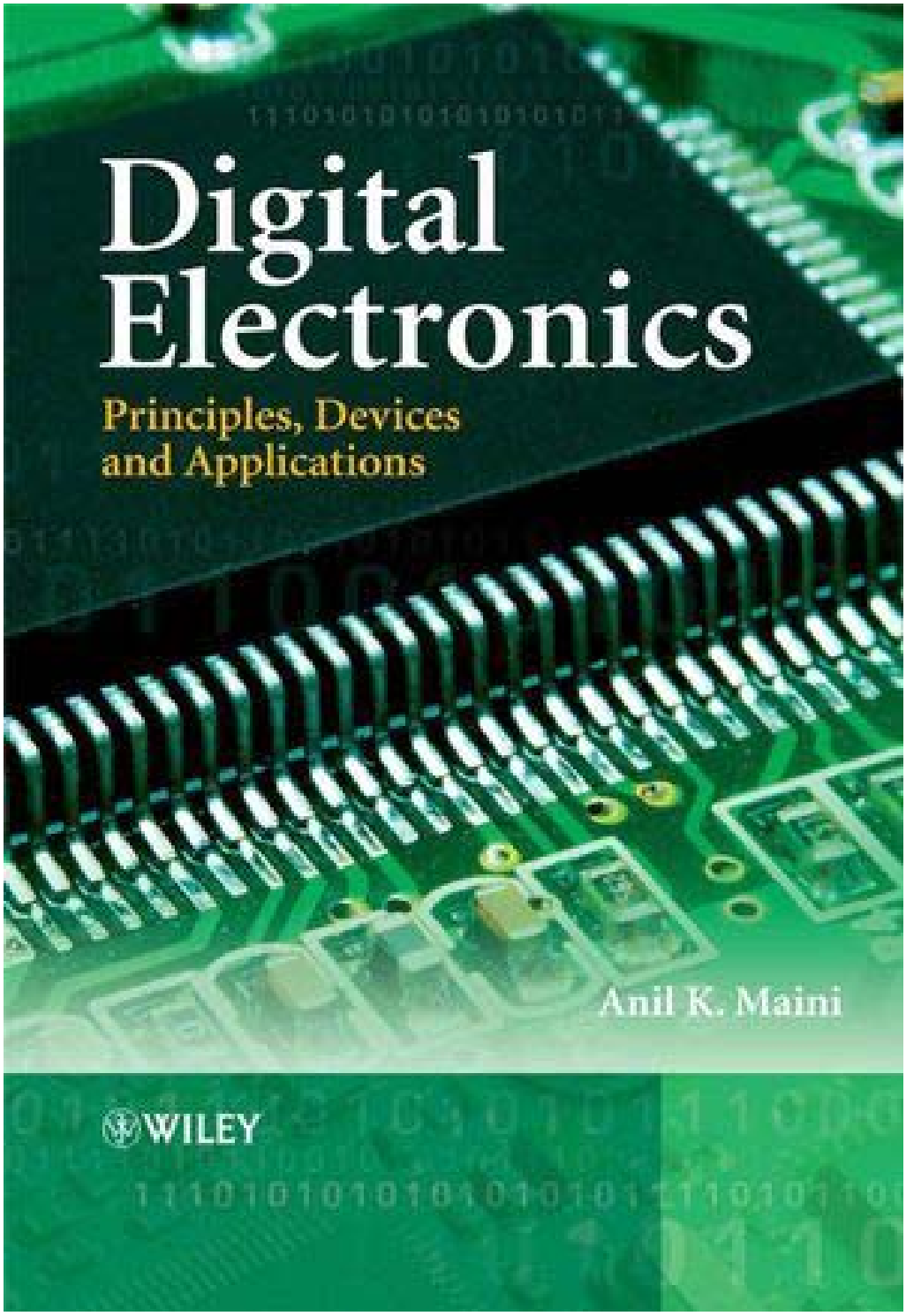
Companion Website of the book
DIGITAL ELECTRONICS: PRINCIPLES, DEVICES AND APPLICATIONS



Application Relevant Information on DIGITAL INTEGRATED CIRCUITS

The companion website contains application relevant information on different categories of digital integrated circuits discussed in detail in the text. The information is presented under the following headings.

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1. Numerical index of digital integrated circuits of TTL family

Table C.1 lists the numerical index of the digital integrated circuits belonging to the TTL family. The devices covered include logic gates and related devices, arithmetic circuits, multiplexers, de-multiplexers, encoders and decoders, flip flops and counters and registers. (TTL family is discussed in detail in chapter-5, logic gates in chapter-4, arithmetic circuits in chapter-7, multiplexers, demultiplexers, encoders and decoders in chapter 8, flip flops in chapter 10 and counters and registers in chapter-11 of the book).

Table C.1

Numerical index of Digital Integrated Circuits

Type No.	Function
7400	Quad 2-input NAND gate
7401	Quad 2-input NAND gate (open collector)
7402	Quad 2-input NOR gate
7403	Quad 2-input NAND gate (open collector)
7404	Hex Inverter
7405	Hex Inverter (open collector)
7408	Quad 2-input AND gate
7409	Quad 2-input AND gate (open collector)
7410	Triple 3-input NAND gate
74107	Dual JK Flip Flop with CLEAR
74109	Dual JK Positive Edge Triggered Flip Flop with PRESET and CLEAR
7411	Triple 3-input AND gate
74112	Dual JK Negative Edge Triggered Flip Flop with PRESET and CLEAR
74113	Dual JK Negative Edge Triggered Flip Flop with PRESET
74114	Dual JK Negative Edge Triggered Flip Flop with PRESET and CLEAR
7412	Triple 3-input NAND gate (open collector)
74121	Monostable Multivibrator
74122	Retriggerable Monostable Multivibrator
74123	Dual Retriggerable Monostable Multivibrator
74125	Quad tristate Non-inverting buffer (LOW Enable)
74126	Quad tristate Non-inverting buffer (HIGH Enable)
7413	Dual 4-input Schmitt NAND gate
74132	Quad 2-input Schmitt trigger NAND gate
74133	13-input NAND gate
74136	Quad 2-input EX-OR gate (open collector)
74138	1-of-8 decoder/demultiplexer
74139	Dual 1-of-4 decoder/demultiplexer
7414	Hex Schmitt trigger Inverter
74145	1-of-10 decoder/driver (open collector)
74147	10-line-to 4-line priority encoder

Table C.1 (contd.)

Type No.	Function
74148	8-line-to 3-line priority encoder
74150	16-input Multiplexer
74151	8-input multiplexer
74152	8-input multiplexer
74153	Dual 4-input multiplexer
74154	4-of-16 decoder/demultiplexer
74155	Dual 1-of-4 decoder/demultiplexer
74156	Dual 1-of-4 decoder/demultiplexer (open collector)
74157	Quad 2-input non-inverting multiplexer
74158	Quad 2-input inverting multiplexer
74160	BCD Decade Counter with Asynchronous CLEAR
74161	4-Bit Binary Counter with Asynchronous CLEAR
74162	BCD Decade Counter with Synchronous CLEAR
74163	4-Bit Binary Counter with Synchronous CLEAR
74164	8-bit Shift Register (Serial-in/Parallel-out)
74165	8-bit shift register (Parallel-in/Serial-out)
74166	8-bit Shift Register (Parallel-in/Serial-out)
74174	Hex D-type Flip Flop with CLEAR
74175	Quad Edgr Triggered D-type Flip Flop with CLEAR
74178	4-bit Parallel Access Shift Register
7418	Dual 4-input NAND gate
74181	4-Bit ALU and Function Generator
74182	Look Ahead Carry Generator
74183	Dual Carry Save Full Adder
7419	Hex Schmitt trigger inverter
74190	Presettable BCD-Decade UP/DOWN Counter
74191	Presettable 4-Bit Binary UP/DOWN Counter
74192	Presettable BCD-Decade UP/DOWN Counter
74193	Presettable 4-Bit Binary UP/DOWN Counter
74194	4-bit Right/Left Universal Shift Register
74198	8-bit universal shift register (Parallel-in/Parallel-out Bidirectional)
74199	8-bit universal shift register (Parallel-in/Parallel-out bidirectional)
7420	Dual 4-input NAND gate
7421	Dual 4-input AND gate
7422	Dual 4-input NAND gate (open collector)

Table C.1 (contd.)

Type No.	Function
74221	Dual Monostable Multivibrator
74240	Octal tristate Inverting Bus/Line driver
74241	Octal tristate Bus/Line driver
74242	Quad tristate Inverting Bus Transceiver
74243	Quad tristate Non-inverting Bus Transceiver
74244	Quad tristate Non-inverting Driver
74245	Quad tristate Non-inverting Bus Transceiver
74247	BCD-to-7 segment decoder/driver (open collector)
74248	BCD-to-7 segment decoder/driver with Pull-ups
74251	8-input 3-state multiplexer
74253	Dual 4-input 3-state multiplexer
74256	Dual 4-bit addressable latch
74256	Dual 4-bit Addressable Latch
74257	Quad 2-input 3-state non-inverting multiplexer
74258	Quad 2-input 3-state inverting multiplexer
74259	8-bit addressable latch
74259	8-bit Addressable Latch
74266	Quad 2-input Exclusive-NOR gate (open collector)
7427	Triple 3-input NOR gate
74273	Octal D-type Flip Flop with Master RESET
74279	Quad SET/RESET Latch
74283	4-Bit Full Binary Adder
74290	Decade Counter
74293	4-Bit Binary Counter
74298	Dual 2-input multiplexer with output latches
7430	8-input NAND gate
7432	Quad 2-input OR gate
74348	8-line-to 3-line priority encoder (3-state)
74353	Dual 4-input multiplexer
74365	Hex tristate Non-inverting Buffer with Common Enable
74366	Hex tristate Inverting Buffer with Common Enable
74367	Hex tristate Non-inverting Buffer
74368	Hex tristate Inverting buffer
74373	Octal Transparent Latch (3-state)
74374	Octal D-type Flip flop (3-state)

Table C.1 (contd.)

Type No.	Function
74377	Octal D-type Flip Flop with common ENABLE
74378	Hex D-type Flip Flop with ENABLE
74379	4-Bit D-type Flip Flop with ENABLE
74386	Quad 2-input EX-OR gate
74390	Dual Decade Counter
74393	Dual 4-Bit Binary Counter
74398	Quad 2-input multiplexer with output register
74399	Quad 2-input multiplexer with output register
7442	1-of-10 decoder
74465	Octal tristate Non-inverting Buffer
7451	Dual 2-wide 2-input 3-input AND-OR-INVERT gate
74533	Octal Transparent Latch (3-state)
74534	Octal D-type Flip Flop (3-state)
7454	4-wide AND-OR-INVERT gate
74540	Octal tristate Inverting Buffer/Line Driver
74541	Octal tristate Non-inverting Buffer/Line Driver
7455	2-wide 4-input AND-OR-INVERT gate
74573	Octal D-type Latch (3-state)
74574	Octal D-type Flip Flop (3-state)
74640	Octal tristate Inverting Bus Transceiver
74641	Octal tristate Non-inverting Bus Transceiver (Open collector)
74645	Octal tristate Non-inverting Bus Transceiver
7473	Dual JK Negative Edge Triggered Flip flop with CLEAR
7474	Dual D-type Positive Edge Triggered Flip Flop with PRESET and CLEAR
7475	4-Bit D-type Latch
7476	Dual JK flip flop with PRESET and CLEAR
7478	Dual JK flip flop with PRESET and CLEAR
7483	4-Bit Full Adder
7485	4-Bit Magnitude Comparator
7486	Quad 2-input EX-OR gate
74885	8-bit Magnitude Comparator
7490	Decade Counter
7491	8-bit Shift Register (Serial-in/Serial-out)
7493	4-bit Binary Counter

2. Functional index of digital integrated circuits of TTL family

Tables C.2 to C.6 list the functional indices of the digital integrated circuits of the TTL family for logic gates and related devices, arithmetic circuits, multiplexers and de-multiplexers, flip flops, counters and registers respectively. (TTL family is discussed in detail in chapter-5, logic gates in chapter-4, arithmetic circuits in chapter-7, multiplexers, demultiplexers, encoders and decoders in chapter 8, flip flops in chapter 10 and counters and registers in chapter-11 of the book).

Table C.2

Logic Gates belonging to the TTL Family

Type Number	Function
7400	Quad 2-input NAND gate
7401	Quad 2-input NAND gate (open collector)
7402	Quad 2-input NOR gate
7403	Quad 2-input NAND gate (open collector)
7404	Hex Inverter
7405	Hex Inverter (open collector)
7408	Quad 2-input AND gate
7409	Quad 2-input AND gate (open collector)
7410	Triple 3-input NAND gate
7411	Triple 3-input AND gate
7412	Triple 3-input NAND gate (open collector)
7413	Dual 4-input Schmitt NAND gate
7414	Hex Schmitt trigger Inverter
7418	Dual 4-input NAND gate
7419	Hex Schmitt trigger inverter
7420	Dual 4-input NAND gate
7421	Dual 4-input AND gate
7422	Dual 4-input NAND gate (open collector)
7427	Triple 3-input NOR gate
7430	8-input NAND gate
7432	Quad 2-input OR gate
7451	Dual 2-wide 2-input 3-input AND-OR-INVERT gate
7454	4-wide AND-OR-INVERT gate
7455	2-wide 4-input AND-OR-INVERT gate
7486	Quad 2-input EX-OR gate
74125	Quad tristate Non-inverting buffer (LOW Enable)
74126	Quad tristate Non-inverting buffer (HIGH Enable)
74132	Quad 2-input Schmitt trigger NAND gate

Table C.2 (contd.)

Type Number	Function
74133	13-input NAND gate
74136	Quad 2-input EX-OR gate (open collector)
74240	Octal tristate Inverting Bus/Line driver
74241	Octal tristate Bus/Line driver
74242	Quad tristate Inverting Bus Transceiver
74243	Quad tristate Non-inverting Bus Transceiver
74244	Quad tristate Non-inverting Driver
74245	Quad tristate Non-inverting Bus Transceiver
74266	Quad 2-input Exclusive-NOR gate (open collector)
74365	Hex tristate Non-inverting Buffer with Common Enable
74366	Hex tristate Inverting Buffer with Common Enable
74367	Hex tristate Non-inverting Buffer
74368	Hex tristate Inverting buffer
74386	Quad 2-input EX-OR gate
74465	Octal tristate Non-inverting Buffer
74540	Octal tristate Inverting Buffer/Line Driver
74541	Octal tristate Non-inverting Buffer/Line Driver
74640	Octal tristate Inverting Bus Transceiver
74641	Octal tristate Non-inverting Bus Transceiver (Open collector)
74645	Octal tristate Non-inverting Bus Transceiver

Table C.3
Arithmetic Circuits belonging to TTL family

Type Number	Function
7483	4-Bit Full Adder
7485	4-Bit Magnitude Comparator
74181	4-Bit ALU and Function Generator
74182	Look Ahead Carry Generator
74183	Dual Carry Save Full Adder
74283	4-Bit Full Binary Adder
74885	8-bit Magnitude Comparator

Table C.4
Multiplexers and Demultiplexer Circuits belonging to TTL family

Type Number	Function
7442	1-of-10 decoder
74138	1-of-8 decoder/demultiplexer
74139	Dual 1-of-4 decoder/demultiplexer
74145	1-of-10 decoder/driver (open collector)
74147	10-line-to 4-line priority encoder
74148	8-line-to 3-line priority encoder
74150	16-input Multiplexer
74151	8-input multiplexer
74152	8-input multiplexer
74153	Dual 4-input multiplexer
74154	4-of-16 decoder/demultiplexer
74155	Dual 1-of-4 decoder/demultiplexer
74156	Dual 1-of-4 decoder/demultiplexer (open collector)
74157	Quad 2-input non-inverting multiplexer
74158	Quad 2-input inverting multiplexer
74247	BCD-to-7 segment decoder/driver (open collector)
74248	BCD-to-7 segment decoder/driver with Pull-ups
74251	8-input 3-state multiplexer
74253	Dual 4-input 3-state multiplexer
74256	Dual 4-bit addressable latch
74257	Quad 2-input non-inverting 3-state multiplexer
74258	Quad 2-input 3-state inverting multiplexer
74259	8-bit addressable latch
74298	Dual 2-input multiplexer with output latches
74348	8-line-to 3-line priority encoder (3-state)
74353	Dual 4-input multiplexer
74398	Quad 2-input multiplexer with output register
74399	Quad 2-input multiplexer with output register

Table C.5
Flip flops belonging to the TTL family

Type Number	Function
7473	Dual JK Negative Edge Triggered Flip flop with CLEAR
7474	Dual D-type Positive Edge Triggered Flip Flop with PRESET and CLEAR
7475	4-Bit D-type Latch
7476	Dual JK flip flop with PRESET and CLEAR
7478	Dual JK flip flop with PRESET and CLEAR
74107	Dual JK Flip Flop with CLEAR
74109	Dual JK Positive Edge Triggered Flip Flop with PRESET and CLEAR
74112	Dual JK Negative Edge Triggered Flip Flop with PRESET and CLEAR
74113	Dual JK Negative Edge Triggered Flip Flop with PRESET
74114	Dual JK Negative Edge Triggered Flip Flop with PRESET and CLEAR
74121	Monostable Multivibrator
74122	Retriggerable Monostable Multivibrator
74123	Dual Retriggerable Monostable Multivibrator
74174	Hex D-type Flip Flop with CLEAR
74175	Quad Edgr Triggered D-type Flip Flop with CLEAR
74221	Dual Monostable Multivibrator
74256	Dual 4-bit Addressable Latch
74259	8-bit Addressable Latch
74273	Octal D-type Flip Flop with Master RESET
74279	Quad SET/RESET Latch
74373	Octal Transparent Latch (3-state)
74374	Octal D-type Flip flop (3-state)
74377	Octal D-type Flip Flop with common ENABLE
74378	Hex D-type Flip Flop with ENABLE
74379	4-Bit D-type Flip Flop with ENABLE
74533	Octal Transparent Latch (3-state)
74534	Octal D-type Flip Flop (3-state)
74573	Octal D-type Latch (3-state)
74574	Octal D-type Flip Flop (3-state)

Table C.6
Counters and Registers belonging to TTL family

Type Number	Function
7490	Decade Counter
7491	8-bit Shift Register (Serial-in/Serial-out)
7493	4-bit Binary Counter
74160	BCD Decade Counter with Asynchronous CLEAR
74161	4-Bit Binary Counter with Asynchronous CLEAR
74162	BCD Decade Counter with Synchronous CLEAR
74163	4-Bit Binary Counter with Synchronous CLEAR
74164	8-bit Shift Register (Serial-in/Parallel-out)
74165	8-bit shift register (Parallel-in/Serial-out)
74166	8-bit Shift Register (Parallel-in/Serial-out)
74178	4-bit Parallel Access Shift Register
74190	Presettable BCD-Decade UP/DOWN Counter
74191	Presettable 4-Bit Binary UP/DOWN Counter
74192	Presettable BCD-Decade UP/DOWN Counter
74193	Presettable 4-Bit Binary UP/DOWN Counter
74194	4-bit Right/Left Universal Shift Register
74198	8-bit universal shift register (Parallel-in/Parallel-out Bidirectional)
74199	8-bit universal shift register (Parallel-in/Parallel-out Bidirectional)
74290	Decade Counter
74293	4-Bit Binary Counter
74390	Dual Decade Counter
74393	Dual 4-Bit Binary Counter

3. Numerical index of digital integrated circuits of CMOS logic family

Table C.7 lists the numerical index of the digital integrated circuits of the CMOS family. The devices covered include logic gates and related devices, arithmetic circuits, multiplexers, de-multiplexers, encoders and decoders, flip flops and counters and registers. (CMOS family is discussed in detail in chapter-5, logic gates in chapter-4, arithmetic circuits in chapter-7, multiplexers, demultiplexers, encoders and decoders in chapter 8, flip flops in chapter 10 and counters and registers in chapter-11 of the book).

Table C.7
Numerical index of Digital Integrated Circuits of the CMOS logic family

Type Number	Function
4001B	Quad 2-input NOR gate
4002B	Dual 4-input NOR gate
4008	4-Bit Binary Full Adder
40097B	Tristate Hex Non-inverting Buffer
40098B	Tristate Inverting Buffer
4011B	Quad 2-input NAND gate
4012B	Dual 4-input NAND gate
4013	Dual D-type Flip Flop
4014 B	8-Bit Static Shift Register (Synchronous Parallel or Serial-in/Serial-out)
40147	10-line to 4-line BCD priority encoder
4015 B	Dual 4-bit Static Shift Register (Serial-in/Parallel-out)
40160 B	Decade Counter with Asynchronous Clear
40161 B	Binary Counter with Asynchronous Clear
40162 B	Decade Counter
40163 B	Binary Counter
4017 B	5-stage Johnson Counter
40174	Hex D-type Flip Flop
40175	Quad D-type Flip Flop
40181	4-Bit Arithmetic Logic Unit
40182	Look Ahead Carry Generator
4019	Quad 2-input multiplexer
40192B	Presettable BCD UP/DOWN Counter
40193 B	Presettable Binary UP/DOWN Counter
4021 B	8-bit Static Shift Register (Asynchronous Parallel-in or Synchronous Serial-in/Serial-out)
4023B	Triple3-input NAND gate
4025B	Triple 3-input NOR gate
4027	Dual JK Flip Flop
4028	1-of-10 decoder
4029 B	Synchronous Presettable 4-bit UP/DOWN Counter

Table C.7 (Contd.)

Type Number	Function
4030B	Quad 2-input EX-OR gate
4035 B	4-bit Universal Shift Register
4042	Quad D-type Latch
4044	Quad R/S Latch with 3-state output
4047	Low Power Monostable/Astable Multivibrator
4049B	Hex Inverting Buffer
4050B	Hex Non-inverting Buffer
4069UB	Hex Inverter
4070B	Quad 2-input EX-OR gate
4071B	Quad 2-input OR gate
4076	Quad D-type Flip Flop with 3-state output
4081B	Quad 2-input AND gate
4086B	4-wide 2-input AND-OR-INVERT gate
4093B	Quad 2-input Schmitt NAND
4510 B	Presettable UP/DOWN BCD Counter
4511	BCD to 7-segment latch/decoder/driver
4511	BCD-to-7 segment Latch/Decoder/Driver
4512	8-input 3-state multiplexer
4514	1-of-16 decoder/demultiplexer with input latch
4515	1-of-16 decoder/demultiplexer with input latch
4518 B	Dual 4-bit Decade Counter
4520B	Dual 4-bit binary counter
4522 B	4-bit BCD Programmable divide-by-N counter
4527	BCD Rate Multiplier
4528	Dual Retriggerable Resettable Monostable Multivibrator
4532	8-line to 3-line priority encoder
4539	Dual 4-input multiplexer
4543	BCD to 7-segmnt latch/decoder/driver for LCD displays
4543	BCD-to-7 segment Latch/Decoder/Driver for LCD
4555	Dual 1-of-4 decoder/demultiplexers
4556	Dual 1-of-4 decoder/demultiplexers
4585	4-Bit Magnitude Comparator
4722 B	Programmable Counter/Timer
4723	Dual 4-bit addressable latch
4723	Dual 4-bit Addressable Latch
4724	8-bit addressable latch
4724	8-bit Addressable Latch
4731 B	Quad 64-bit Static Shift Register

4. Functional index of digital integrated circuits of CMOS logic family

Table C.8 to Table C.12 list the functional indices of the digital integrated circuits of the CMOS family for Logic gates and related devices, arithmetic circuits, multiplexers and demultiplexers, Flip Flops and Counters and Registers respectively. (CMOS family is discussed in detail in chapter-5, logic gates in chapter-4, arithmetic circuits in chapter-7, multiplexers, demultiplexers, encoders and decoders in chapter 8, flip flops in chapter 10 and counters and registers in chapter-11 of the book)

Table C.8
Logic Gates belonging to CMOS family

Type Number	Function
4001B	Quad 2-input NOR gate
4002B	Dual 4-input NOR gate
4011B	Quad 2-input NAND gate
4012B	Dual 4-input NAND gate
4023B	Triple3-input NAND gate
4025B	Triple 3-input NOR gate
4030B	Quad 2-input EX-OR gate
4049B	Hex Inverting Buffer
4050B	Hex Non-inverting Buffer
40097B	Tristate Hex Non-inverting Buffer
40098B	Tristate Inverting Buffer
4069UB	Hex Inverter
4070B	Quad 2-input EX-OR gate
4071B	Quad 2-input OR gate
4081B	Quad 2-input AND gate
4086B	4-wide 2-input AND-OR-INVERT gate
4093B	Quad 2-input Schmitt NAND

Table C.9
Arithmetic circuits belonging to CMOS family

Type Number	Function
4008	4-Bit Binary Full Adder
4527	BCD Rate Multiplier
4585	4-Bit Magnitude Comparator
40181	4-Bit Arithmetic Logic Unit
40182	Look Ahead Carry Generator

Table C.10
Multiplexer and Demultiplexer Circuits belonging to CMOS family

Type Number	Function
4019	Quad 2-input multiplexer
4028	1-of-10 decoder
40147	10-line to 4-line BCD priority encoder
4511	BCD to 7-segment latch/decoder/driver
4512	8-input 3-state multiplexer
4514	1-of-16 decoder/demultiplexer with input latch
4515	1-of-16 decoder/demultiplexer with input latch
4532	8-line to 3-line priority encoder
4539	Dual 4-input multiplexer
4543	BCD to 7-segmnt latch/decoder/driver for LCD displays
4555	Dual 1-of-4 decoder/demultiplexers
4556	Dual 1-of-4 decoder/demultiplexers
4723	Dual 4-bit addressable latch
4724	8-bit addressable latch

Table C.11
Flip Flops belonging to CMOS family

Type Number	Function
4013	Dual D-type Flip Flop
4027	Dual JK Flip Flop
4042	Quad D-type Latch
4044	Quad R/S Latch with 3-state output
4047	Low Power Monostable/Astable Multivibrator
4076	Quad D-type Flip Flop with 3-state output
40174	Hex D-type Flip Flop
40175	Quad D-type Flip Flop
4511	BCD-to-7 segment Latch/Decoder/Driver
4528	Dual Retriggerable Resettable Monostable Multivibrator
4543	BCD-to-7 segment Latch/Decoder/Driver for LCD
4723	Dual 4-bit Addressable Latch
4724	8-bit Addressable Latch

Table C.12
Counters and Registers belonging to the CMOS family

Type Number	Function
4014 B	8-Bit Static Shift Register (Synchronous Parallel or Serial-in/Serial-out)
4015 B	Dual 4-bit Static Shift Register (Serial-in/Parallel-out)
4017 B	5-stage Johnson Counter
4021 B	8-bit Static Shift Register (Asynchronous Parallel-in or Synchronous Serial-in/Serial-out)
4029 B	Synchronous Presettable 4-bit UP/DOWN Counter
4035 B	4-bit Universal Shift Register
40160 B	Decade Counter with Asynchronous Clear
40161 B	Binary Counter with Asynchronous Clear
40162 B	Decade Counter
40163 B	Binary Counter
40192B	Presettable BCD UP/DOWN Counter
40193 B	Presettable Binary UP/DOWN Counter
4510 B	Presettable UP/DOWN BCD Counter
4518 B	Dual 4-bit Decade Counter
4520B	Dual 4-bit binary counter
4522 B	4-bit BCD Programmable divide-by-N counter
4722 B	Programmable Counter/Timer
4731 B	Quad 64-bit Static Shift Register

5. Numerical index of digital integrated circuits of ECL family

Table C.13 lists the numerical index of the digital integrated circuits of the ECL family. The devices covered include logic gates and related devices, arithmetic circuits, multiplexers, de-multiplexers, encoders and decoders, flip flops and counters and registers. (ECL family is discussed in detail in chapter-5, logic gates in chapter-4, arithmetic circuits in chapter-7, multiplexers, demultiplexers, encoders and decoders in chapter 8, flip flops in chapter 10 and counters and registers in chapter-11 of the book).

Table C.13
Numerical Index of Digital Integrated circuits of ECL family

Type Number	Function
10100	Quad 2-input NOR gate with strobe
10101	Quad 2-input OR/NOR gate
10102	Quad 2-input NOR gate
10103	Quad 2-input OR gate
10104	Quad 2-input AND gate
10113	Quad 2-inpu EX-OR gate
10114	Triple Line Receiver
10115	Quad Line Receiver
10116	Triple Line Receiver
10117	Dual 2-wide 2-3 input OR-AND/OR-AND-INVERT gate
10118	Dual 2-wide 3-input OR-AND gate
10123	Triple 4-3-3 Input Bus Driver
10128	Dual Bus Driver
10129	Quad Bus Driver
10130	Quad D-type Latch
10131	Dual D-type Master/Slave Flip Flop
10132	Dual 2-input multiplexer with latch and common reset
10133	Quad D-type Latch (Negative transition)
10134	Dual multiplexer with latch
10135	Dual JK Master/Slave Flip Flop
10136	Universal Hexadecimal Counter
10137	Universal Decade Counter
10141	4-Bit Universal Shift Register
10153	Quad Latch (Positive transition)
10154	Binary Counter (4-bit)
10158	Quad 2-input multiplexer (non-inverting)
10159	Quad 2-input multiplexer (inverting)
10161	3-to-8 line decoder (LOW)

Table C.13 (contd.)

10162	**3-to-8 line decoder (HIGH)**
10164	**8-line multiplexer**
10165	**8-input priority encoder**
10168	**Quad D-type Latch**
10171	**Dual 2-to-4 line decoder (LOW)**
10172	**Dual 2-to-4 line decoder (HIGH)**
10173	**Quad 2-input multiplexer/latch**
10174	**Dual 4-to-1 multiplexer**
10175	**Quint Latch**
10176	**Hex D-type Master/Slave Flip Flop**
10178	**4-bit binary counter**
10179	**Look Ahead Carry Block**
10180	**Dual High Speed 2-Bit Adder/Subtractor**
10181	**4-Bit Arithmetic Logic Unit/Function Generator**
10182	**4-Bit Arithmetic Logic Unit/Function Generator**
10183	**4×2 Multiplier**
10188	**Hex Buffer with Enable**
10192	**Quad Bus Driver**
10194	**Dual Simultaneous Transceiver**
10195	**Hex Buffer with Invert/ Non-invert control**
10198	**Monostable multivibrator**
10231	**High Speed Dual D-type M/S Flip Flop**
1658	**Voltage Controlled Multivibrator**
1666	**Dual Clocked RS Flip Flop**
1668	**Dual Clocked Latch**
1670	**D-type Master/slave Flip Flop**

6. Functional index of digital integrated circuits of ECL family

Table C.14 to Table C.19 list the functional indices of the digital integrated circuits of the ECL family for Logic gates and related devices, arithmetic circuits, multiplexers and demultiplexers, Flip Flops and Counters and Registers respectively. (ECL family is discussed in detail in chapter-5, logic gates in chapter-4, arithmetic circuits in chapter-7, multiplexers, demultiplexers, encoders and decoders in chapter 8, flip flops in chapter 10 and counters and registers in chapter-11 of the book).

Table C.14
Logic Gates belonging to ECL family

Type Number	Function
10100	Quad 2-input NOR gate with strobe
10101	Quad 2-input OR/NOR gate
10102	Quad 2-input NOR gate
10103	Quad 2-input OR gate
10104	Quad 2-input AND gate
10113	Quad 2-inpu EX-OR gate
10114	Triple Line Receiver
10115	Quad Line Receiver
10116	Triple Line Receiver
10117	Dual 2-wide 2-3 input OR-AND/OR-AND-INVERT gate
10118	Dual 2-wide 3-input OR-AND gate
10123	Triple 4-3-3 Input Bus Driver
10128	Dual Bus Driver
10129	Quad Bus Driver
10188	Hex Buffer with Enable
10192	Quad Bus Driver
10194	Dual Simultaneous Transceiver
10195	Hex Buffer with Invert/Non-invert control

Table C.15
Arithmetic Circuits belonging to ECL family

Type Number	Function
10179	Look Ahead Carry Block
10180	Dual High Speed 2-Bit Adder/Subtractor
10181	4-Bit Arithmetic Logic Unit/Function Generator
10182	4-Bit Arithmetic Logic Unit/Function Generator
10183	4×2 Multiplier

Table C.16
Multiplexers and Demultiplexer Circuits belonging to ECL family

Type Number	Function
10132	Dual 2-input multiplexer with latch and common reset
10134	Dual multiplexer with latch
10158	Quad 2-input multiplexer (non-inverting)
10159	Quad 2-input multiplexer (inverting)
10161	3-to-8 line decoder (LOW)
10162	3-to-8 line decoder (HIGH)
10164	8-line multiplexer/latch
10165	8-input priority encoder
10171	Dual 2-to-4 line decoder (LOW)
10172	Dual 2-to-4 line decoder (HIGH)
10173	Quad 2-input multiplexer/latch
10174	Dual 4-to-1 multiplexer

Table C.17
Flip Flops belonging to ECL family

Type Number	Function
MC10130	Quad D-type Latch
MC10131	Dual D-type Master/Slave Flip Flop
MC10133	Quad D-type Latch (Negative transition)
MC10135	Dual JK Master/Slave Flip Flop
MC10153	Quad Latch (Positive transition)
MC10168	Quad D-type Latch
MC10175	Quint Latch
MC10176	Hex D-type Master/Slave Flip Flop
MC10198	Monostable multivibrator
MC10231	High Speed Dual D-type M/S Flip Flop
MC1666	Dual Clocked RS Flip Flop
MC1668	Dual Clocked Latch
MC1670	D-type Master/slave Flip Flop
MC1658	Voltage Controlled Multivibrator

Table C.18
Counters and Registers belonging to ECL family

Type Number	Function
MC 10136	Universal Hexadecimal Counter
MC 10137	Universal Decade Counter
MC 10141	4-Bit Universal Shift Register
MC 10154	Binary Counter (4-bit)
MC 10178	4-bit binary counter

7. Popular A/D converters

Table C.19 enlists some of the popular A/D converter type numbers along with their salient features. (A/D converters are discussed in detail in chapter 12 of the book).

Table C.19
Popular A/D Type Numbers

Type Number	Description	Manufacturer
AD 570	8-bit A/D converter	Analog Devices
AD 571	10-bit A/D converter	Analog Devices
AD 572	12-bit successive approximation type A/D converter	Analog Devices
AD 573	10-bit A/D converter	Analog Devices
AD 574A	12-bit A/D converter	Analog Devices
AD 575	10-bit A/D converter with serial output	Analog Devices
AD 578	12-bit A/D converter	Analog Devices
AD 579	10-bit A/D converter	Analog Devices
AD 670	Low cost 8-it A/D converter	Analog Devices
AD 673	8-it A/D converter	Analog Devices
AD 674A	12-it A/D converter	Analog Devices
AD 678	12-bit 200 KSPS complete sampling A/D converter	Analog Devices
AD 679	14-bit 100 KSPS complete sampling A/D converter	Analog Devices
AD 770	200 MSPS wide band 8-bit A/D converter	Analog Devices
AD 779	14-bit 100 KSPS complete sampling A/D converter	Analog Devices
AD 1170	High resolution integrating A/D converter	Analog Devices
AD 1376	High speed 16-bit A/D converter	Analog Devices
AD 1377	High speed 16-bit A/D converter	Analog Devices
AD 1380	Low cost 16-bit sampling A/D converter	Analog Devices
AD 1678	12-bit 200 KSPS sampling A/D converter	Analog Devices
AD 1679	14-bit 100 KSPS sampling A/D converter	Analog Devices
AD 1779	14-bit 100 KSPS sampling A/D converter	Analog Devices
AD 1871	24-bit 96 kHz multi-bit sigma-delta A/D converter	Analog Devices
AD 5200/ 5210 series	12-bit successive approximation high accuracy A/D converter	Analog Devices
AD 7572	LC^2MOS high speed 12-bit A/D converter	Analog Devices
AD 7575	LC^2MOS 5 μs 8-bit A/D converter with Track/Hold	Analog Devices
AD 7576	LC^2MOS 10 μs μP-compatible 8-bit A/D converter	Analog Devices

Table C.19 (contd.)

Type Number	Description	Manufacturer
AD 7578	CMOS 12-bit successive approximation A/D converter	Analog Devices
AD 7579/ 7580	LC^2MOS 10-bit sampling A/D converter	Analog Devices
AD 7582	CMOS 12-bit successive approximation A/D converter	Analog Devices
AD 7672	LC^2MOS high speed 12-bit A/D converter	Analog Devices
AD 7772	LC^2MOS serial output 12-bit A/D converter	Analog Devices
AD 7820/7821	LC^2MOS High speed µP-compatible 8-bit A/D converters with Track/Hold function	Analog Devices
AD 7824/7828	LC^2MOS High speed 4 (7824) and 8 (7828) channel 8-bit A/D converters	Analog Devices
AD 7870	LC^2MOS 12-bit 100 kHz sampling A/D converter	Analog Devices
AD 7871/ 7872	LC^2MOS 14-bit sampling A/D converters	Analog Devices
AD 7878	LC^2MOS 12-bit 100 kHz sampling A/D converter with DSP interface	Analog Devices
AD 9000	High speed 6-bit A/D converter	Analog Devices
AD 9002	High speed 8-bit A/D converter	Analog Devices
AD 9003	12-bit 1 MHz A/D converter	Analog Devices
AD 9005	12-bit 10MSPS A/D converter	Analog Devices
AD 9006/9016	High speed 6-bit A/D converters	Analog Devices
AD 9011	8-bit 10MSPS A/D converter	Analog Devices
AD 9012	High speed 8-bit TTL A/D converter	Analog Devices
AD 9028/9038	High speed 8-bit A/D converters	Analog Devices
AD 9048	8-bit video A/D converter	Analog Devices
AD-ADC 71/72	High resolution 16-bit A/D converters	Analog Devices
AD-ADC80	12-bit successive approximation A/D converter	Analog Devices
AD-ADC84/85, AD 5240	Fast 12-bit A/D converters	Analog Devices
ADC 1130/1131	14-bit high speed A/D converter	Analog Devices
ADC 1140	Low cost 16-bit A/D converter	Analog Devices
CAV 1040	10-bit video A/D converter	Analog Devices
CAV 1205	12-bit 5 MHz Eurocard A/D converter	Analog Devices
CAV 1220	12-bit video A/D converter	Analog Devices
HAS 1201	12-bit 1 MHz A/D converter	Analog Devices
HAS 1204	Ultra high speed 12-bit A/D converter	Analog Devices
HAS 1409	14-bit 125KHz A/D converter	Analog Devices
MOD 1205	12-bit video A/D converter	Analog Devices

Table C.19 (Contd.)

Type Number	Description	Manufacturer
ADC 700	16-bit µP-compatible A/D converter	Burr Brown
ADC 774	12-bit µP-compatible A/D converter	Burr Brown
ADS 574	12-bit µP-compatible sampling CMOS A/D converter	Burr Brown
ADS 602	12-bit 1MHz sampling A/D converter	Burr Brown
ADS 774	12-bit µP-compatible sampling CMOS A/D converter	Burr Brown
ADS 7800	12-bit 3 µs sampling A/D converter	Burr Brown
ADS 7803	Auto calibrating 4-channel 12-bit A/D converter	Burr Brown
DSP 101/ 102	DSP compatible sampling single channel (DSP 101)/ Dual channel (DSP 102) A/D converters	Burr Brown
ADC 601	12-bit 900 ns A/D converter	Burr Brown
ADC 603	12-bit 10 MHz sampling A/D converter	Burr Brown
ADC 614	14-bit 5.12 MHz sampling A/D converter	Burr Brown
ADC 701/ SHC 702	16-bit 512 kHz sampling A/D converter	Burr Brown
ADC 7802	Auto calibrating 4-channel 12-bit A/D converter	Burr Brown
PCM 78P	16-bit audio A/D converter	Burr Brown
ADC-908	CMOS µP-compatible fast A/D converter	PMI
ADC 910	10-bit µP-compatible high speed A/D converter	PMI
ADC 912	CMOS µP-compatible 12-bit A/D converter	PMI
ADC 922	12-bit 3 µs A/D converter	PMI
PM 0820	CMOS 8-bit high speed A/D converter	PMI
PM 7572	12-bit high speed BiCMOS A/D converter	PMI
PM 7574	CMOS µP-compatible 8-bit A/D converter	PMI
ADC 0800	8-bit A/D converter	National
ADC 0801/ 0802/0803/ 0804/0805	8-bit µP-compatible A/D converter	National
ADC 0808/0809	8-bit µP-compatible A/D converter with 8-channel multiplexer	National
ADC 0816/0817	8-bit µP-compatible A/D converter with 16-channel multiplexer	National
ADC 0833	8-bit serial input/output A/D converter with 4-channel multiplexer	National
ADC 1001/1021	10-bit µP-compatible A/D converter	National
ADC 1080/1280	12-bit successive approximation A/D converter	National
ADC1210/ 1211	12-bit CMOS A/D converter	National

Table C.19 (Contd.)

Type Number	Description	Manufacturer
TLC 0820	8-bit high speed A/D converter	TI
TLC 7135	4 ½ digit A/D converter	TI
TLC 0808/0809	Low power CMOS 8-bit A/D converter with 8-channel multiplexer	TI
TLC 5501	Ultra high speed 6-bit A/D converter	TI
TLC 5502-5	Ultra high speed 8-bit A/D converter	TI
TLC 5503-2	Low power ultra high speed video A/D converter	TI
TLC 5503-5	Low power ultra high speed 8-bit flash A/D converter	TI
ICL 7106	High performance low power A/D converter of dual slope integrating type with LCD interface for DPM and DVM applications	INTERSIL
ICL 7107	High performance low power A/D converter of dual slope integrating type with LED interface for DPM and DVM applications	INTERSIL

8. Popular D/A converters

Table C.20 enlist some of the popular D/A converter type numbers along with their salient features. (D/A converters are discussed in detail in chapter-12 of the book).

Table C.20
Popular D/A Type Numbers

Type Number	Description	Manufacturer
AD 390	Quad 12-bit μP-compatible D/A converter	Analog Devices
AD 392	Quad 12-bit D/A converter	Analog Devices
AD 394/395	Quad 14-bit μP-compatible multiplying D/A converter	Analog Devices
AD 396	Quad 14-bit μP-compatible multiplying D/A converter	Analog Devices
AD 561	Low cost monolithic 10-bit D/A converter	Analog Devices
AD 562/563	12-bit D/A converters	Analog Devices
AD 565A/566A	High speed 12-bit monolithic D/A converters	Analog Devices
AD 568	Ultra-high speed 12-bit monolithic D/A converter	Analog Devices
AD 569	16-bit Monotonic voltage output D/A converter	Analog Devices
AD 662	12-bit single supply 12-bit voltage output D/A converter	Analog Devices
AD 664	Quad 12-bit D/A converter	Analog Devices
AD 667	12-bit μP-compatible D/A converter	Analog Devices
AD 668	12-bit ultra-high speed multiplying D/A converter	Analog Devices
AD 1145	Low cost 16-bit D/A converter	Analog Devices
AD 1147/1148	16-bit μP-compatible D/A converter	Analog Devices
AD 7111	CMOS logarithmic D/A converter	Analog Devices
AD 7224	LC^2MOS 8-bit D/A converter with output amplifier	Analog Devices
AD 7225	LC^2MOS quad 8-bit D/A converter with separate Reference inputs	Analog Devices
AD 7226	LC^2MOS quad 8-bit D/A converter	Analog Devices
AD 7228	LC^2MOS octal 8-bit D/A converter	Analog Devices
AD 7237/47	LC^2MOS dual 12-bit D/A converter	Analog Devices
AD 7245/48	LC^2MOS 12-bit D/A converter	Analog Devices
AD 7524	CMOS 8-bit buffered multiplying D/A converter	Analog Devices
AD 7528	CMOS dual 8-bit buffered multiplying D/A converter	Analog Devices
AD 7533	CMOS low cost 10-bit multiplying D/A converter	Analog Devices
AD 7534	LC^2MOS μP-compatible 14-bit D/A converter	Analog Devices
AD 7535	LC^2MOS μP-compatible 14-bit D/A converter	Analog Devices
AD 7536	LC^2MOS μP-compatible 14-bit D/A converter	Analog Devices
AD 7537	LC^2MOS μP-compatible (8+4) loading dual 12-bit D/A converter	Analog Devices
AD 7538	LC^2MOS μP-compatible 14-bit D/A converter	Analog Devices

Table C.20 (Contd.)

Type Number	Description	Manufacturer
AD 7541A	12-bit CMOS multiplying D/A converter	Analog Devices
AD 7542	12-bit CMOS μP-compatible D/A converter	Analog Devices
AD 7543	12-bit CMOS serial-input D/A converter	Analog Devices
AD 7545	12-bit CMOS buffered multiplying D/A converter	Analog Devices
AD 7547	LC^2MOS parallel loading dual 12-bit D/A converter	Analog Devices
AD 7548	LC^2MOS μP-compatible 12-bit D/A converter	Analog Devices
AD 7549	LC^2MOS dual 12-bit μP-compatible D/A converter	Analog Devices
AD 7840	LC^2MOS complete 14-bit D/A converter	Analog Devices
AD7845	LC^2MOS complete 12-bit multiplying D/A converter	Analog Devices
AD 7846	LC^2MOS 16-bit voltage output D/A converter	Analog Devices
AD 9700	Monolithic video D/A converter	Analog Devices
AD 9701	250 MHz video D/A converter	Analog Devices
AD 9768	Ultra-high speed D/A converter	Analog Devices
AD-DAC71/72	16-bit D/A converter	Analog Devices
AD-DAC80/ DAC85/DAC87	Complete low cost monolithic D/A converter	Analog Devices
DAC 667	12-bit μP-compatible D/A converter	Burr Brown
DAC 700/01/02/03	16-bit D/A converters	Burr Brown
DAC 707/08/09	16-bit μP-compatible D/A converter	Burr Brown
DAC 813	12-bit μP-compatible D/A converter	Burr Brown
DAC 2814	Dual 12-bit D/A converter with serial interface	Burr Brown
DAC 2815	Dual 12-bit D/A converter with 8-bit port interface	Burr Brown
DAC 4814	Quad 12-bit D/A converter with serial interface	Burr Brown
DAC 4815	Quad 12-bit D/A converter with 8-bit port interface	Burr Brown
DAC 7800/01/02	Dual monolithic CMOS multiplying D/A converters	Burr Brown
DAC 65	12-bit high speed D/A converter	Burr Brown
DAC 650	12-bit 500 MHz D/A converter	Burr Brown
DSP 201/202	DSP compatible single/dual D/A converter	Burr Brown
DAC 800/0801/0802	8-bit D/A converters	National
DAC 806/0807/0808	8-bit D/A converters	National
DAC 830/0831/0832	8-bit μP-compatible double buffered D/A converters	National
DAC 000/01/02 /06//07/08	μP-compatible double buffered D/A converters	National
DAC 1020/21/22	10-bit binary multiplying D/A converters	National
DAC 1200/01	12-bit D/A converters	National
DAC 1208/09/10	12-bit μP-compatible double buffered D/A converters	National
DAC 1218/19	12-bit binary multiplying D/A converters	National

Table C.20 (Contd.)

Type Number	Description	Manufacturer
DAC 1220/21/22	12-bit binary multiplying D/A converters	National
DAC 1230/31/32	12-bit μP-compatible double buffered D/A converters	National
DAC 1280/80A	12-bit D/A converters	National
DAC 1285/85A (DAC 85/87)	12-bit D/A converters	National
AD 7520/7530	10-bit multiplying D/A converters	National
AD 7521/7531	12-bit multiplying D/A converters	National
TLC 7524	8-bit multiplying D/A converter	TI
TLC 7528	Dual 8-bit multiplying D/A converter	TI
TL 5601	Ultra-high speed 6-bit D/A converter	TI
TL 5602	Ultra-high speed video D/A converter	TI
DAC-08 series	8-bit high speed multiplying D/A converters	Signetics
MC 1508-8/1408-8/1408-7	8-bit multiplying D/A converters	Signetics
NE 5007/5008 /SE 5008	8-bit high speed multiplying D/A converters	Signetics
NE/SE 5009	8-bit high speed multiplying D/A converters	Signetics
NE/SE 5018	8-bit μP-compatible D/A converters	Signetics
NE/SE 5118	8-bit μP-compatible D/A converters (current output)	Signetics
NE/SE 5119	8-bit μP-compatible D/A converters (current output)	Signetics
NE 5020	10-bit μP-compatible D/A converter	Signetics
DAC-08	8-bit high speed multiplying D/A converter	Raytheon
DAC-10	10-bit high speed multiplying D/A converter	Raytheon
DAC 4881	High performance μP-compatible 12-bit D/A converter	Raytheon
DAC 4888	8-bit μP-compatible D/A converter	Raytheon
DAC 6012	12-bit high speed multiplying D/A converter	Raytheon
DAC 8565	12-bit high speed multiplying D/A converter	Raytheon
DAC-01	6-bit voltage output D/A converter	PMI
DAC-02/03	10-bit voltage output D/A converters	PMI
DAC-08	8-bit high speed multiplying D/A converter	PMI
DAC-10	10-bit high speed multiplying D/A converter	PMI
DAC-20	2-digit BCD high speed multiplying D/A converter	PMI
DAC-86	Companding D/A converter	PMI
DAC-88	Companding D/A converter	PMI
DAC-89	Companding D/A converter	PMI
DAC-100	10-bit current output D/A converter	PMI

Table C.20 (Contd.)

Type Number	Description	Manufacturer
DAC-108	8-bit high speed multiplying D/A converter	PMI
DAC-312	12-bithigh speed multiplying D/A converter	PMI
DAC-400	12-bit Ultra-high speed multiplying D/A converter	PMI
DAC-888	8-bit high speed µP-compatible Multiplying D/A converter	PMI
DAC-1408	8-bit multiplying D/A converter	PMI
DAC-8012	12-bit CMOS multiplying D/A converter with memory	PMI
DAC-8043	12-bit CMOS multiplying D/A converter with serial input	PMI
DAC-8143	12-bit serial daisy-chain CMOS D/A converter	PMI
DAC-8212	Dual 12-bit buffered multiplying CMOS D/A converter	PMI
DAC-8221	Dual 12-bit buffered multiplying CMOS D/A converter	PMI
DAC-8222	Dual 12-bit double buffered multiplying CMOS D/A converter	PMI
DAC-8228/29	Dual 8-bit CMOS D/A converter with voltage output	PMI
DAC-8248	Dual 12-bit double buffered CMOS D/A converter	PMI
DAC-8408	Quad 8-bit multiplying CMOS D/A converter with memory	PMI
DAC-8412	Quad 12-bit voltage output Bi-CMOS D/A converter	PMI
DAC-8426	Quad 8-bit voltage output CMOS D/A converter with internal 10 volts reference	PMI
DAC-8800	Octal 8-bit CMOS D/A converter	PMI
PM-562	12-bit multiplying current output D/A converter	PMI
PM-6012	12-bit high speed multiplying D/A converter	PMI
PM-7224	8-bit CMOS D/A converter with voltage output	PMI
PM-7226	Quad 8-bit CMOS D/A converter with voltage output	PMI
PM-7228	Octal 8-bit D/A converter	PMI
PM-7524	8-bit CMOS buffered multiplying D/A converter	PMI
PM-7528	Dual 8-bit CMOS buffered multiplying D/A converter	PMI
PM-7533	CMOS low cost 10-bit multiplying D/A converter	PMI
PM-7541	12-bit CMOS multiplying D/A converter	PMI
PM-7542	12-bit CMOS multiplying D/A converter	PMI
PM-7543	12-bit CMOS multiplying D/A converter with serial input	PMI
PM-7545/ PM-7645	12-bit buffered multiplying CMOS D/A converter	PMI
PM-7628	Dual 8-bit buffered multiplying CMOS D/A converter	PMI

9. Popular Microprocessors

Table C.21 to C.24 enlist some of the popular 8-bit, 16-bit, 32-bit and 64-bit microprocessors respectively along with their salient features. (Microprocessors are discussed in detail in chapter-13 of the book).

Table C.21
8-bit microprocessors

Type Number	Manufacturer	Salient Features
8080	**Intel**	**Successor to Intel 8008 CPU**
8085	**Intel**	**Enhanced version of Intel 8080 CPU**
8088	**Intel**	**8 bit version of Intel 8086 CPU**
6800	**Motorola**	**Motorola's first microprocessor. Had** very similar architecture to the 8080
6809	**Motorola**	**Enhanced version of the 6800 microprocessor**
NSC800	**National Semiconductor**	8-bit CMOS CPU with the instruction set of Zilog's Z80 and the multiplexed bus of Intel's 8085
SC/MP II	**National Semiconductor**	Designed to fill the gap between four-bit CPUs (4004, 4040) and eight-bit microprocessors
1802	**RCA**	one-chip implementation of the earlier two-chip RCA 1801
2650	**Signetics**	Had a full complement of video, communications, and keyboard interface chips designed for use in video display terminals
8X300	**Signetics**	**RISC like microprocessor**
Z80	**Zilog**	**Improved version of 8080 processor**
Z180	**Zilog**	**High-integration version of Z80 processor**

Table C.22
16-bit microprocessors

Type Number	Manufacturer	Salient Features
8086	**Intel**	**First generation of 80X86 processors**
80186	**Intel**	**Mostly used as embedded processor**
80188	**Intel**	**Mostly used as embedded processor**
80286	**Intel**	**Second generation of 80X86 processors**
68000	**Motorola**	**First generation of Motorola 680X0 processors**
68010	**Motorola**	**Second generation of Motorola 680X0 processors**
68012	**Motorola**	**Second generation of Motorola 680X0 processors**
V30	**NEC**	**8086-compatible processor with 8080 emulation mode**
V50	**NEC**	**8086-compatible processor with integrated peripherals and 8080 emulation mode**
TMS9900	**TI**	Single chip version of the TI 990 microcomputer series
Z800x	**Zilog**	**16-bit microprocessor with** separate code, data and stack memory space

Table C.23
32-bit microprocessors

Type Number	Manufacturer	Salient Features
29000	AMD	Embedded RISC microprocessor
29030	AMD	Embedded RISC microprocessor
29040	AMD	High performance embedded RISC microprocessor
K5	AMD	Pentium class processor
K6	AMD	Pentium/Pentium II class processor
K6-2	AMD	Pentium II class processor, enhanced version of K6
K6-III	AMD	Pentium II class processor enhanced version of K6-2
K7	AMD	Pentium III/IV processor
SA-110 ARM		Low-power embedded strongARM microprocessor
80386	Intel	Third generation of 80x86 processors
80486	Intel	Fourth generation of 80x86 processors
Pentium	Intel	Fifth generation of 80x86 processors superscalar architecture MMX
Pentium II	Intel	Sixth generation of 80x86 processors
Celeron	Intel	Low cost version of Pentium II
Pentium III	Intel	Enhanced and faster version of Pentium II
Pentium IV	Intel	New generation of Pentium processors
Xeon	Intel	High performance version of Pentium IV
80860	Intel	Embedded 32-bit microprocessor with integrated 3D graphics
80960	Intel	Embedded 32-bit microprocessor
68020	Motorola	Third generation of 680X0 series of processors
68030	Motorola	Fourth generation of 680x0 series of processors
68040	Motorola	Fifth generation of 680x0 series of processors
68060	Motorola	Sixth generation of 680x0 series of processors
PowerPC 603	Motorola	RISC microprocessor
32016	National semiconductor	32-bit microprocessor with 16-bit data bus

Table C.24
64-bit microprocessors

Type Number	Manufacturer	Salient Features
K8	AMD	Eighth generation of X86 processors
Itanium	Intel	High performance
Core 2	Intel	
R4000	MIPS Technologies	RISC processor
R4400	MIPS Technologies	Enhanced version of R4000 RISC processor
R4600	MIPS Technologies	Enhanced version of R4400 RISC processor
R5000	MIPS Technologies	Super-scalar RISC microprocessor
R10000	MIPS Technologies	Super-scalar RISC microprocessor
UltraSparc II	Sun Microsystems	Second generation of UltraSparc processors
UltraSparcIIi	Sun Microsystems	Second generation of UltraSparc processors
UltraSparc III	Sun Microsystems	Third generation of UltraSparc processors

10. Popular microcontrollers

Table C.25-27 lists some of the popular 8-bit, 16-bit and 32-bit microcontroller type numbers along with their salient features. (Microcontrollers are discussed in detail in chapter-14 of the book).

Table C.25
8-bit microcontrollers

Type Number	Manufacturer	Salient features
80C51/87C51/ 80C31	Dallas Semiconductor and Other Manufacturers	MCS-51 architecture, CMOS technology
80C31FA/8XC 51FA/FB/FC	Dallas Semiconductor and Other Manufacturers	Same as 80C51 except for the size of ROM and RAM, which is 0K/8K/16K/32K ROM and 256 bytes RAM
80C31RA+/8X C51RA+/RB+/ RC+	Dallas Semiconductor and Other manufacturers	The same as 80C51 except for the size of ROM and RAM, which is 0K/8K/16K/32K ROM and 512 bytes RAM
8XC51RD+	Dallas Semiconductor and Other manufacturers	The same as 80C51 except for the size of ROM and RAM, which is 64K ROM and 1024 bytes RAM
80C32/8XC52/ 54/58	Dallas Semiconductor and Other Manufacturers	The same as 80C51 except for the size of ROM and RAM, which is 0K/8K/16K/32K ROM and 256 bytes RAM
89C51	ATMEL and Other Manufacturers	MCS-51 architecture, CMOS technology, 4K × 8 of in-system reprogrammable ROM, 128 × 8 internal RAM
68HC05 Family of	Freescale Semiconductor	Eight-bit M68HC05 core, a clock speed of 4 MHz, 920 bytes of on-chip RAM, 32K of ROM
68HC11 Family	Freescale Semiconductor	Fully static chip design using an eight-bit M68HC11 core, a clock speed of 5 MHz, 0/256/512/768/1024 bytes of on-chip RAM (in different variants), 0/12/20 kB of on-chip ROM or EPROM
PIC 16X84 Family	(Microchip Technology)	High-performance RISC CPU, 14-bit wide instructions, eight-bit wide data path, 1024 14 EEPROM program memory, 64 bytes of on-chip data EEPROM
XC-800 Family	Infineon	High performance microcontrollers
MCS-51	Intel	128 or 256 bytes of RAM up to 128 bytes of I/O, 512 bytes to 64kB ROM
Z8	Zilog	8-bit Harvard architecture ROM/EPROM/OTP microcontroller with on-chip SRAM
eZ8 (Encore Z8)	Zilog	Improved version of Z8 with better pipelining feature and with on-chip flash memory and SRAM

Table C.26
16-bit microcontrollers

Type Number	Manufacturer	Salient features
68HC12 Family	Freescale Semiconductor	High-performance 16-bit CPU core with 1024 bytes of RAM, 32K of flash EEPROM and 768 bytes of EEPROM
68HC16 Family	Freescale Semiconductor	16-bit enhancement of the eight-bit 68HC11 family with 8K of ROM, 4K of RAM
XC166 Family	Infineon	The same as 80C51 except for the size of ROM and RAM, which is 0K/8K/16K/32K ROM and 512 bytes RAM
PIC 24F	Microchip Technology	16-128 kB of Flash memory, 4kB/8kB data RAM
PIC 24H	Microchip Technology	12-256 kB of Flash memory, 1kB/8kB/16kB data RAM
MCS-96 family	Intel	Commonly used in Embedded systems
MCS 296 family	Intel	Improved version of MCS-96 family

Table C.27
32-bit microcontrollers

Type Number	Manufacturer	Salient features
683XX Family	Freescale Semiconductors	10K of RAM, 256K of flash, a clock speed of 33 MHz, 48 I/O lines, a 16-bit timer, a 16-channel/10-bit A/D converter and four serial communication channels
MCORE Family	Freescale Semiconductors	32K of RAM, 256K of flash, 33 MHz of clock speed, two serial communication channels, 104 I/O lines, an eight-channel A/D converter and two timers
MPC500 Family	Freescale Semiconductors	Configured around a 32-bit PowerPC core with 36K of RAM, 1024K of flash, a 66 MHz clock, three serial communication channels, 101 I/O lines, 40 channels of A/D conversion and 70 timer channels
MCFXXX Family	Freescale Semiconductors	Configured around ColdFire Version 2 core with 64K RAM, 66 MHz clock, 5 serial communication channels, including an I^2C bus and CAN support, 150 I/O lines and 4 timer channels
LPC3000 Family	Philips Semiconductors	Based on Philips' Nexperia platform, configured around an ARM926EJ core with the VFP9 floating-point coprocessor with 32K of instruction cache and 32K of data cache
TRICORETM Family	Infineon	Unified, single-core 32-bit microcontroller–DSP architecture optimized for real-time embedded systems

11. Pin connection diagrams and other relevant application information on logic gates and related devices

Figs.C.1 to C.31 give the pin connection diagram and other application relevant information of some of the popular logic gates and related devices. (Logic gates and other related devices are discussed in detail in chapter-4 of the book).

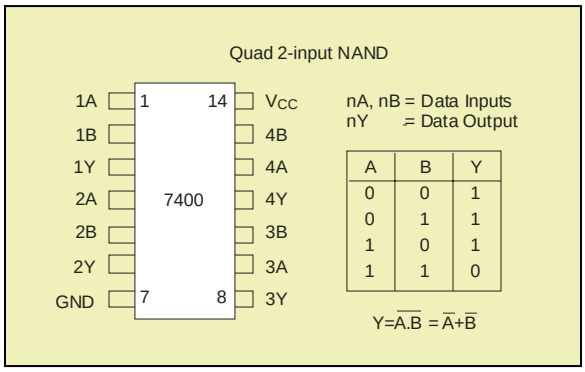


Fig.C.1

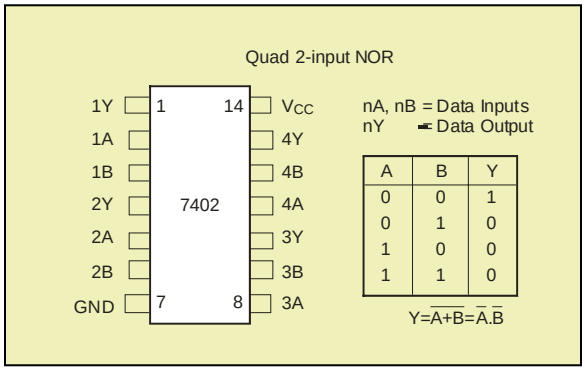


Fig.C.2

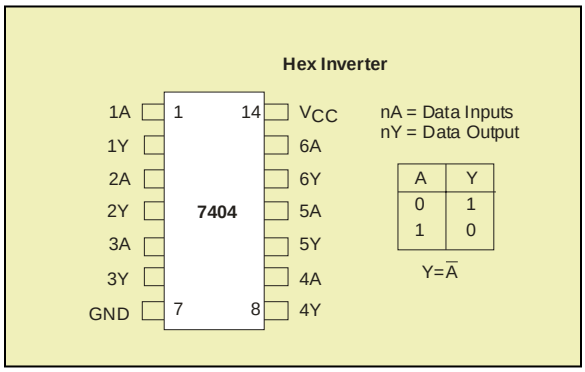


Fig.C.3

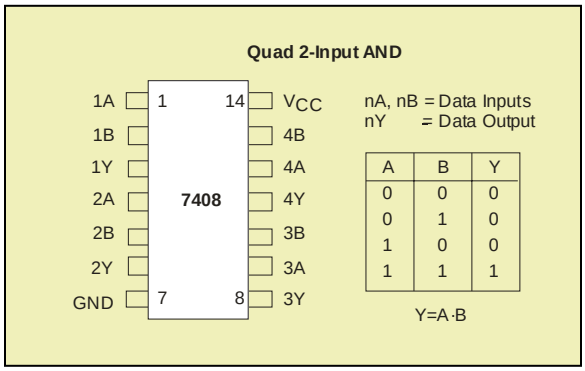


Fig.C.4

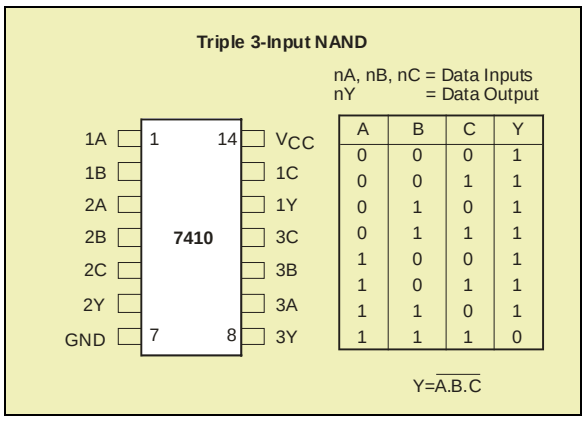


Fig.C.5

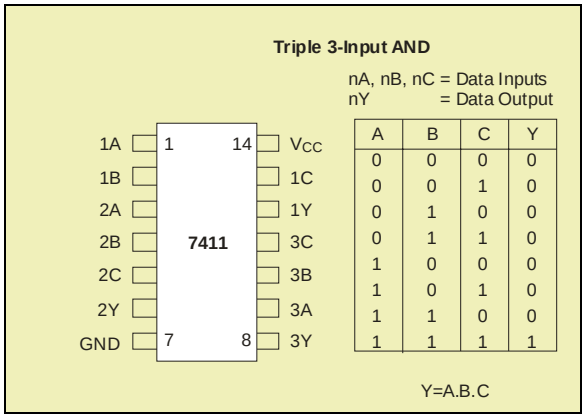


Fig.C.6

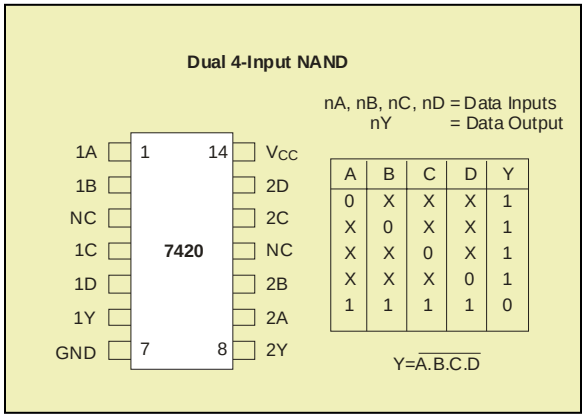


Fig.C.7

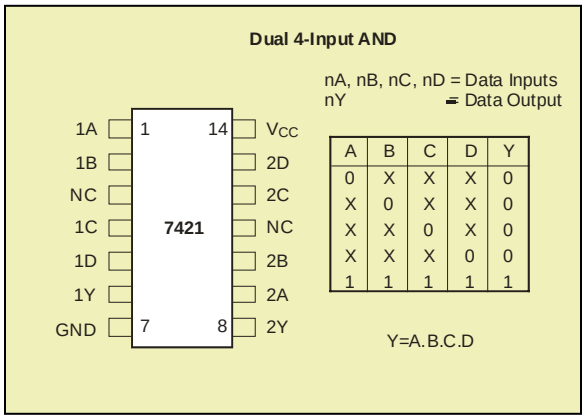


Fig.C.8

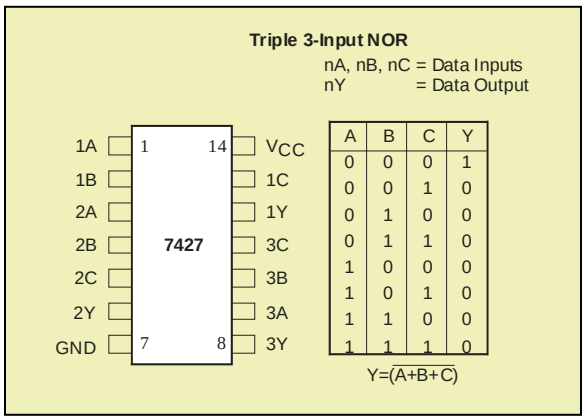
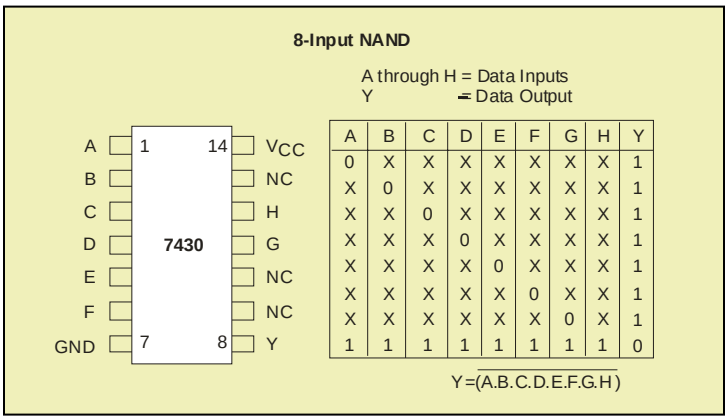
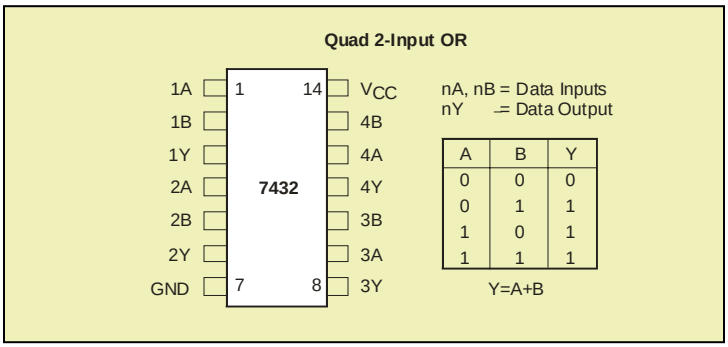


Fig.C.9



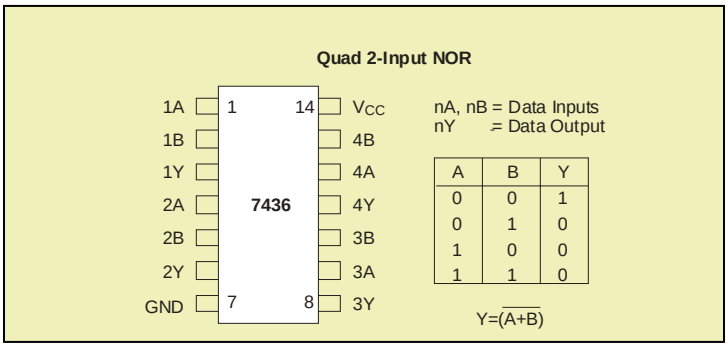
A	B	C	D	E	F	G	H	Y
0	X	X	X	X	X	X	X	1
X	0	X	X	X	X	X	X	1
X	X	0	X	X	X	X	X	1
X	X	X	0	X	X	X	X	1
X	X	X	X	0	X	X	X	1
X	X	X	X	X	0	X	X	1
X	X	X	X	X	X	0	X	1
1	1	1	1	1	1	1	1	0

Fig.C.10



A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

Fig.C.11



A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0

Fig.C.12

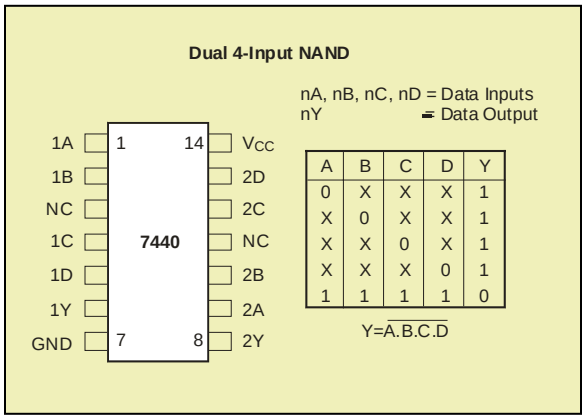


Fig.C.13

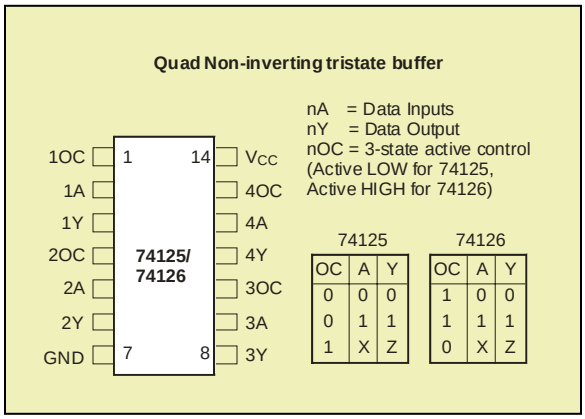


Fig.C.14

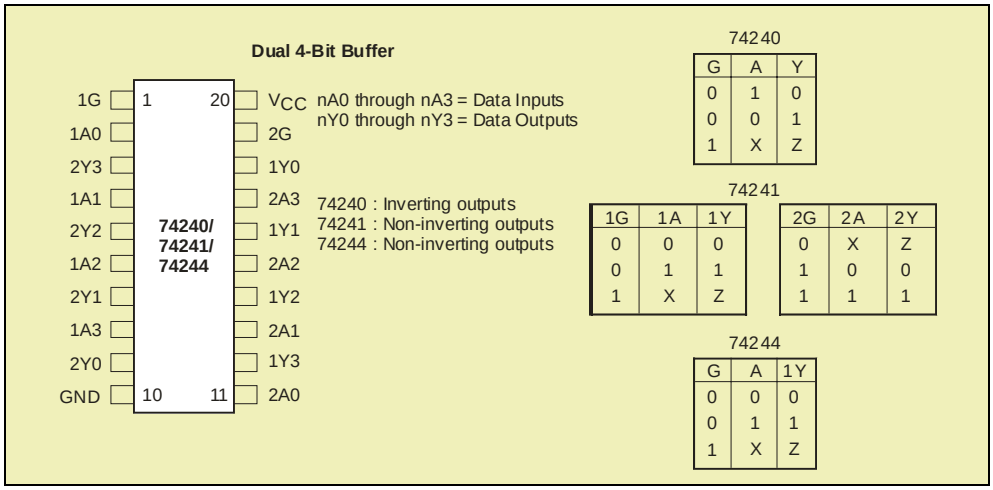


Fig.C.15

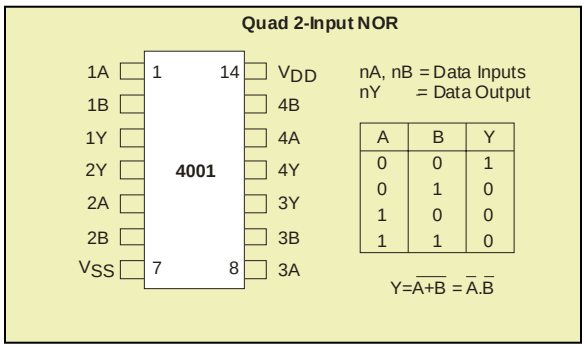


Fig.C.16

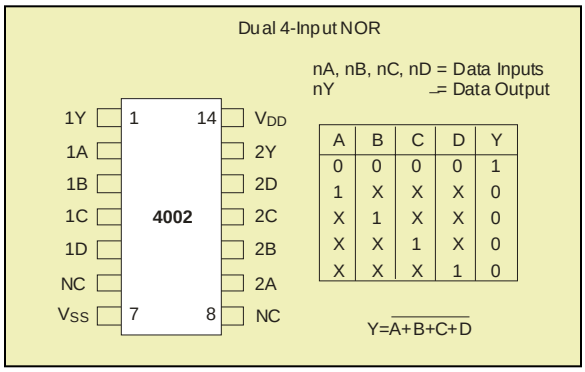


Fig.C.17

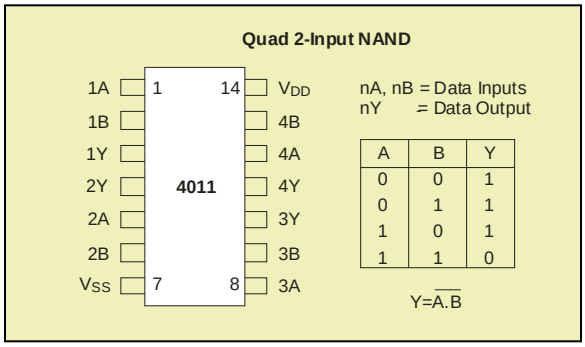


Fig.C.18

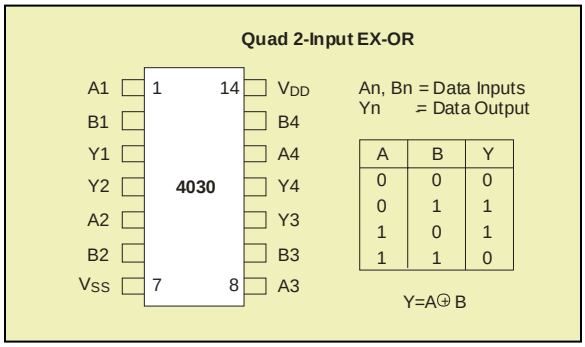


Fig.C.19

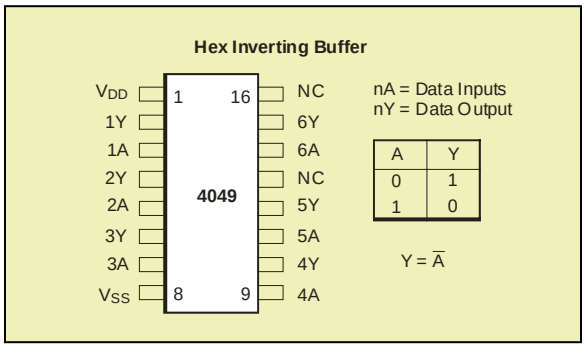


Fig.C.20

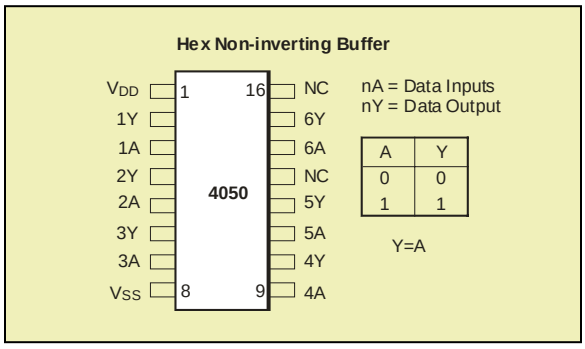


Fig.C.21

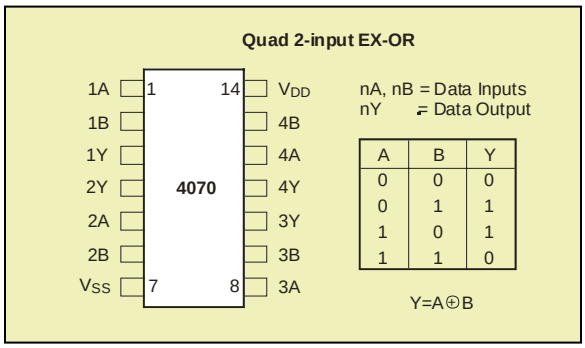


Fig.C.22

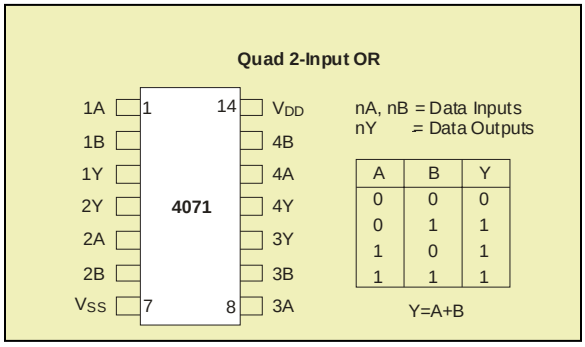


Fig.C.23

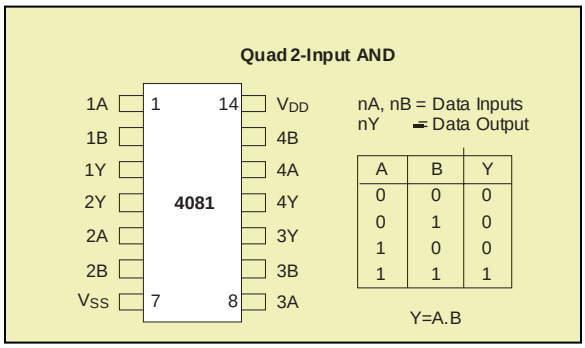


Fig.C.24

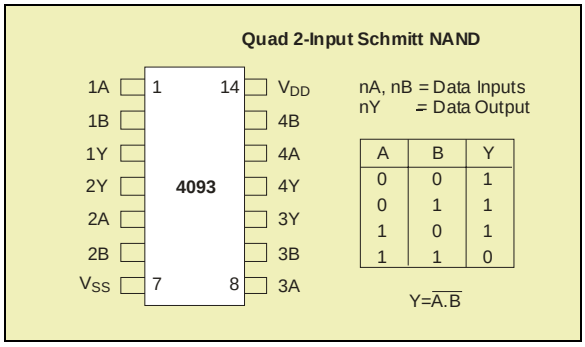


Fig.C.25

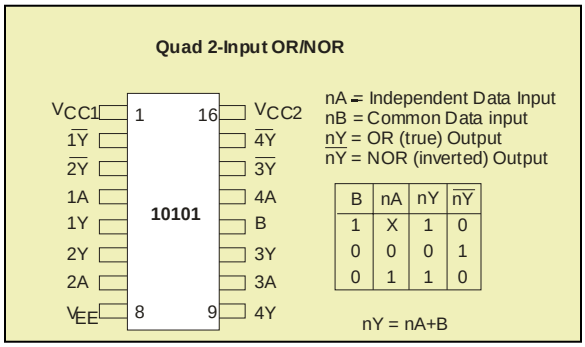


Fig.C.26

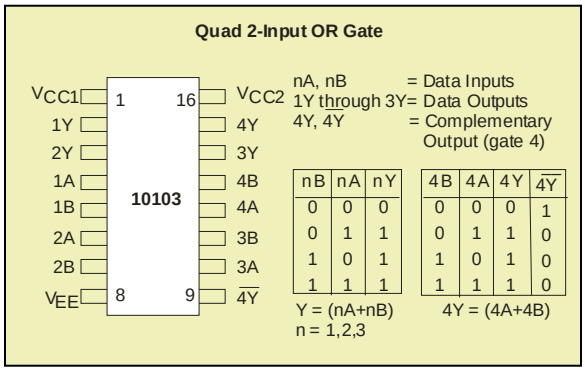


Fig.C.27

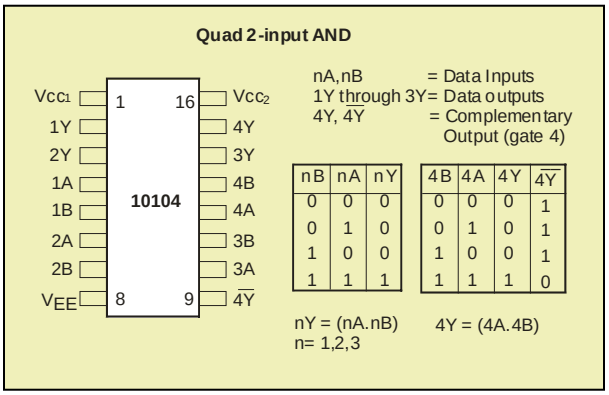


Fig.C.28

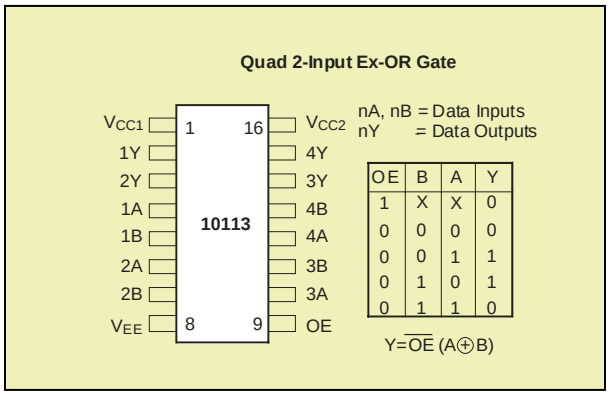


Fig.C.29

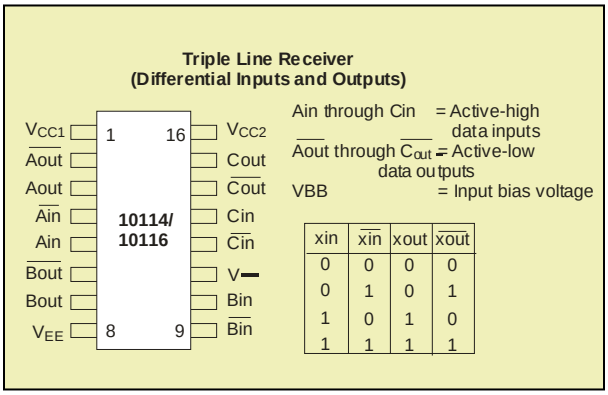


Fig.C.30

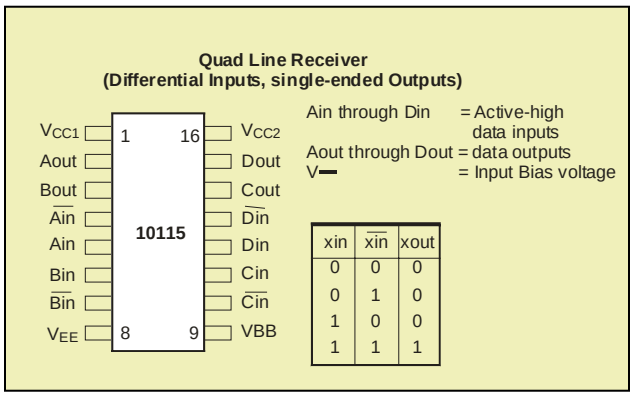
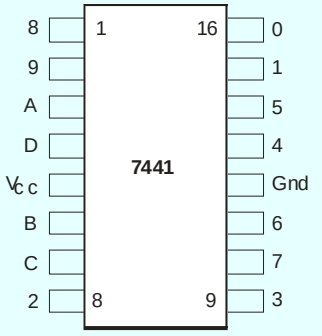

Quad Line Receiver
(Differential Inputs, single-ended Outputs)
VCC1
Aout
Bout
Ain
Ain
Bin
Bin
VEE
1
16
8
9
10115
VCC2
Dout
Cout
Din
Din
Cin
Cin
VBB
Ain through Din = Active-high data inputs
Aout through Dout = data outputs
V— = Input Bias voltage
xin | xin | xout
0 | 0 | 0
0 | 1 | 0
1 | 0 | 0
1 | 1 | 1

Fig.C.31

12. Pin connection diagrams and other relevant application information on multiplexers and de-multiplexers

Figs.C.32 to C.48 give the pin connection diagram and other application relevant information of some of the popular multiplexer and demultiplexer devices. (Multiplexers and demultiplexers are discussed in detail in chapter-8 of the book).

BCD-to-Decimal Decoder (Open Collector Outputs)

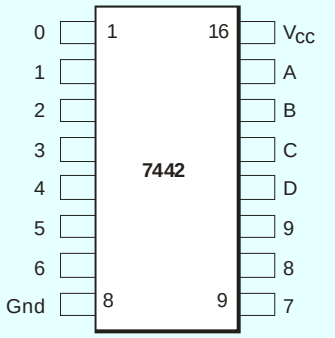


D C B A	0 1 2 3 4 5 6 7 8 9
0 0 0 0	0 1 1 1 1 1 1 1 1 1
0 0 0 1	1 0 1 1 1 1 1 1 1 1
0 0 1 0	1 1 0 1 1 1 1 1 1 1
0 0 1 1	1 1 1 0 1 1 1 1 1 1
0 1 0 0	1 1 1 1 0 1 1 1 1 1
0 1 0 1	1 1 1 1 1 0 1 1 1 1
0 1 1 0	1 1 1 1 1 1 0 1 1 1
0 1 1 1	1 1 1 1 1 1 1 0 1 1
1 0 0 0	1 1 1 1 1 1 1 1 0 1
1 0 0 1	1 1 1 1 1 1 1 1 1 0
Over range	
1 0 1 0	0 1 1 1 1 1 1 1 1 1
1 0 1 1	1 0 1 1 1 1 1 1 1 1
1 1 0 0	1 1 0 1 1 1 1 1 1 1
1 1 0 1	1 1 1 0 1 1 1 1 1 1
1 1 1 0	1 1 1 1 0 1 1 1 1 1
1 1 1 1	1 1 1 1 1 0 1 1 1 1

A through D: Data Inputs (A is LSB)
0 through 9 : Decoded Outputs (Active LOW)

Fig.C.32

BCD-to-Decimal decoder

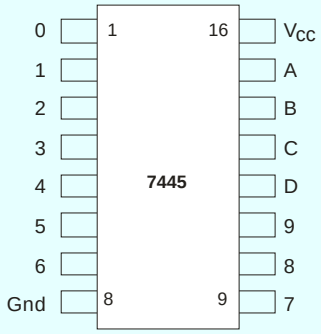


D C B A	0 1 2 3 4 5 6 7 8 9
0 0 0 0	0 1 1 1 1 1 1 1 1 1
0 0 0 1	1 0 1 1 1 1 1 1 1 1
0 0 1 0	1 1 0 1 1 1 1 1 1 1
0 0 1 1	1 1 1 0 1 1 1 1 1 1
0 1 0 0	1 1 1 1 0 1 1 1 1 1
0 1 0 1	1 1 1 1 1 0 1 1 1 1
0 1 1 0	1 1 1 1 1 1 0 1 1 1
0 1 1 1	1 1 1 1 1 1 1 0 1 1
1 0 0 0	1 1 1 1 1 1 1 1 0 1
1 0 0 1	1 1 1 1 1 1 1 1 1 0
Invalid	
1 0 1 0	1 1 1 1 1 1 1 1 1 1
1 0 1 1	1 1 1 1 1 1 1 1 1 1
1 1 0 0	1 1 1 1 1 1 1 1 1 1
1 1 0 1	1 1 1 1 1 1 1 1 1 1
1 1 1 0	1 1 1 1 1 1 1 1 1 1
1 1 1 1	1 1 1 1 1 1 1 1 1 1

A through D: Data Inputs (A is LSB)
0 through 9 : Decoded Outputs (Active LOW)

Fig.C.33

BCD-to-Decimal decoder

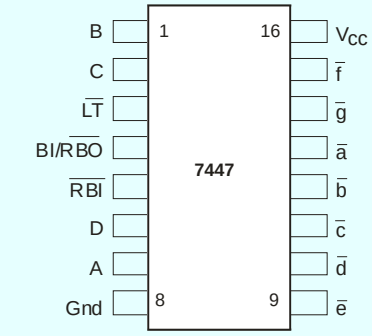


D	C	B	A	0	1	2	3	4	5	6	7	8	9
0	0	0	0	0	1	1	1	1	1	1	1	1	1
0	0	0	1	1	0	1	1	1	1	1	1	1	1
0	0	1	0	1	1	0	1	1	1	1	1	1	1
0	0	1	1	1	1	1	0	1	1	1	1	1	1
0	1	0	0	1	1	1	1	0	1	1	1	1	1
0	1	0	1	1	1	1	1	1	0	1	1	1	1
0	1	1	0	1	1	1	1	1	1	0	1	1	1
0	1	1	1	1	1	1	1	1	1	1	0	1	1
1	0	0	0	1	1	1	1	1	1	1	1	0	1
1	0	0	1	1	1	1	1	1	1	1	1	1	0
Invalid													
1	0	1	0	1	1	1	1	1	1	1	1	1	1
1	0	1	1	1	1	1	1	1	1	1	1	1	1
1	1	0	0	1	1	1	1	1	1	1	1	1	1
1	1	0	1	1	1	1	1	1	1	1	1	1	1
1	1	1	0	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1

A through D : Data Inputs (A is LSB)
0 through 9 : Decoded Outputs (Active LOW)

Fig.C.34

BCD-to-7 Segment Decoder(Active LOW Open Collector Outputs)

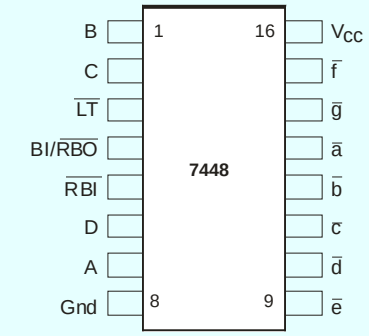


A through D : Data Inputs (A is LSB)
a through g : Decoded Outputs (Active LOW)
$\overline{LT}$: Lamp Test Input
$\overline{RBI}$: Ripple Blanking Input
$\overline{BI/RBO}$: Blanking Input/ Blanking Output

Funtion	$\overline{LT}$	$\overline{RBI}$	D	C	B	A	$\overline{BI/RBO}$	$\overline{a}$	$\overline{b}$	$\overline{c}$	$\overline{d}$	$\overline{e}$	$\overline{f}$	$\overline{g}$
0	1	1	0	0	0	0	1	0	0	0	0	0	0	1
1	1	x	0	0	0	1	1	1	0	0	1	1	1	1
2	1	x	0	0	1	0	1	0	0	1	0	0	1	0
3	1	x	0	0	1	1	1	0	0	0	0	1	1	0
4	1	x	0	1	0	0	1	1	0	0	1	1	0	0
5	1	x	0	1	0	1	1	0	1	0	0	1	0	0
6	1	x	0	1	1	0	1	1	1	0	0	0	0	0
7	1	x	0	1	1	1	1	0	0	0	1	1	1	1
8	1	x	1	0	0	0	1	0	0	0	0	0	0	0
9	1	x	1	0	0	1	1	0	0	0	1	1	0	0
10	1	x	1	0	1	0	1	1	1	0	0	0	1	0
11	1	x	1	0	1	1	1	1	1	0	0	1	1	0
12	1	x	1	1	0	0	1	1	0	1	1	1	0	0
13	1	x	1	1	0	1	1	0	1	1	0	1	0	0
14	1	x	1	1	1	0	1	1	1	1	0	0	0	0
15	1	x	1	1	1	1	1	1	1	1	1	1	1	1
Blank	x	x	x	x	x	x	0	1	1	1	1	1	1	1
Ripple Blank	1	0	0	0	0	0	0	1	1	1	1	1	1	1
LampTest	0	x	x	x	x	x	1	0	0	0	0	0	0	0

Fig.C.35

BCD-to-7 Segment Decoder(Active LOW Open Collector Outputs)

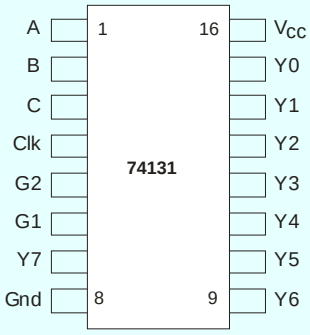


A through D : Data Inputs (A is LSB)
a through g : Decoded Outputs (Active LOW)
$\overline{LT}$: Lamp Test Input
$\overline{RBI}$: Ripple Blanking Input
$BI/\overline{RBO}$: Blanking Input/ Blanking Output

Funtion	$\overline{LT}$	$\overline{RBI}$	D	C	B	A	$BI/\overline{RBO}$	$\overline{a}$	$\overline{b}$	$\overline{c}$	$\overline{d}$	$\overline{e}$	$\overline{f}$	$\overline{g}$
0	1	1	0	0	0	0	1	1	1	1	1	1	1	0
1	1	x	0	0	0	1	1	0	1	1	0	0	0	0
2	1	x	0	0	1	0	1	1	1	0	1	1	0	1
3	1	x	0	0	1	1	1	1	1	1	1	0	0	1
4	1	x	0	1	0	0	1	0	1	1	0	0	1	1
5	1	x	0	1	0	1	1	1	0	1	1	0	1	1
6	1	x	0	1	1	0	1	0	0	1	1	1	1	1
7	1	x	0	1	1	1	1	1	1	1	0	0	0	0
8	1	x	1	0	0	0	1	1	1	1	1	1	1	1
9	1	x	1	0	0	1	1	1	1	1	0	0	1	1
10	1	x	1	0	1	0	1	0	0	0	1	1	0	1
11	1	x	1	0	1	1	1	0	0	1	1	0	0	1
12	1	x	1	1	0	0	1	0	1	0	0	0	1	1
13	1	x	1	1	0	1	1	1	0	0	1	0	1	1
14	1	x	1	1	1	0	1	0	0	0	1	1	1	1
15	1	x	1	1	1	1	1	0	0	0	0	0	0	0
Blank	x	x	x	x	x	x	0	0	0	0	0	0	0	0
Ripple Blank	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Lamp Test	0	x	x	x	x	x	1	1	1	1	1	1	1	1

Fig.C.36

3 : 8 Line Decoder/Demultiplexer

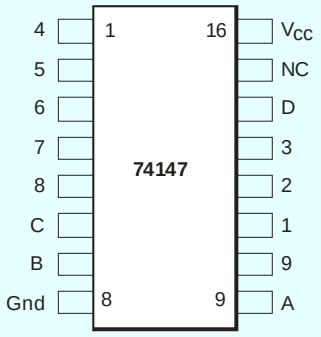


Clk	G1	G2	C	B	A	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7
X	X	1	X	X	X	1	1	1	1	1	1	1	1
X	0	X	X	X	X	1	1	1	1	1	1	1	1
-	1	0	0	0	0	0	1	1	1	1	1	1	1
-	1	0	0	0	1	1	0	1	1	1	1	1	1
-	1	0	0	1	0	1	1	0	1	1	1	1	1
-	1	0	0	1	1	1	1	1	0	1	1	1	1
-	1	0	1	0	0	1	1	1	1	0	1	1	1
-	1	0	1	0	1	1	1	1	1	1	0	1	1
-	1	0	1	1	0	1	1	1	1	1	1	0	1
-	1	0	1	1	1	1	1	1	1	1	1	1	0
X	1	0	X	X	X	0	0	0	0	0	0	0	0

A, B, C : Select Inputs
Y0 through Y7 : Data Outputs
Clk : Clock Input
G1, G2 : Output Enables

Fig.C.37

Decimal-to-BCD Priority Encoder
(Active LOW Inputs/Outputs)

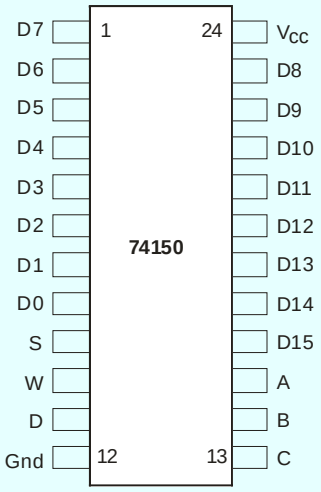


1	2	3	4	5	6	7	8	9	D	C	B	A
1	1	1	1	1	1	1	1	1	1	1	1	1
X	X	X	X	X	X	X	X	0	0	1	1	0
X	X	X	X	X	X	X	0	1	0	1	1	1
X	X	X	X	X	X	0	1	1	1	0	0	0
X	X	X	X	X	0	1	1	1	1	0	0	1
X	X	X	X	0	1	1	1	1	1	0	1	0
X	X	X	0	1	1	1	1	1	1	0	1	1
X	X	0	1	1	1	1	1	1	1	1	0	0
X	0	1	1	1	1	1	1	1	1	1	0	1
0	1	1	1	1	1	1	1	1	1	1	1	0

1 through 9 : Decimal Inputs
A, B, C, D : BCD Priority Outputs

Fig.C.38

16 : 1 Multiplexer



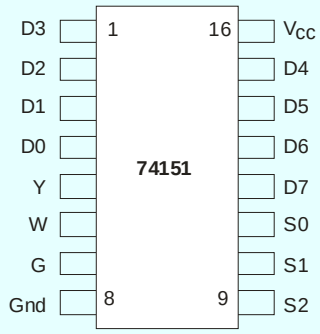
D	C	B	A	S	W
X	X	X	X	1	1
0	0	0	0	0	$\overline{D0}$
0	0	0	1	0	$\overline{D1}$
0	0	1	0	0	$\overline{D2}$
0	0	1	1	0	$\overline{D3}$
0	1	0	0	0	$\overline{D4}$
0	1	0	1	0	$\overline{D5}$
0	1	1	0	0	$\overline{D6}$
0	1	1	1	0	$\overline{D7}$
1	0	0	0	0	$\overline{D8}$
1	0	0	1	0	$\overline{D9}$
1	0	1	0	0	$\overline{D10}$
1	0	1	1	0	$\overline{D11}$
1	1	0	0	0	$\overline{D12}$
1	1	0	1	0	$\overline{D13}$
1	1	1	0	0	$\overline{D14}$
1	1	1	1	0	$\overline{D15}$

D0 through D15 : Data Inputs
W : Data Output (Active LOW)
A, B, C, D : Select Inputs
S : Strobe

Fig.C.39

8 : 1 Multiplexer (With strobe input)

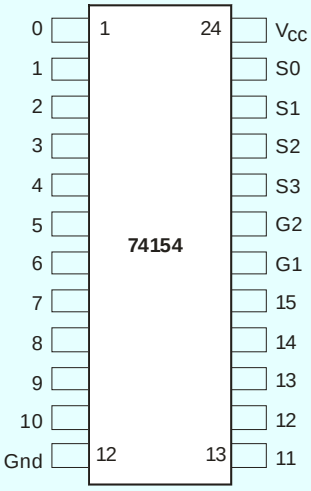
G	S2	S1	S0	Y	W
1	X	X	X	0	1
0	0	0	0	D0	$\overline{D0}$
0	0	0	1	D1	$\overline{D1}$
0	0	1	0	D2	$\overline{D2}$
0	0	1	1	D3	$\overline{D3}$
0	1	0	0	D4	$\overline{D4}$
0	1	0	1	D5	$\overline{D5}$
0	1	1	0	D6	$\overline{D6}$
0	1	1	1	D7	$\overline{D7}$



D0 through D7 : Data Inputs
Y : Data Output (Active HIGH)
W : Data Output (Active LOW)
S2, S1, S0 : Select Inputs
G : Strobe Input

Fig.C.40

4 : 16 Line Decoder



S0 through S3 : Select Inputs
0 through 15 : Data Outputs
G1, G2 : Strobe Inputs

Fig.C.41

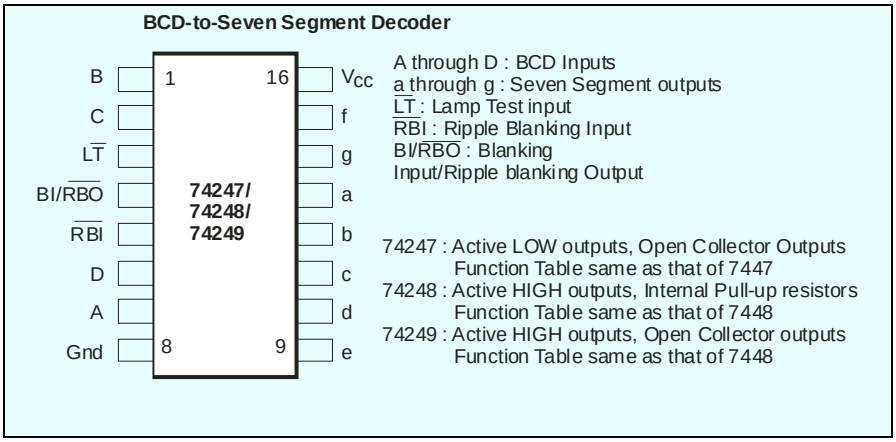


Fig.C.42

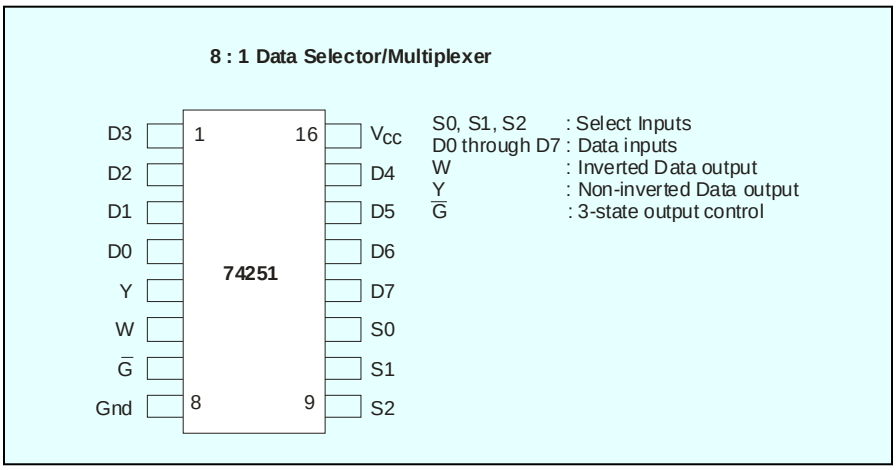


Fig.C.43

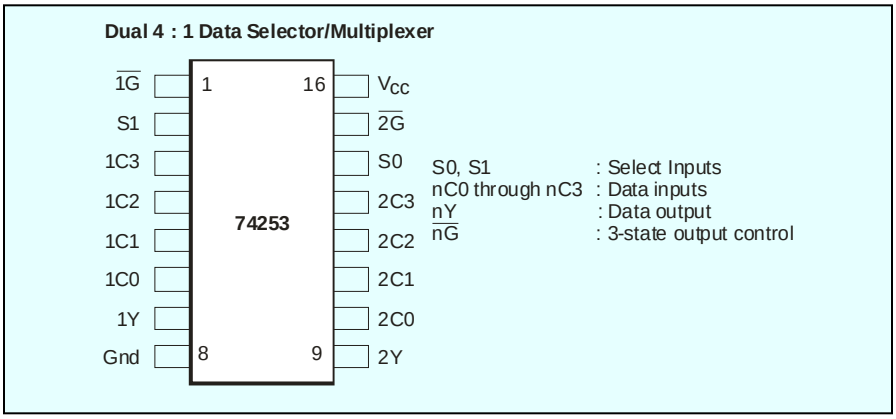
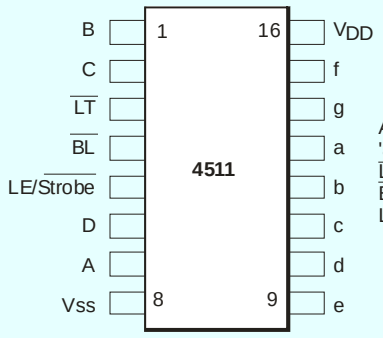


Fig.C.44

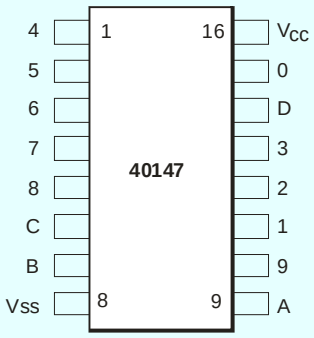
BCD-to-7 Segment Latch Decoder Driver



A, B, C, D : BCD inputs
'a' through 'g' : SevenSegment outputs
$\overline{LT}$: Lamp Test input
$\overline{BL}$: Blanking input
LE : Latch Enable input

Fig.C.45

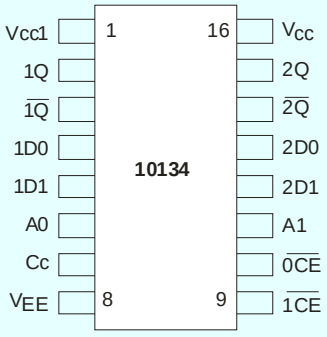
10-line to 4-line BCD priority encoder



Inputs										Outputs			
0	1	2	3	4	5	6	7	8	9	D	C	B	A
0	0	0	0	0	0	0	0	0	0	1	1	1	1
1	0	0	0	0	0	0	0	0	0	0	0	0	0
X	1	0	0	0	0	0	0	0	0	0	0	0	1
X	X	1	0	0	0	0	0	0	0	0	0	1	0
X	X	X	1	0	0	0	0	0	0	0	0	1	1
X	X	X	X	1	0	0	0	0	0	0	1	0	0
X	X	X	X	X	1	0	0	0	0	0	1	0	1
X	X	X	X	X	X	1	0	0	0	0	1	1	0
X	X	X	X	X	X	X	1	0	0	0	1	1	1
X	X	X	X	X	X	X	X	1	0	1	0	0	0
X	X	X	X	X	X	X	X	X	1	1	0	0	1

Fig.C.46

Dual Multiplexers



A0, A1 : Input Select
nD0-nD1 : Data Inputs
nQ, $\overline{nQ}$: Data Outputs
$\overline{nCE}$: Clock Enable

C	A0	nD0	nD1	Q_{n+1}
L	L	L	L	L
L	L	H	H	H
L	H	X	L	L
L	H	X	H	H
H	X	X	Q_n	Q_n

$C=\overline{CE}+C_C$

Fig.C.47

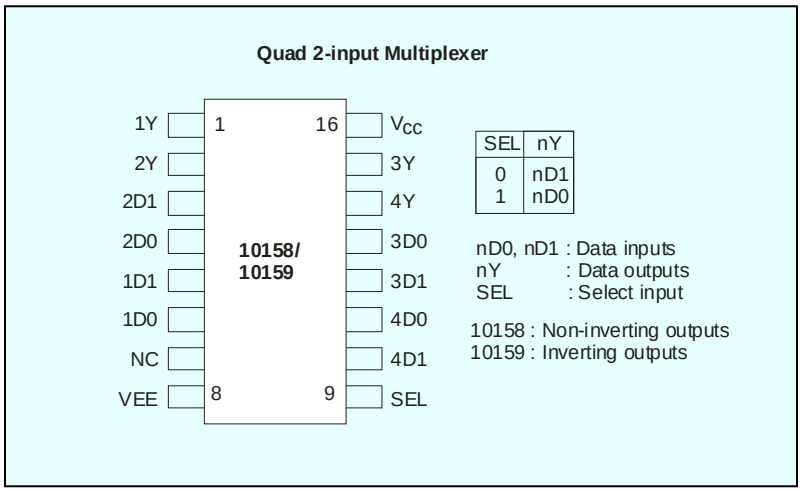

Quad 2-input Multiplexer
1Y
2Y
2D1
2D0
1D1
1D0
NC
VEE
1
16
8
9
10158/
10159
VCC
3Y
4Y
3D0
3D1
4D0
4D1
SEL
SEL nY
0 nD1
1 nD0
nD0, nD1 : Data inputs
nY : Data outputs
SEL : Select input
10158 : Non-inverting outputs
10159 : Inverting outputs

Fig.C.48

13. Pin connection diagrams and other relevant application information on digital ICs for arithmetic operations

Figs.C.49 to C.60 give the pin connection diagram and other application relevant information of some of the popular digital ICs for arithmetic operations. (Arithmetic circuits discussed in detail in chapter-7 of the book).

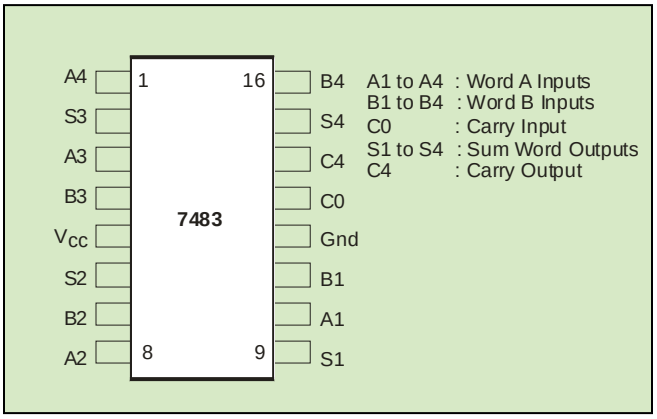


Fig.C.49

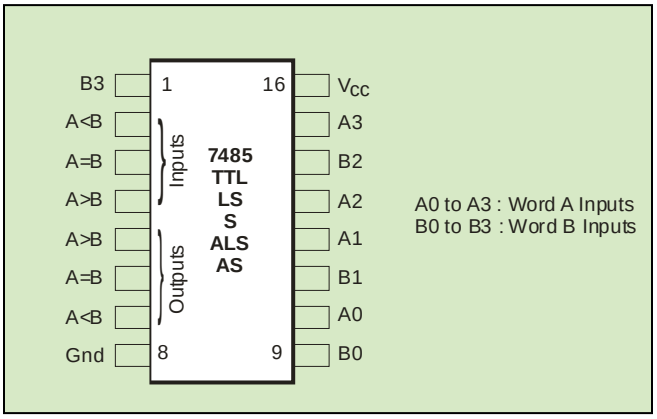
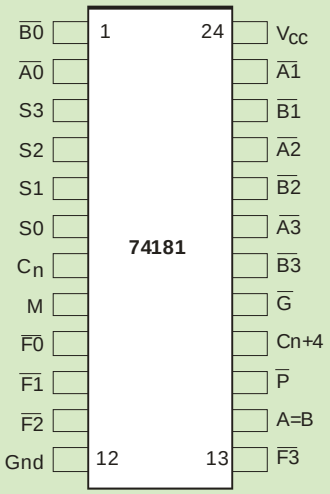


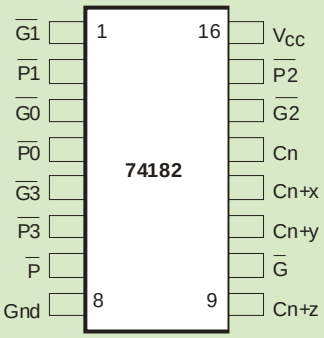
Fig.C.50



$\overline{A0}$ through $\overline{A3}$: Word A input
$\overline{B0}$ through $\overline{B3}$: Word B input
$\overline{F0}$ through $\overline{F3}$: Output Word
S0 through S3 : Function Select input
M : Mode Select input
Cn : Carry input
A=B : Equality Output (Active HIGH)
$\overline{Cn+4}$: Carry Output
$\overline{G}$: Carry Generate Output (Active LOW)
$\overline{P}$: Carry Propagate Output (Active LOW)

SELECTION				M=1 Logic Function	M=0 Cn=0 Arithmetic Fuction
S3	S2	S1	S0		
0	0	0	0	$\overline{A}$	A Minus 1
0	0	0	1	$\overline{AB}$	AB Minus 1
0	0	1	0	$\overline{A}+B$	A $\overline{B}$ Minus 1
0	0	1	1	1	Minus 1
0	1	0	0	$(\overline{A+B})$	A Plus $(A+\overline{B})$
0	1	0	1	$\overline{B}$	AB plus $(A+\overline{B})$
0	1	1	0	$\overline{A} \oplus \overline{B}$	A Minus B minus 1
0	1	1	1	$A+\overline{B}$	$A+\overline{B}$
1	0	0	0	$\overline{A}B$	A Plus (A + B)
1	0	0	1	$A \oplus B$	A plus B
1	0	1	0	B	A $\overline{B}$ plus (A + B)
1	0	1	1	A+B	A + B
1	1	0	0	0	A Plus A
1	1	0	1	$A\overline{B}$	AB plus A
1	1	1	0	AB	A $\overline{B}$ minus A
1	1	1	1	A	A

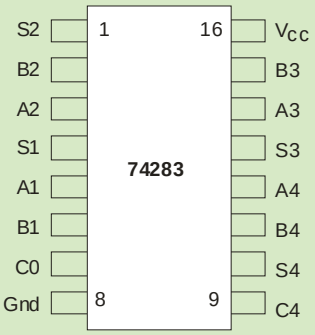
Fig.C.51



G0 through G3 : Carry Generate Inputs
P0 through P3 : Carry Propagate Inputs
Cn : Carry Inputs
Cn + x, Cn +y, Cn + z : Carry Outputs
G : Carry Generate Output
P : Carry Propagate Output

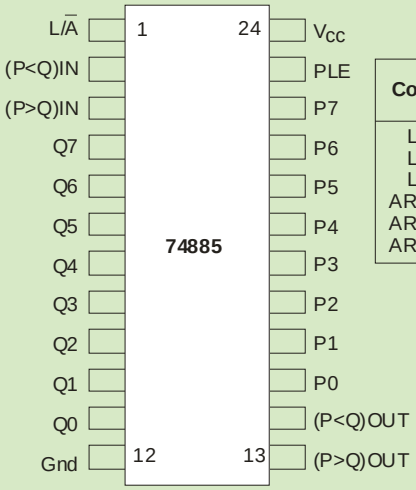
Cn	$\overline{G0}$	$\overline{P0}$	$\overline{G1}$	$\overline{P1}$	$\overline{G2}$	$\overline{P2}$	$\overline{G3}$	$\overline{P3}$	Cn+x	Cn+y	Cn+z	$\overline{G}$	$\overline{P}$
X	1	1							0				
0	1	X							0				
X	0	X							1				
1	X	0							1				
X	X	X	1	1						0			
X	1	1	1	X						0			
0	1	X	1	X						0			
X	X	X	0	X						1			
X	0	X	X	0						1			
1	X	0	X	0						1			
X	X	X	X	X	1	1					0		
X	X	X	1	1	1	X					0		
X	1	1	1	X	1	X					0		
0	1	X	1	X	1	X					0		
X	X	X	X	X	0	X					1		
X	X	X	0	X	X	0					1		
X	0	X	X	0	X	0					1		
1	X	0	X	0	X	0					1		
	X		X	X	X	X	1	1				1	
	X		X	X	1	1	1	X				1	
	X		1	1	1	X	1	X				1	
	1		1	X	1	X	1	X				1	
	X		X	X	X	X	0	X				0	
	X		X	X	0	X	X	0				0	
	X		0	X	X	0	X	0				0	
	0		X	0	X	0	X	0				0	
		1		X		X		X					1
		X		1		X		X					1
		X		X		1		X					1
		X		X		X		1					1
		0		0		0		0					0

Fig.C.52



INPUT				OUTPUT					
				C0=0 C2=0			C0=1 C2=1		
A1 A3	B1 B3	A2 A4	B2 B4	S1 S3	S2 S4	C2 C4	S1 S3	S2 S4	C2 C4
0	0	0	0	0	0	0	1	0	0
1	0	0	0	1	0	0	0	1	0
0	1	0	0	1	0	0	0	1	0
1	1	0	0	0	1	0	1	1	0
0	0	1	0	0	1	0	1	1	0
1	0	1	0	1	1	0	0	0	1
0	1	1	0	1	1	0	0	0	1
1	1	1	0	0	0	1	1	0	1
0	0	0	1	0	1	0	1	1	0
1	0	0	1	1	1	0	0	0	1
0	1	0	1	1	1	0	0	0	1
1	1	0	1	0	0	1	1	0	1
0	0	1	1	0	0	1	1	0	1
1	0	1	1	1	0	1	0	1	1
0	1	1	1	1	0	1	0	1	1
1	1	1	1	0	1	1	1	1	1

Fig.C.53

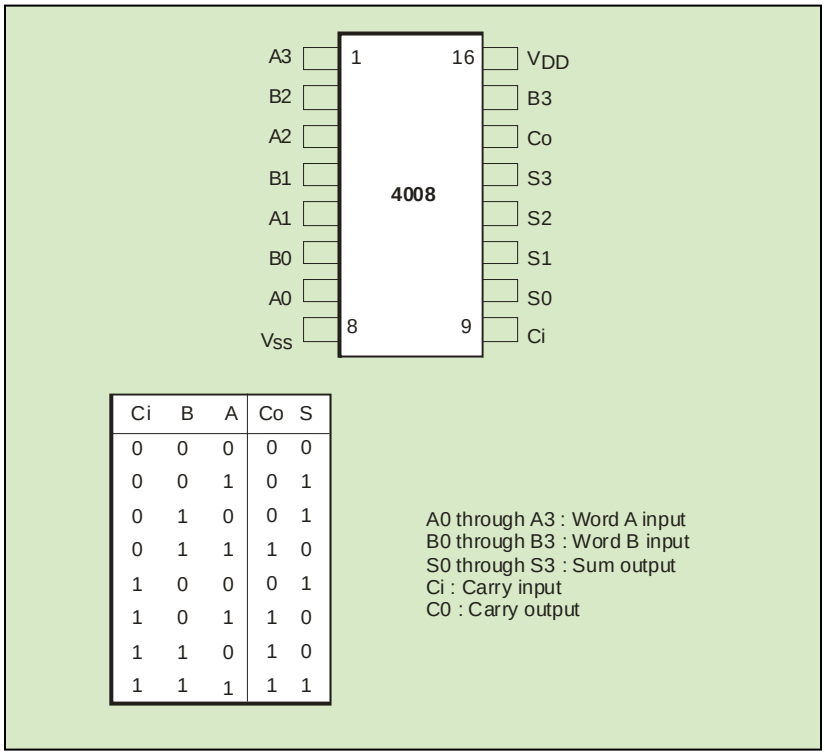


Function Table

Comparison	L/A	Data Inputs P0-P7, Q0-Q7	Input P>Q	Input P<Q	Output P>Q	Output P<Q
LOGICAL	H	P > Q	X	X	H	L
LOGICAL	H	P < Q	X	X	L	H
LOGICAL	H	P = Q	H ORL	H ORL	H ORL	H ORL
ARITHMETIC	L	P AG Q	X	X	H	L
ARITHMETIC	L	Q AG P	X	X	L	H
ARITHMETIC	L	P = Q	H ORL	H ORL	H ORL	H ORL

For P = Q cases, (P > Q) output follows (P > Q) input and (P < Q) output follows (P < Q) input
AG : Arithmetically greater than
PLE : P Latch Enable
L/A : Function select (HIGH for logic operations and LOW for Arithmetic operations

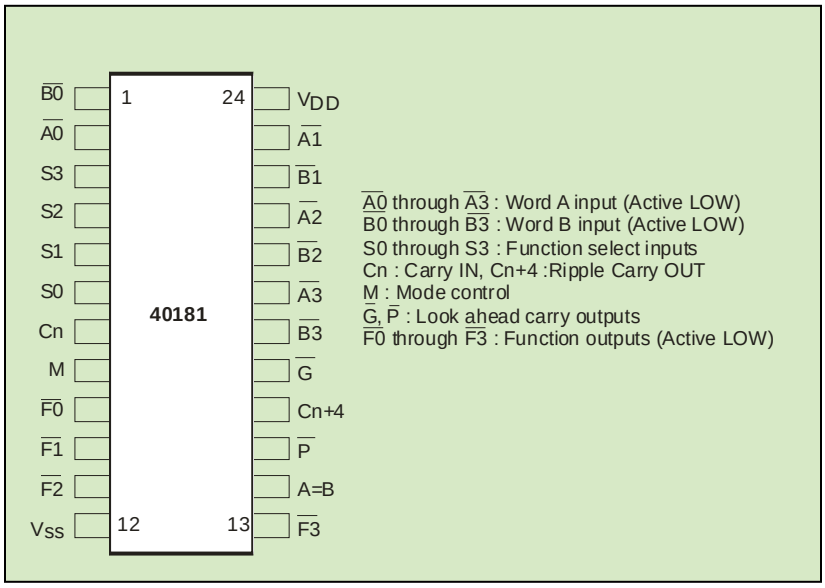
Fig.C.54



Ci	B	A	Co	S
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1

A0 through A3 : Word A input
B0 through B3 : Word B input
S0 through S3 : Sum output
Ci : Carry input
C0 : Carry output

Fig.C.55



$\overline{A0}$ through $\overline{A3}$: Word A input (Active LOW)
$\overline{B0}$ through $\overline{B3}$: Word B input (Active LOW)
S0 through S3 : Function select inputs
Cn : Carry IN, Cn+4 :Ripple Carry OUT
$\overline{M}$: Mode control
$\overline{G}$, $\overline{P}$: Look ahead carry outputs
$\overline{F0}$ through $\overline{F3}$: Function outputs (Active LOW)

Fig.C.56

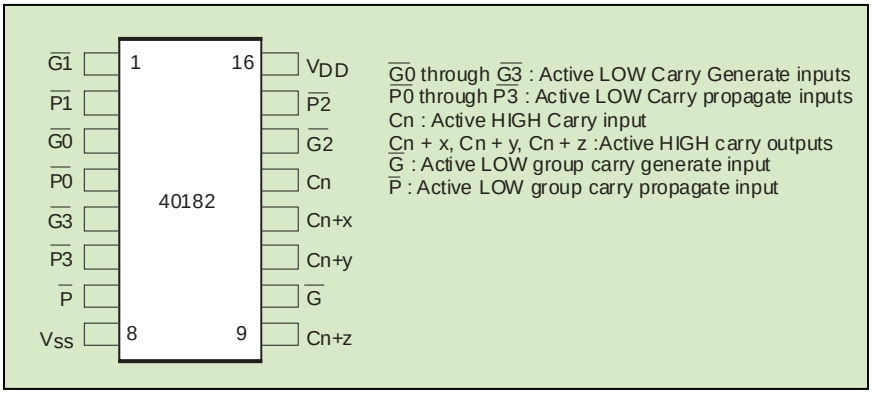


Fig.C.57

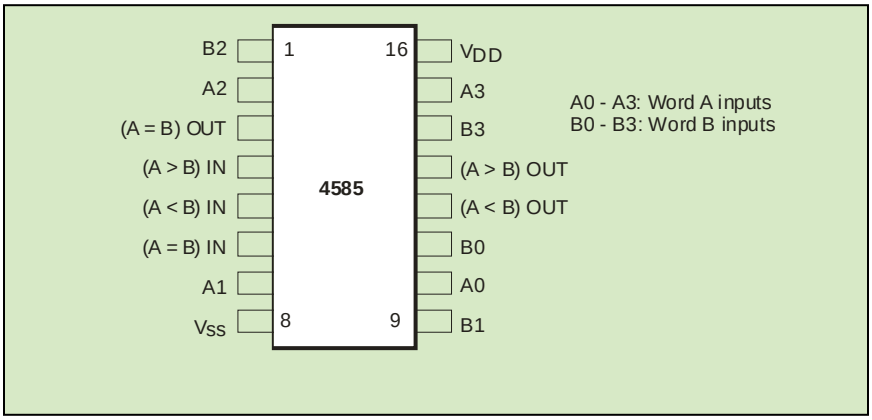


Fig.C.58

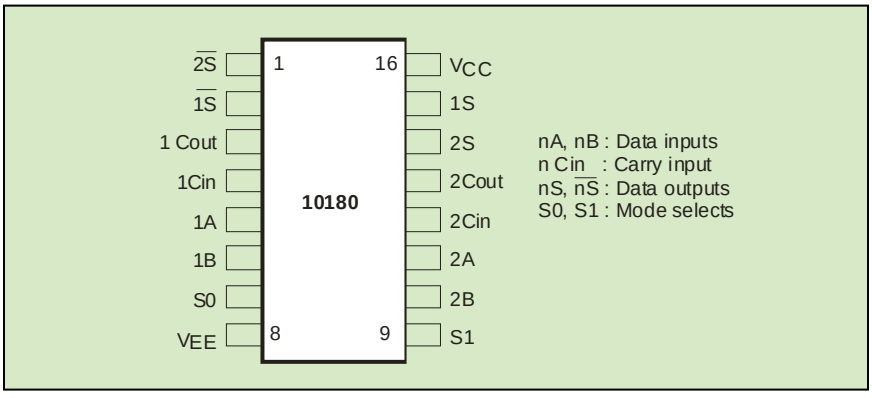
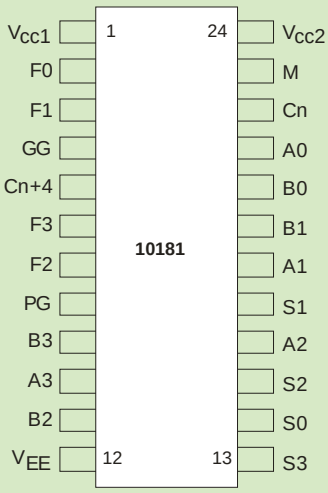


Fig.C.59



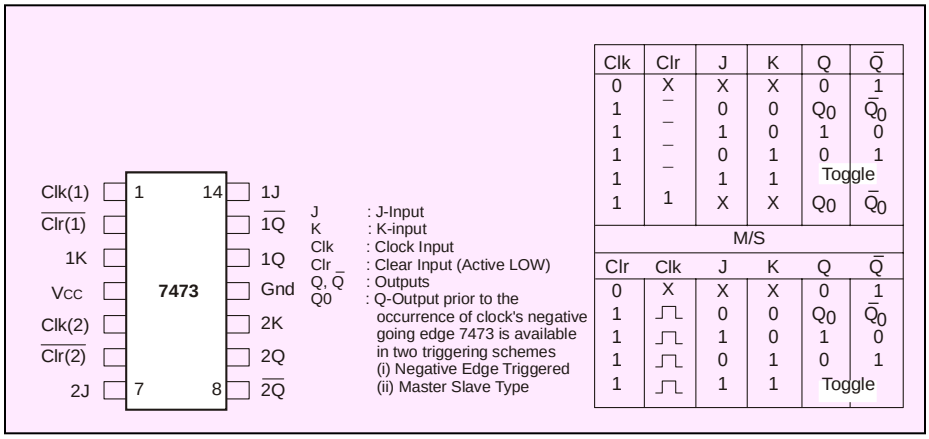
A0 through A3 : Word A inputs
B0 through B3 : Word B inputs
Cn : Carry input
F0 through F3 : Word F inputs
GG : Group generate output
Cn + 4 : Carry output
M : mode Select
S0 through S3 : Function Selects

S3	S2	S1	S0	M=1	M = 0, Cn = 0
0	0	0	0	$\overline{A}$	A
0	0	0	1	$\overline{A}+B$	A Plus A $\overline{B}$
0	0	1	0	$\overline{A}+B$	A Plus AB
0	0	1	1	Logical '1'	A times 2
0	1	0	0	$\overline{AB}$	(A+B) Plus 0
0	1	0	1	$\overline{B}$	(A + B) plus ($A\overline{B}$)
0	1	1	0	$A \oplus B$	A Plus B
0	1	1	1	$A+\overline{B}$	A plus (A + B)
1	0	0	0	$\overline{A}\,B$	(A+$\overline{B}$) plus 0
1	0	0	1	$A \oplus B$	A minus B minus 1
1	0	1	0	B	(A + $\overline{B}$) plus ($A\overline{B}$)
1	0	1	1	A+B	A plus (A + $\overline{B}$)
1	1	0	0	Logical '0'	minus 1
1	1	0	1	$A\,\overline{B}$	A $\overline{B}$ minus 1
1	1	1	0	AB	AB minus 1
1	1	1	1	A	A minus 1

Fig.C.60

14. Pin connection diagrams and other relevant application information on flip flops and related devices

Figs.C.61 to C.84 give the pin connection diagram and other application relevant information of some of the popular flip flops and related devices. (Flip Flops and related devices are discussed in detail in chapter-10 of the book).



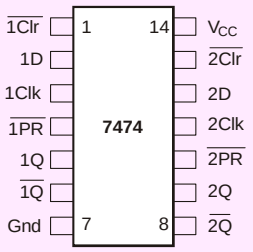
Clk	Clr	J	K	Q	$\bar{Q}$
0	X	X	X	0	1
1	⎺	0	0	Q_0	$\bar{Q}_0$
1	⎺	1	0	1	0
1	⎺	0	1	0	1
1	⎺	1	1	Toggle	
1	1	X	X	Q_0	$\bar{Q}_0$

M/S

Clr	Clk	J	K	Q	$\bar{Q}$
0	X	X	X	0	1
1	⎍	0	0	Q_0	$\bar{Q}_0$
1	⎍	1	0	1	0
1	⎍	0	1	0	1
1	⎍	1	1	Toggle	

Fig.C.61

Dual D-Type Flip-Flop

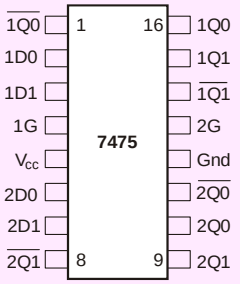


nD : Data Input
nClk : Clock Input
nPR : Preset Input
nClr : Clear Input
Q, Q : Outputs

PR	Clr	Clk	D	Q	$\bar{Q}$
0	1	X	X	1	0
1	0	X	X	0	1
0	0	X	X	Unstable	
1	1	-	1	1	0
1	1	-	0	0	1
1	1	0	X	Q_0	$\bar{Q}_0$

Fig.C.62

Dual 2-Bit D-Type Latch



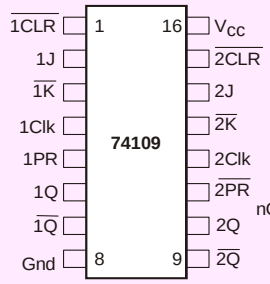
nD0, nD1 : Data Inputs
nG : Latch Enable Input
nQ_0 , nQ_1, nQ_0, nQ_1 : Output

D	G	Q	$\bar{Q}$
0	1	0	1
1	1	1	0
X	0	Q_0	$\bar{Q}_0$

Q_0 = State of Q prior to occurrence of negative going edge at G-input

Fig.C.63

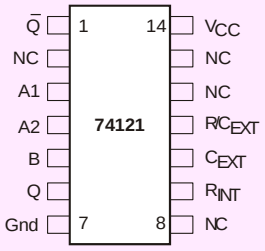
Dual Positive Edge Trigger J-K Flip Flop



nJ : J-Input
nK : K-Input
nPR : Preset input (Active LOW)
nCLR : Clear input (Active LOW)
nCLK : Clock Input
nQ, nQ : Outputs

Fig.C.64

Monostable Multvibrator (Positive and Negative Edge Triggered)

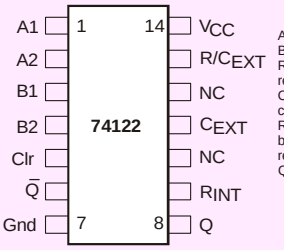


A1, A2 : Negative going trigger input
B : Positive going trigger input
R_{INT} : Connection to internal timing resistor
C_{EXT} : Connection for external timing capacitor
R/C_{EXT} : Connection for common point between external timing capacitor and resistor
Q, $\bar{Q}$: Outputs

A1	A2	B	Q	$\bar{Q}$
0	X	1	0	1
X	0	1	0	1
X	X	0	0	1
1	1	X	0	1
1	⎺	1	⎍	⎎
⎺	1	1	⎍	⎎
⎺	⎺	1	⎍	⎎
0	X	-	⎍	⎎
X	0	-	⎍	⎎

Fig.C.65

Retriggerable Monostable Multivibrator (Positive an Negative Edge Trigger)

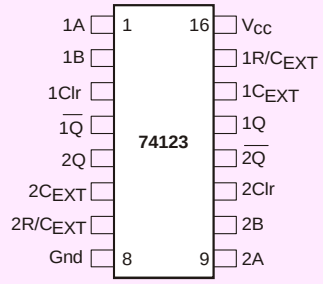


A1, A2 : Negative going trigger input
B : Positive going trigger input
R_{INT} : Connection to internal timing resistor
C_{EXT} : Connection for external timing capacitor
R/C_{EXT} : Connection for common point between external timing capacitor and resistor
Q, $\bar{Q}$: Outputs

Clr	A1	A2	B1	B2	Q	$\bar{Q}$
0	X	X	X	X	0	1
X	1	1	X	X	0	1
X	X	X	0	X	0	1
X	X	X	X	0	0	1
1	0	X	-	1	⎍	⎎
1	0	X	1	-	⎍	⎎
1	X	0	-	1	⎍	⎎
1	X	0	1	-	⎍	⎎
1	1	⎺	1	1	⎍	⎎
1	⎺	⎺	1	1	⎍	⎎
1	⎺	1	1	1	⎍	⎎
-	0	X	1	1	⎍	⎎
-	X	0	1	1	⎍	⎎

Fig.C.66

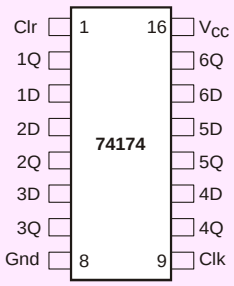
Dual Retriggerable Monostable Multivibrator
(Positive and Negative Edge Triggered)



nA : Negative going trigger inputs
nB : Positive going trigger inputs
nC_{EXT} : Connection for external timing capacitor
nR/C_{EXT} : Connection for common point between resistor and capacitor
nQ, $\overline{nQ}$: Outputs

Fig.C.67

6-Bit D-Type Flip-Flop

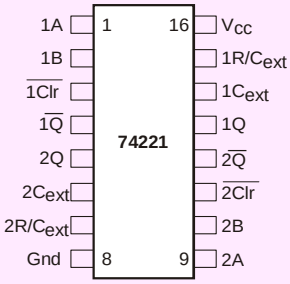


Clr	Clk	D	Q
0	X	X	0
1	-	1	1
1	-	0	0
1	0	X	Q_0

nD : Data Inputs
nQ : Data Outputs
Clk : Clock (Positive Edge Trigger)
Clr : Clear Input (Active LOW)

Fig.C.68

Dual Monostable Multivibrator
(Non-Retriggerable)

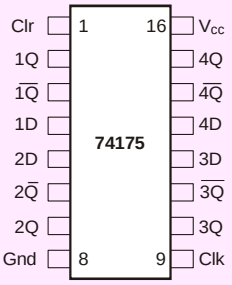


nA : Negative going trigger input
nB : Positive going trigger input
nC_{ext} : Connection for external timing capacitor
nR/C_{ext} : Connection for common point between external timing resistor and capacitor
nQ, $\overline{nQ}$: Outputs

$\overline{Clr}$	A	B	Q	$\overline{Q}$
0	X	X	0	1
X	1	X	0	1
X	X	0	0	1
1	0	-	⎍	⎎
1	¯	1	⎍	⎎
-	0	1	⎍	⎎

Fig.C.69

4-Bit D-Type Flip-Flop
(Complementary Outputs)

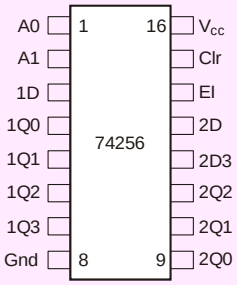


nD : Data Inputs
nQ, nQ : Data Outputs
CLK : Clock (Positive Edge Trigger)
CLR : Clear Input (Active LOW)

Clr	Clk	D	Q	$\overline{Q}$
0	X	X	0	1
1	-	1	1	0
1	-	0	0	1
1	0	X	Q_0	$\overline{Q_0}$

Fig.C.70

Dual 4-Bit Addressable D-Type Latch

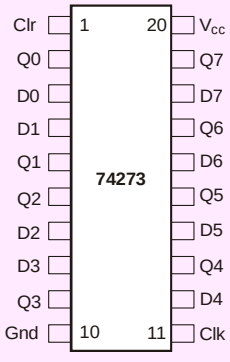


nD : Data Inputs
nQ0 through nQ3 :Data outputs (Active HIGH)
A0, A1 : Data Output Selects
Clr : Clear Control (Active LOW)
EI : Latch Control (Active LOW)

Clr	EI	A1	A0	Q0	Q1	Q2	Q3	MODE
0	1	X	X	0	0	0	0	CLEAR
0	0	0	0	D	0	0	0	Demultiplex
0	0	0	1	0	D	0	0	
0	0	1	0	0	0	D	0	
0	0	1	1	0	0	0	D	
1	1	X	X	$Q0_0$	$Q1_0$	$Q2_0$	$Q3_0$	Memory
1	0	0	0	D	$Q1_0$	$Q2_0$	$Q3_0$	Addressable
1	0	0	1	$Q0_0$	D	$Q2_0$	$Q3_0$	Latch
1	0	1	0	$Q0_0$	$Q1_0$	D	$Q3_0$	output
1	0	1	1	$Q0_0$	$Q1_0$	$Q2_0$	D	

Fig.C.71

8-bit D-Type Flip Flop



D0 through D7 : Data inputs
Q0 through Q7 : Data outputs
CLK : Clock input (Positive Edge)
Clr : Clear Input (Active LOW)

OE	Clk	D	Q
0	X	X	0
0	-	1	1
0	-	0	0
1	0	X	Q_0

Fig.C.72

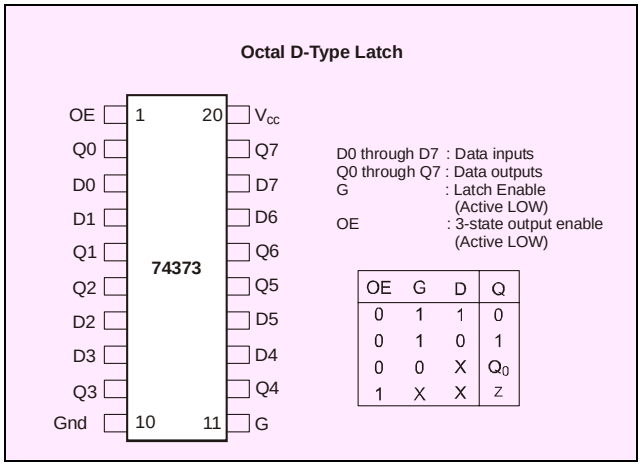


Fig.C.73

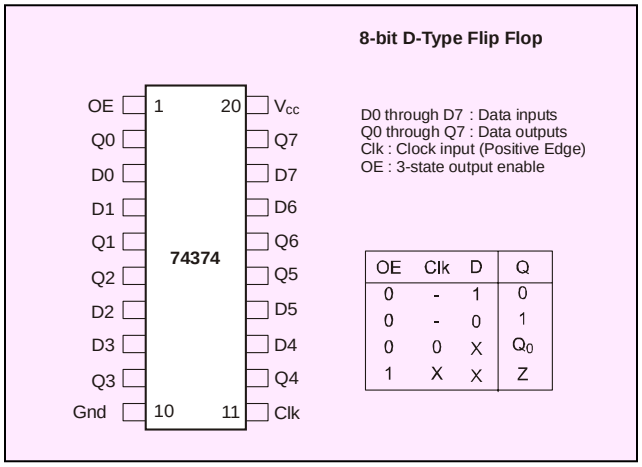


Fig.C.74

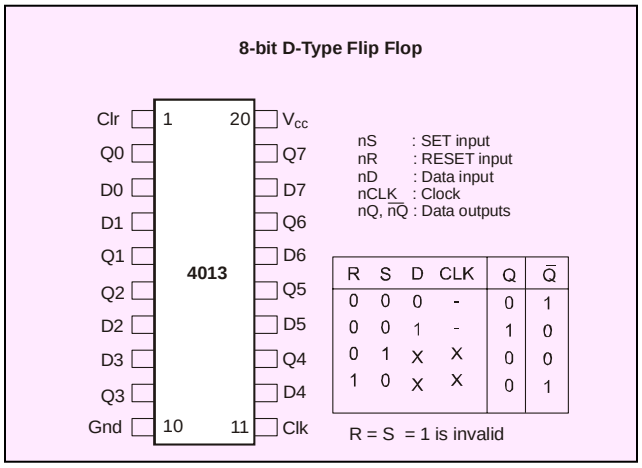
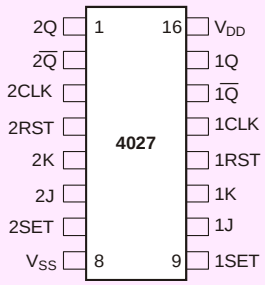


Fig.C.75

DualJ-K Flip-Flop

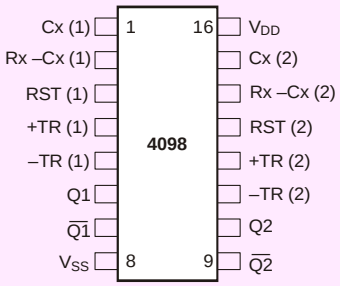


nJ, nK : J-K inputs
nRST : RESET inputs
nQ, n$\overline{Q}$: Outputs
nSET : SET inputs
nCLK : Clock

SET	RST	CLK	J	K	Q	$\overline{Q}$
1	0	X	X	X	1	0
0	1	X	X	X	0	1
1	1	X	X	X	Invalid	
0	1	-	0	0	No change	
0	0	-	0	1	0	1
0	0	-	1	0	1	0
0	0	-	1	1	Toggle	

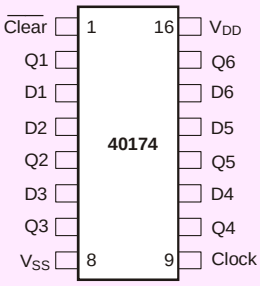
Fig.C.76

Dual Monostable Multivibrator



nCx : External Capacitor
nRx-Cx : Common point of external R and C
nRST : Reset(Active LOW)
(n) + TR : Positive edge trigger input
(n) - $\overline{TR}$: Negative edgetrigger input
nQ, n$\overline{Q}$: Output

Fig.C.77



nD : Data inputs
nQ : Outputs
$\overline{Clear}$: Clear input (Active LOW)

Fig.C.78

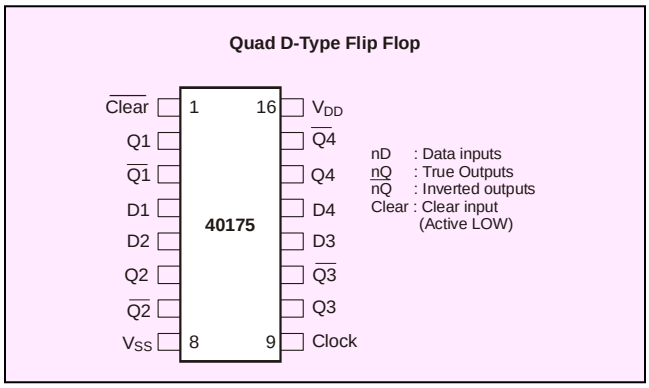


Fig.C.79

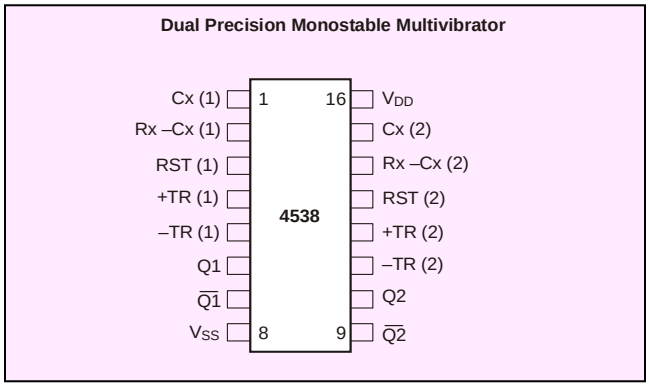


Fig.C.80

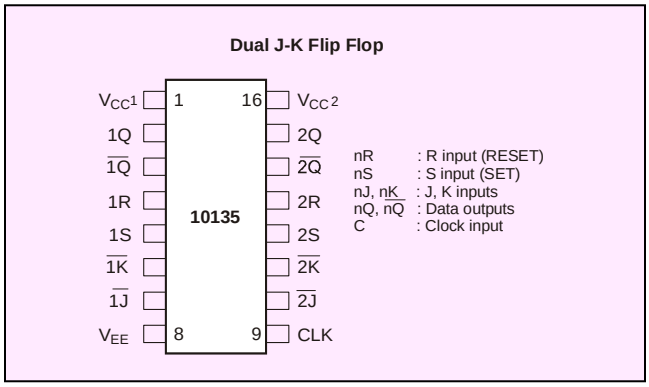


Fig.C.81

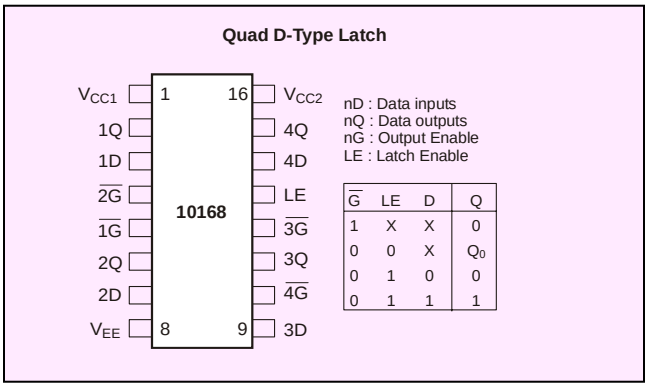


Fig.C.82

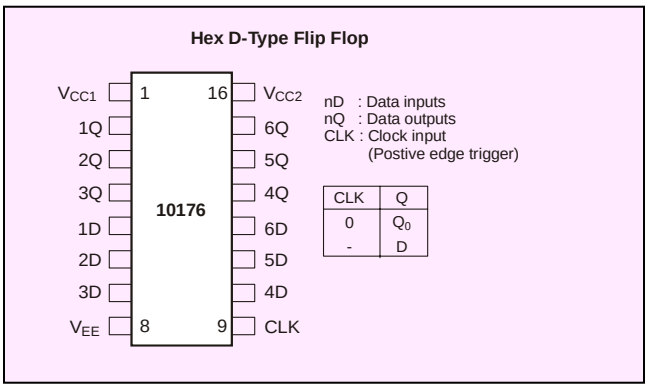


Fig.C.83

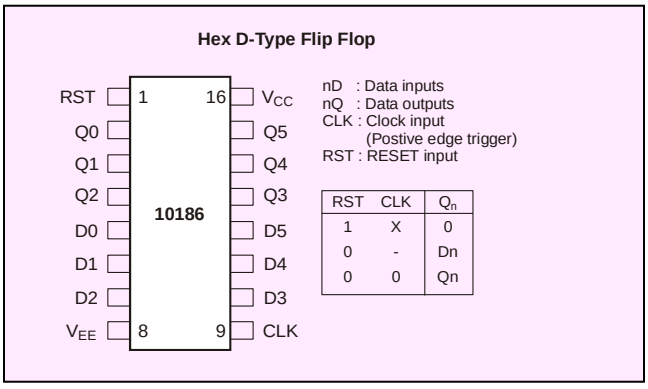
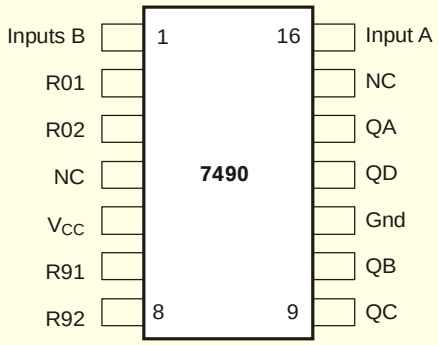


Fig.C.84

15. Pin connection diagrams and other relevant application information on counters

Figs.C.85 to C.100 give the pin connection diagram and other application relevant information of some of the popular counter devices. (Counters are discussed in detail in chapter-11 of the book).

BCD Counter (Decade)

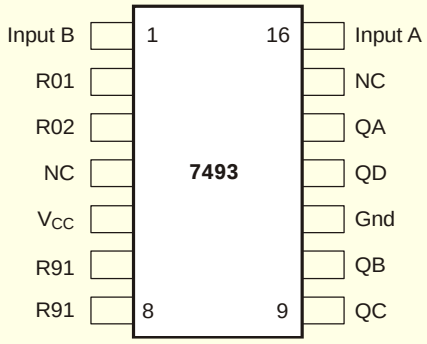


Input A, B : Inputs
QA through QD : Outputs
R01, R02 : Reset to '0' inputs
R91, R92 : Reset to '9' inputs

R01	R02	R19	R92	QD	QC	QB	QA
1	1	0	X	0	0	0	0
1	1	X	0	0	0	0	0
X	X	1	1	1	0	0	1
X	0	X	0	Count			
0	X	0	X	Count			
0	X	X	0	Count			
X	0	0	X	Count			

Fig.C.85

4-Bit Binary Counter

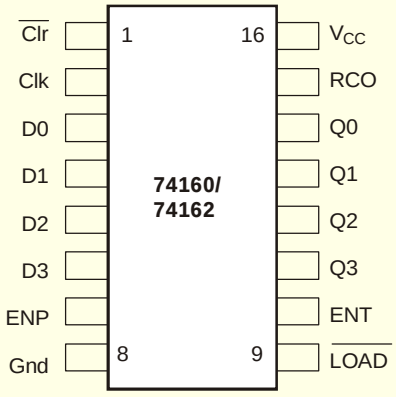


Input A, B : Inputs
QA through QD : Outputs
R01, R02 : Reset to '0' inputs

R01	R02	QD	QC	QB	QA
1	1	0	0	0	0
0	X	Count			
X	0	Count			

Fig.C.86

4-Bit Counter



D0 through D3 : Preset Data Inputs
Q0 throughQ3 : Data Outputs
RCO : Ripple Carry Output
Clk : Clock Input (Positive Edge Triggered)
LOAD : Preset Control (Synchronous, Active LOW)
Clr : Clear Input (Asynchronous, Active LOW) for74160 and synchronous, Active LOW for 74162
ENP : Count Enable Parallel
ENT : Count Enable Trickle

74160

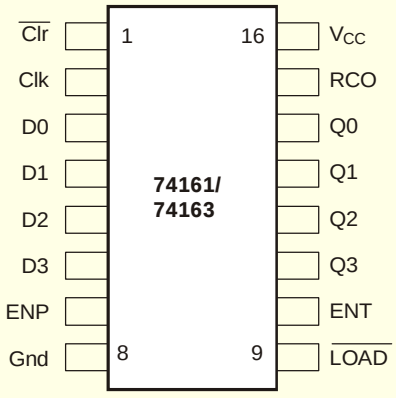
Clk	Clr	ENP	ENT	LOAD	Function
X	0	X	X	X	Clear
X	1	1	0	1	Count/RCO Disabled
X	1	0	1	1	Count Disabled
X	1	0	0	1	Count/RCO Disabled
...	1	X	X	0	LOAD
...	1	1	1	1	COUNT

74162

Clk	Clr	ENP	ENT	LOAD	Function
...	0	X	X	X	Clear
X	1	1	0	1	Count/RCO Disabled
X	1	0	1	1	Count Disabled
X	1	0	0	1	Count/RCO Disabled
...	1	X	X	0	LOAD
...	1	1	1	1	COUNT

Fig.C.87

4-Bit Binary Up-Counter



D0 through D3 : Preset Data Inputs
Q0 throughQ3 : Data Outputs
RCO : Ripple Carry Output
Clk : Clock Input (Positive Edge Triggered)
$\overline{\text{LOAD}}$: Preset Control (Synchronous, Active LOW)
$\overline{\text{Clr}}$: Clear Input (Asynchronous, Active LOW) for74161 and synchronous, Active LOW for 74163
ENP : Count Enable Parallel
ENT : Count Enable Trickle

74161

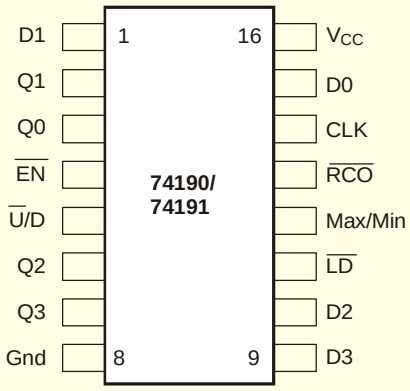
Clk	Clr	ENP	ENT	LOAD	Function
X	0	X	X	X	Clear
X	1	1	0	1	Count/RCO Disabled
X	1	0	1	1	Count Disabled
↑	1	X	X	0	LOAD
↑	1	1	1	1	COUNT

74162

Clk	Clr	ENP	ENT	LOAD	Function
↑	0	X	X	X	Clear
X	1	1	0	1	Count/RCO Disabled
X	1	0	1	1	Count Disabled
X	1	0	0	1	Count/RCO Disabled
↑	1	X	X	0	LOAD
↑	1	1	1	1	COUNT

Fig.C.88

Synchronous Up/Down Counter

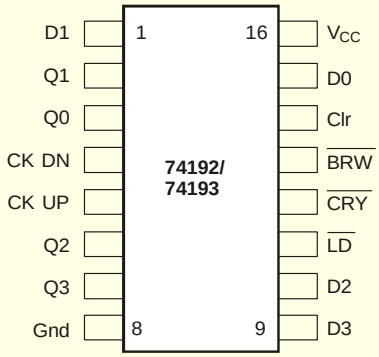


LD	EN	U/D	CLK	Function
1	0	0	↑	Count UP
1	0	1	↑	Count DOWN
0	X	X	X	Load
1	1	X	X	No Change

D0 through D3 : Parallel data inputs
Q0 through Q3 : Count outputs
CLK : Clock input
U/D : Count Up/Down control
LD : Parallel Load Control
Max/Min : Max/Min count output
RCO : Ripple Clock Output
74190 : BCD
74191 : 4-Bit Binary

Fig.C.89

Synchronous Up/Down Counter

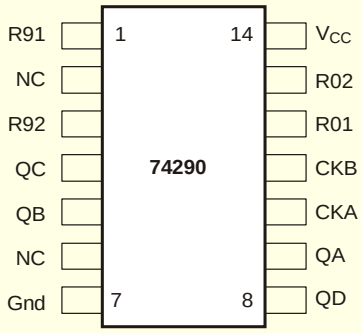


CKUP	CKDN	Clr	LD	Function
↑	1	0	1	Count UP
1	↑	0	1	Count Down
X	X	1	X	Clear
X	X	0	0	Load

D0 through D3 : Parallel data inputs
Q0 through Q3 : Count outputs
CK UP : Up-Count clock input
CK DN : Down-Count clock input
LD : Parallel load control
Clr : Clear input
CRY : Carry input
BRW : Borrow output
74192 : BCD
74193 : 4-Bit Binary

Fig.C.90

BCD Counter
(Divide-by-2/Divide-by-5)

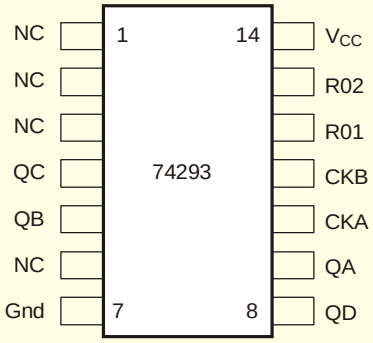


R01	R02	R91	R92	QD	QC	QB	QA
1	1	0	X	0	0	0	0
1	1	X	0	0	0	0	0
X	X	1	1	1	0	0	1
X	0	X	0		Count		
0	X	0	X		Count		
0	X	X	0		Count		
X	0	0	X		Count		

CKA : Clock for section A,
CKB : Clock for section B, C, D,
QA through QD : Outputs
R01, R02 : Reset-to-0 Inputs
R91, R92 : Reset-to-9 Inputs
CKA, CKB : Negative edge Triggered

Fig.C.91

BCD Counter
(Divide-by-2/Divide-by-5)

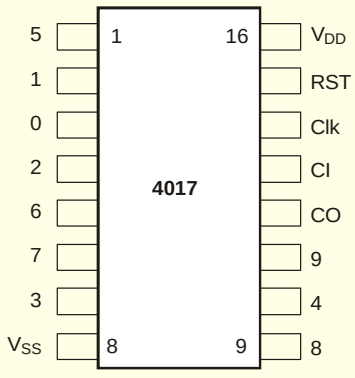


CKA : Clock for section A,
CKB : Clock for section B, C, D
QA through QD : Outputs
R01, R02 : Reset-to-0 Inputs
R91, R92 : Reset-to-9 Inputs
CKA, CKB : Negative edge Triggered

R01	R02	QD	QC	QB	QA
1	1	0	0	0	0
0	X	Count			
X	0	Count			

Fig.C.92

Decade Counter



Clk : Clock
0 through 9 : Decimal outputs
RST : Reset
C : Clock Inhibit
CO : Carry Out

Function Table

RST	CE	Clk	Function
1	X	X	Reset to '0'
0	0	↑	Count
0	1	↓	Count

Count Sequence Table

0	1	2	3	4	5	6	7	8	9	CO
1	0	0	0	0	0	0	0	0	0	1
0	1	0	0	0	0	0	0	0	0	1
0	0	1	0	0	0	0	0	0	0	1
0	0	0	1	0	0	0	0	0	0	1
0	0	0	0	1	0	0	0	0	0	1
0	0	0	0	0	1	0	0	0	0	0
0	0	0	0	0	0	1	0	0	0	0
0	0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	0	0	1	0

Fig.C.93

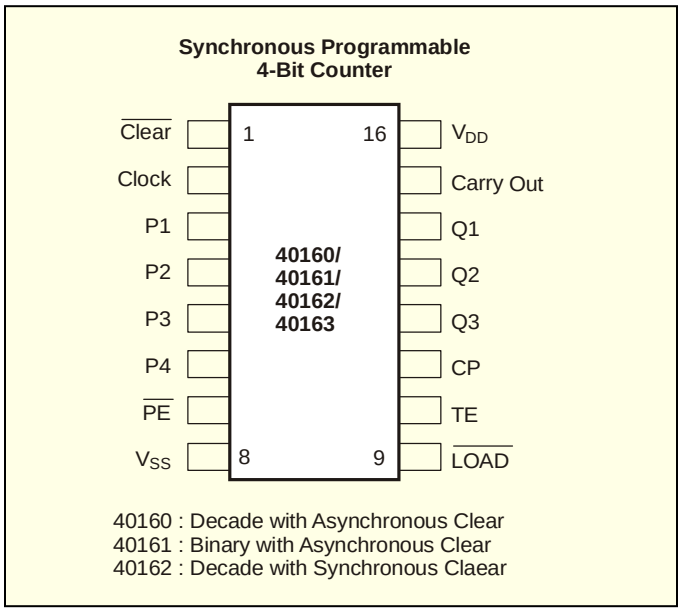


Fig.C.94

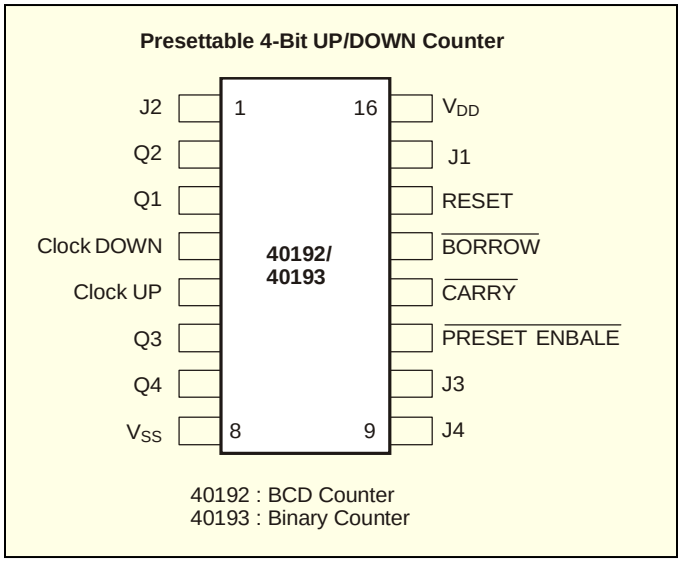
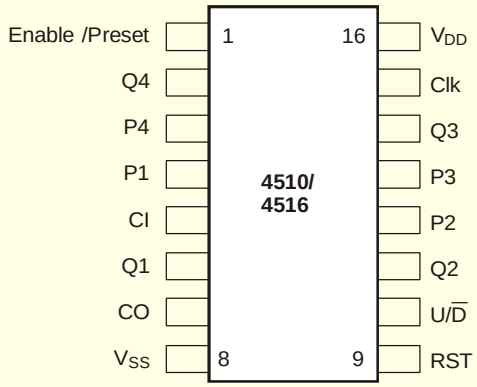


Fig.C.95

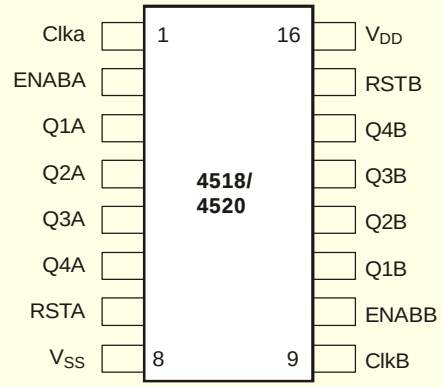
Presettable UP/DOWN Counter



P1 through P4 : preset inputs
Q1 through Q4 : outputs
RST : Reset input
Clk : Clock input
CI : Carry IN
CO : Carry OUT
NOTE
4510 in a BCD-counter while
4516 is a 4-bit binary counter

Fig.C.96

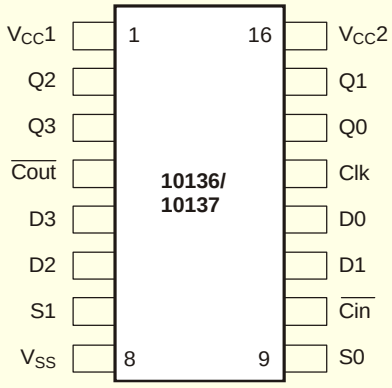
Dual UP Counter



RSTA, RSTB : RESET (Active HIGH)
Clka, Clkb : Clock input (Positive edge trigger)
Q1A-Q4A, Q1B-Q4B :Output
ENABA, ENABB : Enable input
4518 : Dual BCDUP-counter
4520 : Dual Binary UP-counter

Fig.C.97

4-Bit Counter
(10136/10137)

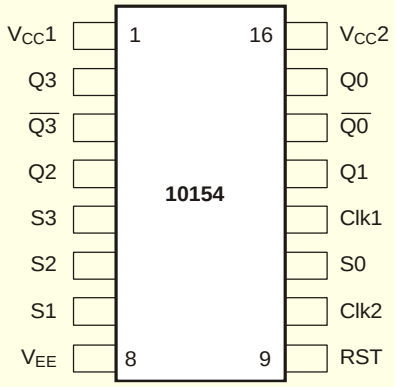


D0 through D3 :
Preset data inputs
Q0 through Q3 : Data outputs
$\overline{Cin}$: Carry input
S0, S1 : Mode controls
Clk : Clock input
$\overline{C_{out}}$: Carry output

$\overline{Cin}$	S0	S1	MODE
X	0	0	Load
0	0	1	Count UP
1	0	1	Hold Count
0	1	0	Count DOWN
1	1	0	Hold Count
X	1	1	Stop Count

Fig.C.98

4-Bit Binary Counter

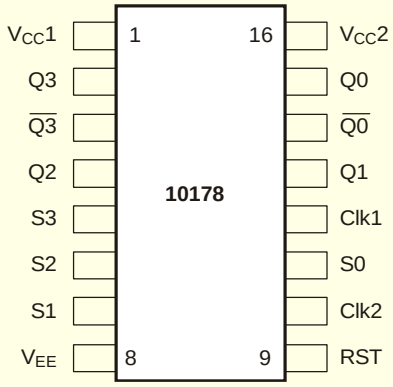


S0 through S3 : SET inputs
RST : RESET input
Clk0 : Clock for section 0
Clk 1 : Clock for sections 1,2 and 3
Q0 through Q3 : Active HIGH count outputs
$\overline{Q0}$, $\overline{Q3}$: Active LOW outputs
RST = S = 1 is invalid

RST	S	Clk	Q
0	0	↑	Count
0	1	X	1
1	0	X	0

Fig.C.99

4-Bit Binary Counter



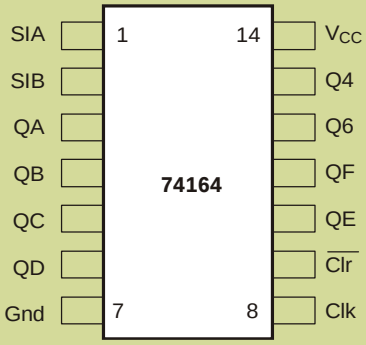
S0 through S3 : SET inputs
RST : RESET input
Clk0 : Clock for section 0
Clk 1 : Clock for sections 1,2 and 3
Q0 through Q3 : Active HIGH count outputs
$\overline{Q0}$, $\overline{Q3}$: Active LOW outputs

Fig.C.100

16. Pin connection diagrams and other relevant application information on shift registers

Figs.C.101 to C.105 give the pin connection diagram and other application relevant information of some of the popular shift register devices. (Shift Registers are discussed in detail in chapter-11 of the book).

8-Bit SIPO Shift Register

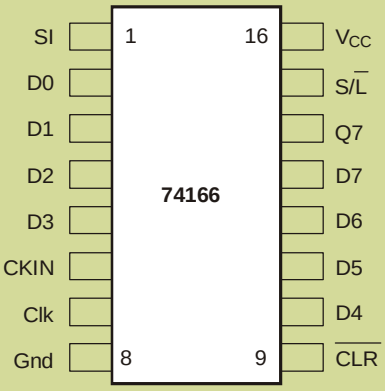


$\overline{Clr}$	SIA	SIB	Clk	QA	QB	QC	QD	QE	QF	QG	QH
0	X	X	X	0	0	0	0	0	0	0	0
1	1	1	↑	1	QA_N	QB_N	QC_N	QD_N	QE_N	QF_N	Q_0
1	0	0	↑	0	$Q0_0$	$Q1_0$	$Q2_0$	$Q3_0$	$Q4_0$	$Q5_0$	$Q6_0$
1	X	X	↑	0	$Q0_0$	$Q1_0$	$Q2_0$	$Q3_0$	$Q4_0$	$Q5_0$	$Q6_0$

SIA, SIB :Serial Inputs
QA through Q4 : Data Outputs
Clk : Clock Input
Clr : Clear Input

Fig.C.101

8-Bit Shift Register
(Serial/Parallel in/Serial OUT)

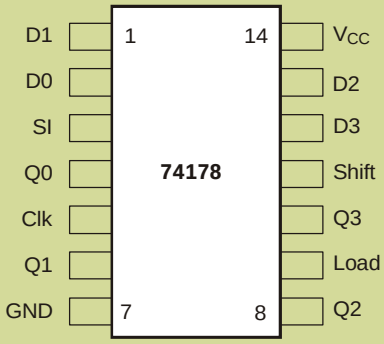


Inputs					Internal		Output
$\overline{Clr}$	S/$\overline{L}$	CKIN	Clk	SI	Q0	Q6	Q7
0	X	X	X	X	0	0	0
1	X	L	L	X	D0	D6	D7
1	1	0	↑	1	1	$Q5_0$	$Q6_0$
1	1	0	↑	0	0	$Q5_0$	$Q6_0$
1	X	1	↑	X	$Q0_0$	$Q6_0$	$Q7_0$

D0 through D7 : Parallel inputs
SI : Serial input
CLK : Clock
Q7 :Data Output
S/L : Shift/Parallel-load Control
CKIN : Clock Inhibit

Fig.C.102

4-Bit Universal Shift Register

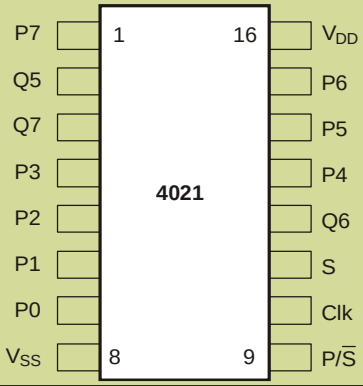


Shift	Load	$\overline{Clk}$	SI	Q0	Q1	Q2	Q3
0	0	↓	X	$Q0_0$	$Q1_0$	$Q2_0$	$Q3_0$
0	1	↓	X	D0	D1	D2	D3
1	X	↓	1	1	$Q0_0$	$Q1_0$	$Q2_0$
1	X	↓	0	0	$Q0_0$	$Q1_0$	$Q2_0$

D0 through D3 : Parallel inputs
SI : Serial input
Q0 through Q3 : Data Outputs
Load : Parallel Load Control
Shift : Serial Shift Control
Clk : Clock Input

Fig.C.103

8-Bit Shift Register



P0 through P7 : Parallel Data input
Clk : Clock
$P/\overline{S}$: Parallel/Serial Select
Q5, Q6, Q7 : Data output

Clk	P/S	Function
X	1	Parallel in
↑	0	Shift right

Fig.C.104

4-Bit Bidirectional universal Shift Register

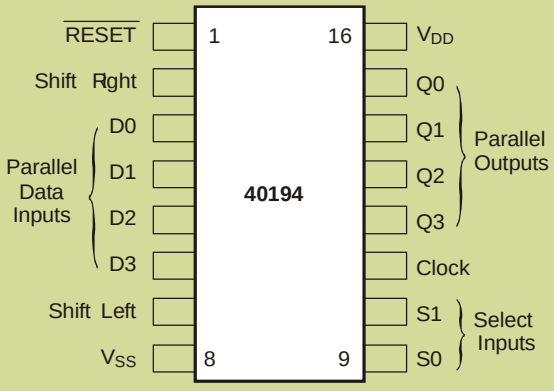


Fig.C.105

17. Pin connection diagrams and other relevant application information on microprocessors and peripheral devices

Figs.C.106 to C.126 give the pin connection diagram and other application relevant information of some of the popular microprocessors. (Microprocessors and peripheral devices are discussed in detail in chapter-13 of the book).

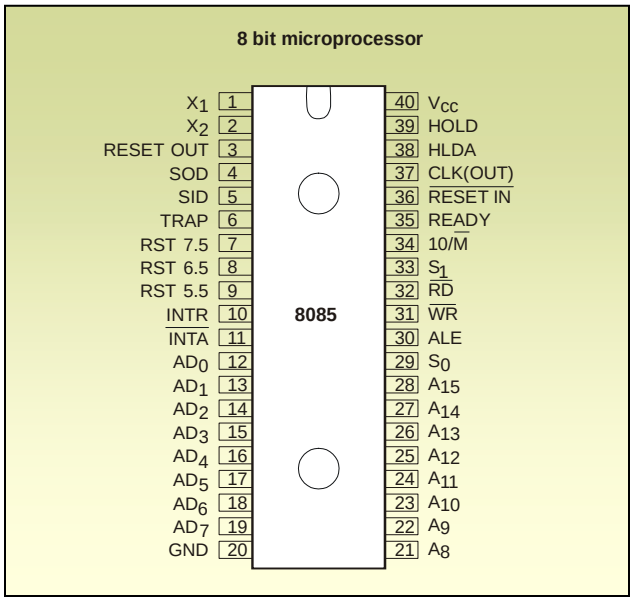


Fig.C.106

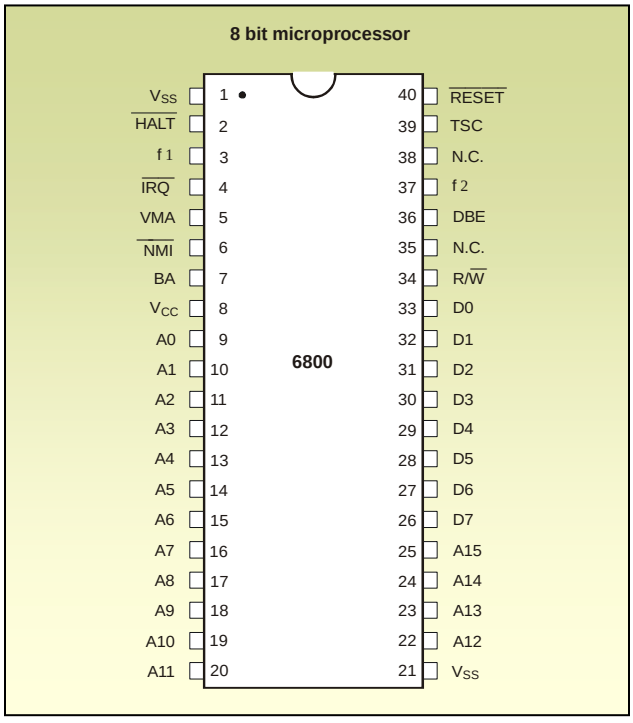


Fig.C.107

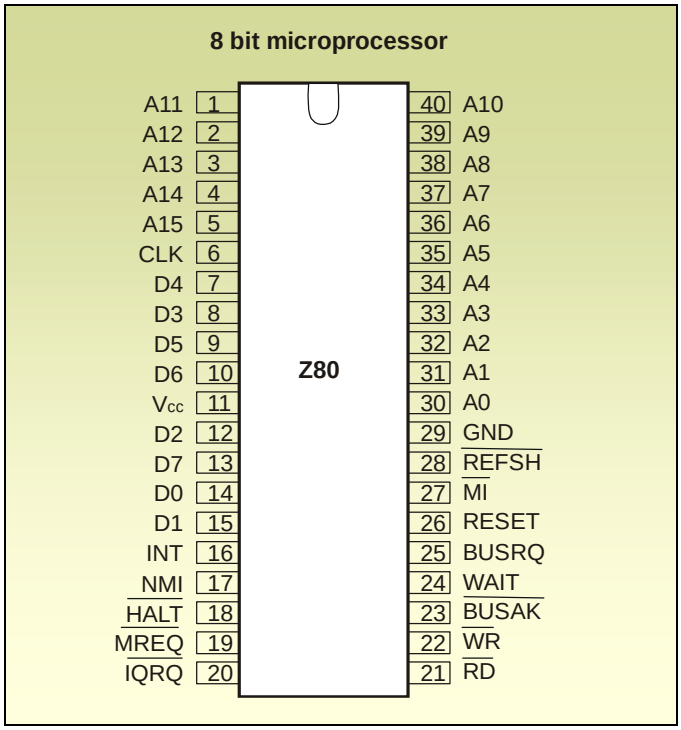


Fig.C.108

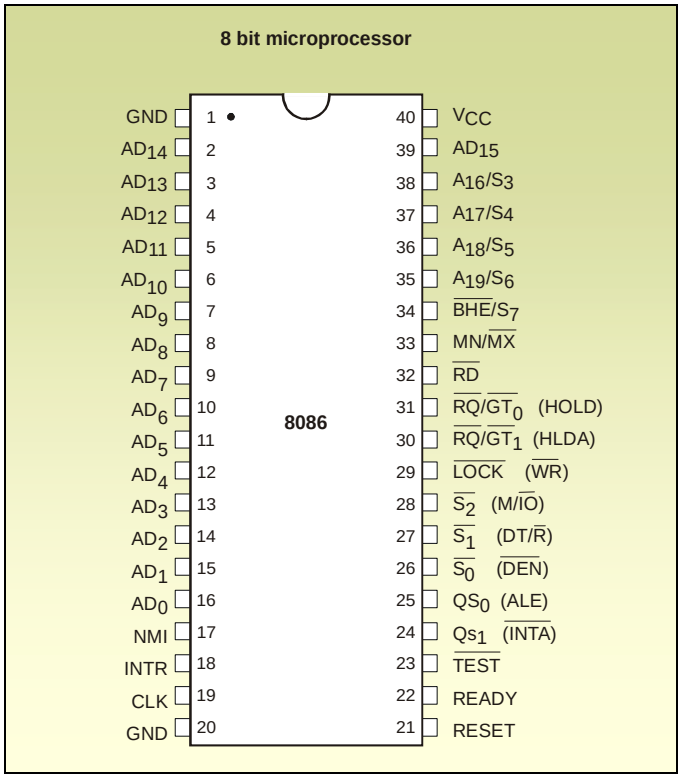


Fig.C.109

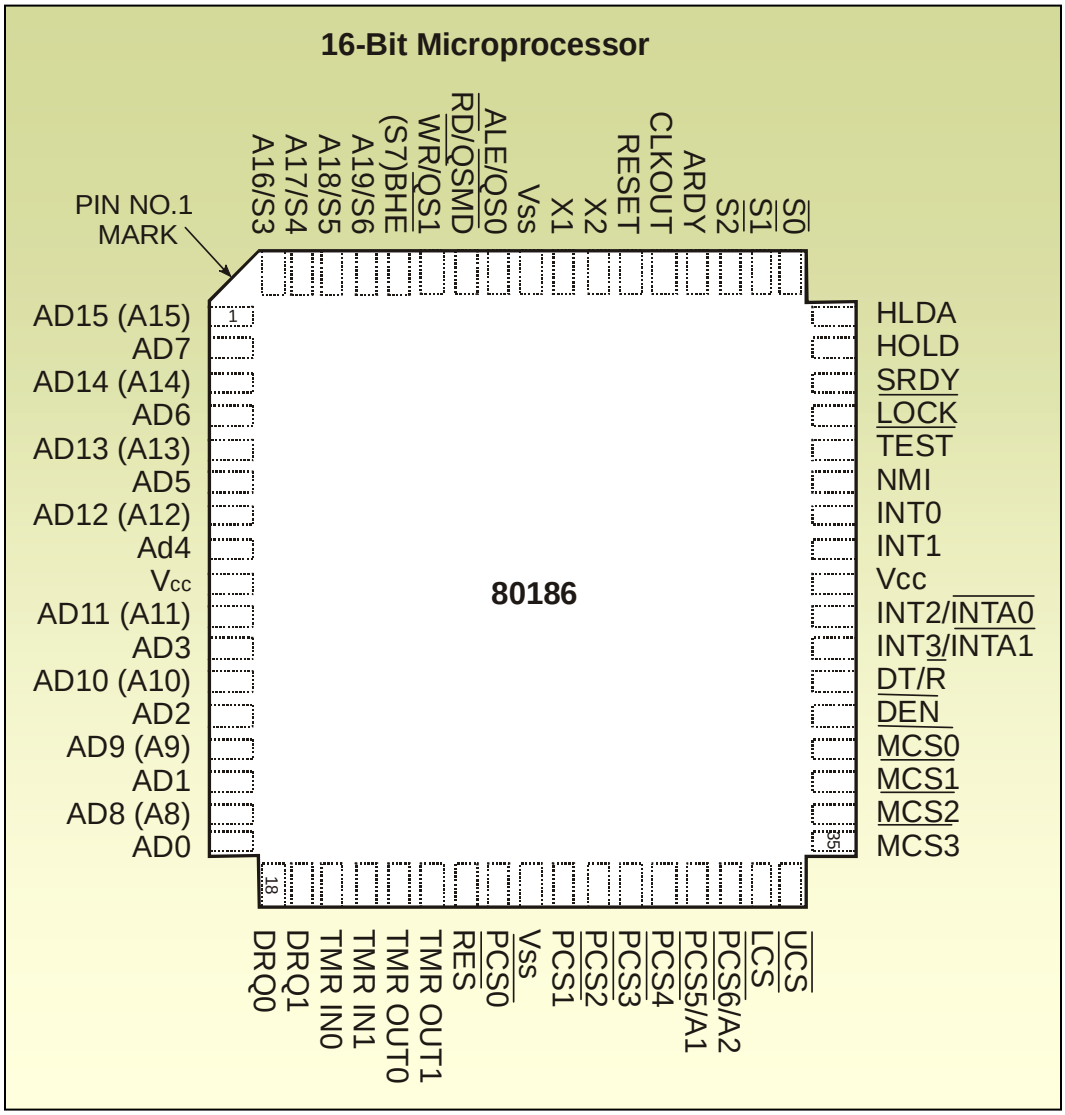

16-Bit Microprocessor
80186
PIN NO.1 MARK
1
18
35
A16/S3
A17/S4
A18/S5
A19/S6
(S7)BHE
WR/QS1
RD/QSMD
ALE/QS0
Vss
X1
X2
RESET
CLKOUT
ARDY
S2
S1
S0
AD15 (A15)
AD7
AD14 (A14)
AD6
AD13 (A13)
AD5
AD12 (A12)
Ad4
Vcc
AD11 (A11)
AD3
AD10 (A10)
AD2
AD9 (A9)
AD1
AD8 (A8)
AD0
HLDA
HOLD
SRDY
LOCK
TEST
NMI
INT0
INT1
Vcc
INT2/INTA0
INT3/INTA1
DT/R
DEN
MCS0
MCS1
MCS2
MCS3
DRQ0
DRQ1
TMR IN0
TMR IN1
TMR OUT0
TMR OUT1
RES
PCS0
Vss
PCS1
PCS2
PCS3
PCS4
PCS5/A1
PCS6/A2
LCS
UCS

Fig.C.110

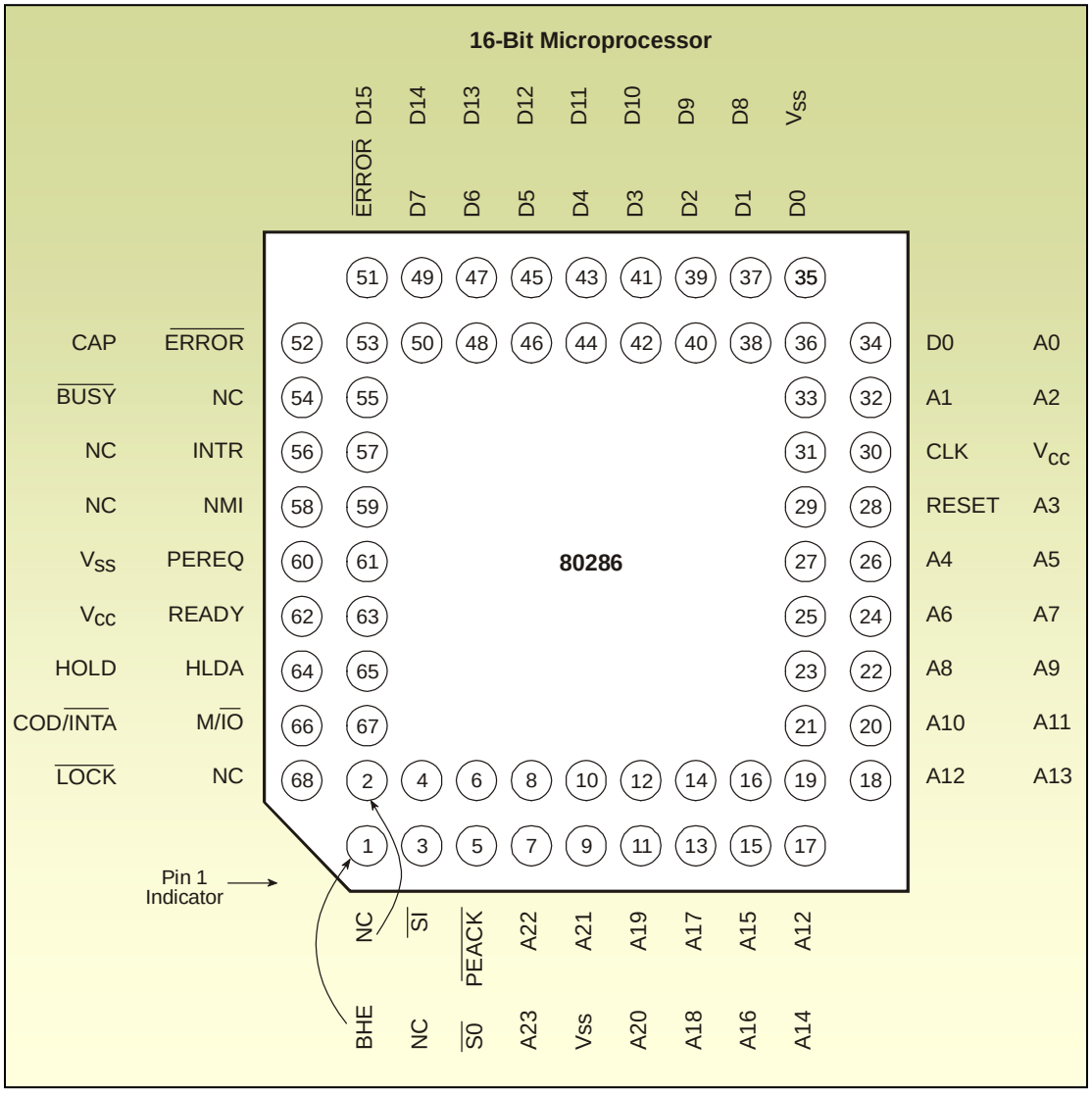
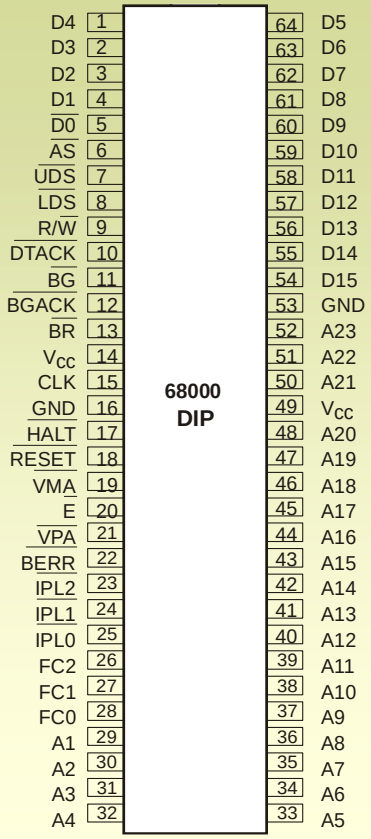
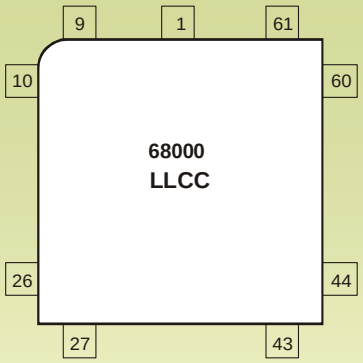

16-Bit Microprocessor
80286
D15
D14
D13
D12
D11
D10
D9
D8
Vss
ERROR
D7
D6
D5
D4
D3
D2
D1
D0
CAP
ERROR
BUSY
NC
NC
INTR
NC
NMI
Vss
PEREQ
Vcc
READY
HOLD
HLDA
COD/INTA
M/IO
LOCK
NC
D0
A0
A1
A2
CLK
Vcc
RESET
A3
A4
A5
A6
A7
A8
A9
A10
A11
A12
A13
Pin 1
Indicator
NC
SI
PEACK
A22
A21
A19
A17
A15
A12
BHE
NC
S0
A23
Vss
A20
A18
A16
A14

Fig.C.111

16 bit microprocessor

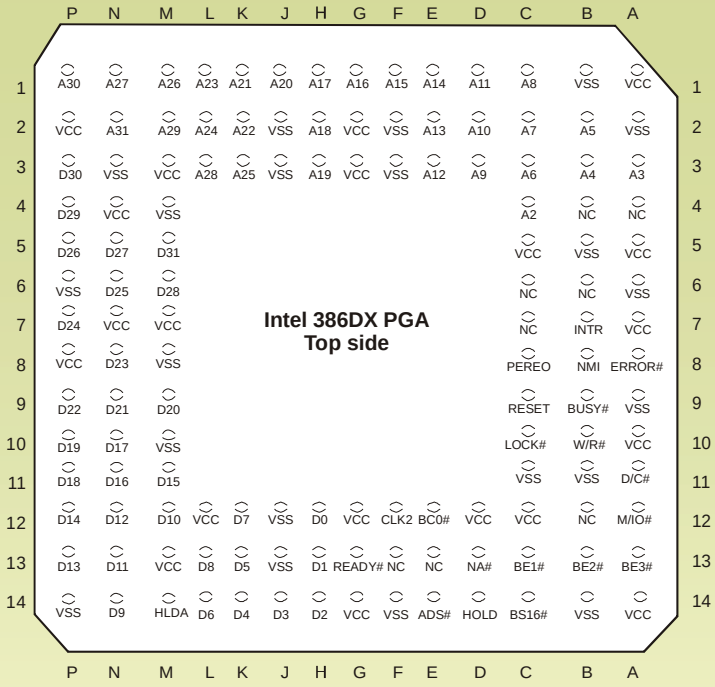




LLCC	Function	LLCC	Function
1	D4	35	A4
2	D3	36	A5
3	D2	37	A6
4	D1	38	A7
5	D0	39	A8
6	AS	40	A9
7	UDS	41	A10
8	LDS	42	A11
9	R/W	43	A12
10	DTACK	44	A13
11	BG	45	A14
12	BGACK	46	A15
13	BR	47	A16
14	Vcc	48	A17
15	CLK	49	A18
16	GND	50	A19
17	GND	51	A20
18	NC	52	Vcc
19	HALT	53	A21
20	RESET	54	A22
21	VMA	55	A23
22	E	56	GND
23	VPA	57	GND
24	BERR	58	D15
25	IPL2	59	D14
26	IPL1	60	D13
27	IPL0	61	D12
28	FC2	62	D11
29	FC1	63	D10
30	FC0	64	D9
31	NC	65	D8
32	A1	66	D7
33	A2	67	D6
34	A3	68	D5

Fig.C.112

32-Bit Microprocessor

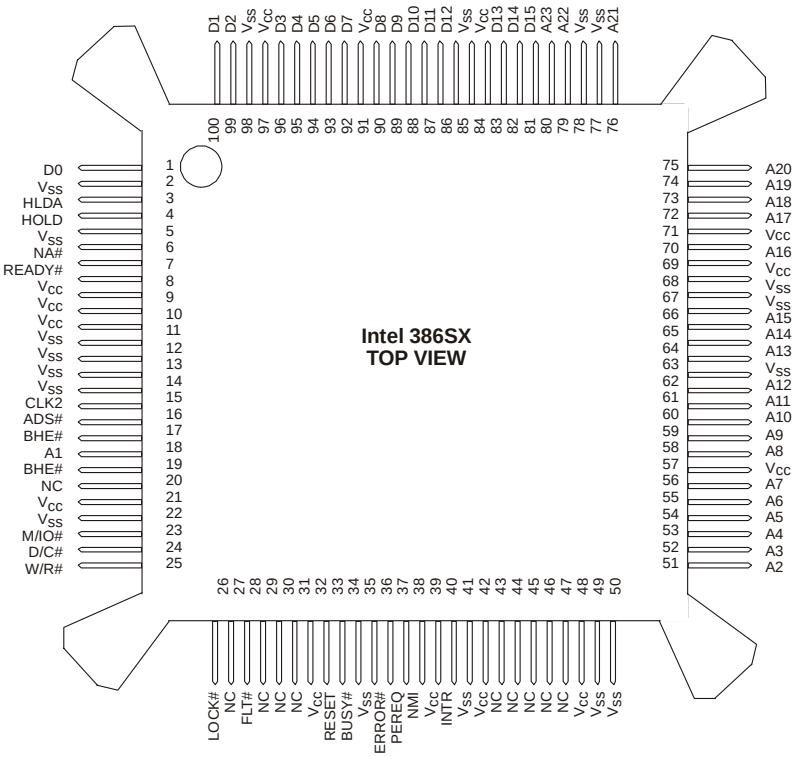


Intel 386DX PGA Pinout functional grouping

Signal/Pin		Signal/Pin		Signal/Pin		Signal/Pin		Signal/Pin		Signal/Pin	
A2	C4	A24	L2	D6	L14	D28	M6	Vcc	C12	Vss	F2
A3	A3	A25	K3	D7	K12	D29	P4		D12		F3
A4	B3	A26	M1	D8	L13	D30	P3		G2		F14
A5	B2	A27	N1	D9	N14	D31	M5		G3		J2
A6	C3	A28	L3	D10	M12	D/C#	A11		G12		J3
A7	C2	A29	M2	D11	N13	ERROR#	A8		G14		J12
A8	C1	A30	P1	D12	N12	HLDA	M14		L12		J13
A9	D3	A31	N2	D13	P13	HOLD	D14		M3		M4
A10	D2	ADS#	E14	D14	P12	INTR	B7		M7		M8
A11	D1	BE0#	E12	D15	M11	LOCK#	C10		M13		M10
A12	E3	BE1#	C13	D16	N11	M/IO#	A12		N4		N3
A13	E2	BE2#	B13	D17	N10	NA#	D13		N7		P6
A14	E1	BE3#	A13	D18	P11	NMI	B8		P2		P14
A15	F1	BS16#	C14	D19	P10	PEREQ	C8		P8	W/R#	B10
A16	G1	BUSY#	B9	D20	M9	READY#	G13	Vss	A2	N.C.	A4
A17	H1	CLK2	F12	D21	N9	RESET	C9		A6		B4
A18	H2	D0	H12	D22	P9	V_{CC}	A1		A9		B6
A19	H3	D1	H13	D23	N8		A5		B1		B12
A20	J1	D2	H14	D24	P7		A7		B5		C6
A21	K1	D3	J14	D25	N6		A10		B11		C7
A22	K2	D4	K14	D26	P5		A14		B14		E13
A23	L1	D5	K13	D27	N5		C5		C11		F13

Fig.C.113

32 bit microprocessor



Address		Data		Control		N/C	V_{CC}	V_{SS}
A1	18	D0	1	ADS#	16	20	8	2
A2	51	D1	100	BHE#	19	27	9	5
A3	52	D2	99	BLE#	17	29	10	11
A4	53	D3	96	BUSY#	34	30	21.	12
A5	54	D4	95	CLK2	15	31	32	13
A6	55	D5	94	D/C#	24	43	39	13
A7	56	D6	93	ERROR#	36	44	42	22
A8	58	D7	92	FLT#	28	45	48	35
A9	59	D8	90	HLDA	3	46	57	41
A10	60	D9	89	HOLD	4	47	69	49
A11	61	D10	88	INTR	40		71	50
A12	62	D11	87	LOCK#	26		84	63
A13	64	D12	86	M/IO#	23		91	67
A14	65	D13	83	NA#	6		97	68
A15	66	D14	82	NMI	38			77
A16	70	D15	81	PEREQ	37			78
A17	72			READY#	7			85
A18	73			RESET	33			98
A19	74			W/R#	25			
A20	75							
A21	76							
A22	79							
A23	80							

Fig.C.114

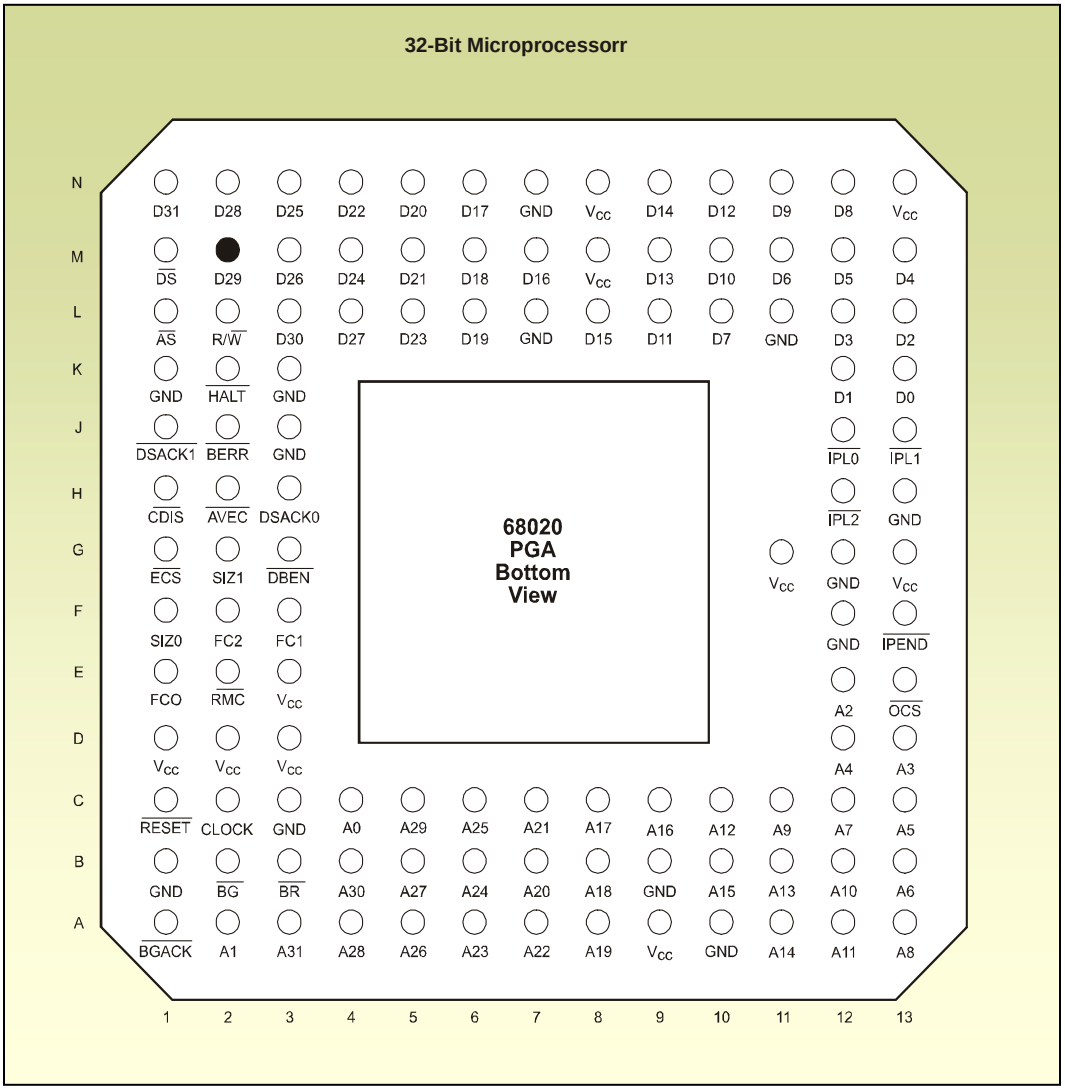

32-Bit Microprocessorr
68020
PGA
Bottom
View
N D31 D28 D25 D22 D20 D17 GND VCC D14 D12 D9 D8 VCC
M DS D29 D26 D24 D21 D18 D16 VCC D13 D10 D6 D5 D4
L AS R/W D30 D27 D23 D19 GND D15 D11 D7 GND D3 D2
K GND HALT GND D1 D0
J DSACK1 BERR GND IPL0 IPL1
H CDIS AVEC DSACK0 IPL2 GND
G ECS SIZ1 DBEN VCC GND VCC
F SIZ0 FC2 FC1 GND IPEND
E FC0 RMC VCC A2 OCS
D VCC VCC VCC A4 A3
C RESET CLOCK GND A0 A29 A25 A21 A17 A16 A12 A9 A7 A5
B GND BG BR A30 A27 A24 A20 A18 GND A15 A13 A10 A6
A BGACK A1 A31 A28 A26 A23 A22 A19 VCC GND A14 A11 A8
1 2 3 4 5 6 7 8 9 10 11 12 13

Fig.C.115

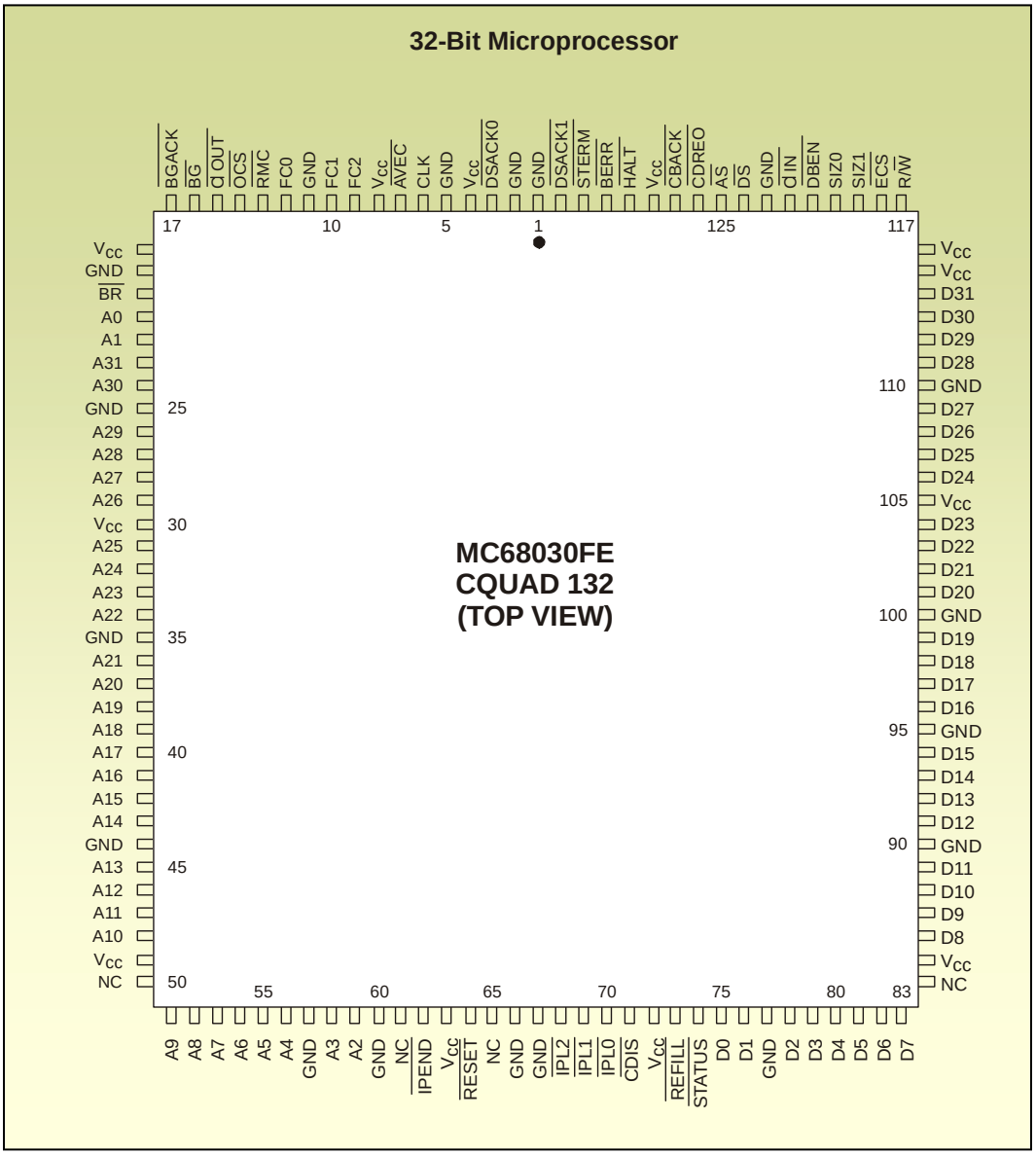

32-Bit Microprocessor
MC68030FE
CQUAD 132
(TOP VIEW)
BGACK
BG
OUT
OCS
RMC
FC0
GND
FC1
FC2
Vcc
AVEC
CLK
GND
Vcc
DSACK0
GND
GND
DSACK1
STERM
BERR
HALT
Vcc
CBACK
CDREO
AS
DS
GND
IN
DBEN
SIZ0
SIZ1
ECS
R/W
17
10
5
1
125
117
Vcc
GND
BR
A0
A1
A31
A30
GND
A29
A28
A27
A26
Vcc
A25
A24
A23
A22
GND
A21
A20
A19
A18
A17
A16
A15
A14
GND
A13
A12
A11
A10
Vcc
NC
25
30
35
40
45
50
Vcc
Vcc
D31
D30
D29
D28
GND
D27
D26
D25
D24
Vcc
D23
D22
D21
D20
GND
D19
D18
D17
D16
GND
D15
D14
D13
D12
GND
D11
D10
D9
D8
Vcc
NC
110
105
100
95
90
83
55
60
65
70
75
80
A9
A8
A7
A6
A5
A4
GND
A3
A2
GND
NC
IPEND
Vcc
RESET
NC
GND
GND
IPL2
IPL1
IPL0
CDIS
Vcc
REFILL
STATUS
D0
D1
GND
D2
D3
D4
D5
D6
D7

Fig.C.116

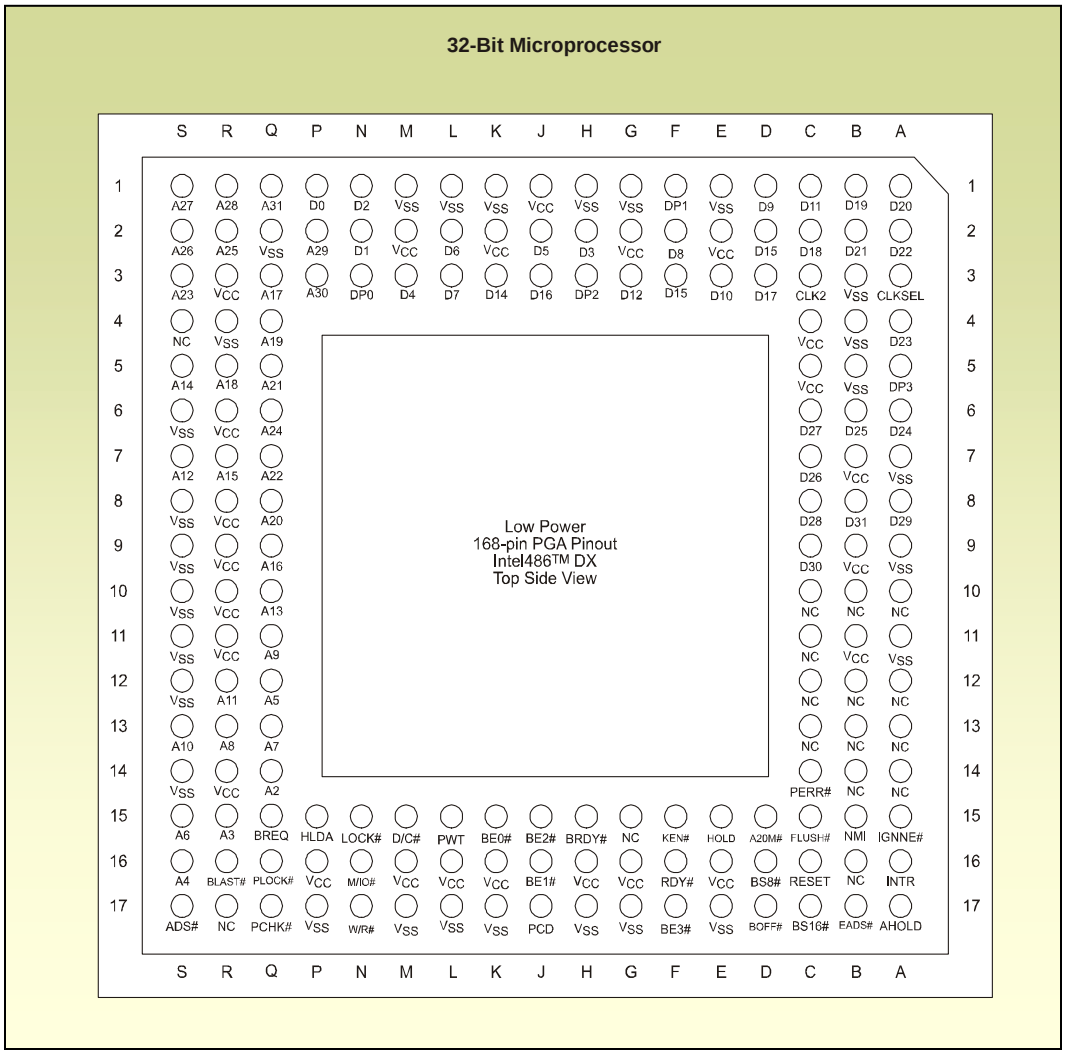

32-Bit Microprocessor
S R Q P N M L K J H G F E D C B A
1 A27 A28 A31 D0 D2 VSS VSS VSS VCC VSS VSS DP1 VSS D9 D11 D19 D20 1
2 A26 A25 VSS A29 D1 VCC D6 VCC D5 D3 VCC D8 VCC D15 D18 D21 D22 2
3 A23 VCC A17 A30 DP0 D4 D7 D14 D16 DP2 D12 D15 D10 D17 CLK2 VSS CLKSEL 3
4 NC VSS A19 VCC VSS D23 4
5 A14 A18 A21 VCC VSS DP3 5
6 VSS VCC A24 D27 D25 D24 6
7 A12 A15 A22 D26 VCC VSS 7
8 VSS VCC A20 D28 D31 D29 8
9 VSS VCC A16 D30 VCC VSS 9
10 VSS VCC A13 NC NC NC 10
11 VSS VCC A9 NC VCC VSS 11
12 VSS A11 A5 NC NC NC 12
13 A10 A8 A7 NC NC NC 13
14 VSS VCC A2 PERR# NC NC 14
15 A6 A3 BREQ HLDA LOCK# D/C# PWT BE0# BE2# BRDY# NC KEN# HOLD A20M# FLUSH# NMI IGNNE# 15
16 A4 BLAST# PLOCK# VCC M/IO# VCC VCC VCC BE1# VCC VCC RDY# VCC BS8# RESET NC INTR 16
17 ADS# NC PCHK# VSS W/R# VSS VSS VSS PCD VSS VSS BE3# VSS BOFF# BS16# EADS# AHOLD 17
S R Q P N M L K J H G F E D C B A
Low Power
168-pin PGA Pinout
Intel486™ DX
Top Side View

Fig.C.117

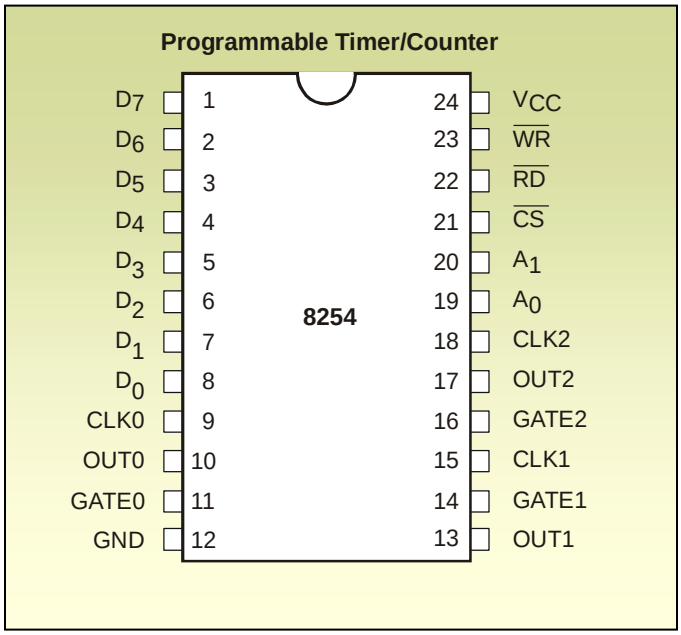


Fig.C.118

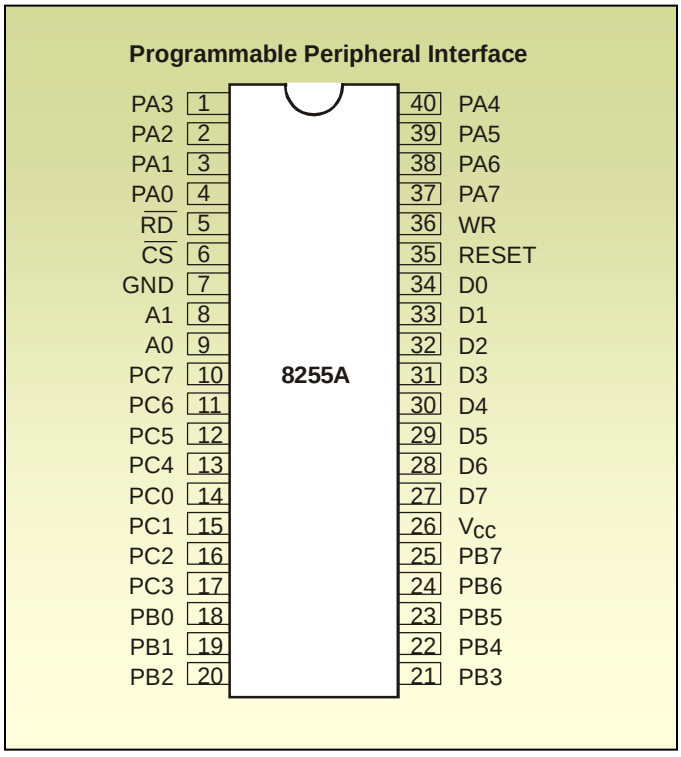


Fig.C.119

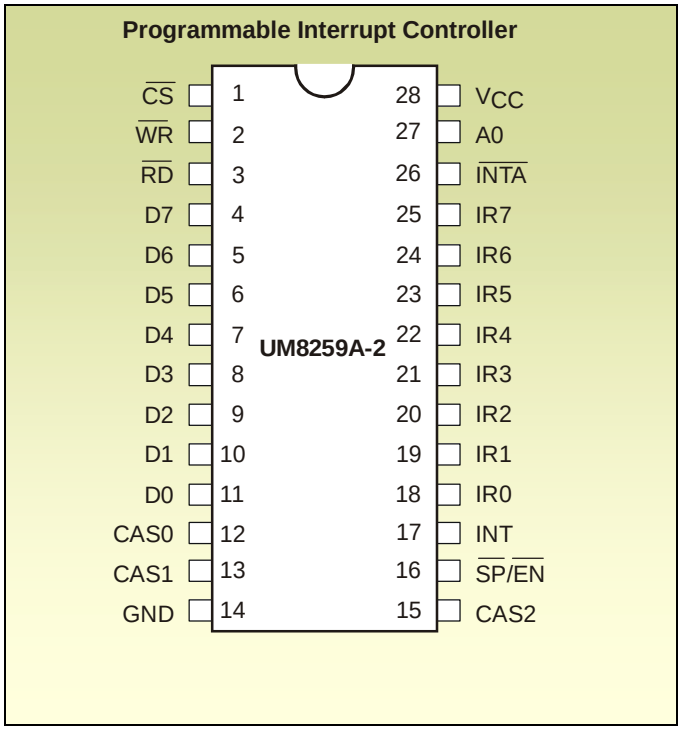


Fig.C.120

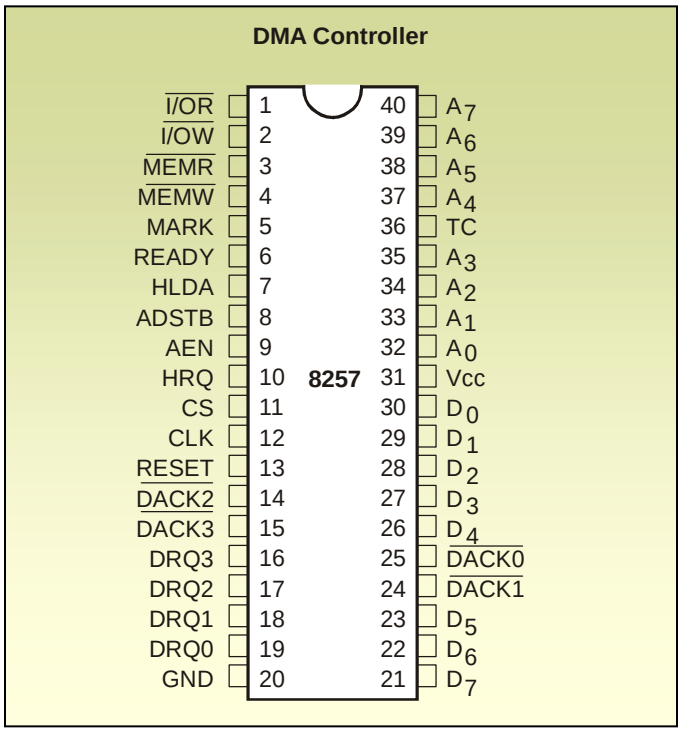


Fig.C.121

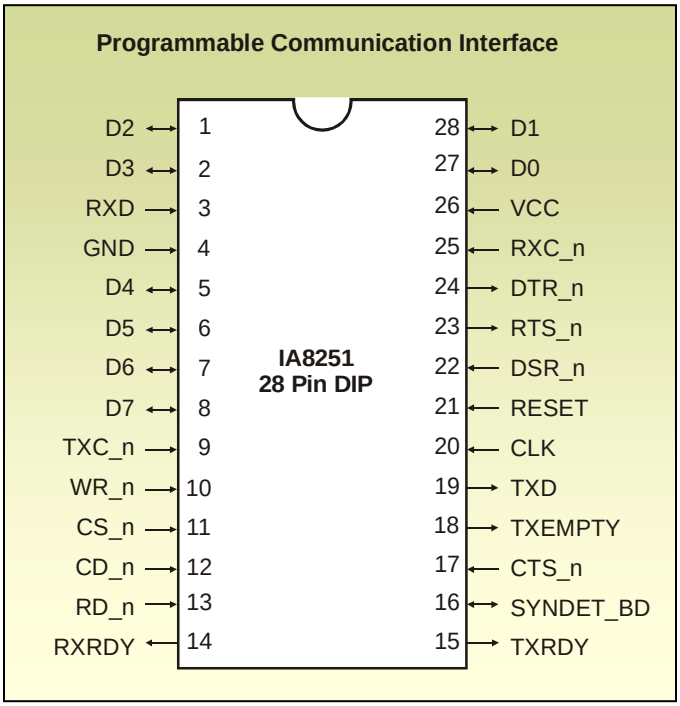


Fig.C.122

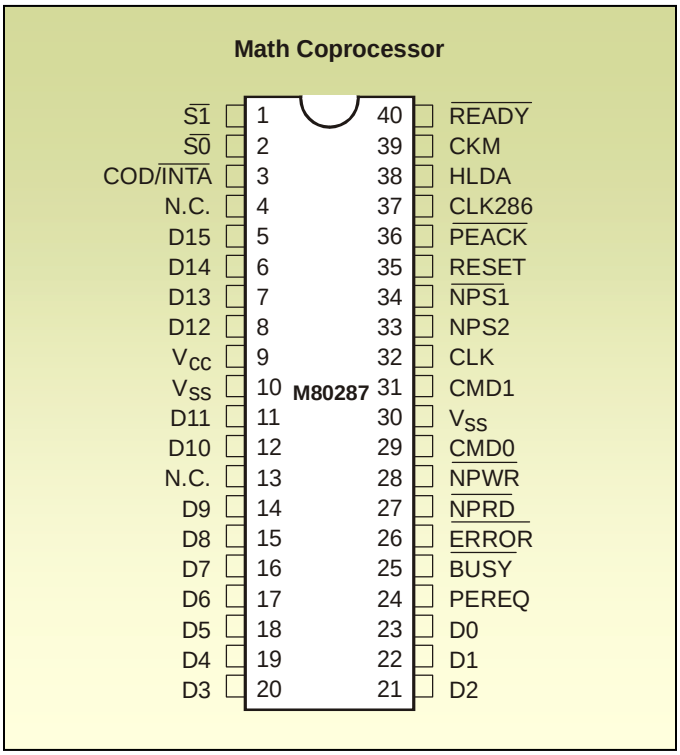


Fig.C.123

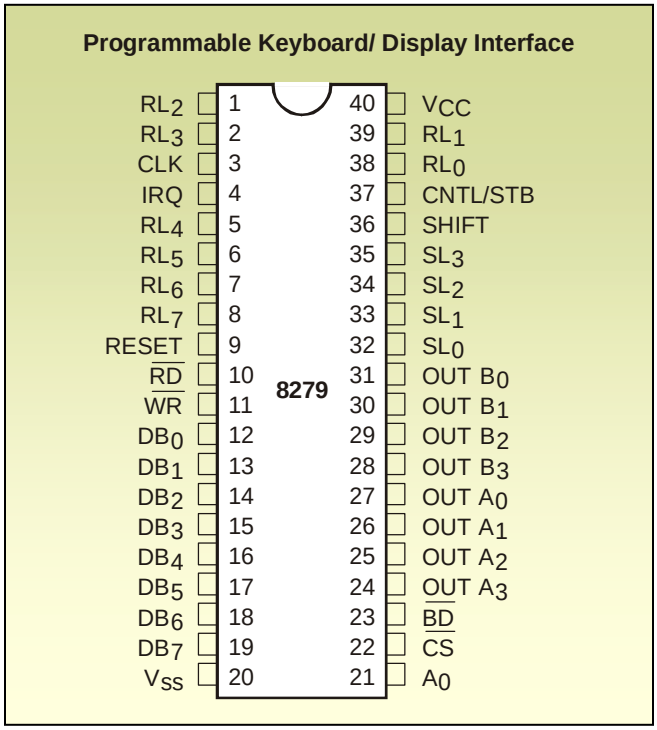


Fig.C.124

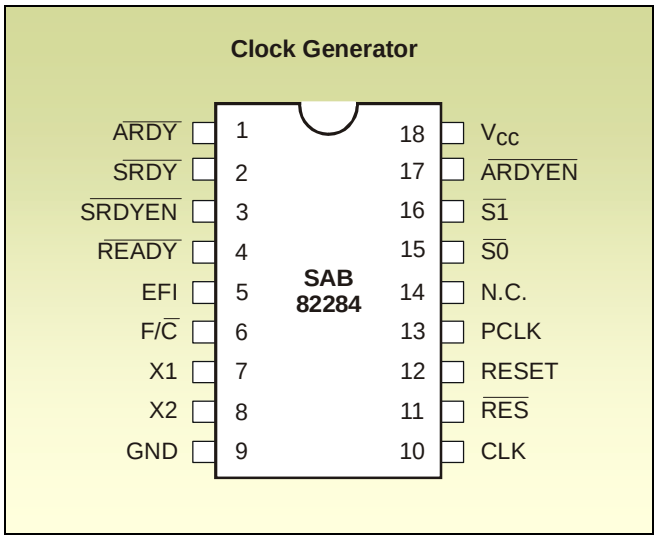


Fig.C.125

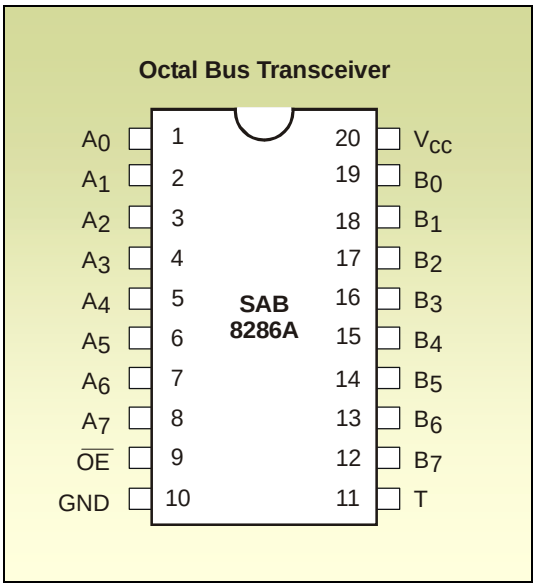

Octal Bus Transceiver
SAB
8286A
A0 1
A1 2
A2 3
A3 4
A4 5
A5 6
A6 7
A7 8
OE 9
GND 10
20 Vcc
19 B0
18 B1
17 B2
16 B3
15 B4
14 B5
13 B6
12 B7
11 T

Fig.C.126

18. Pin connection diagrams and other relevant application information on microcontrollers

Figs.C.127 to C.137 give the pin connection diagram and other application relevant information of some of the popular microcontrollers. (Microcontrollers are discussed in detail in chapter-14 of the book).

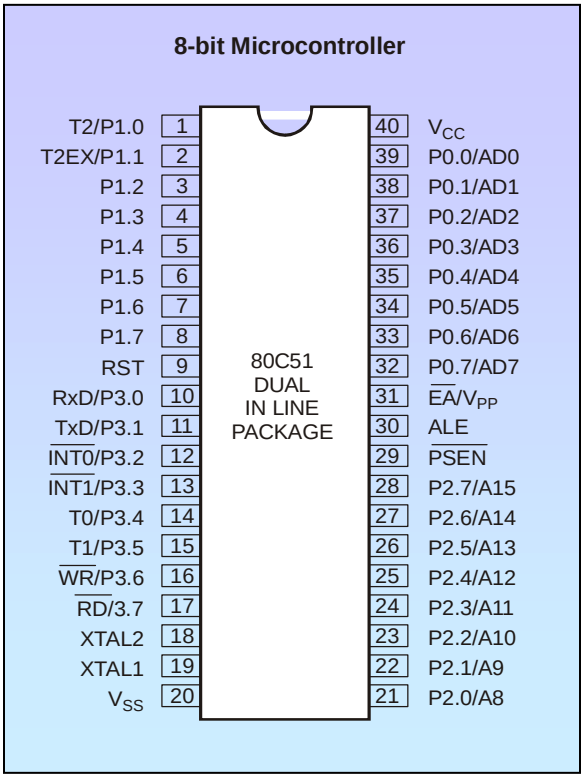
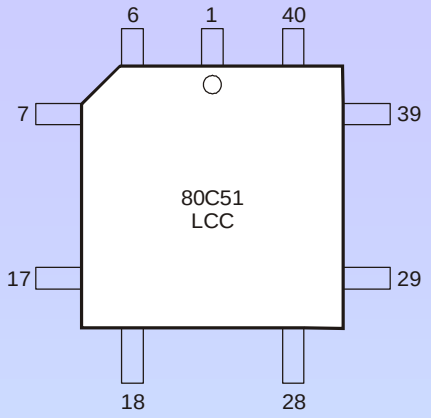


Fig.C.127

8-bit Microcontroller

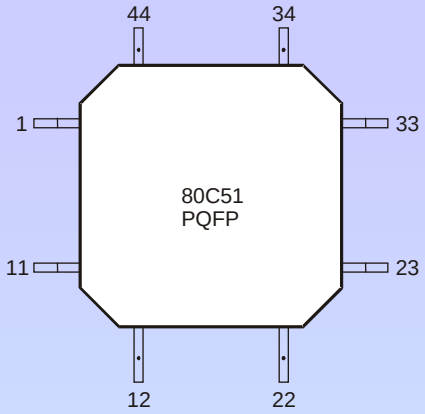


Pin	Function	Pin	Function	Pin	Function
1	NIC*	16	P3.4/T0	31	P2.7/A15
2	P1.0/T2	17	P3.5/T1	32	$\overline{PSEN}$
3	P1.1/T2EX	18	P3.6/$\overline{WR}$	33	ALE
4	P1.2	19	P3.7/$\overline{RD}$	34	NIC*
5	P1.3	20	XTAL2	35	$\overline{EA}/V_{PP}$
6	P1.4	21	XTAL1	36	P0.7/AD7
7	P1.5	22	VSS	37	P0.6/AD6
8	P1.6	23	NIC*	38	P0.5/AD5
9	P1.7	24	P2.0/A8	39	P0.4/AD4
10	RST	25	P1.1/A9	40	P0.3/AD3
11	P3.0/RxD	26	P2.2/A10	41	P0.2/AD2
12	NIC*	27	P3.3/A11	42	P0.1/AD1
13	P3.1/$\overline{RxD}$	28	P4.4/A12	43	P0.0/AD0
14	P3.2/$\overline{INT0}$	29	P5.5/A13	44	V_{CC}
15	P3.3/$\overline{INT1}$	30	P6.6/A14		

*NO INTERNAL CONNECTION

Fig.C.128

8-bit Microcontroller



Pin	Function	Pin	Function	Pin	Function
1	P1.5	16	V_{SS}	31	P0.6/AD6
2	P2.6	17	NIC*	32	P0.5/AD5
3	P3.7	18	P2.0/A8	33	P0.4/AD4
4	RST	19	P2.1/A9	34	P0.3/AD3
5	P3.0/RxD	20	P2.2/A10	35	P0.2/AD2
6	NIC*	21	P2.3/A11	36	P0.1/AD1
7	P3.1/TxD	22	P2.4/A12	37	P0.0/AD0
8	P3.2/$\overline{INT0}$	23	P2.5/A13	38	V_{CC}
9	P3.3/$\overline{INT1}$	24	P2.6/A14	39	NIC*
10	P3.4/T0	25	P2.7/A15	40	P1.0/T2
11	P3.5/T1	26	$\overline{PSEN}$	41	P1.1/T2EX
12	P3.6/$\overline{WR}$	27	ALE	42	P1.2
13	P3.7/$\overline{RD}$	28	NIC*	43	P1.3
14	XTAL2	29	$\overline{EA}/V_{PP}$	44	P1.4
15	XTAL1	30	P0.7/AD7		

*NO INTERNAL CONNECTION

Fig.C.129

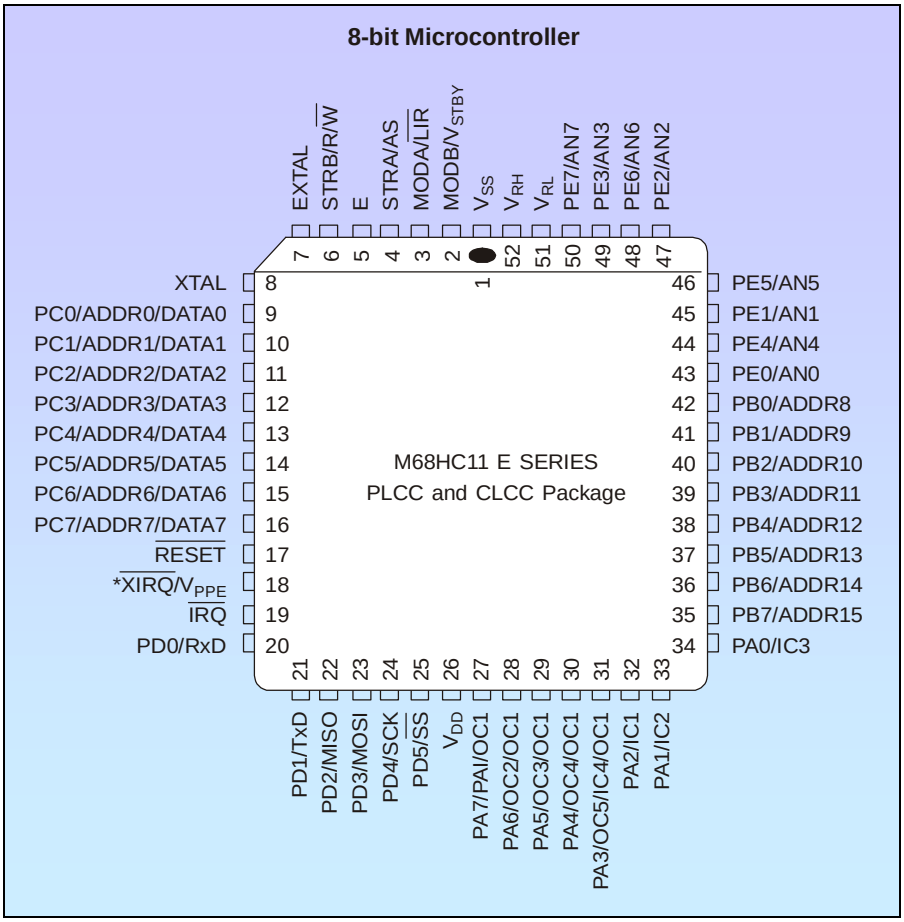

8-bit Microcontroller
EXTAL 7
STRB/R/W 6
E 5
STRA/AS 4
MODA/LIR 3
MODB/VSTBY 2
VSS 1
VRH 52
VRL 51
PE7/AN7 50
PE3/AN3 49
PE6/AN6 48
PE2/AN2 47
XTAL 8
PC0/ADDR0/DATA0 9
PC1/ADDR1/DATA1 10
PC2/ADDR2/DATA2 11
PC3/ADDR3/DATA3 12
PC4/ADDR4/DATA4 13
PC5/ADDR5/DATA5 14
PC6/ADDR6/DATA6 15
PC7/ADDR7/DATA7 16
RESET 17
*XIRQ/VPPE 18
IRQ 19
PD0/RxD 20
46 PE5/AN5
45 PE1/AN1
44 PE4/AN4
43 PE0/AN0
42 PB0/ADDR8
41 PB1/ADDR9
40 PB2/ADDR10
39 PB3/ADDR11
38 PB4/ADDR12
37 PB5/ADDR13
36 PB6/ADDR14
35 PB7/ADDR15
34 PA0/IC3
M68HC11 E SERIES
PLCC and CLCC Package
21 PD1/TxD
22 PD2/MISO
23 PD3/MOSI
24 PD4/SCK
25 PD5/SS
26 VDD
27 PA7/PAI/OC1
28 PA6/OC2/OC1
29 PA5/OC3/OC1
30 PA4/OC4/OC1
31 PA3/OC5/IC4/OC1
32 PA2/IC1
33 PA1/IC2

Fig.C.130

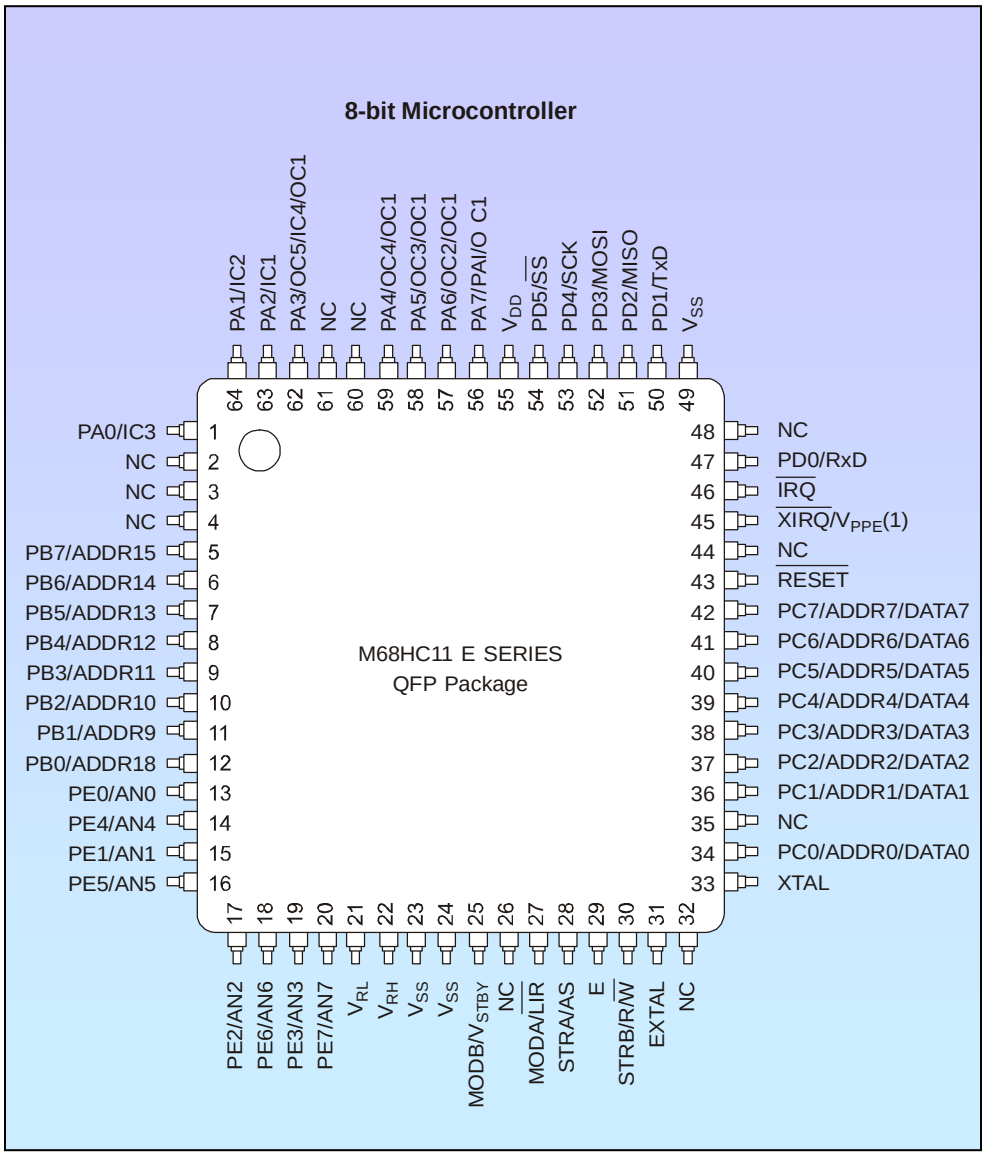

8-bit Microcontroller
M68HC11 E SERIES
QFP Package
1 PA0/IC3
2 NC
3 NC
4 NC
5 PB7/ADDR15
6 PB6/ADDR14
7 PB5/ADDR13
8 PB4/ADDR12
9 PB3/ADDR11
10 PB2/ADDR10
11 PB1/ADDR9
12 PB0/ADDR18
13 PE0/AN0
14 PE4/AN4
15 PE1/AN1
16 PE5/AN5
17 PE2/AN2
18 PE6/AN6
19 PE3/AN3
20 PE7/AN7
21 VRL
22 VRH
23 VSS
24 VSS
25 MODB/VSTBY
26 NC
27 MODA/LIR
28 STRA/AS
29 E
30 STRB/R/W
31 EXTAL
32 NC
33 XTAL
34 PC0/ADDR0/DATA0
35 NC
36 PC1/ADDR1/DATA1
37 PC2/ADDR2/DATA2
38 PC3/ADDR3/DATA3
39 PC4/ADDR4/DATA4
40 PC5/ADDR5/DATA5
41 PC6/ADDR6/DATA6
42 PC7/ADDR7/DATA7
43 RESET
44 NC
45 XIRQ/VPPE(1)
46 IRQ
47 PD0/RxD
48 NC
49 VSS
50 PD1/TxD
51 PD2/MISO
52 PD3/MOSI
53 PD4/SCK
54 PD5/SS
55 VDD
56 PA7/PAI/O C1
57 PA6/OC2/OC1
58 PA5/OC3/OC1
59 PA4/OC4/OC1
60 NC
61 NC
62 PA3/OC5/IC4/OC1
63 PA2/IC1
64 PA1/IC2

Fig.C.131

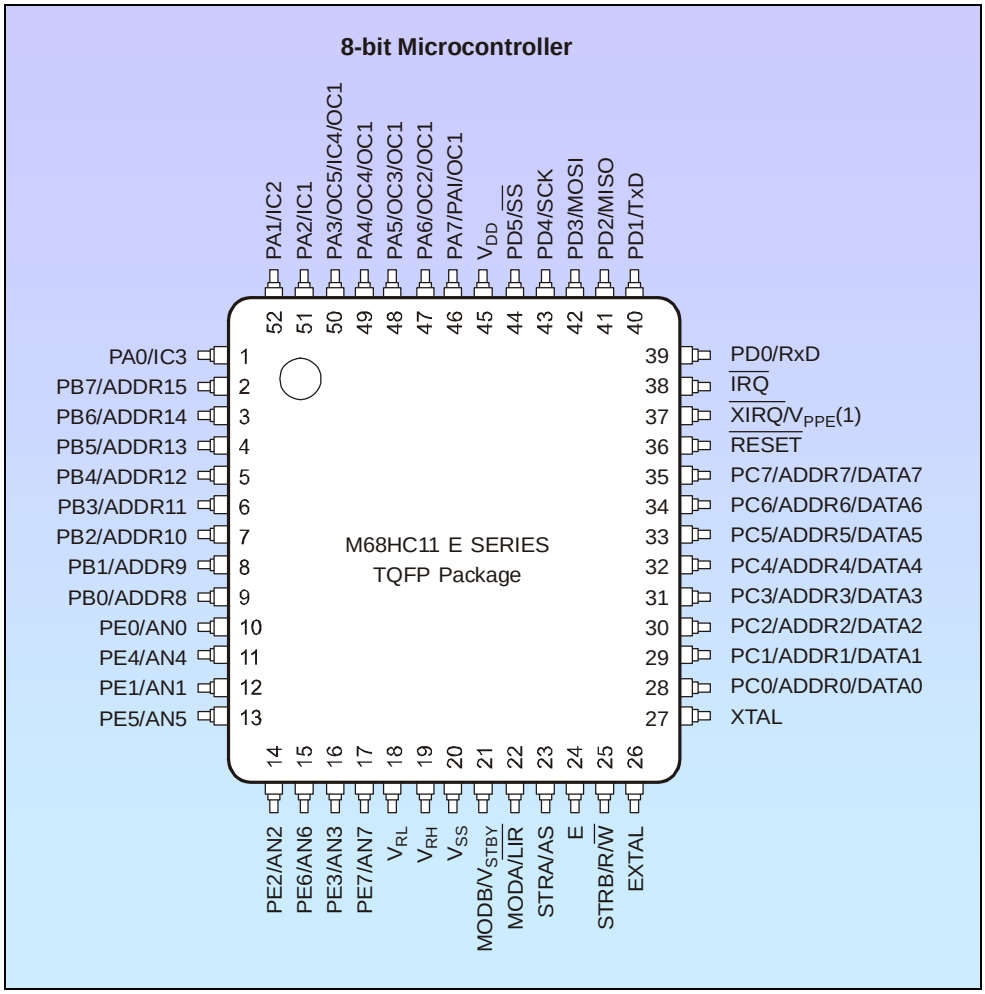

8-bit Microcontroller
M68HC11 E SERIES
TQFP Package
PA0/IC3 1
PB7/ADDR15 2
PB6/ADDR14 3
PB5/ADDR13 4
PB4/ADDR12 5
PB3/ADDR11 6
PB2/ADDR10 7
PB1/ADDR9 8
PB0/ADDR8 9
PE0/AN0 10
PE4/AN4 11
PE1/AN1 12
PE5/AN5 13
14 PE2/AN2
15 PE6/AN6
16 PE3/AN3
17 PE7/AN7
18 VRL
19 VRH
20 VSS
21 MODB/VSTBY
22 MODA/LIR
23 STRA/AS
24 E
25 STRB/R/W
26 EXTAL
27 XTAL
28 PC0/ADDR0/DATA0
29 PC1/ADDR1/DATA1
30 PC2/ADDR2/DATA2
31 PC3/ADDR3/DATA3
32 PC4/ADDR4/DATA4
33 PC5/ADDR5/DATA5
34 PC6/ADDR6/DATA6
35 PC7/ADDR7/DATA7
36 RESET
37 XIRQ/VPPE(1)
38 IRQ
39 PD0/RxD
40 PD1/TxD
41 PD2/MISO
42 PD3/MOSI
43 PD4/SCK
44 PD5/SS
45 VDD
46 PA7/PAI/OC1
47 PA6/OC2/OC1
48 PA5/OC3/OC1
49 PA4/OC4/OC1
50 PA3/OC5/IC4/OC1
51 PA2/IC1
52 PA1/IC2

Fig.C.132

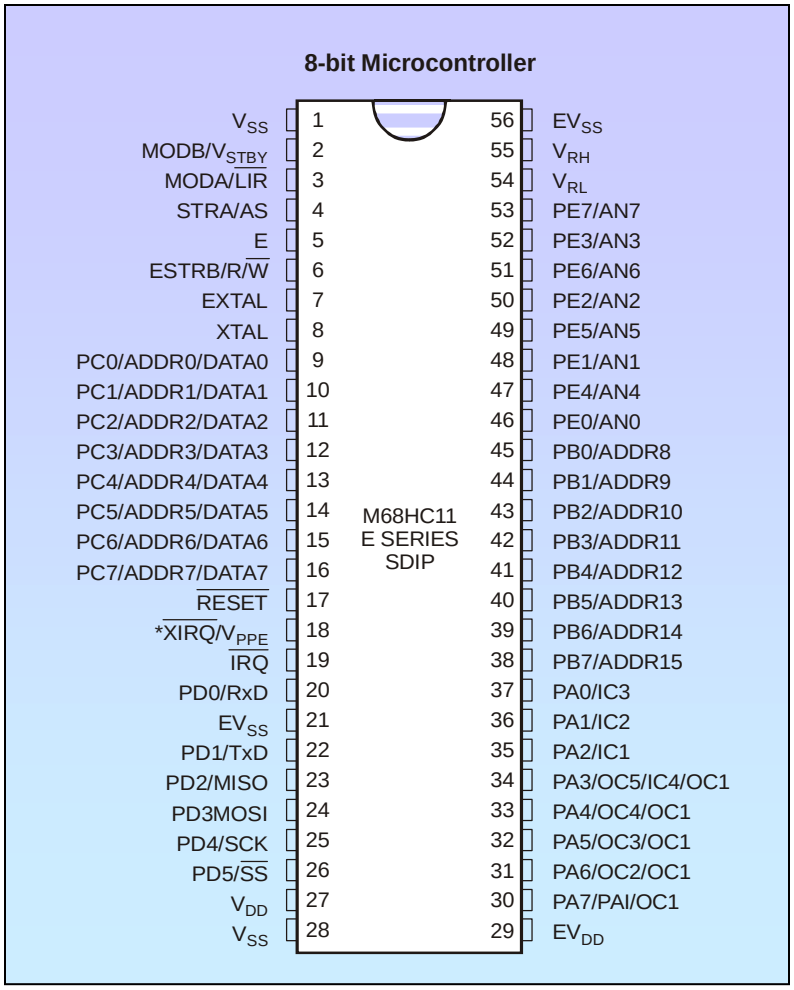

8-bit Microcontroller
V_{SS} 1
MODB/V_{STBY} 2
MODA/LIR 3
STRA/AS 4
E 5
ESTRB/R/$\overline{W}$ 6
EXTAL 7
XTAL 8
PC0/ADDR0/DATA0 9
PC1/ADDR1/DATA1 10
PC2/ADDR2/DATA2 11
PC3/ADDR3/DATA3 12
PC4/ADDR4/DATA4 13
PC5/ADDR5/DATA5 14
PC6/ADDR6/DATA6 15
PC7/ADDR7/DATA7 16
$\overline{RESET}$ 17
*$\overline{XIRQ}$/V_{PPE} 18
$\overline{IRQ}$ 19
PD0/RxD 20
EV_{SS} 21
PD1/TxD 22
PD2/MISO 23
PD3MOSI 24
PD4/SCK 25
PD5/$\overline{SS}$ 26
V_{DD} 27
V_{SS} 28
M68HC11
E SERIES
SDIP
56 EV_{SS}
55 V_{RH}
54 V_{RL}
53 PE7/AN7
52 PE3/AN3
51 PE6/AN6
50 PE2/AN2
49 PE5/AN5
48 PE1/AN1
47 PE4/AN4
46 PE0/AN0
45 PB0/ADDR8
44 PB1/ADDR9
43 PB2/ADDR10
42 PB3/ADDR11
41 PB4/ADDR12
40 PB5/ADDR13
39 PB6/ADDR14
38 PB7/ADDR15
37 PA0/IC3
36 PA1/IC2
35 PA2/IC1
34 PA3/OC5/IC4/OC1
33 PA4/OC4/OC1
32 PA5/OC3/OC1
31 PA6/OC2/OC1
30 PA7/PAI/OC1
29 EV_{DD}

Fig.C.133

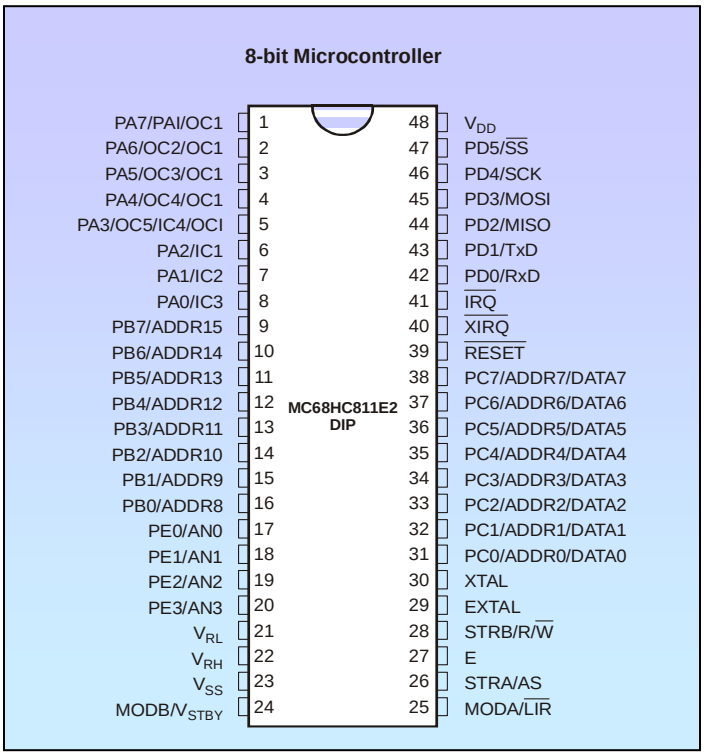


Fig.C.134

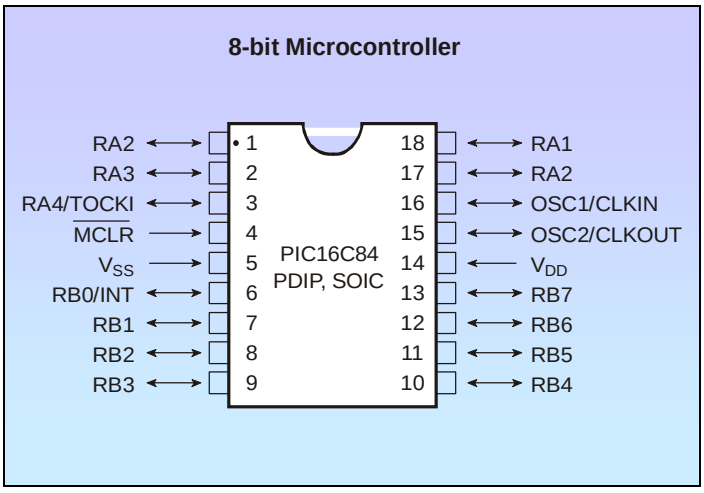


Fig.C.135

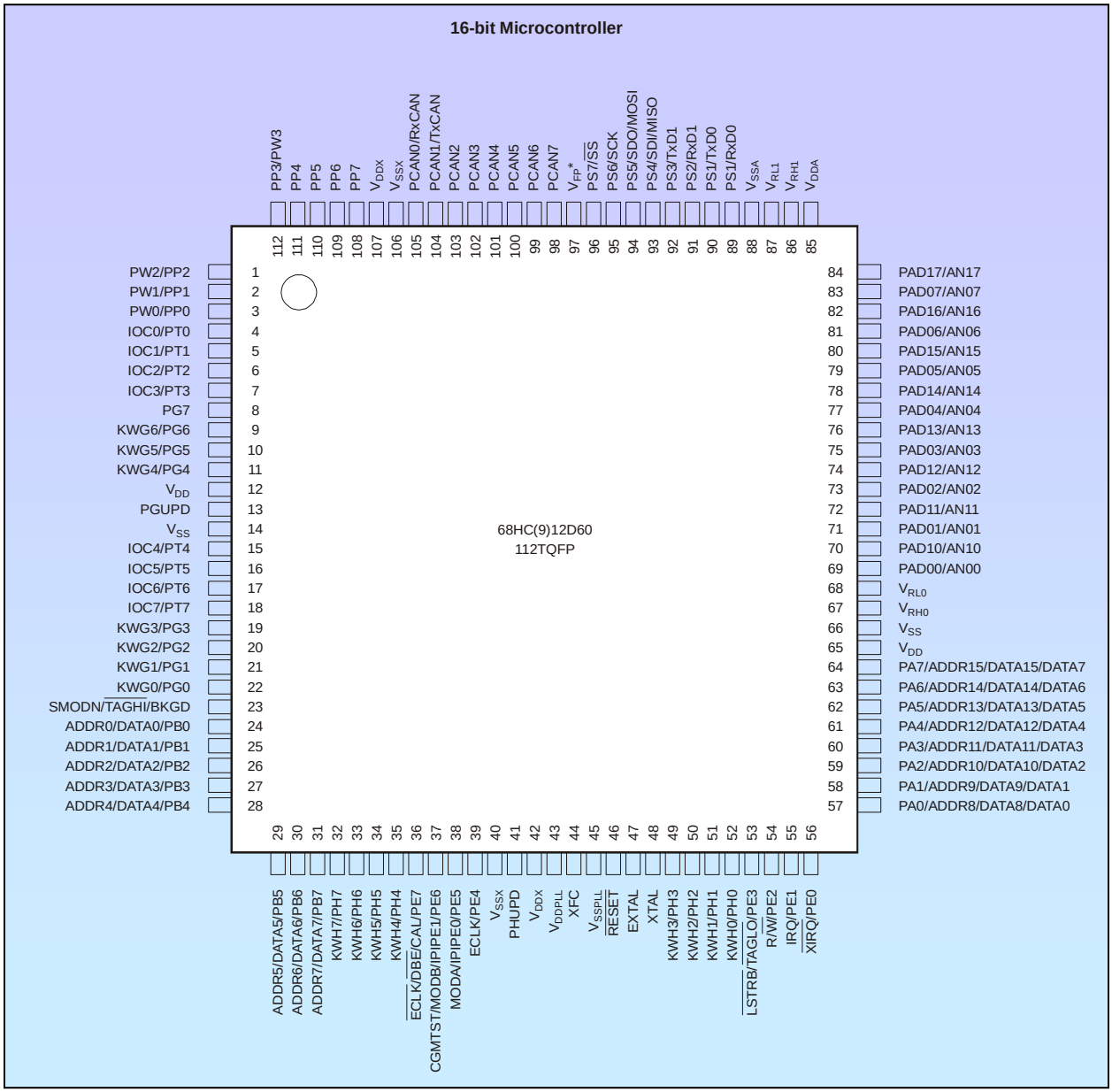
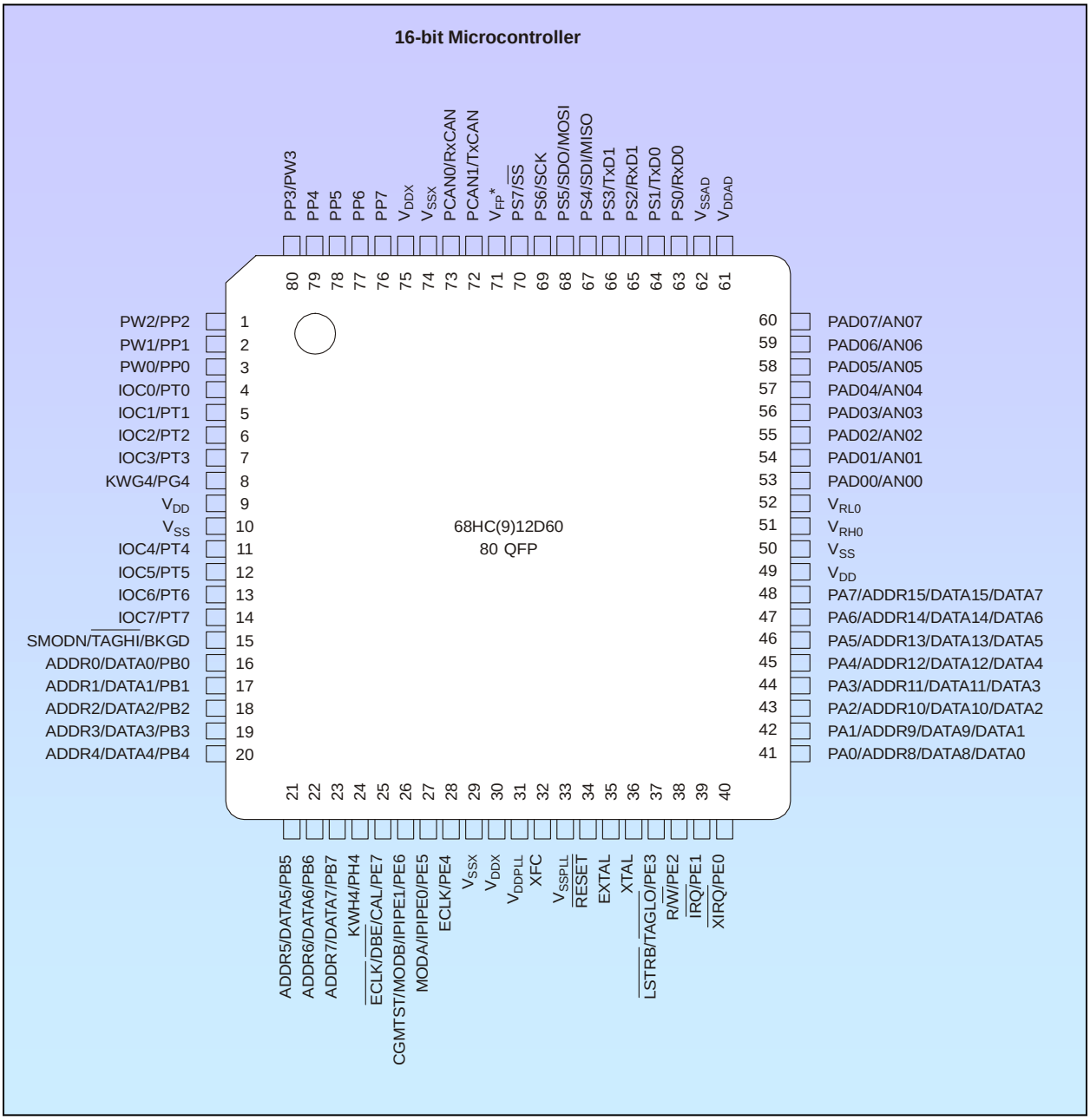

16-bit Microcontroller
68HC(9)12D60
112TQFP
1 PW2/PP2
2 PW1/PP1
3 PW0/PP0
4 IOC0/PT0
5 IOC1/PT1
6 IOC2/PT2
7 IOC3/PT3
8 PG7
9 KWG6/PG6
10 KWG5/PG5
11 KWG4/PG4
12 VDD
13 PGUPD
14 VSS
15 IOC4/PT4
16 IOC5/PT5
17 IOC6/PT6
18 IOC7/PT7
19 KWG3/PG3
20 KWG2/PG2
21 KWG1/PG1
22 KWG0/PG0
23 SMODN/TAGHI/BKGD
24 ADDR0/DATA0/PB0
25 ADDR1/DATA1/PB1
26 ADDR2/DATA2/PB2
27 ADDR3/DATA3/PB3
28 ADDR4/DATA4/PB4
29 ADDR5/DATA5/PB5
30 ADDR6/DATA6/PB6
31 ADDR7/DATA7/PB7
32 KWH7/PH7
33 KWH6/PH6
34 KWH5/PH5
35 KWH4/PH4
36 ECLK/DBE/CAL/PE7
37 CGMTST/MODB/IPIPE1/PE6
38 MODA/IPIPE0/PE5
39 ECLK/PE4
40 VSSX
41 PHUPD
42 VDDX
43 VDDPLL
44 XFC
45 VSSPLL
46 RESET
47 EXTAL
48 XTAL
49 KWH3/PH3
50 KWH2/PH2
51 KWH1/PH1
52 KWH0/PH0
53 LSTRB/TAGLO/PE3
54 R/W/PE2
55 IRQ/PE1
56 XIRQ/PE0
57 PA0/ADDR8/DATA8/DATA0
58 PA1/ADDR9/DATA9/DATA1
59 PA2/ADDR10/DATA10/DATA2
60 PA3/ADDR11/DATA11/DATA3
61 PA4/ADDR12/DATA12/DATA4
62 PA5/ADDR13/DATA13/DATA5
63 PA6/ADDR14/DATA14/DATA6
64 PA7/ADDR15/DATA15/DATA7
65 VDD
66 VSS
67 VRH0
68 VRL0
69 PAD00/AN00
70 PAD10/AN10
71 PAD01/AN01
72 PAD11/AN11
73 PAD02/AN02
74 PAD12/AN12
75 PAD03/AN03
76 PAD13/AN13
77 PAD04/AN04
78 PAD14/AN14
79 PAD05/AN05
80 PAD15/AN15
81 PAD06/AN06
82 PAD16/AN16
83 PAD07/AN07
84 PAD17/AN17
85 VDDA
86 VRH1
87 VRL1
88 VSSA
89 PS1/RxD0
90 PS1/TxD0
91 PS2/RxD1
92 PS3/TxD1
93 PS4/SDI/MISO
94 PS5/SDO/MOSI
95 PS6/SCK
96 PS7/SS
97 VFP*
98 PCAN7
99 PCAN6
100 PCAN5
101 PCAN4
102 PCAN3
103 PCAN2
104 PCAN1/TxCAN
105 PCAN0/RxCAN
106 VSSX
107 VDDX
108 PP7
109 PP6
110 PP5
111 PP4
112 PP3/PW3

Fig.C.136


16-bit Microcontroller
68HC(9)12D60
80 QFP
1 PW2/PP2
2 PW1/PP1
3 PW0/PP0
4 IOC0/PT0
5 IOC1/PT1
6 IOC2/PT2
7 IOC3/PT3
8 KWG4/PG4
9 VDD
10 VSS
11 IOC4/PT4
12 IOC5/PT5
13 IOC6/PT6
14 IOC7/PT7
15 SMODN/TAGHI/BKGD
16 ADDR0/DATA0/PB0
17 ADDR1/DATA1/PB1
18 ADDR2/DATA2/PB2
19 ADDR3/DATA3/PB3
20 ADDR4/DATA4/PB4
21 ADDR5/DATA5/PB5
22 ADDR6/DATA6/PB6
23 ADDR7/DATA7/PB7
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27 MODA/IPIPE0/PE5
28 ECLK/PE4
29 VSSX
30 VDDX
31 VDDPLL
32 XFC
33 VSSPLL
34 RESET
35 EXTAL
36 XTAL
37 LSTRB/TAGLO/PE3
38 R/W/PE2
39 IRQ/PE1
40 XIRQ/PE0
41 PA0/ADDR8/DATA8/DATA0
42 PA1/ADDR9/DATA9/DATA1
43 PA2/ADDR10/DATA10/DATA2
44 PA3/ADDR11/DATA11/DATA3
45 PA4/ADDR12/DATA12/DATA4
46 PA5/ADDR13/DATA13/DATA5
47 PA6/ADDR14/DATA14/DATA6
48 PA7/ADDR15/DATA15/DATA7
49 VDD
50 VSS
51 VRH0
52 VRL0
53 PAD00/AN00
54 PAD01/AN01
55 PAD02/AN02
56 PAD03/AN03
57 PAD04/AN04
58 PAD05/AN05
59 PAD06/AN06
60 PAD07/AN07
61 VDDAD
62 VSSAD
63 PS0/RxD0
64 PS1/TxD0
65 PS2/RxD1
66 PS3/TxD1
67 PS4/SDI/MISO
68 PS5/SDO/MOSI
69 PS6/SCK
70 PS7/SS
71 VFP*
72 PCAN1/TxCAN
73 PCAN0/RxCAN
74 VSSX
75 VDDX
76 PP7
77 PP6
78 PP5
79 PP4
80 PP3/PW3

Fig.C.137