Pluto Manager - Program listing Pluto 0 Logic
File=C:\Users\joaoprod\Documents\GitHub\lsstCamVacPLC\firmware\vaccum_ps_01.sps
Name=<FILENAME>
File date=10/25/2018 2:29:09 PM Print date=10/25/2018 2:29:23 PM   PLC CRC=E75B

ABB

Page 1

Pluto 0 Logic

1

> Start

2 10 s filter on the VHX-UTT-GCC-00 Relay 2 (<0.001 Torr NO)

HV0001
I0.40

HVInterlockHigh
M0.15

I0.40=HV0001   VHX-UTT-GCC-00 Relay 2 (<0.001 Torr NO)

3

SM_1Hz
SM0.3 — P —

HVInterlockHigh
M0.15

| Upcount |
| CU   Q |
| Reset |
| Value ← 10 |

HVInterlockHighFilter
M0.17

SM0.3=SM_1Hz   1Hz pulses, On during one cycle

4 HV Permit to Ref

HVInterlockHighFilter
M0.17

HVStatBlock
M0.26

HVStatLatchReset
M0.23

| StartT |
| In1   Q |
| Start |
| IndReset |
| Test |

HVStat
Q0.1

HVInterlockHighLatchStatus
M0.21

Q0.1=HVStat   HEX-Can Vacuum Status PRT-UTT-PLC-03/I5

5

HVInterlockHighFilter
M0.17

HVStatBlock
M0.26

HVStat
Q0.1

HVInterlockHighLatchNeedsReset
M0.84

Q0.1=HVStat   HEX-Can Vacuum Status PRT-UTT-PLC-03/I5

6 10 s filter on the VCR UTT-GCC-00 Relay 2 (<0.001 Torr NO)

CV0001
I0.36

CVInterlockHigh
M0.16

I0.36=CV0001   VCR-UTT-GCC-00 Relay 2 (<0.001 Torr NO)

Pluto Manager - Program listing Pluto 0 Logic
File=C:\Users\joaoprod\Documents\GitHub\lsstCamVacPLC\firmware\vaccum_ps_01.sps
Name=<FILENAME>
File date=10/25/2018 2:29:09 PM Print date=10/25/2018 2:29:23 PM   PLC CRC=E75B

Page 2

ABB

7

SM_1Hz
SM0.3
—| P |—

CVInterlockHigh
M0.16
—|/|—

Upcount
CU   Q
Reset
Value

10 → Value

CVInterlockHighFilter
M0.20
—( )—

SM0.3=SM_1Hz   1Hz pulses, On during one cycle

---

8 CV permit to Ref

CVInterlockHighFilter CVStatkBlock
M0.20   M0.25
—|/|—   —|/|—

CVStatLatchReset
M0.24
—| |—

StartT
In1   Q
Start
IndReset
Test

CVStat
Q0.0
—( )—

CVInterlockHighLatchStatus
M0.22
—( )—

Q0.0=CVStat   Cryostat Vacuum Status PRT-UTT-PLC-03/I6

9

CVInterlockHighFilter CVStatkBlock CVStat
M0.20   M0.25   Q0.0
—|/|—   —|/|—   —|/|—

CVInterlockHighLatchNeedsReset
M0.80
—( )—

Q0.0=CVStat   Cryostat Vacuum Status PRT-UTT-PLC-03/I6

---

10 HV turbo pump speed setpoint input

HVTurboPumpOFF
I0.6
—|/|—

HVTurboPumpON
M0.32
—( )—

---

11 Close VHX-UTT-VGC-00 = (Hex TurboPumpOff OFF) AND (Relay Output of MKS925 is Open)

HVTurboPumpON MKS925
M0.32   I0.34
—| |—   —|/|—

MainVhxVcc
Q0.3
—(R)—

MainVhxVccForcedClose
M0.66
—( )—

I0.34=MKS925   Roughing Pump
Q0.3=MainVhxVcc   HEX-Can VHX-UTT-VCC-01

Pluto Manager - Program listing Pluto 0 Logic
File=C:\Users\joaoprod\Documents\GitHub\lsstCamVacPLC\firmware\vaccum_ps_01.sps
Name=<FILENAME>
File date=10/25/2018 2:29:09 PM Print date=10/25/2018 2:29:23 PM   PLC CRC=E75B

Page 3

ABB

12

MainVhxVccForcedClose
M0.66

MainVhxVccNotForcedCloseReset
M0.69

StartT
In1   Q
Start
           IndReset
Test

MainVhxVccNotForcedCloseLatch
M0.67

MainVhxVccNotForcedCloseLatchStatus
M0.68

13

MainVhxVccForcedClose   MainVhxVccNotForcedCloseLatch
M0.66   M0.67

MainVhxVccNotForcedCloseLatchNeedsReset
M0.85

14 Manual order to close VHX-UTT-VGC-00

CloseMainVhxVcc
M0.61

—| N |—

MainVhxVcc
Q0.3

—< R >—

Q0.3=MainVhxVcc   HEX-Can VHX-UTT-VCC-01

15 VHX-UTT-VGC-00 allowed to open = Hex TurboPumpOff ON OR (Hex TurboPumpOff OFF AND (VHX-UTT-GCC-00 Relay 1
AND VHX-UTT-GCC-01 Relay 1))

HVTurboPumpOFF   MainVhxVccNotForcedCloseLatch
I0.6   M0.67

HVTurboPumpON   HV01
M0.32   I0.37

MainVhxVccAlowedOpen
M0.62

I0.37=HV01   VHX-UTT-GCC-00 Relay 1 (<0.1 Torr NO) and VHX-UTT-GCC-01 Relays 1 (<0.001 Torr NO)

16

MainVhxVccAlowedOpen
M0.62

OpenMainVhxVcc
M0.60

—| N |—

MainVhxVccAllowedOpenLatchReset
M0.65

StartT
In1   Q

           IndReset

Start

Test

MainVhxVccAllowedOpenLatch
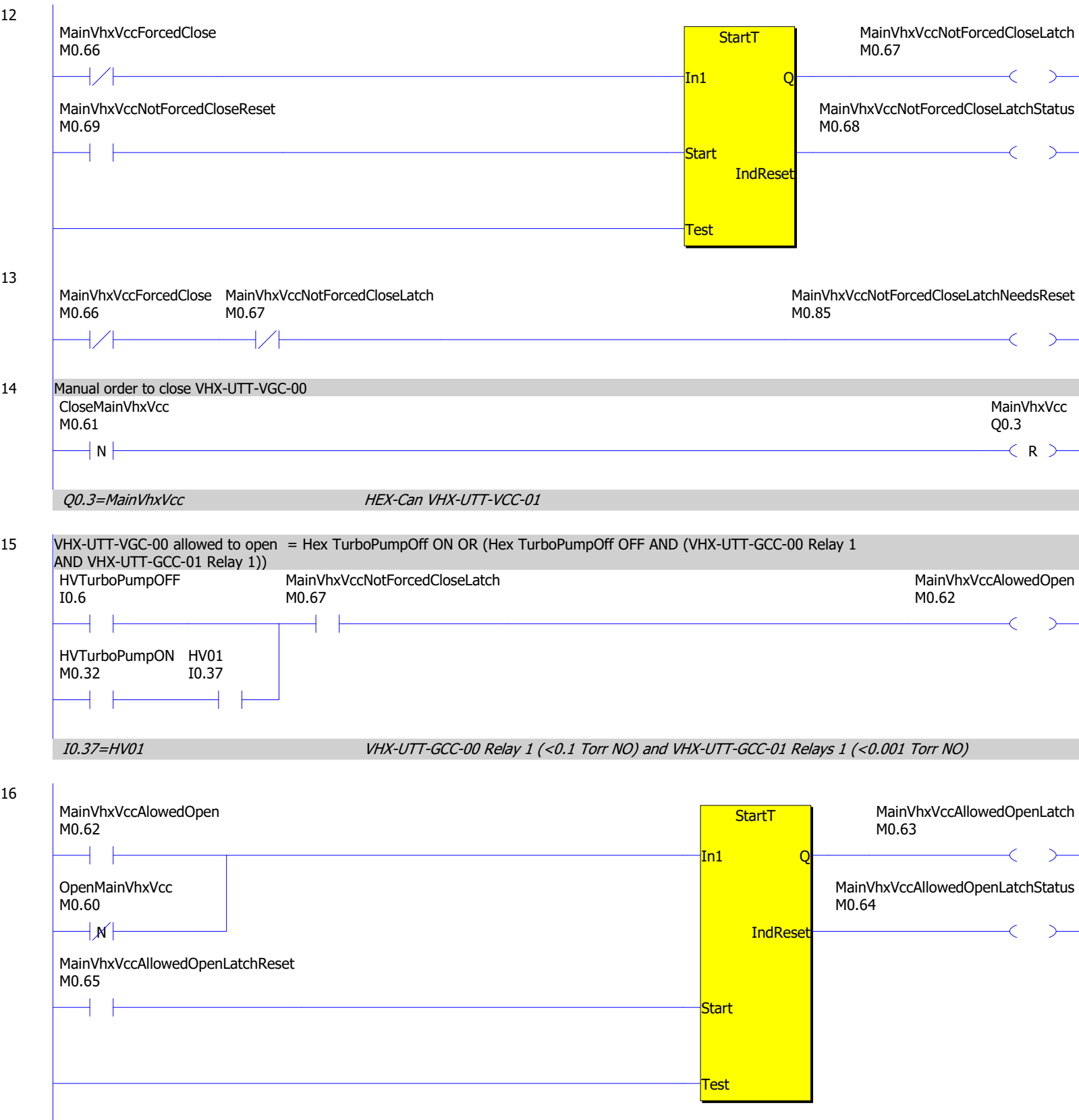M0.63

MainVhxVccAllowedOpenLatchStatus
M0.64

Pluto Manager - Program listing Pluto 0 Logic
File=C:\Users\joaoprod\Documents\GitHub\lsstCamVacPLC\firmware\vaccum_ps_01.sps
Name=<FILENAME>
File date=10/25/2018 2:29:09 PM Print date=10/25/2018 2:29:23 PM   PLC CRC=E75B

ABB

Page 4

17

```
MainVhxVccAlowedOpen      MainVhxVccAllowedOpenLatch                                    MainVhxVccAllowedOpenLatchNeedsReset
M0.62                     M0.63                                                         M0.86
  ──┤ ├──────────┬────────────┤/├──────────────────────────────────────────────────────────< >──

OpenMainVhxVcc            │
M0.60                     │
  ──┤N├───────────────────┘
```

18

```
MainVhxVccNotForcedCloseLatch   CloseMainVhxVcc   OpenMainVhxVcc   MainVhxVccAllowedOpenLatch            MainVhxVcc
M0.67                           M0.61             M0.60            M0.63                                 Q0.3
  ──┤ ├──────────────────────────┤/├──────────────┤N├──────────────┤ ├──────────────────────────────────< S >──
```

Q0.3=MainVhxVcc	HEX-Can VHX-UTT-VCC-01

19 Heat-Exchanger Turbo Pump Control

```
HVTurboUnder10   MKS925   HVTurboPumpON   VhxPumpPermBlock                    ┌──────────────┐            VhxPumpPerm
I0.0             I0.34    M0.32           M0.72                               │    StartT    │            Q0.5
  ──┤ ├────┬───────┤ ├──────┤ ├──────────────┤/├────────────────────────────┤In1        Q  ├─────────────< >──
           │                                                                 │              │
           │     HVTurboPumpOFF                                              │              │         VhxPumpPermLatchStatus
           │     I0.6                                                        │              │         M0.70
           └──────┤ ├────────────────────────────────────────┐              │      IndReset├─────────────< >──
                                                              │              │              │
VhxPumpPermReset                                              │              │              │
M0.71                                                         │              │              │
  ──┤ ├──────────────────────────────────────────────────────┴──────────────┤Start         │
                                                                             │              │
                                                                             │              │
                                                                             │              │
                                                              ───────────────┤Test          │
                                                                             └──────────────┘
```

I0.0=HVTurboUnder10	HEX Vacuum Gauge for interlock safety VHX-UTT-GCC-01 Relay 2 (<10 Torr NO)U
I0.34=MKS925	Roughing Pump
Q0.5=VhxPumpPerm	HEX-Can Turbo Pump Permit VHX-UTT-PCT-01/J1-3

20

```
HVTurboUnder10   MKS925   HVTurboPumpON   VhxPumpPermBlock   VhxPumpPerm              VhxPumpPermLatchNeedsReset
I0.0             I0.34    M0.32           M0.72              Q0.5                      M0.87
  ──┤ ├────┬───────┤ ├──────┤ ├──────────────┤/├─────────────┤/├───────────────────────────────< >──
           │
           │     HVTurboPumpOFF
           │     I0.6
           └──────┤ ├──────────────┘
```

I0.0=HVTurboUnder10	HEX Vacuum Gauge for interlock safety VHX-UTT-GCC-01 Relay 2 (<10 Torr NO)U
I0.34=MKS925	Roughing Pump
Q0.5=VhxPumpPerm	HEX-Can Turbo Pump Permit VHX-UTT-PCT-01/J1-3

21 HV turbo pump speed setpoint input

```
CVTurboPumpOFF                                                                         CVTurboPumpON
I0.7                                                                                   M0.34
  ──┤/├──────────────────────────────────────────────────────────────────────────────────< >──
```
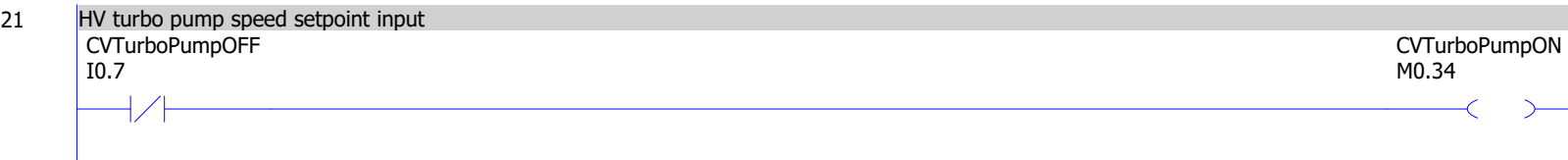
Pluto Manager - Program listing Pluto 0 Logic
File=C:\Users\joaoprod\Documents\GitHub\lsstCamVacPLC\firmware\vaccum_ps_01.sps
Name=<FILENAME>
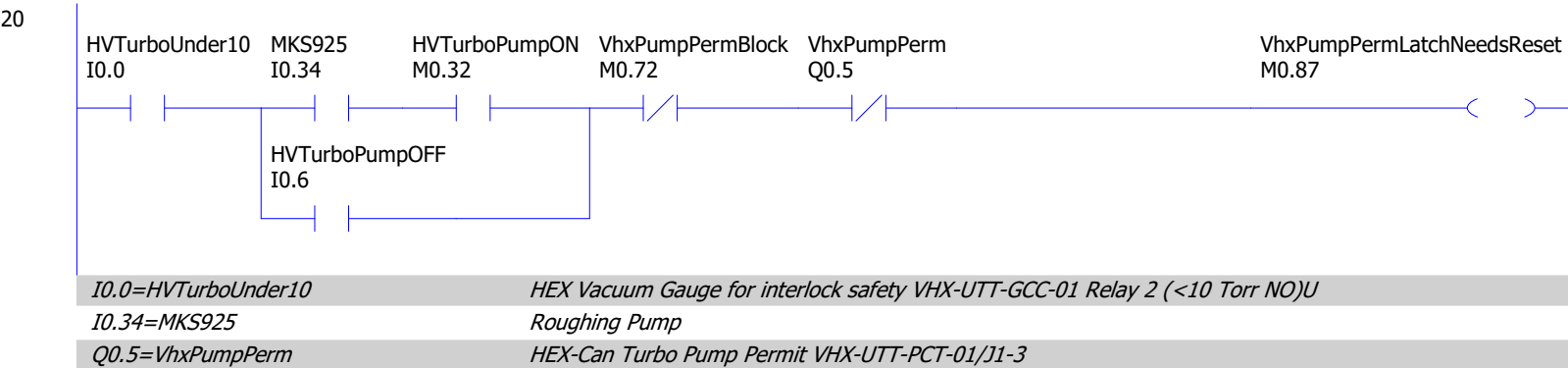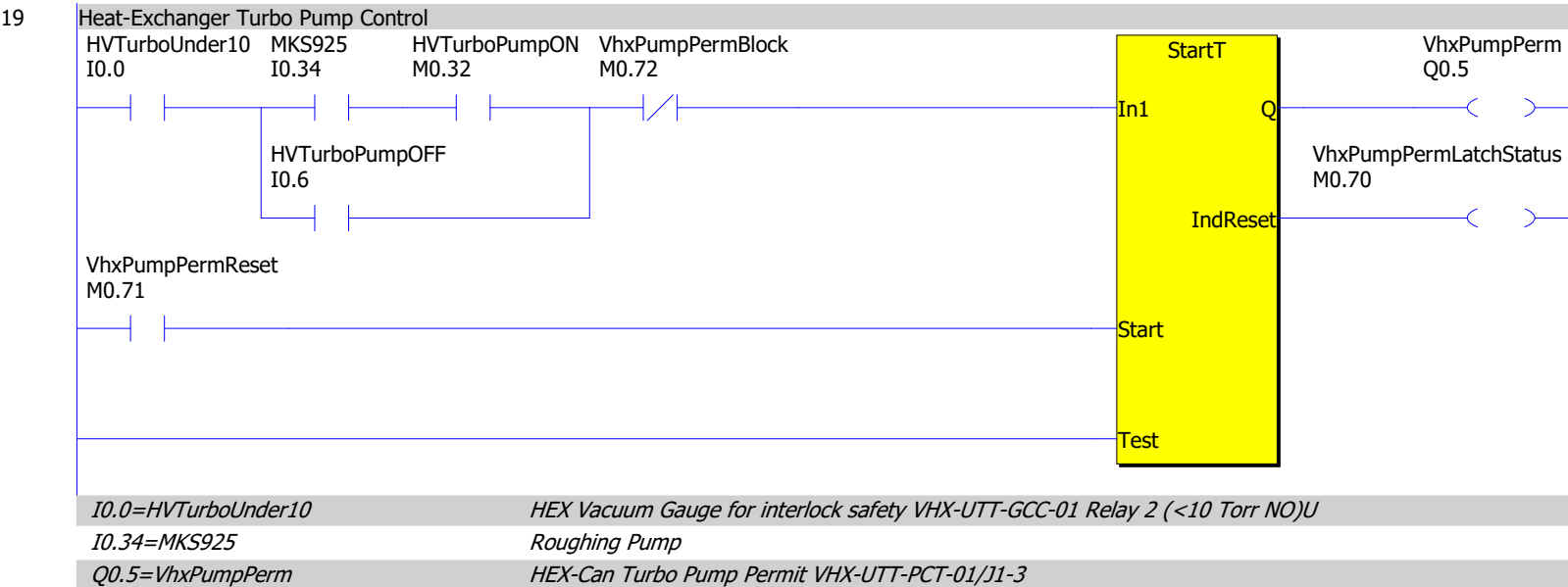File date=10/25/2018 2:29:09 PM Print date=10/25/2018 2:29:23 PM   PLC CRC=E75B

Page 5

22 Close VCR-UTT-VGC-00 (Set PLC output to 0v) = Cryostat TurboPumpOff OFF AND (Relay Output of MKS925 is Open)

```
CVTurboPumpON     MKS925                                                          MainVcrVcc
M0.34             I0.34                                                           Q0.2
  ─┤ ├──────────────┤/├──                                                          ─( R )─

                                                                                  MainVcrVccForcedClose
                                                                                  M0.46
                                                                                   ─(   )─
```

    I0.34=MKS925   Roughing Pump
    Q0.2=MainVcrVcc   Cryostat VCR-UTT-VCC-00

23

```
MainVcrVccForcedClose                     ┌──────────────┐     MainVcrVccNotForcedCloseLatch
M0.46                                     │    StartT    │     M0.47
  ─┤/├──────────────────────────────────  In1         Q ├──────  ─(   )─
                                          │              │
MainVcrVccNotForcedCloseReset             │              │     MainVcrVccNotForcedCloseLatchStatus
M0.49                                     │              │     M0.48
  ─┤ ├───────────────────────────────── Start           │──────  ─(   )─
                                          │     IndReset │
                                          │              │
                                          │              │
                                          │              │
                                        ── Test          │
                                          └──────────────┘
```

24

```
MainVcrVccForcedClose  MainVcrVccNotForcedCloseLatch               MainVcrVccNotForcedCloseLatchNeedsReset
M0.46                  M0.47                                       M0.81
  ─┤/├──────────────────┤/├─────────────────────────────────────────  ─(   )─
```

25 Manual Close

```
CloseMainVcrVcc                                                                   MainVcrVcc
M0.41                                                                             Q0.2
  ─┤ N ├──────────────────────────────────────────────────────────────────────────  ─( R )─
```

    Q0.2=MainVcrVcc   Cryostat VCR-UTT-VCC-00

26

```
CVTurboPumpOFF          MainVcrVccNotForcedCloseLatch                             MainVcrVccAlowedOpen
I0.7                    M0.47                                                     M0.42
  ─┤ ├──────────────┬─────┤ ├────────────────────────────────────────────────────  ─(   )─
                    │
CVTurboPumpON   CV01│
M0.34           I0.35│
  ─┤ ├──────────┤ ├─┘
```

    I0.35=CV01   VCR-UTT-GCC-00 Relay 1 (<0.1 Torr NO) and VCR-UTT-GCC-01 Relays 1 (<0.001 Torr NO)

Pluto Manager - Program listing Pluto 0 Logic
File=C:\Users\joaoprod\Documents\GitHub\lsstCamVacPLC\firmware\vaccum_ps_01.sps
Name=<FILENAME>
File date=10/25/2018 2:29:09 PM Print date=10/25/2018 2:29:23 PM   PLC CRC=E75B
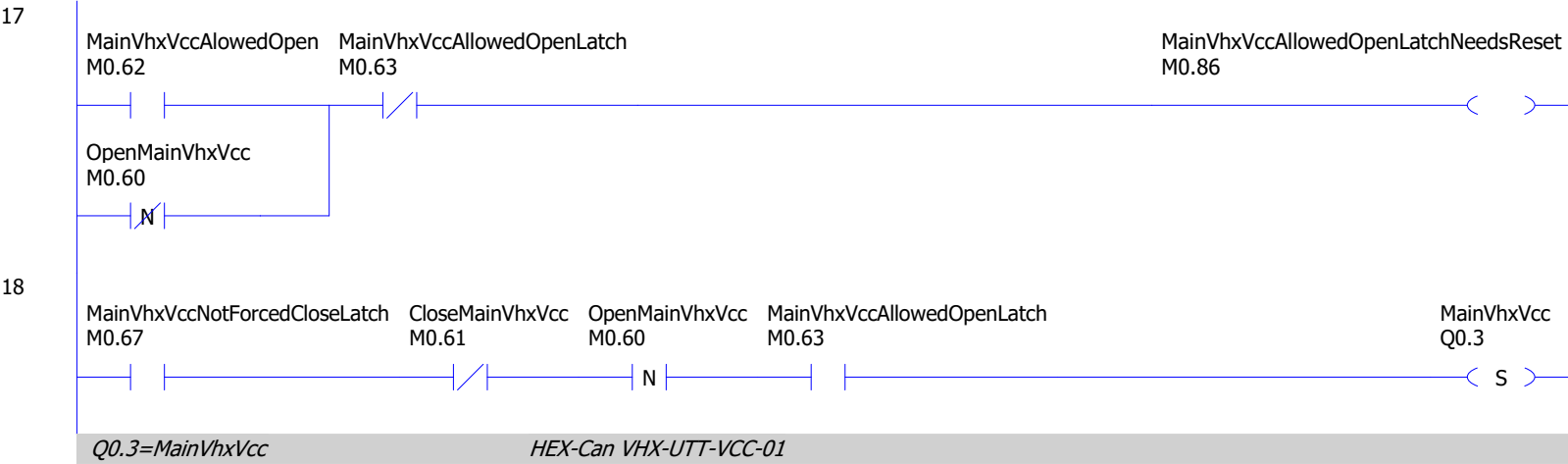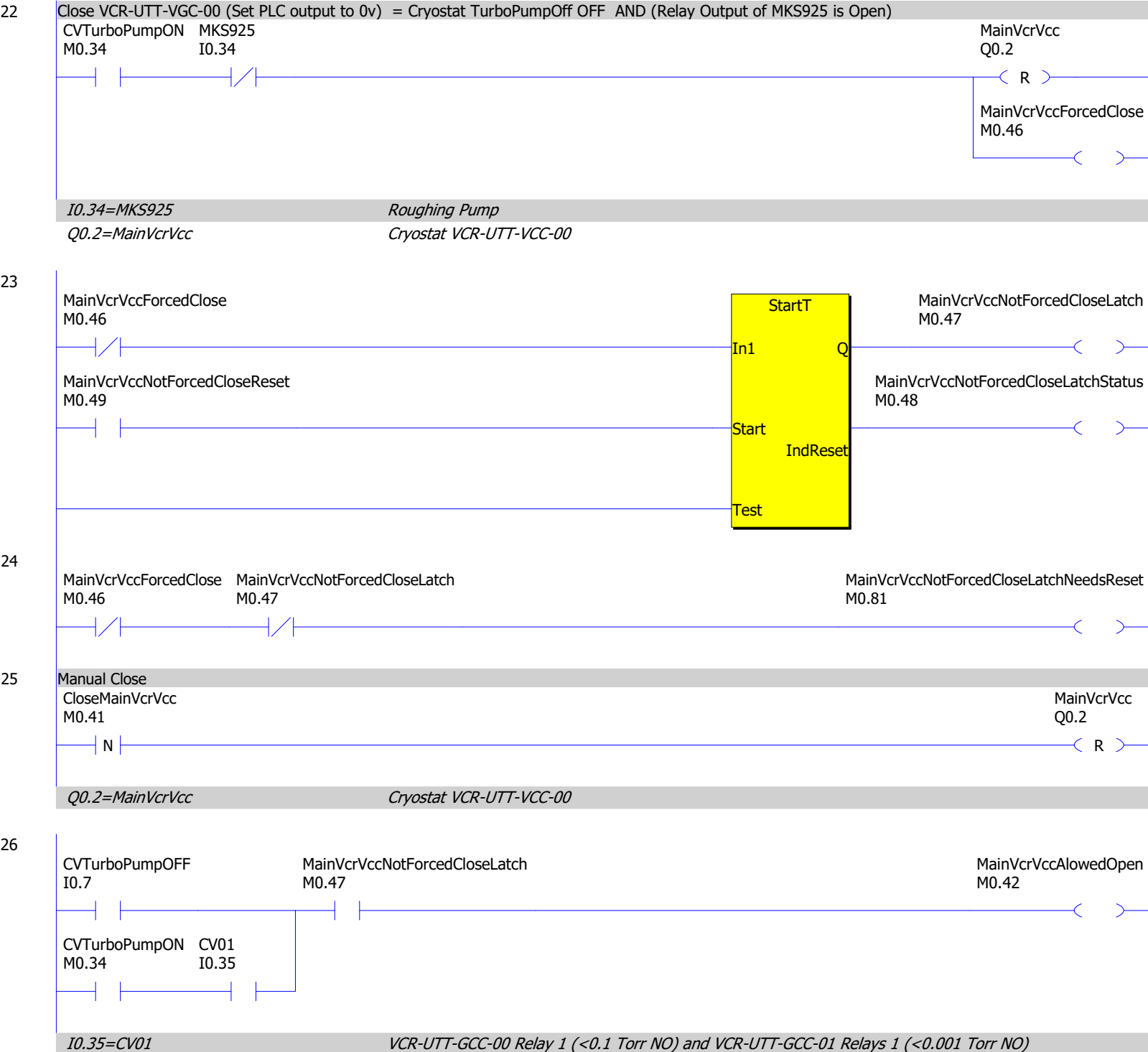
Page 6

ABB

27 VHX-UTT-VGC-00 allowed to open = Hex TurboPumpOff ON OR (Hex TurboPumpOff OFF AND (VHX-UTT-GCC-00 Relay 1 AND VHX-UTT-GCC-01 Relay 1))

MainVcrVccAlowedOpen
M0.42

OpenMainVcrVcc
M0.40

MainVcrVccAllowedOpenLatchReset
M0.45

StartT

In1   Q

IndReset

Start

Test

MainVcrVccAllowedOpenLatch
M0.43

MainVcrVccAllowedOpenLatchStatus
M0.44

28
MainVcrVccAlowedOpen
M0.42

MainVcrVccAllowedOpenLatch
M0.43

OpenMainVcrVcc
M0.40

MainVcrVccAllowedOpenLatchNeedsReset
M0.82

29
MainVcrVccNotForcedCloseLatch
M0.47

CloseMainVcrVcc
M0.41

OpenMainVcrVcc
M0.40

MainVcrVccAllowedOpenLatch
M0.43

MainVcrVcc
Q0.2

S

Q0.2=MainVcrVcc   Cryostat VCR-UTT-VCC-00

30 Cryo Turbo Pump Control
CVTurboUnder10
I0.3

MKS925
I0.34

CVTurboPumpON
M0.34

VcrPumpPermBlock
M0.52

CVTurboPumpOFF
I0.7

VcrPumpPermReset
M0.51

StartT

In1   Q

IndReset

Start

Test

VcrPumpPerm
Q0.4

VcrPumpPermLatchStatus
M0.50

I0.3=CVTurboUnder10   Cryostat Turbo Vac VCR-UTT-GCC-01 Relay 2 (<10 Torr NO)
I0.34=MKS925   Roughing Pump
Q0.4=VcrPumpPerm   Cryo Turbo Pump Permit VCR-UTT-PCT-00/J1-3

Pluto Manager - Program listing Pluto 0 Logic
File=C:\Users\joaoprod\Documents\GitHub\lsstCamVacPLC\firmware\vaccum_ps_01.sps
Name=<FILENAME>
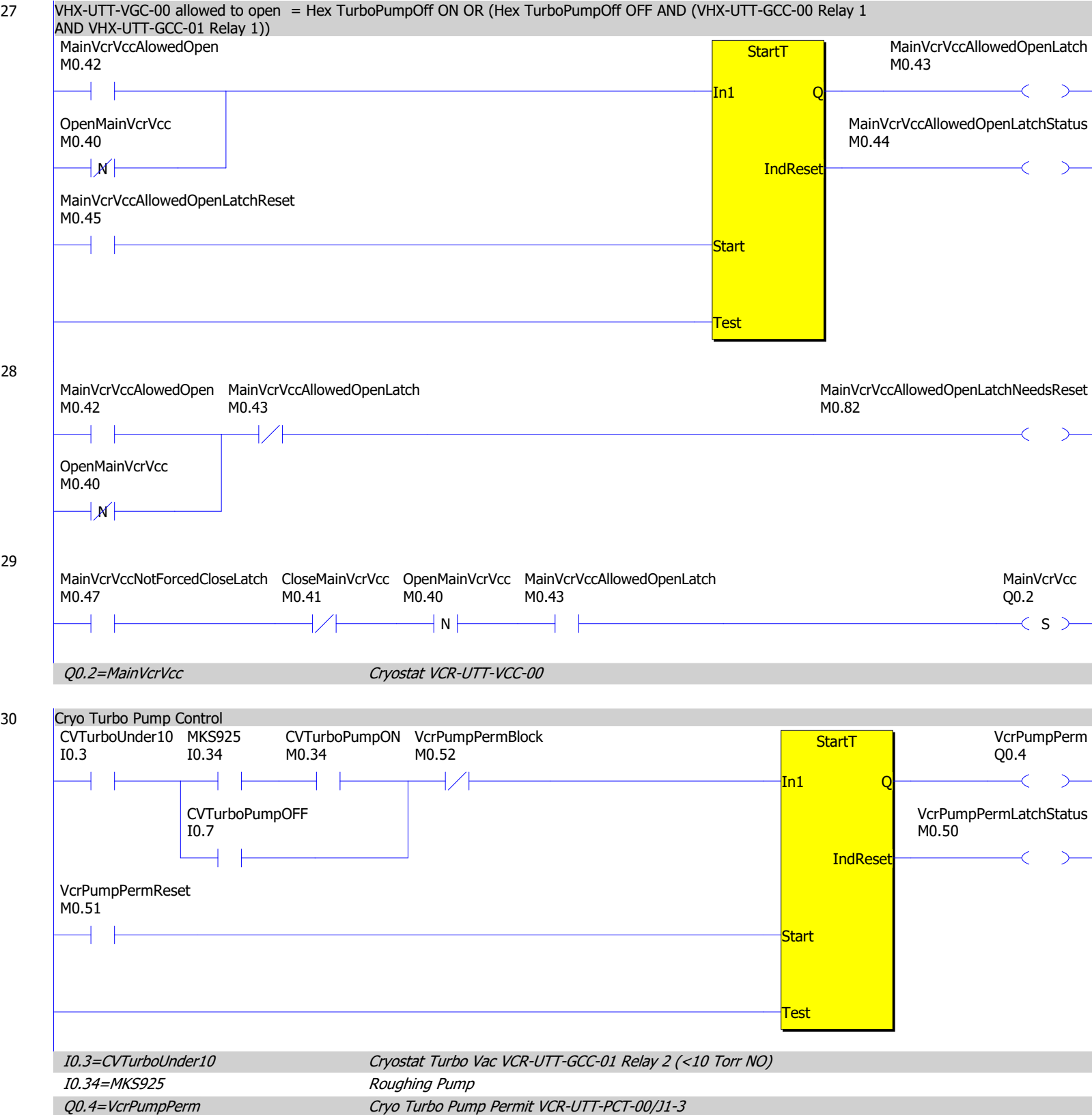File date=10/25/2018 2:29:09 PM Print date=10/25/2018 2:29:23 PM   PLC CRC=E75B

ABB

Page 7

31

```
CVTurboUnder10  MKS925      CVTurboPumpON  VcrPumpPermBlock  VcrPumpPerm                          VcrPumpPermLatchNeedsReset
I0.3            I0.34        M0.34          M0.52            Q0.4                                  M0.83
 ┤├──────┤├──────────┤├──────────────┤├────────────┤/├──────────────┤/├─────────────────────────────( )

                CVTurboPumpOFF
                I0.7
                 ┤├
```

I0.3=CVTurboUnder10	Cryostat Turbo Vac VCR-UTT-GCC-01 Relay 2 (<10 Torr NO)
I0.34=MKS925	Roughing Pump
Q0.4=VcrPumpPerm	Cryo Turbo Pump Permit VCR-UTT-PCT-00/J1-3

32

VCR-UTT-VCC-(00-04) Close and open commands

```
VcrVcc01Close                                                              VcrVcc01
M0.1                                                                       Q0.20
 ┤N├─────────────────────────────────────────────────────────────────────( R )
```

Q0.20=VcrVcc01	VCR-UTT-VCC-01

33

```
VcrVcc01Open   VcrVcc01Close                                               VcrVcc01
M0.0           M0.1                                                        Q0.20
 ┤N├────────────┤/├───────────────────────────────────────────────────────( S )
```

Q0.20=VcrVcc01	VCR-UTT-VCC-01

34

```
VcrVcc02Close                                                              VcrVcc02
M0.3                                                                       Q0.21
 ┤N├─────────────────────────────────────────────────────────────────────( R )
```

Q0.21=VcrVcc02	VCR-UTT-VCC-02

35

```
VcrVcc02Open   VcrVcc02Close                                               VcrVcc02
M0.2           M0.3                                                        Q0.21
 ┤N├────────────┤/├───────────────────────────────────────────────────────( S )
```

Q0.21=VcrVcc02	VCR-UTT-VCC-02

36

```
VcrVcc03Close                                                              VcrVcc03
M0.5                                                                       Q0.22
 ┤N├─────────────────────────────────────────────────────────────────────( R )
```

Q0.22=VcrVcc03	VCR-UTT-VCC-03

37

```
VcrVcc03Open   VcrVcc03Close                                               VcrVcc03
M0.4           M0.5                                                        Q0.22
 ┤N├────────────┤/├───────────────────────────────────────────────────────( S )
```

Q0.22=VcrVcc03	VCR-UTT-VCC-03

Pluto Manager - Program listing Pluto 0 Logic
File=C:\Users\joaoprod\Documents\GitHub\lsstCamVacPLC\firmware\vaccum_ps_01.sps
Name=<FILENAME>
File date=10/25/2018 2:29:09 PM Print date=10/25/2018 2:29:23 PM   PLC CRC=E75B

Page 8

ABB

38

VcrVcc04Close
M0.7
—| N |—

VcrVcc04
Q0.23
—(R)—

Q0.23=VcrVcc04   VCR-UTT-VCC-04

39

VcrVcc04Open   VcrVcc04Close
M0.6   M0.7
—| N |——————————|/|—

VcrVcc04
Q0.23
—(S)—

Q0.23=VcrVcc04   VCR-UTT-VCC-04

40

Power Outputs

APower
Q0.10
—( )—

BPower
Q0.11
—( )—

CPower
Q0.12
—( )—

Q0.10=APower   VCR-UTT-VCC-00
Q0.11=BPower   VHX-UTT-VGC-00
Q0.12=CPower   roufhing pump contact