



3.3V CMOS 3-LINE TO 8-LINE DECODER/DEMULTIPLEXER WITH 5 VOLT TOLERANT I/O

IDT74LVC138A

FEATURES:

- 0.5 MICRON CMOS Technology
- ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)
- Vcc = 3.3V ± 0.3V, Normal Range
- Vcc = 2.7V to 3.6V, Extended Range
- CMOS power levels (0.4µ W typ. static)
- Rail-to-Rail output swing for increased noise margin
- All inputs, outputs, and I/Os are 5V tolerant
- Supports hot insertion
- Available in QSOP, SOIC, SSOP, and TSSOP packages

DRIVE FEATURES:

- High Output Drivers: ±24mA
- Reduced system switching noise

APPLICATIONS:

- 5V and 3.3V mixed voltage systems
- Data communication and telecommunication systems

DESCRIPTION:

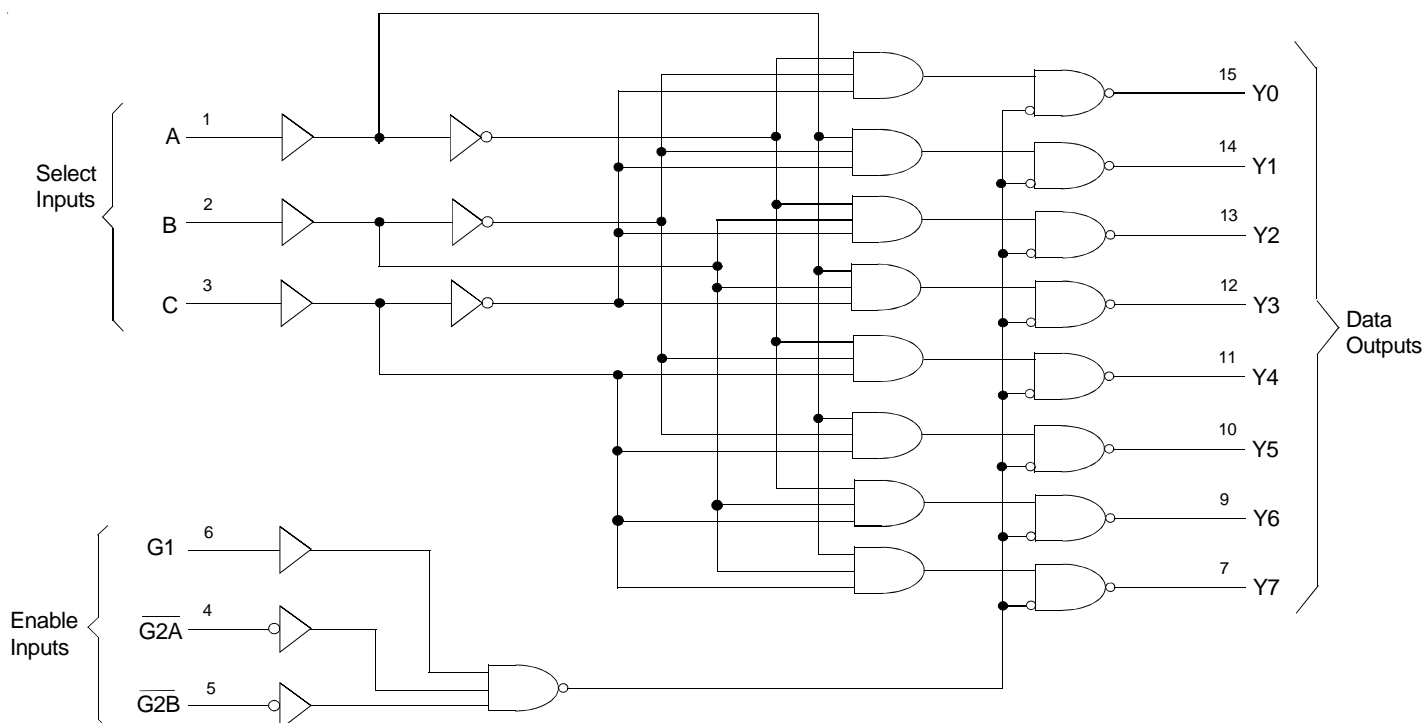
The LVC138A 3-line to 8-line decoder/demultiplexer is built using advanced dual metal CMOS technology. This device is designed for high-performance memory-decoding or data-routing applications requiring very short propagation delay times. In high performance memory systems, this decoder minimizes the effects of system decoding. When employed with high-speed memories utilizing a fast enable circuit, the delay times of these decoders and the enable time of the memory are usually less than the typical access time of the memory. This means that the effective system delay introduced by the decoder is negligible.

The conditions at the binary-select inputs and the three enable inputs select one of eight output lines. Two active-low enable inputs and one active-high enable input reduce the need for external gates or inverters when expanding. A 24-line decoder can be implemented without external inverters and a 32-line decoder requires only one inverter. An enable input can be used as a data input for demultiplexing applications.

Inputs can be driven from either 3.3V or 5V devices. This feature allows the use of this device as a translator in a mixed 3.3V/5V supply system.

The LVC138A has been designed with a ±24mA output driver. This driver is capable of driving a moderate to heavy load while maintaining speed performance.

FUNCTIONAL BLOCK DIAGRAM

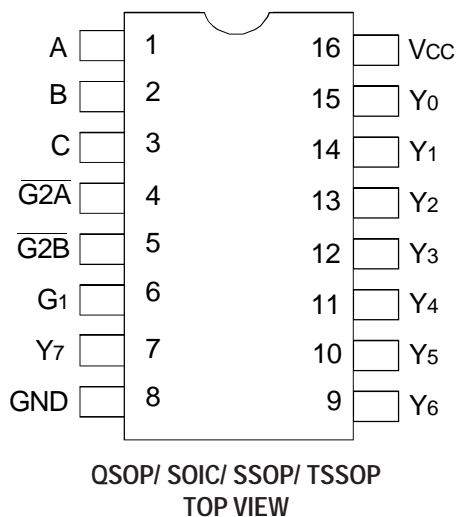


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INDUSTRIAL TEMPERATURE RANGE

AUGUST 1999

PIN CONFIGURATION



ABSOLUTE MAXIMUM RATINGS⁽¹⁾

| Symbol | Description | Max | Unit |
|------------------------------------|---|--------------|------|
| VTERM | Terminal Voltage with Respect to GND | -0.5 to +6.5 | V |
| TSTG | Storage Temperature | -65 to +150 | °C |
| IOUT | DC Output Current | -50 to +50 | mA |
| I _{IK} I _{OK} | Continuous Clamp Current, V _I < 0 or V _O < 0 | -50 | mA |
| I _{CC} I _{SS} | Continuous Current through each V _{CC} or GND | ±100 | mA |

NOTE:

1. Stresses greater than those listed under ABSOLUTE 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.

PIN DESCRIPTION

| Pin Names | Description |
|-------------------------------------|----------------------------|
| G1 | Input Enable |
| $\overline{G2A}$, $\overline{G2B}$ | Input Enables (Active LOW) |
| Y _x | Data Outputs |
| A, B, C | Select Data Inputs |

CAPACITANCE (T_A = +25°C, F = 1.0MHz)

| Symbol | Parameter ⁽¹⁾ | Conditions | Typ. | Max. | Unit |
|------------------|--------------------------|-----------------------|------|------|------|
| C _{IN} | Input Capacitance | V _{IN} = 0V | 4.5 | 6 | pF |
| C _{OUT} | Output Capacitance | V _{OUT} = 0V | 5.5 | 8 | pF |
| C _{I/O} | I/O Port Capacitance | V _{IN} = 0V | 6.5 | 8 | pF |

NOTE:

1. As applicable to the device type.

FUNCTION TABLE⁽¹⁾

| Enable Inputs | | | Select Inputs | | | Outputs | | | | | | | |
|---------------|------------------|------------------|---------------|---|---|---------|----|----|----|----|----|----|----|
| G1 | $\overline{G2A}$ | $\overline{G2B}$ | C | B | A | Y0 | Y1 | Y2 | Y3 | Y4 | Y5 | Y6 | Y7 |
| X | H | X | X | X | X | H | H | H | H | H | H | H | H |
| X | X | H | X | X | X | H | H | H | H | H | H | H | H |
| L | X | X | X | X | X | H | H | H | H | H | H | H | H |
| H | L | L | L | L | L | L | H | H | H | H | H | H | H |
| H | L | L | L | L | H | H | L | H | H | H | H | H | H |
| H | L | L | L | H | L | H | H | L | H | H | H | H | H |
| H | L | L | L | H | H | H | H | H | L | H | H | H | H |
| H | L | L | H | L | L | H | H | H | H | L | H | H | H |
| H | L | L | H | H | L | H | H | H | H | H | L | H | H |
| H | L | L | H | H | H | H | H | H | H | H | H | H | L |

NOTE:

1. H = HIGH Voltage Level
L = LOW Voltage Level
X = Don't Care

DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:

Operating Condition: $T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$

| Symbol | Parameter | Test Conditions | | Min. | Typ. ⁽¹⁾ | Max. | Unit |
|--|--|---|----------------------------|------|---------------------|------|------|
| V _{IH} | Input HIGH Voltage Level | V _{CC} = 2.3V to 2.7V | | 1.7 | — | — | V |
| | | V _{CC} = 2.7V to 3.6V | | 2 | — | — | |
| V _{IL} | Input LOW Voltage Level | V _{CC} = 2.3V to 2.7V | | — | — | 0.7 | V |
| | | V _{CC} = 2.7V to 3.6V | | — | — | 0.8 | |
| I _{IH} I _{IL} | Input Leakage Current | V _{CC} = 3.6V | V _I = 0 to 5.5V | — | — | ±5 | μA |
| I _{OZH} I _{OZL} | High Impedance Output Current (3-State Output pins) | V _{CC} = 3.6V | V _O = 0 to 5.5V | — | — | ±10 | μA |
| I _{OFF} | Input/Output Power Off Leakage | V _{CC} = 0V, V _{IN} or V _O ≤ 5.5V | | — | — | ±50 | μA |
| V _{IK} | Clamp Diode Voltage | V _{CC} = 2.3V, I _{IN} = -18mA | | — | -0.7 | -1.2 | V |
| V _H | Input Hysteresis | V _{CC} = 3.3V | | — | 100 | — | mV |
| I _{CCL} I _{CCH} I _{CCZ} | Quiescent Power Supply Current | V _{CC} = 3.6V, V _{IN} = GND or V _{CC} | | — | — | 10 | μA |
| ΔI _{CC} | Quiescent Power Supply Current Variation | One input at V _{CC} - 0.6V, other inputs at V _{CC} or GND | | — | — | 500 | μA |

NOTE:

1. Typical values are at V_{CC} = 3.3V, +25°C ambient.

OUTPUT DRIVE CHARACTERISTICS

| Symbol | Parameter | Test Conditions ⁽¹⁾ | | Min. | Max. | Unit |
|-----------------|---------------------|--------------------------------|--------------------------|-----------------------|------|------|
| V _{OH} | Output HIGH Voltage | V _{CC} = 2.3V to 3.6V | I _{OH} = -0.1mA | V _{CC} - 0.2 | — | V |
| | | V _{CC} = 2.3V | I _{OH} = -6mA | 2 | — | |
| | | V _{CC} = 2.3V | I _{OH} = -12mA | 1.7 | — | |
| | | V _{CC} = 2.7V | | 2.2 | — | |
| | | V _{CC} = 3V | | 2.4 | — | |
| | | V _{CC} = 3V | I _{OH} = -24mA | 2.2 | — | |
| V _{OL} | Output LOW Voltage | V _{CC} = 2.3V to 3.6V | I _{OL} = 0.1mA | — | 0.2 | V |
| | | V _{CC} = 2.3V | I _{OL} = 6mA | — | 0.4 | |
| | | | I _{OL} = 12mA | — | 0.7 | |
| | | V _{CC} = 2.7V | I _{OL} = 12mA | — | 0.4 | |
| | | V _{CC} = 3V | I _{OL} = 24mA | — | 0.55 | |

NOTE:

1. V_{IH} and V_{IL} must be within the min. or max. range shown in the DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE table for the appropriate V_{CC} range.
T_A = -40°C to +85°C.

OPERATING CHARACTERISTICS, $T_A = 25^\circ\text{C}$

| Symbol | Parameter | Test Conditions | V _{CC} = 2.5V±0.2V | V _{CC} = 3.3V±0.3V | Unit |
|--------|-------------------------------|---------------------------------|-----------------------------|-----------------------------|------|
| | | | Typical | Typical | |
| CPD | Power Dissipation Capacitance | C _L = 0pF, f = 10Mhz | — | 27 | pF |

SWITCHING CHARACTERISTICS⁽¹⁾

| Symbol | Parameter | V _{CC} = 2.5V ± 0.2V | | V _{CC} = 2.7V | | V _{CC} = 3.3V ± 0.3V | | Unit |
|--------------------------------------|---|-------------------------------|------|------------------------|------|-------------------------------|------|------|
| | | Min. | Max. | Min. | Max. | Min. | Max. | |
| t _{PLH} t _{PHL} | Propagation Delay A to B, C to Y _x | — | — | — | 7.9 | 1 | 6.7 | ns |
| t _{PLH} t _{PHL} | Propagation Delay $\overline{G2A}$ or $\overline{G2B}$ to Y _x | — | — | — | 7.4 | 1 | 6.5 | ns |
| t _{PLH} t _{PHL} | Propagation Delay G1 to Y _x | — | — | — | 6.4 | 1 | 5.8 | ns |
| t _{SU} | Setup Time, at A, B, and C before G | 2.4 | — | 2.5 | — | 2.3 | — | ns |
| t _H | Hold Time, at A, B, and C after G | 1.6 | — | 1.5 | — | 1.5 | — | ns |
| t _{sk(0)} | Output Skew ⁽²⁾ | — | — | — | — | — | 1 | ns |

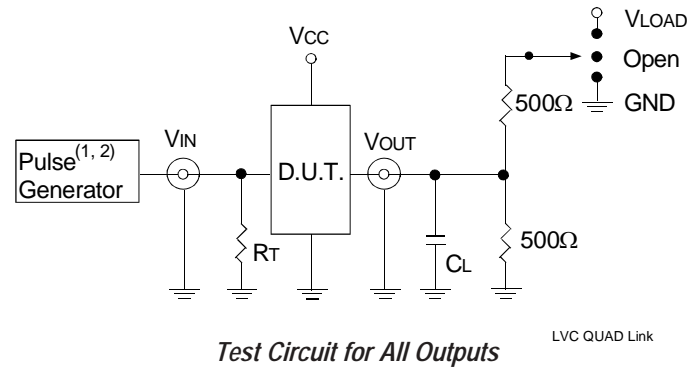
NOTES:

1. See TEST CIRCUITS AND WAVEFORMS. $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$.
2. Skew between any two outputs of the same package and switching in the same direction.

TEST CIRCUITS AND WAVEFORMS

TEST CONDITIONS

| Symbol | V _{CC} ⁽¹⁾ = 2.5V ± 0.2V | V _{CC} ⁽²⁾ = 3.3V ± 0.3V & 2.7V | Unit |
|-------------------|--|---|------|
| V _{LOAD} | 2 x V _{CC} | 6 | V |
| V _{IH} | V _{CC} | 2.7 | V |
| V _T | V _{CC} / 2 | 1.5 | V |
| V _{LZ} | 150 | 300 | mV |
| V _{HZ} | 150 | 300 | mV |
| C _L | 30 | 50 | pF |



DEFINITIONS:

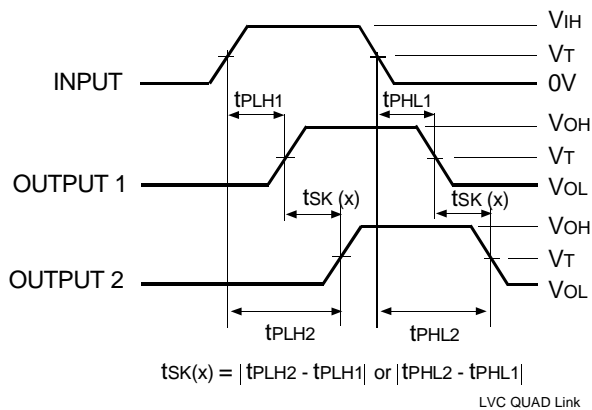
C_L = Load capacitance: includes jig and probe capacitance.
R_T = Termination resistance: should be equal to Z_{out} of the Pulse Generator.

NOTES:

1. Pulse Generator for All Pulses: Rate ≤ 10MHz; t_r ≤ 2ns; t_r ≤ 2ns.
2. Pulse Generator for All Pulses: Rate ≤ 10MHz; t_r ≤ 2.5ns; t_r ≤ 2.5ns.

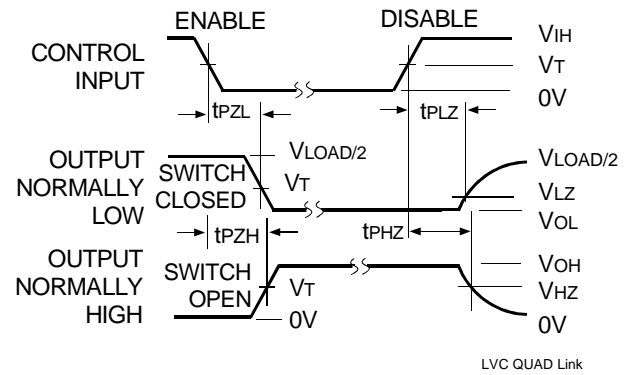
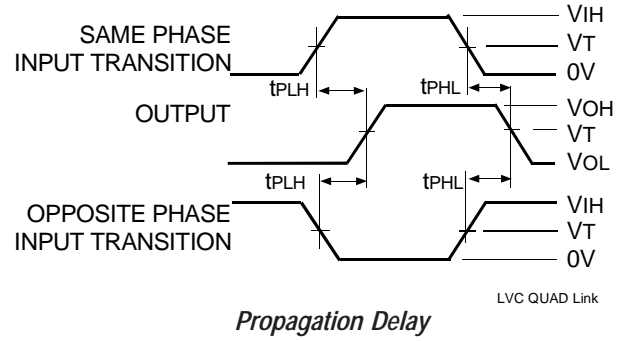
SWITCH POSITION

| Test | Switch |
|---|-------------------|
| Open Drain Disable Low Enable Low | V _{LOAD} |
| Disable High Enable High | GND |
| All Other Tests | Open |



NOTES:

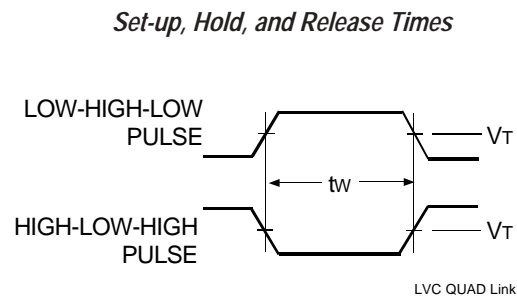
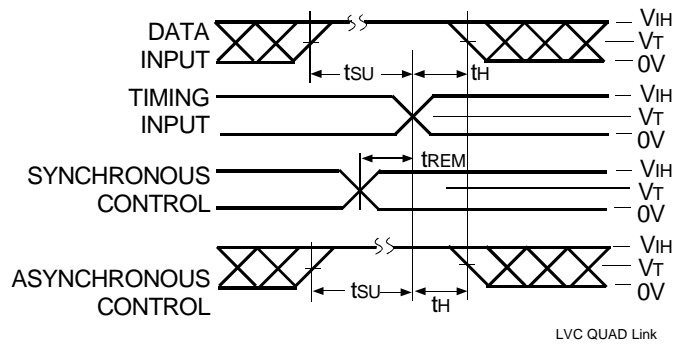
1. For t_{SK}(a) OUTPUT1 and OUTPUT2 are any two outputs.
2. For t_{SK}(b) OUTPUT1 and OUTPUT2 are in the same bank.



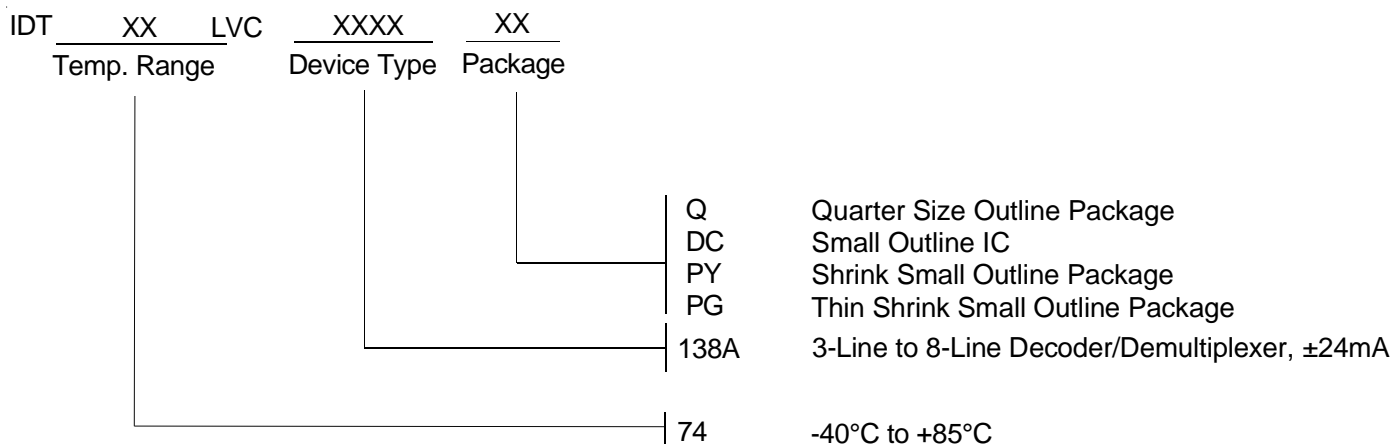
NOTE:

1. Diagram shown for input Control Enable-LOW and input Control Disable-HIGH.

Enable and Disable Times



ORDERING INFORMATION



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