

# BIPOLAR ANALOG INTEGRATED CIRCUIT

## $\mu$ PC1905

### SWITCHING REGULATOR CONTROL CIRCUIT FOR 500 kHz OPERATION

$\mu$ PC1905 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  $\mu$ PC1905 are as follows:

- ① Supply voltage is as high as 31 V.  
→ It is possible to drive output power MOS FET with high voltage.
- ② Hysteresis voltage of under voltage lockout circuit is 6.5 V.  
→ The ripple allowance of input capacitor is wide and a smaller capacitor can be used.

#### 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       |

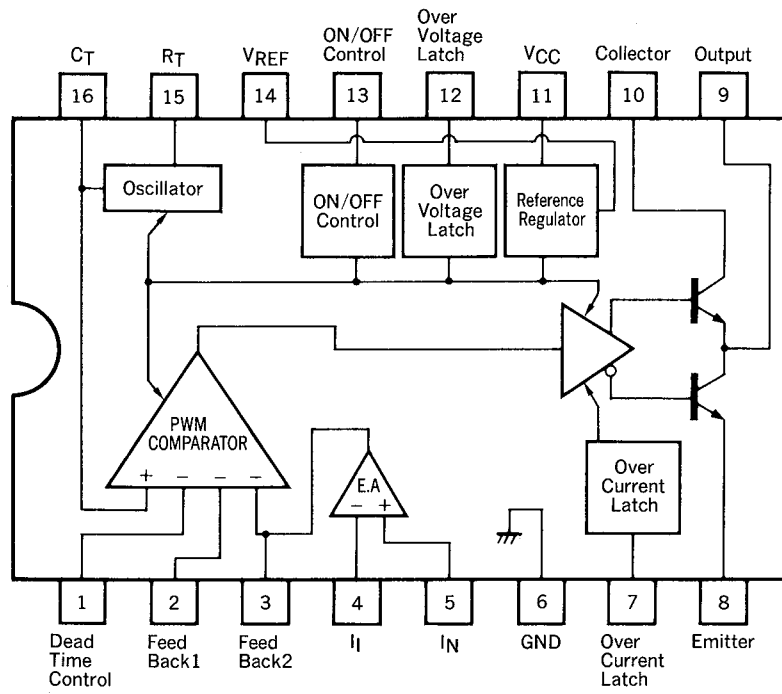
#### FEATURES

- 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 |
|----------------|------------------------------|---------------|
| $\mu$ PC1905CX | 16 pin plastic DIP (300 mil) | Standard      |
| $\mu$ PC1905GS | 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)



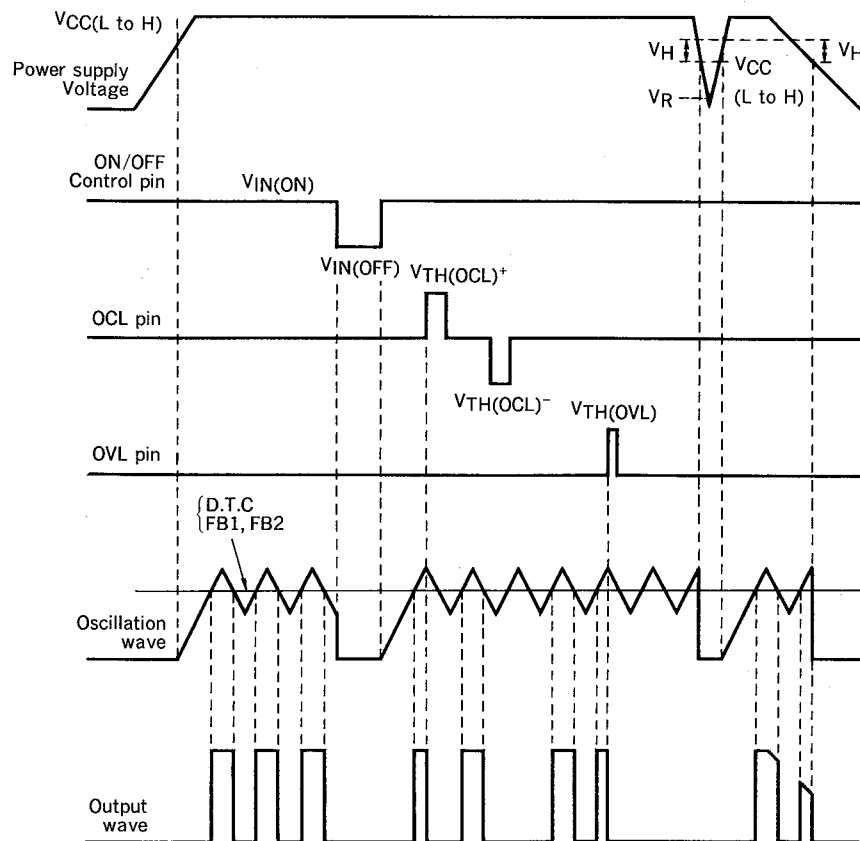
ABSOLUTE MAXIMUM RATING ( $T_a = 25^\circ\text{C}$ )

| PARAMETER               | SYMBOL             | RATING                        | UNIT             |    |
|-------------------------|--------------------|-------------------------------|------------------|----|
| Supply Voltage          | $V_{CC}$           | 31                            | V                |    |
| Output Voltage          | $V_C$              | 31                            | V                |    |
| Output Current          | $I_C(\text{DC})$   | 100                           | mA               |    |
| Peak Output Current     | $I_C(\text{peak})$ | 1.2                           | A                |    |
| Total Power Dissipation | μPC1905CX          | $P_T(T_a = 25^\circ\text{C})$ | 1 000            | mW |
|                         | μPC1905GS          | $P_T(T_a = 25^\circ\text{C})$ | 694              | mW |
| Operation Temperature   | $T_{\text{opt}}$   | -20 to +85                    | $^\circ\text{C}$ |    |
| Storage Temperature     | $T_{\text{stg}}$   | -55 to +150                   | $^\circ\text{C}$ |    |

RECOMMENDED OPERATION REQUIREMENTS

| PARAMETER               | SYMBOL           | MIN. | TYP.  | MAX.  | UNIT |
|-------------------------|------------------|------|-------|-------|------|
| Supply Voltage          | $V_{CC}$         | 12   | 18    | 30    | V    |
| Oscillation Frequency   | $f_{\text{OSC}}$ | 50   | 200   | 500   | kHz  |
| Output Load Capacitance | $C_L$            | -    | 2 200 | 3 000 | pF   |

OPERATION WAVES

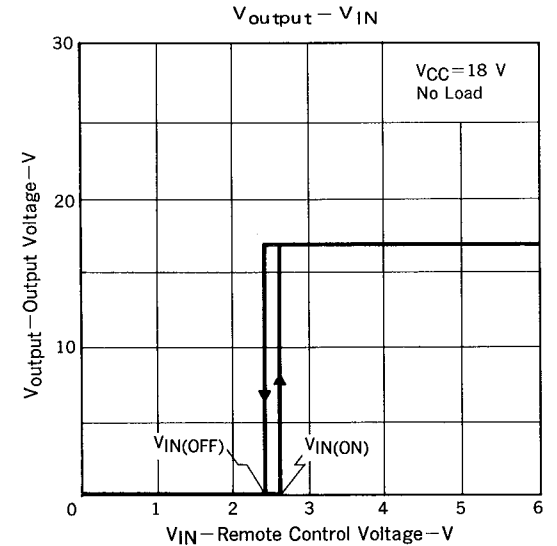
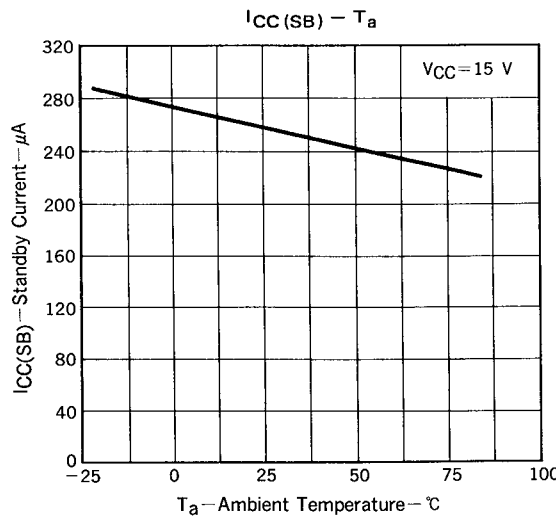
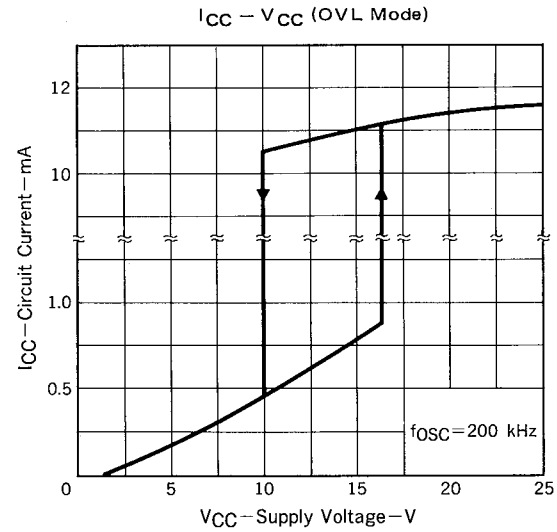
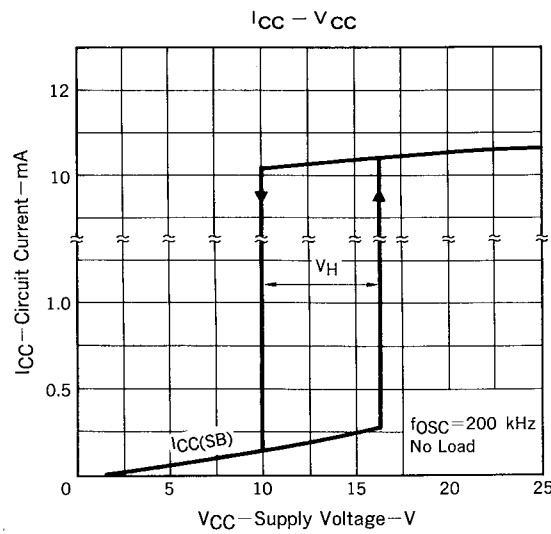
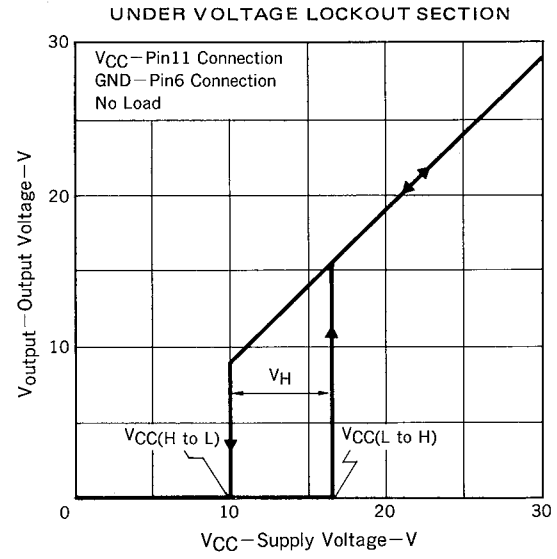
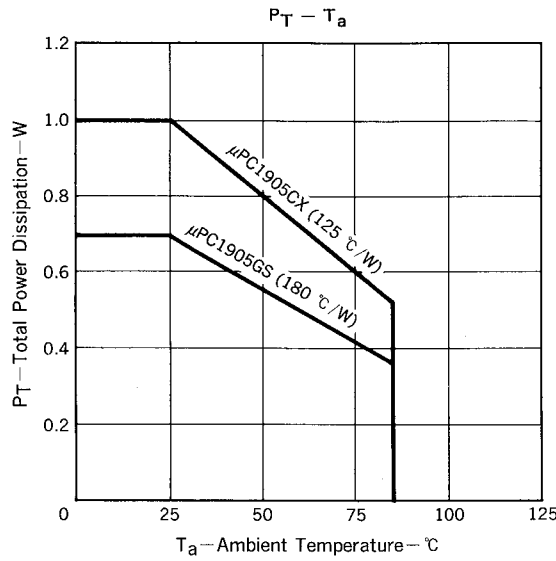


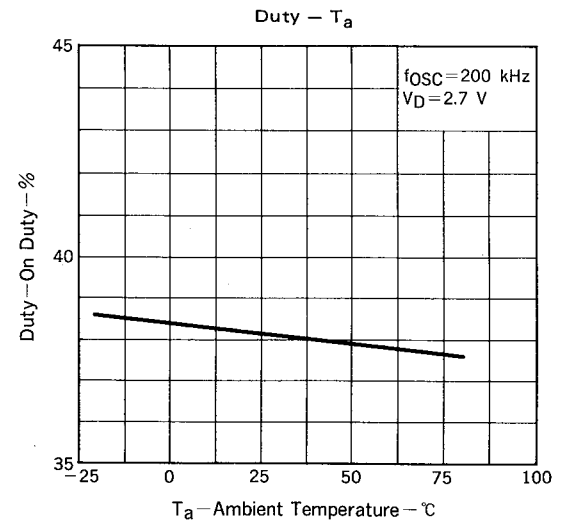
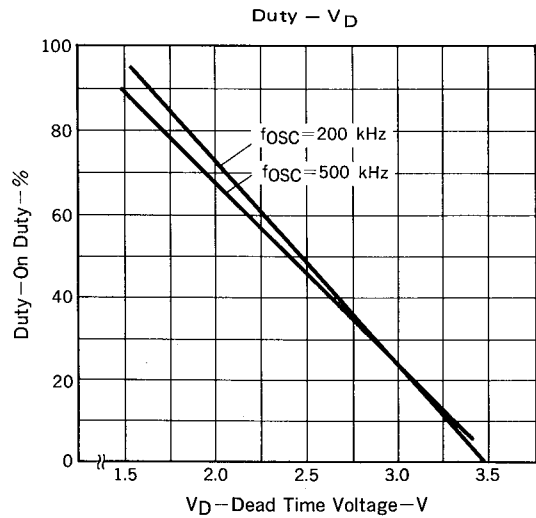
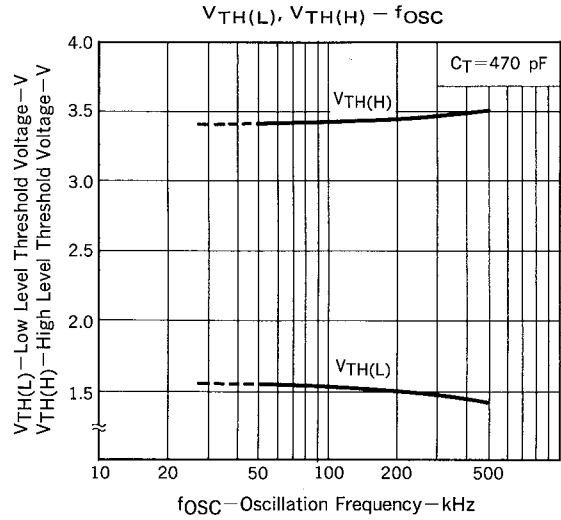
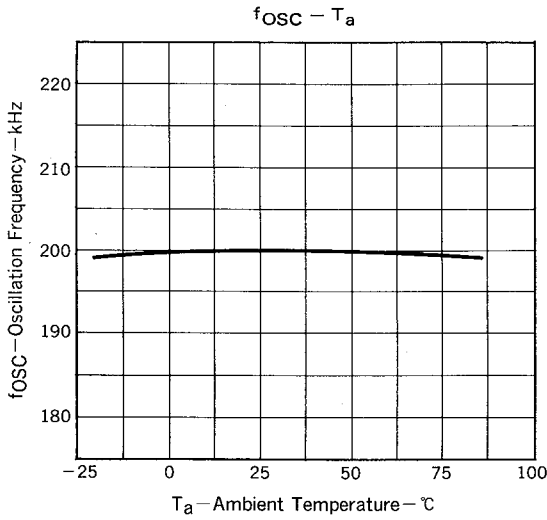
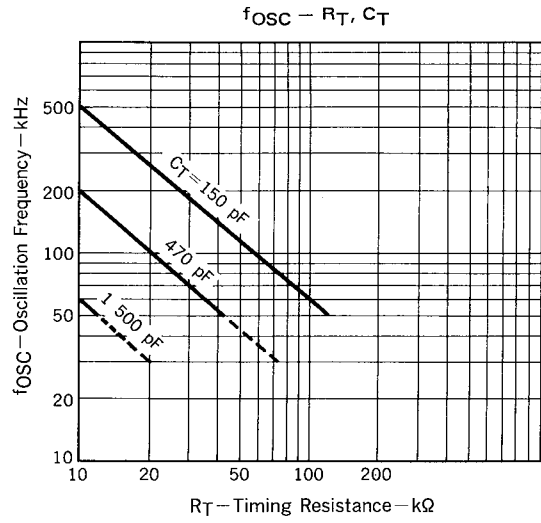
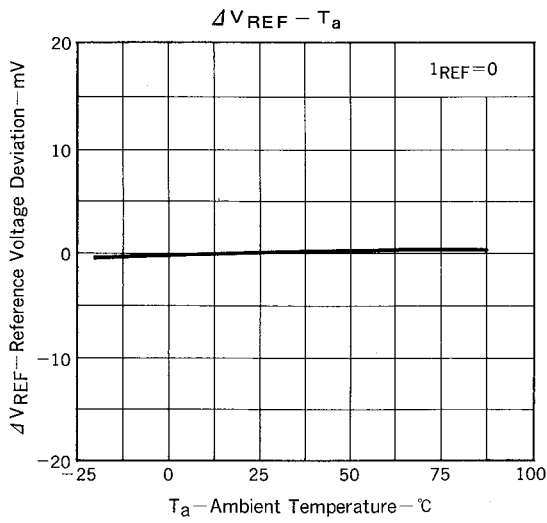
ELECTRICAL CHARACTERISTICS (T<sub>a</sub> = 25 °C, V<sub>CC</sub> = 18 V, C<sub>T</sub> = 470 pF, R<sub>T</sub> = 10 kΩ, f<sub>OSC</sub> = 200 kHz)

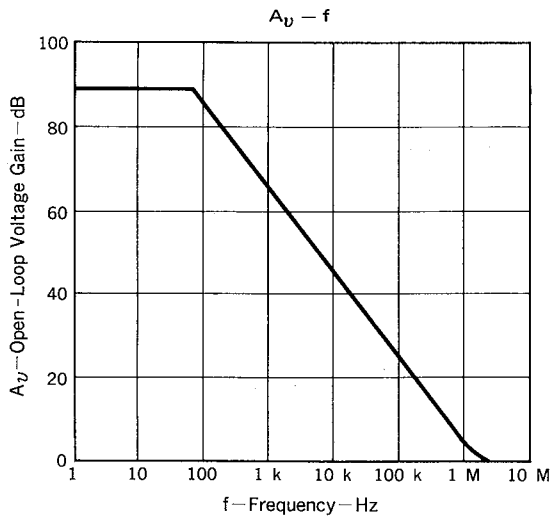
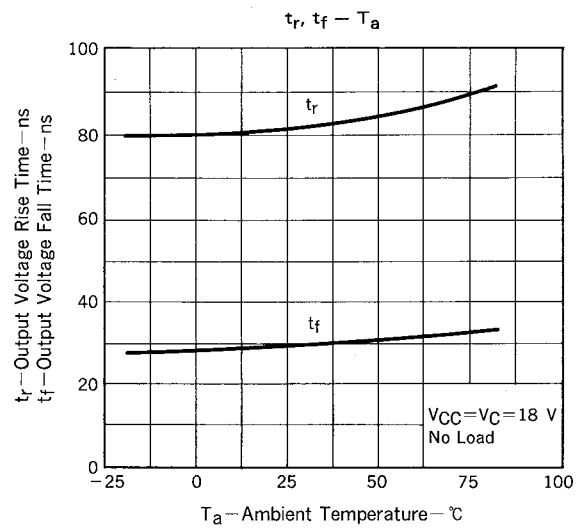
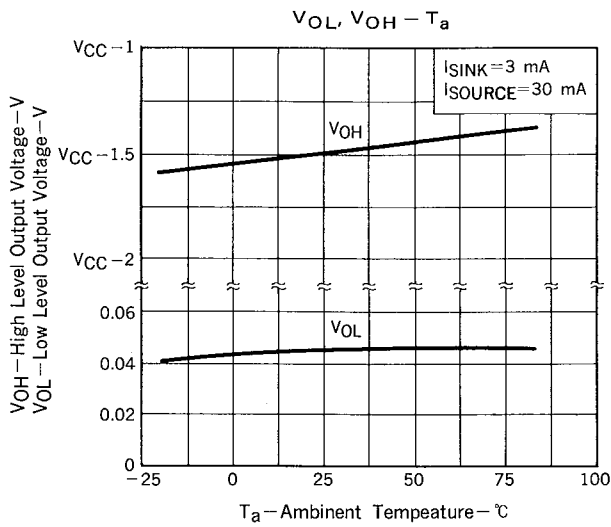
| BLOCK                         | PARAMETER                              | SYMBOL                            | MIN. | TYP.                 | MAX. | UNIT  | CONDITIONS  |
|-------------------------------|--|-----------------------------------|------|----------------------|------|-------|---|
| Total                         | Standby Current                        | I <sub>CC(SB)</sub>               | 0.1  | 0.25                 | 0.4  | mA    | V <sub>CC</sub> = 15 V, -10 °C ≤ T <sub>a</sub> ≤ 85 °C                   |
|                               | Circuit Current at OVL Operation Mode  | I <sub>CC(OVL)</sub>              |      | 10                   |      | mA    |   |
|                               | Circuit Current at Off Mode            | I <sub>CC(OFF)</sub>              |      | 10                   |      | mA    |   |
|                               | Circuit Current                        | I <sub>CC</sub>                   |      | 10                   | 15   | mA    | V <sub>CC</sub> = V <sub>C</sub> = 24 V, V <sub>D</sub> = 2.7 V, no load  |
| Under Voltage Lockout Section | Start-Up Threshold Voltage             | V <sub>CC(L to H)</sub>           | 15.5 | 16.5                 | 17.5 | V     |   |
|                               | Threshold Hysteresis                   | V <sub>H</sub>                    | 5.5  | 6.5                  | 7.5  | V     |   |
| Reference Voltage Section     | Output Voltage                         | V <sub>REF</sub>                  | 4.8  | 5                    | 5.2  | V     | I <sub>REF</sub> = 0  |
|                               | Line Regulation                        | REG <sub>IN</sub>                 |      | 4                    | 10   | mV    | 12 V ≤ V <sub>CC</sub> ≤ 30 V, I <sub>REF</sub> = 0                       |
|                               | Load Regulation                        | REG <sub>L</sub>                  |      | 2                    | 12   | mV    | 0 ≤ I <sub>REF</sub> ≤ 3 mA   |
|                               | Output Voltage Temperature Coefficient | V <sub>REF/ΔT</sub>               |      | 100                  | 700  | μV/°C | I <sub>REF</sub> = 0, -10 °C ≤ T <sub>a</sub> ≤ +85 °C                    |
|                               | Short Circuit Current                  | I <sub>O short</sub>              |      | 15                   |      | mA    | V <sub>REF</sub> = 0  |
| PWM Section                   | Input Bias Current                     | I <sub>B</sub>                    |      |                      | 10   | μA    |   |
|                               | Low Level Threshold Voltage            | V <sub>TH(L)</sub>                |      | 1.5                  |      | V     |   |
|                               | High Level Threshold Voltage           | V <sub>TH(H)</sub>                |      | 3.5                  |      | V     |   |
|                               | Dead Time Temperature Coefficient      | ΔDT/ΔT                            |      | 1                    | 5    | %     | V <sub>D</sub> = 0.54 V <sub>REF</sub> , -10 °C ≤ T <sub>a</sub> ≤ +85 °C |
| Oscillator Section            | Oscillation Frequency                  | f <sub>OSC</sub>                  | 180  | 200                  | 220  | kHz   |   |
|                               | Frequency Line Regulation              | Δf/ΔV <sub>CC</sub>               |      | 0.6                  |      | %     | 12 V ≤ V <sub>CC</sub> ≤ 30 V   |
|                               | Frequency Temperature Coefficient      | Δf/ΔT                             |      | 1                    | 5    | %     | -10 °C ≤ T <sub>a</sub> ≤ +85 °C  |
| Output Section                | Low Level Output Voltage               | V <sub>OL</sub>                   |      |                      | 0.5  | V     | I <sub>SINK</sub> = 3 mA, V <sub>CC</sub> = V <sub>C</sub>                |
|                               | High Level Output Voltage              | V <sub>OH</sub>                   |      | V <sub>CC</sub> -1.6 |      | V     | I <sub>SOURCE</sub> = 30 mA, V <sub>CC</sub> = V <sub>C</sub>             |
|                               | Output Voltage Rise Time               | t <sub>r</sub>                    |      | 80                   |      | ns    | R <sub>L</sub> = 15 Ω, C <sub>L</sub> = 2 200 pF                          |
|                               | Output Voltage Fall Time               | t <sub>f</sub>                    |      | 30                   |      | ns    | V <sub>CC</sub> = V <sub>C</sub>  |
| Remote Control Section        | Input Voltage at Output ON             | V <sub>IN(ON)</sub>               | 2.3  | 2.5                  | 2.7  | V     |   |
|                               | Input Voltage at Output OFF            | V <sub>IN(OFF)</sub>              | 2.1  | 2.3                  | 2.5  | V     |   |
|                               | Hysteresis Width                       | V <sub>H</sub>                    | 0.1  | 0.2                  | 0.3  | V     |   |
| Over Voltage Latch Section    | Over Voltage Threshold Voltage         | V <sub>TH(OVL)</sub>              | 2.0  | 2.4                  | 2.8  | V     | -10 °C ≤ T <sub>a</sub> ≤ +85 °C  |
|                               | Input Bias Current                     | I <sub>B(OVL)</sub>               |      |                      | 4    | μA    | OVL pin voltage = V <sub>TH(OVL)</sub>                                    |
|                               | OVL Reset Voltage                      | V <sub>R(OVL)</sub>               |      | 2                    |      | V     |   |
|                               | Delay to Output                        | t <sub>d(OVL)</sub>               |      | 600                  |      | ns    |   |
| Over Current Latch Section    | Over Current Threshold Voltage         | V <sub>TH(OCL)</sub> <sup>+</sup> | 200  | 220                  | 240  | mV    | -10 °C ≤ T <sub>a</sub> ≤ +85 °C  |
|                               | Over Current Threshold Voltage         | V <sub>TH(OCL)</sub> <sup>-</sup> | -230 | -210                 | -190 | mV    | -10 °C ≤ T <sub>a</sub> ≤ +85 °C  |
|                               | OCL Pin Output Current                 | I <sub>B(OCL)</sub>               |      | 250                  |      | μA    |   |
|                               | Delay to Output                        | t <sub>d(OCL)</sub> <sup>+</sup>  |      | 120                  |      | ns    |   |
|                               | Delay to Output                        | t <sub>d(OCL)</sub> <sup>-</sup>  |      | 190                  |      | ns    |   |

| BLOCK                       | PARAMETER                       | SYMBOL      | MIN. | TYP. | MAX. | UNIT | CONDITIONS                              |
|-----------------------------|---------------------------------|-------------|------|------|------|------|---|
| Error Amplification Section | Input Bias Current              | $I_B$ (AMP) |      |      | 1    | μA   | $V_{IN} = 2.5 V$                        |
|                             | Open-Loop Voltage Gain          | $A_v$       | 60   | 90   |      | 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    | $12 V \leq V_{CC} \leq 30 V,$           |
|                             | Common Mode Input Voltage Range | $V_{ICM}^-$ |      |      | -0.3 | V    | $-10^\circ C \leq T_a \leq +85^\circ C$ |

TYPICAL CHARACTERISTICS (T<sub>a</sub> = 25 °C)







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

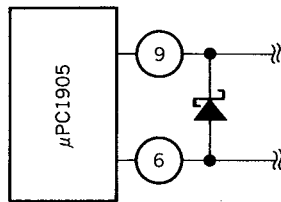
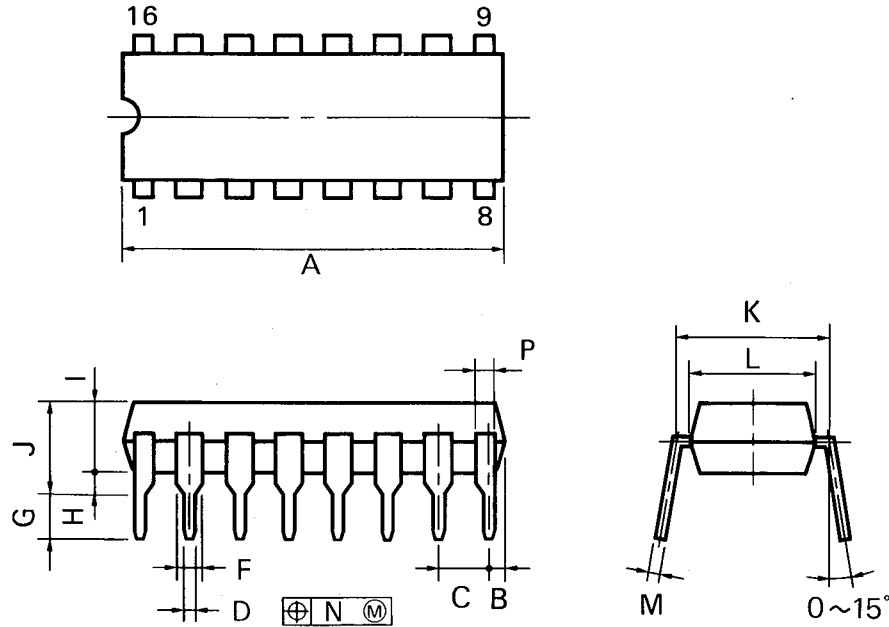


Fig.1



16PIN PLASTIC DIP (300 mil)

μPC1905CX



P16C-100-300B

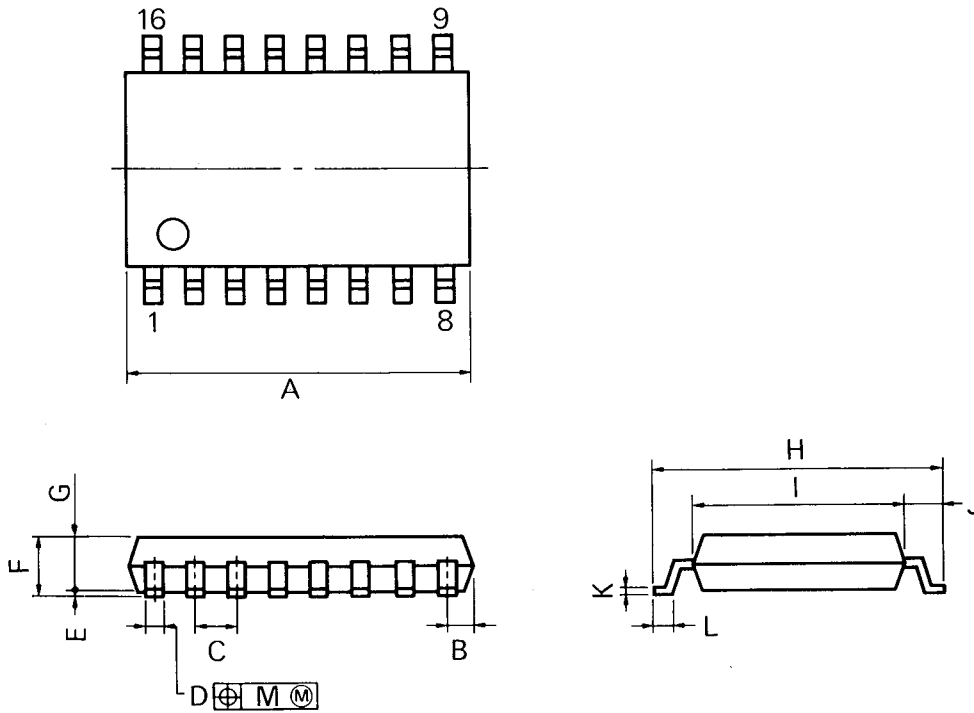
NOTES

- 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 ±0.10                               | 0.020 <sup>+0.004</sup> / <sub>-0.005</sub> |
| 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 <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)

μPC1905GS



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                                     |



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Application examples recommended by NEC Corporation

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Special: Automotive and Transportation equipment, Communication equipment (trunk line), Train and Traffic control devices, Burning control systems, antidisaster systems, anticrime systems etc.