2048/1024 BIT DYNAMIC RECIRCULATING SHIFT REGISTERS

- **Single Supply Voltage -- +5 Volts**
- **Fully TTL Compatible -- Inputs, Outputs and Clock**
- **Single Phase Clock**
- **Guaranteed 1 MHz Operation with 100 pF Load, over Temperature Range**
- **Low Power Dissipation -- 120 µw/bit typically at 1 MHz**

- **Low Clock Capacitance -- 7 pF**
- **Write/Recirculate and Chip Select Logic Incorporated on Chip**
- **Standard Configurations -- Dual 1024 Bit -- 2401 Single 1024 Bit -- 2405**

SERIAL MEMORIES

The 2401/2405 are 2048/1024 bit dynamic recirculating shift registers. They are directly TTL compatible in all respects: inputs, outputs, clock and a single +5 volt power supply.

Write/recirculate controls are provided to eliminate the need for external logic elements when recirculating data.

Two chip select inputs have been provided to allow easy selection of an individual package when outputs of several devices have been "OR-tied". A separate internal "pullup" resistor (R_L) is provided which can be externally connected to the output pin to achieve full signal swing.

This Intel shift register family is fabricated with N-channel silicon gate technology. This technology provides the designer with high performance, easy to use MOS circuits. Only a single +5V power supply is needed and all devices are directly TTL compatible, including clocks.

PIN CONFIGURATIONS
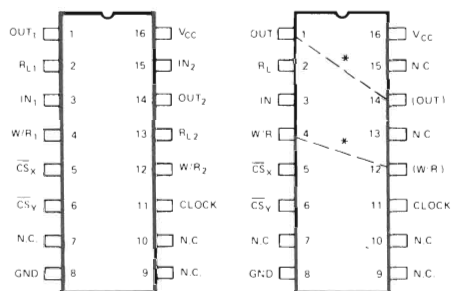
* DASH LINES INDICATE NECESSARY EXTERNAL PRINTED CIRCUIT BOARD CONNECTIONS FOR PROPER OPERATION OF THE 2405. (SEE APPLICATION SECTION)

LOGIC DIAGRAM
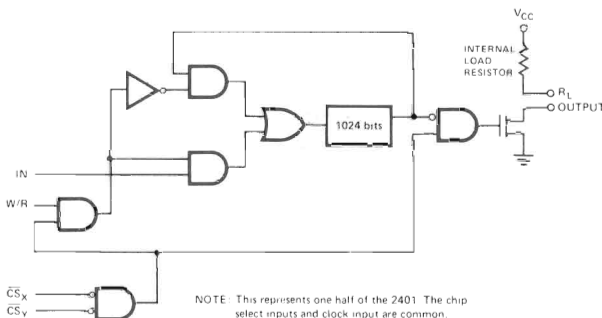
NOTE: This represents one half of the 2401. The chip select inputs and clock input are common.

PIN NAMES

IN	DATA INPUT	OUT	DATA OUTPUT
W/R	WRITE/RECIRCULATE CONTROL	R_L	INTERNAL LOAD RESISTOR
$\overline{CS}_X$, $\overline{CS}_Y$	CHIP SELECT INPUT	N.C.	NO CONNECTION

TRUTH TABLE

FUNCTION	PIN SYMBOL		
	W/R	$\overline{CS}_X$	$\overline{CS}_Y$
WRITE MODE	H	L	L
RECIRCULATE	L	X	X
	X	H	X
	X	X	H
READ MODE	X	L	L

H = Logic High Level   L = Logic Low Level
X = Don't Care Condition

Absolute Maximum Ratings*

Ambient Temperature Under Bias: 0° C to 70° C
Storage Temperature: −65° C to +150° C
Power Dissipation: 1W
Voltage on Any Pin with Respect
to Ground: −0.5V to +7V

*COMMENT:

Stresses above those listed under "Absolute Maximum Rating" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or at any other condition above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

D. C. Characteristics

$T_A = 0°$ to $70°C$, $V_{CC} = +5V \pm 5\%$, unless otherwise specified.

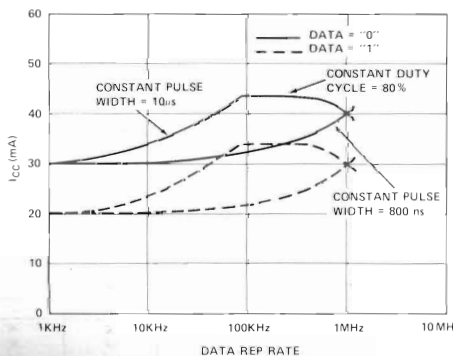| SYMBOL	PARAMETER	LIMITS			UNITS	TEST CONDITIONS
		MIN.	TYP.[1]	MAX.		
I_{LI}	INPUT LEAKAGE			10	μA	$V_{IN} = 5.25V$
I_{LO}	OUTPUT LEAKAGE			100	μA	$V_{OUT} = 5.25V$
I_{CC}	POWER SUPPLY CURRENT		45	70	mA	$T_A = 25°C$ ⎤ $V_{CC} = 5.25V$;
			50	80	mA	$T_A = 0°C$ ⎦ 80% DUTY CYCLE
V_{IH}	INPUT HIGH LEVEL VOLTAGE (ALL INPUTS)	2.2		5.25	V	
V_{IL}	INPUT LOW LEVEL VOLTAGE (ALL INPUTS)	−0.3		0.65	V	
V_{OH}	OUTPUT HIGH LEVEL VOLTAGE	2.4		V_{CC}	V	$I_{OH} = -1mA$, $R_L = 1.5K \pm 5\%$ ohms, external
V_{OL}	OUTPUT LOW LEVEL VOLTAGE	0		0.45	V	$I_{OL} = 5.0mA$, $R_L = 1.5K \pm 5\%$ ohms, external [2]

NOTES: 1. Typical values are at 25° C and at nominal voltage.
2. The following was used to calculate I_{OL}.

$$I_{OL} = \frac{V_{CC} (max.) - V_{OL} (max.)}{R_L (min.)} + I_{LI} \text{ (TTL device)} = \frac{5.25 - 0.45}{1.425} + 1.6 = 4.97mA.$$

Also note that the internal load resistor, R_{LI}, has a value ranging from 500 ohms minimum to 2,200 ohms maximum. The internal load resistor can be used when driving from one 2401/2405 to another 2401/2405 or to other MOS inputs.

POWER SUPPLY CURRENT (I_{CC}) VS. DATA REP RATE

EFFECTIVE INPUT CHARACTERISTIC
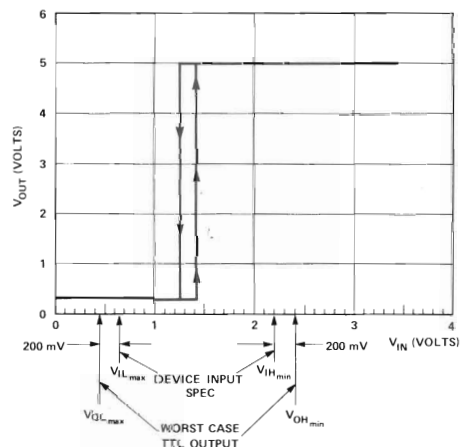
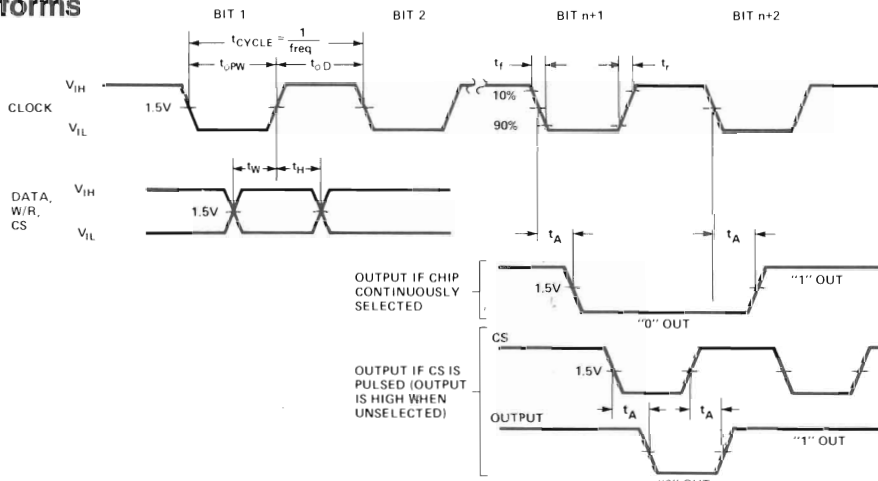## A. C. Characteristics $T_A = 0°C$ to $70°C$, $V_{CC} = +5V \pm 5\%$, unless otherwise specified.

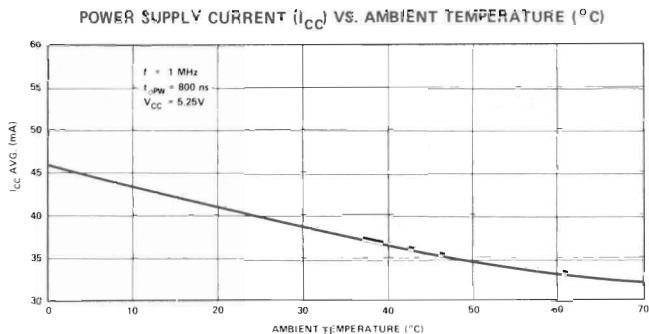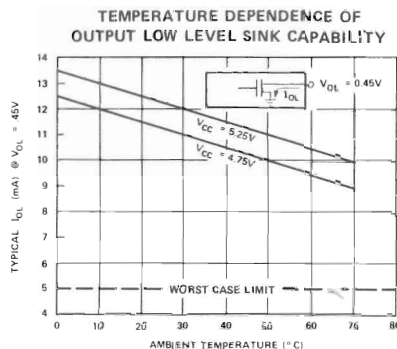| SYMBOL	PARAMETER	LIMITS			UNITS	TEST CONDITIONS
		MIN.	TYP.	MAX.		
FREQ. MAX.	MAX. DATA REP. RATE			1	MHz	
FREQ. MIN.	MIN. DATA REP. RATE	1 25[1]			KHz KHz	$T_A = 25°C$ $T_A = 70°C$
$t_{\phi PW}$	CLOCK PULSE WIDTH	0.80		10	μs	
$t_{\phi D}$	CLOCK PULSE DELAY	0.20 0.20		1000 40	μs μs	$T_A = 25°C$ $T_A = 70°C$
t_r, t_f	CLOCK RISE AND FALL TIME			50	ns	
t_W	WRITE TIME	200			ns	
t_H	HOLD TIME	150			ns	
t_A	ACCESS TIME FROM CLOCK OR CHIP SELECT		250	500	ns	$R_L = 1.5K \pm 5\%$ ohm, EXTERNAL $C_L = 100\,pF$ ONE TTL LOAD

NOTE: 1. 100 kHz in plastic (P) package.

Capacitance $T_A = 25°C$

SYMBOL	PARAMETER	LIMITS			UNITS	TEST CONDITIONS
		MIN.	TYP.	MAX.		
C_{IN}	DATA, W/R & CS INPUT CAPACITANCE		4	7	pF	ALL PINS AT AC GROUND; 250 mV PEAK TO PEAK, 1 MHz
C_{OUT}	OUTPUT CAPACITANCE		10	14	pF	
C_ϕ	CLOCK CAPACITANCE		4	7	pF	

Waveforms

SERIAL MEMORIES

D. C. Characteristics

TEMPERATURE DEPENDENCE OF
OUTPUT LOW LEVEL SINK CAPABILITY

POWER SUPPLY CURRENT (I_{CC}) VS. AMBIENT TEMPERATURE (°C)

A. C. Characteristics

MINIMUM DATA RATE AND MAXIMUM CLOCK DELAY
VS. AMBIENT TEMPERATURE FOR CERAMIC (C) PACKAGE

MINIMUM CLOCK PULSE WIDTH AND
EFFECTIVE MAXIMUM DATA RATE AT 80%
DUTY CYCLE VS.
POWER SUPPLY VOLTAGE (V_{CC})

ACCESS TIME VS. LOAD CAPACITANCE
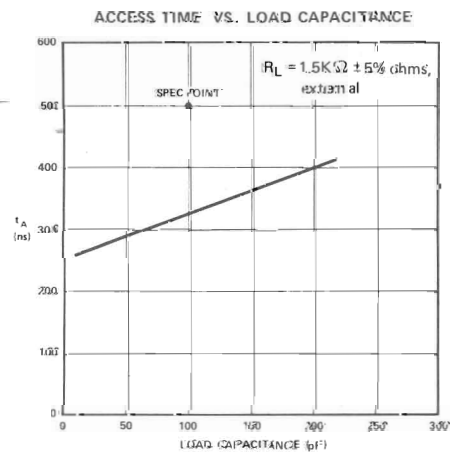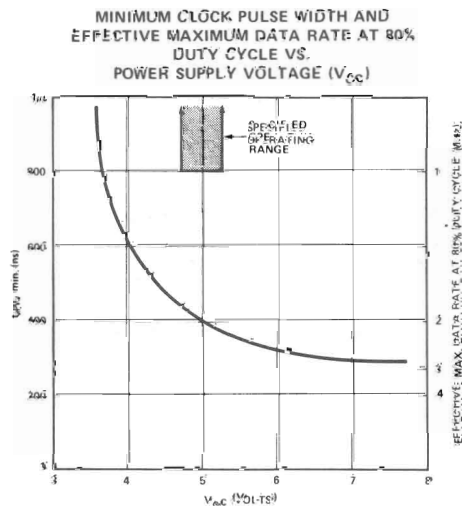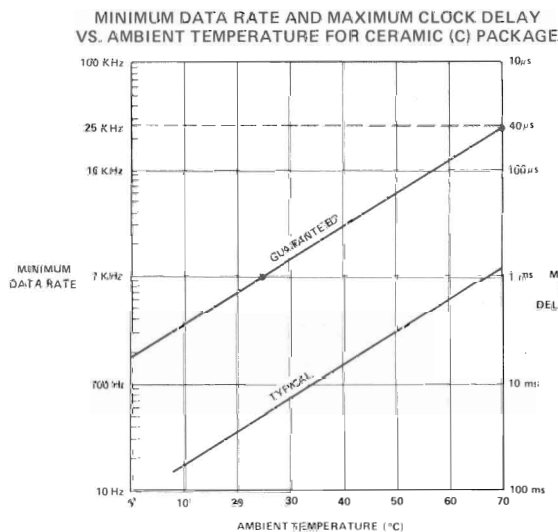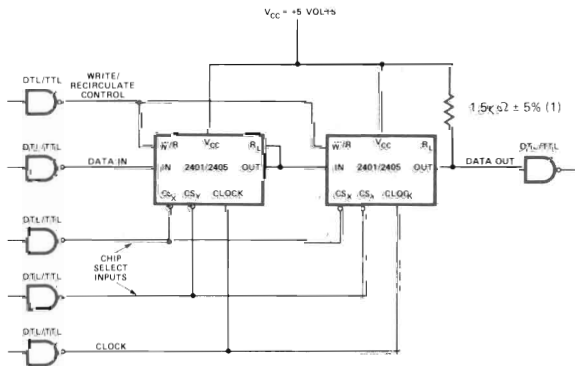
Typical Application Of TTL Compatible Shift Registers

NOTE (1): The 2401/2405 is directly compatible device to device.
An external 1.5KΩ ± 5% load resistor is recommended for driving
one TTL load with the 2401/2405 output.