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*                                         *
*              VCA 3330                   *
*                                         *
*         VME TO CAMAC ADAPTOR            *
*                                         *
*         TECHNICAL MANUAL AND            *
*                                         *
*       PROGRAMMING INSTRUCTIONS          *
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CONTENTS.

1. Introduction

The VCA 3330 is a VME slave module which allows a VME Master to address remote CAMAC crates and access modules within these crates. Up to 8 CAMAC crates can be connected, on a "daisy-chain" ribbon cable connection, which can be up to 30 metres long in all. The bus carried by this ribbon cable consists of 16-bits of Data, 6 Address lines and some Control Signals. The device receiving this bus in the CAMAC crate(s) is the Hytec 1331 Controller, designed originally to interface to a Personality Card in an IBM PC/AT.

The 1331 is operated from the VCA 3330 by addressing its (the 1331's) internal registers, which are mapped directly into VME address space. The VCA 3330 itself also contains registers accessible from the VME bus, through which overall control of the connection to CAMAC is achieved.

2. Basic Operational Description

The operation of the VCA 3330 in conjunction with the 1331 is best understood by considering one crate only connected. Access to other crates is then achieved by simply selecting a different crate through the Control and Status Register (CSR) as we will see.

The registers of the VCA 3330 and the 1331 appear in A16 (Short Addressing) space on the VME bus, at a starting address set by on-board switches (see Section 3). This "Base Address" can be set to any 256-byte boundary in A16 space. Starting at the Base Address, at increasing bus addresses, we see first the on-board registers of the VCA 3330 and then those of the remote CAMAC Crate Controller. These increasing bus addresses will be referred to by their OFFSET from the base address, e.g. "Base + 1C", where the offset (1C) is expressed in Hexadecimal.

The registers should be accessed using the standard A16 Address Modifiers, 29 and 2D Hex., and they may be addressed in either D16 mode or in D08 (EO) mode. Users should note that some registers are only 8 bits wide and that these should only be operated in 8-bit 'even' mode or 16-bit mode. Writing to or reading their "top-half" will give indeterminate operation. In the descriptions which follow, the expression "bits 0 - 7" will mean VME bus data bits D0 to D7.

2.1 VCA 3330 On-Board Registers

These registers are formed in a group similar to those found in a VXI Register Based Slave design. This structure is implemented by Hytec to make all our designs consistent, with a similar "standard" register set, and to make the conversion to VXI as simple as possible.

OFFSET	DESCRIPTION	Read/Write	Width
0C	Interrupt Vector Readback	Read Only	16 Bits
04	Control and Status Register	R/W	16 Bits
02	Model Number	Read Only	16 Bits
00	I.D. / Interrupt Vector	R/W	16 Bits

2.1.1 I.D. / Interrupt Vector Register

This register has different functions for read and write:

When Read, it gives the top 4 bits all '1', indicating a Register Based design, A16 only, and the bottom 12 bits are Hytec's unique code 'F7F'.

When Written, it accepts an Interrupt Vector on bits 0 – 7 which it will output when in receipt of Interrupt Acknowledge.

2.1.2 Model Number Register

This Read Only register outputs the units own model number - 3330 decimal - on bits 0 - 15.

2.1.3 Control and Status Register

This register contains some read only bits and some readable and writeable bits. It may be written or read 8 or 16 bits at a time. The functions of the bits are as follows:

Bit 0 - Busy/Reset   This bit is part of the booking mechanism of the module, which may be used to ensure that only one processor can use the CAMAC link at a time. When reading, it means the module is "Busy" if read as a '1', or "Available" if read as a zero. The act of reading the CSR will clock this bit from a '0' to a '1' on the trailing edge of the read signal. The bit can only be reset to '0' by writing a '1' to it. This also sends a reset to the CAMAC crate(s). Thus to book the module, the VME processor should read the CSR, hoping to see this bit at '0', then use the link and then issue reset to clear the busy bit, allowing another processor to book the module.

Bit 1 - Not used, read as '0', writing has no effect.

Bits 2,3 - No function inside the module, read as '1', writing has no effect.

Bit 4 - Ready. This bit is read only and has precisely the opposite meaning to the Busy bit, bit 0.

Bit 5 - Not used, read as '0', writing has no effect.

Bit 6 - Interrupt Flag. This bit is read only, and when read as a '1' means that one or more of the CAMAC crates are generating Interrupt.

Bit 7 - Interrupt Enable. This bit is read/write and when set to '1' allows a CAMAC Interrupt to generate a VME Interrupt.

Bits 8-10 - CAMAC Crate Select. These bits are read/write and select in binary the number of the CAMAC Crate to be addressed. Even if only one crate is in use, these bits should be written to zero, since they are not cleared on power-up.

Bits 11-13 - Interrupt Level Select. These bits are again read/write and select in binary the number of the VME IRQ line to be used to pass an interrupt to a VME processor. Writing all zeroes will mean that no VME interrupt can be generated, writing all ones selects IRQ7.

Bit 14 - Not used, read as '1', writing has no effect.

Bit 15 - Not used, read as '0', writing has no effect.

2.1.4 Interrupt Vector Readback Register

This register allows the Interrupt Vector written to the module at offset 0 to be read back for checking. The bottom 8 bits contain the vector data, the top 8 bits will be read as '0'.

2.2 1331 CAMAC Controller Register Mapping

The registers of the remote CAMAC Controller are addressed directly from the VME bus, starting at offset 10 HEX.

A diagram of the Register Positions and their functions is shown below:

Offset	READ FUNCTION	WRITE FUNCTION
1E	DIAGNOSTIC (Not used)	-----------
1C	READ/REPEAT CYCLE	WRITE/REPEAT CYCLE
1A	Read Back N,A,F	CAMAC Function Code (F)
18	Read Encoded LAM	CAMAC Station No. (N)
16	CAMAC CSR	CAMAC Subaddress (A)
14	Data High (R17-R24)	Data High (W17-W24)
12	Data Mid (R9-R16)	Data Mid (W9-W16)
10	Data Low (R1-R8)	Data Low (W1-W8)

All the registers are 8 bits wide except the Read/Write/Repeat register which can be addressed in either 8 or 16-bit mode. All 8-bit mode accesses must be performed on word (even byte) boundaries.

For full details of how these registers are programmed, refer to the 1331 manual, remembering that when this manual refers to register addresses in a PC’s IO space, these must be converted into VME addresses.

A brief example of operating the 1331 from VME appears in section 4.

3. Setting up Instructions.

The only setting up required on the module is to select the base address, mentioned earlier, in A16 addressing space. An 8-way DIL switch allows any 256 byte boundary to be chosen as the start address for the module's set of registers, which occupy 16 words or 32 bytes.

The switch is labelled "SW1" and its positions are numbered from 1 to 8. Position 1 corresponds to address line A08, while position 8 corresponds to A15. Switch OPEN means that the corresponding address line must be in the '1' state, switch CLOSED selects the '0' state.

Suppose we wish to select the starting address C500 HEX. In binary, this looks like:

C500 = 1 1 0 0, 0 1 0 1, 0 0 0 0, 0 0 0 0

Where the first '1' corresponds to address line A15. Now position 8 on the switch corresponds to A15, so that should be OPEN, and so should position 7, because A14 needs to be a '1' also. Then positions 6,5 and 4 should all be CLOSED, position 3 OPEN, 2 CLOSED and finally 1 OPEN. Looking now at the picture for the "top half" of the address, it looks like this:-

HEX Value -			C				5	
Address Line	15	14	13	12	11	10	9	8
Binary -	1	1	0	0	0	1	0	1
Switch Pos'n	8	7	6	5	4	3	2	1
Selection	O	O	C	C	C	O	C	O

Where "O" denotes OPEN, and "C" means CLOSED.

All other "setting up" is done by software, through the CSR and the Vector Register.

The registers of the 3330 and those of the 1331 occupy 32 bytes of VME address space, from Base address to Base address + 1E, so in the example above, the range would be:-

C500 to C51E

Address lines A07, A06 and A05 are monitored internally and must all be '0' so the module will not respond to addresses from C520 to C5FE.

4. Addressing CAMAC through the VCA 3330

The following example of how to operate a CAMAC crate from VME uses Hytec's CATY-VME language. The operations used work as follows:

```
VW8 0,'XC500,'X29,A
```

This is a VME Write of 8 bits of data from variable A to crate 0 (using Hytec's PC-VME Interface), address HEX C500, using address modifier HEX 29.

The abbreviation -'X- denotes Hexadecimal.

Similarly, we have:

VW16 and VW32, as well as VR8, VR16 and VR32, the last three read 8, 16 or 32 bits of VME data into a named variable:-

```
VR16 0,'XC500,'X29,A
```

In CATY-VME you can declare a register as a string to save you having to write it out all the time, so:

```
VW16 0,'XC516,'X29,0
```

is the same as:

```
CSR=0,'XC516,'X29
VW16 CSR,0
```

So, having explained what all the statements mean, to our example:

```
10 REM PROGRAM TO WRITE AND READ 24 BITS TO/FROM CAMAC
20 REM BASE ADDRESS IS C500
30
40 VCSR=0,'XC504,'X29          ;VCA3330 CSR
50 VID =0,'XC502,'X29          ;VCA3330 ID
60 D0  =0,'XC510,'X29          ;CAMAC DATA LOW
70 D1  =0,'XC512,'X29          ;CAMAC DATA MID
80 D2  =0,'XC514,'X29          ;CAMAC DATA HIGH
90 SA  =0,'XC516,'X29          ;CAMAC SUBADDRESS
100 SN =0,'XC518,'X29          ;CAMAC STATION NUMBER
110 FUN=0,'XC51A,'X29          ;CAMAC FUNCTION CODE
120
200 REM FIRST CHECK UNIT IS OK
210 VR16 VID,A                 ;READ THE MODULE'S ID
220 IF A=3330 GOTO 240         ;SHOULD BE 3330 DECIMAL
230 PRINT "MODULE ID WRONG, EXPECTED 3330, GOT ",A
```

```
240 VR16 VCSR,A                ;READ CSR TO BOOK
250 IF A & 1 THEN GOTO 1000    ;ALREADY BUSY!!
260 VW16 VCSR,0                ;SELECT CRATE 0, NO INTERRUPTS
270 REM READY TO SET UP CAMAC
280 VW8 SN,1                   ;SELECT STATION 1
290 VW8 SA,0                   ;SELECT SUBADDRESS 0
300 FOR D=0 TO 255             ;8 BIT INCREMENT
310 LET E=255-D                ;DIFFERENT DATA FOR MID BYTE
320 VW8 D0,D                   ;WRITE LOW BYTE DATA
330 VW8 D1,E                   ;AND MID BYTE
340 VW8 D2,D                   ;AND HIGH BYTE
350 VW8 FUN,16                 ;SEND FUNCTION CODE, DO CYCLE
360 VW8 FUN,0                  ;NOW DO THE READ BACK
370 VR8 SA,X                   ;READ THE 1331 CSR TO CHECK Q,X
380 LET X=X&129                ;TOP AND BOTTOM BITS ONLY
390 IF X<129 GOTO 2000         ;DID NOT GET Q AND X
400 VR8 D0,R                   ;READ LOW BYTE
410 VR8 D1,S                   ;AND MID BYTE
420 VR8 D2,T                   ;AND HIGH BYTE
430 IF R=D GOTO 450            ;CHECK DATA
440 PRINT "LOW BYTE DATA ERROR, WROTE",D,"READ BACK",R
450 IF S=E GOTO 470
460 PRINT "MID BYTE DATA ERROR, WROTE",E,"READ BACK",S
470 IF T=D GOTO 490
480 PRINT "HIGH BYTE DATA ERROR, WROTE",D,"READ BACK",T
490 NEXT D                     ;NEXT DATA
500 GOTO 300                   ;DO IT ALL AGAIN
1000 PRINT "MODULE IS NOT A VCA 3330 !!!!!!!"
1010 STOP
2000 PRINT  "CAMAC MODULE DID NOT RESPOND WITH Q AND X !!!"
2010 GOTO 400                  ;CHECK DATA ANYWAY
```

5. PARTS LIST

Part	Type	Comment
IC1	74LS645-1	
IC2	74LS645-1	
IC3	PAL18P8	"3330P3"
IC4	74LS652	
IC5	74LS641-1	
IC6	74S38	
IC7	74LS373	
IC8	74LS123	
IC9	74LS688	
IC10	N82S23	PROM "3330P10"
IC11	PAL22P10	"3330P11"
IC12	74LS652	
IC13	N82S23	PROM "3330P13"
IC14	74LS14	
IC15	74LS138	
IC16	74LS244	
IC17	PAL22P10	"3330P10"
IC18	74LS74	
IC19	74LS244	
D1	IN4148	
R1	100K	
R2	1K0	
R3	2K2	
R4	680R	
R5	10K	
R6	1K0	
R7	1K0	
R8	100K	
C1	10uF 16V Tantalum Electrolytic	
C2	470pF Ceramic	
C3	33pF Ceramic	
C4-C14 inc.	100nF Ceramic	

RN1,2,6,8	SIL	Resistor	network,	8	common	resistors,	470R
RN3	"	"	"	"	"	"	100K
RN4,5,7,9	"	"	"	"	"	"	560R

SW1 8-way DIL Switch