

## Features

- Operates as a 4-bit GTL – /GTL/GTL+ sampling receiver or as a LVTTL to GTL – /GTL/GTL+ driver
- 2.3 V to 3.6 V operation with 5 V tolerant LVTTL input
- GTL input and output 3.6 V tolerant
- Vref adjustable from 0.5 V to VCC/2
- Partial power-down permitted
- ESD protection exceeds 2000 V HBM per JESD22-A114 and 1000 V CDM per JESD22-CC101
- Latch-up protection exceeds 200 mA per JESD78
- Package offered: TSSOP14

## Description

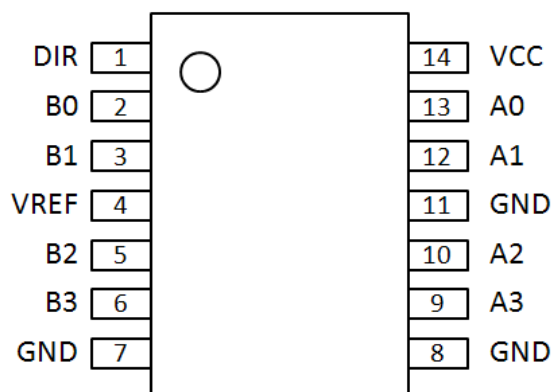
The PI4GTL2014 is a 4-bit translating transceiver designed for 3.3 V LVTTL system interface with a GTL – /GTL/GTL+ bus, where GTL – /GTL/GTL+ refers to the reference voltage of the GTL bus and the input/output voltage thresholds associated with it.

The direction pin allows the part to function as either a GTL to LVTTL sampling receiver or as a LVTTL to GTL interface.

The PI4GTL2014 LVTTL inputs (only) are tolerant up to 5.5 V allowing direct access to TTL or 5 V CMOS inputs. The LVTTL outputs are not 5.5 V tolerant.

The PI4GTL2014 GTL inputs and outputs operate up to 3.6 V, allowing the device to be used in higher voltage open-drain output applications.

## Pin Configuration



## Pin Description

| Pin Name | Pin#   | Description                     |
|----------|--------|---------------------------------|
| DIR      | 1      | Direction control input (LVTTL) |
| B0       | 2      | Data inputs/outputs (GTL)       |
| B1       | 3      |                                 |
| B2       | 5      |                                 |
| B3       | 6      |                                 |
| A0       | 13     | Data inputs/outputs (LVTTL)     |
| A1       | 12     |                                 |
| A2       | 10     |                                 |
| A3       | 9      |                                 |
| VREF     | 4      | GTL reference voltage           |
| GND      | 7,8,11 | Ground (0 V)                    |
| VCC      | 14     | Positive supply voltage         |

## Maximum Ratings

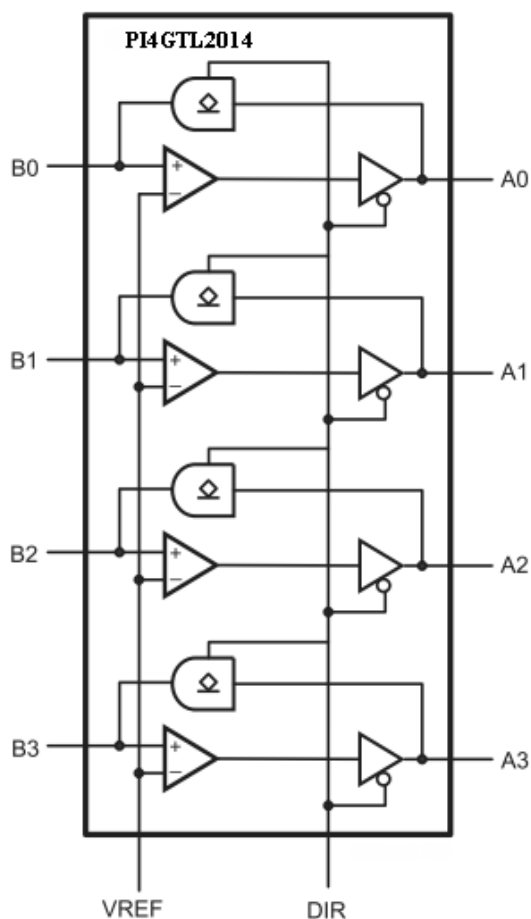
|                                                          |                   |
|----------------------------------------------------------|-------------------|
| Power supply .....                                       | -0.5V to +4.6V    |
| Voltage on an I/O pin .....                              | GND-0.5V to +7.0V |
| Supply current .....                                     | ±160mA            |
| Ground supply current .....                              | 400mA             |
| Total power dissipation .....                            | 200mW             |
| Operation temperature .....                              | -40~85°C          |
| Storage temperature .....                                | -65~150°C         |
| Maximum Junction temperature, T <sub>j</sub> (max) ..... | 125°C             |
| Total power dissipation .....                            | 200mW             |

### Note:

Stresses greater than those listed under MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

## PI4GTL2014 Block Diagram

Figure 1: Block diagram



### Function Table:

H = HIGH voltage level; L = LOW voltage level.

| DIR | A (LVTTTL) | B (GTL) |
|-----|------------|---------|
| H   | Input      | Output  |
| L   | Output     | Input   |

## Limiting Values

| Symbol           | Parameter                 | Conditions                                           | Min.                | Max. | Unit |
|------------------|---------------------------|------------------------------------------------------|---------------------|------|------|
| VCC              | Supply voltage            |                                                      | -0.5                | 4.6  | V    |
| I <sub>IK</sub>  | Input clamping current    | V <sub>I</sub> < 0V                                  | -                   | -50  | mA   |
| V <sub>I</sub>   | Input voltage             | A port                                               | -0.5 <sup>[1]</sup> | 7    | V    |
|                  |                           | B port                                               | -0.5 <sup>[1]</sup> | 4.6  | V    |
| I <sub>OK</sub>  | Output clamping current   | A port; V <sub>O</sub> < 0V                          | -                   | -50  | mA   |
| V <sub>O</sub>   | Output voltage            | Output in OFF or HIGH state                          |                     |      |      |
|                  |                           | A port                                               | -0.5 <sup>[1]</sup> | 7    | V    |
|                  |                           | B port                                               | -0.5 <sup>[1]</sup> | 4.6  | V    |
| I <sub>OL</sub>  | LOW-level output current  | Current into any output in the LOW state             |                     |      |      |
|                  |                           | A port                                               | -                   | 32   | mA   |
|                  |                           | B port                                               | -                   | 80   | mA   |
| I <sub>OH</sub>  | HIGH-level output current | Current into any output in the HIGH state;<br>A port | -                   | -32  | mA   |
| T <sub>stg</sub> | Storage temperature       |                                                      | <sup>[2]</sup> -60  | 150  | °C   |

Note:

[1] The input and output negative voltage ratings may be exceeded if the input and output clamp current ratings are observed.

[2] The performance capability of a high-performance integrated circuit in conjunction with its thermal environment can create junction temperatures which are detrimental to reliability. The maximum junction temperature of this integrated circuit should not exceed 150 °C.

## Operating Conditions <sup>[1]</sup>

| Symbol           | Parameter                          | Conditions             | Min.                     | Typ.               | Max.                     | Unit |
|------------------|------------------------------------|------------------------|--------------------------|--------------------|--------------------------|------|
| VCC              | Supply voltage                     |                        | 2.3                      | -                  | 3.6                      | V    |
| V <sub>TT</sub>  | Termination voltage <sup>[2]</sup> | Lowest voltage         | 0.71                     | 0.75               | 0.79                     | V    |
|                  |                                    | GTL-                   | 0.85                     | 0.9                | 0.95                     | V    |
|                  |                                    | GTL                    | 1.14                     | 1.2                | 1.26                     | V    |
|                  |                                    | GTL+                   | 1.35                     | 1.5                | 1.65                     | V    |
| V <sub>ref</sub> | Reference voltage                  | overall                | 0.43                     | 2/3V <sub>TT</sub> | VCC/2                    | V    |
|                  |                                    | Lowest voltage         | 0.43                     | 0.5                | 0.55                     |      |
|                  |                                    | GTL-                   | 0.5                      | 0.6                | 0.63                     | V    |
|                  |                                    | GTL                    | 0.76                     | 0.8                | 0.84                     | V    |
|                  |                                    | GTL+                   | 0.87                     | 1                  | 1.1                      | V    |
| V <sub>I</sub>   | Input voltage                      | B port                 | 0                        | V <sub>TT</sub>    | 3.6                      | V    |
|                  |                                    | except B port          | 0                        | 3.3                | 5.5 <sup>[3]</sup>       | V    |
| V <sub>IH</sub>  | HIGH-level input voltage           | B port                 | V <sub>ref</sub> + 0.050 | -                  | -                        | V    |
|                  |                                    | except B port VCC=3.3V | 2                        | -                  | -                        | V    |
|                  |                                    | except B port VCC=2.5V | 1.7                      |                    |                          | V    |
| V <sub>IL</sub>  | LOW-level input voltage            | B port                 | -                        | -                  | V <sub>ref</sub> - 0.050 | V    |
|                  |                                    | except B port VCC=3.3V | -                        | -                  | 0.8                      | V    |
|                  |                                    | except B port VCC=2.5V |                          |                    | 0.7                      | V    |
| I <sub>OH</sub>  | HIGH-level output current          | A port VCC=3.3V        | -                        | -                  | -16                      | mA   |
|                  |                                    | A port VCC=2.5V        |                          |                    | -6                       | mA   |
| I <sub>OL</sub>  | LOW-level output current           | B port                 | -                        | -                  | 40                       | mA   |
|                  |                                    | A port VCC=3.3V        | -                        | -                  | 16                       | mA   |
|                  |                                    | A port VCC=2.5V        | -                        | -                  | 12                       | mA   |
| T <sub>amb</sub> | Ambient temperature                | operating in free-air  | -40                      | -                  | -85                      | °C   |

Note:

[1] Unused inputs must be held HIGH or LOW to prevent them from floating.

[2] V<sub>TT</sub> maximum of 3.6 V with resistor sized so IOL maximum is not exceeded.

[3] A0, A1, A2, A3 V<sub>I(max)</sub> is 3.6 V if configured as outputs (DIR = L).

## Static Characteristics

Recommended operating conditions; voltages are referenced to GND (ground = 0 V).  $T_{amb} = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$

| Symbol                         | Parameter                                | Conditions                                                                                            | Min.           | Typ. <sup>[1]</sup> | Max.      | Unit          |
|--------------------------------|------------------------------------------|-------------------------------------------------------------------------------------------------------|----------------|---------------------|-----------|---------------|
| $V_{OH}$                       | HIGH-level output voltage                | A port; $V_{CC} = 2.3\text{ V}$ to $3.6\text{ V}$ ; $I_{OH} = -100\text{ }\mu\text{A}$ <sup>[2]</sup> | $V_{CC} - 0.2$ |                     |           | V             |
|                                |                                          | A port; $V_{CC} = 3.0\text{ V}$ ; $I_{OH} = -16\text{ mA}$ <sup>[2]</sup>                             | 2.0            |                     |           | V             |
|                                |                                          | A port; $V_{CC} = 2.3\text{ V}$ ; $I_{OH} = -6\text{ mA}$ <sup>[2]</sup>                              | 1.7            |                     |           | V             |
| $V_{OL}$                       | LOW-level output voltage                 | B port; $V_{CC} = 3.0\text{ V}$ ; $I_{OL} = 40\text{ mA}$ <sup>[2]</sup>                              |                | 0.23                | 0.4       | V             |
|                                |                                          | B port; $V_{CC} = 2.3\text{ V}$ ; $I_{OL} = 40\text{ mA}$ <sup>[2]</sup>                              |                | 0.26                | 0.4       | V             |
|                                |                                          | A port; $V_{CC} = 3.0\text{ V}$ ; $I_{OL} = 8\text{ mA}$ <sup>[2]</sup>                               |                | 0.28                | 0.4       | V             |
|                                |                                          | A port; $V_{CC} = 3.0\text{ V}$ ; $I_{OL} = 12\text{ mA}$ <sup>[2]</sup>                              |                | 0.4                 | 0.55      | V             |
|                                |                                          | A port; $V_{CC} = 3.0\text{ V}$ ; $I_{OL} = 16\text{ mA}$ <sup>[2]</sup>                              |                | 0.55                | 0.8       | V             |
|                                |                                          | A port; $V_{CC} = 2.3\text{ V}$ ; $I_{OL} = 8\text{ mA}$ <sup>[2]</sup>                               |                | 0.3                 | 0.45      | V             |
|                                |                                          | A port; $V_{CC} = 2.3\text{ V}$ ; $I_{OL} = 12\text{ mA}$ <sup>[2]</sup>                              |                | 0.47                | 0.7       | V             |
| $I_I$                          | Input current                            | control inputs; $V_{CC} = 3.6\text{ V}$ ; $V_I = V_{CC}$ or GND                                       |                |                     | $\pm 1$   | $\mu\text{A}$ |
|                                |                                          | B port; $V_{CC} = 3.6\text{ V}$ ; $V_I = V_{TT}$ or GND                                               |                |                     | $\pm 1$   | $\mu\text{A}$ |
|                                |                                          | A port; $V_{CC} = 0\text{ V}$ or $3.6\text{ V}$ ; $V_I = 5.5\text{ V}$                                |                |                     | 10        | $\mu\text{A}$ |
|                                |                                          | A port; $V_{CC} = 3.6\text{ V}$ ; $V_I = V_{CC}$                                                      |                |                     | $\pm 1$   | $\mu\text{A}$ |
|                                |                                          | A port; $V_{CC} = 3.6\text{ V}$ ; $V_I = 0\text{ V}$                                                  |                |                     | -5        | $\mu\text{A}$ |
| $I_{OZ}$                       | OFF-state output current                 | A port; $V_{CC} = 0\text{ V}$ ; $V_I$ or $V_O = 0\text{ V}$ to $3.6\text{ V}$                         |                |                     | $\pm 100$ | $\mu\text{A}$ |
| $I_{CC}$                       | Quiescent supply current                 | A port; $V_{CC} = 3.6\text{ V}$ ; $V_I = V_{CC}$ or GND; $I_O = 0\text{ mA}$                          |                | 4                   | 10        | mA            |
|                                |                                          | B port; $V_{CC} = 3.6\text{ V}$ ; $V_I = V_{TT}$ or GND; $I_O = 0\text{ mA}$                          |                | 4                   | 10        | mA            |
| $\Delta I_{CC}$ <sup>[3]</sup> | Additional quiescent current (per input) |                                                                                                       |                |                     | 500       | $\mu\text{A}$ |
| $C_i$                          | Input capacitance                        | control inputs; $V_I = 3.0\text{ V}$ or $0\text{ V}$                                                  |                | 2                   |           | pF            |
| $C_{io}$                       | Input/output capacitance                 | A port; $V_O = 3.0\text{ V}$ or $0\text{ V}$                                                          |                | 4.6                 |           | pF            |
|                                |                                          | B port; $V_O = V_{TT}$ or $0\text{ V}$                                                                |                | 3.4                 |           | pF            |

Note:

[1] All typical values are measured at  $V_{CC} = 3.3\text{ V}$  and  $T_{amb} = 25^{\circ}\text{C}$ .

[2] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

[3] This is the increase in supply current for each input that is at the specified TTL voltage level rather than  $V_{CC}$  or GND.

## Dynamic Characteristics

All typical values are at VCC = 3.3 V and Tamb = 25 ° C.

| Symbol                            | Parameter                     | Conditions | Min. | Typ. <sup>[1]</sup> | Max. | Unit |
|-----------------------------------|-------------------------------|------------|------|---------------------|------|------|
| GTL - ; Vref = 0.5V; VTT = 0.75 V |                               |            |      |                     |      |      |
| t <sub>PLH</sub>                  | LOW to HIGH propagation delay | An to Bn   |      | 2.1                 | 5    | ns   |
| t <sub>PHL</sub>                  | HIGH to LOW propagation delay | An to Bn   |      | 4.1                 | 7    | ns   |
| t <sub>PLH</sub>                  | LOW to HIGH propagation delay | Bn to An   |      | 6                   | 9    | ns   |
| t <sub>PHL</sub>                  | HIGH to LOW propagation delay | Bn to An   |      | 4.8                 | 8    | ns   |
| GTL - ; Vref = 0.6 V; VTT = 0.9 V |                               |            |      |                     |      |      |
| t <sub>PLH</sub>                  | LOW to HIGH propagation delay | An to Bn   |      | 2.0                 | 5    | ns   |
| t <sub>PHL</sub>                  | HIGH to LOW propagation delay | An to Bn   |      | 4.2                 | 7    | ns   |
| t <sub>PLH</sub>                  | LOW to HIGH propagation delay | Bn to An   |      | 6                   | 9    | ns   |
| t <sub>PHL</sub>                  | HIGH to LOW propagation delay | Bn to An   |      | 4.8                 | 8    | ns   |
| GTL - ; Vref = 0.8 V; VTT = 1.2 V |                               |            |      |                     |      |      |
| t <sub>PLH</sub>                  | LOW to HIGH propagation delay | An to Bn   |      | 2.0                 | 5    | ns   |
| t <sub>PHL</sub>                  | HIGH to LOW propagation delay | An to Bn   |      | 4.9                 | 8    | ns   |
| t <sub>PLH</sub>                  | LOW to HIGH propagation delay | Bn to An   |      | 6                   | 9    | ns   |
| t <sub>PHL</sub>                  | HIGH to LOW propagation delay | Bn to An   |      | 4.7                 | 8    | ns   |
| GTL+; Vref = 1.0 V; VTT = 1.5 V   |                               |            |      |                     |      |      |
| t <sub>PLH</sub>                  | LOW to HIGH propagation delay | An to Bn   |      | 2.0                 | 5    | ns   |
| t <sub>PHL</sub>                  | HIGH to LOW propagation delay | An to Bn   |      | 5.1                 | 8    | ns   |
| t <sub>PLH</sub>                  | LOW to HIGH propagation delay | Bn to An   |      | 6.1                 | 9    | ns   |
| t <sub>PHL</sub>                  | HIGH to LOW propagation delay | Bn to An   |      | 4.5                 | 7    | ns   |

## Dynamic Characteristics

All typical values are at VCC = 2.5 V and Tamb = 25 ° C.

| Symbol                            | Parameter                     | Conditions | Min. | Typ. <sup>[1]</sup> | Max. | Unit |
|-----------------------------------|-------------------------------|------------|------|---------------------|------|------|
| GTL - ; Vref = 0.5V; VTT = 0.75 V |                               |            |      |                     |      |      |
| t <sub>PLH</sub>                  | LOW to HIGH propagation delay | An to Bn   |      | 2.3                 | 5    | ns   |
| t <sub>PHL</sub>                  | HIGH to LOW propagation delay | An to Bn   |      | 6.5                 | 10   | ns   |
| t <sub>PLH</sub>                  | LOW to HIGH propagation delay | Bn to An   |      | 7.5                 | 12   | ns   |
| t <sub>PHL</sub>                  | HIGH to LOW propagation delay | Bn to An   |      | 5.8                 | 9    | ns   |
| GTL - ; Vref = 0.6 V; VTT = 0.9 V |                               |            |      |                     |      |      |
| t <sub>PLH</sub>                  | LOW to HIGH propagation delay | An to Bn   |      | 2.3                 | 5    | ns   |
| t <sub>PHL</sub>                  | HIGH to LOW propagation delay | An to Bn   |      | 5.7                 | 10   | ns   |
| t <sub>PLH</sub>                  | LOW to HIGH propagation delay | Bn to An   |      | 7.5                 | 12   | ns   |
| t <sub>PHL</sub>                  | HIGH to LOW propagation delay | Bn to An   |      | 5.6                 | 9    | ns   |
| GTL - ; Vref = 0.8 V; VTT = 1.2 V |                               |            |      |                     |      |      |
| t <sub>PLH</sub>                  | LOW to HIGH propagation delay | An to Bn   |      | 2.3                 | 5    | ns   |
| t <sub>PHL</sub>                  | HIGH to LOW propagation delay | An to Bn   |      | 7.5                 | 12   | ns   |
| t <sub>PLH</sub>                  | LOW to HIGH propagation delay | Bn to An   |      | 7.5                 | 12   | ns   |
| t <sub>PHL</sub>                  | HIGH to LOW propagation delay | Bn to An   |      | 5.6                 | 9    | ns   |
| GTL+; Vref = 1.0 V; VTT = 1.5 V   |                               |            |      |                     |      |      |
| t <sub>PLH</sub>                  | LOW to HIGH propagation delay | An to Bn   |      | 2.3                 | 5    | ns   |
| t <sub>PHL</sub>                  | HIGH to LOW propagation delay | An to Bn   |      | 8.6                 | 12   | ns   |
| t <sub>PLH</sub>                  | LOW to HIGH propagation delay | Bn to An   |      | 8.8                 | 12   | ns   |
| t <sub>PHL</sub>                  | HIGH to LOW propagation delay | Bn to An   |      | 5.6                 | 9    | ns   |

## Waveforms

$V_M = 1.5\text{ V}$  at  $V_{CC} \geq 3.0\text{ V}$ ;  $V_M = V_{CC}/2$  at  $V_{CC} \leq 2.7\text{ V}$  for A ports and control pins;  
 $V_M = V_{ref}$  for B ports.

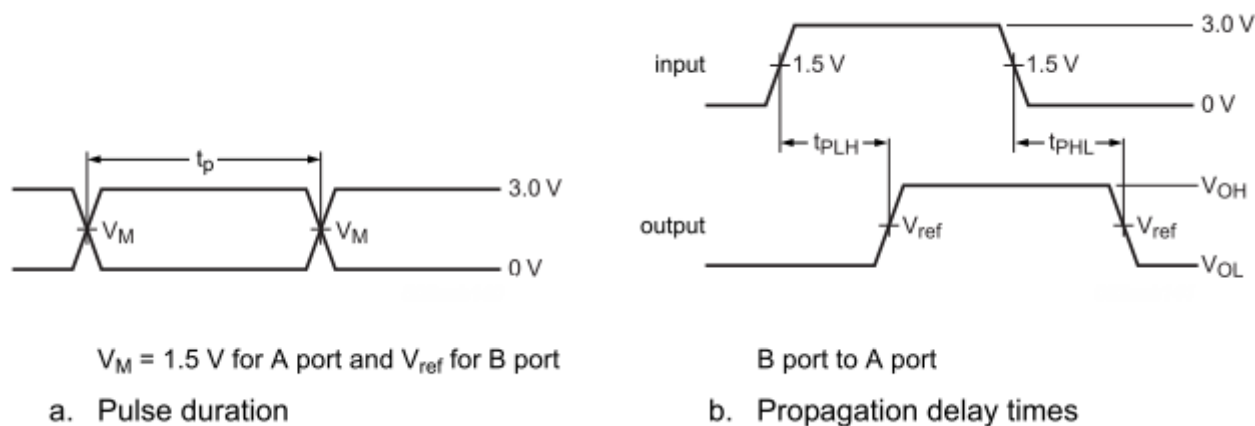
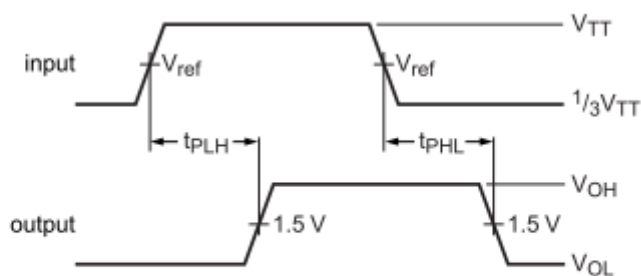


Fig 2. Voltage waveforms



$PRR \leq 10\text{ MHz}$ ;  $Z_0 = 50\ \Omega$ ;  $t_r \leq 2.5\text{ ns}$ ;  $t_f \leq 2.5\text{ ns}$

Fig 3. Propagation delay, Bn to An



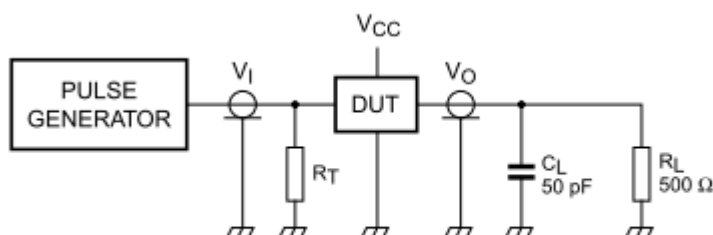


Fig 4. Load circuitry for switching times

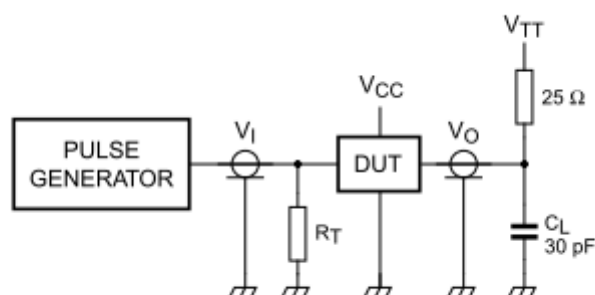


Fig 5. Load circuit for B outputs

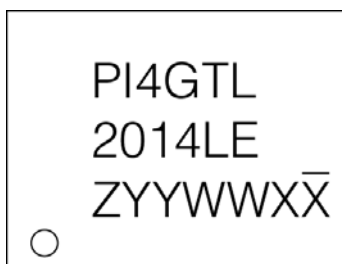
RL — Load resistor

CL — Load capacitance; includes jig and probe capacitance

RT — Termination resistance; should be equal to output impedance of pulse generators.

## Part Marking

### L Package



Z: Die Rev

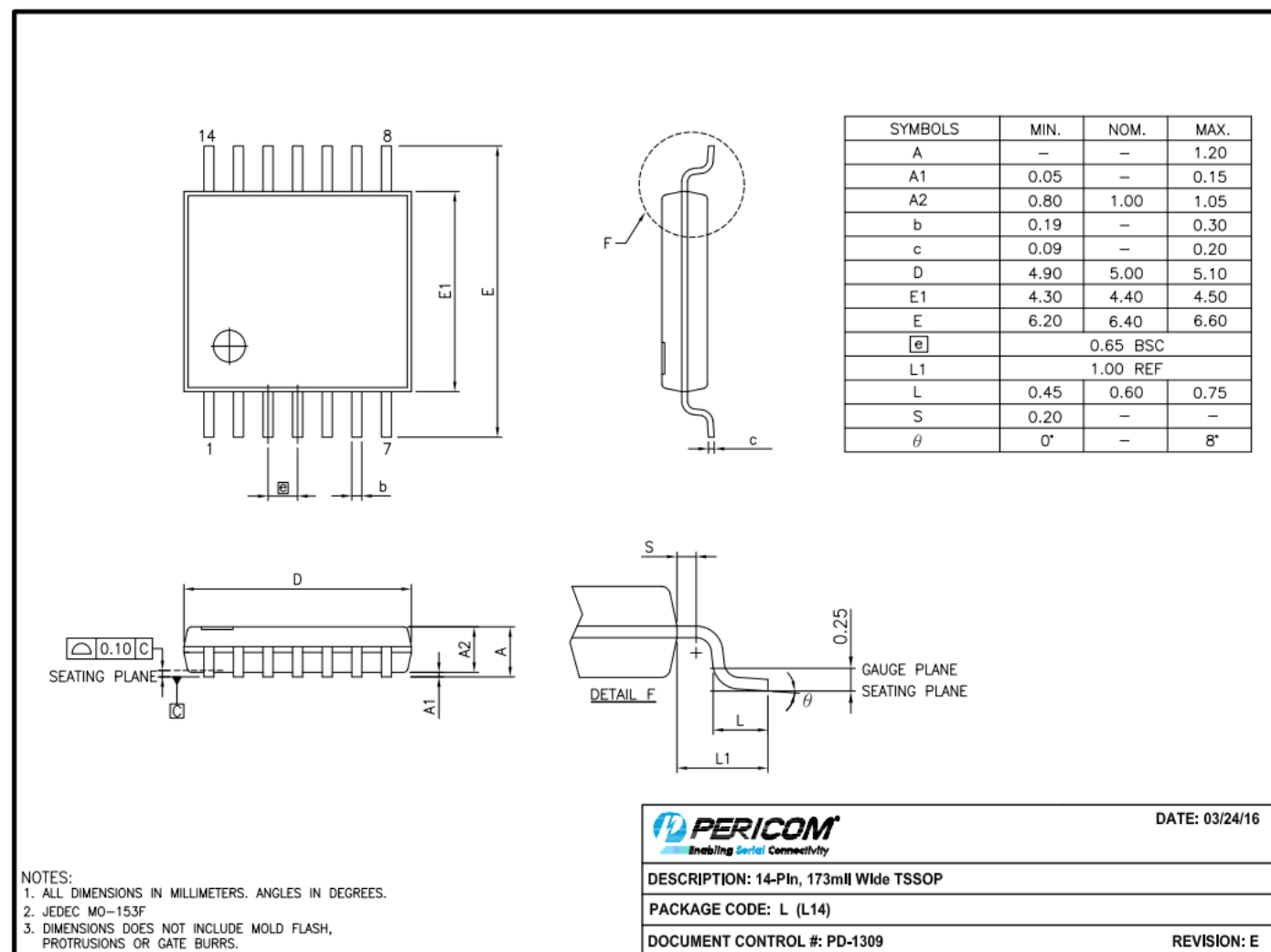
YYWW: Year & Work week

1st X: Assembly Code

2nd X: Wafer Fab site Code

## Package Mechanical

### TSSOP-14(L)



#### For latest package info.

please check: <http://www.diodes.com/design/support/packaging/pericom-packaging/packaging-mechanicals-and-thermal-characteristics/>

## Ordering Information

| Part Number   | Package Code | Package                      |
|---------------|--------------|------------------------------|
| PI4GTL2014LEX | L            | 14-Pin, 173 mil Wide (TSSOP) |

#### Notes:

- Thermal characteristics can be found on the company web site at [www.diodes.com/design/support/packaging/](http://www.diodes.com/design/support/packaging/)
- E = Pb-free and Green
- X suffix = Tape/Reel

**IMPORTANT NOTICE**

DIODES INCORPORATED MAKES NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARDS TO THIS DOCUMENT, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION).

Diodes Incorporated and its subsidiaries reserve the right to make modifications, enhancements, improvements, corrections or other changes without further notice to this document and any product described herein. Diodes Incorporated does not assume any liability arising out of the application or use of this document or any product described herein; neither does Diodes Incorporated convey any license under its patent or trademark rights, nor the rights of others. Any Customer or user of this document or products described herein in such applications shall assume all risks of such use and will agree to hold Diodes Incorporated and all the companies whose products are represented on Diodes Incorporated website, harmless against all damages.

Diodes Incorporated does not warrant or accept any liability whatsoever in respect of any products purchased through unauthorized sales channel.

Should Customers purchase or use Diodes Incorporated products for any unintended or unauthorized application, Customers shall indemnify and hold Diodes Incorporated and its representatives harmless against all claims, damages, expenses, and attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized application.

Products described herein may be covered by one or more United States, international or foreign patents pending. Product names and markings noted herein may also be covered by one or more United States, international or foreign trademarks.

This document is written in English but may be translated into multiple languages for reference. Only the English version of this document is the final and determinative format released by Diodes Incorporated.

**LIFE SUPPORT**

Diodes Incorporated products are specifically not authorized for use as critical components in life support devices or systems without the express written approval of the Chief Executive Officer of Diodes Incorporated. As used herein:

A. Life support devices or systems are devices or systems which:

1. are intended to implant into the body, or
2. support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in significant injury to the user.

B. A critical component is any component in a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or to affect its safety or effectiveness.

Customers represent that they have all necessary expertise in the safety and regulatory ramifications of their life support devices or systems, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of Diodes Incorporated products in such safety-critical, life support devices or systems, notwithstanding any devices- or systems-related information or support that may be provided by Diodes Incorporated. Further, Customers must fully indemnify Diodes Incorporated and its representatives against any damages arising out of the use of Diodes Incorporated products in such safety-critical, life support devices or systems.

Copyright © 2016, Diodes Incorporated  
[www.diodes.com](http://www.diodes.com)