Toaster-Flo Controller

Variant: Preliminary

2026-02-04
Rev 2.0

TOP VIEW

3D render of your PCB here (Top View)

BOTTOM VIEW

3D render of your PCB here (Bottom View)

NOTES

Designed for 120VAC

Not fitted components are marked as ✗

DRAFT - Very early stage of schematic, ignore details.
PRELIMINARY - Close to final schematic.
CHECKED - There shouldn't be any mistakes. Contact the engineer if you find any.
RELEASED - A board with this schematic has been sent to production.

Preliminary 02/2026

DESIGN CONSIDERATIONS

DESIGN NOTE: Example text for informational design notes.

DESIGN NOTE: Example text for debug notes.

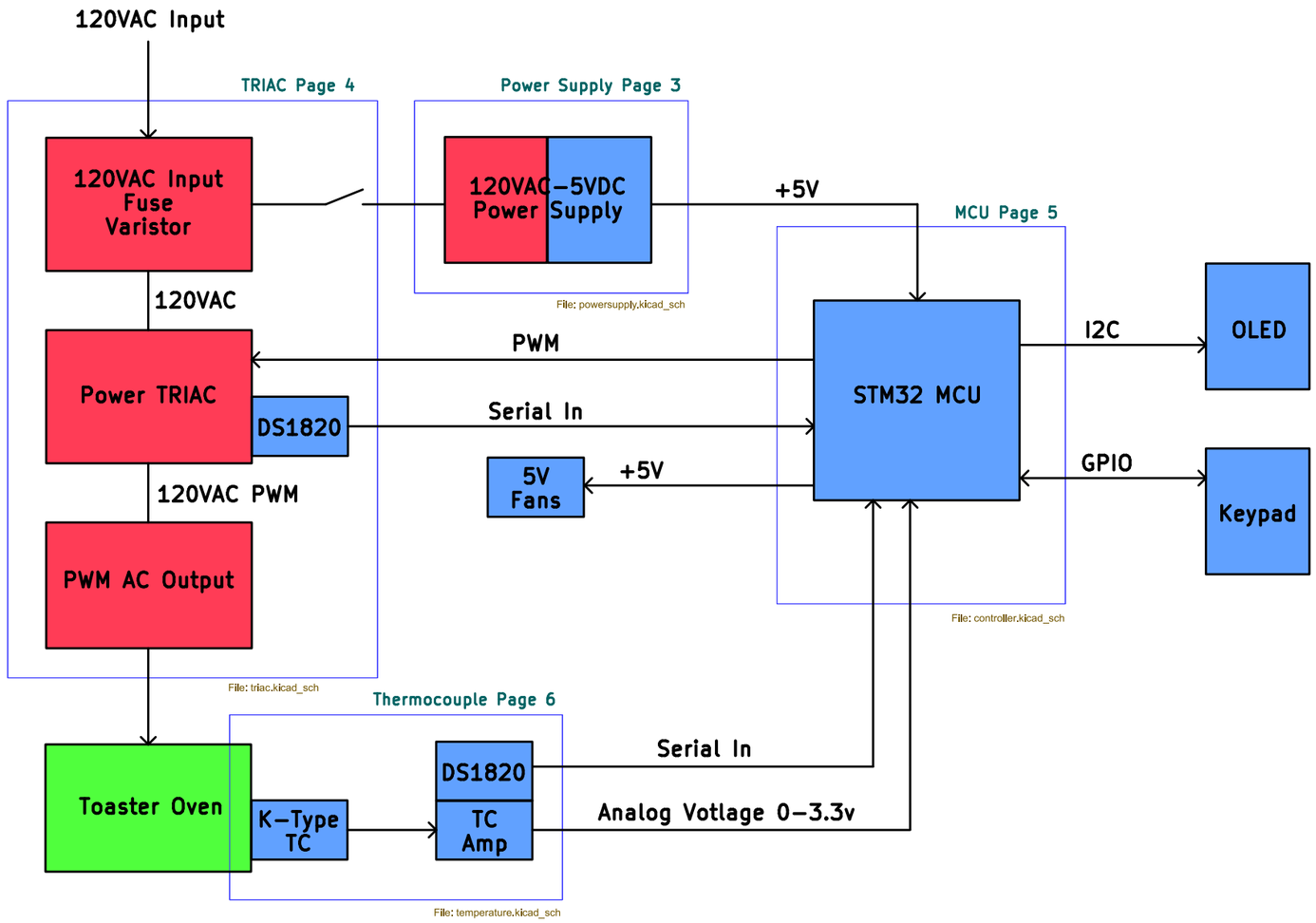
DESIGN NOTE: Example text for cautionary design notes.

DESIGN NOTE: Example text for critical design notes.

LAYOUT NOTE: Example text for critical layout guidelines.

Comments:	Company: MTP Engineering LLC		Variant: Preliminary	
	Board Name: Toaster-Flo Controller		Project Name: Toaster-Flo	
Sheet Title: Cover Page	File Name: main-board.kicad_sch	Designer: Michael Pate	Date: Last Modified Date	Revision: 2.0
Sheet Path: /		Reviewer: Michael Pate	Size: A3	Sheet: 1 of 7

[2] Block Diagram



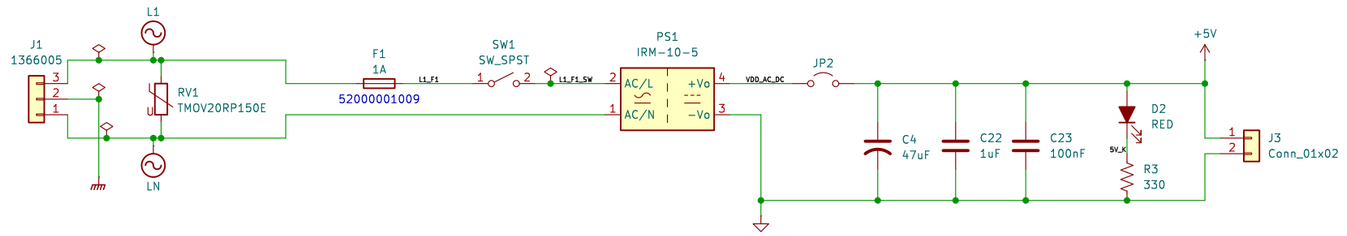
Target specifications:

Input voltage:	120 VAC
Power Output:	1200W
Duty Cycle:	0-80%

Comments:	Company: **MTP Engineering LLC**		Variant: Preliminary	
	Board Name: **Toaster-Flo Controller**		Project Name: **Toaster-Flo**	
Sheet Title: Block Diagram	File Name: Block Diagram.kicad_sch	Designer: Michael Pate	Date: Last Modified Date	Revision: 2.0
Sheet Path: /Block Diagram/		Reviewer: Michael Pate	Size: **A3**	Sheet: **2** of **7**

[3] Power Supply

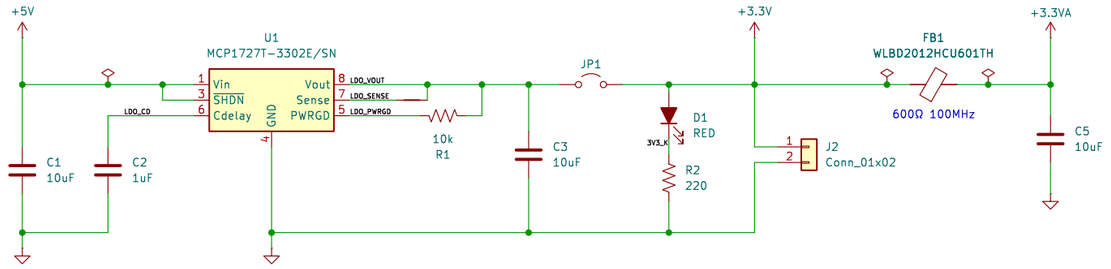
SPST Switch
panel-mounted
to enclosure



HIGH VOLTAGE:
Ensure appropriate isolation between AC and DC circuits!

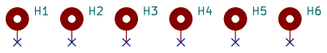
Air isolation gap underneath PS1

Bulk capacitance
for 5V rail



See MCP1727
datasheet typical
application

Use M2.5 mounting screws
to secure PCB to housing



	Comments: IRM-10-5 Datasheet MCP1727T-3302E/SN Datasheet	Company: **MTP Engineering LLC**		Variant: Preliminary	
		Board Name: **Toaster-Flo Controller**		Project Name: **Toaster-Flo**	
	Sheet Title: Power Supply	File Name: powersupply.kicad_sch	Designer: Michael Pate	Date: Last Modified Date	Revision: 2.0
	Sheet Path: /Block Diagram/Power Supply Page 3/		Reviewer: Michael Pate	Size: **A3**	Sheet: **3** of **7**

[4] TRIAC

Per MOC3085 Datasheet:
$V_{F,LED}$=1.4V @ I_F=20mA
I_{FT}=5mA, $I_{F,MAX}$=50mA

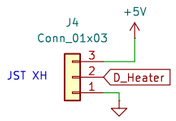
Use R_5=330Ω so I_{LED}=~15mA for 5V IO from MCU

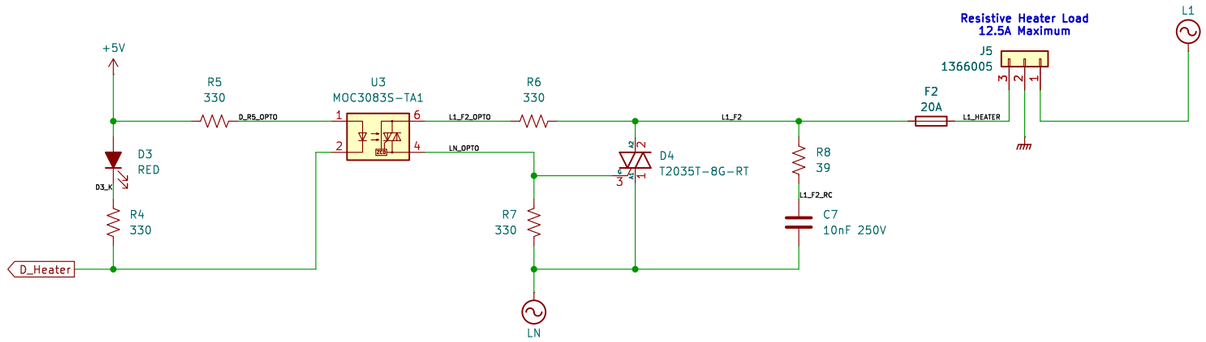
For the MOC3083S, surge current I_{TSM}=1A
$R_{6,MIN}$=$V_{IN,PK}$/1A
$V_{IN,PK}$=180V for typ. 115VAC supply
$R_{6,MIN}$=180/1=180Ω
Following procedure from AN-3003 pg. 2

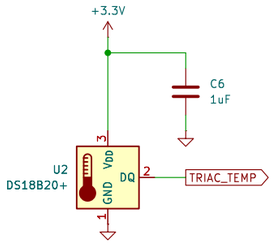
No RC snubber required, see datasheet for T2035T-8G
But for cheap insurance, use a 39Ω/0.01uF RC snubber

At 60Hz, X_{C2}=~265kΩ. At 120V, $I_{C2,RMS}$=~0.45mA

JP4 for testing only, DNP for production





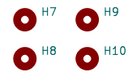


DS18B20 mounted on TRIAC heatsink to measure device temperature. Use JST PH footprint

R_7 prevents optocoupler leakage from triggering the power triac.
MOC3083S I_{DRM2}=0.5mA
T2035T I_{GT}=35mA

HIGH VOLTAGE: Ensure appropriate isolation between AC and DC circuits!

HIGH POWER: Ensure appropriate size traces for AC components!



Place holes for 40x40x10 push pin heatsink
Coolingsourcethermal.com
CS8674010B0

StackExchange resources for TRIAC driver design

https://electronics.stackexchange.com/questions/381961/triac-optocoupler-circuit

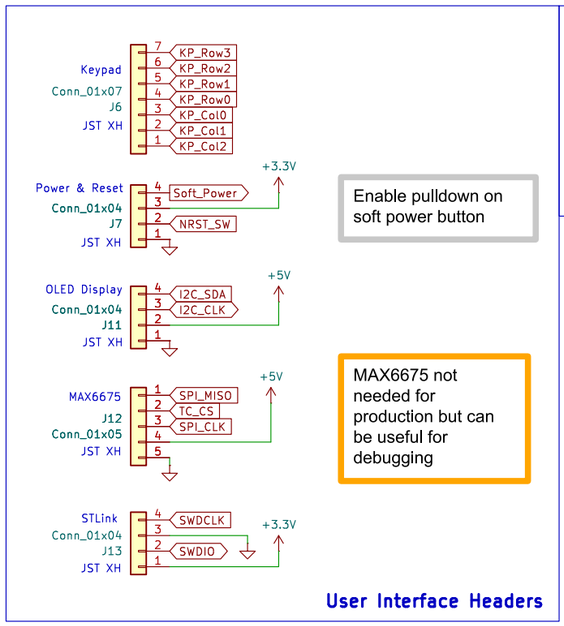
https://electronics.stackexchange.com/questions/248743/how-is-the-gate-trigger-resistor-value-calculated-for-a-triac/248775

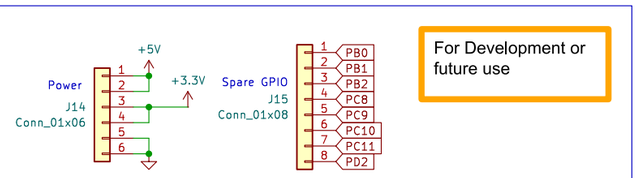
https://electronics.stackexchange.com/questions/437809/triac-switching-circuit-with-optocoupler

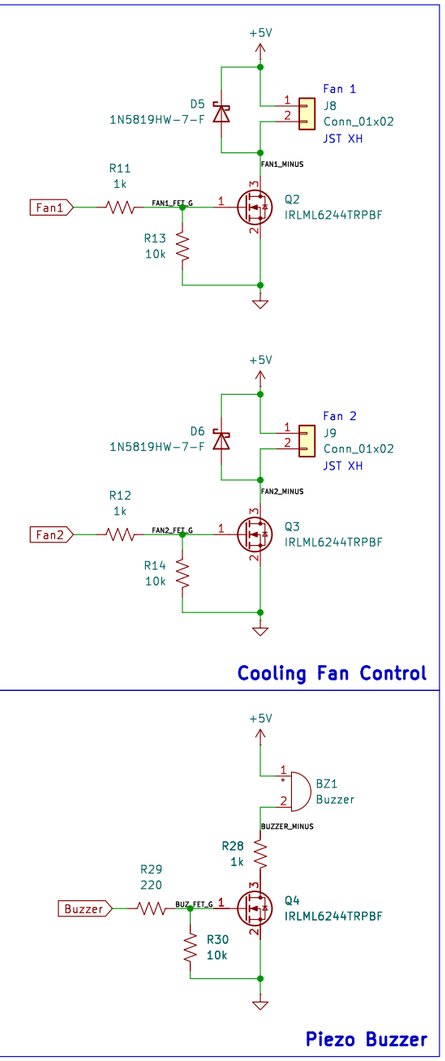
https://electronics.stackexchange.com/questions/53500/optotriactriac-how-do-i-calculate-the-gate-resistor

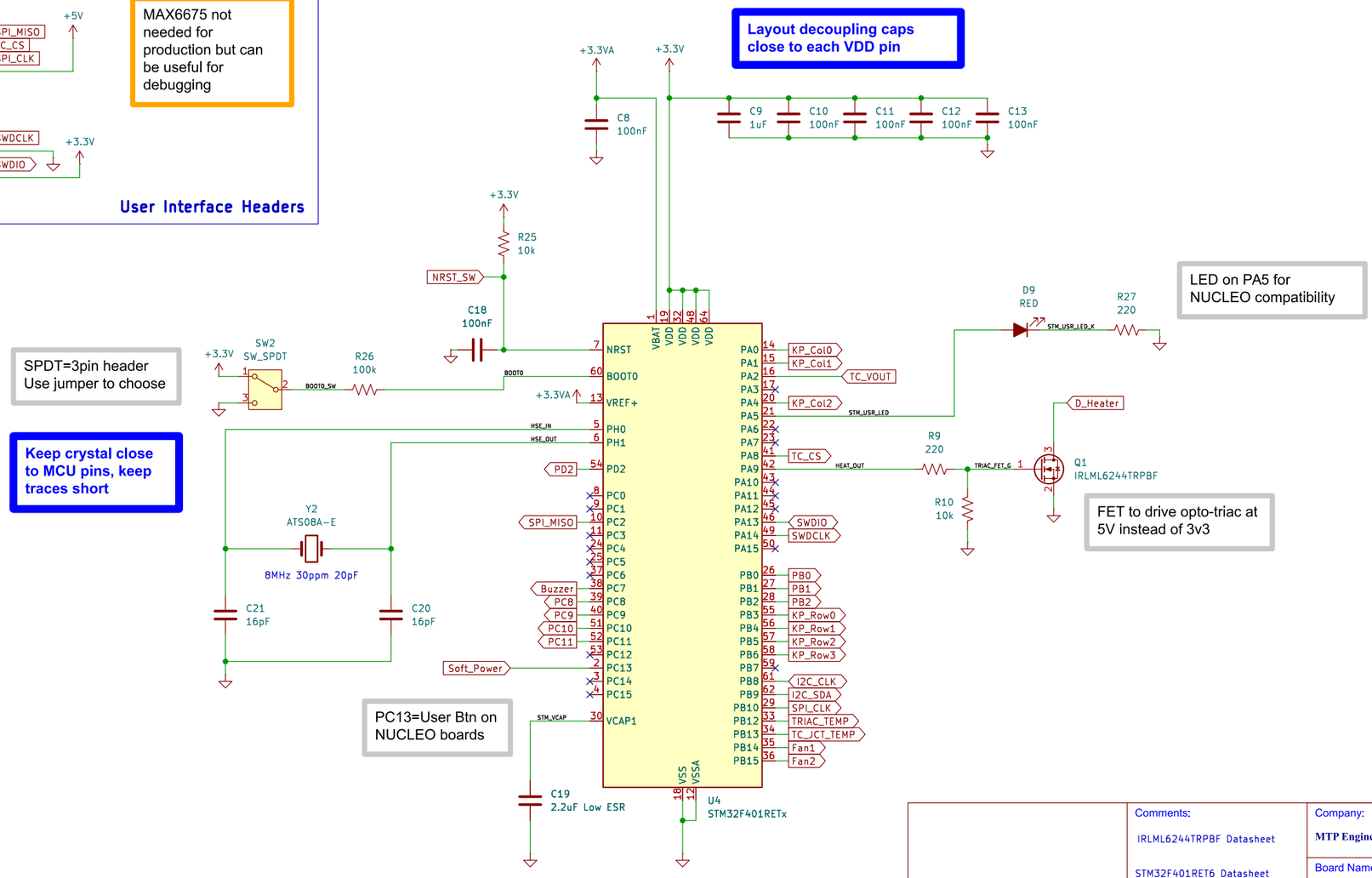
Comments: Link to TRIAC Circuit Example Link to T2035T Datasheet Link to MOC3083S Datasheet Link to Onsemi AN-3003 PDF CS8674010B0 Heatsink	Company: MTP Engineering LLC		Variant: Preliminary	
	Board Name: Toaster-Flo Controller		Project Name: Toaster-Flo	
Sheet Title: TRIAC	File Name: triac.kicad_sch	Designer: Michael Pate	Date: Last Modified Date	Revision: 2.0
Sheet Path: /Block Diagram/TRIAC Page 4/		Reviewer: Michael Pate	Size: A3	Sheet: 4 of 7

[5] Microcontroller



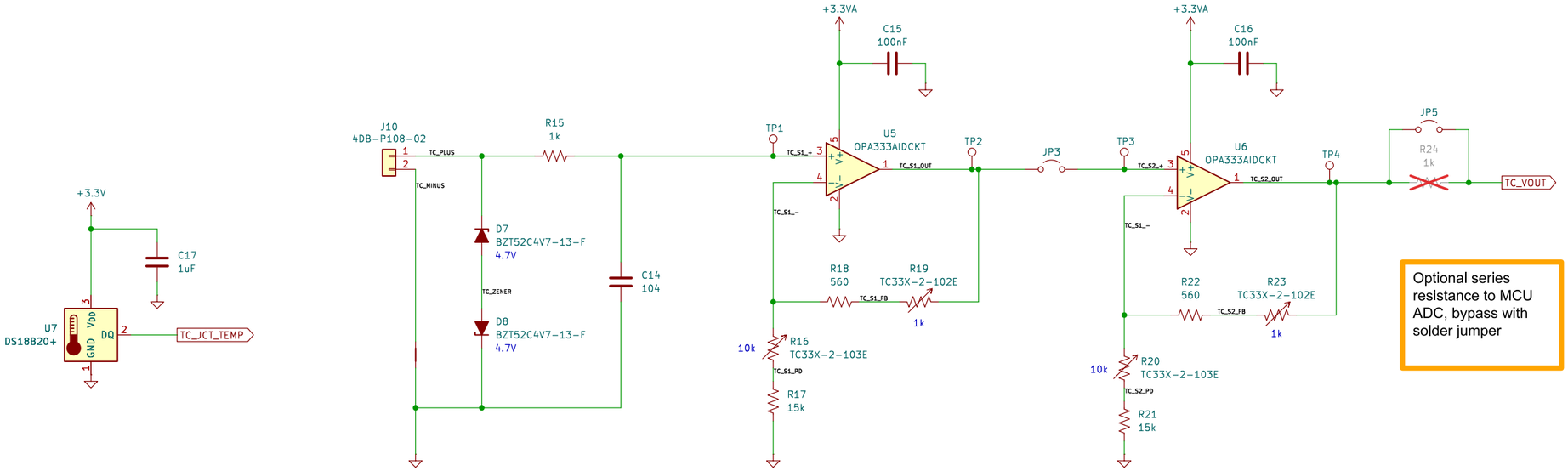






Comments: IRLML6244TRPBF Datasheet; STM32F401RET6 Datasheet; 1N5819HW-7-F Datasheet	Company: MTP Engineering LLC		Variant: Preliminary	
	Board Name: Toaster-Flo Controller		Project Name: Toaster-Flo	
Sheet Title: Microcontroller	File Name: controller.kicad_sch	Designer: Michael Pate	Date: Last Modified Date	Revision: 2.0
Sheet Path: /Block Diagram/MCU Page 5/		Reviewer: Michael Pate	Size: A3	Sheet: 5 of 7

[6] Thermocouple



Optional series resistance to MCU ADC, bypass with solder jumper

DS18B20 mounted near TC connector, for cold junction measurement/compensation

Input zeners and RC filter for input shaping.

Gain = $1+((R_4+R_5)/(R_2+R_3))$
Nominal Gain 22.3 per stage
Two stages, final gain 497

Both op-amp stages are identical

TODO:
Change gain of amplifier such that an output of 3.3V corresponds to 300 degrees C

From chart, a K type TC has a voltage of about 8.1mV at a temperature of 200C.

To output 4V when the TC is at 200C, we need a gain of 4/0.0081=493.8 or 494.

After tuning for proper performance, potentiometers should be protected from being turned

Comments: K Type TC Voltages; OPA333AIDCKT Datasheet; DS18B20+ Datasheet	Company: MTP Engineering LLC		Variant: Preliminary	
	Board Name: Toaster-Flo Controller		Project Name: Toaster-Flo	
Sheet Title: Thermocouple	File Name: temperature.kicad_sch	Designer: Michael Pate	Date: Last Modified Date	Revision: 2.0
Sheet Path: /Block Diagram/Thermocouple Page 6/		Reviewer: Michael Pate	Size: A3	Sheet: 6 of 7

[7] Revision History

DD.MM.YYYY - xxx Revision
Variant: xxx

- 04.02.2026
  Revision 2.0 Preliminary 0

DD.MM.YYYY - xxx Revision
Variant: xxx

DD.MM.YYYY - xxx Revision
Variant: xxx

DD.MM.YYYY - xxx Revision
Variant: xxx

Comments:	Company: **MTP Engineering LLC**		Variant: Preliminary	
	Board Name: **Toaster-Flo Controller**		Project Name: **Toaster-Flo**	
Sheet Title: Revision History	File Name: Revision History.kicad_sch	Designer: Michael Pate	Date: Last Modified Date	Revision: 2.0
Sheet Path: /Revision History/		Reviewer: Michael Pate	Size: **A3**	Sheet: **7** of **7**