**National Semiconductor**

## MNDS1776-X REV 2A0

# PI-BUS TRANSCEIVER

## General Description

The DS1776 is an octal PI-bus Transceiver. The A to B path is latched. B outputs are open collector with series Schottky diode, ensuring minimum B output loading. B inputs have glitch rejection circuitry, 4 ns typical.

Designed using Nationals Bi-CMOS process for both low operating and disabled power. AC performance is optimized for the PI-Bus inter-operability requirements.

The DS1776 is an octal latched transceiver and is intended to provide the electrical interface to a high performance wired-or bus. This bus has a loaded characteristic impedance range of 20 Ohm to 50 Ohm and is terminated on each end with a 30 Ohm to 40 Ohm resistor.

The DS1776 is an octal bidirectional transceiver with open collector B and TRI-STATE A port output drivers. A latch function is provided for the A port signals. The B port output driver is designed to sink 100 mA from 2V and features a controlled linear ramp to minimize crosstalk and ringing on the bus.

A separate high level control voltage (Vx) is provided to prevent the A side output high level from exceeding future high density processor supply voltage levels. For 5V systems, Vx is tied to Vcc.

## Industry Part Number

DS1776

## NS Part Numbers

DS1776E/883

## Prime Die

DS1776

## Controlling Document

5962-9231701M3A

## Processing

MIL-STD-883, Method 5004

## Quality Conformance Inspection

MIL-STD-883, Method 5005

| Subgrp | Description | Temp ($^\circ$C) |
|---|---|---|
| 1 | Static tests at | +25 |
| 2 | Static tests at | +125 |
| 3 | Static tests at | -55 |
| 4 | Dynamic tests at | +25 |
| 5 | Dynamic tests at | +125 |
| 6 | Dynamic tests at | -55 |
| 7 | Functional tests at | +25 |
| 8A | Functional tests at | +125 |
| 8B | Functional tests at | -55 |
| 9 | Switching tests at | +25 |
| 10 | Switching tests at | +125 |
| 11 | Switching tests at | -55 |

## (Absolute Maximum Ratings)

A0-A7 Current Applied to Output in Low Output State (Io)

          40mA

A0-A7, B0-B7 Input Voltage (Vi)

          -0.5V to +5.5V

B0-B7 Current Applied to Output in Low Output State (Io)

          200mA

ESD Tolerance
    Czap = 120pF, Rzap = 1500 Ohms          0.5kV

Input Current (Ii)

          -40mA to +5mA

Lead Temperature
    (Soldering, 10 seconds)          260 C

Storage Temperature Range

          -65 C to +150 C

Supply Voltage (Vcc)

          -0.5V to +7.0V

Voltage Applied to Output in High Output State (Vo)

          -0.5V to +VccV

Vx, Voh Output Level Control Voltage
    (A Outputs)          -0.5V to +7.0V

$\overline{OEB}$n, OEA, $\overline{LE}$ Input Voltage (Vi)

          -0.5V to +7.0V

Power Dissipation
    LCC PKG          740 mW

## Recommended Operating Conditions

Operating Temperature Range (TA)

          Min=-55, Max=+125 C

Supply Voltage (Vcc)

          Min=4.5V, Max=5.5V

# Electrical Characteristics

## DC PARAMETERS

(The following conditions apply to all the following parameters, unless otherwise specified.)
DC:   Vcc = 5.5V

| SYMBOL | PARAMETER | CONDITIONS | NOTES | PIN-NAME | MIN | MAX | UNIT | SUB-GROUPS |
|--------|-----------|-----------|-------|----------|-----|-----|------|------------|
| Vil2 | Low Level In Voltage B0-B7 | Vcc = 4.5 | 1 | | | 1.45 | V | 1, 2, 3 |
| Vil1 | All Other Inputs | Vcc = 4.5 | | | | .8 | V | 1, 2, 3 |
| Vih1 | Hi Level In Voltage OEB0/1, OEA, An, LE | | 1 | | 2 | | V | 1, 2, 3 |
| Vih2 | High Level In Voltage B0-B7 | | | | 1.6 | | V | 1, 2, 3 |
| Ioh1 | High Level Output Current A0-A7 | Vcc = 4.5, Vin = Vih or Vil, Voh = 2.5V | 2 | | | -3 | mA | 1, 2, 3 |
| Ioh2 | High Level Output Current B0-B7 | Vcc = 5.5, Vil = 0.8V, Vih = 2.0V, Voh = 2.1V | | | | 100 | uA | 1, 2, 3 |
| Iol1 | Low Level Output Current A0-A7 | Vcc = 4.5, Vin = Vih or Vil, Vol = 0.5V | 3 | | | 20 | mA | 1, 2, 3 |
| Iol2 | Low Level Output Current B0-B7 | Vcc = 4.5, Vin = Vih or Vil, Vol = 1.15V | | | | 100 | mA | 1, 2, 3 |
| Voh | High Level Output Voltage A0-A7 | Vcc = 4.5, Vin = Vil or Vih, Ioh = -3 mA, Vx = 4.5v | | | 2.5 | 4.5 | V | 1, 2, 3 |
| | | Vcc = 4.5, Vin = Vil or Vih, Ioh =-0.4 mA,Vx = 3.13/3.47 | | | 2.5 | VX | V | 1, 2, 3 |
| Vol | Low Level Output Voltage A0-A7 | Vcc = 4.5, Vil = Max, Vih = Min, Iol = 20mA, Vx = Vcc | | | | 0.5 | V | 1, 2, 3 |
| Volb | Low Level Output Voltage B0-B7 | Vcc = 4.5, Vil = Max, Vih = Min, Iol = 100mA | | | | 1.15 | V | 1, 2, 3 |
| | | Vcc = 4.5, Vil = Max, Vih = Min, Iol = 4mA | | | 0.4 | | V | 1, 2, 3 |
| Vik | Input Clamp Voltage A0-A7 | Vcc = 4.5, Ii = -40mA | | | | -0.5 | V | 1, 2, 3 |
| Vik | Input Clamp Voltage Other Inputs | Vcc = 4.5, Ii = -18mA | | | | -1.2 | V | 1, 2, 3 |
| Iih1 | Input Current Max Input Voltage OEBn, OEA, LE | Vcc = 5.5, Vi = 7.0V | | | | 100 | uA | 1, 2, 3 |
| Iih2 | Input Current Max Input Voltage A0-A7, B0-B7 | Vcc = 5.5, Vi = 5.5V | | | | 1 | mA | 1, 2, 3 |
| Iih3 | High Level Input Current OEBn, OEA, LE | Vcc = 5.5, Vi = 2.7V | | | | 20 | uA | 1, 2, 3 |

# Electrical Characteristics

## DC PARAMETERS (Continued)

(The following conditions apply to all the following parameters, unless otherwise specified.)
DC:   Vcc = 5.5V

| SYMBOL | PARAMETER | CONDITIONS | NOTES | PIN-NAME | MIN | MAX | UNIT | SUB-GROUPS |
|---|---|---|---|---|---|---|---|---|
| Iih4 | High Level Input Current B0-B7 | Vcc = 5.5, Vi = 2.1V | | | | 100 | uA | 1, 2, 3 |
| Iil1 | Low Level Input Current OEBn, OEA | Vcc = 5.5, Vi = 0.5V | | | | -20 | uA | 1, 2, 3 |
| Iil2 | Low Level Input Current LE | Vcc = 5.5, Vi = 0.5V | | | | -20 | uA | 1 |
| | | | | | | -40 | uA | 2, 3 |
| Iil3 | Low Level Input Current B0-B7 | Vcc = 5.5, Vi = 0.3V | | | | -100 | uA | 1, 2, 3 |
| Iozh + Iih | TRI-STATE Output Current, High Level Voltage Applied A0-A7 | Vcc = 5.5, Vo = 2.7V | | | | 70 | uA | 1, 2, 3 |
| Iozl + Iil | TRI-STATE Output Current, Low Level Voltage Applied A0-A7 | Vcc = 5.5, Vo = 0.5V | | | | -70 | uA | 1, 2, 3 |
| Ix | High Level Control Current | Vcc=5.5,Vx=5.5V, $\overline{LE}$=OEA=$\overline{OEB}$n=2.7V, A0-A7 = 2.7, B0-B7 = 2V | | | -100 | 100 | uA | 1, 2, 3 |
| | | Vcc=5.5,Vx=3.13V and 3.47V, $\overline{LE}$=OEA=2.7V, $\overline{OEB}$n=A0-A7=2.7V, B0-B7-2V | | | -10 | 10 | mA | 1, 2, 3 |
| Ios | Short Circuit Output Current A0-A7 only | Vcc=5.5, Bn = 1.9V, OEA = 2.0V, $\overline{OEB}$n = 2.7V, Vout = 0V | 4 | | -60 | -150 | mA | 1, 2, 3 |
| Icch | Supply Current (Total) ICCH | Vcc=5.5, Vin (An) = 5.0V | | | | 37 | mA | 1, 2 |
| | | | | | | 41 | mA | 3 |
| Iccl | Supply Current (Total) ICCL | Vcc=5.5, Vin (An) = 0.5V | | | | 38 | mA | 1, 3 |
| | | | | | | 34 | mA | 2 |
| Iccz | Supply Current (Total) ICCZ | Vcc=5.5, Vin (An) = 0.5V | | | | 35 | mA | 1, 2, 3 |
| Ioff | Power Off Output Current B0-B7 | Vcc=0, Bn = 2.1V, Vil = Max, Vih = Min | | | | 100 | uA | 1, 2, 3 |

# Electrical Characteristics

## AC PARAMETERS: B to A PATH

(The following conditions apply to all the following parameters, unless otherwise specified.)
AC:  Vcc = 5V $\pm$10%, Cl = 50pF, Rl = 500 Ohms

| SYMBOL | PARAMETER | CONDITIONS | NOTES | PIN-NAME | MIN | MAX | UNIT | SUB-GROUPS |
|--------|-----------|------------|-------|----------|-----|-----|------|------------|
| TPLH | Propagation Delay B to A | | | | 4.5 | 17 | nS | 9, 10, 11 |
| TPHL | Propagation Delay B to A | | | | 6.0 | 17 | nS | 9, 10, 11 |
| TPZH | Output Enable OEA To A | | | | 4.0 | 17 | nS | 9, 10, 11 |
| TPZL | Output Enable OEA To A | | | | 4.0 | 21 | nS | 9, 10, 11 |
| TPHZ | Output Disable OEA to A | | | | 2.0 | 12 | nS | 9, 10, 11 |
| TPLZ | Output Disable OEA to A | | | | 2.0 | 13 | nS | 9, 10, 11 |

## AC PARAMETERS: A to B PATH

(The following conditions apply to all the following parameters, unless otherwise specified.)
AC:  Vcc = 5V $\pm$10%, Cl = 30pF, Rl = 9 Ohms

| SYMBOL | PARAMETER | CONDITIONS | NOTES | PIN-NAME | MIN | MAX | UNIT | SUB-GROUPS |
|--------|-----------|------------|-------|----------|-----|-----|------|------------|
| TPLH | Propagation Delay A to B | | | | 2.0 | 13 | nS | 9, 11 |
| | | | | | 2.0 | 17 | nS | 10 |
| TPHL | Propagation Delay A to B | | | | 2.5 | 13 | nS | 9, 10, 11 |
| TPLH | Propagation Delay $\overline{\text{LE}}$ to B | | | | 2.0 | 16 | nS | 9, 11 |
| TPLH | Propagation Delay $\overline{\text{LE}}$ to B | | | | 2.0 | 22 | nS | 10 |
| TPHL | Propagation Delay $\overline{\text{LE}}$ to B | | | | 2.0 | 16 | nS | 9, 10, 11 |
| TPLH | Enable/Disable Time $\overline{\text{OEB}}$n to B | | | | 2.0 | 13 | nS | 9, 11 |
| TPLH | Enable/Disable Time $\overline{\text{OEB}}$n to B | | | | 2.0 | 16 | nS | 10 |
| TPHL | Enable/Disable Time $\overline{\text{OEB}}$n to B | | | | 3.5 | 14 | nS | 9 |
| TPHL | Enable/Disable Time $\overline{\text{OEB}}$n to B | | | | 3.5 | 13 | nS | 10 |
| TPHL | Enable/Disable Time $\overline{\text{OEB}}$n to B | | | | 3.5 | 16 | nS | 11 |

# Electrical Characteristics

## AC PARAMETERS: SETUP/HOLD/PULSE WIDTH SPECS

(The following conditions apply to all the following parameters, unless otherwise specified.)
AC:　Vcc = 5V $\pm$10%

| SYMBOL | PARAMETER | CONDITIONS | NOTES | PIN-NAME | MIN | MAX | UNIT | SUB-GROUPS |
|---|---|---|---|---|---|---|---|---|
| TS | A to LE Setup | | | | 7.0 | | nS | 9, 10, 11 |
| TH | A to LE Hold | | | | 0.0 | | nS | 9, 10, 11 |
| TW | LE Pulse Width Low | | | | 12 | | nS | 9, 10, 11 |

　　　Note 1:　Tested Go/No Go.
　　　Note 2:　Same as Voh.
　　　Note 3:　Same as Vol.
　　　Note 4:　Not more than one output to be shorted at a time.

# Graphics and Diagrams

| GRAPHICS# | DESCRIPTION |
| --- | --- |
| 6138HRC1 | 28L LEADLESS CHIP CARRIER TYPE C(B/I CKT) |
| E28ARD | LCC (E), TYPE C, 28 TERMINAL(P/P DWG) |

**See attached graphics following this page.**

## Revision History

| Rev | ECN # | Rel Date | Originator | Changes |
|-----|-------|----------|------------|---------|
| 2A0 | M0003000 | 08/24/98 | Mike Fitzgerald | Changed tpZL (Output Enable OEA to A) maximum limit from 17ns to 21ns, subgroups 9,10,11. |