



# 8228 SYSTEM CONTROLLER AND BUS DRIVER FOR 8080A CPU

- **Single Chip System Control for MCS<sup>®</sup>-80 Systems**
- **Built-In Bidirectional Bus Driver for Data Bus Isolation**
- **Allows the Use of Multiple Byte Instructions (e.g. CALL) for Interrupt Acknowledge**
- **Reduces System Package Count**
- **User Selected Single Level Interrupt Vector (RST 7)**
- **Available in EXPRESS — Standard Temperature Range**
- **Available in 28-Lead Cerdip and Plastic Packages**  
(See Packaging Spec, Order #231369)

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The Intel 8228 is a single chip system controller and bus driver for MCS<sup>®</sup>-80. It generates all signals required to directly interface MCS-80 family RAM, ROM, and I/O components.

A bidirectional bus driver is included to provide high system TTL fan-out. It also provides isolation of the 8080 data bus from memory and I/O. This allows for the optimization of control signals, enabling the systems designer to use slower memory and I/O. The isolation of the bus driver also provides for enhanced system noise immunity.

A user selected single level interrupt vector (RST 7) is provided to simplify real time, interrupt driven, small system requirements. The 8228 also generates the correct control signals to allow the use of multiple byte instructions (e.g., CALL) in response to an interrupt acknowledge by the 8080A. This feature permits large, interrupt driven systems to have an unlimited number of interrupt levels.

The 8228 is designed to support a wide variety of system bus structures and also reduce system package count for cost effective, reliable design of MCS-80 systems.

**NOTE:**

The specifications for the 3228 are identical with those for the 8228.

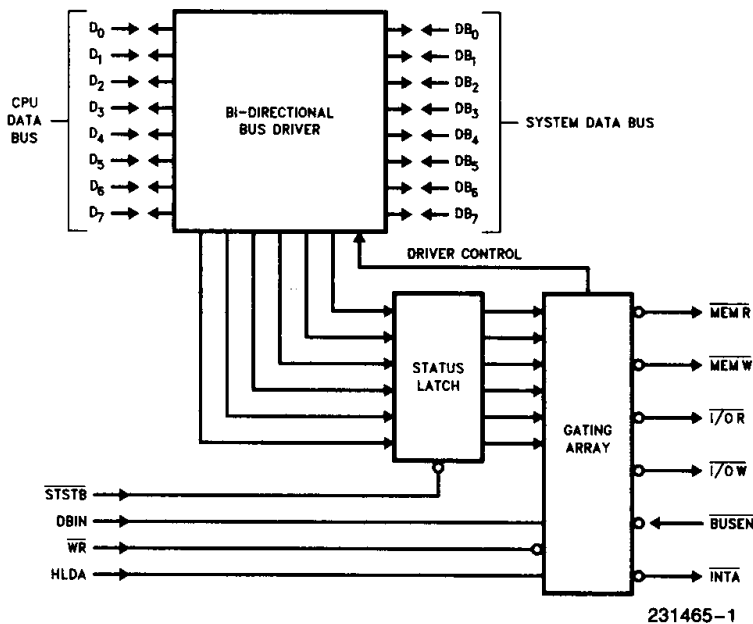
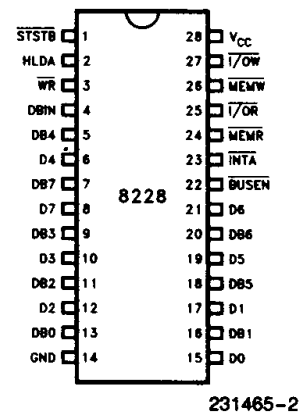


Figure 1. Block Diagram



D7-DO	Data Bus (8080 Side)	INTA	Interrupt Acknowledge
DB7-DB0	Data Bus (System Side)	HLDA	HLDA (from 8080)
I/OR	I/O Read	WR	WR (from 8080)
I/OW	I/O Write	BUSEN	Bus Enable Input
MEMR	Memory Read	STSTB	Status Strobe (from 8224)
MEMW	Memory Write	V <sub>CC</sub>	+5V
DBIN	DBIN (from 8080)	GND	0 Volts

Figure 2. Pin Configuration

**ABSOLUTE MAXIMUM RATINGS\***

Temperature Under Bias ..... 0°C to +70°C  
 Storage Temperature ..... -65°C to +150°C  
 Supply Voltage,  $V_{CC}$  ..... -0.5V to +7V  
 Input Voltage ..... -1.5 to +7V  
 Output Current ..... 100 mA

NOTICE: This is a production data sheet. The specifications are subject to change without notice.

*\*WARNING: Stressing the device beyond the "Absolute Maximum Ratings" may cause permanent damage. These are stress ratings only. Operation beyond the "Operating Conditions" is not recommended and extended exposure beyond the "Operating Conditions" may affect device reliability.*

**D.C. CHARACTERISTICS**  $T_A = 0^\circ\text{C to } +70^\circ\text{C}$ ,  $V_{CC} = 5\text{V} \pm 5\%$ 

Symbol	Parameter		Limits			Unit	Test Conditions
			Min	Typ(1)	Max		
$V_C$	Input Clamp Voltage, All Input			0.75	-1.0	V	$V_{CC} = 4.75\text{V}; I_C = -5\text{ mA}$
$I_F$	Input Load Current	$\overline{STSTB}$			500	$\mu\text{A}$	$V_{CC} = 5.25\text{V}$
		$D_2$ & $D_6$			750	$\mu\text{A}$	$V_F = 0.45\text{V}$
		$D_0, D_1, D_4,$ $D_5$ & $D_7$			250	$\mu\text{A}$	
		All Other Inputs			250	$\mu\text{A}$	
$I_R$	Input Leakage Current	$\overline{STSTB}$			100	$\mu\text{A}$	$V_{CC} = 5.25\text{V}$ $V_R = 5.25\text{V}$
		$DB_0$ - $DB_7$			20	$\mu\text{A}$	
		All Other Inputs			100	$\mu\text{A}$	
$V_{TH}$	Input Threshold Voltage, All Inputs		0.8		2.0	V	$V_{CC} = 5\text{V}$
$I_{CC}$	Power Supply Current			140	190	mA	$V_{CC} = 5.25\text{V}$
$V_{OL}$	Output Low Voltage	$D_0$ - $D_7$			0.45	V	$V_{CC} = 4.75\text{V}; I_{OL} = 2\text{ mA}$
		All Other Outputs			0.45	V	$I_{OL} = 10\text{ mA}$
$V_{OH}$	Output High Voltage	$D_0$ - $D_7$	3.6	3.8		V	$V_{CC} = 4.75\text{V}; I_{OH} = -10\mu\text{A}$
		All Other Outputs	2.4			V	$I_{OH} = -1\text{ mA}$
$I_{OS}$	Short Circuit Current, All Outputs		15		90	mA	$V_{CC} = 5\text{V}$
$I_{O(off)}$	Off State Output Current All Control Outputs				100	$\mu\text{A}$	$V_{CC} = 5.25\text{V}; V_O = 5.25\text{V}$
					-100	$\mu\text{A}$	$V_O = 0.45\text{V}$
$I_{INT}$	INTA Current				5	mA	(See INTA Test Circuit)

**NOTE:**

1. Typical values are for  $T_A = 25^\circ\text{C}$  and nominal supply voltages.

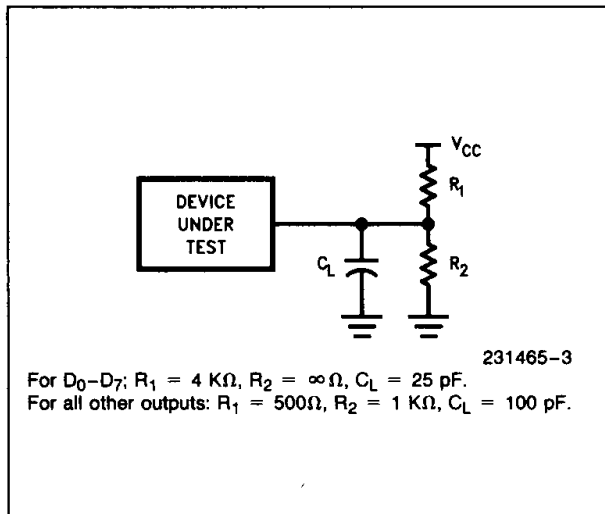
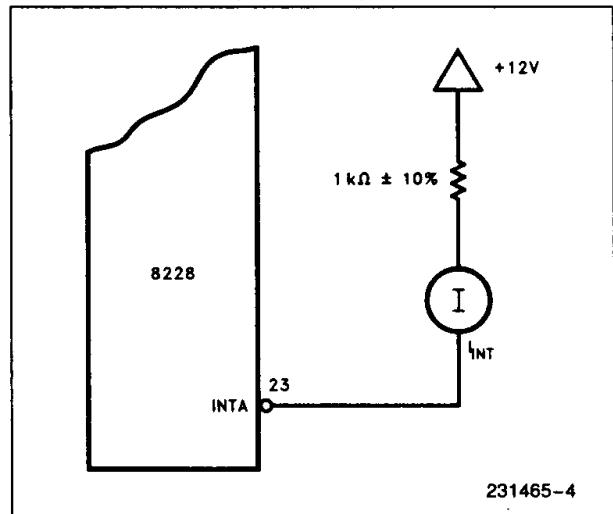
**CAPACITANCE**  $V_{BIAS} = 2.5V, V_{CC} = 5.0V, T_A = 25^\circ C, f = 1 \text{ MHz}$ 

1. This parameter is periodically sampled and not 100% tested.

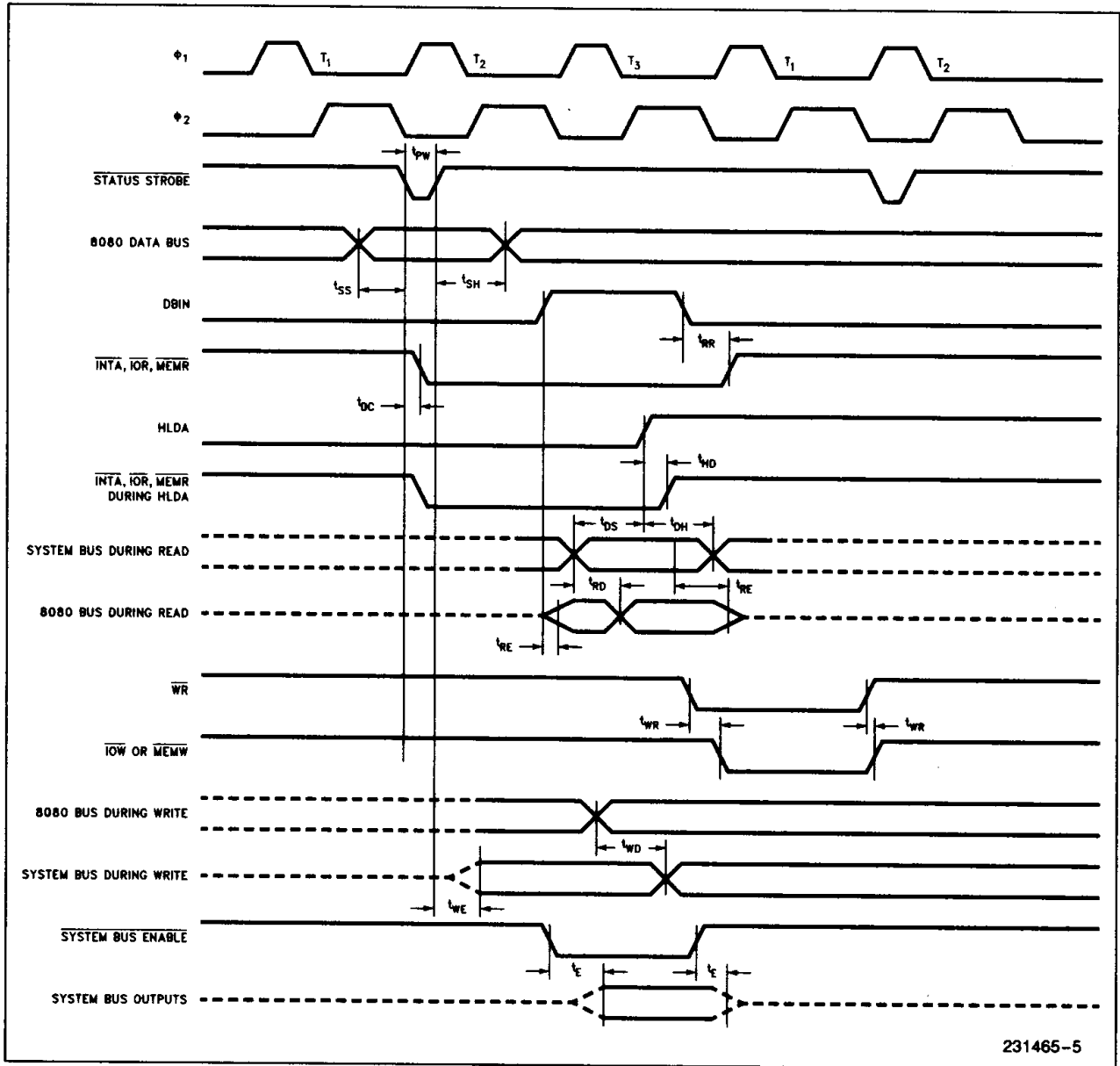
Symbol	Parameter	Limits			Unit
		Min	Typ(1)	Max	
$C_{IN}$	Input Capacitance		8	12	pF
$C_{OUT}$	Output Capacitance Control Signals		7	15	pF
I/O	I/O Capacitance (D or DB)		8	15	pF

**A.C. CHARACTERISTICS**  $T_A = 0^\circ C \text{ to } +70^\circ C, V_{CC} = 5V \pm 5\%$ 

Symbol	Parameter	Limits		Unit	Conditions
		Min	Max		
$t_{PW}$	Width of Status Strobe	22		ns	
$t_{SS}$	Setup Time, Status Inputs $D_0-D_7$	8		ns	
$t_{SH}$	Hold Time, Status Inputs $D_0-D_7$	5		ns	
$t_{DC}$	Delay from $\overline{STSTB}$ to any Control Signal	20	60	ns	$C_L = 100 \text{ pF}$
$t_{RR}$	Delay from $\overline{DBIN}$ to Control Outputs		30	ns	$C_L = 100 \text{ pF}$
$t_{RE}$	Delay from $\overline{DBIN}$ to Enable/Disable 8080 Bus		45	ns	$C_L = 25 \text{ pF}$
$t_{RD}$	Delay from System Bus to 8080 Bus during Read		30	ns	$C_L = 25 \text{ pF}$
$t_{WR}$	Delay from $\overline{WR}$ to Control Outputs	5	45	ns	$C_L = 100 \text{ pF}$
$t_{WE}$	Delay to Enable System Bus $DB_0-DB_7$ after $\overline{STSTB}$		30	ns	$C_L = 100 \text{ pF}$
$t_{WD}$	Delay from 8080 Bus $D_0-D_7$ to System Bus $DB_0-DB_7$ during Write	5	40	ns	$C_L = 100 \text{ pF}$
$t_E$	Delay from System Bus Enable to System Bus $DB_0-DB_7$		30	ns	$C_L = 100 \text{ pF}$
$t_{HD}$	HLDA to Read Status Outputs		25	ns	
$t_{DS}$	Setup Time, System Bus Inputs to HLDA	10		ns	
$t_{DH}$	Hold Time, System Bus Inputs to HLDA	20		ns	$C_L = 100 \text{ pF}$

**A.C. TESTING LOAD CIRCUIT**

**INTA Test Circuit (for RST 7)**


**WAVEFORMS**



VOLTAGE MEASUREMENT POINTS: D<sub>0</sub>-D<sub>7</sub> (when outputs) Logic "0" = 0.8V, Logic "1" = 3.0V. All other signals measured at 1.5V.