Personal Computer Hardware Reference Library

IBM Expansion Unit

6361468

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Description

The IBM Expansion Unit option enhances the system unit by adding expansion slots in a separate unit. This option consists of an extender card, expansion unit cable, and the expansion unit. The expansion unit contains a power supply, an expansion board, and a receiver card. This option utilizes one expansion slot in the system unit to provide seven additional expansion slots in the expansion unit.

Expansion Unit Cable

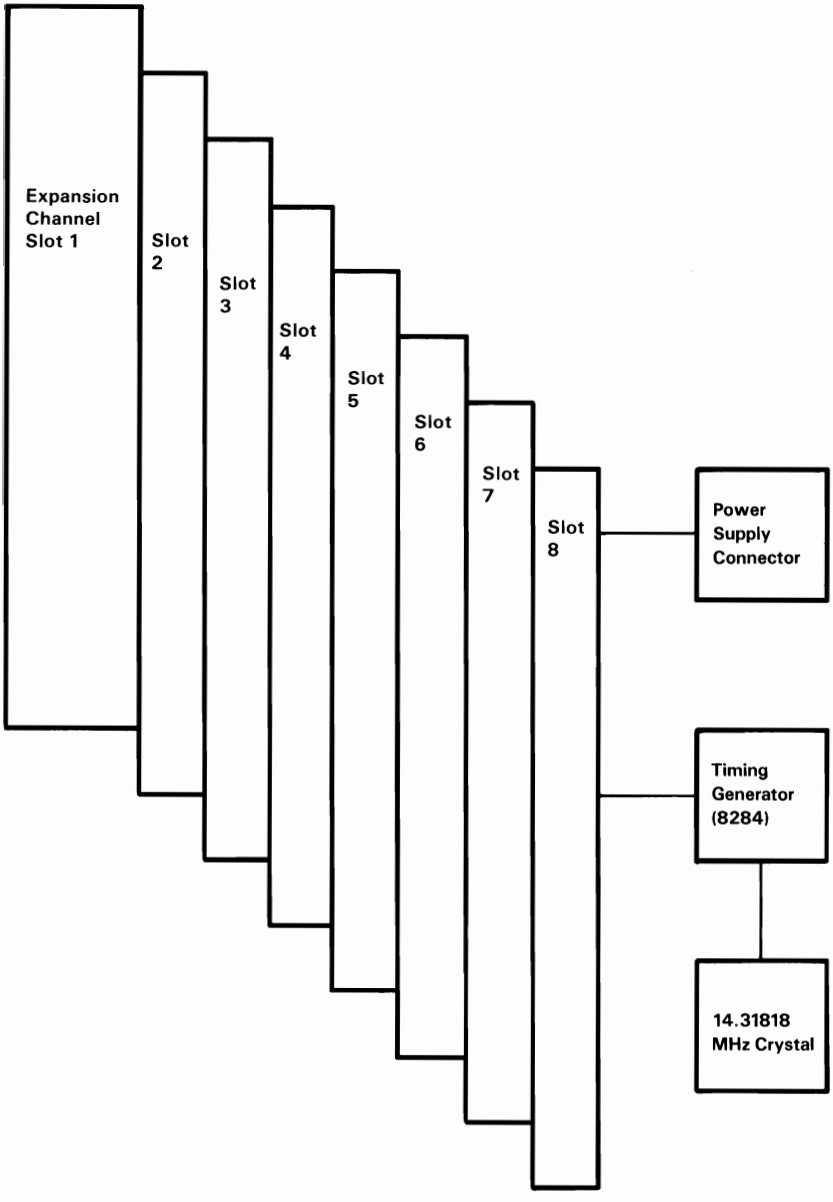
The expansion unit cable consists of a 56-wire, foil-shielded cable terminated on each end with a 62-pin D-shell male connector. Either end of the expansion unit cable can be plugged into the extender card or the receiver card.

Expansion Board

The expansion board is a support board that carries the I/O channel signals from the option adapters and receiver card. These signals, except 'osc,' are carried over the expansion unit cable. Because 'osc' is not sent over the expansion cable, a 14.31818-MHz signal is generated on the expansion board. This signal may not be in phase with the 'osc' signal in the system unit.

Decoupling capacitors provided on the expansion board aid in noise filtering.

The following is a block diagram of the expansion board.



Expansion Board Block Diagram

Power Supply

The expansion unit dc power supply is a 130-watt, 4 voltage-level switching regulator. It is integrated into the expansion unit and supplies power for the expansion unit and its options. The dc output voltages for the power supply are listed in the following table:

Voltage (Vdc)	Current (Amps)		Regulation (Tolerance)	
Nominal	Minimum	Maximum	+ %	- %
+ 5.0	2.3	15.0	5	4
- 5.0	0.0	0.3	10	8
+ 12.0	0.4	4.2	5	4
- 12.0	0.0	0.25	10	9

Vdc Output

All power levels are regulated with overvoltage and overcurrent protection. The input is fused and is either 120 Vac or 220/240 Vac. If dc overload or overvoltage conditions exist, the supply automatically shuts down until the condition is corrected. The supply is designed for continuous operation at 130 watts.

The power supply is located at the right rear of the expansion unit. It provides two separate connections for power to the fixed disk drives and supplies operating voltages to the expansion board through two "keyed" connectors that plug into a 12-pin male connector on the expansion board.

Vac Output

The receptacle at the rear of the power supply is a nonstandard connector designed to be used only for the IBM Monochrome Display. The power supply provides a filtered ac output that is switched on and off with the main power switch. The maximum current available at this output is 1 ampere for the 120-volt power supply and 0.5 amperes for the 220/240-volt power supply.

Overvoltage and Overcurrent Protection

Voltage Nominal Vac	Type Protection	Rating Amps
110	Fuse	5
220	Fuse	3

Power On/Off Cycle: When the power supply is switched Off for a minimum of 1.0 second, and then switched On, the 'power good' signal is regenerated.

The 'power good' signal indicates that there is adequate power to continue processing. If the power goes below the specified levels, the 'power good' signal triggers a system shutdown.

This signal is the logical AND of the dc output-voltage 'sense' signal and the ac input-voltage 'fail' signal. This signal is TTL-compatible up-level for normal operation or down-level for fault conditions. The ac 'fail' signal causes 'power good' to go to a down-level when any output voltage falls below the regulation limits.

The dc output-voltage 'sense' signal holds the 'power good' signal at a down level (during power-on) until all output voltages have reached their respective minimum sense levels. The 'power good' signal has a turn-on delay of at least 100 ms but no greater than 500 ms.

The sense levels of the dc outputs are shown in the following table.

Output (Vdc)	Minimum (Vdc)	Sense Voltage Nominal (Vdc)	Maximum (Vdc)
+5	+4.5	+5.0	+5.5
−5	−4.3	−5.0	−5.5
+12	+10.8	+12.0	+13.2
−12	−10.2	−12.0	−13.2

Extender Card

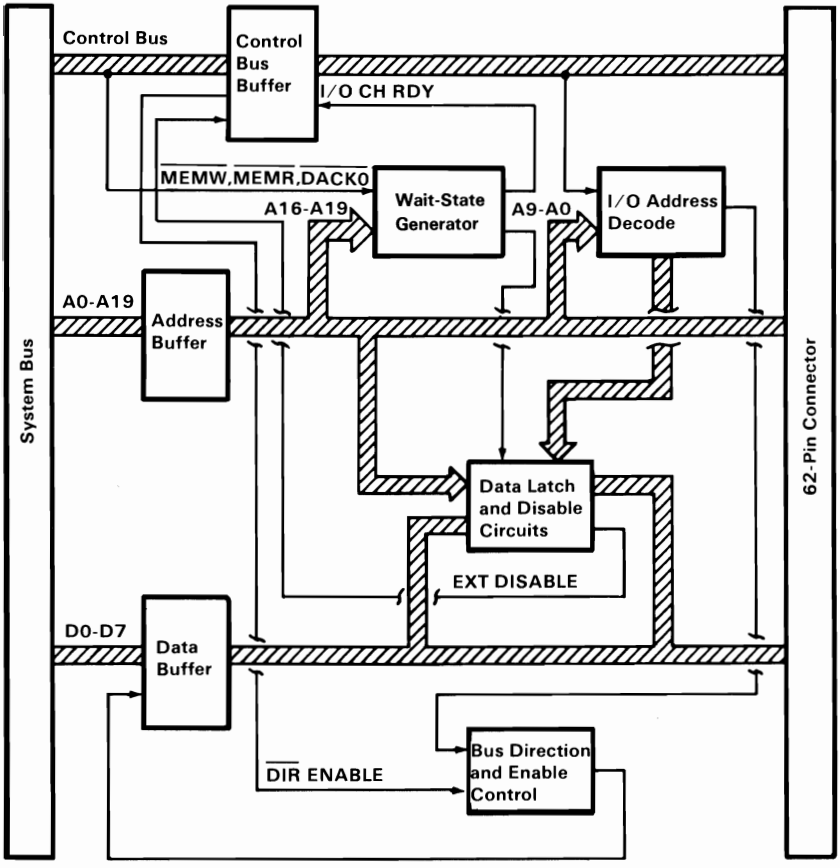
The extender card is a four-plane card. It re-drives the I/O channel to provide sufficient power to avoid capacitive effects of the cable. The extender card presents only one load per line of the I/O channel.

The extender card has a wait-state generator that inserts a wait state on memory-read and memory-write operations (except refreshing) for all memory contained in the expansion unit. The address range for wait-state generation is controlled by switch settings on the extender card.

The dual-in-line package (DIP) switch on the extender card should be set to indicate the maximum contiguous read/write memory in the system unit. The extender card switch settings are described under "Switch Settings" in the *Guide to Operations* manual. Switch positions 1 through 4 correspond to address bits hex A19 to hex A16.

The DIP-switch settings determine which address segments have a wait state inserted during memory-read and memory-write operations. Wait states are required for any memory, including ROM on option adapters, in the expansion unit. Wait states are not inserted in the highest segment, hex addresses F0000 to FFFFF (segment F).

The following is a block diagram of the extender card.

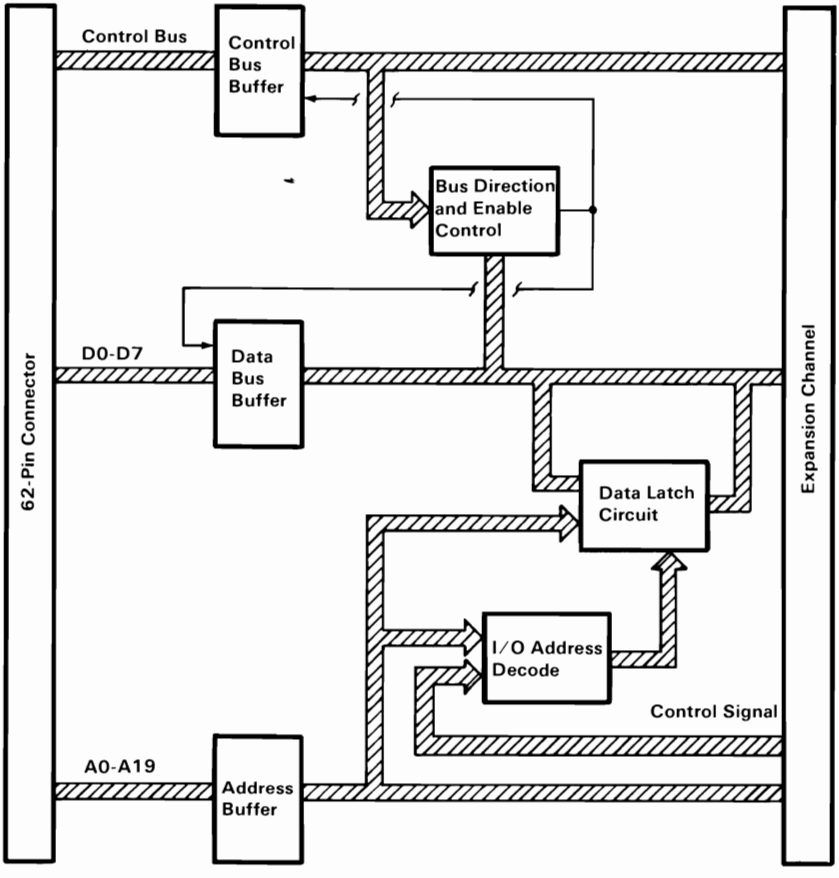


Extender Card Block Diagram

Receiver Card

The receiver card is a four-plane card that fits in expansion slot 8 of the expansion unit. It re-drives the I/O channel to provide sufficient power for additional options and to avoid capacitive effects. Directional control logic is contained on the receiver card to resolve contention and direct data flow on the I/O channel. Steering signals are transmitted back through the expansion unit cable for use on the extender card.

The following is a block diagram of the receiver card.



Receiver Card Block Diagram

8 Expansion Unit

Programming Considerations

Several registers associated with the Expansion Unit option are programmable and readable for diagnostic test purposes. The following figures indicate the locations and functions of the registers on the extender card and receiver card.

Location	Function
Memory FXXXX(*)	Write to memory to latch address bits
Port 210	Write to latch expansion bus data (ED0 - ED7)
Port 210	Read to verify expansion bus data (ED0 - ED7)
Port 211	Read high-order address bits (A8 - A15)
Port 211	Write to clear wait test latch
Port 212	Read low-order address bits (A0 - A7)
Port 213	Write 00 to disable expansion unit
Port 213	Write 01 to enable expansion unit
Port 213	Read status of expansion unit D0 = enable/disable D1 = wait-state request flag D2-D3 = not used D4-D7 = switch position 1 = Off 0 = On
(*) Example:	Write to memory location F123:4 = 00 Read Port 211 = 12 Read Port 212 = 34
(All values in hexadecimal)	

Extender Card Registers

Location	Function
Memory FXXXX(*)	Write to memory to latch address bits
Port 214	Write to latch data bus bits (D0 - D7)
Port 214	Read data bus bits (D0 - D7)
Port 215	Read high-order address bits (A8 - A15)
Port 216	Read low-order address bits (A0 - A7)
(*) Example:	Write to memory location F123:4 = 00 Read Port 215 = 12 Read Port 216 = 34
(All values in hexadecimal)	

Receiver Card Registers

The expansion unit is automatically enabled upon power-up. Both the extender card and receiver card will be written to, if the expansion unit is not disabled when writing to FXXXX. However, the system unit and the expansion unit are read back separately.

Interface

All signals found on the system unit's I/O channel will be provided to expansion slots in the expansion unit, with the exception of the 'osc' signal and the system unit's power supply voltages.

A 'ready' line on the expansion channel makes it possible to operate with slow I/O or memory devices. If the channel's I/O 'ch rdy' line is not activated by an addressed device, all microprocessor-generated memory cycles take five microprocessor clock cycles per byte for memory in the expansion unit.

The following table contains a list of all the signals that are re-driven by the extender and receiver cards, and their associated time delays. The delay times include the delay due to signal propagation in the expansion unit cable. Assume a nominal cable delay of 3 ns. As such, device access will be less than 260 ns.

Signal	Nominal Delay (ns)	Maximum Delay (ns)	Direction (*)
AO - A19	27	39	Out
AEN	27	39	Out
DACKO - DACK3	27	39	Out
$\overline{\text{MEMR}}$	27	39	Out
$\overline{\text{MEMW}}$	51	75	Out
$\overline{\text{IOR}}$	51	75	Out
$\overline{\text{IOW}}$	27	39	Out
ALE	27	39	Out
CLK	27	39	Out
T/C	27	39	Out
RESET	27	39	Out
IRQ2 - IRQ7	36	(**)	In
DRQ1 - DRQ3	36	(**)	In
I/O CH RDY	36	51	In
$\overline{\text{I/O CH CK}}$	36	51	In
DO - D7 (Read)	84	133	In
DO - D7 (Write)	19	27	Out

(*) With resepct to the system unit.

(**) Asynchronous nature of interrupts and other requests are more dependent on microprocessor recognition than electrical signal propagation through expansion logic.

Specifications

Size	
Height	142 mm (5.5 in.)
Width	500 mm (19.6 in.)
Depth	410 mm (16.1 in.)
Weight	14.9 kg (33 lb)
Power Cable	
Length	1.83 m (6 ft)
Size	18 AWG
Signal Cable	
Length	1 m (3.28 ft)
Size	22 AWG

Physical Specifications

Voltage (Vac)			Frequency (Hz)	Current (Amps)
Nominal	Minimum	Maximum	± 3 Hz	Maximum
110	90	137	60	3 at 90 Vac
220/240	180	259	50	1.6 at 180 Vac

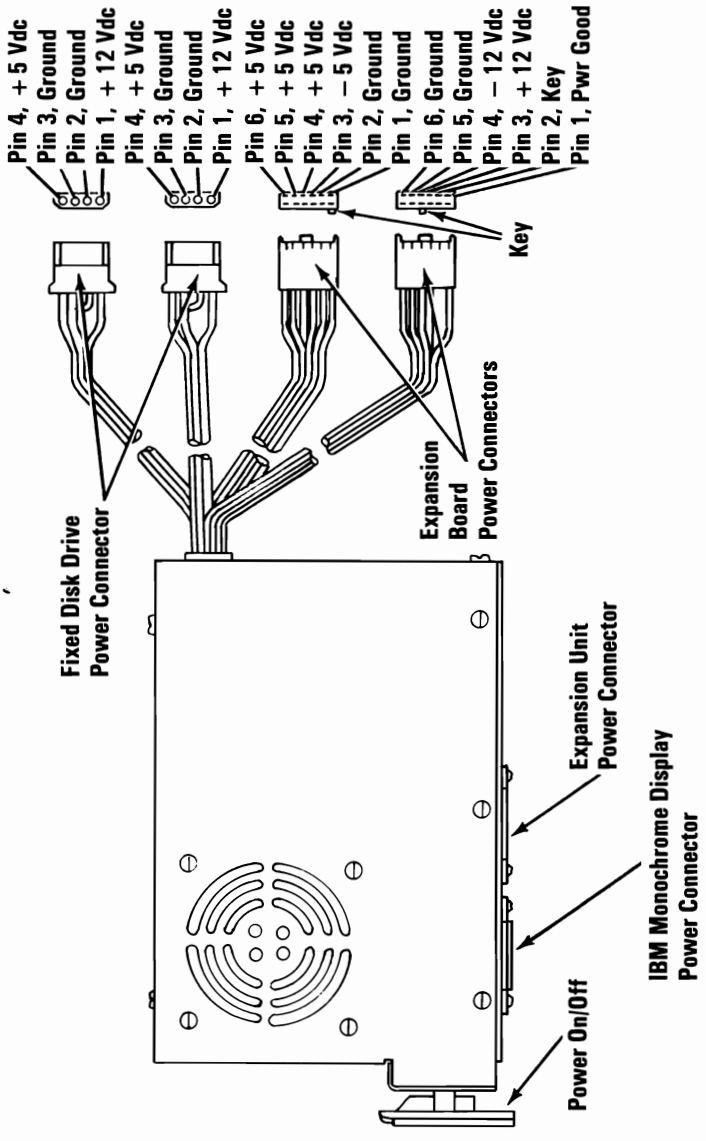
Input Requirements

Environment	
Air Temperature	
System On	15.6 to 32.2°C (60 to 90°F)
System Off	10 to 43°C (50 to 110°F)
Humidity	
System On	8 to 80%
System Off	20 to 80%
Heat Output	717 BTU/hr

Additional Specifications

Power Supply

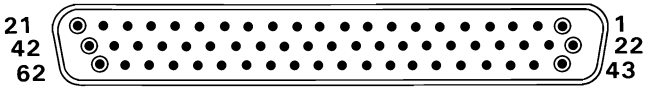
The power supply pin configurations and locations follow:



Power Supply and Connectors

Extender Card and Receiver Card

The extender card and receiver card rear-panel connectors are the same. Pin and signal assignments for the extender and receiver cards are shown below.

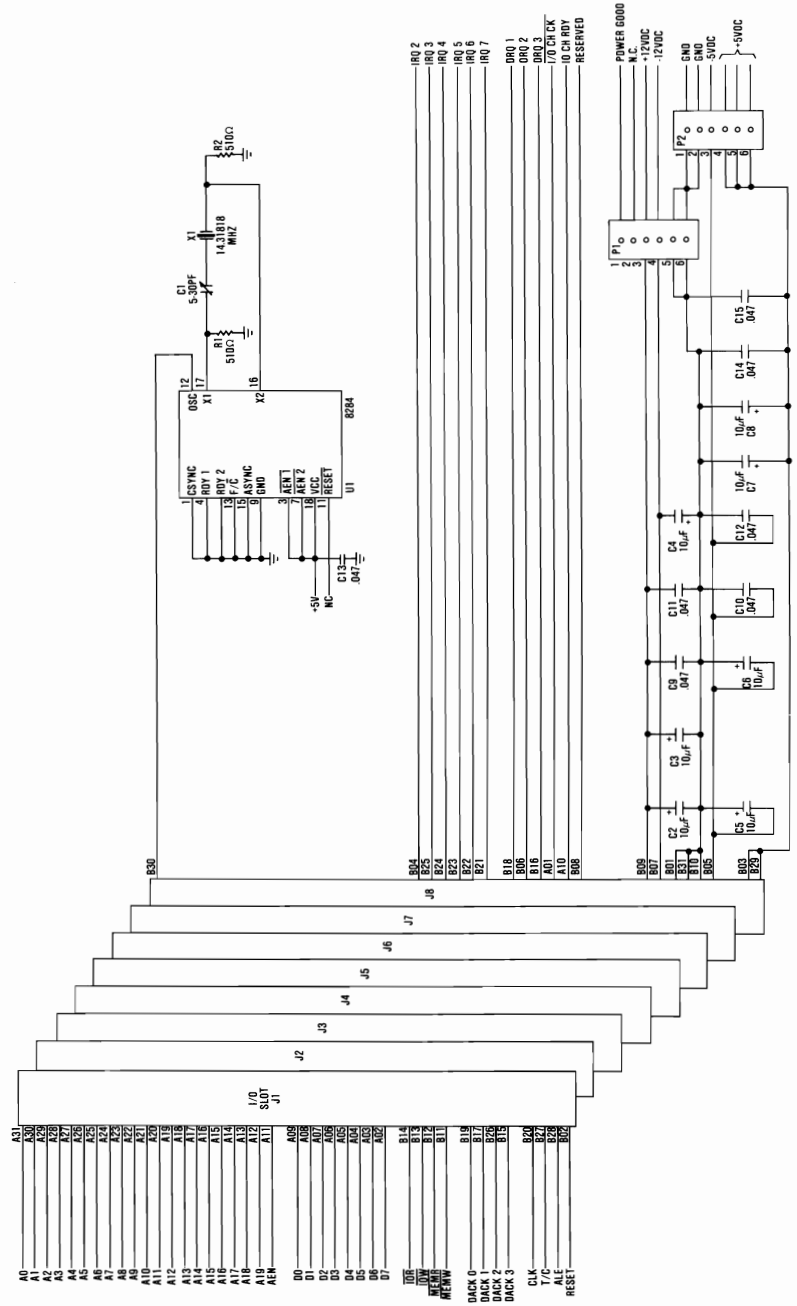


Pin	Signal	Pin	Signal	Pin	Signal
1	+E IRQ6	22	+E D5	43	+E IRQ7
2	+E DRQ2	23	+E DRQ1	44	+E D6
3	+E DIR	24	+E DRQ3	45	+E I/O CH RDY
4	+E ENABLE	25	RESERVED	46	+E IRQ3
5	+E CLK	26	+E ALE	47	+E D7
6	-E MEM IN EXP	27	+E T/C	48	+E D1
7	+E A17	28	+E RESET	49	-E I/O CH CK
8	+E A16	29	+E AEN	50	+E IRQ2
9	+E A5	30	+E A19	51	+E DO
10	-E DACKO	31	+E A14	52	+E D2
11	+E A15	32	+E A12	53	+E D4
12	+E A11	33	+E A18	54	+E IRQ5
13	+E A10	34	-E MEMR	55	+E IRQ4
14	+E A9	35	-E MEMW	56	+E D3
15	+E A1	36	+E A0	57	GND
16	+E A3	37	-E DACK3	58	GND
17	-E DACK1	38	+E A6	59	GND
18	+E A4	39	-E IOR	60	GND
19	-E DACK2	40	+E A8	61	GND
20	-E IOW	41	+E A2	62	GND
21	+E A13	42	+E A7		

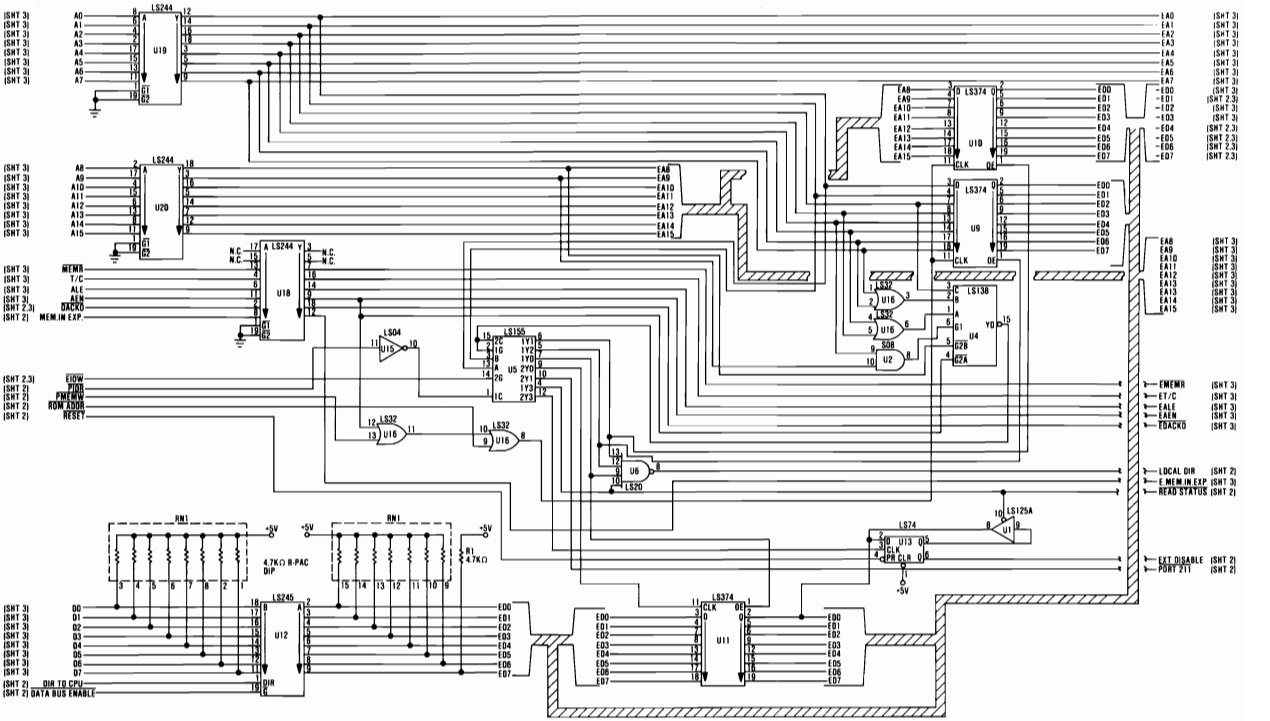
E = Extended

Connector Specifications

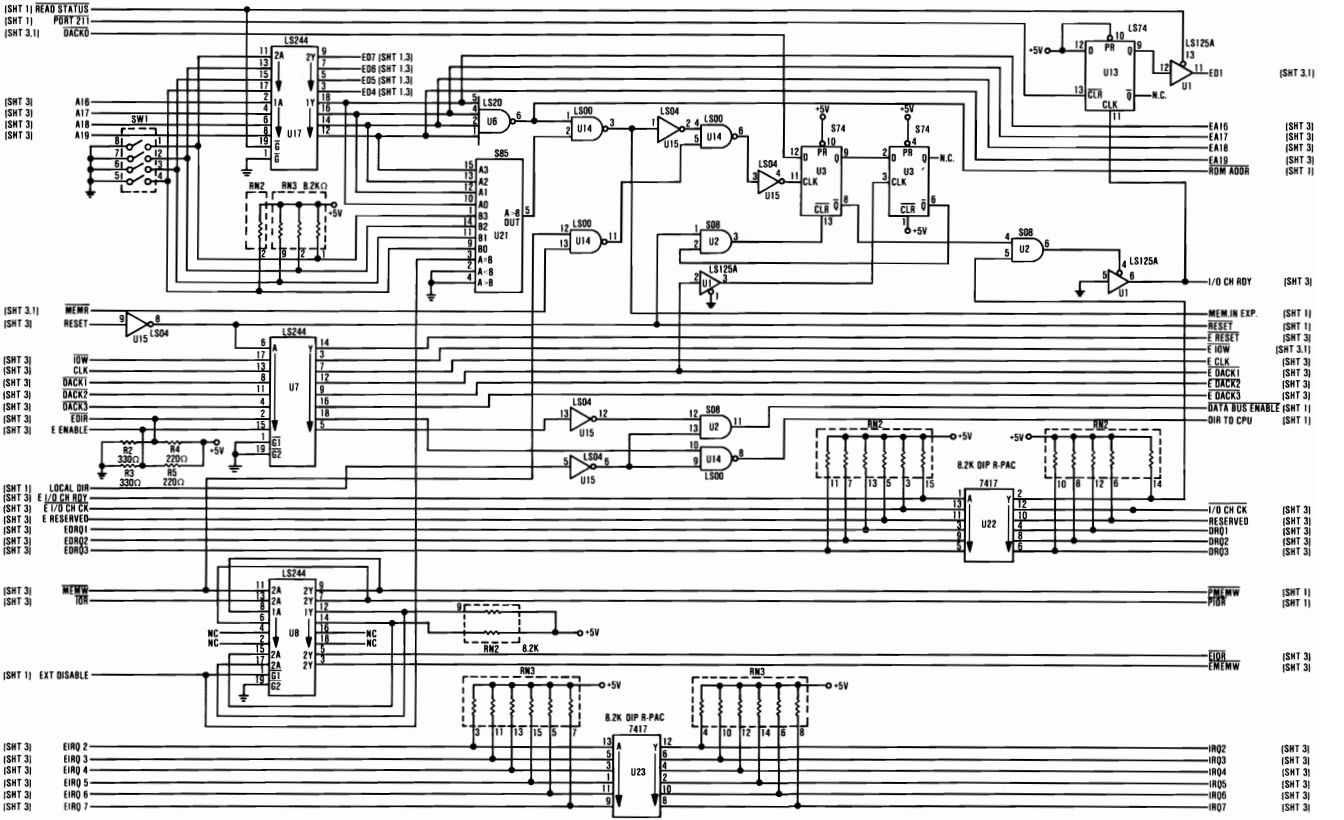
Logic Diagrams



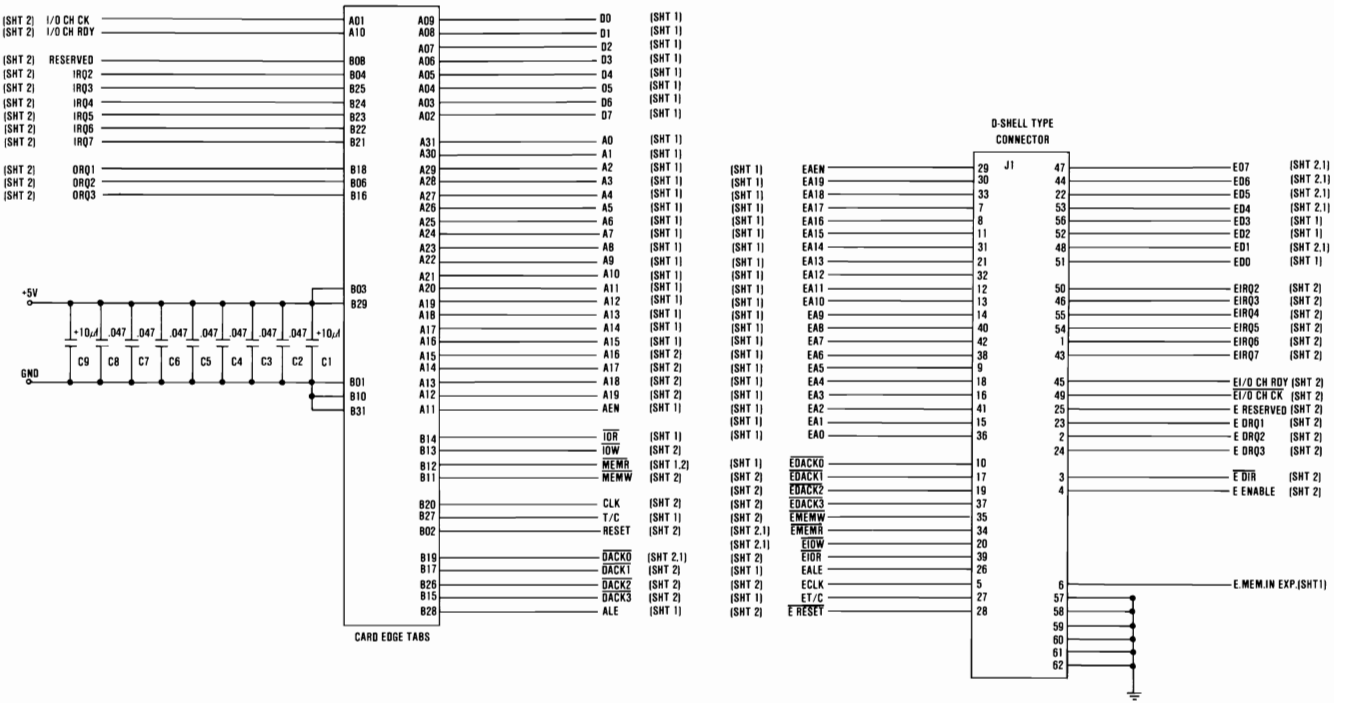
Expansion Board (Sheet 1 of 1)



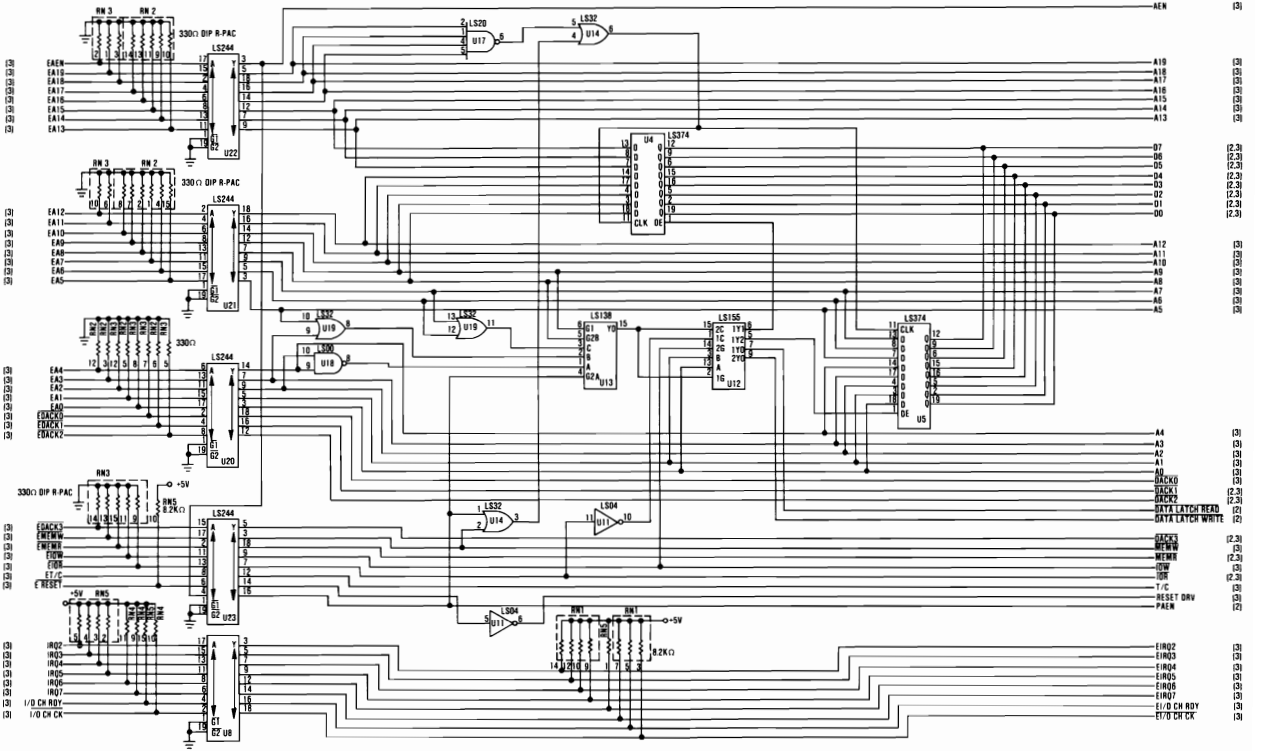
Extender Card (Sheet 1 of 3)



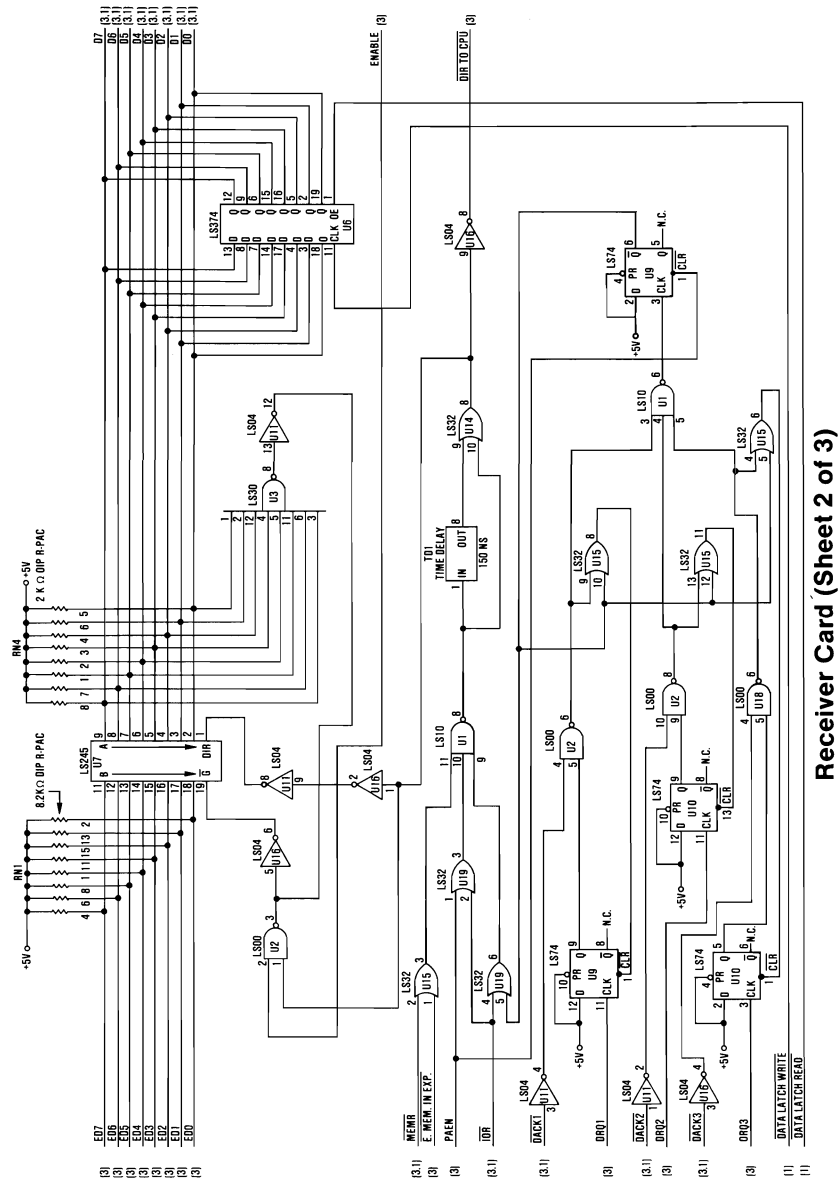
Extender Card (Sheet 2 of 3)

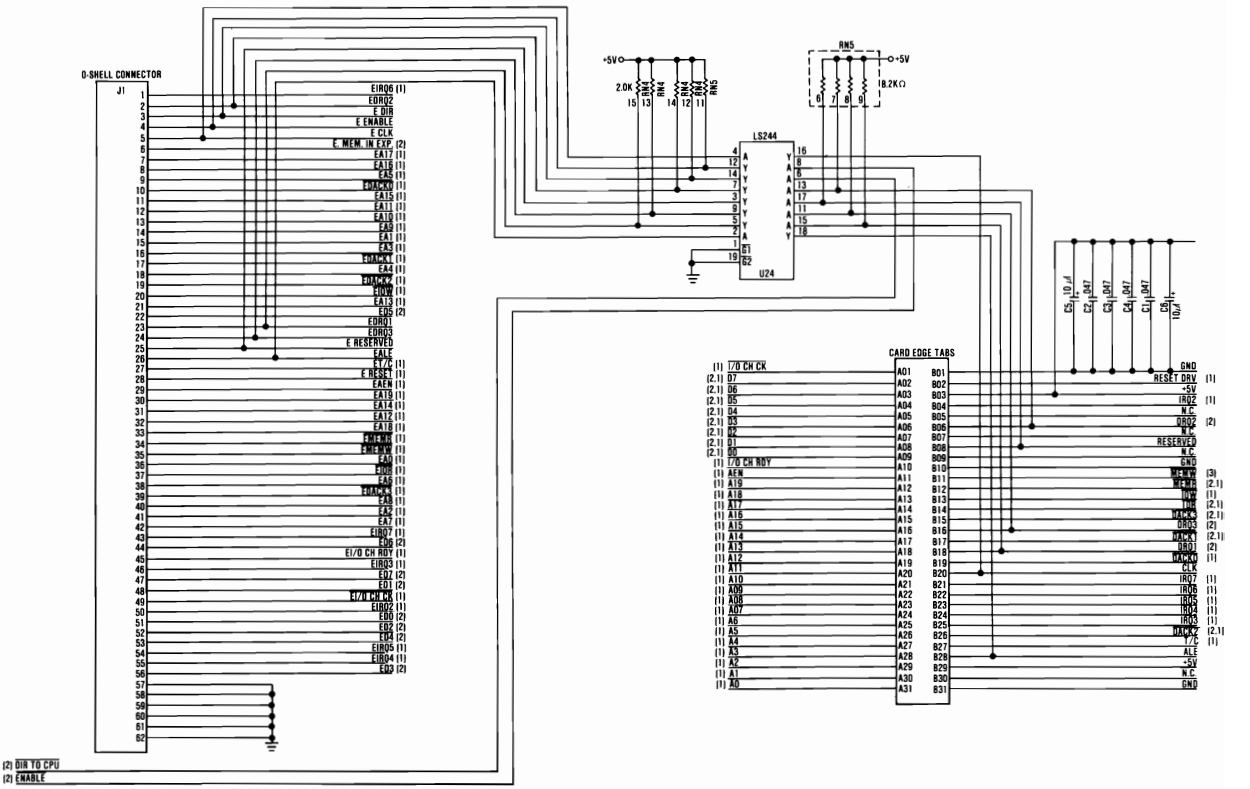


Extender Card (Sheet 3 of 3)



Receiver Card (Sheet 1 of 3)


Receiver Card (Sheet 2 of 3)
RN1
8.2KΩ DIP R-PAC
RN4
2 KΩ DIP R-PAC
+5V
LS245
LS374
LS04
LS30
LS00
LS32
LS10
LS74
TD1
TIME DELAY
IN
OUT
150 NS
ENABLE
DIR TO CPU
D7
D6
D5
D4
D3
D2
D1
D0
ED7
ED6
ED5
ED4
ED3
ED2
ED1
ED0
MEMR
E MEM IN EXP
PAEN
IOR
DACK1
DACK2
DACK3
DRQ1
DRQ2
DRQ3
DATA LATCH WRITE
DATA LATCH READ
N.C.



Receiver Card (Sheet 3 of 3)

Notes: