

EZ MIDI CONTROL 3.0

EZ MIDI Control- The fastest way to add modern features to guitar effects including: Presets, MIDI, OLED display, tap tempo, multiple LFOs and more.

We have 15 years of experience adding digital control to analog circuits. EZ MIDI was designed as a starting point for our own effect designs and have often reduced the cost of adding MIDI & Presets to a pedal to under \$10 in parts. This can vary depending on the design.

What is the difference between EZ MIDI 1.0 and EZ MIDI 3.0?

EZ MIDI 1 was intended to be customized by you with boards or pre-programmed STM32 microcontrollers shipped from us.

For EZ MIDI 3 you can supply parts yourself. The code needed for EZ MIDI 3 is available for free. There are instructions in for loading the code on to the microcontroller. The free version includes all features, but operates for two hours between power cycles. It is intended for development purposes.

For a professional design you'll need an activation key dongle to unlock the time limit.

A challenge designing anything with MIDI or presets is that every analog control needs to be converted to a virtual control. EZ MIDI uses MCP digital pots and control voltage as a solution. Sample circuits are included in this document as well as schematics for basic setup in KICAD.

While EZ MIDI offers many features most are optional. This document primarily covers **EZ MIDI MCP**, suitable for overdrives, fuzz, distortions, EQ and **EZ MIDI LFO** suitable for modulation effects.

List of options for both versions and a mock-up of an idea of what each version could look like in a final design.

This document primarily covers two EZ MIDI versions for production designs:

EZ MIDI MCP: MIDI control of all parameters Savable Presets (recalled by foot switches or knob) Bypass control via latching relay or analog switch. OLED display Up to 8 control knobs & digital pots. 2 Toggle → control voltage	EZ MIDI LFO: MIDI control of all parameters Savable Presets (recalled by foot switches or knob) Bypass control via latching relay or analog switch. OLED display Up to 11 LFOs selectable via knob (more available via MIDI.) Up to 8 control knobs. Up to 6 digital pots 2 Toggle → control voltage
	

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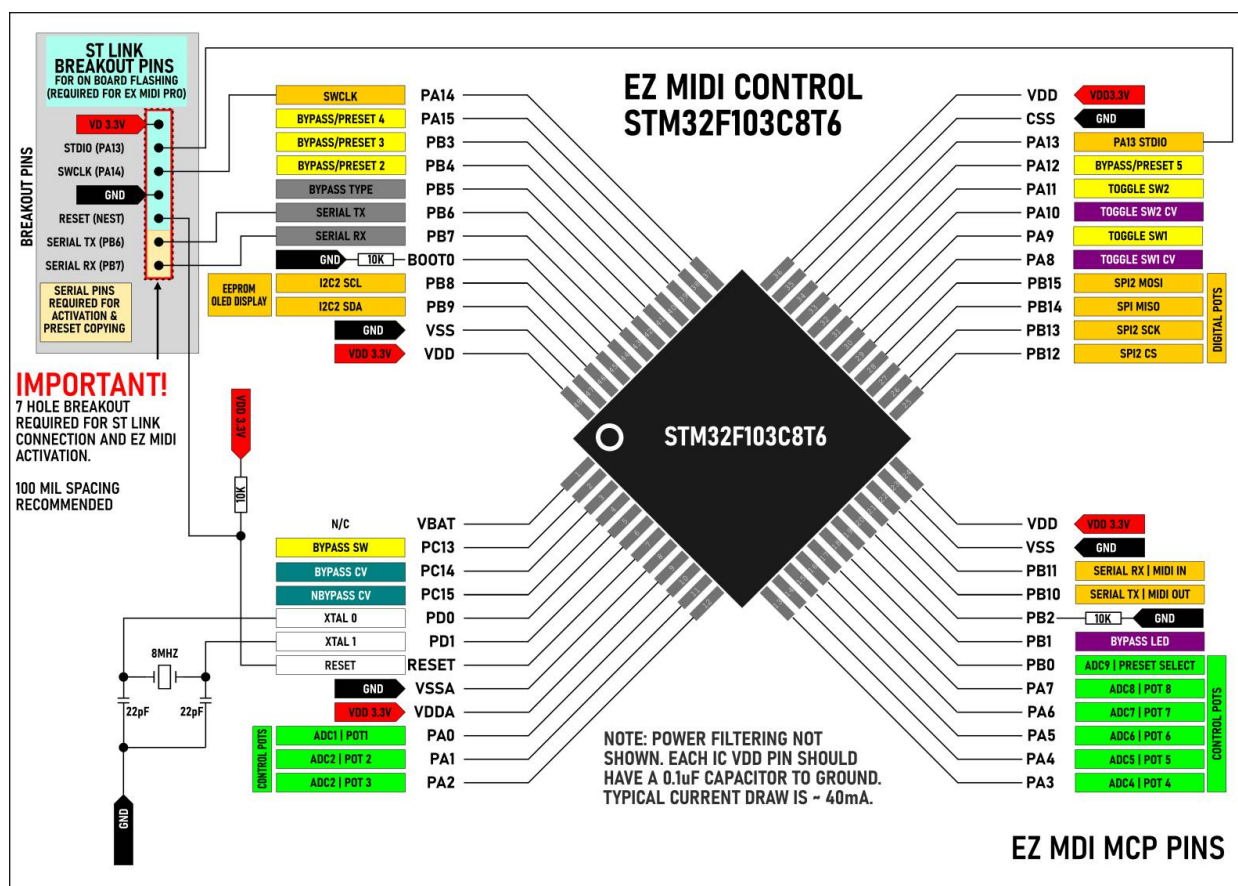
This document was believed to be accurate at the time it was created. Specifications are subject to change without notice.

EZ MIDI MCP PIN CONNECTIONS

Below are the pin connections for EZ MIDI MCP on the STM32F103.

Details on peripherals and integration will follow. This is the basic circuit to get EZ MIDI running on the STM32F103.

Note the 7 pin breakout on the left. This is required for flashing EZ MIDI code onto the microcontroller, activation and copying preset data.



EZ MIDI MCP controls up to 8 digital pots which can be integrated into your effect design. Settings for the digital pots can be controlled by potentiometers on ADC 1-8.

Up to 8 control potentiometers and 1 potentiometer to recall presets. Alternatively presets can be recalled via a multi-footswitch design.

Two toggle switches control two control voltages. These can be connected to analog switches.

Presets are stored to a 24LC32 or compatible EEPROM. The OLED display is not necessary, but even if it's not included in a final design, it can be helpful for developing a design.

FLASHING EZ MIDI CODE TO THE STM32F103

You will need:

USB ST LINK programmer

Jumper wires with female to female Dupont connectors (often included with ST LINK)

100mil (2.54mm) header pins

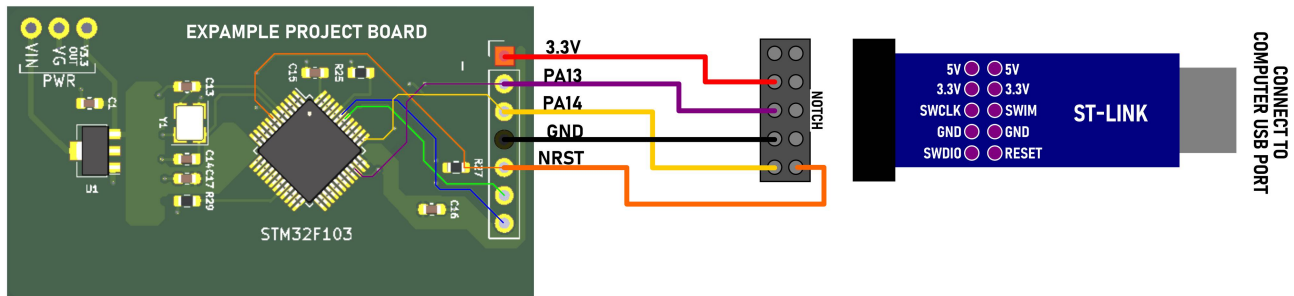
A computer and USB cable.

You will need software from ST

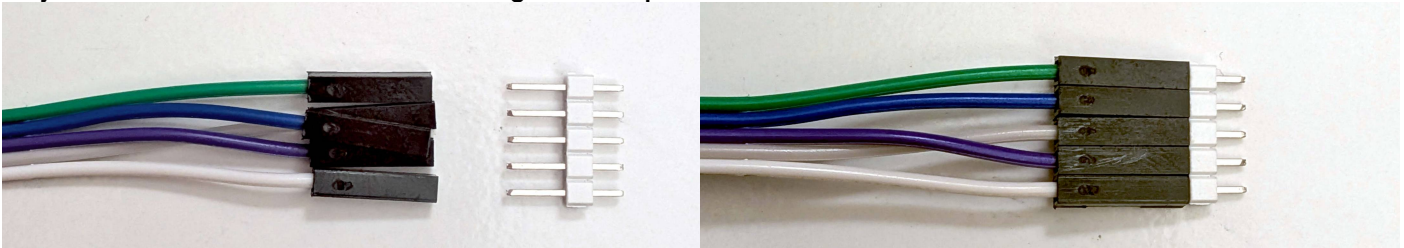
Windows: use [ST LINK Utility](#) or [STM32Cube Programmer](#).

Mac: [STMCube Programmer](#).

Basic connection to a prototype board. (Power to STM32 not shown)



To Keep wires in the right order use header pins to hold them together. This is also used to connect to your circuit board without needing header pins on the board.



Connect pins and ST LINK to your circuit board



FLASHING EZ MIDI CODE TO THE STM32F103

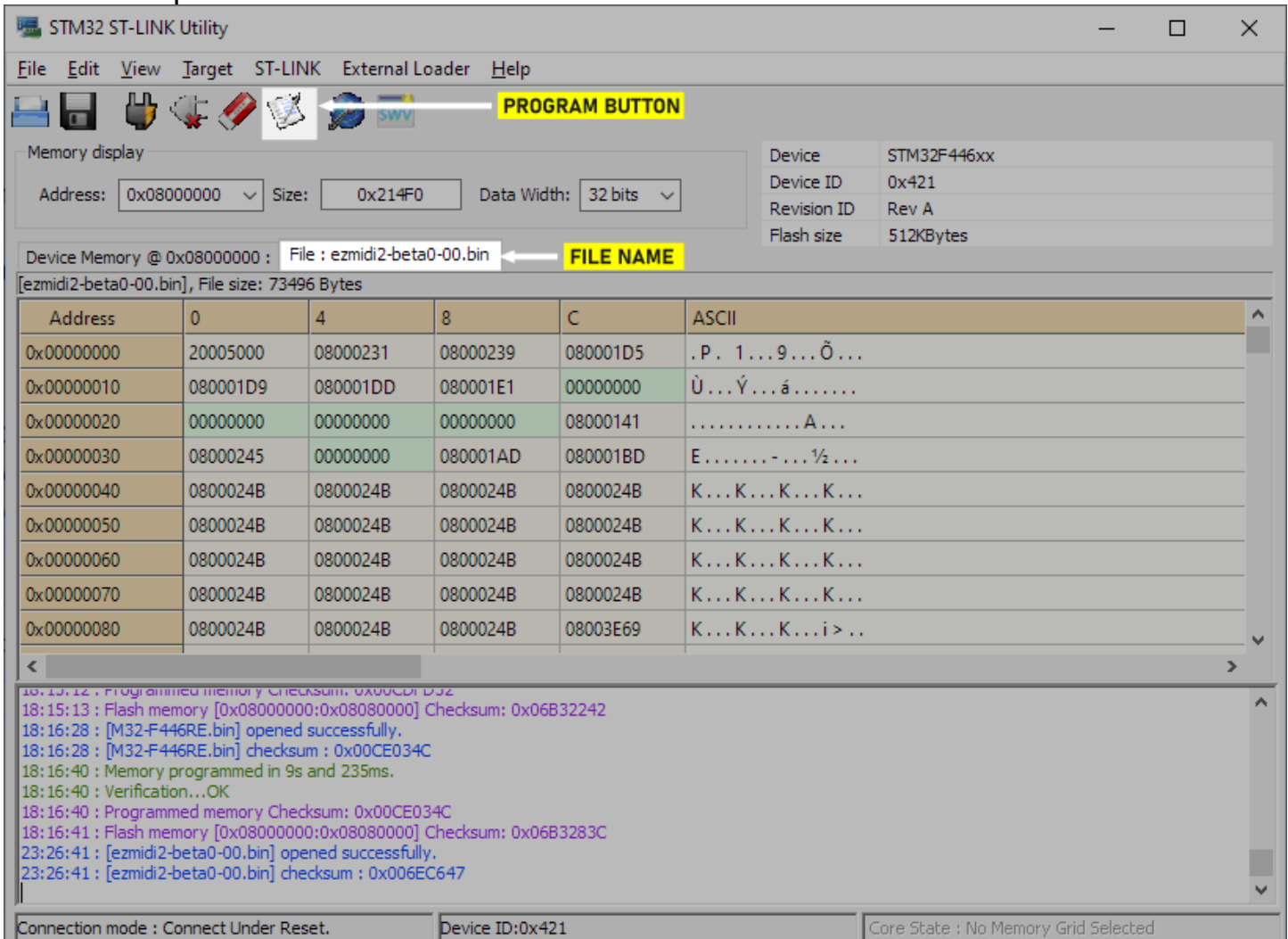
This only covers ST LINK utility. This is simpler than using the STMCube Programmer software. There is a video on our youtube channel that covers this.

Open the ST LINK utility, click FILE>OPEN and find the EZ MIDI code on your computer.

The file name should appear.

Then press the PROGRAM BUTTON.

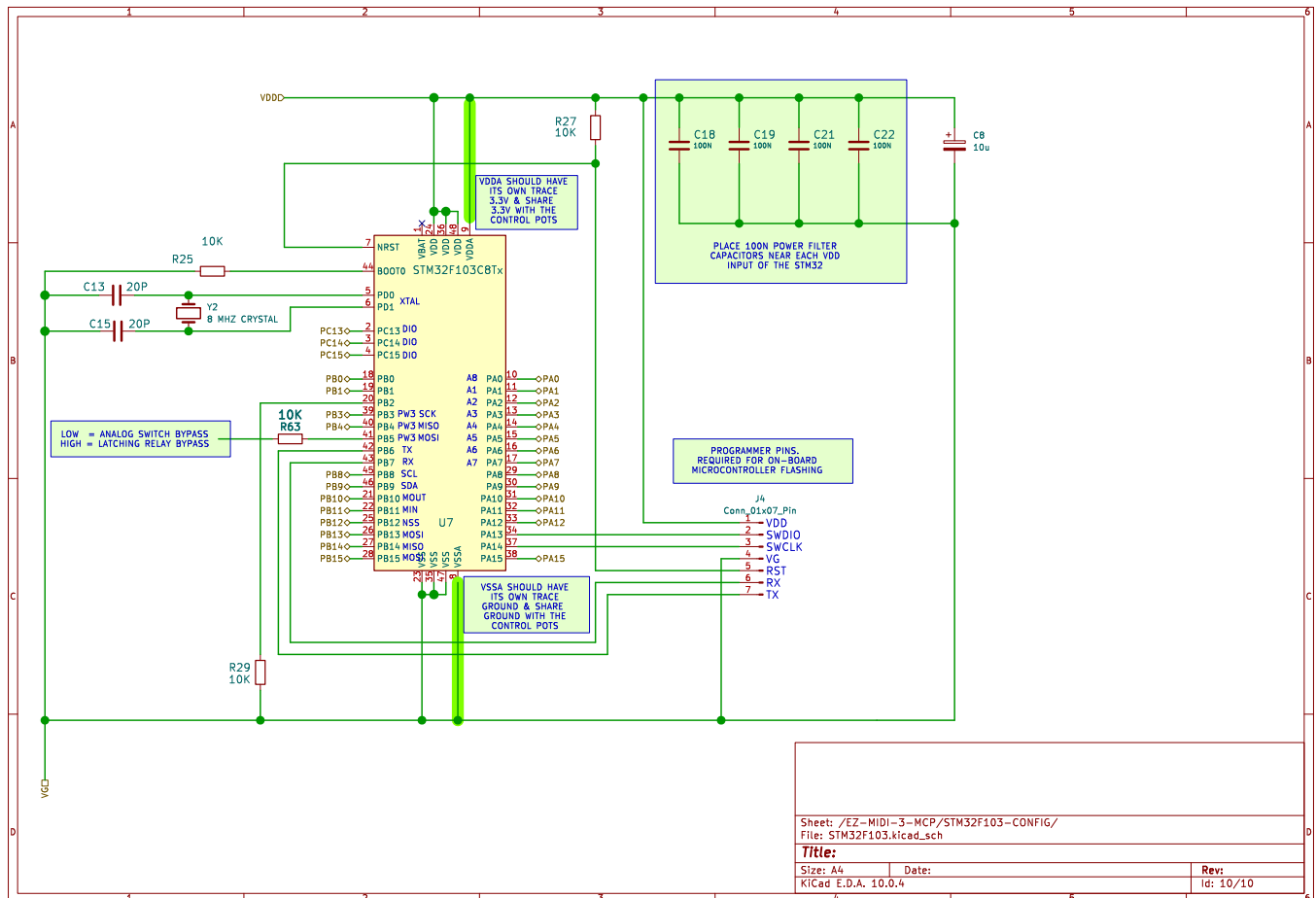
A progress bar will popup. After a few seconds it should be complete. If there is an error it is usually a connection problem.



SCHEMATICS:

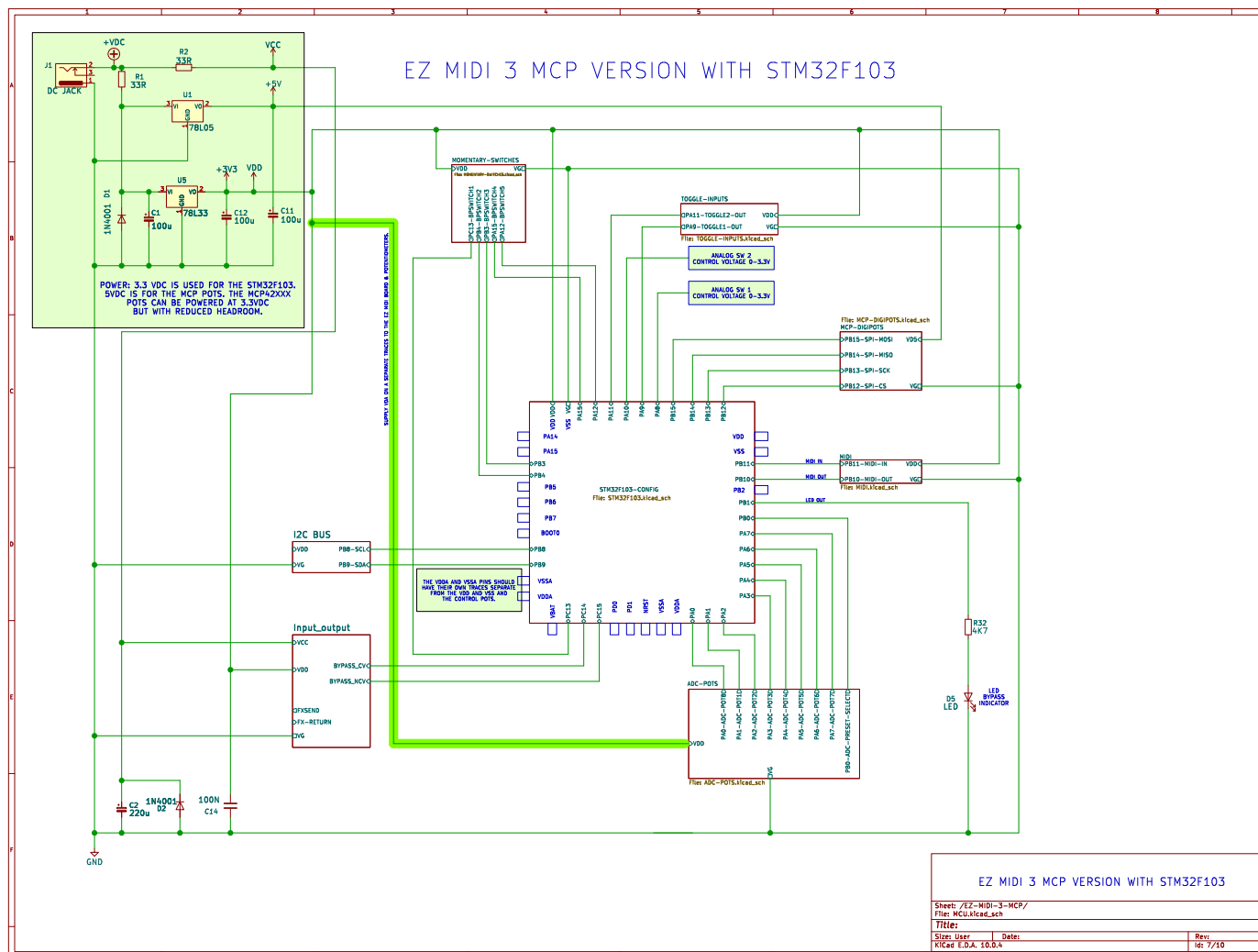
STM32F103 BASIC CONFIGURATION:
This is the bare minimum to get the STM32F103 up and running.
This circuit is ready flashing and activation.

This is the bare minimum to get the STM32F103C8T6 to flash and activate. This circuit is ready flashing and activation.



SCHEMATICS:

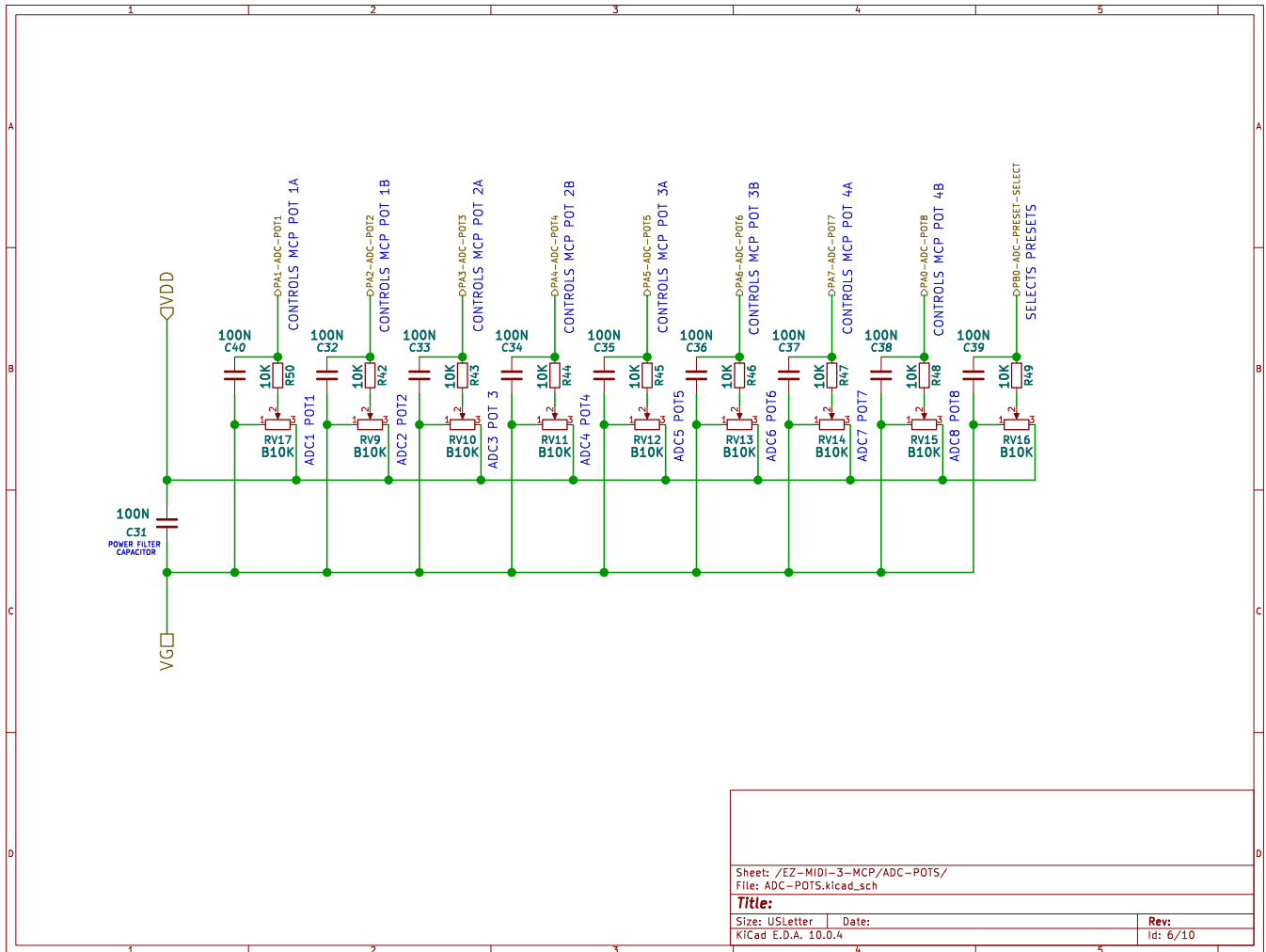
Overview of STM32F103 EZ MIDI MCP connections to switches, pots and peripheral



SCHEMATIC:

Control pots control corresponding MCP digital pots. The 10K resistors and 100N capacitors are recommended to reduce noise.

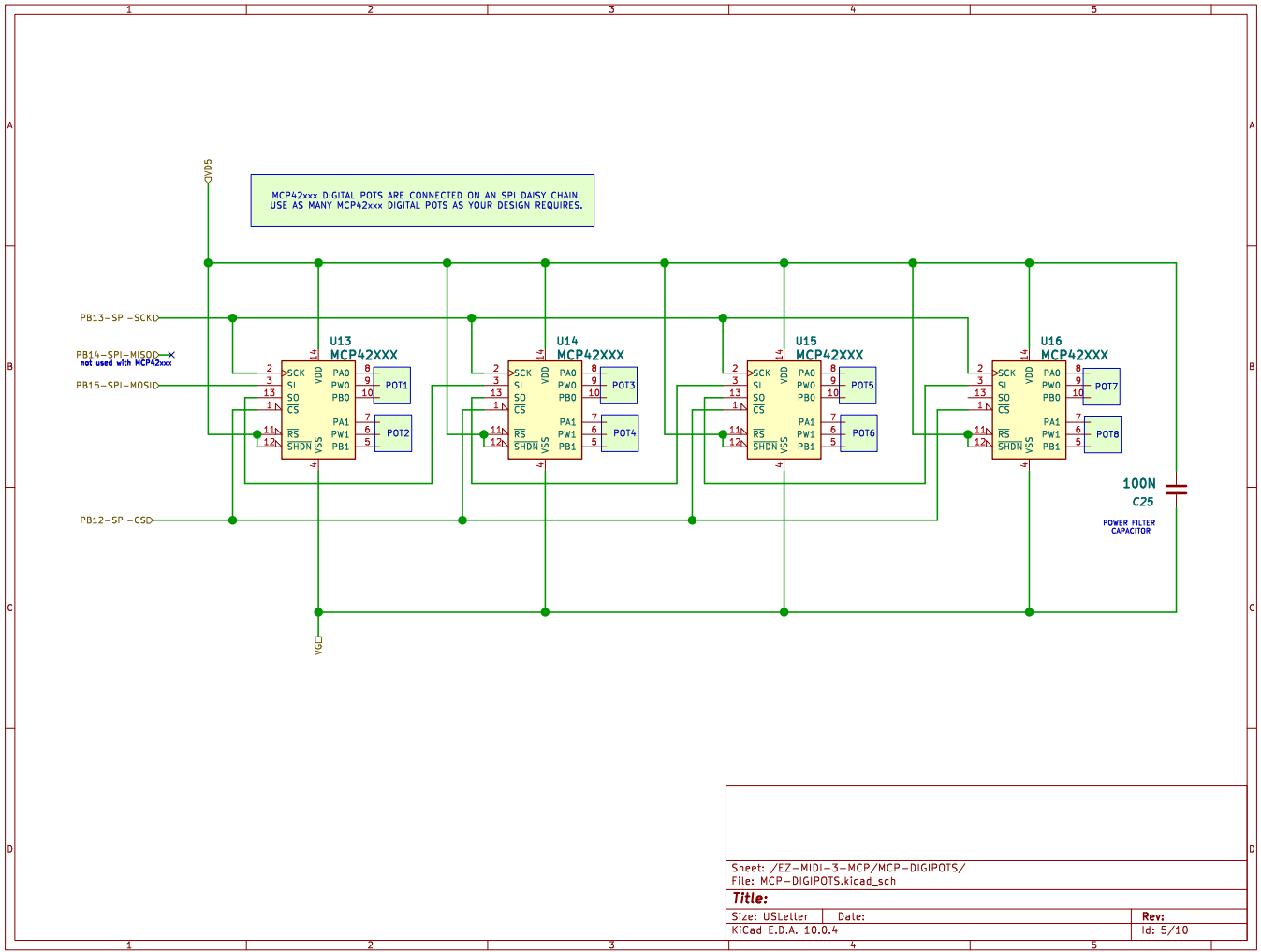
Always start your design using ADC1/POT1 first and adding more as necessary. For example if your design requires four control pots use ADC1 through ADC4.



SCHEMATICS:

MCP DIGITAL POTS

The MCP42xxx digital pots connect in a daisy chain. You can use as many or few as your design requires.



SCHEMATICS:

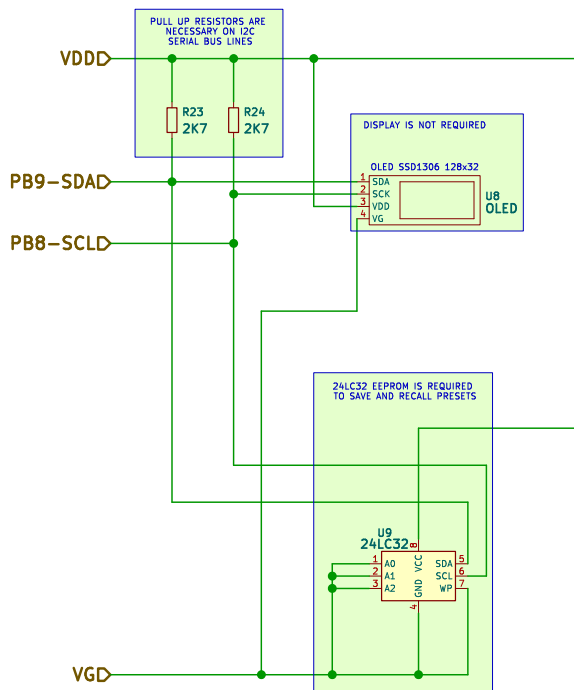
I2C BUS: I2C is a serial protocol used to communicate with peripherals.

The 24LC32 eeprom is used for storing and recalling preset data.

The OLED SSD1306 display will display preset data and parameter updates.

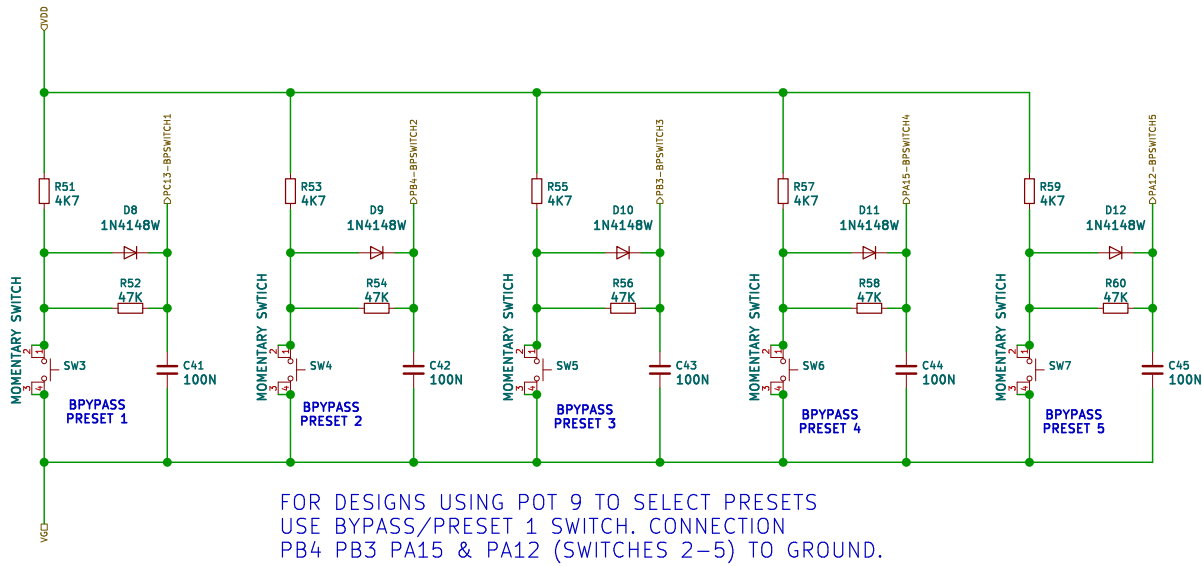
There are several version of the SSD1306 display and many knockoffs that have slight differences in the protocol. EZ MIDI 3 should work with most of them.

R23 & R24 are pull up resistors for the I2C line. The resistors are required even if an eeprom and display are not used in your design.



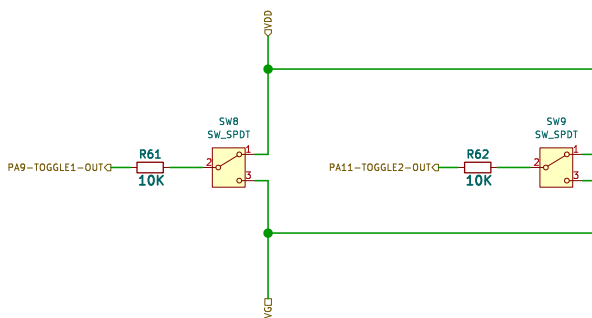
SCHEMATICS:

EZ MIDI MCP based design using ADC9/POT9 to recall presets use bypass preset switch 1 (PC13) & connect all other bypass switch pins to ground.



Toggle Switches:

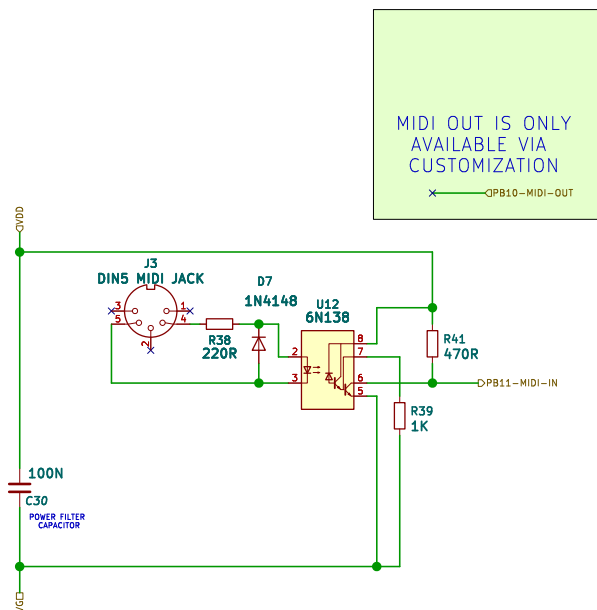
Toggle's are used to control PA8 & PA10 output pins from the STM32F103. This makes the settings recall-able via preset.



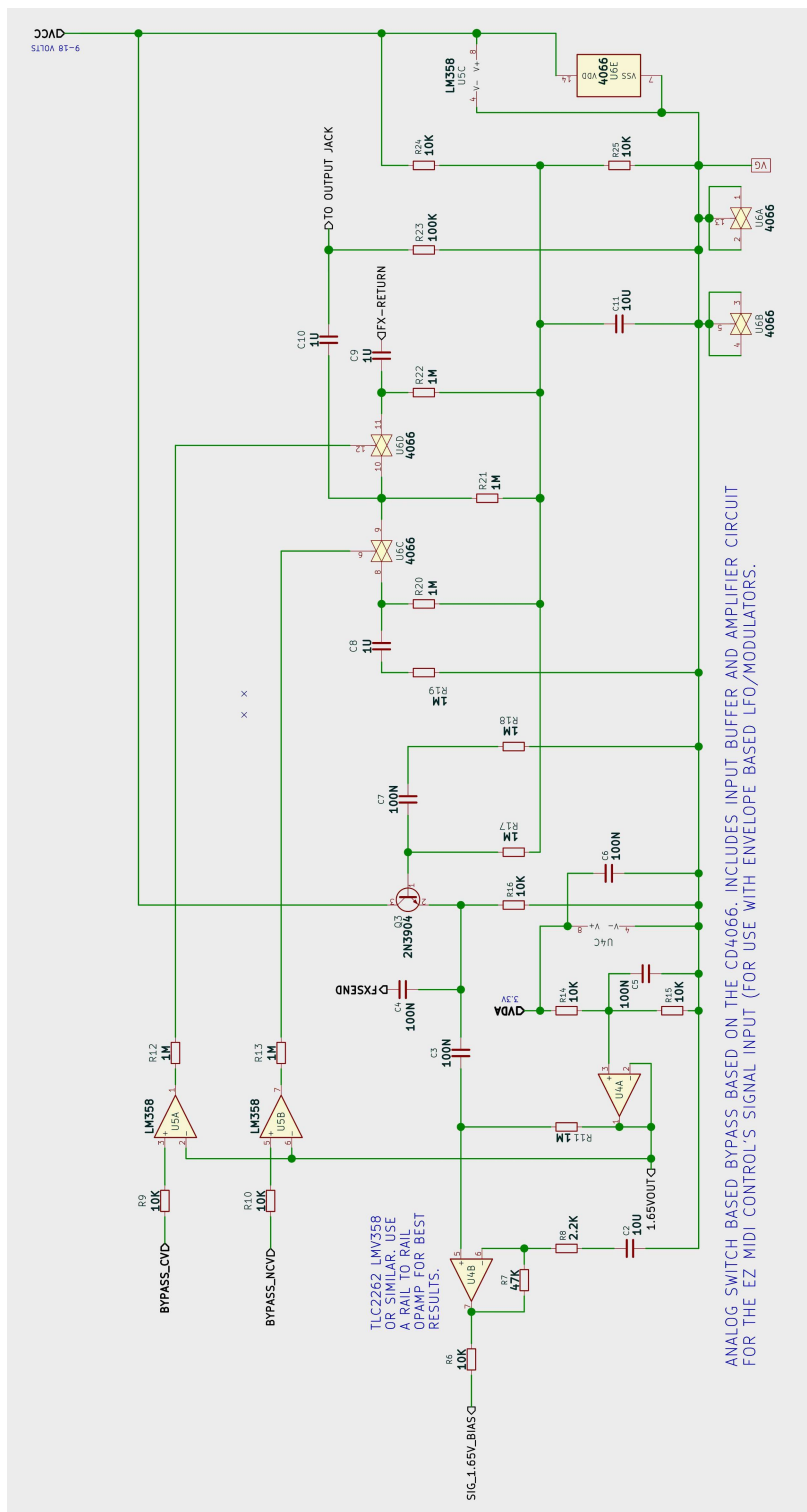
SCHEMATICS:

The MIDI in circuit uses a 6N138 optoisolator. The optoisolator is necessary to ensure that an effect pedal does not share a ground connection to a midi interface or controller.

The 6N138 is a long time favorite in MIDI circuits. It is highly compatible with most MIDI setups.



EXAMPLE SCHEMATIC USING CD4066 FOR ANALOG SWITCH BYPASS:



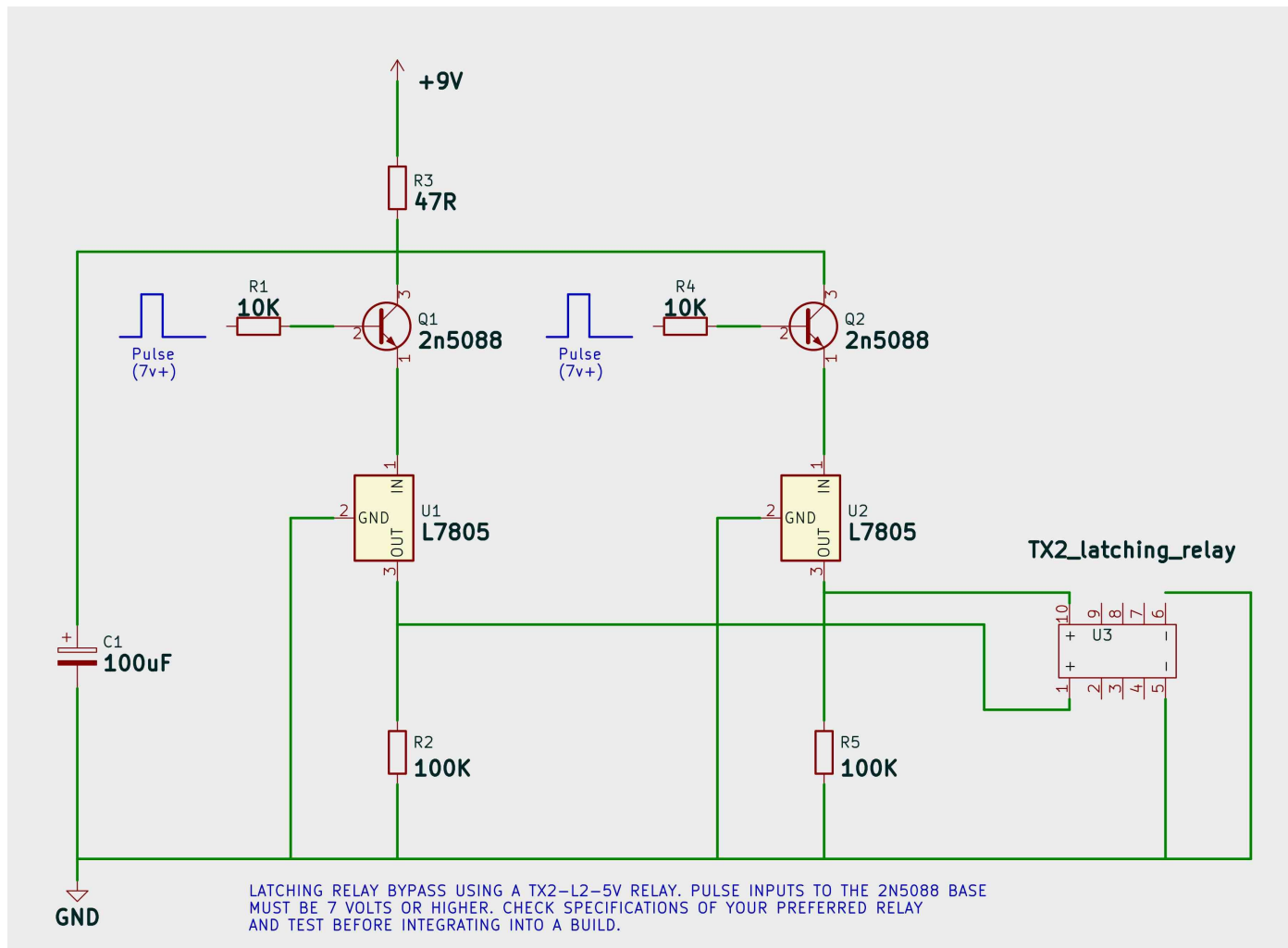
Power filtering not shown. Test with your design before integrating it into a build.

EXAMPLE SCHEMATIC USING A TX2-L2-5V LATCHING RELAY.

Be aware that latching relays require significant current to change state, and may be damaged if the coil voltage is exceeded. This schematic was tested with a TX-L2-5V latching relay.

The L7805 is a 5 volt regulator. It is used unconventionally ensuring the relay coil's voltage does not exceed 5 volts. The pulse voltage inputs must exceed 7 volts to engage the relay's coils. The resting voltage should be below 0.6v to ensure no current passes through the relay's coil when not in use. R2 and R5 may not be necessary.

The pulse signals come from PC14 & PC15. They will need to be amplified to 7+ volts for this circuit to work. The amplified pulse signals should go to R1 and R4.



Power filtering not shown.

Amplification of the pulse signal from the EZ MIDI control board is not shown.

Test with your design before integrating it into a build.

EZ MIDI MCP: CONTROL ROUTING & DATA RANGES.

INPUT	PARAMETER	ACTION/OUTPUT
CONTROL POT 1	PARAM 1 0-4095	DIGITAL POT A1
CONTROL POT 2	PARAM 2 0-4095	DIGITAL POT A2
CONTROL POT 3	PARAM 3 0-4095	DIGITAL POT B1
CONTROL POT 4	PARAM 4 0-4095	DIGITAL POT B2
CONTROL POT 5	PARAM 5 0-4095	DIGITAL POT C1
CONTROL POT 6	PARAM 6 0-4095	DIGITAL POT C2
CONTROL POT 7	PARAM 7 0-4095	DIGITAL POT D1
CONTROL POT 7	PARAM 8 0-4095	DIGITAL POT D2
TOGGLE 1	PARAM 9 0-1	TOGGLE CONTROL VOLTAGE
TOGGLE 2	PARAM 10 0-11	TOGGLE CONTROL VOLTAGE
PRESET POT (9)		SELECT 11 PRESETS
BP SWITCH 1 BP SWITCH 2 BP SWITCH 3 BP SWITCH 4 BP SWITCH 5		BYPASS FX ON/OFF SELECTS PRESET LED
LONG PRESS		SAVE PRESETS

 = SAVABLE PARAMETER

MIDI CC IMPLEMENTATION:

MIDI CC MAP: FUZZ MODE

MIDI CC	RANGE	PARAMETER
7	0-127	PARAM 1: POT1
12	0-127	PARAM 2: POT2
13	0-127	PARAM 3: POT3
14	0-127	PARAM 4: POT4
15	0-127	PARAM 5: POT5
16	0-127	PARAM 6: POT6
20	0-127	PARAM 6: POT7
21	0-127	PARAM 8: POT8
26	0-1	PARAM 9: TOGGLE1
27	0-1	PARAM 10: TOGGLE2
99	>0	BYPASS EFFECT
100	>0	ENGAGE EFFECT
101	>0	FLIP BYPASS STATE
102	0-1	0 BYPASS EFFECT 1 ENGAGE EFFECT

Sending MIDI PC messages 0-10 will change the current preset.

STARTUP PARAMETERS: Applicable when EZ MIDI Control is built into an effect with EEPROM1 configuration.

On startup EZ MIDI control reads the EEPROM to retrieve customization design data, user presets and power up data. The power up data consists of two parameters, the MIDI channel and MIDI clock enabled/disabled.

After loading the data the LED flashes momentarily. While the LED is flashing press SW1 (bypass switch) to enter the setup “menu.”

The menu’s only user feedback is a flashing LED, and uses POT 8 and SW1.

The LED flashes according to the Pot 8’s position. One long flash followed by two groups of short flashes confirms the selection.

POT8	Flash 1	Flash	Flash	Action
1	Long	2x	1x	Factory Reset
2	Long	2x	2x	Reset power up settings (MIDI chan1, MIDI clock enabled)
3	Long	2x	3x	Not used
4	Long	2x	4x	Set MIDI Channel 1-10
5	Long	3x	1x	Set MIDI channel 11-16
6	Long	3x	2x	Set MIDI clock enabled
7	Long	3x	3x	Set MIDI clock disabled
8	Long	3x	4x	Not used
9	Long	4x	1x	Not used
10	Long	4x	2x	Serial Print EEPROM data
11	Long	4x	3x	Exit

After setting Pot 8, press SW1 to start the action.

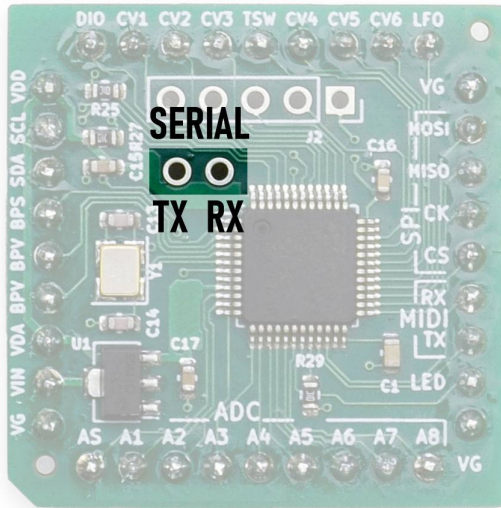
After a factory reset or resetting power up settings the effect will restart.

After setting the MIDI channel or MIDI clock settings the effect will remain in the setup menu until 11 is selected and SW1 is pressed.

WARP LFO LIST:

0	SineSquare	58	HardFadeToZeroTri16	117	SoftFadeOutInToCenterSine	176	HardFadeToZeroSqr8
1	TriSquare	59	SoftFadeOutInToCenterSaw	118	SoftFadeOutInToZeroSine	177	HardFadeToZeroSqr16
2	DutyCycle	60	SoftFadeOutInToZeroSaw	119	HardFadeToCenterSine	178	NWTri
3	Random	61	SoftFadeToCenterSaw	120	HardFadeToCenterSine	179	NWTriCenter
4	WarpEnvUp	62	HardFadeToCenterSaw	121	SoftFadeToZeroSine	180	NWSine
5	WarpEnvDn	63	SoftFadeToZeroSaw	122	HardFadeToZeroSine	181	NWSineCenter
6	SqrTriMix4	64	HardFadeToZeroSaw	123	SoftFadeOutInToCenterSine2	182	NWRamp
7	SqrTriMix8	65	SoftFadeOutInToCenterSaw4	124	SoftFadeOutInToCenterSine4	183	NWSaw
8	SqrTriMix16	66	SoftFadeOutInToCenterSaw8	125	SoftFadeOutInToCenterSine8	184	NWRandom
9	RndTriMix4	67	SoftFadeOutInToCenterSaw16	126	SoftFadeOutInToCenterSine16	185	NWPulse25
10	RndTriMix8	68	SoftFadeOutInToZeroSaw4	127	SoftFadeOutInToZeroSine2	186	NWPulse33
11	RndTriMix16	69	SoftFadeOutInToZeroSaw8	128	SoftFadeOutInToZeroSine4	187	NWSqr
12	StepTri	70	SoftFadeOutInToZeroSaw16	129	SoftFadeOutInToZeroSine8	188	NWPulse66
13	StepSine	71	SoftFadeToCenterSaw2	130	SoftFadeOutInToZeroSine16	189	NWPulse75
14	StepSaw	72	SoftFadeToCenterSaw4	131	SoftFadeToCenterSine2	190	NWSineLog
15	StepRamp	73	SoftFadeToCenterSaw8	132	SoftFadeToCenterSine4	191	NWSineExp
16	Tri3XMix	74	SoftFadeToCenterSaw16	133	SoftFadeToCenterSine8	192	NWTriLog
17	Tri4XMix	75	HardFadeToCenterSaw2	134	SoftFadeToCenterSine16	193	NWTriExp
18	Tri5XMix	76	HardFadeToCenterSaw4	135	HardFadeToCenterSine2	194	NWRampLog
19	Sine3XMix	77	HardFadeToCenterSaw8	136	HardFadeToCenterSine4	195	NWRampExp
20	Sine4XMix	78	HardFadeToCenterSaw16	137	HardFadeToCenterSine8	196	NWSawExp
21	Sine5XMix	79	SoftFadeToZeroSaw2	138	HardFadeToCenterSine16	197	NWSawExp
22	SawExpLog	80	SoftFadeToZeroSaw4	139	SoftFadeToZeroSine2	198	NWSlowEnvUp
23	RampExpLog	81	SoftFadeToZeroSaw8	140	SoftFadeToZeroSine4	199	NWMedEnvUp
24	TriExpLog	82	SoftFadeToZeroSaw16	141	SoftFadeToZeroSine8	200	NWFastEnvUp
25	SineExpLog	83	HardFadeToZeroSaw2	142	SoftFadeToZeroSine16	201	NWExpEnvUp
26	SinePulseDistortion	84	HardFadeToZeroSaw4	143	HardFadeToZeroSine2	202	NWLogEnvUp
27	DbtPhaseDistortion	85	HardFadeToZeroSaw8	144	HardFadeToZeroSine4	203	NWSinEnvUp
28	DbtSinePhaseDistortion	86	HardFadeToZeroSaw16	145	HardFadeToZeroSine8	204	NWSlowEnvDn
29	SinePhaseDistortion	87	SoftFadeOutInToCenterRamp	146	HardFadeToZeroSine16	205	NWMedEnvDn
30	PhaseDistortion	88	SoftFadeOutInToZeroRamp	147	SoftFadeOutInToCenterSqr	206	NWFastEnvDn
31	SyncRamp1to8	89	SoftFadeToCenterRamp	148	SoftFadeOutInToZeroSqr	207	NWExpEnvDn
32	SyncTri	90	HardFadeToCenterRamp	149	SoftFadeToCenterSqr	208	NWLogEnvDn
33	WindowedSyncTri	91	SoftFadeToZeroRamp	150	HardFadeToCenterSqr	209	NWSinEnvDn};
34	WindowedSyncSine	92	HardFadeToZeroRamp	151	HardFadeToCenterSqr		
35	SoftFadeOutInToCenterTri	93	SoftFadeOutInToCenterRamp2	152	SoftFadeToZeroSqr		
36	SoftFadeOutInToZeroTri	94	SoftFadeOutInToCenterRamp4	153	HardFadeToZeroSqr		
37	SoftFadeToCenterTri	95	SoftFadeOutInToCenterRamp8	154	SoftFadeOutInToCenterSqr2		
38	HardFadeToCenterTri	96	SoftFadeOutInToCenterRamp16	155	SoftFadeOutInToCenterSqr4		
39	SoftFadeToZeroTri	97	SoftFadeOutInToZeroRamp2	156	SoftFadeOutInToCenterSqr8		
40	HardFadeToZeroTri	98	SoftFadeOutInToZeroRamp4	157	SoftFadeOutInToCenterSqr16		
41	SoftFadeOutInToCenterTri4	99	SoftFadeOutInToZeroRamp8	158	SoftFadeOutInToZeroSqr2		
42	SoftFadeOutInToCenterTri8	100	SoftFadeOutInToZeroRamp16	159	SoftFadeOutInToZeroSqr4		
43	SoftFadeOutInToCenterTri16	101	SoftFadeToCenterRamp2	160	SoftFadeOutInToZeroSqr8		
44	SoftFadeOutInToZeroTri4	102	SoftFadeToCenterRamp4	161	SoftFadeOutInToZeroSqr16		
45	SoftFadeOutInToZeroTri8	103	SoftFadeToCenterRamp8	162	SoftFadeToCenterSqr2		
46	SoftFadeOutInToZeroTri16	104	SoftFadeToCenterRamp16	163	SoftFadeToCenterSqr4		
47	SoftFadeToCenterTri4	105	HardFadeToCenterRamp2	164	SoftFadeToCenterSqr8		
48	SoftFadeToCenterTri8	106	HardFadeToCenterRamp4	165	SoftFadeToCenterSqr16		
49	SoftFadeToCenterTri16	107	HardFadeToCenterRamp8	166	HardFadeToCenterSqr2		
50	HardFadeToCenterTri4	108	HardFadeToCenterRamp16	167	HardFadeToCenterSqr4		
51	HardFadeToCenterTri8	109	SoftFadeToZeroRamp2	168	HardFadeToCenterSqr8		
52	HardFadeToCenterTri16	110	SoftFadeToZeroRamp4	169	HardFadeToCenterSqr16		
53	SoftFadeToZeroTri4	111	SoftFadeToZeroRamp8	170	SoftFadeToZeroSqr2		
54	SoftFadeToZeroTri8	112	SoftFadeToZeroRamp16	171	SoftFadeToZeroSqr4		
55	SoftFadeToZeroTri16	113	HardFadeToZeroRamp2	172	SoftFadeToZeroSqr8		
56	HardFadeToZeroTri4	114	HardFadeToZeroRamp4	173	SoftFadeToZeroSqr16		
57	HardFadeToZeroTri8	115	HardFadeToZeroRamp8	174	HardFadeToZeroSqr2		
58	HardFadeToZeroTri16	116	HardFadeToZeroRamp16	175	HardFadeToZeroSqr4		

SERIAL OUTPUT:



On power up EZ MIDI control sends start up data to the serial pins.

Additionally there are serial print options via midi and the setup menu. This is useful for storing data on a computer and writing to EEPROMs from the computer.

Writing data to the EEPROM:

This is the official programmer from the manufacturer or 24xxxx EEPROMs:

<https://www.microchip.com/en-us/development-tool/DV243003>

There are many USB EEPROM programmers available, but they are not all the same. Before purchasing one be aware that **some low-cost EEPROM programmers can overload a computer's USB power if misused**. Choose an I2C programmer compatible with the 24LC32. Read documentation, read reviews and follow instructions.

REFERENCES AND LINKS:

24LC32 EEPROM: <https://ww1.microchip.com/downloads/en/DeviceDoc/21072G.pdf>

MCP42xxx Digital potentiometer: <https://ww1.microchip.com/downloads/en/devicedoc/11195c.pdf>

11 Detent potentiometer (Used for Pot 7 & 8)

16 mm Alpha: <https://mou.sr/4fhTMq9>

<https://smallbear-electronics.mybigcommerce.com/alpha-single-gang-16mm-solder-lug-11-detents/>

9MM: <https://smallbear-electronics.mybigcommerce.com/single-gang-9mm-right-angle-pc-mount-11-detents-6-mm-shaft/>

OLED Display: <https://www.amazon.com/dp/B07FMDB6TR?th=1>

MIDI Jack: <https://www.adafruit.com/product/1134>

6N138 High Speed Optocoupler (used for MIDI in): <https://mou.sr/3zZqXi6>

Power up: Refers to powering on EZ MIDI control and/or relevant data that is used when first powered up.

Design data or Design customization data: Data stored on the eeprom used to customize functionality.

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