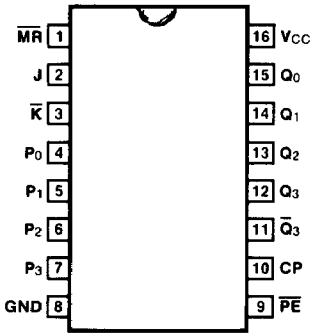
9300 010669
93H00 010258
93L00 010199
93S00 010671

4-BIT UNIVERSAL SHIFT REGISTER

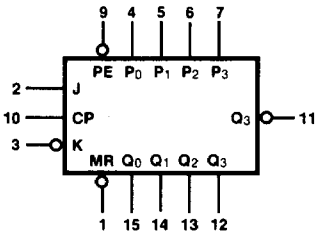
DESCRIPTION — The '00 is a 4-bit universal shift register. As a high speed multifunctional sequential logic block, it is useful in a wide variety of register and counter applications. It may be used in serial-serial, shift left, shift right, serial-parallel, parallel-serial, and parallel-parallel data register transfers.

- **ASYNCHRONOUS MASTER RESET**
- **J, $\overline{K}$ INPUTS TO FIRST STAGE**

CONNECTION DIAGRAM
PINOUT A



LOGIC SYMBOL



VCC = Pin 16
GND = Pin 8

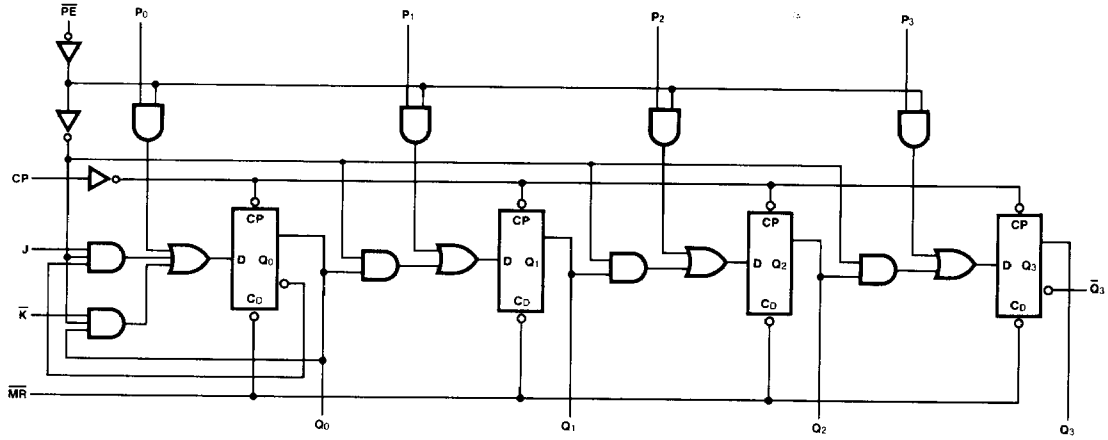
ORDERING CODE: See Section 9

PKGS	PIN OUT	COMMERCIAL GRADE: VCC = +5.0 V ±5%, TA = 0°C to +70°C	MILITARY GRADE: VCC = +5.0 V ±10%, TA = -55°C to +125°C	PKG TYPE
Plastic DIP (P)	A	9300PC, 93H00PC 93L00PC, 93S00PC		9B
Ceramic DIP (D)	A	9300DC, 93H00DC 93L00DC, 93S00DC	9300DM, 93H00DM 93L00DM, 93S00DM	6B
Flatpak (F)	A	9300FC, 93H00FC 93L00FC, 93S00FC	9300FM, 93H00FM 93L00FM, 93S00FM	4L

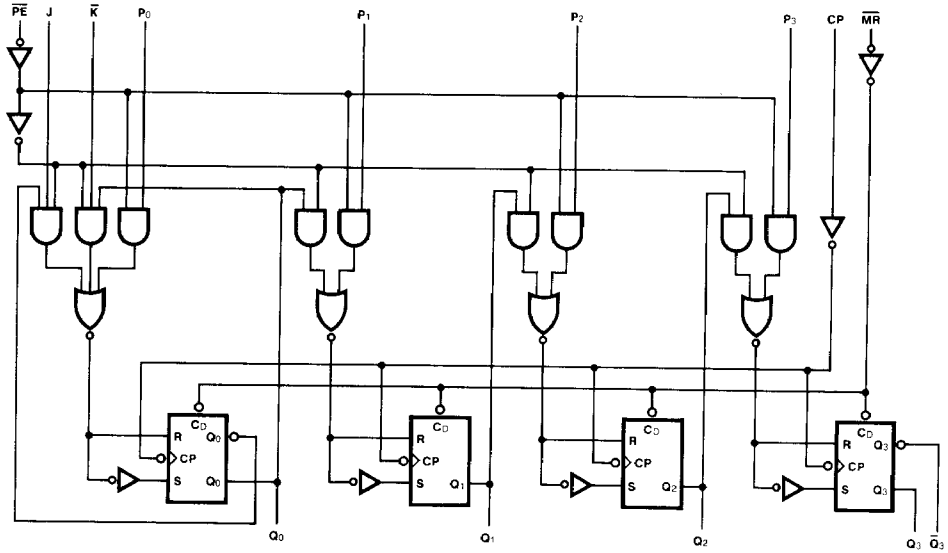
INPUT LOADING/FAN-OUT: See Section 3 for U.L. definitions

PIN NAMES	DESCRIPTION	93XX (U.L.) HIGH/LOW	93H (U.L.) HIGH/LOW	93L (U.L.) HIGH/LOW	93S (U.L.) HIGH/LOW
$\overline{PE}$	Parallel Enable Input (Active LOW)	2.3/2.3	1.0/1.0	1.15/0.575	1.25/1.25
$P_0 - P_3$	Parallel Inputs	1.0/1.0	1.0/1.0	0.5/0.25	1.0/1.0
J	First Stage J Input (Active HIGH)	1.0/1.0	1.0/1.0	0.5/0.25	1.0/1.0
$\overline{K}$	First Stage K Input (Active LOW)	1.0/1.0	1.0/1.0	0.5/0.25	1.0/1.0
CP	Clock Pulse Input (Active Rising Edge)	2.0/2.0	2.0/2.0	1.0/0.5	2.5/2.5
$\overline{MR}$	Master Reset Input	1.0/1.0	1.0/1.0	0.5/0.25	1.25/1.25
$Q_0 - Q_3$	Parallel Outputs	12/6.0	16/8.0	10/5.0 (3.0)	25/12.5
$\overline{Q}_3$	Complementary Last Stage Output	16/8.0	20/10	10/5.0 (3.0)	25/12.5

LOGIC DIAGRAMS
'00, 'H00, 'L00



'S00



FUNCTIONAL DESCRIPTION — The Logic Diagrams and Truth Table indicate the functional characteristics of the '00 4-bit shift register. The device is useful in a wide variety of shifting, counting and storage applications. It performs serial, parallel, serial-to-parallel, or parallel-to-serial data transfers.

The '00 has two primary modes of operation, shift right ($Q_0 \rightarrow Q_1$) and parallel load, which are controlled by the state of the Parallel Enable ($\overline{PE}$) input. When the $\overline{PE}$ input is HIGH, serial data enters the first flip-flop Q_0 via the J and $\overline{K}$ inputs and is shifted one bit in the direction $Q_0 \rightarrow Q_1 \rightarrow Q_2 \rightarrow Q_3$ following each LOW-to-HIGH clock transition. The $J\overline{K}$ inputs provide the flexibility of the JK type input for special applications, and the simple D-type input for general applications by tying the two pins together. When the $\overline{PE}$ input is LOW, the '00 appears as four common clocked D flip-flops. The data on the parallel inputs $P_0 - P_3$ is transferred to the respective $Q_0 - Q_3$ outputs following the LOW-to-HIGH clock transition. Shift left operation ($Q_3 \rightarrow Q_2$) can be achieved by tying the Q_n outputs to the P_{n-1} inputs and holding the $\overline{PE}$ input LOW.

All serial and parallel data transfers are synchronous, occuring after each LOW-to-HIGH clock transition. Since the '00 utilizes edge triggering, there is no restriction on the activity of the J, $\overline{K}$, P_n and $\overline{PE}$ inputs for logic operation — except for the setup and release time requirements. A LOW on the asynchronous Master Reset ($\overline{MR}$) input sets all Q outputs LOW, independent of any other input condition.

TRUTH TABLE

OPERATING MODE	INPUTS ($\overline{MR}$ = H)							OUTPUTS @ t_{n+1}				
	$\overline{PE}$	J	$\overline{K}$	P_0	P_1	P_2	P_3	Q_0	Q_1	Q_2	Q_3	$\overline{Q}_3$
SHIFT MODE	H	L	L	X	X	X	X	L	Q_0	Q_1	Q_2	$\overline{Q}_2$
	H	L	H	X	X	X	X	Q_0	Q_0	Q_1	Q_2	$\overline{Q}_2$
	H	H	L	X	X	X	X	$\overline{Q}_0$	Q_0	Q_1	Q_2	$\overline{Q}_2$
	H	H	H	X	X	X	X	H	Q_0	Q_1	Q_2	$\overline{Q}_2$
PARALLEL ENTRY MODE	L	X	X	L	L	L	L	L	L	L	L	H
	L	X	X	H	H	H	H	H	H	H	H	L

*t_{n+1} = Indicates state after next LOW-to-HIGH clock transition.

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

DC CHARACTERISTICS OVER OPERATING TEMPERATURE RANGE (unless otherwise specified)

SYMBOL	PARAMETER		93XX Min	93XX Max	93H Min	93H Max	93L Min	93L Max	93S Min	93S Max	UNITS	CONDITIONS
I_{OS}	Output Short Circuit Current		-20	-80	-30	-100					mA	V_{CC} = Max, V_{OUT} = 0 V
I_{CC}	Power Supply Current	XC		92		112		23		120	mA	V_{CC} = Max
		XM		86		102						

AC CHARACTERISTICS: V_{CC} = +5.0 V, T_A = +25° C (See Section 3 for waveforms and load configurations)

SYMBOL	PARAMETER	93XX C_L = 15 pF Min	93XX C_L = 15 pF Max	93H C_L = 15 pF Min	93H C_L = 15 pF Max	93L C_L = 15 pF Min	93L C_L = 15 pF Max	93S C_L = 15 pF Min	93S C_L = 15 pF Max	UNITS	CONDITIONS
f_{max}	Maximum Shift Frequency	30		45		10		70		MHz	Figs. 3-1, 3-8
t_{PLH} t_{PHL}	Propagation Delay CP to Q_n		22 26		16 21		35 51		8.5 12	ns	Figs. 3-1, 3-8
t_{PHL}	Propagation Delay $\overline{MR}$ to Q_n		40		28		60		23	ns	Figs. 3-1, 3-17

AC OPERATING REQUIREMENTS: V_{CC} = +5.0 V, T_A = +25° C

SYMBOL	PARAMETER	93XX Min	93XX Max	93H Min	93H Max	93L Min	93L Max	93S Min	93S Max	UNITS	CONDITIONS
t_s (H) t_s (L)	Setup Time HIGH or LOW, J, $\overline{K}$ and $P_0 - P_3$ to CP	20 20		12 12		60 60		6.0 6.0		ns	Fig. 3-6
t_h (H) t_h (L)	Hold Time HIGH or LOW, J, $\overline{K}$ and $P_0 - P_3$ to CP	0 0		0 0		0 0		0 0		ns	
t_s (H) t_s (L)	Setup Time HIGH or LOW, $\overline{PE}$ to CP	39 39		15 15		68 68		8.0 8.0		ns	Fig. 3-6
t_h (H) t_h (L)	Hold Time HIGH or LOW, $\overline{PE}$ to CP	-10 -10		0 0		-20 -20		0 0		ns	
t_w (H) t_w (L)	CP Pulse Width HIGH or LOW	17 17		12 12		38 38		7.0 7.0		ns	Fig. 3-8
t_w (L)	$\overline{MR}$ Pulse Width LOW	25		19		53		12		ns	Fig. 3-16
t_{rec}	Recovery Time $\overline{MR}$ to CP	25		7.0		70		5.0		ns	