

# NM95MS14

## Plug 'n Play Front-End Devices for ISA-Bus Systems

### General Description

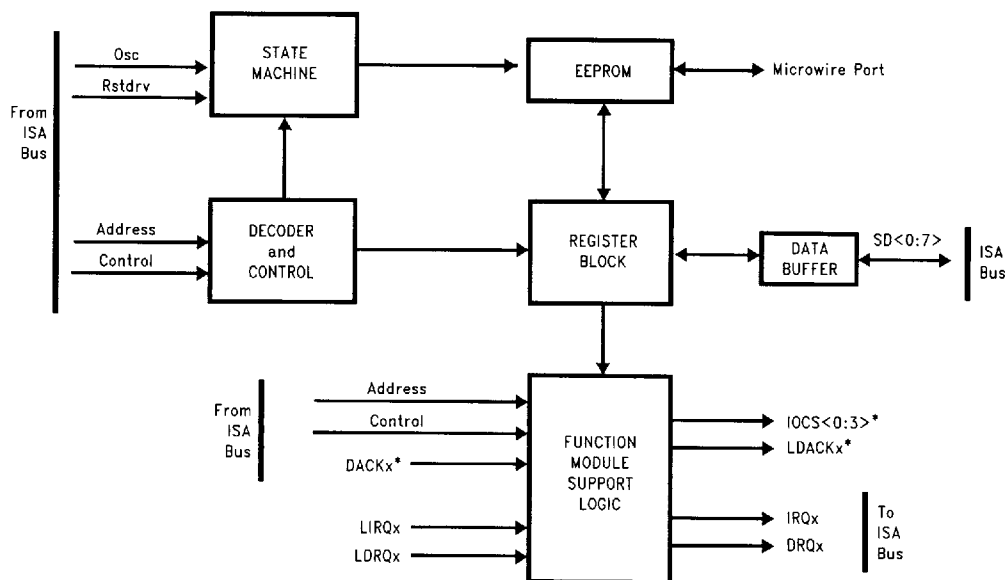
The NM95MS14 is the smaller of a family of devices designed to provide complete Plug 'n Play Capability for ISA bus systems. The NM95MS14 includes the necessary state machine logic to manage the Plug 'n Play protocol in addition to switches for steering Interrupt and DMA requests. It also features a built-in 2k bits of serial EEPROM for storing the resource data specified in the Plug 'n Play Standard. In addition, 4k bits of EEPROM is available for use by other on-board logic. This device provides a "truly complete" single-chip solution for implementing Plug 'n Play on ISA-Bus Adapter cards. The NM95MS14 supports one logical device with a flexible choice of DMA/IRQ selection and I/O Chip-select generation.

NM95MS14 is implemented using National's Advanced CMOS process and operates single power supply. The NM95MS14 is available in a 48-pin TQFP package.

### Features

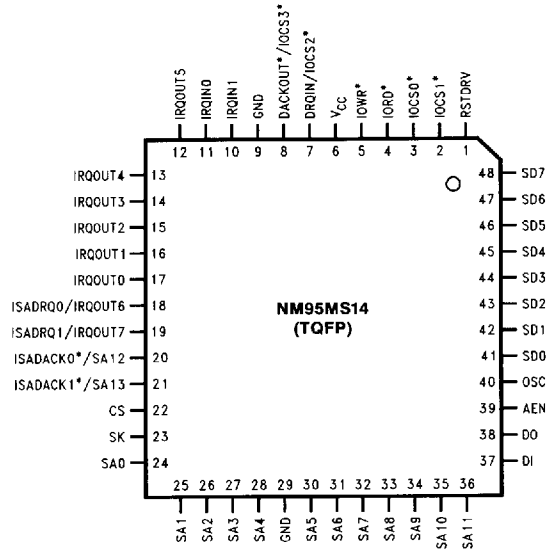
- Complete implementation of Plug 'n Play standard
  - Direct interface to ISA bus
- Two modes of operation
  - DMA mode
  - Extended Interrupt mode
- 6 or 8 ISA bus interrupt lines and 2 DRQ/DACK lines supported
- On-chip EEPROM for resource request table
- Additional 4 Kbits of on-chip EEPROM available for external access
- 24 mA drivers for data outputs
- 48-pin TQFP package

### Block Diagram



TL/D/12315-1

## Connection Diagram



TL/D/12315-2

**Commercial Temperature Range (0°C to +70°C)**  
**Order Number NM95MS14S**

Signals	Type	Description
SA <11:0>	I	Address inputs from the ISA bus.
IORD*	I	I/O read strobe from the ISA bus.
IOWR*	I	I/O write strobe from the ISA bus.
AEN	I	Address Enable from ISA Bus—used in conjunction with DMA.
SD <7:0>	I/O	Data bus—lower byte—from/to the ISA bus.
OSC	I	"OSC" Clock from the ISA bus—used for internal state machines.
RSTDRV	I	Reset input from the ISA bus.
SK, DI	I	Clock and Data input lines for Microwire bus connection to access a portion (4k) on chip EEPROM.
CS	I	Chip select for Microwire port. There should be a pulldown resistor of 4.7k on CS pin if unused externally.
DO	O	Data output line for the Microwire interface detailed above. There should be a pull-up resistor of 4.7k on this line, if used externally.
IRQOUT <5:0>	O	Connection to ISA bus interrupt request pins. On-chip interrupt request(s) may be connected to any 6 of the ISA IRQ lines.
IRQIN <1:0>	I	Interrupt request from on-board logic.
DRQin/IOCS2*	I/O	DMA request from on-board logic, or Programmable chipselect (2) depending on mode selected.
DACKOUT*/IOCS3*	O	DMA Acknowledge for on-board logic or Programmable chipselect (3) depending on mode selected.
ISADREQ <1:0> / IRQOUT <7:6>	O	Connection for two ISA bus DMA Request lines, or additional interrupt request lines depending on the mode selected.
ISADACK <1:0> * / SA <13:12>	I	DMA Acknowledge from the ISA bus or additional address lines depending on the mode selected.
IOCS <1:0> *	O	Programmable chip selects to address on-board peripherals.

\*Signal name with a "\*" means its an active low signal.

## Pinout Details for the NM95MS14

Mode 00 = DMA Mode; Mode 01 = Extended Interrupt Mode

Pin #	Pin Name	
TQFP	DMA Mode	Ext. Intr. Mode
1	RSTDRV	RSTDRV
2	IOCS1*	IOCS1*
3	IOCS0*	IOCS0*
4	IORD*	IORD*
5	IOWR*	IOWR*
6	V <sub>CC</sub>	V <sub>CC</sub>
7	DRQIN	IOCS2*
8	DACKOUT*	IOCS3*
9	GND	GND
10	IRQIN1	IRQIN1
11	IRQIN0	IRQIN0
12	IRQOUT5	IRQOUT5
13	IRQOUT4	IRQOUT4
14	IRQOUT3	IRQOUT3
15	IRQOUT2	IRQOUT2
16	IRQOUT1	IRQOUT1

Pin #	Pin Name	
TQFP	DMA Mode	Ext. Intr. Mode
17	IRQOUT0	IRQOUT0
18	ISADREQ0	IRQOUT6
19	ISADREQ1	IRQOUT7
20	ISADACK0*	SA12
21	ISADACK1*	SA13
22	CS	CS
23	SK	SK
24	SA0	SA0
25	SA1	SA1
26	SA2	SA2
27	SA3	SA3
28	SA4	SA4
29	GND	GND
30	SA5	SA5
31	SA6	SA6
32	SA7	SA7

Pin #	Pin Name	
TQFP	DMA Mode	Ext. Intr. Mode
33	SA8	SA8
34	SA9	SA9
35	SA10	SA10
36	SA11	SA11
37	DI	DI
38	DO	DO
39	AEN	AEN
40	OSC	OSC
41	SD0	SD0
42	SD1	SD1
43	SD2	SD2
44	SD3	SD3
45	SD4	SD4
46	SD5	SD5
47	SD6	SD6
48	SD7	SD7

**Note:** Mode selection (00 or 01) is done by setting MS bits in the EEPROM configuration register. Detailed information about this is described in User's Guide.

## Absolute Maximum Ratings

Ambient Storage Temperature  $-65^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$   
 All Input or Output Voltages  
 with Respect to Ground  $V_{CC} + 1\text{V}$  to  $-0.3\text{V}$   
 Lead Temperature  
 (Soldering, 10 seconds)  $+300^{\circ}\text{C}$   
 ESD Rating 2000V Min

## Operating Conditions

Ambient Operating Temperature  
 NM95MS14  $0^{\circ}\text{C}$  to  $+70^{\circ}\text{C}$   
 Positive Power Supply ( $V_{CC}$ )  $4.5\text{V}$  to  $5.5\text{V}$

## DC Electrical Characteristics

Symbol	Parameter	Test Conditions	Limits			Units
			Min	Typ (Note 1)	Max	
$I_{CCA}$	Active Power Supply Current	$f_{SCL} = 100\text{ kHz}$		6	10	mA
$I_{LI}$	Input Leakage Current	$V_{IN} = \text{GND or } V_{CC}$		0.2	1.0	$\mu\text{A}$
$I_{LO}$	Output Leakage Current	$V_{OUT} = \text{GND to } V_{CC}$			1.0	$\mu\text{A}$
$V_{IL}$	Input Low Voltage			-0.1	0.8	V
$V_{IH}$	Input High Voltage		2.0		$V_{CC} + 1.0$	V
$V_{OL}$	Output Low Voltage	$I_{OL} = 24\text{ mA (Note 3)}$ $I_{OL} = 2.1\text{ mA (Note 4)}$			0.4	V
$V_{OH}$	Output High Voltage	$I_{OH} = -3\text{ mA (Note 3)}$ $I_{OH} = -400\text{ }\mu\text{A (Note 4)}$	2.4 2.4			V V

## Capacitance $T_A = +25^{\circ}\text{C}$ , $f = 1.0\text{ MHz}$ , $V_{CC} = 5\text{V}$

Symbol	Test	Conditions	Max	Units
$C_{I/O}$ (Note 2)	Input/Output Capacitance	$V_{I/O} = 0\text{V}$	8	pF
$C_{IN}$ (Note 2)	Input Capacitance	$V_{IN} = 0\text{V}$	6	pF
$C_{OUT}$ (Note 2)	Output Capacitance	$V_{OUT} = 0\text{V}$	6	pF

**Note 1:** Typical values are for  $T_A = 25^{\circ}\text{C}$  and nominal supply voltage (5V).

**Note 2:** This parameter is periodically sampled and not 100% tested.

**Note 3:** These values are for ISA signals like  $SD[0:7]$ ,  $IRQx$ ,  $DRQx$ .

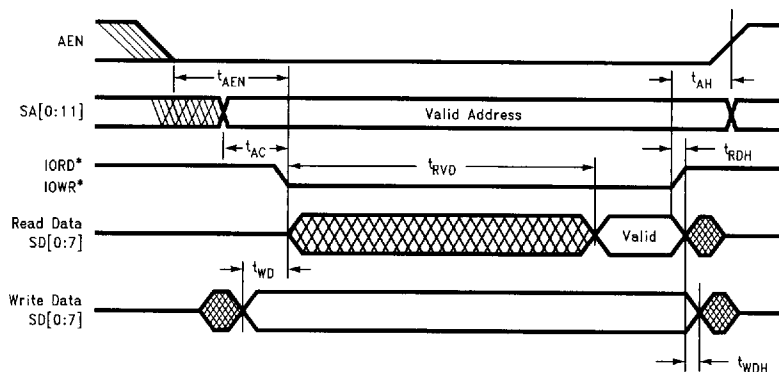
**Note 4:** These values are for card signal like  $IOCS[0:3]^*$ ,  $DO(EEPROM)$ .

## AC Electrical Characteristics

Symbol	Parameter	Min	Max	Unit
$t_{AEN}$	AEN Valid to Command Active	100		ns
$t_{AC}$	Address Valid to Command Active	88		ns
$t_{RPVD}$	Active Read to Valid Data		200	ns
$t_{AH}$	Address, AEN Hold from Inactive Command	30		ns
$t_{RDH}$	Read Data Hold from Inactive Read		5	ns
$t_{WD}$	Write Data Valid before Write Active	22		ns
$t_{WDH}$	Write Data Hold after Write Inactive	25		ns
$t_{CSA}$	Chip Selects Valid from Address Valid	5	25	ns
$t_{CSC}$	Chip Selects Valid from Command Active	5	25	ns
$t_{IDD}$	Propagation Delay for $IRQ/DRQ/DACK$	5	25	ns

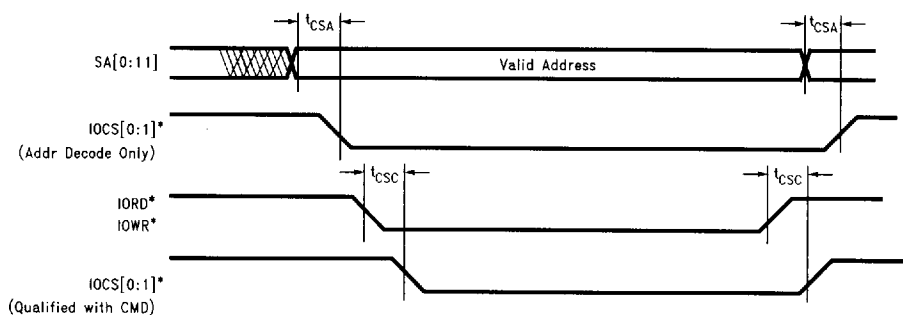
# Timing Diagrams

## (1) Timings for ISA Read/Write Cycle



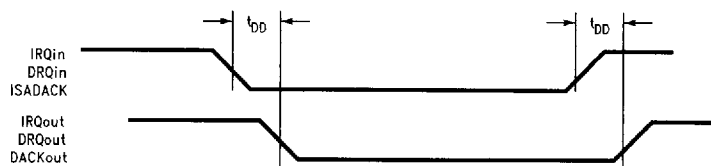
TL/D/12315-3

## (2) Decode Delay for Chipselect Generation



TL/D/12315-4

## (3) Propagation Delay for IRQ/DRQ/DACK



TL/D/12315-5

## INTRODUCTION

The NM95MS14 is a single-chip solution for the ISA Plug 'n Play (PnP) specification. It implements the complete state machine and the necessary logic for supporting configurable Interrupts and DMA channels on the ISA bus for one logical device. Apart from providing "Plug 'n Play" capability, it has built-in EEPROM that eliminates external EEPROM. This device is available in a space saving 48-pin Thin Quad Flat Pack (TQFP) package.

## Functional Description

NM95MS14 has two modes of operation, viz, "DMA mode" and "Extended Interrupt mode". These modes are programmed using the mode select (MS) bits in one of the

configuration registers (Refer to the User's guide for detailed information). Each of these modes are discussed below.

## DMA Mode

In the DMA mode, support is provided for

- One on-board DMA request that is switchable to any two DMA channels on the ISA bus.
- Two on-board interrupt request lines switchable to any six IRQ lines on the ISA bus.
- Two programmable I/O chip selects for on-board logic.

Figure 1 shows a Block Diagram of NM95MS14 configured for DMA Mode.

## Block Diagrams (Continued)

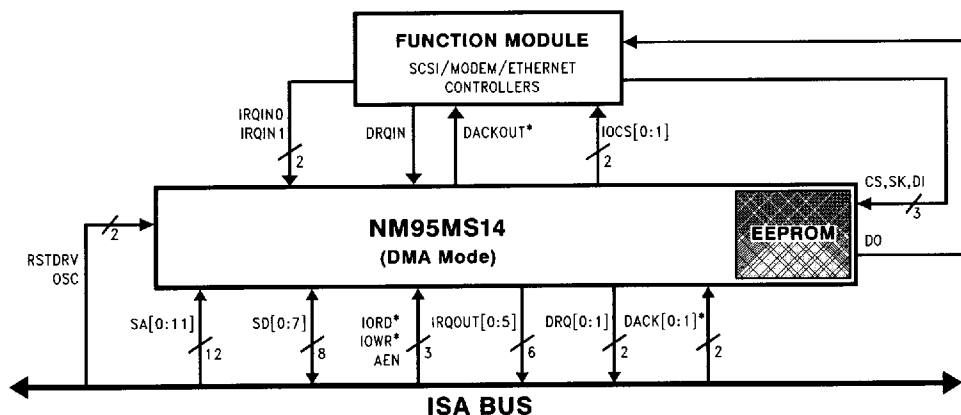


FIGURE 1

TL/D/12315-6

## Extended Interrupt Mode

In the Ext. Int mode, support is provided for:

- Two on-board interrupt request lines switchable to any eight IRQ lines on the ISA bus.
- Four programmable I/O chip selects for on-board logic.
- ISA address SA12 and SA13 are also included for extended decode.

Figure 2 shows a Block Diagram of NM95MS14 configured for Extended Interrupt Mode.

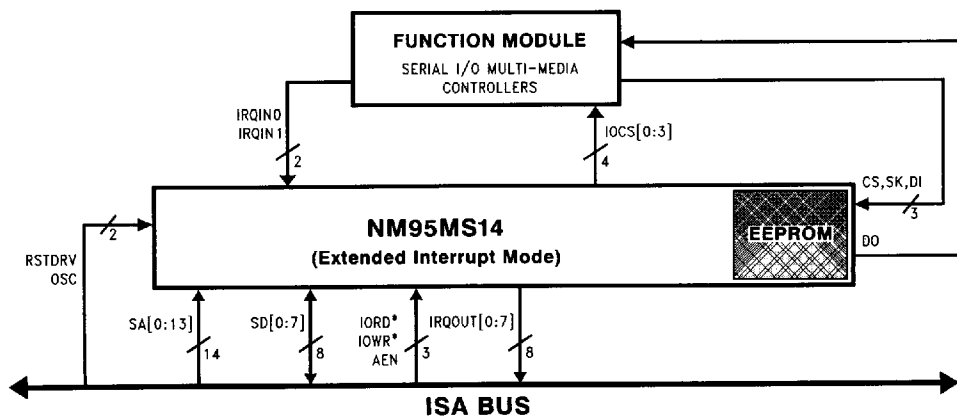


FIGURE 2

TL/D/12315-7

### Chipselect Generation

Individual I/O chipselect can be generated in the following two ways:

A) Address Decode only

B) Address Decode qualified by Command (IORD\*, IOWR\*).

"Address Decode only" provision enables to generate the IOCS16\* signal (directly from the chipselect) early enough to meet the ISA specifications during 16-bit transfers.

### On-Chip EEPROM

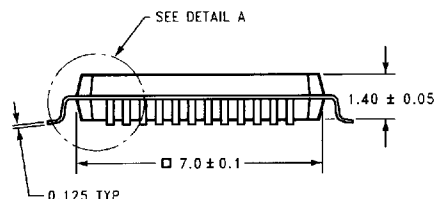
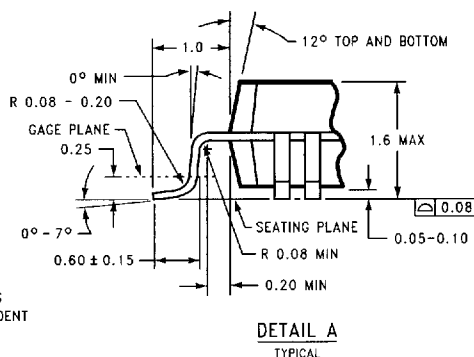
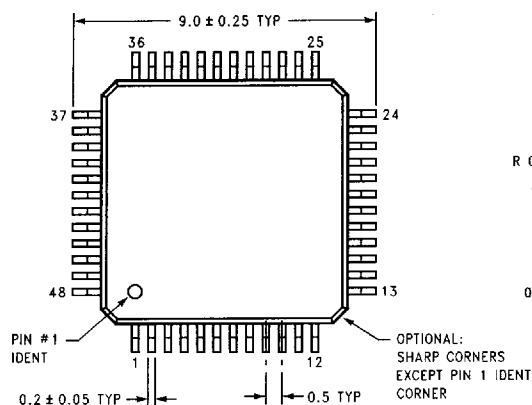
NM95MS14 has 6k of EEPROM on chip. All the Plug 'n Play resource data structure for the logical device is stored in this EEPROM. Of the 6k bits, 4k bits are available for the logical device's external usage. The logical device can access the EEPROM through a microwire port, which is essentially a 4-wire serial bus. The pins CS, SK, DI & DO follow the exact timing as the standard microwire bus and are compatible to the NM93Cxx family of EEPROMs.

### EEPROM Programming

The entire 6k bits of EEPROM can be programmed through the ISA bus. The EEPROM can be programmed by putting the device (NM95MS14) in the Config. state (as defined in the PnP standard). Under this state 4 registers at address 0xF0-0xF3 are accessible to program the EEPROM. The data to be programmed is loaded in register at address 0xF3 and 0xF2 (LSB and MSB respectively). The address to be programmed is loaded in register at address 0xF1. The Ninth bit of address for 6k bits of memory is provided through the register at address 0xF0. Both read write are possible. The actual operation does not begin until Go Ahead (GA) bit is set. Programming a word takes approximately 10 ms. The status of the operation can be polled by the Status bit. This bit is set when the operation is in progress and will be reset when complete. The register at address 0xF0 is the STATUS and COMMAND register. This is the handshake register in programming the EEPROM and is explained below in a tabular format.

STATUS and COMMAND register	0xF0	Bit[1:0]	- OP Code bits	10 - Read operation 01 - Write operation	
		Bit[2]	GA(Go ahead bits)		
			If set to 1 the programming will continue.		
		Bit[3]	- Status/Busy bit	"1" is busy, "0" is done.	
		Bit[6:4]	- Reserved, should be 0.		
		Bit[7]	- It provides A8 of the address. A[0:7] is provided by 0xF1 reg.		
Address Register	0xF1	Address Register [A0–A7]			
Data Register	0xF2	Data Byte [MSB]			
Data Register	0xF3	Data Byte [LSB]			

### Physical Dimensions millimeters



VBH48A (REV C)

**TQFP Package (S)**  
**Package Number VBH48A**  
**Order Number NM95MS14S**

## LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.
- 48547

49547



**National Semiconductor Corporation**  
2900 Semiconductor Drive  
P.O. Box 58090  
Santa Clara, CA 95052-8090  
Tel: 1(800) 272-9959  
TWX: (910) 339-9240

**National Semiconductor GmbH**  
Livry-Gargan-Str. 10  
D-82256 Fürstenfeldbruck  
Germany  
Tel: (81-41) 35-0  
Telex: 527649  
Fax: (81-41) 35-1

**National Semiconductor  
Japan Ltd.**  
Sumitomo Chemical  
Engineering Center  
Bldg. 7F  
1-7-1, Nakase, Mihama-Ku  
Chiba-City,  
Ciba Prefecture 261  
Tel: (043) 299-2300  
Fax: (043) 299-2500

**National Semiconductor**  
**Hong Kong Ltd.**  
13th Floor, Straight Block,  
Ocean Centre, 5 Canton Rd.  
Tsimshatsui, Kowloon  
Hong Kong  
Tel: (852) 2737-1600  
Fax: (852) 2736-9960

**National Semiconductores  
Do Brazil Ltda.**  
Rue Deputado Lacorda Franco  
120-3A  
Sao Paulo-SP  
Brazil 05418-000  
Tel: (55-11) 212-5066  
Telex: 391-1131931 NSBR BR  
Fax: (55-11) 212-1181

**National Semiconductor  
(Australia) Pty, Ltd.**  
Building 16  
Business Park Drive  
Monash Business Park  
Nottingham, Melbourne  
Victoria 3168 Australia  
Tel: (3) 558-9999  
Fax: (3) 558-9998