

MC14500B

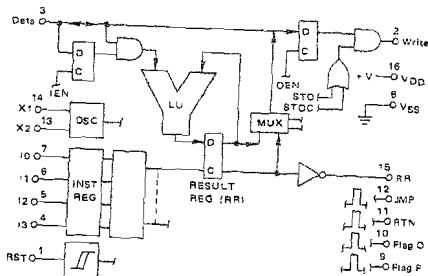
INDUSTRIAL CONTROL UNIT

The MC14500B Industrial Control Unit (ICU) is a single bit CMOS processor. The ICU is designed for use in systems requiring decisions based on successive single bit information. An external ROM stores the control program. With a program counter (and output latches and input multiplexers, if required) the ICU in a system forms a stored program controller that replaces combinatorial logic. Applications include relay logic processing, serial data manipulation and control. The ICU also may control an MPU or be controlled by an MPU.

- 16 Instructions
- DC to 1.0 MHz Operation at VDD = 5 V
- On Chip Clock (Oscillator)
- Executes One Instruction per Clock Cycle
- 3 V to 18 V Operation
- Noise Immunity Typically 45% of VDD
- Quiescent Current 5.0 μ Adc Typical at VDD = 5 V
- Capable of Driving One Low-Power Schottky Load or Two Low-Power TTL Loads over Full Temperature Range

Detailed operation and applications are given in the "MC14500B Industrial Control Unit" handbook.

BLOCK DIAGRAM



CMOS LSI

(LOW-POWER COMPLEMENTARY MOS)

INDUSTRIAL CONTROL UNIT



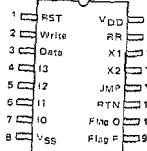
L SUFFIX CERAMIC PACKAGE CASE B20
P SUFFIX PLASTIC PACKAGE CASE 849

ORDERING INFORMATION

MC14500B Suffix Denotes

- L Ceramic Package
- P Plastic Package
- A Extended Operating Temperature Range
- C Limited Operating Temperature Range

PIN ASSIGNMENT



MAXIMUM RATINGS (Voltages referenced to VSS)

Rating	Symbol	Value	Unit
DC Supply Voltage	VDD	-0.5 to +18	Vdc
Input Voltage, All Inputs	Vin	-0.5 to VDD + 0.5	Vdc
DC Current Drain per Pin	I	10	mAdc
Operating Temperature Range - AL Device	TA	-55 to +125	°C
CL/CP Device		-40 to +85	
Storage Temperature Range	Tstg	-65 to +150	°C

This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields; however, it is advised that normal precautions be taken to avoid application of any voltage higher than maximum rated voltages to this high impedance circuit. For proper operation it is recommended that Vin and Vout be constrained to the range VSS < Vin or Vout < VDD.

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	VDD Vdc	Tlow*		25°C		THigh*		Unit	
			Min	Max	Min	Typ	Max	Min		Max
Output Voltage Vin = VDD or 0	VOL	5.0	-	0.05	-	0	0.05	-	0.05	Vdc
		10	-	0.05	-	0	0.05	-	0.05	
		15	-	0.05	-	0	0.05	-	0.05	
Vin = 0 or VDD	VOH	5.0	4.95	-	4.95	5.0	-	4.95	-	Vdc
		10	9.95	-	9.95	10	-	9.95	-	
		15	14.95	-	14.95	15	-	14.95	-	
Input Voltage # RST, D, X2 (V0 = 4.5 or 0.5 Vdc) (V0 = 9.0 or 1.0 Vdc) (V0 = 13.5 or 1.5 Vdc)	VIL	5.0	-	1.5	-	2.25	1.5	-	1.5	Vdc
		10	-	3.0	-	4.50	3.0	-	3.0	
		15	-	4.0	-	6.75	4.0	-	4.0	
V0 = 0.5 or 4.5 Vdc (V0 = 1.0 or 9.0 Vdc) (V0 = 1.5 or 13.5 Vdc)	VIH	5.0	3.5	-	3.5	2.75	-	3.5	-	Vdc
		10	7.0	-	7.0	5.50	-	7.0	-	
		15	11.0	-	11.0	8.25	-	11.0	-	
Input Voltage # I0, I1, I2, I3 (V0 = 4.5 or 0.5 Vdc) (V0 = 9.0 or 1.0 Vdc) (V0 = 13.5 or 1.5 Vdc)	VIL	5.0	-	0.8	-	1.1	0.8	-	0.8	Vdc
		10	-	1.6	-	2.2	1.6	-	1.6	
		15	-	2.4	-	3.4	2.4	-	2.4	
V0 = 0.5 or 4.5 Vdc (V0 = 1.0 or 9.0 Vdc) (V0 = 1.5 or 13.5 Vdc)	VIH	5.0	2.0	-	2.0	1.9	-	2.0	-	Vdc
		10	5.0	-	5.0	3.1	-	5.0	-	
		15	10	-	10	4.3	-	10	-	
Output Drive Current Data, Write (AL/CL/CP Device)	IOH	5.0	-1.0	-	-1.0	-2.0	-	-1.0	-	mAdc
		10	-	-	-	-6.0	-	-	-	
		15	-	-	-	-12	-	-	-	
V0 = 0.4 Vdc (V0 = 0.5 Vdc) (V0 = 1.5 Vdc)	IOL	5.0	1.6	-	1.6	3.2	-	1.6	-	mAdc
		10	-	-	-	5.0	-	-	-	
		15	-	-	-	12	-	-	-	
Output Drive Current Other Outputs (AL Device)	IOH	5.0	-3.0	-	-2.4	-4.2	-	-1.7	-	mAdc
		10	-0.64	-	-0.51	-0.88	-	-0.38	-	
		15	-1.5	-	-1.3	-2.25	-	-0.9	-	
V0 = 0.4 Vdc (V0 = 0.5 Vdc) (V0 = 1.5 Vdc)	IOL	5.0	0.64	-	0.51	0.88	-	0.38	-	mAdc
		10	1.6	-	1.3	2.25	-	0.9	-	
		15	4.2	-	3.4	8.8	-	2.4	-	
Output Drive Current Other Outputs (CL/CP Device)	IOH	5.0	-2.5	-	-2.1	-4.2	-	-1.7	-	mAdc
		10	-0.52	-	-0.44	-0.88	-	-0.38	-	
		15	-1.3	-	-1.1	-2.25	-	-0.9	-	
V0 = 0.4 Vdc (V0 = 0.5 Vdc) (V0 = 1.5 Vdc)	IOL	5.0	0.52	-	0.44	0.88	-	0.38	-	mAdc
		10	1.3	-	1.1	2.25	-	0.9	-	
		15	3.6	-	3.0	8.8	-	2.4	-	

ELECTRICAL CHARACTERISTICS (continued)

Characteristic	Symbol	VDD Vdc	Tlow*		25°C			Thigh*		Unit
			Min	Max	Min	Typ	Max	Min	Max	
Input Current, RST (AL/CL/CP Device)	I _{in}	15	26	--	--	150	--	--	250	μA _{dc}
Input Current (AL Device)	I _{in}	15	--	±0.1	--	±0.00001	±0.1	--	±1.0	μA _{dc}
Input Current (CL/CP Device)	I _{in}	15	--	±0.3	--	±0.00001	±0.3	--	±1.0	μA _{dc}
Input Capacitance (Data)	C _{in}	--	--	--	--	15	--	--	--	pF
Input Capacitance (All Other Inputs) (V _{in} = 0)	C _{in}	--	--	--	--	5.0	7.5	--	--	pF
Quiescent Current (AL Device) (Per Package)	I _{DD}	5.0	--	5.0	--	0.005	5.0	--	150	μA _{dc}
		10	--	10	--	0.010	10	--	300	
		15	--	20	--	0.015	20	--	600	
Quiescent Current (CL/CP Device) (Per Package)	I _{DD}	5.0	--	20	--	0.005	20	--	150	μA _{dc}
		10	--	40	--	0.010	40	--	300	
		15	--	80	--	0.015	80	--	600	
**Total Supply Current at an External Load Capacitance (C _L) on All Outputs	I _T	--	--	--	--	I _T = (1.5 μA/kHz) f + I _{DD}		--	--	μA _{dc}
						I _T = (3.0 μA/kHz) f + I _{DD}				
						I _T = (4.5 μA/kHz) f + I _{DD}				

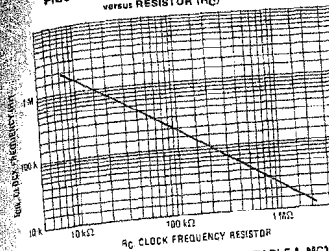
* T_{low} = -85°C for AL Device, -40°C for CL/CP Device
 * T_{high} = +125°C for AL Device, +85°C for CL/CP Device
 ** The formulas given are for the typical characteristics only at 25°C
 # Noise immunity specified for worst case input combination

SWITCHING CHARACTERISTICS (T_A = 25°C; t_r = 20 ns for X and -Inputs; C_L = 50 pF for JMP, X1, R, S, Flag O, Flag F, C_L = 150 pF for RTN load for Data and Write.)

Characteristic	Symbol	VDD Vdc	All Types			Unit
			Min	Typ	Max	
Propagation Delay Time X1 to RR	t _{PLH} , t _{PHL}	5.0	--	250	500	ns
		10	--	125	250	
		15	--	100	200	
X1 to Flag F, Flag O, RTN, JMP		5.0	--	200	400	ns
		10	--	100	200	
		15	--	85	170	
X1 to Write		5.0	--	225	450	ns
		10	--	125	250	
		15	--	100	200	
X1 to Data		5.0	--	250	500	ns
		10	--	120	240	
		15	--	100	200	
RST to RR		5.0	--	250	500	ns
		10	--	125	250	
		15	--	100	200	
RST to X1		5.0	--	450	Note 1	ns
		10	--	200		
		15	--	150		
RST to Flag F, Flag O, RTN, JMP		5.0	--	400	800	ns
		10	--	200	400	
		15	--	150	300	
RST to Write, Data		5.0	--	450	900	ns
		10	--	225	450	
		15	--	175	350	
Clock Pulse Width, X1	t _{w(c)}	5.0	400	200	--	ns
		10	200	100	--	
		15	180	90	--	
Reset Pulse Width, RST	t _{w(R)}	5.0	600	300	--	ns
		10	250	125	--	
		15	200	100	--	
Setup Time - Instruction	t _{su(I)}	5.0	400	200	--	ns
		10	250	125	--	
		15	180	90	--	
Data	t _{su(D)}	5.0	200	100	--	ns
		10	100	50	--	
		15	80	40	--	
Hold Time - Instruction	t _{h(I)}	5.0	100	0	--	ns
		10	50	0	--	
		15	50	0	--	
Data	t _{h(D)}	5.0	200	100	--	ns
		10	100	50	--	
		15	100	50	--	

NOTE 1. Maximum Reset Delay may extend to one-half clock period.

FIGURE 1 - TYPICAL CLOCK FREQUENCY versus RESISTOR (R_C)



Pin No.	Function	Symbol
1	Chip Reset	RST
2	Write Pulse	Write
3	Data In/Out	I ₃
4	MSB Instruction Word	I ₂
5	Bit 2 Instruction Word	I ₁
6	Bit 1 Instruction Word	I ₀
7	LSB Instruction Word	VSS
8	Negative Supply (Ground)	Flag F
9	Flag on NOP F	Flag O
10	Flag on NOP O	RTN
11	Subroutine Return Flag	JMP
12	Jump Instruction Flag	X2
13	Oscillator Input	X1
14	Oscillator Dutyout	RR
15	Result Register	VDD
16	Positive Supply	

TABLE 1. MC14500B INSTRUCTION SET

Instruction Code	Mnemonic	Action
0 0000	NOFC	No change in registers. RR → RR, Flag O → JL
1 0001	LD	Load result register. Data → RR
2 0010	LDC	Load complement. Data → RR
3 0011	AND	Logical AND. RR ← Data → RR
4 0100	ANDC	Logical AND complement. RR ← Data → RR
5 0101	OR	Logical OR. RR ← Data → RR
6 0110	ORC	Logical OR complement. RR ← Data → RR
7 0111	XNOR	Exclusive NOR. (RR ← Data, RR → 1)
8 1000	STQ	Store. RR → Data Pin, Write → JL
9 1001	STOC	Store complement. RR → Data Pin, Write → JL
A 1010	IEN	Input enable. Data → IEN Register
B 1011	OEN	Output enable. Data → OEN Register
C 1100	JMP	Jump. JMP Flag → JL
D 1101	RTN	Return. RTN Flag → JL and skip next instruction
E 1110	SKZ	Skip next instruction if RR = 0
F 1111	NOFF	No change in registers. RR → RR, Flag F → JL

FIGURE 2 - OUTLINE OF A TYPICAL ORGANIZATION FOR A MC14500B-BASED SYSTEM

