



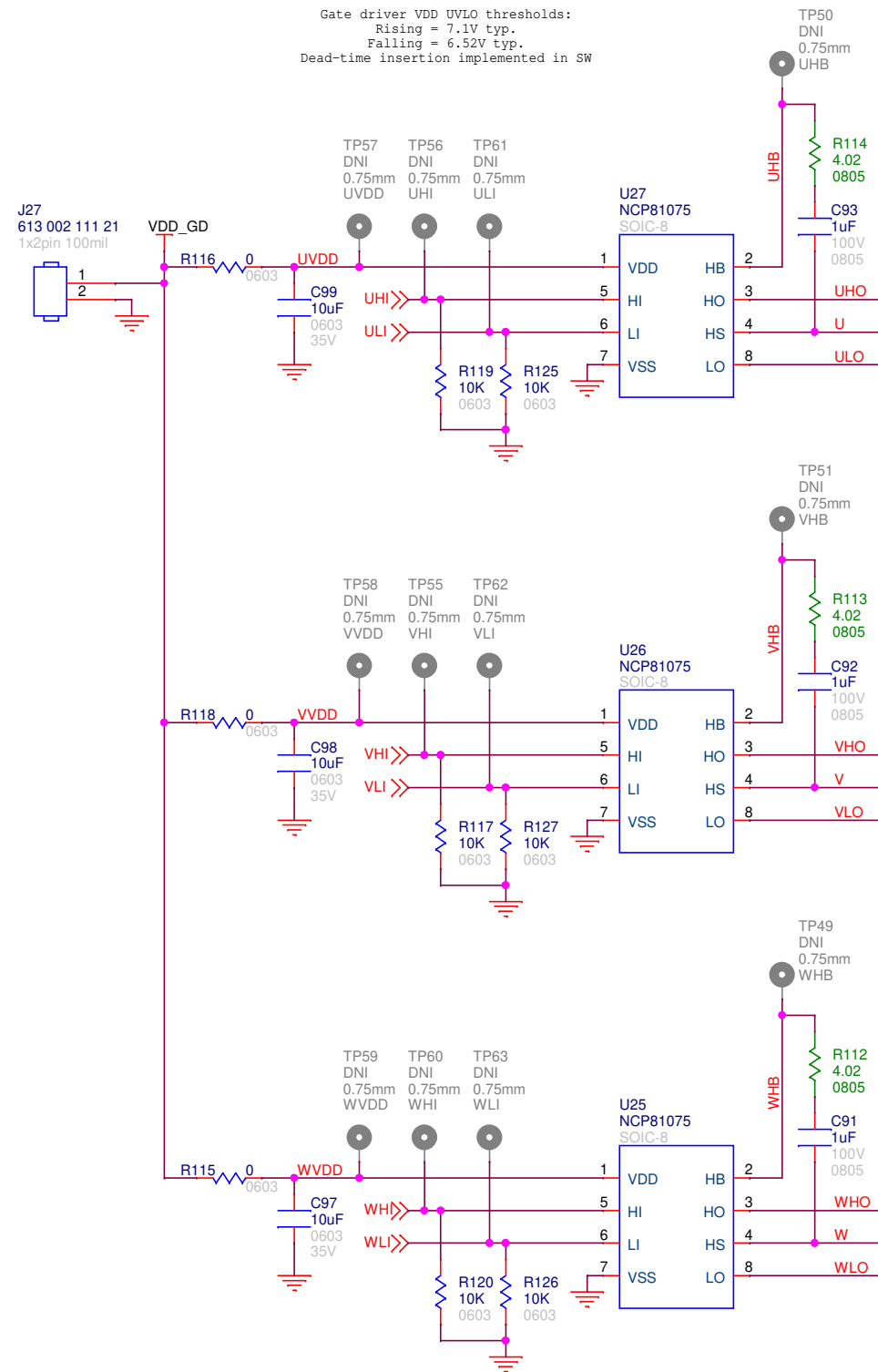
## 3-Phase BLDC Motor Driver MDK Power Board

Variant	OPN
12-16V	STR-10-16V-BLDC-MDK-GEVB
16-30V	STR-16-30V-BLDC-MDK-GEVB
30-60V	STR-30-60V-BLDC-MDK-GEVB
60-100V	STR-60-100V-BLDC-MDK-GEVB

onsemi		
Title 3-Phase BLDC Motor Driver MDK Power Board	Orderable Part Number See Table	
Variant Name VIN 60V to 100V Xilinx UCB	Document Number ONSEC-20-023	Rev REV1
Date: Wednesday, September 15, 2021	Sheet	1 of 6

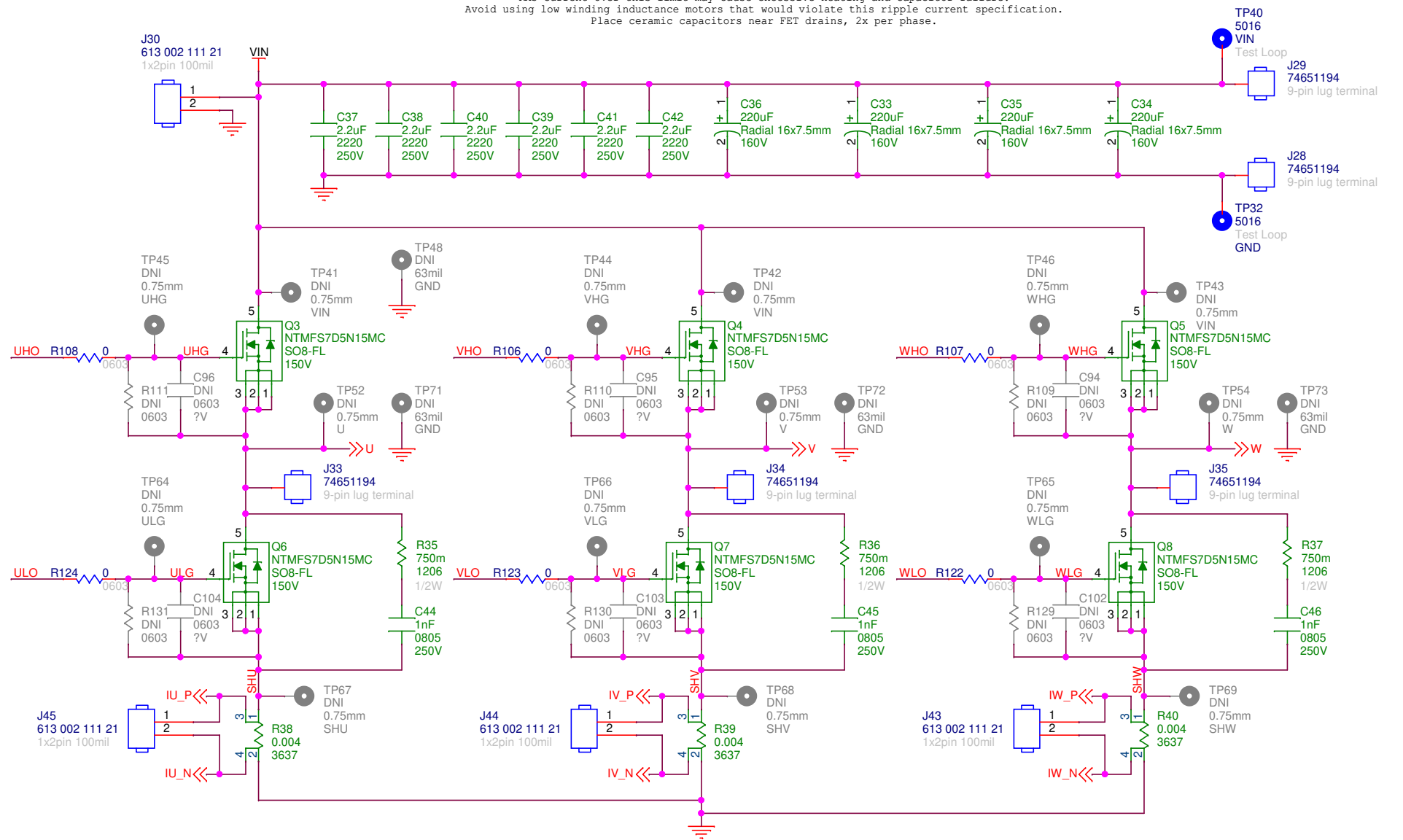
# MOSFET Inverter and Gate Drivers

## 3x Half H-Bridge Gate Drivers



## Inverter Power Stage

Max 3A RMS ripple current per input bulk capacitor.  
 RMS current over this limit may cause excessive heating and capacitor failure.  
 Avoid using low winding inductance motors that would violate this ripple current specification.  
 Place ceramic capacitors near FET drains, 2x per phase.



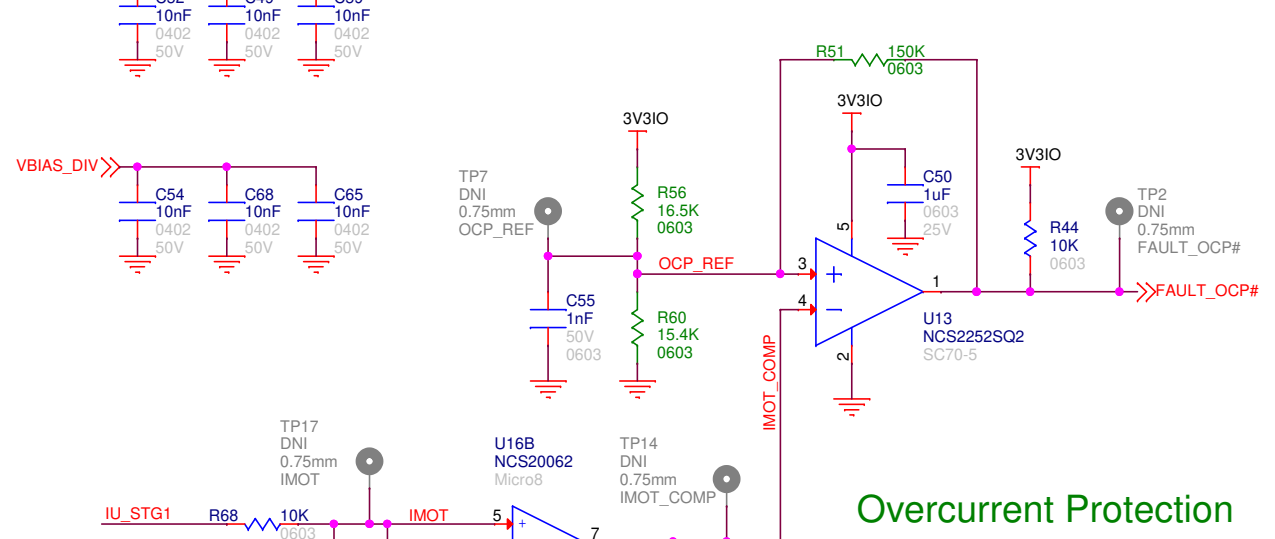
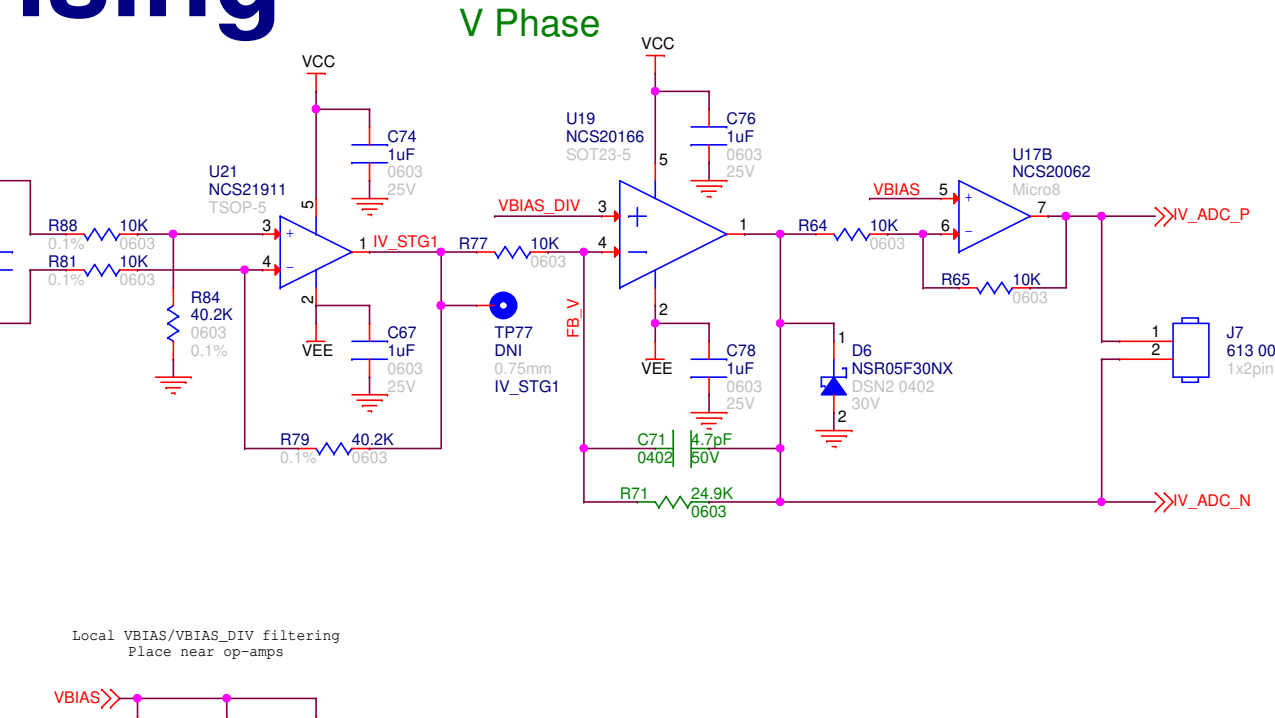
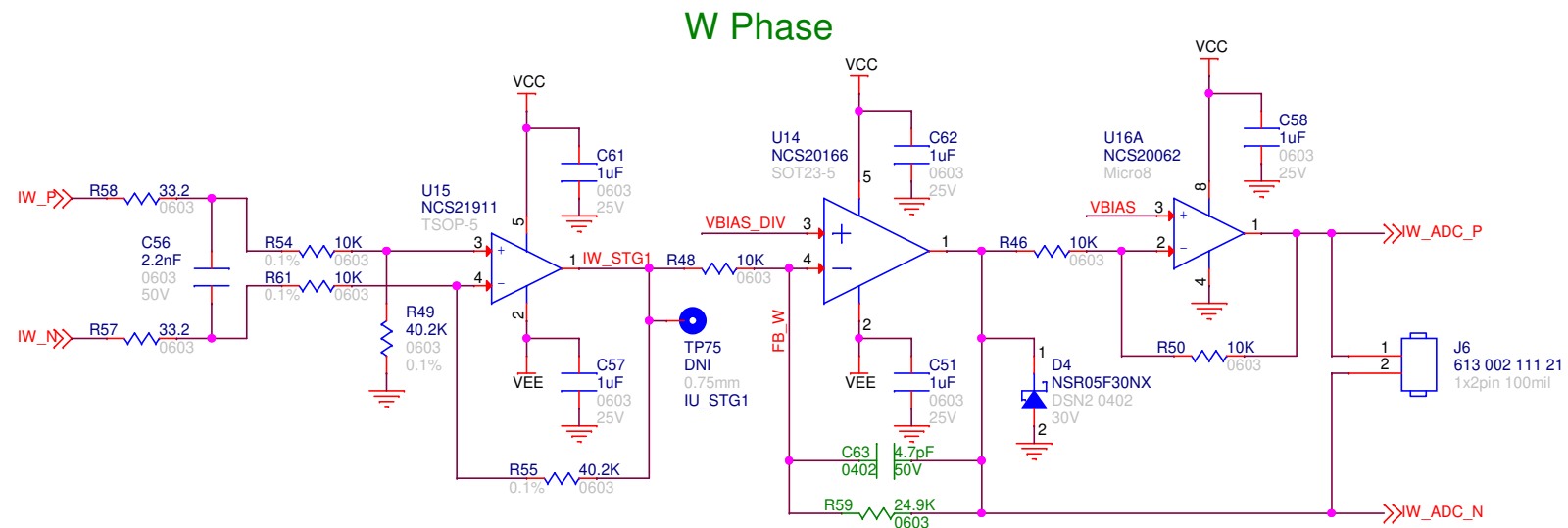
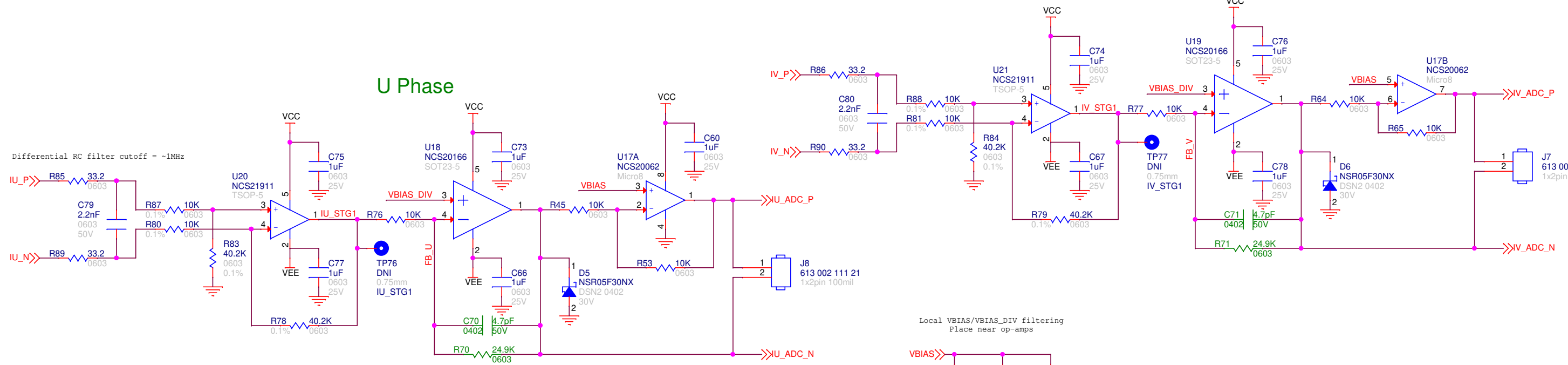
## Input/Output Parameters

VARIANT	MAX ELECTRICAL OUTPUT POWER [W]	VIN RANGE [V]	MAX AVG IOUT @ MIN VIN/MAX VIN [A]
10-16V	600	10-16	60/37.5
16-30V	960	16-30	60/37.5
30-60V	1200	30-60	40/20
60-100V	1200	60-100	20/12

onsemi

Title 3-Phase BLDC Motor Driver MDK Power Board		Orderable Part Number See Table	
Variant Name VIN 60V to 100V Xilinx UCB		Document Number ONSEC-20-023	Rev REV1
Date: Wednesday, September 15, 2021		Sheet	2 of 6

# Current Sensing



Current sensing is bi-directional  
 Total bandwidth = ~500kHz  
 First stage gain fixed at ~4V/V  
 Approximate FS phase current sense voltage range (Ix\_ADC\_P-Ix\_ADC\_N):  
 -3.2V -> 3.2V (Xilinx UCB)  
 -1.7V -> 1.7V (MOAB UCB)

Current Sense Parameters

	CURRENT SENSE VOLTAGE GAIN [V/V]				APPROX. FULL-SCALE (+/-) PHASE CURRENT [A]				APPROXIMATE CURRENT RESOLUTION [mA]			
	VARIANT				VARIANT				VARIANT			
UCB	10-16V	16-30V	30-60V	60-100V	10-16V	16-30V	30-60V	60-100V	10-16V	16-30V	30-60V	60-100V
Xilinx	19.993	19.993	13.302	9.977	80	80	60	40	40	40	20	20
MOAB	10.697	10.697	7.132	5.329								

## Overcurrent Protection

Peak motor current OCP  
 Trip thresholds per variant:  
 Board A/B = 120A  
 Board C = 80A  
 Board D = 40A

**onsemi**

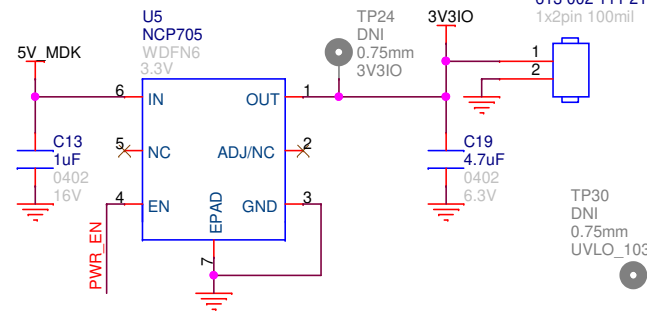
Title: 3-Phase BLDC Motor Driver MDK Power Board  
 Orderable Part Number: See Table

Variant Name: VIN 60V to 100V Xilinx UCB  
 Document Number: ONSEC-20-023  
 Rev: REV1

Date: Wednesday, September 15, 2021  
 Sheet: 3 of 6

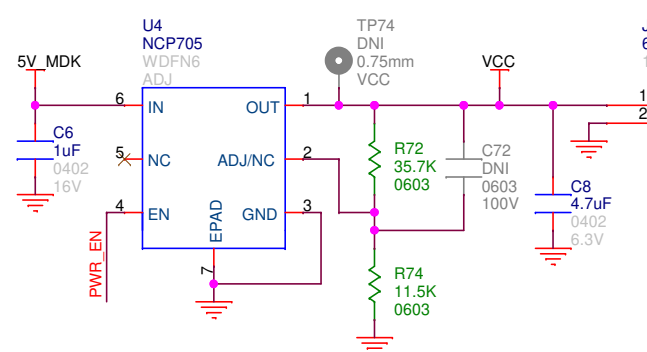
# Power

## 3.3V Digital Supply



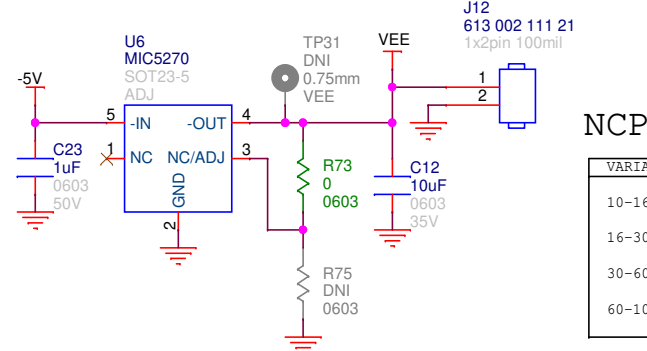
## Positive Analog Supply

VCC = 3.3V (Xilinx UCB), 1.8V (MOAB UCB)



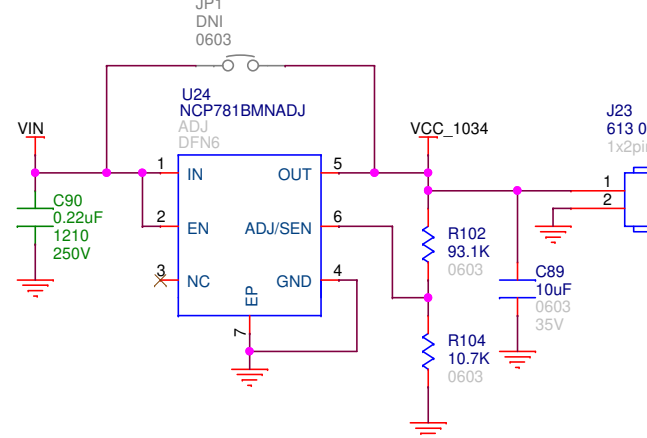
## Negative Analog Supply

VEE = -1.2V (Xilinx UCB), -2.4V (MOAB UCB)



## NCP1034 VCC Supply

10-16VIN: VIN shorted to VCC  
Other variants: VCC = 12V

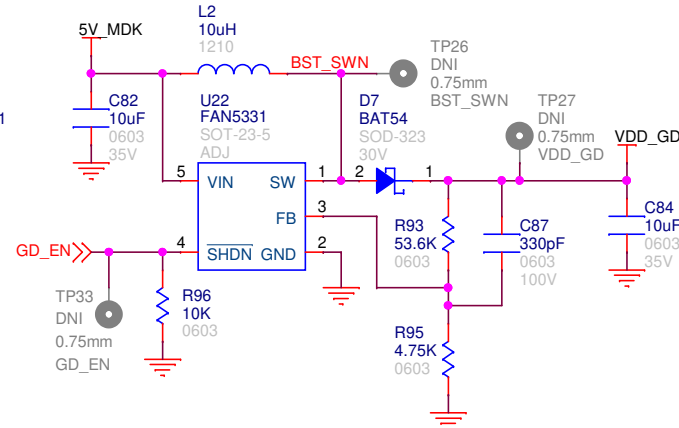


## NCP1034 Parameters

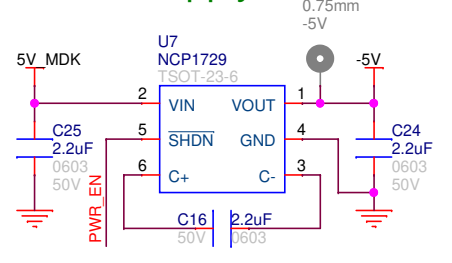
VARIANT	FSW	UVLO RISE	UVLO FALL
10-16V	440kHz	9.8V	9.0V
16-30V	440kHz	15.4V	14.1V
30-60V	200kHz	26.9V	24.7V
60-100V	100kHz	54V	49.7V

## 15V Gate Driver Supply

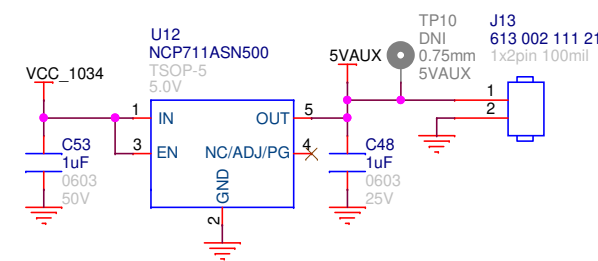
VDD\_GD = 15.1V  
Max output current = 150mA



## -5V Supply

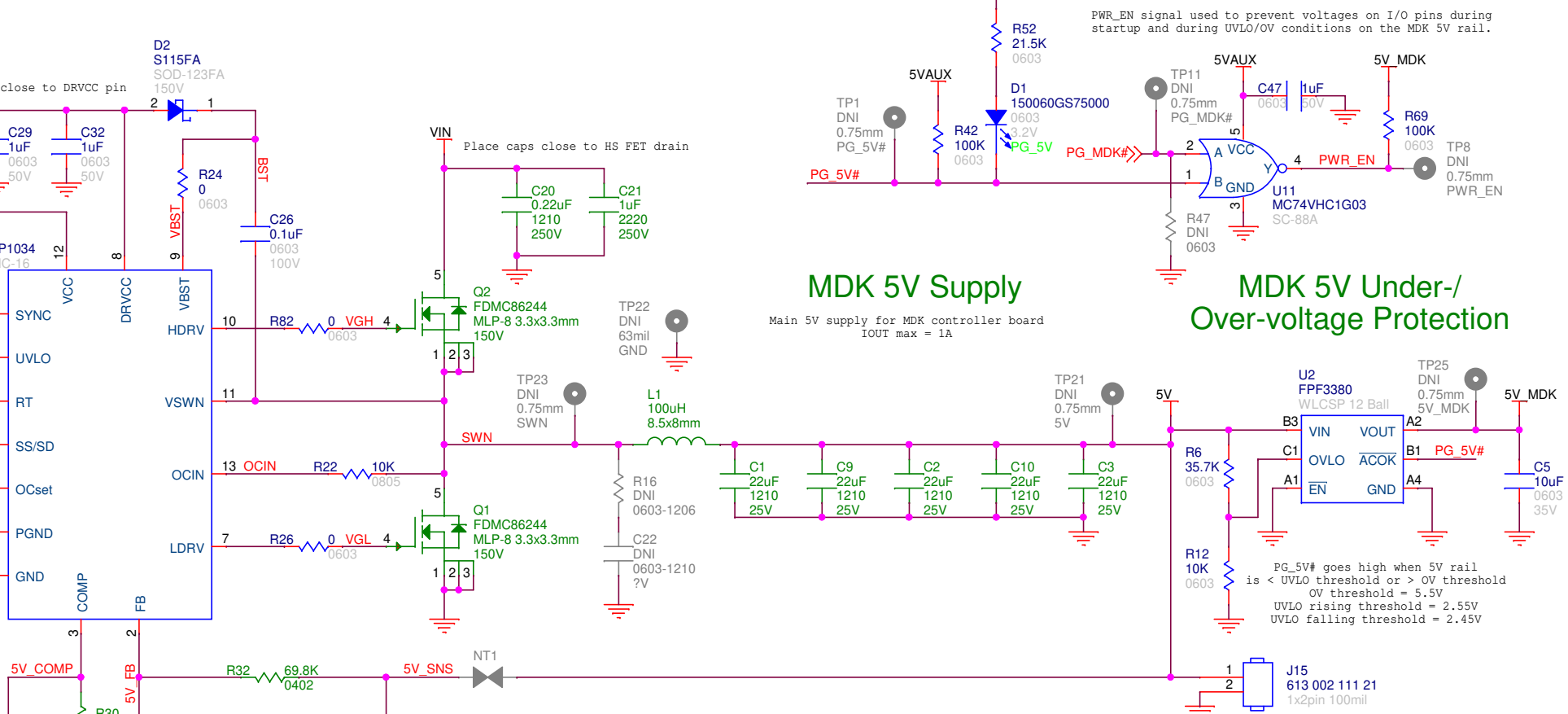


## 5V Auxiliary Supply

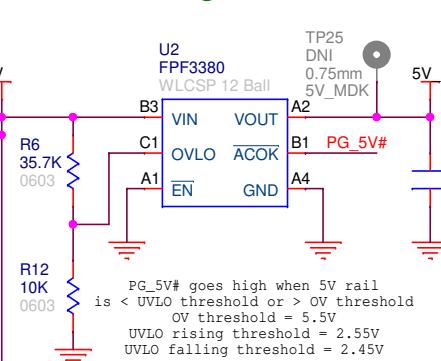


## MDK 5V Supply

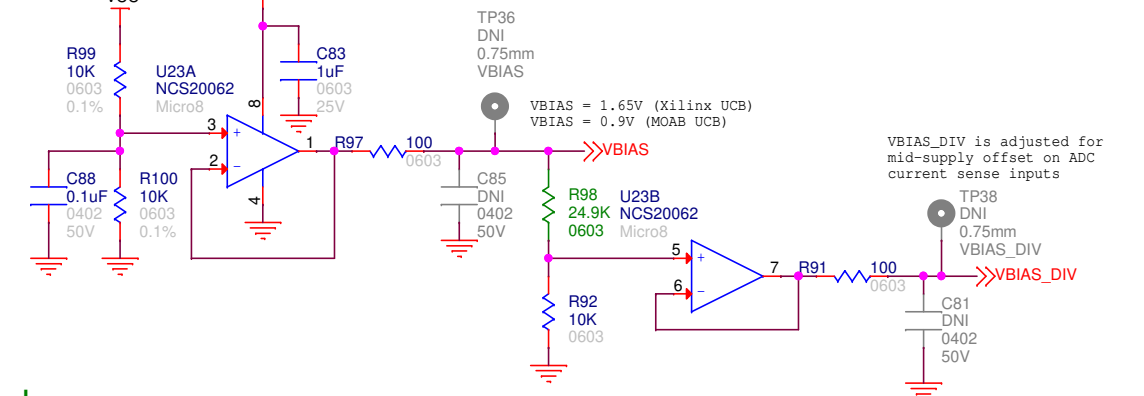
Main 5V supply for MDK controller board  
IOUT max = 1A



## MDK 5V Under-/Over-voltage Protection



## ADC Offset Voltage

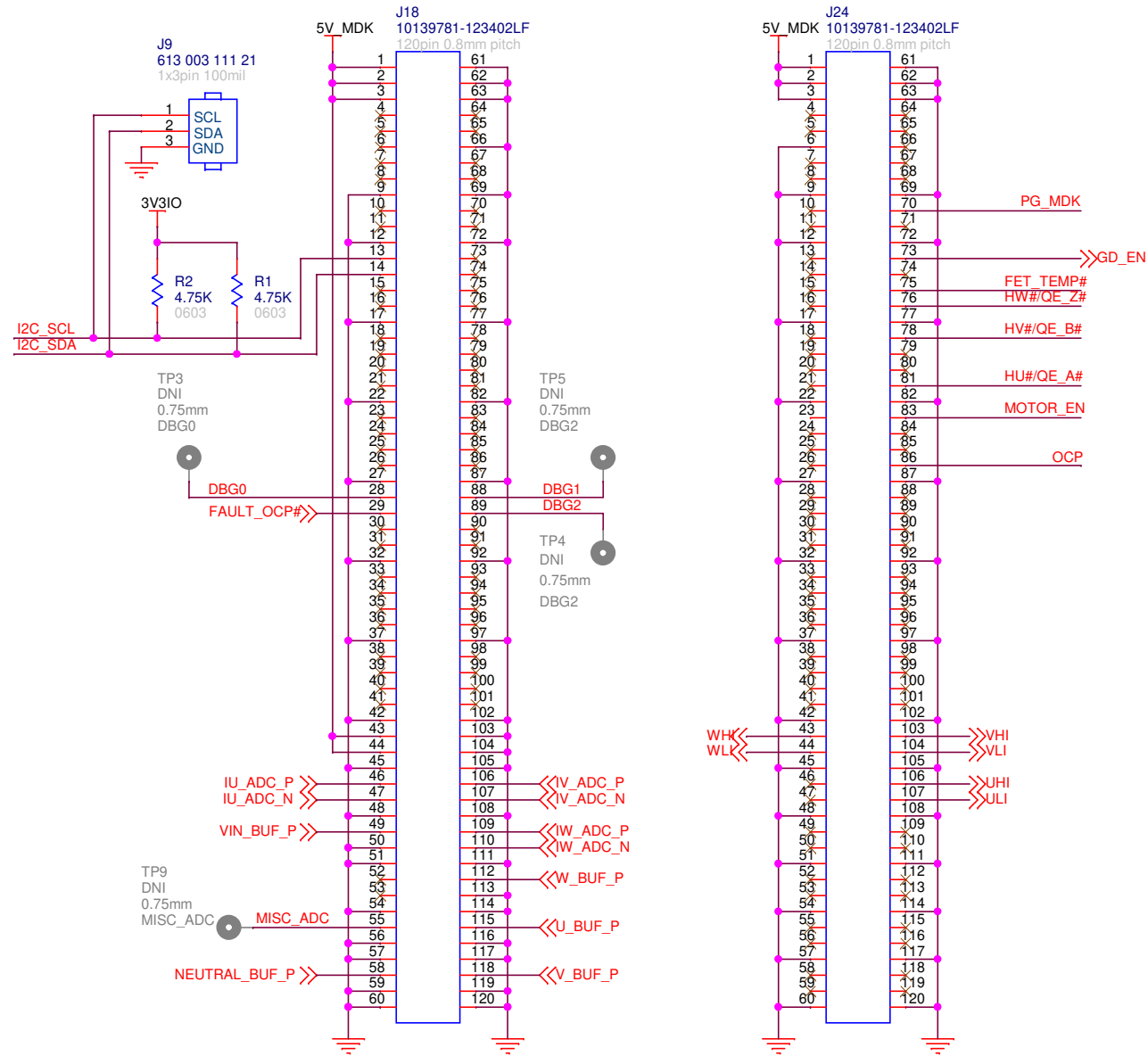


Title 3-Phase BLDC Motor Driver MDK Power Board		Orderable Part Number See Table
Variant Name VIN 60V to 100V Xilinx UCB	Document Number ONSEC-20-023	Rev REV1
Date: Wednesday, September 15, 2021	Sheet	4 of 6

# Connectors/Mechanical/Misc. I/O

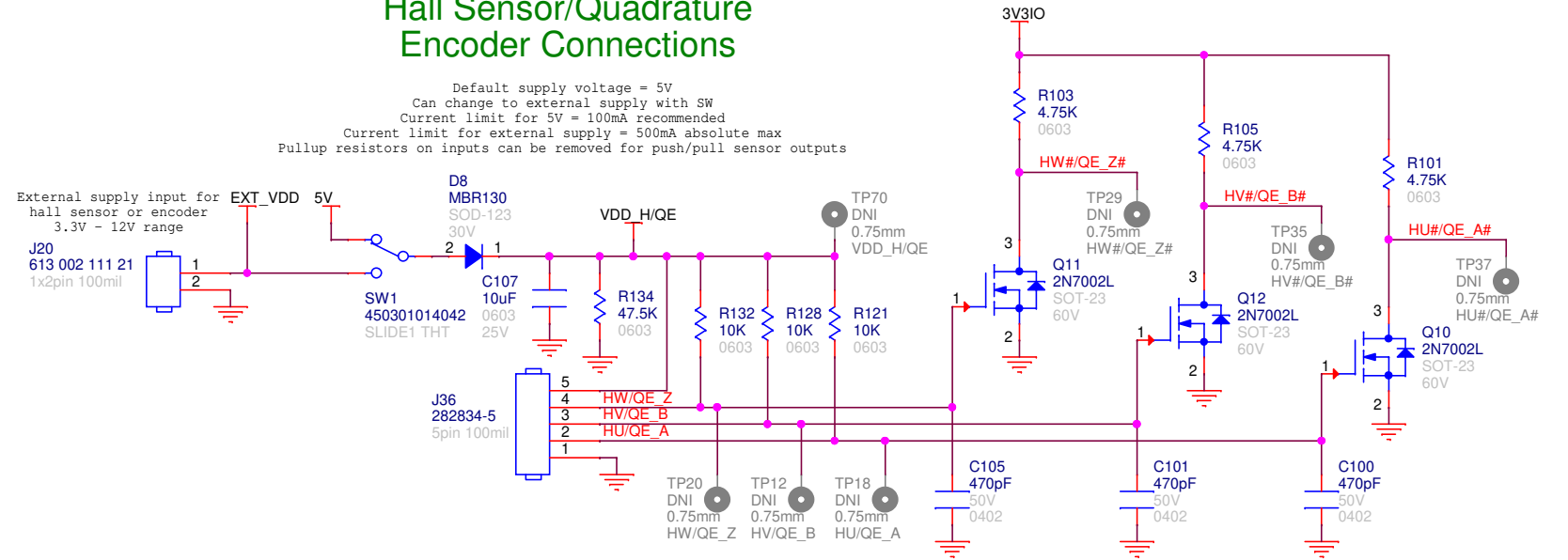
## MDK Controller Board Connectors

Connector pinouts compatible with both the Xilinx UCB and MOAB UCB  
 J17 mates with JP1 on controller board  
 J23 mates with JP2 on controller board

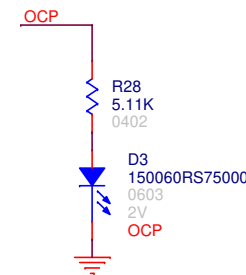


## Hall Sensor/Quadrature Encoder Connections

Default supply voltage = 5V  
 Can change to external supply with SW  
 Current limit for 5V = 100mA recommended  
 Current limit for external supply = 500mA absolute max  
 Pullup resistors on inputs can be removed for push/pull sensor outputs

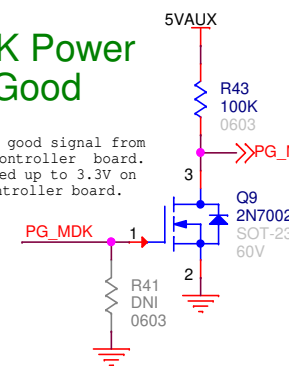


## OCP Fault Indicator

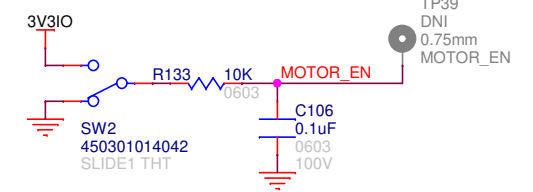


## MDK Power Good

Power good signal from MDK controller board. Pulled up to 3.3V on controller board.

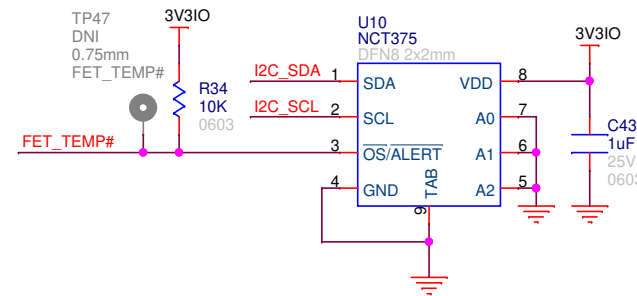


## Manual Motor Enable

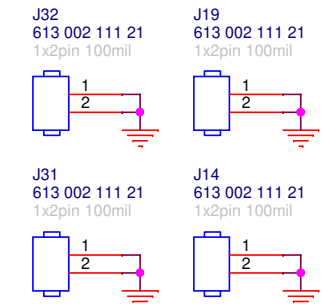


## H-Bridge Temperature Monitor

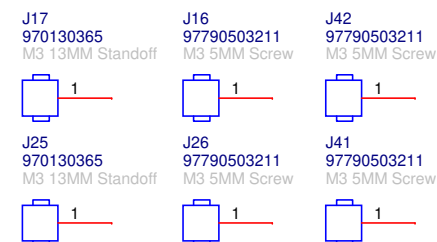
Monitors inverter H-bridge FET temperature  
 I2C slave address = 0x48



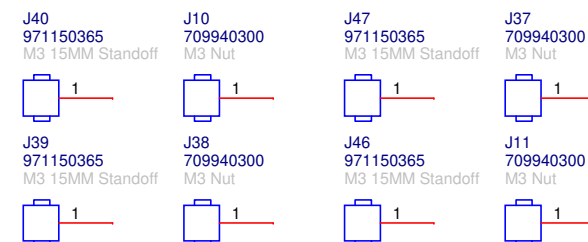
## GND Headers



## MDK Mounting Standoffs/Screws



## Board Standoffs/Nuts



onsemi

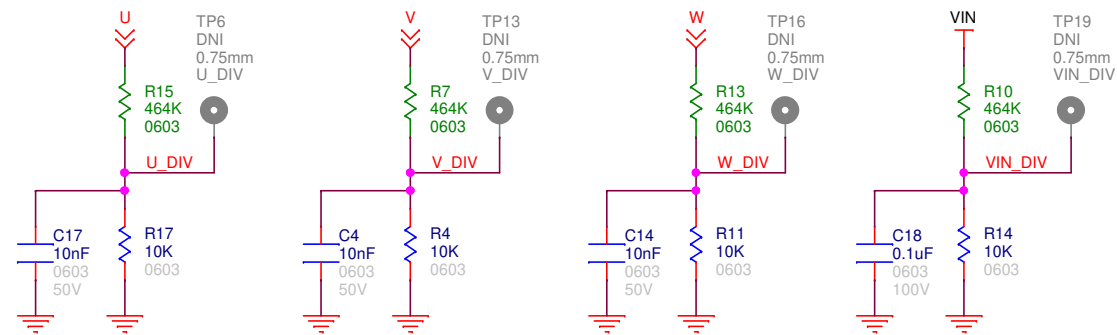
Title 3-Phase BLDC Motor Driver MDK Power Board		Orderable Part Number See Table	
Variant Name VIN 60V to 100V Xilinx UCB		Document Number ONSEC-20-023	Rev REV1
Date: Wednesday, September 15, 2021		Sheet	5 of 6

# Voltage Sensing

## Virtual Motor Neutral Recreation for Zero-Crossing Detection

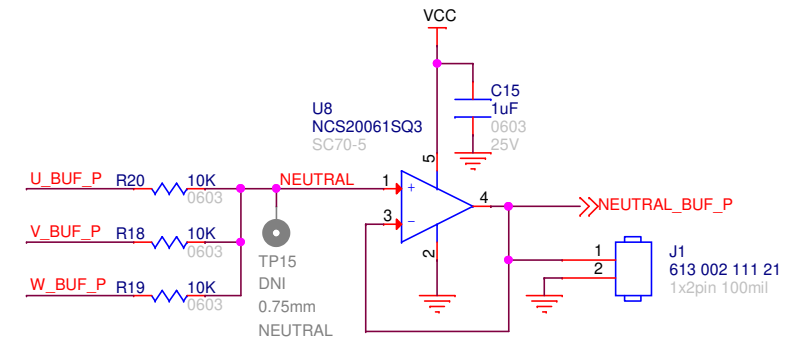
### Phase/Bus Voltage ADC Dividers

All voltage dividers scaled to produce 3.2V (Xilinx UCB) or 1.7V (MOAB UCB) at 150% of max DC bus voltage

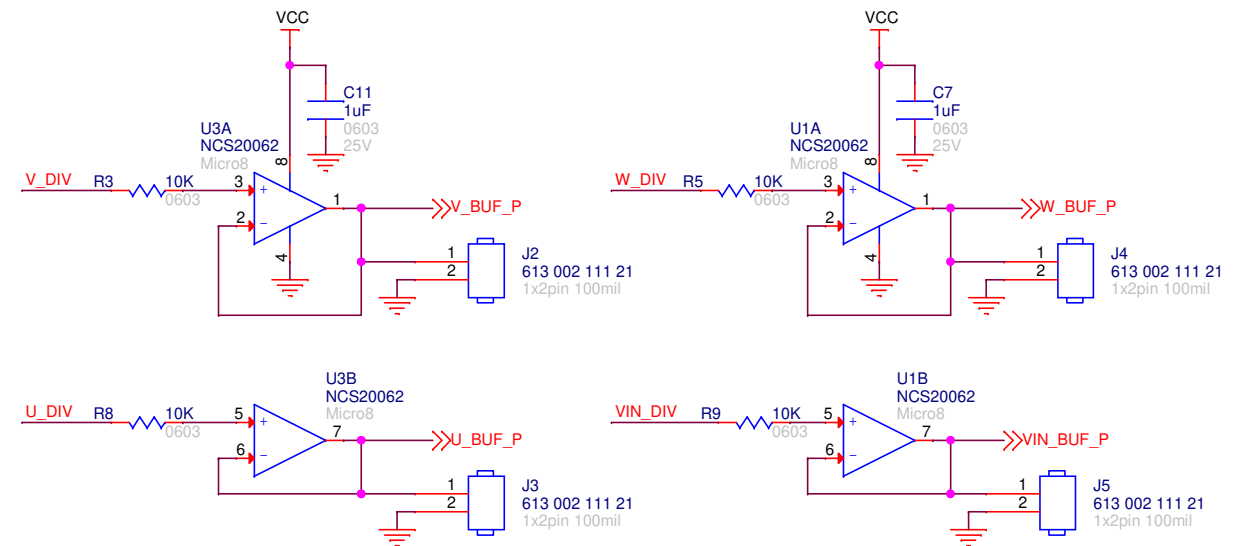


### Divider parameters

VARIANT	DIVIDER SCALING FACTOR		FILTER CUTOFF FREQUENCY [Hz]	
	Xilinx UCB	MOAB UCB	Xilinx UCB	MOAB UCB
10-16V	0.1335	0.0714	1836	1713
16-30V	0.0714	0.0377	1713	1653
30-60V	0.0352	0.0188	1649	1621
60-100V	0.0211	0.0111	1625	1609



### ADC Divider Buffers



onsemi

Title 3-Phase BLDC Motor Driver MDK Power Board		Orderable Part Number See Table
Variant Name VIN 60V to 100V Xilinx UCB		Document Number ONSEC-20-023
Date: Wednesday, September 15, 2021		Rev REV1