted triangle wave (C_T'). The OUT₂ pin (pin 6) is high level while the level-shifted triangle wave is high.

(4) Triangle wave level shift

The triangle wave that controls OUT₂ is the original triangle wave of the C_T pin (pin 16) shifted to a lower potential via the level shift circuit (OLS). The amount of shift (V_d) can be adjusted using the resistor (R_{CT2}) connected between the C_{T2} pin (pin 2) and the V_{REF} pin.

The relationship between the shift amount (V_d) and the resistance value (kΩ) of the resistor R_{CT2} connected to the C_{T2} pin (pin 2) is as follows.

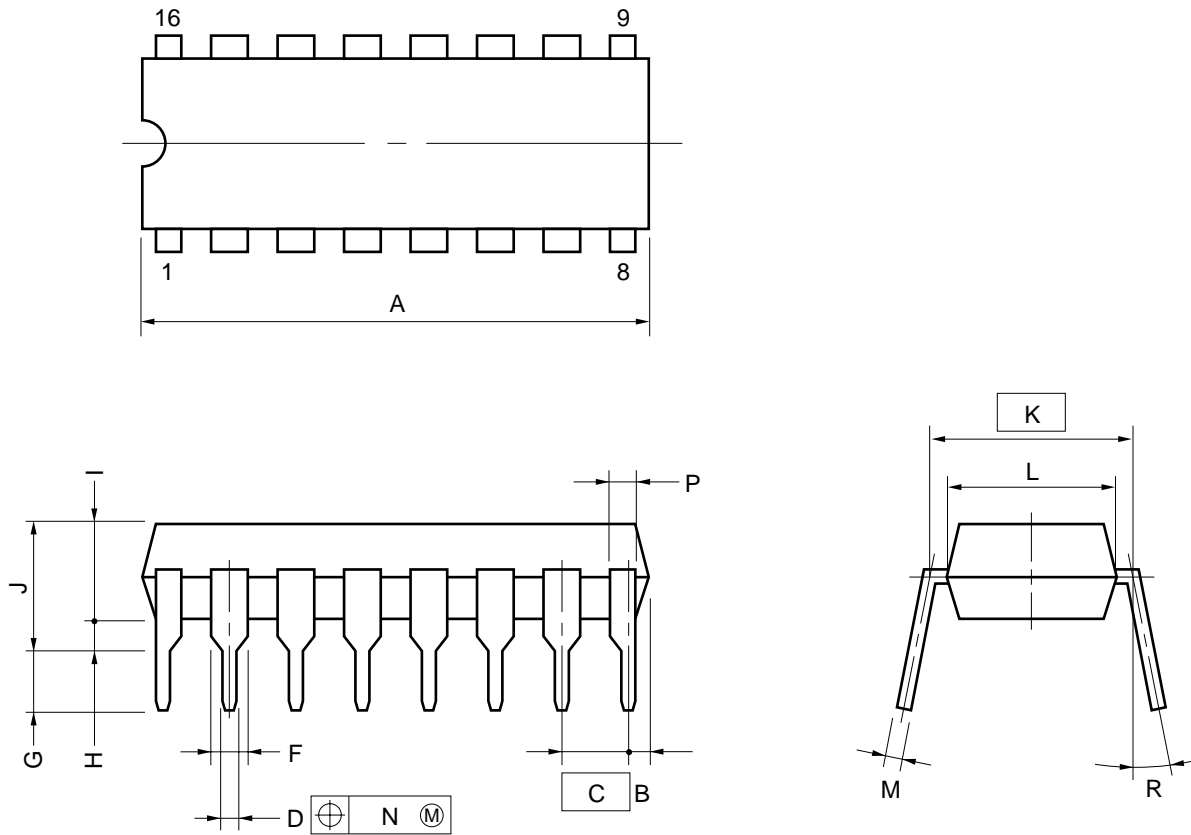
$$V_d = \frac{4.3}{R_{CT2}[k\Omega] + 10} \times 2 [V]$$

(5) Dead-time (t_{qc}, t_{qd}) adjustment

The dead time between the fall of OUT₁ and the rise of OUT₂ (t_{qc}) and the dead time between the fall of OUT₂ and the rise of OUT₁ (t_{qd}) is determined by the oscillation frequency and the amount of level shift of the triangle wave. Although usually t_{qc} = t_{qd}, if setting these independently, connect a suitable resistor between the C_T pin and the V_{REF} pin, as well as between the C_T pin and GND, and adjust the dead time by making the oscillation waveform asymmetrical.

PACKAGE DRAWINGS

16 PIN PLASTIC DIP (300 mil)



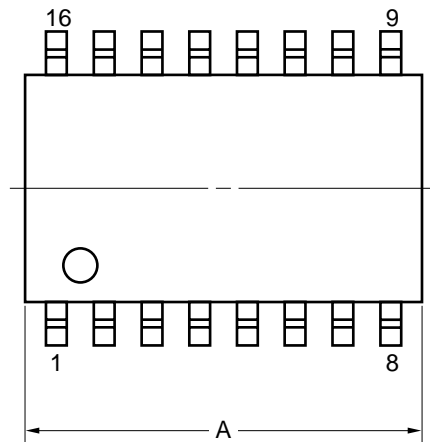
NOTES

- 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.

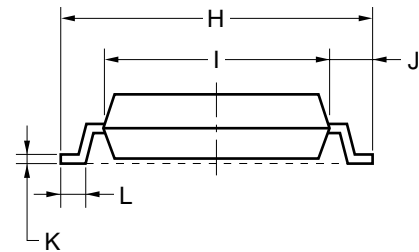
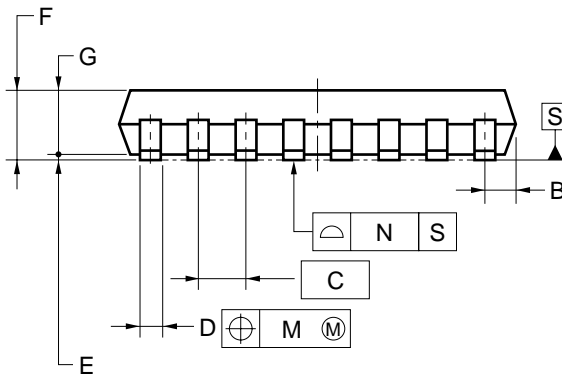
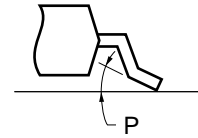
ITEM	MILLIMETERS	INCHES
A	20.32 MAX.	0.800 MAX.
B	1.27 MAX.	0.050 MAX.
C	2.54 (T.P.)	0.100 (T.P.)
D	0.50±0.10	0.020 ^{+0.004} _{-0.005}
F	1.1 MIN.	0.043 MIN.
G	3.5±0.3	0.138±0.012
H	0.51 MIN.	0.020 MIN.
I	4.31 MAX.	0.170 MAX.
J	5.08 MAX.	0.200 MAX.
K	7.62 (T.P.)	0.300 (T.P.)
L	6.5	0.256
M	0.25 ^{+0.10} _{-0.05}	0.010 ^{+0.004} _{-0.003}
N	0.25	0.01
P	1.1 MIN.	0.043 MIN.
R	0~15°	0~15°

P16C-100-300B-1

16 PIN PLASTIC SOP (300 mil)



detail of lead end



NOTE

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

ITEM	MILLIMETERS
A	10.2±0.2
B	0.78 MAX.
C	1.27 (T.P.)
D	0.42 ^{+0.08} _{-0.07}
E	0.1±0.1
F	1.65±0.15
G	1.55
H	7.7±0.3
I	5.6±0.2
J	1.1±0.2
K	0.22 ^{+0.08} _{-0.07}
L	0.6±0.2
M	0.12
N	0.10
P	3° ^{+7°} _{-3°}

P16GM-50-300B-5

RECOMMENDED SOLDERING CONDITIONS

The μPC1909 should be soldered and mounted under the following recommended conditions. For the details of the recommended soldering conditions, refer to the document **Semiconductor Device Mounting Technology Manual (C10535E)**. For soldering methods and conditions other than those recommended below, contact your NEC sales representative.

Insertion Type

μPC1909CX: 16-pin plastic DIP (300 mils)

Soldering Method	Soldering Conditions
Wave soldering (pins only)	Solder bath temperature: 260°C Max., Time: 10 seconds max.
Partial heating	Pin temperature: 300°C max., Time: 3 seconds max. (per pin)

Caution Apply wave soldering only to the pins and be careful not to bring solder into direct contact with the package.

Surface Mounting Type

μPC1909GS: 16-pin plastic SOP (300 mils)

Soldering Method	Soldering Conditions	Recommended Condition symbol
Infrared reflow	Package peak temperature: 235°C, Time: 30 seconds max. (at 210°C or higher), Count: Twice or less	IR35-00-2
VPS	Package peak temperature: 215°C, Time: 40 seconds max. (at 200°C or higher), Count: Twice or less	VP15-00-2
Wave soldering	Soldering bath temperature: 260°C or less, Time: 10 seconds max., Count: Once, Preheating temperature: 120°C MAX. (package surface temperature)	WS60-00-1

Caution Do not use different soldering methods together.

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