



# 52004 4K BIT (512 x 8)NVRAM

PRELIMINARY

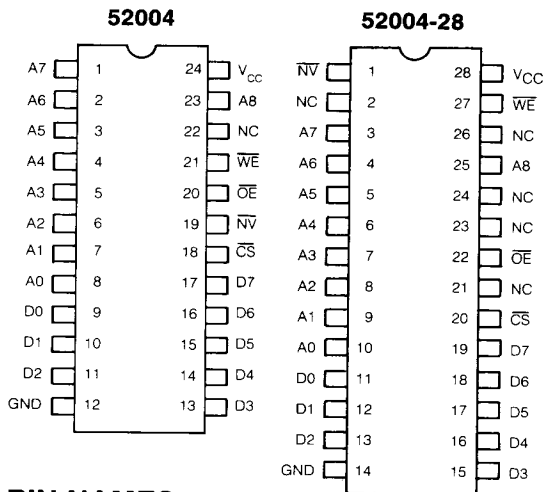
- 4K Bit Static RAM backed by 4K Bit Electrically Erasable PROM
- Fully 5V Only Operation
- Directly TTL Compatible
- In Circuit EEPROM Changes
- SRAM Cycle Time less than 300 ns
- Power-Failure Protection

- Unlimited Recall Cycles
- Memory Margining Capability
- Operating ranges
  - 52004 ..... 0°C to +70°C
  - 52004I ..... -40°C to +85°C
  - 52004HR ..... -55°C to +125°C

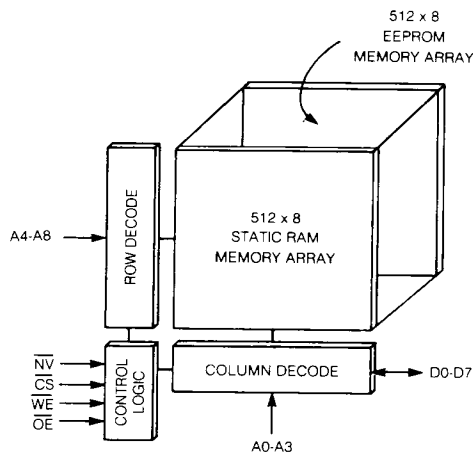
MEMORIES  
NVRAM

The NCR 52004 non-volatile RAM combines 4K (512 x 8) bits of conventional static RAM (SRAM) with an identical size array of Electrically Erasable PROM (EEPROM). Non-volatile data can be stored in the EEPROM while independent data is accessed simultaneously in the SRAM. Data can be transferred back and forth between the SRAM and the EEPROM by simple Store and Recall operations. A non-volatile Store signal transfers data from the SRAM to the non-volatile EEPROM where it is safely stored even when power is removed. When power is restored, the data in the EEPROM is automatically recalled into the SRAM. Data stored in the non-volatile EEPROM can be recalled an unlimited number of times. The NCR 52004 requires only a single 5 volt power supply for all modes of operation, and is completely TTL compatible with fully static timing and three state outputs. The NCR 52004 is available in a 24 pin package and an optional 28 pin package, in commercial, industrial and high reliability versions.

## PIN CONFIGURATION



## FUNCTIONAL BLOCK DIAGRAM



## PIN NAMES

A0-A8	Address Inputs	WE	Write Enable
D0-D7	Data I/O	OE	Output Enable
CS	Chip Select	NC	No Connection
NV	Non-Volatile Enable	VCC	+ 5 Volts ± 10%

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This is advance information and NCR reserves the right to change the specifications without notice.

## DEVICE OPERATION

### SRAM READ/WRITE

The NCR 52004 can be read like a conventional static RAM. With  $\overline{CS}$  and  $\overline{OE}$  low and  $\overline{WE}$  high, valid data will be presented to output pins. With  $\overline{CS}$  and  $\overline{WE}$  low, and  $\overline{OE}$  high, the SRAM can be written to like a conventional static RAM.

### STORE

Transferring data from the SRAM to the non-volatile EEPROM is controlled by the Store operation. The  $\overline{NV}$  input signal controls the non-volatile operations (i.e., Store and Recall), except for automatic data recall upon power up. When  $\overline{NV}$  and  $\overline{WE}$  are brought low, the entire contents of the SRAM array are copied into the non-volatile EEPROM array. The data in the SRAM is unaffected by a Store operation. The Recall cycle is inhibited by a Store operation, and  $\overline{CS}$  can either be high or low.

The I/O terminals are in the high impedance state during a Store operation. The contents of the EEPROM remain valid with or without power being supplied. The data retention time of the EEPROM can be measured by memory margining.

During power up or power down, precaution must be taken to prevent an unintentional Store cycle. Holding  $\overline{NV}$  high will inhibit the initiation of a Store cycle. Additionally, a Store operation should not be initiated until the supply voltage ( $V_{CC}$ ) is at specification limits.

### RECALL

The data stored in the non-volatile EEPROM array is transferred back into the SRAM by the Recall operation. When  $\overline{NV}$  and  $\overline{OE}$  are brought low, the entire contents of the EEPROM are copied back into the SRAM (overwriting any data already existing in the SRAM). An Array Recall cycle can take place when  $\overline{CS}$  is either high or low. An array Recall operation will automatically be performed upon power up. The data in the EEPROM is unaffected by a Recall operation.

The Data I/O terminals are in a high impedance state during a non-volatile operation (i.e., Store or Recall). When a non-volatile cycle is initiated, all other operations are inhibited until the first operation is complete.

### MEMORY MARGINING

The NCR 52004 supports margining of the memory transistors. Memory margining allows device retention time to be projected for the purpose of device evaluation. An application note describing the memory margining algorithm is available.

### MODE SELECTION

MODE	INPUTS			
	$\overline{CS}$	$\overline{NV}$	$\overline{WE}$	$\overline{OE}$
READ	L	H	H	L
WRITE	L	H	L	H
STORE	X	L	L	H
RECALL	X	L	H	L

### ABSOLUTE MAXIMUM RATINGS

All inputs or outputs relative to Vss . . . . . - 0.5 to + 7V  
 Storage temperature without data retention . . . . . -65°C to + 150°C

Stress above "absolute maximum ratings" may result in damage to the device. Functional operation of devices at the "absolute maximum ratings" or above the recommended operational limits stipulated elsewhere in this specification is not implied.

### RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	52004			52004I			52004HR**			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
VCC	Supply voltage	4.5	5.0	5.5	4.5	5.0	5.5	4.5	5.0	5.5	V
V <sub>IH</sub>	Input high level voltage	2.0		V <sub>CC</sub>	2.0		V <sub>CC</sub>	2.0		V <sub>CC</sub>	V
V <sub>IL</sub>	Input low level voltage	-0.3		0.8	-0.3		0.8	-0.3		0.8	V
T <sub>A</sub>	Ambient Temperature	0		70	-40		85	-55		125	°C

All voltages are with respect to GND.

### STATIC ELECTRICAL CHARACTERISTICS, OVER RECOMMENDED OPERATION CONDITIONS (UNLESS OTHERWISE NOTED)

Symbol	Parameter	Condition	52004			52004I			52004HR**			Unit
			Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
I <sub>IN</sub>	Input leakage current	V <sub>IN</sub> = 0V TO 5.5V		0.1	10		0.1	10		0.1	10	µA
I <sub>O</sub>	I <sub>O</sub> leakage current	V <sub>O</sub> = 0.4V TO 5.5V Chip Deselected		0.1	10		0.1	10		0.1	10	µA
I <sub>CC</sub>	Supply Current	Outputs Open		35	70		45	80		45	80	mA
V <sub>OH</sub>	Output High Voltage	I <sub>OH</sub> = -400µA	2.4			2.4			2.4			V
V <sub>OL</sub>	Output Low Voltage	I <sub>OL</sub> = 2.1mA			0.4			0.4			0.4	V
T <sub>S</sub>	Non-Volatile storage time		TBD									yr

\* Typical values are at 25°C and typical supply voltages.

### CAPACITANCE T<sub>A</sub> = 25°C, f = 1.0 MHz, V<sub>CC</sub> = 5V

Symbol	Parameter	Condition	52004			52004I			52004HR**			Unit
			Min	Typ	Max	Min	Typ*	Max	Min	Typ	Max	
C	Capacitance of Input & Data I/O pins	All pins at VSS (ground)			10			10			10	pF

\*\*The 52004HR Data is preliminary and is subject to change.



## AC CHARACTERISTICS OVER RECOMMENDED OPERATING CONDITIONS (UNLESS OTHERWISE NOTED)

### READ CYCLE

Symbol	Parameter	52004			52004I			52004HR**			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
t <sub>RC</sub>	Read Cycle Time	300			300			450			ns
t <sub>ACC</sub>	Address Access Time			300			300			450	ns
t <sub>A</sub>	Chip Select or Output Enable to Data Active	0			0			0			ns
t <sub>OE</sub>	Output Enable Time			100			120			120	ns
t <sub>CS</sub>	Chip Select Access Time			100			120			120	ns
t <sub>OH</sub>	Output Hold Time	10			10			10			ns
t <sub>OZ</sub>	Chip Select Or Output Enable To Output High Impedance Time			90			90			90	ns

### WRITE CYCLE

Symbol	Parameter	52004			52004I			52004HR**			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
t <sub>WC</sub>	Write Cycle Time	300			300			450			ns
t <sub>w</sub>	Write Pulse Width	150			150			300			ns
t <sub>WR</sub>	Write Release Time	25			25			25			ns
t <sub>DW</sub>	Data to Write Time Overlap	150			150			200			ns
t <sub>DH</sub>	Data Hold From Write Time	20			20			20			ns
t <sub>AS</sub>	Address Setup Time	50			50			50			ns

### STORE CYCLE

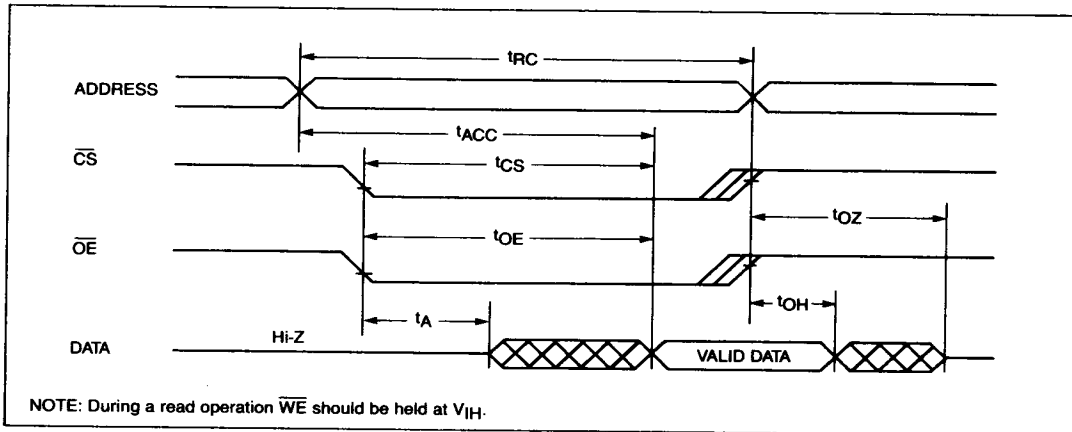
Symbol	Parameter	52004			52004I			52004HR**			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
t <sub>STC</sub>	Store Cycle Time			10			10			10	ms
t <sub>NW</sub>	NV to Write Overlap	100			100			100			ns
t <sub>NS</sub>	NV Setup Time	0			0			0			ns
t <sub>STZ</sub>	Store to Output Hi-Z			100			100			100	ns
t <sub>SC</sub>	Number of Store Cycles	10 <sup>4</sup>			10 <sup>4</sup>			10 <sup>4</sup>			cycle

### RECALL CYCLE

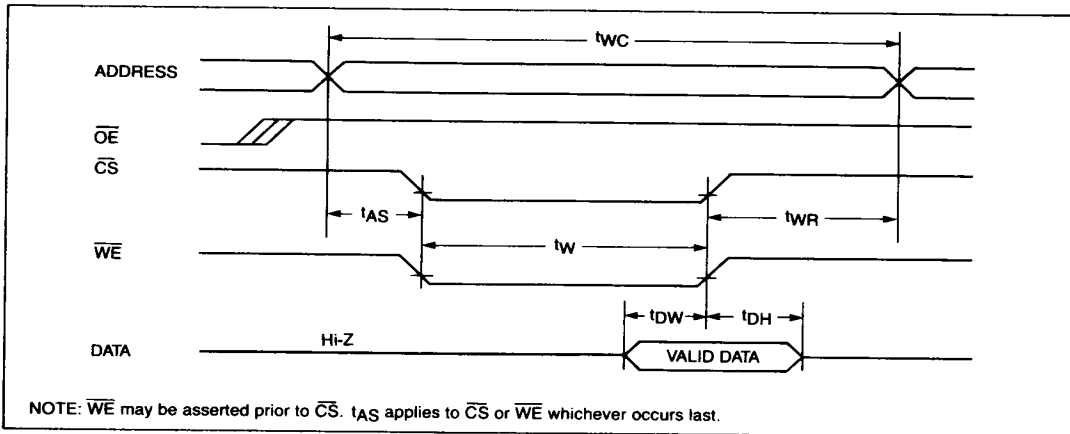
Symbol	Parameter	52004			52004I			52004HR**			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
t <sub>RCC</sub>	Array Recall Cycle Time			20							μs
t <sub>NO</sub>	NV to Output Overlap	200			450			450			ns
t <sub>NS</sub>	NV Setup time	0			0			0			ns
t <sub>RCZ</sub>	Recall to Output Hi-Z			100			100			100	ns

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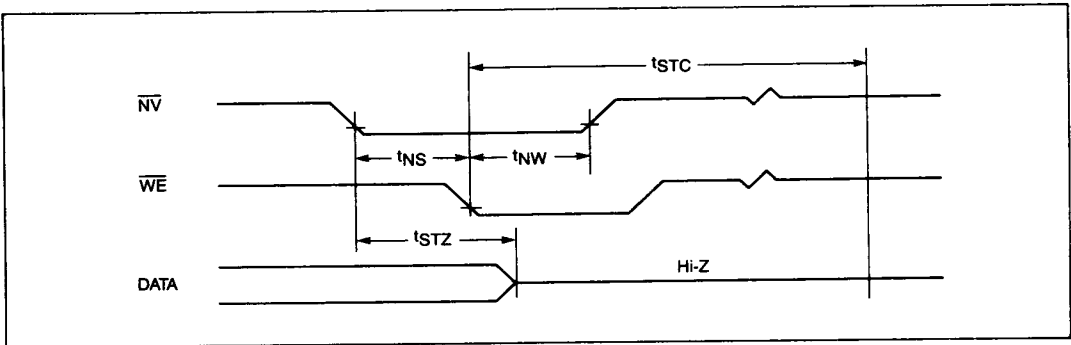
### READ CYCLE



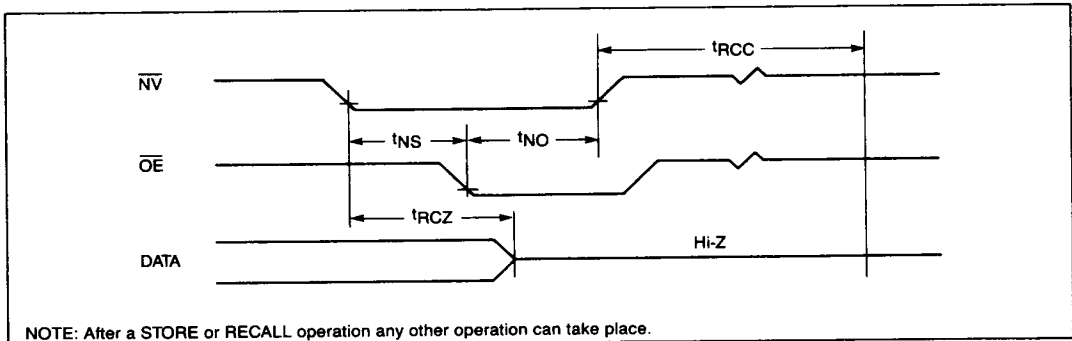
### WRITE CYCLE



**STORE CYCLE**



**RECALL CYCLE**

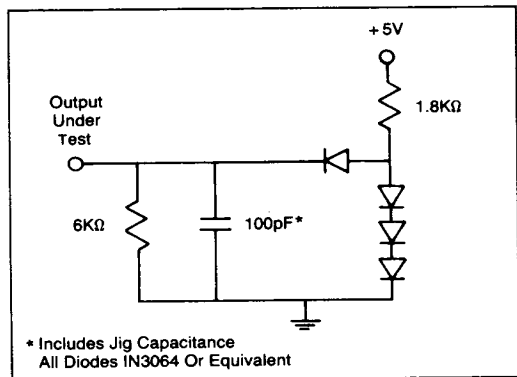


NOTE: After a STORE or RECALL operation any other operation can take place.

**A. C. CONDITIONS OF TESTS**

Input Pulse Levels . . . . . 0.8 Volts to 2.0 Volts  
 Input Rise & Fall Times . . . . . 10 nsec  
 Output Timing Levels . . . . . 0.8 Volts to 2.0 Volts

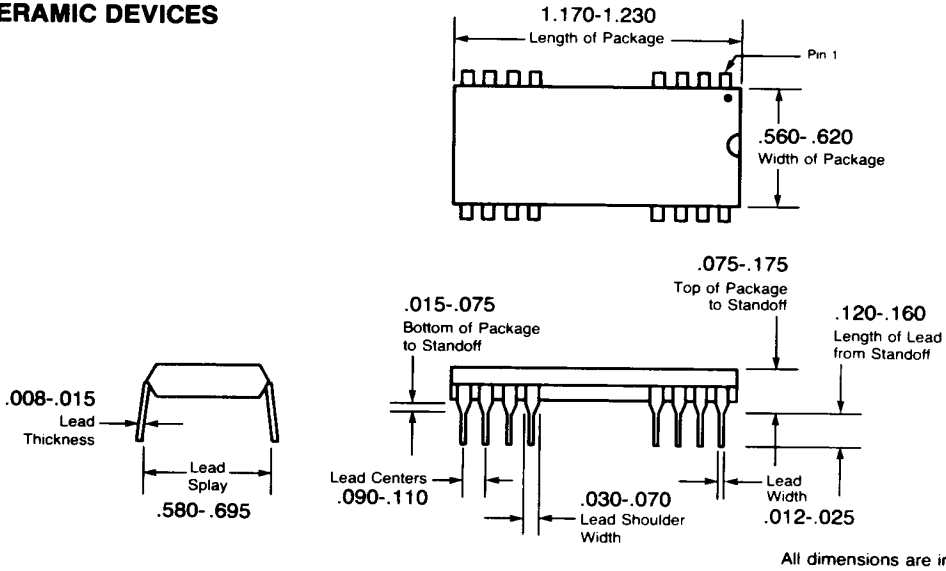
**TEST LOAD CIRCUIT**



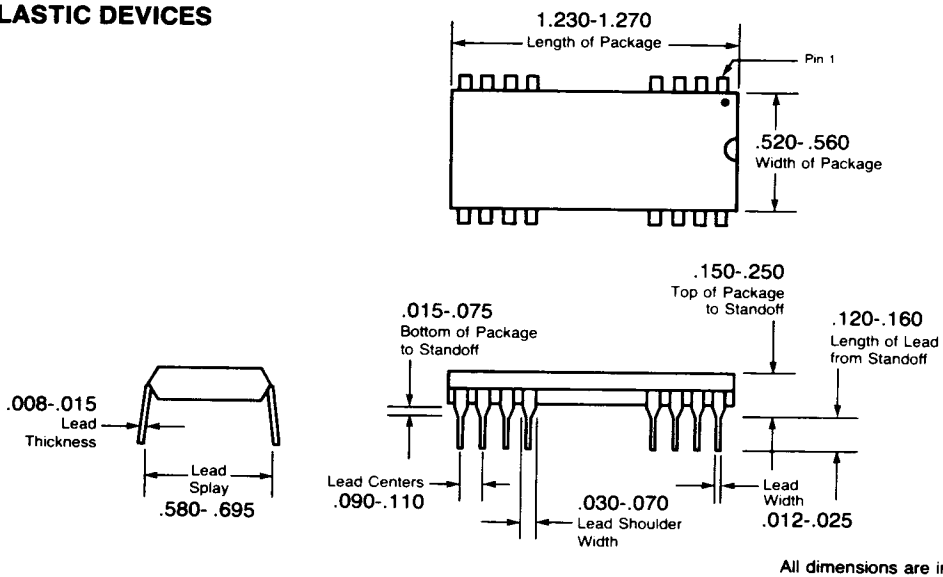
**MECHANICAL DATA 24 PIN**

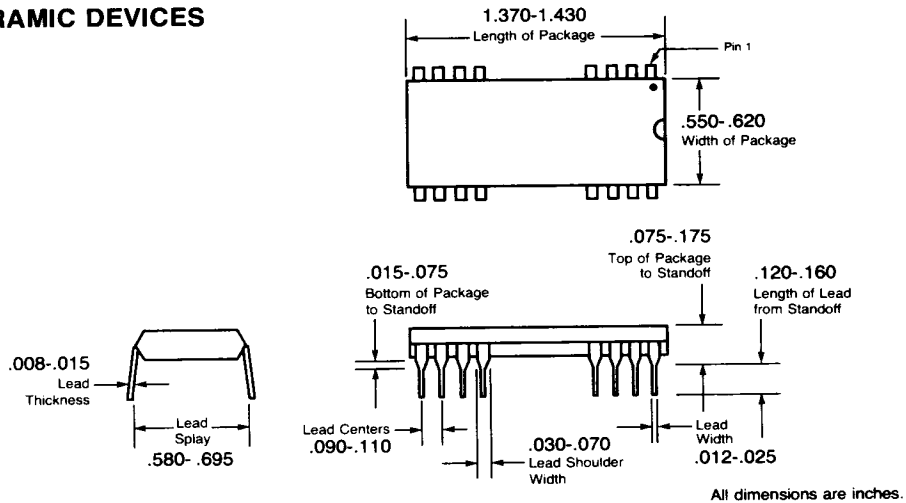
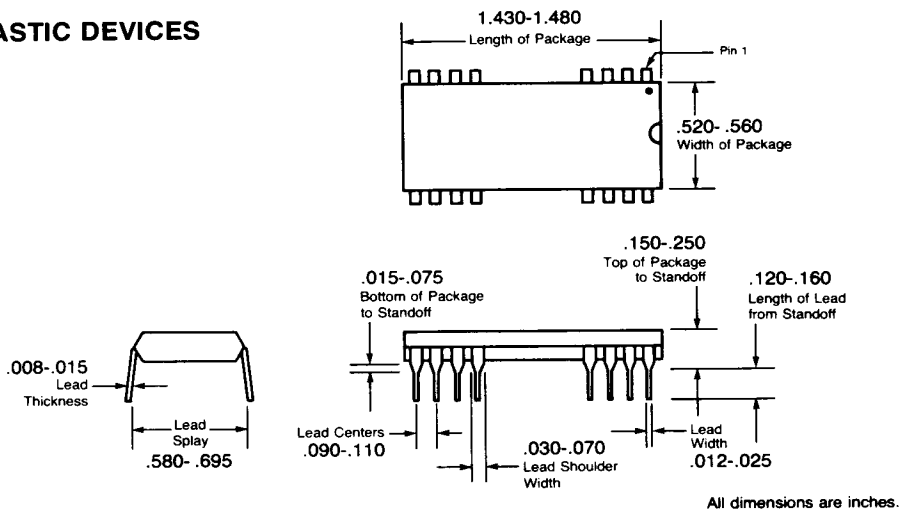
MEMORIES  
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**CERAMIC DEVICES**



**PLASTIC DEVICES**



**MECHANICAL DATA 28 Pin****CERAMIC DEVICES****PLASTIC DEVICES****NCR**

NCR Microelectronics Division  
 8181 Byers Road  
 Miamisburg, Ohio 45342  
 Telex: 241669 NCR NVMEM MSBG  
 Phone: 1-800-543-5618 outside Ohio  
 513/866-7217 Ohio or International