⚡National
Semiconductor

74LVX138
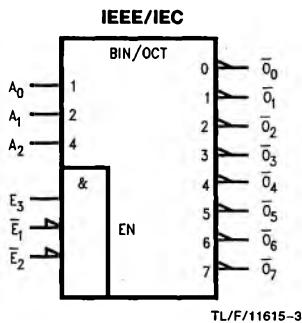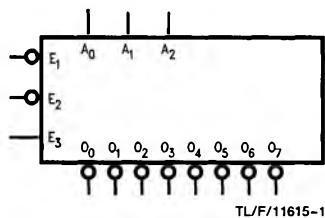# Low Voltage 1-of-8 Decoder/Demultiplexer

General Description

The LVX138 is a high-speed 1-of-8 decoder/demultiplexer. This device is ideally suited for high-speed bipolar memory chip select address decoding. The multiple input enables allow parallel expansion to a 1-of-24 decoder using just three LVX138 devices or a 1-of-32 decoder using four LVX138 devices and one inverter.

Features

■ Input voltage level translation from 5V to 3V
■ Ideal for low power/low noise 3.3V applications
■ Available in SOIC JEDEC, SOIC EIAJ and SSOP packages
■ Guaranteed simultaneous switching noise level and dynamic threshold performance

Ordering Code: See Section 11

Logic Symbols

TL/F/11615–1

IEEE/IEC

TL/F/11615–3

Connection Diagram

Pin Assignment for SOIC and SSOP

TL/F/11615–2
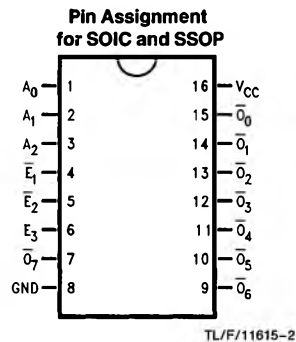
Pin Names	Description
A_0-A_2	Address Inputs
$\overline{E}_1-\overline{E}_2$	Enable Inputs
E_3	Enable Input
$\overline{O}_0-\overline{O}_7$	Outputs

	SOIC JEDEC	SOIC EIAJ	SSOP TYPE I
Order Number	74LVX138M 74LVX138MX	74LVX138SJ 74LVX138SJX	74LVX138MSCX
See NS Package Number	M16A	M16D	MSC16

Functional Description

The LVX138 high-speed 1-of-8 decoder/demultiplexer accepts three binary weighted inputs (A_0, A_1, A_2) and, when enabled, provides eight mutually exclusive active-LOW outputs ($\overline{O}_0$–$\overline{O}_7$). The LVX138 features three Enable inputs, two active-LOW ($\overline{E}_1$, $\overline{E}_2$) and one active-HIGH (E_3). All outputs will be HIGH unless $\overline{E}_1$ and $\overline{E}_2$ are LOW and E_3 is HIGH.

The LVX138 can be used as an 8-output demultiplexer by using one of the active LOW Enable inputs as the data input and the other Enable inputs as strobes. The Enable inputs which are not used must be permanently tied to their appropriate active-HIGH or active-LOW state.
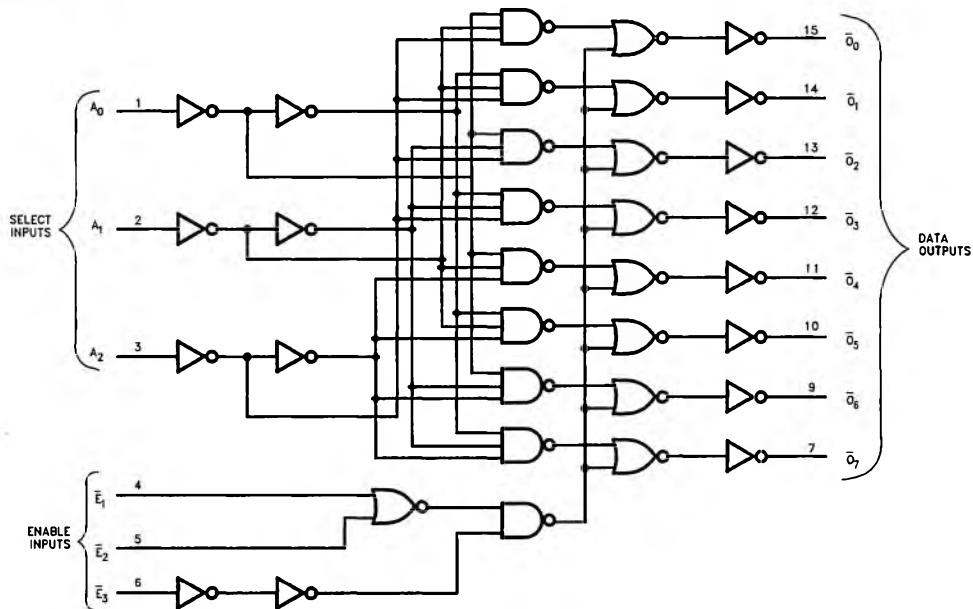
Truth Table

Inputs						Outputs							
$\overline{E}_1$	$\overline{E}_2$	E_3	A_0	A_1	A_2	$\overline{O}_0$	$\overline{O}_1$	$\overline{O}_2$	$\overline{O}_3$	$\overline{O}_4$	$\overline{O}_5$	$\overline{O}_6$	$\overline{O}_7$
H	X	X	X	X	X	H	H	H	H	H	H	H	H
X	H	X	X	X	X	H	H	H	H	H	H	H	H
X	X	L	X	X	X	H	H	H	H	H	H	H	H
L	L	H	L	L	L	L	H	H	H	H	H	H	H
L	L	H	H	L	L	H	L	H	H	H	H	H	H
L	L	H	L	H	L	H	H	L	H	H	H	H	H
L	L	H	H	H	L	H	H	H	L	H	H	H	H
L	L	H	L	L	H	H	H	H	H	L	H	H	H
L	L	H	H	L	H	H	H	H	H	H	L	H	H
L	L	H	L	H	H	H	H	H	H	H	H	L	H
L	L	H	H	H	H	H	H	H	H	H	H	H	L

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial

Logic Diagram

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Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

Absolute Maximum Ratings (Note)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage (V_{CC})	$-0.5V$ to $+7.0V$
DC Input Diode Current (I_{IK})	
$V_I = -0.5V$	-20 mA
DC Input Voltage (V_I)	$-0.5V$ to $7V$
DC Output Diode Current (I_{OK})	
$V_O = -0.5V$	-20 mA
$V_O = V_{CC} + 0.5V$	$+20$ mA
DC Output Voltage (V_O)	$-0.5V$ to $V_{CC} + 0.5V$
DC Output Source or Sink Current (I_O)	± 25 mA
DC V_{CC} or Ground Current (I_{CC} or I_{GND})	± 75 mA
Storage Temperature (T_{STG})	$-65°C$ to $+150°C$
Power Dissipation	180 mW

Note: The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the "Electrical Characteristics" table are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

Recommended Operating Conditions

Supply Voltage (V_{CC})	2.0V to 3.6V
Input Voltage (V_I)	0V to 5.5V
Output Voltage (V_O)	0V to V_{CC}
Operating Temperature (T_A)	$-40°C$ to $+85°C$
Input Rise and Fall Time (Δ_t / Δ_v)	0 ns/V to 100 ns/V

DC Electrical Characteristics

Symbol	Parameter	V_{CC}	74LVX138 $T_A = +25°C$ Min	Typ	Max	74LVX138 $T_A = -40°C$ to $+85°C$ Min	Max	Units	Conditions	
V_{IH}	High Level Input Voltage	2.0	1.5			1.5		V		
		3.0	2.0			2.0				
		3.6	2.4			2.4				
V_{IL}	Low Level Input Voltage	2.0			0.5		0.5	V		
		3.0			0.8		0.8			
		3.6			0.8		0.8			
V_{OH}	High Level Output Voltage	2.0	1.9	2.0		1.9		V	$V_{IN} = V_{IL}$ or V_{IH}	$I_{OH} = -50\ \mu A$
		3.0	2.9	3.0		2.9				$I_{OH} = -50\ \mu A$
		3.0	2.58			2.48				$I_{OH} = -4$ mA
V_{OL}	Low Level Output Voltage	2.0	0.0		0.1		0.1	V	$V_{IN} = V_{IL}$ or V_{IH}	$I_{OL} = 50\ \mu A$
		3.0	0.0		0.1		0.1			$I_{OL} = 50\ \mu A$
		3.0			0.36		0.44			$I_{OL} = 4$ mA
I_{IN}	Input Leakage Current	3.6			± 0.1		± 1.0	μA	$V_{IN} = 5.5V$ or GND	
I_{CC}	Quiescent Supply Current	3.6			4.0		40.0	μA	$V_{IN} = V_{CC}$ or GND	

Noise Characteristics: See Section 2 for Test Methodology

Symbol	Parameter	V_CC (V)	74LVX138 T_A = 25°C Typ	74LVX138 T_A = 25°C Limit	Units	C_L (pF)
V_OLP	Quiet Output Maximum Dynamic V_OL	3.3	0.3	0.5	V	50
V_OLV	Quiet Output Minimum Dynamic V_OL	3.3	−0.3	−0.5	V	50
V_IHD	Minimum High Level Dynamic Input Voltage	3.3		2.0	V	50
V_ILD	Maximum Low Level Dynamic Input Voltage	3.3		0.8	V	50

Note: Input $t_r = t_f = 3$ ns

AC Electrical Characteristics: See Section 2 for Test Methodology

Symbol	Parameter	V_CC (V)	74LVX138 T_A = +25°C Min	74LVX138 T_A = +25°C Typ	74LVX138 T_A = +25°C Max	74LVX138 T_A = −40°C to +85°C Min	74LVX138 T_A = −40°C to +85°C Max	Units	C_L (pF)
t_PLH t_PHL	Propagation Delay Time A_n to $\overline{O}_n$	2.7		7.1	13.8	1.0	16.5	ns	15
				9.6	17.3	1.0	20.0		50
		3.3 ±0.3		5.5	8.8	1.0	10.5		15
				8.0	12.3	1.0	14.0		50
t_PLH t_PHL	Propagation Delay Time $\overline{E}_1$ or $\overline{E}_2$ to $\overline{O}_n$	2.7		8.8	16.0	1.0	18.5	ns	15
				11.3	19.5	1.0	22.0		50
		3.3 ±0.3		6.9	10.4	1.0	11.5		15
				9.4	13.9	1.0	15.0		50
t_PLH t_PHL	Propagation Delay Time E_3 to $\overline{O}_n$	2.7		8.7	16.3	1.0	19.5	ns	15
				11.2	19.8	1.0	23.0		50
		3.3 ±0.3		6.8	10.6	1.0	12.5		15
				9.3	14.1	1.0	16.0		50
t_OSHL t_OSLH	Output to Output Skew (Note 1)	2.7			1.5		1.5	ns	50

Note 1: Parameter guaranteed by design. $t_{OSLH} = |t_{PLHm} - t_{PLHn}|$, $t_{OSHL} = |t_{PHLm} - t_{PHLn}|$

Capacitance

Symbol	Parameter	74LVX138 T_A = +25°C Min	74LVX138 T_A = +25°C Typ	74LVX138 T_A = +25°C Max	74LVX138 T_A = −40°C to +85°C Min	74LVX138 T_A = −40°C to +85°C Max	Units
C_IN	Input Capacitance		4	10		10	pF
C_PD	Power Dissipation Capacitance (Note 1)		34				pF

Note 1: C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation: $I_{CC(opr.)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}$