MMU2 and Duet with Duex

* Tested with firmware v2.02 -- **known issues:** triggers wait till the tool change has completed to then show the message that unloading/loading fault has occurred and pause. This isn't desirable when the fault occurs on unloading before switching to another filament. As of v2.03beta3 trigger messages are shown at the correct time when an unloading/loading fault occurs but doesn’t yet pause the tool change. DC42 is aware of this and hopefully has it fixed soon.
* “Finda” or filament sensor is connected to the “V” axis endstop
* Use strong nema17 motors with 45Ncm or higher stall (mainly for “W” axis)
* V axis needs to be on the main duet board for endstop/sensor to function correctly (this is a hardware limitation from what i've read, I'm not 100% sure)
* Name axes U,V,W this avoids gcode parameter conflicts with the triggers, trust me!
* Stall settings WILL vary compared to below examples, you will need to tune for your motors
* In the startup gcode after temperatures are set by the slicer you will need to add T-1 P0 and then either T0 or leave unselected. The Slicer will then select the correct tool anyway from memory.
* End of print gcode I've inserted T-1 so when finished the machine is always unloaded. I also do this before power panic pause.
* Cancel.g I added T-1 also
* Slic3r PE will work and has all the functionality that you need with ramming etc but if you would like to use Simplify3d i recommend using it with Filaswitch which is a postprocessing python script that has a bunch of smarts written in to save filament and a few other goodies and is also itself configurable. <https://github.com/spegelius/filaswitch> , there's also a fork that has been written specifically for the MMU2 and its found here <https://github.com/paukstelis/filaswitch> . Cura and other slicers i have no experience with.
* Use 1.8mm or 1.85mm PTFE tube for inside the Hotend as this narrow tube creates nice smooth tips and adds to reliability, heres the link to the right stuff <https://www.amazon.com/Fluorostore-F015156-2M-Tubing-Printer-Translucent/dp/B01ERLVLJQ/ref=sr_1_2?ie=UTF8&qid=1548894053&sr=8-2&keywords=fluorostore#detail-bullets>
* The PTFE tube from the MMU2 to the extruder is just the standard 2mm x 4mm
* For MMU2 specific issues and some reading for a rainy day have a look here: <https://manual.prusa3d.com/c/Original_Prusa_i3_MK3_to_Multi_Material_2_upgrade>
* A Bill of Materials for the MMU2 can be found here for those who want to home build like i did: <https://github.com/cskozlowski/mmu2/blob/master/doc/BOM.md> this isnt authored by me, i just used it as a guide

Macro flow diagram

Tpre”n”.g

>> Tpremaster.g. (Includes trigger2)

>>Tpost”n”.g

>>Tpostmaster.g

Tfree”n”.g

>>TipSmoothing.g

>>Tfreemaster.g. (Includes trigger3)

Macros for MMU2

U = Selector Axis

V = filament drive axis (\*\*\*\*this axis must be on the main duet board not duex\*\*\*)

W = tumbler/idler axis

tpre0.g

; called before tool 0 is selected

G90 ; absolute moves

M913 U100 V100 W100

G1 U1 F2000 ; move selector to T0 position

G1 W4 F10000 ; move idler to T0 position

M400 ; wait for moves to stop

M98 P"tpremaster.g"

M591 D0 P2 C4 S1 ; activate filament sensor

tpre1.g

; called before tool 1 is selected

G90 ; absolute moves

M913 U100 V100 W100

G1 U15 F2000 ; move selector to T1 position

G1 W18 F10000 ; move idler to T1 position

M400 ; wait for moves to stop

M98 P"tpremaster.g"

M591 D1 P2 C4 S1 ; activate filament sensor

tpre2.g

; called before tool 2 is selected

G90 ; absolute moves

M913 U100 V100 W100

G1 U29 F2000 ; move selector to T2 position

G1 W32 F10000 ; move idler to T2 position

M400 ; wait for moves to stop

M98 P"tpremaster.g"

M591 D2 P2 C4 S1 ; activate filament sensor

tpre3.g

; called before tool 3 is selected

G90 ; absolute moves

M913 U100 V100 W100

G1 U43 F2000 ; move selector to T3 position

G1 W46 F10000 ; move idler to T3 position

M400 ; wait for moves to stop

M98 P"tpremaster.g"

M591 D3 P2 C4 S1 ; activate filament sensor

tpre4.g

; called before tool 4 is selected

G90 ; absolute moves

M913 U100 V100 W100

G1 U57 F2000 ; move selector to T4 position

G1 W59 F10000 ; move idler to T4 position

M400 ; wait for moves to stop

M98 P"tpremaster.g"

M591 D4 P2 C4 S1 ; activate filament sensor

tpremaster.g

M574 V1 S0 ; set V axis max endstop to switched low

G91 ; relative moves

G1 V30 S1 F3000 ; feed filament to filament sensor

G92 V0 ; force V to 0mm

G1 V20 F3000 ; feed a bit more to reliably switch sensor and reach tube

M400

M581 V S1 T2 C1 ; activate trigger 2 on rising edge

M582 T2 ; check filament sensor to confirm loading successful

M581 T2 S-1 ; deactivate trigger 2

M400

M574 V1 S3 ; set V axis max endstop to sensorless

M913 V30 ; reduce motor current to 30% to prevent grinding

M915 V S7 F0 ; set stall guard parameters

M400 ; wait for moves to finish

G1 S1 V900 F5000 ; fast feed filament into extruder

G92 V0 ; force V to 0mm

G90 ; absolute moves

tpost0.g

; called after tool 0 has been selected

M913 U100 V100 W100 ; 100% current on UVW

G1 W4 ; move W to engage filament

M116 P0 ; wait for nozzle heat up

M98 P"tpostmaster.g" ; run postmaster.g

tpost1.g

; called after tool 1 has been selected

;

M913 U100 V100 W100

G1 W18 F10000

M116 P1

M98 P"tpostmaster.g"

tpost2.g

; called after tool 2 has been selected

M913 U100 V100 W100

G1 W32 F10000

M116 P2

M98 P"tpostmaster.g"

tpost3.g

; called after tool 3 has been selected

M913 U100 V100 W100

G1 W46 F10000

M116 P3

M98 P"tpostmaster.g"

tpost4.g

; called after tool 4 has been selected

M913 U100 V100 W100

G1 W59 F10000

M116 P4

M98 P"tpostmaster.g"

tpostmaster.g

G1 E5 V5 F300 ; feed filament into extruder with both V and E axis

;activate laser pew pew pew

G90 ; absolute moves

G1 W78 F10000 ; move W to safe position

G91 ; relative moves

G1 E90 F5000 ; drive extruder for 90mm

G1 E10 F300 ; slowly load the hotend

G90 ; absolute moves

tfree0.g

; called when tool 0 is freed

;deactivate laser pew pew pew

M913 U100 V100 W100

M98 P"TipSmoothing.g"

G90 ; absolute moves

G1 W4 F10000 ; select T0 with idler

M591 D0 P2 C4 S0 ; deactivate filament sensor

M98 P"tfreemaster.g"

tfree1.g

; called when tool 1 is freed

;deactivate laser pew pew pew

M913 U100 V100 W100

M98 P"TipSmoothing.g"

G90 ; absolute moves

G1 W18 F10000 ; select T1 with idler

M591 D1 P2 C4 S0 ; deactivate filament sensor

M98 P"tfreemaster.g"

tfree2.g

; called when tool 2 is freed

;deactivate laser pew pew pew

M913 U100 V100 W100

M98 P"TipSmoothing.g"

G90 ; absolute moves

G1 W32 F10000 ; select T2 with idler

M591 D2 P2 C4 S0 ; deactivate filament sensor

M98 P"tfreemaster.g"

tfree3.g

; called when tool 3 is freed

;deactivate laser pew pew pew

M913 U100 V100 W100

M98 P"TipSmoothing.g"

G90 ; absolute moves

G1 W46 F10000 ; select T3 with idler

M591 D3 P2 C4 S0 ; deactivate filament sensor

M98 P"tfreemaster.g"

tfree4.g

; called when tool 4 is freed

;deactivate laser pew pew pew

M98 P"TipSmoothing.g"

G90 ; absolute moves

G1 W59 F10000 ; select T4 with idler

M591 D4 P2 C4 S0 ; deactivate filament sensor

M98 P"tfreemaster.g"

tfreemaster.g

G91 ; relative moves

M574 V1 S1 ; set V axis min endstop to switched high temporarily

G92 V0 ; force V axis position to 0mm

G1 V-900 S1 F5000 ; retract filament till sensor switches off

G92 V0 ; force V axis position to 0mm

G1 V-22 F3000 ; retract to position clear of selector

M400

M581 V S0 T3 C1 ; activate trigger 3 on falling edge while printing

M582 T3 ; check filament sensor to confirm unloading successful

M581 V S-1 T3 C1 ; deactivate trigger 3

M400

G90 ; absolute moves

Tipsmoothing.g (optional or just retract extruder 110mm instead of this macro)

G1 E-15 F6600 ; fast retract with extruder

G1 E-14 F1200 ; cooling and shaping moves

G1 E-4 F600 ; cooling and shaping moves

G1 E-2 F360 ; cooling and shaping moves

G1 E8 F609 ; cooling and shaping moves

G1 E-10 F507 ; cooling and shaping moves

G1 E10 F406 ; cooling and shaping moves

G1 E-10 F304 ; cooling and shaping moves

G4 P1000 ; pause for cooling for 5 sec

G1 E-80 F3000 ; retract out of extruder

Filament-change.g

T-1 ; deselect tool to unload filament

G90 ; absolute moves

G1 U75 F2000 ; move selector out of the way

G1 V900 F5000 ; drive filament out the front of MMU2

G1 W78 F10000 ; move W axis to safe position

M291 P"remove old filament, load new filament and press OK" R"Filament has run out" S2

T R1 ; select previous tool

M24 ; resume print

trigger2.g

; for detecting loading problems

M291 P"Loading failure detected" S2

trigger3.g

;for detecting unloading problems

M291 P"Unloading failure detected" S2

Example Config.g (just the mmu2 bits)

; Drives

M569 P0 S0 ; Drive 0 goes forwards X

M569 P1 S0 ; Drive 1 goes forwards Z

M569 P2 S1 ; Drive 2 goes backwards Y

M569 P3 S1 ; Drive 3 goes backwards E

M569 P4 S0 ; Drive 4 goes backwards V

M569 P5 S1 ; Drive 5 goes forwards U

M569 P6 S0 ; Drive 6 goes forwards W

M584 X0 Y2 Z1 E3 V4 U5 W6 ; Apply custom drive mapping

M350 X16 Y16 Z16 E16 U16 V16 W16 I1 ; Configure microstepping with interpolation

M92 X100 Y100 Z100 E423 U400 V145 W26 ; Set steps per mm 476.5 for QR 415 for BMG

M566 X800 Y800 Z200 E2000 U400 V2000 W2000 ; Set maximum instantaneous speed changes (mm/min)

M203 X9000 Y9000 Z1800 E5000 U5000 V10000 W20000 ; Set maximum speeds (mm/min)

M201 X1500 Y1500 Z500 E5000 U500 V2000 W2000 ; Set accelerations (mm/s^2)

M906 X1000 Y1000 Z1000 E700 U1000 V2000 W2000 I30 ; Set motor currents (mA) and motor idle factor in per cent

; Axis Limits

M208 X-10 Y0 Z0 U0 V-1000 W0 S1 ; Set axis minimum

M208 X260 Y250 Z280 U75 V1000 W78 S0 ; Set axis maximum

; Endstops

M574 X1 Y1 Z2 S0 ; Set active low endstops xmin, ymin, zmax

M574 U1 V1 W1 S3 ; Set additional axes as sensorless endstops

;Tools

M563 P0 D0 H1 ; Define tool 0

G10 P0 X0 Y0 Z0 ; Set tool 0 axis offsets

G10 P0 R0 S0 ; Set initial tool 0 active and standby temperatures to 0C

M563 P1 D0 H1 ; Define tool 1

G10 P1 X0 Y0 Z0 ; Set tool 1 axis offsets

G10 P1 R0 S0 ; Set initial tool 1 active and standby temperatures to 0C

M563 P2 D0 H1 ; Define tool 2

G10 P2 X0 Y0 Z0 ; Set tool 2 axis offsets

G10 P2 R0 S0 ; Set initial tool 2 active and standby temperatures to 0C

M563 P3 D0 H1 ; Define tool 3

G10 P3 X0 Y0 Z0 ; Set tool 3 axis offsets

G10 P3 R0 S0 ; Set initial tool 3 active and standby temperatures to 0C

M563 P4 D0 H1 ; Define tool 4

G10 P4 X0 Y0 Z0 ; Set tool 4 axis offsets

G10 P4 R0 S0 ; Set initial tool 4 active and standby temperatures to 0C

Homeu.g

M913 U50 ; reduce motor current to 50% to prevent bad noises

M915 U S5 F0 ; set stall parameters

G91 ; use relative positioning

G1 S1 U5 F2000 ; move out 5mm

G1 S1 U-100 F1000 ; move carriage to home

G90 ; back to absolute positioning

M400 ; make sure everything has stopped before we reset the motor currents

M913 U100 ; motor currents back to normal

Homev.g

G92 V0

Homew.g

M913 W70 ; reduce motor current to 70% to prevent bad noises

M915 W S3 H200 F0 R0 ; set stall parameters

G91 ; use relative positioning

G1 S1 W10 F20000 ; move idler out 5mm

G1 S1 W-120 F20000 ; move idler home

M400 ; make sure everything has stopped before we reset the motor currents

G1 W78 F10000

M913 W100 ; motor currents back to normal

G90 ; back to absolute positioning

Notes and thoughts:

* For increased reliability might be good to add another endstop (as opposed to sensorless) at the extruder to detect loading even further?
* If tipsmoothing.g isn't used be sure to retract into the PTFE tube and pause for at least 5 seconds or filament will be deformed by extruder
* For filament change to work perfectly there's a small mod to the selector and pulley body needed. Stls will be added soon
* I added the comments in for where i’d insert the laser filament sensor gcode as i plan to incorporate that into my machine when they come back in stock

Change log:

3/2/19 - released

4/2/19 - added firmware version, some notes about stls, author, slicer info and some links

5/2/19 - added some comments to triggers for future testing

7/2/19 - added known issues to first page. Removed M400 from triggers. Change tipsmoothing pause to 5

seconds

17/02/19 - fixed up some typos thanks Mikhail

31/03/19- removed V1 from trigger messages as per changes in v2.03beta3. Added details about behaviour changes in 2.03beta3

02/04/19 - removed some unnecessary M400’s

27/06/19 - fix error with only calling filament sensor T0 regardless of which tool was selected, now each filament error states the current extruder number. Also edited Tipsmoothing.g with refined tip shaping profile.

Author

Gavatron3000