FEB 12 1991

National Semiconductor

November 1990

74FR16245
16-Bit Transceiver with TRI-STATE® Outputs

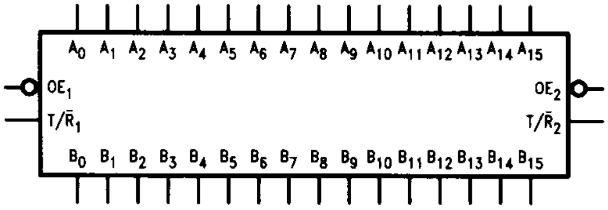
General Description

The 'FR16245 contains sixteen non-inverting bidirectional buffers with TRI-STATE outputs and is intended for bus-oriented applications. Current sinking capability is 64 mA on both the A and B ports. The device is byte controlled. Each byte has separate control inputs which can be shorted together for full 16-bit operation. The transmit/receive ($T/\overline{Rn}$) inputs determine the direction of data flow through the transceiver. The output enable ($\overline{OE}n$) inputs disable both A and B ports by placing them in an high impedance state.

Features

- Non-inverting buffers
- Bidirectional data paths
- A and B output sink capability of 64 mA, source capability of 15 mA
- Separate control pins for each byte
- Guaranteed 4000V minimum ESD protection
- Guaranteed pin to pin skew
- Low TRI-STATE I_{IL}
- 16-Bit version of the 'F245 or 'F645

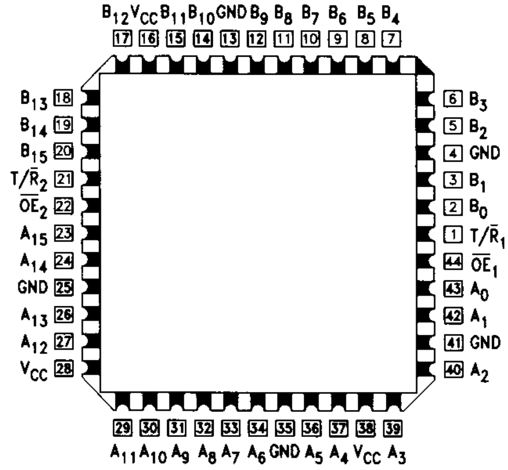
Logic Symbol



TL/F/10614-1

Connection Diagram

Pin Assignment for PCC



TL/F/10614-3

TRI-STATE® is a registered trademark of National Semiconductor Corporation.
FACT™ is a trademark of National Semiconductor Corporation.

Pin Descriptions

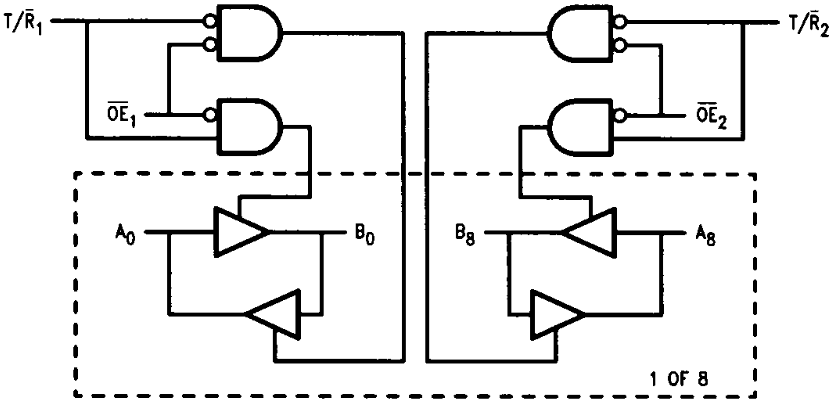
Pin Names	Description
$\overline{OE}_n$	Output Enable Input
$T/\overline{R}_n$	Transmit/Receive Input
A_0–A_{15}	A Bus Inputs/ TRI-STATE Outputs
B_0–B_{15}	B Bus Inputs/ TRI-STATE Outputs

Truth Table

Inputs				Output Operating Mode	
Byte1 (0:7)		Byte2 (8:15)			
$\overline{OE}_1$	$T/\overline{R}_1$	$\overline{OE}_2$	$T/\overline{R}_2$	Byte1 (0:7)	Byte2 (8:15)
L	L	H	X	Bus B Data to A	High Z State
L	H	H	X	Bus A Data to B	High Z State
H	X	L	L	High Z State	Bus B Data to A
H	X	L	H	High Z State	Bus A Data to B
L	L	L	L	Bus B Data to A	Bus B Data to A
L	H	L	H	Bus A Data to B	Bus A Data to B
H	X	H	X	High Z State	High Z State

H = High Voltage Level
L = Low Voltage Level
X = Immaterial

Logic Diagram



TL/F/10614–2

Absolute Maximum Ratings (Note 1)

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

Storage Temperature	−65°C to +150°C
Ambient Temperature under Bias	−55°C to +125°C
Junction Temperature under Bias	−55°C to +175°C
V_{CC} Pin Potential to Ground Pin	−0.5V to +7.0V
Input Voltage (Note 2)	−0.5V to +7.0V
Input Current (Note 2)	−30 mA to +5.0 mA
Voltage Applied to Output in HIGH State (with V_{CC} = 0V)	
Standard Output	−0.5V to V_{CC}
TRI-STATE Output	−0.5V to +5.5V
Current Applied to Output in LOW State (Max)	Twice the Rated I_{OL} (mA)
ESD Last Passing Voltage (Min)	4000V

Note 1: Absolute maximum ratings are values beyond which the device may be damaged or have its useful life impaired. Functional operation under these conditions is not implied.

Note 2: Either voltage limit or current limit is sufficient to protect inputs.

Recommended Operating Conditions

Free Air Ambient Temperature	
Commercial	0°C to +70°C
Supply Voltage	
Commercial	+4.5V to +5.5V

DC Electrical Characteristics

Symbol	Parameter	74FR			Units	V_{CC}	Conditions
		Min	Typ	Max			
V_{IH}	Input HIGH Voltage	2.0			V		Recognized as a HIGH Signal
V_{IL}	Input LOW Voltage			0.8	V		Recognized as a LOW Signal
V_{CD}	Input Clamp Diode Voltage			−1.2	V	Min	$I_{IN} = -18$ mA
V_{OH}	Output HIGH Voltage	2.4 2.0	2.8 2.44		V	Min	$I_{OH} = -3$ mA $I_{OH} = -15$ mA (A_n, B_n)
V_{OL}	Output LOW Voltage		0.45	0.55	V	Min	$I_{OL} = 64$ mA (A_n, B_n)
I_{IH}	Input HIGH Current			5.0	μA	Max	$V_{IN} = 2.7V$
I_{BVI}	Input HIGH Current Break-Down Test			7.0	μA	Max	$V_{IN} = 7.0V$ ($\overline{OE}_n$, $T/\overline{R}_n$)
I_{BVIT}	Input HIGH Current Breakdown Test (I/O)			0.1	mA	Max	$V_{IN} = 5.5V$ (A_n, B_n)
I_{IL}	Input LOW Current			−150 −100	μA μA	Max Max	$V_{IN} = 0.5V$ ($T/\overline{R}_n$, A_n, B_n) $V_{IN} = 0.5V$ ($\overline{OE}_n$)

DC Electrical Characteristics (Continued)

Symbol	Parameter	74FR			Unit	V_{CC}	Conditions
		Min	Typ	Max			
I_{OS}	Output Short-Circuit Current	−100		−225	mA	Max	$V_{OUT} = 0V$ (A_n, B_n)
I_{IH} + I_{OZH}	Output Leakage Current		0	25	µA	Max	$V_{OUT} = 2.7V$ (A_n, B_n)
I_{IL} + I_{OZL}	Output Leakage Current		−20	−150	µA	Max	$V_{OUT} = 0.5V$ (A_n, B_n)
I_{CEX}	Output High Leakage Current			50	µA	Max	$V_{OUT} = V_{CC}$ (A_n, B_n)
V_{ID}	Input Leakage Test	4.75			V	0.0	$I_{ID} = 1.9\ \mu A$ All Other Pins Grounded
I_{OD}	Output Circuit Leakage Current			3.75	µA	0.0	$V_{IOD} = 150$ mV All Other Pins Grounded
I_{ZZ}	Bus Drainage Test			100	µA	0.0	$V_{OUT} = 5.25V$ (A_n, B_n)
I_{CCH}	Power Supply Current		70	105	mA	Max	V_O = HIGH
I_{CCL}	Power Supply Current		127	165	mA	Max	V_O = LOW
I_{CCZ}	Power Supply Current		71	105	mA	Max	V_O = HIGH Z
C_{IN}	Input Capacitance		8.0		pF	5.0	$\overline{OE}$, T/$\overline{R}$
			17.0		pF	5.0	A_n, B_n

AC Electrical Characteristics

Symbol	Parameter	74FR $T_A = +25°C$ $V_{CC} = +5.0V$ $C_L = 50$ pF			74FR T_A, V_{CC} = Comm V_{CC} = Comm $C_L = 50$ pF		Unit
		Min	Typ	Max	Min	Max	
t_{PLH} t_{PHL}	Propagation Delay A_n to B_n or B_n to A_n	1.3 1.3	2.7 2.2	4.3 4.3	1.3 1.3	4.3 4.3	ns
t_{PZH} t_{PZL}	Output Enable Time	3.9 3.9	6.9 9.7	13.9 13.9	3.9 3.9	13.9 13.9	ns
t_{PHZ} t_{PLZ}	Output Disable Time	1.8 1.8	3.9 4.4	6.3 6.3	1.8 1.8	6.3 6.3	ns

Extended AC Characteristics

Symbol	Parameter	74FR T_A = Comm V_{CC} = Comm C_L = 50 pF 16 Outputs Switching (Note 2)		74FR T_A = Comm V_{CC} = Comm C_L = 250 pF (Note 3)		Unit
		Min	Max	Min	Max	
t_{PLH} t_{PHL}	Propagation Delay A_n to B_n or B_n to A_n	1.3 1.3	5.8 5.8	3.2 3.2	8.2 8.2	ns
t_{PZH} t_{PZL}	Output Enable Time	3.9 3.9	14.6 14.6			ns
t_{PHZ} t_{PLZ}	Output Disable Time	1.8 1.8	6.3 6.3			ns
t_{OSHL} (Note 1)	Pin to Pin Skew for HL Transitions		TBD			ns
t_{OSLH} (Note 1)	Pin to Pin Skew for LH Transitions		TBD			ns
t_{OST} (Note 1)	Pin to Pin Skew for HL/LH Transitions		TBD			ns

Note 1: Skew is defined as the absolute value of the difference between the actual propagation delays for any two outputs of the same device. The specification applies to any outputs switching HIGH to LOW (t_{OSHL}) LOW to HIGH (t_{OSLH}), or any combination of HIGH to LOW and/or LOW to HIGH (t_{OST}).

Note 2: This specification is guaranteed but not tested The limits apply to propagation delays for all paths described switching in phase, i.e., all LOW-to-HIGH, HIGH-to-LOW, TRI-STATE-to-HIGH, etc.

Note 3: These specifications guaranteed but not tested. The limits represent propagation delays with 250 pF load capacitors in place of the 50 pF load capacitors in the standard AC load. This specification pertains to single output switching only.

Ordering Information

The device number is used to form part of a simplified purchasing code where the package type and temperature range are defined as follows:

74FR 16245 Q C QR

Temperature Range Family
74FR = Commercial

Device Type

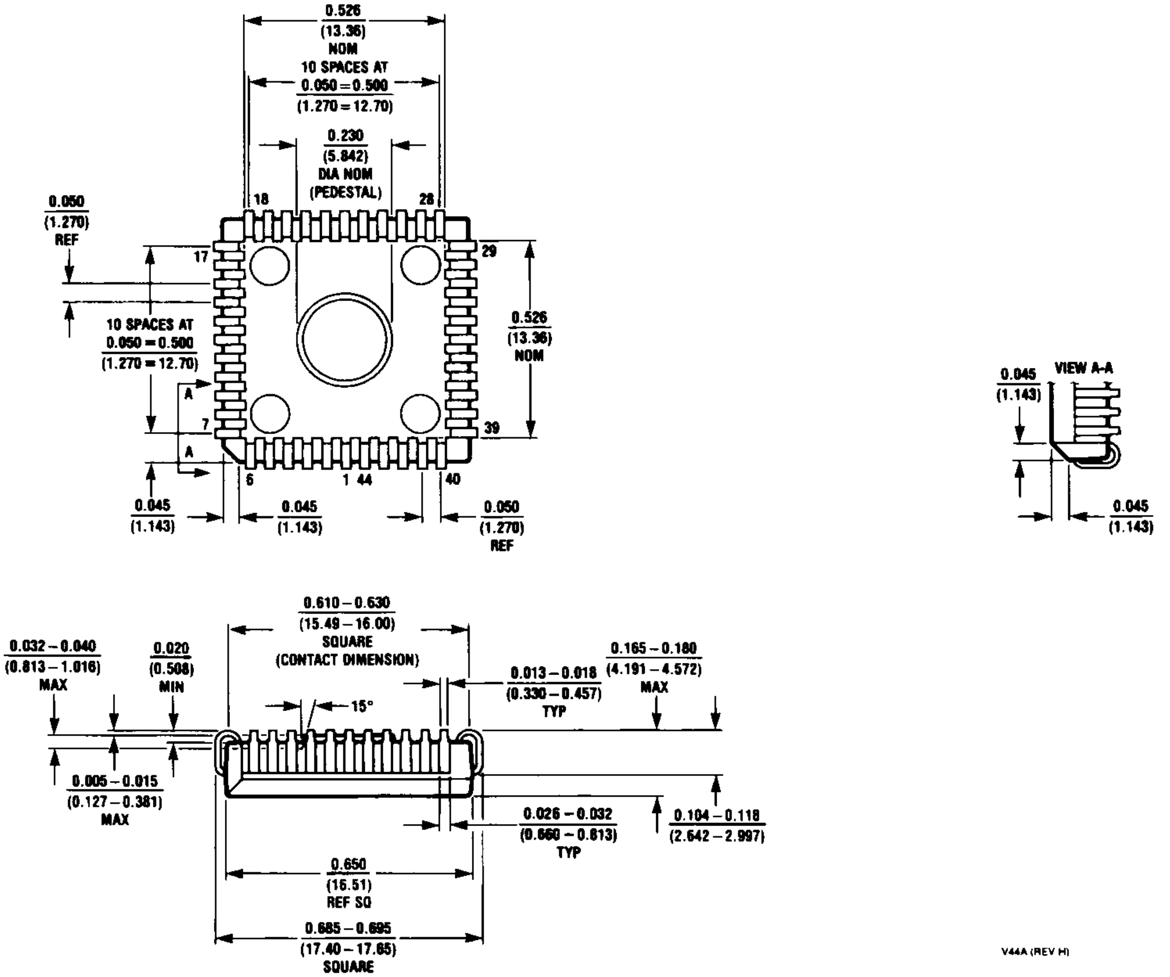
Package Code
Q = Plastic Lead Chip Carrier (PCC)

Special Variations
X = Devices shipped in 13″ reels
QR = Commercial grade device with burn-in

Temperature Range
C = Commercial (0°C to +70°C)

Physical Dimensions inches (millimeters)

Lit # 114635



44-Lead Plastic Chip Carrier (Q)
NS Package Number V44A

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) 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 a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

MAR 1 2 1991

National Semiconductor Corporation
2900 Semiconductor Drive
P.O. Box 58090
Santa Clara, CA 95052-8090
Tel: (408) 721-5000
TWX: (910) 339-9240

National Semiconductor GmbH
Industriestrasse 10
D-8080 Furstenfeldbruck
West Germany
Tel: (0-81-41) 103-0
Telex: 527-649
Fax: (08141) 103554

National Semiconductor Japan Ltd.
Sanseido Bldg. 5F
4-15 Nishi Shinjuku
Shinjuku-Ku,
Tokyo 160, Japan
Tel: 3-299-7001
FAX: 3-299-7000

National Semiconductor Hong Kong Ltd.
Suite 513, 5th Floor
Chinachem Golden Plaza,
77 Mody Road, Tsimshatsui East,
Kowloon, Hong Kong
Tel: 3-7231290
Telex: 52996 NSSEA HX
Fax: 3-3112536

National Semicondutores Do Brasil Ltda.
Av. Brig. Faria Lima, 1383
6.0 Andor-Conj. 62
01451 Sao Paulo, SP, Brasil
Tel: (55/11) 212-5066
Fax: (55/11) 211-1181 NSBR BR

National Semiconductor (Australia) PTY, Ltd.
1st Floor, 441 St. Kilda Rd.
Melbourne, 3004
Victory, Australia
Tel: (03) 267-5000
Fax: 61-3-2677458