

## 54F/74F413 64 x 4 First-In First-Out Buffer Memory with Parallel I/O

### General Description

The 'F413 is an expandable fall-through type high-speed First-In First-Out (FIFO) buffer memory organized as 64 words by four bits. The 4-bit input and output registers record and transmit, respectively, asynchronous data in parallel form. Control pins on the input and output allow for handshaking and expansion. The 4-bit wide, 62-bit deep fall-through stack has self-contained control logic.

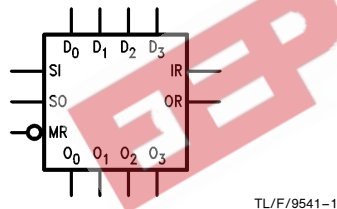
### Features

- Separate input and output clocks
- Parallel input and output
- Expandable without external logic
- 15 MHz data rate
- Supply current 160 mA max
- Available in SOIC, (300 mil only)

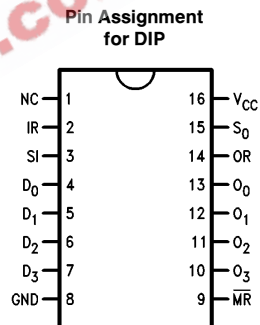
Commercial	Military	Package Number	Package Description
74F413PC		N16E	16-Lead (0.300" Wide) Molded Dual-In-Line
	54F413DM (Note 1)	J16A	16-Lead Ceramic Dual-In-Line

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

### Logic Symbol



### Connection Diagram



TL/F/9541-2

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## Unit Loading/Fan Out

Pin Names	Description	54F/74F	
		U.L. HIGH/LOW	Input $I_{IH}/I_{IL}$ Output $I_{OH}/I_{OL}$
$D_0-D_3$	Data Inputs	1.0/0.667	$20\ \mu\text{A}/-0.4\ \text{mA}$
$O_0-O_3$	Data Outputs	50/13.3	$-1\ \text{mA}/8\ \text{mA}$
IR	Input Ready	1.0/0.667	$20\ \mu\text{A}/-0.4\ \text{mA}$
SI	Shift In	1.0/0.667	$20\ \mu\text{A}/-0.4\ \text{mA}$
SO	Shift Out	1.0/0.667	$20\ \mu\text{A}/-0.4\ \text{mA}$
OR	Output Ready	1.0/0.667	$20\ \mu\text{A}/-0.4\ \text{mA}$
MR	Master Reset	1.0/0.667	$20\ \mu\text{A}/-0.4\ \text{mA}$

## Functional Description

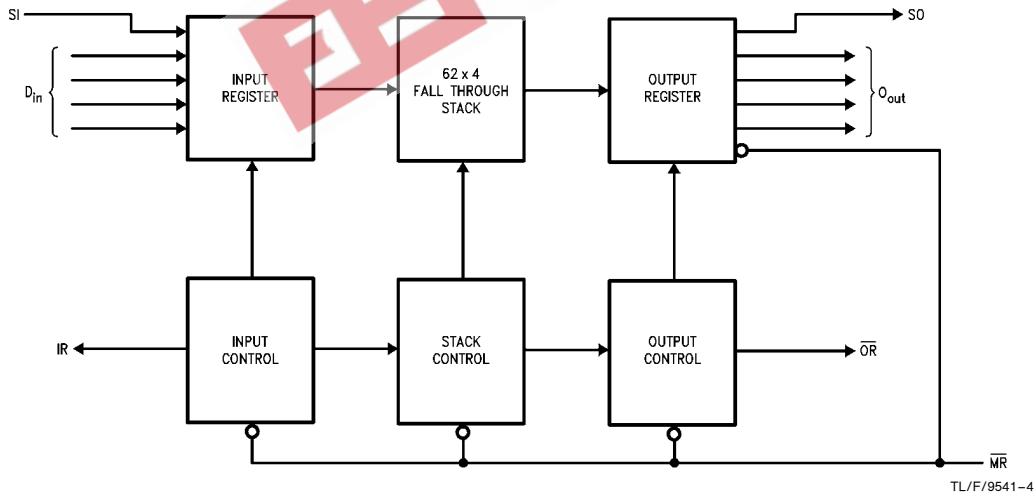
**Data Input**—Data is entered into the FIFO on  $D_0-D_3$  inputs. To enter data the Input Ready (IR) should be HIGH, indicating that the first location is ready to accept data. Data then present at the four data inputs is entered into the first location when the Shift In (SI) is brought HIGH. An SI HIGH signal causes the IR to go LOW. Data remains at the first location until SI is brought LOW. When SI is brought LOW and the FIFO is not full, IR will go HIGH, indicating that more room is available. Simultaneously, data will propagate to the second location and continue shifting until it reaches the output stage or a full location. If the memory is full, IR will remain LOW.

**Data Transfer**—Once data is entered into the second cell, the transfer of any full cell to the adjacent (downstream) empty cell is automatic, activated by an on-chip control. Thus data will stack up at the end of the device while empty locations will “bubble” to the front. The  $t_{PT}$  parameter defines the time required for the first data to travel from input to the output of a previously empty device.

**Data Output**—Data is read from the  $O_0-O_3$  outputs. When data is shifted to the output stage, Output Ready (OR) goes HIGH, indicating the presence of valid data. When the OR is HIGH, data may be shifted out by bringing the Shift Out (SO) HIGH. A HIGH signal at SO causes the OR to go LOW. Valid data is maintained while the SO is HIGH. When SO is brought LOW, the upstream data, provided that stage has valid data, is shifted to the output stage. When new valid data is shifted to the output stage, OR goes HIGH. If the FIFO is emptied, OR stays LOW, and  $O_0-O_3$  remains as before, i.e., data does not change if FIFO is empty.

**Input Ready and Output Ready** may also be used as status signals indicating that the FIFO is completely full (Input Ready stays LOW for at least  $t_{PT}$ ) or completely empty (Output Ready stays LOW for at least  $t_{PT}$ ).

## Block Diagram



## 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					V		Recognized as a LOW Signal
V <sub>CD</sub>	Input Clamp Diode Voltage					V	Min	I <sub>IN</sub> = -18 mA
V <sub>OH</sub>	Output HIGH Voltage	54F 10% V <sub>CC</sub> 74F 10% V <sub>CC</sub> 74F 5% V <sub>CC</sub>	2.4 2.4 2.7			V	Min	I <sub>OH</sub> = -1 mA I <sub>OH</sub> = -1 mA I <sub>OH</sub> = -1 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> = 8 mA I <sub>OL</sub> = 8 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		-0.4			mA	Max	V <sub>IN</sub> = 0.5V
I <sub>OS</sub>	Output Short-Circuit Current		-20	-130		mA	Max	V <sub>OUT</sub> = 0V
I <sub>CCH</sub>	Power Supply Current		115	160		mA	Max	V <sub>O</sub> = HIGH

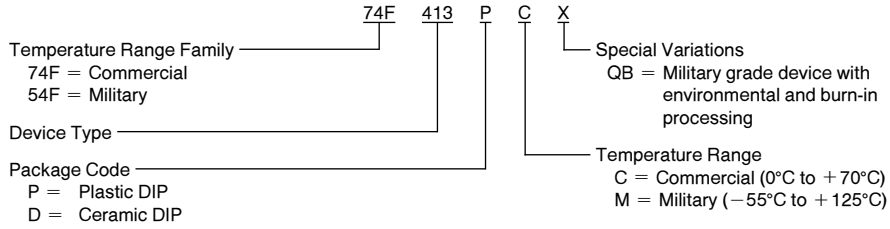
AC Electrical Characteristics									
Symbol	Parameter	74F			54F		74F		Units
		T <sub>A</sub> = +25°C V <sub>CC</sub> = +5.0V C <sub>L</sub> = 50 pF			T <sub>A</sub> , V <sub>CC</sub> = Mil C <sub>L</sub> = 50 pF		T <sub>A</sub> , V <sub>CC</sub> = Com C <sub>L</sub> = 50 pF		
		Min	Typ	Max	Min	Max	Min	Max	
f <sub>max</sub>	Shift In Rate	10			8.0		10		MHz
f <sub>max</sub>	Shift Out Rate	10			8.0		10		MHz
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay Shift In to IR	1.5		44.0	1.5	50.0	1.5	48.0	ns
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay Shift Out to OR	1.5		31.0	1.5	37.0	1.5	35.0	
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay Shift Out to OR	1.5		52.0	1.5	57.0	1.5	55.0	ns
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay Output Data Delay	1.5		31.0	1.5	37.0	1.5	35.0	
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay Output Data Delay	1.5		46.0	1.5	52.0	1.5	50.0	ns
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay Master Reset to IR	1.5		34.0	1.5	39.0	1.5	37.0	
t <sub>PLH</sub>	Propagation Delay Master Reset to IR	1.5		27.0	1.5	33.0	1.5	31.0	ns
t <sub>PLH</sub>	Propagation Delay Master Reset to OR	1.5		30.0	1.5	34.0	1.5	32.0	ns

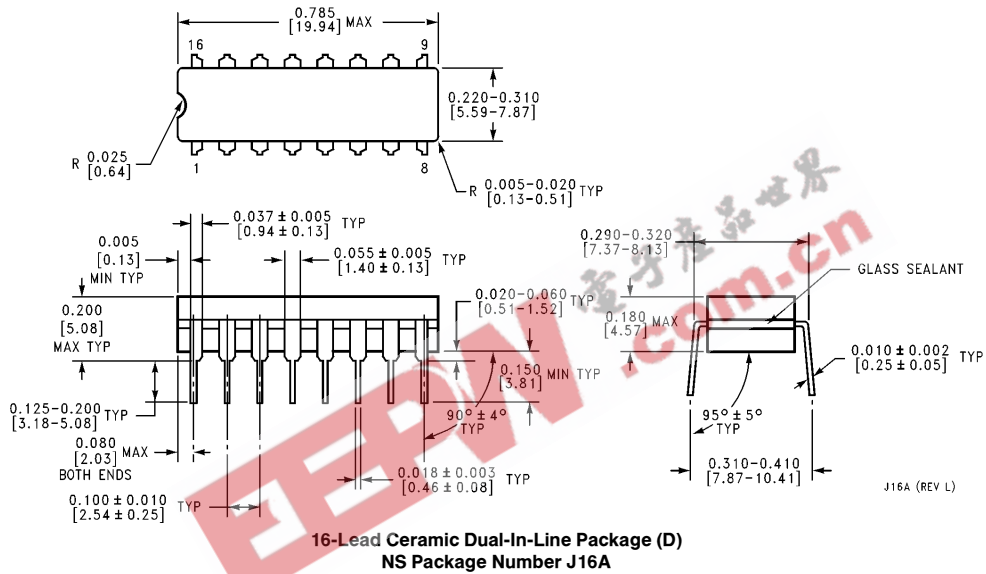
AC Operating Requirements								
Symbol	Parameter	74F		54F		74F		Units
		T <sub>A</sub> = +25°C V <sub>CC</sub> = +5.0V		T <sub>A</sub> , V <sub>CC</sub> = Mil		T <sub>A</sub> , V <sub>CC</sub> = Com		
		Min	Max	Min	Max	Min	Max	
t <sub>s</sub> (H) t <sub>s</sub> (L)	Setup Time, HIGH or LOW D <sub>n</sub> to SI	1.0		1.0		1.0		ns
t <sub>h</sub> (H) t <sub>h</sub> (L)	Hold Time, HIGH or LOW D <sub>n</sub> to SI	10.0		10.0		10.0		
t <sub>w</sub> (H) t <sub>w</sub> (L)	Shift In Pulse Width HIGH or LOW	5.0		5.0		5.0		ns
t <sub>w</sub> (H) t <sub>w</sub> (L)	Shift Out Pulse Width HIGH or LOW	10.0		10.0		10.0		
t <sub>w</sub> (H)	Input Ready Pulse Width, HIGH	7.5		8.5		7.5		ns
t <sub>w</sub> (L)	Output Ready Pulse Width, LOW	7.5		8.5		7.5		ns
t <sub>w</sub> (L)	Master Reset Pulse Width, LOW	5.0		5.0		5.0		ns
t <sub>w</sub> (L)	Master Reset Pulse Width, LOW	10.0		10.0		10.0		ns
t <sub>rec</sub>	Recovery Time, MR to SI	32.0		35.0		35.0		ns
t <sub>PT</sub>	Data Throughput Time		0.9		1.0		1.0	μs

## Ordering Information

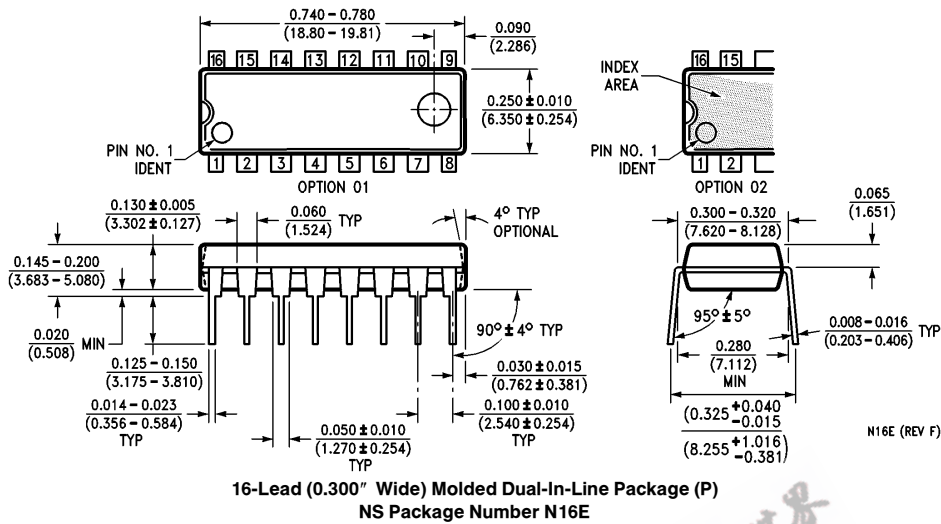
The device number is used to form part of a simplified purchasing code where the package type and temperature range are defined as follows:



## Physical Dimensions inches (millimeters)



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



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