

PROJECT	BMS_Carrier_Board.PrjPcb	
DOCUMENT	Controller Board Interface	
PART NUMBER	MS-ELE0003	VARIANT BMS_Carrier_Board
DRAWN BY	Liam Hawkins	REVISION 1.1
LAST MODIFIED	2020/1/28	SHEET 1 OF 4

MIDNIGHT

SUN

Engineering 5 - 1002  
University of Waterloo  
(519) 888-4567 x32978  
hardware@uwmidsun.com

Table 4. SPI Modes

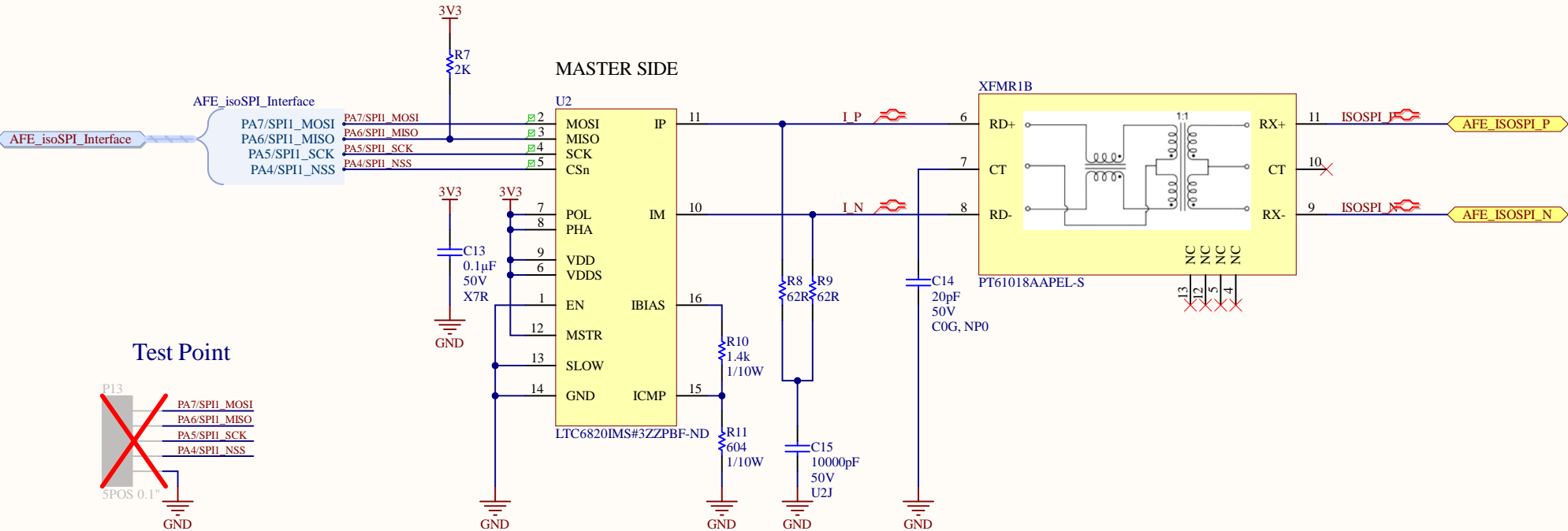
MODE	POL	PHA	DESCRIPTION
0	0	0	SCK Idles Low, Latches on Rising (1st) Edge
1	0	1	SCK Idles Low, Latches on Falling (2nd) Edge
2	1	0	SCK Idles High, Latches on Falling (1st) Edge
3	1	1	SCK Idles High, Latches on Rising (2nd) Edge

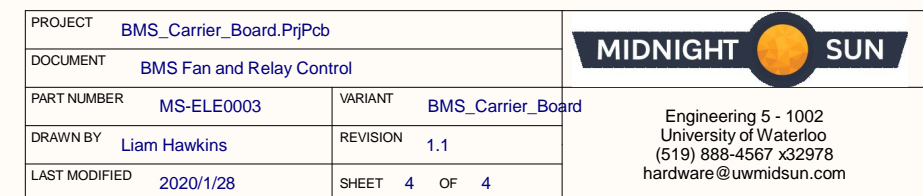
SCK idles high, latches on 2nd rising edge

Pulse Drive Current  $I_{IP} = 20 \cdot I_{BIAS} = 20\text{mA}$

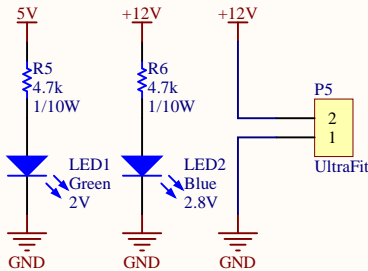
Transmitted Differential Signal Amplitude  $V_A = I_{IP} \cdot 120/2 = 1.2\text{V}$

Bias Current  $I_{BIAS}$  can be adjusted from 0.1mA to 1mA  
Currently set to 1mA

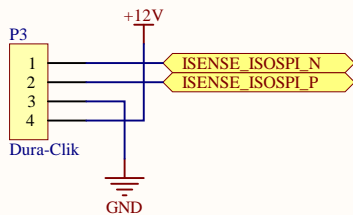




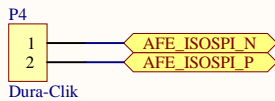
12V Power



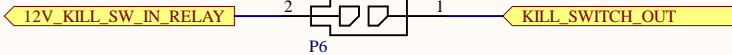
BMS Current Sense



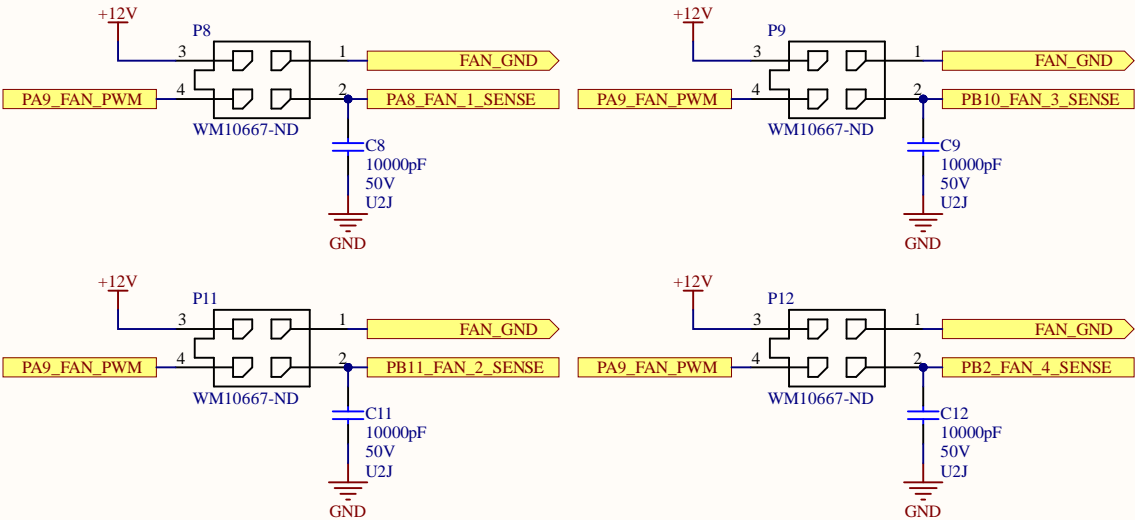
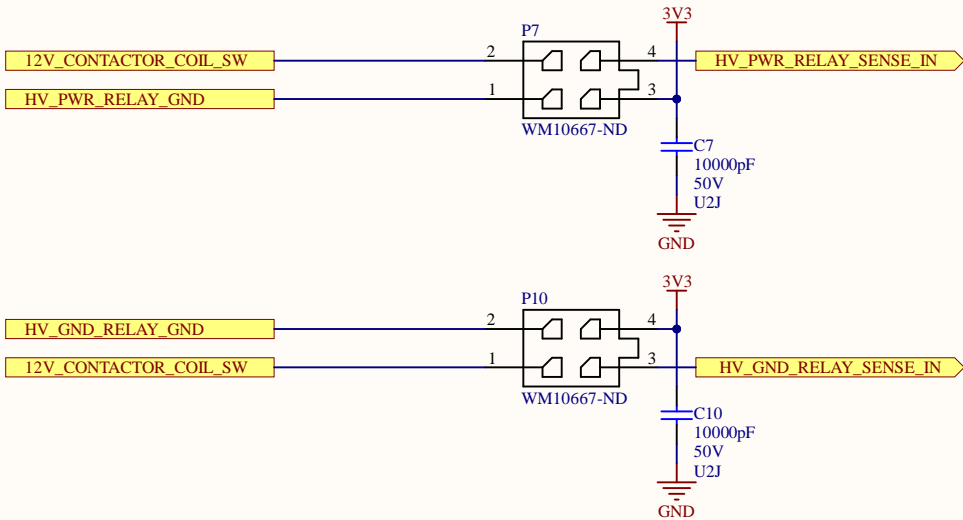
AFE isoSPI



Kill Switch



Relays & Fans



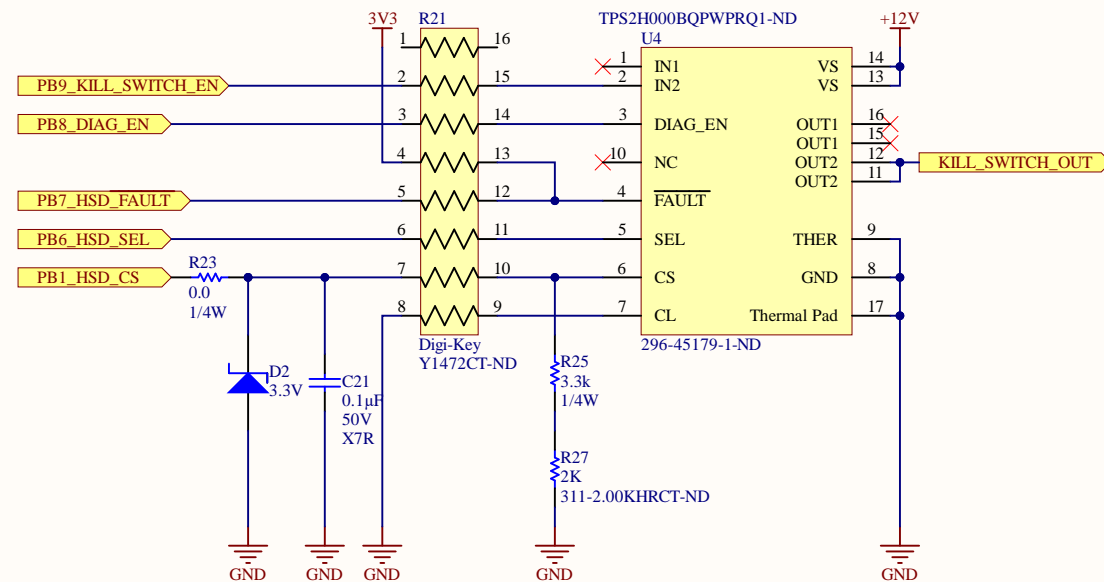
PROJECT	BMS_Carrier_Board.PrjPcb	
DOCUMENT	BMS Fan and Relay Control	
PART NUMBER	MS-ELE0003	VARIANT BMS_Carrier_Board
DRAWN BY	Liam Hawkins	REVISION 1.1
LAST MODIFIED	2020/1/28	SHEET 4 OF 4

MIDNIGHT

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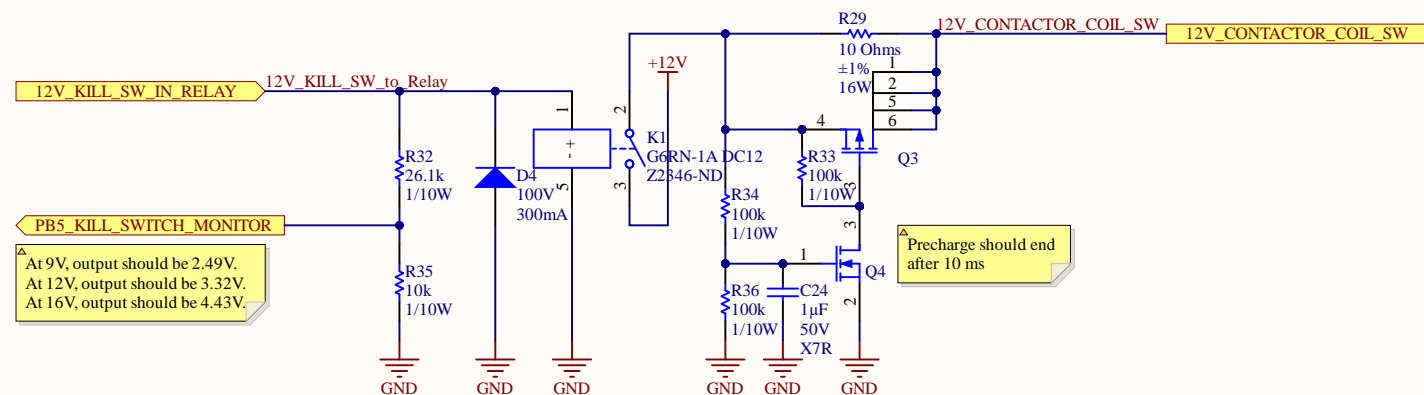
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## High Side Driver to Kill Switch

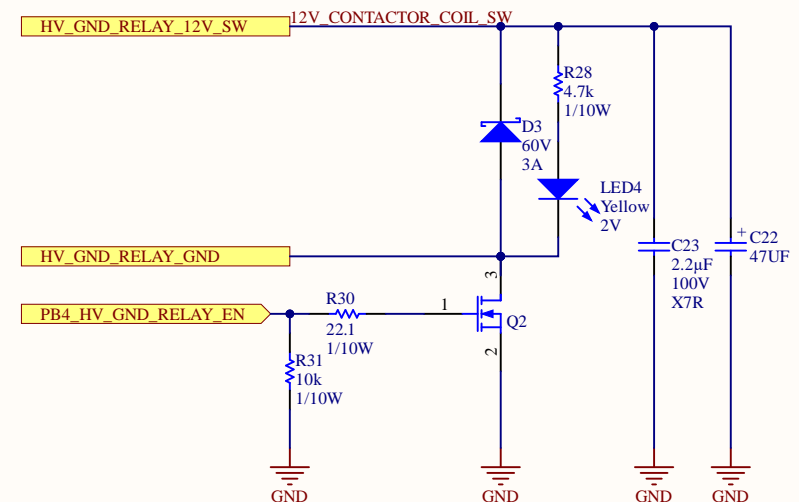
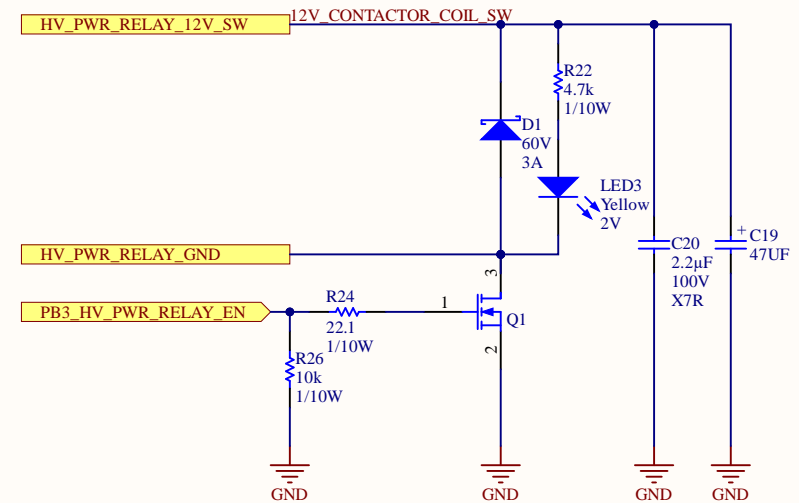



Should be high mainly (3.3 V input from MCU)

## Kill Switch Relay



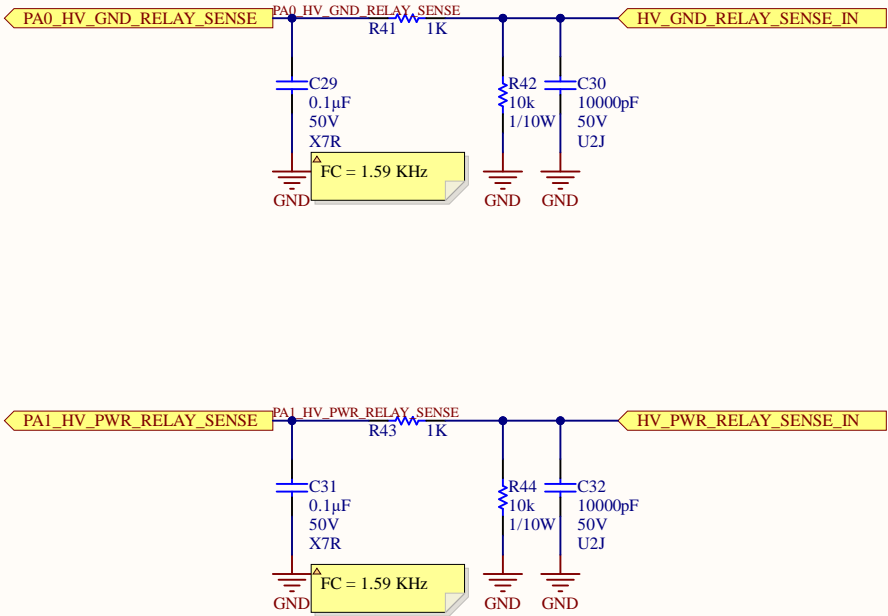
Precharge should end after 10 ms




PROJECT		BMS_Carrier_Board.PrjPcb			
DOCUMENT		BMS Fan and Relay Control			
PART NUMBER	MS-ELE0003	VARIANT	BMS_Carrier_Board		
DRAWN BY	Liam Hawkins	REVISION	1.1		
LAST MODIFIED	2020/1/28	SHEET	4	OF	4
<div>Engineering 5 - 1002</div> <div>University of Waterloo</div> <div>(519) 888-4567 x32978</div> <div>hardware@uwmidsun.com</div>					



Firmware Detection State of Contactor



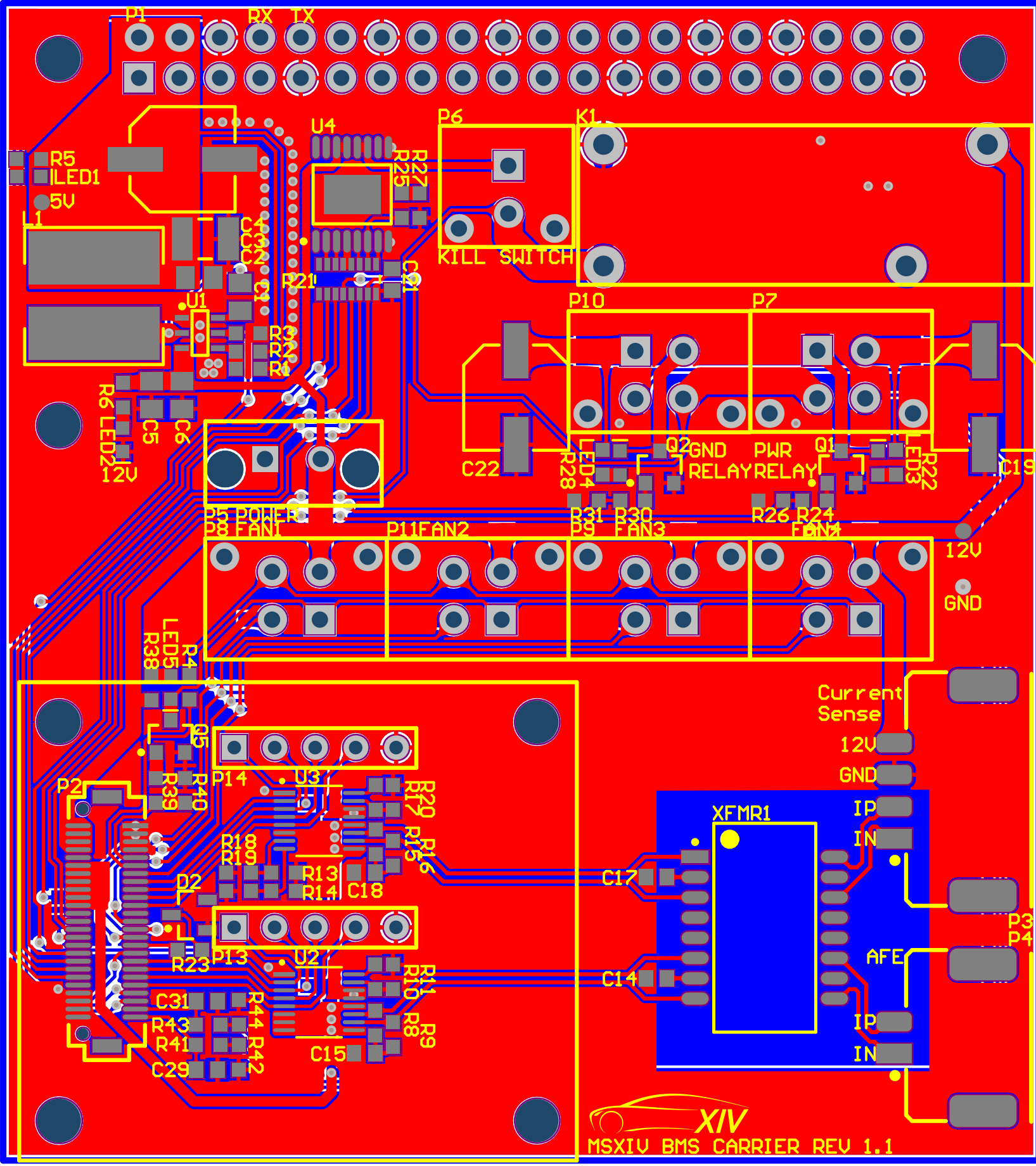
PROJECT		BMS_Carrier_Board.PrjPcb		<div><div>MIDNIGHT</div><div></div><div>SUN</div></div> <div>Engineering 5 - 1002 University of Waterloo (519) 888-4567 x32978 hardware@uwmid.sun.com</div>
DOCUMENTFirmware Detection State of Contactor				
PART NUMBER	MS-ELE0003	VARIANT	BMS_Carrier_Board	
DRAWN BY	Liam Hawkins	REVISION	1.1	
LAST MODIFIED	2020/1/28	SHEET	* OF *	

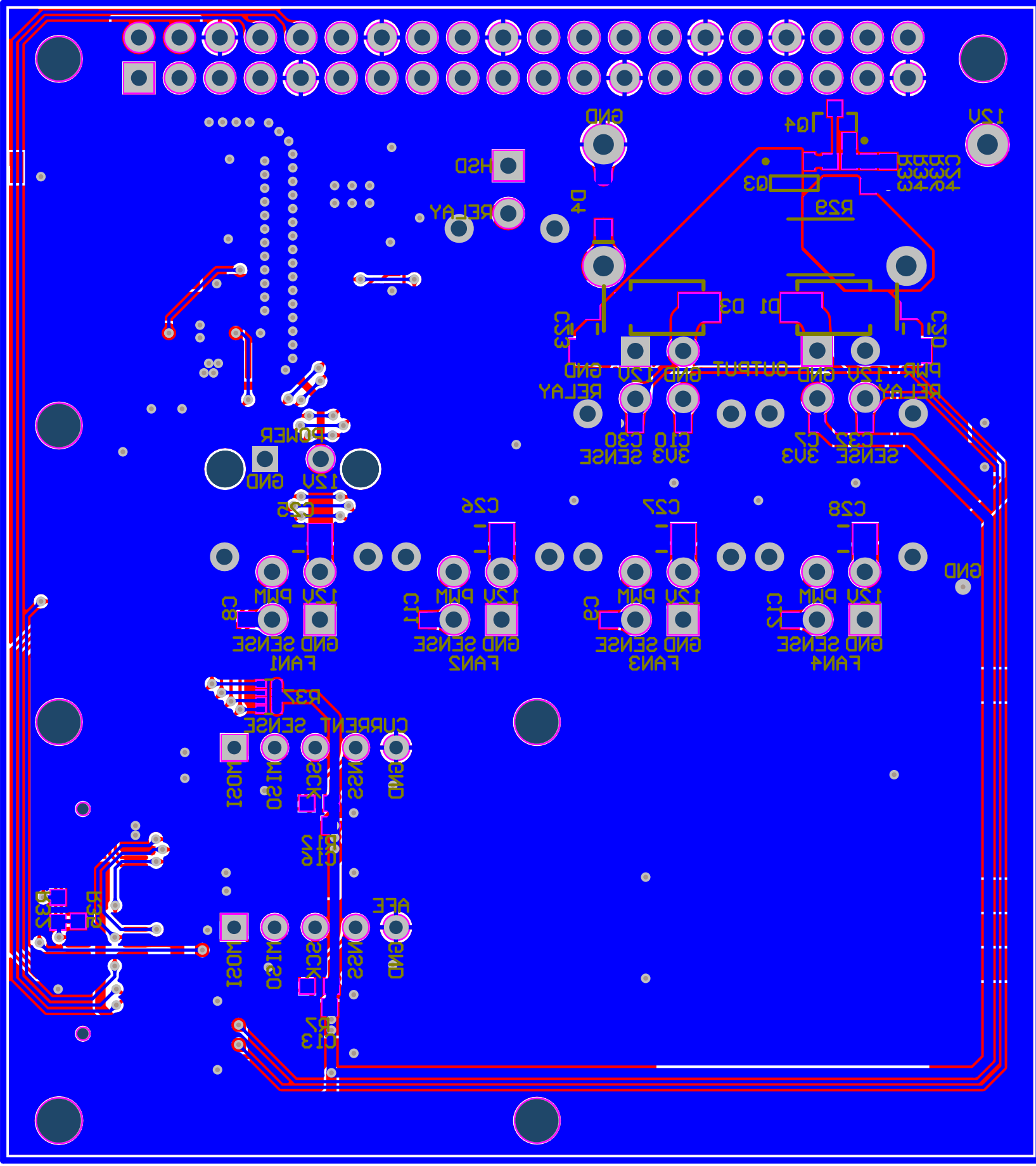
Bill of Materials	
Project:	BMS_Carrier_Board.PriPcb
Revision:	1.1
Project Lead:	Liam Hawkins
Generated On:	2020/1/28 18:14
Production Quantity:	1
Currency	CAD
Total Parts Count:	107

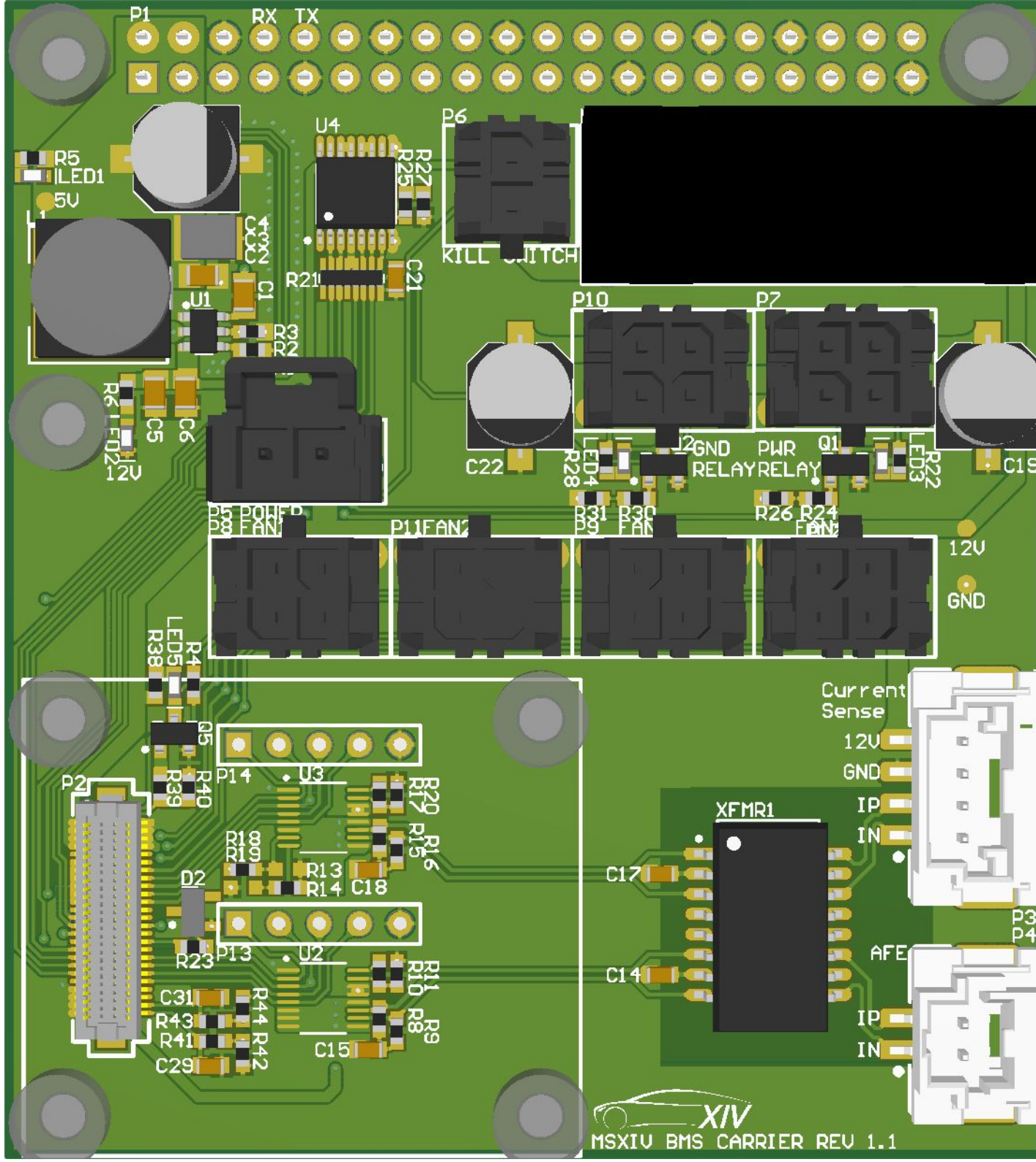


LibRef	Designator	Manufacturer 1	Manufacturer Part Number 1	Supplier 1	Supplier Part Number 1	Supplier Unit Price 1	Quantity	Supplier Subtotal 1
CAP CER 0.1UF 100V 10% X7R 0805	C1, C2, C6	Murata	GCM21BR72A104KA37L	Digi-Key	490-4789-1-ND	0.42172	3	\$ 1.27
CAP CER 47UF 6.3V X7R 1210	C3	Murata	GCJ32ER70J476KE01L	Digi-Key	490-10559-1-ND	1.77	1	\$ 1.77
CAP ALUM 47UF 20% 35V SMD	C4, C19, C22			Digi-Key	CE3961CT-ND, [NoParam]		3	
CAP CER 22UF 35V X5R 0805	C5	TDK	C2012X5R1V226M125AC	Digi-Key	445-14428-1-ND	1.5	1	\$ 1.50
CAP CER 10nF 50V 5% X7R 0603	C7, C8, C9, C10, C11, C12, C15, C18, C30, C3	KEMET	C0603C103J5JACTU	Digi-Key	399-13384-1-ND	0.2952	10	\$ 2.95
CAP CER 0.1UF 50V 10% X7R 0603	C13, C16, C21, C29, C31	Kyocera AVX	06035C104KAT2A	Digi-Key	478-5052-1-ND	0.13179	5	\$ 0.66
CAP CER 20PF 50V ±5% C0G/NP0 0603	C14, C17	Murata	GRM1885C1H200JA01D	Digi-Key	490-1410-1-ND	0.14496	2	\$ 0.29
CAP CER 2.2UF 100V ±20% X7R 1206	C20, C23, C25, C26, C27, C28	Murata	GRM31CR72A225MA73L	Digi-Key	490-12773-1-ND		6	
CAP CER 1UF 50V 10% X7R 0603	C24	Taiyo Yuden	UMK107AB7105KA-T	Digi-Key	587-3247-1-ND	0.32946	1	\$ 0.33
DIODE SCHOTTKY 60V 3A SMA	D1, D3	Diodes	B360A-13-F	Digi-Key	B360A-FDICT-ND	0.50079	2	\$ 1.00
DIODE ZENER 3.3V 250mW	D2	Rohm	BZX84C3V3LFHT116	Digi-Key	ZX84C3V3LFHT116CT-ND	0.17132	1	\$ 0.17
DIODE GEN PURP 100V 300MA SOD123	D4	Diodes Zetex	1N4148WQ-7-F	Digi-Key	1N4148WQ-7-FDICT-ND	0.26357	1	\$ 0.26
RELAY SPST 12V 8A OMRON	K1	Omron	G6RN-1ADC12	Digi-Key	Z2346-ND	5.36	1	\$ 5.36
IND 3.3uH 5.2A 20MOHM SMD	L1	TDK	VLB040T-3R3N	Digi-Key	445-6581-1-ND		1	
LED GREEN CLEAR 2V 0603	LED1	Würth Electronics	150060VS75000	Digi-Key	732-4980-1-ND	0.1845	1	\$ 0.18
LED BLUE CLEAR 2.8V 0603	LED2	Vishay Lite-On	LTST-C1931BKT-5A	Digi-Key	160-1827-1-ND	0.59304	1	\$ 0.59
LED YELLOW CLEAR 2.1V 0603	LED3, LED4	Würth Electronics	150060YS75000	Digi-Key	732-4981-1-ND	0.1845	3	\$ 0.55
CONN 40POS RECEPTACLE 2.54 mm	P1	Adafruit Industries	1992	Digi-Key	1528-1969-ND	3.89	1	\$ 3.89
CONN 50POS Bergstak Plug 0.02"	P2	Amphenol FCI	10132797-055100LF	Digi-Key	609-5226-1-ND	1.9	1	\$ 1.90
CONN 4POS DURA-CLIK 0.079"	P3	Molex	5600200420	Digi-Key	WM10864CT-ND	2.19	1	\$ 2.19
CONN 2POS DURA-CLIK 0.079" VERT	P4	Molex	5600200220	Digi-Key	WM10862CT-ND	1.03	1	\$ 1.03
CONN 2POS ULTRA-FIT 0.138"	P5	Molex	1722861302	Digi-Key	WM11673-ND	2.1	1	\$ 2.10
CONN 2POS MICRO-FIT 3mm	P6	Molex	430450227	Digi-Key	WM10657-ND	1.11	1	\$ 1.11
CONN 4POS MICRO-FIT 3mm	P7, P8, P9, P10, P11, P12	Molex	43045-0427	Digi-Key	WM10667-ND	1.77	6	\$ 10.60
MOSFET N-CH 30V 6.2A 0.9W SOT-23	Q1, Q2, Q4, Q5	Diodes	DMN3023L-7	Digi-Key	DMN3023L-7DICT-ND	0.48761	4	\$ 1.95
MOSFET P-CH 30V 4A 1.6W SOT-23-6	Q3	STMicroelectronics	STT4P3LLH6	Digi-Key	497-15521-1-ND	0.71164	1	\$ 0.71
RES 54.9K OHM 1% 1/10W 0603	R1	Panasonic	ERJ-3EKF5492V	Digi-Key	P54.9KHCT-ND	0.13179	1	\$ 0.13
RES 10K OHM 1% 1/10W 0603	R2, R3, R26, R31, R35, R38, R42, R44	Yageo Phycomp	RC0603FR-0710KL	Digi-Key	311-10.0KHRCT-ND	0.13179	8	\$ 1.05
RES 22.1 OHM 1% 1/10W 0603	R4, R24, R30, R37	Yageo	RC0603FR-0722R1L	Digi-Key	311-22.1HRCT-ND	0.13179	4	\$ 0.53
RES 4.7K OHM 1% 1/10W 0603	R5, R6, R22, R28, R36	Yageo Phycomp	RC0603FR-074K7L	Digi-Key	311-4.70KHRCT-ND	0.13179	5	\$ 0.66
RES 2K OHM 1% 1/10W 0603	R7, R12, R27	Yageo	RC0603FR-072KL	Digi-Key	311-2.00KHRCT-ND	0.13179	3	\$ 0.40
RES 62 OHM 0.1% 1/10W 0603	R8, R9, R15, R16	Panasonic	ERA3AE620V	Digi-Key	P62DBCT-ND	0.46125	4	\$ 1.85
RES 1.4k OHM 1% 1/10W 0603	R10, R17	Yageo	RC0603FR-071K4L	Digi-Key	311-1.40KHRCT-ND	0.13179	2	\$ 0.26
RES 604 OHM 1% 1/10W 0603	R11, R20	Yageo	RC0603FR-07604RL	Digi-Key	311-604HRCT-ND	0.13179	2	\$ 0.26
RES 0.0 OHM 1/4W 0603	R14, R18, R23	Vishay Dale	CRCW06030000Z0EAHP	Digi-Key	541-0.0SBCT-ND	0.19768	3	\$ 0.59
RES ARRAY 4.7K OHM 8 RES 1506	R21	Panasonic	EXB-2HV472JV	Digi-Key	Y1472CT-ND	0.38218	1	\$ 0.38
RES 3.3K OHM 1% 1/4W 0603	R25	Panasonic	ERJ-PA3F3301V	Digi-Key	P3.3KBYCT-ND	0.1845	1	\$ 0.18
RES 10 OHM 1% 16W 2512	R29	Susumu	CPA2512Q10R0FS-T10	Digi-Key	CPA25Q10.0CT-ND	3.86	1	\$ 3.86
RES 26.1K OHM 1% 1/10W 0603	R32	Yageo Phycomp	RC0603FR-0726K1L	Digi-Key	311-26.1KHRCT-ND	0.13179	1	\$ 0.13
RES 100K OHM 5% 1/8W 0603	R33, R34, R36	Yageo	RC0603JR-07100KL	Digi-Key	311-100KGRCT-ND	0.13179	3	\$ 0.40
RES ARRAY 10K OHM 1% 4RES 0804	R35	Vishay Dale	CRA04S08310K0FTD	Digi-Key	CRA4S810.0KACT-ND	0.56668	1	\$ 0.57
RES 1K OHM 5% 1/10W 0603	R41, R43	Yageo	RC0603JR-071KL	Digi-Key	311-1.0KGRCT-ND	0.13179	2	\$ 0.26
REG BUCK 4.5V TO 17V, 5A, SYNCHRONOUS S	U1	Texas Instruments	TPS565201DDCT	Digi-Key	296-47501-1-ND	2.03	1	\$ 2.03
ISOSPI COMM INTERFACE LTC6820IMS#3ZZPB	U2, U3	Analog Devices / Linear Technology	LTC6820IMS#3ZZPBF	Digi-Key	LTC6820IMS#3ZZPBF-ND	7.96	2	\$ 15.92
IC HSD Dual-Channel 40V 1KOhm	U4	Texas Instruments	TPS2H00BQPWPRQ1	Digi-Key	PS2H00BQPWPRQ1-ND		1	
IC PULSE XFMR 1CT:1CT 350UH SMD	XFMR1	Bourns	PT61018AAPEL-S	Digi-Key	PT61018AAPEL-SCT-ND	5.05	1	\$ 5.05
							Total:	\$ 76.89









## Electrical Rules Check Report

Class	Document	Message
Error	BMS Carrier - Battery Relay Controls.SchDoc	Duplicate Component Designators LED4
Error	BMS Carrier - Battery Relay Controls.SchDoc	Duplicate Component Designators R35
Error	BMS Carrier - Battery Relay Controls.SchDoc	Duplicate Component Designators R36
Error	BMS Carrier - Battery Relay Controls.SchDoc	Duplicate Net Names Wire NetLED4_1
Warning	BMS Carrier - Connectors.SchDoc	Net PA8 has no driving source (Pin C12-1, Pin P2-7, Pin P12-2, Pin R35-5)
Warning	BMS Carrier - Connectors.SchDoc	Net PB2 has no driving source (Pin C8-1, Pin P2-15, Pin P8-2, Pin R35-8)
Warning	BMS Carrier - Connectors.SchDoc	Net PB10/USART3_TX/I2C2_SCL has no driving source (Pin C11-1, Pin P2-14, Pin P11-2, Pin R35-7)
Warning	BMS Carrier - Connectors.SchDoc	Net PB11/USART3_RX/I2C2_SDA has no driving source (Pin C9-1, Pin P2-13, Pin P9-2, Pin R35-6)

## Design Rules Verification Report

Filename : C:\Users\YCA42\hardware\MSXIV\_BMS\_Carrier\_Board\BMS\_Carrier\_Board.Pc

Warnings 0  
Rule Violations 159

Warnings	
Total	0

Rule Violations	
Clearance Constraint (Gap=0.152mm) (All),(All)	0
Short-Circuit Constraint (Allowed=No) (All),(All)	0
Un-Routed Net Constraint ( (All) )	0
Modified Polygon (Allow modified: No), (Allow shelved: No)	0
Width Constraint (Min=0.203mm) (Max=2.54mm) (Preferred=0.203mm) (All)	0
Power Plane Connect Rule(Direct Connect)(Expansion=0.508mm) (Conductor Width=0.254mm) (Air Gap=0.254mm)	0
Hole Size Constraint (Min=0.025mm) (Max=5.08mm) (All)	0
Hole To Hole Clearance (Gap=0.254mm) (All),(All)	0
Minimum Solder Mask Sliver (Gap=0.254mm) (All),(All)	159
Silk To Solder Mask (Clearance=0.254mm) (Disabled)(IsPad),(All)	0
Silk to Silk (Clearance=0.254mm) (Disabled)(All),(All)	0
Net Antennae (Tolerance=0mm) (All)	0
Height Constraint (Min=0mm) (Max=25.4mm) (Preferred=12.7mm) (All)	0
Total	159

<b>Minimum Solder Mask Sliver (Gap=0.254mm) (All),(All)</b>	
Minimum Solder Mask Sliver Constraint: (0.172mm < 0.254mm) Between Pad C1-1(13.875mm,53.275mm) on Top Layer And Pad R3-1(13.6mm,51.9mm)	
Minimum Solder Mask Sliver Constraint: (0.172mm < 0.254mm) Between Pad C1-1(13.875mm,53.275mm) on Top Layer And Pad R2-1(13.6mm,51.9mm)	
Minimum Solder Mask Sliver Constraint: (0.072mm < 0.254mm) Between Pad C1-1(13.875mm,53.275mm) on Top Layer And Pad R2-1(13.6mm,51.9mm)	
Minimum Solder Mask Sliver Constraint: (0.021mm < 0.254mm) Between Pad C11-1(25.676mm,33.916mm) on Bottom Layer And Pad R2-1(13.6mm,51.9mm)	
Minimum Solder Mask Sliver Constraint: (0.222mm < 0.254mm) Between Pad C1-2(13.875mm,55.025mm) on Top Layer And Pad R2-1(13.6mm,51.9mm)	
Minimum Solder Mask Sliver Constraint: (0.097mm < 0.254mm) Between Pad C12-1(48.401mm,33.9mm) on Bottom Layer And Pad R2-1(13.6mm,51.9mm)	
Minimum Solder Mask Sliver Constraint: (0.222mm < 0.254mm) Between Pad C13-1(19.5mm,9.6mm) on Bottom Layer And Pad R2-1(13.6mm,51.9mm)	
Minimum Solder Mask Sliver Constraint: (0.222mm < 0.254mm) Between Pad C13-2(18.15mm,9.6mm) on Bottom Layer And Pad R2-1(13.6mm,51.9mm)	
Minimum Solder Mask Sliver Constraint: (0.027mm < 0.254mm) Between Pad C15-1(22.357mm,6.725mm) on Top Layer And Pad R2-1(13.6mm,51.9mm)	
Minimum Solder Mask Sliver Constraint: (0.039mm < 0.254mm) Between Pad C15-1(22.357mm,6.725mm) on Top Layer And Pad R2-1(13.6mm,51.9mm)	
Minimum Solder Mask Sliver Constraint: (0.077mm < 0.254mm) Between Pad C18-1(22.364mm,18.05mm) on Top Layer And Pad R2-1(13.6mm,51.9mm)	
Minimum Solder Mask Sliver Constraint: (0.039mm < 0.254mm) Between Pad C18-1(22.364mm,18.05mm) on Top Layer And Pad R2-1(13.6mm,51.9mm)	
Minimum Solder Mask Sliver Constraint: (0.147mm < 0.254mm) Between Pad C2-1(10.425mm,55.4mm) on Top Layer And Pad C3-1(10.225mm,57.8mm)	
Minimum Solder Mask Sliver Constraint: (0.166mm < 0.254mm) Between Pad C21-1(23.405mm,55.899mm) on Top Layer And Pad C3-1(10.225mm,57.8mm)	
Minimum Solder Mask Sliver Constraint: (0.166mm < 0.254mm) Between Pad C21-2(23.405mm,54.549mm) on Top Layer And Pad C3-1(10.225mm,57.8mm)	
Minimum Solder Mask Sliver Constraint: (0.147mm < 0.254mm) Between Pad C2-2(12.175mm,55.4mm) on Top Layer And Pad C3-2(13.125mm,57.8mm)	
Minimum Solder Mask Sliver Constraint: (0.158mm < 0.254mm) Between Pad C24-1(54.55mm,62.665mm) on Bottom Layer And Pad C3-2(13.125mm,57.8mm)	
Minimum Solder Mask Sliver Constraint: (0.158mm < 0.254mm) Between Pad C24-2(54.55mm,61.315mm) on Bottom Layer And Pad C3-2(13.125mm,57.8mm)	
Minimum Solder Mask Sliver Constraint: (0.071mm < 0.254mm) Between Pad C25-1(18.901mm,39mm) on Bottom Layer And Pad C3-2(13.125mm,57.8mm)	
Minimum Solder Mask Sliver Constraint: (0.071mm < 0.254mm) Between Pad C25-2(16.151mm,39mm) on Bottom Layer And Pad C3-2(13.125mm,57.8mm)	
Minimum Solder Mask Sliver Constraint: (0.071mm < 0.254mm) Between Pad C26-1(30.301mm,39mm) on Bottom Layer And Pad C3-2(13.125mm,57.8mm)	
Minimum Solder Mask Sliver Constraint: (0.071mm < 0.254mm) Between Pad C26-2(27.551mm,39mm) on Bottom Layer And Pad C3-2(13.125mm,57.8mm)	
Minimum Solder Mask Sliver Constraint: (0.071mm < 0.254mm) Between Pad C27-1(41.701mm,39mm) on Bottom Layer And Pad C3-2(13.125mm,57.8mm)	
Minimum Solder Mask Sliver Constraint: (0.071mm < 0.254mm) Between Pad C27-2(38.951mm,39mm) on Bottom Layer And Pad C3-2(13.125mm,57.8mm)	
Minimum Solder Mask Sliver Constraint: (0.071mm < 0.254mm) Between Pad C28-1(53.101mm,39mm) on Bottom Layer And Pad C3-2(13.125mm,57.8mm)	
Minimum Solder Mask Sliver Constraint: (0.071mm < 0.254mm) Between Pad C28-2(50.351mm,39mm) on Bottom Layer And Pad C3-2(13.125mm,57.8mm)	
Minimum Solder Mask Sliver Constraint: (0.045mm < 0.254mm) Between Pad C30-1(38.651mm,46.238mm) on Bottom Layer And Pad C3-2(13.125mm,57.8mm)	
Minimum Solder Mask Sliver Constraint: (0.095mm < 0.254mm) Between Pad C30-2(37.301mm,46.238mm) on Bottom Layer And Pad C3-2(13.125mm,57.8mm)	
Minimum Solder Mask Sliver Constraint: (0.125mm < 0.254mm) Between Pad C7-2(48.751mm,46.237mm) on Bottom Layer And Pad C3-2(13.125mm,57.8mm)	
Minimum Solder Mask Sliver Constraint: (0.035mm < 0.254mm) Between Pad C8-1(14.263mm,33.933mm) on Bottom Layer And Pad C3-2(13.125mm,57.8mm)	
Minimum Solder Mask Sliver Constraint: (0.097mm < 0.254mm) Between Pad C9-1(37.001mm,33.9mm) on Bottom Layer And Pad C3-2(13.125mm,57.8mm)	
Minimum Solder Mask Sliver Constraint: (0.128mm < 0.254mm) Between Pad D2-2(11.825mm,16.35mm) on Top Layer And Via (13.01mm,16.9mm) from C3-2(13.125mm,57.8mm)	
Minimum Solder Mask Sliver Constraint: (0.127mm < 0.254mm) Between Pad D2-3(11.825mm,14.45mm) on Top Layer And Pad C3-2(13.125mm,57.8mm)	
Minimum Solder Mask Sliver Constraint: (0.137mm < 0.254mm) Between Pad D4-1(36.678mm,61.69mm) on Bottom Layer And Pad C3-2(13.125mm,57.8mm)	
Minimum Solder Mask Sliver Constraint: (0.125mm < 0.254mm) Between Pad K1-2(55.678mm,56.11mm) on Multi-Layer And Pad C3-2(13.125mm,57.8mm)	
Minimum Solder Mask Sliver Constraint: (0.062mm < 0.254mm) Between Pad LED1-1(-0.136mm,61.71mm) on Top Layer And Pad C3-2(13.125mm,57.8mm)	
Minimum Solder Mask Sliver Constraint: (0.062mm < 0.254mm) Between Pad LED1-2(1.364mm,61.71mm) on Top Layer And Pad R5-1(1.4mm,62.8mm)	
Minimum Solder Mask Sliver Constraint: (0.095mm < 0.254mm) Between Pad LED3-1(53.9mm,43mm) on Top Layer And Pad R22-2(55.023mm,43mm)	
Minimum Solder Mask Sliver Constraint: (0.095mm < 0.254mm) Between Pad LED3-2(53.9mm,44.5mm) on Top Layer And Pad R22-2(55.023mm,43mm)	
Minimum Solder Mask Sliver Constraint: (0.069mm < 0.254mm) Between Pad LED4-1(37.7mm,43mm) on Top Layer And Pad R28-2(36.603mm,43mm)	
Minimum Solder Mask Sliver Constraint: (0.069mm < 0.254mm) Between Pad LED4-2(37.7mm,44.5mm) on Top Layer And Pad R28-2(36.603mm,43mm)	
Minimum Solder Mask Sliver Constraint: (0.183mm < 0.254mm) Between Pad LED5-1(9.51mm,30.416mm) on Top Layer And Pad R28-2(36.603mm,43mm)	
Minimum Solder Mask Sliver Constraint: (0.162mm < 0.254mm) Between Pad LED5-1(9.51mm,30.416mm) on Top Layer And Pad R28-2(36.603mm,43mm)	
Minimum Solder Mask Sliver Constraint: (0.183mm < 0.254mm) Between Pad LED5-2(9.51mm,28.916mm) on Top Layer And Pad R28-2(36.603mm,43mm)	
Minimum Solder Mask Sliver Constraint: (0.162mm < 0.254mm) Between Pad LED5-2(9.51mm,28.916mm) on Top Layer And Pad R4-2(10.7mm,28.9mm)	
Minimum Solder Mask Sliver Constraint: (0.105mm < 0.254mm) Between Pad P2-(4mm,22.05mm) on Multi-Layer And Pad P2-(5.5mm,22.8mm) on Top Layer	
Minimum Solder Mask Sliver Constraint: (0.105mm < 0.254mm) Between Pad P2-(4mm,7.95mm) on Multi-Layer And Pad P2-(5.5mm,7.2mm) on Top Layer	
Minimum Solder Mask Sliver Constraint: (0.247mm < 0.254mm) Between Pad P2-4(7.3mm,19.5mm) on Top Layer And Via (7.3mm,20.4mm) from Top Layer	
Minimum Solder Mask Sliver Constraint: (0.022mm < 0.254mm) Between Pad Q1-1(50.7mm,42.5mm) on Top Layer And Pad R24-2(50.7mm,41.4mm) on Top Layer	
Minimum Solder Mask Sliver Constraint: (0.022mm < 0.254mm) Between Pad Q2-1(39.3mm,42.5mm) on Top Layer And Pad R30-2(39.3mm,41.4mm) on Top Layer	
Minimum Solder Mask Sliver Constraint: (0.198mm < 0.254mm) Between Pad Q3-1(47.7mm,62.665mm) on Bottom Layer And Pad R30-2(39.3mm,41.4mm) on Top Layer	
Minimum Solder Mask Sliver Constraint: (0.198mm < 0.254mm) Between Pad Q3-2(48.65mm,62.665mm) on Bottom Layer And Pad R30-2(39.3mm,41.4mm) on Top Layer	





Minimum Solder Mask Sliver (Gap=0.254mm) (All),(All)	
Minimum Solder Mask Sliver Constraint: (0.187mm < 0.254mm) Between Pad R21-13(20.351mm,56.2mm) on Top Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.166mm < 0.254mm) Between Pad R21-13(20.351mm,56.2mm) on Top Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.244mm < 0.254mm) Between Pad R21-14(19.843mm,56.2mm) on Top Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.166mm < 0.254mm) Between Pad R21-14(19.843mm,56.2mm) on Top Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.166mm < 0.254mm) Between Pad R21-15(19.335mm,56.2mm) on Top Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.166mm < 0.254mm) Between Pad R21-16(18.827mm,56.2mm) on Top Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.194mm < 0.254mm) Between Pad R21-16(18.827mm,56.2mm) on Top Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.216mm < 0.254mm) Between Pad R21-9(22.383mm,56.2mm) on Top Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.166mm < 0.254mm) Between Pad R21-9(22.383mm,56.2mm) on Top Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.102mm < 0.254mm) Between Pad R2-2(15.15mm,50.745mm) on Top Layer And Pad R3-2(15.15mm,51.9mm)	
Minimum Solder Mask Sliver Constraint: (0.227mm < 0.254mm) Between Pad R2-2(15.15mm,50.745mm) on Top Layer And Via (15.15mm,51.9mm) from	
Minimum Solder Mask Sliver Constraint: (0.147mm < 0.254mm) Between Pad R24-1(49.15mm,41.4mm) on Top Layer And Pad R26-1(47.95mm,41.4mm)	
Minimum Solder Mask Sliver Constraint: (0.082mm < 0.254mm) Between Pad R25-1(24.004mm,59.125mm) on Top Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.235mm < 0.254mm) Between Pad R25-1(24.004mm,59.125mm) on Top Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.207mm < 0.254mm) Between Pad R25-1(24.004mm,59.125mm) on Top Layer And Via (25.14mm,59.125mm)	
Minimum Solder Mask Sliver Constraint: (0.082mm < 0.254mm) Between Pad R25-2(24.004mm,60.675mm) on Top Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.163mm < 0.254mm) Between Pad R3-1(13.6mm,51.9mm) on Top Layer And Pad U1-4(12.475mm,50.95mm)	
Minimum Solder Mask Sliver Constraint: (0.072mm < 0.254mm) Between Pad R3-1(13.6mm,51.9mm) on Top Layer And Pad U1-5(12.475mm,51.9mm)	
Minimum Solder Mask Sliver Constraint: (0.163mm < 0.254mm) Between Pad R3-1(13.6mm,51.9mm) on Top Layer And Pad U1-6(12.475mm,52.85mm)	
Minimum Solder Mask Sliver Constraint: (0.202mm < 0.254mm) Between Pad R32-1(2.445mm,16.5mm) on Bottom Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.202mm < 0.254mm) Between Pad R32-2(2.445mm,14.95mm) on Bottom Layer And Pad R35-1(3.7mm,15mm)	
Minimum Solder Mask Sliver Constraint: (0.147mm < 0.254mm) Between Pad R33-1(50.9mm,62.665mm) on Bottom Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.147mm < 0.254mm) Between Pad R33-2(50.9mm,61.115mm) on Bottom Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.136mm < 0.254mm) Between Pad R34-1(52.1mm,61.115mm) on Bottom Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.136mm < 0.254mm) Between Pad R34-2(52.1mm,62.665mm) on Bottom Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.047mm < 0.254mm) Between Pad R37-1(16.175mm,29.889mm) on Bottom Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.047mm < 0.254mm) Between Pad R37-2(16.175mm,29.339mm) on Bottom Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.047mm < 0.254mm) Between Pad R37-3(16.175mm,28.839mm) on Bottom Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.047mm < 0.254mm) Between Pad R37-5(15.175mm,28.289mm) on Bottom Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.047mm < 0.254mm) Between Pad R37-6(15.175mm,28.839mm) on Bottom Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.047mm < 0.254mm) Between Pad R37-7(15.175mm,29.339mm) on Bottom Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.206mm < 0.254mm) Between Pad R41-1(11.1mm,7.241mm) on Top Layer And Pad R43-1(11.1mm,8.5mm)	
Minimum Solder Mask Sliver Constraint: (0.072mm < 0.254mm) Between Pad R41-2(12.65mm,7.241mm) on Top Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.206mm < 0.254mm) Between Pad R41-2(12.65mm,7.241mm) on Top Layer And Pad R43-2(12.65mm,8.5mm)	
Minimum Solder Mask Sliver Constraint: (0.218mm < 0.254mm) Between Pad R41-2(12.65mm,7.241mm) on Top Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.197mm < 0.254mm) Between Pad R41-2(12.65mm,7.241mm) on Top Layer And Via (13.775mm,7.266mm)	
Minimum Solder Mask Sliver Constraint: (0.218mm < 0.254mm) Between Pad R42-1(13.775mm,7.241mm) on Top Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.206mm < 0.254mm) Between Pad R42-1(13.775mm,7.241mm) on Top Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.072mm < 0.254mm) Between Pad R43-2(12.65mm,8.5mm) on Top Layer And Pad R44-1(13.775mm,8.5mm)	
Minimum Solder Mask Sliver Constraint: (0.197mm < 0.254mm) Between Pad R43-2(12.65mm,8.5mm) on Top Layer And Via (13.775mm,8.5mm) from	
Minimum Solder Mask Sliver Constraint: (0.162mm < 0.254mm) Between Pad R5-1(1.4mm,62.8mm) on Top Layer And Via (1.364mm,61.71mm) from Top	
Minimum Solder Mask Sliver Constraint: (0.038mm < 0.254mm) Between Pad R8-1(22.357mm,9.405mm) on Top Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.203mm < 0.254mm) Between Pad R8-1(22.357mm,9.405mm) on Top Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.131mm < 0.254mm) Between Pad R8-1(22.357mm,9.405mm) on Top Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.131mm < 0.254mm) Between Pad R8-1(22.357mm,9.405mm) on Top Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.23mm < 0.254mm) Between Pad R8-1(22.357mm,9.405mm) on Top Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.038mm < 0.254mm) Between Pad R8-2(22.357mm,7.855mm) on Top Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.038mm < 0.254mm) Between Pad R8-2(22.357mm,7.855mm) on Top Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.131mm < 0.254mm) Between Pad R8-2(22.357mm,7.855mm) on Top Layer And Pad	
Minimum Solder Mask Sliver Constraint: (0.197mm < 0.254mm) Between Pad U1-5(12.475mm,51.9mm) on Top Layer And Via (13.6mm,51.9mm) from	
Minimum Solder Mask Sliver Constraint: (0.204mm < 0.254mm) Between Pad U2-12(21.007mm,9.675mm) on Top Layer And Via (21mm,10.4mm) from	
Minimum Solder Mask Sliver Constraint: (0.229mm < 0.254mm) Between Pad U3-12(21.014mm,21.05mm) on Top Layer And Via (21mm,21.8mm) from	



Minimum Solder Mask Sliver (Gap=0.254mm) (All),(All)	
Minimum Solder Mask Sliver Constraint: (0.23mm < 0.254mm) Between Pad U3-15(21.014mm,22.551mm) on Top Layer And Via (21mm,21.8mm) from	
Minimum Solder Mask Sliver Constraint: (0.128mm < 0.254mm) Between Pad U4-10(22.525mm,63.55mm) on Top Layer And Via (23.381mm,63.55mm)	
Minimum Solder Mask Sliver Constraint: (0.047mm < 0.254mm) Between Pad U4-7(22.525mm,57.65mm) on Top Layer And Via (23.3mm,57.6mm) from	