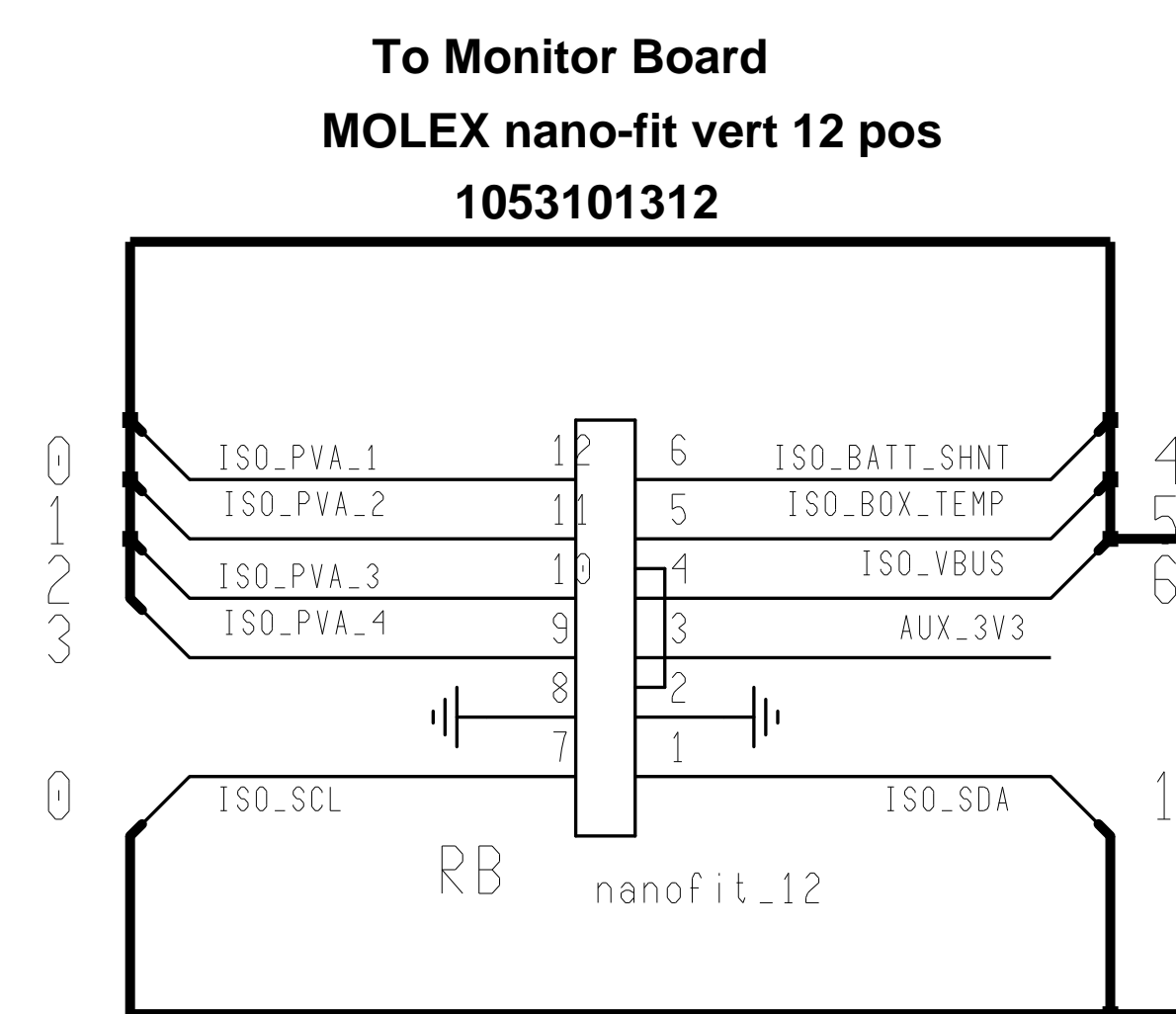


Relay Board Grounding Scheme
 SCH2982-GR
 2/23/2021
 Mircea Bogdan
 The University of Chicago

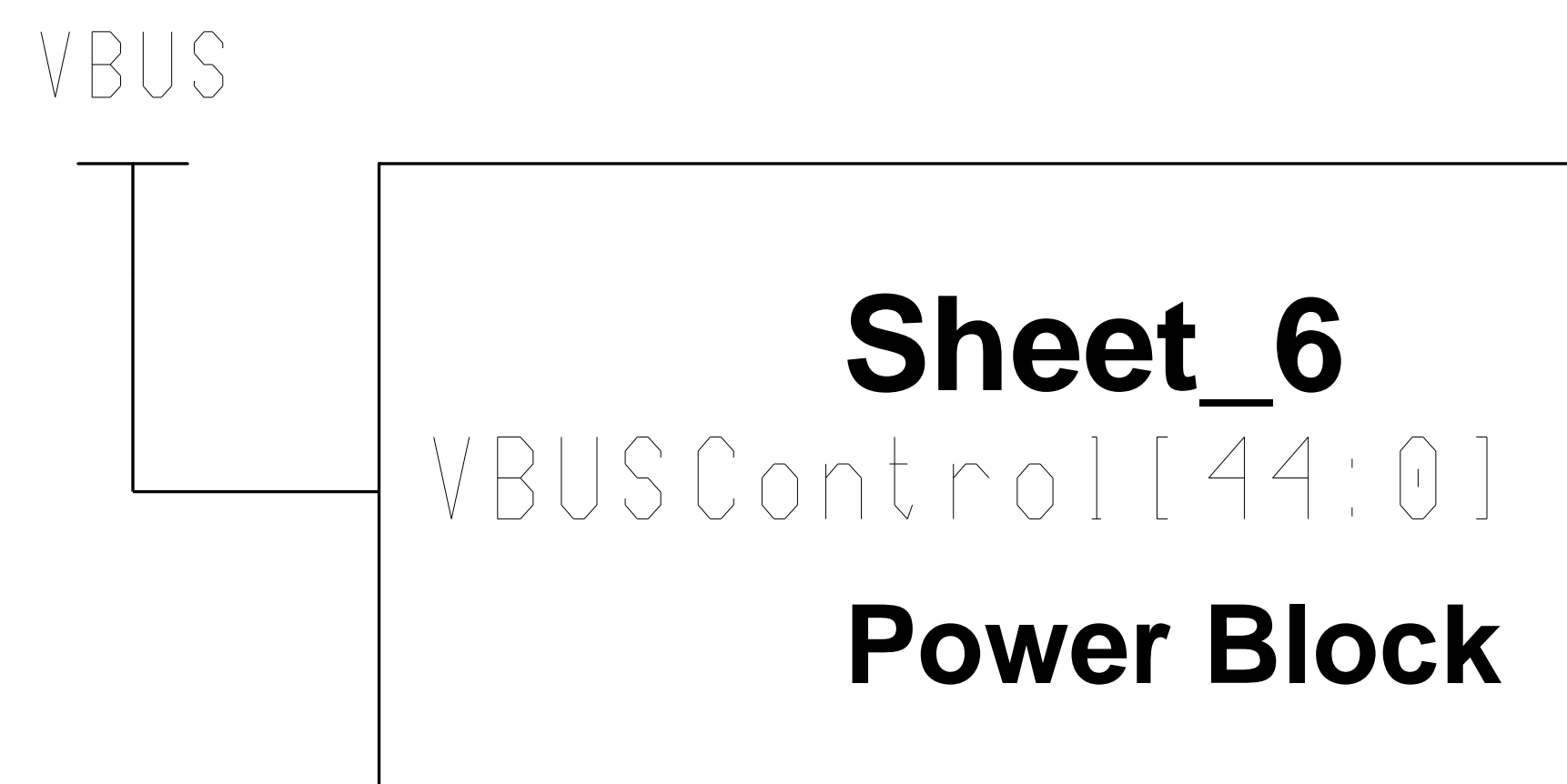
Sheet_2
 Sheet_3_1,....,4
 Sheet_4_1,....,6
 Sheet_5

PreRelayControl

I2C[1:0] Control[44:0] Local_PVA[8:0]



Local_PVA[8:0] Sheet_7
 PVA[6:0] Sheet_8_1,2
 Sheet_9_1,....,12
Analog Buffers



0_I2C[1:0] Sheet_11
 Sheet_12
 1_I2C[1:0] Sheet_13
 Control[44:0] Sheet_14
 Control Sheet_15
 Sheet_16

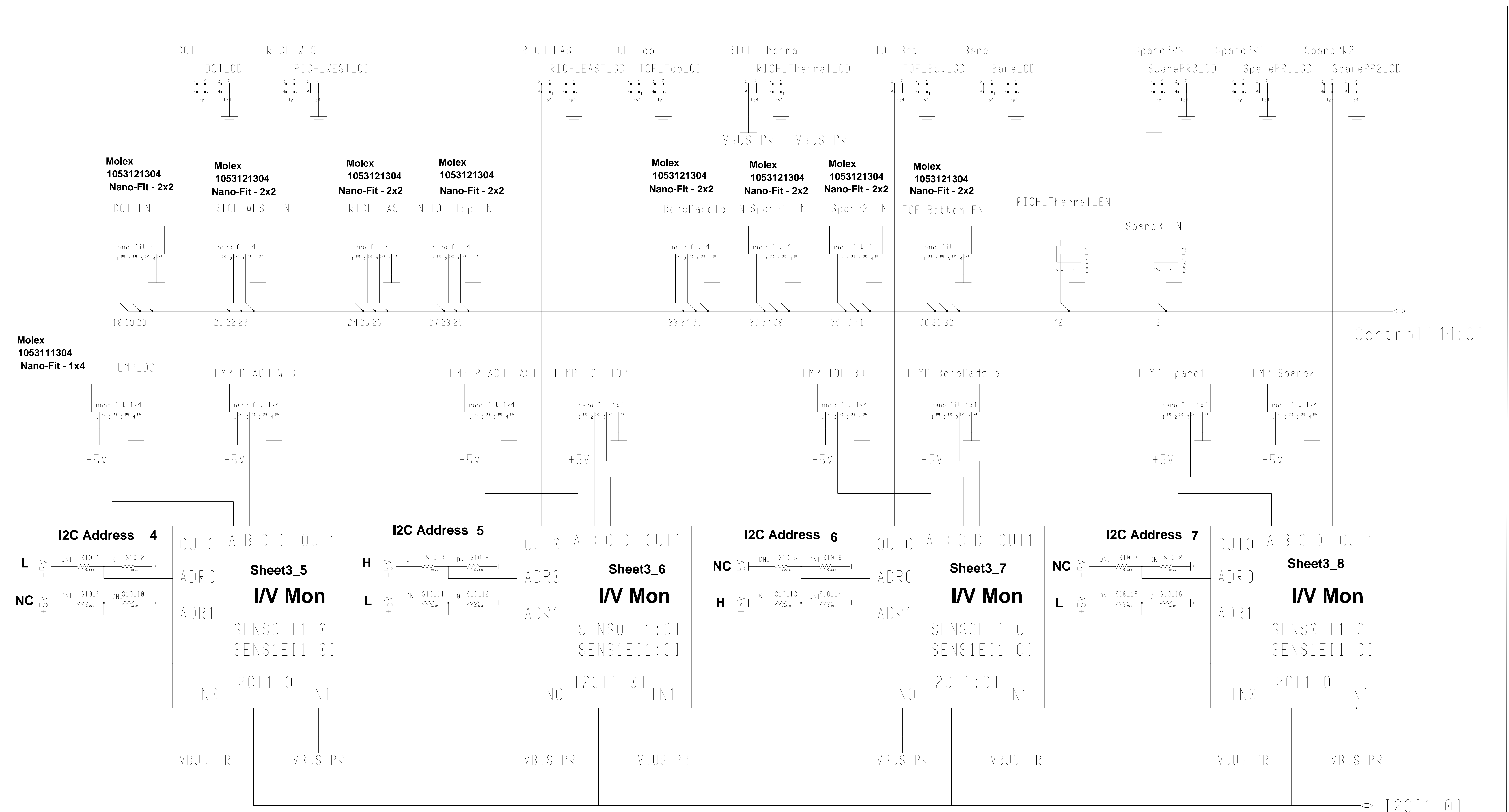
I2C[1:0] Control[44:0]

Sheet_10
 Sheet_3_5,....,8

PostRelayControl

SCH-2982
 SPC-2983
 ASM-2984

Engineer: M. Bogdan	The University of Chicago HELIX Relay Box Board Top Level		
Drawn by: M. Bogdan			
DATE: 3/10/2021	REV. A	DRW. 2982	Sheet 1

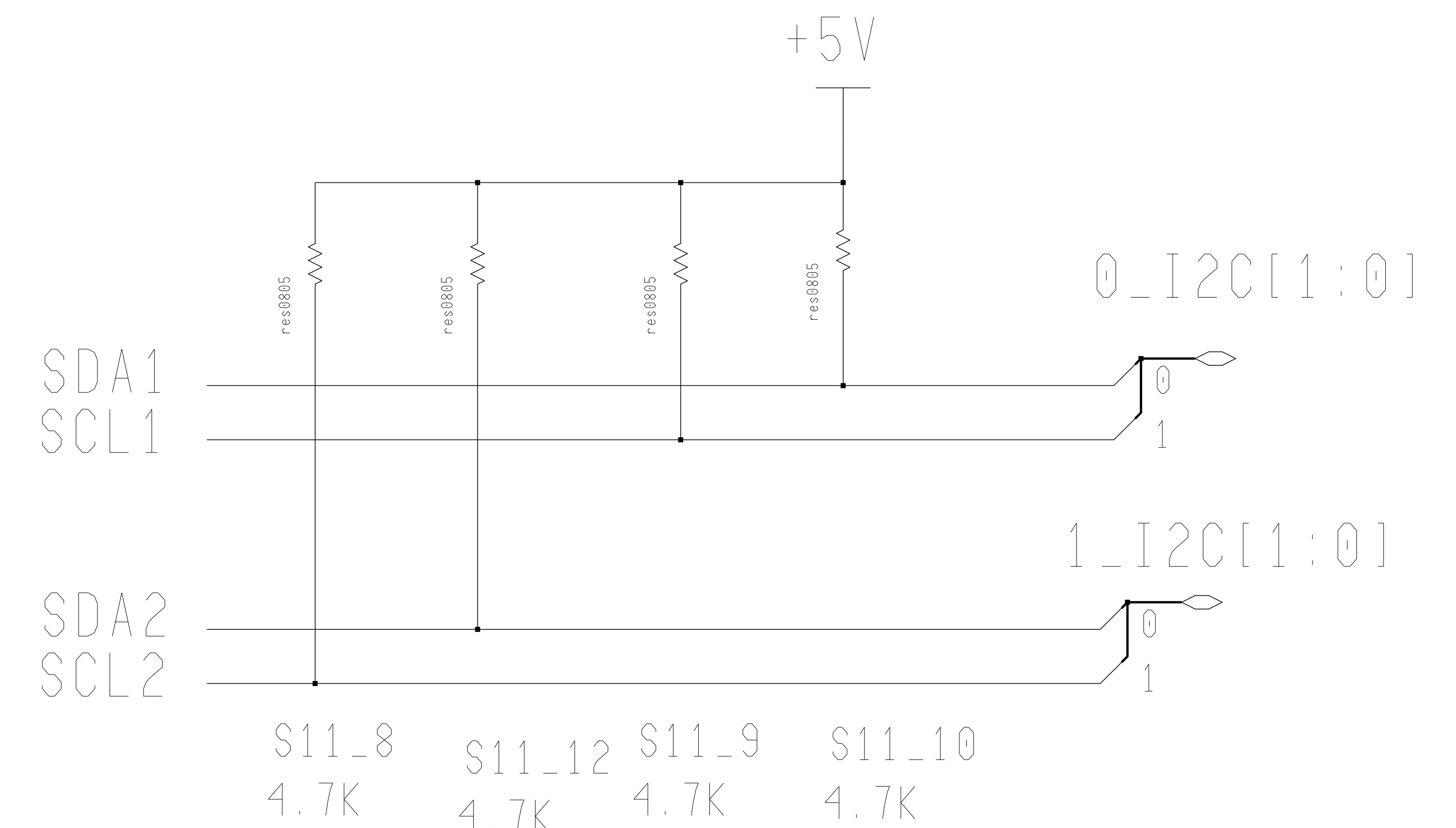
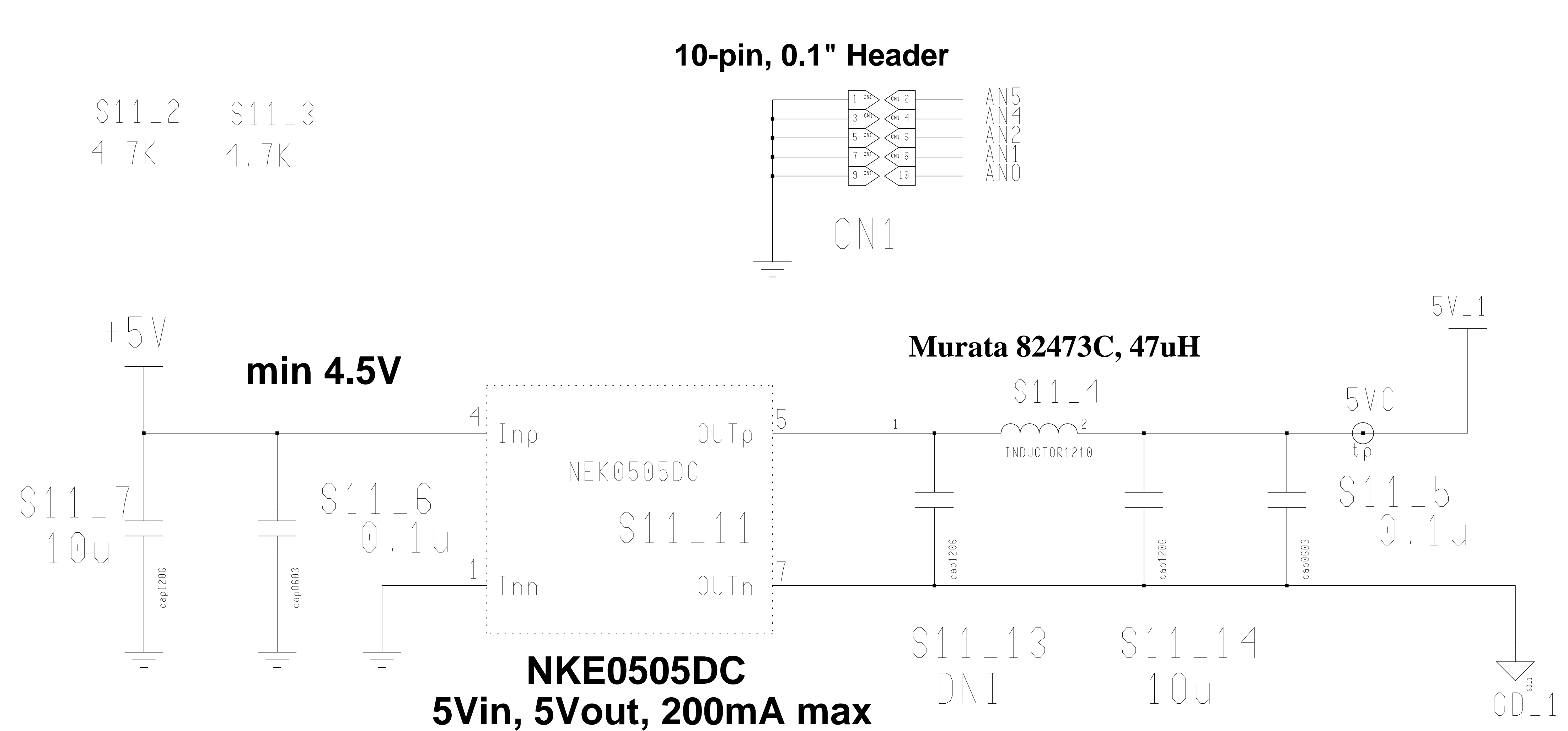
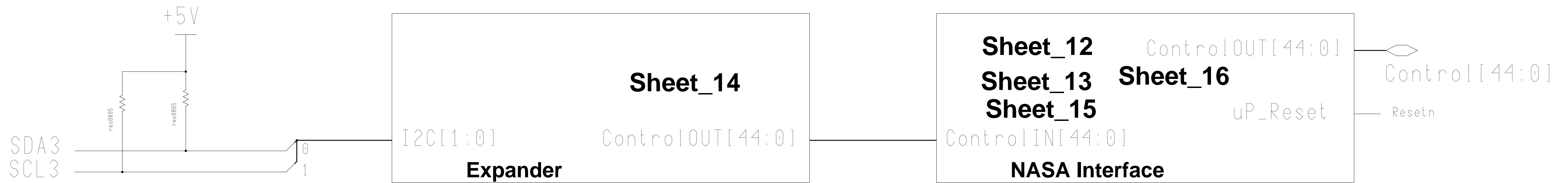
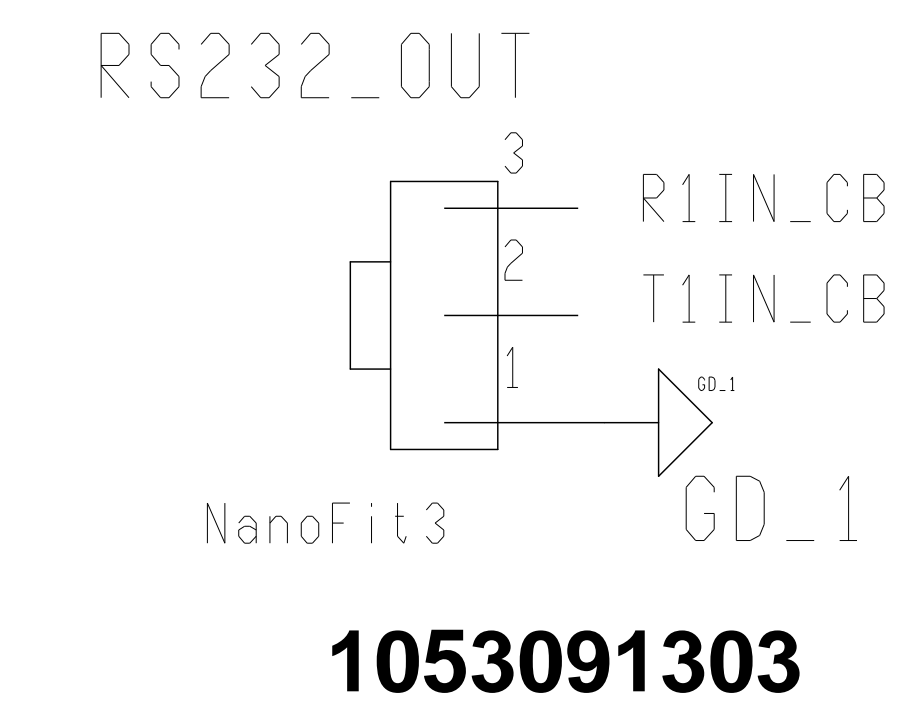
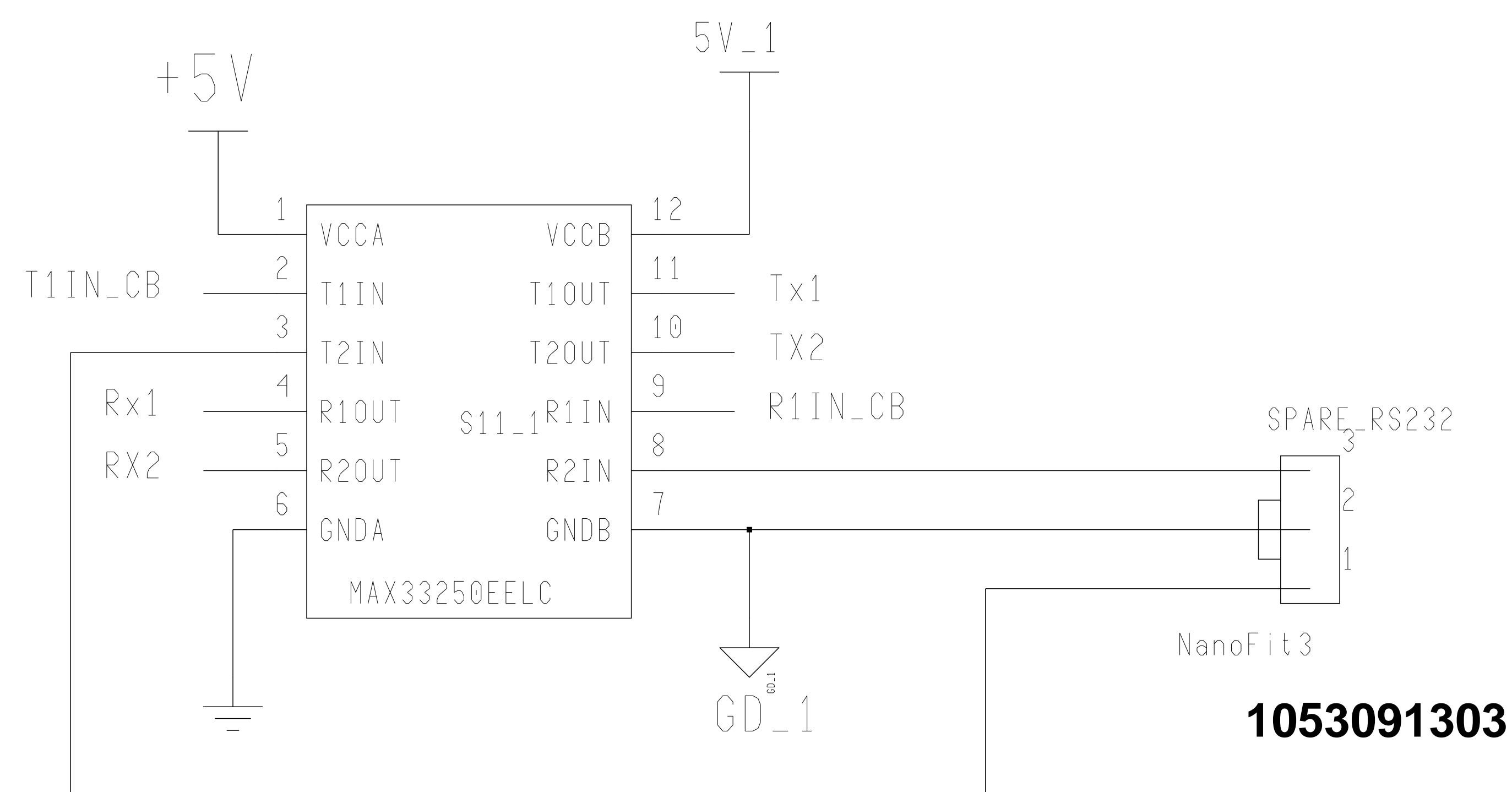
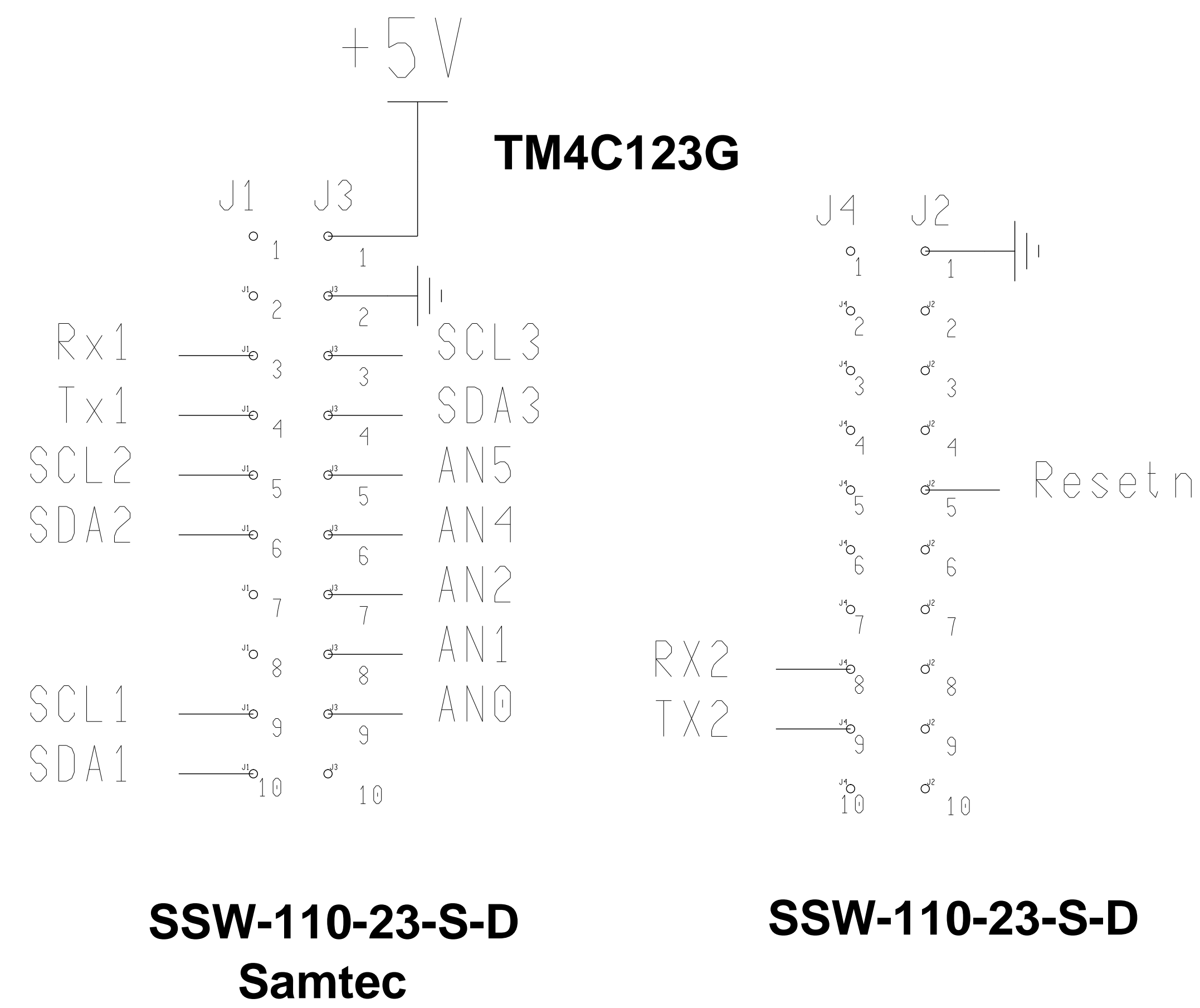


SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan
Drawn by: M. Bogdan
DATE: 3/19/2021

The University of Chicago
HELIX Relay Box Board
Post-Relay Control

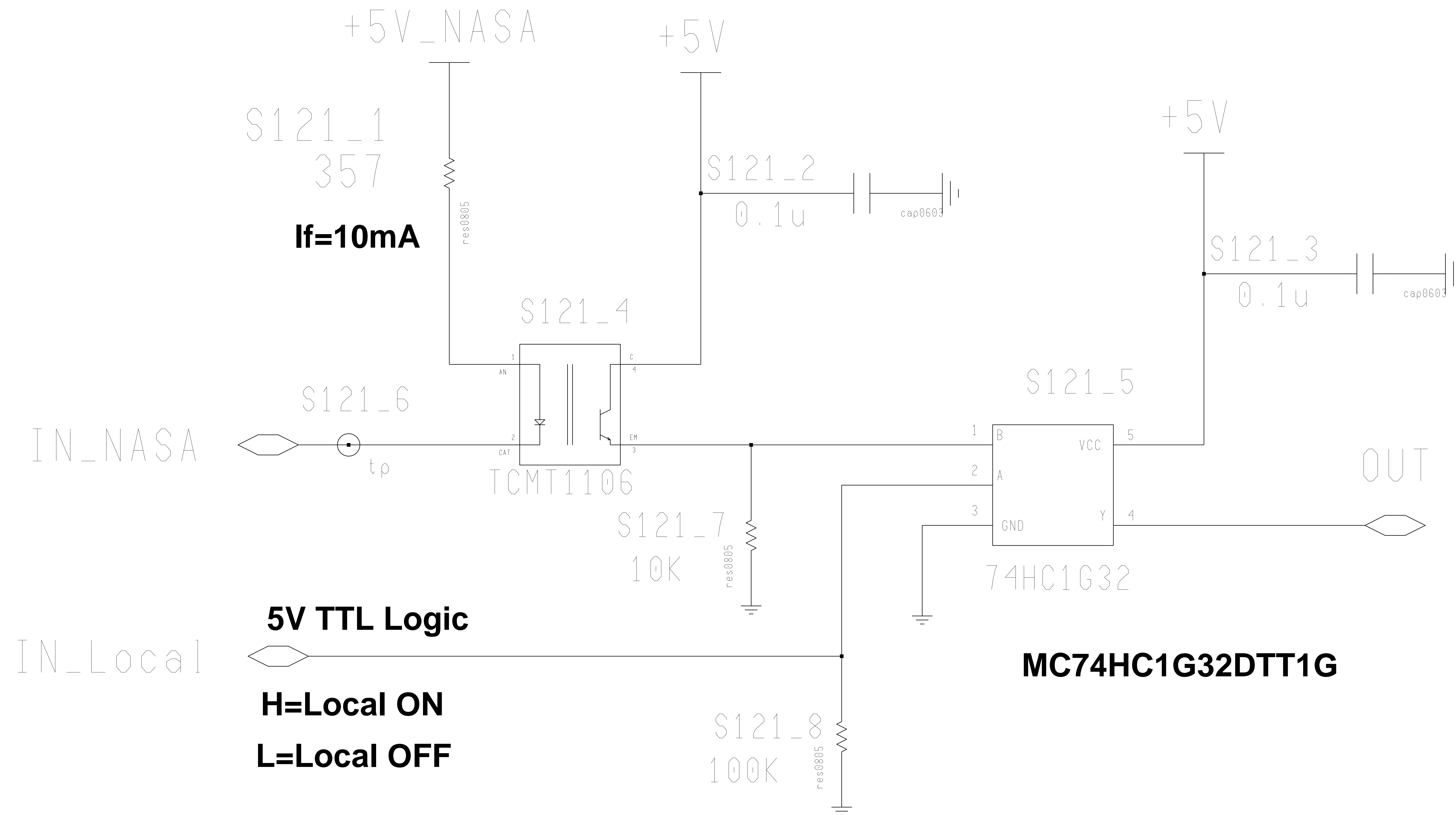
REV. A | DRW. 2982 | Sheet 10



SCH-2982
SPC-2983
ASM-2984

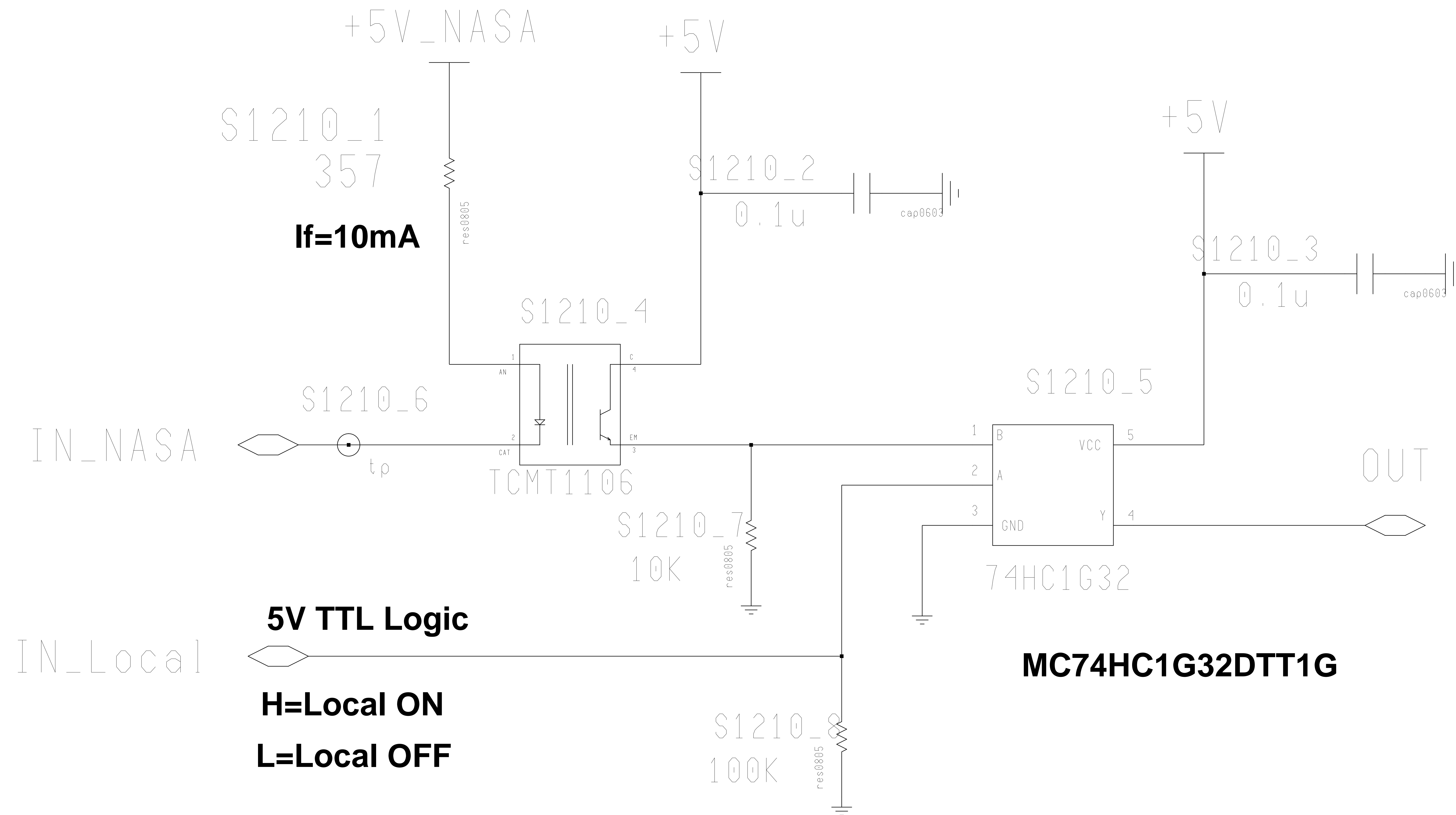
Engineer: **M. Bogdan**
Drawn by: **M. Bogdan**
DATE: **3/26/2021**

The University of Chicago
HELIX Relay Box Board
Microprocessor Block



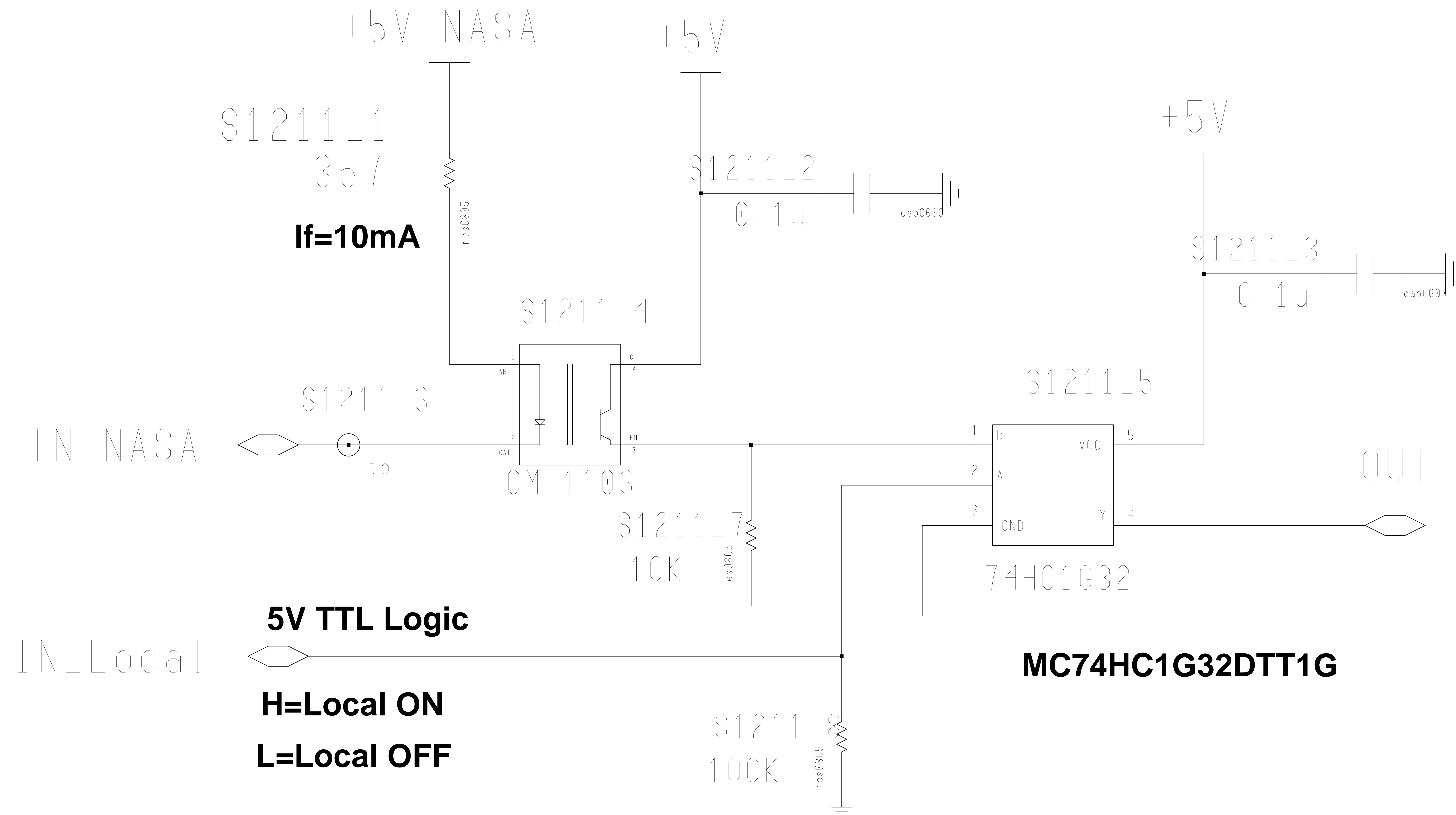
SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Isolated_OR _1		
Drawn by: M. Bogdan			
DATE: 3/26/2021			
REV. A	DRW. 2982	Sheet	12_1



SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Isolated_OR _1		
Drawn by: M. Bogdan			
DATE: 3/26/2021			
REV. A	DRW. 2982	Sheet	12_10



If=10mA

5V TTL Logic

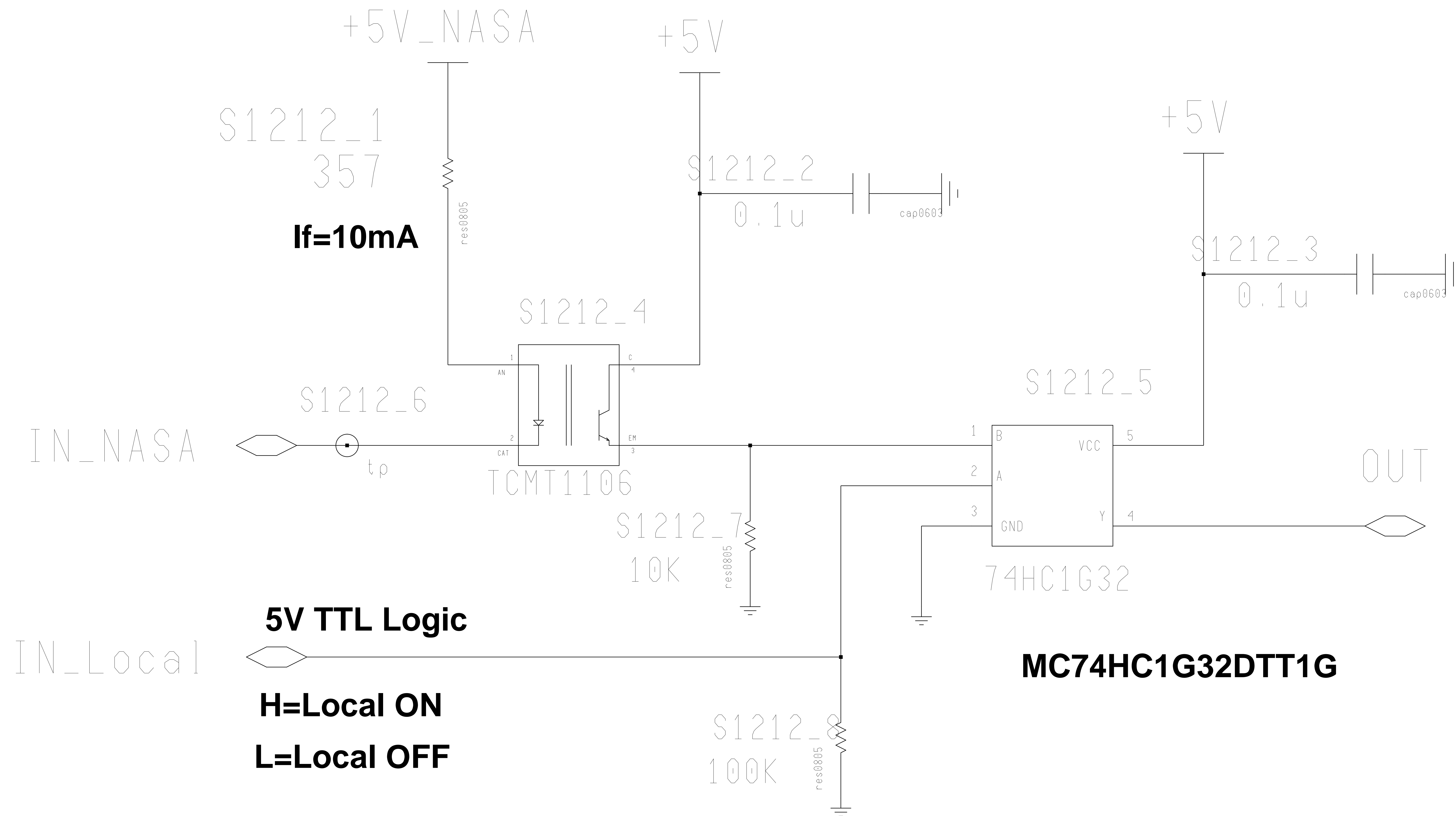
H=Local ON

L=Local OFF

MC74HC1G32DTT1G

SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Isolated_OR _1		
Drawn by: M. Bogdan			
DATE: 3/26/2021			
REV. A	DRW. 2982	Sheet	12_11



If=10mA

5V TTL Logic

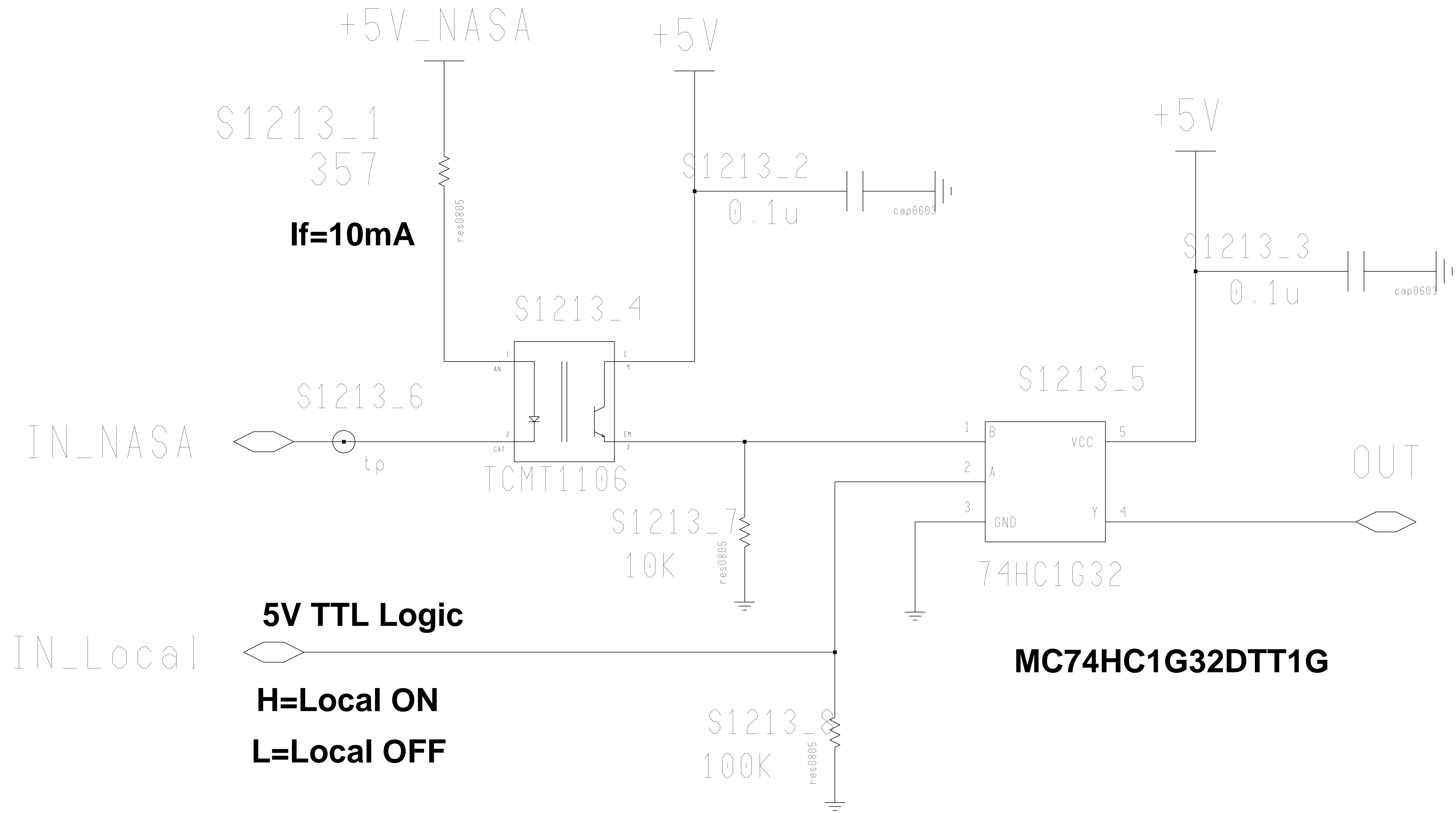
H=Local ON

L=Local OFF

MC74HC1G32DTT1G

SCH-2982
SPC-2983
ASM-2984

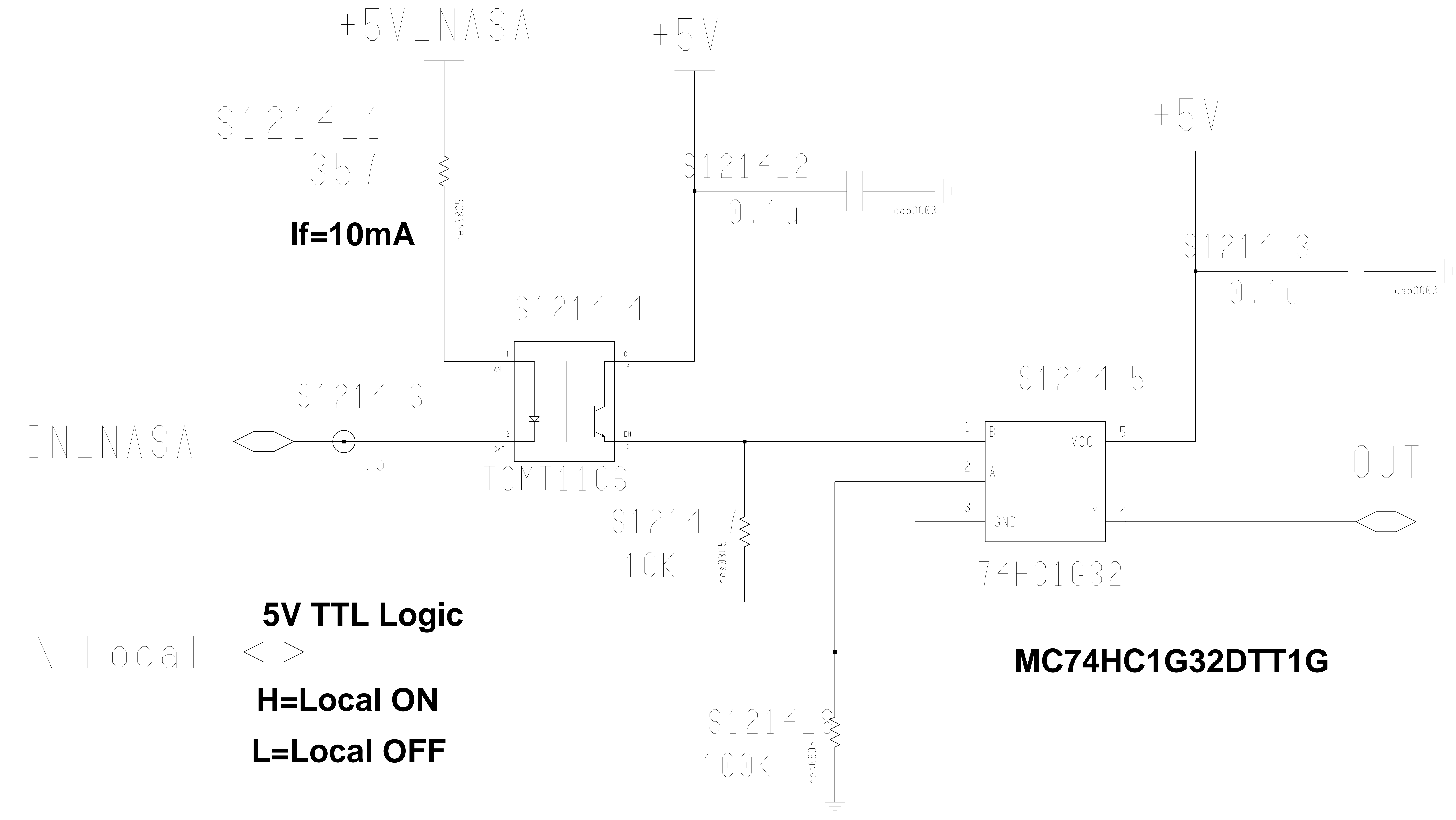
Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Isolated_OR _1		
Drawn by: M. Bogdan			
DATE: 3/26/2021			
REV. A	DRW. 2982	Sheet	12_12



5V TTL Logic
H=Local ON
L=Local OFF

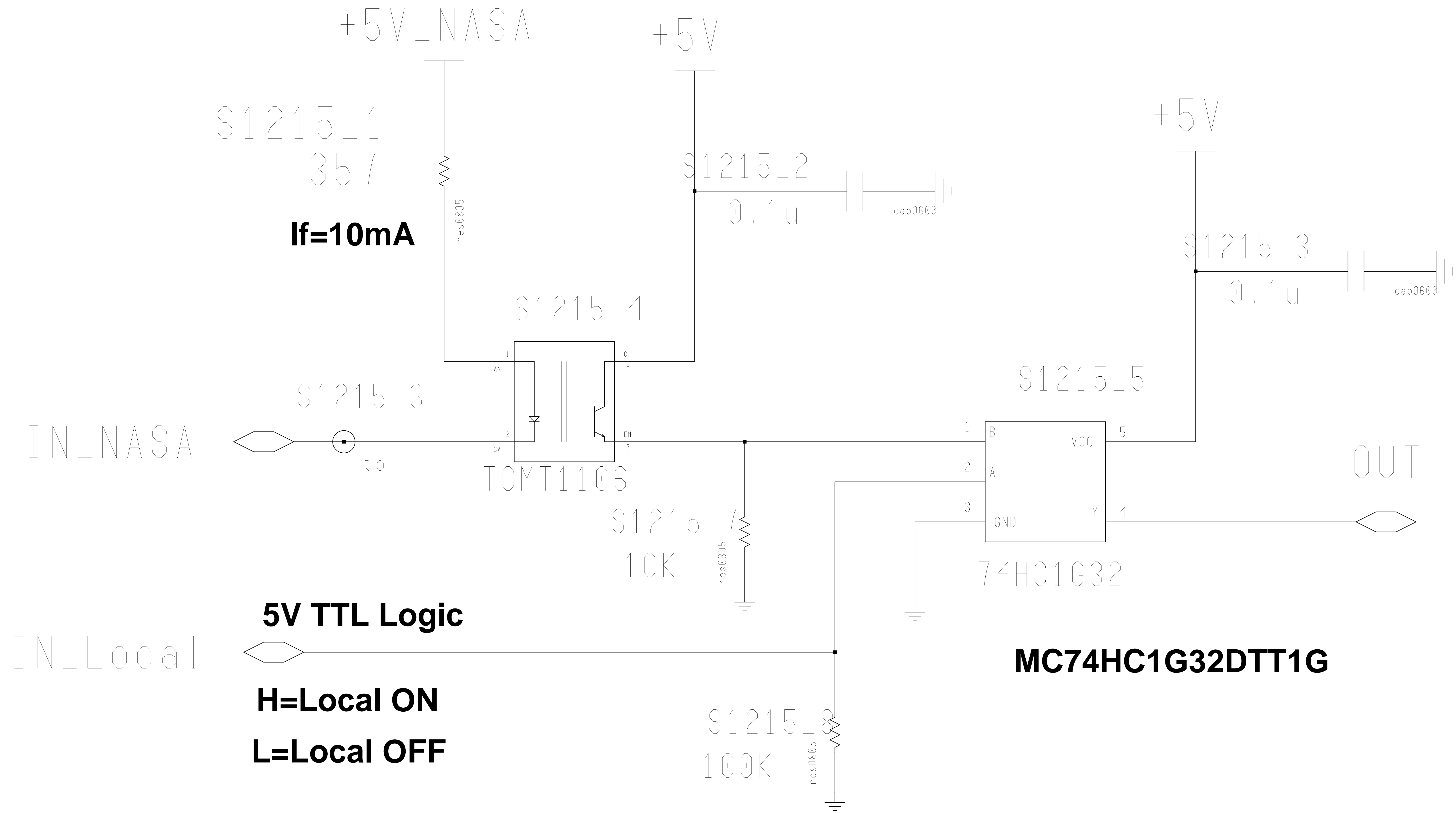
SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Isolated_OR _1		
Drawn by: M. Bogdan			
DATE: 3/26/2021			
REV. A	DRW. 2982	Sheet	12_13



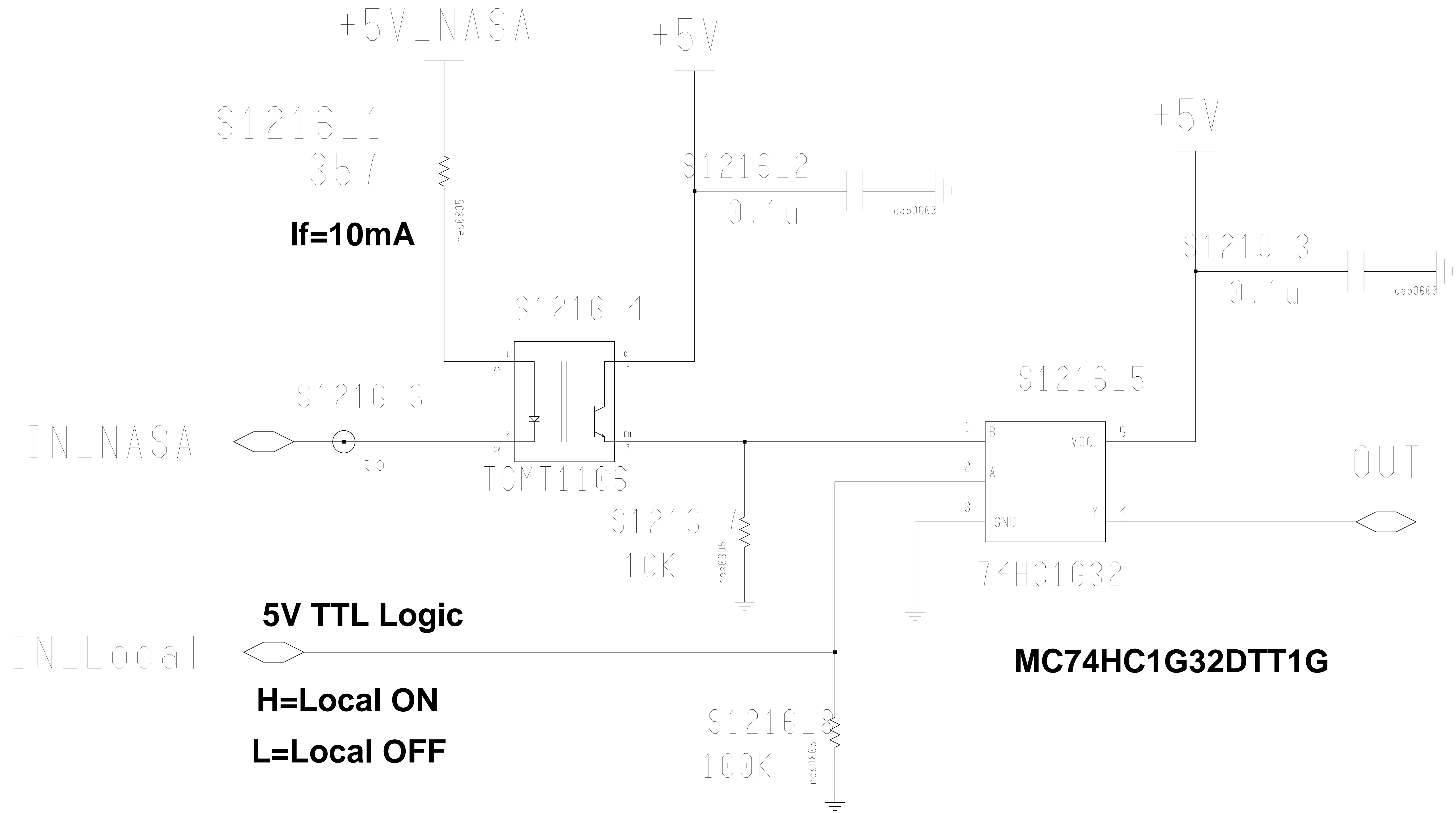
SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Isolated_OR _1		
Drawn by: M. Bogdan			
DATE: 3/26/2021			
REV. A	DRW. 2982	Sheet	12_14



SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Isolated_OR _1		
Drawn by: M. Bogdan			
DATE: 3/26/2021			
REV. A	DRW. 2982	Sheet	12_15



If=10mA

5V TTL Logic

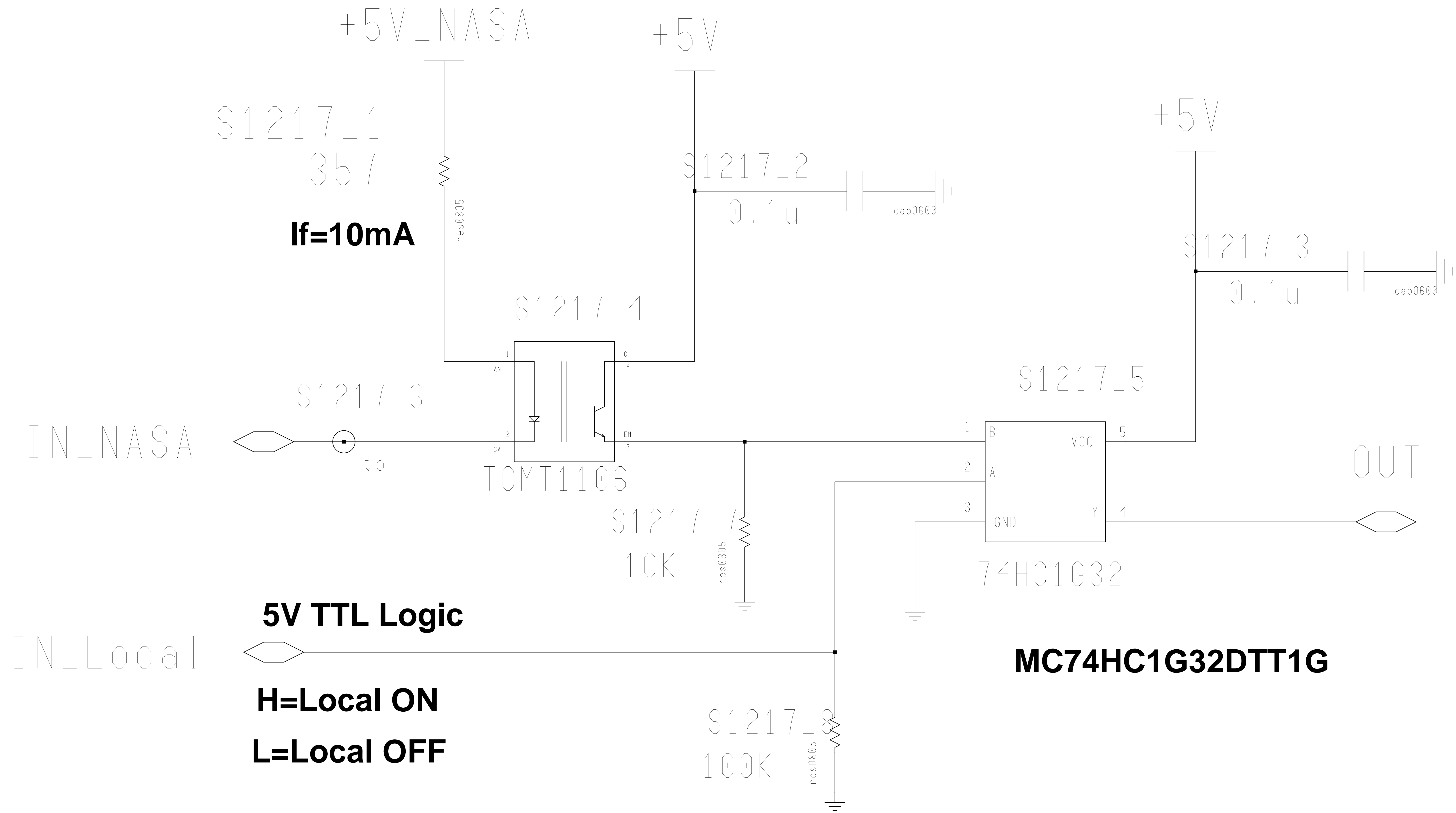
H=Local ON

L=Local OFF

MC74HC1G32DTT1G

SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Isolated_OR _1		
Drawn by: M. Bogdan			
DATE: 3/26/2021			
REV. A	DRW. 2982	Sheet	12_16



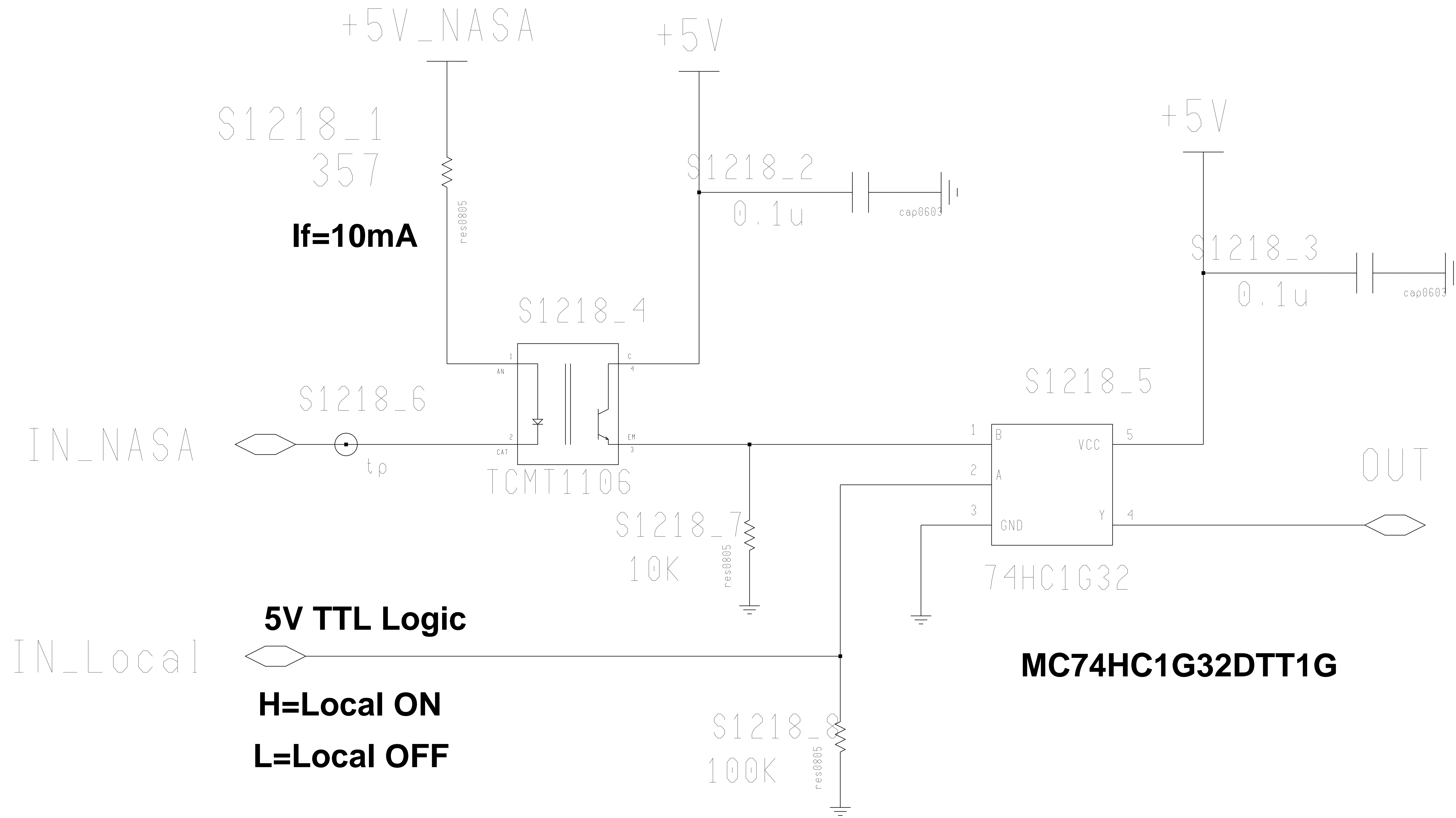
If=10mA

5V TTL Logic
H=Local ON
L=Local OFF

MC74HC1G32DTT1G

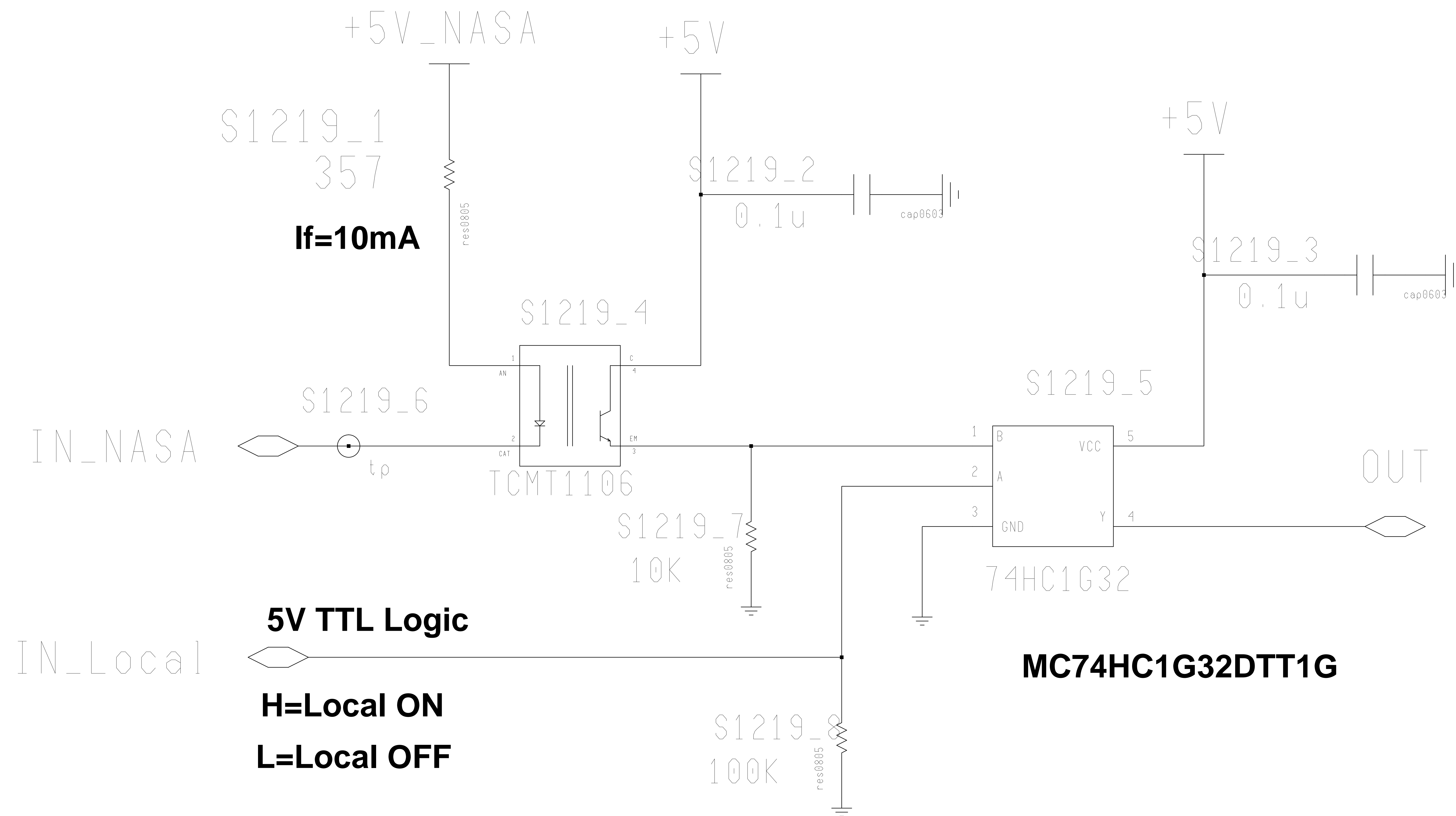
SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Isolated_OR _1		
Drawn by: M. Bogdan			
DATE: 3/26/2021			
REV. A	DRW. 2982	Sheet	12_17



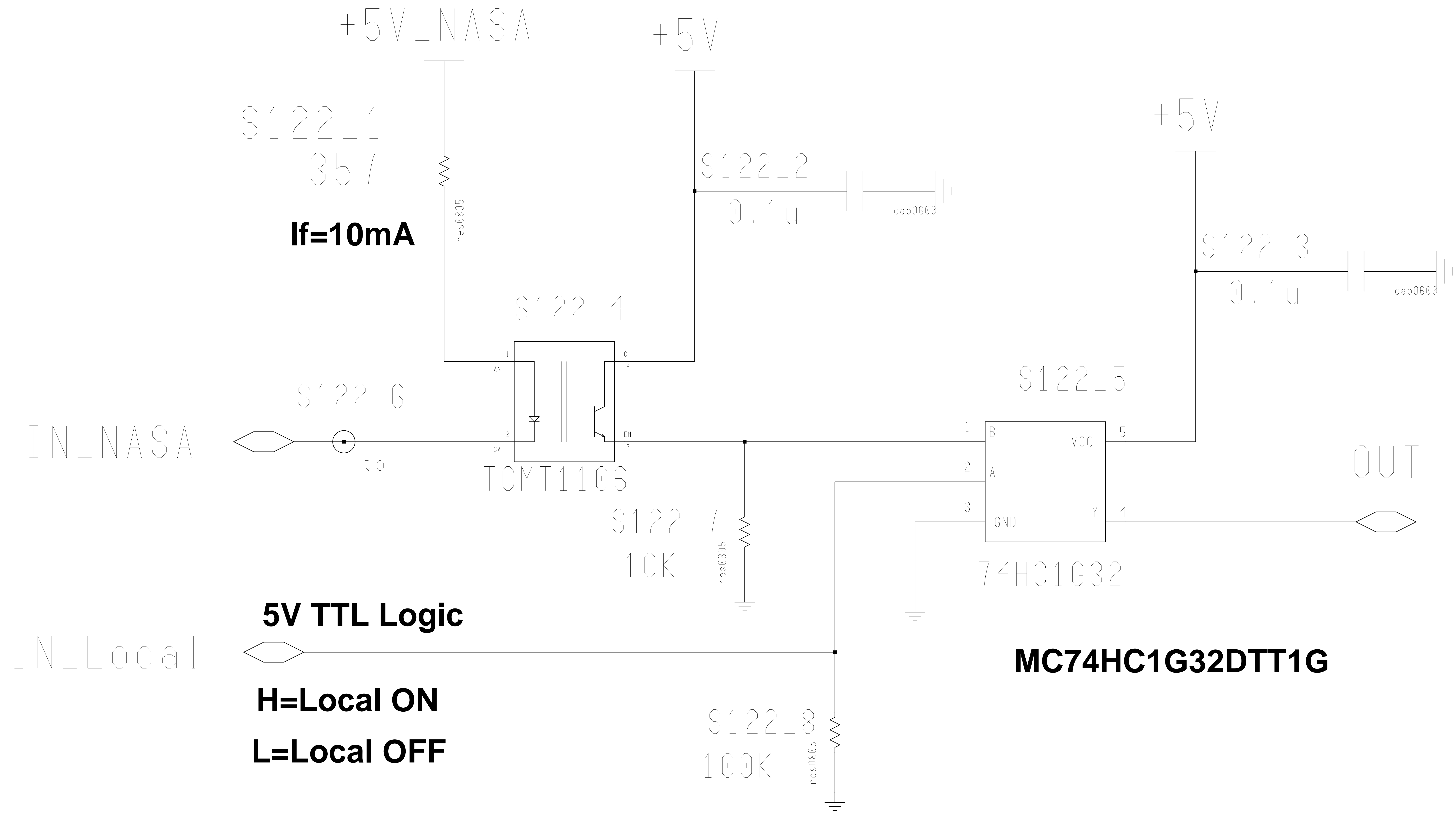
SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Isolated_OR _1		
Drawn by: M. Bogdan			
DATE: 3/26/2021			
REV. A	DRW. 2982	Sheet	12_18



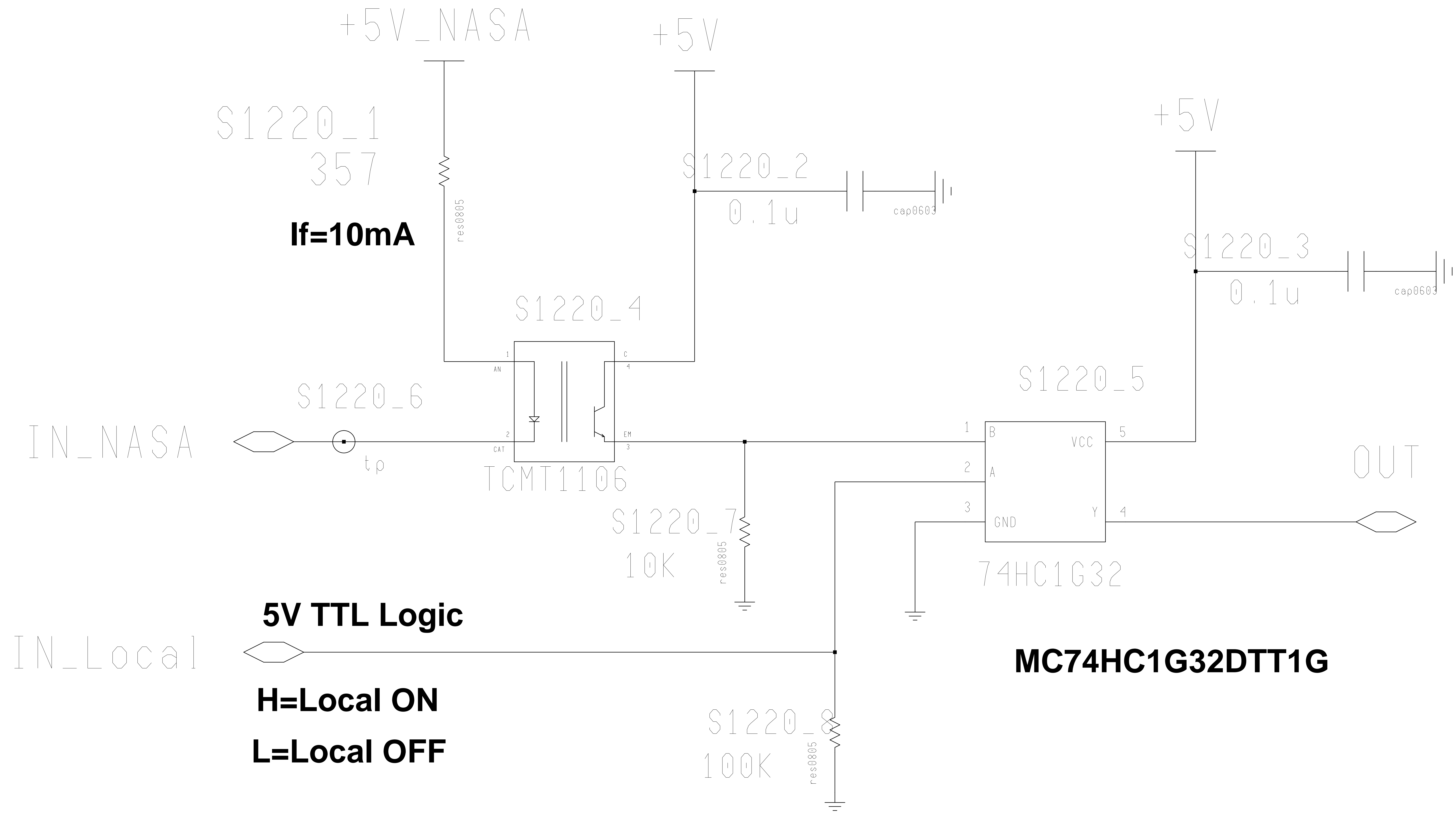
SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Isolated_OR _1		
Drawn by: M. Bogdan			
DATE: 3/26/2021			
REV. A	DRW. 2982	Sheet	12_19



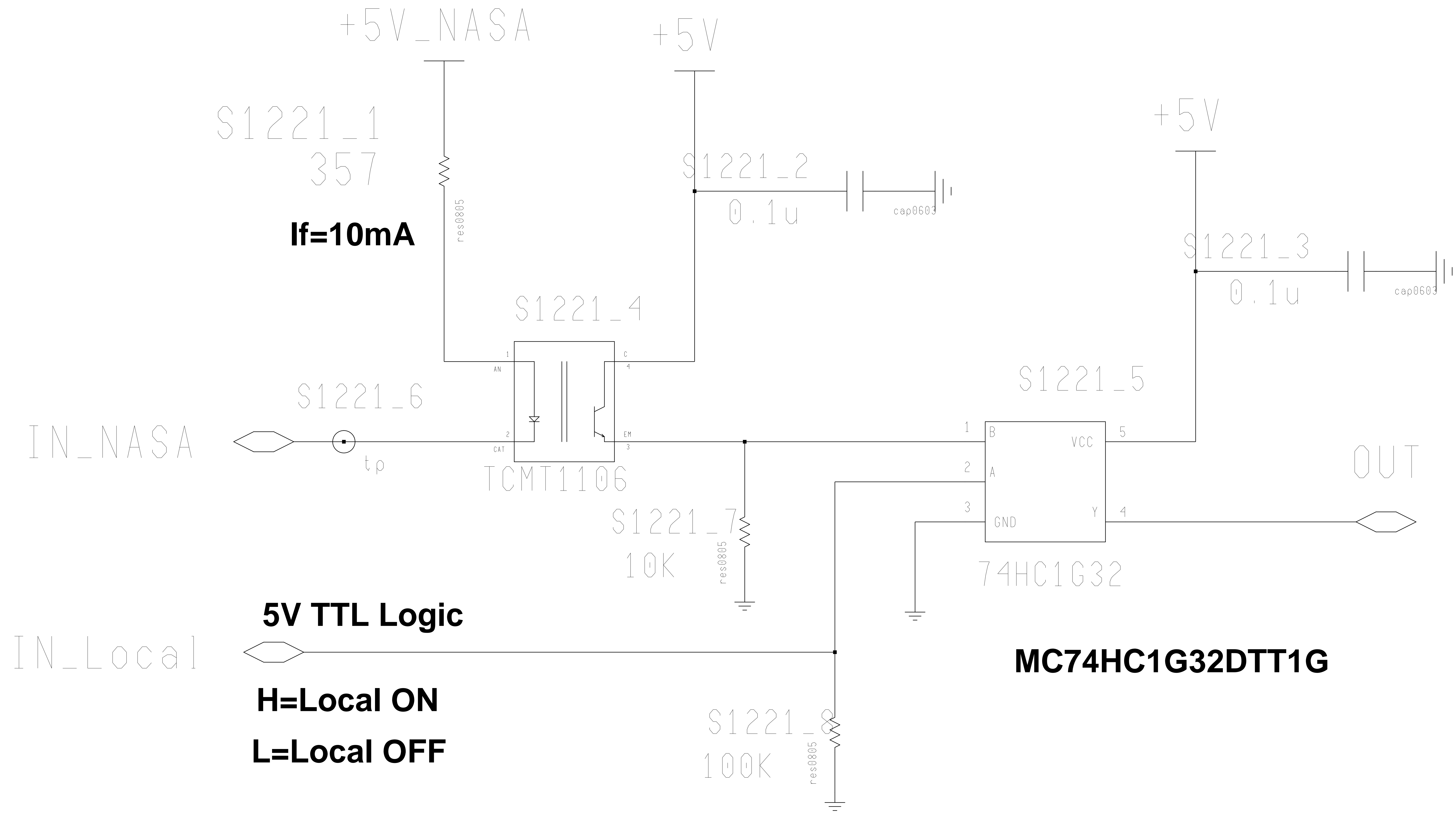
SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Isolated_OR _1		
Drawn by: M. Bogdan			
DATE: 3/26/2021			
REV. A	DRW. 2982	Sheet	12_2



SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Isolated_OR _1		
Drawn by: M. Bogdan			
DATE: 3/26/2021			
REV. A	DRW. 2982	Sheet	12_20



IN_NASA

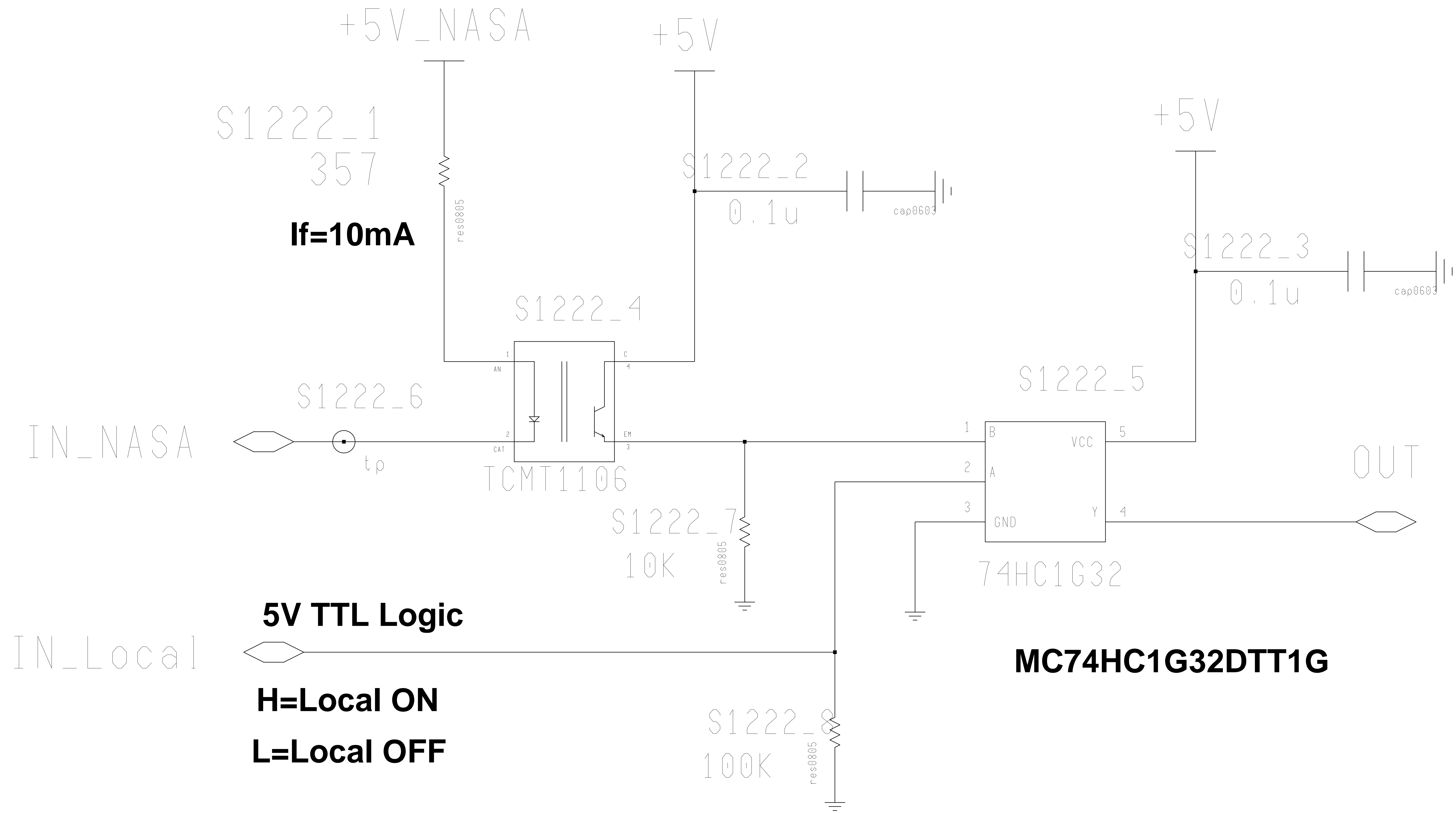
IN_Local

5V TTL Logic
H=Local ON
L=Local OFF

MC74HC1G32DTT1G

SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Isolated_OR _1		
Drawn by: M. Bogdan			
DATE: 3/26/2021			
REV. A	DRW. 2982	Sheet	12_21



If=10mA

5V TTL Logic

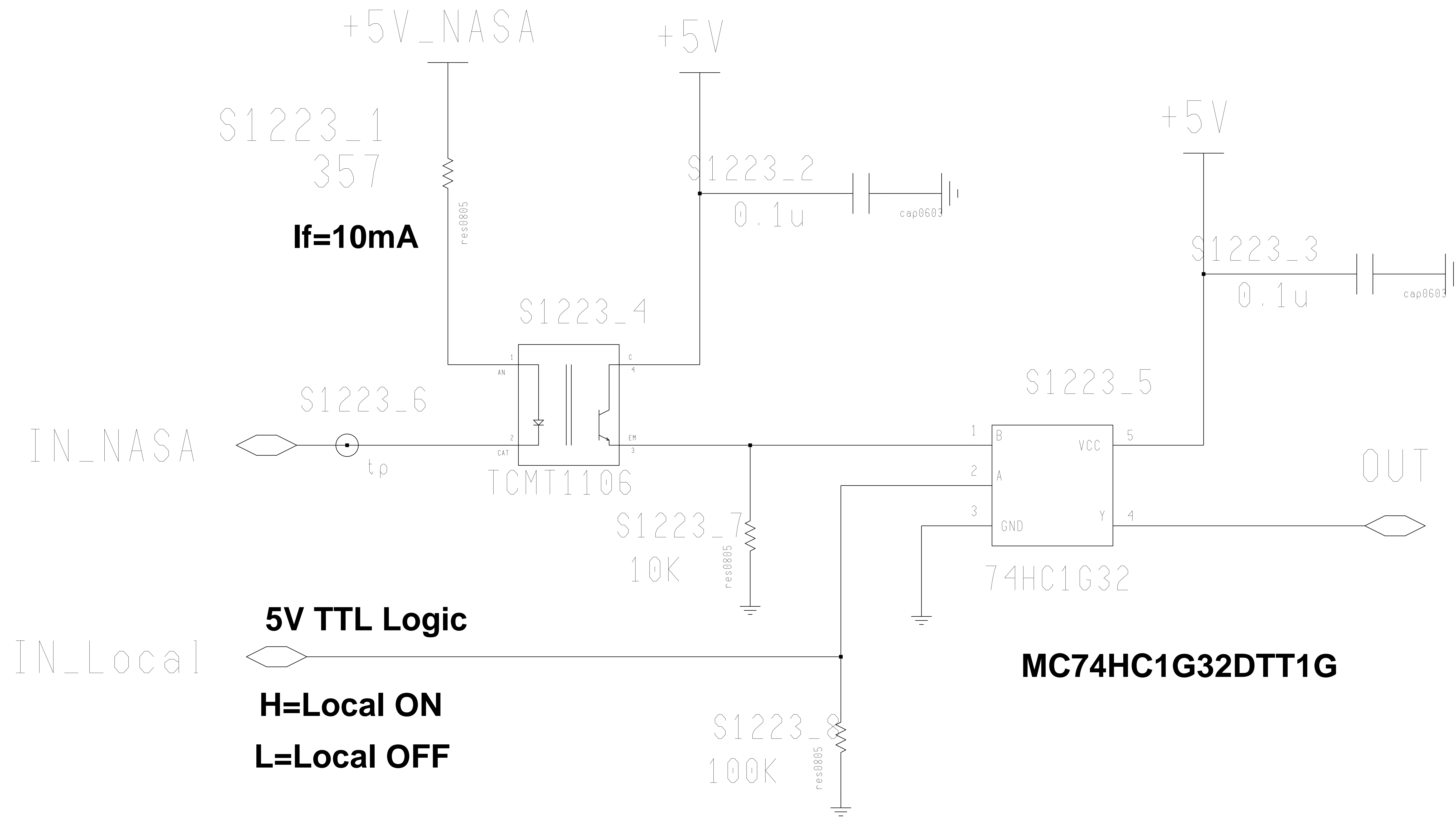
H=Local ON

L=Local OFF

MC74HC1G32DTT1G

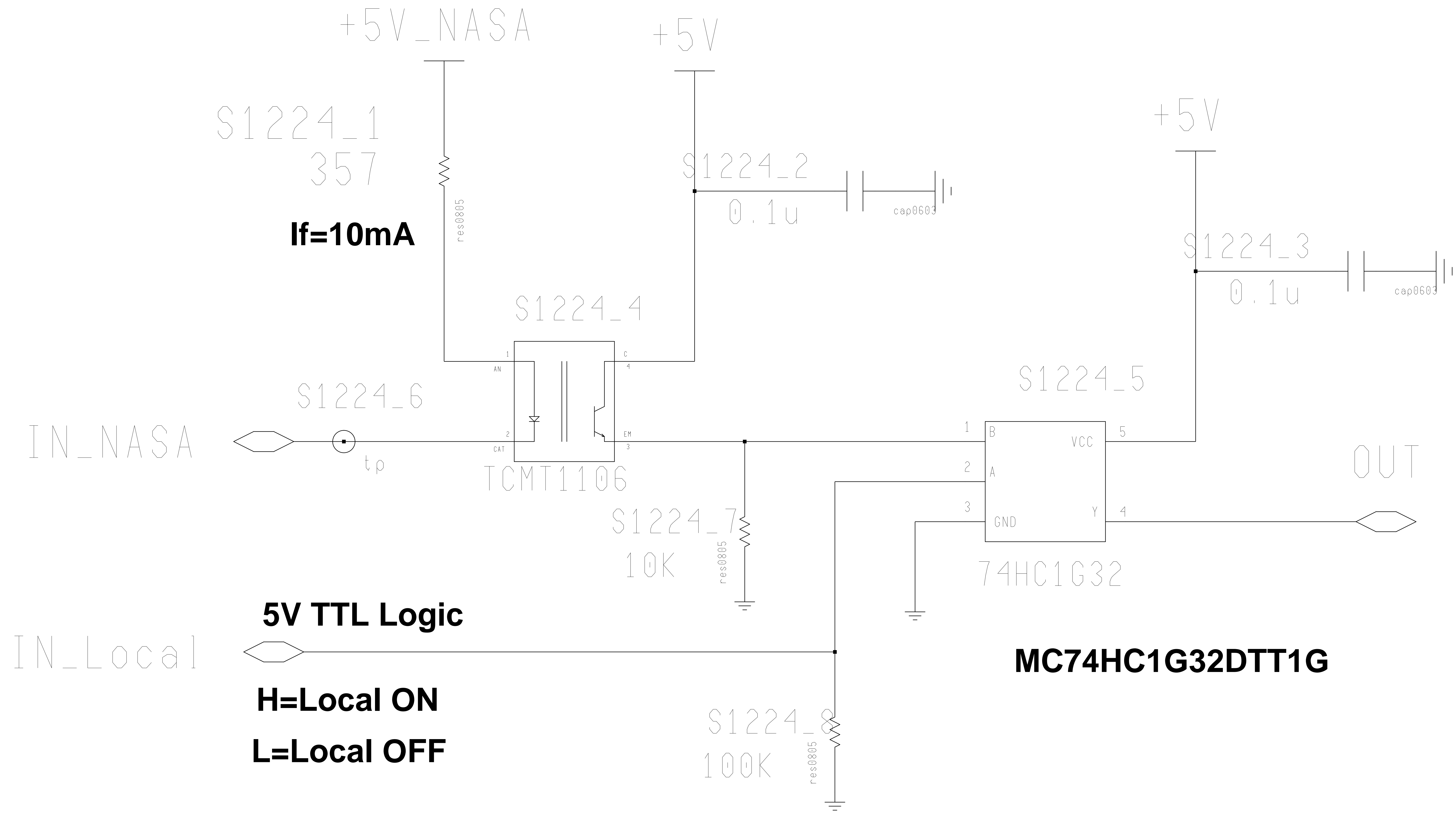
SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Isolated_OR _1		
Drawn by: M. Bogdan			
DATE: 3/26/2021			
REV. A	DRW. 2982	Sheet	12_22



SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Isolated_OR _1		
Drawn by: M. Bogdan			
DATE: 3/26/2021			
REV. A	DRW. 2982	Sheet	12_23



If=10mA

5V TTL Logic

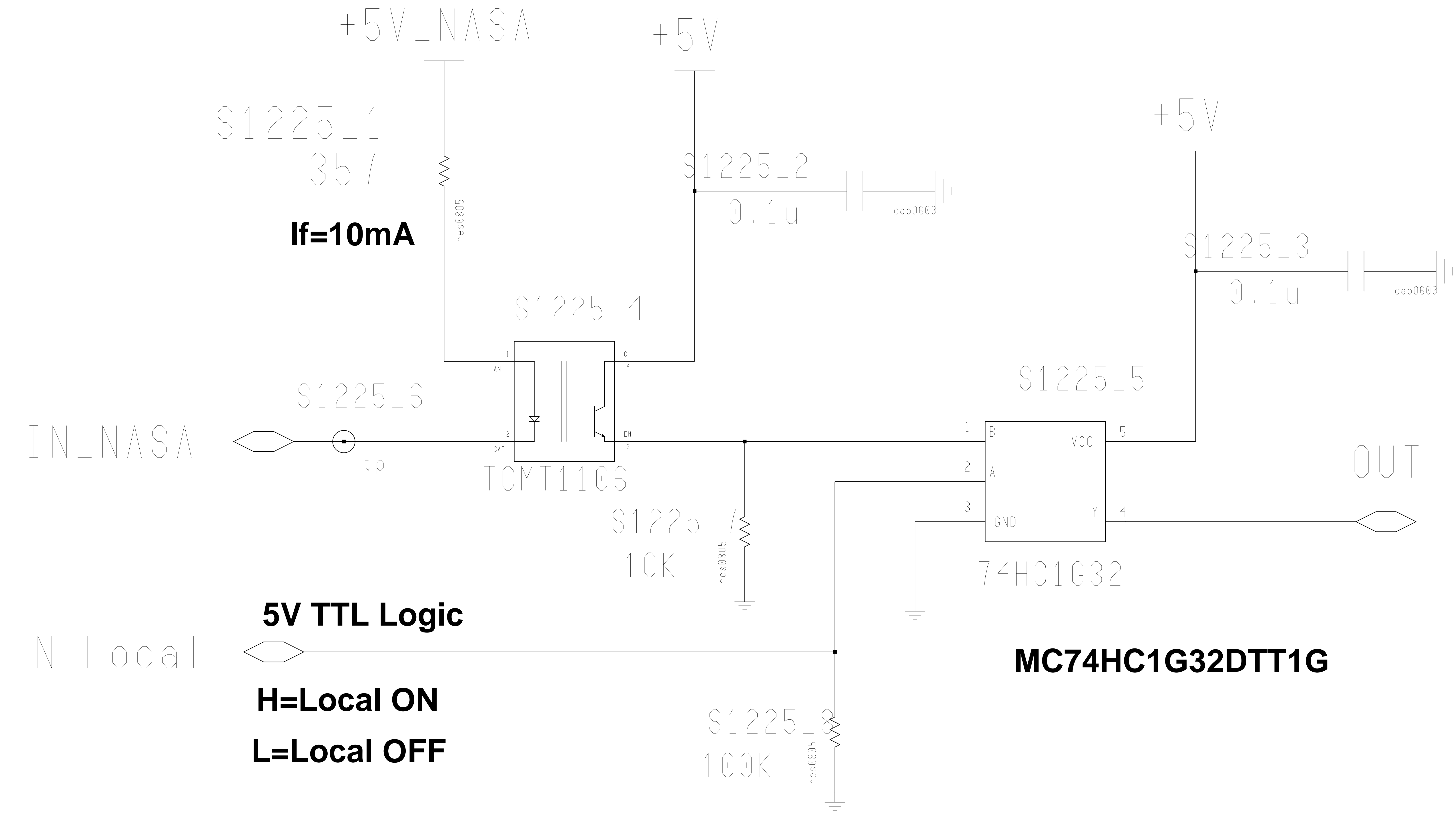
H=Local ON

L=Local OFF

MC74HC1G32DTT1G

SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Isolated_OR _1		
Drawn by: M. Bogdan			
DATE: 3/26/2021			
REV. A	DRW. 2982	Sheet	12_24



If=10mA

5V TTL Logic

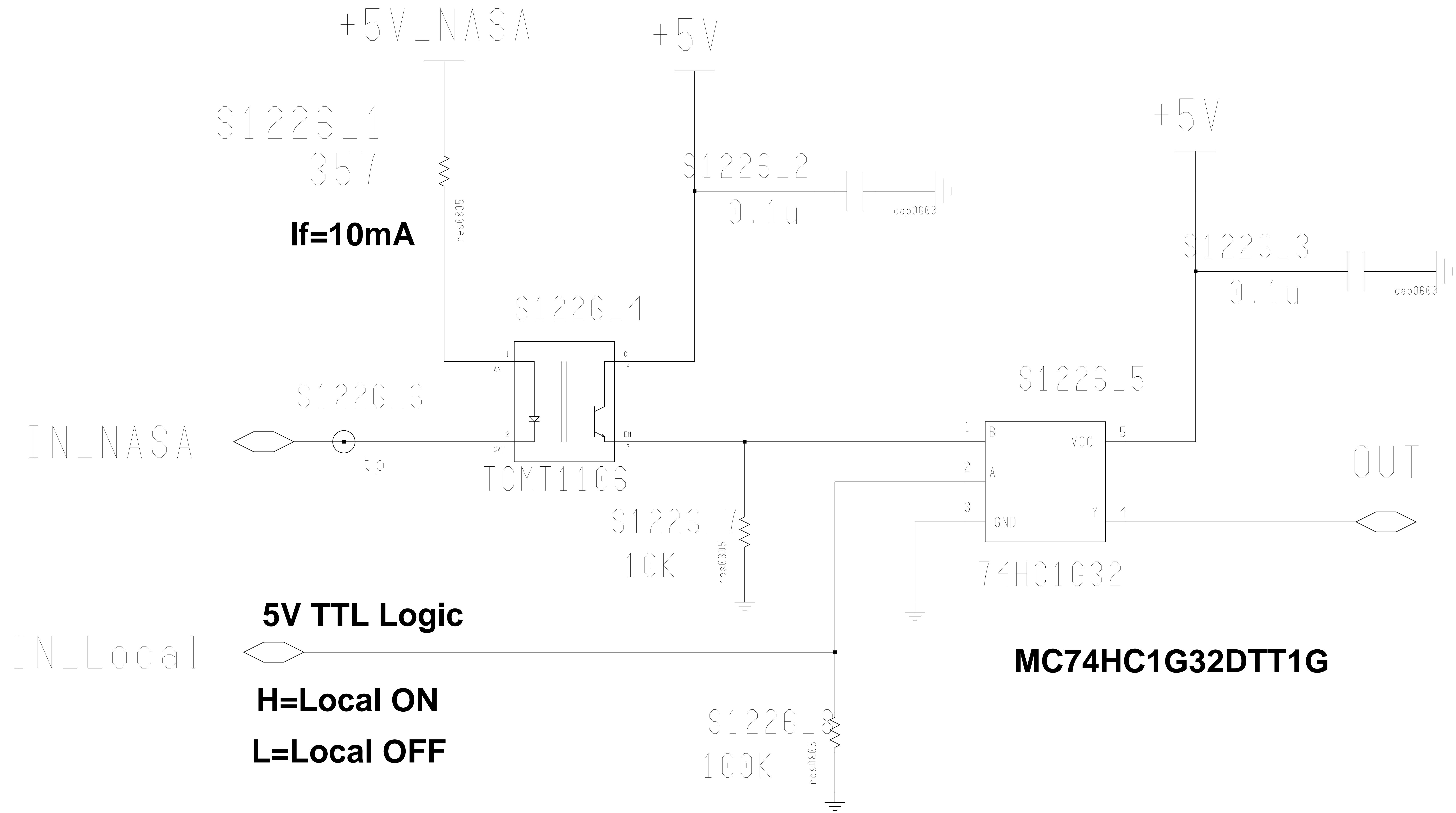
H=Local ON

L=Local OFF

MC74HC1G32DTT1G

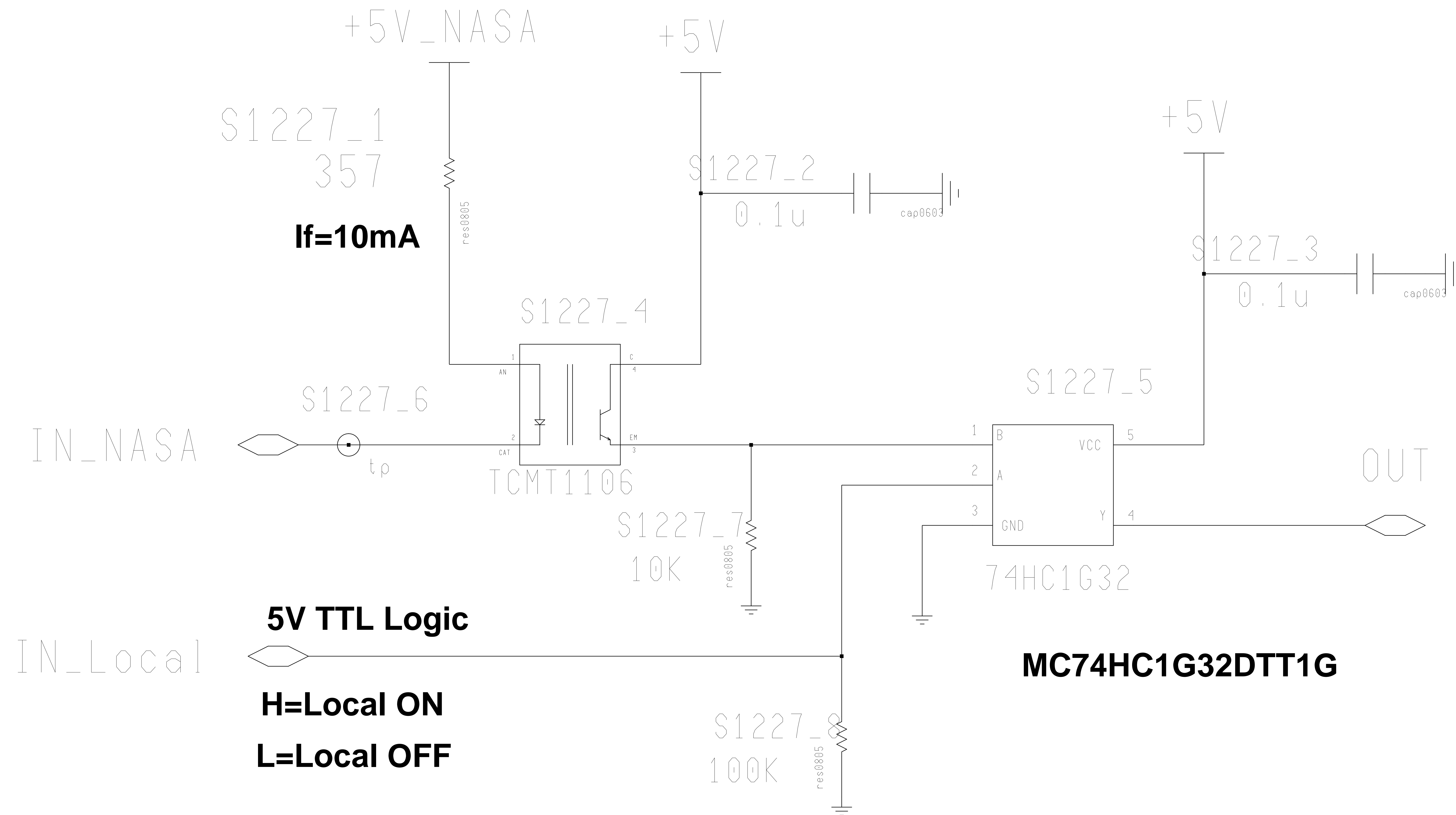
SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Isolated_OR _1		
Drawn by: M. Bogdan			
DATE: 3/26/2021			
REV. A	DRW. 2982	Sheet	12_25



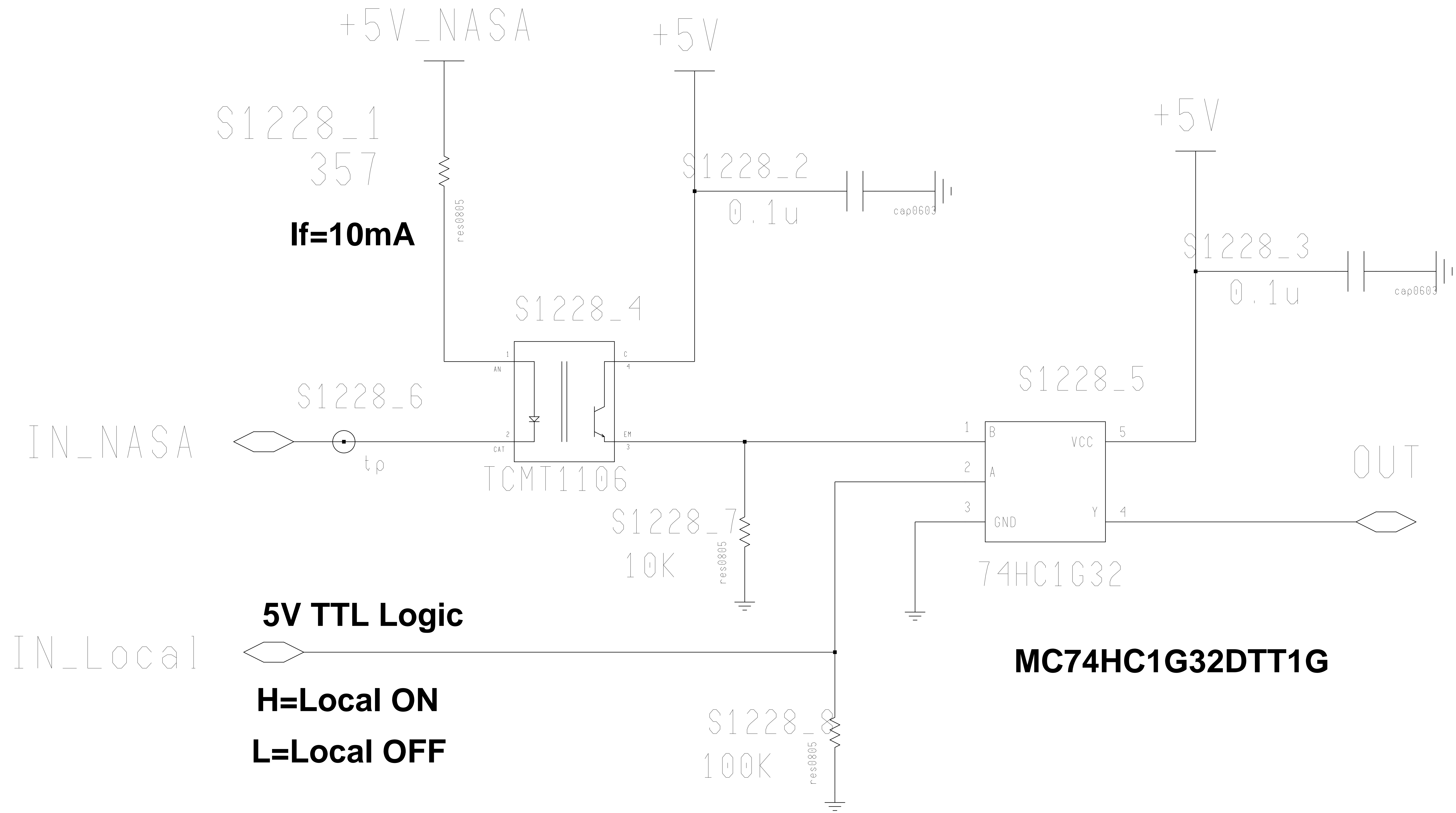
SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Isolated_OR _1		
Drawn by: M. Bogdan			
DATE: 3/26/2021			
REV. A	DRW. 2982	Sheet	12_26



SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Isolated_OR _1		
Drawn by: M. Bogdan			
DATE: 3/26/2021			
REV. A	DRW. 2982	Sheet	12_27



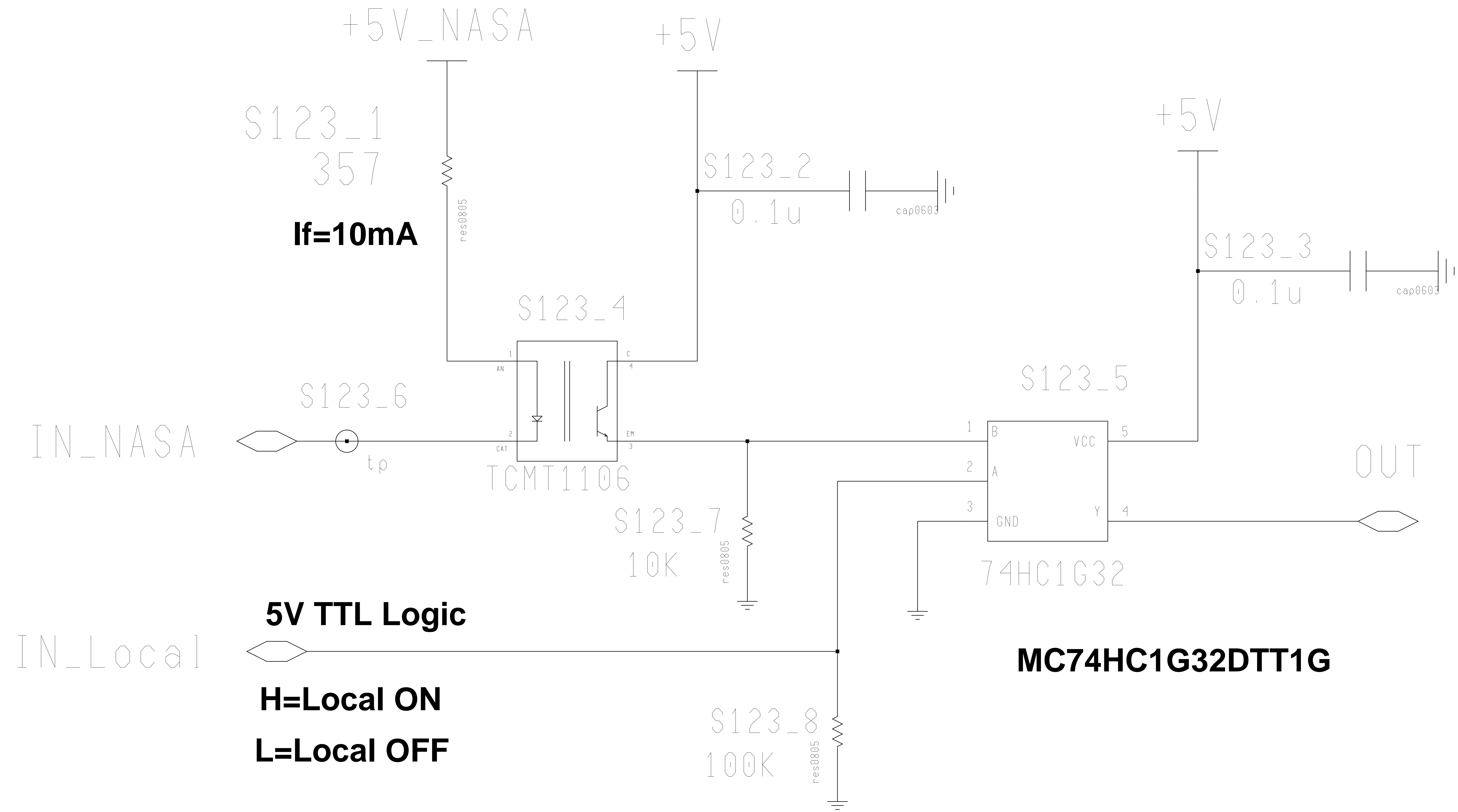
If=10mA

5V TTL Logic
H=Local ON
L=Local OFF

MC74HC1G32DTT1G

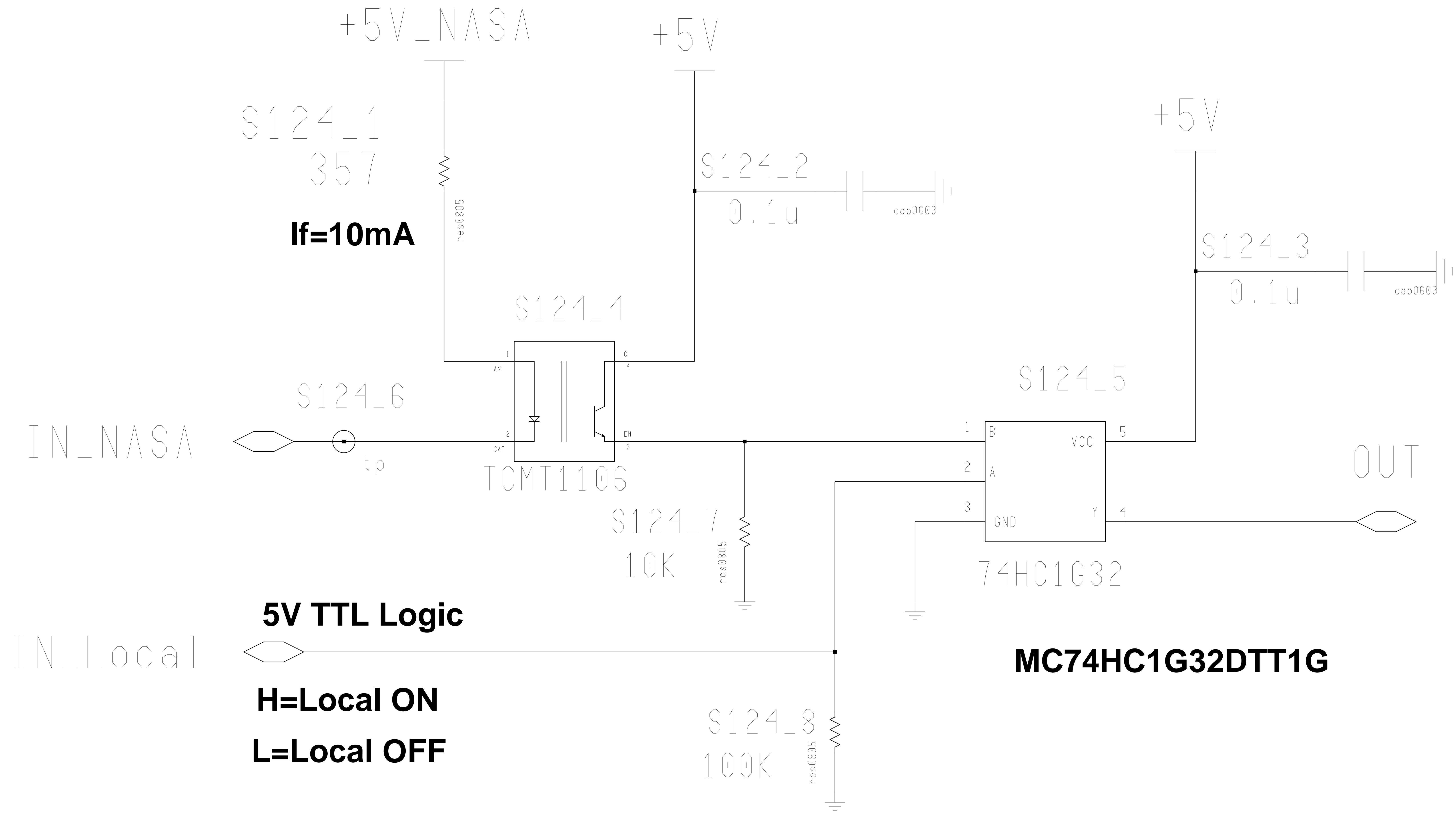
SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Isolated_OR _1		
Drawn by: M. Bogdan			
DATE: 3/26/2021			
REV. A	DRW. 2982	Sheet	12_28



SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Isolated_OR _1		
Drawn by: M. Bogdan			
DATE: 3/26/2021			
REV. A	DRW. 2982	Sheet	12_3



If=10mA

5V TTL Logic

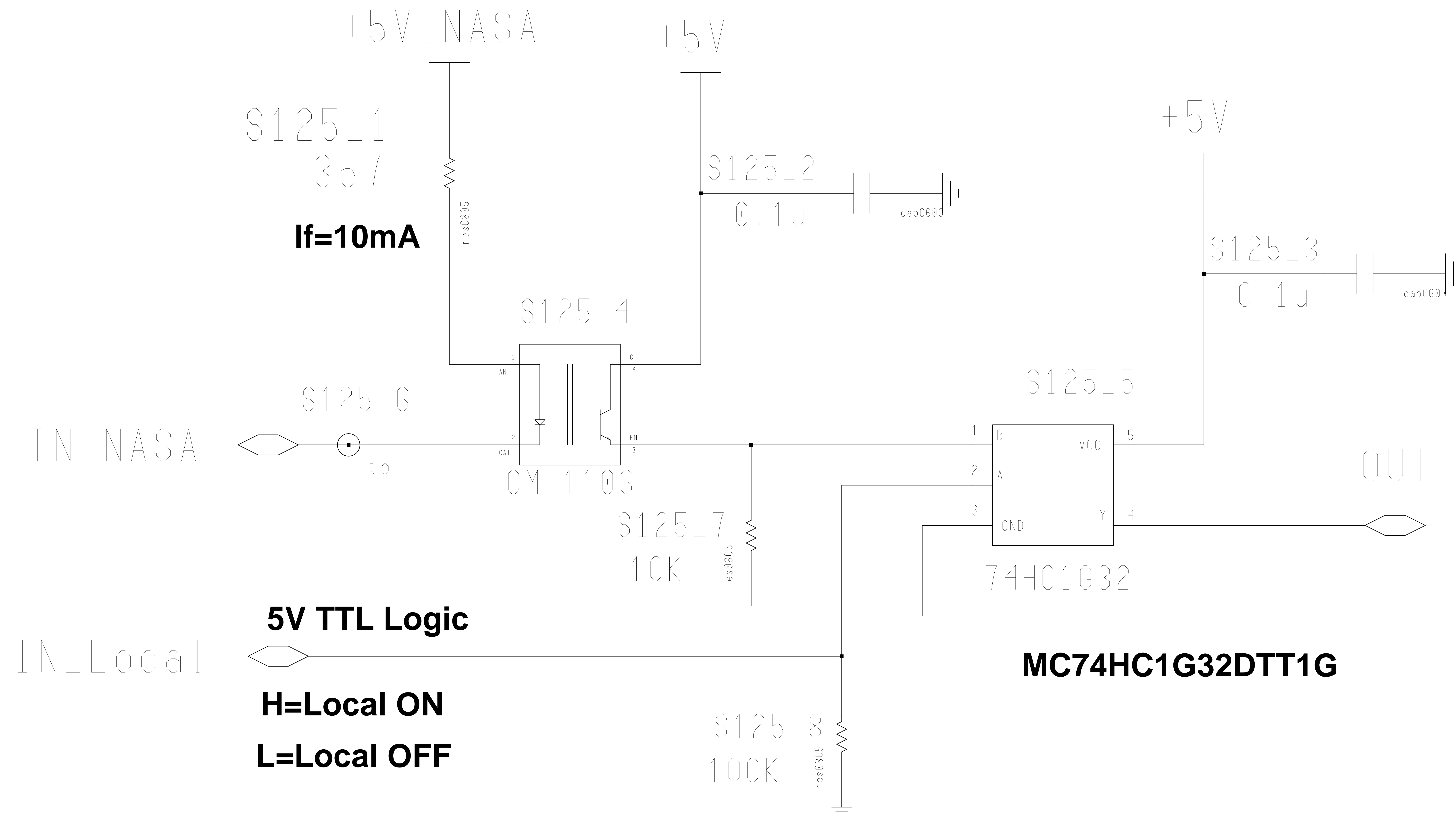
H=Local ON

L=Local OFF

MC74HC1G32DTT1G

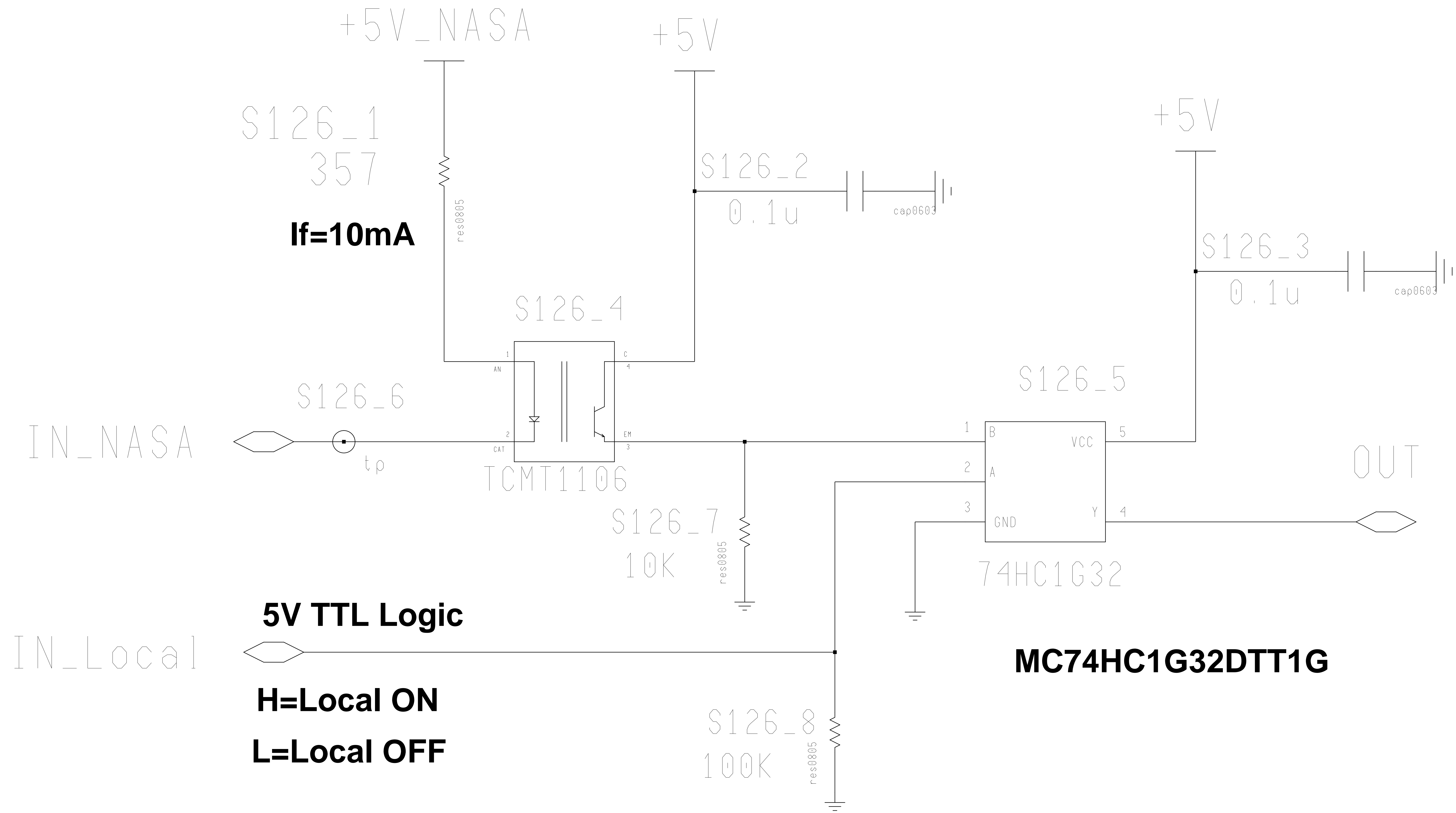
SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Isolated_OR _1		
Drawn by: M. Bogdan			
DATE: 3/26/2021			
REV. A	DRW. 2982	Sheet	12_4



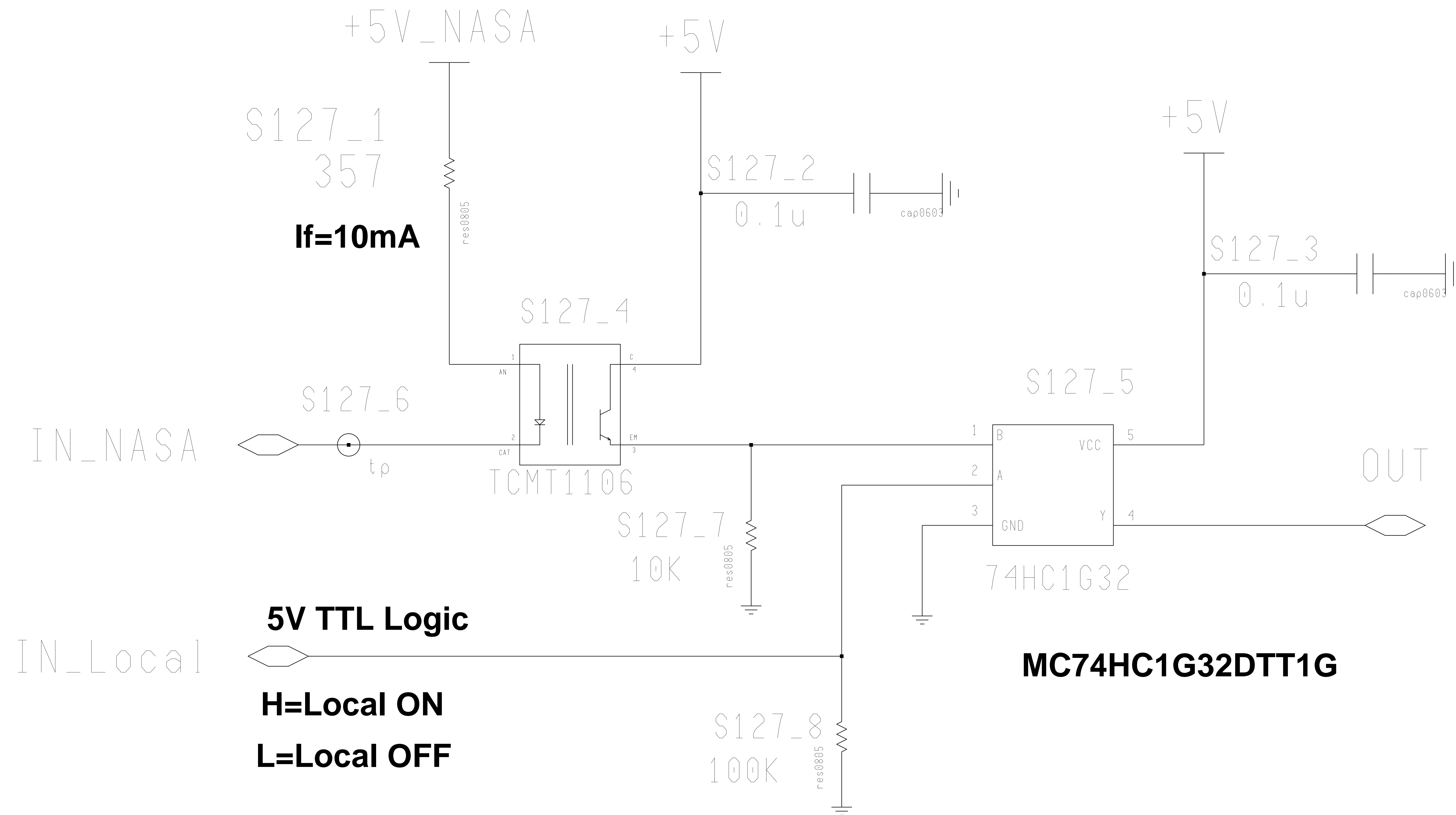
SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Isolated_OR _1		
Drawn by: M. Bogdan			
DATE: 3/26/2021			
REV. A	DRW. 2982	Sheet	12_5



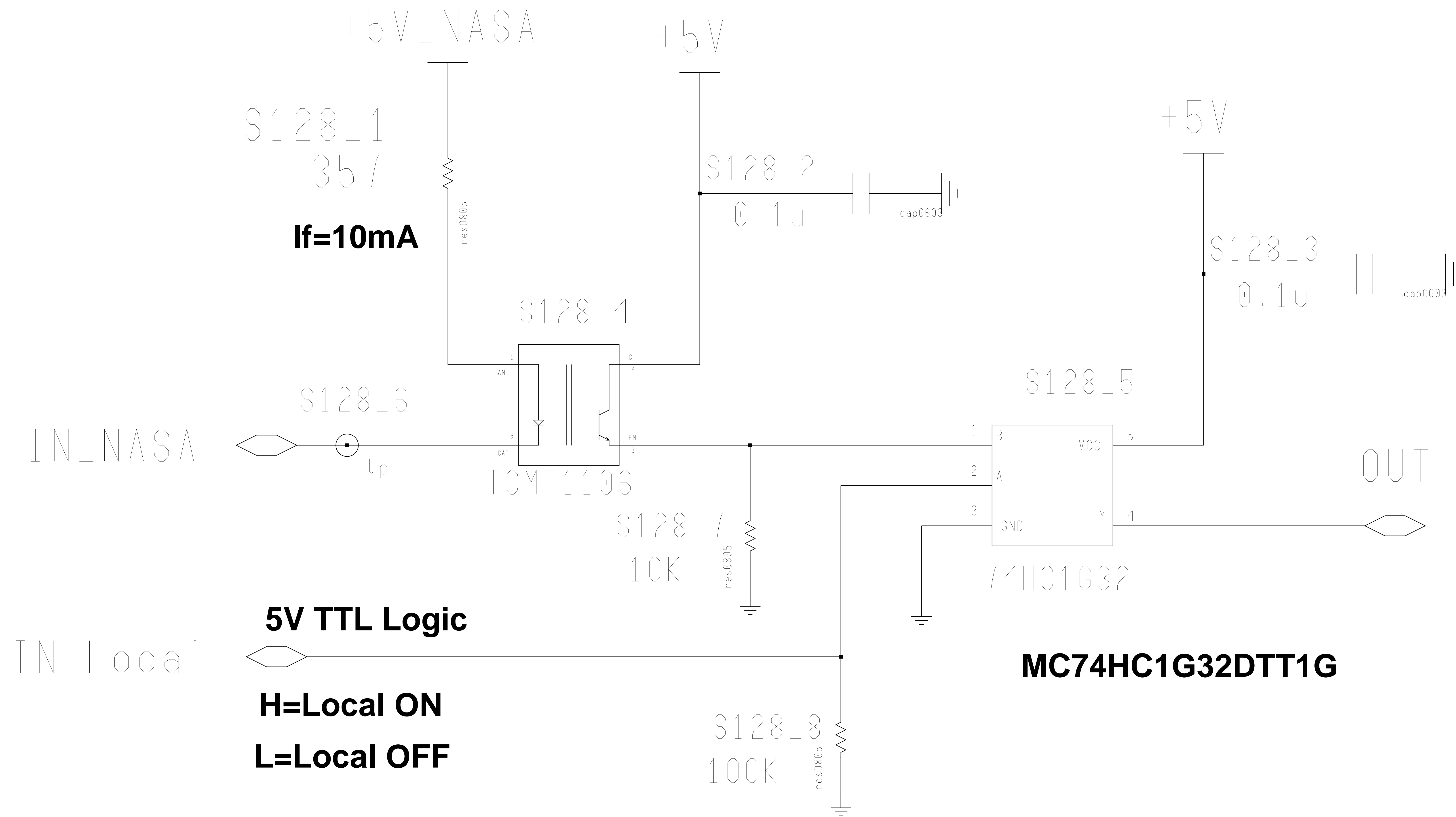
SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Isolated_OR _1		
Drawn by: M. Bogdan			
DATE: 3/26/2021			
REV. A	DRW. 2982	Sheet	12_6



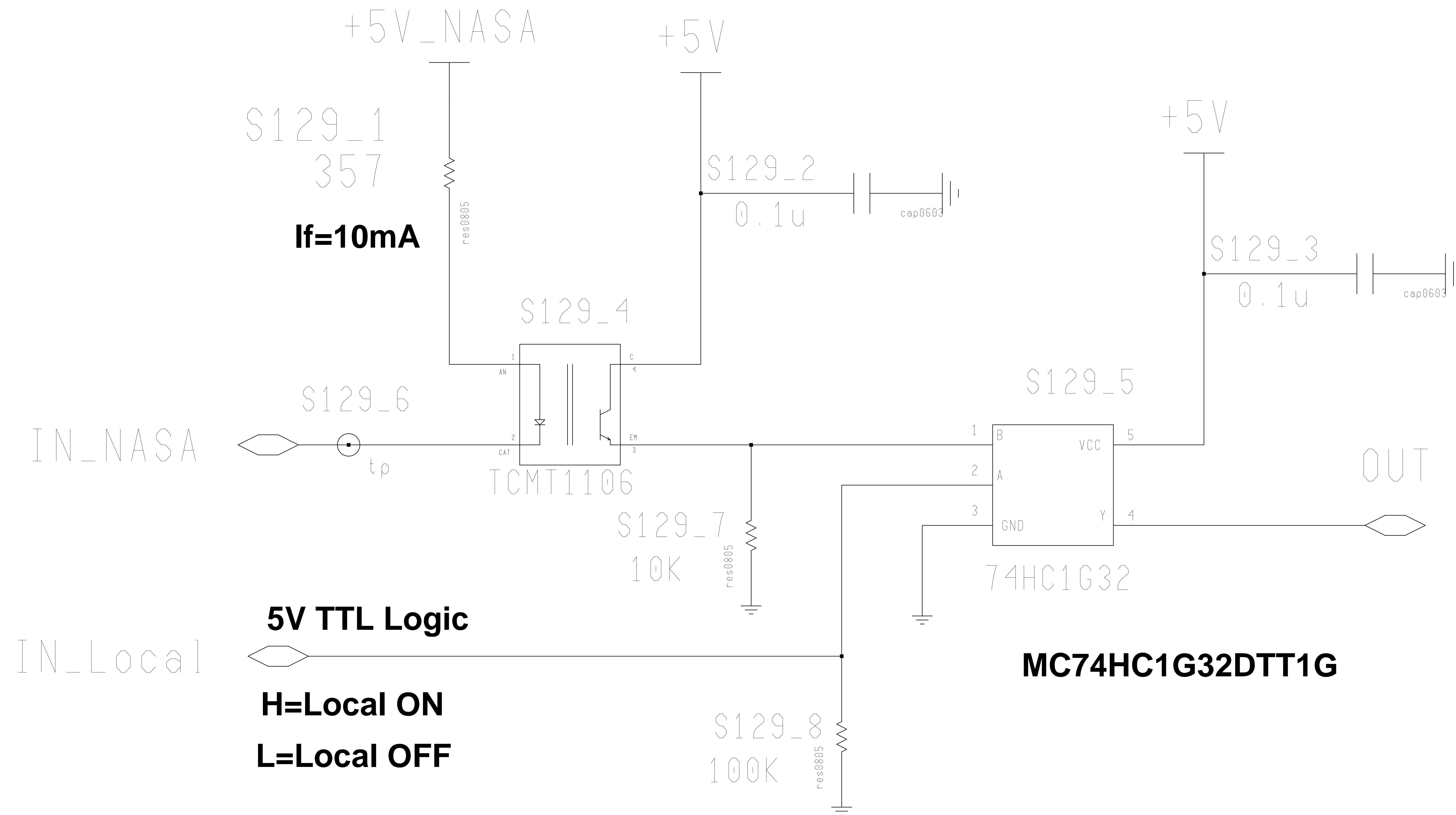
SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Isolated_OR _1		
Drawn by: M. Bogdan			
DATE: 3/26/2021			
REV. A	DRW. 2982	Sheet	12_7



SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Isolated_OR _1		
Drawn by: M. Bogdan			
DATE: 3/26/2021			
REV. A	DRW. 2982	Sheet	12_8

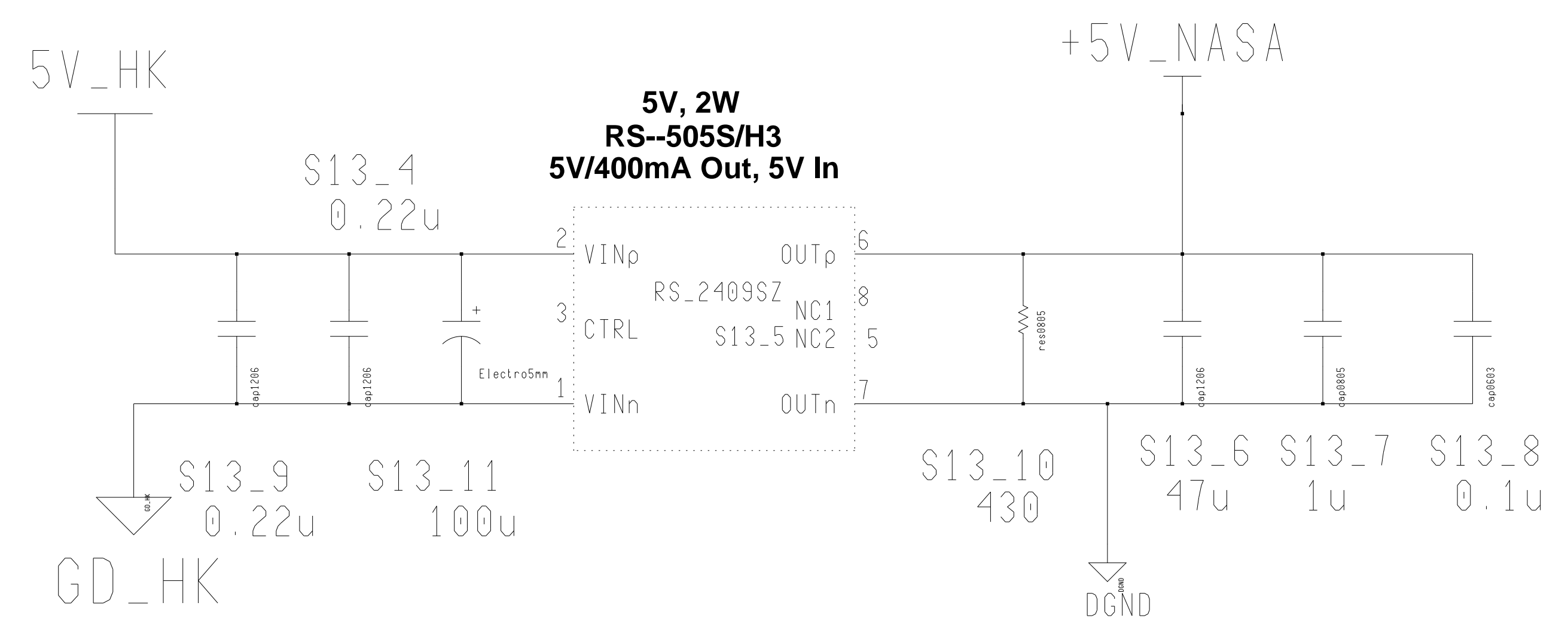
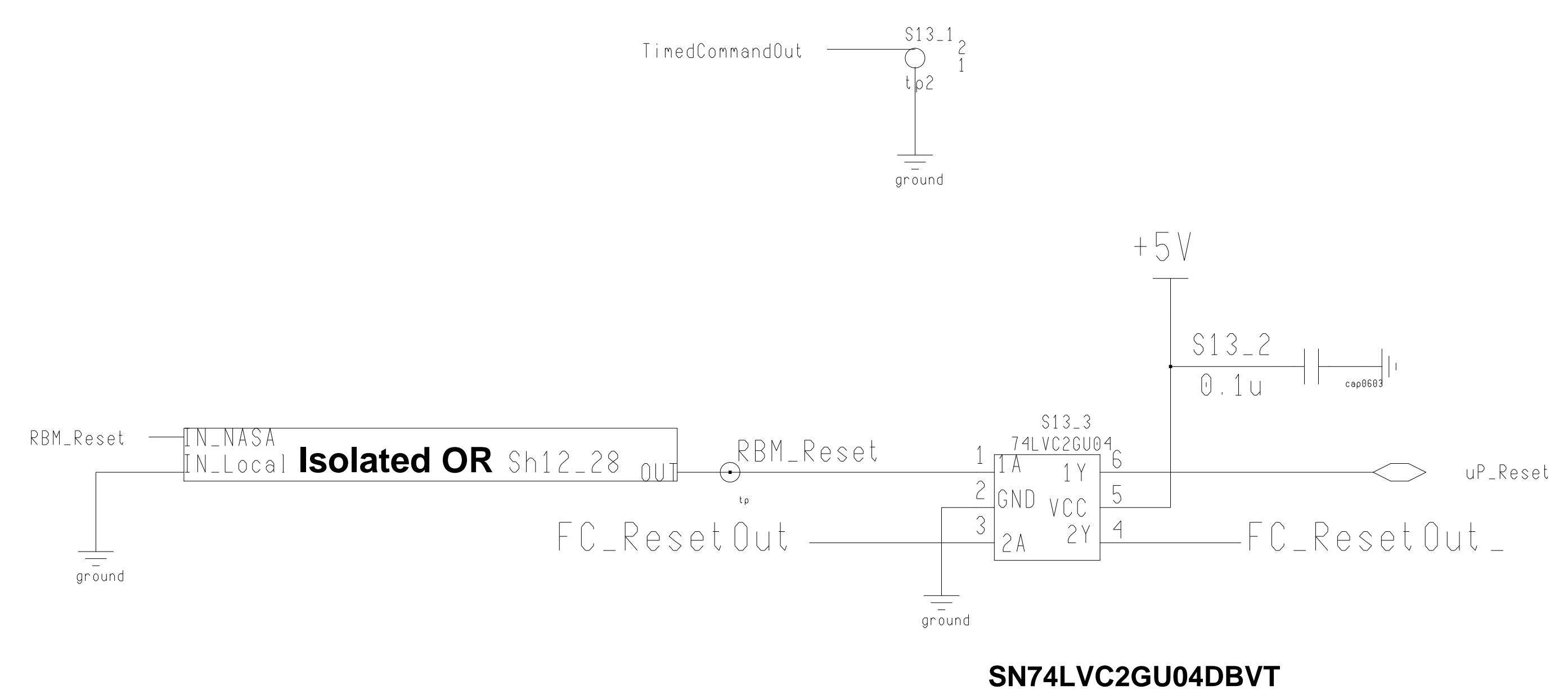
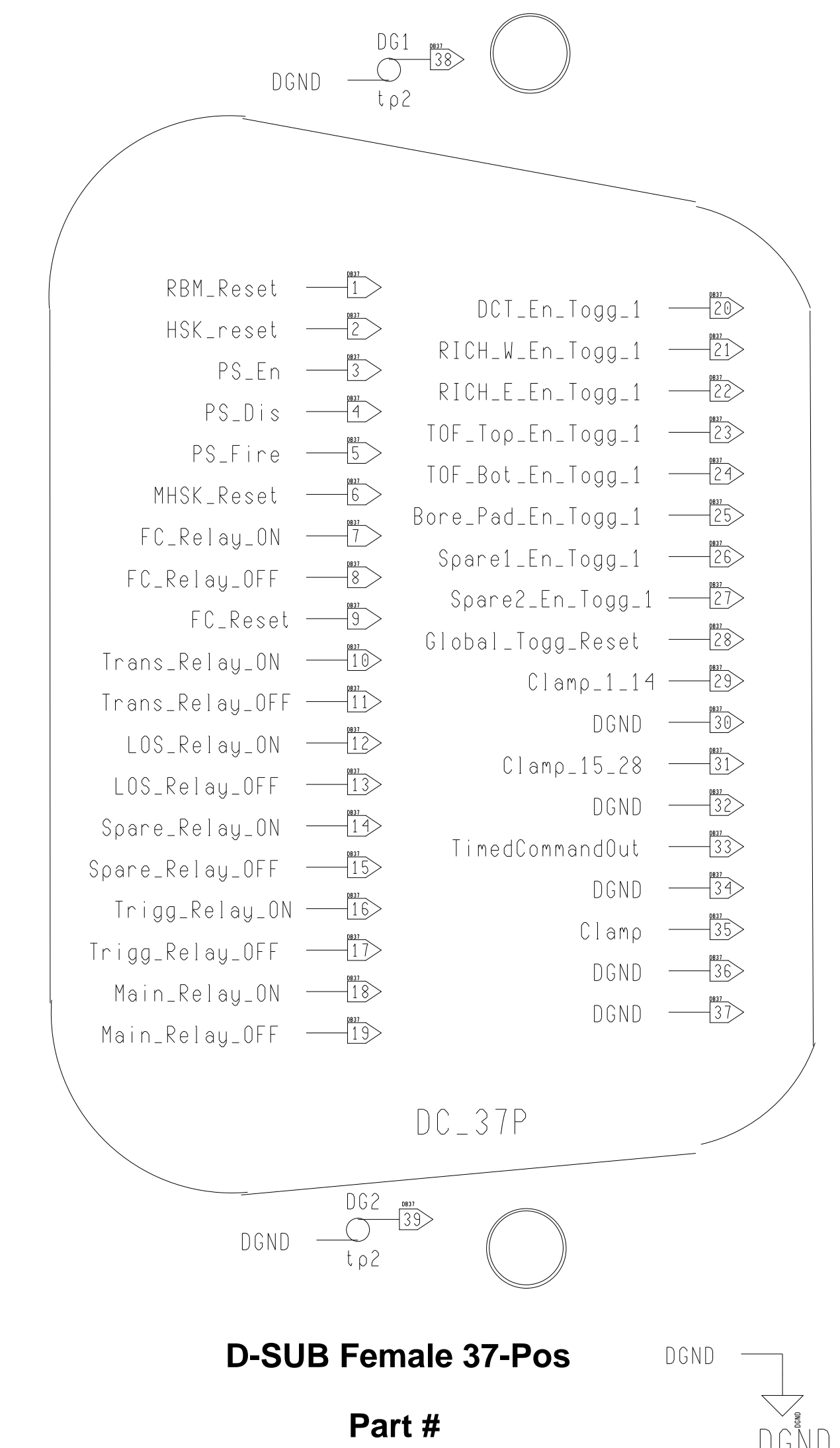
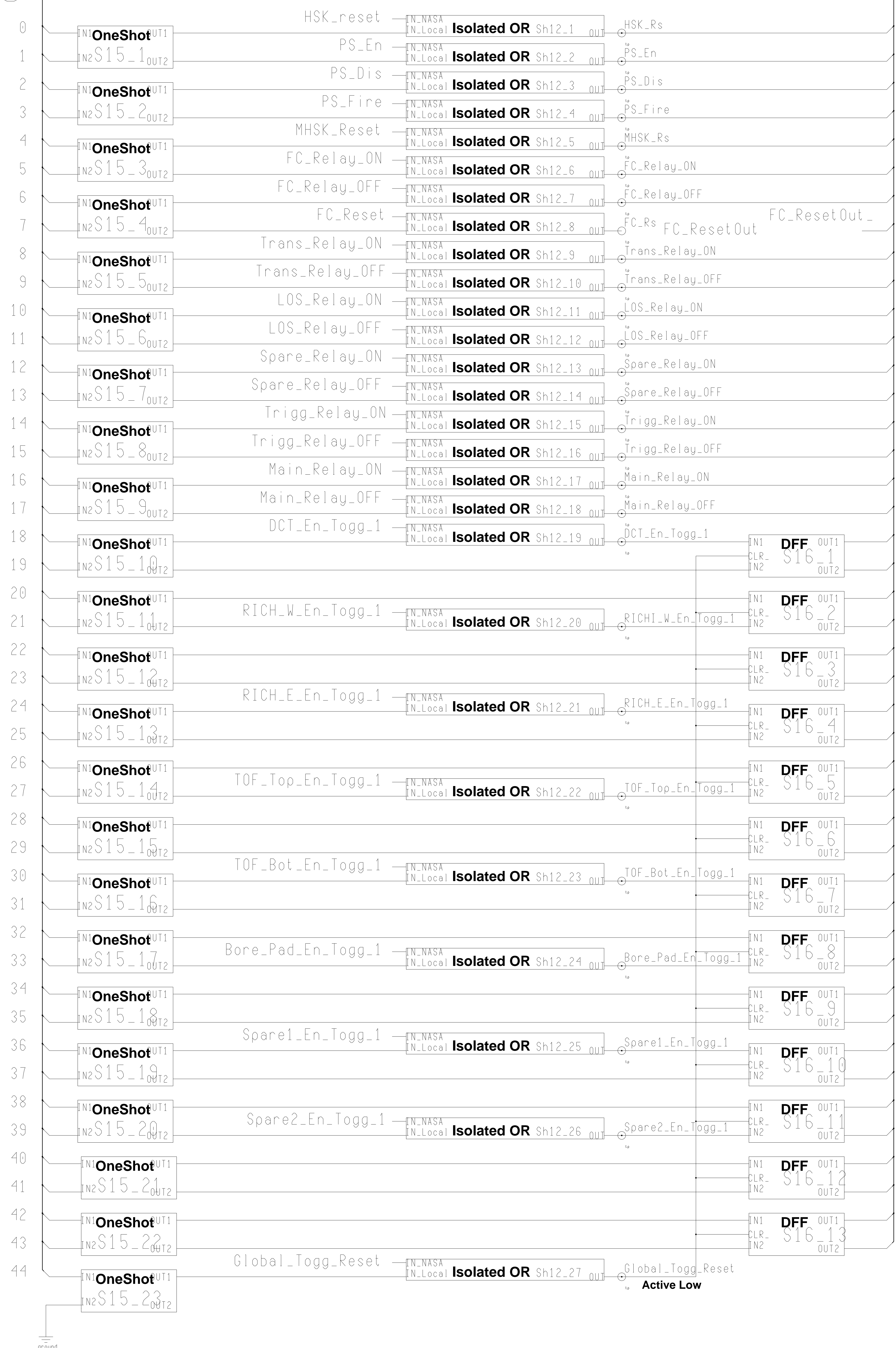


SCH-2982
SPC-2983
ASM-2984

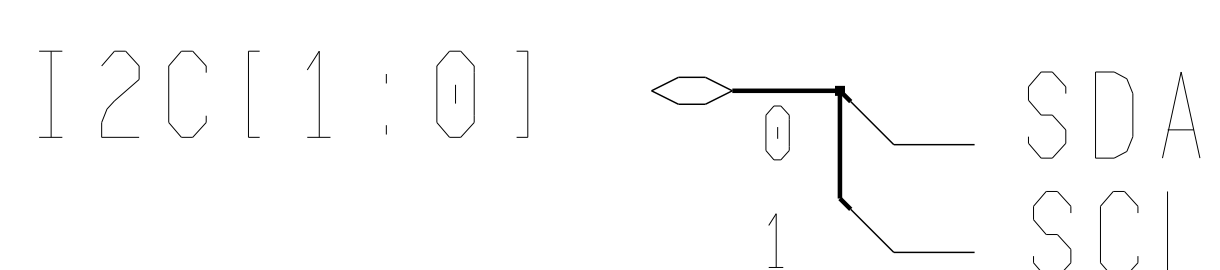
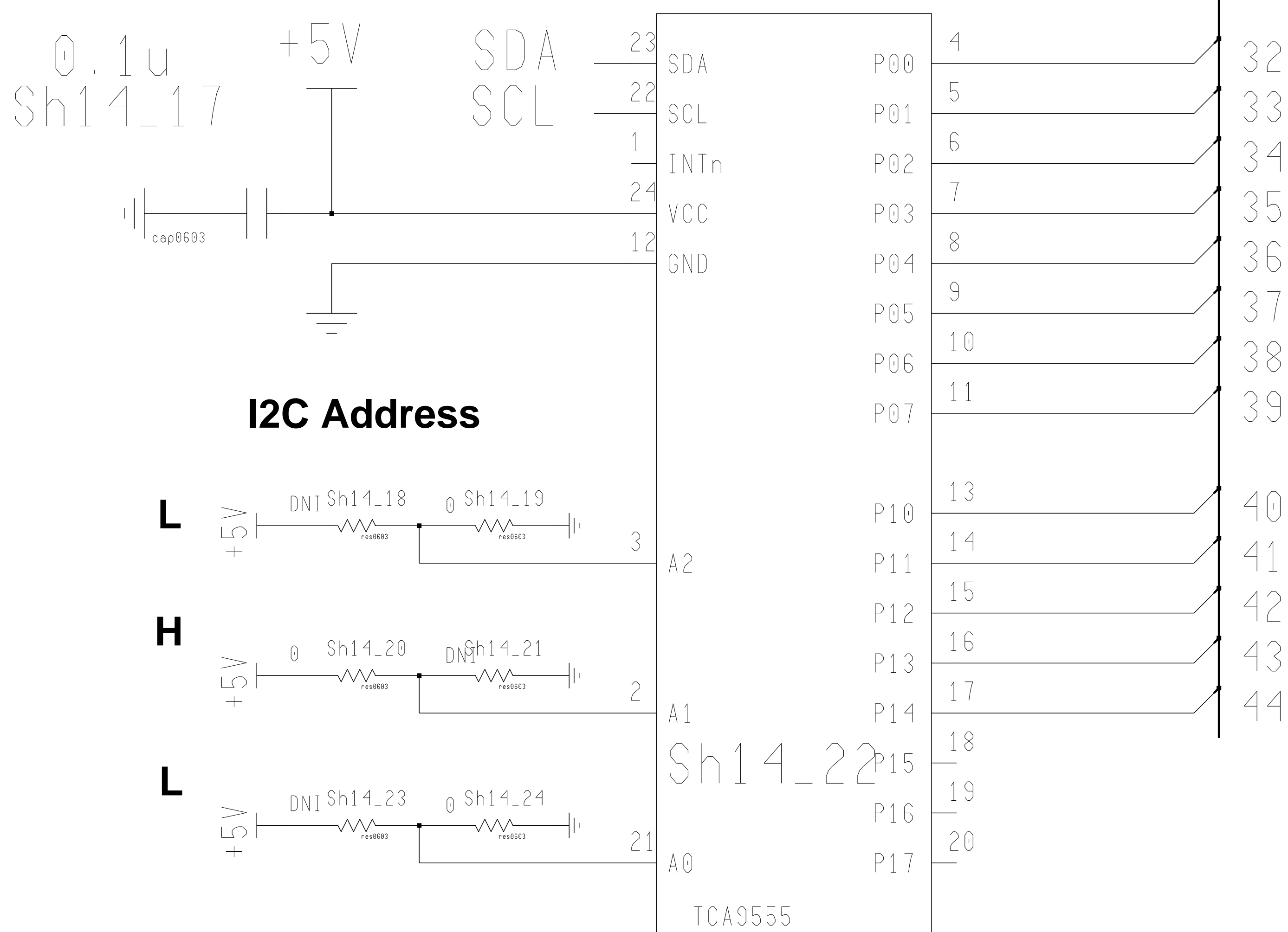
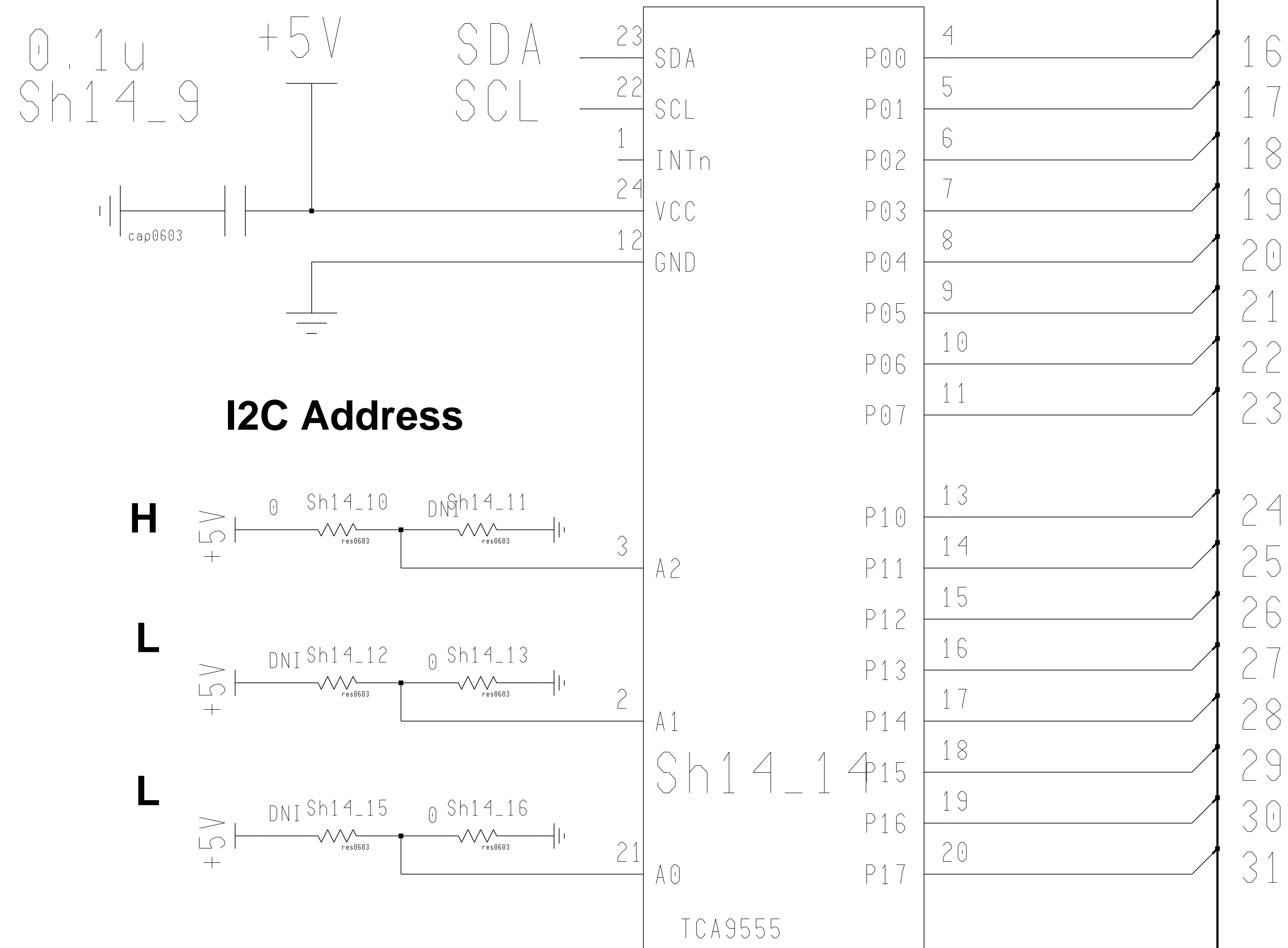
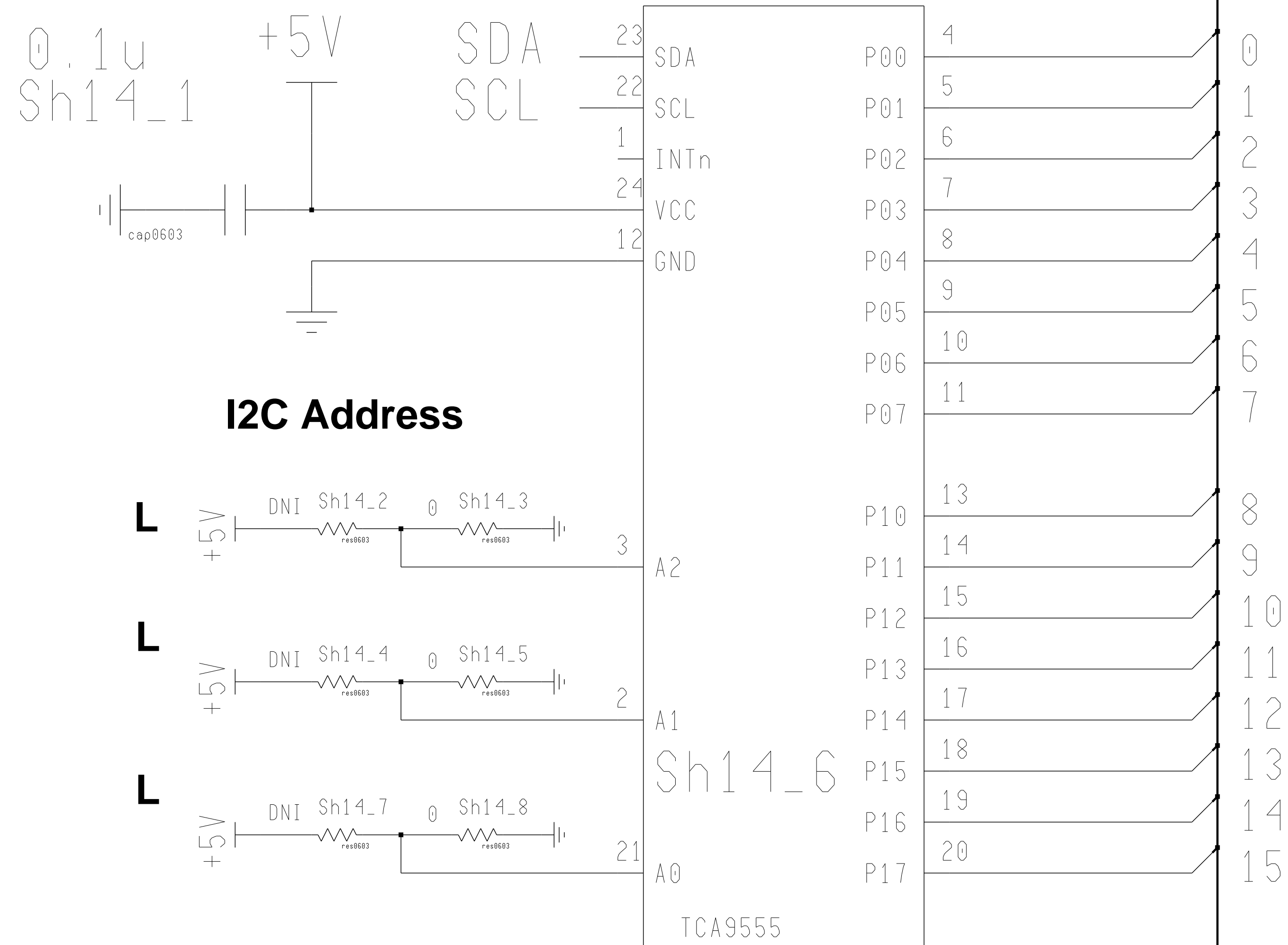
Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Isolated_OR _1		
Drawn by: M. Bogdan			
DATE: 3/26/2021			
REV. A	DRW. 2982	Sheet	12_9

ControlIN[44:0]

ControlOUT[44:0]



Control[OUT[44:0]

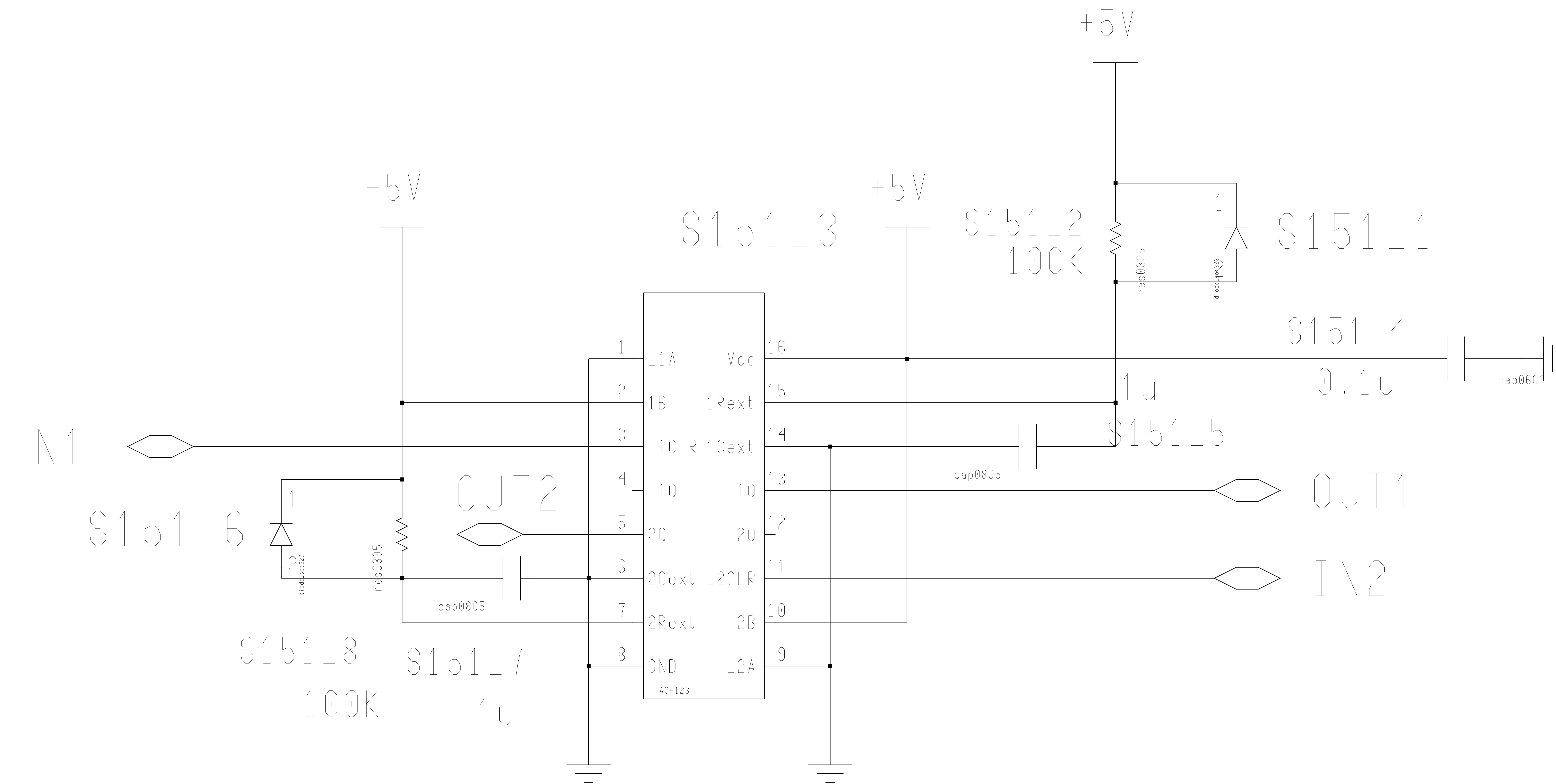


SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan
Drawn by: M. Bogdan
DATE: 2/24/2021

The University of Chicago
HELIX Relay Box Board
Expander Block

REV. A | DRW. 2982 | Sheet 14

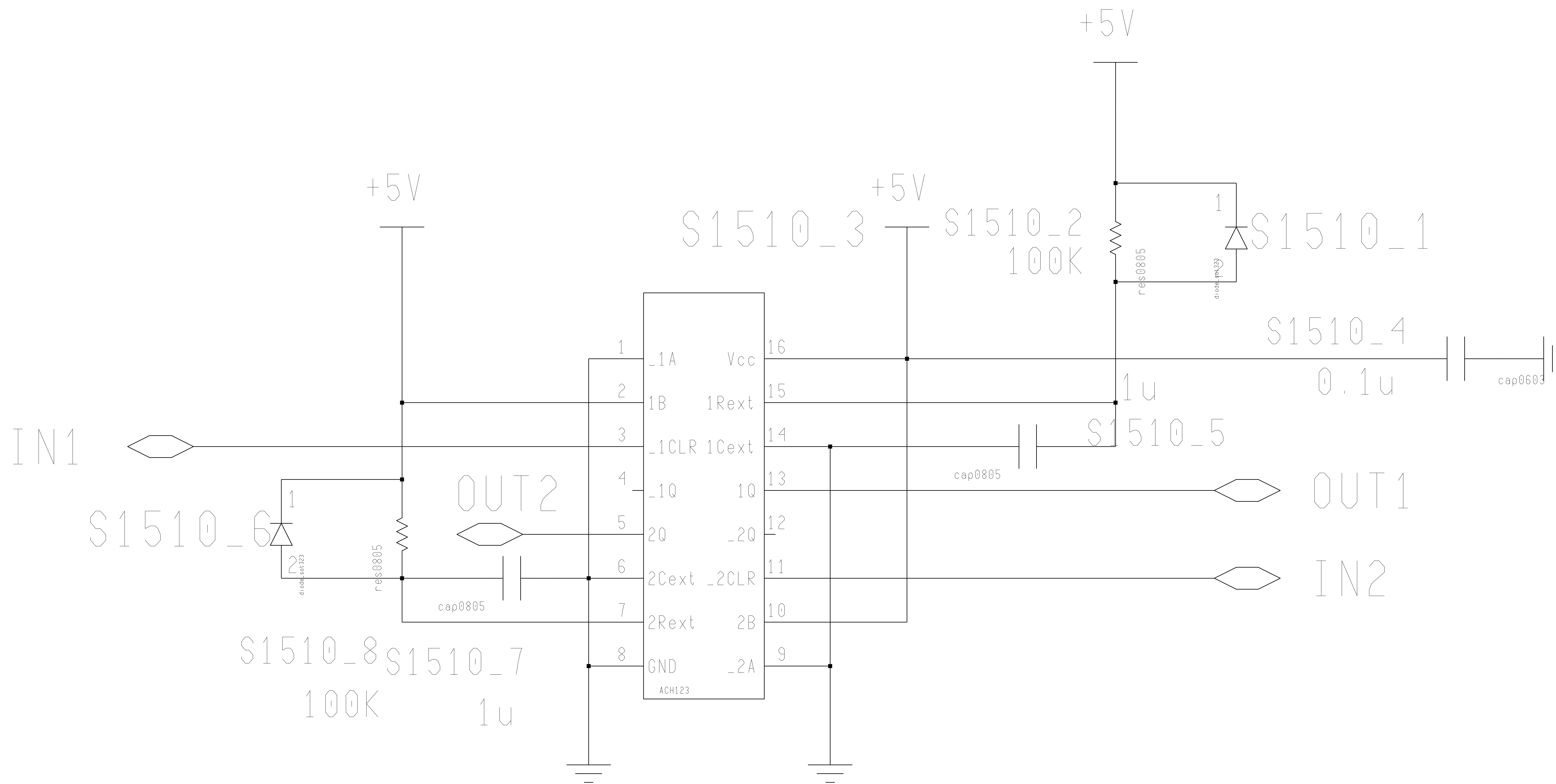


SN74AHC123AD

**SCH-2982
SPC-2983
ASM-2984**

OUT1 - 100ms H pulse on IN1 Transition to H
OUT2 - 100ms H pulse on IN2 Transition to H

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> OneShot_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet	15_1

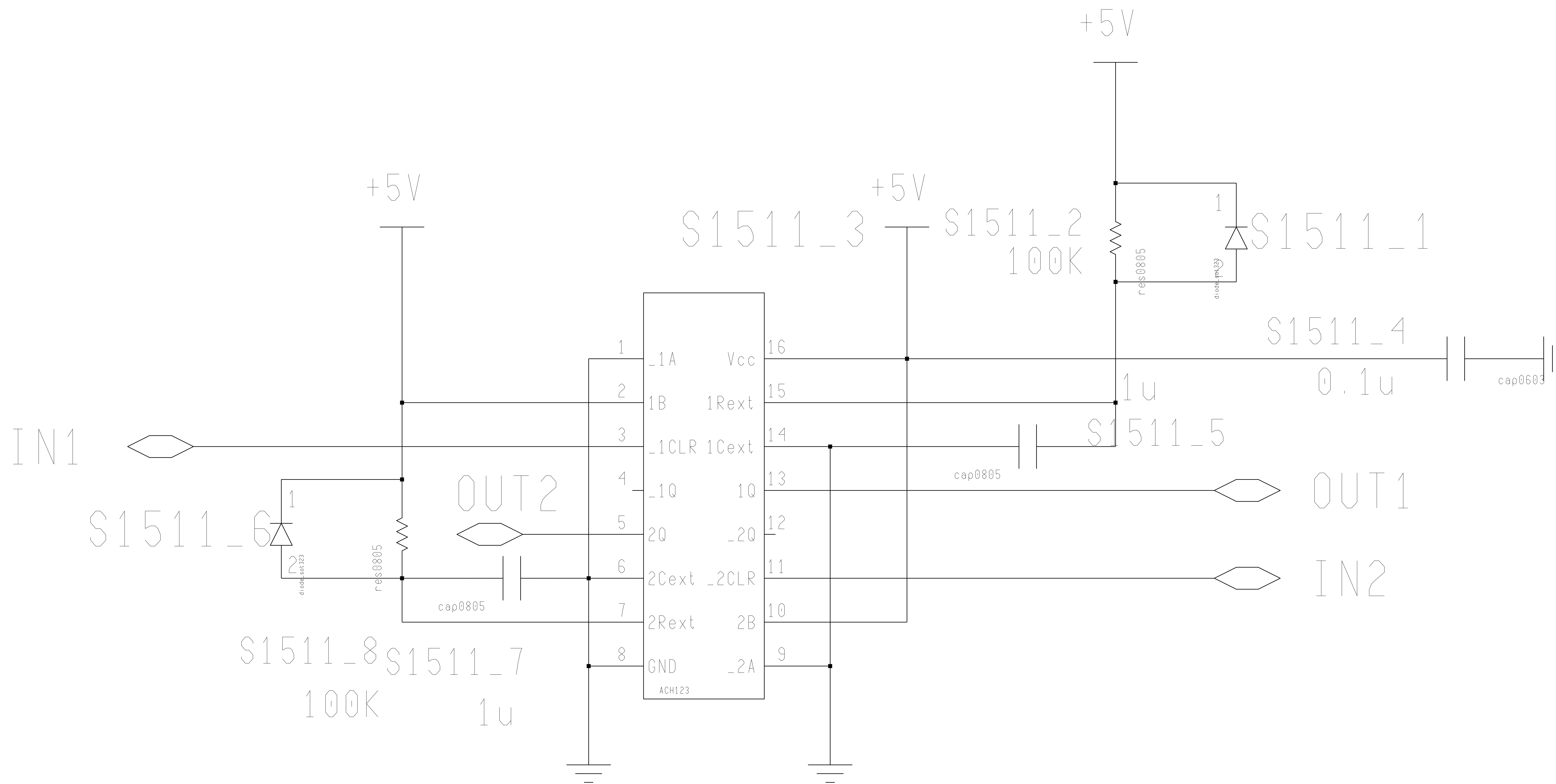


SN74AHC123AD

**SCH-2982
SPC-2983
ASM-2984**

**OUT1 - 100ms H pulse on IN1 Transition to H
OUT2 - 100ms H pulse on IN2 Transition to H**

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> OneShot_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet	15_10

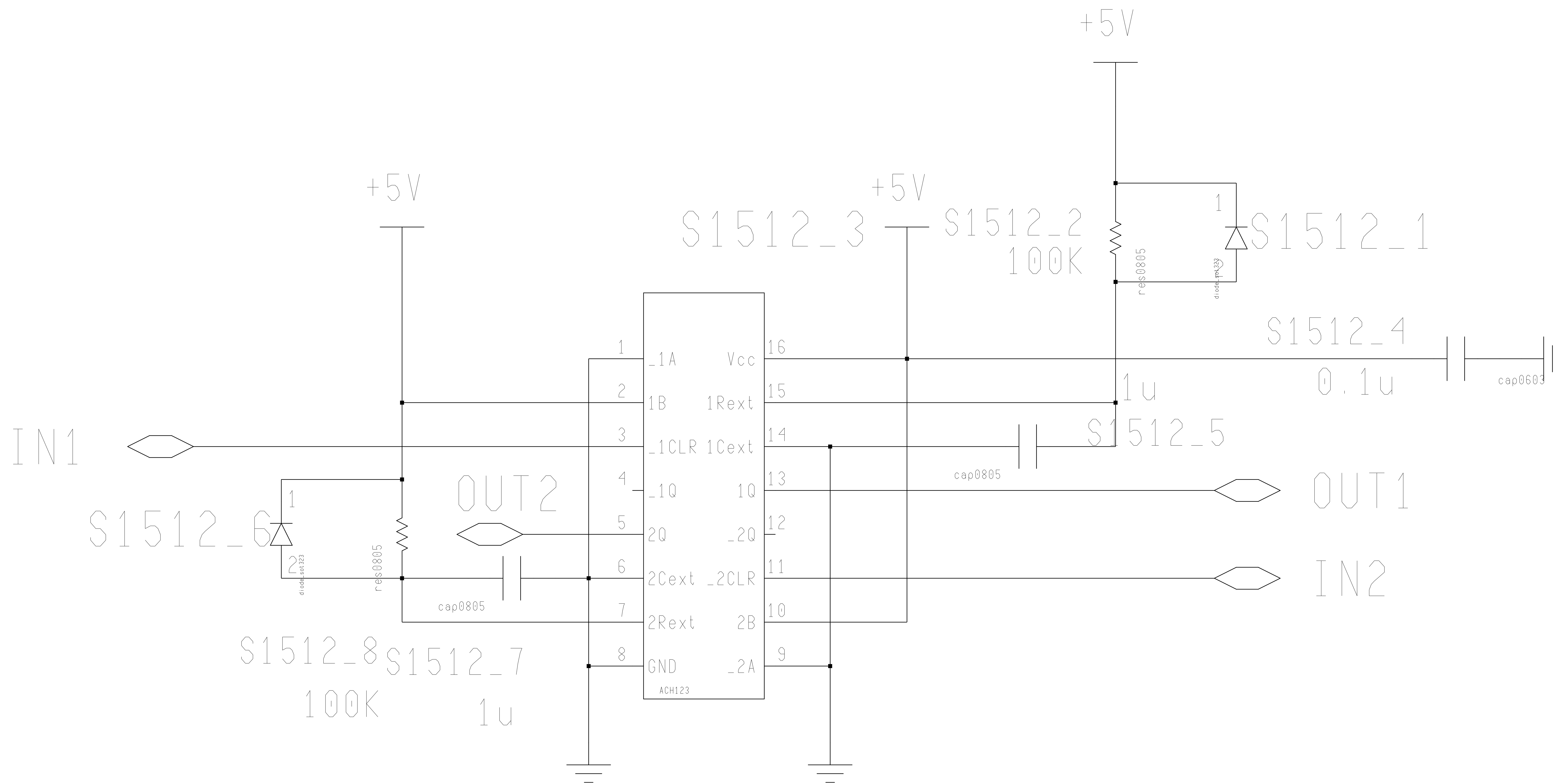


SN74AHC123AD

**SCH-2982
SPC-2983
ASM-2984**

OUT1 - 100ms H pulse on IN1 Transition to H
OUT2 - 100ms H pulse on IN2 Transition to H

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> OneShot_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet	15_11

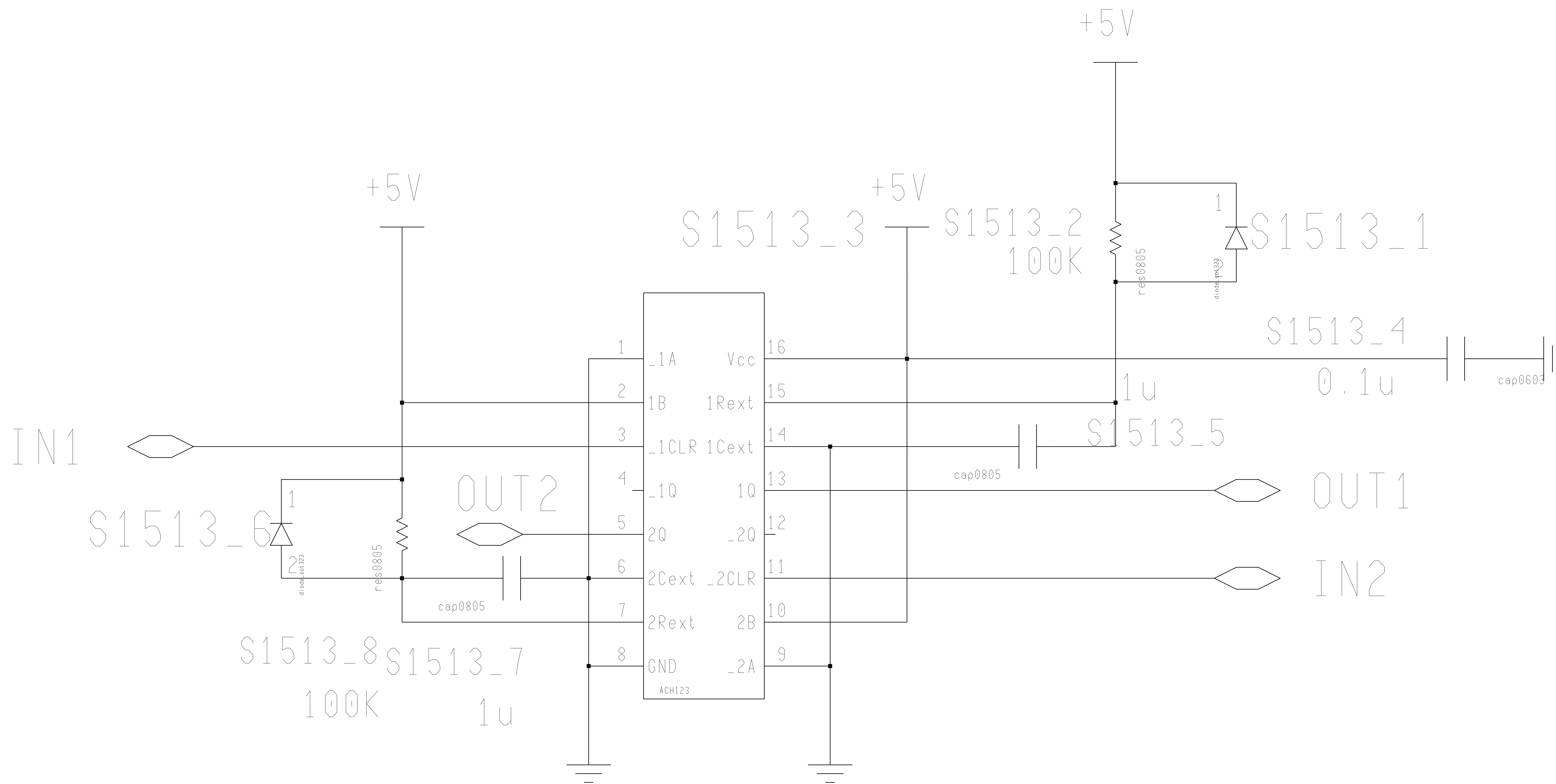


SN74AHC123AD

**SCH-2982
SPC-2983
ASM-2984**

OUT1 - 100ms H pulse on IN1 Transition to H
OUT2 - 100ms H pulse on IN2 Transition to H

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> OneShot_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet	15_12

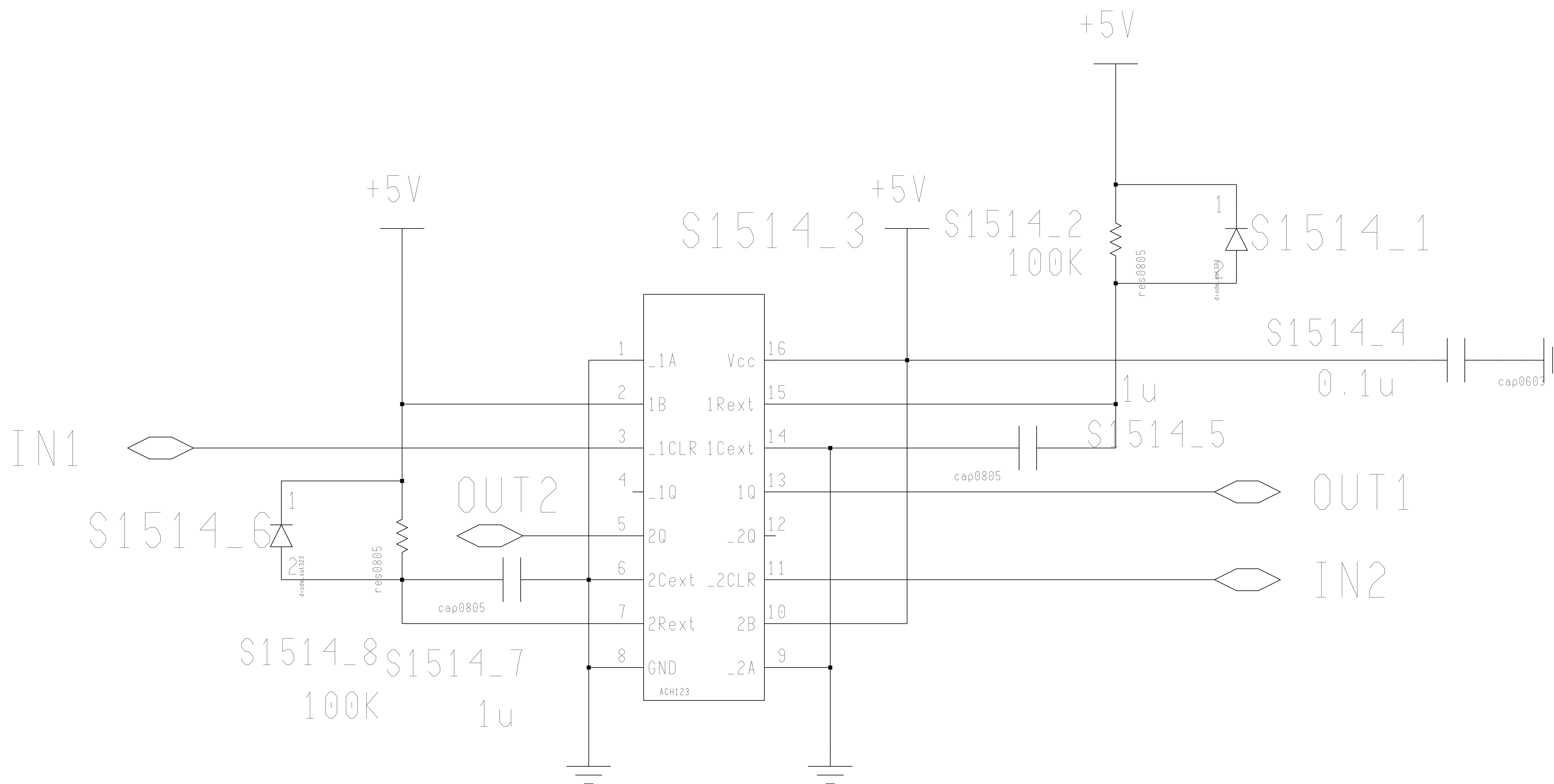


SN74AHC123AD

**SCH-2982
SPC-2983
ASM-2984**

**OUT1 - 100ms H pulse on IN1 Transition to H
OUT2 - 100ms H pulse on IN2 Transition to H**

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> OneShot_1	
Drawn by: M. Bogdan		
DATE: 3/15/2021		
REV. A	DRW. 2982	Sheet 15_13

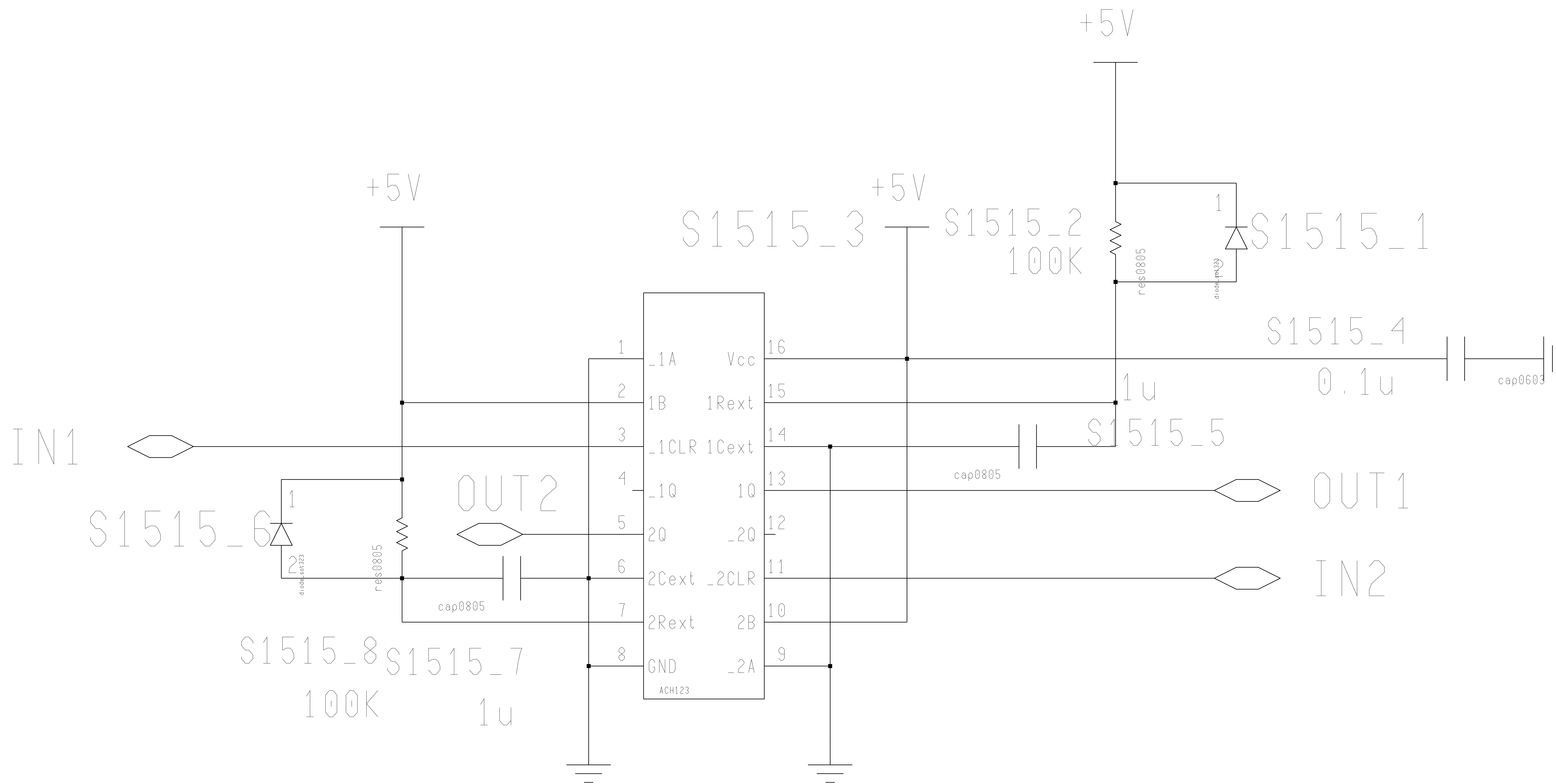


SN74AHC123AD

**SCH-2982
SPC-2983
ASM-2984**

OUT1 - 100ms H pulse on IN1 Transition to H
OUT2 - 100ms H pulse on IN2 Transition to H

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> OneShot_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet	15_14

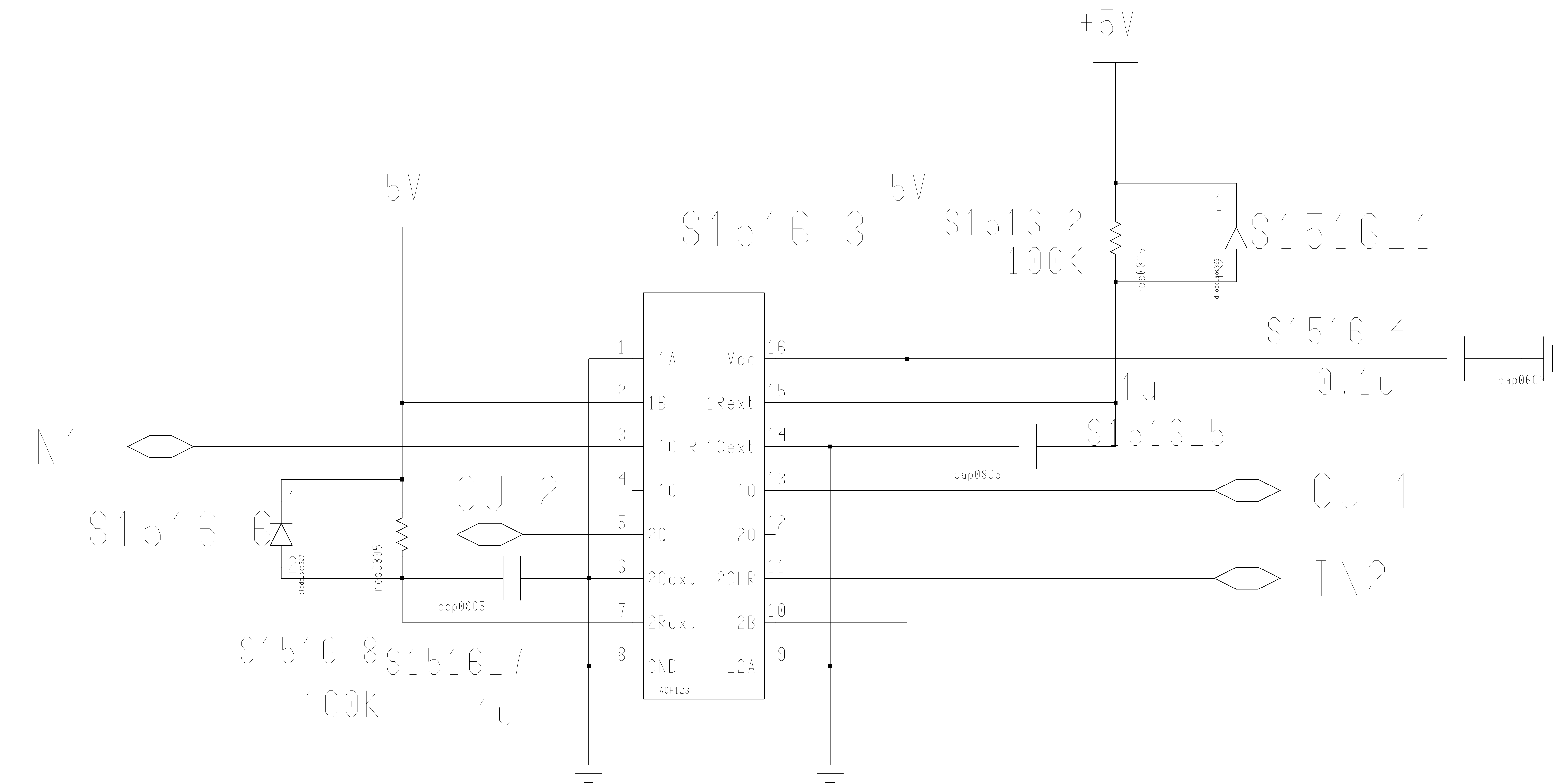


SN74AHC123AD

**SCH-2982
SPC-2983
ASM-2984**

OUT1 - 100ms H pulse on IN1 Transition to H
OUT2 - 100ms H pulse on IN2 Transition to H

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> OneShot_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet	15_15

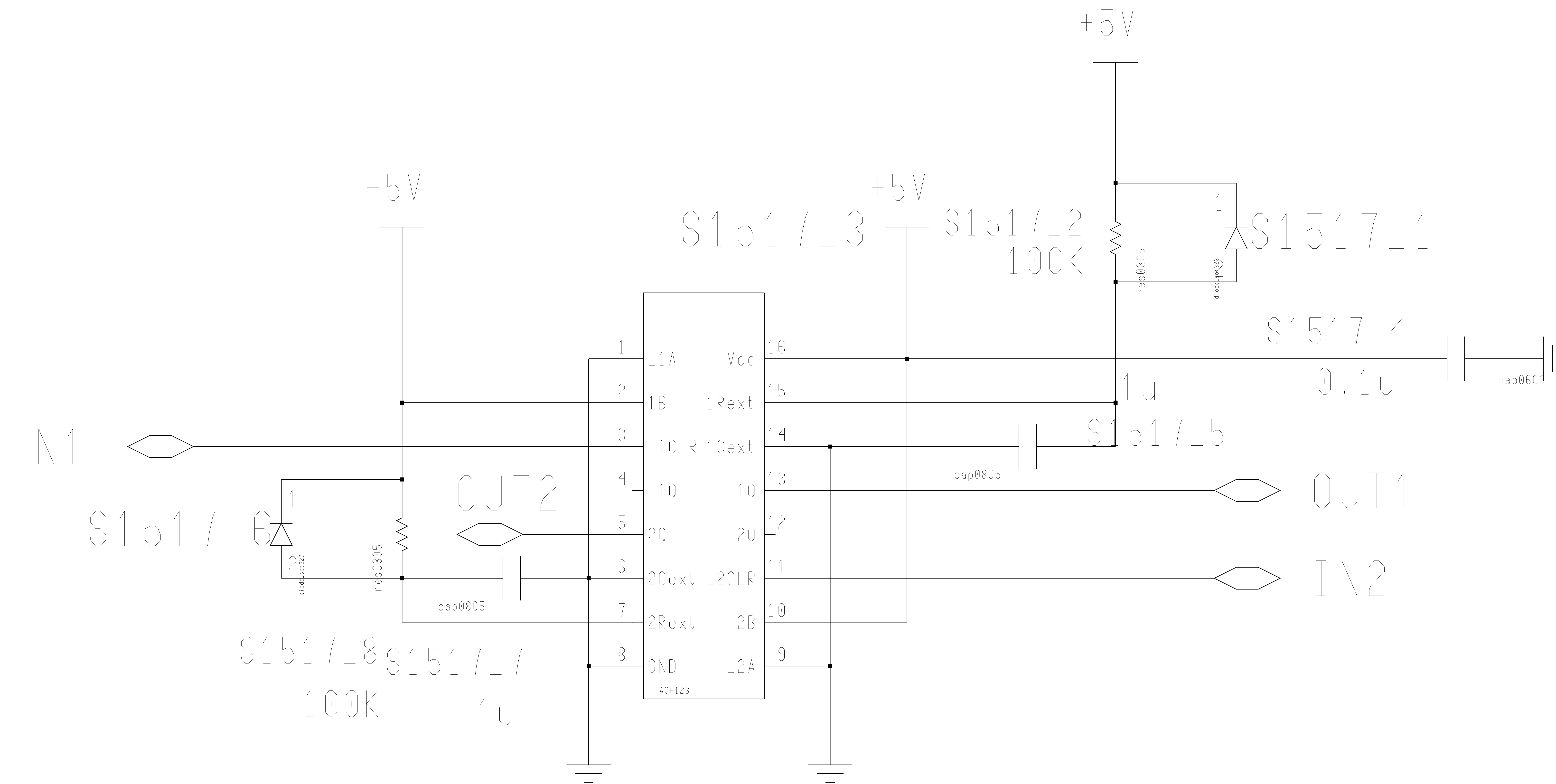


SN74AHC123AD

**SCH-2982
SPC-2983
ASM-2984**

**OUT1 - 100ms H pulse on IN1 Transition to H
OUT2 - 100ms H pulse on IN2 Transition to H**

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> OneShot_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet	15_16

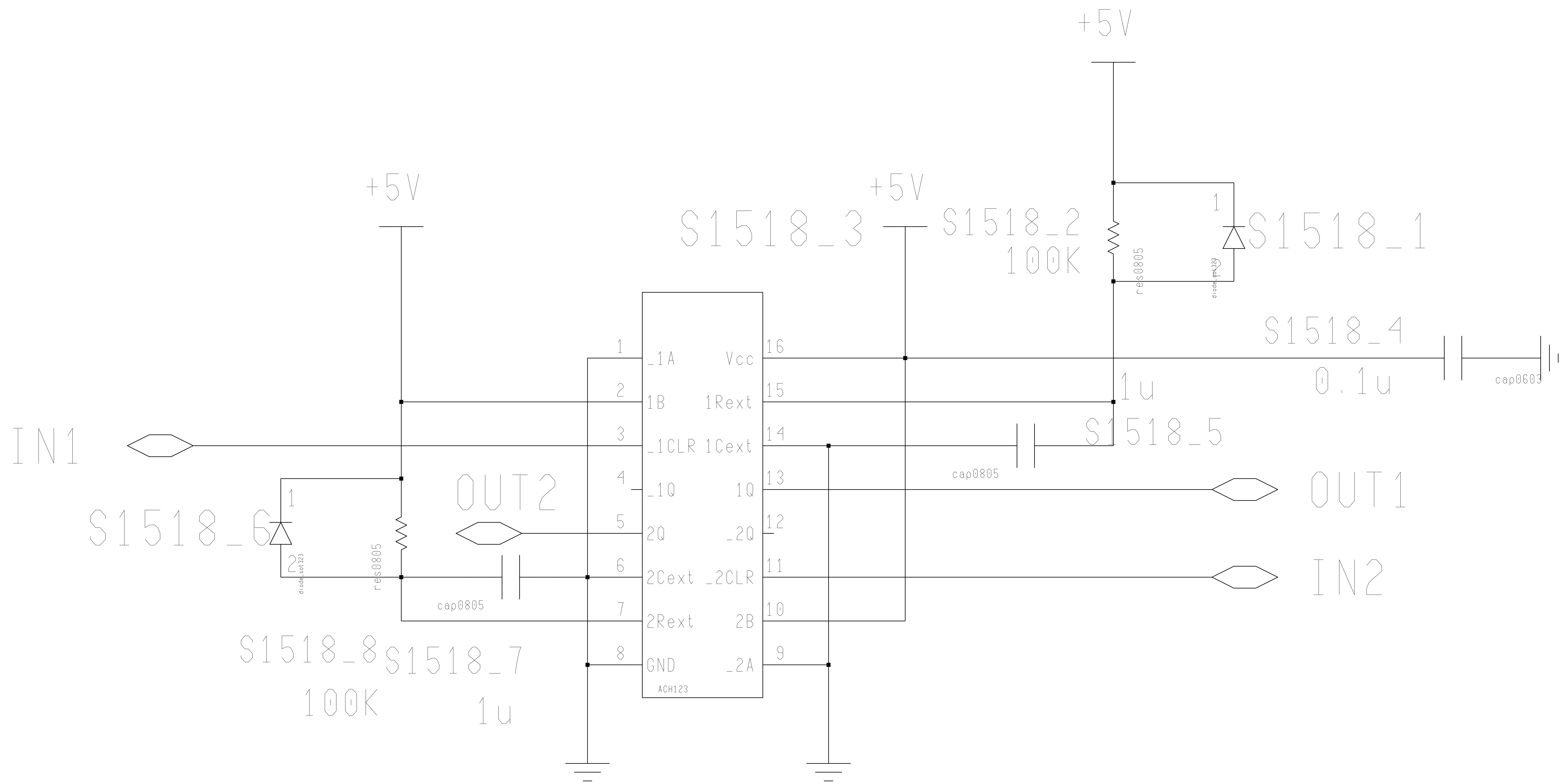


SN74AHC123AD

**SCH-2982
SPC-2983
ASM-2984**

**OUT1 - 100ms H pulse on IN1 Transition to H
OUT2 - 100ms H pulse on IN2 Transition to H**

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> OneShot_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet	15_17

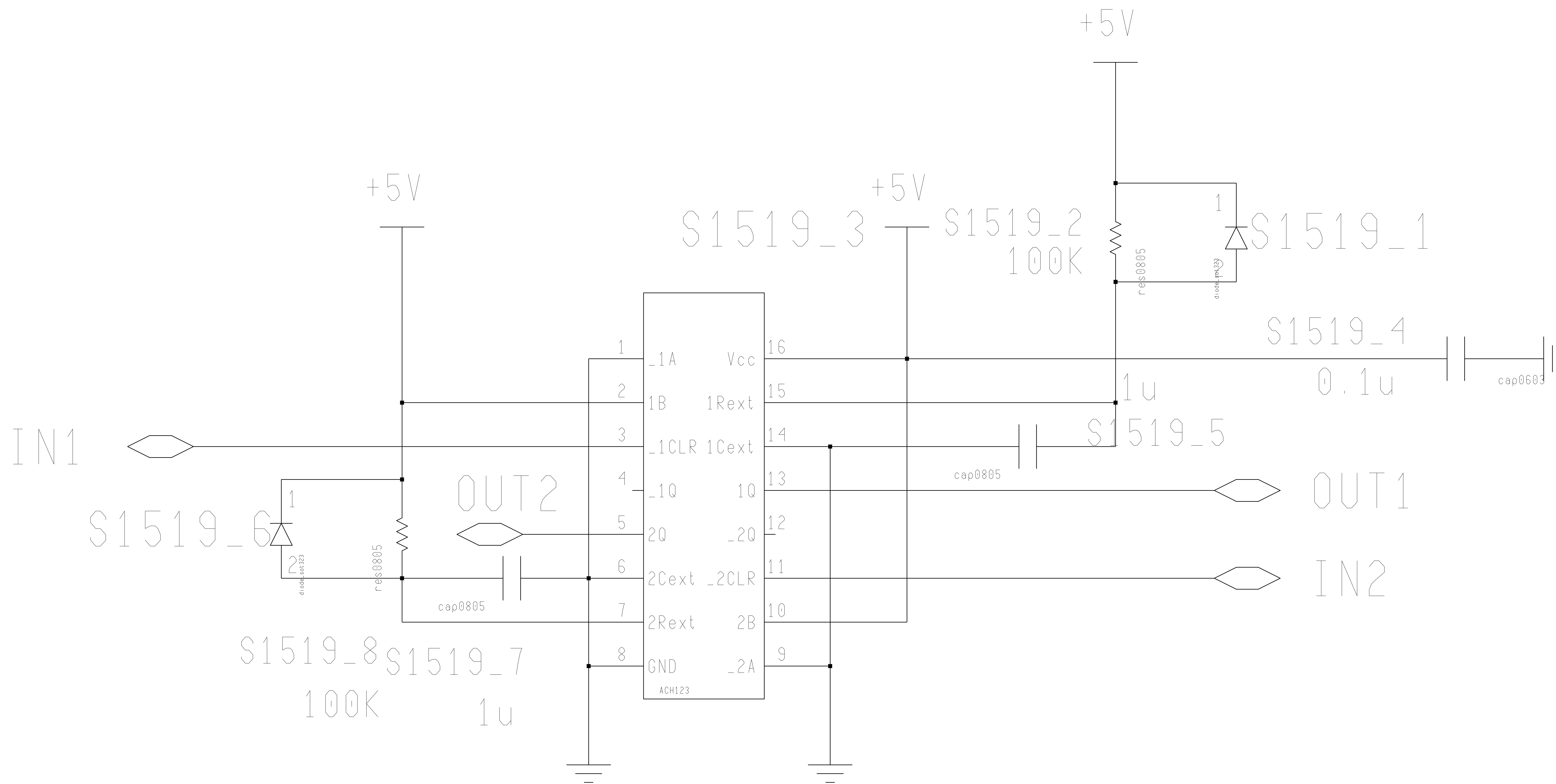


SN74AHC123AD

**SCH-2982
SPC-2983
ASM-2984**

**OUT1 - 100ms H pulse on IN1 Transition to H
OUT2 - 100ms H pulse on IN2 Transition to H**

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> OneShot_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet	15_18

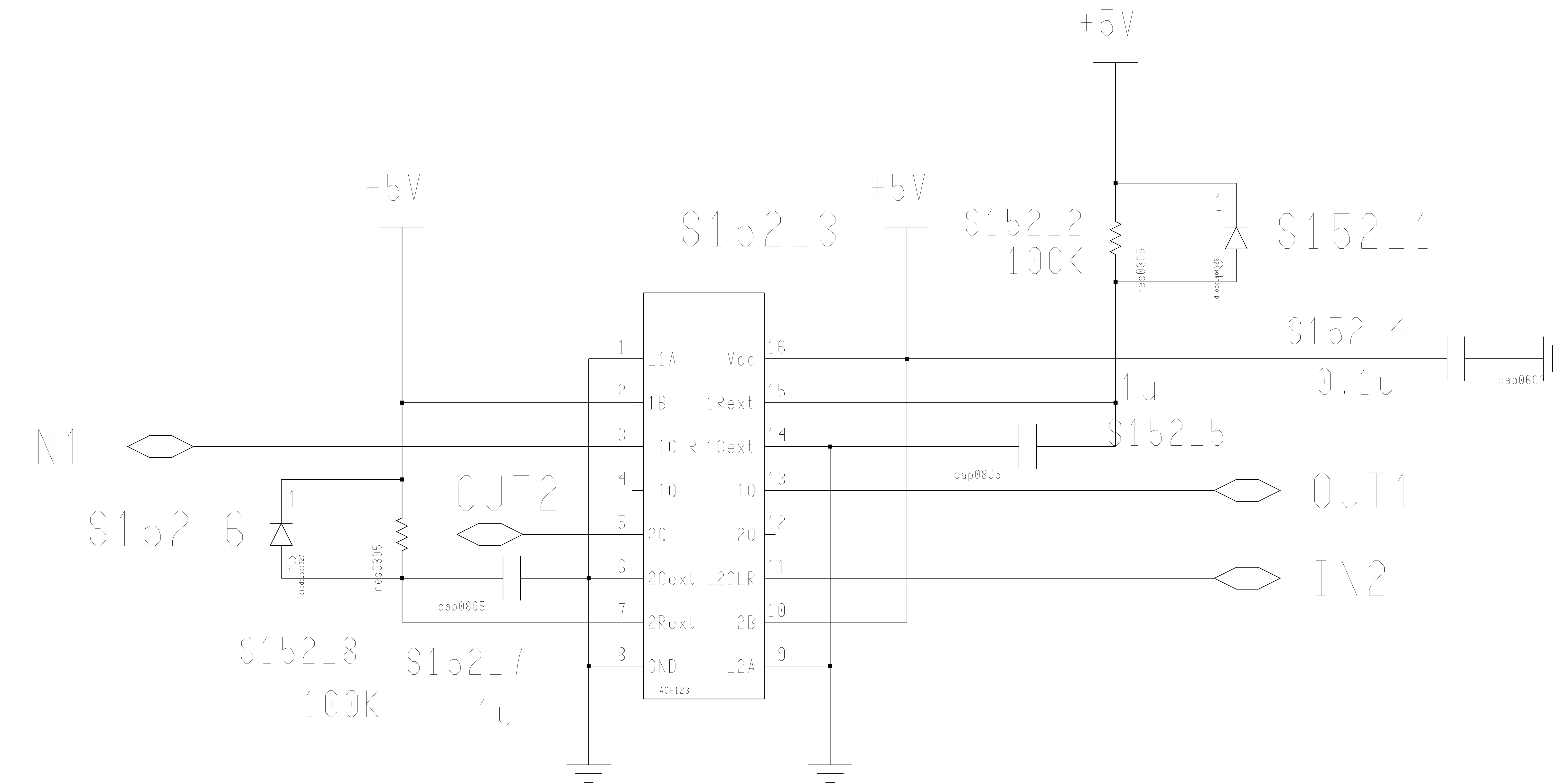


SN74AHC123AD

**SCH-2982
SPC-2983
ASM-2984**

OUT1 - 100ms H pulse on IN1 Transition to H
OUT2 - 100ms H pulse on IN2 Transition to H

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> OneShot_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet	15_19

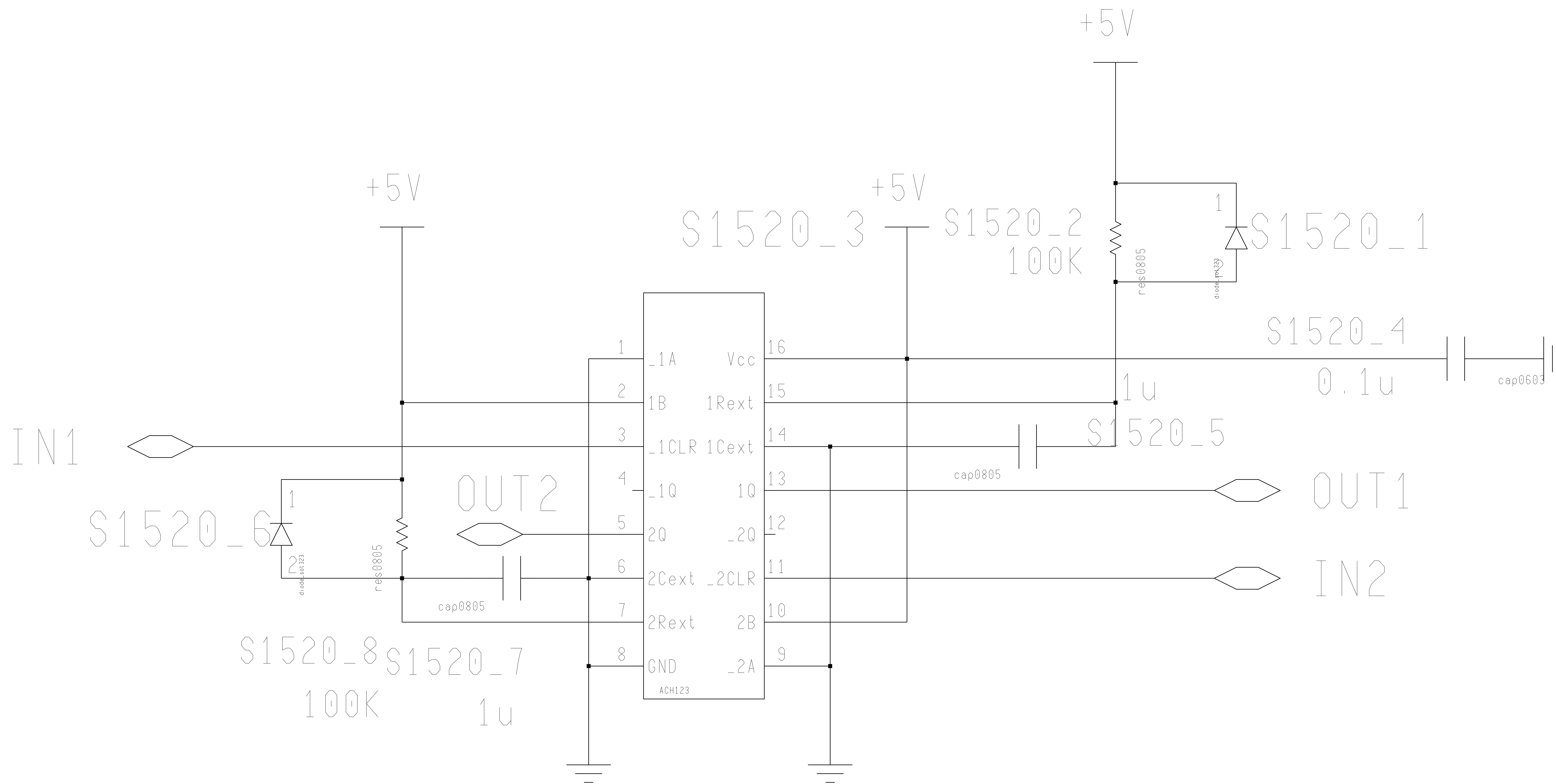


SN74AHC123AD

**SCH-2982
SPC-2983
ASM-2984**

OUT1 - 100ms H pulse on IN1 Transition to H
OUT2 - 100ms H pulse on IN2 Transition to H

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> OneShot_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet	15_2

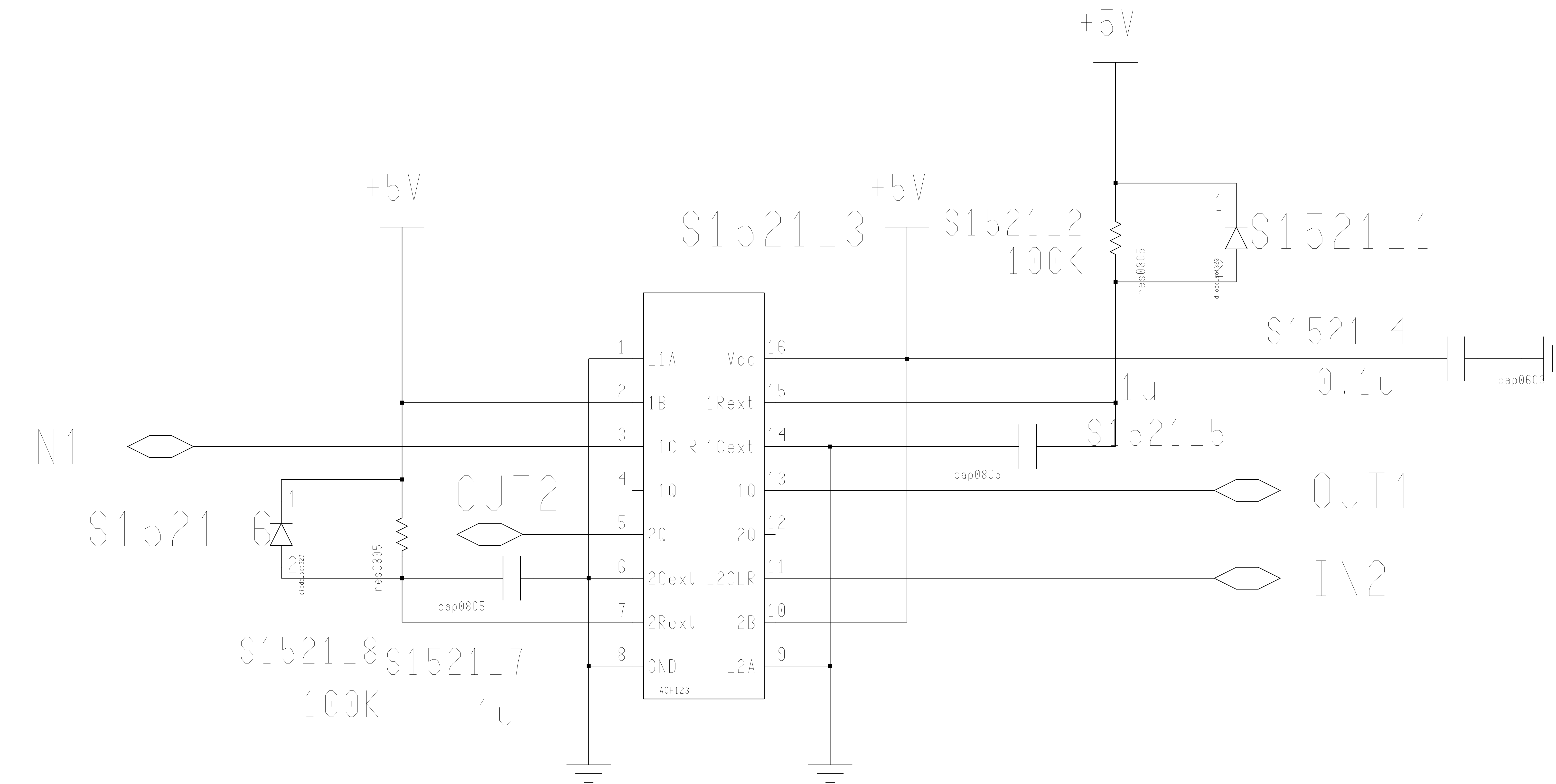


SN74AHC123AD

**SCH-2982
SPC-2983
ASM-2984**

OUT1 - 100ms H pulse on IN1 Transition to H
OUT2 - 100ms H pulse on IN2 Transition to H

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> OneShot_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet	15_20

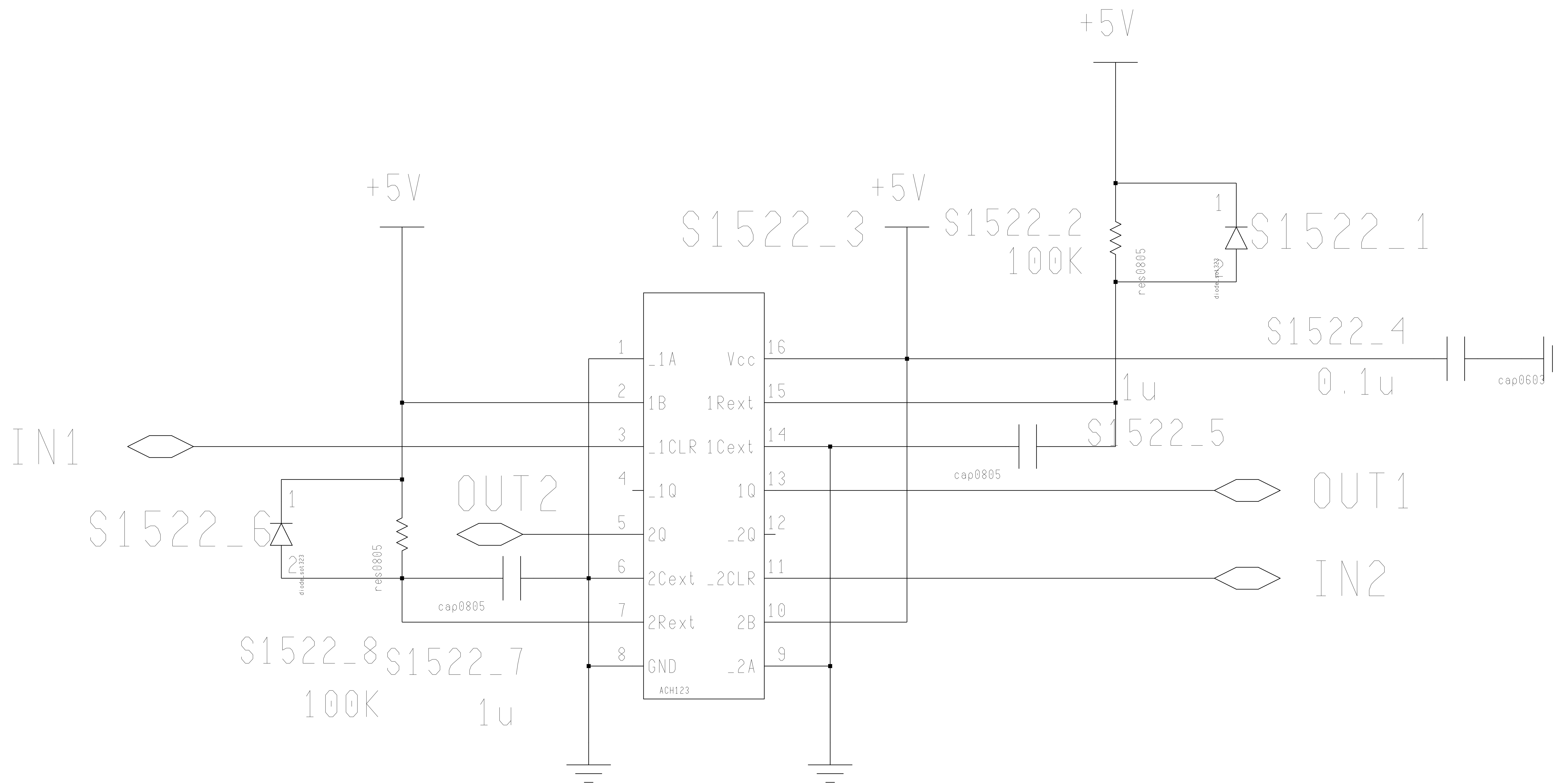


SN74AHC123AD

**SCH-2982
SPC-2983
ASM-2984**

**OUT1 - 100ms H pulse on IN1 Transition to H
OUT2 - 100ms H pulse on IN2 Transition to H**

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> OneShot_1	
Drawn by: M. Bogdan		
DATE: 3/15/2021		
REV. A	DRW. 2982	Sheet 15_21

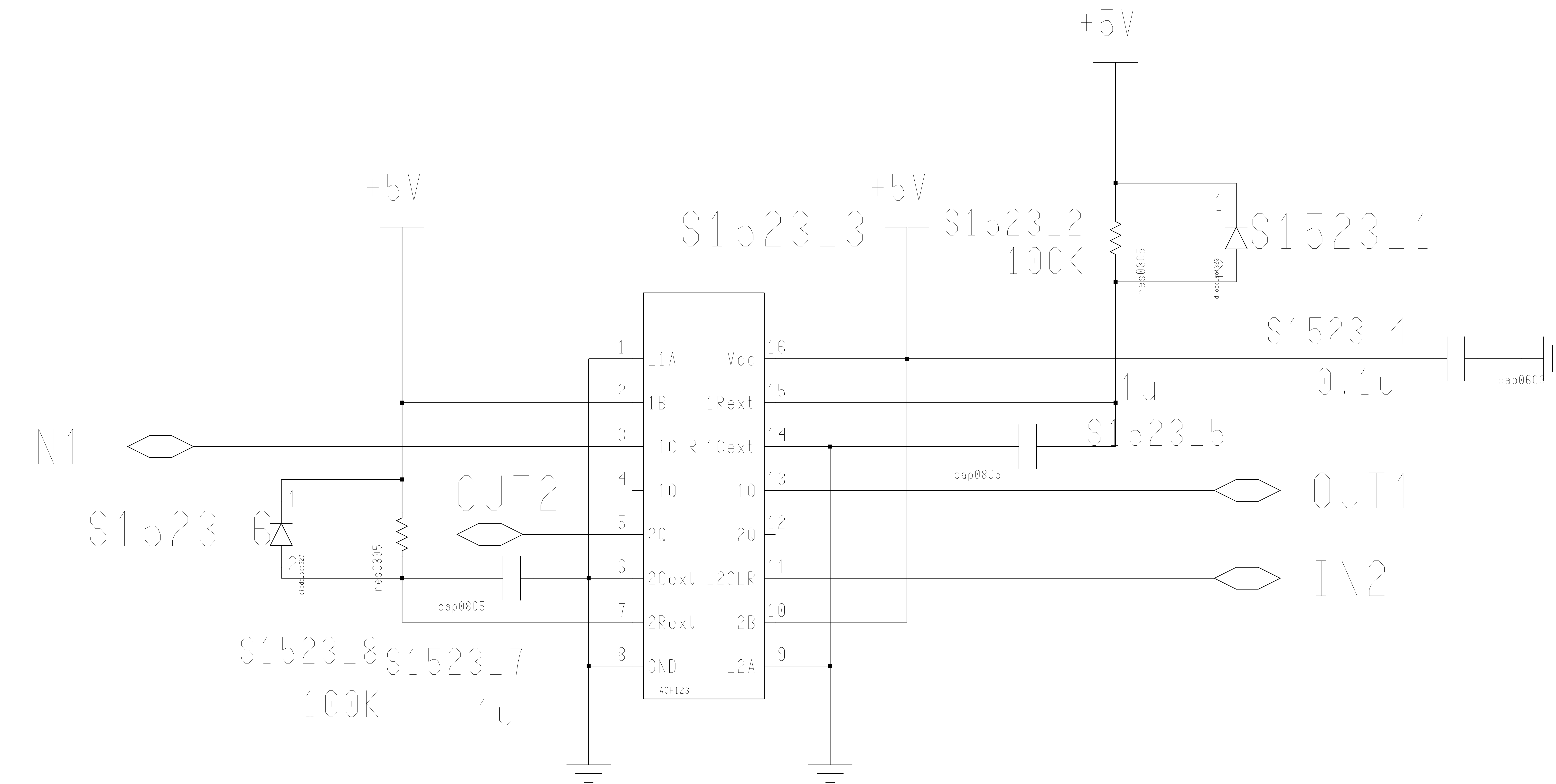


SN74AHC123AD

**SCH-2982
SPC-2983
ASM-2984**

OUT1 - 100ms H pulse on IN1 Transition to H
OUT2 - 100ms H pulse on IN2 Transition to H

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> OneShot_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet	15_22

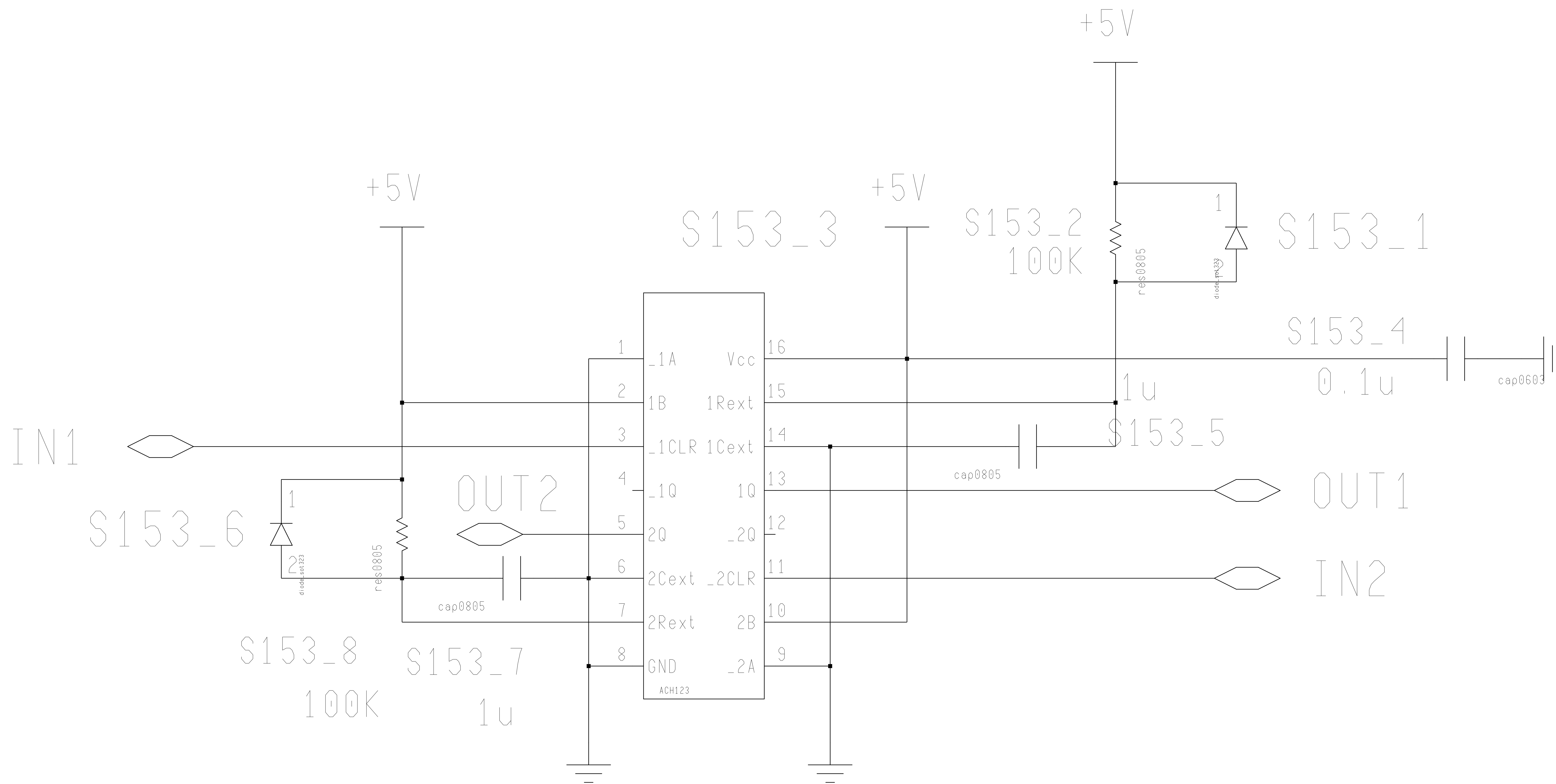


SN74AHC123AD

**SCH-2982
SPC-2983
ASM-2984**

**OUT1 - 100ms H pulse on IN1 Transition to H
OUT2 - 100ms H pulse on IN2 Transition to H**

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> OneShot_1	
Drawn by: M. Bogdan		
DATE: 3/15/2021		
REV. A	DRW. 2982	Sheet

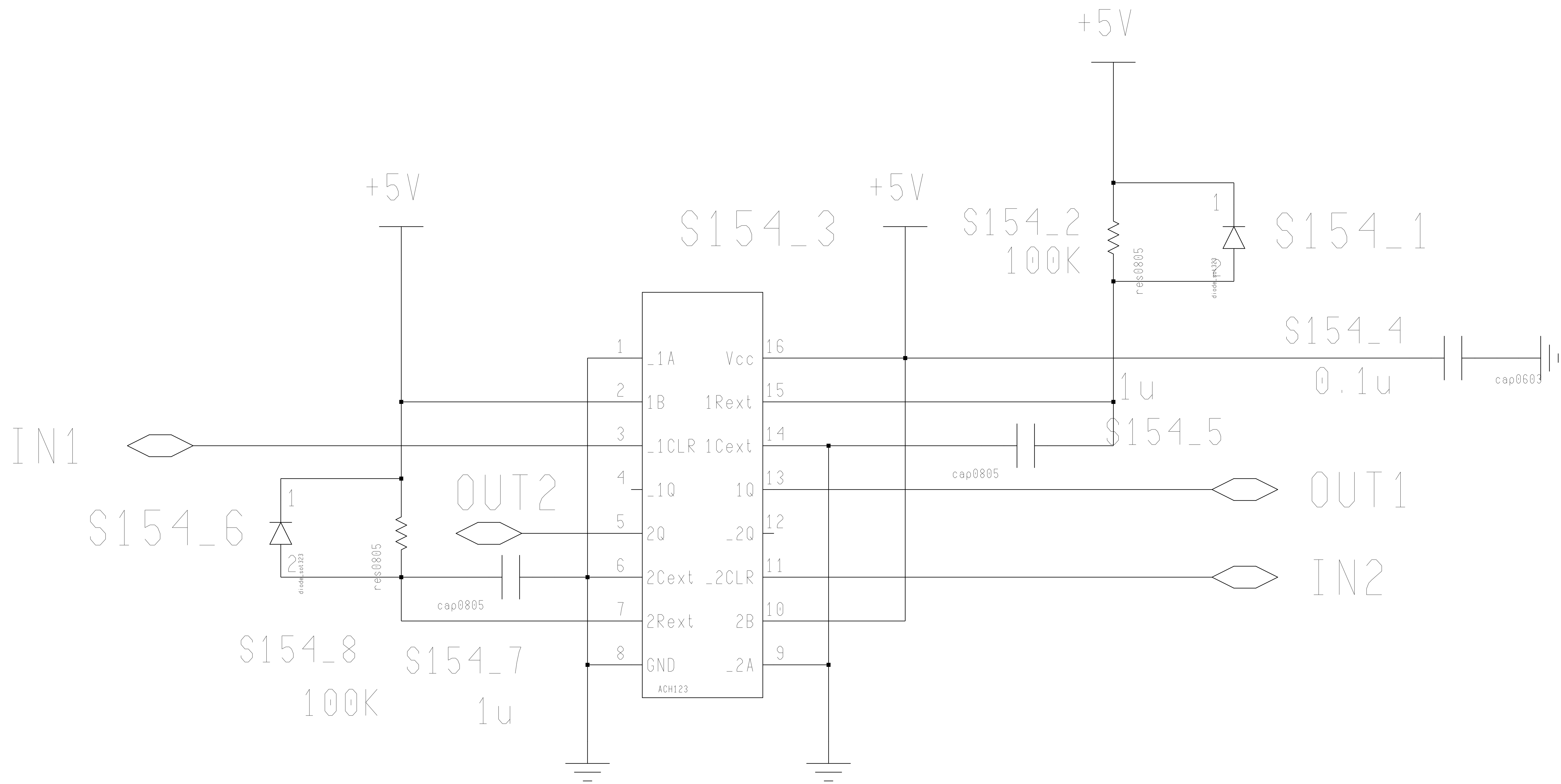


SN74AHC123AD

**SCH-2982
SPC-2983
ASM-2984**

OUT1 - 100ms H pulse on IN1 Transition to H
OUT2 - 100ms H pulse on IN2 Transition to H

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> OneShot_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet	15_3

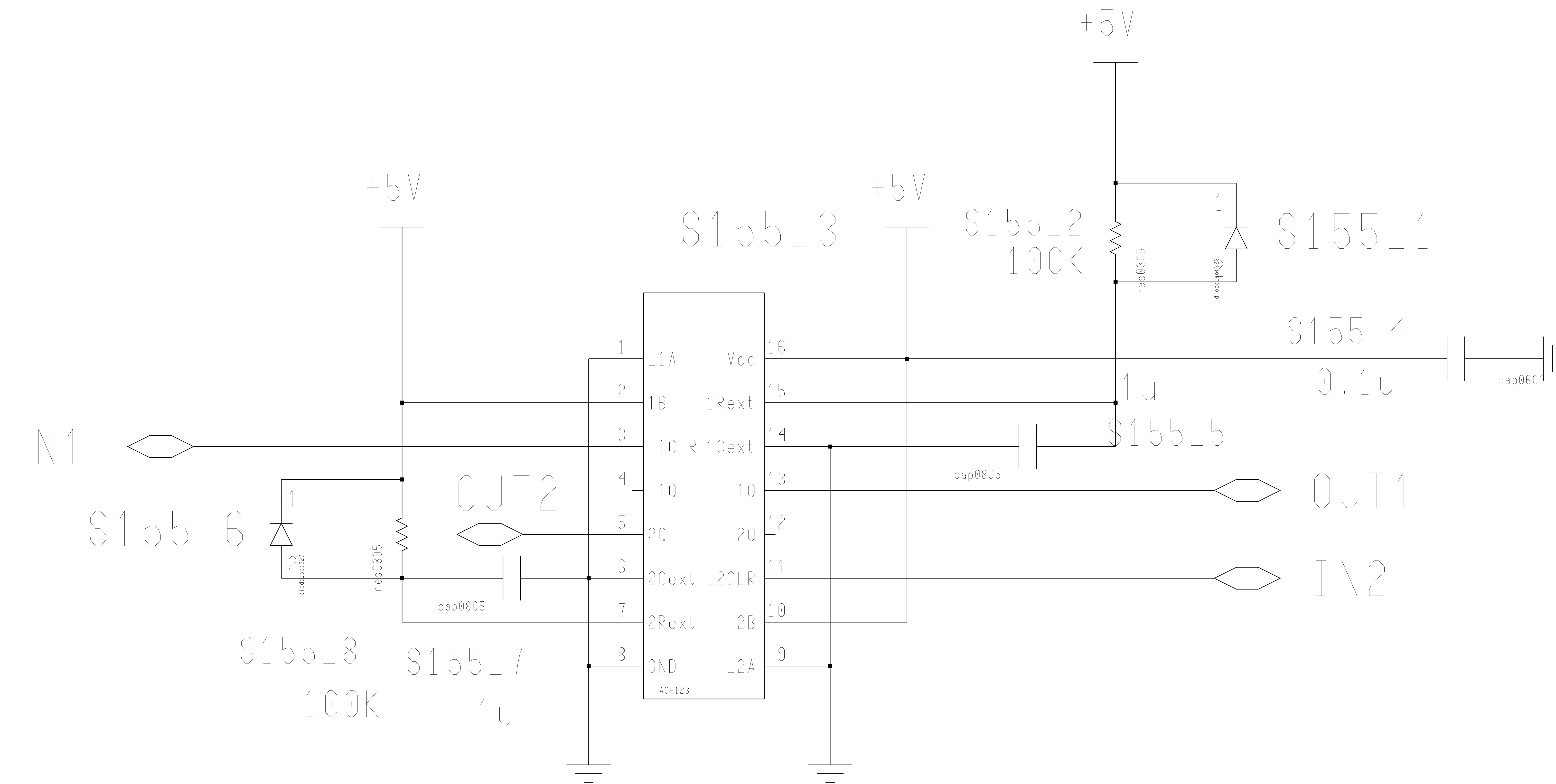


SN74AHC123AD

**SCH-2982
SPC-2983
ASM-2984**

OUT1 - 100ms H pulse on IN1 Transition to H
OUT2 - 100ms H pulse on IN2 Transition to H

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> OneShot_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet	15_4

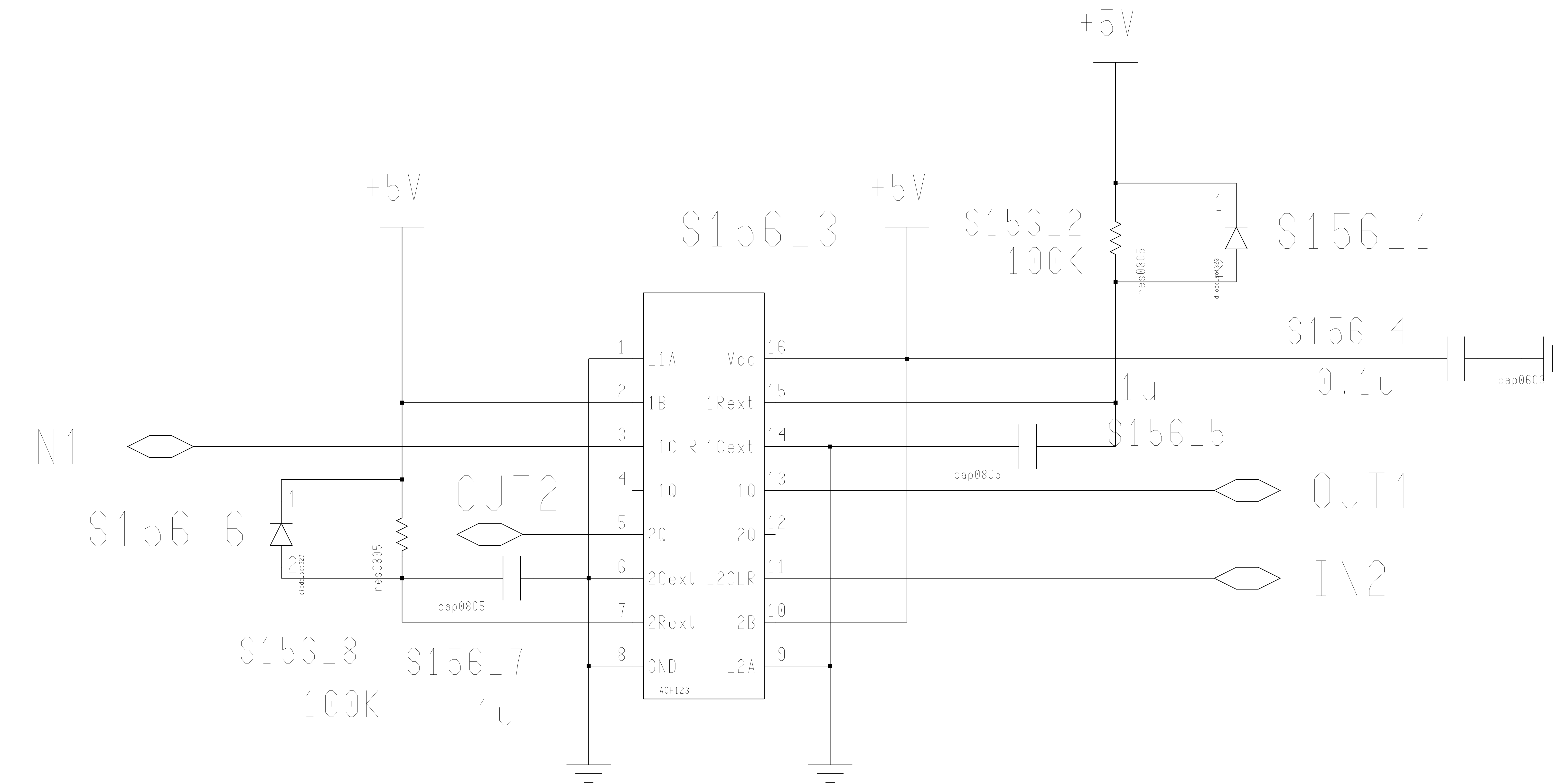


SN74AHC123AD

**SCH-2982
SPC-2983
ASM-2984**

**OUT1 - 100ms H pulse on IN1 Transition to H
OUT2 - 100ms H pulse on IN2 Transition to H**

Engineer: M. Bogdan	The University of Chicago HELIX Relay Box Board OneShot_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet	15_5

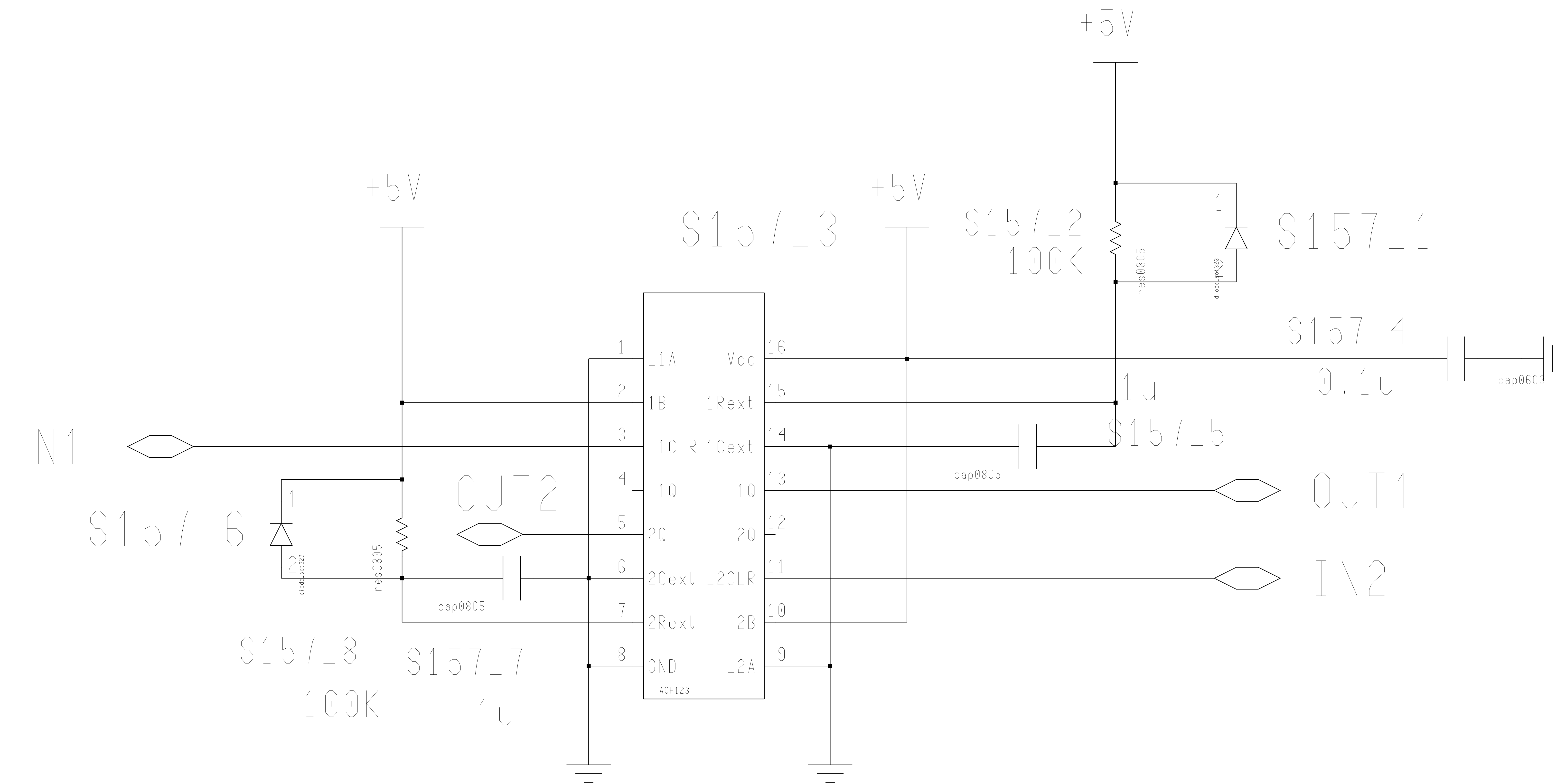


SN74AHC123AD

**SCH-2982
SPC-2983
ASM-2984**

**OUT1 - 100ms H pulse on IN1 Transition to H
OUT2 - 100ms H pulse on IN2 Transition to H**

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> OneShot_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet	15_6

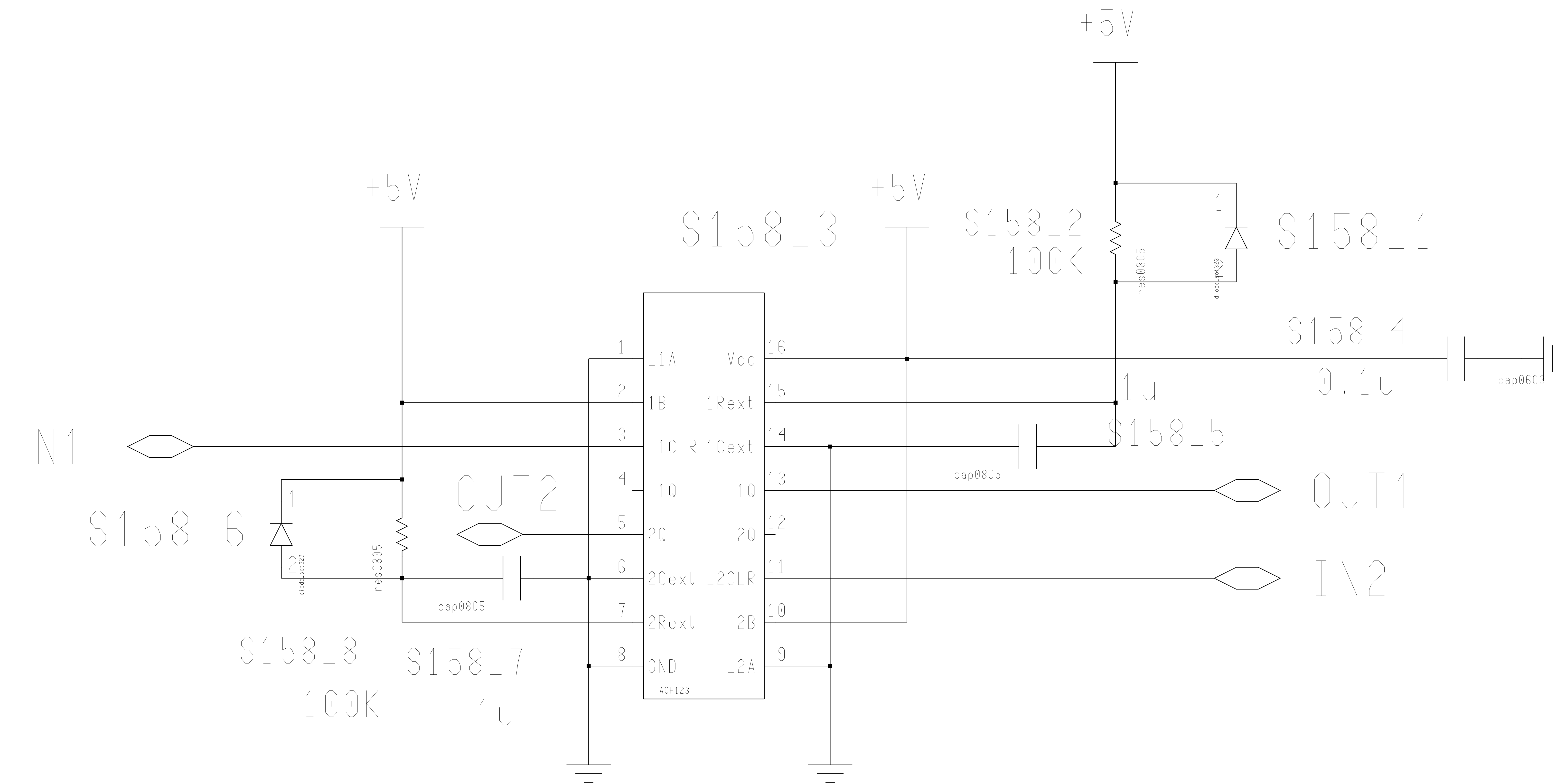


SN74AHC123AD

**SCH-2982
SPC-2983
ASM-2984**

OUT1 - 100ms H pulse on IN1 Transition to H
OUT2 - 100ms H pulse on IN2 Transition to H

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> OneShot_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet	15_7

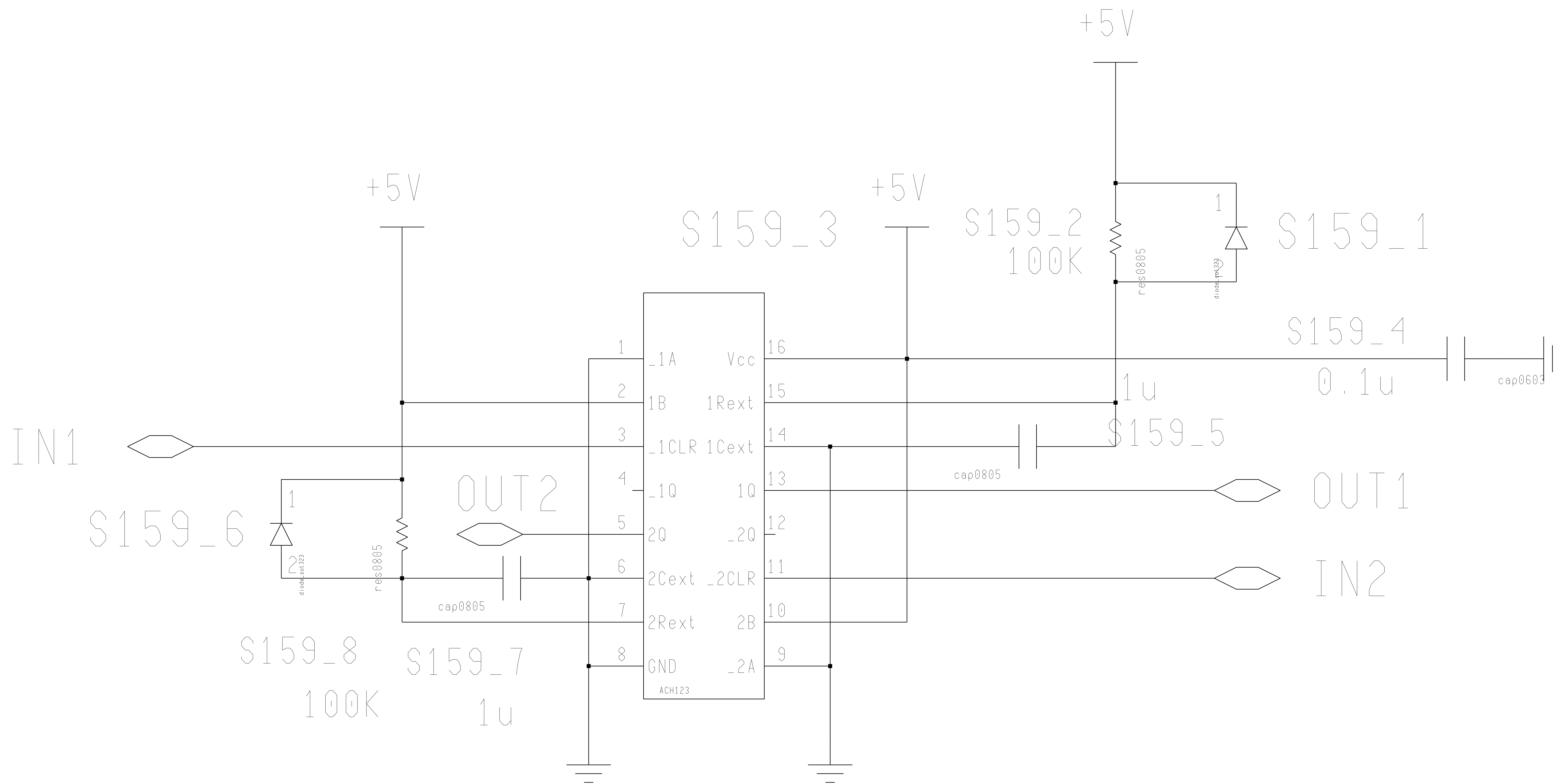


SN74AHC123AD

**SCH-2982
SPC-2983
ASM-2984**

**OUT1 - 100ms H pulse on IN1 Transition to H
OUT2 - 100ms H pulse on IN2 Transition to H**

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> OneShot_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet	15_8

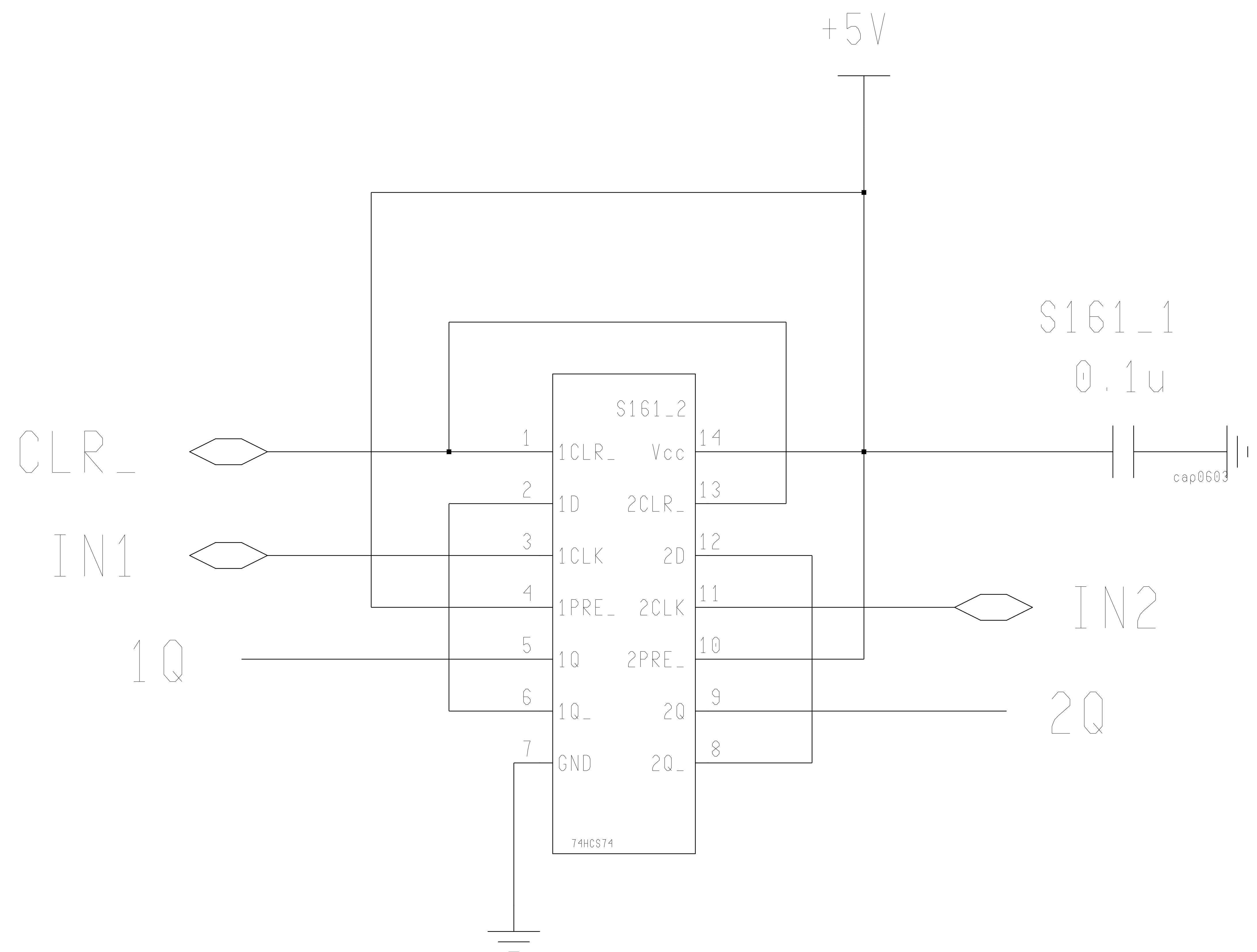


SN74AHC123AD

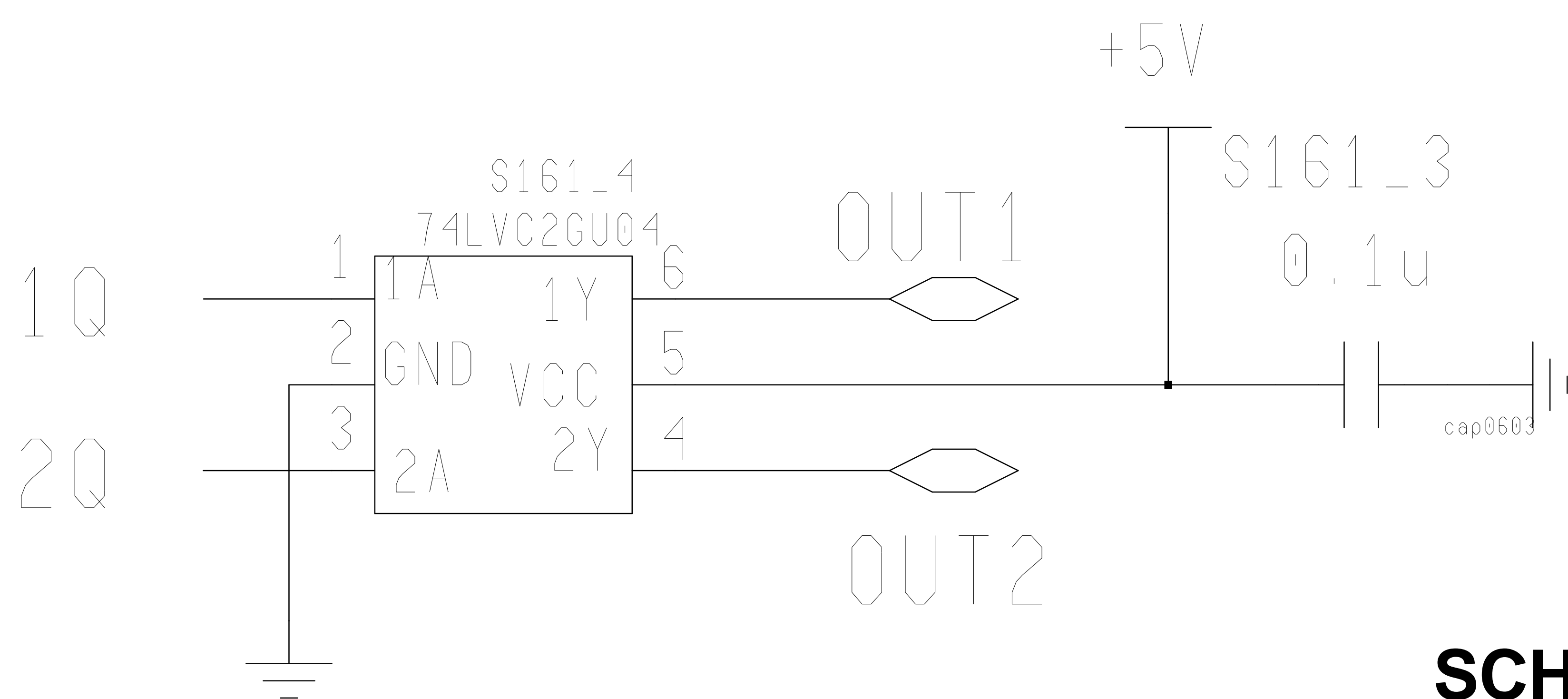
**SCH-2982
SPC-2983
ASM-2984**

OUT1 - 100ms H pulse on IN1 Transition to H
OUT2 - 100ms H pulse on IN2 Transition to H

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> OneShot_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet	15_9



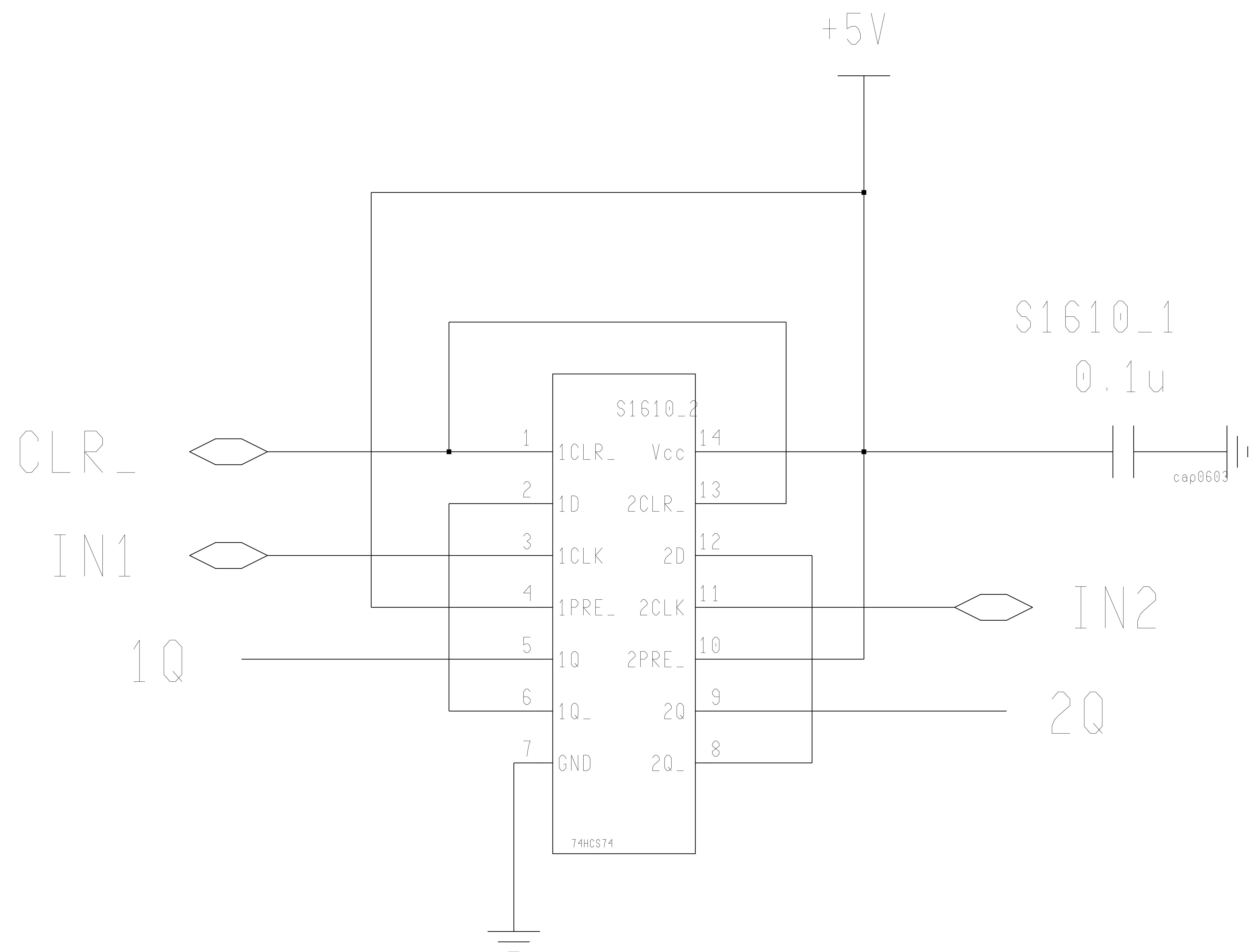
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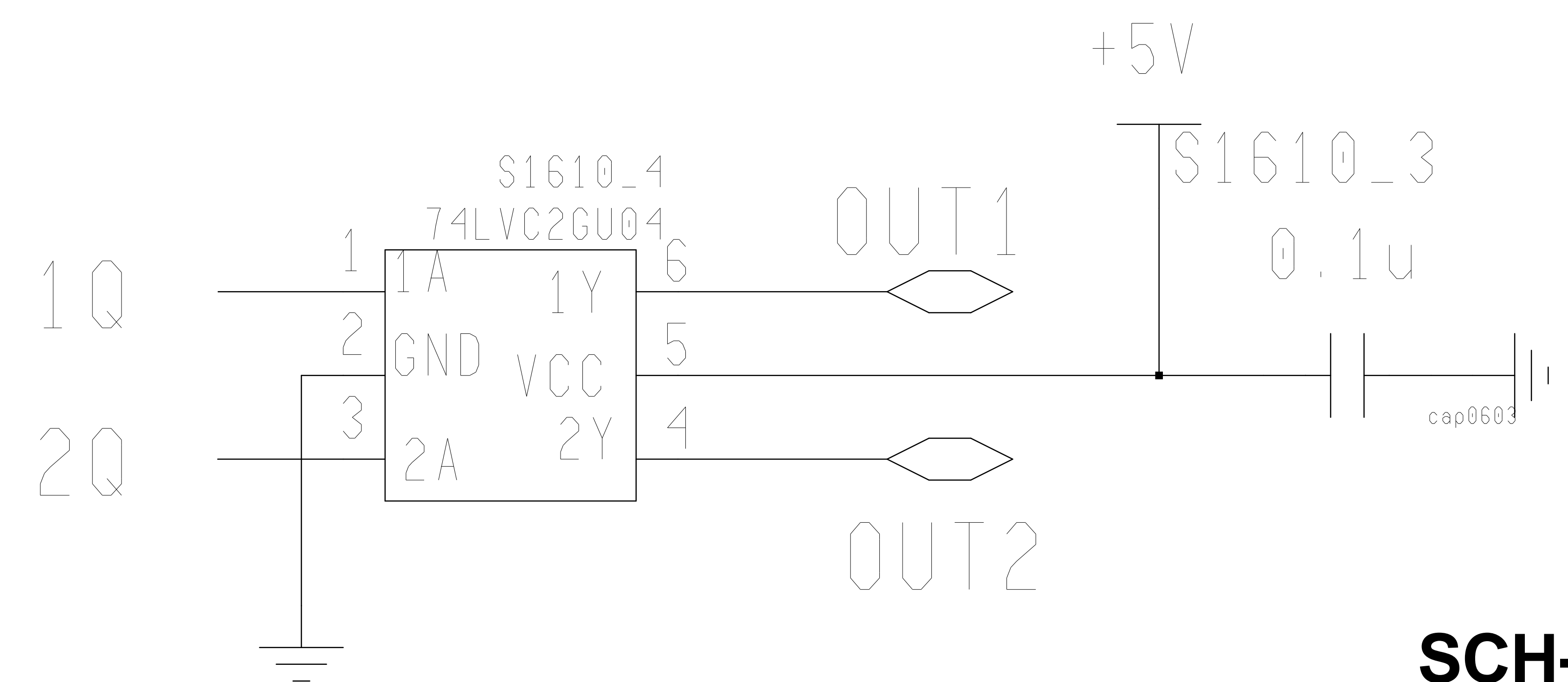
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**SCH-2982
SPC-2983
ASM-2984**

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> DFF_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet	16_1



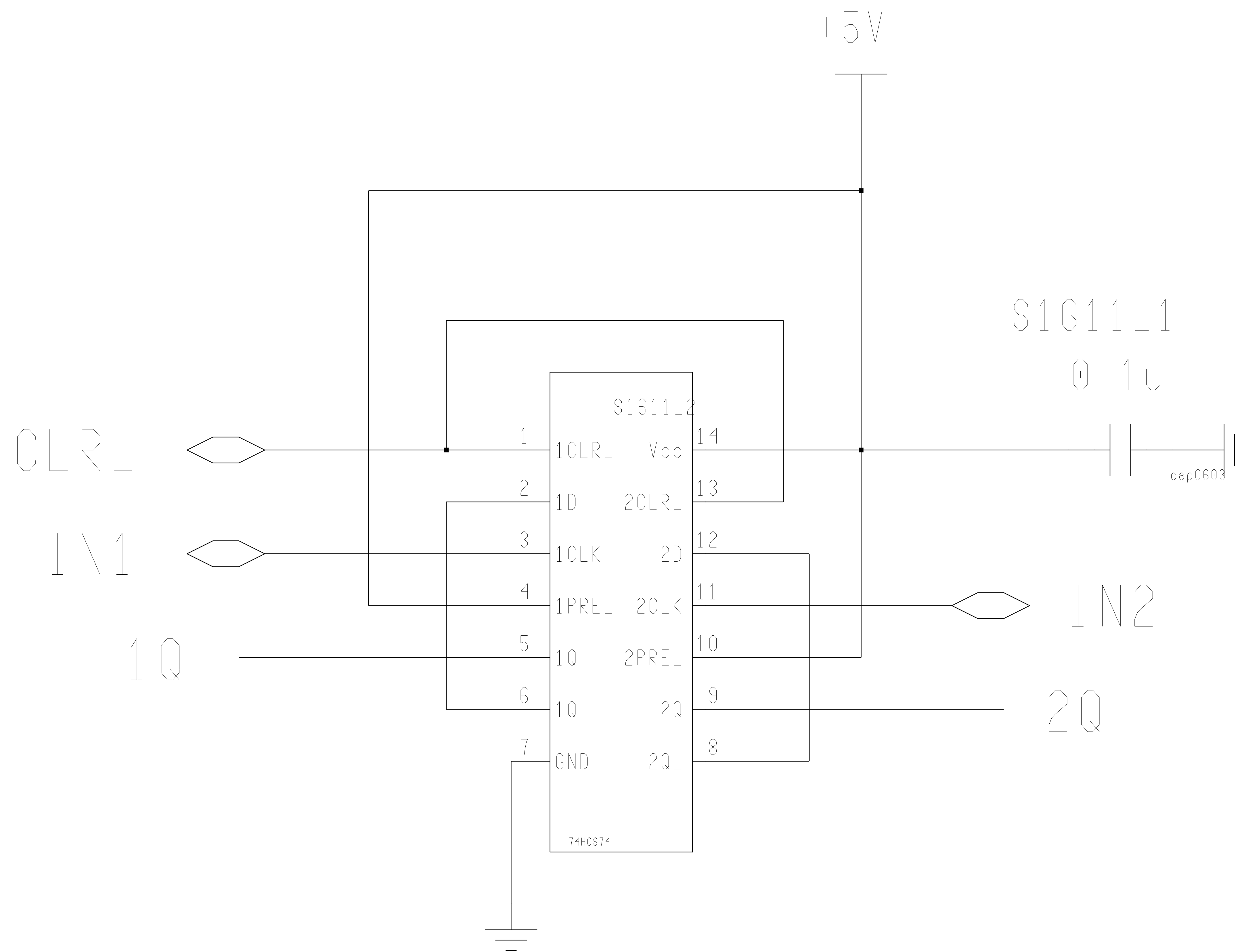
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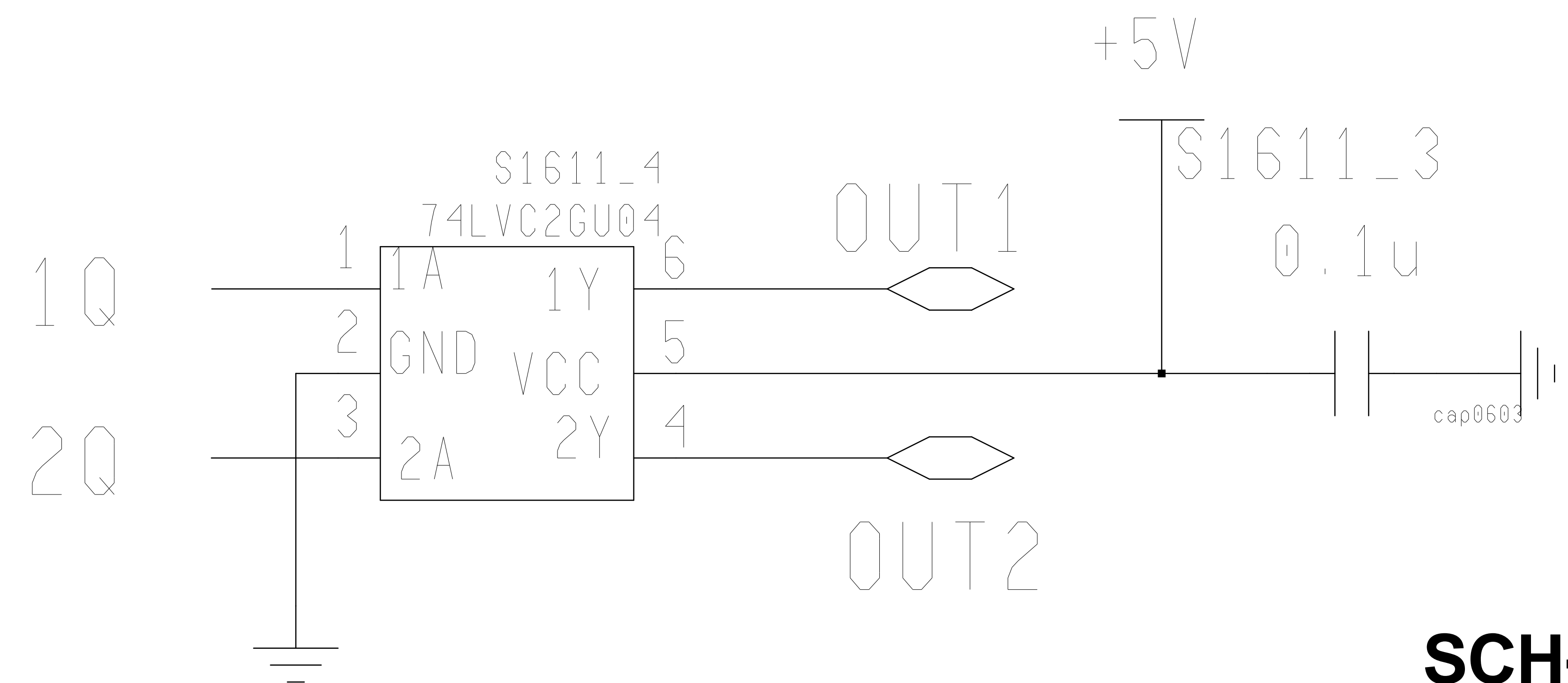
NLV27WZ16DFT2G

**SCH-2982
SPC-2983
ASM-2984**

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> DFE_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet	16_10



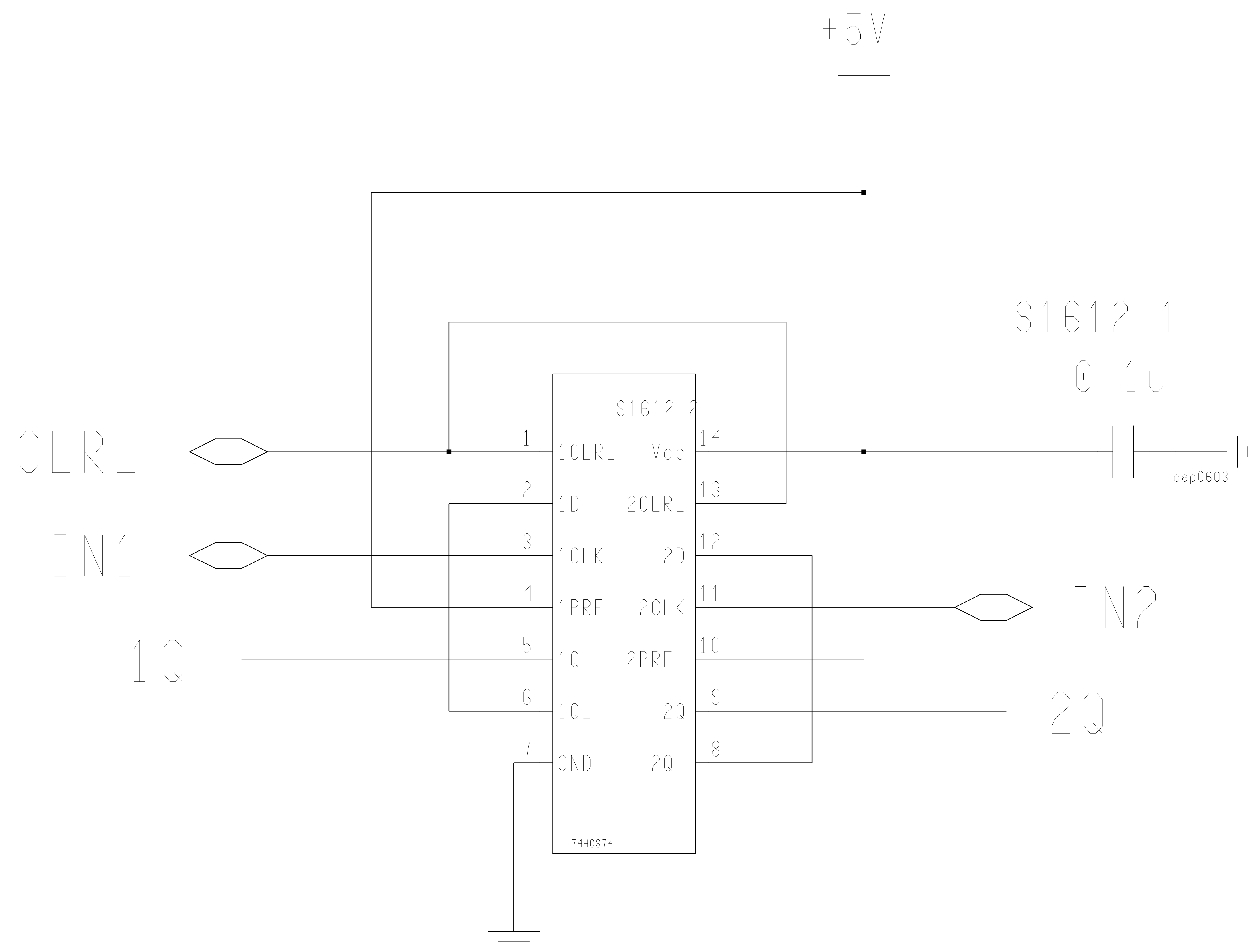
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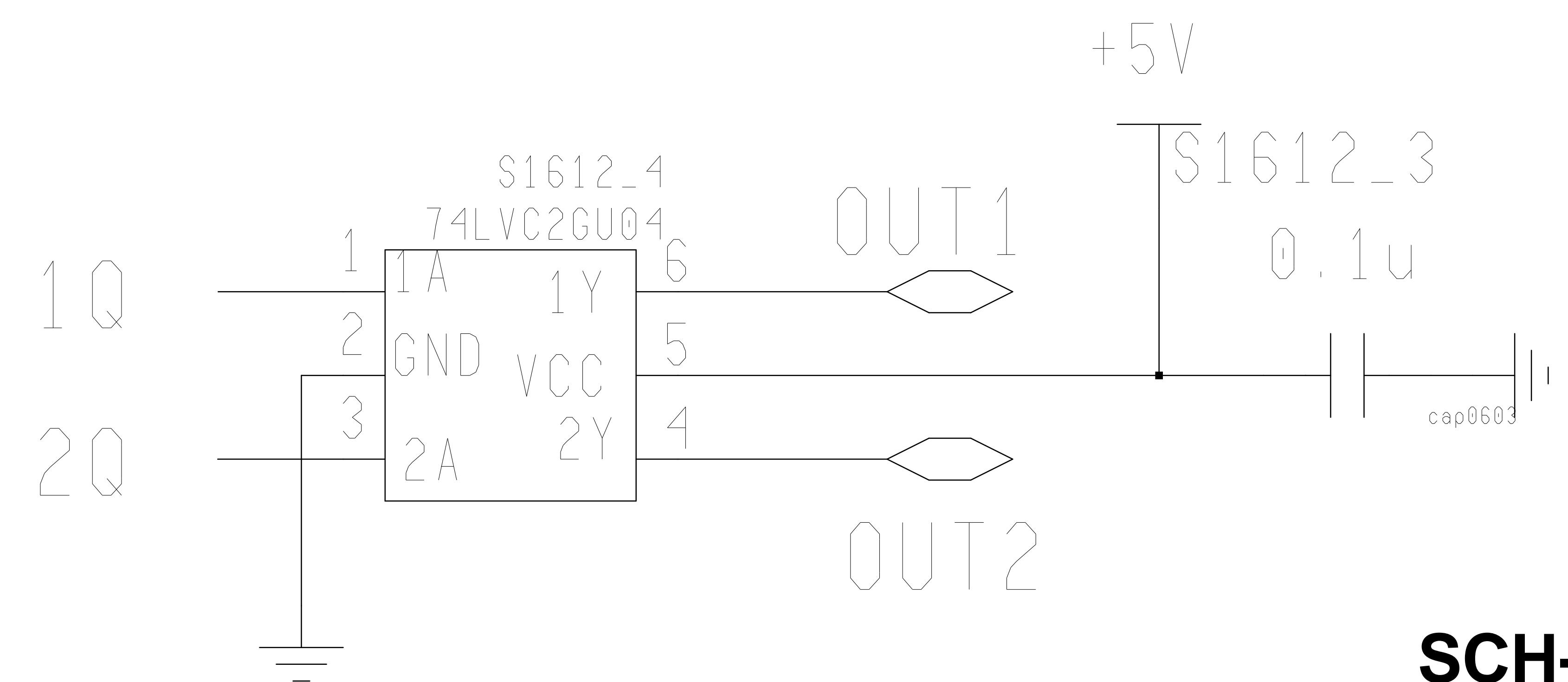
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**SCH-2982
SPC-2983
ASM-2984**

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> DFF_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet	16_11



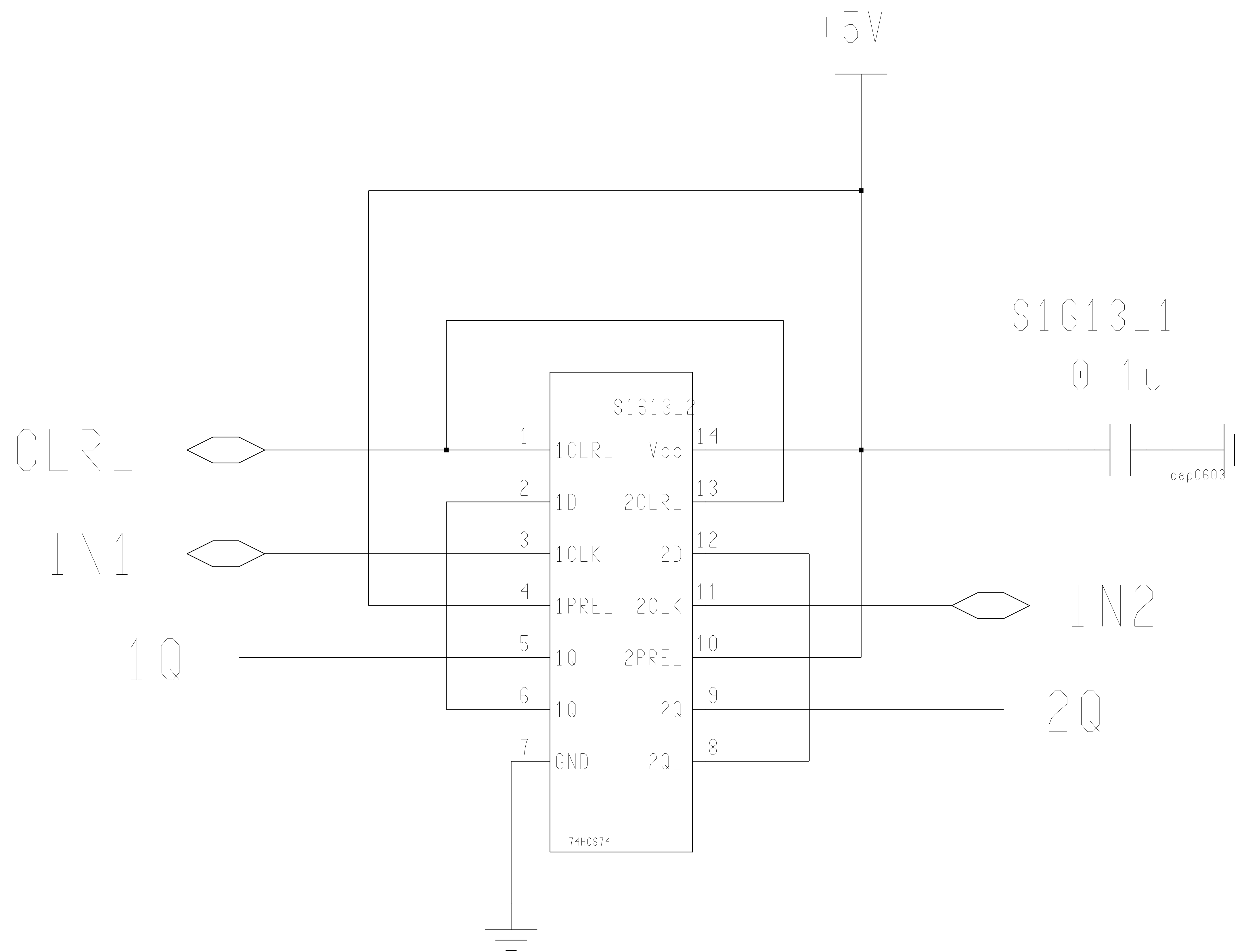
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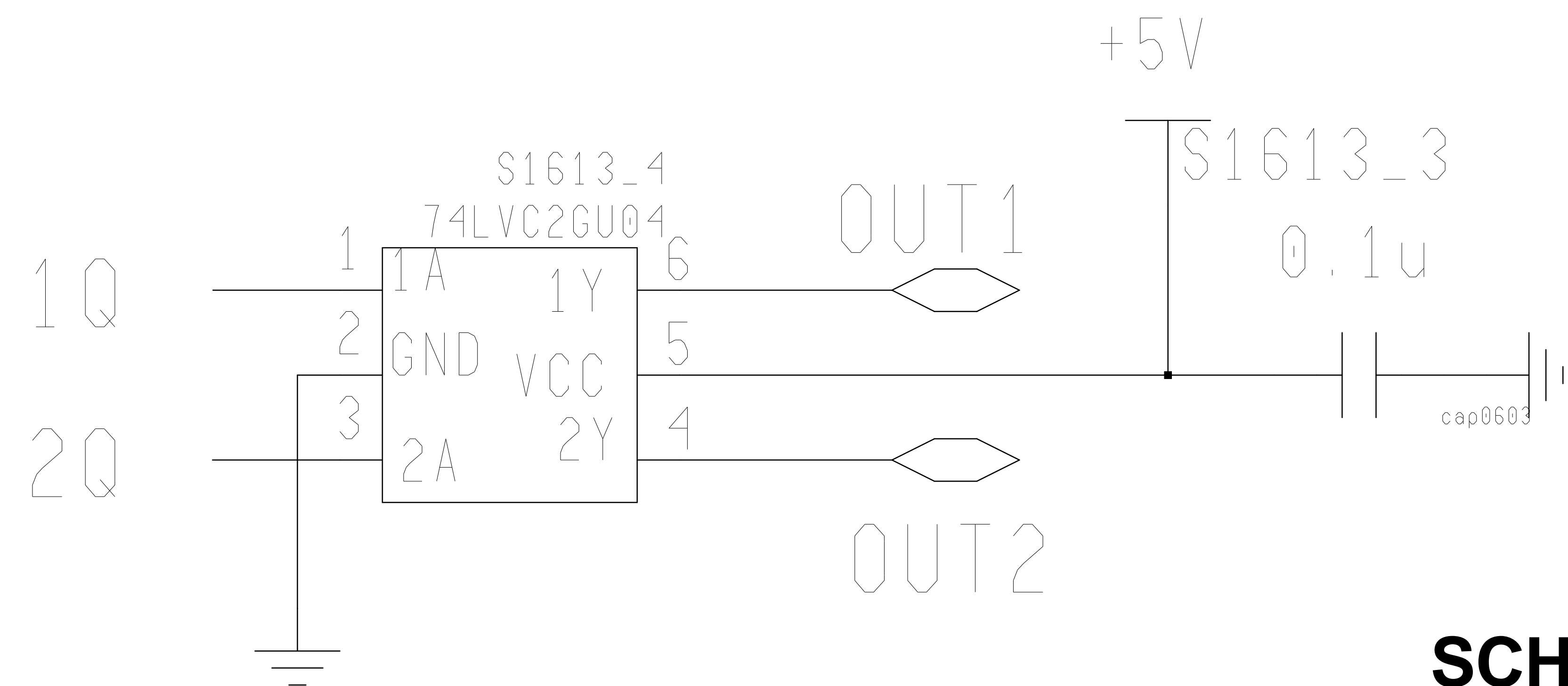
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**SCH-2982
SPC-2983
ASM-2984**

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> DFF_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet	16_12



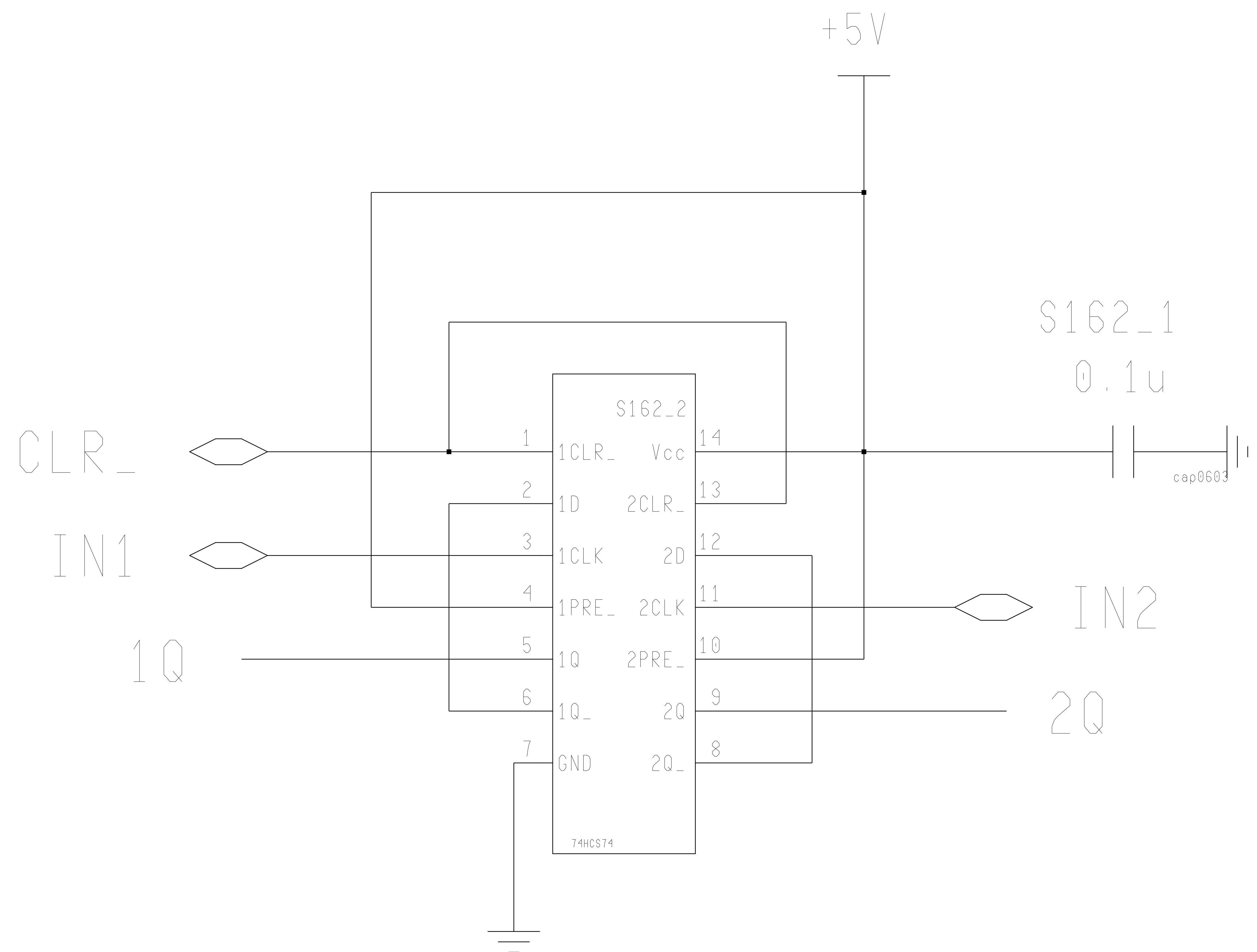
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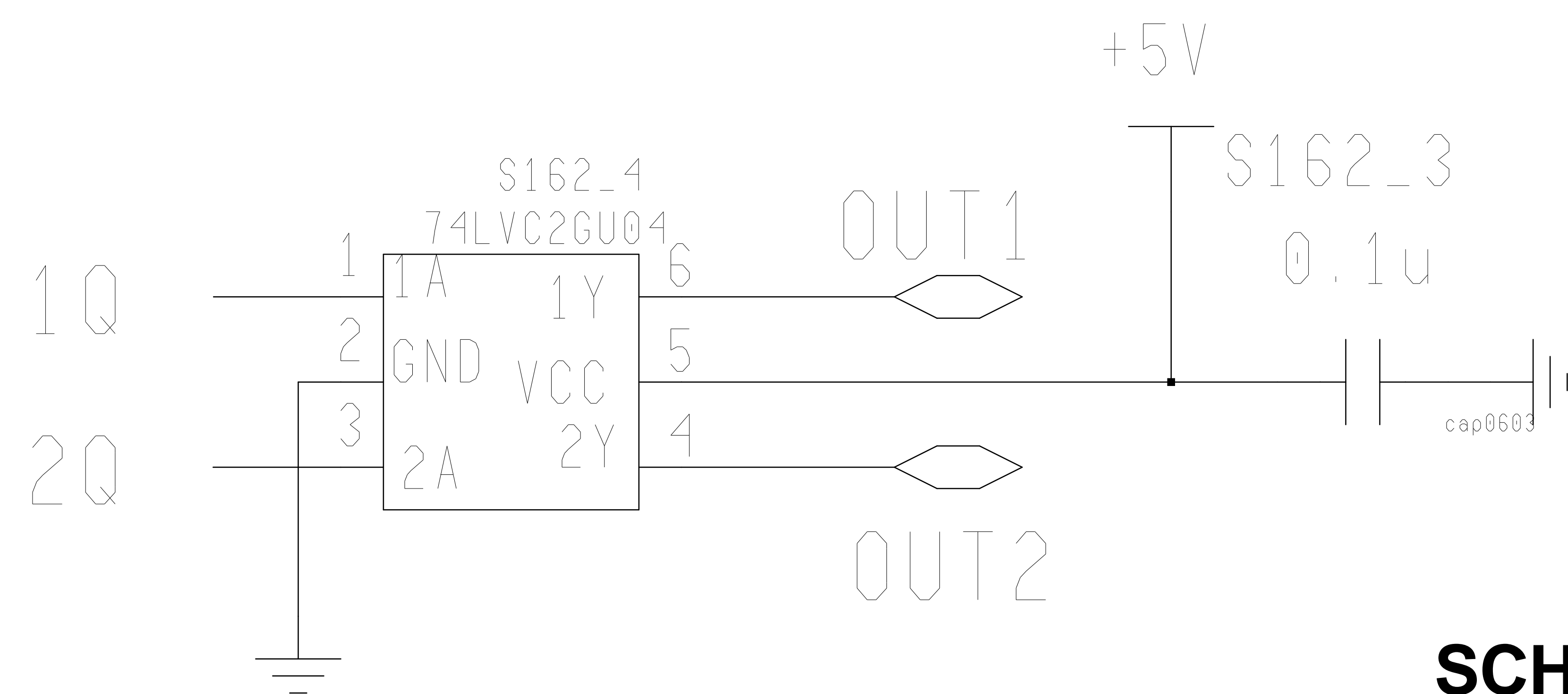
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**SCH-2982
SPC-2983
ASM-2984**

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> DFF_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet	16_13



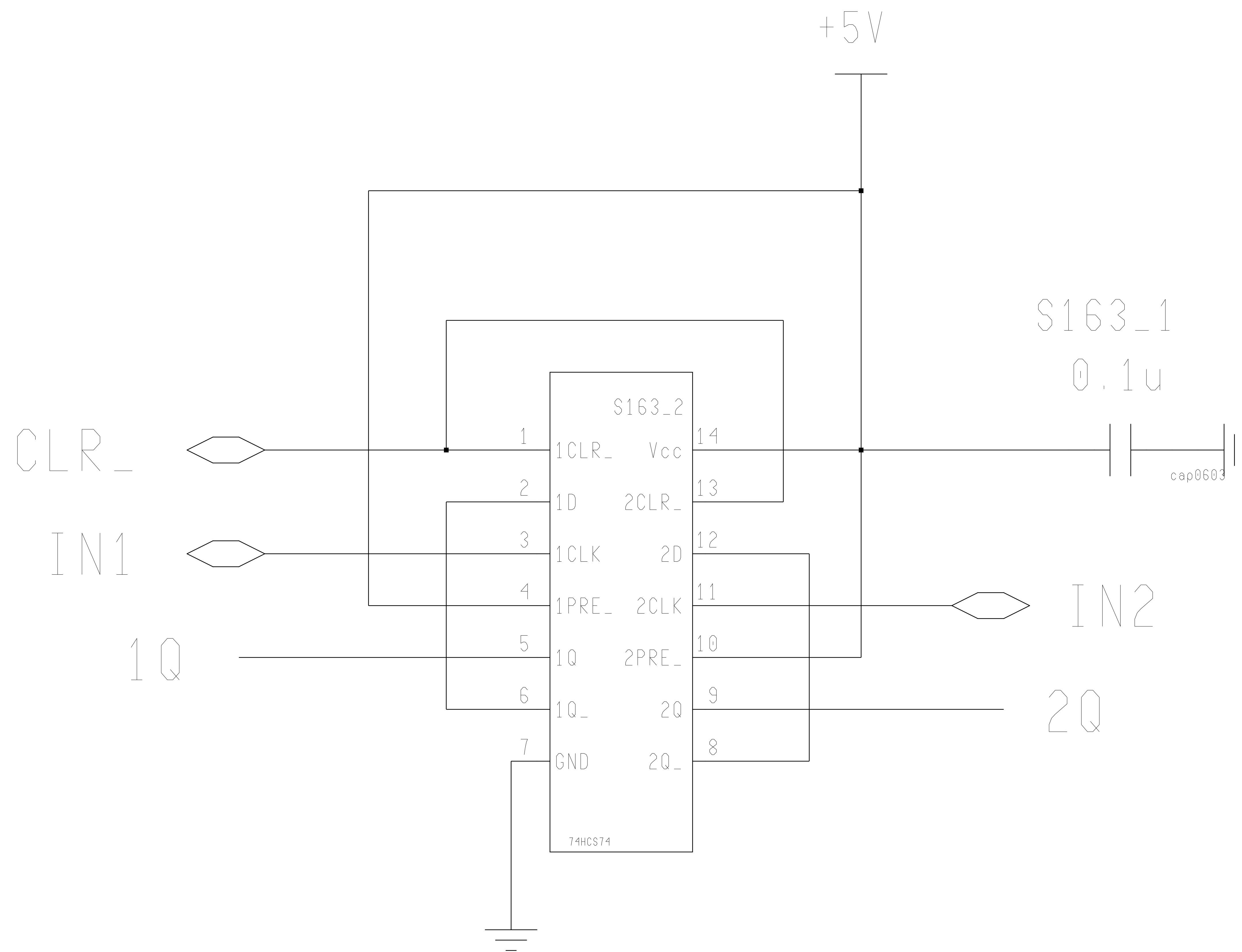
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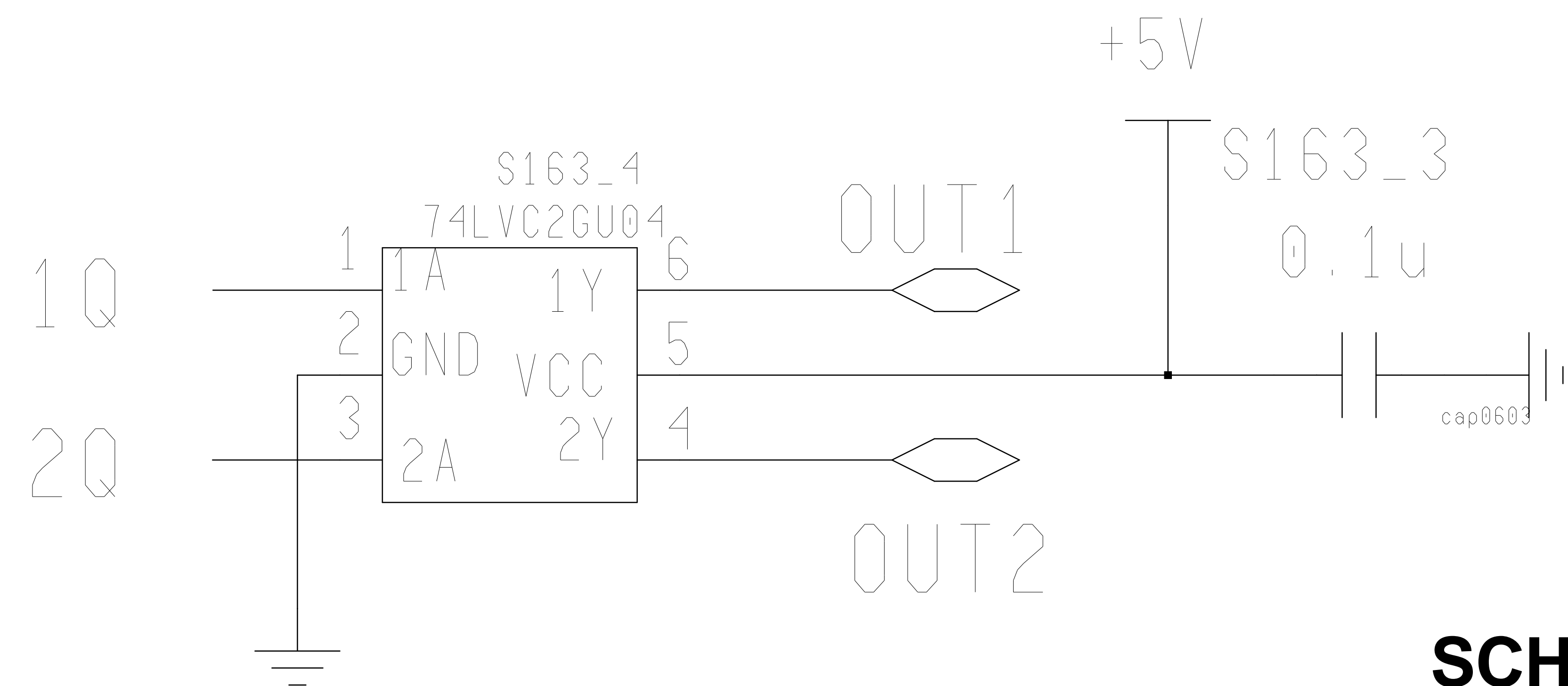
NLV27WZ16DFT2G

**SCH-2982
SPC-2983
ASM-2984**

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> DFE_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet 16_2	



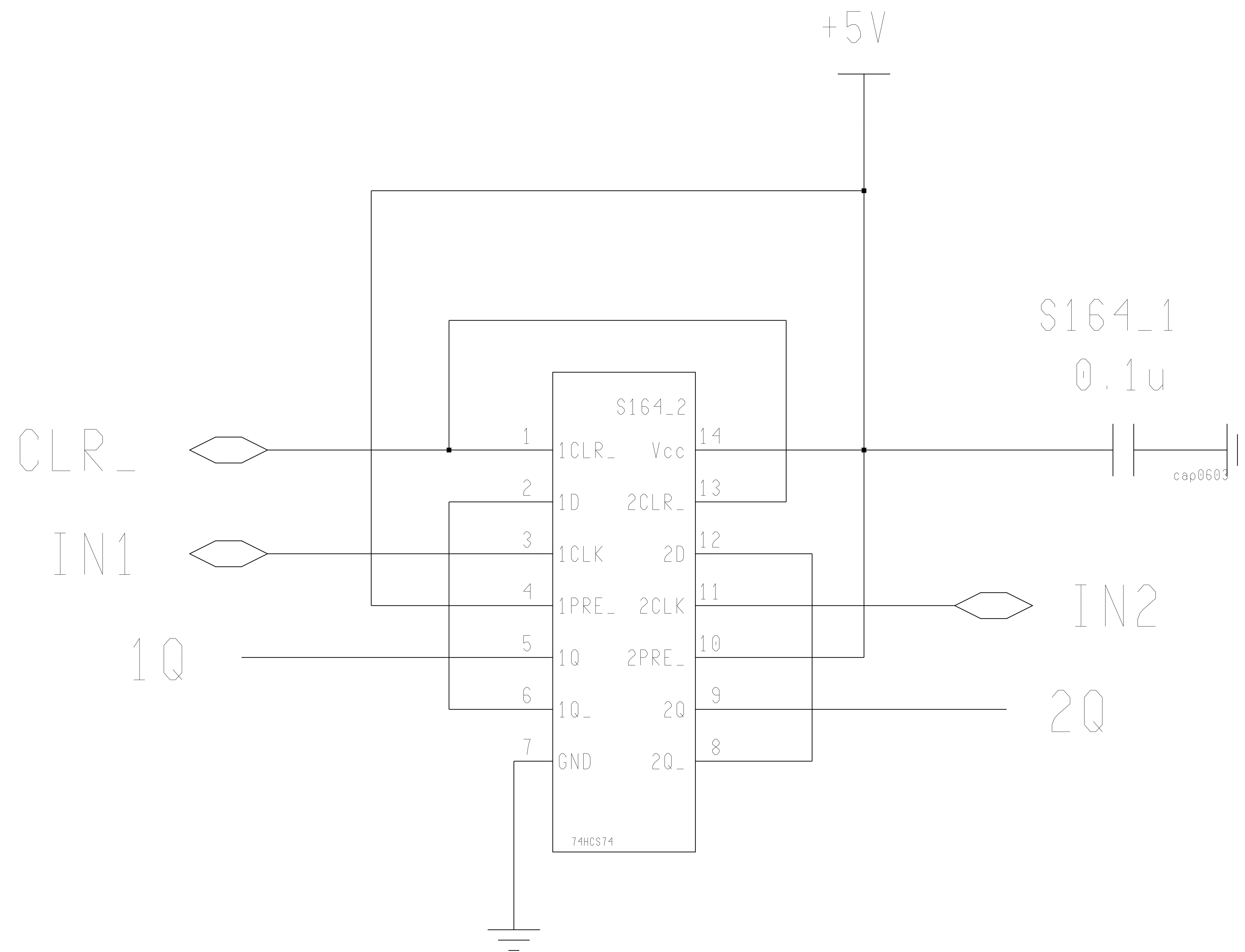
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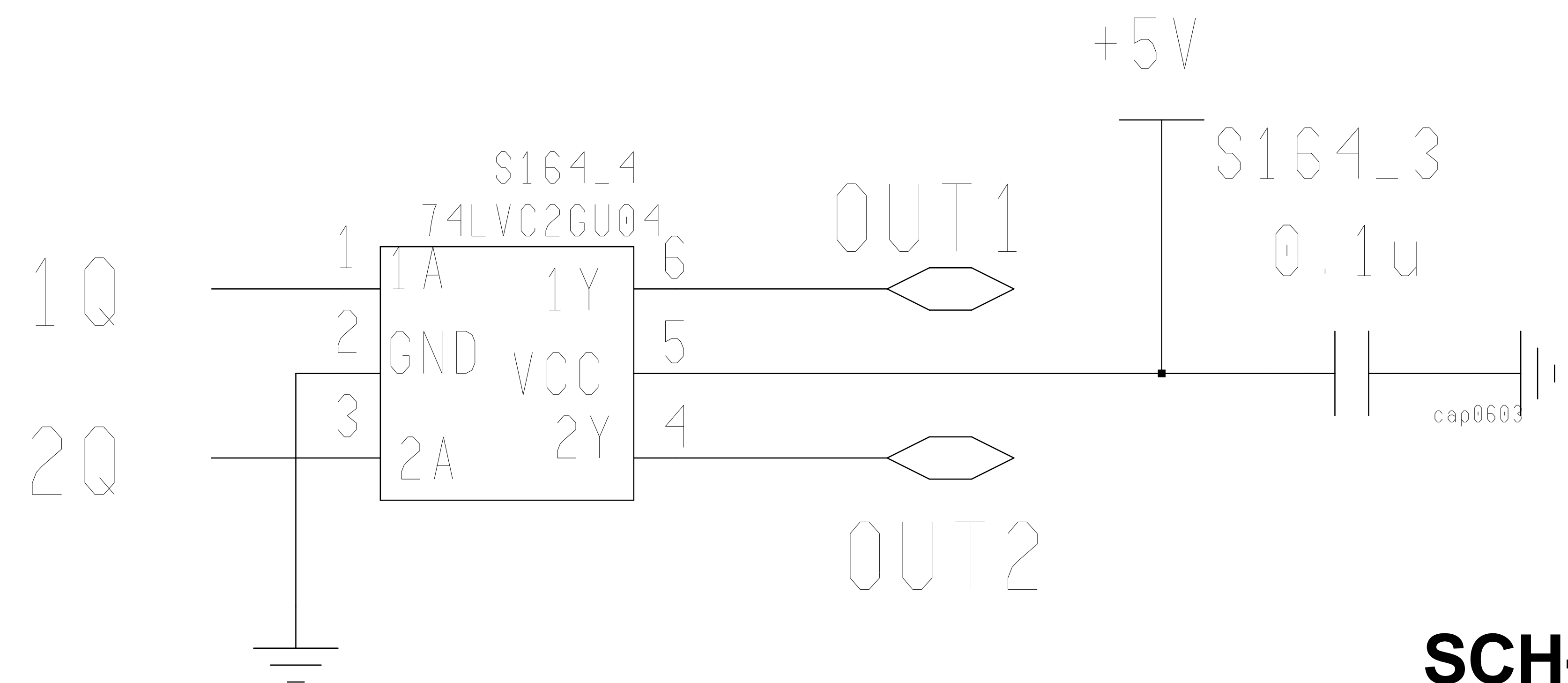
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**SCH-2982
SPC-2983
ASM-2984**

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> DFE_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet	16_3



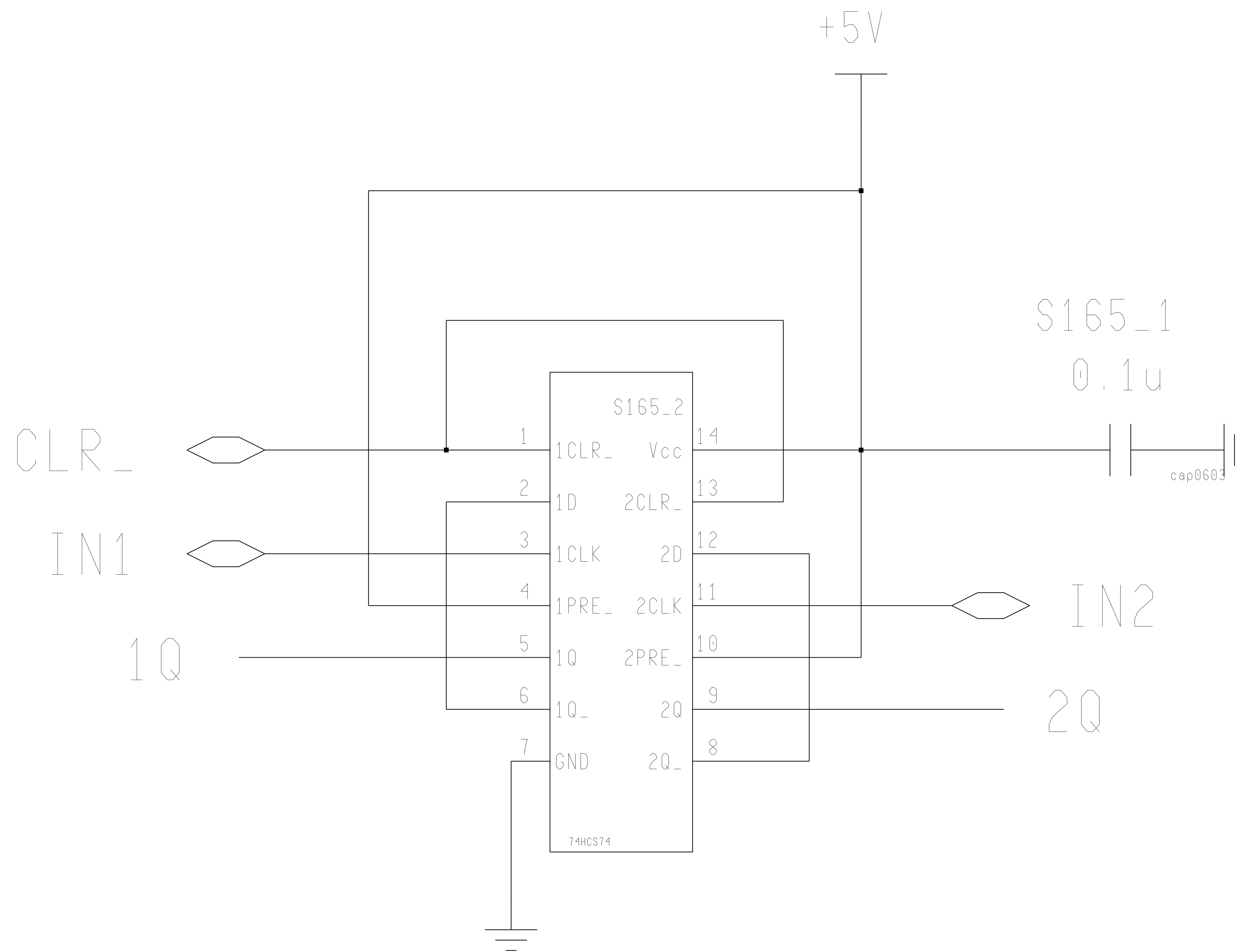
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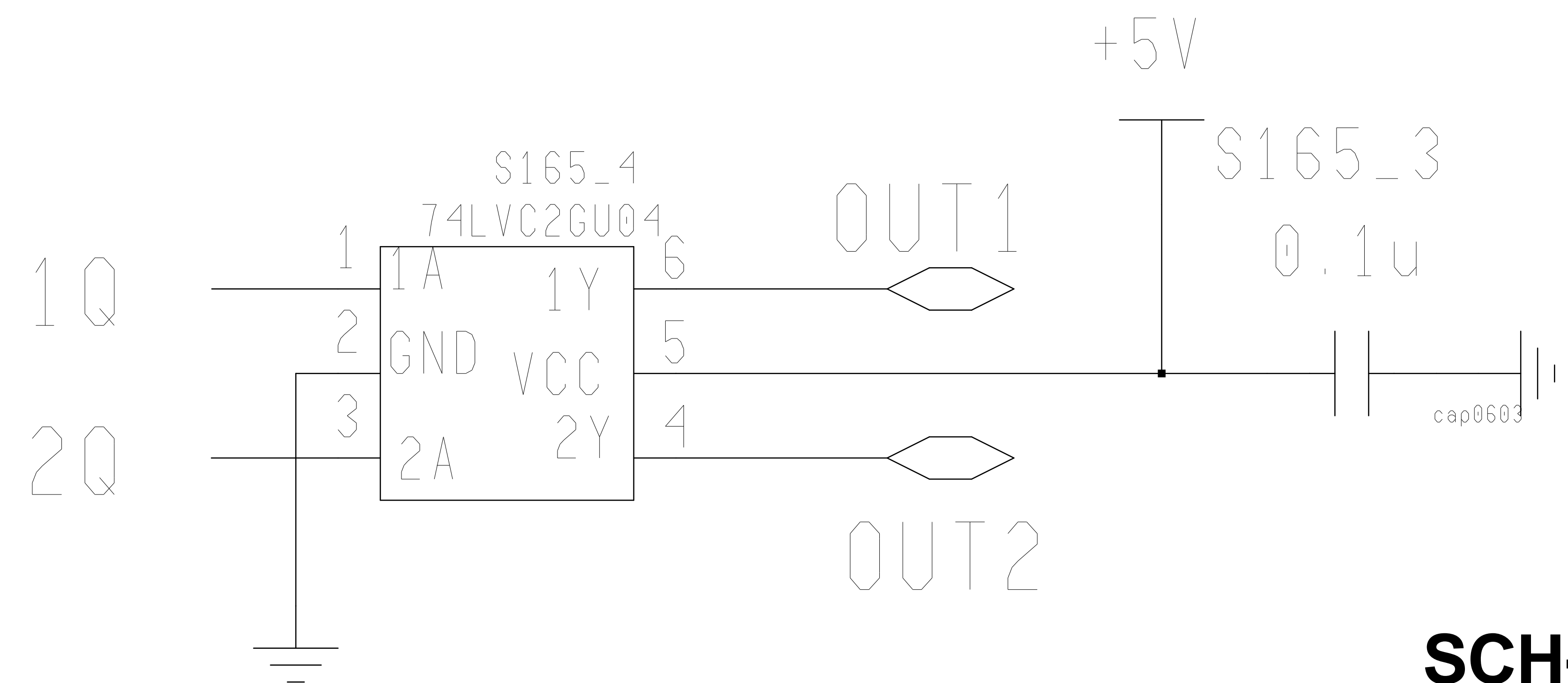
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**SCH-2982
SPC-2983
ASM-2984**

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> DFE_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet 16_4	



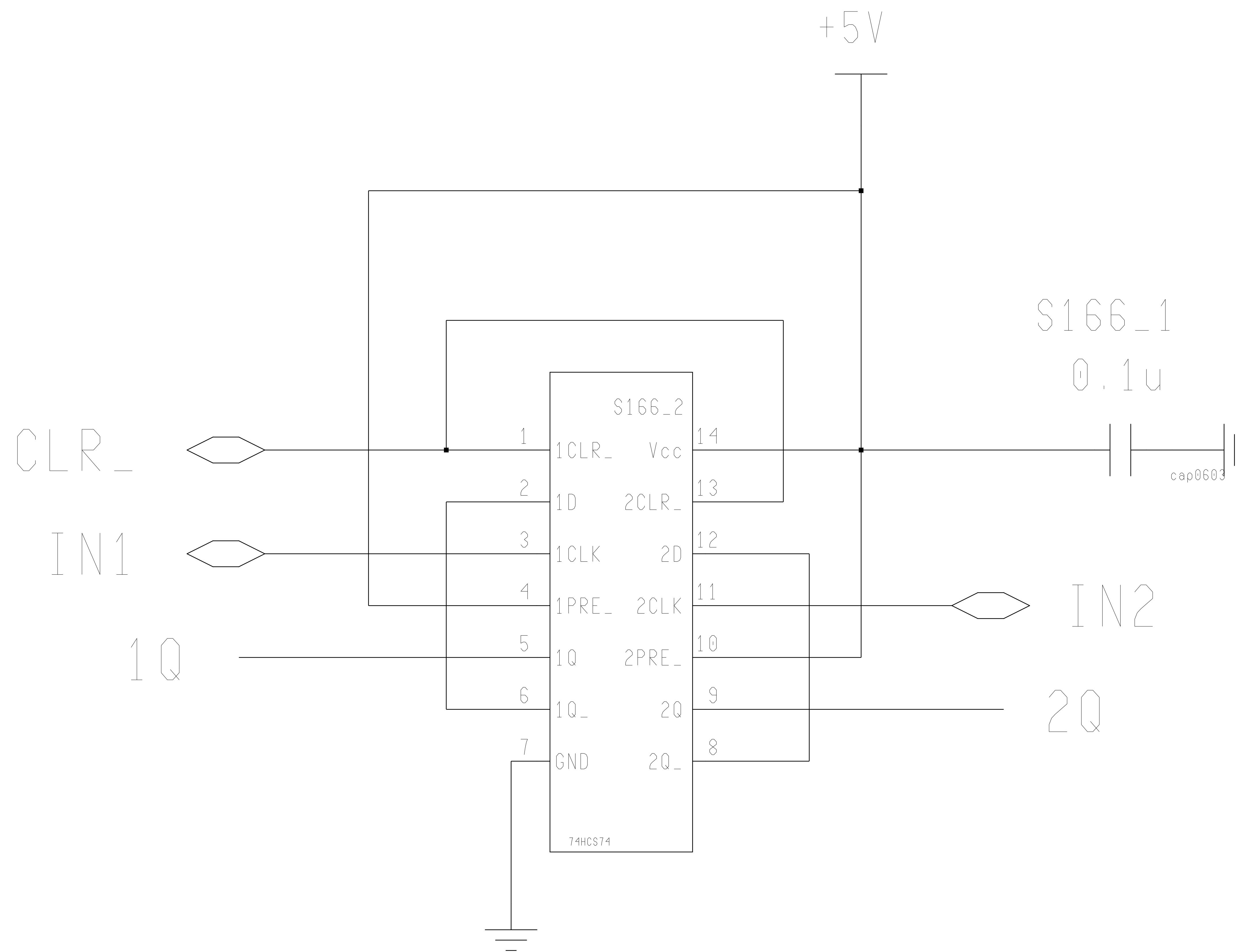
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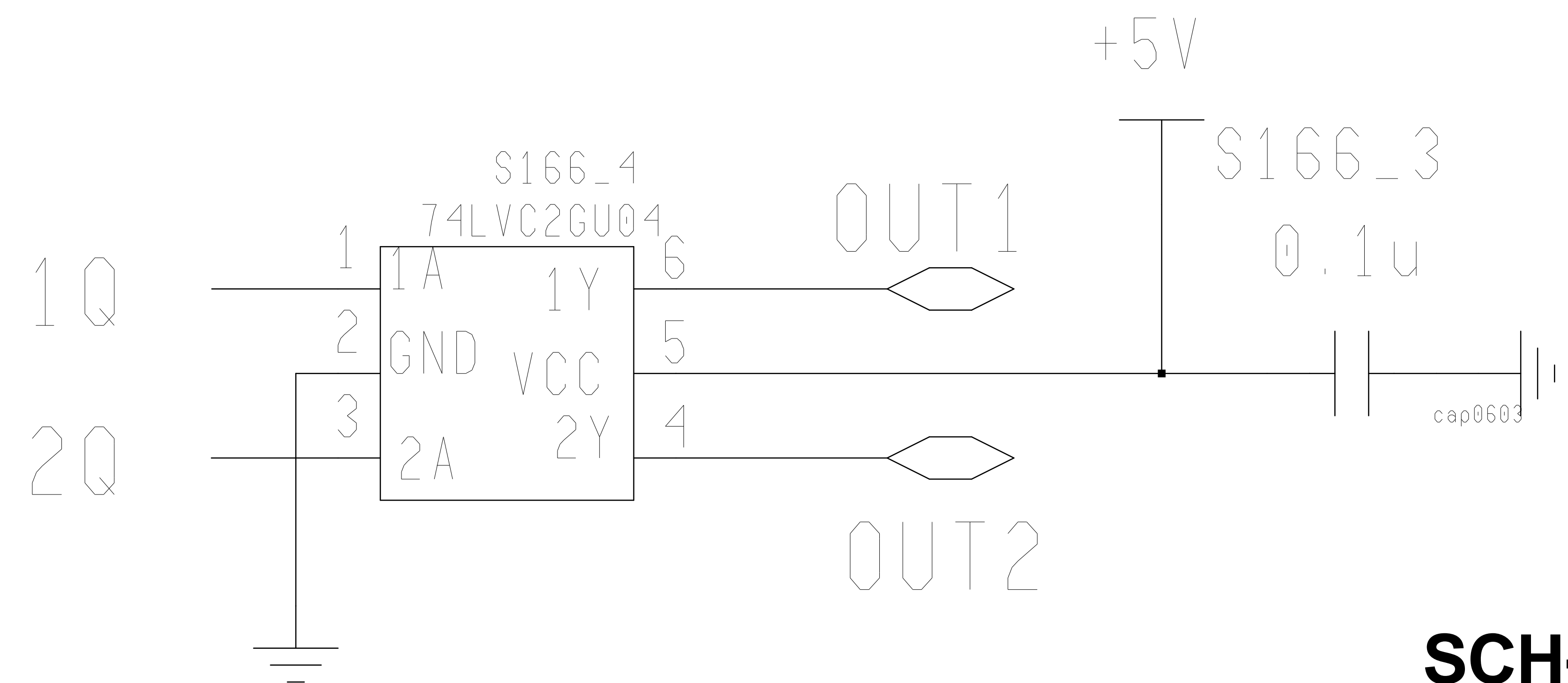
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**SCH-2982
SPC-2983
ASM-2984**

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> DFF_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet 16_5	



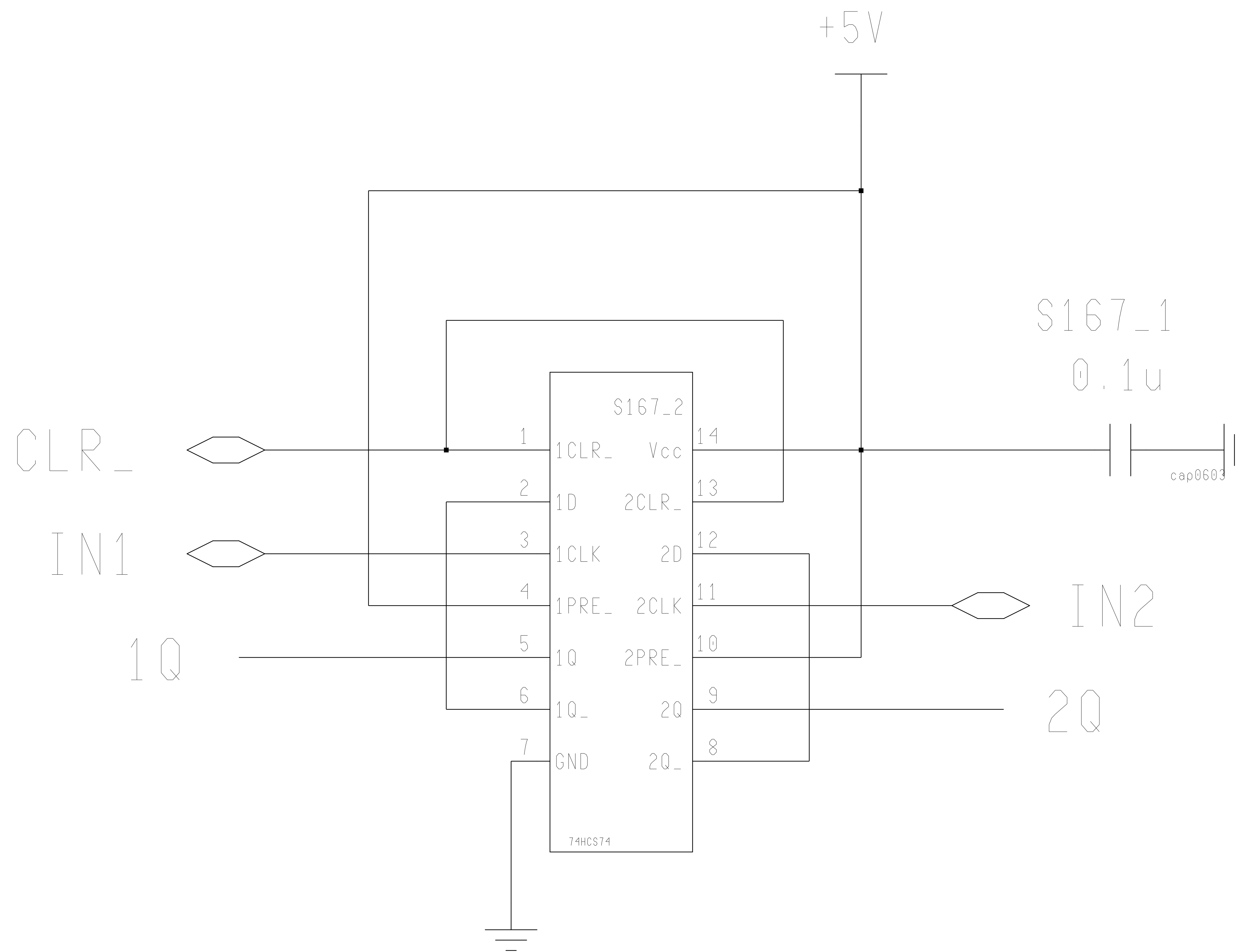
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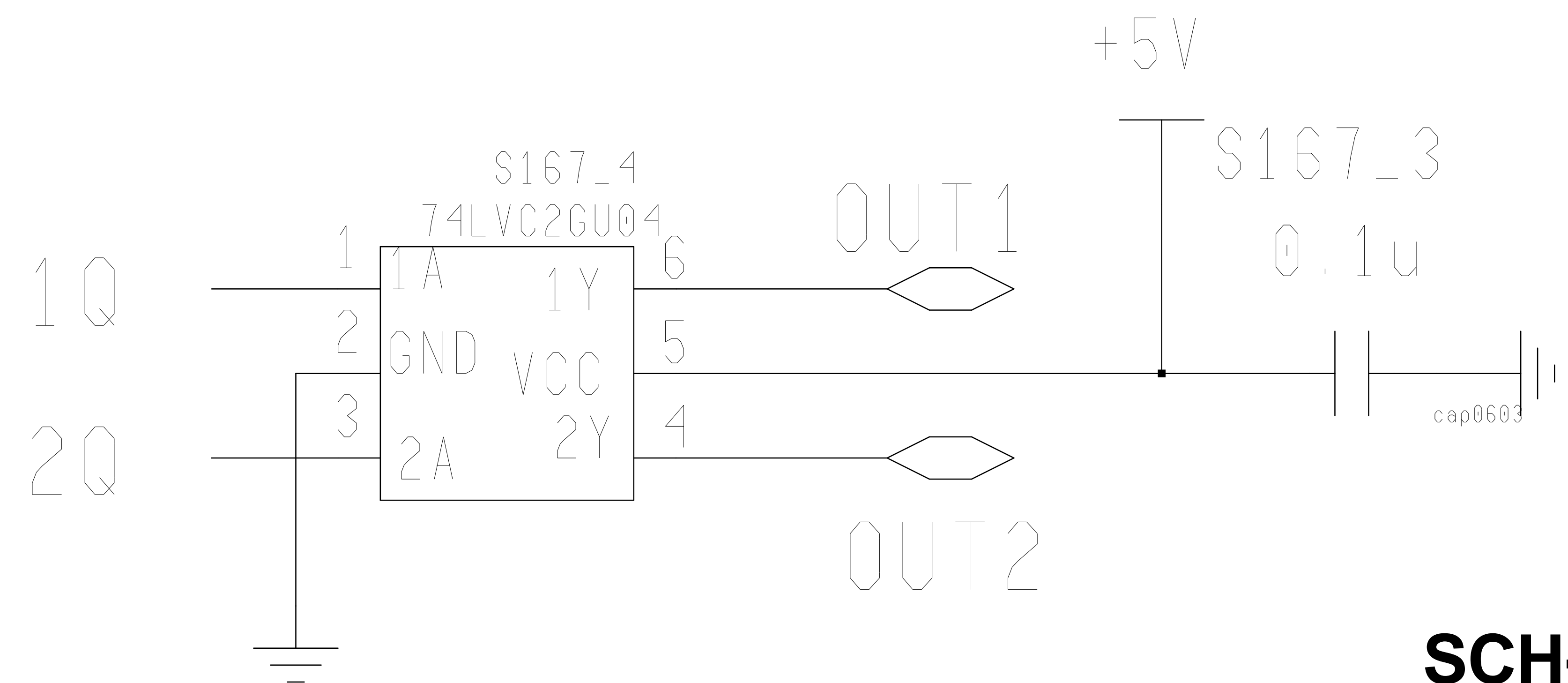
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**SCH-2982
SPC-2983
ASM-2984**

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> DFE_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet	16_6



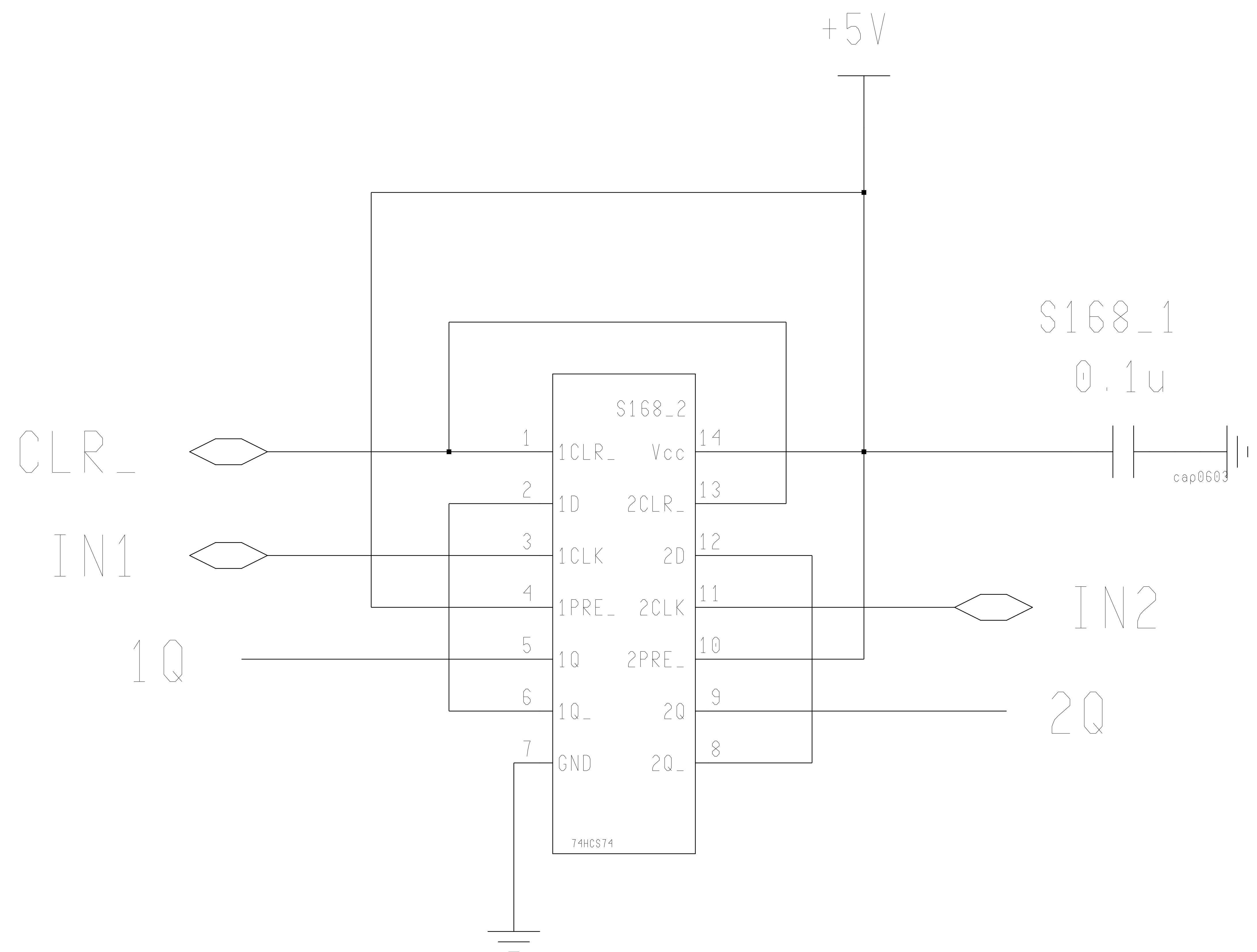
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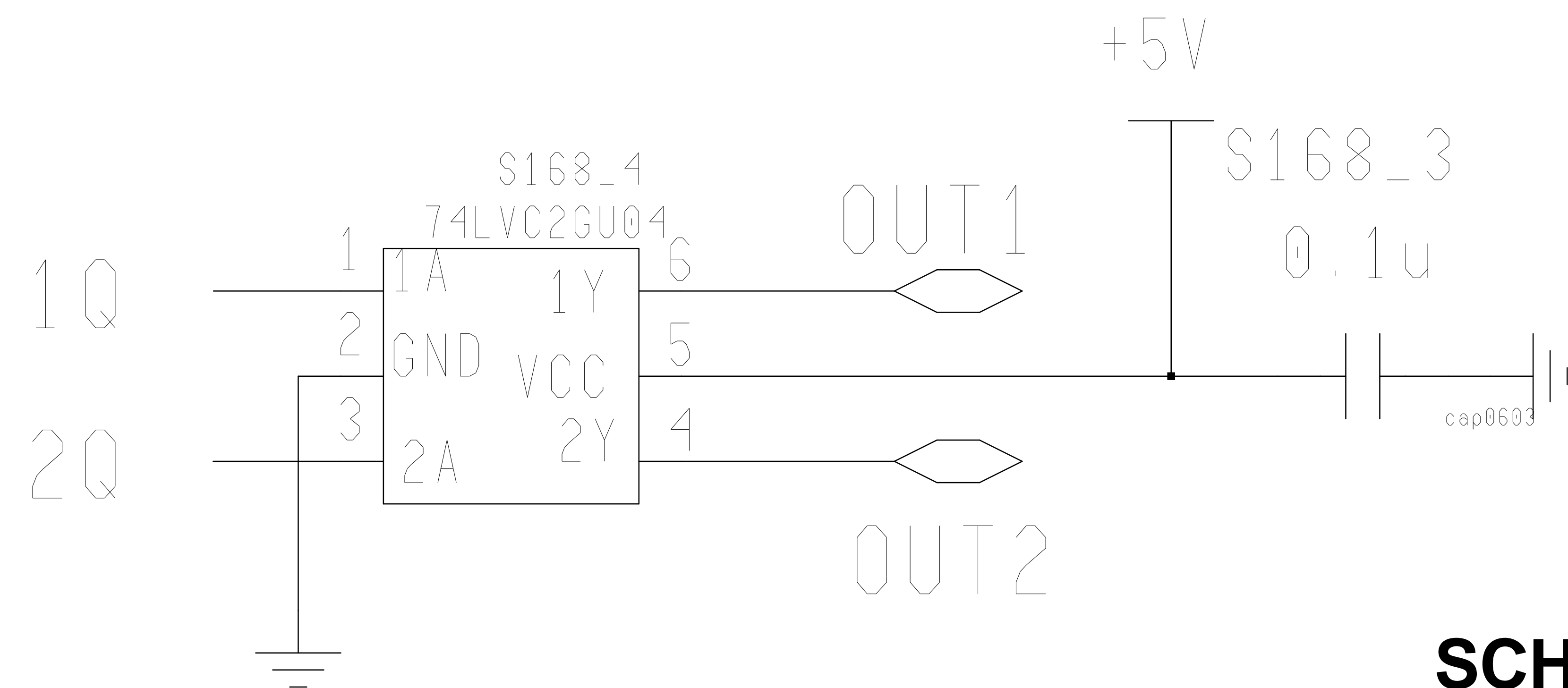
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**SCH-2982
SPC-2983
ASM-2984**

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> DFF_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet	16_7



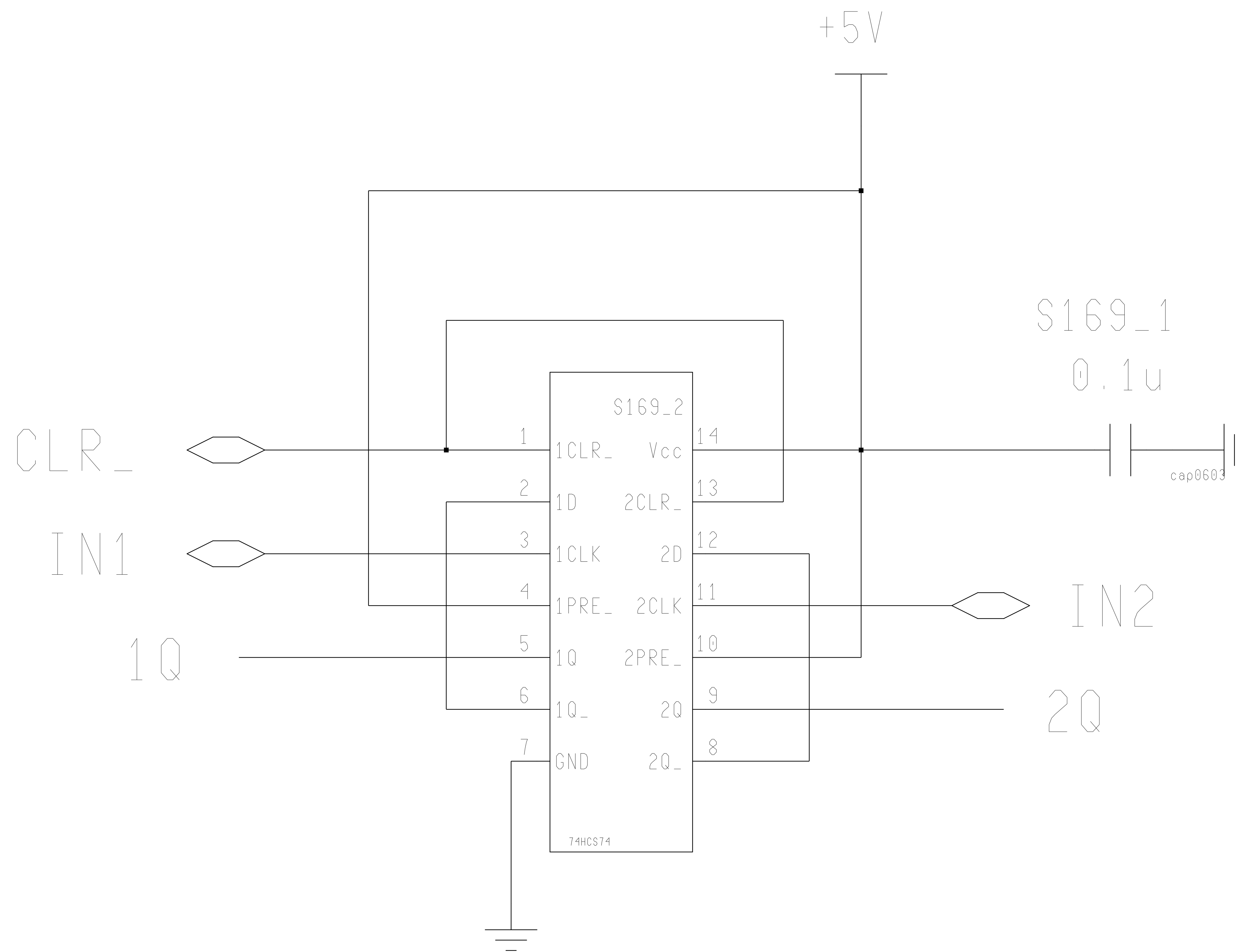
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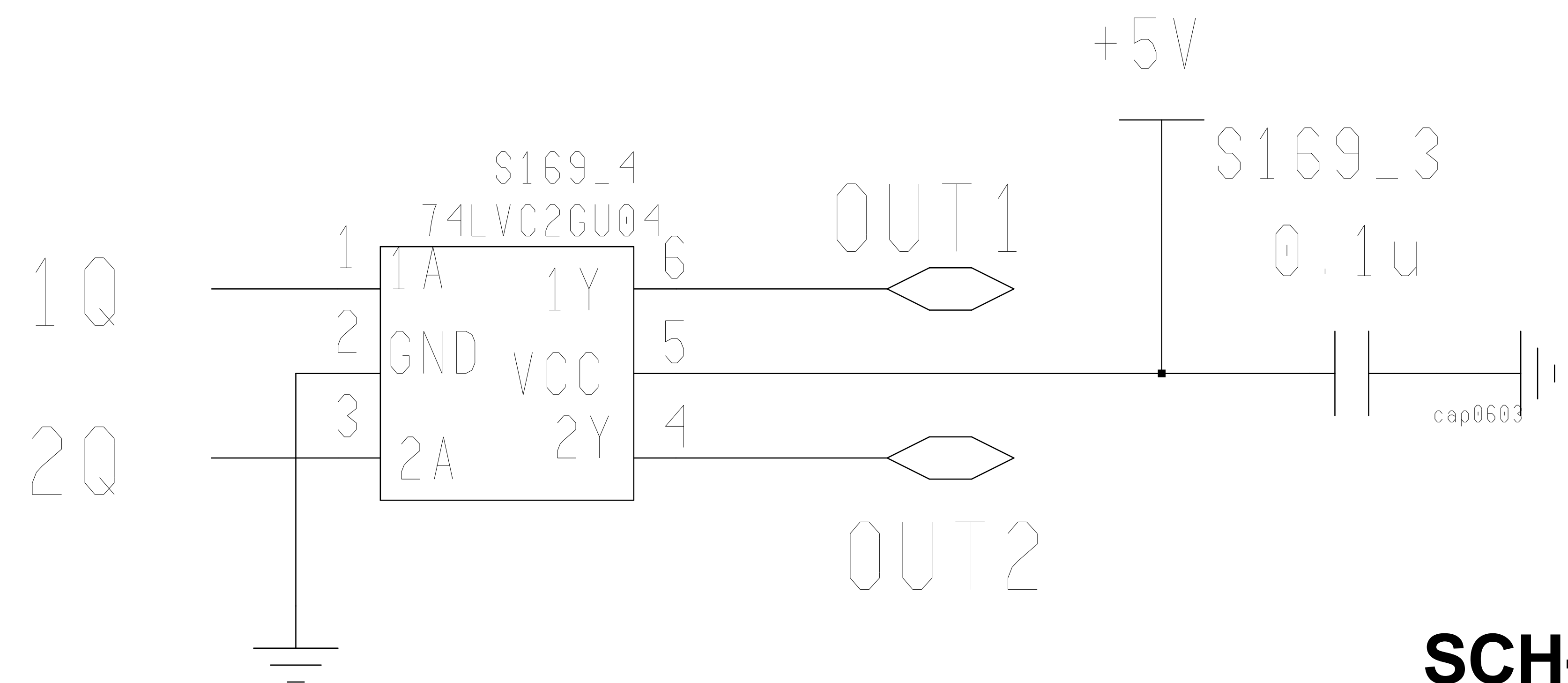
NLV27WZ16DFT2G

**SCH-2982
SPC-2983
ASM-2984**

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> DFF_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet	16_8



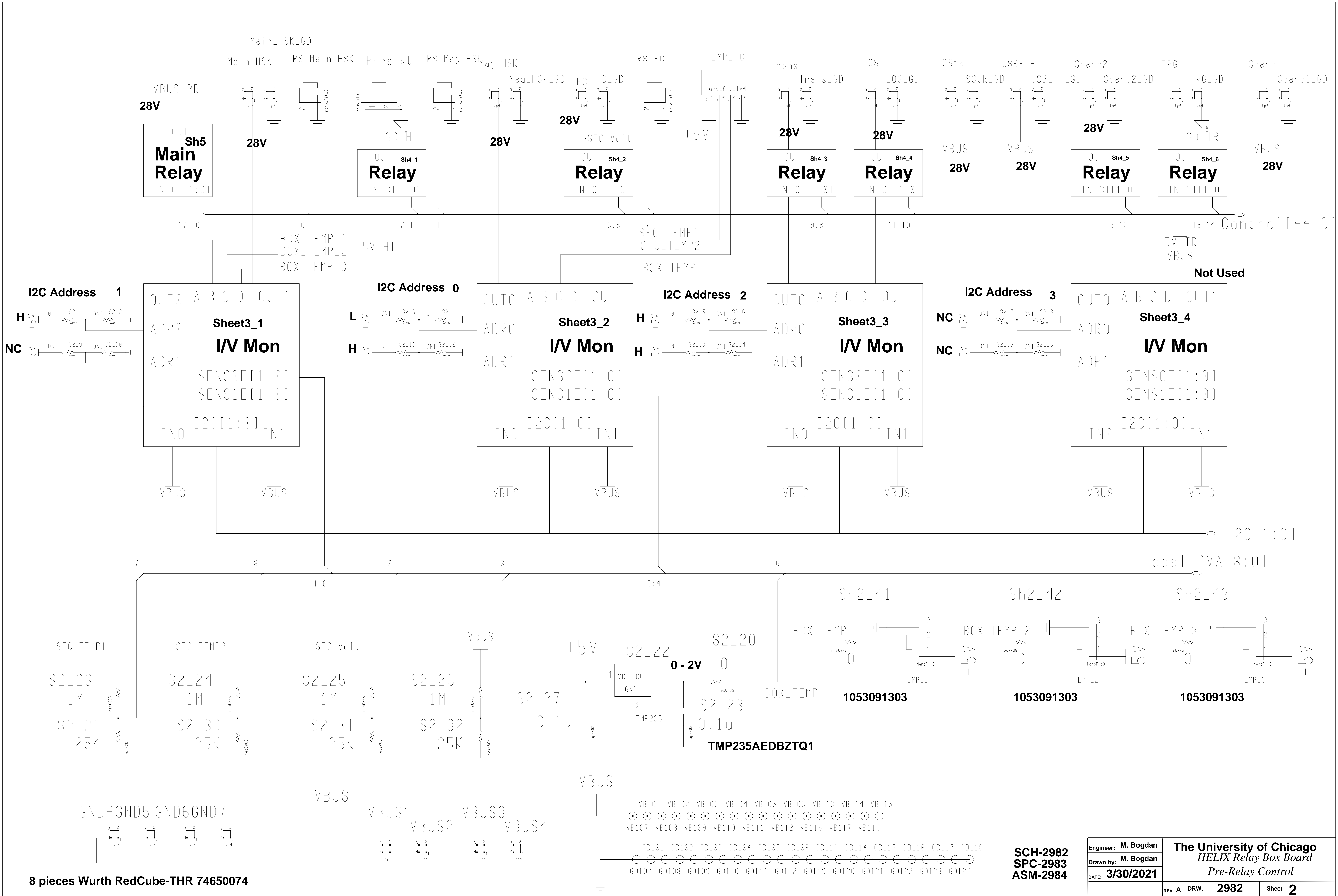
SN74HCS74DR



NLV27WZ16DFT2G

**SCH-2982
SPC-2983
ASM-2984**

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> DFF_1		
Drawn by: M. Bogdan			
DATE: 3/15/2021			
REV. A	DRW. 2982	Sheet	16_9

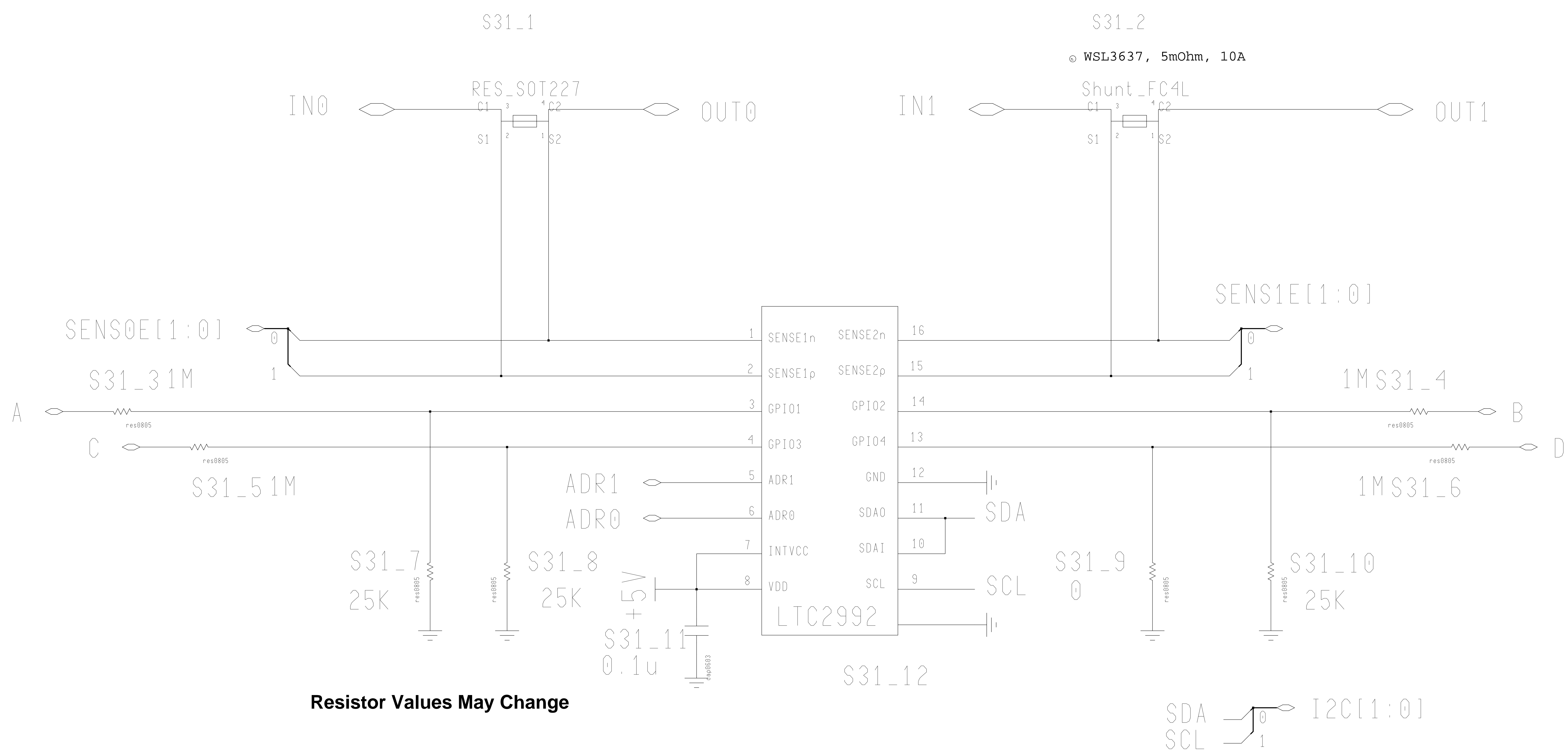


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SCH-2982
 SPC-2983
 ASM-2984

Engineer: M. Bogdan
 Drawn by: M. Bogdan
 DATE: 3/30/2021

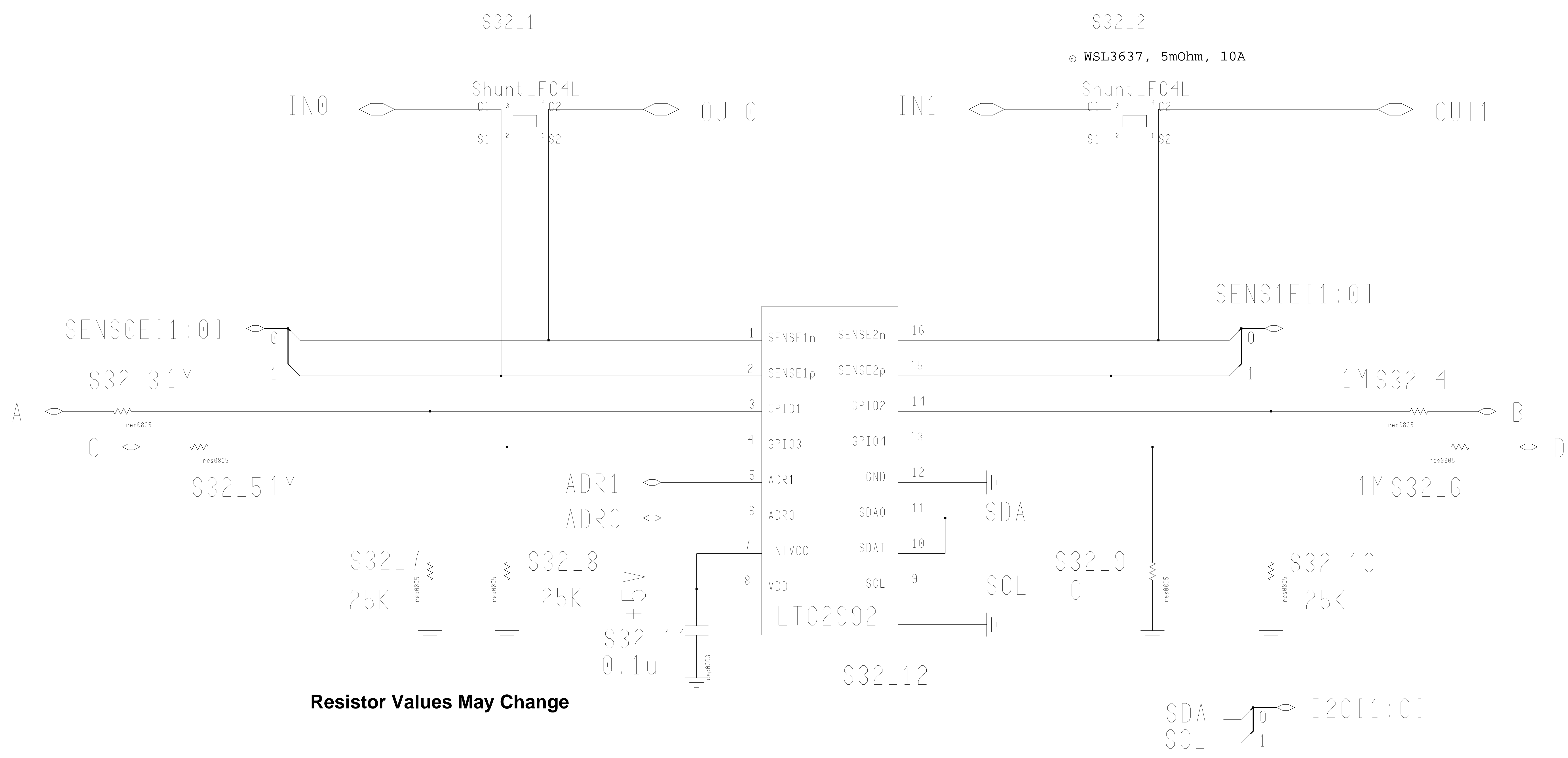
The University of Chicago
 HELIX Relay Box Board
 Pre-Relay Control



Resistor Values May Change

SCH-2982
SPC-2983
ASM-2984

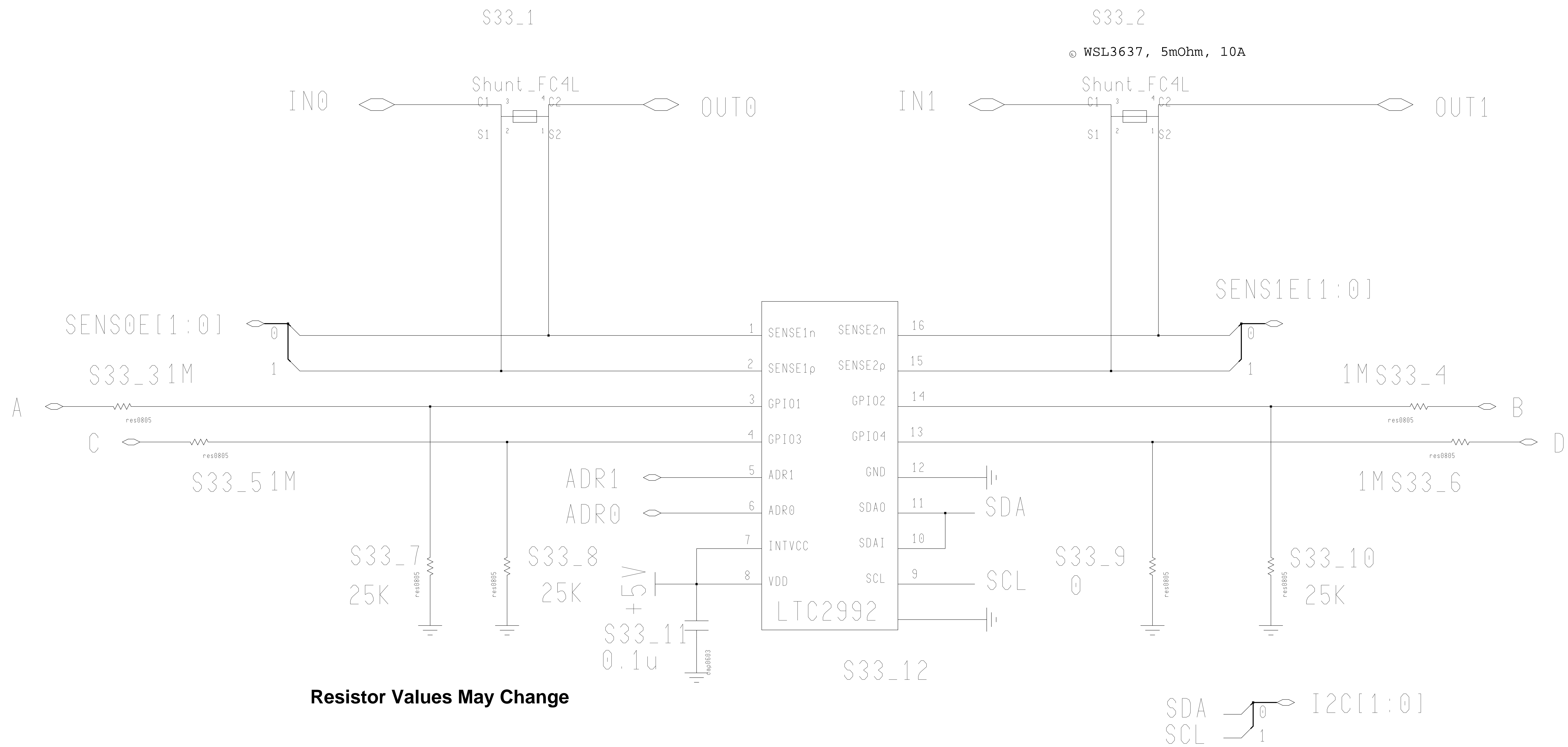
Engineer: M. Bogdan	The University of Chicago HELIX Relay Box Board I/V Monitor	
Drawn by: M. Bogdan		
DATE: 3/22/2021		
REV. A	DRW. 2982	Sheet 3_1



Resistor Values May Change

**SCH-2982
SPC-2983
ASM-2984**

Engineer: M. Bogdan	The University of Chicago	
Drawn by: M. Bogdan	<i>HELIX Relay Box Board</i>	
DATE: 3/22/2021	I/V Monitor	
REV. A	DRW. 2982	Sheet 3_2

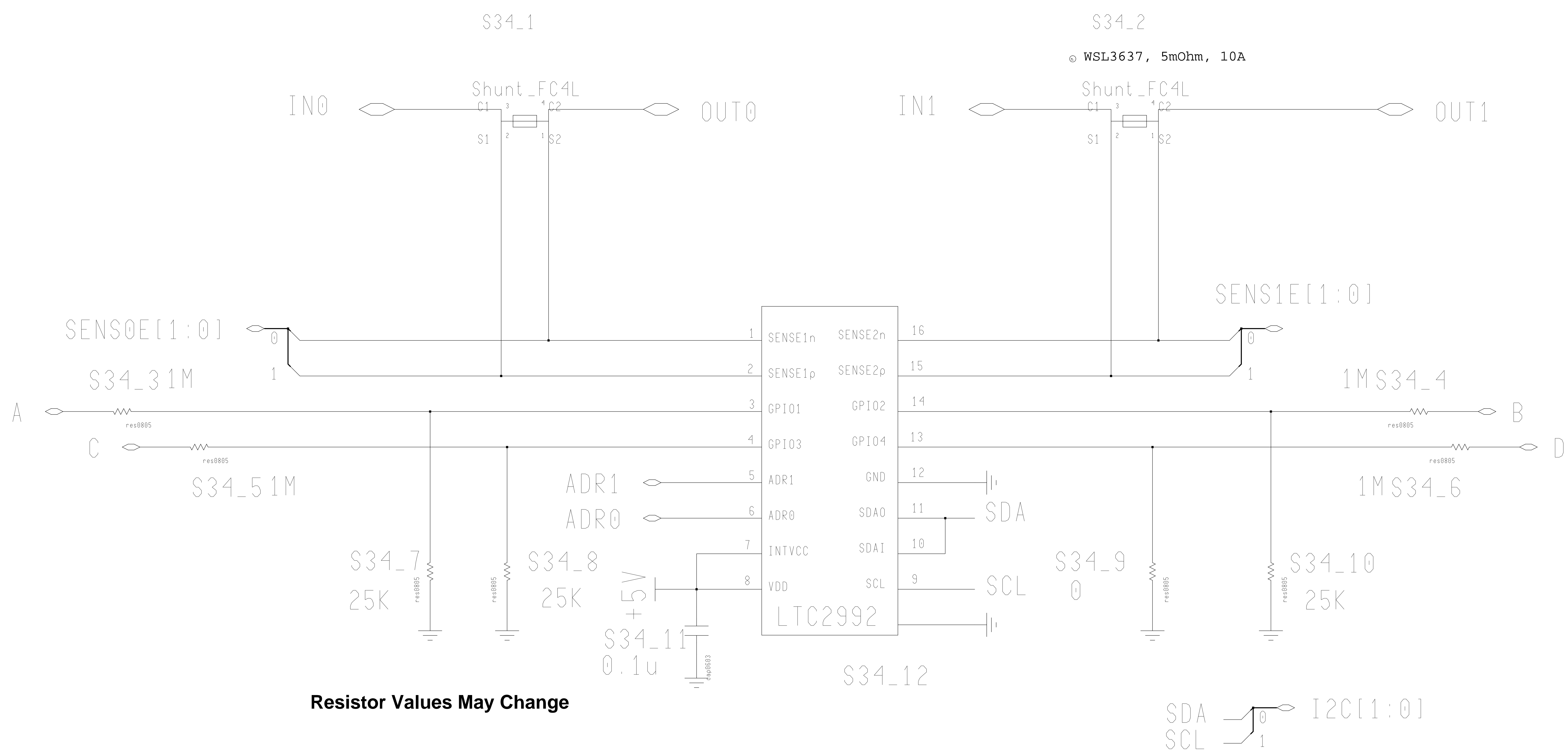


SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan
Drawn by: M. Bogdan
DATE: 3/22/2021

The University of Chicago
HELIX Relay Box Board
I/V Monitor

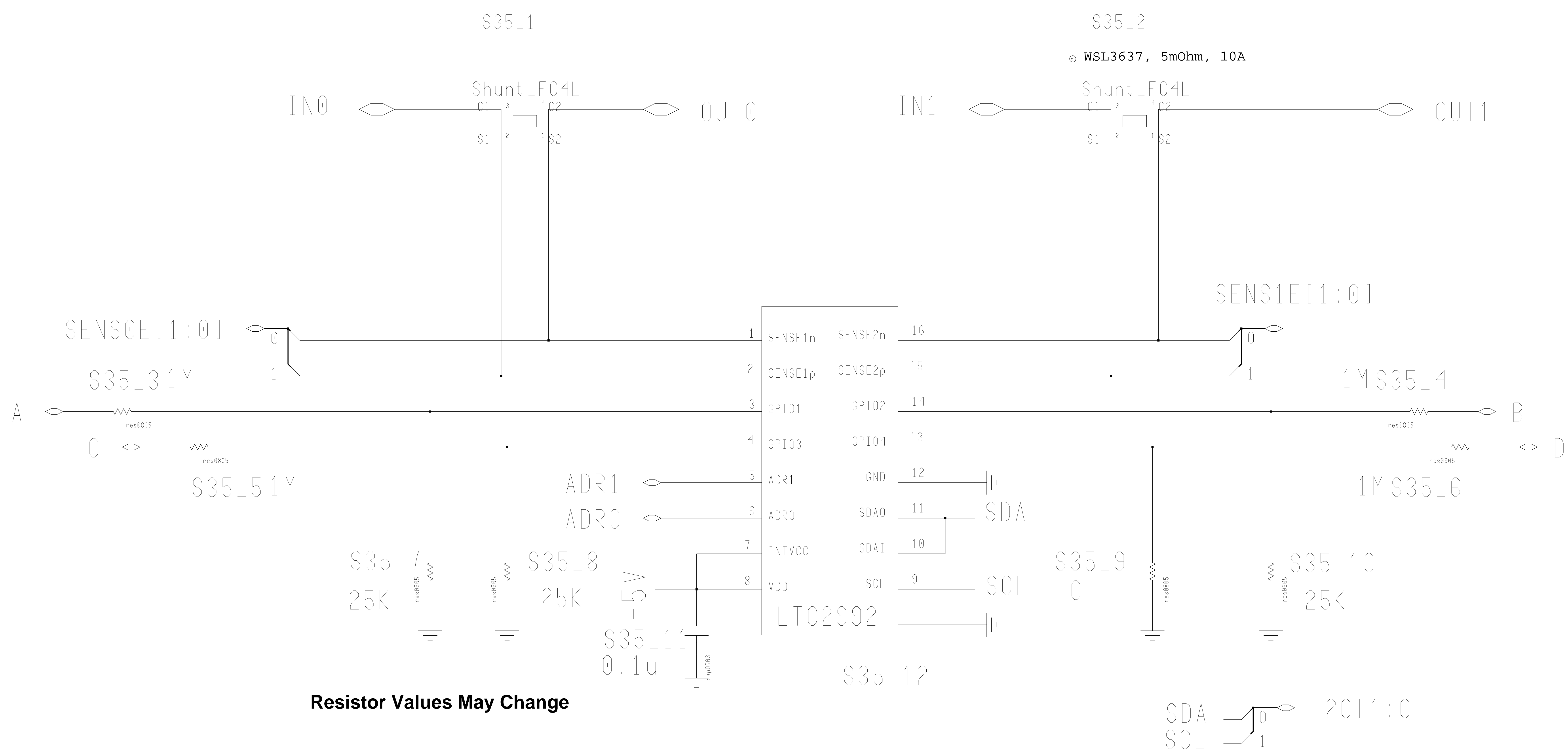
REV. A | DRW. 2982 | Sheet 3_3



Resistor Values May Change

SCH-2982
 SPC-2983
 ASM-2984

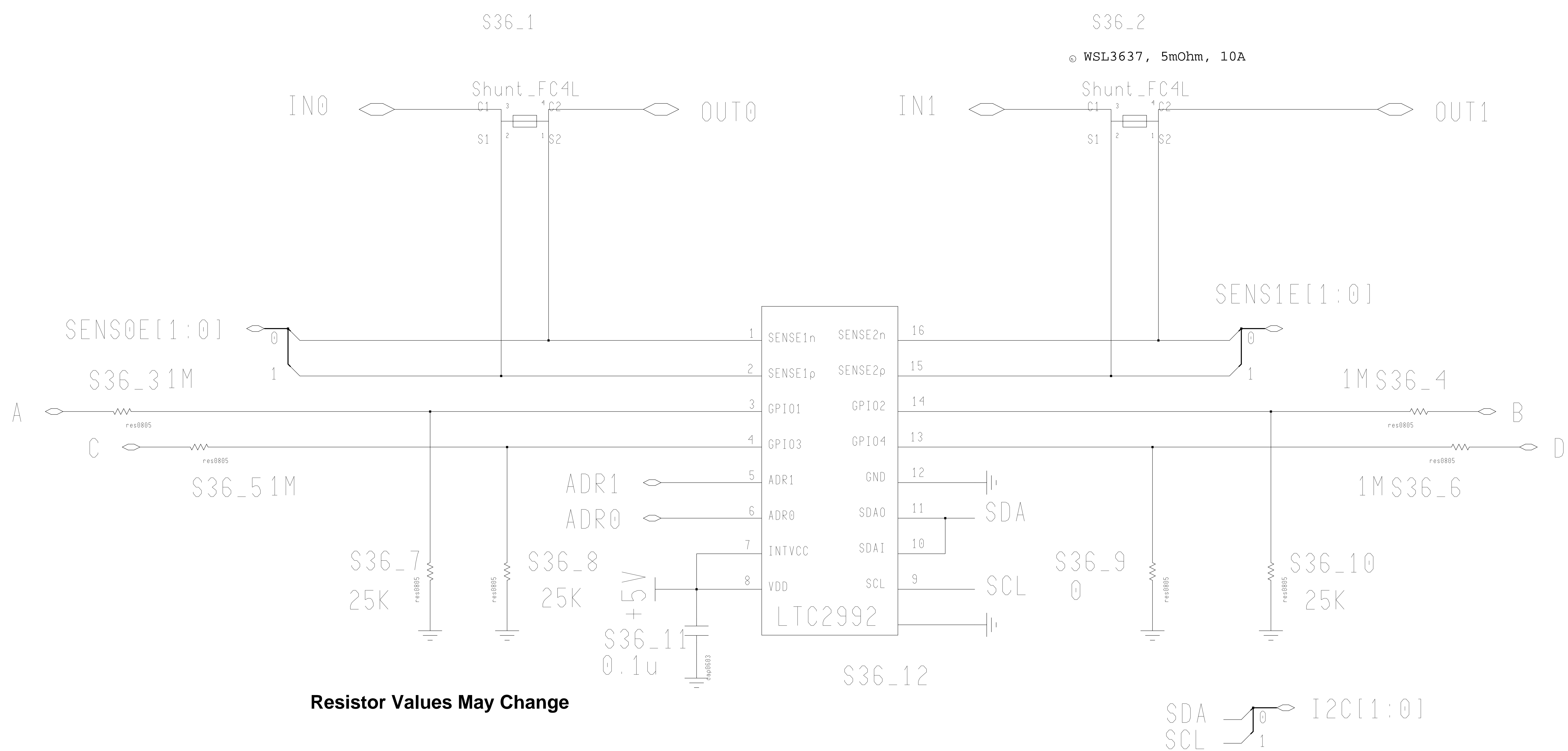
Engineer: M. Bogdan	The University of Chicago HELIX Relay Box Board	
Drawn by: M. Bogdan		
DATE: 3/22/2021	I/V Monitor	
REV. A	DRW. 2982	Sheet 3_4



Resistor Values May Change

SCH-2982
SPC-2983
ASM-2984

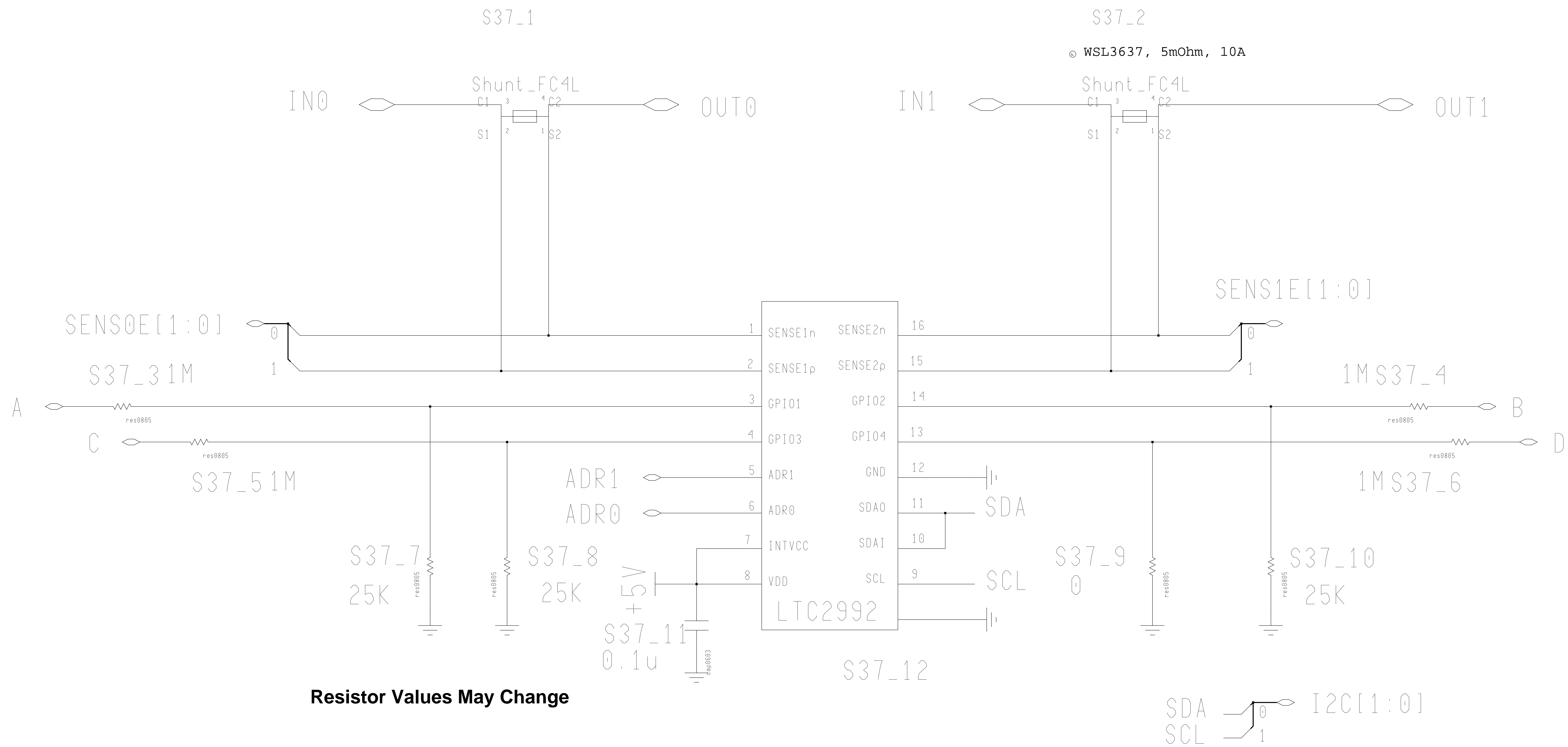
Engineer: M. Bogdan	The University of Chicago HELIX Relay Box Board	
Drawn by: M. Bogdan		
DATE: 3/22/2021	I/V Monitor	
REV. A	DRW. 2982	Sheet 3_5



Resistor Values May Change

SCH-2982
 SPC-2983
 ASM-2984

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> I/V Monitor	
Drawn by: M. Bogdan		
DATE: 3/22/2021		
REV. A	DRW. 2982	Sheet 3_6



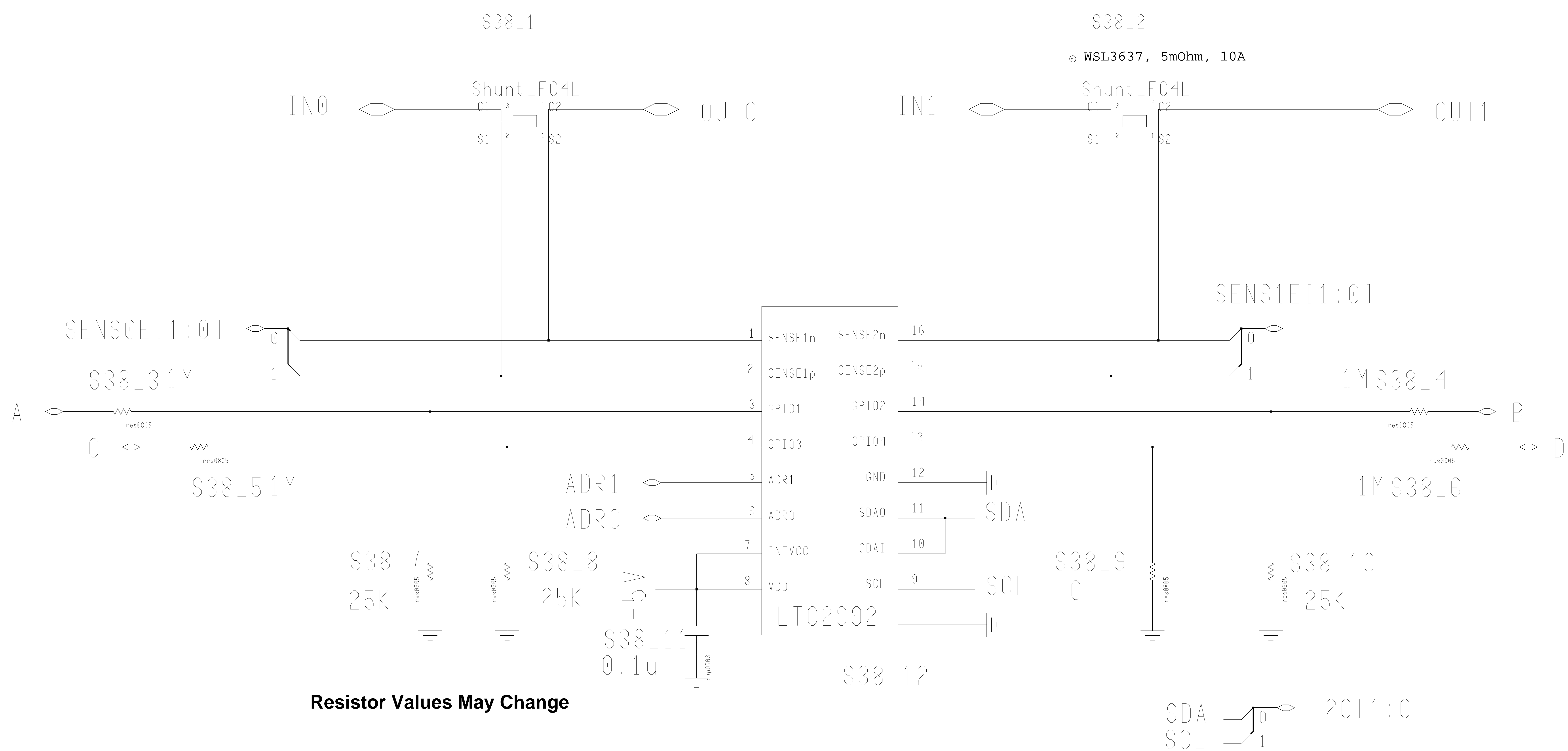
Resistor Values May Change

SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan
Drawn by: M. Bogdan
DATE: 3/22/2021

The University of Chicago
HELIX Relay Box Board
I/V Monitor

REV. A | DRW. 2982 | Sheet 3_7



Resistor Values May Change

SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan	The University of Chicago HELIX Relay Box Board I/V Monitor	
Drawn by: M. Bogdan		
DATE: 3/22/2021		
REV. A	DRW. 2982	Sheet 3_8

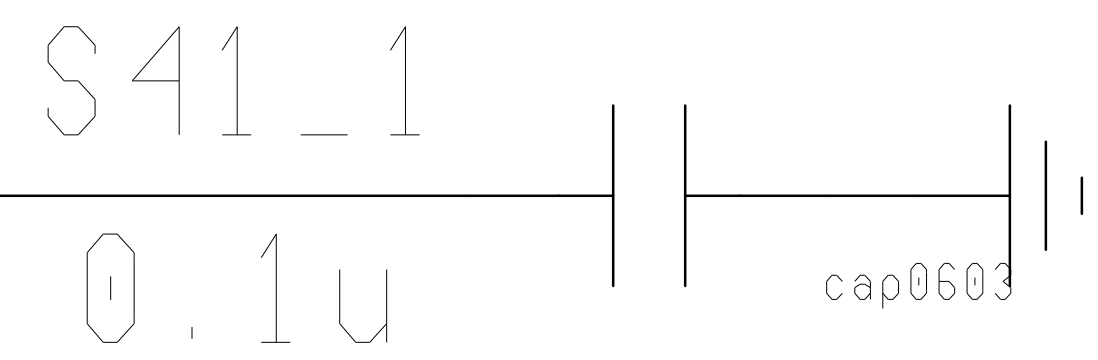
CT[1:0]



**100ms Pulse H
Contact ON**

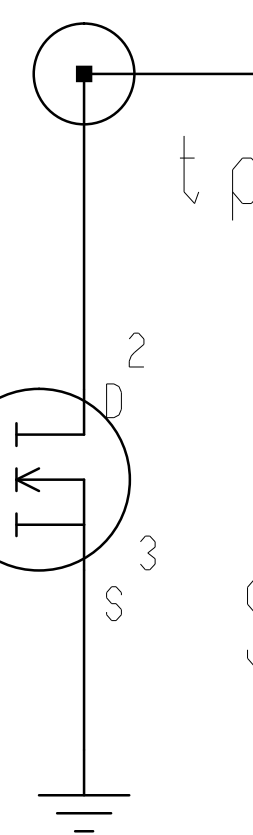
**100ms Pulse H
Contact OFF**

VBUS



MM3Z33VST1G

S41_3

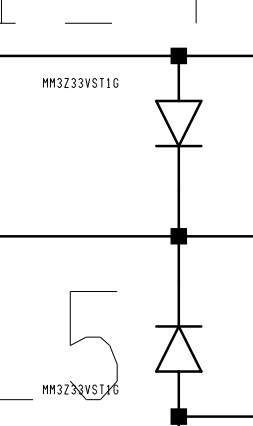


AOD2922

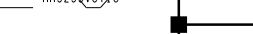
res0805

S41_6

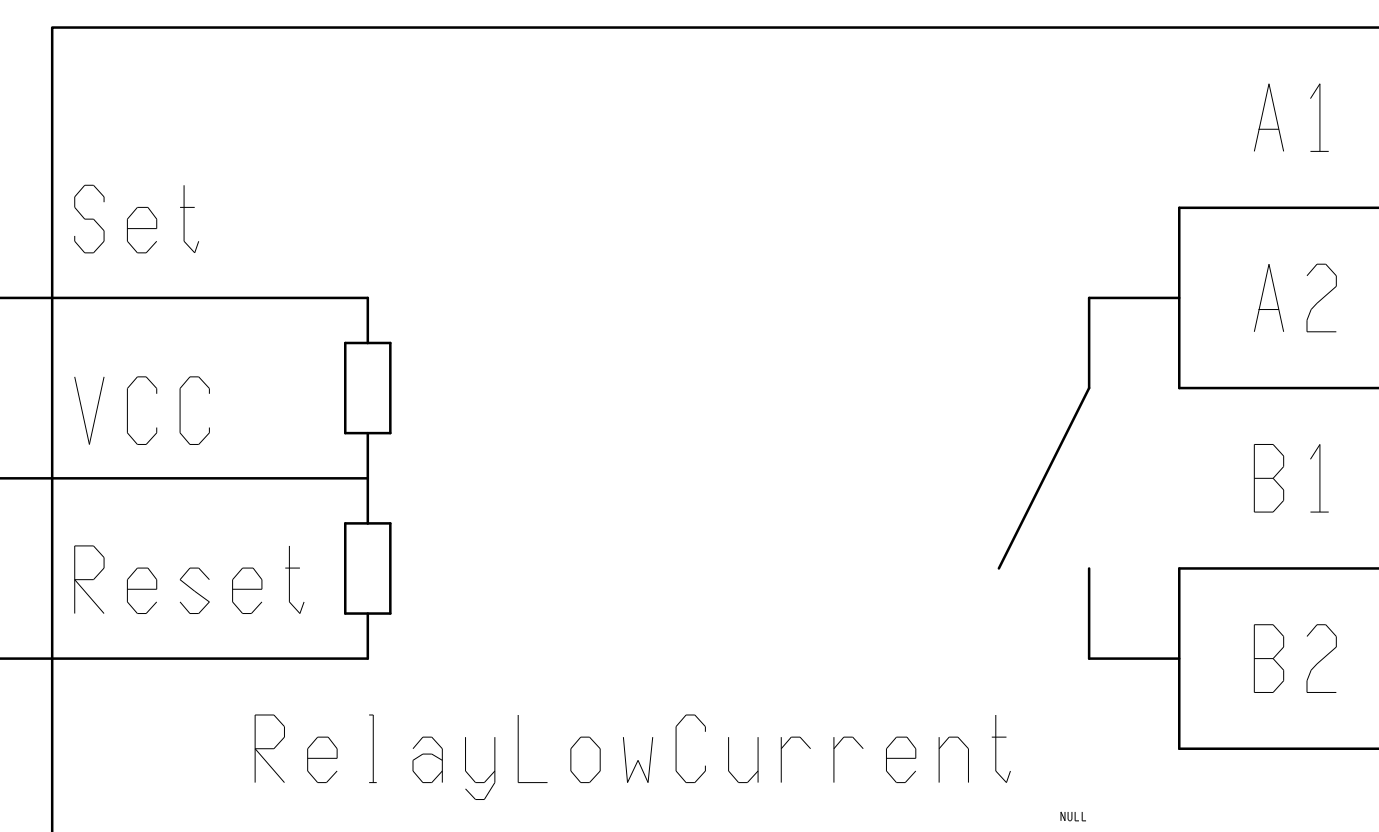
S41_4



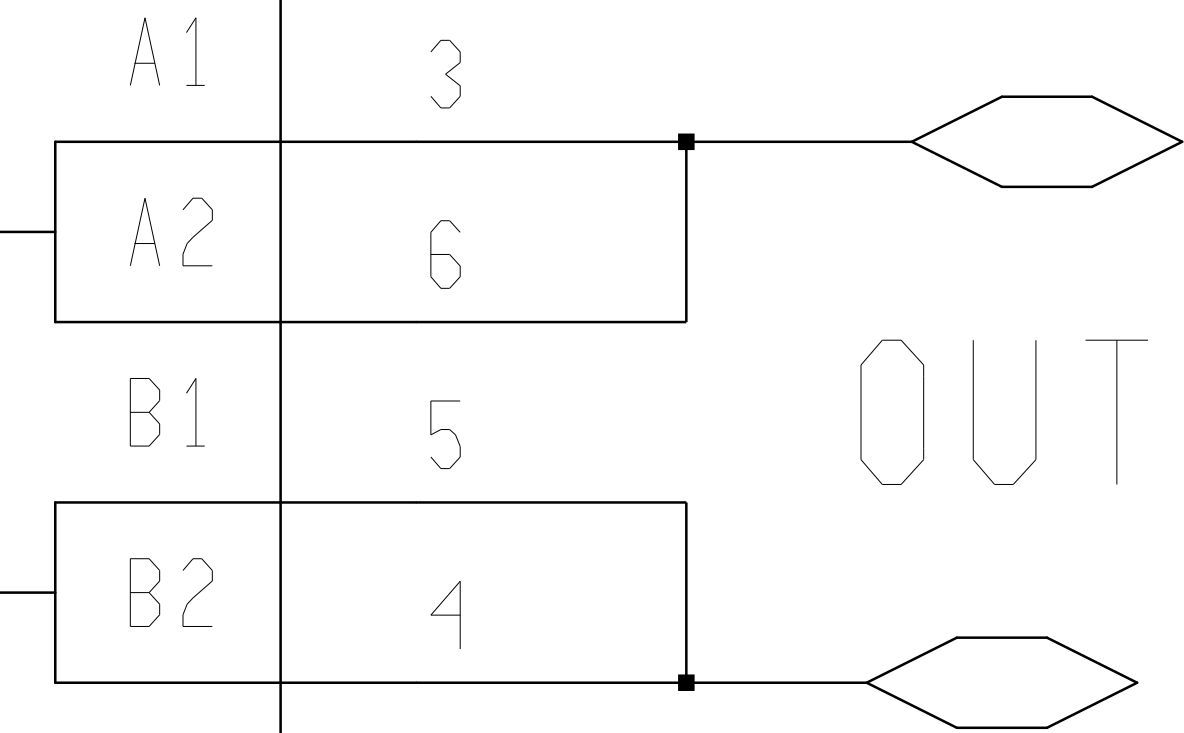
S41_5



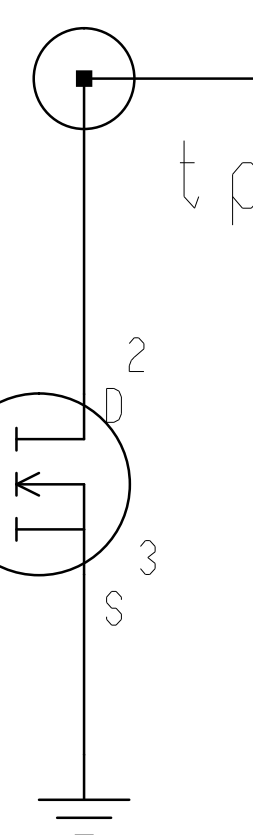
S41_2



**Omron G5RL-K1A-E-DC24
NO Relay**



S41_8



AOD2922

S41_9

**SCH-2982
SPC-2983
ASM-2984**

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Low Current Relay - 1		
Drawn by: M. Bogdan			
DATE: 4/2/2021			
REV. A	DRW. 2982	Sheet	4_1

CT[1:0]

VBUS

S42_1
0.1u
cap0603

MM3Z33VST1G

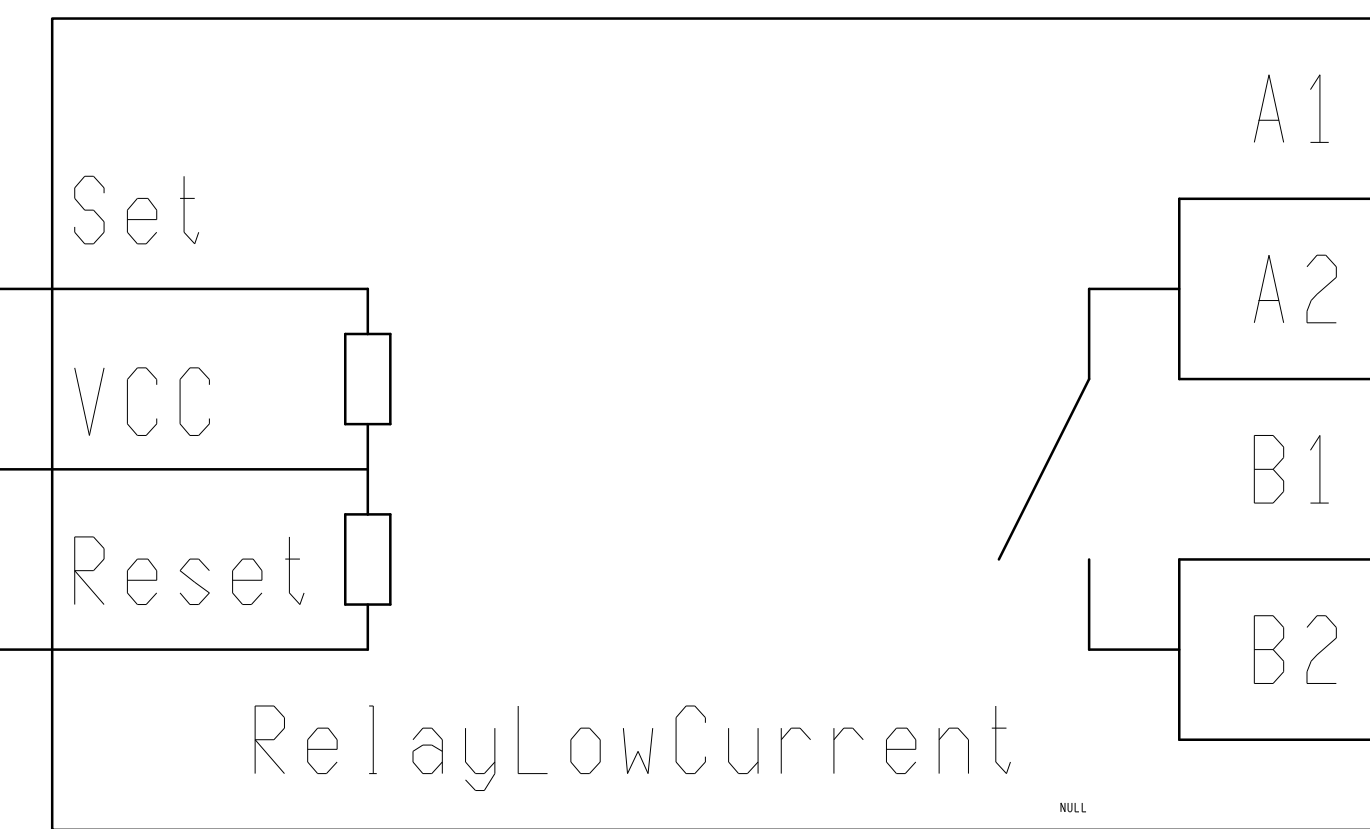
S42_2

IN

**100ms Pulse H
Contact ON**

S42_3

S42_4



OUT

**Omron G5RL-K1A-E-DC24
NO Relay**

S42_7
AOD2922

S42_6

S42_8

**100ms Pulse H
Contact OFF**

S42_9

AOD2922

**SCH-2982
SPC-2983
ASM-2984**

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Low Current Relay - 1		
Drawn by: M. Bogdan			
DATE: 4/2/2021			
REV. A	DRW. 2982	Sheet	4_2

CT[1:0]

VBUS

S43_1
0.1u
cap0603

MM3Z33VST1G

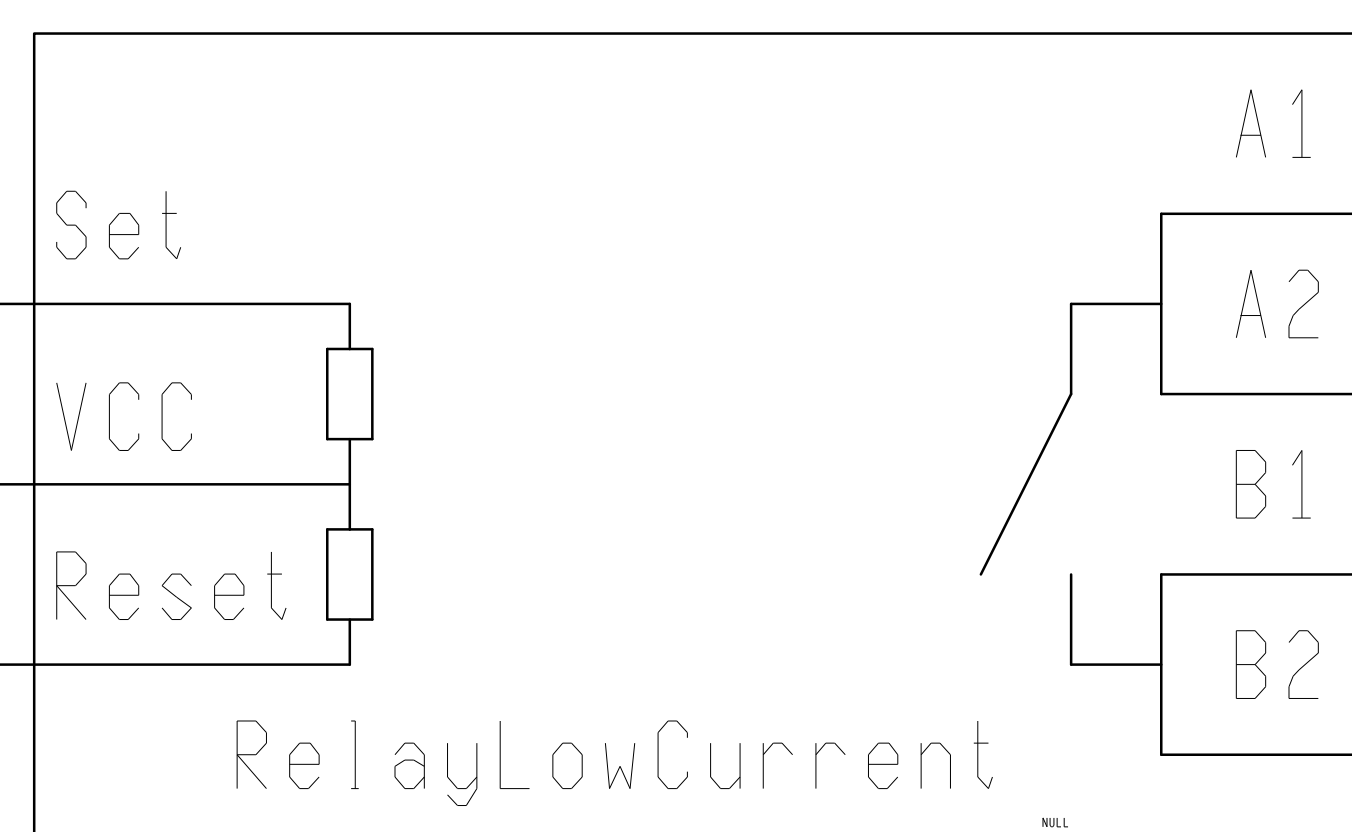
S43_2

IN

**100ms Pulse H
Contact ON**

S43_3

S43_4



**Omron G5RL-K1A-E-DC24
NO Relay**

OUT

AOD2922

**100ms Pulse H
Contact OFF**

S43_8

S43_9

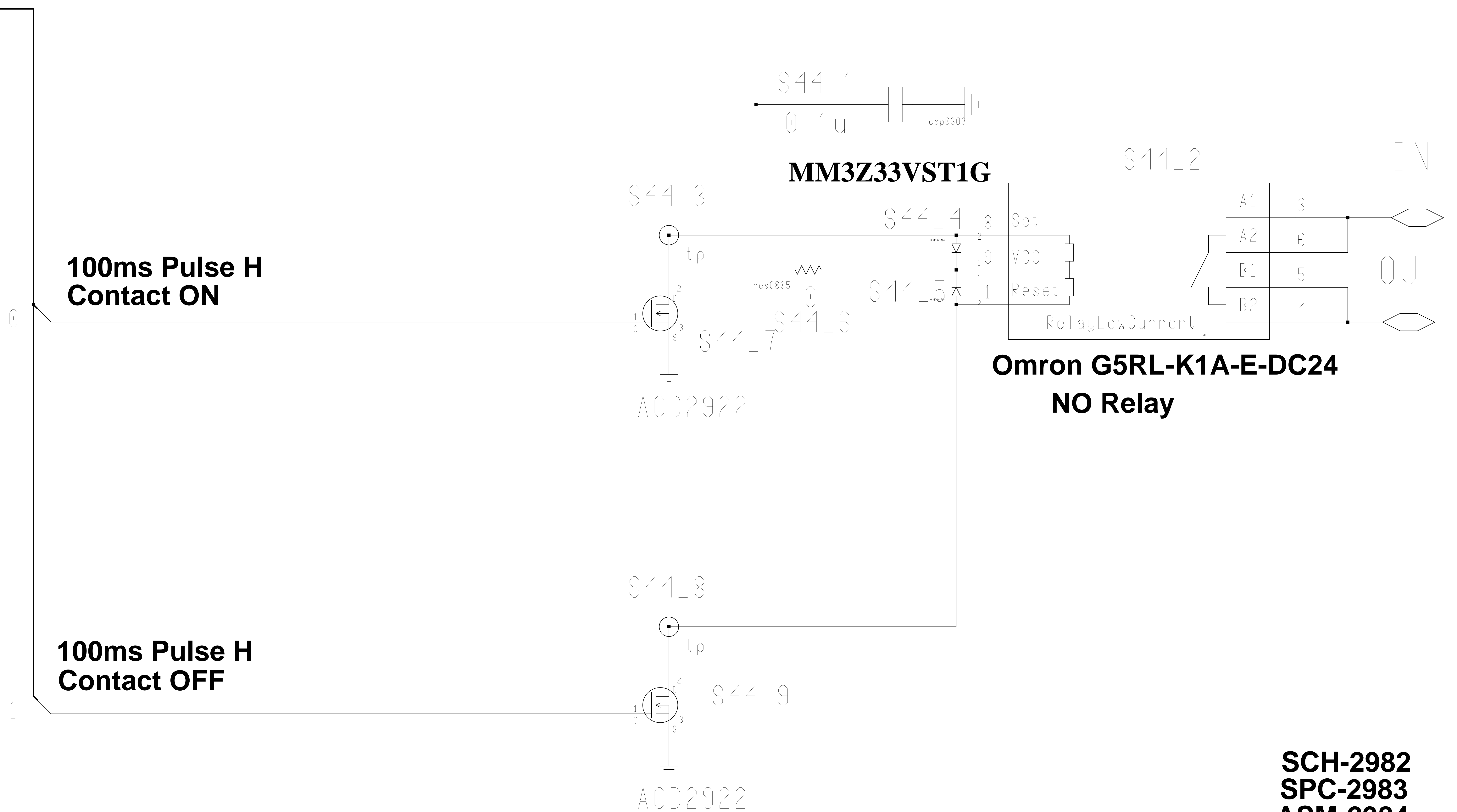
AOD2922

**SCH-2982
SPC-2983
ASM-2984**

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Low Current Relay - 1		
Drawn by: M. Bogdan			
DATE: 4/2/2021			
REV. A	DRW. 2982	Sheet	4_3

CT[1:0]

VBUS



SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Low Current Relay - 1		
Drawn by: M. Bogdan			
DATE: 4/2/2021			
REV. A	DRW. 2982	Sheet	4_4

CT[1:0]

VBUS

S45_1
0.1u
cap0603

MM3Z33VST1G

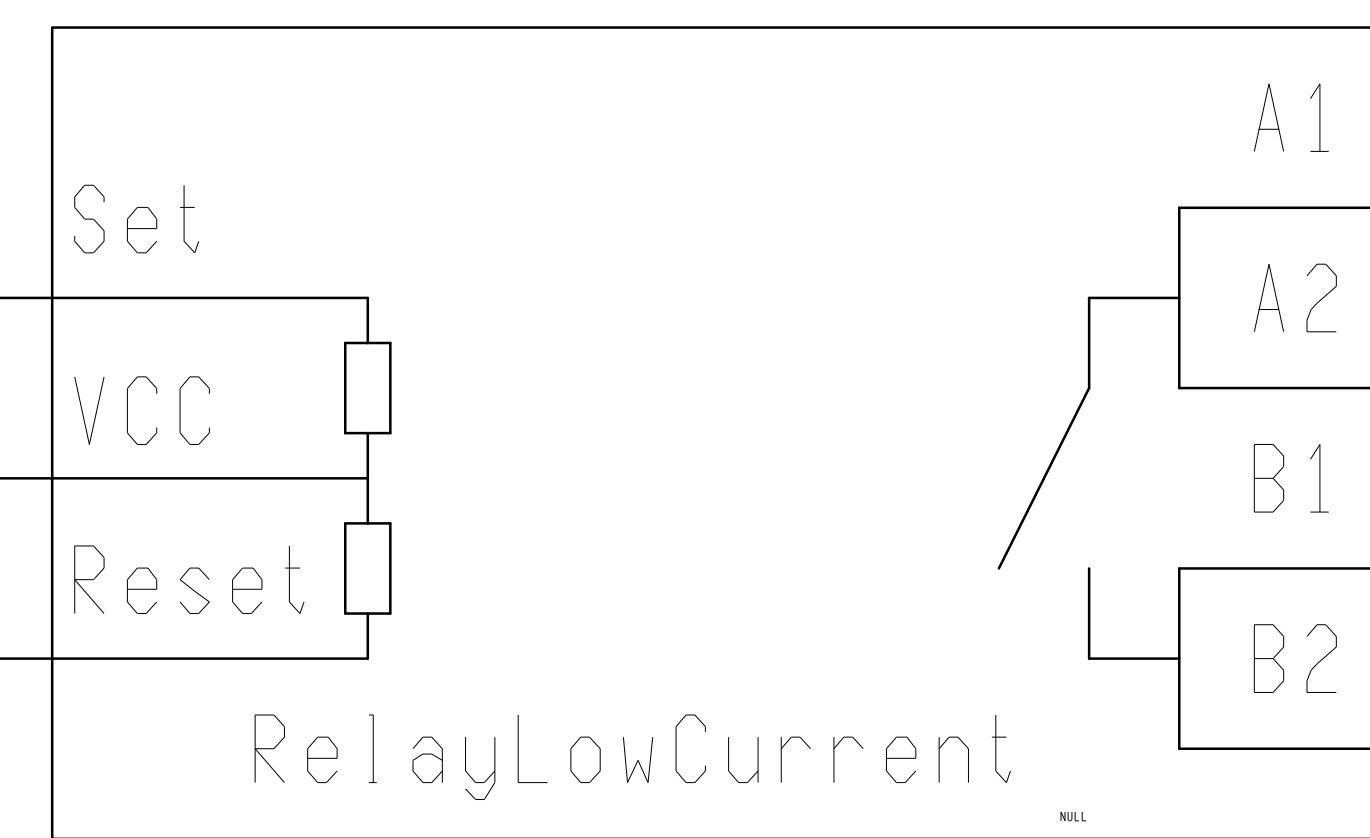
S45_2

IN

**100ms Pulse H
Contact ON**

S45_3

S45_4



**Omron G5RL-K1A-E-DC24
NO Relay**

OUT

S45_7
AOD2922

S45_6
res0805

S45_8

**100ms Pulse H
Contact OFF**

S45_9

AOD2922

**SCH-2982
SPC-2983
ASM-2984**

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Low Current Relay - 1		
Drawn by: M. Bogdan			
DATE: 4/2/2021			
REV. A	DRW. 2982	Sheet 4_5	

CT[1:0]

VBUS

S46_1
0.1u
cap0603

MM3Z33VST1G

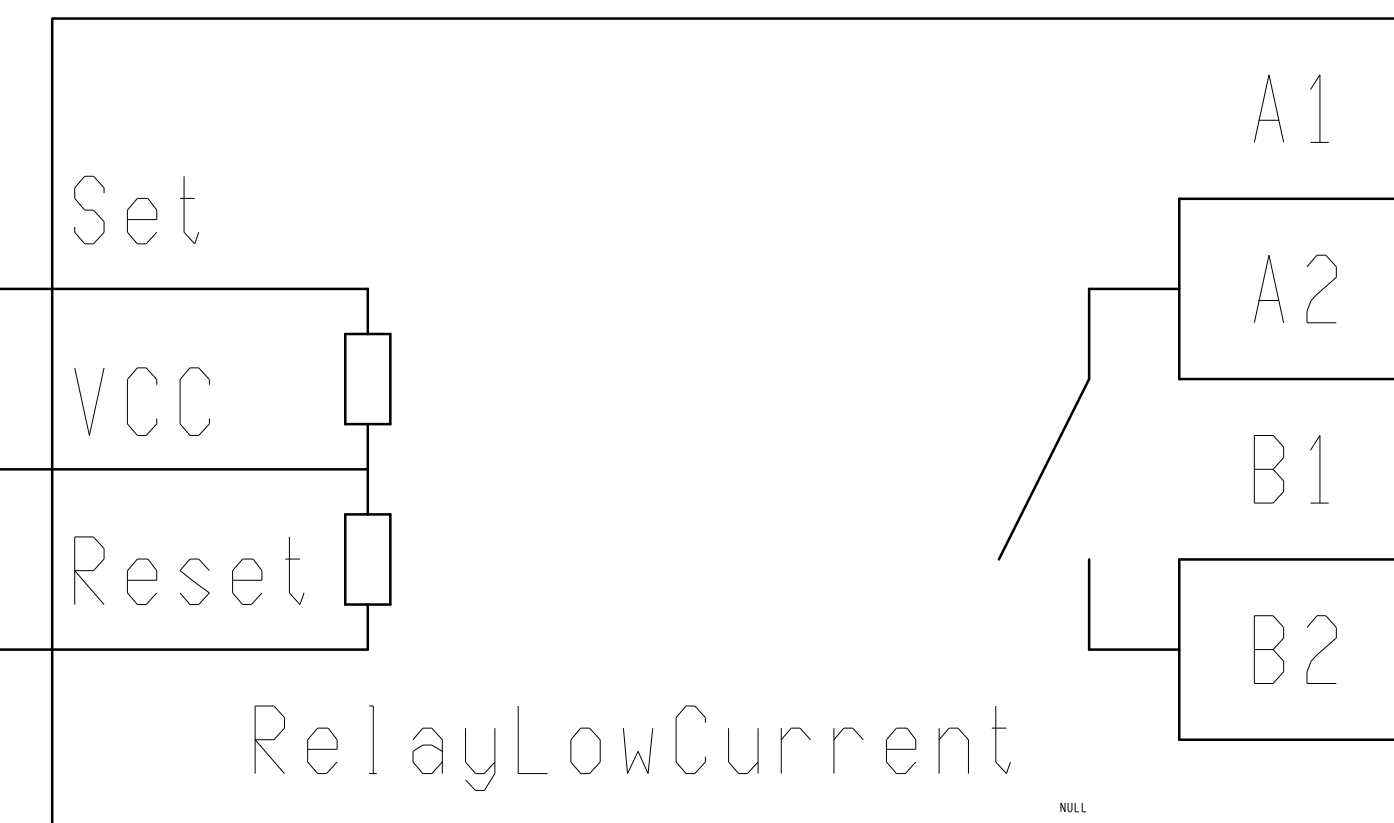
S46_2

IN

**100ms Pulse H
Contact ON**

S46_3

S46_4



A1

3

OUT

A2

6

B1

5

B2

4

**Omron G5RL-K1A-E-DC24
NO Relay**

S46_7
AOD2922

S46_8

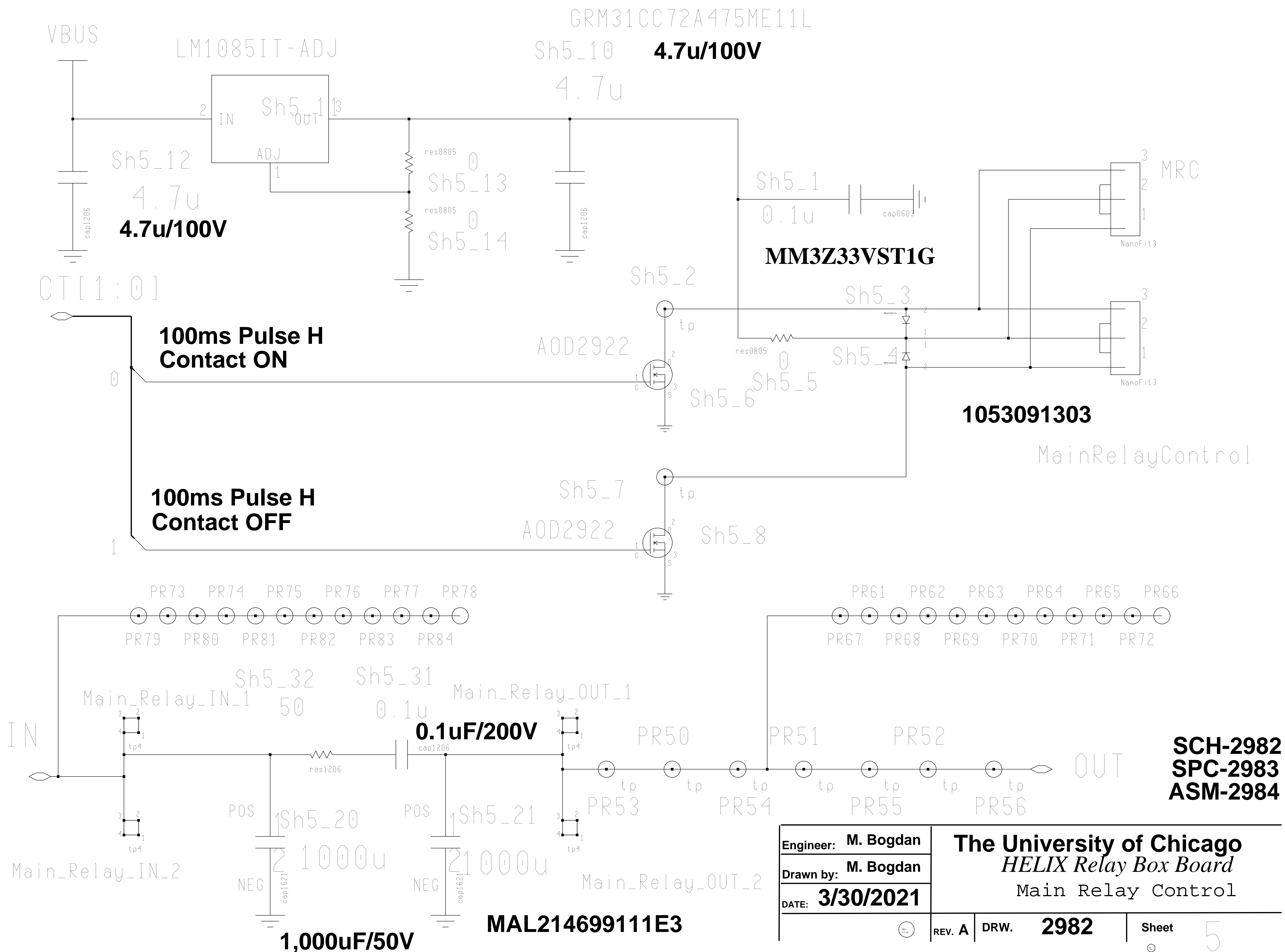
**100ms Pulse H
Contact OFF**

S46_9

AOD2922

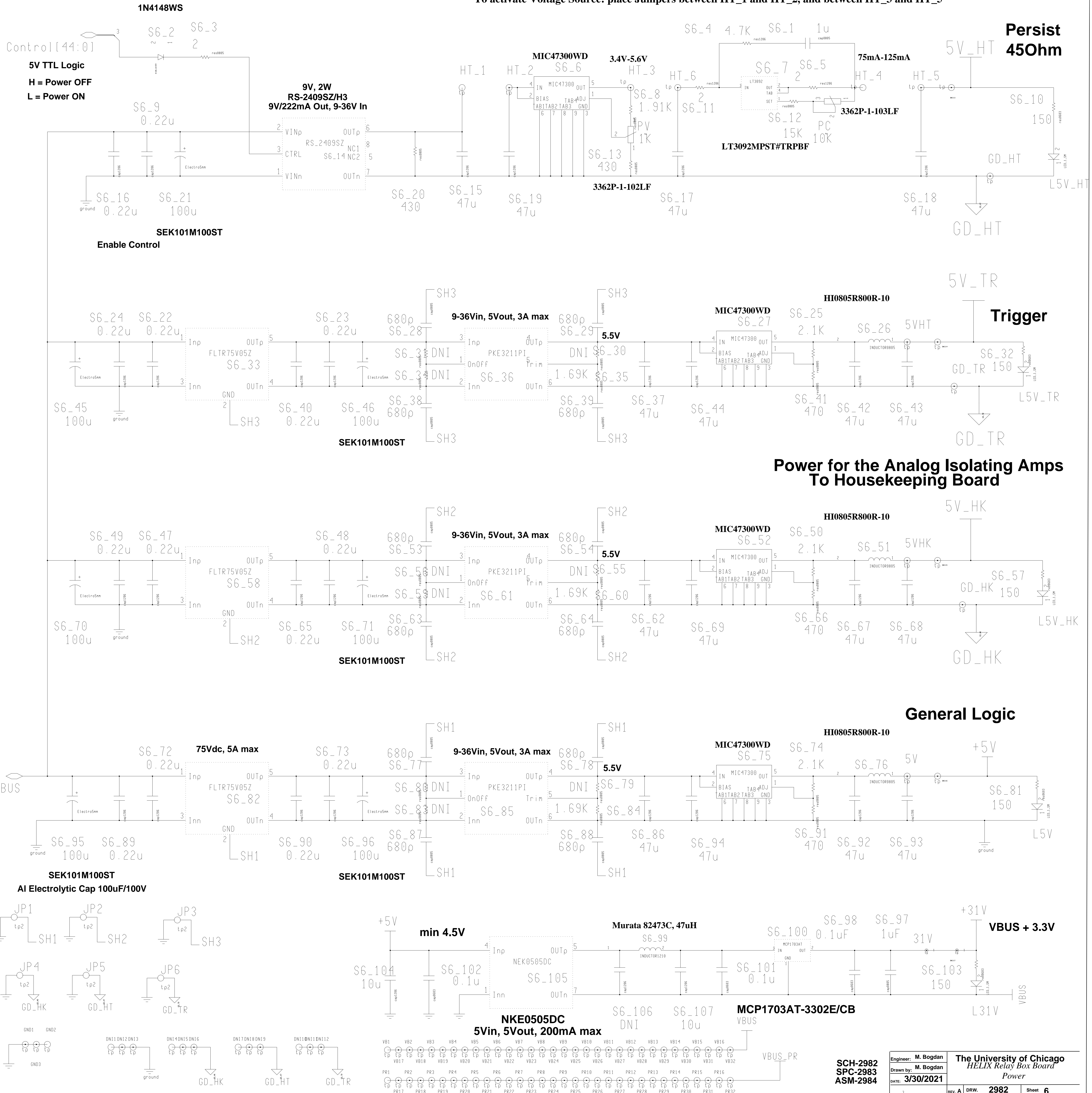
**SCH-2982
SPC-2983
ASM-2984**

Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Low Current Relay - 1		
Drawn by: M. Bogdan			
DATE: 4/2/2021			
REV. A	DRW. 2982	Sheet	4_6

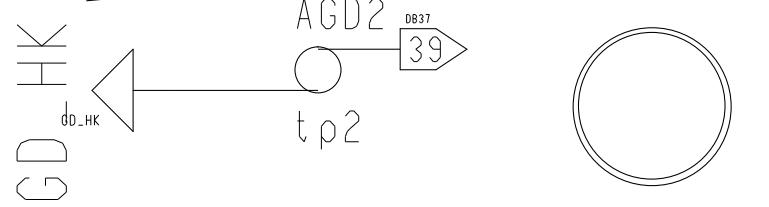
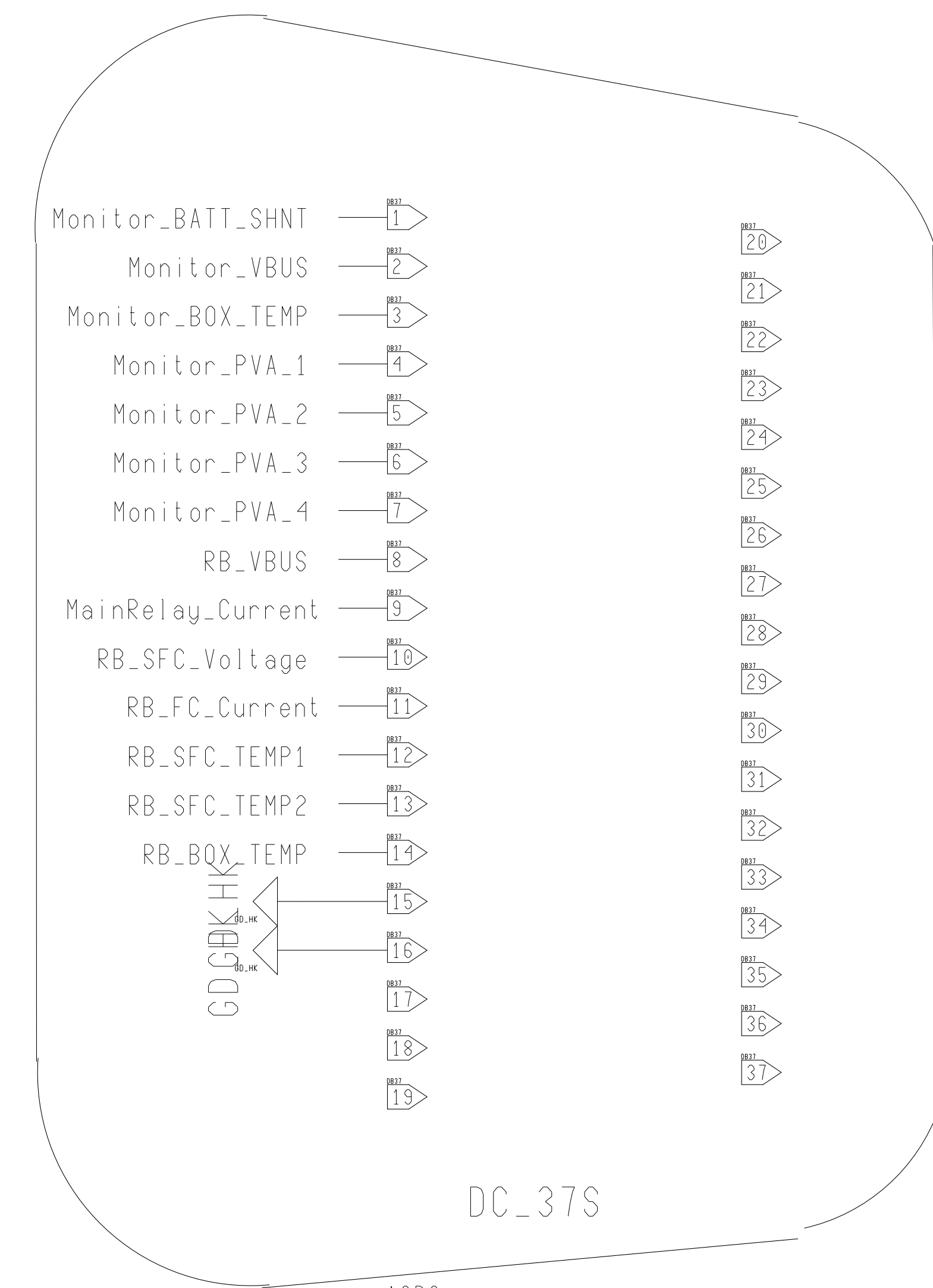
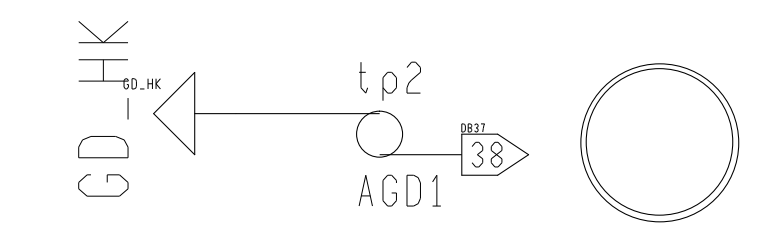
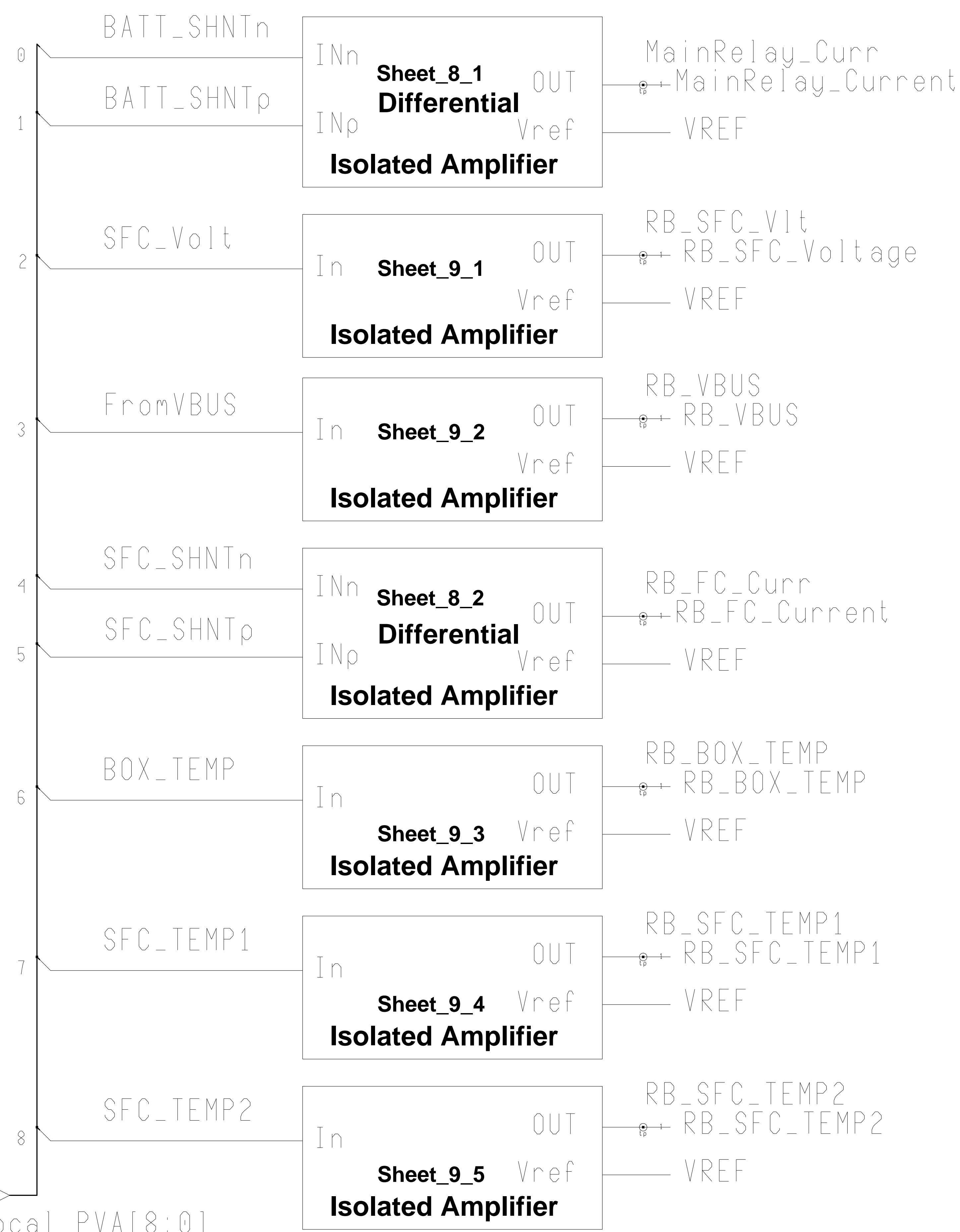
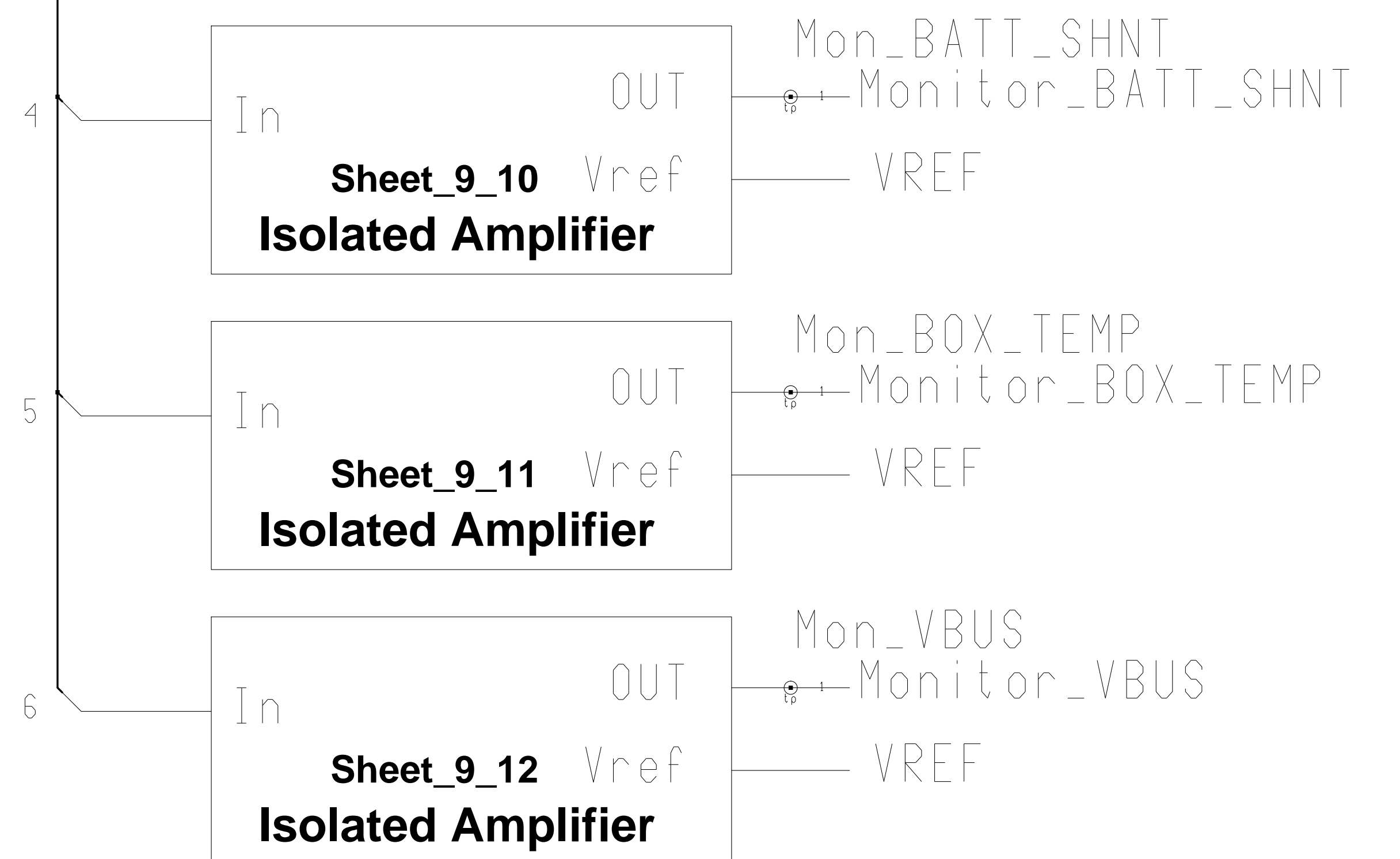
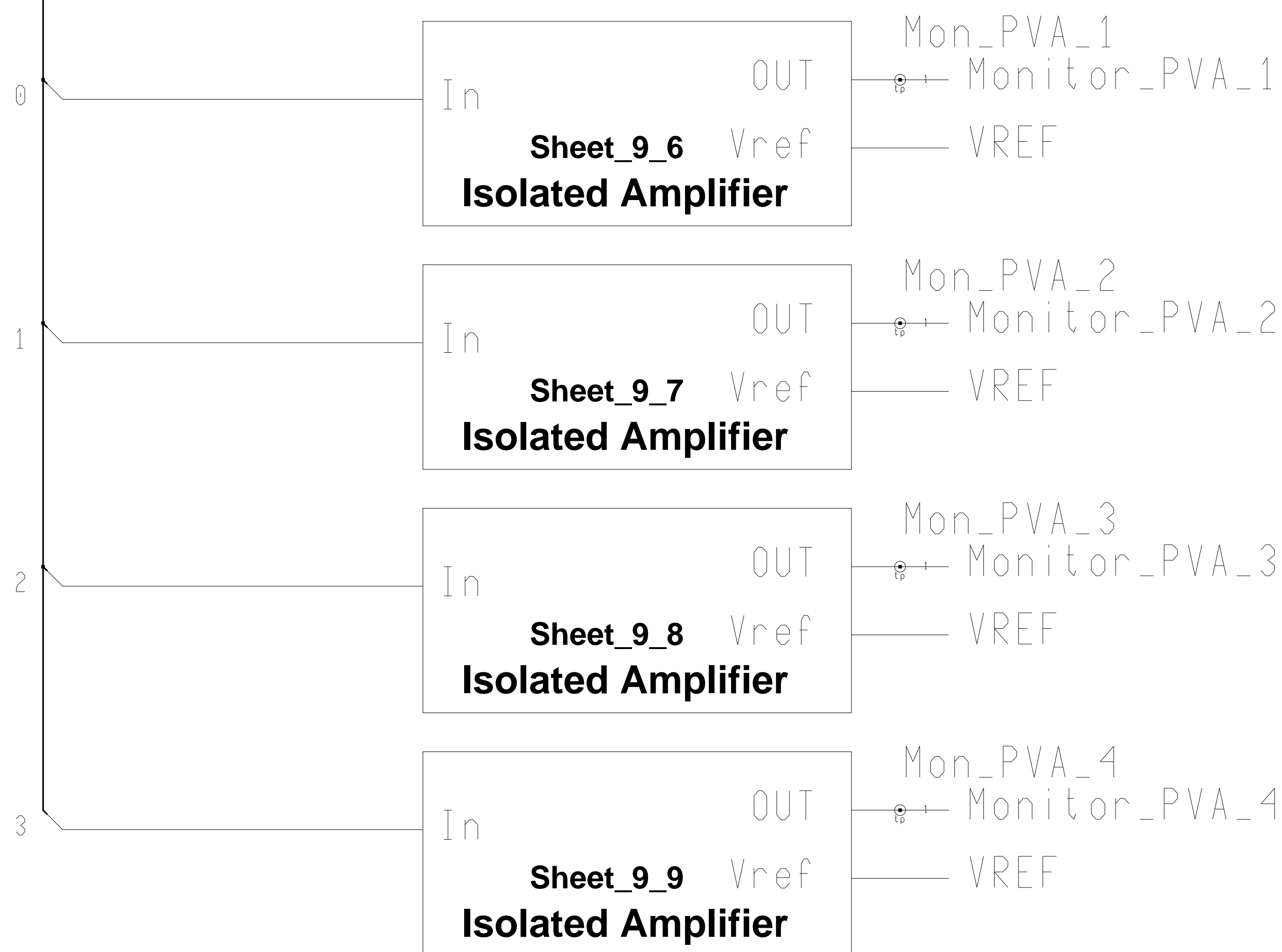


Engineer: M. Bogdan	The University of Chicago <i>HELIX Relay Box Board</i> Main Relay Control		
Drawn by: M. Bogdan			
DATE: 3/30/2021			
REV. A	DRW. 2982	Sheet 5	

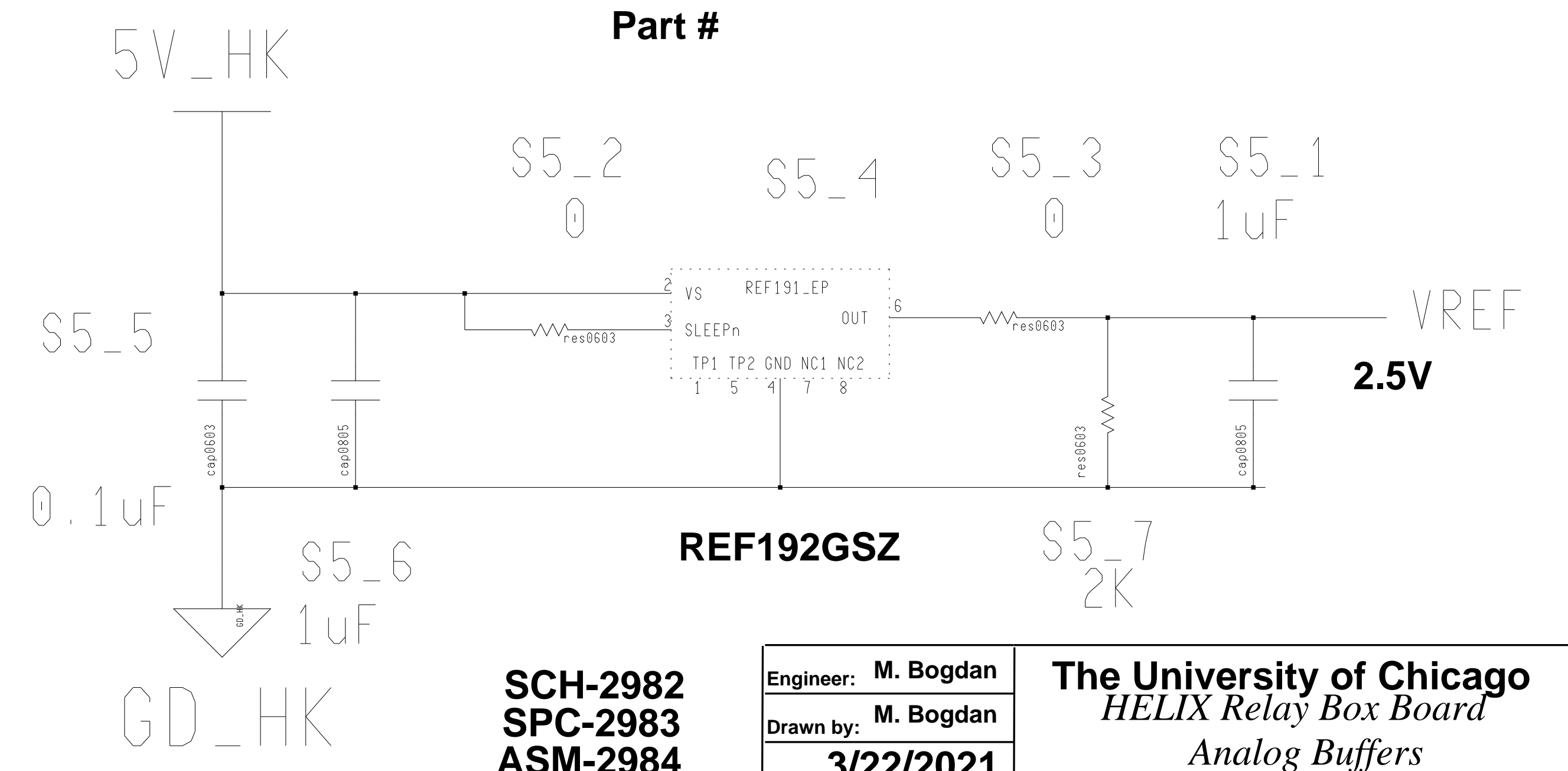
To activate Current Source: place Jumpers between HT_1 and HT_6, and between HT_4 and HT_5
 To activate Voltage Source: place Jumpers between HT_1 and HT_2, and between HT_3 and HT_5



PVA[6:0]



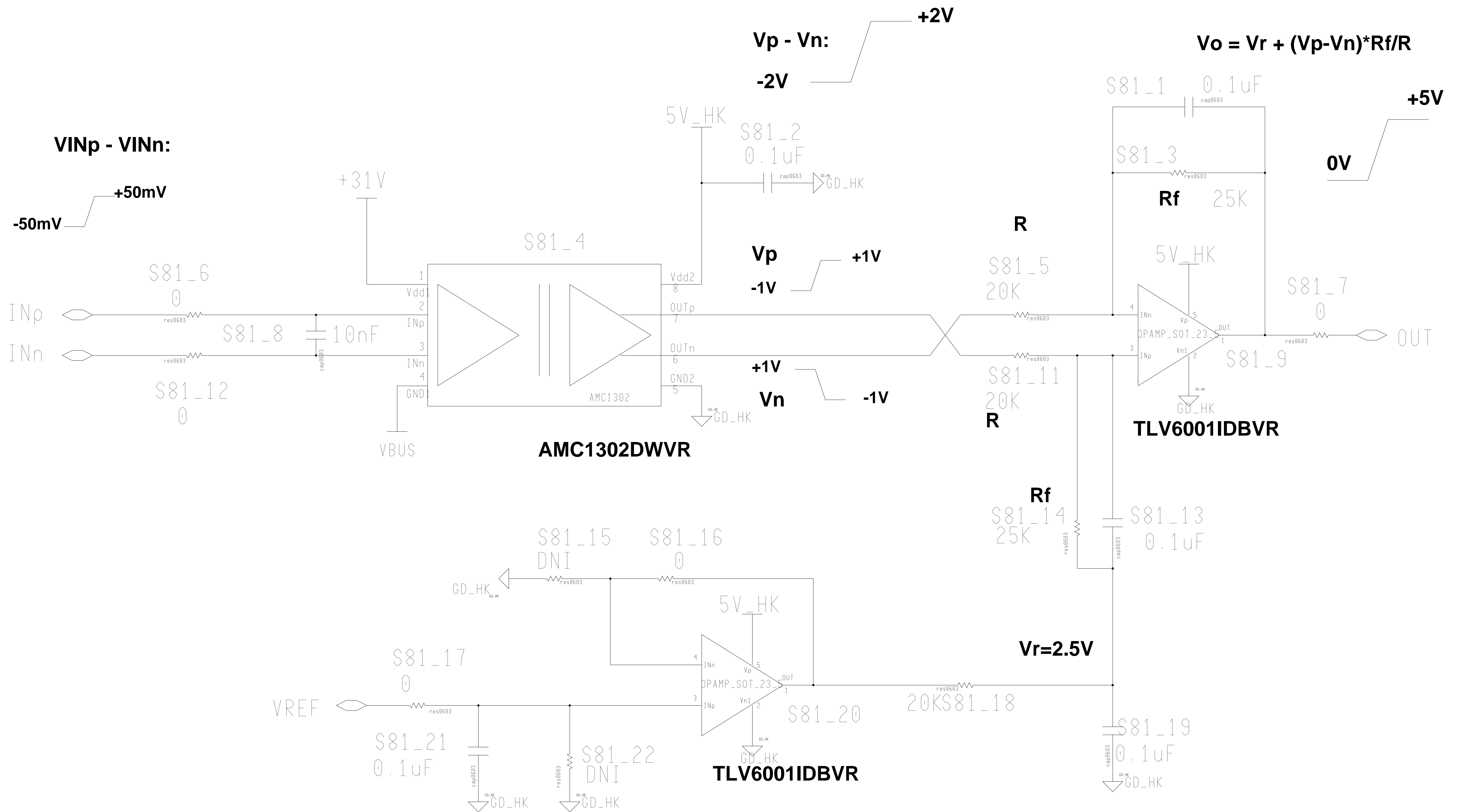
D-SUB Female 37-Pos
Part #



SCH-2982
SPC-2983
ASM-2984

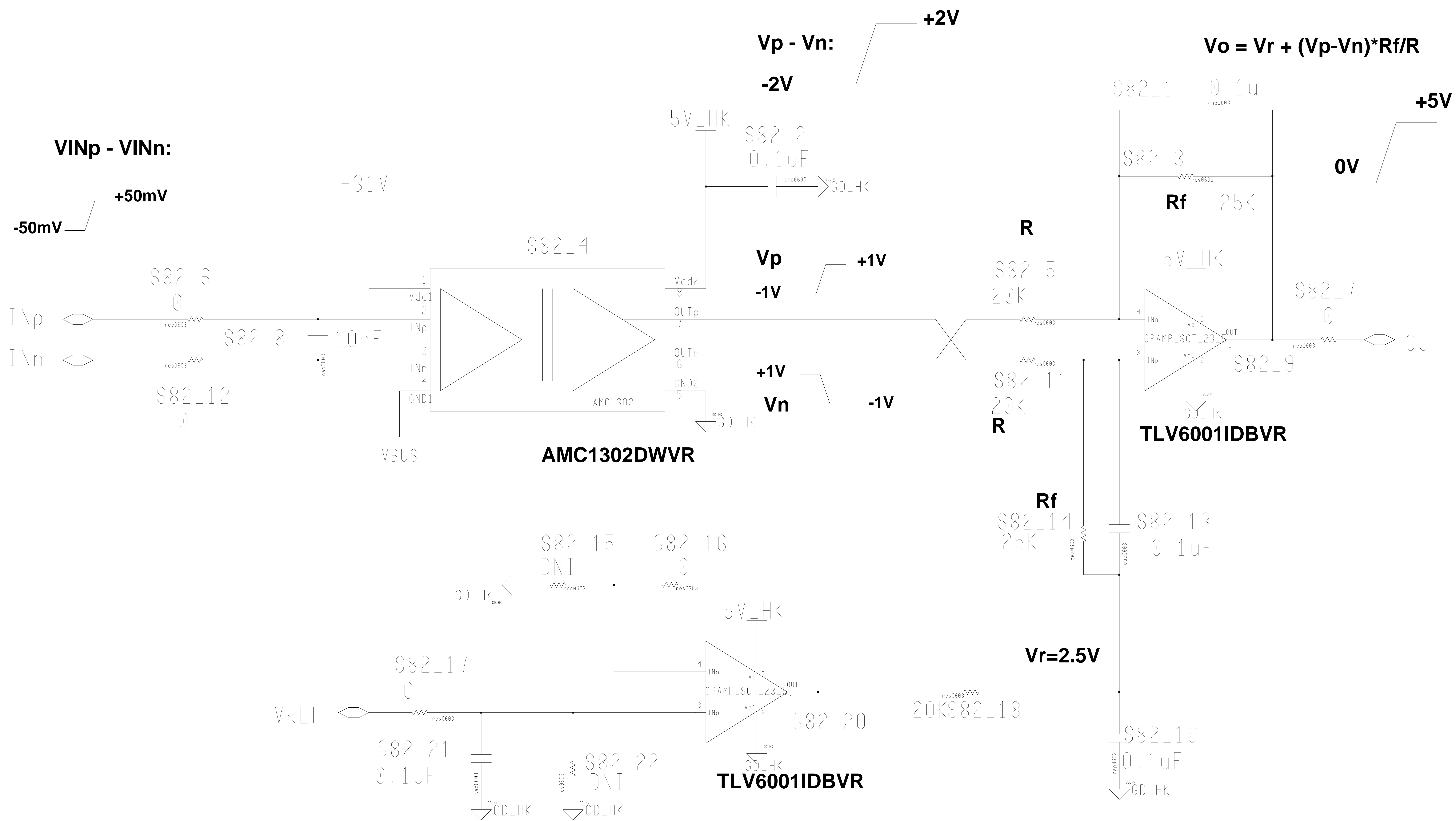
Engineer: M. Bogdan	The University of Chicago HELIX Relay Box Board Analog Buffers
Drawn by: M. Bogdan	
DATE: 3/22/2021	
REV. A	DRW. 2982

Local_PVA[8:0]



SCH-2982
 SPC-2983
 ASM-2984

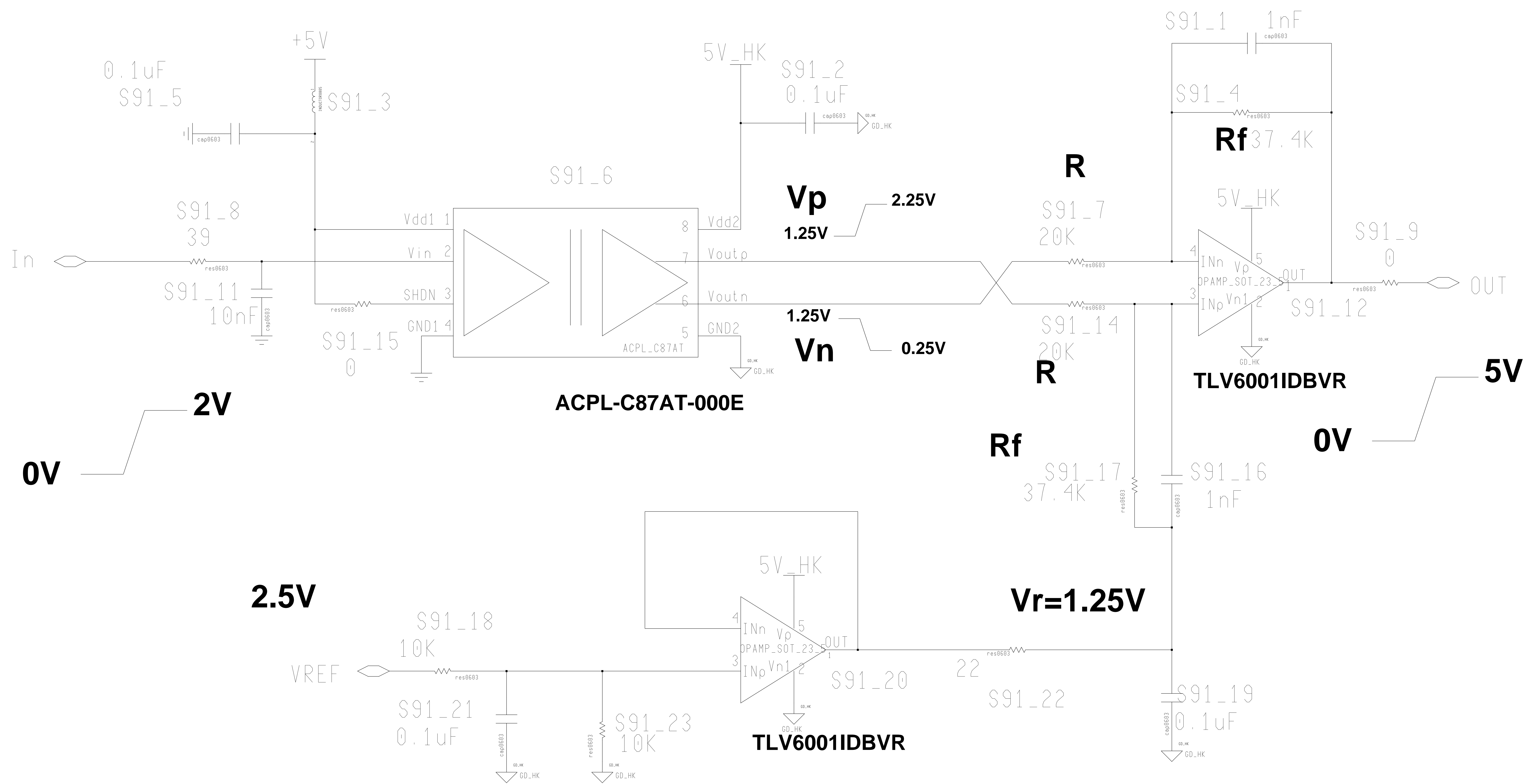
Engineer: M. Bogdan	The University of Chicago	
Drawn by: M. Bogdan	HELIX Relay Box Board	
DATE: 3/22/2021	Diferential Isolated Amplifier - 1	
REV. A	DRW. 2982	Sheet 8_1



SCH-2982
 SPC-2983
 ASM-2984

Engineer: M. Bogdan	The University of Chicago	
Drawn by: M. Bogdan	HELIX Relay Box Board	
DATE: 3/22/2021	Diferential Isolated Amplifier - 1	
REV. A	DRW. 2982	Sheet 8_2

$$V_o = V_r + (V_p - V_n) * R_f / R$$

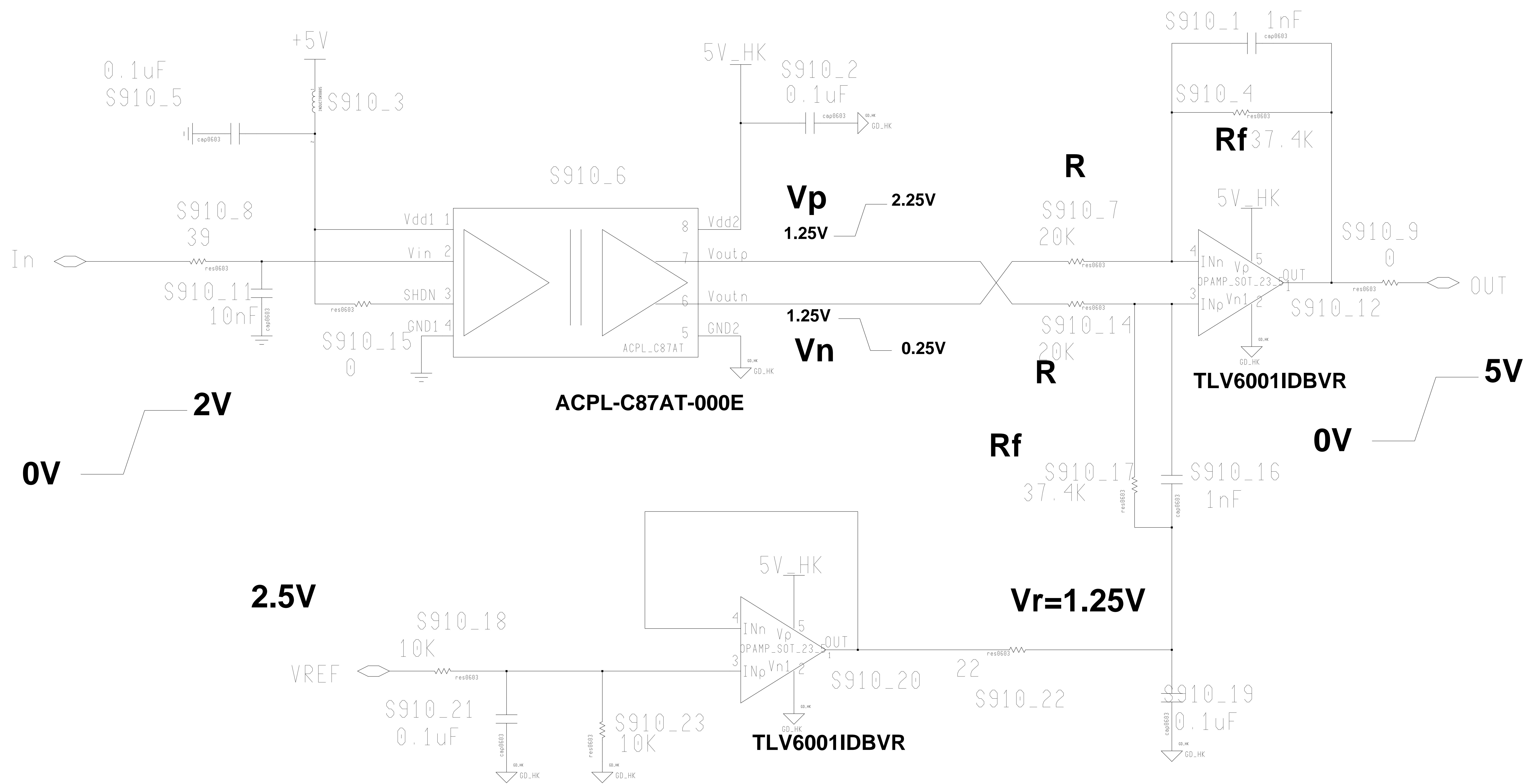


SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan
Drawn by: M. Bogdan
DATE: 3/22/2021

The University of Chicago
HELIX Relay Box Board
Isolated Amplifier - 1

$$V_o = V_r + (V_p - V_n) * R_f / R$$

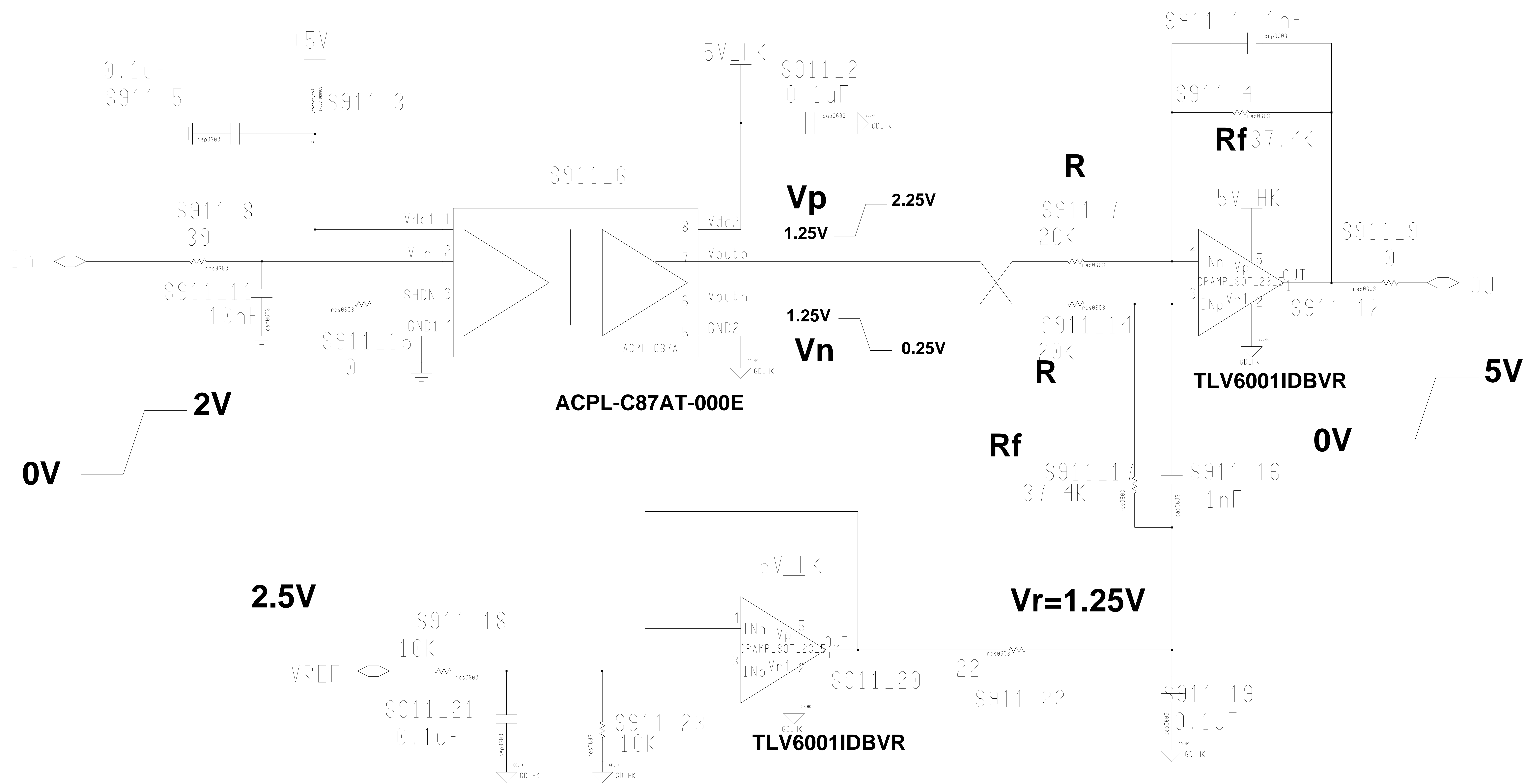


SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan
Drawn by: M. Bogdan
DATE: 3/22/2021

The University of Chicago
HELIX Relay Box Board
Isolated Amplifier - 1

$$V_o = V_r + (V_p - V_n) * R_f / R$$

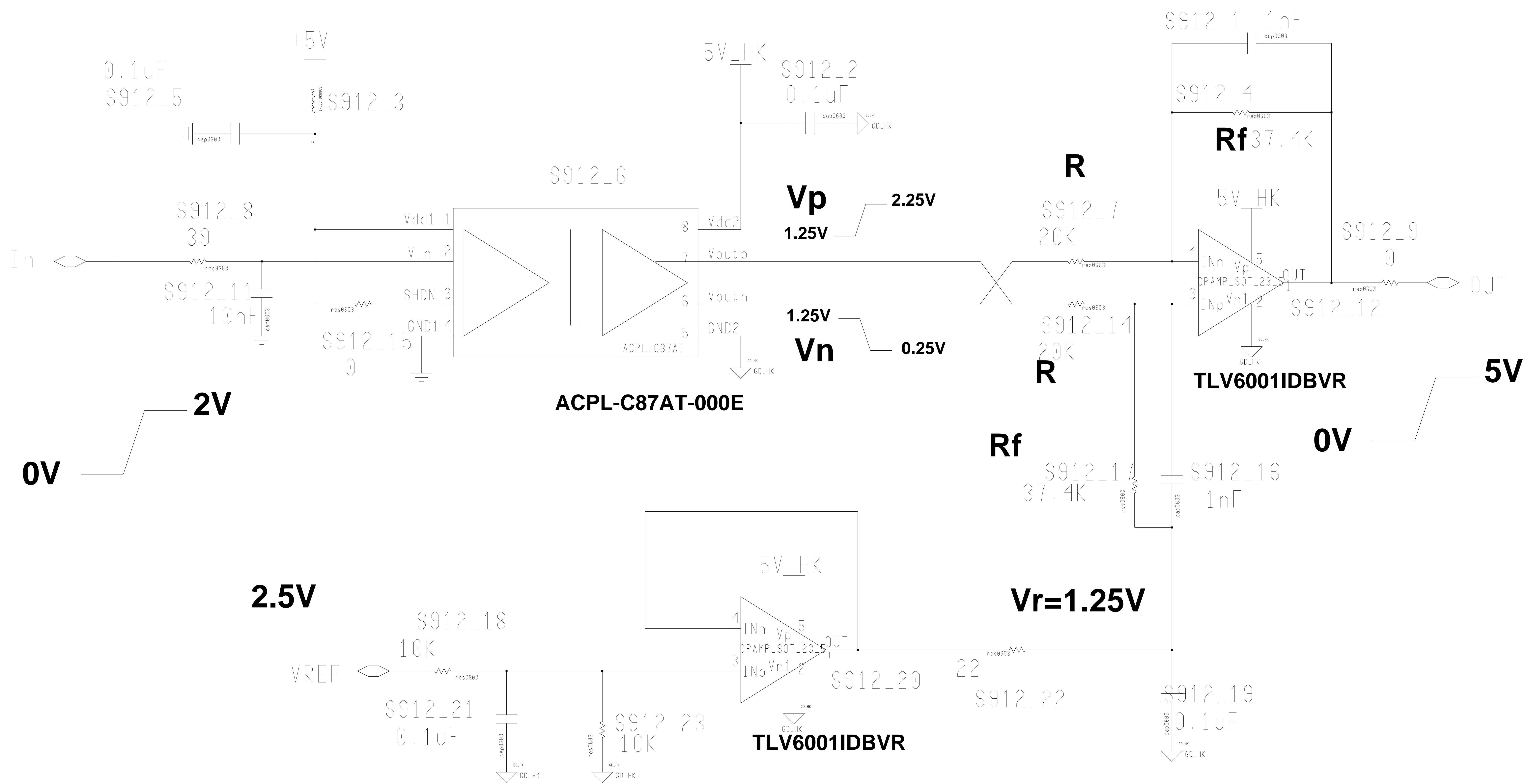


SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan
Drawn by: M. Bogdan
DATE: 3/22/2021

The University of Chicago
HELIX Relay Box Board
Isolated Amplifier - 1

$$V_o = V_r + (V_p - V_n) * R_f / R$$

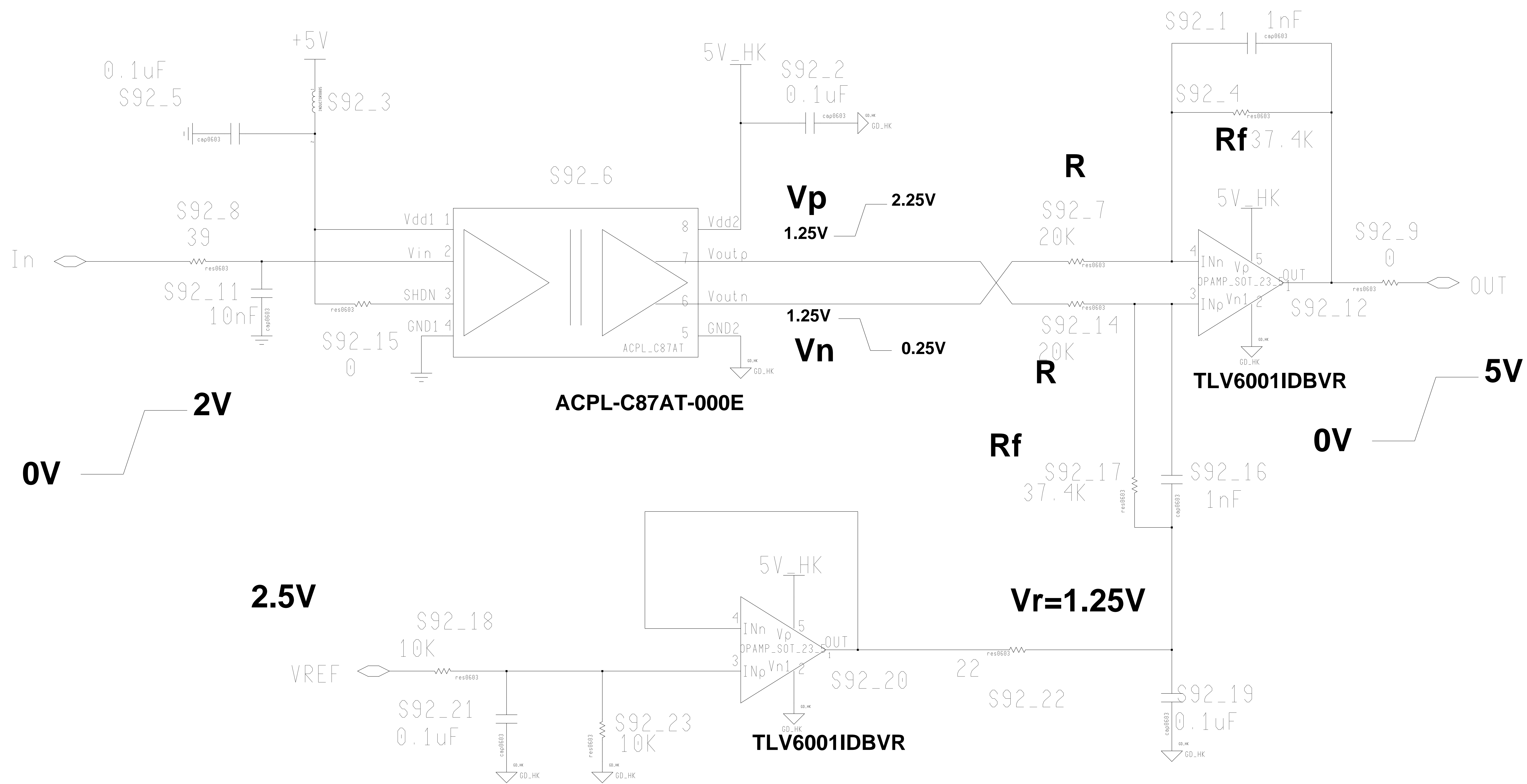


SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan
Drawn by: M. Bogdan
DATE: 3/22/2021

The University of Chicago
HELIX Relay Box Board
Isolated Amplifier - 1

$$V_o = V_r + (V_p - V_n) * R_f / R$$

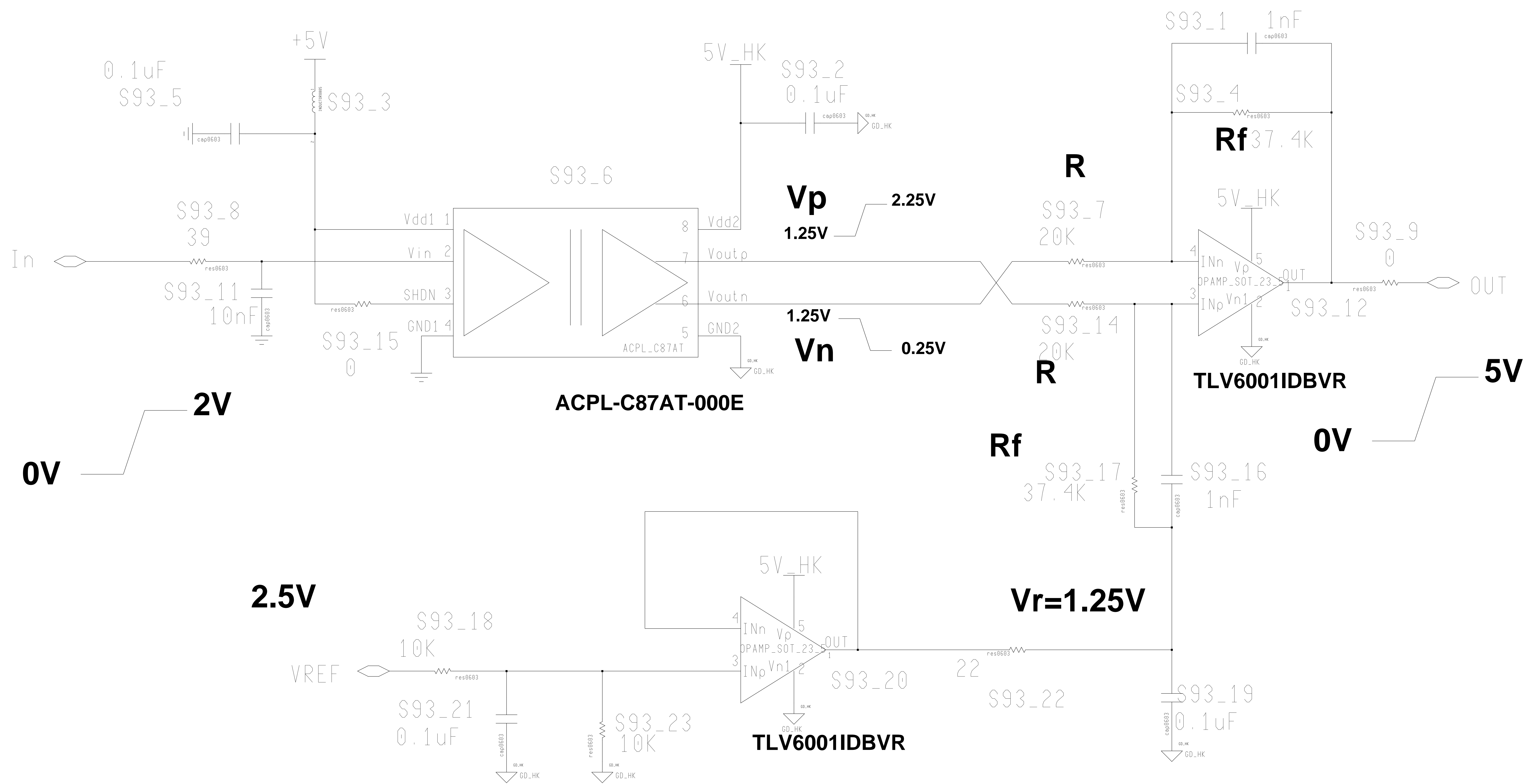


SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan
Drawn by: M. Bogdan
DATE: 3/22/2021

The University of Chicago
HELIX Relay Box Board
Isolated Amplifier - 1

$$V_o = V_r + (V_p - V_n) * R_f / R$$

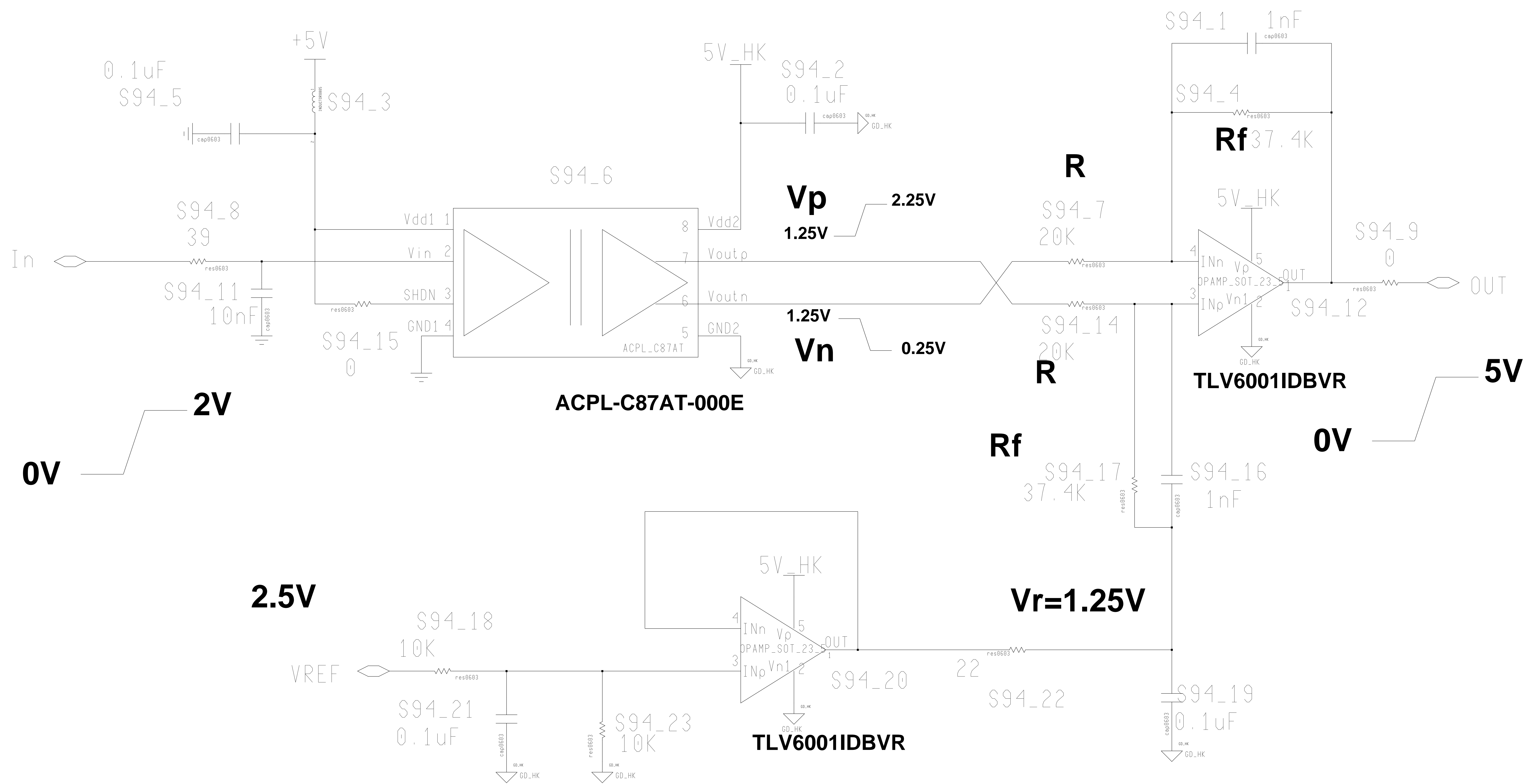


SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan
Drawn by: M. Bogdan
DATE: 3/22/2021

The University of Chicago
HELIX Relay Box Board
Isolated Amplifier - 1

$$V_o = V_r + (V_p - V_n) * R_f / R$$

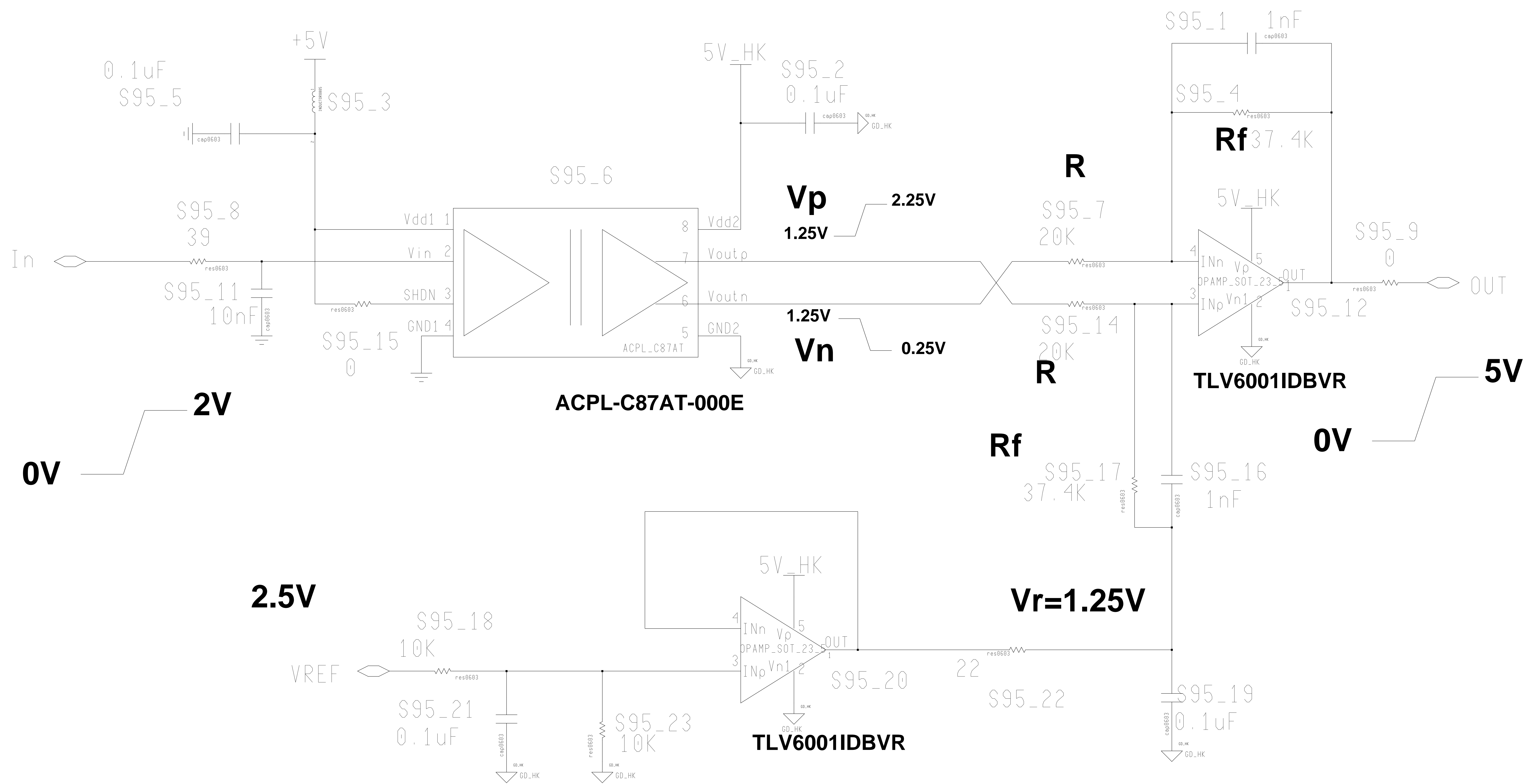


SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan
Drawn by: M. Bogdan
DATE: 3/22/2021

The University of Chicago
HELIX Relay Box Board
Isolated Amplifier - 1

$$V_o = V_r + (V_p - V_n) * R_f / R$$

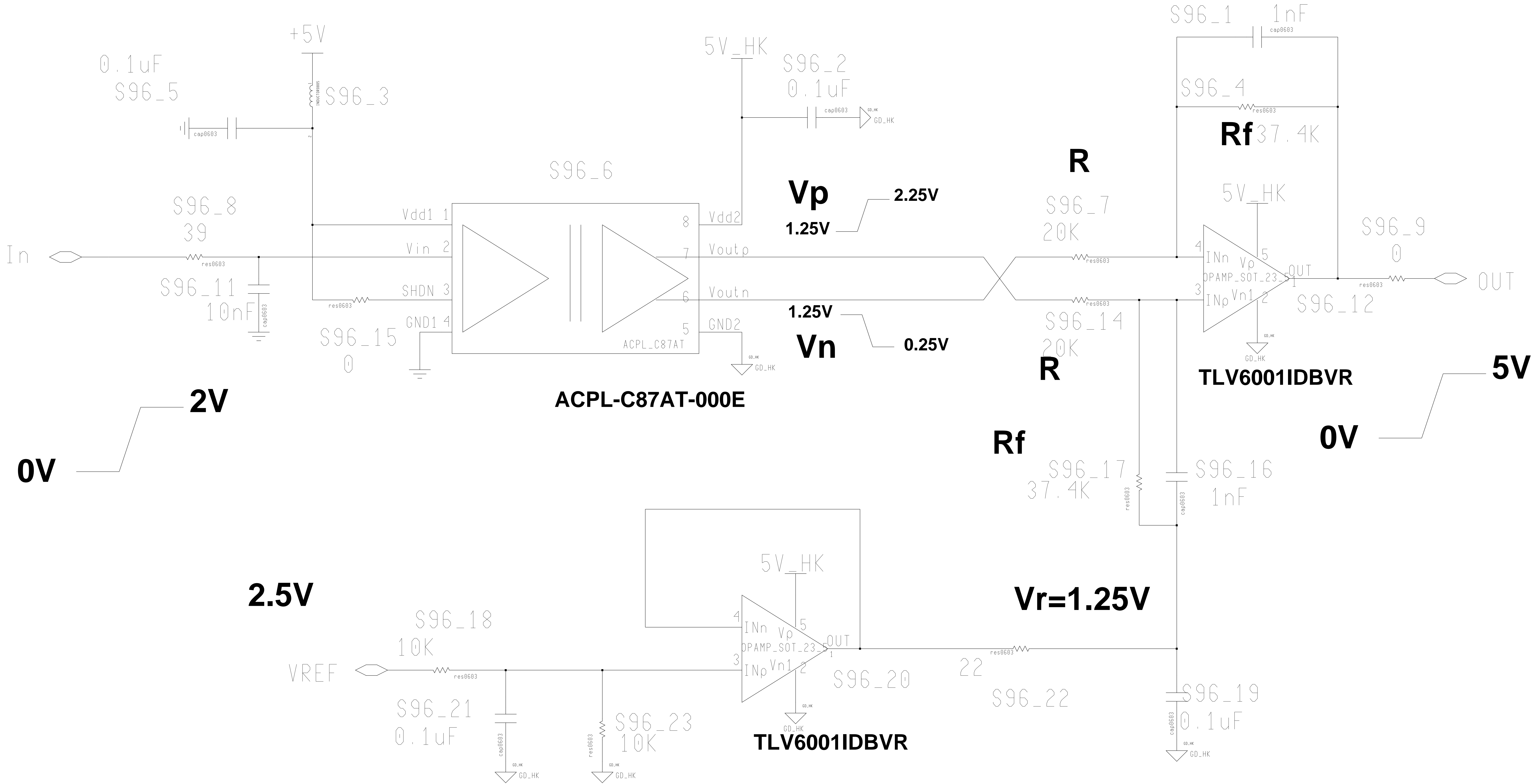


SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan
Drawn by: M. Bogdan
DATE: 3/22/2021

The University of Chicago
HELIX Relay Box Board
Isolated Amplifier - 1

$$V_o = V_r + (V_p - V_n) * R_f / R$$

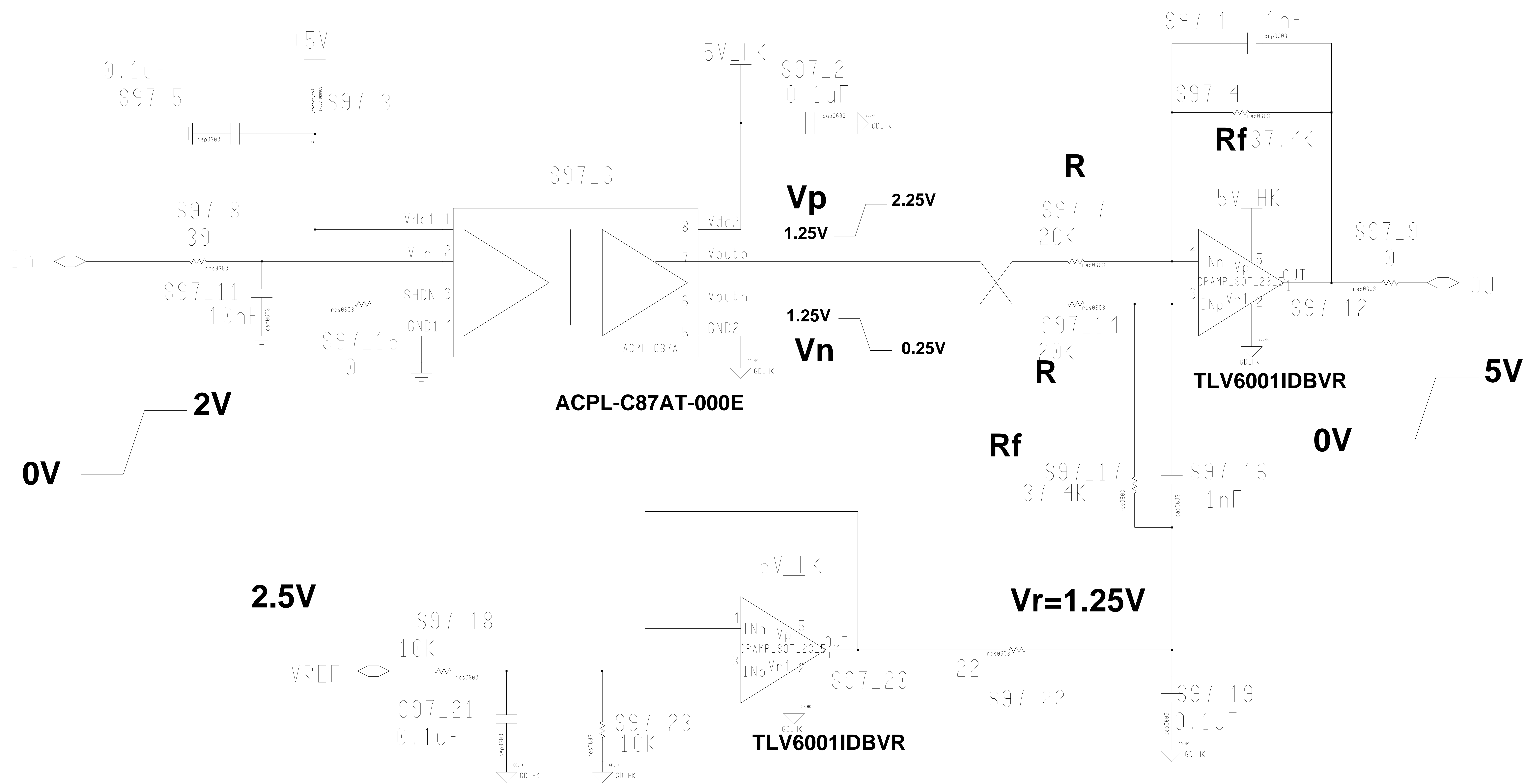


SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan
Drawn by: M. Bogdan
DATE: 3/22/2021

The University of Chicago
HELIX Relay Box Board
Isolated Amplifier - 1

$$V_o = V_r + (V_p - V_n) * R_f / R$$

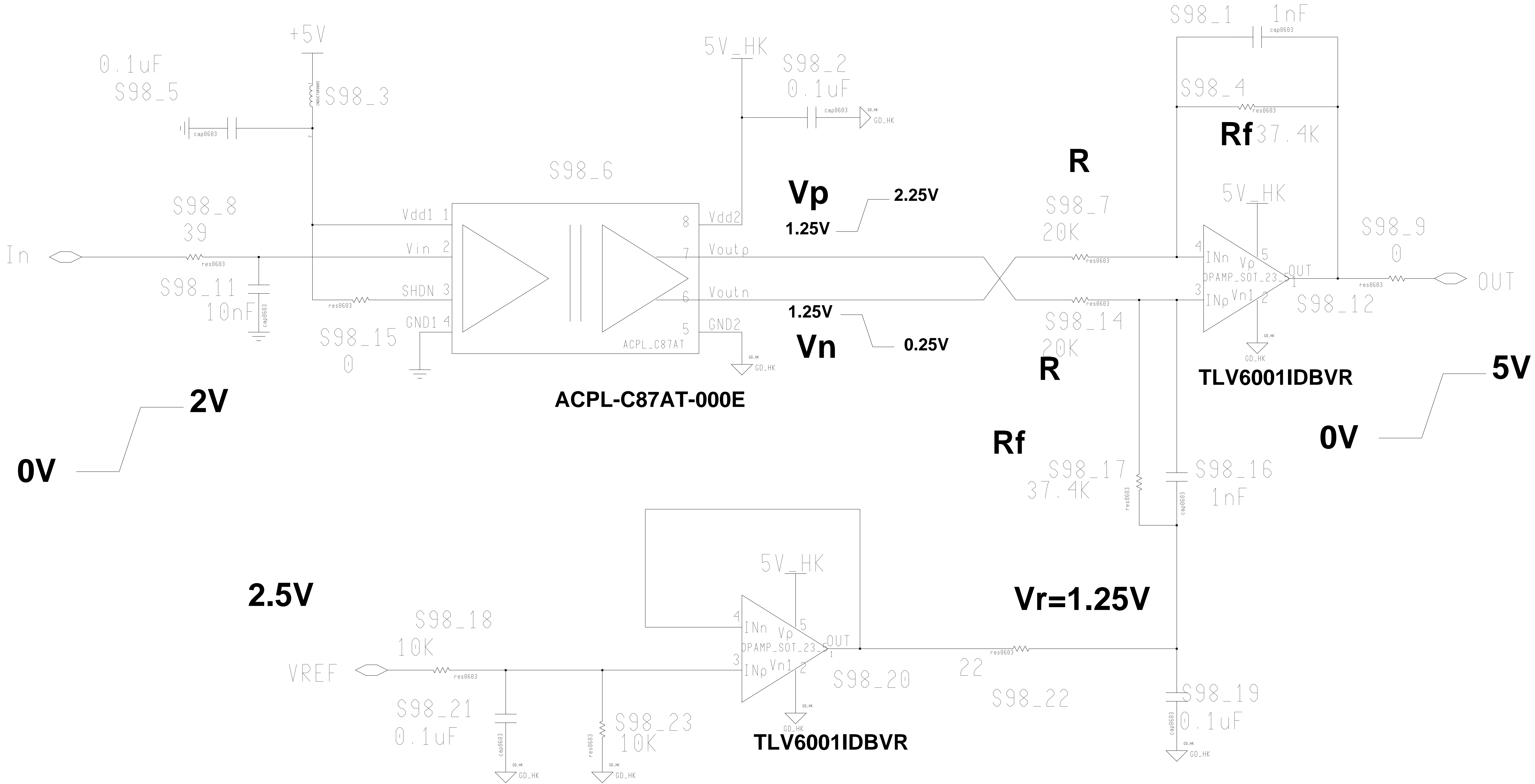


SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan
Drawn by: M. Bogdan
DATE: 3/22/2021

The University of Chicago
HELIX Relay Box Board
Isolated Amplifier - 1

$$V_o = V_r + (V_p - V_n) * R_f / R$$

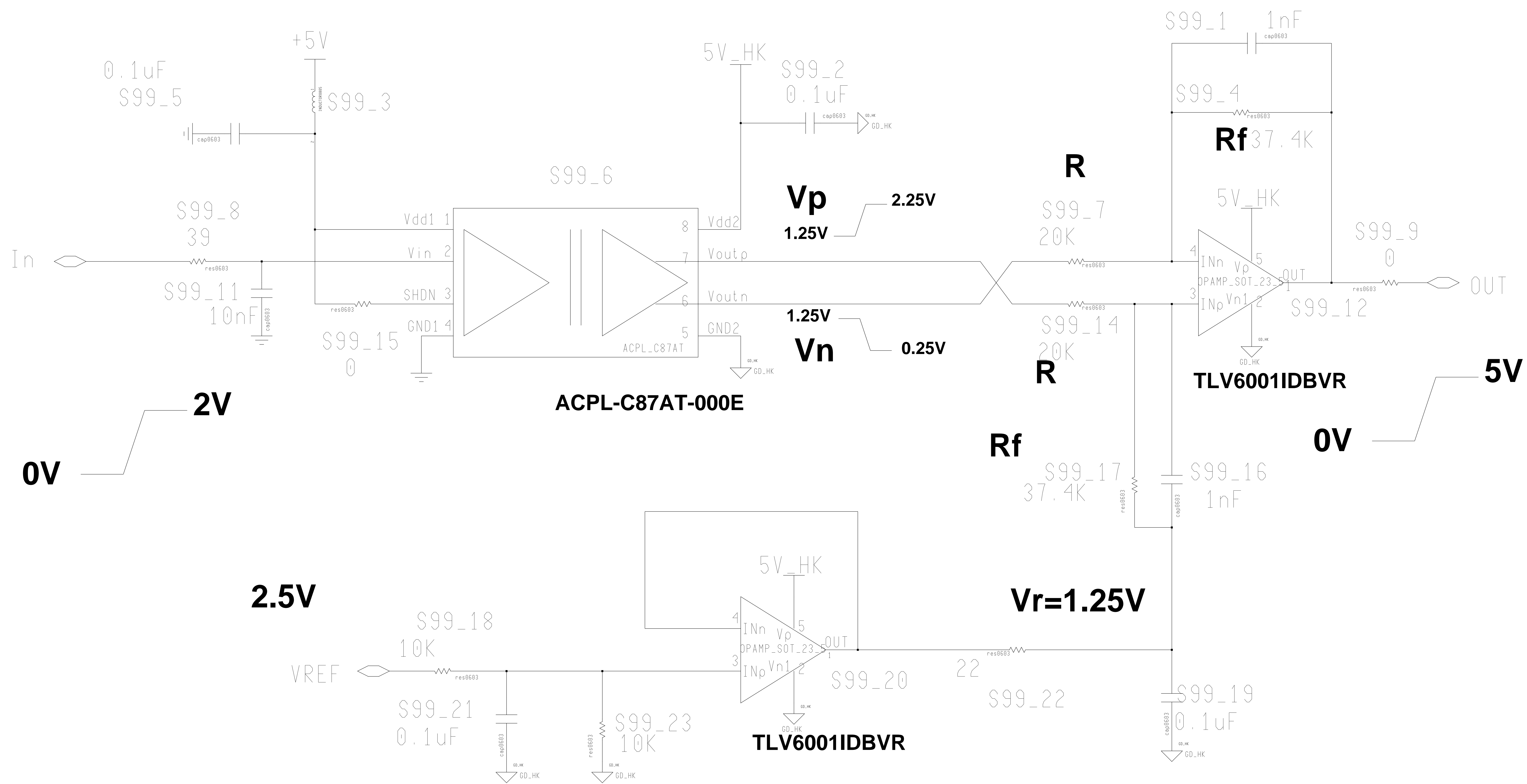


SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan
Drawn by: M. Bogdan
DATE: 3/22/2021

The University of Chicago
HELIX Relay Box Board
Isolated Amplifier - 1

$$V_o = V_r + (V_p - V_n) * R_f / R$$



SCH-2982
SPC-2983
ASM-2984

Engineer: M. Bogdan
Drawn by: M. Bogdan
DATE: 3/22/2021

The University of Chicago
HELIX Relay Box Board
Isolated Amplifier - 1