

## RS-232 LINE DRIVER/RECEIVER

The  $\mu$ PD4713A is a high-voltage silicon gate CMOS line driver/receiver conforming to the EIA/TIA-232-E standard. It can operate with a single +5 V power source because it is provided with a DC-DC converter. In addition, this line driver/receiver has many ancillary functions, including output control, threshold select, and standby functions. Because the  $\mu$ PD4713A is provided with three output driver circuits and three receiver circuits, it can constitute an RS-232 interface circuit with a single chip.

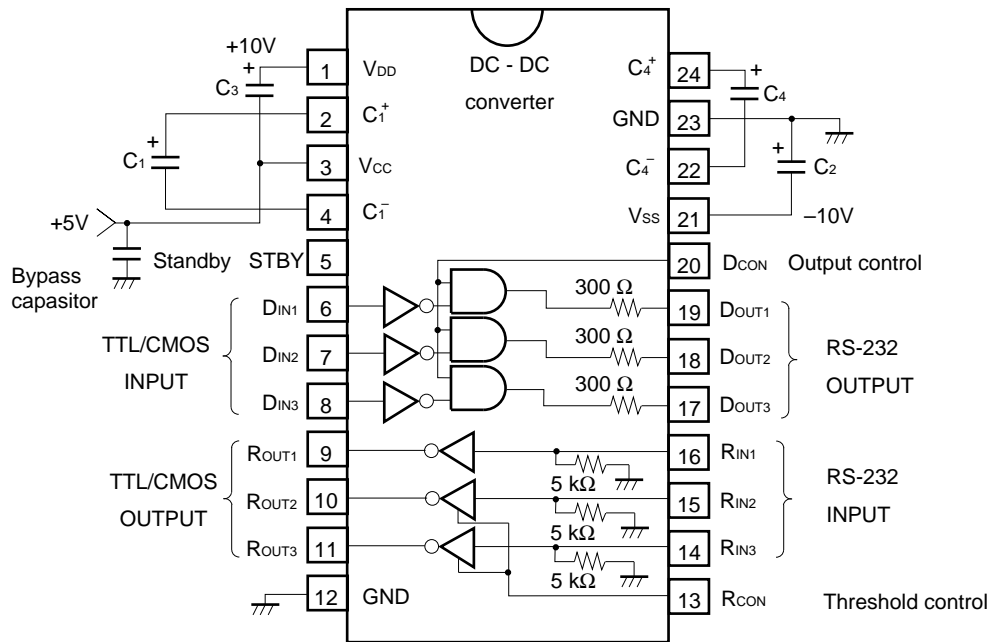
**FEATURES**

- Conforms to EIA/TIA-232-E (RS-232C) standard
- +5 V single power source
- Threshold select pin selecting two types of threshold voltages
- Standby mode can be set by making standby pin high to reduce circuit current.
- Three-state output configuration. Both driver and receiver outputs go into high-impedance state in standby mode.

**ORDERING INFORMATION**

Part Number	Package
$\mu$ PD4713ACX	24-pin plastic DIP (300 mil)
$\mu$ PD4713AGT	24-pin plastic SOP (375 mil)

**BLOCK DIAGRAM/PIN CONFIGURATION (Top View)**



- \* V<sub>DD</sub> and V<sub>SS</sub> are output pins of voltages internally boosted. Connecting a load directly to these pins is not recommended.
- \*\* The standby pin is internally pulled down.
- \*\*\* Use capacitors with a working voltage of 16 V or higher as C<sub>1</sub> through C<sub>4</sub>. Insert a bypass Capacitor about 0.1 to 1 μF between V<sub>CC</sub> pin to GND pin.

**TRUTH TABLE**

**Drivers**

STBY	D <sub>CON</sub>	D <sub>IN</sub>	D <sub>OUT</sub>	Remark
H	X	X	Z	Standby mode (DC-DC converter stops)
L	L	X	L	Mark level output
L	H	L	H	Space level output
L	H	H	L	Mark level output

**Receivers**

STBY	R <sub>IN</sub>	R <sub>OUT</sub>	Remark
H	X	Z	Stanby mode (DC-DC converter stops)
L	L	H	Mark level input
L	H	L	Space level input

**Receiver input threshold voltage**

R <sub>CON</sub>	R <sub>IN1</sub>	R <sub>IN2</sub> to R <sub>IN3</sub>
L	A mode	A mode
H	A mode	B mode

H: high level, L: low level, Z: high impedance, X: H or L

**ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25 °C)**

Parameter	Symbol	Ratings	Unit
Supply voltage	V <sub>CC</sub>	-0.5 to +6.0	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
Driver output voltage	D <sub>OUT</sub>	-25.0 to +25.0 <b>Note1</b>	V
Receiver output voltage	R <sub>OUT</sub>	-0.5 to V <sub>CC</sub> + 0.5	V
Receiver input current	I <sub>IN</sub>	±60.0	mA
Operating temperature range	T <sub>A</sub>	-40 to +85	°C
Storage temperature range	T <sub>stg</sub>	-55 to +150	°C
Power dissipation	P <sub>T</sub>	0.5	W

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

**RECOMMENDED OPERATING RANGE**

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Supply voltage	V <sub>CC</sub>	4.5	5.0	5.5	V
Receiver input voltage	R <sub>IN</sub>	-25		+25	V
Operating temperature range	T <sub>A</sub>	-20		80	°C
External capacitance	<b>Note 2</b>	4.7		47	μF

**Note 2.** The capacitance of an electrolytic capacitor decreases at a low temperature (0 °C or lower). Determine the capacitance of the capacitor to be used taking this into consideration when the μPD4713A is used at a low temperature. Keep the wiring length between the capacitor and IC as short as possible.

**ELECTRICAL CHARACTERISTICS (OVERALL)**

(Unless otherwise specified,  $V_{CC} = +5\text{ V} \pm 10\%$ ,  $T_A = -20\text{ }^\circ\text{C}$  to  $+80\text{ }^\circ\text{C}$ ,  $C_1$  to  $C_4 = 22\text{ }\mu\text{F}$ )

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Circuit current	$I_{CC1}$	$V_{CC} = +5\text{ V}$ , no load, $R_{IN}$ pin open (Standby pin open)		5.0	18.0	mA
Circuit current	$I_{CC2}$	$V_{CC} = +5\text{ V}$ , $R_L = 3\text{ k}\Omega$ ( $D_{OUT}$ ), $D_{IN} = \text{GND}$ , $R_{IN}$ and $R_{OUT}$ pins open (Standby pin open)		21.0	40.0	mA
Standby circuit current	$I_{CC}$ (Standby)	$V_{CC} = +5\text{ V}$ , no load, $R_{IN}$ pin open (Standby pin high)		50	120	$\mu\text{A}$
Standby low-level input voltage	$V_{IL}$ (Standby)	<b>Note 3</b>			0.8	V
Standby high-level input voltage	$V_{IH}$ (Standby)		2.0			V
Standby high-level input current	$I_{IH}$ (Standby)	$V_{CC} = +5.5\text{ V}$ $V_I = 5.5\text{ V}$			100	$\mu\text{A}$
Standby low-level input current	$I_{IL}$ (Standby)	$V_{CC} = +5.5\text{ V}$ $V_I = 0\text{ V}$			-1	$\mu\text{A}$
Input capacitance	$C_{IN}$	Driver input and receiver input $V_{CC} = +5\text{ V}$ , vs. GND, $f = 1\text{ MHz}$			10	pF

\* TYP.: Typical (reference) value at  $T_A = 25\text{ }^\circ\text{C}$ .

**Note 3.** Because the standby pin is internally pulled down, if the standby pin is left open, operating mode is in effect.

**ELECTRICAL CHARACTERISTICS (DRIVER)**

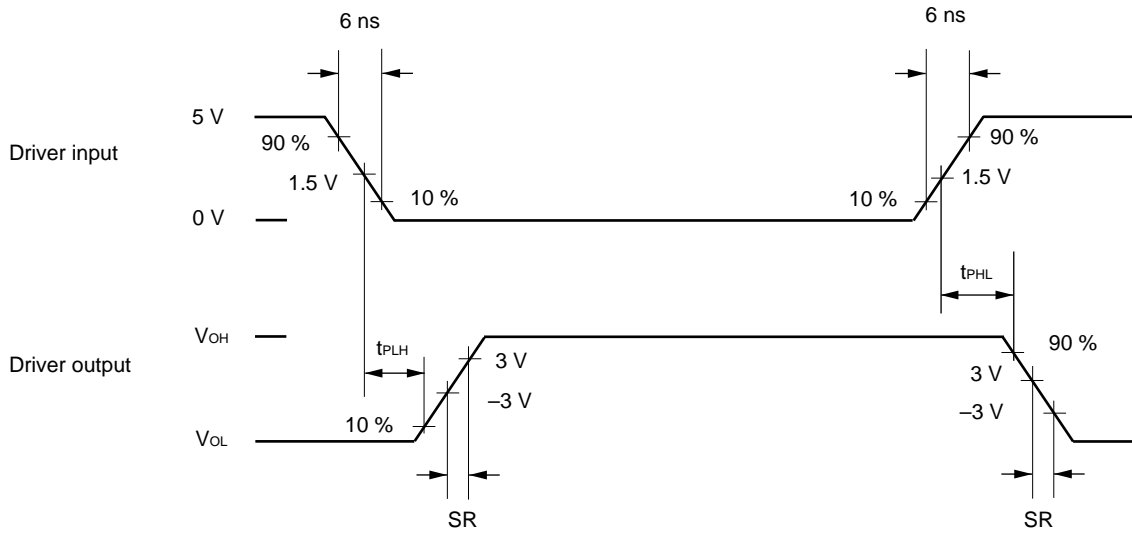
(Unless otherwise specified,  $V_{CC} = +5\text{ V} \pm 10\%$ ,  $T_A = -20\text{ }^\circ\text{C}$  to  $+80\text{ }^\circ\text{C}$ ,  $C_1$  to  $C_4 = 22\text{ }\mu\text{F}$ )

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Low-level input voltage	$V_{IL}$				0.8	V
High-level input voltage	$V_{IH}$		2.0			V
Low-level input current	$I_{IL}$		0		-1.0	$\mu\text{A}$
High-level input current	$I_{IH}$		0		1.0	$\mu\text{A}$
Output voltage	$V_{DO}$	$V_{CC} = +5.0\text{ V}$ , $R_L = \infty$ , $T_A = 25\text{ }^\circ\text{C}$		$\pm 9.7$		V
		$V_{CC} = +5.0\text{ V}$ , $R_L = 3\text{ k}\Omega$	$\pm 5.5$			V
		$V_{CC} = +4.5\text{ V}$ , $R_L = 3\text{ k}\Omega$	$\pm 5.0$			V
Output short current	$I_{SC}$	$V_{CC} = +5.0\text{ V}$ , vs. GND		$\pm 15$	$\pm 40$	mA
Slew rate	SR	$C_L = 10\text{ pF}$ , $R_L = 3\text{ to }7\text{ k}\Omega$	1.5	9	30	V/ $\mu\text{s}$
		$C_L = 2500\text{ pF}$ , $R_L = 3\text{ to }7\text{ k}\Omega$	1.5	4	30	V/ $\mu\text{s}$
Propagation delay time <b>Note 4</b>	$t_{PHL}$	$R_L = 3.5\text{ k}\Omega$ , $C_L = 2500\text{ pF}$		0.8		$\mu\text{s}$
	$t_{PLH}$					
Output resistance	$R_O$	$V_{CC} = V_{DD} = V_{SS} = 0\text{ V}$ $V_{OUT} = \pm 2\text{ V}$	300	500		$\Omega$
Standby output transition time	$t_{DAZ}$	<b>Note 5</b>		4	10	$\mu\text{s}$
Standby output transition time	$t_{DZA}$	<b>Note 5</b>		25	50	ms

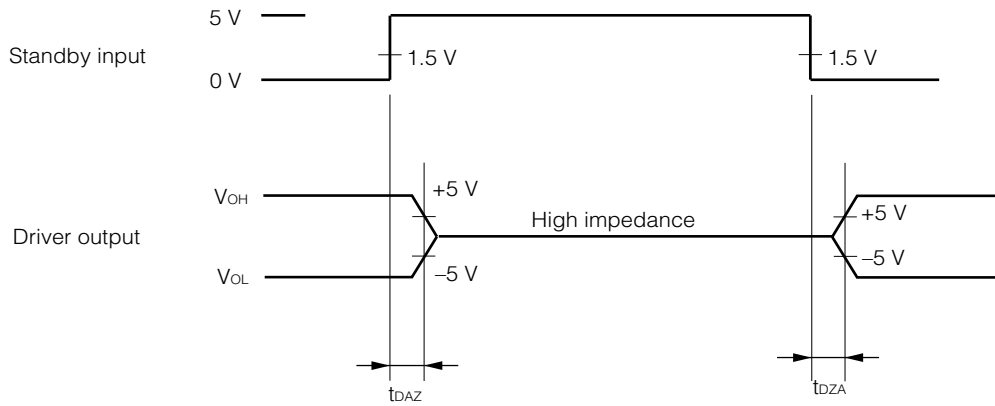
\* TYP.: Typical (reference) value at  $T_A = 25\text{ }^\circ\text{C}$ .

**Note 4. Test point**

If the output control pin is made low, the driver output goes low regardless of the driver input state.



**Note 5. Test Point**



Do not perform communication within the standby output transition time t<sub>DZA</sub> on power application or on releasing the standby mode.

**ELECTRICAL CHARACTERISTICS (RECEIVER)**

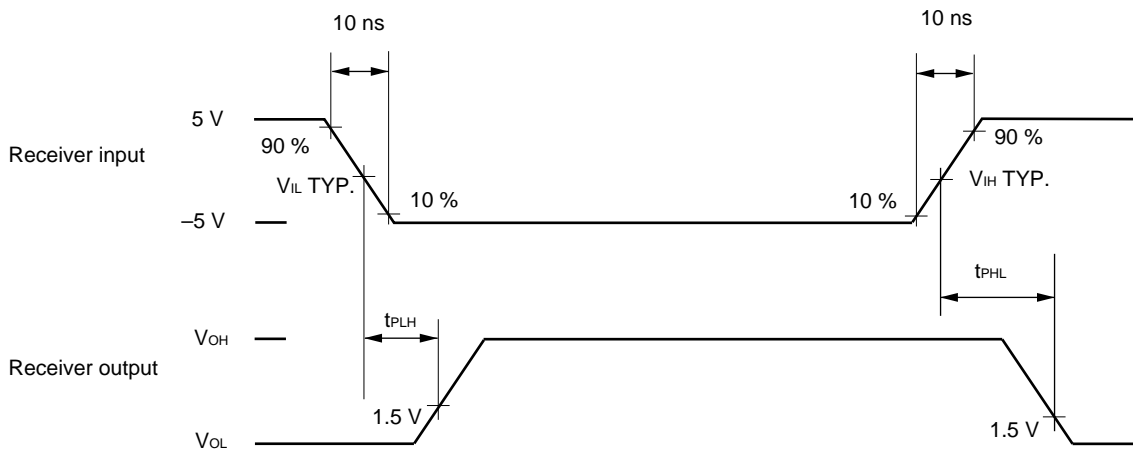
(Unless otherwise specified,  $V_{CC} = +5\text{ V} \pm 10\%$ ,  $T_A = -20\text{ }^\circ\text{C}$  to  $+80\text{ }^\circ\text{C}$ ,  $C_1$  to  $C_4 = 22\text{ }\mu\text{F}$ )

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Low-level output voltage	$V_{OL}$	$I_{OUT} = 4\text{ mA}$			0.4	V
High-level output voltage	$V_{OH}$	$I_{OUT} = -4\text{ mA}$	$V_{CC}$ -0.8			V
Low-level input voltage	$V_{IL}$	R <sub>CON</sub> pin			0.8	V
High-level input voltage	$V_{IH}$	R <sub>CON</sub> pin	2.0			V
Propagation delay time <b>Note 7</b>	$t_{PHL}$ $t_{PLH}$	$R_L = 1\text{ k}\Omega$ , $C_L = 150\text{ pF}$		0.13		$\mu\text{s}$
Input current	$I_{IN}$			1		mA
Input resistance	$R_I$		3	5	7	k $\Omega$
Input pin release voltage	$V_{IO}$	Input threshold A mode only			0.5	V
Input threshold A mode (R <sub>CON</sub> pin low)	$V_{IH}$	$V_{CC} = +5\text{ V}$	1.6	2.2	2.6	V
	$V_{IL}$	$V_{CC} = +5\text{ V}$	0.6	1	1.6	V
	$V_H$	$V_{CC} = +5\text{ V}$ (hysteresis width)	0.5	1.2	1.8	V
Input threshold B mode <b>Note 6</b> (R <sub>CON</sub> pin high)	$V_{IH}$	$V_{CC} = +5\text{ V}$	1.6	2.2	2.6	V
	$V_{IL}$	$V_{CC} = +5\text{ V}$	-0.4	-1.8	-3.0	V
	$V_H$	$V_{CC} = +5\text{ V}$ (hysteresis width)	2.6	4.0	5.4	V
Standby output transition time	$t_{DAZ}$	<b>Note 8</b>		0.4	1	$\mu\text{s}$
Standby output transition time	$t_{DZA}$	<b>Note 8</b>		1	10	ms

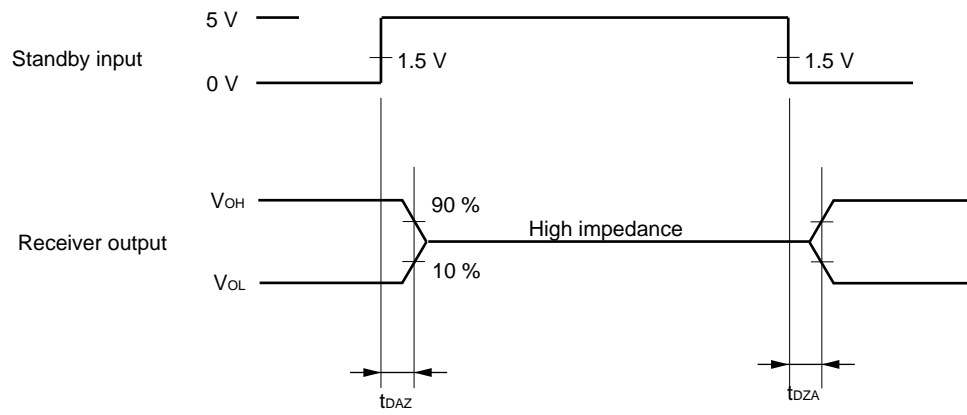
\* TYP.: Typical (reference) value at  $T_A = 25\text{ }^\circ\text{C}$ .

**Note 6.** This data is applicable to receivers 2 and 3 only. Receiver 1 is fixed in A mode.

**Note 7.** Test Point



**Note 8. Test Point**

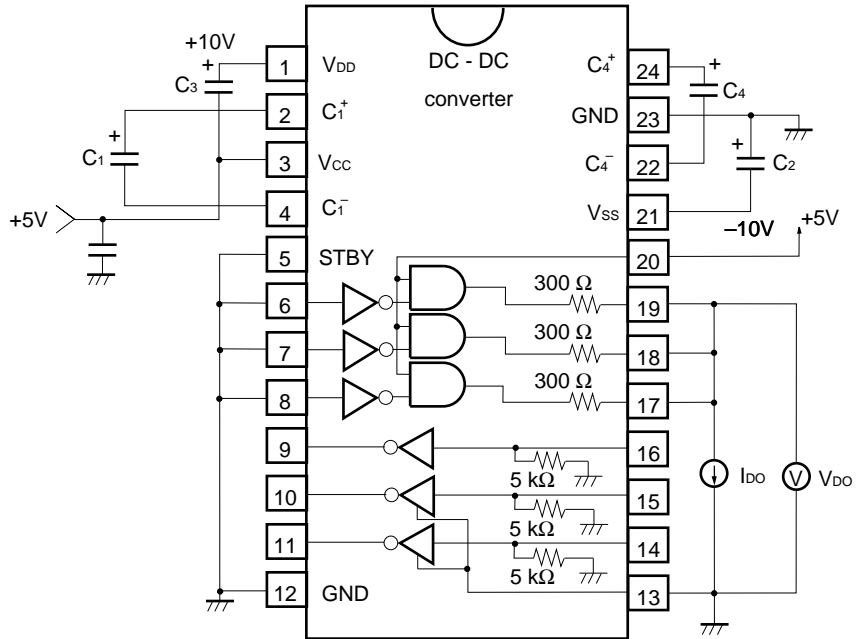


The receiver output is undefined during the standby output transition time  $t_{DZA}$ . Do not perform communication in the standby output transition time  $t_{DZA}$  on power application or on releasing the standby mode.

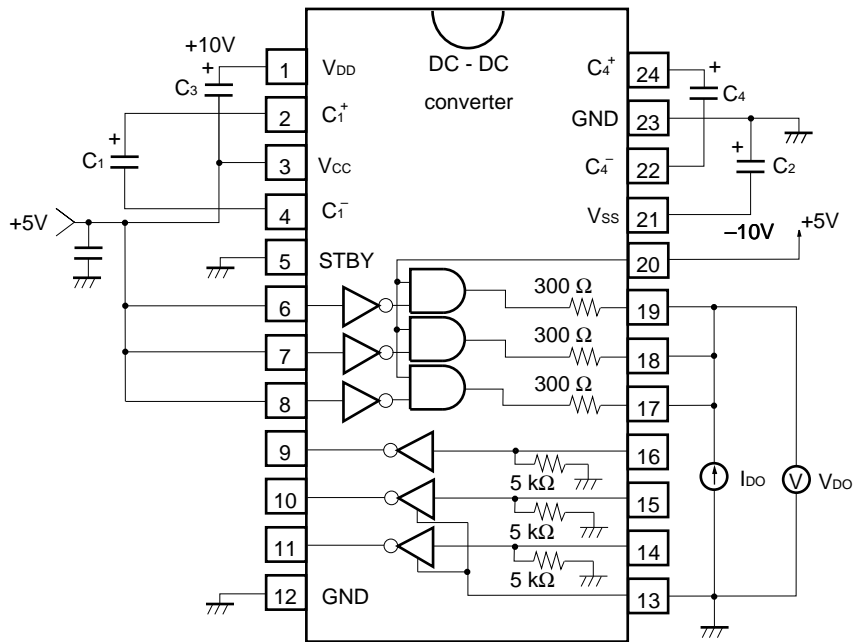


TEST CIRCUIT

Driver output voltage/Output current (+ side)

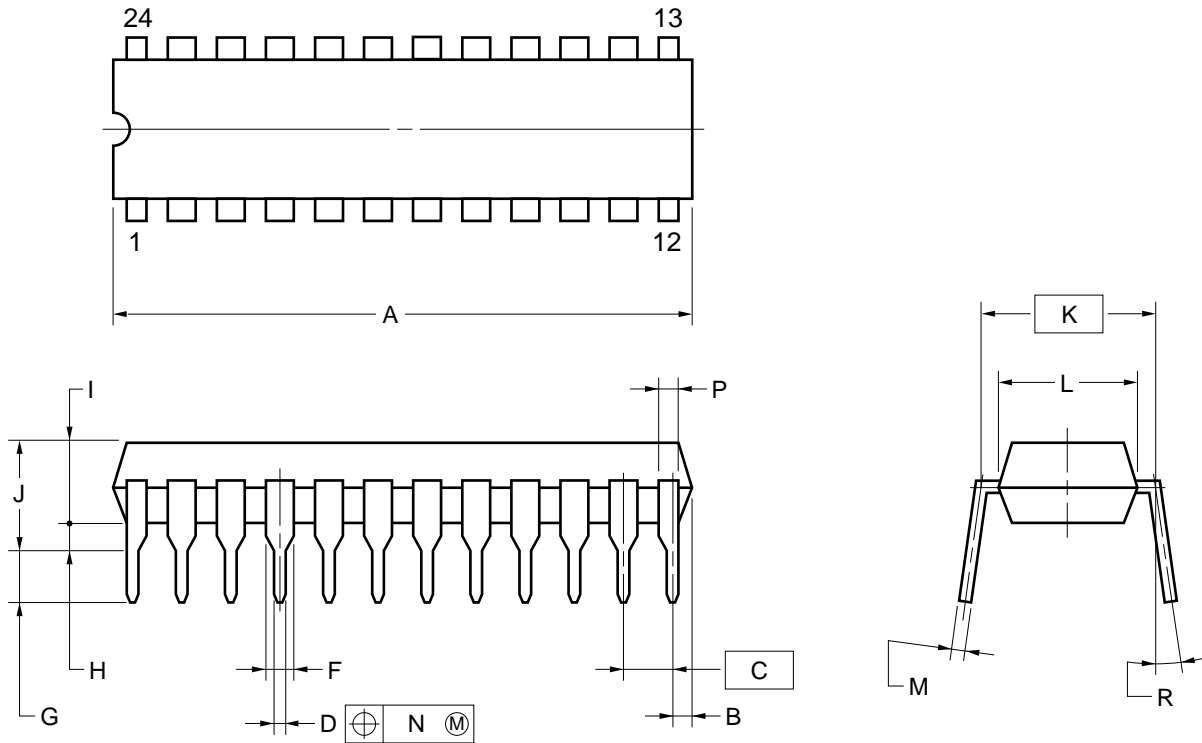


Driver output voltage/Output current (- side)



PACKAGE DRAWINGS

24PIN PLASTIC DIP (300 mil)



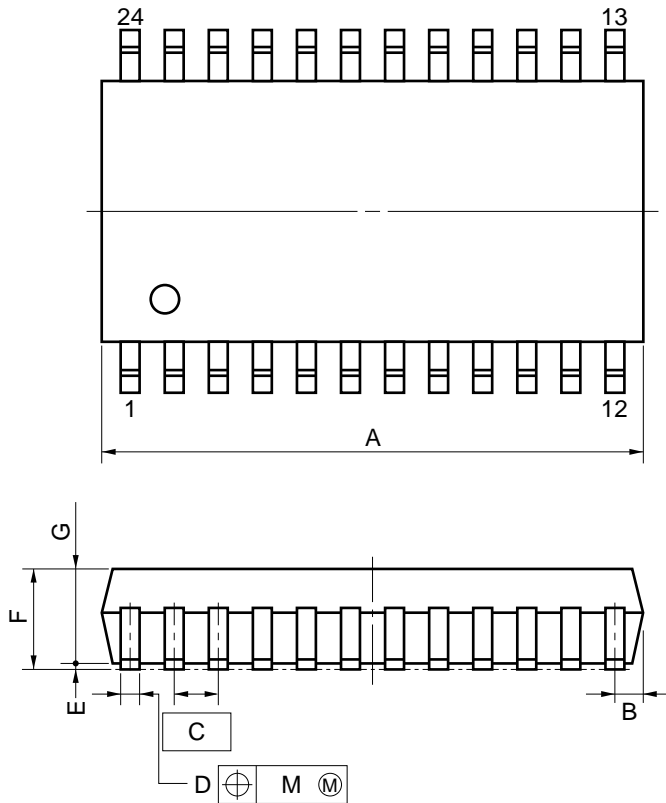
NOTES

- 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.

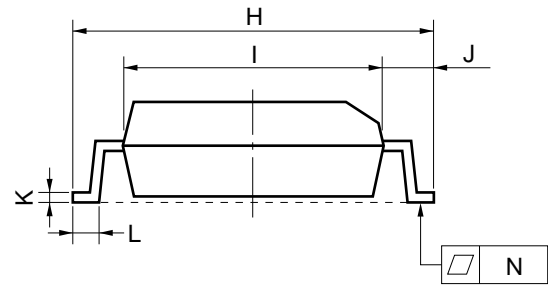
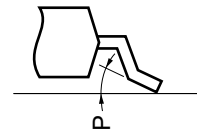
ITEM	MILLIMETERS	INCHES
A	33.02 MAX.	1.300 MAX.
B	2.54 MAX.	0.100 MAX.
C	2.54 (T.P.)	0.100 (T.P.)
D	0.50±0.10	0.020 <sup>+0.004</sup> <sub>-0.005</sub>
F	1.2 MIN.	0.047 MIN.
G	3.5±0.3	0.138±0.012
H	0.51 MIN.	0.020 MIN.
I	4.31 MAX.	0.170 MAX.
J	5.08 MAX.	0.200 MAX.
K	7.62 (T.P.)	0.300 (T.P.)
L	6.4	0.252
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	1.0 MIN.	0.039 MIN.
R	0~15°	0~15°

P24C-100-300A-1

24 PIN PLASTIC SOP (375 mil)



detail of lead end



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	15.54 MAX.	0.612 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±0.1	0.004±0.004
F	2.9 MAX.	0.115 MAX.
G	2.50	0.098
H	10.3±0.3	0.406 <sup>+0.012</sup> <sub>-0.013</sub>
I	7.2	0.283
J	1.6	0.063
K	0.15 <sup>+0.10</sup> <sub>-0.05</sub>	0.006 <sup>+0.004</sup> <sub>-0.002</sub>
L	0.8±0.2	0.031 <sup>+0.009</sup> <sub>-0.008</sub>
M	0.12	0.005
N	0.15	0.006
P	3° <sup>+7°</sup> <sub>-3°</sub>	3° <sup>+7°</sup> <sub>-3°</sub>

P24GM-50-375B-3

**RECOMMENDED SOLDERING CONDITIONS**

Soldering the μPD4713A under the conditions listed in the table below is recommended.

For soldering methods and conditions other than those recommended, consult NEC.

**Surface mount type**

For the details of the recommended soldering conditions of the surface mount type, refer to Information document “Semiconductor Device Mounting Technology Manual” (C10535EJ7V0IF00)

**μPD4713AGT**

Soldering Method	Soldering Condition	Recommended Condition Symbol
Infrared reflow	Package peak temperature: 235 °C, Time: 30 seconds MAX. (210 °C MIN.), Number of times: 2, Number of days: not limited*	IR35-00-2
VPS	Package peak temperature: 215 °C, Time: 40 seconds MAX. (200 °C MIN.), Number of times: 2, Number of days: not limited*	VP15-00-2
Wave soldering	Soldering bath temperature: 260 °C MAX., Time: 10 seconds MAX., Number of times: 1, Number of days: not limited*	WS60-00-1
Pin partial heating	Pin temperature: 300 °C MAX. (lead temperature), Time: 3 seconds MAX. (per lead pin), Number of days: not limited*	

\* The number of days the device can be stored at 25 °C, 65 % RH MAX. after the dry pack has been opened.

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

**Through-hole type**

**μPD4713ACX**

Soldering Method	Soldering Conditions
Wave soldering	Soldering bath temperature: 260 °C MAX., Time: 10 seconds MAX.

**REFERENCE DOCUMENTS**

“NEC Semiconductor Device Reliability/Quality Control System” (IEI-1212)

“Quality Grade on NEC Semiconductor Devices” (IEI-1209)

“Semiconductor Device Mounting Technology Manual” (C10535EJ7V0IF00)

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Special: Transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, safety equipment and medical equipment (not specifically designed for life support)

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