NOTES:

1. Unless otherwise stated:
   Resistors are 250 mW, 1% tolerance.
   Capacitors are 50V, 10% tolerance.

2. Port and Net Name scopes for this project are:
   Port — NOT Global (connected via Sheet Symbols)
   Net Name — Local (connected on same page only)

3. Do not install (DNI).

D13,D14,D29,D30,R1,R29,R33,R35,R54,R55,R63,R67,R68,R81,R138,R139,R140,R141,R159,R160,R165,R166,R167,R168,R177,R178,R186,R187,R189,R193,R194,R208,R228,R231,R235,R237,R238,R258,R262,R263,R264,R306,R307,R333,R335,R343,R344,R350,R351,R352,R353,R363,R366,R374,R375,R377,R379,R383,R385,R386,R388,R391,U26

4. Tailored value.
   Nominal value shown.

REVISION BLOCK			
REV	DESCRIPTION	DATE	INCORP. BY

Sheet_Symbol_HA_Tach
SB_PG5.SCHDOC

East_Tach+ East_Vel_Out
East_Tach- West_Vel_Out
West_Tach+ East_Tach_Out
West_Tach- West_Tach_Out
East_Vel_In HA_Lab_Select
West_Vel_In HA_Vel_Feedback

South_Tach+ South_Vel_Out
South_Tach- North_Vel_Out
North_Tach+ South_Tach_Out
North_Tach- North_Tach_Out
South_Vel_In Dec_Lab_Select
North_Vel_In Dec_Vel_Feedback

Sheet_Symbol_Dec_Tach
SB_PG4.SCHDOC

Sheet_Symbol_Overspeed
SB_PG13.SCHDOC

HA_Vel_Feedback
Dec_Vel_Feedback
HA_Overspeed_N
Dec_Overspeed_N

Sheet_Symbol_CPLD
SB_PG6.SCHDOC

Tel_Amp_Enable_&_Therm_Stat
Tel_Brake_Release_&_Amp_Enable_N
Red_Tel_Brake_Release_&_Amp_Enable
HA_Overspeed_N Dome_Amp_Enable_&_Therm_Stat
Dec_Overspeed_N Dome_Amp_Enable_N
Lab_Select

Sheet_Symbol_Relays
SB_PG8.SCHDOC

Tel_Amp_Enable_&_Therm_Stat
Tel_Brake_Release_&_Amp_Enable_N
Red_Tel_Brake_Release_&_Amp_Enable
Emerg_Stop_N
Dome_Amp_Enable_&_Therm_Stat
Dome_Amp_Enable_N
24V
Brake_Release_Relay
Tel_Amp_En_N
Tel_Amp_Rtn
Dome_Amp_En_N
Dome_Amp_Rtn

Sheet_Symbol_Overcurrent
SB_PG11.SCHDOC; SB_PG12.SCHDOC; SB_PG14.SCHDOC; SB_PG15.SCHDOC

West_Current West_Overcurrent_N
East_Current East_Overcurrent_N
North_Current North_Overcurrent_N
South_Current South_Overcurrent_N
Dome1_Current Dome1_Overcurrent_N
Dome2_Current Dome2_Overcurrent_N
Dome3_Current Dome3_Overcurrent_N

Sheet_Symbol_Input_Buffer
SB_PG9.SCHDOC;SB_PG10.SCHDOC

Mtr_Cntr_Err_N Mtr_Cntr_Err_BUF_N
TCS_Lockout_N TCS_Lockout_BUF_N
Brake_Release_In Brake_Release_In_BUF
Watchdog_In
Reset_N Reset_BUF_N
Horizon_Stop Horizon_Stop_BUF_N
HA_Stop_West HA_Stop_West_BUF_N
HA_Stop_East HA_Stop_East_BUF_N
HA_Emerg_West HA_Emerg_West_BUF_N
HA_Emerg_East HA_Emerg_East_BUF_N
Dec_Stop_North Dec_Stop_North_BUF_N
Dec_Stop_South Dec_Stop_South_BUF_N
Dec_Emerg_North Dec_Emerg_North_BUF_N
Dec_Emerg_South Dec_Emerg_South_BUF_N
Emerg_Stop_N Emerg_Stop_BUF_N
TOP_Dome_Cntl_Software TOP_Dome_Cntl_Software_BUF
TOP_Tel_Enable_Switch TOP_Tel_Enable_Switch_BUF
TOP_Lm_Override_Switch TOP_Lm_Override_Switch_BUF
HP_Stop HP_Stop_BUF_N
SPARE1 SPARE1_BUF_N
SPARE2 SPARE2_BUF_N
TOP_Dome_Cntl_Handpaddle TOP_Dome_Cntl_Handpaddle_BUF
Watchdog_In_BUF

Sheet_Symbol_WD
SB_PG7.SCHDOC

Watchdog_In_BUF
CPLD_Clk
SB_Clock_WD_Err_N
Watchdog_Timer_Error_N

HA_Overspeed_Latch
Dec_Overspeed_Latch
West_Overcurrent_Latch
East_Overcurrent_Latch
North_Overcurrent_Latch
South_Overcurrent_Latch
Dome1_Overcurrent_Latch
Dome2_Overcurrent_Latch
Dome3_Overcurrent_Latch
Emerg_Stop_Latch
HP_Stop_Latch
Mtr_Cntr_Err_Latch
TCS_Lockout_Latch
HA_Stop_W_Latch
HA_Stop_E_Latch
HA_Emerg_W_Latch
HA_Emerg_E_Latch
Dec_Stop_N_Latch
Dec_Stop_S_Latch
Dec_Emerg_N_Latch
Dec_Emerg_S_Latch
Horizon_Stop_Latch
Watchdog_Timer_Latch
SB_Clock_WD_Err_Latch
Dome_Amp_Enable_&_Therm_Stat_Latch
Tel_Amp_Enable_&_Therm_Stat_Latch
Lab_Select_Latch
Spare1_Latch
Spare2_Latch
CPLD_Clk TOP_Dome_Cntl_Handpaddle_BUF
SB_Clock_WD_Err_N TOP_TCS_Enable
Watchdog_Timer_Error_N TOP_Brake_Enable_Out

J3

1	East Drive+	26	North_Current
2	East Drive-	27	South_Current
3		28	Dome1_Current
4	West Drive+	29	Dome2_Current
5	West Drive-	30	Dome3_Current
6		31	Horizon Stop
7	South Drive+	32	HA Stop W
8	South Drive-	33	HA Stop E
9		34	HA Emerg W
10	North Drive+	35	HA Emerg E
11	North Drive-	36	Dec Stop N
12		37	Dec Stop S
13	East Vel In	38	Dec Emerg N
14	West Vel In	39	Dec Emerg S
15	South Vel In	40	Emerg Stop
16	North Vel In	41	TOP DomeCntl Software
17	HA Vel Feedback	42	TOP Tel Enable Switch
18	Dec Vel Feedback	43	TOP Lm Override Switch
19	Mtr Cntr Err	44	HP Stop
20	TCS Lockout	45	Spare In 1
21	Brake En In	46	Spare In 2
22	Watchdog In	47	
23	Reset	48	TOP DomeCntl Handpaddle
24	West Current	49	
25	East Current	50	

1-5499923-0 24VGND PCGND AGND

J4

24V	1	26	West Tach Out
Brake Enable Re	2		South Tach Out
East Tach Out	3		East Vel Out
Tel Amp	4		West Vel Out
Tel Amp Ret	5		South Vel Out
Dome Amp	6		North Vel Out
Dome Amp Ret	7		HA OS Latch
	8		Dec OS Latch
	9		West OC Latch
	10		East OC Latch
	11		North OC Latch
	12		South OS Latch
	13		Dome1 OC Latch
	14		Dome2 OC Latch
	15		Dome3 OC Latch
	16		Emerg Stop Latch
	17		HP Stop Latch
	18		Mtr Cntr Err Latch
	19		TCS Lockout Latch
	20		HA Stop W Latch
	21		HA Stop E Latch
	22		HA Emerg W Latch
	23		HA Emerg E Latch
	24		Dec Stop N Latch
	25		Dec Stop S Latch
	26		Dec Emerg N Latch
	27		Dec Emerg S Latch
	28		Horizon Stop Latch
	29		Watchdog Timer Latch
	30		SB_Clock_WD_Err_Latch
	31		Dome Amp Enable & Therm Stat Latch
	32		Tel Amp Enable & Therm Stat Latch
	33		Lab Select Latch
	34		Spare Latch Out 1
(OR OPTO_22_rtn_currents)	35		Spare Latch Out 2
	36		North Tach Out
	37		
	38		TOP TCS Enable
	39		TOP Brake Enable Out
	40		

1-5499923-0

Sheet_Symbol_Encoder
SB_PG3.SCHDOC

+5V_DIG

J5

1	West_Encoder_BUF	9	
2	West_Encoder_In	10	North_Encoder_In
3	East_Encoder_BUF	11	
4	West_Encoder_Rtn	12	North_Encoder_Rtn
5	North_Encoder_BUF	13	
6	East_Encoder_In	14	South_Encoder_In
7	South_Encoder_BUF	15	
8	East_Encoder_Rtn	16	South_Encoder_Rtn

5499922-3 DGND EGND

Sheet_Symbol_Power_Filter
SB_PG2.SCHDOC

J1

1	+5V_SE_Raw	8	
2	+5V_SE_Rtn	9	+15V_Raw
3	+5V_WD_Raw	10	
4	+5V_WD_Rtn	11	15V_Rtn
5	+5V_DIG_Raw	12	
6		13	-15V_Raw
7	+5V_DIG_Rtn	14	

5499922-2

1 2 3 4 5

22-23-2051

Sheet_Symbol_Spares
SB_PG16.SCHDOC

(Contains spare / unused components)

University of Hawaii
Institute for Astronomy

DWG #	REV	TITLE
T3-2070	-	TCS3 Safety Board

ENGINEER	LAST EDIT	SIZE	SHEET
E. Warmbier	3/19/2009 12:31:50 PM	B	1 of 16

FILE: Z:\TCS\Safety Board Schematics,PL,CCA\Safety Board Protel\Safety Board Rev D\SB_PG1.SCHDOC

DWG # T3-2070 REV -

REVISION BLOCK
SEE SHEET 1

+15V_Raw
15V_Rtn
-15V_Raw
+5V_WD_Raw
+5V_WD_Rtn
+5V_DIG_Raw
+5V_DIG_Rtn
+5V_SE_Raw
+5V_SE_Rtn

R194 0 3.DNI
R193 1k 3.DNI
R1 0 3.DNI
R197 0
R198 0
R391 0 3.DNI
R388 0 3.DNI
R386 0
R383 0 3.DNI
R307 0
R306 0 3.DNI

C2 1uF
C1 1uF
C48 25V 22uF
C49 25V 22uF
C50 100uF 25V
C44 25V 22uF
C45 25V 22uF
C46 100uF 25V
C162 1uF
C158 1uF
C112 1uF
C164 100uF 25V
C165 100uF 25V
C163 470uF 10V
C161 100uF 25V
C159 100uF 25V
C157 470uF 10V
C113 100uF 25V
C111 100uF 25V
C110 470uF 10V

L2 ZJYS51R5-M4PAT-01 500mA
L3 8532-46LTR 5.6mH 180mA
L1 8532-46LTR 5.6mH 180mA
L9 8532-38LTR 370mA 1.2mH
L8 50105C 1mH 700mA
L6 8532-38LTR 370mA 1.2mH
L7 50105C 1mH 700mA
L5 8532-38LTR 370mA 1.2mH
L4 50105C 1mH 700mA

R195 15.8
R190 15.8
R191 1.21k
R188 1.21k
R389 3.01
R390 249
R382 3.01
R387 249
R302 3.01
R301 249
R213 0
R203 0
R202 0
R210 0

DS2 Green
DS1 Green
DS7 Green
DS6 Green
DS3 Green

TP4 Red +15V
TP2 Red -15V
TP3 Black
TP52 Red +5V_WD
TP49 Black
TP51 Red +5V_DIG
TP50 Black
TP36 Red +5V_SE
TP37 Black

TP1 Black Chassis
TP29 Black PCGND
TP38 Black
TP24 Black
TP33 Black
AGND
TP48 Black
TP34 Black
DGND
WDGND
SEGND

D1 NC LM4040DIM3-5.0/NOPB 5V 330 mW 1%
R17 4.87k
C3 1uF
-5_VREF
-15V
AGND

R46 4.87k
D8 NC LM4040DIM3-5.0/NOPB 5V 330 mW 1%
C19 1uF
+5_VREF
+15V
AGND

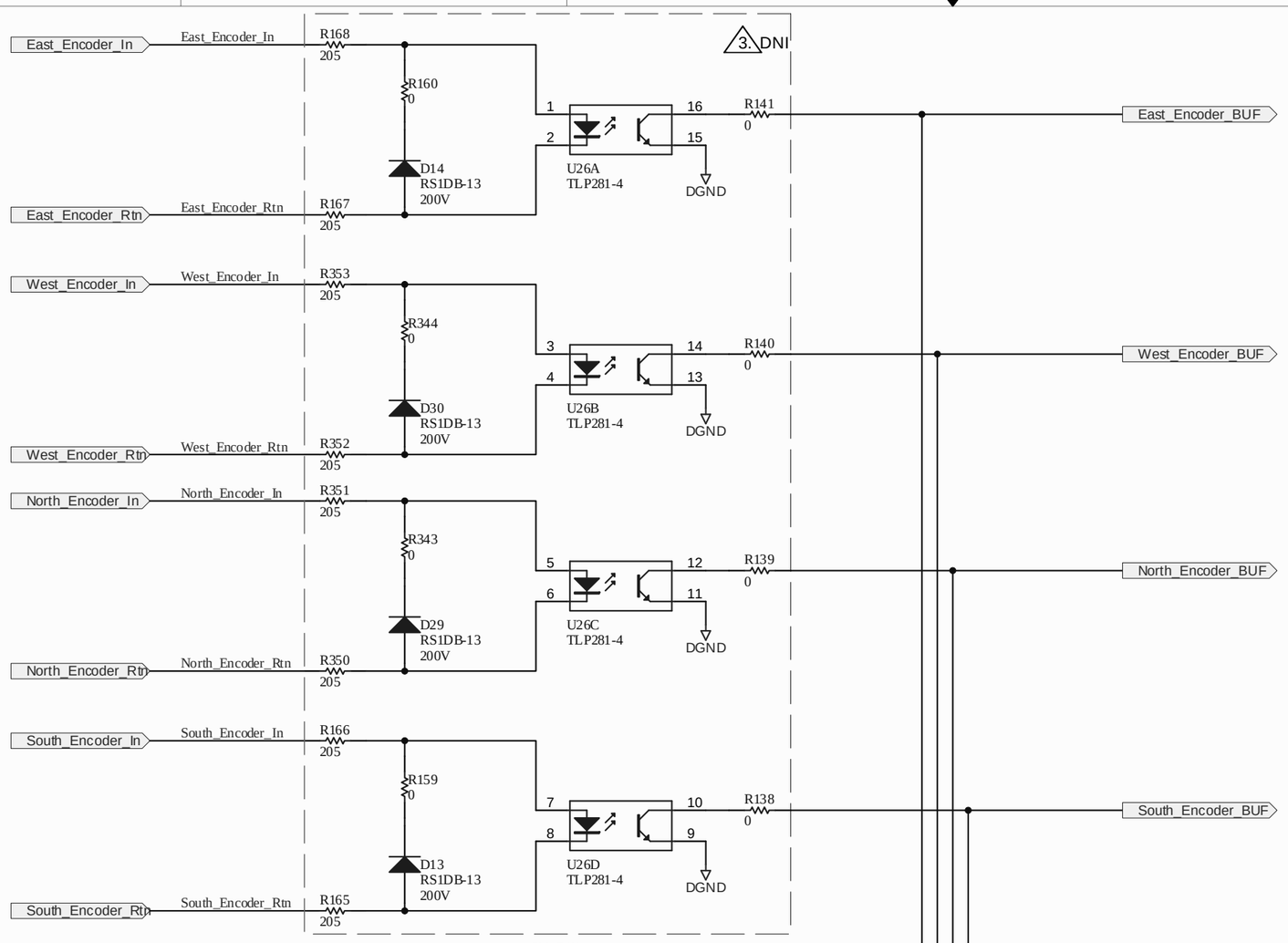
Note: DO NOT overlap input and output planes of filter in layout.
This defeats the whole purpose by creating a bypass capacitance.

Power Filtering & References

DWG #	REV	SIZE	SHEET
T3-2070	-	B	2 of 16

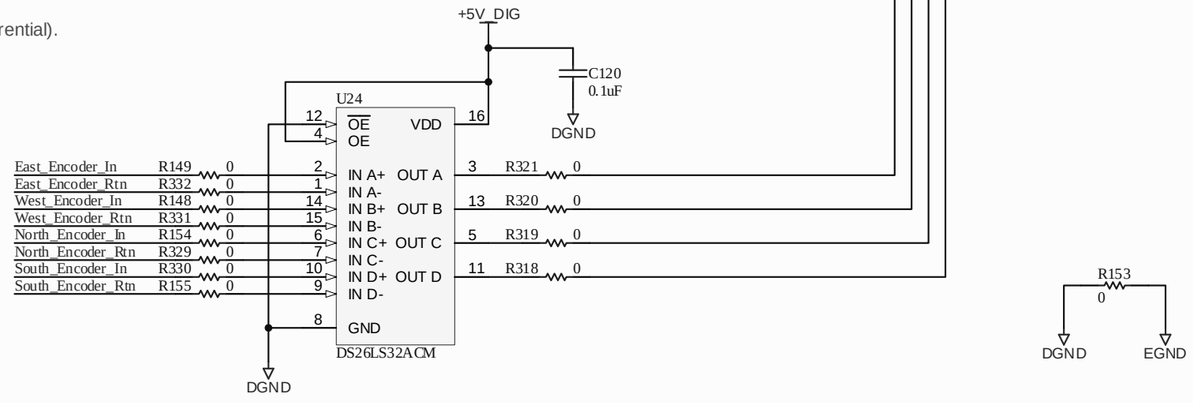
DWG # T3-2070 REV -

REVISION BLOCK
SEE SHEET 1



Note: US Digital Corp EQUAD accepts TTL logic or open collector. It has 5k pullup to +5V. Configurable via switch for rising/falling edge.

Note: Input signals are RS422 (differential).



Note: All XXX_Encoder_In and XXX_Encoder_Rtn pairs should be matched to within 100 mil.

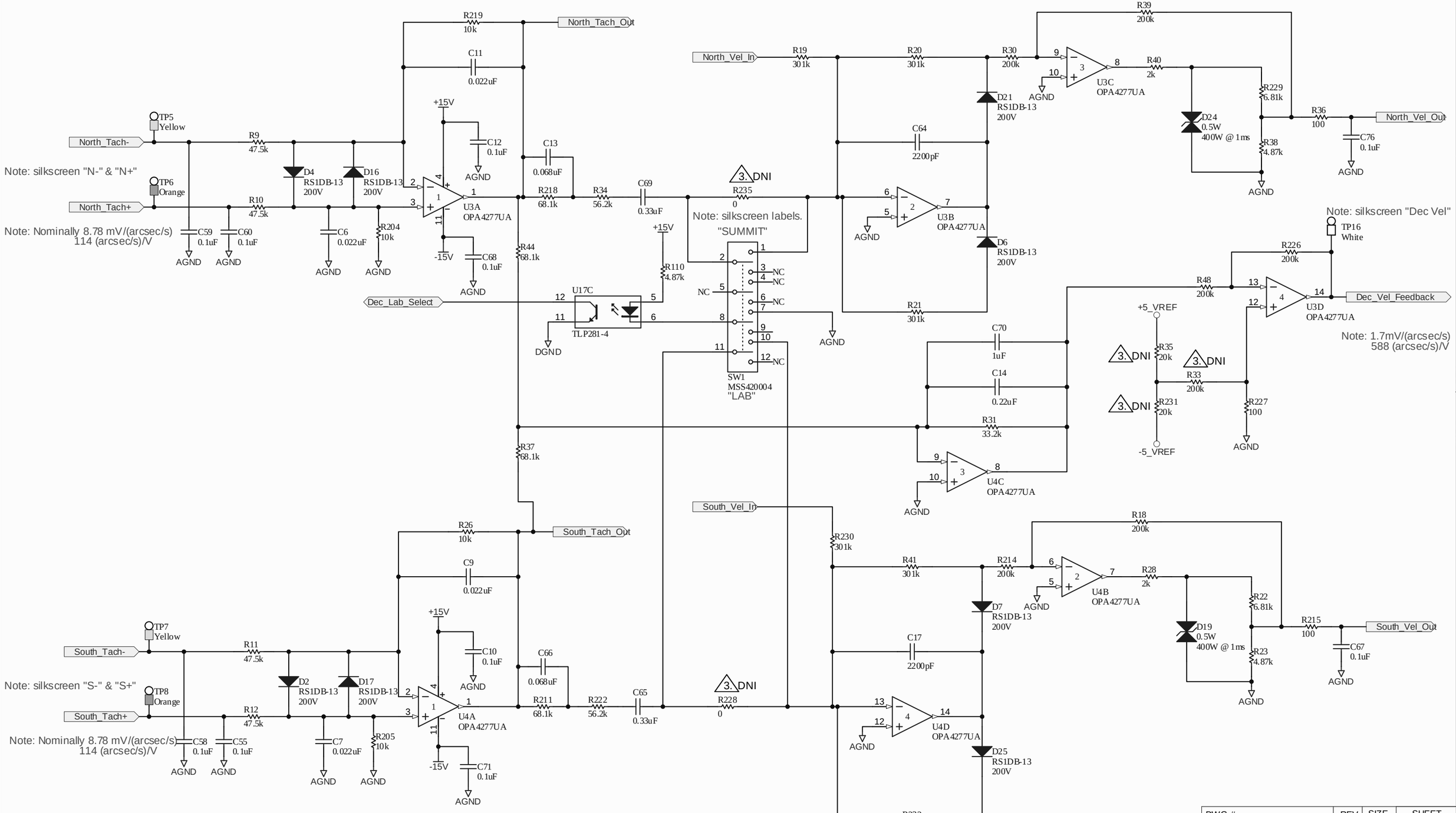
Axis Incremental Encoder Converters

DWG #	REV	SIZE	SHEET
T3-2070	-	B	3 of 16

DWG # T3-2070

REV -

REVISION BLOCK
SEE SHEET 1



Dec Tachometer & Servo Command

DWG #	REV	SIZE	SHEET
T3-2070	-	B	4 of 16

REV -

DWG # T3-2070

REVISION BLOCK
SEE SHEET 1

West_Tach_Out
R57 10k
C22 0.022uF
+15V
C85 0.1uF
AGND
C82 0.068uF
R246 68.1k
R245 56.2k
C20 0.33uF
R240 68.1k
R236 68.1k
TP9 Yellow
West_Tach-
R13 47.5k
D3 RS1DB-13 200V
D15 RS1DB-13 200V
Note: silkscreen "W-" & "W+"
TP10 Orange
West_Tach+
R14 47.5k
Note: Nominally 8.78 mV/(arcsec/s)
114 (arcsec/s)/V
C53 0.1uF
C56 0.1uF
C61 0.022uF
R206 10k
-15V
C23 0.1uF
U8A OPA4277UA
3. DNI
R238 0
Note: silkscreen labels.
"SUMMIT"
HA_Lab_Select
U17B
TLP281-4
DGND
+15V
R284 4.87k
SW2 MSS420004
"LAB"
NC
R52 301k
West_Vel_In
R256 301k
R242 301k
R249 200k
R70 200k
U8C OPA4277UA
R62 2k
D27 RS1DB-13 200V
D26 0.5W 400W @ 1ms
R71 6.81k
R259 4.87k
R80 100
West_Vel_Out
C92 0.1uF
C21 2200pF
U8B OPA4277UA
D9 RS1DB-13 200V
Note: silkscreen "HA Vel"
TP23 White
R75 200k
R66 200k
U8D OPA4277UA
HA_Vel_Feedback
+5_VREF
C18 1uF
C72 0.22uF
R233 33.2k
U2C OPA4277UA
3. DNI
R258 20k
R262 200k
R263 20k
R255 100
-5_VREF
Note: 1.7mV/(arcsec/s)
588 (arcsec/s)/V
East_Vel_In
R220 301k
R216 200k
R223 301k
R24 200k
U2D OPA4277UA
R32 2k
D23 RS1DB-13 200V
D22 0.5W 400W @ 1ms
R42 6.81k
R234 4.87k
R43 100
East_Vel_Out
C77 0.1uF
C73 2200pF
U2B OPA4277UA
D20 RS1DB-13 200V
R224 301k
East_Tach_Out
R207 10k
C4 0.022uF
C8 0.068uF
R212 68.1k
R25 56.2k
C63 0.33uF
R29 0
TP11 Yellow
East_Tach-
R15 47.5k
D5 RS1DB-13 200V
D18 RS1DB-13 200V
Note: silkscreen "E-" & "E+"
TP12 Orange
East_Tach+
R16 47.5k
Note: Nominally 8.78 mV/(arcsec/s)
114 (arcsec/s)/V
C54 0.1uF
C57 0.1uF
C62 0.022uF
R209 10k
C16 0.1uF
C15 0.1uF
U2A OPA4277UA

HA Tachometer & Servo Command

DWG #	REV	SIZE	SHEET
T3-2070	-	B	5 of 16

DWG # T3-2070

CPLD & Watchdog Circuits

REVISION BLOCK
SEE SHEET 1

J6
87831-1420
+5V_DIG
TMS
TCK
TDO
TDI
NC
NC
DGND

Note: JTAG signals should be matched to within 100 mil.

U32
XC9572-15TQG100C
XC9572-15TQ100C
+5V_DIG

Dec_Stop_South_BUF_N
HA_Stop_East_BUF_N
Emerg_Stop_BUF_N
South_Overcurrent_N
Dec_Emerg_North_BUF_N
HA_Stop_West_BUF_N
SB_Clock_WD_Err_N
Horizon_Stop_BUF_N
HA_Overspeed_N
Dome_Amp_Enable_N
North_Overcurrent_N
Mtr_Cntr_Err_BUF
East_Overcurrent_N
Dome3_Overcurrent_N
Watchdog_Timer_Error_N
Dome1_Overcurrent_N
SPARE1_BUF
Tel_Amp_Enable_&_Therm_Stat_Latch
Spare1_Latch
Horizon_Stop_Latch
Dec_Emerg_S_Latch
Dome_Amp_Enable_&_Therm_Stat_Latch
Dec_Stop_S_Latch
Dec_Stop_N_Latch
SB_Clock_WD_Err_Latch

Dome1_Overcurrent_Latch
Dec_Emerg_South_BUF_N
TOP_Dome_Cntl_Software_BUF
Red_Tel_Brake_Release_&_Amp_Enable
Dec_Stop_North_BUF_N
Dome_Amp_Enable_&_Therm_Stat
Tel_Amp_Enable_&_Therm_Stat
TOP_Tel_Enable_Switch_BUF
HA_Emerg_East_BUF_N
HA_Overspeed_Latch
Dec_Overspeed_Latch
Tel_Brake_Release_&_Amp_Enable_N
West_Overcurrent_Latch
East_Overcurrent_Latch
South_Overcurrent_Latch
Dome2_Overcurrent_Latch
North_Overcurrent_Latch
HP_Stop_Latch

Spare_Resistor1 0 R179
SPARE2_BUF
Lab_Select_Latch
TOP_Lm_Override_Switch_BUF
Dec_Overspeed_N
Spare2_Latch
TOP_TCS_Enable
Spare_Resistor2 0 R180
TOP_Brake_Enable_Out
Brake_Release_In_BUF
TCS_Lockout_BUF_N
HA_Emerg_West_BUF_N
HP_Stop_BUF_N
Reset_BUF_N
TOP_Dome_Cntl_Handpaddle_BUF
West_Overcurrent_N
Dome2_Overcurrent_N

+5V_DIG
R181
10k
LAB_Select

Watchdog_Timer_Latch
HA_Stop_E_Latch
Dec_Emerg_N_Latch
HA_Stop_W_Latch
TCS_Lockout_Latch
HA_Emerg_E_Latch
Emerg_Stop_Latch
Mtr_Cntr_Err_Latch
Dome3_Overcurrent_Latch
HA_Emerg_W_Latch

Note: Distribute caps evenly among VCCINT and VCCIO pins.

+5V_DIG
C149 1uF
C148 1uF
C154 1uF
C150 1uF
C139 1uF
C138 1uF
C145 1uF
C146 0.1uF
C147 0.1uF
C155 0.1uF
C151 0.1uF
C140 0.1uF
C142 0.1uF
C137 0.1uF
DGND

+5V_DIG
C37 0.01uF
C36 0.1uF
U29
TS555IDT
CVOLT
RST
DISC
THR
TRIG
VCC
OUT
GND
R163 4.75k
R162 4.75k
R169 100k
C38 10uF 25V
local_clock
DGND

Note: Clock is about 10 Hz.

U28E
U28F
M74HC14RM13TR
M74HC14RM13TR
CPLD_Clk

U27
74AC541MTR
U30
74AC541MTR
U33
74AC541MTR
U35
74AC541MTR
+5V_DIG
C33 0.1uF
C134 0.1uF
C143 0.1uF
C152 0.1uF
DGND
R161 0
OE1
OE2
VCC
GND
A1 A2 A3 A4 A5 A6 A7 A8
Y1 Y2 Y3 Y4 Y5 Y6 Y7 Y8

HA_Overspeed_Latch
Dec_Overspeed_Latch
West_Overcurrent_Latch
East_Overcurrent_Latch
North_Overcurrent_Latch
South_Overcurrent_Latch
Dome1_Overcurrent_Latch
Dome2_Overcurrent_Latch
Dome3_Overcurrent_Latch
Emerg_Stop_Latch
HP_Stop_Latch
Mtr_Cntr_Err_Latch
TCS_Lockout_Latch
HA_Stop_W_Latch
HA_Stop_E_Latch
HA_Emerg_W_Latch
HA_Emerg_E_Latch
Dec_Stop_N_Latch
Dec_Stop_S_Latch
Dec_Emerg_N_Latch
Dec_Emerg_S_Latch
Horizon_Stop_Latch
Watchdog_Timer_Latch
SB_Clock_WD_Err_Latch
Dome_Amp_Enable_&_Therm_Stat_Latch
Tel_Amp_Enable_&_Therm_Stat_Latch
Lab_Select_Latch
Spare1_Latch
Spare2_Latch
TOP_TCS_Enable
TOP_Brake_Enable_Out

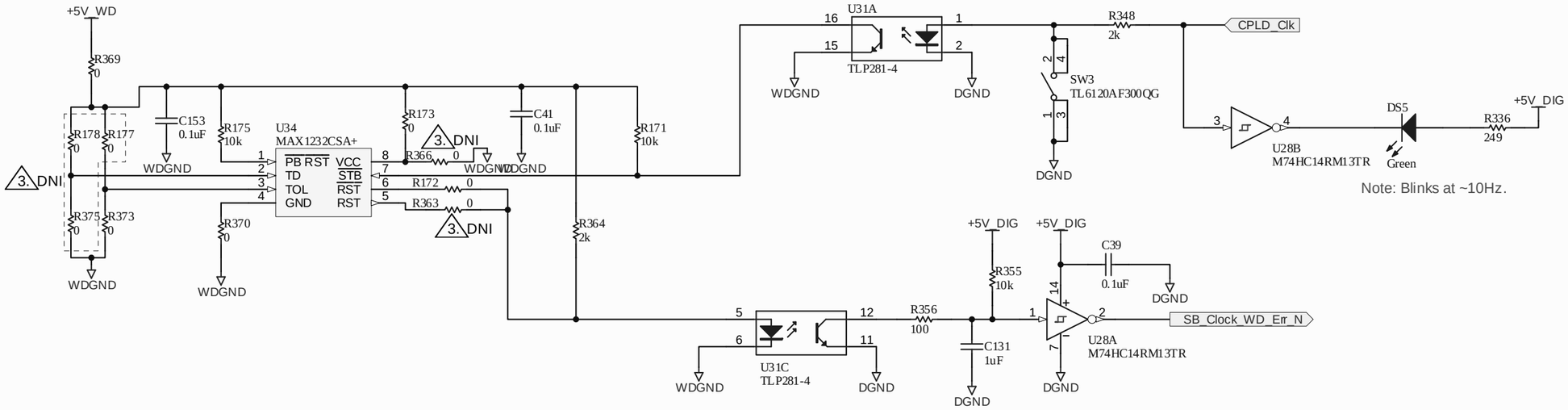
Note: Output buffers used mainly for off board output signals.

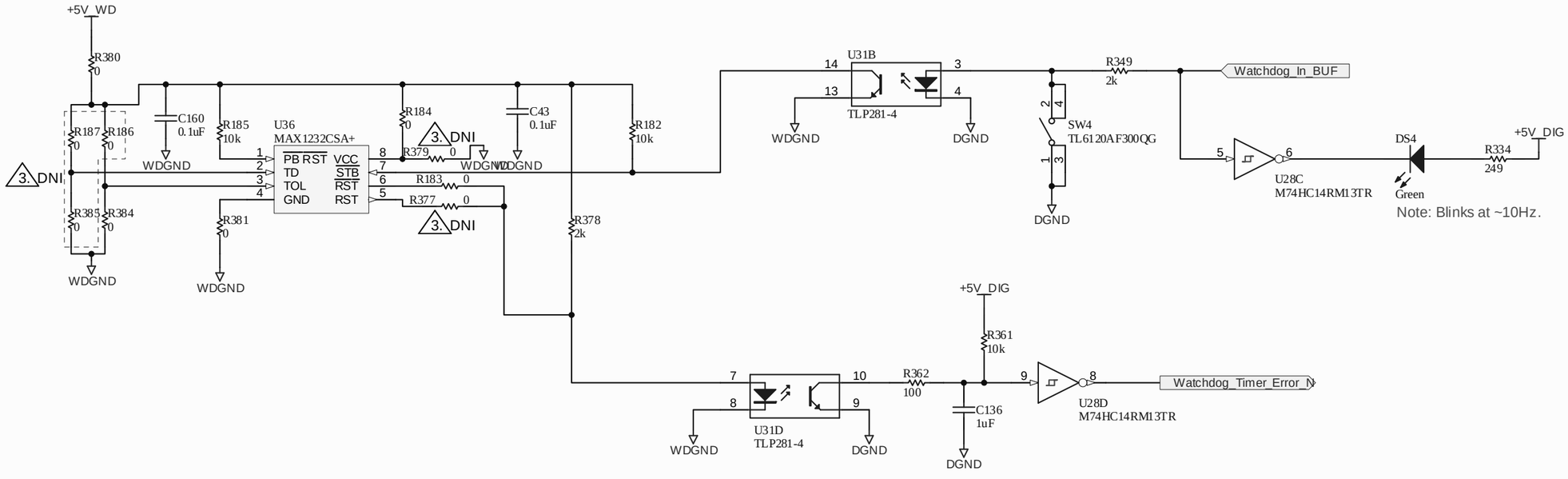
R376 0
Spare2_Latch
R374 0
3. DNI
DGND

DWG #	REV	SIZE	SHEET
T3-2070	-	B	6 of 16

DWG # T3-2070
REV -

REVISION BLOCK
SEE SHEET 1





Note: The 0 ohm jumpers make it possible to use another watchdog IC. For example, a PIC 16F629 microcontroller could be programmed as a watchdog IC.

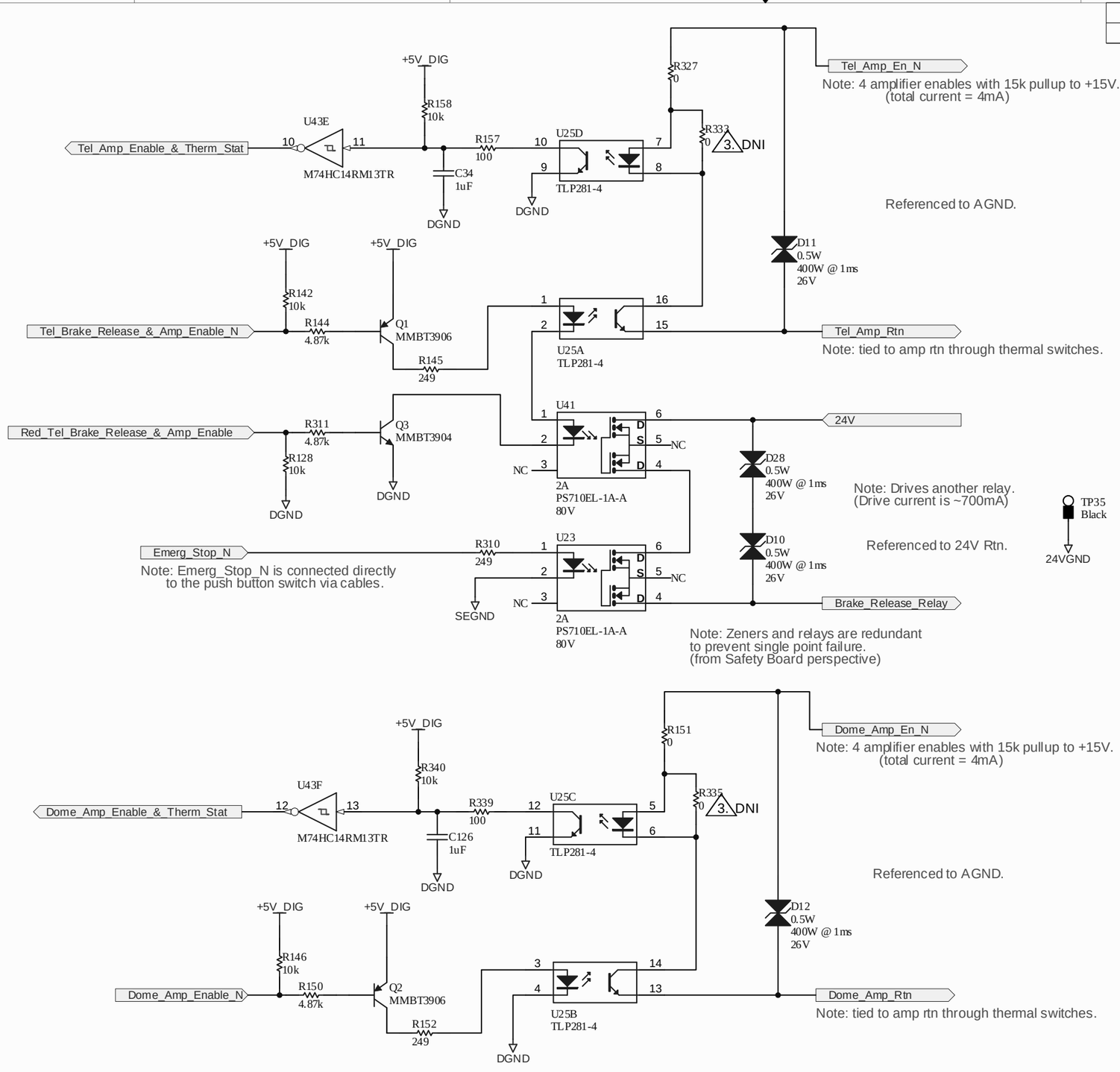
Watchdog Circuits

DWG #	REV	SIZE	SHEET
T3-2070	-	B	7 of 16

DWG # T3-2070

REV -

REVISION BLOCK
SEE SHEET 1

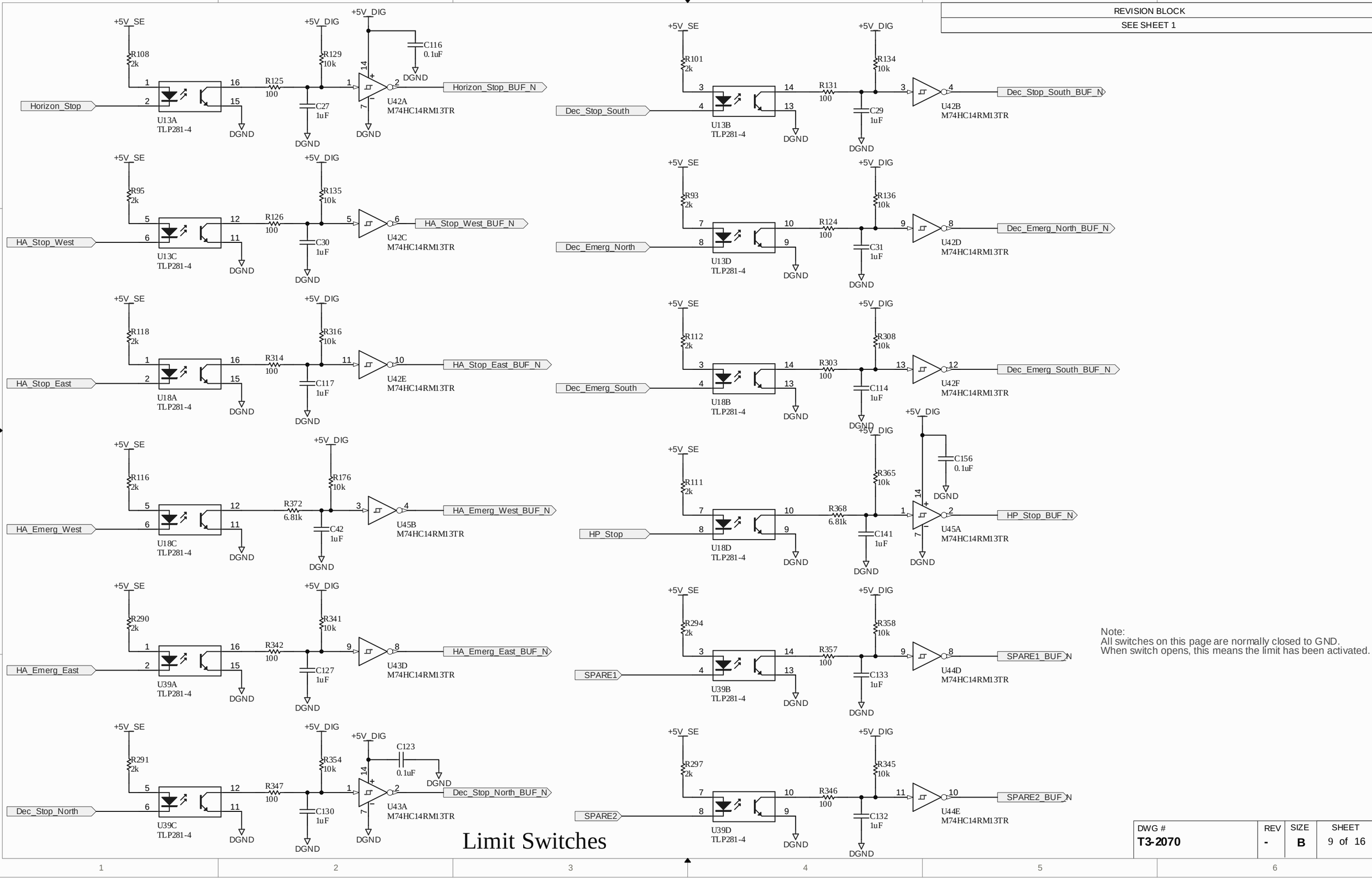


Relays - Brake, Telescope Amp, Dome Amps

DWG #	REV	SIZE	SHEET
T3-2070	-	B	8 of 16

DWG# T3-2070 REV -

REVISION BLOCK
SEE SHEET 1



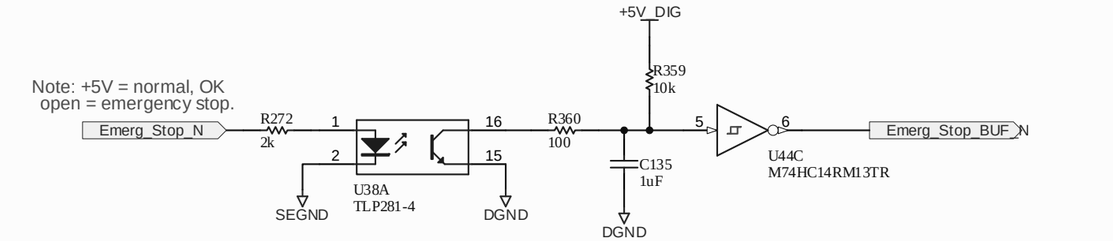
Note:
All switches on this page are normally closed to GND.
When switch opens, this means the limit has been activated.

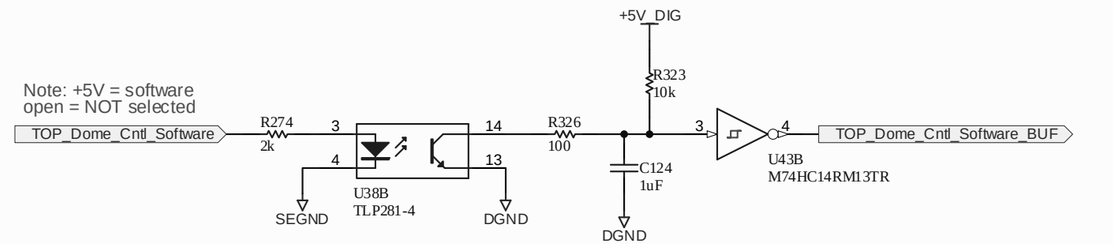
Limit Switches

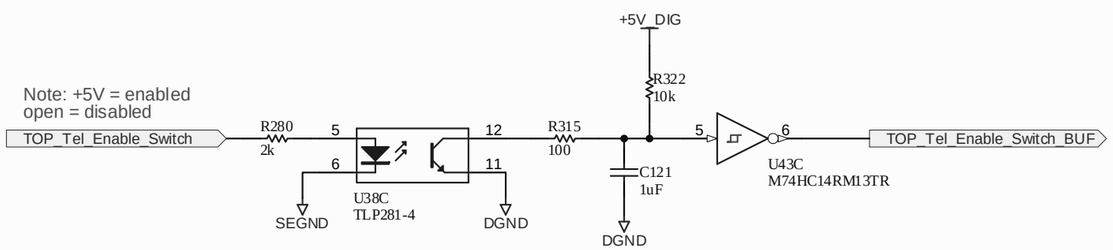
DWG #	REV	SIZE	SHEET
T3-2070	-	B	9 of 16

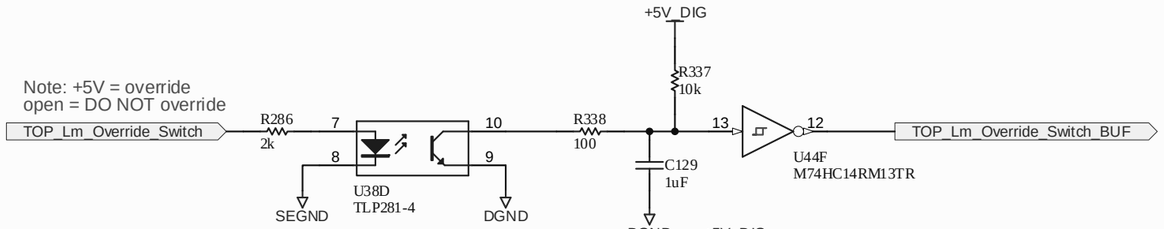
REV -

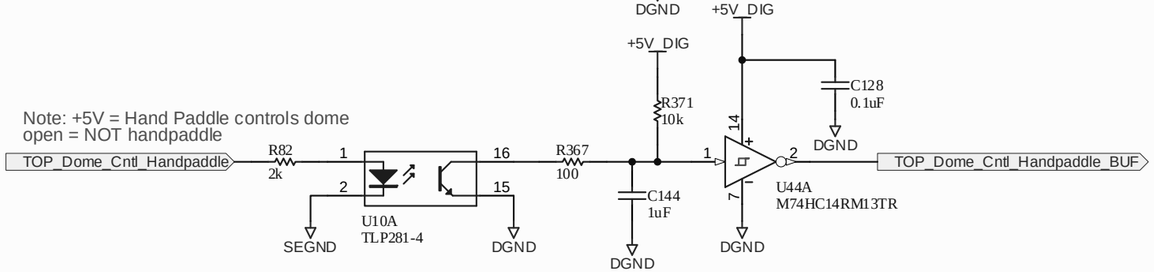
DWG # T3-2070





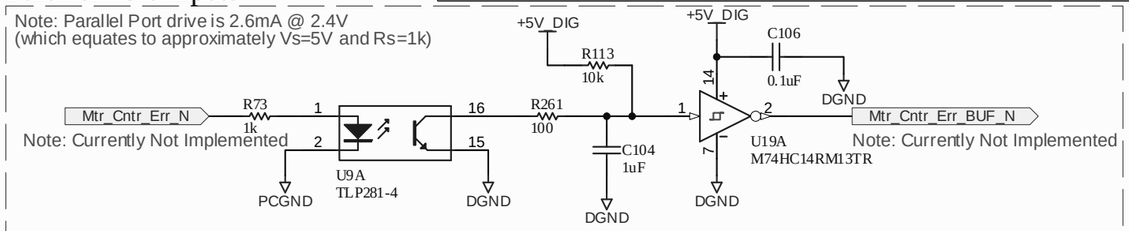


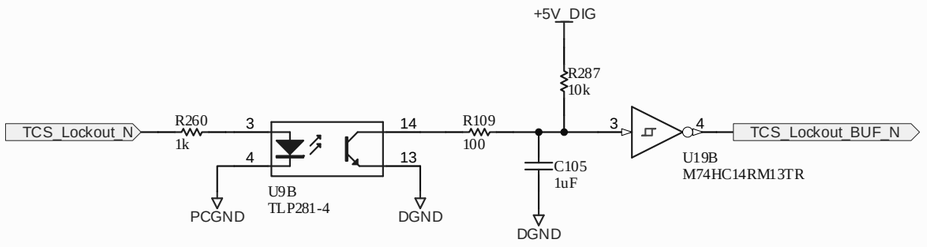


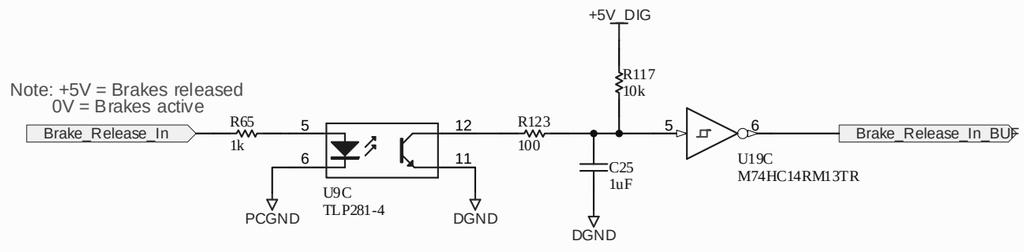


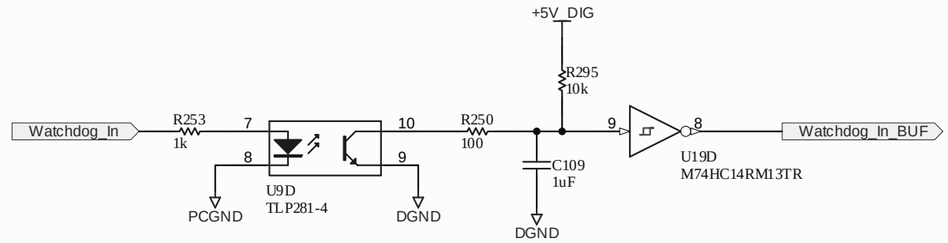
Parallel Port Inputs

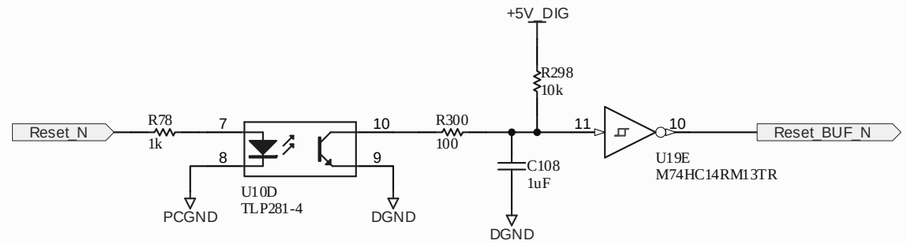
Note: Parallel Port drive is 2.6mA @ 2.4V
(which equates to approximately Vs=5V and Rs=1k)











REVISION BLOCK
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DWG # T3-2070

Limit Switches & Parallel Port

DWG #	REV	SIZE	SHEET
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REVISION BLOCK

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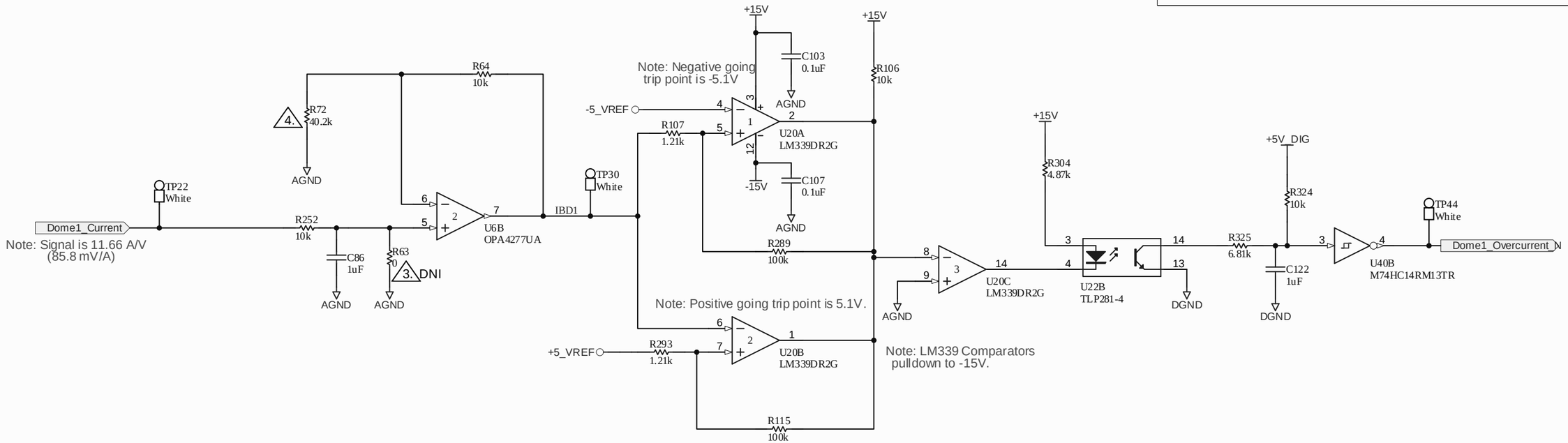
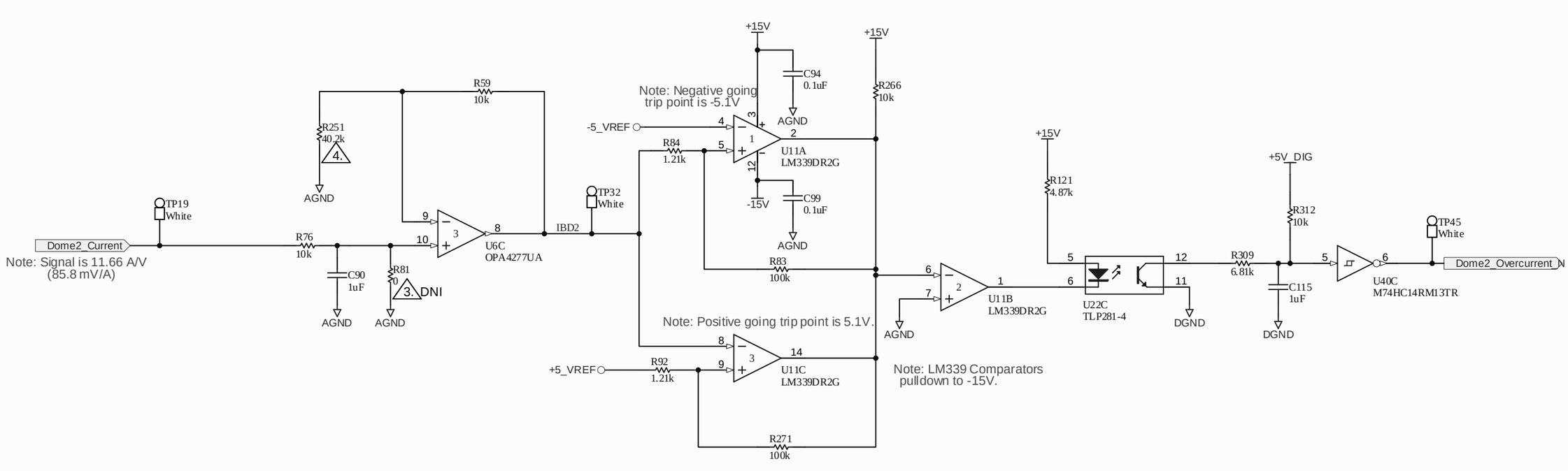




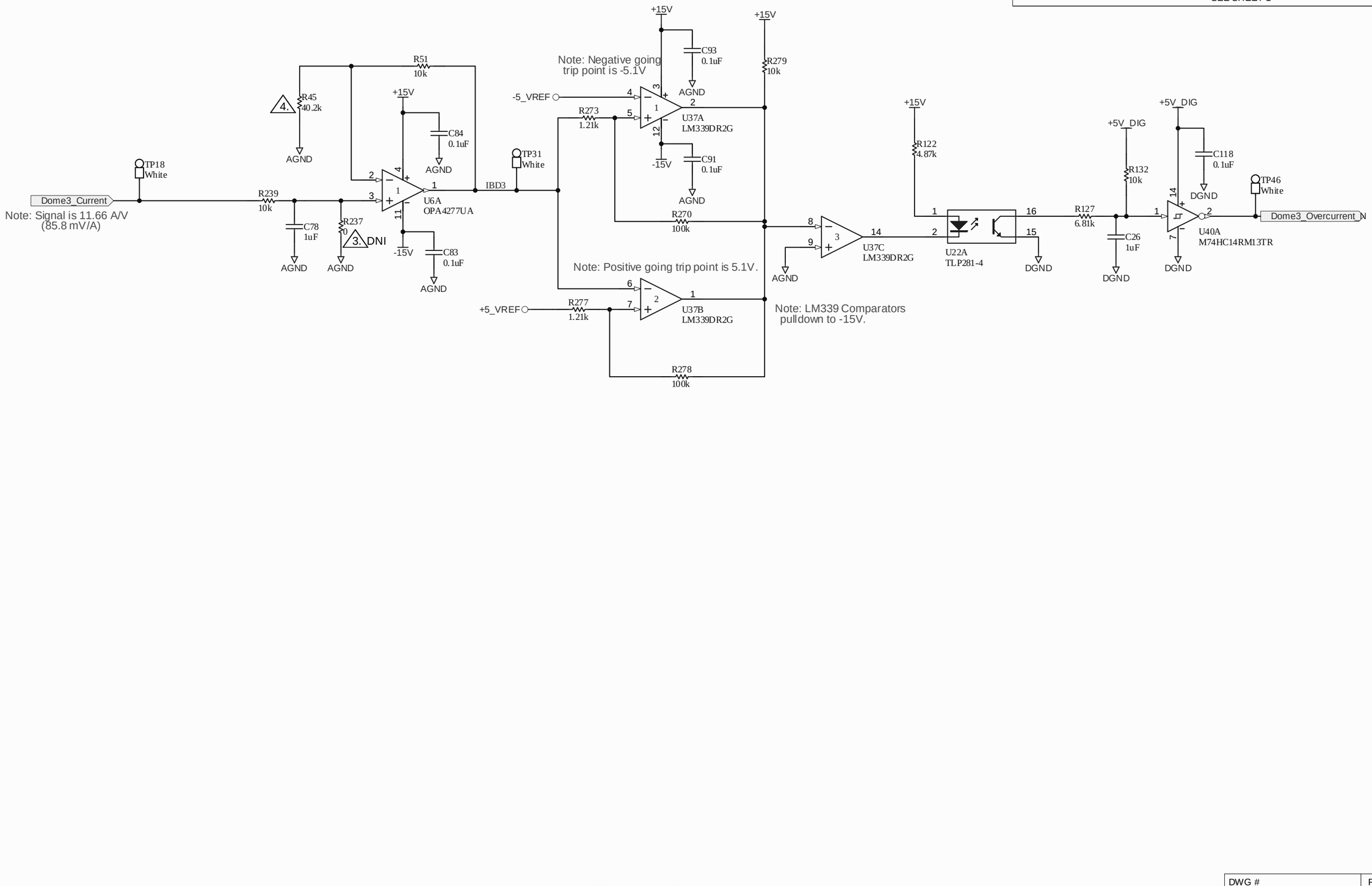
Dome Overcurrent

DWG #	REV	SIZE	SHEET
T3-2070	-	B	11 of 16

DWG # T3-2070

REV -

REVISION BLOCK
SEE SHEET 1



REV -

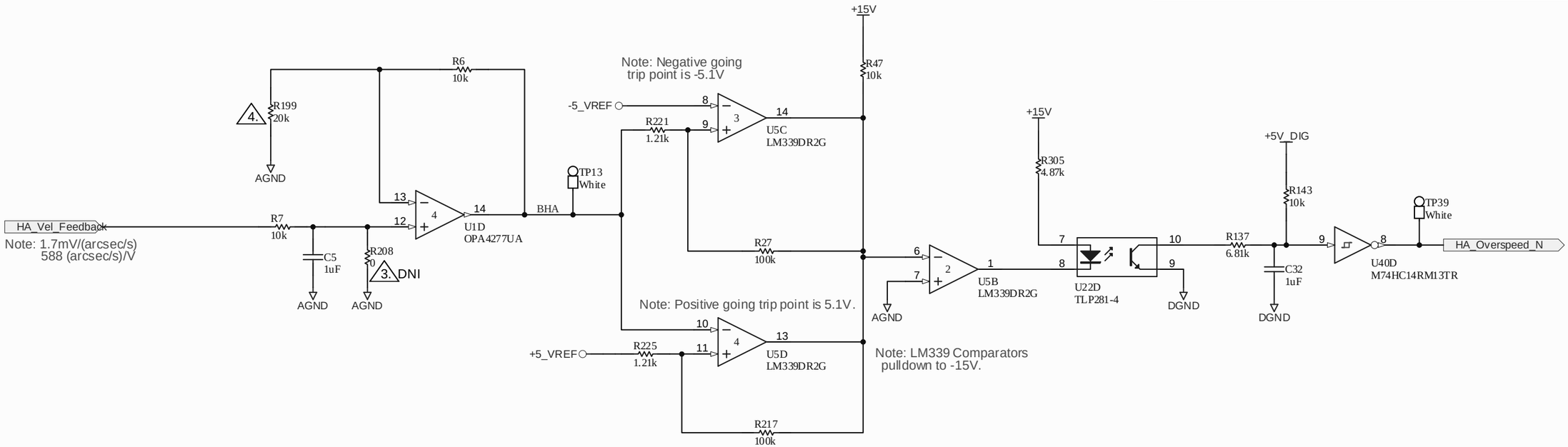
DWG# T3-2070

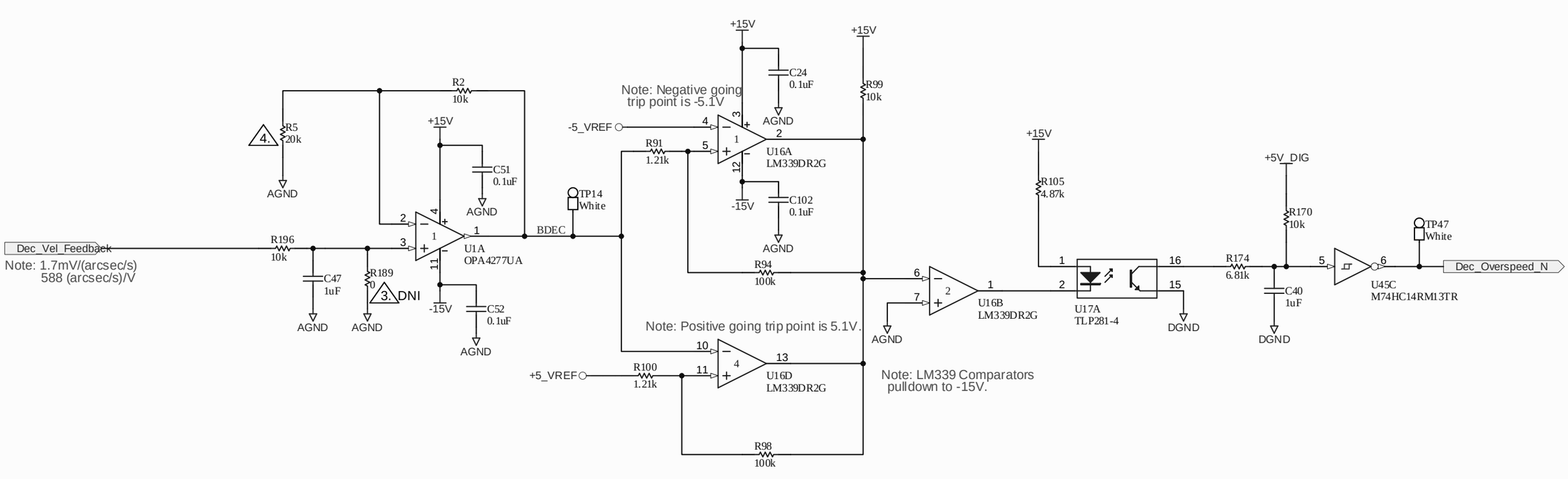
Dome Overcurrent

DWG #	REV	SIZE	SHEET
T3-2070	-	B	12 of 16

REVISION BLOCK

SEE SHEET 1





HA & Dec Overspeed

DWG #	REV	SIZE	SHEET
T3-2070	-	B	13 of 16

DWG # T3-2070

REV -

REVISION BLOCK

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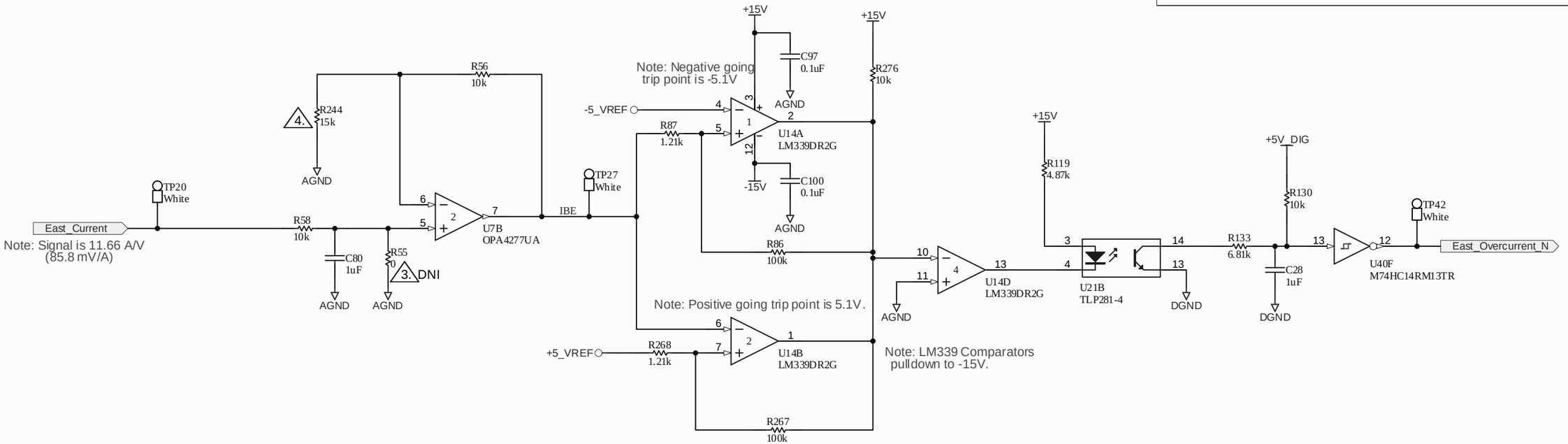

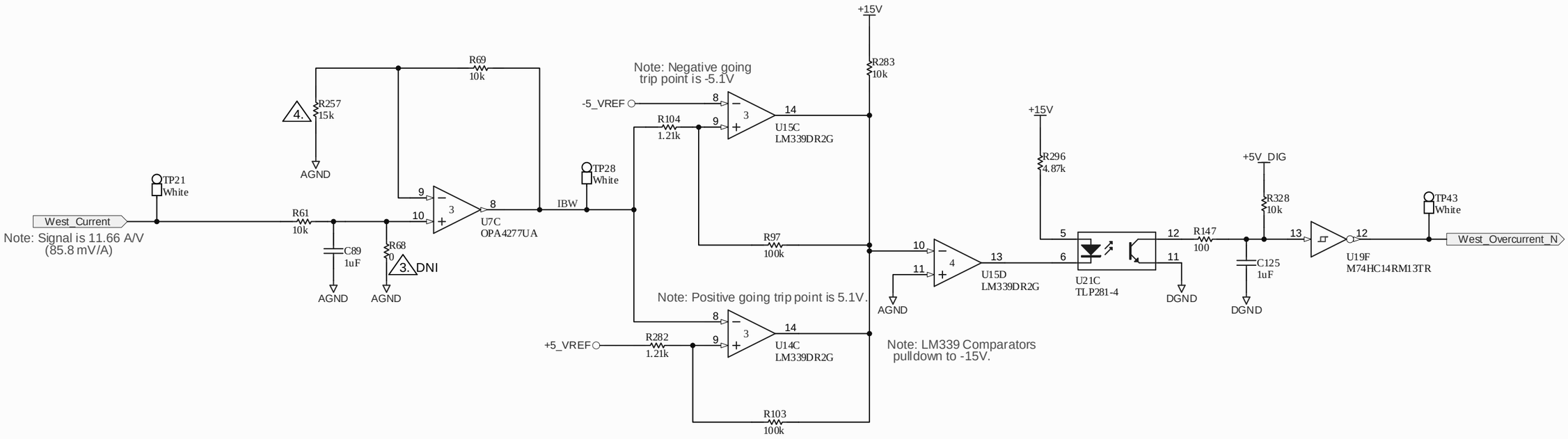

East & West Overcurrent

DWG #	REV	SIZE	SHEET
T3-2070	-	B	14 of 16

REVISION BLOCK
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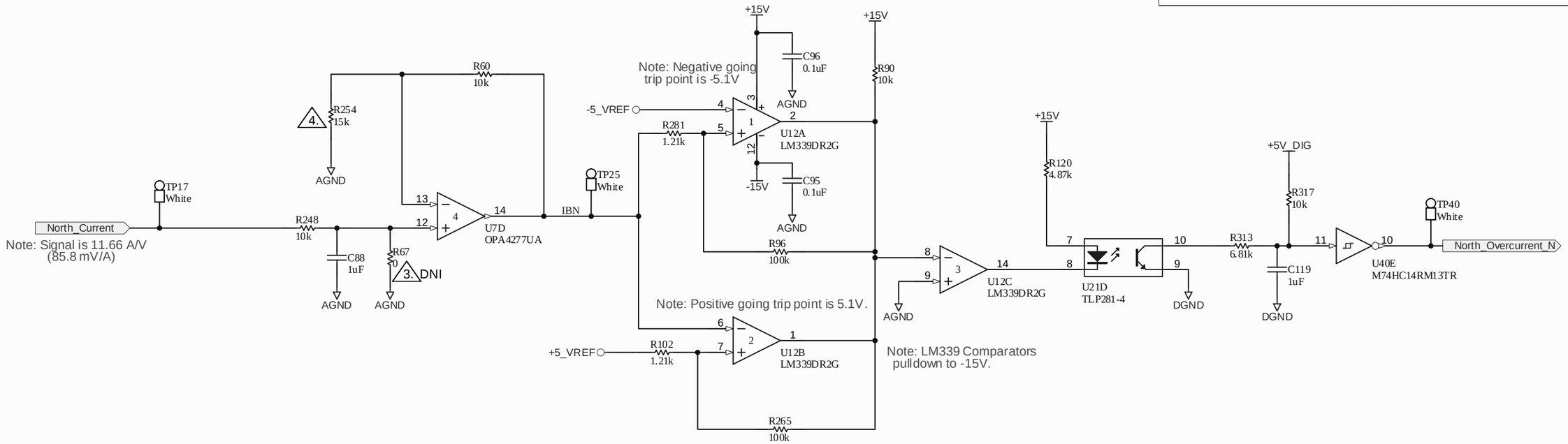

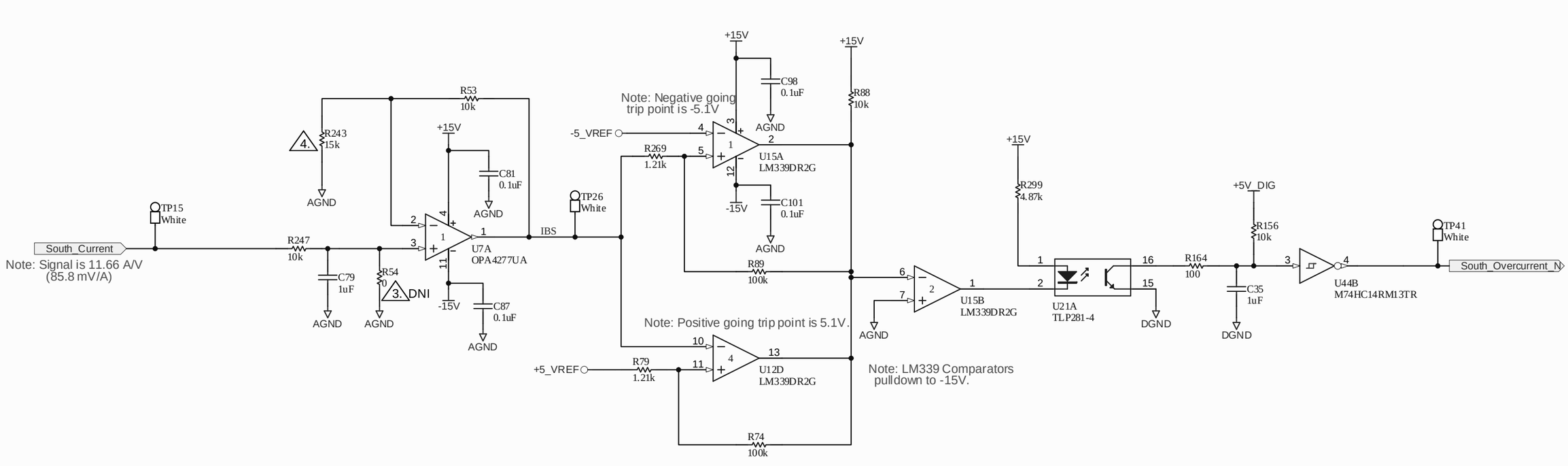

North & South Overcurrent

DWG #	REV	SIZE	SHEET
T3-2070	-	B	15 of 16

DWG # T3-2070

REV -

REVISION BLOCK
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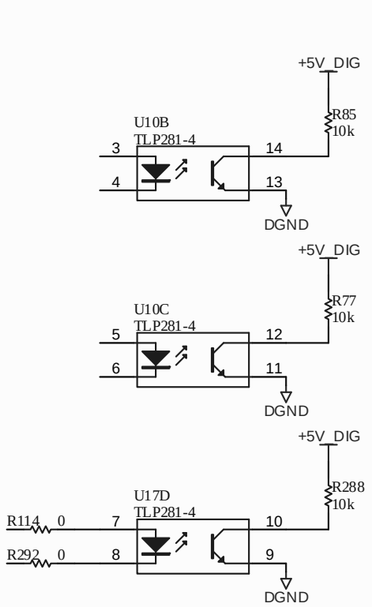

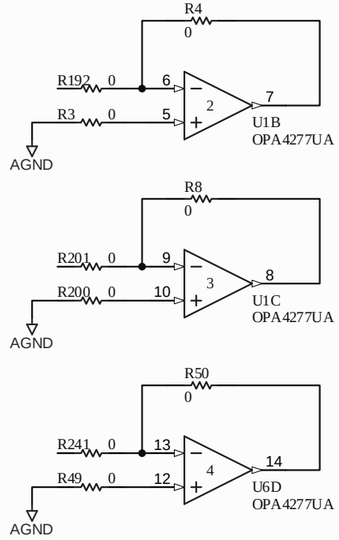

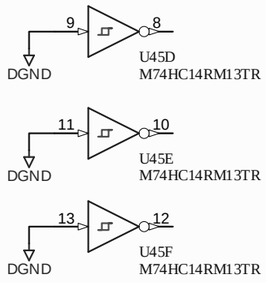

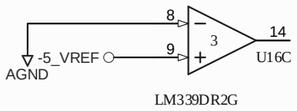

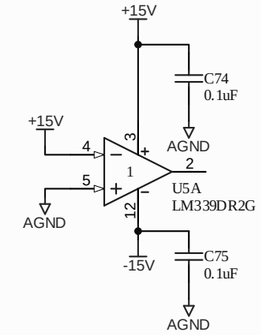

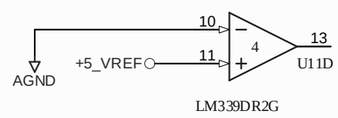

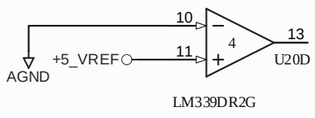

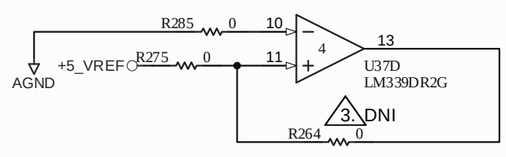

Spare / Unused Multipart Circuits

DWG #	REV	SIZE	SHEET
T3-2070	-	B	16 of 16

REV -

DWG # T3-2070