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C-C BUS
User's Manual

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FOREWORD

We at PBJ would like to take this opportunity to thank you for your purchase and at the same time solicit your assistance. We would like to ask that you take a few minutes and send us your comments and suggestions, not only on the products but specially on the documentation. If there are areas that were not clear to you, chances are that it was not clear to someone else. If you think an example or a picture might clarify something let us know. Remember, the only guide we have is your input. If it's negative we can change it, if it's positive at least we know we are on the right track.

The Radio Shack Color Computer is not only a fun computer it is also a very powerful computer. Our aim is to supply high quality products that will enhance the computer's capability and the user's enjoyment.

Thank you.

INTRODUCTION

The C-C BUS is an expansion board designed for use with the Radio Shack Color Computer. The board allows the user to connect up to six cartridges and/or accessory boards to the computer simultaneously. Each slot on the board is software selectable and can be turned on or off simply by poke-ing the slot number to a latch on the C-C BUS. The ability to software select the slots also allows the user to expand system memory beyond the 64K limit of the computer through a bank switching scheme.

The C-C BUS also accomodates accessory boards designed to use the high memory locatins (HFF60-HFFBF), as I/O area. In this area the boards are slot independent and the user must be aware of any addressing conflicts.

DESIGN FEATURES

* All signals are fully buffered as they enter the board.
*To reduce any RFI caused by bringing the signals out of the shielded computer case, a scheme has been implemented on the C-C BUS which essentially isolates the bus (and any cartridges installed on it) from the computer until the CPU needs to access something on the bus. At that time the buffers are turned 'on', allowing the signals to pass through. After the access is completed the buffers are turned 'off' again, isolating the bus from the CPU.
*To elliminate any address contention problems, the C-C BUS also senses when the computer has been placed in a 64K RAM mode. Access to any cartridge on the bus that would conflict with the internal RAM addressing is prevented until the computer is returned to the 32K RAM mode. Of course access to slot independent cartridges is always allowed.
*A latch is provided on the C-C BUS to allow software selection of any one of the six slots. This feature allows the computer full access to the bus (under program control) without user intervention (to manually turn slot switches on and off). This feature also allows the computer to have access to memory larger than 64K. Each of the slots can optionally contain up to 16K of RAM which a program might use as data storage.
*On power-up, slot number '7' is automatically selected and if a disk controller is installed in that slot it will automatically execute.
*On-board +5V power supply for cartridges/accessories (optional +12V available on board for use with CoCo II).
*Flexible ribbon cable connection gives the user freedom in locating the C-C BUS at his/her preference.

MEMORY MAP

The following describes a new address map for your computer and shows addresses used by other PBJ, Inc. accessory boards.

0000-7FFF	System RAM
8000-9FFF	Extended Basic ROM
A000-BFFF	Basic ROM
C000-FEFF	Latch dependent adresses for cartridges
FF00-FF3F	Internal PIA's
FF40-FF5F	Disk controller
FF60-FFBF	I/O Area (see below)
FFC0-FFDF	SAM registers
FFE0-FFF1	Reserved (by Motorola)
FFF2-FFFF	Interrupt vectors

I/O MAP

FF60-FF63	Radio Shack Digitizer
FF7C-FF7F	C-C BUS slot select latch
FF90-FF93	Parallel printer port (P-C PAK)
FF94-FF97	Real time clock (P-C PAK)
FF98-FF9F	WORD-PAK (CRT controller)

DISK SYSTEM

If you have a disk based system there are a few precautions you have to take to utilize the C-C BUS to it's maximum potential.

Since Disk Basic is operating from one of the slots on the C-C BUS, it is not possible to just select a different slot and continue running since by selecting another slot you have turned the disk cartridge off. This will cause a system crash and you will have to cold start. Therefore, before selecting another slot you must first leave Disk Basic. A simple way of doing this was demonstrated by H. Schroeder in the March '83 issue of Rainbow magazine (pg. 54). A 'sledgehammer' approach is to just poke the slot number right from Disk Basic. This will cause a system crash but you can easily regain control by pressing the reset button. This will return you to Extended Basic.

CARTRIDGE 'AUTO START'

Although provisions are made on the C-C BUS for auto start of ROM cartridges on power up, it should be left disabled. The main reason for this is that it will interfere with the disk controller (since it causes an interrupt) and it will also prevent you from returning to

Basic after running a cartridge program.
It is recommended that to run a cartridge program it be entered by an 'EXEC&HA0FC' command. This way you can exit the program through a reset. After reset, another cartridge may then be run by selecting the appropriate slot and 'EXEC', or Disk Basic can be enabled (selecting the slot that the disk controller is on, enabling cold start with 'POKE113,0' and then pressing the reset button), returning to the disk operating system.

INSTALLATION

Before connecting the C-C BUS to the computer make sure that the computer is turned off. Connect the female end of the 'S-cable' to the edge connector on the C-C BUS, connect the male end of the 'S-cable' to the ROM port. Make sure that the cable is straight (no twists) so that corresponding pins will mate. Install any cartridges or boards on the bus. If you have a disk controller and want it to execute when power is applied, install it on slot 'seven' (the one closest to the edge connector).
NOTE: CARTRIDGE ORIENTATION- the side of the cartridge which would normally face up when installed in the ROM port (the label side) will now be the side which is facing the edge connector.
Connect the male phono plug (on the wall transformer cable) to the jack on the C-C BUS. Plug the wall transformer to a 115VAC outlet. Since you will have several devices requiring 115VAC supply (computer, cassette, C-C BUS, etc.) it is recommended that you purchase a plug mold to supply power to the different devices. You should buy one that has at least four outlets and a power switch. This will allow you to turn off the power to all the devices at once. If you do not use a plug mold make sure you disconnect the wall transformer when you are not using the computer (C-C BUS). If you do not, you will leave the bus and anything connected on it powered at all times. Always unplug the wall transformer from the wall receptacle before disconnecting the phono plug (if required) on the C-C BUS. Also always turn the computer off before disconnecting the C-C BUS.
Most of the above precautions will be unnecessary if you use a plug mold. Since everything will be powered (and un-powered) at the same time.

USING THE C-C BUS

Install any cartridge or boards on the C-C BUS (make sure power has been turned off). If you have a Disk controller place it in slot #7 for automatic execution.
NOTE: Slot #7 is not dedicated to the disk controller, you

may install the Disk controller in any slot, then if you want to run Disk Basic just poke the slot number at the latch address (i.e., 'POKE 65404,4' if the Disk controller was in slot 4), type 'POKE113,0' to enable cold start, and then press reset button. To execute a ROM pack simply type 'EXEC&HA0FC'. To leave the program press the reset button. This will return you to Extended Basic.
Poke-ing a number between 7 and 2 to location 65404 (HFF7C), will select the corresponding slot allowing it to be accessed. 'Seven' being the number for the slot closest to the ribbon cable connector, and 'two' being the farthest. Please note that there are some cartridges that are slot independent (such as the WORD-PAK, P-C PAK, X-PAD, etc.). These reside in an absolute memory location and are always available to the CPU. There is no slot selection required.

NOTE: If Disk Basic is not automatically executed on power-up, type the following: 'POKE 65404,7' and 'EXEC 49152'.

MEMORY EXPANSION

A unique feature of the C-C BUS is that it allows the user to expand the computer's memory by adding one or more memory boards to the C-C BUS. This memory can be used as data storage and accessed through a small machine language routine located in lower RAM, or it can be used for program storage. When used as program storage the program can only be run when the computer is in the 32K mode and the appropriate slot is selected.

There is one precaution to take when RAM boards are installed on the bus. And that is that when the computer is in the 64K mode, even though no conflict will occur due to the protection provided on the bus, there is no way to prevent writing to the board. Therefore when in 64K mode always make sure that the slot selected does not contain a RAM board or else whatever is being written to the computer's internal RAM will also be written to the RAM board. If there is nothing there you want to protect then it does no harm, but if it's data you want to protect then de-select the slot that contains the RAM board before going into 64K mode.

POWER SUPPLY

The C-C BUS is normally supplied with an on-board power supply that provides 5V @ 1amp to the cartridges installed on the BUS. Traces are provided on the board for populating an optional +12V supply (if required).
NOTE: Purchasers of bare board should note that the C-C BUS

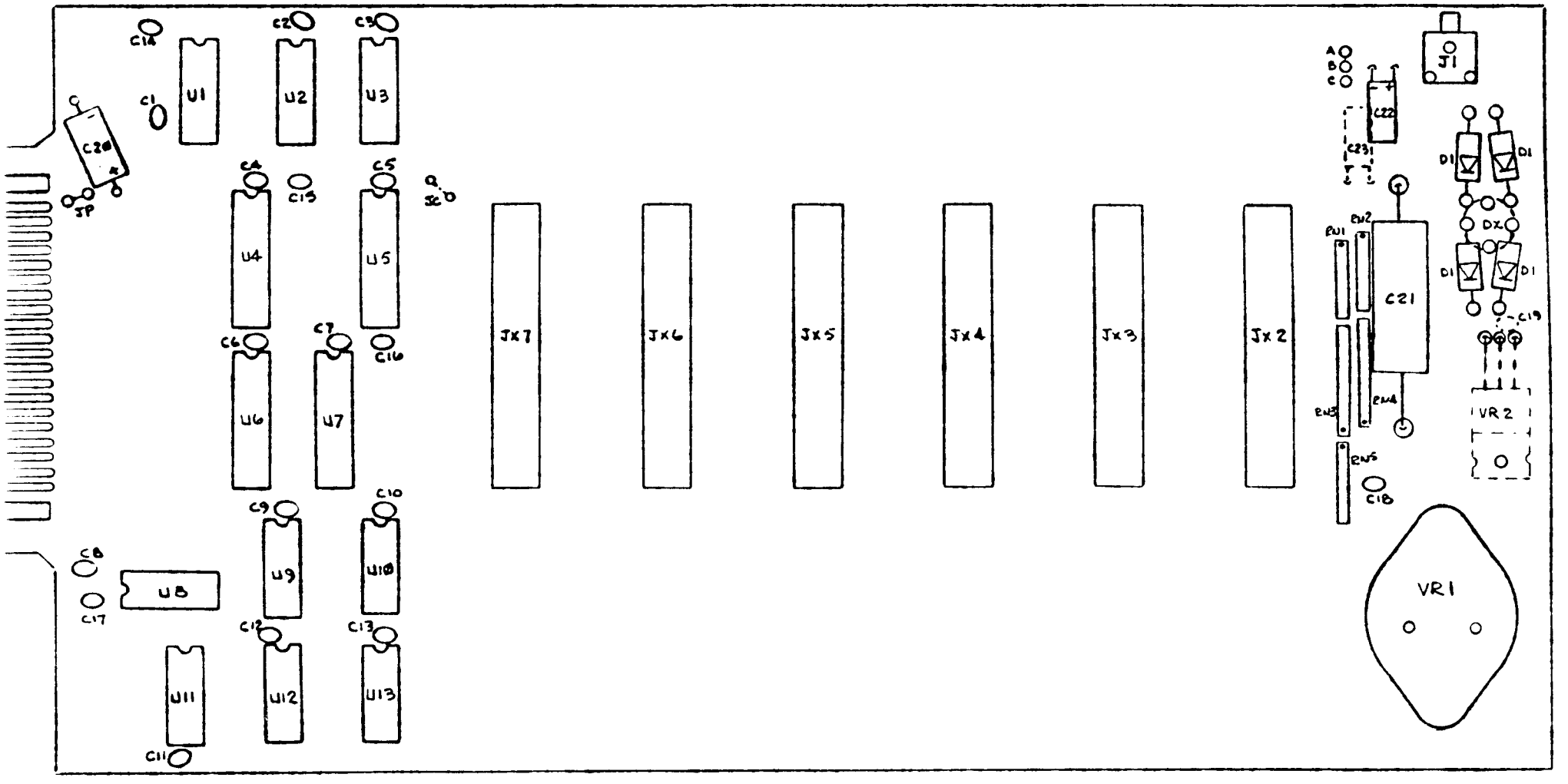
can be configured to draw it's power from the computer's power supply. Using the computer's power supply will obviously limit the number of devices you can install on the bus. Depending on the power consumption of the cartridges you install on the bus, you should have enough power available to power two or three cartridges (minimum). The computer supplies the following voltages to the ROM port:

Color Computer	CoCo II
5V @ 300 mA	5V @ 300 mA
+12V @ 300 mA	N/A
-12V @ 100 mA	N/A

To enable the +5V line from the computer to the bus a jumper must be added (see layout dwg.)

RFI

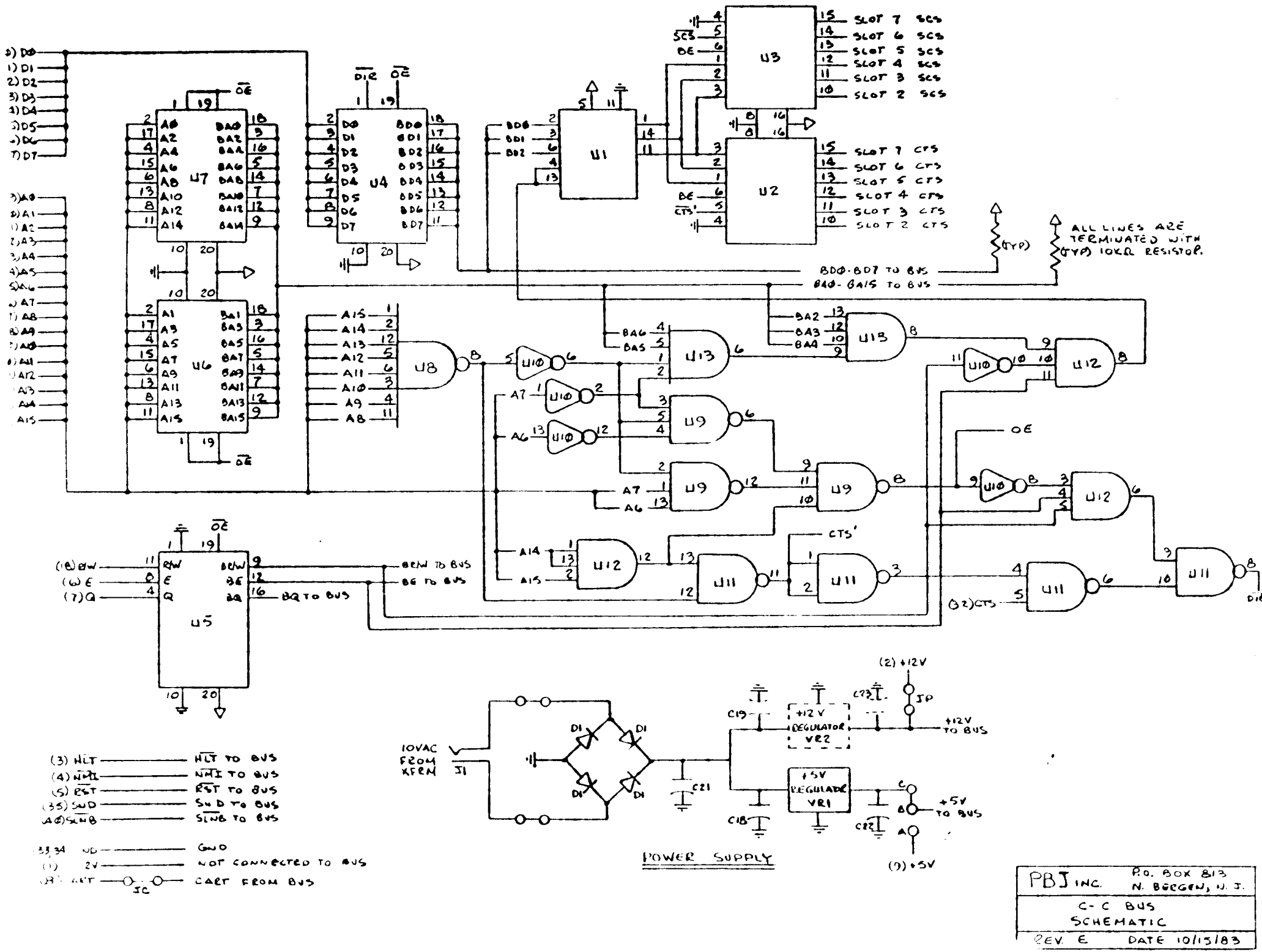
Although great care has been taken to reduce noice generated by bringing signals out of the shielded computer case, some noise is always generated (as with the disk controller). If the interference is objectionable (and it will depend a great deal on the TV used), further reduction can be achieved by using a 75 ohm coaxial cable between the computer and the TV (most newer TV's have a 75 ohm input connection for use with cable TV). This should elliminate all interference.
The length of the ribbon cable will also determine how much interference you will produce. Normally the C-C BUS is provided with a 6 inch cable. If a longer cable is required (to move the C-C BUS to another location) then it is recommend that a 'shield sleeve' be installed around the cable. This is a metal mesh sleeve with ground drain leads which will slip over the cable. The drain leads can then be soldered to the ground plane on the C-C BUS. The ribbon cable should however never be made excessively long since other problems will arise due to signal loss.



REFERENCE	DESCRIPTION	REFERENCE	DESCRIPTION
U1	74LS75	U2,U3	74LS138
U4	74LS245	U5,U6,U7	74LS244
U8	74LS30	U9	74LS10
U10	74LS04	U11	74LS00
U12	74LS11	U13	74LS21
C1-C14	CER DISK (.01uF)	C15-C19	6.8uF TANT
C20	22 uF ELECT	C22,C23	47uF ELECT
VR1	7805K VOLT REG	VR2	7812U VOLT REG
J1	PHONO JACK (SWITCHCRAFT #MDPC2ARA)	C21	2200uF ELECT.
		D1	1N5400 RECTIFIER
* RN1,RN2,RN5	4 ELEMENT RESIST. NETWORK	* RN3,RN4	7 ELEMENT RESIST. NETWORK
Jx	EDGE CONNECTORS (TI #H421121-20 OR EQUAL)		

* NOT REQUIRED

PBJ INC.	P.O. BOX 813 N BERGEN, N.J.
C-C BUS COMPONENT LAYOUT	
REV. E	DATE 10/15/83



PBJ INC.	P.O. BOX 813 N. BERGEN, N. J.
C-C BUS SCHEMATIC	
REV. E	DATE 10/15/83

WARRANTY

All equipment manufactured by PBJ, Inc. is warranted to be free from defects in material and workmanship for a period of 90 days from date of sale. Defects not caused by user negligence, misuse or abuse will be repaired free of charge, provided the equipment is returned, postpaid, to PBJ, Inc. within the warranty period. All equipment manufactured by PBJ, Inc. is fully tested prior to being shipped, therefore, PBJ, Inc. reserves the right to determine which repairs are in-warranty where shipping damage, misuse or abuse is in question. This warranty is limited to replacement of defective parts, no responsibility is assumed for damage to other equipment.
All software sold with the equipment is supplied on an "AS-IS" basis, without warranty.

REPAIR POLICY

Minimum service charge for all repairs is $15. Repair costs will be calculated as parts costs plus $25 per hour of labor. Repaired equipment will be returned C.O.D. for shipping and repair cost.

WARRANTY REGISTRATION

Fill out the information requested below and mail to:

PBJ, Inc.
P.O. Box 813
North Bergen, New Jersey 07047

Purchaser's Name:
Street:
City: State:
Zipcode:

Equipment Purchased:
Serial No.:
Date of Purchase: