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DATA-ACQUSITION SYSTEM FOR DEBUGGING CORRELATOR HARDWARE

ABSTRACT: For debugging any FX ASIC based hardware, a need was felt to have a Data-Acquisition System which would be compatible with the format in which one gets output from the ASIC and then store the data on to a PC Hard-Disk for further analysis later on in order to verify the hardware – be it FFT or MAC – and fine tune it accordingly. To meet this requirement, since otherwise it was not at all possible to monitor 16-18 output bits simultaneously on an Oscilloscope, a Data Acquisition card was built around the 8251 USART Chip to provide a temporary memory-buffer for the ASIC output and then transfers the data to a PC on a Simplex Serial-Link. The serial-link has been successfully used at a baud rate of 9.6k .

REQUIREMENTS: Output of the ASIC is in the form of 18-bits. For debugging the Hardware, its necessary to have available the bit-pattern that appears at the output with each clock-edge. Even after leaving the 2 LSB's, the Data-Acquistion has to have the capability of accepting 16-Bits simultaneously.

Moreover, after acquiring the data, one would also like to search for any repetitive error patterns in the output and that requires the memory buffer to have sufficient depth to store o/p's of a few FFT Cycles in one go.

IMPLEMENTATION: Keeping these requirements in mind, the circuit which has been implemented consists of two 7C185 RAMs in parallel which provide a buffer size of (8k X 16). Chip 8251 provides a Simplex Serial interface with a PC. 8k data points of width 16 each get written into this buffer and after that 8251 transfers the data to a PC – one Byte at a time. IC 1488 Driver Chip provides necessary output voltage levels for RS232 interface.

Necessary intelligence required in the circuit to generate various control signals has been implemented

in GAL22V10 and PAL16L8. This includes, among other things, logic to load Mode Word and Command word to initialize 8251, selection of appropriate clock etc.

Mode-word and the Command-word can be set through two 8-bit DIP Switches available on the board. For this Simplex link, one has to load these two Bytes only once.

Address generator for the RAM's has been implemented in EPLD - EPM5032D which we had got from RRI.

OPERATION: Each data-acquisition sequence starts with pressing a Push-Button on the board. This initializes various components to a known initial state, RESETs 8251, loads Mode and Command Words in this sequence.

For 16-bit data to get written to the RAM , the users should provide an active-low WE pulse of minimum 20ns duration after the data to be input is stable.

Once the 8k X 16 buffer is filled, all further Write operations are disabled and 8251 reads one Byte at a time and sends it to the PC bit by bit.

INSTRUCTIONS FOR USERS: A user needs to be aware of the following things only:

(i) Location of the Push-Button : since there is only one on the board, it would be extremely difficult to miss that.

(ii)Data Inputs : 16 data inputs can be used by plugging in 16-single-strand wires into the Single Inline Sockets made available on the board. They are numbered D0 to D15 from left to right.

(iii) WE Input : this must be plugged in at the pin-2 of PAL 16L8 (ref. USART15).

(iv) Output: Serial output is available on a 25pin D-Type connector which must be connected to a PC.

(v) An active Low RST pulse which starts the operation is available for any usage OFF the CARD.

(v) Location of the Board itself: any Correlator-Group person may be contacted for that.

Encl. :

(i) OrCAD Schematic

(ii) ABEL Program for PAL 16L8

(iii)ABEL Program for GAL 22V10

(Note: The Schematic was updated to include connectors etc also in order to make a proper PCB. Acquisition System and these few later additions may be ignored for the General Purpose Board which is presently available in the Lab)

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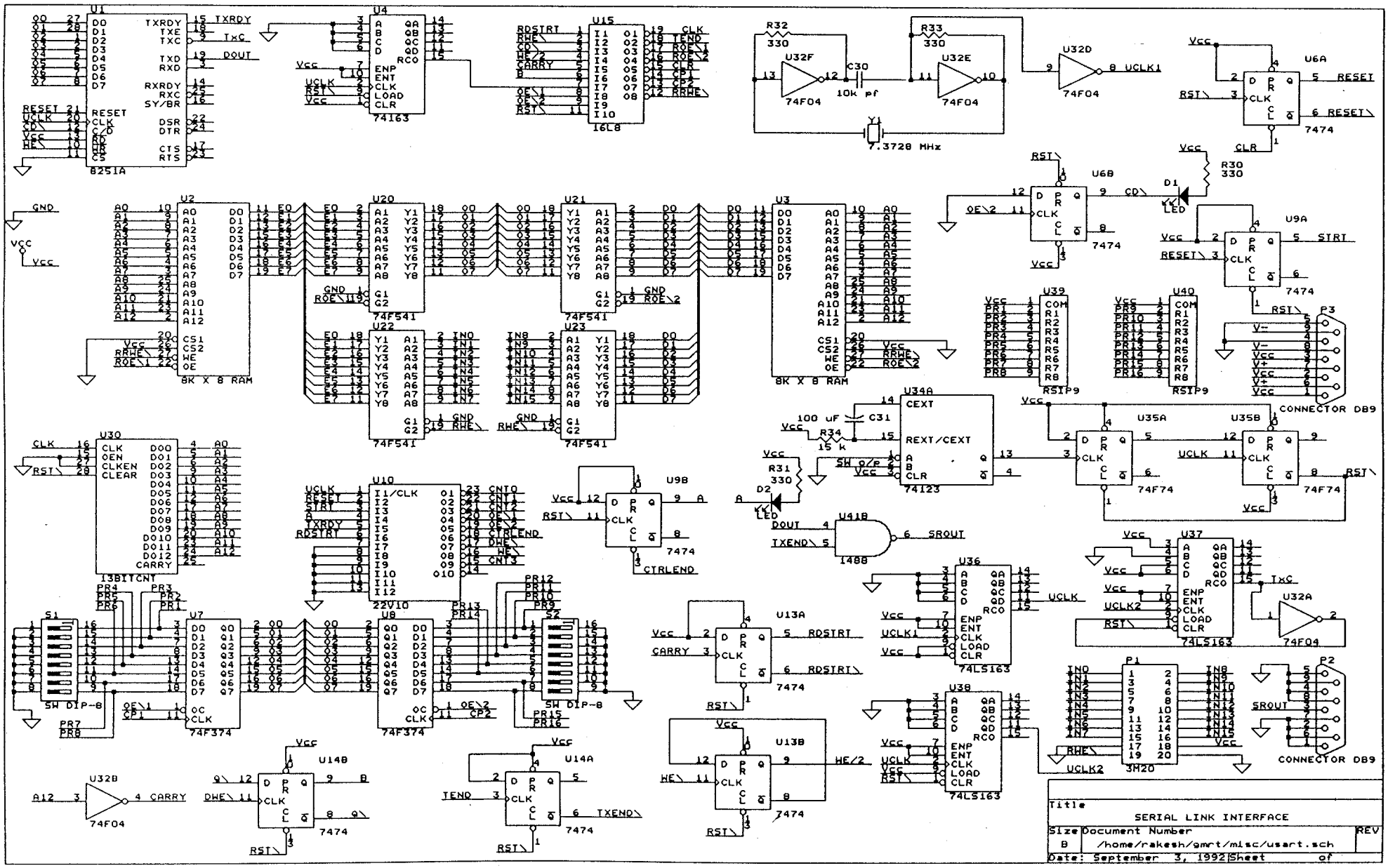
U1
8251A
U4
74163
U15
I6L8
R32
330
R33
330
U32F
74F04
U32E
74F04
C30
10k pf
U32D
74F04
Y1
7.3728 MHz
U6A
7474
U6B
7474
R30
330
D1
LED
U9A
7474
U2
8K X 8 RAM
U20
74F541
U21
74F541
U3
8K X 8 RAM
U22
74F541
U23
74F541
U39
RSIP9
U40
RSIP9
P3
CONNECTOR DB9
U34A
74123
C31
100 uF
R34
15 k
R31
330
D2
LED
U41B
I488
U35A
74F74
U35B
74F74
U30
I3BITCNT
U10
22V10
U9B
7474
CTRLEND
U36
74LS163
U37
74LS163
U32A
74F04
S1
5W DIP-8
U7
74F374
U8
74F374
S2
5W DIP-8
U13A
7474
U13B
7474
U38
74LS163
P1
3M20
P2
CONNECTOR DB9
U32B
74F04
U14B
7474
U14A
7474
Title
SERIAL LINK INTERFACE
Size
B
Document Number
/home/rakesh/gmrt/misc/usart.sch
REV
Date: September 3, 1992
Sheet
of

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USRT10
Serial Link Interface'

        USRT10    device                    'P22V10' ;

"INPUTS : "

        CLK             PIN 1;
        RESET           PIN 2 ;    "Active High"
        STRT            PIN 3;
        A               PIN 4;
        TXRDY           PIN 5;
        RDSTRT          PIN 6;
"       WE              PIN 7;     Active Low"

"OUTPUTS: "
        CNT0            PIN 23 ;
        CNT1            PIN 22 ;
        CNT2            PIN 21 ;
        OE1             PIN 20 ;
        OE2             PIN 19 ;
        CTRLEND         PIN 18 ;
        DWE             PIN 17 ;
        WE              PIN 16 ;
        CNT3            PIN 15 ;

"DEFINITIONS:"

COUNT = [CNT3,CNT2,CNT1,CNT0] ;

"EQUATIONS :"

equations
[CNT3,CNT2,CNT1,CNT0].CLK = CLK;
OE1.CLK = CLK;
OE2.CLK = CLK;
CTRLEND.CLK = CLK;
WE.CLK = CLK;
DWE.CLK = CLK;


COUNT := (COUNT + 1) & !RESET & A;
!OE1  := STRT & (COUNT < 3) & A & !RESET ;

!OE2  := STRT & A & !RESET & ( COUNT>8) & (COUNT<12);
!CTRLEND := (COUNT == 13);

!WE   :=  !OE1 & (COUNT==1) & !RESET
        # !OE2 & (COUNT ==10 ) & !RESET
        # TXRDY & (WE==1) & RDSTRT & !RESET;
!DWE := !WE & !RESET;


"TEST VECTORS :"
test_vectors     ([CLK,STRT,RESET,A,COUNT] -> [COUNT,OE1,OE2,CTRLEND,WE])
                  [.c.,  0 ,  1  ,.x.,.x.] -> [   0 , 1 ,  1, 1      , 1] ;
                  [.c.,  1 ,  0  ,1,  0  ] -> [   1 , 0 ,  1, 1      , 1] ;
                  [.c.,  1 ,  0  ,1,  1  ] -> [   2 , 0 ,  1, 1      , 0] ;
                  [.c.,  1 ,  0  ,1,  2  ] -> [   3 , 0 ,  1, 1      , 1] ;
                  [.c.,  1 ,  0  ,1,  3  ] -> [   4 , 1 ,  1, 1      , 1] ;
                  [.c.,  1 ,  0  ,1,  4  ] -> [   5 , 1 ,  1, 1      , 1] ;
                  [.c.,  1 ,  0  ,1,  5  ] -> [   6 , 1 ,  1, 1      , 1] ;
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[.c.,  1 ,  0  ,1,  7  ] -> [  8 , 1 ,  1, 1     , 1] ;
[.c.,  1 ,  0  ,1,  8  ] -> [  9 , 1 ,  1, 1     , 1] ;
[.c.,  1 ,  0  ,1,  9  ] -> [ 10 , 1 ,  0, 1     , 1];
[.c.,  1 ,  0  ,1, 10  ] -> [ 11 , 1 ,  0, 1     , 0];
[.c.,  1 ,  0  ,1, 11  ] -> [ 12 , 1 ,  0, 1     , 1];
[.c.,  1 ,  0  ,1, 12  ] -> [ 13 , 1 ,  1, 1     , 1];
[.c.,  1 ,  0  ,0, 13  ] -> [  0 , 1 ,  1, 0     , 1];
[.c.,  1 ,  0  ,0, .x. ] -> [  0 , 1 ,  1, 1     , 1];

test_vectors    ([CLK,OE1,OE2,TXRDY,RDSTRT,WE] -> [WE])
                [.c., 0 , 1 , 1 , 1  ,     0] -> [0] ;
                [.c., 1 , 1 , 1 , 1  ,     0] -> [1] ;
                [.c., 0 , 1 , 1 , 1  ,     1] -> [0] ;
                [.c., 1 , 0 , 1 , 1  ,     1] -> [1] ;
                [.c., 1 , 1 , 0 , 1  ,   .X.] -> [1] ;
                [.c., 1 , 0 , 1 , 0  ,     1] -> [1] ;

end GAL_USRT10
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rol Logic for Serial Interface'

        USRT15    device                    'P16L8' ;

NPUTS : "

        RDSTRT              PIN 1;
        RWE                 PIN 2;
        CD                  PIN 3;
        WE2                 PIN 4;
        CARRY               PIN 5;
        B                   PIN 6;
        NCLR                PIN 7;
        OE1                 PIN 8;
        OE2                 PIN 9;
        RST                 PIN 11;

"OUTPUTS: "
        CLK                 PIN 19 ;
        TEND                PIN 18 ;
        ROE1                PIN 17 ;
        ROE2                PIN 16 ;
        CLR                 PIN 15 ;
        CP1                 PIN 14 ;
        CP2                 PIN 13 ;
        RRWE                PIN 12 ;
"EQUATIONS :"
equations

        CLK  = (!CD & WE2 & RDSTRT & RST) # (RWE & !RDSTRT & RST) ;
        TEND = CARRY & RDSTRT ;
        ROE1 = B  # !RDSTRT ;
        ROE2 = !B # !RDSTRT ;
        CLR = !NCLR;
        CP1 = !OE1;
        CP2 = !OE2;
       !RRWE= !RWE & !RDSTRT ;
"TEST VECTORS:"
test_vectors  ([RDSTRT,RWE,CD,WE2,RST] -> [CLK])
               [ 0    , 1 ,.X.,.X., 1 ] -> [1];
               [ 0    , 0 ,.X.,.X., 1 ] -> [0];
               [ 1    , .X.,0 , 1 , 1 ] -> [1];
               [ 1    , .X.,0 , 0 , 1 ] -> [0];
               [.X.   , .X.,.X.,.X.,0 ] -> [0];
end PAL_USRT15
```