DØ CRYO TO DØ PHYSICS DAQ COMMUNICATIONS LINK

ENGINEERING NOTE

3740.515-EN-420

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OVERVIEW: This engineering note documents a communication link between the DØ cryo/gas control system and the DØ physics data acquisition computer system. This note is being written well after the work has been completed, in order to document this communications link, and to satisfy needs of planned upgrades. These upgrades are the DØ Super Conducting Solenoid, VLPC system, and Silicon Detector System.

The DØ cryo/gas control system is a Programmable Logic Controller based process control system. It is responsible for controlling many of the physical parameters of the DØ experiment, such as Calorimeter cooling, vacuum, Instrument air, TRD gas pressures and flows, WAMUS pressures and flows, SAMUS pressure and flows, etc. It works independent of the Physics DAQ system.

There is a need for the Physics DAQ system to record some of these process values with the DØ physics data. This process data will later be used to calibrate certain features of the Physics data during reconstruction. The process data is also used to interlock (via the Physics DAQ system) some of the other DØ systems such as the TRD high voltage system. Some of the Process data values will be continuously monitored and will stop the Physics data taking of the experiment if it is out of tolerance.

Components: The PLC uses a Basic programming language I/O Module #505-7101 with 2 serial ports. 1 of the ports communicates with Token ring node #070D located in room #510. The other Basic module serial port is used to control and program the module from an IBM compatible computer. Both ports are using an RS232 serial interface.

The Token ring node #070D has a serial server program running that was programmed by Bob Goodwin and is maintained by Greg Cisco. This program is automatically loaded when there is a power recovery after an upset.

How It Works: The PLC is constantly updating both input and output at a rate of about 40 ms/IO update cycle. The Basic Module will download the listed I/O into it's memory then transmit these values over the serial link to the Token Ring Node at a rate of about 1 complete cycle/3 minutes. This data is transmitted in the form of something known as an S1 record. These records are continually updated over and over to a block of memory in the Token Ring Node.

The Physics DAQ computers will update it's database from this block of memory in the Token Ring Node. There is a time stamp sent along with this block of data. The Physics DAQ section checks to see that the time stamp is updated every so often, and if it's not, will cause an alarm in the DØ main control room.

The current name of the Basic module executable program is S-REC-PR. The software that runs on the compatible computer that programs the Basic module is called B-TERM. It can and does run under Windows for Workgroups and Windows NT. B-TERM can but doesn't need to run once the Basic module is programmed and in the run mode. It can be run however to check the output of either serial port. B-TERM itself, is not much more than a terminal emulator.

Players: This project was completed in September of 1993.

Dan Markley was the organizer of the project.

Mike McGee was the principal Basic programmer of the Basic Module.

Greg Cisko was a basic programming consultant and the Token Ring Node coordinator.

Bob Angstadt was a basic programming consultant.

Bob Goodwin was the Token Ring Node software writer.

Laura Paterno was the DAQ system programmer.

Expansion: There are 150 memory locations continuously transmitted to the Token ring node. Each memory location stores a 12 bit word. Of those 150 locations only about 100 contain assigned data. 50 locations will be abandoned after run 1B due to the removal of the TRD system. This will leave about 100 memory locations for future transmittal of process data to the Physics DAQ systems. This should be more than enough to cover the planned Solenoid, VLPC, Silicon detector etc.

What this means, is that in order to expand the number of communicated I/O, none of the internal programming of the com link software will have to be altered.

Also Included in This Note:

1. A hard copy of the Basic code currently running in the Basic I/O module.
2. A spread sheet that defines the data that is transferred from the PLC to the Token Ring Node.

#	BASE	SLOT/PT	VME CHANNEL	V ADD	ADDRESS	TAG	DESCRIPTION	SEX	RANGE
1			300	V3701			YEAR		
2			301	V3702			MONTH		
3			302	V3703			DAY		
4			303	V3704			HOUR		
5			304	V3705			MINUTE		
6			305	V3706			SECONDS		
7			306	V3707					
8			307	V3708					
9			308	V3709					
10			309	V3710					
11	1	1/1	30A	V3711	WX2049	DET 1P	DET 1 TO ATM DIFFERENTIAL	(4-20 ma)	-5" T0+5"H2O
12	1	1/2	30B	V3712	2050	GAP 1P	GAP 1 TO DET 1 DIFFERENTIAL	(4-20 ma)	-5" T0+5"H2O
13	1	1/3	30C	V3713	2051	RAD 1P	RAD 1 TO GAP 1 DIFFERENTIAL	(4-20 ma)	-5" T0+5"H2O
14	1	1/4	30D	V3714	2052				
15	1	1/5	30E	V3715	2053	DET 2P	DET 2 TO ATM DIFFERENTIAL	(4-20, ma)	-5" T0+5"H2O
16	1	1/6	30F	V3716	2054	GAP 2P	GAP 2 TO DET 2 DIFFERENTIAL	(4-20 ma)	-5" T0+5"H2O
17	1	1/7	310	V3717	2055	RAD 2P	RAD 2 TO GAP 2 DIFFERENTIAL	(4-20 ma)	-5" T0+5"H2O
18	1	1/8	311	V3718	2056				
19	1	2/1	312	V3719	WX2057	DET 3P	DET 3 TO ATM DIFFERENTIAL	(4-20 ma)	-5" T0+5"H2O
20	1	2/2	313	V3720	2058	GAP 3P	GAP 3 TO DET 3 DIFFERENTIAL	(4-20 ma)	-5" T0+5"H2O
21	1	2/3	314	V3721	2059	RAD 3P	RAD 3 TO GAP 3 DIFFERENTIAL	(4-20 ma)	-5" T0+5"H2O
22	1	2/4	315	V3722	2060				
23	1	2/5	316	V3723	2061				
24	1	2/6	317	V3724	2062				
25	1	2/7	318	V3725	2063				
26	1	2/8	319	V3726	2064				
27	1	3/1	31A	V3727	WX2065	RAD 1FL OW	RAD 1 FLOW	(0-5 VOLTS)	0-70 LPH
28	1	3/2	31B	V3728	2066	GAP 1FL OW	GAP 1 FLOW	(0-5 VOLTS)	0-15 LPH
29	1	3/3	31C	V3729	2067	DET 1FL OW	DET 1 FLOW	(0-5 VOLTS)	0-40 LPH
30	1	3/4	31D	V3730	2068	RAD 2FL OW	RAD 2 FLOW	(0-5 VOLTS)	0-100 LPH
31	1	3/5	31E	V3731	2069	GAP 2FL OW	GAP 2 FLOW	(0-5 VOLTS)	0-25 LPH
32	1	3/6	31F	V3732	2070	DET 2FL OW	DET 2 FLOW	(0-5 VOLTS)	0-50 LPH

DØCRYO PLC TO VME COMMUNICATIONS LIST

#	BASE	SLOT/PT	VME CHANNEL	V ADD	ADDRESS	TAG	DESCRIPTION	SEX	RANGE
33	1	3/7	320	V3733	2071	RAD 3FL OW	RAD 3 FLOW	(0-5 VOLTS)	0-120 LPH
34	1	3/8	321	V3734	2072	GAP 3FL OW	GAP 3 FLOW	(0-5 VOLTS)	0-25 LPH
35	1	4/1	322	V3735	WX2073	DET 3FL OW	DET 3 FLOW	(0-5 VOLTS)	0-65 LPH
36	1	4/2	323	V3736	2074				
37	1	4/3	324	V3737	2075				
38	1	4/4	325	V3738	2076				
39	1	4/5	326	V3739	2077				
40	1	4/6	327	V3740	2078				
41	1	4/7	328	V3741	2079				
42	1	4/8	329	V3742	2080	PLA TAT M	PLATFORM ATM PRESS. TRANSMITTER	0-5 VOLTS=800	1060 MBAR
43	2	1/1	32A	V3743	WX2209	TRD LPS	L.P.S.	(4-20 MA)	0-30 PSIG
44	2	1/2	32B	V3744	2210	TRD SUC	SUCTION PRESSURE	(4-20 MA)	-5 TO 5 "H2O
45	2	1/3	32C	V3745	2211	TRD CDI S	TRD PUMP DISCHARGE PRESSURE	(4-20 MA)	0-30 PSIG
46	2	1/4	32D	V3746	2212	TRD VOL 0	VOL Ø PRESSURE	(4-20 MA)	0-30 PSIG
47	2	1/5	32E	V3747	2213	TRD XEP LT	XENON PRESSURE TO PLATFORM	(4-20 MA)	0-30 PSIG
48	2	1/6	32F	V3748	2214	TRD CAN	CANARY PRESSURE	(4-20 MA)	-5 TO 5 "H2O
49	2	1/7	330	V3749	2215		TRD VAC PUMP VACUUM PIRANNI	(4-20 MA)	0-1000 TORR
50	2	1/8	331	V3750	2216	TRD H2O	TRD MOISTURE ANALYZER	(4-20 MA)	100-10K PPM
51	2	2/1	332	V3751	WX2217	TRD TXE FL	XENON TOTAL FLOW METER	0-5 VDC	0-150 LPH
52	2	2/2	333	V3752	2218	ROO MAT M	TRD ROOM ATM PRESSURE	0-5VOLTS=800	1060 MBAR
53	2	2/3	334	V3753	2219				
54	2	2/4	335	V3754	2220				
55	2	2/5	336	V3755	2221				
56	2	2/6	337	V3756	2222				
57	2	2/7	338	V3757	V2223				
58	2	2/8	339	V3758	2224	TRD O2	O2 ANALYZER	(4-20 MA)	0-10 PPM
59	1	6/1	33A	V3759	WX2089	TRD PLT TPM	TRD PLATFORM GAS TEMPERATURE	(-200 TO 850	CELCIUS
60	3	1/3	33B	V3760	515	TRD RM TMP	TRD ROOM GAS TEMPERATURE	(-75 TO +175	CELCIUS
61	0	1/1	33C	V3761	WX0001	PT 233 A	CC UPPER VPT	(4-20 MA)	14-27 PSIA
62	0	1/2	33D	V3762	2	PT 234 A	CC LOWER VPT	(4-20 MA)	14-27 PSIA
63	0	1/3	33E	V3763	3	PT 240 A	CC MIDDLE VPT	(4-20 MA)	14-27 PSIA
64	0	1/4	33F	V3764	4	DPT 235 A	CC TOP TO BOTTOM VPT DIFFERENTIAL	(4-20 MA)	0-2.5 PSIA

DØ CRYO PLC TO VME COMMUNICATIONS LIST

#	BASE	SLOT/PT	VME CHANNEL	V ADD	ADDRESS	TAG	DESCRIPTION	SEX	RANGE
65	0	1/5	340	V3765	5	PT 210 N	CC CONDENSOR OUTLET PRESSURE	(4-20 MA)	0-75 PSIA
66	0	1/6	341	V3766	6	PT 204 A	CC CRYOSTAT PRESSURE MONITOR	(4-20 MA)	14-27 PSIA
67	0	1/7	342	V3767	7	PT 230 A	CC CRYOSTAT PRESSURE CONTROL	(4-20 MA)	14-27 PSIA
68	0	1/8	343	V3768	8	DPT 222 A	CC VPT DIFFERENTIAL FROM TOP TO BOT	(4-20 MA)	0-10 PSI
69	0	2/1	344	V3769	WX0009				
70	0	2/2	345	V3770	10	BI 223 A	CC ARGON LIQUID OPERATING LEVEL	(4-20 MA)	0 TO 100%
71	0	2/8	346	V3771	16	PT 333 A	SEC UPPER VPT	(4-20 MA)	14-27 PSIA
72	0	3/1	347	V3772	WX0017	PT 334 A	SEC LOWER VPT	(4-20 MA)	14-27 PSIA
73	0	3/2	348	V3773	18	PT 340 A	SEC MIDDLE VPT	(4-20 MA)	14-27 PSIA
74	0	3/5	349	V3774	21	PT 304 A	SEC CRYOSTAT PRESSURE MONITOR	(4-20 MA)	14-27 PSIA
75	0	4/5	34A	V3775	29	PT 330 A	SEC CRYOSTAT PRESSURE CONTROL	(4-20 MA)	14-27 PSIA
76	0	4/6	34B	V3776	30	DPT 322 A	SEC DIFFERENTIAL TOP TO BOT(level)	(4-20 MA)	0-10 PSI
77	0	5/3	34C	V3777	35	BI 323 A	SEC ARGON LIQUID OPERATING LEVEL	(4-20 MA)	0 TO 100%
78	0	3/4	34D	V3778	WX20	PT 310 N	SEC CONDENSOR OUTLET PRESSURE	(4-20 MA)	0-75 PSIA
79	0	7/2	34E	V3779	50	PT 133 A	NEC UPPER VPT	(4-20 MA)	14-27 PSIA
80	0	7/3	34F	V3780	51	PT 134 A	NEC LOWER VPT	(4-20 MA)	14-27 PSIA
81	0	7/4	350	V3781	52	PT 140 A	NEC MIDDLE VPT	(4-20 MA)	14-27 PSIA
82	0	7/6	351	V3782	54	PT 110 N	NEC CONDENSOR OUTLET PRESSURE	(4-20 MA)	0-75 PSIA
83	0	7/7	352	V3783	55	PT 104 A	NEC CRYOSTAT PRESSURE MONITOR	(4-20 MA)	14-27 PSIA
84	0	7/8	353	V3784	56	PT 130 A	NEC CRYOSTAT PRESSURE CONTROL	(4-20 MA)	14-27 PSIA
85	0	8/1	354	V3785	WX0057	DPT 122 A	NEC DIFFERENTIAL TOP TO BOT(level)	(4-20 MA)	0-10 PSI
86	0	8/2	355	V3786	58				
87	0	8/3	356	V3787	59	BI 123 A	NEC ARGON LIQUID OPERATING LEVEL	(4-20 MA)	0 TO 100%
88	3	3/1	357	V3788	WX529	FTR 1 REC	WAMUS FLOW TO VENT	0-5 VDC	0-100 SLPM
89	3	3/2	358	V3789	530	FT 1 AR	WAMUS ONE PASS FLOW	0-5 VDC	0-100 SLPM
90	3	3/3	359	V3790	531	FT 1 REC	WAMUS FLOW TO CHAMBERS	0-5 VDC	0-106.16 SLPM
91	3	3/4	35A	V3791	532	PT 2 REC	WAMUS PUMP DISCHARGE PRESS	(4-20 MA)	0-60 PSI
92	3	3/5	35B	V3792	533	PT 3 REC	WAMUS CHAMBER INLET PRESS	(4-20 MA)	0-25"H2O
93	3	4/1	35C	V3793	WX537	SAM FL	SAMUS CHAMBER SUPPLY FLOW	0-5 VDC	0-5.0 SLPM
94	3	4/2	35D	V3794	538	C O2	WAMUS CO2 (ANARAD ANALYZER)	1-5 VDC	0-10%
95	3	4/3	35E	V3795	539	FRE ON	WAMUS FREON (ROSEMOUNT ANAL)	4-20MA	0-20%
96	3	4/4	35F	V3796	540	H 2O	WAMUS H2O (PANAMETRICS ANAL)	0-2 VDC	0-250 PPM

#	BASE	SLOT/PT	VME CHANNEL	V ADD	ADDRESS	TAG	DESCRIPTION	SEX	RANGE
97	3	4/5	360	V3797	541	O2	WAMUS O2 (CUSTOM ANALYZER)	4-20MA	O-200 PPM
98	3	4/6	361	V3798	542	SAM PT9 4	SAMUS MIXING TANK PRESSURE	4-20 MA	0-50 PSI
99	3	4/7	362	V3799	543	SAM SUP	SAMUS PRESSURE SUPPLY TO CHAM	4-20 MA	0-138.4"H2O
100			363	V3800					
101			364	V3801					
102			365	V3802					
103			366	V3803					
104			367	V3804					
105			368	V3805					
106			369	V3806					
107			36A	V3807					
108			36B	V3808					
109			36C	V3809					
110			36D	V3810					
111			36E	V3811					
112			36F	V3812					
113			370	V3813					
114			371	V3814					
115			372	V3815					
116			373	V3816					
117			374	V3817					
118			375	V3818					
119			376	V3819					
120			377	V3820					
121			378	V3821					
122			379	V3822					
123			37A	V3823					
124			37B	V3824					
125			37C	V3825					
126			37D	V3826					
127			37E	V3827					
128			37F	V3828					

#	BASE	SLOT/PT	VME CHANNEL	V ADD	ADDRESS	TAG	DESCRIPTION	SEX	RANGE
129			380	V3829					
130			381	V3830					
131			382	V3831					
132			383	V3832					
133			384	V3833					
134			385	V3834					
135			386	V3835					
136			387	V3836					
137			388	V3837					
138			389	V3838					
139			38A	V3839					
140			38B	V3840					
141			38C	V3841					
142			38D	V3842					
143			38E	V3843					
144			38F	V3844					
145			390	V3845					
146			391	V3846					
147			392	V3847					
148			393	V3848					
149			394	V3849					
150			395	V3850					

S-REC-PR

```

~1 10 REM *****
*****
15 REM Purpose of Module: Handles i/o of s1 records from
20 REM D0soft::'s RS232 (VMS) port to Shea/Goodwin VME.
25 REM Author: R. Angstadt
30 REM Modified and converted to QBASIC by Michael McGee 17 AU
G 93
35 REM Further Modified to remove all <CR>'s, and changed "WRIT
E"
40 REM to "PRINT" in SWRITE -> by Greg Cisko 8 Sep 93.
45 REM Converted to BASIC Module language by Michael McGee 21 O
CT 93
50 REM *****
*****
60 DIM R3[3],S[3],M[3],H[300],TM[100]
70 DIM C0[200],VAL[200],TIM[20],CS[200],D[200],FAC[200]
80 DIM ADR[200],DAT[200],D1[200],CH[200],CW[200]
90 ESCAPE ! Only way to stop program once started: Key invoked
escape.
100 UNIT 3 ! Write to output port 1. May change to port 2.
105 $ADR[0]="V3701" ! Defines initial Vmemory location for read

110 CALL "PCREAD",ADR[0],DAT[0],8
112 REM Calling the PLC time for timing sequence.
115 FF=DAT[4]
116 PRINT FF
120 REM MIV is the interval in minutes and initialize.
125 MIV=3
130 MIN=0
134 REC=150
135 CALL "PCREAD",ADR[0],DAT[0],8
140 MIN=DAT[4]
145 REM Start of timing code...
150 IF MIN=FF THEN GOTO 185
155 GOTO 110
156 REM Continues timing sequence, calling DAT(4) which is minute
s
160 CALL "PCREAD",ADR[0],DAT[0],8
165 MIN=DAT[4]
170 REM When condition is met, the next set of records are sent.
173 PRINT MP,MIN
174 PRINT MP,MIN
175 IF MP=MIN THEN GOTO 185
176 IF MP>MIN THEN GOTO 185
180 GOTO 160
185 MP=MIN+MIV
187 REM loop initializes character strings and data storage array
s.
190 FOR JJ=0 TO 150
195 $C0[JJ]=""
```

S-REC-PR

```

200  DAT[JJ]=0
205  FAC[JJ]=0
210  $CH[JJ]=" "
220  CAT=0
230  NEXT JJ
235  REM Calling PLC for the 150 integers.
240  CALL "PCREAD",ADR[0],DAT[0],150
245  REM Loop constructs and sends s1 records.
246  REM CAT holds the integer from PLC, this value must meet two
247  REM conditions: 1 < CAT <= 32767 (ie. 2**16 = 32766) otherwis
e negative
250  FOR M=0 TO REC
260    CAT=DAT[M]
261    IF CAT<1 THEN CAT=0
262    REM PRINT M; CAT
263    IF CAT>=32767 THEN CAT=0
270    DD=1
280    IF CAT=0 THEN GOTO 300
290    GOTO 310
300    $D1[M]="0000"
305    REM GOSUB 830 converts data integer to HEX form.
310    GOSUB 830
315    REM FAC(M) is used to change the address of the VME channel.
316    REM 768 = 0300 in terms of HEX. This value is sent to GOSUB
830
317    REM for HEX conversion.
320    FAC[M]=768+FAC[M]+M
330    IF M=0 THEN FAC[M]=768
340    DD=3
350    CAT=FAC[M]
360    GOSUB 830
365    REM $C0(M) is the s1 string. $CH(M) is the channel address i
n HEX form
366    REM $D1 is the data converted to HEX.
370    $C0[M]="s10F0000300201000002070D"+$CH[M]+$D1[M]
380    NUM=0
390    LS=0
400    NLO=0
410    NHI=0
420    REM N2 is the record length,
430    N2=LEN[$C0[M]]
440    FOR I=3 TO N2 STEP 2
450      GOSUB 750
460      NHI=NUM
470      NHI=NHI*16
480      I=I+1
490      GOSUB 750
500      I=I-1
510      NLO=NUM
520      LS=LS+NHI+NLO

```

S-REC-PR

```

530  NEXT I
540  LS=LS LXOR 255
550  NLO=LS AND 15
560  NHI=LS AND 240
570  NHI=INP[LS/16]
580  DD=2
590  CAT=NHI
600  GOSUB 830
610  $NH=$B
620  CAT=LS
630  GOSUB 830
640  $CS=$NH+$B
650  $C0[M]=$C0[M]+$CS
660  REM s0, s1 & s9 records for each case in sent to the serial
port.
670  REM
680  IF M>=REC THEN GOTO 720
690  PRINT "s0060000005601A2"
700  PRINT $C0[M]
710  PRINT "s9030001FB"
720  DD=1
730  NEXT M
740  GOTO 160 ! Restart the timing process, after 150 records.
745  REM
750  $R3=$C0[M;I],1
760  IF $R3>="A" THEN IF $R3<="F" THEN GOTO 810
770  IF $R3>="0" THEN IF $R3<="9" THEN GOTO 790
780  PRINT " ERROR $C0 (M) ";$C0[M]
790  NUM=ASC[$R3]-48
800  GOTO 820
810  NUM=ASC[$R3]-55
820  RETURN
830  A=16*16*16*16*16*16
840  L=0
850  $B=""
860  FOR EE=0 TO 7
870    $D[EE]=" "
880  NEXT EE
890  IF CAT=0 THEN GOTO 1170
900  FOR J=1 TO 7
910    I=7-J
920    IF CAT>=A THEN GOTO 940
930    GOTO 1070
940    L=INP[CAT/A]
950    CAT=INP[CAT-(A)*L]
960    IF L>=10 THEN GOTO 980
970    GOTO 1020
980    REM $D(J) = %X%00 ! Converts to ascii..
990    X=L+55
1000  $D[J]=%X%0

```

S-REC-PR

```
1010 GOTO 1090
1020 IF L=0 THEN GOTO 1135
1030 $D[J]="#9",L
1040 X=L+48
1050 $D[J]=%X%0
1060 GOTO 1090
1070 IF J<4 THEN GOTO 1110
1080 $D[J]="0"
1090 IF J<4 THEN GOTO 1110
1100 $B=$B+$D[J]
1110 A=A/16
1120 NEXT J
1130 IF DD=2 THEN $B=$D[7]
1140 IF DD=1 THEN $D1[M]=$B
1150 IF DD=3 THEN $CH[M]=$B
1160 GOTO 1180
1170 $B="#9",0
1180 RETURN
1190 GOTO 160
1200 REM
1210 STOP
1220 END
```