

## 54F/74F410 Register Stack—16 x 4 RAM TRI-STATE® Output Register

### General Description

The 'F410 is a register-oriented high-speed 64-bit Read/Write Memory organized as 16-words by 4-bits. An edge-triggered 4-bit output register allows new input data to be written while previous data is held. TRI-STATE outputs are provided for maximum versatility. The 'F410 is fully compatible with all TTL families.

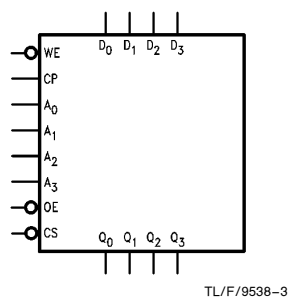
### Features

- Edge-triggered output register
- Typical access time of 35 ns
- TRI-STATE outputs
- Optimized for register stack operation
- 18-pin package
- 9410 replacement

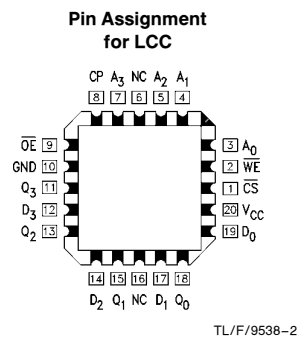
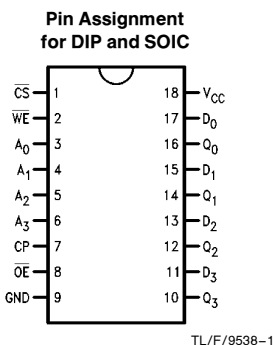
Commercial	Military	Package Number	Package Description
74F410PC		N18A	18-Lead (0.300" Wide) Molded Dual-In-Line
	54F410DM (Note 1)	J18A	18-Lead Ceramic Dual-In-Line
74F410SC		M20B	20-Lead (0.300" Wide) Molded Small Outline, JEDEC
54F410LM		W20A	20-Lead Cerpak

**Note 1:** Military grade device with environmental and burn-in processing. Use suffix = DMOB, LMOB

### Logic Symbol



### Connection Diagrams



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

## Unit Loading/Fan Out

Pin Names	Description	54F/74F	
		U.L. HIGH/LOW	Input $I_{IH}/I_{IL}$ Output $I_{OH}/I_{OL}$
$A_0-A_3$	Address Inputs	1.0/1.0	20 $\mu A$ / -0.6 mA
$D_0-D_3$	Data Inputs	1.0/1.0	20 $\mu A$ / -0.6 mA
$\overline{CS}$	Chip Select Input (Active LOW)	1.0/2.0	20 $\mu A$ / -1.2 mA
$\overline{OE}$	Output Enable Input (Active LOW)	1.0/1.0	20 $\mu A$ / -0.6 mA
$\overline{WE}$	Write Enable Input (Active LOW)	1.0/1.0	20 $\mu A$ / -0.6 mA
CP	Clock Input (Outputs Change on LOW-to-HIGH Transition)	1.0/2.0	20 $\mu A$ / -1.2 mA
$Q_0-Q_3$	TRI-STATE Outputs	150/40 (33.3)	-3 mA/24 mA (20 mA)

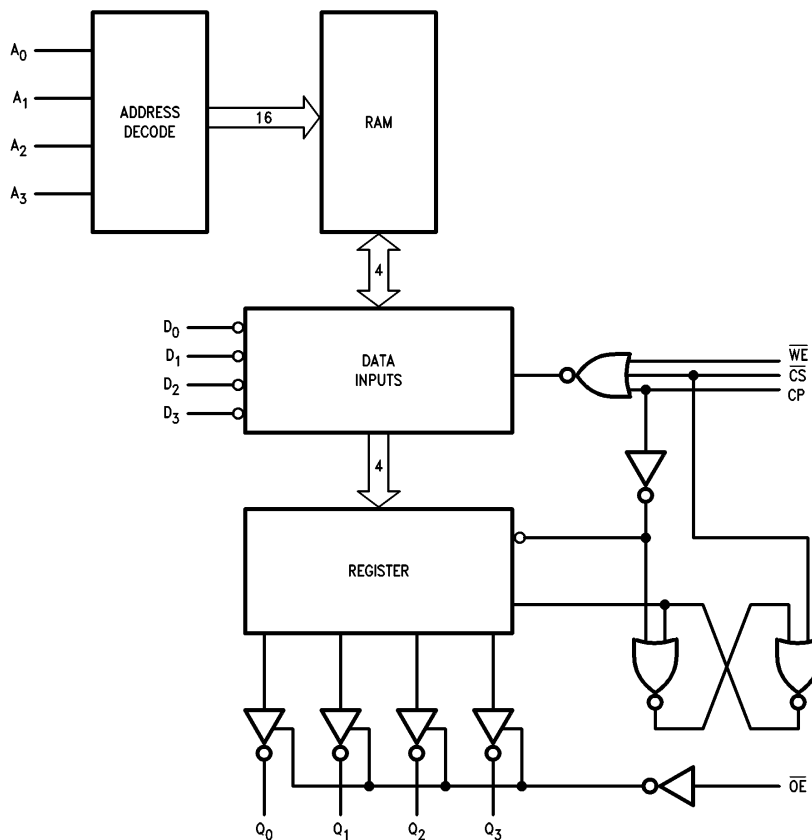
## Functional Description

**Write Operation**—When the three control inputs, Write Enable ( $\overline{WE}$ ), Chip Select ( $\overline{CS}$ ), and Clock (CP), are LOW the information on the data inputs ( $D_0-D_3$ ) is written into the memory location selected by the address inputs ( $A_0-A_3$ ). If the input data changes while  $\overline{WE}$ ,  $\overline{CS}$ , and CP are LOW, the contents of the selected memory location follow these changes, provided setup and hold time criteria are met.

**Read Operation**—Whenever  $\overline{CS}$  is LOW and CP goes from LOW-to-HIGH, the contents of the memory location selected by the address inputs ( $A_0-A_3$ ) are edge-triggered into the Output Register.

The ( $\overline{OE}$ ) input controls the output buffers. When  $\overline{OE}$  is HIGH the four outputs ( $Q_0-Q_3$ ) are in a high impedance or OFF state; when  $\overline{OE}$  is LOW, the outputs are determined by the state of the Output Register.

## Block Diagram



TL/F/9538-4

## 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
Plastic	−55°C to +150°C

V <sub>CC</sub> 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 <sub>CC</sub> = 0V)	
Standard Output	−0.5V to V <sub>CC</sub>
TRI-STATE Output	−0.5V to +5.5V

Current Applied to Output in LOW State (Max)	twice the rated I <sub>OL</sub> (mA)
--	--------------------------------------

**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	
Military	−55°C to +125°C
Commercial	0°C to +70°C
Supply Voltage	
Military	+4.5V to +5.5V
Commercial	+4.5V to +5.5V

## DC Electrical Characteristics

Symbol	Parameter	54F/74F			Units	V <sub>CC</sub>	Conditions
		Min	Typ	Max			
V <sub>IH</sub>	Input HIGH Voltage	2.0			V		Recognized as a HIGH Signal
V <sub>IL</sub>	Input LOW Voltage			0.8	V		Recognized as a LOW Signal
V <sub>CD</sub>	Input Clamp Diode Voltage			−1.2	V	Min	I <sub>IN</sub> = −18 mA
V <sub>OH</sub>	Output HIGH Voltage	54F 10% V <sub>CC</sub> 54F 10% V <sub>CC</sub> 74F 10% V <sub>CC</sub> 74F 10% V <sub>CC</sub> 74F 5% V <sub>CC</sub>	2.5 2.4 2.5 2.4 2.7		V	Min	I <sub>OH</sub> = −1 mA I <sub>OH</sub> = −3 mA I <sub>OH</sub> = −1 mA I <sub>OH</sub> = −3 mA I <sub>OH</sub> = −3 mA
V <sub>OL</sub>	Output LOW Voltage	54F 10% V <sub>CC</sub> 74F 10% V <sub>CC</sub>		0.5 0.5	V	Min	I <sub>OL</sub> = 20 mA I <sub>OL</sub> = 24 mA
I <sub>IH</sub>	Input HIGH Current	54F 74F		20.0 5.0	μA	Max	V <sub>IN</sub> = 2.7V
I <sub>BVI</sub>	Input HIGH Current Breakdown Test	54F 74F		100 7.0	μA	Max	V <sub>IN</sub> = 7.0V
I <sub>CEX</sub>	Output HIGH Leakage Current	54F 74F		250 50	μA	Max	V <sub>OUT</sub> = V <sub>CC</sub>
V <sub>ID</sub>	Input Leakage Test	74F	4.75		V	0.0	I <sub>ID</sub> = 1.9 μA All Other Pins Grounded
I <sub>OD</sub>	Output Leakage Circuit Current	74F		3.75	μA	0.0	V <sub>IOD</sub> = 150 mV All Other Pins Grounded
I <sub>IL</sub>	Input LOW Current			−0.6 −1.2	mA	Max	V <sub>IN</sub> = 0.5V (A <sub>n</sub> , D <sub>n</sub> , $\overline{OE}$ , $\overline{WE}$ ) V <sub>IN</sub> = 0.5V ( $\overline{CS}$ , CP)
I <sub>OZH</sub>	Output Leakage Current			50	μA	Max	V <sub>OUT</sub> = 2.7V
I <sub>OZL</sub>	Output Leakage Current			−50	μA	Max	V <sub>OUT</sub> = 0.5V
I <sub>OS</sub>	Output Short-Circuit Current		−60	−150	mA	Max	V <sub>OUT</sub> = 0V
I <sub>ZZ</sub>	Bus Drainage Test			500	μA	0.0V	V <sub>OUT</sub> = 5.25V

## DC Electrical Characteristics (Continued)

Symbol	Parameter	54F/74F			Units	V <sub>CC</sub>	Conditions
		Min	Typ	Max			
I <sub>CCH</sub>	Power Supply Current		47	70	mA	Max	V <sub>O</sub> = HIGH
I <sub>CCL</sub>	Power Supply Current		47	70	mA	Max	V <sub>O</sub> = LOW
I <sub>CCZ</sub>	Power Supply Current		47	70	mA	Max	V <sub>O</sub> = HIGH Z

## AC Electrical Characteristics

Symbol	Parameter	74F		54F		74F		Units
		T <sub>A</sub> = +25°C V <sub>CC</sub> = +5.0V C <sub>L</sub> = 50 pF		T <sub>A</sub> , V <sub>CC</sub> = Mil C <sub>L</sub> = 50 pF		T <sub>A</sub> , V <sub>CC</sub> = Com C <sub>L</sub> = 50 pF		
		Min	Max	Min	Max	Min	Max	
t <sub>PLH</sub>	Propagation Delay	3.0	8.5	2.5	11.0	2.5	9.5	ns
t <sub>PHL</sub>	CP to Q	3.5	9.0	3.0	12.0	3.0	10.0	
t <sub>PZH</sub>	Enable Time	3.0	8.0	2.5	10.5	2.5	9.0	ns
t <sub>PZL</sub>	$\overline{OE}$ to Q	3.5	9.0	3.0	13.0	3.0	10.0	
t <sub>PHZ</sub>	Disable Time	2.5	6.5	2.0	8.5	2.0	7.5	
t <sub>PLZ</sub>	$\overline{OE}$ to Q	2.5	7.0	2.0	9.5	2.0	8.0	

## AC Operating Requirements

Symbol	Parameter	74F		54F		74F		Units
		T <sub>A</sub> = +25°C V <sub>CC</sub> = +5.0V		T <sub>A</sub> , V <sub>CC</sub> = Mil		T <sub>A</sub> , V <sub>CC</sub> = Com		
		Min	Max	Min	Max	Min	Max	

### READ MODE

t <sub>S</sub> (H)	Setup Time, HIGH or LOW	15.0		23		17.0		ns
t <sub>S</sub> (L)	A <sub>n</sub> to CP	15.0		23		17.0		
t <sub>H</sub> (H)	Hold Time, HIGH or LOW	0		0		0		
t <sub>H</sub> (L)	A <sub>n</sub> to CP	0		0		0		

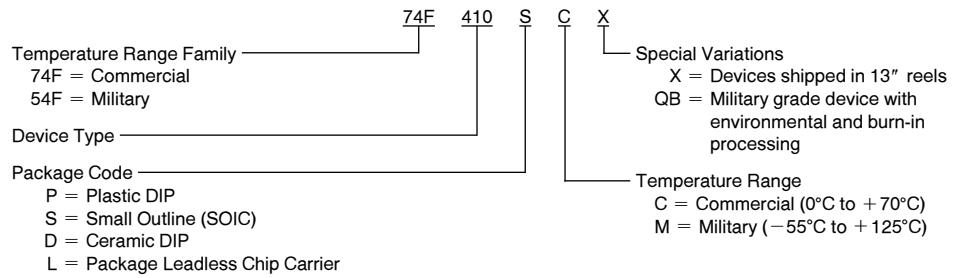
### WRITE MODE

t <sub>S</sub> (H)	Setup Time, HIGH or LOW	0		0		0		ns
t <sub>S</sub> (L)	A <sub>n</sub> to $\overline{WE}$	0		0		0		
t <sub>H</sub> (H)	Hold Time, HIGH or LOW	0		0		0		
t <sub>H</sub> (L)	A <sub>n</sub> to $\overline{WE}$	0		0		0		
t <sub>S</sub> (H)	Setup Time, HIGH or LOW	5.0		8.5		6.0		ns
t <sub>S</sub> (L)	D <sub>n</sub> to $\overline{WE}$	5.0		8.5		6.0		
t <sub>H</sub> (H)	Hold Time, HIGH or LOW	0		2.5		0		
t <sub>H</sub> (L)	D <sub>n</sub> to $\overline{WE}$	0		2.5		0		
t <sub>w</sub>	$\overline{WE}$ Pulse Width Required to Write	7.5		9.5		8.5		ns
t <sub>w</sub>	$\overline{CS}$ Pulse Width Required to Write	7.5		9.5		8.5		ns
t <sub>w</sub>	CP Pulse Width Required to Write	7.5		9.5		8.5		ns

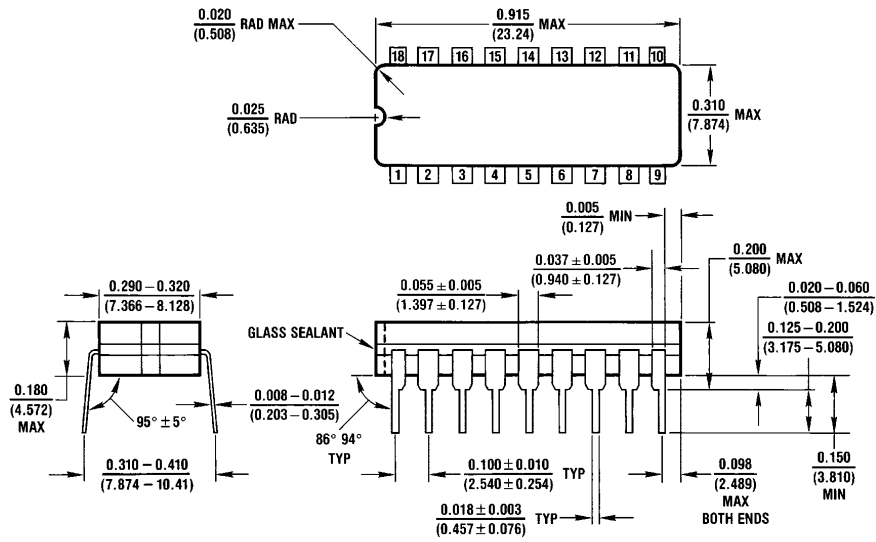
**Note:** Military temperature range for this device is −40°C to +85°C.

## Ordering Information

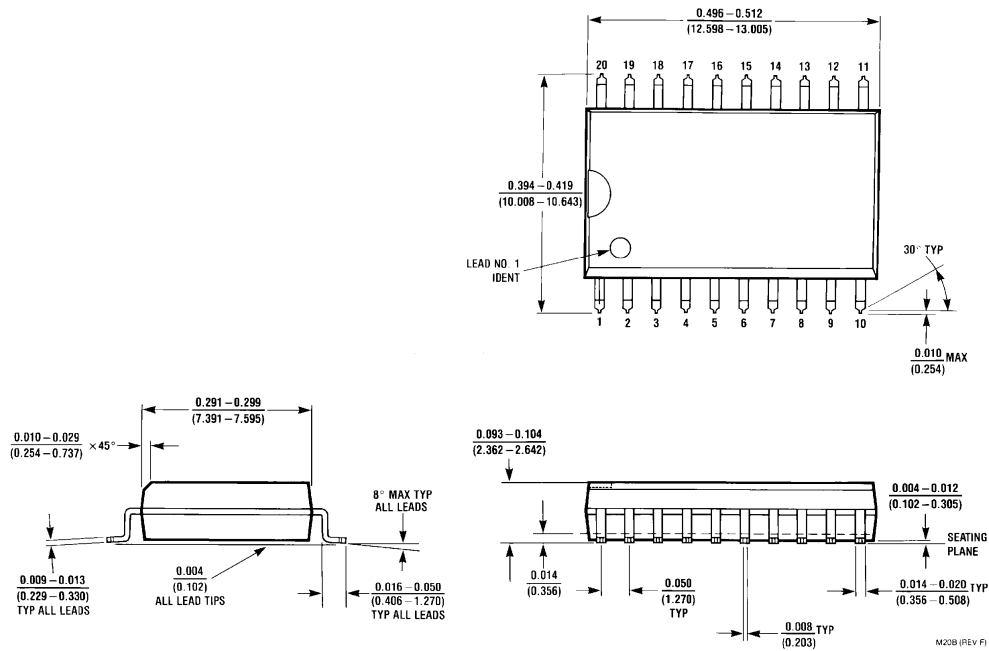
The device number is used to form part of a simplified purchasing code where a package type and temperature range are defined as follows:



## Physical Dimensions inches (millimeters)

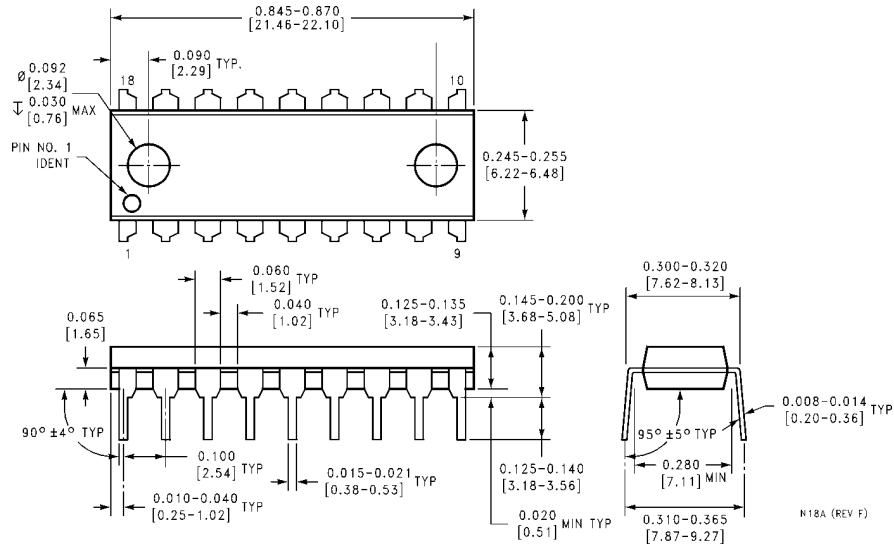


**18-Lead Ceramic Dual-In-Line Package (D)**  
**NS Package Number J18A**

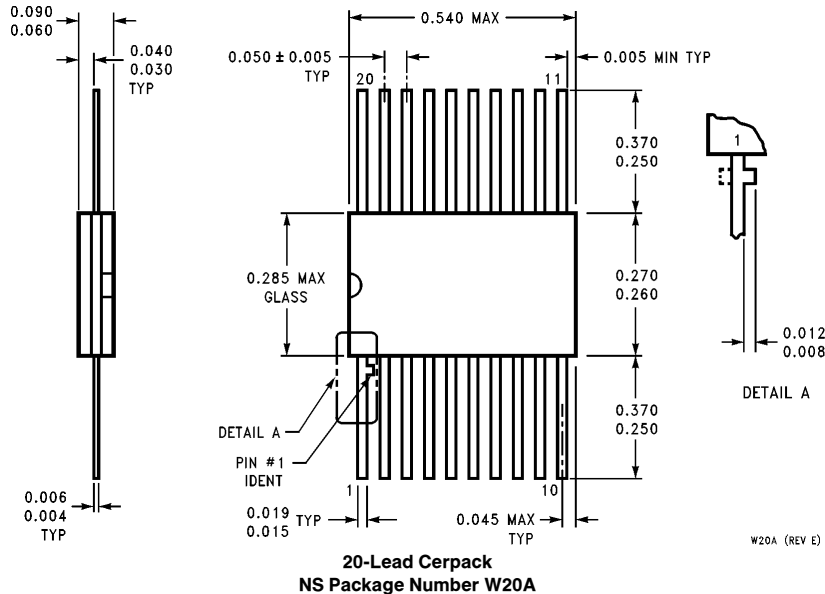


**20-Lead (0.300" Wide) Molded Small Outline Package, JEDEC (S)**  
**NS Package Number M20B**

**Physical Dimensions** inches (millimeters) (Continued)



**18-Lead (0.300" Wide) Molded Dual-In-Line Package (P)**  
**NS Package Number N18A**

**Physical Dimensions** inches (millimeters) (Continued)**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.



**National Semiconductor Corporation**  
1111 West Bardin Road  
Arlington, TX 76017  
Tel: 1(800) 272-9959  
Fax: 1(800) 737-7018

**National Semiconductor Europe**  
Fax: (+49) 0-180-530 85 86  
Email: cnjwge@tevm2.nsc.com  
Deutsch Tel: (+49) 0-180-530 85 85  
English Tel: (+49) 0-180-532 78 32  
Français Tel: (+49) 0-180-532 93 58  
Italiano Tel: (+49) 0-180-534 16 80

**National Semiconductor Hong Kong Ltd.**  
19th Floor, Straight Block,  
Ocean Centre, 5 Canton Rd.  
Tsimshatsui, Kowloon  
Hong Kong  
Tel: (852) 2737-1600  
Fax: (852) 2736-9960

**National Semiconductor Japan Ltd.**  
Tel: 81-043-299-2309  
Fax: 81-043-299-2408

National does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and National reserves the right at any time without notice to change said circuitry and specifications.