NEC

MOS INTEGRATED CIRCUIT

μPD4724

RS-232 LINE DRIVER/RECEIVER AT 3.3 V/5 V

The μPD4724 is a high breakdown voltage silicon gate CMOS line driver/receiver based on the EIA/TIA-232-E standard. This IC features various functions, such as standby, and incorporates a DC/DC converter that switches boost multiples, enabling operation at both +3.3 V and +5 V single supply voltage.

The μPD4724 incorporates three drivers and five receivers, so an RS-232 interface circuit can be easily constructed by connecting five external capacitors.

FEATURES

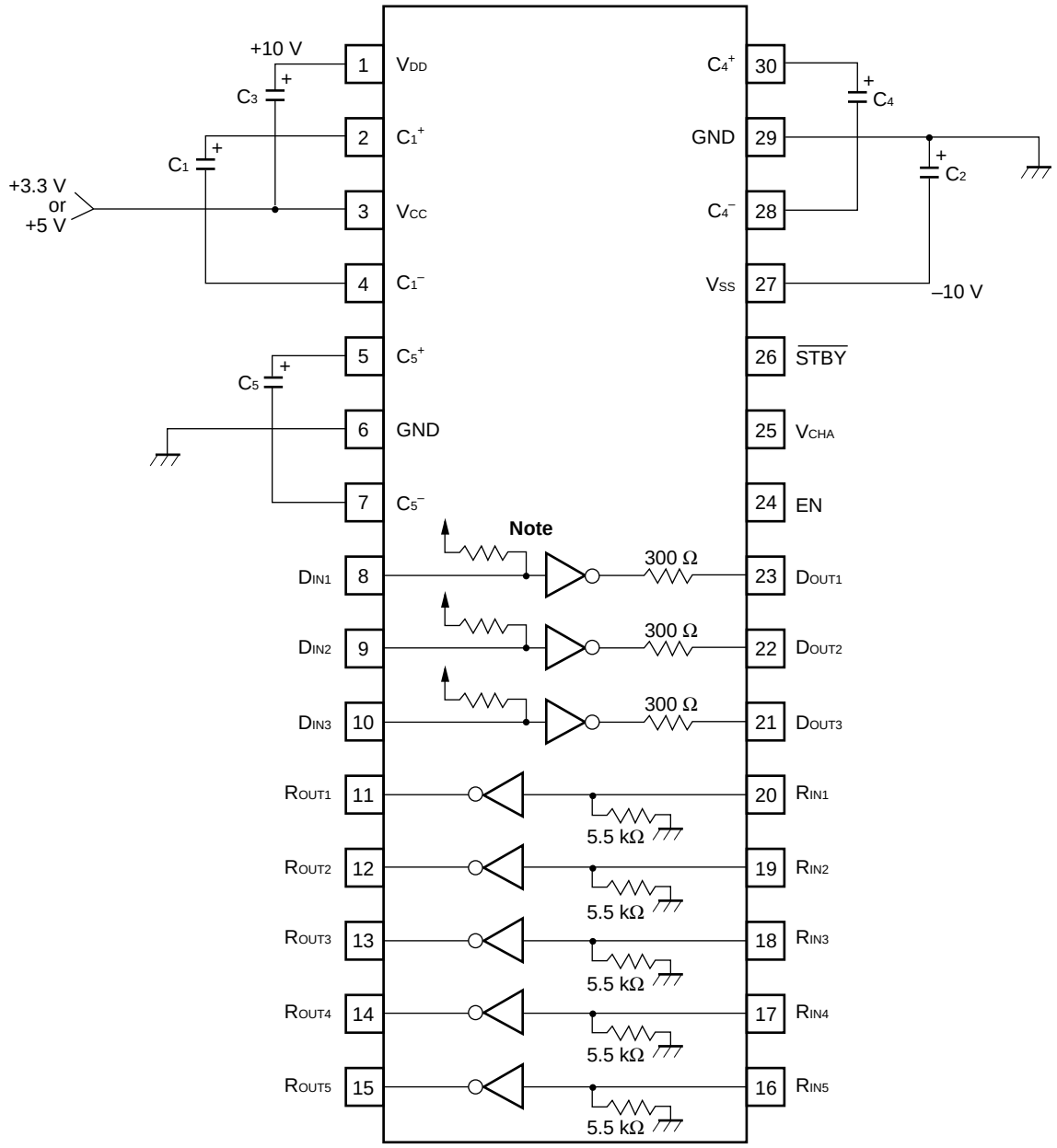
- Based on EIA/TIA-232-E (RS-232-C) standard.
- Single power supply: +3.3 V or +5 V (selectable with the V_{CHA} pin)
- Standby mode: Setting the standby pin to low level switches this IC into the standby mode and makes the driver outputs high-impedance.
- Enable mode: When the enable pin is high level during the standby mode, two receivers can operate as inverters without hysteresis width (The other three receivers are fixed to high level).

ORDERING INFORMATION

Part number	Package
μPD4724GS-GJG	30-pin plastic shrink SOP (300 mil)

Document No. S12201EJ2V0DS00 (2nd edition)
(Previous No. IC-3228)
Date Published January 1997 N
Printed in Japan

BLOCK DIAGRAM/PIN CONFIGURATION (TOP VIEW)



Note The pull-up resistors of the driver inputs are active resistors.

Remark 1. V_{DD} and V_{SS} are pins that output the voltage boosted internally. Don't connect these pins to the load.

2. Capacitors with a breakdown voltage of 20 V or higher are recommended for C_1 to C_5. And it is recommended to insert the capacitor that is 0.1 μF to 1 μF between V_{CC} and GND.

3. The capacitor C_5 does not have to be connected when the IC is used in 5 V mode (V_{CHA} = L).

TRUTH TABLE

Driver

$\overline{STBY}$	D_{IN}	D_{OUT}	Remark
L	×	Z	Standby mode (D/D converter OFF)
H	L	H	Space level output
H	H	L	Mark level output

Receiver

$\overline{STBY}$	EN	R_{IN}		R_{OUT}		Remark
		R_4 to R_5	R_1 to R_3	R_4 to R_5	R_1 to R_3	
L	L	×	×	H	H	Standby mode1 (D/D converter OFF)
L	H	L	×	H	H	Standby mode2 (D/D converter OFF, R_4 and R_5 operate)
L	H	H	×	L	H	Standby mode2 (D/D converter OFF, R_4 and R_5 operate)
H	×	L		H		Mark level input
H	×	H		L		Space level input

3 V and 5 V Switching[Note]

V_{CHA}	Operation mode
L	5 V mode (Double boost)
H	3 V mode (Triple boost)

H: High level, L: Low level, Z: High-impedance, ×: Don't care

Note Be sure to switch the V_{CHA} pin in standby mode ($\overline{STBY}$ = L).

ABSOLUTE MAXIMUM RATINGS (T_A = +25 °C)

Parameter	Symbol	Ratings	Unit
Supply Voltage (V_{CHA} = L)	V_{CC}	–0.5 to +7.0	V
Supply Voltage (V_{CHA} = H)	V_{CC}	–0.5 to +4.5	V
Driver Input Voltage	D_{IN}	–0.5 to V_{CC} + 0.5	V
Receiver Input Voltage	R_{IN}	–30.0 to +30.0	V
Control Input Voltage ($\overline{STBY}$, V_{CHA}, EN)	V_{IN}	–0.5 to V_{CC} + 0.5	V
Driver Output Voltage	D_{OUT}	–25.0 to +25.0**Note**	V
Receiver Output Voltage	R_{OUT}	–0.5 to V_{CC} + 0.5	V
Input Current (D_{IN}, $\overline{STBY}$, V_{CHA}, EN)	I_{IN}	±20.0	mA
Operating Temperature	T_A	–40 to +85	°C
Storage Temperature	T_{stg}	–55 to +150	°C
Power Dissipation	P_T	0.5	W

Note Pulse width = 1 ms, duty cycle = 10 % MAX.

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage (V_{CHA} = L, 5 V mode)	V_{CC}	4.5	5.0	5.5	V
Supply Voltage (V_{CHA} = H, 3 V mode)	V_{CC}	3.0	3.3	3.6	V
High Level Input Voltage (D_{IN})	V_{IH}	2.0		V_{CC}	V
Low Level Input Voltage (D_{IN})	V_{IL}	0		0.8	V
High Level Input Voltage ($\overline{STBY}$, V_{CHA}, EN)	V_{IH}	2.4		V_{CC}	V
Low Level Input Voltage ($\overline{STBY}$, V_{CHA}, EN)	V_{IL}	0		0.6	V
Receiver Input Voltage	R_{IN}	–30		+30	V
Operating Temperature	T_A	–40		+85	°C
Capacitance of External Capacitor	**Note**	0.33		4.7	μF

Note If the use of an electrolytic capacitor at low temperature is likely, set the capacitance with sufficient margin, because the capacitance of an electrolytic capacitor is smaller at lower temperatures (0 °C or lower). Care must be taken to minimize the wiring length between the capacitor and this IC. Using capacitors of excellent high frequency characteristics (such as tantalum, multi-layer ceramic capacitors, and aluminum electrolytic capacitors for switching power supplies) is highly recommended.

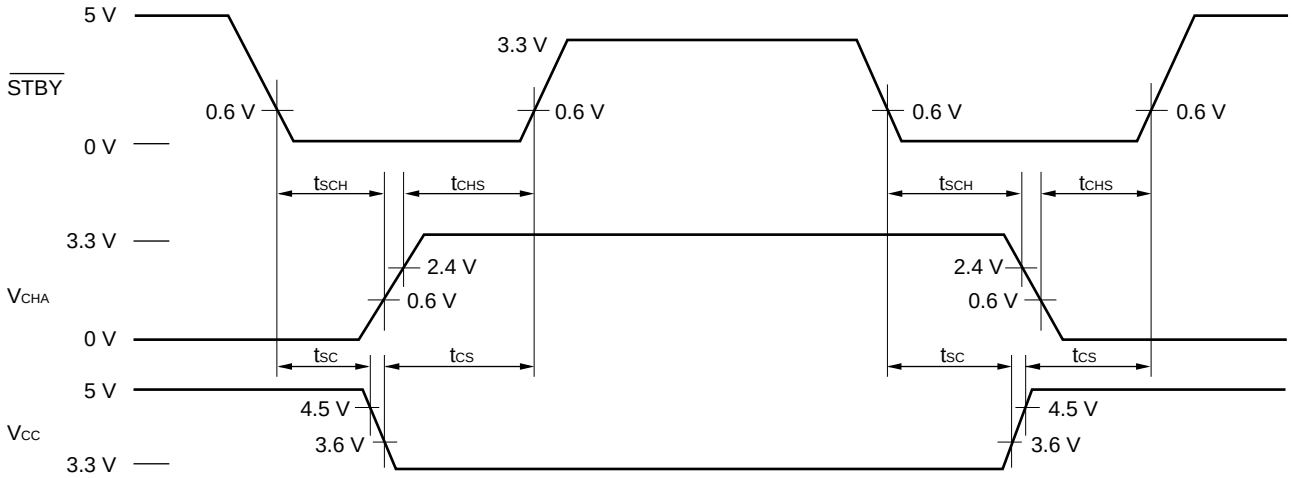
ELECTRICAL SPECIFICATIONS FOR THE IC AS A WHOLE

(T_A = –40 to +85 °C and C_1 to C_5 = 1 μF Unless Otherwise Specified)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Circuit Current	I_{CC1}	V_{CC} = +3.3 V, unloaded, R_{IN} pin is open, $\overline{STBY}$ = H		7.5	15	mA
		V_{CC} = +5.0 V, unloaded, R_{IN} pin is open, $\overline{STBY}$ = H		5.5	11	mA
Circuit Current	I_{CC2}	V_{CC} = +3.3 V, R_L = 3 kΩ(D_{OUT}), D_{IN} = GND, R_{IN} and R_{OUT} pins are open, $\overline{STBY}$ = H		25	35	mA
		V_{CC} = +5.0 V, RL = 3 kΩ(D_{OUT}), D_{IN} = GND, R_{IN} and R_{OUT} pins are open, $\overline{STBY}$ = H		19	28	mA
Circuit Current at Standby (Standby Mode 1)	I_{CC3}	V_{CC} = +3.3 V, No load, D_{IN} and R_{IN} pins are OPEN, $\overline{STBY}$ = L, EN = L, T_A = 25 °C		1	3	μA
		V_{CC} = +3.3 V, No load, D_{IN} and R_{IN} pins are OPEN, $\overline{STBY}$ = L, EN = L		5		μA
		V_{CC} = +5.0 V, No load, D_{IN} and R_{IN} pins are OPEN, $\overline{STBY}$ = L, EN = L, T_A = 25 °C		2	5	μA
		V_{CC} = +5.0 V, No load, D_{IN} and R_{IN} pins are OPEN, $\overline{STBY}$ = L, EN = L		10		μA
Circuit Current at Standby (Standby Mode 2)	I_{CC4}	V_{CC} = +3.3 V, No load, D_{IN} and R_{IN} pins are OPEN, $\overline{STBY}$ = L, EN = H, T_A = 25 °C		1	3	μA
		V_{CC} = +3.3 V, No load, D_{IN} and R_{IN} pins are OPEN, $\overline{STBY}$ = L, EN = H		5		μA
		V_{CC} = +5.0 V, No load, D_{IN} and R_{IN} pins are OPEN, $\overline{STBY}$ = L, EN = H, T_A = 25 °C		2	5	μA
		V_{CC} = +5.0 V, No load, D_{IN} and R_{IN} pins are OPEN, $\overline{STBY}$ = L, EN = H		10		μA
High Level Input Voltage	V_{IH}	V_{CC} = +3.0 to +5.5 V, $\overline{STBY}$, V_{CHA}, and EN pins	2.4			V
Low Level Input Voltage	V_{IL}	V_{CC} = +3.0 to +5.5 V, $\overline{STBY}$, V_{CHA}, and EN pins			0.6	V
High Level Input Current	I_{IH}	V_{CC} = +5.5 V, V_I = +5.5 V, $\overline{STBY}$, V_{CHA}, and EN pins			1	μA
Low Level Input Current	I_{IL}	V_{CC} = +5.5 V, V_I = 0 V, $\overline{STBY}$, V_{CHA}, and EN pins			–1	μA
Input Capacitance	C_{IN}	Driver and receiver inputs, V_{CC} = +3.3 V, to GND, f = 1 MHz			10	pF
		Driver and receiver inputs, V_{CC} = +5.0 V, to GND, f = 1 MHz			10	pF
$\overline{STBY}$ - V_{CHA} Time	t_{SCH}	V_{CC} = +3.0 to +5.5 V, $\overline{STBY}\downarrow \rightarrow V_{CHA}$ Note	1			μs
V_{CHA} - $\overline{STBY}$ Time	t_{CHS}	V_{CC} = +3.0 to +5.5 V, $V_{CHA} \rightarrow \overline{STBY}\uparrow$ Note	1			μs
$\overline{STBY}$ - V_{CC} Time	t_{SC}	V_{CC} = +3.0 to +5.5 V, $\overline{STBY}\downarrow \rightarrow V_{CC}$ Note	1			μs
V_{CC} - $\overline{STBY}$ Time	t_{CS}	V_{CC} = +3.0 to +5.5 V, $V_{CC} \rightarrow \overline{STBY}\uparrow$ Note	1			μs

Remark TYP. values are valid only at T_A = 25 °C and should be used for reference only.

Note Test points for these parameters



ELECTRICAL SPECIFICATIONS FOR THE DRIVERS (T_A = –40 to +85 °C and C_1 to C_5 = 1 μF)

3 V Mode (V_{CHA} = H, V_{CC} = 3.0 to 3.6 V Unless Otherwise Specified)

Parameter	Symbol	Test 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}	V_{CC} = +3.6 V, V_I = 0 V			–25	μA
High Level Input Current	I_{IH}	V_{CC} = +3.6 V, V_I = 3.6 V			1.0	μA
Output Voltage	V_{DO}	V_{CC} = +3.3 V, R_L = ∞, T_A = 25 °C		±9.5		V
		V_{CC} = +3.3 V, R_L = 3 kΩ, T_A = $T_{opt.}$	±5.0	±6.0		V
		V_{CC} = +3.0 V, R_L = 3 kΩ, T_A = 25 °C	±5.0			V
Output Short-Circuit Current	I_{SC}	V_{CC} = +3.3 V, to GND			±40	mA
Slew Rate[Note 1]	SR	C_L = 10 pF, R_L = 3 to 7 kΩ	3.0		30	V/μs
		C_L = 2500 pF, R_L = 3 to 7 kΩ	3.0		30	V/μs
Propagation Delay Time[Note 1]	t_{PHL} t_{PLH}	R_L = 3 kΩ, C_L = 2500 pF		2.5		μs
Output Resistance	R_O	V_{CC} = V_{DD} = V_{SS} = 0 V V_{OUT} = ± 2 V	300			Ω
Output Transfer Time in Standby State	t_{DAZ}	R_L = 3 kΩ, C_L = 2500 pF,[Note 2]		4	10	μs
Output Transfer Time in Standby State	t_{DZA}	R_L = 3 kΩ, C_L = 2500 pF,[Note 2]		1	3	ms
Power On Output Transfer Time	t_{PRA}	R_L = 3 kΩ, C_L = 2500 pF,[Note 3]		1	3	ms

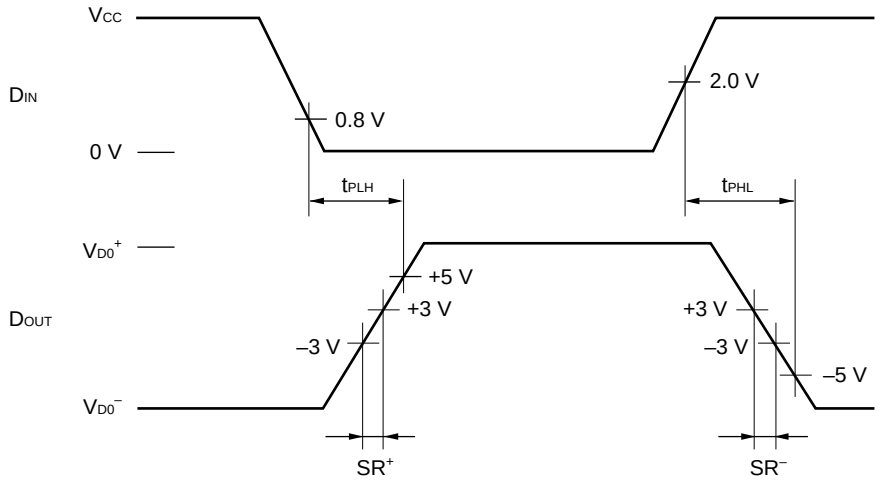
Remark TYP. values are valid only at T_A = 25 °C and should be used for reference only.

5 V Mode (V_{CHA} = L, V_{CC} = 5.0 V ±10 % Unless Otherwise Specified)

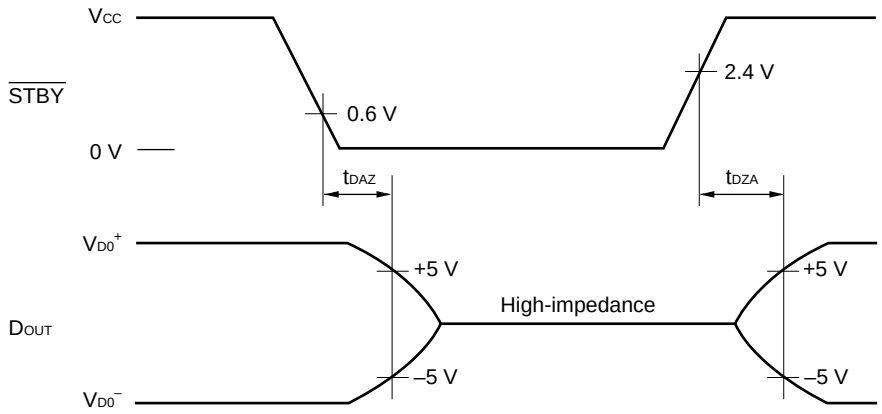
Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Low Level Input Voltage	V_{IL}				0.8	V
High Level Input Voltage	V_{IH}		2.0			V
Low Level Input Current	I_{IL}	V_{CC} = +5.5 V, V_I = 0 V			–40	μA
High Level Input Current	I_{IH}	V_{CC} = +5.5 V, V_I = 5.5 V			1.0	μA
Output Voltage	V_{DO}	V_{CC} = +5.0 V, R_L = ∞, T_A = 25 °C		±9.7		V
		V_{CC} = +5.0 V, R_L = 3 kΩ, T_A = $T_{opt.}$	±6.0			V
		V_{CC} = +4.5 V, R_L = 3 kΩ, T_A = $T_{opt.}$	±5.0			V
Output Short-Circuit Current	I_{SC}	V_{CC} = +5.0 V, to GND			±40	mA
Slew Rate[Note 1]	SR	C_L = 10 pF, R_L = 3 to 7 kΩ	4.0		30	V/μs
		C_L = 2500 pF, R_L = 3 to 7 kΩ	4.0		30	V/μs
Propagation Delay Time[Note 1]	t_{PHL} t_{PLH}	R_L = 3 kΩ, C_L = 2500 pF		2		μs
Output Resistance	R_O	V_{CC} = V_{DD} = V_{SS} = 0 V V_{OUT} = ± 2 V	300			Ω
Output Transfer Time in Standby State	t_{DAZ}	R_L = 3 kΩ, C_L = 2500 pF,[Note 2]		4	10	μs
Output Transfer Time in Standby State	t_{DZA}	R_L = 3 kΩ, C_L = 2500 pF,[Note 2]		0.5	1	ms
Power-On Output Transfer Time	t_{PRA}	R_L = 3 kΩ, C_L = 2500 pF,[Note 2]		0.5	1	ms

Remark TYP. values are valid only at T_A = 25 °C and should be used for reference only.

Note 1 Test points for slew rate, t_{PHL}, and t_{PLH}

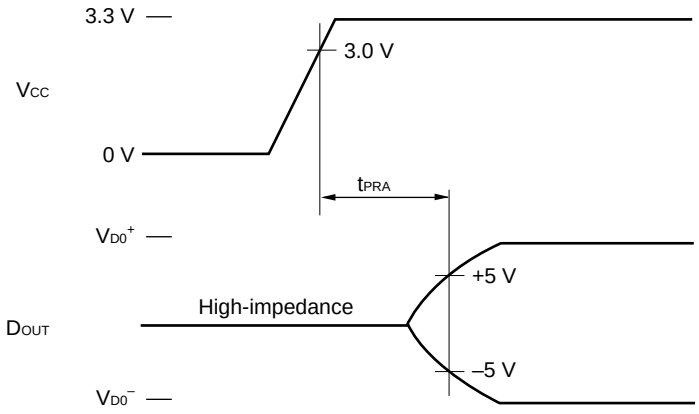


Note 2 Test points for t_{DAZ}, and t_{DZA}



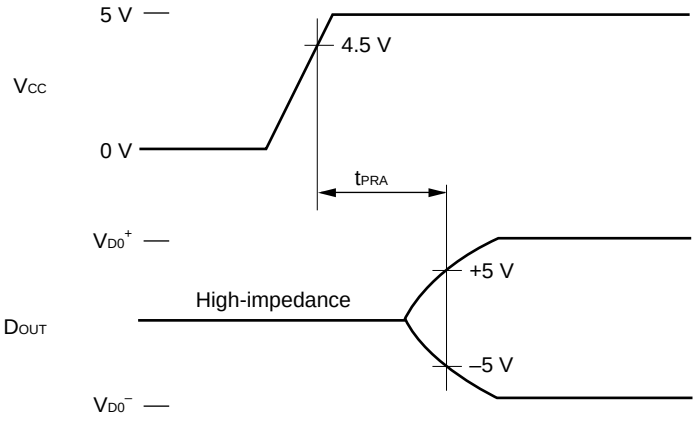
Driver outputs are indefinite during transition time (t_{DZA}).

Note 3 Test points for t_{PRA} in 3 V mode



Driver outputs are indefinite during transition time (t_{PRA}).

Note 4 Test points for t_{PRA} in 5 V mode



Driver outputs are indefinite during transition time (t_{PRA}).

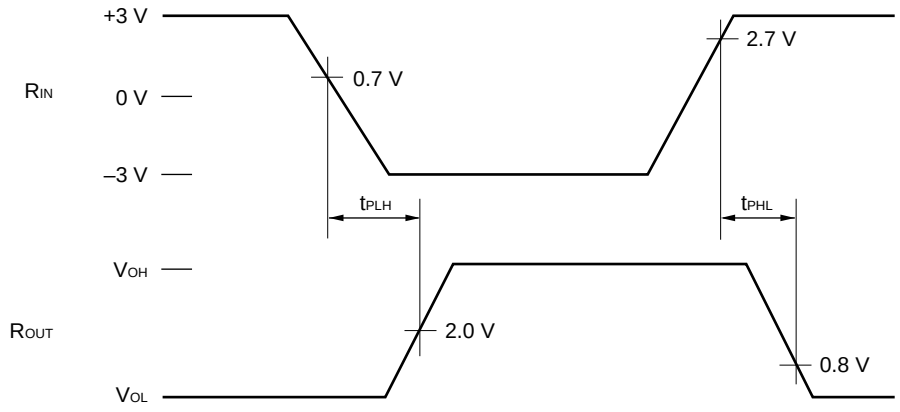
ELECTRICAL SPECIFICATIONS FOR THE RECEIVERS

(V_{CC} = 3.0 to 5.5 V, T_A = –40 to +85 °C and C_1 to C_5 = 1 μF Unless Otherwise Specified)

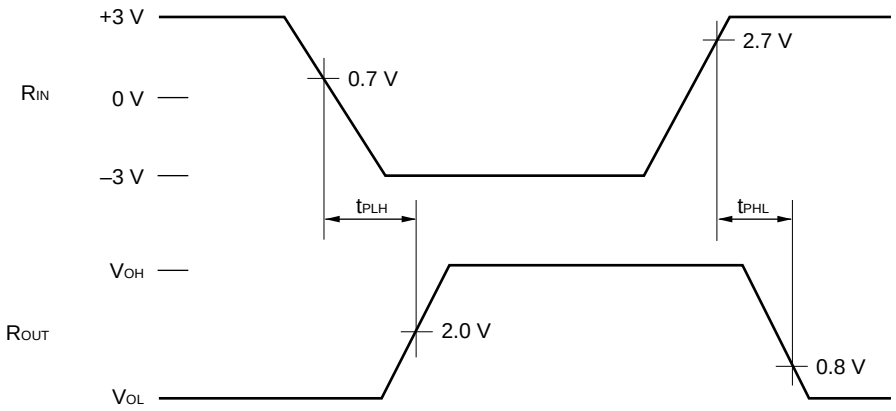
Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Low Level Output Voltage	V_{OL1}	I_{OUT} = 4 mA			0.4	V
High Level Output Voltage	V_{OH1}	I_{OUT} = –4 mA	V_{CC}-0.4			V
Low-Level Output Voltage	V_{OL2}	I_{OUT} = 4 mA, $\overline{STBY}$ = L			0.5	V
High Level Output Voltage	V_{OH2}	I_{OUT} = –4 mA, $\overline{STBY}$ = L	V_{CC}-0.5			V
Propagation Delay Time ($\overline{STBY}$ = H)	t_{PHL} t_{PLH}	$R_{IN} \rightarrow R_{OUT}$, C_L = 150 pF V_{CC} = +3.0 V, **Note 1**		0.2		μs
Propagation Delay Time ($\overline{STBY}$ = L)	t_{PHL} t_{PLH}	$R_{IN} \rightarrow R_{OUT}$, C_L = 150 pF V_{CC} = +3.0 V, **Note 2**		0.1		μs
Propagation Delay Time ($\overline{STBY}$ = L)	t_{PHA} t_{PAH}	EN → R_{OUT}, C_L = 150 pF V_{CC} = +3.0 V, **Note 3**		100	300	ns
Input Resistance	R_I		3	5.5	7	kΩ
Input Terminal Release Voltage	V_{IO}				0.5	V
Input Threshold Voltage (STBY = H)	V_{IH}	V_{CC} = +3.0 to + 5.5 V	1.7	2.3	2.7	V
	V_{IL}	V_{CC} = +3.0 to + 5.5 V	0.7	1.1	1.7	V
	V_H	V_{CC} = +3.0 to + 5.5 V (Hysteresis width)	0.5	1.2	1.8	V
Input Threshold Voltage (STBY = L, EN = H)	V_{IH}	V_{CC} = +3.0 to + 5.5 V	2.7	1.5		V
	V_{IL}	V_{CC} = +3.0 to + 5.5 V		1.5	0.7	V
Output Transition Time in Standby State	t_{DAH}	**Note 4**		0.2	3	μs
Output Transition Time in Standby State	t_{DHA}	V_{CHA} = H (3 V mode), **Note 4**		0.6	3	ms
		V_{CHA} = L (5 V mode), **Note 4**		0.3	1	ms
Power-On Reset Release Time	t_{PRA}	V_{CHA} = H (3 V mode), **Note 5**		1	3	ms
		V_{CHA} = L (5 V mode), **Note 6**		0.5	1	ms

Remark TYP. values are valid only at T_A = 25 °C and should be used for reference only.

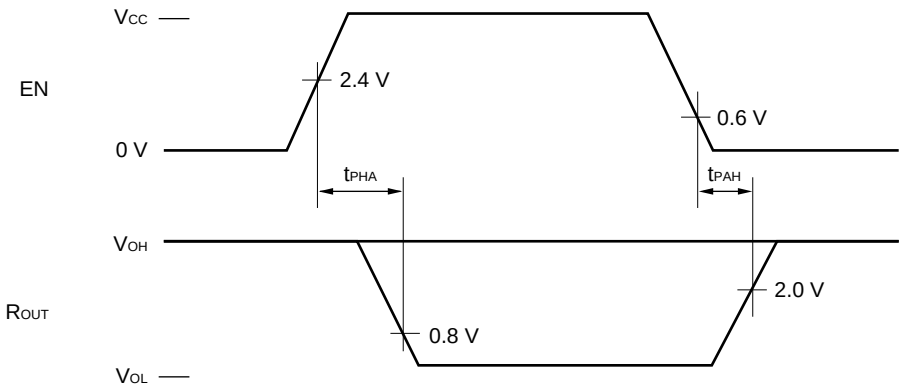
Note 1 Test points for t_{PHL}, t_{PLH}



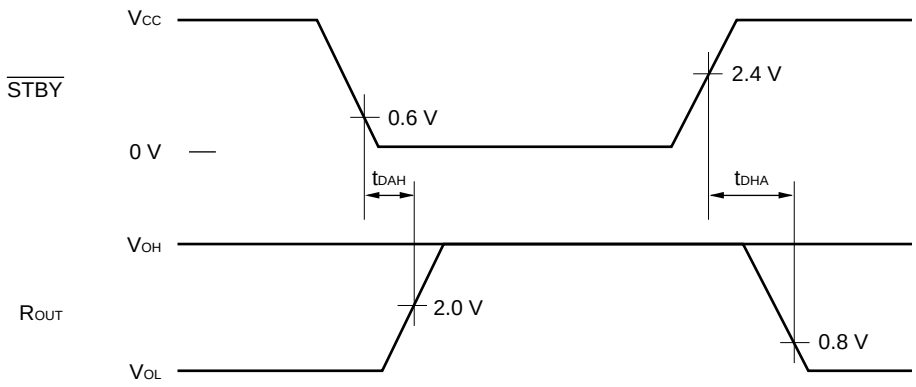
Note 2 Test points for t_{PHL}, t_{PLH}



Note 3 Test points for t_{PHA}, t_{PAH}

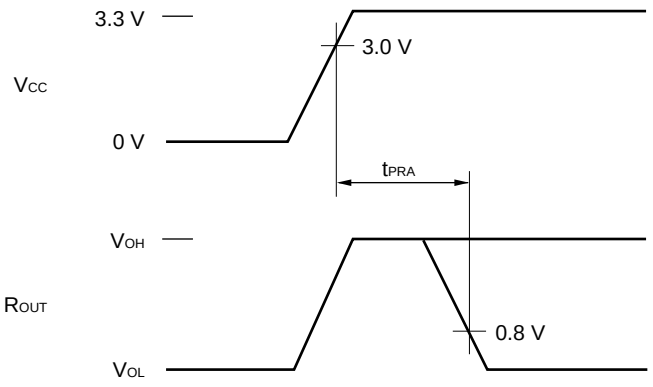


Note 4 Test points for t_{DAH}, t_{DHA}



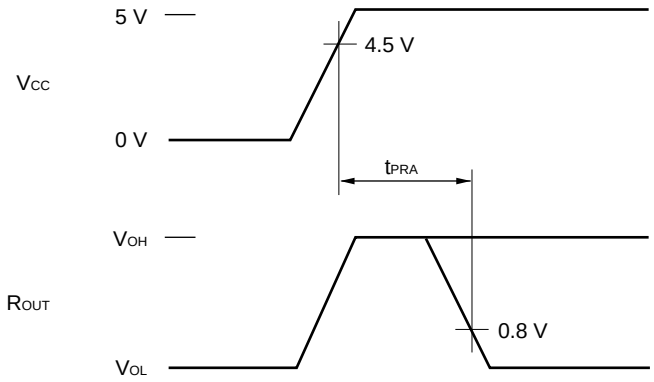
Receiver outputs are indefinite during transition time (t_{DHA}).

Note 5 Test points for t_{PRA} in 3 V mode



Receiver outputs are indefinite during reset release time (t_{PRA}).

Note 6 Test points for t_{PRA} in 5 V mode



Receiver outputs are indefinite during reset release time (t_{PRA}).

REFERENCE MATERIAL

- IC PACKAGE MANUAL (C10943X)
- NEC SEMICONDUCTOR DEVICE RELIABILITY/QUALITY (IEI-1212)

RECOMMENDED SOLDERING CONDITIONS

The following conditions (see table below) must be met 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 "SMT MANUAL" (C10535E).

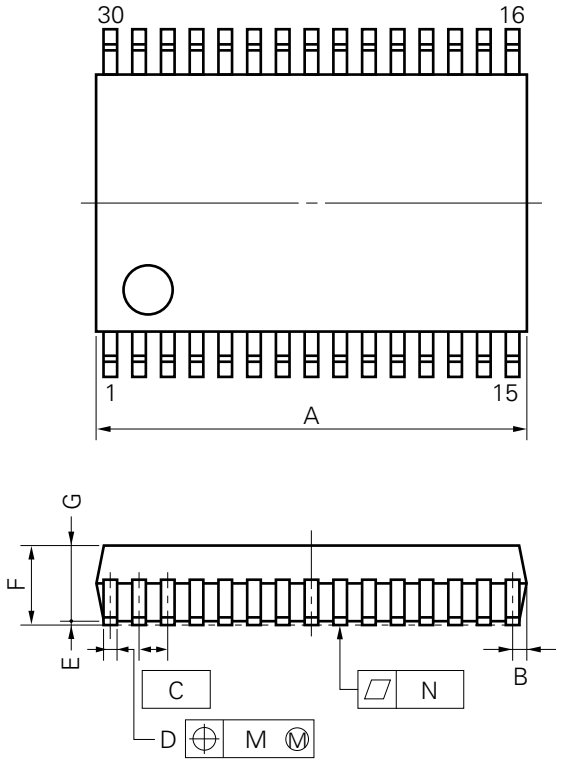
μPD4724GS-GJG

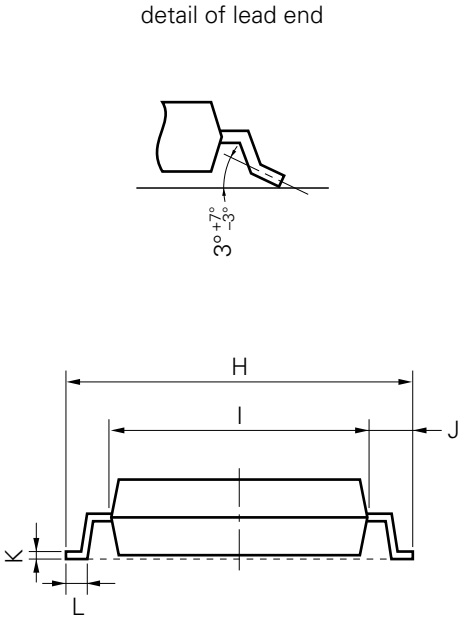
Soldering process	Soldering conditions	Symbol
Infrared ray reflow	Peak package's surface temperature: 230 °C or below, Reflow time: 30 seconds or below (210 °C or higher), Number of reflow process: 2, Exposure limit*: None	IR30-00-2
VPS	Peak package's surface temperature: 215 °C or below, Reflow time: 40 seconds or below (200 °C or higher), Number of reflow process: 2, Exposure limit*: None	VP15-00-2
Wave soldering	Solder temperature: 260 °C or below, Flow time: 10 seconds or below, Number of flow process: 1, Exposure limit*: None	WS60-00-1
Partial heating method	Terminal temperature: 300 °C or below, Flow time: 10 seconds or below, Exposure limit*: None	○

* Exposure limit before soldering after dry-pack package is opened.
  Sotrage 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”.

30 PIN PLASTIC SHRINK SOP (300 mil)





P30GS-65-300B-1

NOTE

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

ITEM	MILLIMETERS	INCHES
A	10.11 MAX.	0.398 MAX.
B	0.51 MAX.	0.020 MAX.
C	0.65 (T.P.)	0.026 (T.P.)
D	$0.30^{+0.10}_{-0.05}$	$0.012^{+0.004}_{-0.003}$
E	0.125±0.075	0.005±0.003
F	2.0 MAX.	0.079 MAX.
G	1.7±0.1	0.067±0.004
H	8.1±0.2	0.319±0.008
I	6.1±0.2	0.240±0.008
J	1.0±0.2	$0.039^{+0.009}_{-0.008}$
K	$0.15^{+0.10}_{-0.05}$	$0.006^{+0.004}_{-0.002}$
L	0.5±0.2	$0.020^{+0.008}_{-0.009}$
M	0.10	0.004
N	0.10	0.004

[MEMO]

M4 96.5