

## RS-232 LINE DRIVER/RECEIVER

The  $\mu$ PD4726 is a high-voltage silicon gate CMOS line driver/receiver conforming to EIA/TIA-232-E Standards. It contains a DC/DC converter and can operate with a +5 V single power supply. In addition, it is also provided with ancillary functions such as a standby function.

This IC is equipped with four driver circuits and seven receiver circuits and can configure a simple RS-232 interface circuit with only four external capacitors.

## FEATURES

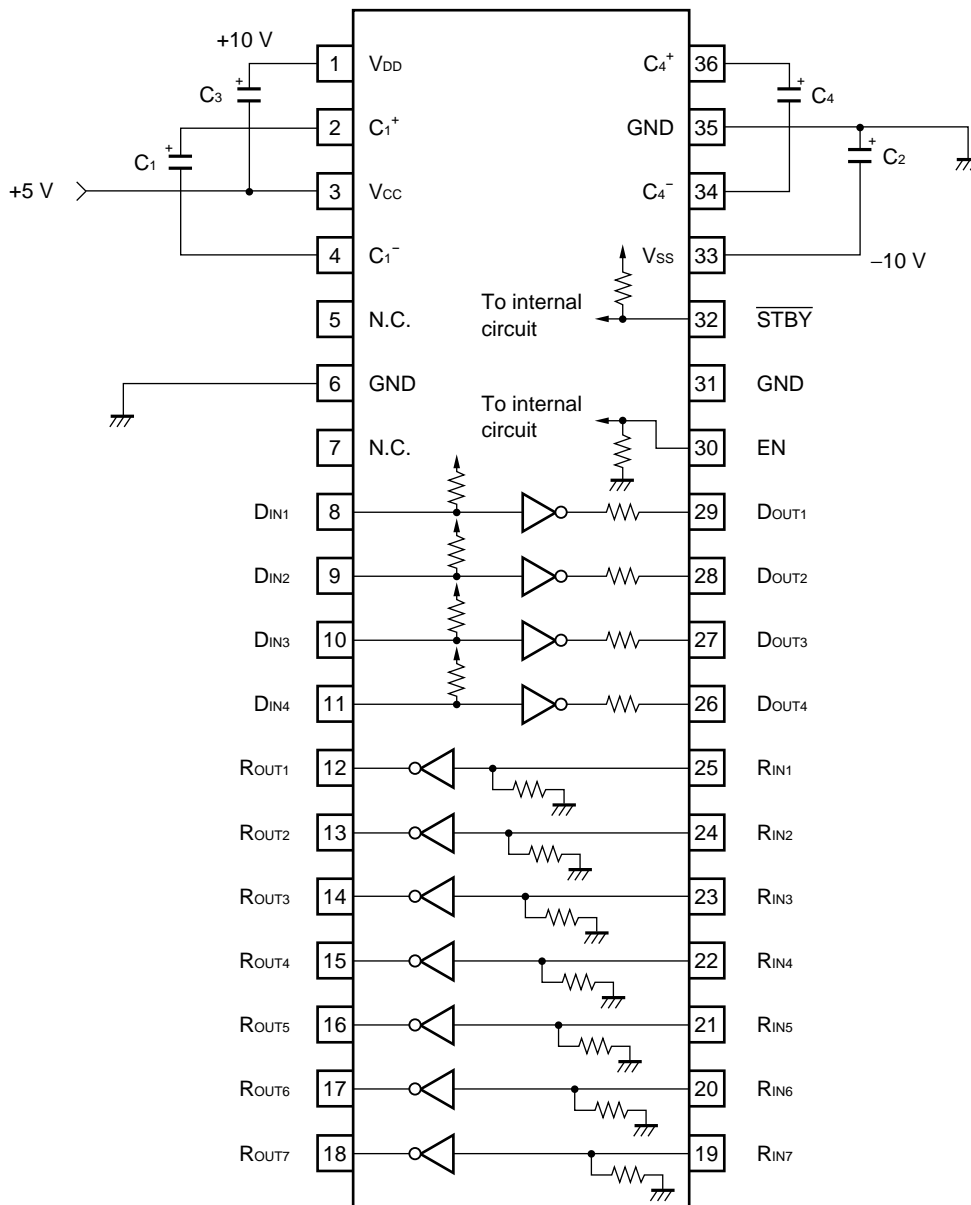
- Conforms to EIA/TIA-32-E (old RS-232C) Standards
- +5 V single power supply
- A standby mode can be set by making the standby pin low to reduce the power dissipation. At this time, the driver outputs go into a high-impedance state.
- Two receiver circuits can operate as inverters without a hysteresis width even in the standby mode. The remaining five receiver circuits are fixed to the high level.

## ORDERING INFORMATION

Part Number	Package	Quality Grade
$\mu$ PD4726GS-BAF	36-pin plastic SSOP (300 mil)	Standard

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.

BLOCK DIAGRAM/PIN CONFIGURATION (Top View)



- Notes 1.** V<sub>DD</sub> and V<sub>SS</sub> output internally boosted voltages. Do not connect a load directly to these pins.
- 2.** It is recommended that capacitors having a breakdown voltage of 20 V or higher be used as C<sub>1</sub> through C<sub>5</sub>. Inserting a bypass capacitor of 0.1 to 1 μF in between V<sub>CC</sub> and GND is also recommended.
- 3.** Be sure to connect all the GND pins. Especially, make sure that pin 31 is connected; otherwise, the μPD4726 will not operate normally. Be sure to leave the NC pins (pins 5 and 7) open.
- 4.** The pull-up resistors for D<sub>IN1</sub> through D<sub>IN4</sub> and  $\overline{\text{STBY}}$  and the pull-down resistor for EN are active resistors.

**TRUTH TABLE**

**Drivers**

$\overline{\text{STBY}}$	D <sub>IN</sub>	D <sub>OUT</sub>	Remarks
L	×	Z	Standby mode (DC/DC converter stops.)
H	L	H	Space level output
H	H	L	Mark level output

**Receivers**

$\overline{\text{STBY}}$	EN	R <sub>IN</sub>		R <sub>OUT</sub>		Remarks
		R <sub>6</sub> - R <sub>7</sub>	R <sub>1</sub> - R <sub>5</sub>	R <sub>6</sub> - R <sub>7</sub>	R <sub>1</sub> - R <sub>5</sub>	
L	L	×	×	H	H	Standby mode 1 (DC/DC converter stops.)
L	H	L	×	H	H	Standby mode 2 (DC/DC converter stops. R <sub>6</sub> and R <sub>7</sub> operate.)
L	H	H	×	L	H	
H	×	L		H		Mark level input
H	×	H		L		Space level input

- H: high level
- L: low level
- Z: high impedance
- ×: H or L

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

Parameter	Symbol	Ratings	Unit
Supply voltage	V <sub>CC</sub>	-0.5 to +7.0	V
Driver input voltage	D <sub>IN</sub>	-0.5 to V <sub>CC</sub> + 0.5	V
Receiver input voltage	R <sub>IN</sub>	-30.0 to +30.0	V
Control input voltage ( $\overline{\text{STBY}}$ , EN)	V <sub>IN</sub>	-0.5 to V <sub>CC</sub> + 0.5	V
Driver output voltage	D <sub>OUT</sub>	-25.0 to +25.0 <sup>Note 5</sup>	V
Receiver output voltage	R <sub>OUT</sub>	-0.5 to V <sub>CC</sub> + 0.5	V
Input current (D <sub>IN</sub> , $\overline{\text{STBY}}$ , EN)	I <sub>IN</sub>	±20.0	mA
Operating ambient temperature	T <sub>opt.</sub>	-40 to +85	°C
Storage temperature	T <sub>stg.</sub>	-55 to +150	°C
Permissible package power dissipation	P <sub>T</sub>	0.5	W

**Note 5.** Pulse width: 1 ms, duty cycle: 10 % MAX.

**RECOMMENDED OPERATING CONDITIONS**

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Supply voltage (V <sub>CHA</sub> = L)	V <sub>CC</sub>	4.5	5.0	5.5	V
Input voltage, high (D <sub>IN</sub> )	V <sub>IH</sub>	2.0		V <sub>CC</sub>	V
Input voltage, low (D <sub>IN</sub> )	V <sub>IL</sub>	0		0.8	V
Input voltage, high ( $\overline{\text{STBY}}$ , EN)	V <sub>IH</sub>	2.4		V <sub>CC</sub>	V
Input voltage, low ( $\overline{\text{STBY}}$ , EN)	V <sub>IL</sub>	0		0.8	V
Receiver input voltage	R <sub>IN</sub>	-30		+30	V
Operating ambient temperature	T <sub>opt.</sub>	-40		+85	°C
External capacitance (nominal value)	<b>Note 6</b>	1		4.7	$\mu$ F

**Note 6.** Use capacitors whose capacitance fluctuation is within ±50 % including fluctuations due to temperature and tolerance (effective value: 0.5 to 7.05  $\mu$ F).

Use of capacitors with excellent high-frequency characteristics (such as multilayer ceramic capacitors, tantalum capacitors, and aluminum electrolytic capacitors for switching power supply) is recommended. Keep the wiring length between a capacitor and an IC pin as short as possible.

## ELECTRICAL SPECIFICATIONS (CHIP)

(Unless otherwise specified,  $T_a = -40$  to  $+85$  °C,  $C_1$  through  $C_5 = 1$  μF)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Circuit current	I <sub>CC1</sub>	V <sub>CC</sub> = +5.0 V, no load, R <sub>IN</sub> pin open, $\overline{\text{STBY}} = \text{H}$			12	mA
Circuit current	I <sub>CC2</sub>	V <sub>CC</sub> = +5.0 V, R <sub>L</sub> = 3 kΩ (D <sub>OUT</sub> ), D <sub>IN</sub> = GND, R <sub>IN</sub> , R <sub>OUT</sub> pins open, $\overline{\text{STBY}} = \text{H}$			38	mA
Circuit current in standby mode (standby mode 1)	I <sub>CC3</sub>	V <sub>CC</sub> = +5.0 V, no load, D <sub>IN</sub> , R <sub>IN</sub> pins open, $\overline{\text{STBY}} = \text{L}$ , EN = L, T <sub>a</sub> = 25 °C		9	20	μA
		V <sub>CC</sub> = +5.0 V, no load, D <sub>IN</sub> , R <sub>IN</sub> pins open, $\overline{\text{STBY}} = \text{L}$ , EN = L,		15		μA
Circuit current in standby mode (standby mode 2)	I <sub>CC4</sub>	V <sub>CC</sub> = +5.0 V, no load, D <sub>IN</sub> , R <sub>IN</sub> pins open, $\overline{\text{STBY}} = \text{L}$ , EN = H, T <sub>a</sub> = 25 °C		9	20	μA
		V <sub>CC</sub> = +5.0 V, no load, D <sub>IN</sub> , R <sub>IN</sub> pins open, $\overline{\text{STBY}} = \text{L}$ , EN = H, T <sub>a</sub> = 25 °C		15		μA
Input voltage, high	V <sub>IH</sub>	$\overline{\text{STBY}}$ , EN pins, V <sub>CC</sub> = +4.5 to +5.5 V	2.4			V
Input voltage, low	V <sub>IL</sub>	$\overline{\text{STBY}}$ , EN pins, V <sub>CC</sub> = +4.5 to +5.5 V			0.8	V
Input current, high	I <sub>IH</sub>	$\overline{\text{STBY}}$ pin, V <sub>CC</sub> = +5.5 V, V <sub>I</sub> = +5.5 V			1	μA
Input current, low	I <sub>IL</sub>	$\overline{\text{STBY}}$ pin, V <sub>CC</sub> = +5.5 V, V <sub>I</sub> = 0 V			-40	μA
Input current, high	I <sub>IH</sub>	EN pin, V <sub>CC</sub> = +5.5 V, V <sub>I</sub> = +5.5 V			40	μA
Input current, low	I <sub>IL</sub>	EN pin, V <sub>CC</sub> = +5.5 V, V <sub>I</sub> = 0 V			-1	μA
Input capacitance	C <sub>IN</sub>	Driver inputs and receiver inputs, V <sub>CC</sub> = +5.0 V, vs. GND, f = 1 MHz			10	pF

**Remark** TYP. value is a reference value at T<sub>a</sub> = 25 °C.

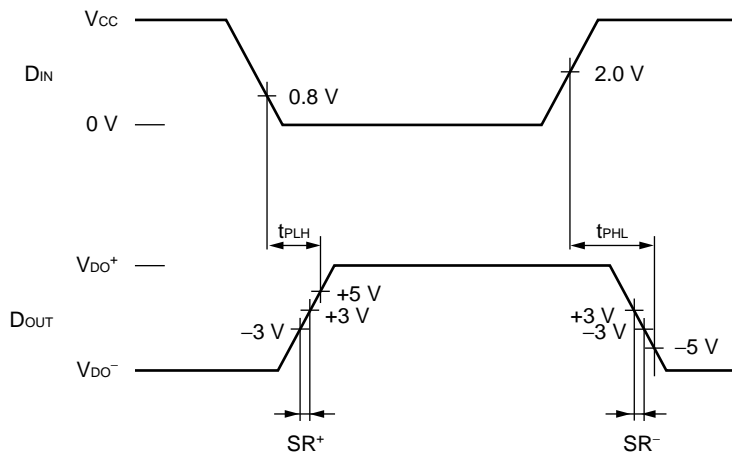
**ELECTRICAL SPECIFICATIONS (DRIVERS)**

(Unless otherwise specified,  $T_a = -40$  to  $+85$  °C,  $V_{CC} = +5.0$  V  $\pm 10$  %,  $C_1$  through  $C_5 = 1$  μF)

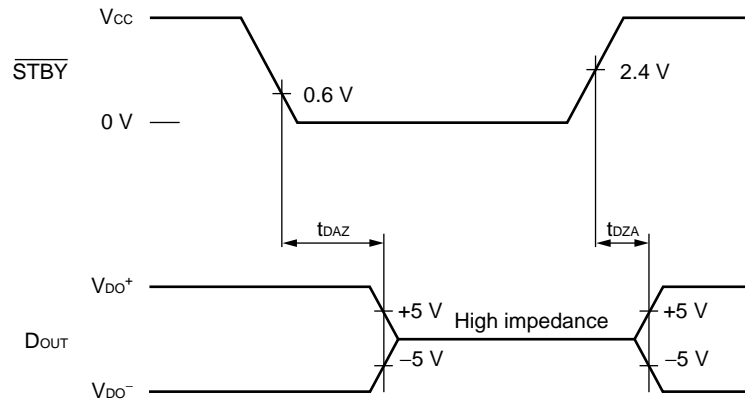
Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input voltage, low	$V_{IL}$				0.8	V
Input voltage, high	$V_{IH}$		2.0			V
Input current, low	$I_{IL}$				-40	μA
Input current, high	$I_{IH}$				1.0	μA
Output voltage	$V_{DO}$	$V_{CC} = +5.0$ V, $R_L = \infty$ , $T_a = 25$ °C		±9.7		V
		$V_{CC} = +5.0$ V, $R_L = 3$ kΩ, $T_a = T_{opt.}$	±5.5			V
		$V_{CC} = +4.5$ V, $R_L = 3$ kΩ, $T_a = T_{opt.}$	±5.0			V
Output short current	$I_{sc}$	$V_{CC} = +5.0$ V, vs. GND			±40	mA
Slew rate	SR	$C_L = 10$ pF, $R_L = 3$ to $7$ kΩ	4.0		30	V/μs
		$C_L = 2$ 500 pF, $R_L = 3$ to $7$ kΩ	4.0		30	V/μs
Propagation delay time <sup>Note 8</sup>	$t_{PHL}$	$R_L = 3$ kΩ, $C_L = 2$ 500 pF		2		μs
	$t_{PLH}$					
Output resistance	$R_0$	$V_{CC} = V_{DD} = V_{SS} = 0$ V $V_{OUT} = \pm 2$ V	300			Ω
Standby output transition time	$t_{DAZ}$	$R_L = 3$ kΩ, $C_L = 2500$ pF, <sup>Note 9</sup>		4	10	μs
Standby output transition time	$t_{DZA}$	$R_L = 3$ kΩ, $C_L = 2500$ pF, <sup>Note 9</sup>		0.5	1	ms
Power-ON output transition time	$t_{PRA}$	$R_L = 3$ kΩ, $C_L = 2500$ pF, <sup>Note 10</sup>		0.5	1	ms

**Remark** TYP. value is a reference value at  $T_a = 25$  °C.

**Note 8. Test point**

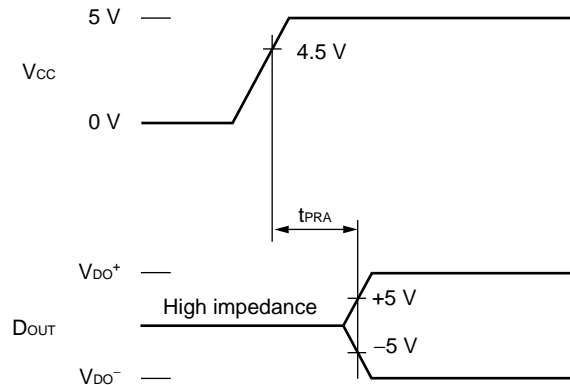


**Note 9. Test point**



The driver output is undefined during the standby output transition time  $t_{\text{DAZ}}$ . Do not perform communication within the standby output transition time  $t_{\text{DAZ}}$  after the standby mode has been released.

**Note 10. Test point**



The driver output is undefined during the power-ON output transition time  $t_{\text{PRA}}$ . Do not perform communication within the power-ON output transition time  $t_{\text{PRA}}$  on power application.

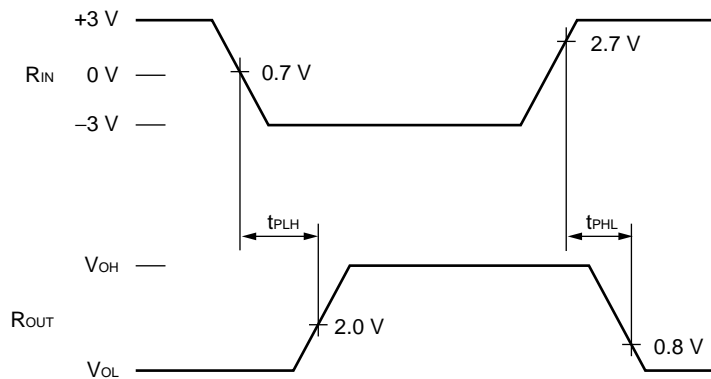
**ELECTRICAL SPECIFICATIONS (RECEIVERS)**

(Unless otherwise specified,  $V_{CC} = 4.5$  to  $5.5$  V,  $T_a = -40$  to  $+85$  °C,  $C_1$  through  $C_5 = 1$  μF)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Output voltage, low (STBY = H)	$V_{OL1}$	$I_{OUT} = 4$ mA			0.4	V
Output voltage, high (STBY = H)	$V_{OH1}$	$I_{OUT} = -4$ mA	$V_{CC} - 0.4$			V
Output voltage, low (STBY = L)	$V_{OL2}$	$I_{OUT} = 4$ mA			0.5	V
Output voltage, high (STBY = L)	$V_{OH2}$	$I_{OUT} = -4$ mA	$V_{CC} - 0.5$			V
Propagation delay time (STBY = H)	$t_{PHL}$ $t_{PLH}$	$R_{IN} \rightarrow R_{OUT}$ , $C_L = 150$ pF $V_{CC} = +4.5$ V, <b>Note 11</b>		0.2		μs
Propagation delay time (STBY = L, EN = H)	$t_{PHL}$ $t_{PLH}$	$R_{IN} \rightarrow R_{OUT}$ ( $R_6, R_7$ ), $C_L = 150$ pF $V_{CC} = +4.5$ V, <b>Note 11</b>		0.1		μs
Propagation delay time (STBY = L)	$t_{PHA}$ $t_{PAH}$	$EN \rightarrow R_{OUT}$ ( $R_6, R_7$ ), $C_L = 150$ pF $V_{CC} = +4.5$ V, <b>Note 12</b>		100	300	ns
Input resistance	$R_i$		3	5.5	7	kΩ
Open voltage across input pins	$V_{IO}$				0.5	V
Input threshold voltage (STBY = H)	$V_{IH}$	$V_{CC} = +4.5$ to $+5.5$ V	1.7	2.3	2.7	V
	$V_{IL}$	$V_{CC} = +4.5$ to $+5.5$ V	0.7	1.1	1.7	V
	$V_H$	$V_{CC} = +4.5$ to $+5.5$ V (hysteresis width)	0.5	1.2	1.8	V
Input threshold voltage (STBY = L, EN = H)	$V_{IH}$	$V_{CC} = +4.5$ to $+5.5$ V, $R_{IN6}, R_{IN7}$	2.7	1.5		V
	$V_{IL}$	$V_{CC} = +4.5$ to $+5.5$ V, $R_{IN6}, R_{IN7}$		1.5	0.7	V
Standby output transition time	$t_{DAH}$	<b>Note 13</b>		0.2	3	μs
Standby output transition time	$t_{DHA}$	<b>Note 13</b>		0.3	1	ms
Power-ON output transition time	$t_{PRA}$	<b>Note 14</b>		0.5	1	ms

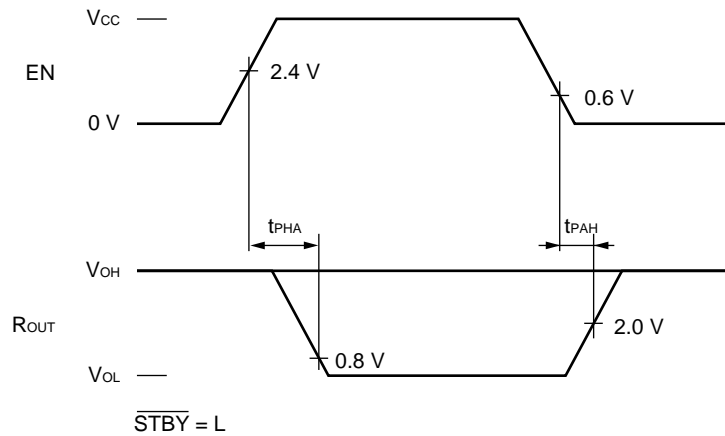
**Remark** TYP. value is a reference value at  $T_a = 25$  °C.

**Note 11. Test point**

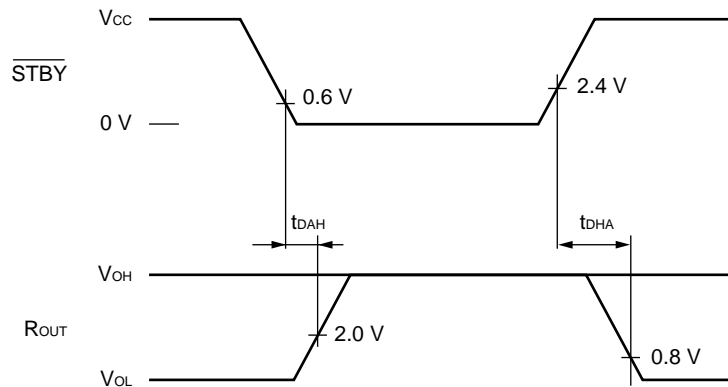




**Note 12. Test point**

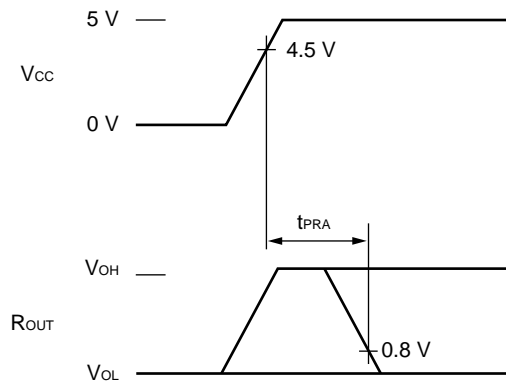


**Note 13. Test point**



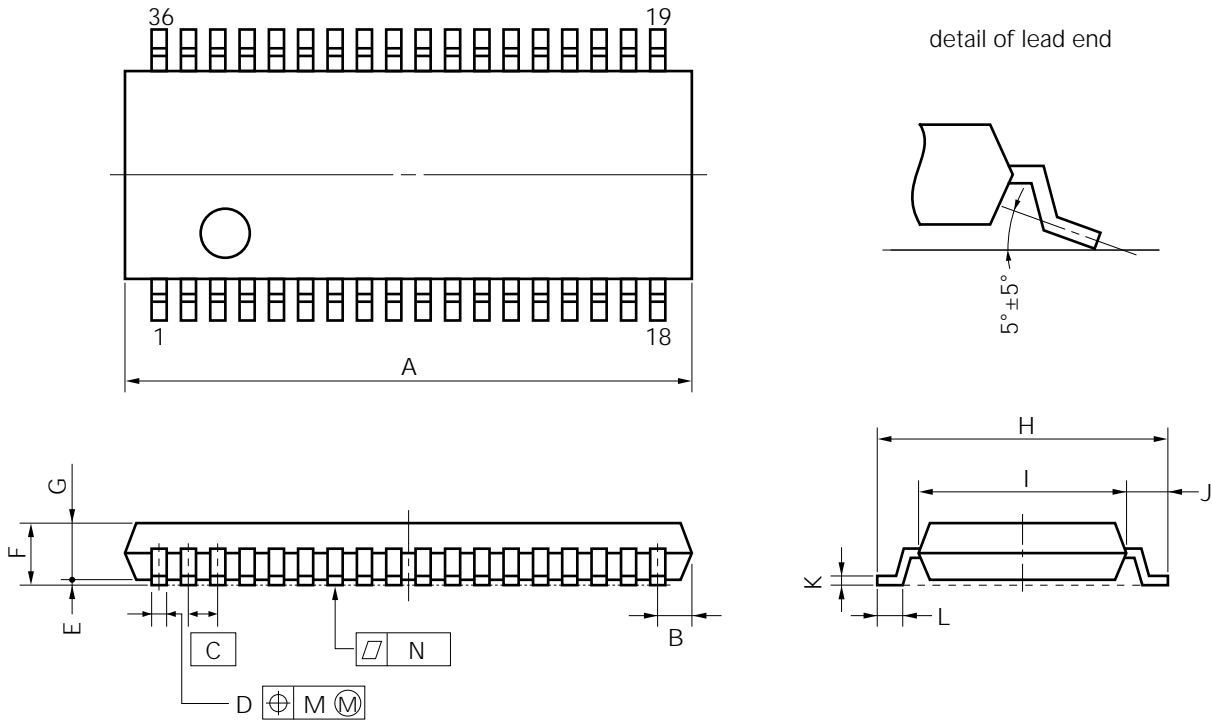
The receiver output is undefined during the standby output transition time t<sub>DHA</sub>. Do not perform communication within the standby output transition time t<sub>DHA</sub> after the standby mode has been released.

**Note 14. Test point**



The receiver output is undefined during the power-ON output transition time t<sub>PRA</sub>. Do not perform communication within the power-ON output transition time t<sub>PRA</sub> on power application.

36 PIN PLASTIC SHRINK SOP (300 mil)



**NOTE**

Each lead centerline is located within 0.10 mm (0.004 inch) of its true position (T.P.) at maximum material condition.

P36GM-80-300B-3

ITEM	MILLIMETERS	INCHES
A	15.54 MAX.	0.612 MAX.
B	0.97 MAX.	0.039 MAX.
C	0.8 (T.P.)	0.031 (T.P.)
D	0.35 <sup>+0.10</sup> <sub>-0.05</sub>	0.014 <sup>+0.004</sup> <sub>-0.003</sub>
E	0.125±0.075	0.005±0.003
F	1.8 MAX.	0.071 MAX.
G	1.55	0.061
H	7.7±0.3	0.303±0.012
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±0.2	0.024 <sup>+0.008</sup> <sub>-0.009</sub>
M	0.10	0.004
N	0.10	0.004

**RECOMMENDED SOLDERING CONDITIONS**

Solder and mount the μPD4726 under the following recommended conditions.  
Consult NEC for conditions other than those recommended.

**μPD4726GS-BAF**

Soldering method	Soldering conditions	Symbol
Infrared ray reflow	Peak temperature of package surface: 235 °C, Reflow time: Within 30 sec (210 °C or higher), Number of reflow process: 2, Exposure limit: None <sup>Note</sup>	IR35-00-2
VPS	Peak temperature of package surface: 215 °C, Reflow time: Within 40 sec (200 °C or higher), Number of reflow process: 2, Exposure limit: None <sup>Note</sup>	VP15-00-2
Wave soldering	Solder temperature: 260 °C or lower, Reflow time: Within 10 sec, Number of reflow process: 1, Exposure limit: None <sup>Note</sup>	WS60-00-1
Partial heating	Pin temperature: 300 °C or lower, Time: Within 10 sec, Exposure limit: None <sup>Note</sup>	

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

**Caution** Do not use two or more soldering methods in combination (except the partial heating method).

**REFERENCE**

Document name	Document No.
Semiconductor Device Mounting Technology Manual	IEI-1207
Quality grade on NEC Semiconductor Devices	IEI-1209
NEC Semiconductor Device Reliability/Quality Control system	IEI-1212

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Specific: Aircrafts, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems or medical equipment for life support, etc.

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Anti-radioactive design is not implemented in this product.