

G-code

From RepRapWiki

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This page tries to describe the flavour of **G-codes** that the RepRap firmwares use and how they work. The main target is additive fabrication using FFF processes. Codes for print head movements follow the NIST RS274NGC G-code standard (http://www.nist.gov/manuscript-publication-search.cfm?pub_id=823374) , so RepRap firmwares are quite usable for CNC milling and similar applications, too. See also on Wikipedia's G-code article (<https://en.wikipedia.org/wiki/G-code>) .

There are a few different ways to prepare GCode for a printer. One is to use a slicer like Slic3r, Skeinforge or Cura. These programs take a CAD model, slice it into layers, and output the GCode required for each layer. Slicers are the easiest way to go from a 3D model to a printed part, but the user sacrifices some flexibility when using them. Another option for GCode generation is to use a lower level library like mecode. Libraries like mecode give you precise control over the tool path, and thus are useful if you have a complex print that is not suitable for naive slicing. The final option is to just write the GCode yourself. This may be the best choice if you just need to run a few test lines while calibrating your printer.

As many different firmwares exist and their developers tend to implement new features without discussing strategies or looking what others did before them, a lot of different sub-flavours for the 3D-Printer specific codes developed over the years. But this is the master page for RepRap. Nowhere in here should the same code be used for two different things; there are always more numbers to use... The rule is: add your new code here, then implement it.

But human nature being what it is, things aren't always done that way, so some multiple uses of the same code exist. The rule is that later appearances by them on this page than the original use of a code are deprecated and should be changed, unless there is a good technical reason (like the general G-Code standard) why a later instance should be preferred. Note that the key date is appearance here, not date of implementation.

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Introduction

A typical piece of Gcode as sent to a RepRap machine might look like this:

```
N3 T0*57
N4 G92 E0*67
N5 G28*22
N6 G1 F1500.0*82
N7 G1 X2.0 Y2.0 F3000.0*85
N8 G1 X3.0 Y3.0*33
```

Gcode can also be stored in files on SD cards. A file containing RepRap Gcode usually has the extension **.g**, **.gco** or **.gcode**. Files for BFB/RapMan have the extension **.bfb**. Gcode stored in file or produced by a slicer might look like this:

```
G92 E0
G28
G1 F1500
G1 X2.0 Y2.0 F3000
G1 X3.0 Y3.0
```

The meaning of all those symbols and numbers (and more) is explained below.

Slicers will (optionally?) add GCode scripts to the beginning and end of their output file to perform specified actions before and/or after a print such as z-probing the build-area, heating/cooling the bed and hotend, performing ooze free "nozzle wipe" startup routine, switching system power on/off, and even "ejecting" parts. More info on the Start GCode routines and End GCode routines pages.

To find out which specific Gcode(s) are implemented in any given firmware, there are little tables attached to the command descriptions, like this one:

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	Yes	automatic	No	Partial	Experimental	deprecated	???	???	???	???	Yes	Partial

Here means:

- {{yes}}
The Gcode is fully supported by the firmware.
- {{partial}} or {{experimental}}
There is some support for the Gcode. Often it is required to check out the source code branch for the firmware (usually stored in a different branch) or to flip configuration switches on the mainboard.
- automatic

The firmware handles this Gcode automatically, so there's no need to send the command. An example is power supply on/off Gcode (M80/M81) in the Teacup firmware.

???

It is unknown if the firmware supports this Gcode. You may want to test this yourself before using it in production.

{{no}}

The firmware does not support this Gcode.

deprecated

The firmware deprecated this Gcode. The firmware author(s) should amend the deprecated Gcode on this page with workarounds (if needed) and the last supported firmware version that will accept this Gcode.

For the technically minded, Gcode line endings are Unix Line Endings (**\n**), but will accept Windows Line Endings (**\r\n**), so you should not need to worry about converting between the two, but it is best practice to use Unix Line Endings where possible.

Fields

A RepRap Gcode is a list of fields that are separated by white spaces or line breaks. A field can be interpreted as a command, parameter, or for any other special purpose. It consists of one letter directly followed by a number, or can be only a stand-alone letter (Flag). The letter gives information about the meaning of the field (see the list below in this section). Numbers can be *integers* (128) or *fractional* numbers (12.42), depending on context. For example, an X coordinate can take integers (**X175**) or fractionals (**X17.62**), but selecting extruder number 2.76 would make no sense. In this description, the numbers in the fields are represented by **nnn** as a placeholder.

In RepRapFirmware, some parameters can be followed by more than one number, with colon used to separate them. Typically this is used to specify extruder parameters, with one value provided per extruder. If only one value is provided where a value is needed for each extruder, then that value is applied to all extruders.

Letter	Meaning
Gnnn	Standard GCode command, such as move to a point
Mnnn	RepRap-defined command, such as turn on a cooling fan
Tnnn	Select tool nnn. In RepRap, a tool is typically associated with a nozzle, which may be fed by one or more extruders.
Snnn	Command parameter, such as time in seconds; temperatures; voltage to send to a motor
Pnnn	Command parameter, such as time in milliseconds; proportional (Kp) in PID Tuning
Xnnn	A X coordinate, usually to move to. This can be an Integer or Fractional number.
Ynnn	A Y coordinate, usually to move to. This can be an Integer or Fractional number.
Znnn	A Z coordinate, usually to move to. This can be an Integer or Fractional number.
U,V,W	Additional axis coordinates (RepRapFirmware)
Innn	Parameter - X-offset in arc move; integral (Ki) in PID Tuning
Jnnn	Parameter - Y-offset in arc move
Dnnn	Parameter - used for diameter; derivative (Kd) in PID Tuning
Hnnn	Parameter - used for heater number in PID Tuning
Fnnn	Feedrate in mm per minute. (Speed of print head movement)
Rnnn	Parameter - used for temperatures
Qnnn	Parameter - not currently used
Ennn	Length of extrudate. This is exactly like X, Y and Z, but for the length of filament to consume.
Nnnn	Line number. Used to request repeat transmission in the case of communications errors.
*nnn	Checksum. Used to check for communications errors.

Comments

Gcode comments begin at a semicolon, and end at the end of the line:

```
N3 T0*57 ; This is a comment
N4 G92 E0*67
; So is this
N5 G28*22
```

Comments and white space will be ignored by your RepRap Printer. It's better to strip these out on the host computer before sending the Gcode to your printer, as this saves bandwidth.

Special fields

N: Line number

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	Yes	Yes	Yes	Yes	Yes	???	Yes	Yes	???	?	Yes	Yes

Example: N123

If present, the line number should be the first field in a line. For G-code stored in files on SD cards the line number is usually omitted.

If checking is supported, the RepRap firmware expects line numbers to increase by 1 each line, and if that doesn't happen it is flagged as an error. But you can reset the count using M110 (see below).

Although supported, usage of N in Machinekit is discouraged as it serves no purpose.

***: Checksum**

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	Yes	Yes	Yes	Yes	Yes	???	Yes	???	???	?	No	Yes

Example: *71

If present, the checksum should be the last field in a line, but before a comment. For G-code stored in files on SD cards the checksum is usually omitted.

If checking is supported, the RepRap firmware checks the checksum against a locally-computed value and, if they differ, requests a repeat transmission of the line of the given number.

Checking

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	Yes	Yes	Yes	Yes	Yes	???	Yes	???	???	?	No	Yes

Example: N123 [...G Code in here...] *71

The RepRap firmware checks the line number and the checksum. You can leave both of these out - RepRap will still work, but it won't do checking. You have to have both or neither though. If only one appears, it produces an error.

The checksum "cs" for a GCode string "cmd" (including its line number) is computed by exor-ing the bytes in the string up to and not including the * character as follows:

```
int cs = 0;
for(i = 0; cmd[i] != '*' && cmd[i] != NULL; i++)
    cs = cs ^ cmd[i];
cs &= 0xff; // Defensive programming...
```

and the value is appended as a decimal integer to the command after the * character.

Buffering

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	Yes	Yes	???	Yes	???	???	Yes	???	???	Yes	Yes	Yes

If buffering is supported, the RepRap firmware stores some commands in a ring buffer internally for execution. This means that there is no (appreciable) delay while a command is acknowledged and the next transmitted. In turn, this means that sequences of line segments can be plotted without a dwell between one and the next. As soon as one of these buffered commands is received it is acknowledged and stored locally. If the local buffer is full, then the acknowledgment is delayed until space for storage in the buffer is available. This is how flow control is achieved.

Typically, the following moving commands are buffered: G0-G3 and G28-G32. The Teacup Firmware buffers also some setting commands: G20, G21, G90 and G91. All other G, M or T commands are not buffered.

RepRapFirmware also implements an internal queue to ensure that certain codes (like M106) are executed in the right order and not when the last move has been added to the look-ahead queue. This feature is not available in RepRapFirmware-dc42.

When an unbuffered command is received it is stored, but it is not acknowledged to the host until the buffer is exhausted and then the command has been executed. Thus the host will pause at one of these commands until it has been done. Short pauses between these commands and any that might follow them do not affect the performance of the machine.

G-commands

G0 & G1: Move

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

- G0 : Rapid linear Move
- G1 : Linear Move

Usage

G0 Xnnn Ynnn Znnn Ennn Fnnn Snnn
G1 Xnnn Ynnn Znnn Ennn Fnnn Snnn

Parameters

*Not all parameters need to be used, but at least **one** has to be used*

Xnnn The position to move to on the X axis

Ynnn The position to move to on the Y axis

Znnn The position to move to on the Z axis

Ennn The amount to extrude between the starting point and ending point

Fnnn The feedrate per minute of the move between the starting point and ending point (if supplied)

Snnn Flag to check if an endstop was hit (**S1** to check, **S0** to ignore, **S2** see note, default is **S0**)¹

Examples

G0 X12 (*move to 12mm on the X axis*)

G0 F1500 (*Set the feedrate to 1500mm/minute*)

G1 X90.6 Y13.8 E22.4 (*Move to 90.6mm on the X axis and 13.8mm on the Y axis while extruding 22.4mm of material*)

The RepRap firmware spec treats G0 and G1 as the same command, since it's just as efficient as not doing so.²

Most RepRap firmwares do subtle things with feedrates.

```
1. G1 F1500
2. G1 X50 Y25.3 E22.4
```

In the above example, we set the feedrate to 1500mm/minute on line 1, then move to 50mm on the X axis and 25.3mm on the Y axis while extruding 22.4mm of filament between the two points.

```
1. G1 F1500
2. G1 X50 Y25.3 E22.4 F3000
```

However, in the above example, we set a feedrate of 1500 mm/minute on line 1, then do the move described above accelerating to a feedrate of 3000 mm/minute as it does so. The extrusion will accelerate along with the X and Y movement, so everything stays synchronized.

The RepRap spec treats the feedrate as simply another variable (like X, Y, Z, and E) to be linearly interpolated. This gives complete control over the acceleration and deceleration of the printer head in such a way that ensures that everything moves smoothly together, and the right volume of material is extruded at all points.³

To reverse the extruder by a given amount (for example to reduce its internal pressure while it does an in-air movement so that it doesn't dribble) simply use G0 or G1 to send an E value that is less than the currently extruded length.

Notes

¹Some firmwares allow for the RepRap to enable or disable the "sensing" of endstops during a move. Please check with whatever firmware you are using to see if they support the S parameter in this way, as damage may occur if you assume incorrectly. In RepRapFirmware, using the S1 or S2 parameter on a delta printer causes the XYZ parameters to refer to the individual tower motor positions instead of the head position, and to enable endstop detection as well if the parameter is S1.

²In the RS274NGC Spec, G0 is *Rapid Move*, which was used to move between the current point in space and the new point as quickly and efficiently as possible, and G1 is *Controlled Move*, which was used to move between the current point in space and the new point as precise as possible.

³Some firmwares may not support setting the feedrate inline with a move.

⁴RepRapFirmware provides an additional 'R1' parameter to tell the machine to go back to the coordinates a print was previously paused at. If this parameter is used and the code contains axis letters, an offset will be added to the pause coordinates (e.g. G1 R1 Z5).

Some older machines, CNC or otherwise, used to move faster if they did not move in a straight line. This is also true for some non-Cartesian printers, like delta or polar printers, which move easier and faster in a curve.

G2 & G3: Controlled Arc Move

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	Yes	Yes ¹	Yes	Yes	No	Yes	???	Yes	Experimental	Yes

Usage

G2 Xnnn Ynnn Innn Jnnn Ennn Fnnn (*Clockwise Arc*)

G3 Xnnn Ynnn Innn Jnnn Ennn Fnnn (*Counter-Clockwise Arc*)

Parameters

Xnnn The position to move to on the X axis

Ynnn The position to move to on the Y axis

Iinn The point in X space from the current X position to maintain a constant distance from

Jnnn The point in Y space from the current Y position to maintain a constant distance from

Eenn The amount to extrude between the starting point and ending point

Fnnn The feedrate per minute of the move between the starting point and ending point (if supplied)

Examples

G2 X90.6 Y13.8 I5 J10 E22.4 (Move in a Clockwise arc from the current point to point (X=90.6,Y=13.8), with a center point at (X=current_X+5, Y=current_Y+10), extruding 22.4mm of material between starting and stopping)

G3 X90.6 Y13.8 I5 J10 E22.4 (Move in a Counter-Clockwise arc from the current point to point (X=90.6,Y=13.8), with a center point at (X=current_X+5, Y=current_Y+10), extruding 22.4mm of material between starting and stopping)

Notes

¹In Marlin Firmware not implemented for **DELTA** and **SCARA** printers.

G4: Dwell

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Pause the machine for a period of time.

Parameters

Pnnn Time to wait, in milliseconds

Snnn Time to wait, in seconds (Only on Repetier, Marlin, Smoothieware, and RepRapFirmware 1.16 and later)

Example

G4 P200

In this case sit still doing nothing for 200 milliseconds. During delays the state of the machine (for example the temperatures of its extruders) will still be preserved and controlled.

On Marlin, Smoothie and RepRapFirmware, the "S" parameter will wait for seconds, while the "P" parameter will wait for milliseconds. "G4 S2" and "G4 P2000" are equivalent.

G6: Direct Stepper Move

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	No	No	No	No	No

Perform a direct, uninterpolated, and non-kinematic synchronized move of one or more steppers directly. Units may be linear (e.g., mm or inches on **DELTA**) or specified in degrees (**SCARA**). This command is useful for initialization, diagnostics, and calibration, and should be disabled on production equipment. This type of move can be potentially dangerous, especially for deltabots, so implementations should do their best to limit movement to prevent twerking and damaging the carriage assembly.

Parameters

Annn Stepper A position or angle

Bnnn Stepper B position or angle

Cnnn Stepper C position or angle

R Relative move flag

SCARA Examples

G6 A45 ; Move SCARA A stepper to the 45° position

G6 B20 R ; Move SCARA B stepper 20° counter-clockwise

DELTA Example

G6 C10 R ; Move DELTA C carriage up by 10mm

G10: Tool Offset

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	Yes	???	???	No	No

Usage

G10 Pnnn Xnnn Ynnn Znnn Rnnn Snnn¹

Parameters

Pnnn Tool number

Xnnn X offset

Ynnn Y offset

U,V,Wnnn U, V and W axis offsets⁵

Znnn Z offset²

Rnnn Standby temperature(s)

Snnn Active temperature(s)

Examples

G10 P2 X17.8 Y-19.3 Z0.0 (*sets the offset for tool (or in older implementations extrude head) 2 to the X, Y, and Z values specified*)
 G10 P1 R140 S205 (*set standby and active temperatures³ for tool 1*)

Remember that any parameter that you don't specify will automatically be set to the last value for that parameter. That usually means that you want explicitly to set Z0.0. RepRapFirmware will report the tool parameters if only the tool number is specified.

The R value is the standby temperature in °C that will be used for the tool, and the S value is its operating temperature. If you don't want the tool to be at a different temperature when not in use, set both values the same. See the T code (select tool) below. In tools with multiple heaters the temperatures for them all are specified thus: R100.0:90.0:20.0 S185.0:200.0:150.0 .

See also M585.

Notes

¹Marlin uses G10/G11 for executing a retraction/unretraction move. The RepRapPro version of Marlin supports G10 for tool offset. Smoothie uses G10 for retract and G10 Ln for setting workspace coordinates.

²It's usually a bad idea to put a non-zero Z value in as well unless the tools are loaded and unloaded by some sort of tool changer or are on independent carriages. When all the tools are in the machine at once they should all be set to the same Z height.

³If the absolute zero temperature (-273.15) is passed as active and standby temperatures, RepRapFirmware will only switch off the tool heater(s) without changing their preset active or standby temperatures. RepRapFirmware-dc42 does not support this setting.

⁴The NIST G-code standard (http://www.nist.gov/customcf/get_pdf.cfm?pub_id=823374) mentions an additional L parameter, which is ignored (except in smoothie). This command is subject to discussion.

⁵Tool offsets are applied after any X axis mapping has been performed. Therefore if for example you map X to U in your M563 command to create the tool, you should specify a U offset not an X offset. If you map X to both X and U, you can specify both offsets.

G10: Retract

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	Yes: 0.92	Yes	dc42,ch	No	???	???	No	Yes

Parameters

Snnn retract length (S1 = long retract, S0 = short retract = default) (Repetier only)

Example

G10

Retracts filament according to settings of M207 (Marlin, RepRapFirmware) or according to the S value (Repetier).

RepRapFirmware recognizes G10 as a command to set tool offsets and/or temperatures if the P parameter is present, and as a retraction command if it is absent.

G11: Unretract

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	Yes: 0.92	Yes	dc42,ch	No	???	???	No	Yes

Parameters

Snnn retract length (S1 = long retract, S0 = short retract = default) (Repetier only)

Example

G11

Unretracts/recovers filament according to settings of M208 (Marlin, RepRapFirmware) or according to the S value (Repetier).

G17..19: Plane Selection (CNC specific)

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	???	???	???	No	???	???	No	Yes	???	Yes	No	No

These codes set the current plane as follows:

- G17 : XY (default)
- G18 : ZX
- G19 : YZ

G20: Set Units to Inches

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	???	Yes	No	Yes

Example
G20

Units from now on are in inches.

G21: Set Units to Millimeters

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	???	Yes	Yes	Yes

Example
G21

Units from now on are in millimeters. (This is the RepRap default.)

G22 & G23: Firmware controlled Retract/Precharge

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	Yes	???	???	No	No

Usage
G22 ; Retract
G23 ; Unretract/Precharge

Relying on machine's firmware to execute extrusion retract/precharge move, instead of having slicer generating to E axis G1 movement. The retract/precharge length, velocity is handled by the machine firmware.

G28: Move to Origin (Home)

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes ¹

Parameters

This command can be used without any additional parameters.

X Flag to go back to the X axis origin

Y Flag to go back to the Y axis origin

Z Flag to go back to the Z axis origin

Examples

```
G28          ; Home all axes
G28 X Z     ; Home the X and Z axes
```

When the firmware receives this command, it quickly moves the specified axes (or all axes if none are given) to the endstops, backs away from each endstop by a short distance, and slowly bumps the endstop again to increase positional accuracy. This process, known as "*Homing*", is required to determine the position of the print carriage(s). Some firmware may even forbid movement away from endstops and other operations until the axes have been homed.

The **X**, **Y**, and **Z** parameters act only as flags. Any coordinates given are ignored. For example, G28 Z10 results in the same behavior as G28 Z. Delta printers cannot home individual axes, but must always home all three towers, so the **X Y Z** parameters are simply ignored on these machines.

Marlin firmware (version 1.1.0 and up) provides an option called `z_SAFE_HOMING` for printers that use a Z probe to home Z instead of an endstop. With this option, the XY axes are homed first, then the carriage moves to a position –usually the middle of the bed– where it can safely probe downward to home Z.

RepRapFirmware uses macro files to home either all axes or individual axes. If all axes are homed, the file `homea11.g` is processed. For individual axes the `homex.g`, `homey.g`, or `homez.g` file will be used. On Delta printers, **G28** command will always home all three towers by processing the `homedelta.g` file, regardless of any **X Y Z** parameters.

Because the behavior of **G28** is unspecified, it is recommended **not** to automatically include **G28** in your ending GCode. On a Cartesian this will result in damaging the printed object. If you need to move the carriage at the completion of a print, use **G0** or **G1**.

Notes

¹ MK4duo has a **B** parameter that tells the printer to return to the coordinates it was at before homing.

G29: Detailed Z-Probe

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	Yes: 0.91.7	No, see G32	Yes, 1.17 and later	Yes	???	???	Yes	Yes

This command uses a probe to measure the bed height at 3 or more points to determine its tilt and overall flatness. It then enables compensation so that the nozzle will remain parallel to the bed. The printer must be homed with **G28** before using this command.

Each firmware behaves differently and depends on the type of bed leveling that's been configured. For example, Marlin 1.0.2 provides 3 different types of automatic bed leveling (probe required) and a manual bed leveling option. See your firmware's documentation for the specific options available.

Usage

G29

G29 Snnn

Parameters

Snnn Firmware-dependent behavior

Pfile.csv Optional file name for bed height map file (RepRapFirmware only)

Examples

```
G29 ; Probe the bed and enable compensation
G29 S2 ; Special operation - see below
```

G29 Auto Bed Leveling in Marlin

Marlin 1.0.2 and earlier provides three options for automatic bed leveling:

- The 3-point method probes the bed at three points to produce a matrix, adjusting for a flat but tilted bed.
- The planar grid method (non-Delta) probes a grid pattern to produce a matrix by the "least-squares" method, adjusting for a flat but tilted bed.
- The bilinear grid method (Delta only) probes a grid pattern to produce a mesh, using bilinear interpolation to adjust for an uneven bed.

Marlin 1.1.0 and up allows the bilinear grid (i.e., "mesh") method to be used on all types of machines, not just deltas. ***This is the recommended method going forward.***

G29 Manual Bed Leveling in Marlin

Marlin firmware (version 1.0.2 and up) provides a `MESH_BED_LEVELING` feature that can be used to perform bed leveling on machines lacking a probe. This form of bed leveling compensates for uneven Z height across the surface of the bed using a mesh and bilinear interpolation.

Manual Bed Leveling Usage

```
G29 S1 ; Move to the first point and wait for a measurement
G29 S2 ; Store the current Z, move to the next point
G29 S3 Xn Yn Zn.nn ; Modify the Z height of a single point
```

Options for the S parameter

S0 Produces a mesh report

S1 Start probing mesh points

S2 Probe the next mesh point

S3 Xn Yn Zn.nn Manually modify a single point

S4 Zn.nn Set z offset. Positive away from bed, negative closer to bed.

G29 in Repetier firmware

Repetier firmware since v0.91 supports **G29** with the optional Snnn parameter as described below. Useful to simply detect the Z bed angle so you can manually readjust your bed and get it as close to in plane as possible. If you wish to apply automatic software Z plane compensation on Repetier, use **G32** instead with firmware 0.92.8 and above.

S0 Default value. Z bed heights are calculated at the measured points, relative to current Z position before issuing **G29**.

S1 Same as S0, except printer immediately moves to Z maximum position (Z max endstop required!), and calculates new Z maximum height. You must first issue G28 Z to home to Z maximum position before issuing **G29 Snnn** for this to work correctly, or the printer height will be invalid.

S2 Same as S1, except new calculated Z height is also stored to EEPROM.

G29 in RepRapFirmware

RepRapFirmware:

S0 (default if no S parameter) Probe the bed, save the height map in a file on the SD card, and activate bed compensation. The default folder for the height map file is `/sys` and the default file name is **heightmap.csv**.

S1 Load the height map from file and activate bed compensation. The default folder and filename as for S0.

S2 Clear bed height map

To define the grid, see M557.

G29.1: Set Z probe head offset

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	Yes	???	???	No	No

Example

```
G29.1 X30 Y20 Z0.5
```

Set the offset of the Z probe head. The offset will be subtracted from all probe moves.

G29.2: Set Z probe head offset calculated from toolhead position

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	Yes	???	???	No	No

Example: G29.2 Z0.0

Set the offset of the Z probe head. The offset will be subtracted from all probe moves. The calculated value is derived from the distance of the toolhead from the current axis zero point.

The user would typically place the toolhead at the zero point of the axis and issue the G29.2 command.

G30: Single Z-Probe

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	use G28 & G92	No	Yes	Yes	Yes	Yes	Yes	???	???	Yes	Yes ¹

Usage

G30 Pnnn Xnnn Ynnn Znnn Hnnn Snnn

Parameters

Pnnn Probe point number

Xnnn X coordinate

Ynnn Y coordinate

Znnn Z coordinate

Hnnn Height correction

Snnn Set parameter

Examples

G30

Examples (RepRapFirmware)

G30 ; Probe the bed at the current XY position. When the probe is triggered, set the Z coordinate to the probe trigger height.

G30 S-1 ; Probe the bed at the current XY position. When the probe is triggered, do not adjust the Z coordinate.

G30 P0 X20 Y50 Z-99999 ; Probe the bed at X20 Y50 and save the XY coordinates and the height error as point 0

G30 P3 X180 Y180 Z-99999 S4 ; Probe the bed at X180 Y180, save the XY coordinates and the height error as point 3 and calculate 4-point compensation or calibration

G30 P3 X180 Y180 Z-99999 S-1 ; As previous example but just report the height errors

In its simplest form probes bed at current XY location.

RepRapFirmware supports additional behaviour: if a Pn field is specified the probed X, Y, and Z values are saved as point n on the bed for calculating the offset plane or for performing delta printer calibration. If X, or Y, or Z values are specified (e.g. G30 P1 X20 Y50 Z0.3) then those values are used instead of the machine's current coordinates. A silly Z value (less than -9999.0) causes the machine to probe at the current point to get Z, rather than using the given value. If an S field is specified (e.g. G30 P1 Z0.3 S) the bed plane is computed for compensation and stored. The combination of these options allows for the machine to be moved to points using G1 commands, and then probe the bed, or for the user to position the nozzle interactively and use those coordinates. The user can also record those values and place them in a setup GCode file for automatic execution.

RepRapFirmware uses the value of the S parameter to specify what computation to perform. If the value is -1 then the Z offsets of all the points probed are printed, but no calibration is done. If the value is zero or not present, then this specifies that the number of factors to be calibrated is the same as the number of points probed. Otherwise, the value indicates the number of factors to be calibrated, which must be no greater than the number of points probed. In version 1.09, the number of factors may be 3, 4 or 5 when doing auto bed compensation on a Cartesian or CoreXY printer, and 3, 4, 6 or 7 when doing auto calibration of a Delta printer.

RepRapFirmware supports an optional H parameter, which is a height correction for that probe point. It allows for the Z probe having a trigger height that varies with XY position. The nominal trigger height of the Z probe (e.g. at bed centre) is declared in the Z parameter of the G31 command in the config.g file. When you probe using G30 and the probe triggers, the firmware will assume that the nozzle is at the nominal trigger height plus the value you have in the H parameter.

¹MK4duo Firmware support an optional parameter for Autocalibration Delta.

Usage

G30 Xnnn Ynnn Znnn Annn E R I D T S U

Parameters

Xnnn X coordinate
Ynnn Y coordinate
Znnn Z coordinate
Annn A Autocalibration width nnn precision
E Adjust Endstop
R Adjust Endstop & Delta Radius
I Adjust Tower
D Adjust Diagonal Rod
T Adjust Tower Radius
Sn Stows the probe if 1 (default=1)
Un <bool> with a non-zero value will apply the result to current zprobe_zoffset

G31: Set or Report Current Probe status

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	Yes: 0.91.7	Yes	Yes	No	???	???	No	No

Usage

G31 Pnnn Xnnn Ynnn Znnn Cnnn Snnn

Parameters

Pnnn Trigger value
Xnnn Probe X offset¹
Ynnn Probe Y offset¹
Znnn Trigger Z height
Cnnn Temperature coefficient²
Snnn Calibration temperature²
Tnnn (RepRapFirmware 1.17 and later) Z probe type to which these parameters apply, defaults to the current Z probe type as defined by M558 P parameter

Examples

G31 P500 Z2.6
G31 X16.0 Y1.5

When used on its own this reports whether the Z probe is triggered, or gives the Z probe value in some units if the probe generates height values. If combined with a Z and P field (example: G31 P312 Z0.7) this will set the Z height to 0.7mm when the Z-probe value reaches 312 when a G28 Z0 (zero Z axis) command is sent. The machine will then move a further -0.7mm in Z to place itself at Z = 0. This allows non-contact measuring probes to approach but not touch the bed, and for the gap left to be allowed for. If the probe is a touch probe and generates a simple 0/1 off/on signal, then G31 Z0.7 will tell the RepRap machine that it is at a height of 0.7mm when the probe is triggered.

In RepRapFirmware, separate G31 parameters may be defined for different probe types (i.e. 0+4 for switches, 1+2 for IR probes and 3 for alternative sensors). To specify which probe you are setting parameters for, send a M558 command to select the probe type before sending the G31 command, or use the T parameter.

In Repetier, G31 supports no parameters and simply prints the high/low status of the Z probe.

Notes

¹X and Y offsets of the Z probe relative to the print head (i.e. the position when the empty tool is selected) can be specified in RepRapFirmware. This allows you to calculate your probe coordinates based on the geometry of the bed, without having to correct them for Z probe X and Y offset.

²In RepRapFirmware, additional parameters 'S' (bed temperature in °C at which the specified Z parameter is correct, default is current bed temperature) and 'C' (temperature coefficient of Z parameter in mm/°C, default zero) can be set for the alternative (ultrasonic) sensor. This is useful for probes that are affected by temperature. This facility is deprecated and likely to be removed in a future version of RepRapFirmware.

G31: Dock Z Probe sled

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	???	No	No	No	???	???	Yes	Yes

G32: Probe Z and calculate Z plane

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No: See G29	Yes: 0.92.8	Yes	Yes	No	???	???	No	No

Usage

G32

G32 Snnn
G32 Snnn Pnnn

This command is implemented as a more sophisticated form of bed leveling which uses a transformation matrix or motorized correction.

Each firmware behaves differently. For example, Repetier firmware allows for motorized rotation of the bed whilst ReprapFirmware probes the bed with a transformation matrix.

Probe and calculate in Reprapfirmware

This command probes the bed at 3 or more pre-defined points (see M557) and updates transformation matrix for bed leveling compensation.

Parameters

Snnn Store transformation matrix after probing¹

Examples

G32
G32 S2

RepRapFirmware executes macro file **bed.g** if present instead of using the M557 coordinates.

Notes

¹Currently only Repetier firmware v0.92.8 and higher have working support for an optional Snnn parameter. The numeric value sets the behavior that occurs immediately after point probe and transformation matrix calculation. These are the values for Reprapfirmware:

S0 Default value. Transformation matrix is updated in RAM but is not stored to EEPROM. Z bed height not calculated.

S1 Transformation matrix is updated in RAM but is not stored to EEPROM. Printer immediately moves to Z maximum position (Z max endstop required!), and calculates new Z maximum height. You must first issue G28 to home to Z maximum position before issuing G32 Snnn for this to work correctly, or the printer height will be invalid.

S2 Same as S1, except transformation matrix and Z max heights are also stored to EEPROM.

S3 Transformation matrix is stored to EEPROM. Z bed height not calculated.

Probe and calculate in Repetier firmware

This command probes the bed at 3 or more pre-defined points and implements bed leveling compensation by either moving the A axis during printing (as with regular bed leveling, G29) or by tilting the bed with motors.

Parameters

Snnn Bed leveling method

Pnnn Bed correction method

The values for Snnn and Pnnn are as follows:

S0 This method measures at the 3 probe points and creates a plane through these points. If you have a really planar bed this gives the optimum result. The 3 points must not be in one line and have a long distance to increase numerical stability.

S1 This measures a grid. Probe point 1 is the origin and points 2 and 3 span a grid. We measure BED_LEVELING_GRID_SIZE points in each direction and compute a regression plane through all points. This gives a good overall plane if you have small bumps measuring inaccuracies.

S2 Bending correcting 4 point measurement. This is for cantilevered beds that have the rotation axis not at the side but inside the bed. Here we can assume no bending on the axis and a symmetric bending to both sides of the axis. So probe points 2 and 3 build the symmetric axis and point 1 is mirrored to 1m across the axis. Using the symmetry we then remove the bending from 1 and use that as plane.

P0 Use a rotation matrix. This will make z axis go up/down while moving in x/y direction to compensate the tilt. For multiple extruders make sure the height match the tilt of the bed or one will scratch. This is the default.

P1 Motorized correction. This method needs a bed that is fixed on 3 points from which 2 have a motor to change the height. The positions are defined in firmware by BED_MOTOR_1_X, BED_MOTOR_1_Y, BED_MOTOR_2_X, BED_MOTOR_2_Y, BED_MOTOR_3_X, BED_MOTOR_3_Y Motor 2 and 3 are the one driven by motor driver 0 and 1. These can be extra motors like Felix Pro 1 uses them or a system with 3 z axis where motors can be controlled individually like the Sparkcube does. This method requires a Z max endstop.

G32: Undock Z Probe sled

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	???	No	No	No	???	???	Yes	Yes

G33: Measure/List/Adjust Distortion Matrix

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	Yes: v0.92.8	No	No	No	???	???	Yes	No

Usage

G33
G33 Lnnn
G33 Rnnn

G33 Xnnn Ynnn Znnn

Parameters

L0 List distortion matrix in a report

R0 Reset distortion matrix

X<pos> Y<pos> Z<zCorrection> Set correction for nearest point

Examples

G33

G33 R0

When used with no parameters, G33 will measure a grid of points and store the distortion dips and valleys in the bed surface, and then enable software distortion correction for the first few or several layers. The values will be stored in EEPROM if enabled in firmware. You must previously have G28 homed, and your Z minimum/maximum height must be set correctly for this to work. Use the optional parameters to list, reset or modify the distortion settings. Distortion correction behavior can be later turned on or off by code M323.

G38.x Straight Probe (CNC specific)

G38.2 probe toward workpiece, stop on contact, signal error if failure

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
???	???	???	???	Yes: 1.1.0	???	Yes	No	???	???	Yes	No	No

G38.3 probe toward workpiece, stop on contact

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
???	???	???	???	Yes: 1.1.0	???	Yes	No	???	???	Yes	No	No

G38.4 probe away from workpiece, stop on loss of contact, signal error if failure

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
???	???	???	???	???	???	???	No	???	???	Yes	No	No

G38.5 probe away from workpiece, stop on loss of contact

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
???	???	???	???	???	???	???	No	???	???	Yes	No	No

G40: Compensation Off (CNC specific)

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
???	???	???	???	???	???	???	No	Yes	???	Yes	No	No

G40 turn cutter compensation off. If tool compensation was on the next move must be a linear move and longer than the tool diameter. It is OK to turn compensation off when it is already off.

G54..59: Coordinate System Select (CNC specific)

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
???	???	???	???	???	???	Yes	No	Yes	???	Yes	No	No

See linuxcnc.org (<http://linuxcnc.org/docs/html/gcode/g-code.html#gcode:g54-g59.3>) for more help

G60: save current position to slot

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
???	???	???	???	???	???	???	???	???	???	???	???	Yes

Usage

G60 Snn

Parameters

Snn <nn> specifies memory slot # (0-based) to save into (default 0)

G61: Apply/restore saved coordinates to the active extruder.

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
???	???	???	???	???	???	???	???	???	???	???	???	Yes

Usage

G61 Xnnn Ynnn Znnn Ennn Fnnn Snn

Parameters

Xnnn X coordinate

Ynnn Y coordinate

Znnn Z coordinate

Ennn E coordinate

Fnnn F Set Feedrate

Snn S specifies memory slot # (0-based)

G80: Cancel Canned Cycle (CNC specific)

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	???	???	???	???	???	???	No	???	???	Yes	No	No

It cancel canned cycle modal motion. G80 is part of modal group 1, so programming any other G code from modal group 1 will also cancel the canned cycle.

G90: Set to Absolute Positioning

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Example: G90

All coordinates from now on are absolute relative to the origin of the machine. (This is the RepRap default.)

G91: Set to Relative Positioning

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Example: G91

All coordinates from now on are relative to the last position. Note: RepRapFirmware latest revision firmware uses M83 to set the extruder to relative mode: extrusion is NOT set to relative by ReprapFirmware on G91: only X,Y and Z are set to relative. By contrast, Marlin (for example) DOES also set extrusion to relative on a G91 command, as well as setting X, Y and Z.

G92: Set Position

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Parameters

This command can be used without any additional parameters.

Xnnn new X axis position

Ynnn new Y axis position

Znnn new Z axis position

Ennn new extruder position

Example

G92 X10 E90

Allows programming of absolute zero point, by resetting the current position to the values specified. This would set the machine's X coordinate to 10, and the extrude coordinate to 90. No physical motion will occur.

A G92 without coordinates will reset all axes to zero.

G92.x: Reset Coordinate System Offsets (CNC specific)

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	???	???	???	???	???	Yes	No	???	???	Yes	No	No

- G92.1 - reset axis offsets to zero and set parameters 5211 - 5219 to zero. (X Y Z A B C U V W)
- G92.2 - reset axis offsets to zero.

G93: Feed Rate Mode (Inverse Time Mode) (CNC specific)

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
???	???	???	???	???	???	???	No	???	???	Yes	No	No

G93 is Inverse Time Mode. In inverse time feed rate mode, an F word means the move should be completed in (one divided by the F number) minutes. For example, if the F number is 2.0, the move should be completed in half a minute.

When the inverse time feed rate mode is active, an F word must appear on every line which has a G1, G2, or G3 motion, and an F word on a line that does not have G1, G2, or G3 is ignored. Being in inverse time feed rate mode does not affect G0 (rapid move) motions.

G94: Feed Rate Mode (Units per Minute) (CNC specific)

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
???	???	???	???	???	???	???	No	???	???	Yes	No	No

G94 is Units per Minute Mode. In units per minute feed mode, an F word is interpreted to mean the controlled point should move at a certain number of inches per minute, millimeters per minute, or degrees per minute, depending upon what length units are being used and which axis or axes are moving.

G100: Calibrate floor or rod radius

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
No	No	No	No	No	Yes: 0.92	No	No	No	???	???	No	No

Parameters

X Flag to set floor for X axis

Y Flag to set floor for Y axis

Z Flag to set floor for Z axis

Rnnn Radius to add

Examples

G100 X Y Z (*set floor for argument passed in. Number ignored and may be absent.*)

G100 R5 (*Add 5 to radius. Adjust to be above floor if necessary*)

G100 R0 (*Set radius based on current z measurement. Moves all axes to zero*)

G130: Set digital potentiometer value

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
No	No	No	No	No	No	No	No	No	Yes	???	No	No

Example: G130 X10 Y18 Z15 A20 B12

Set the digital potentiometer value for the given axes. This is used to configure the current applied to each stepper axis. The value is specified as a value from 0-127; the mapping from current to potentiometer value is machine specific.

G131: Remove offset

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
No	No	No	No	No	Yes: 0.91	No	No	No	???	???	No	No

G132: Calibrate endstop offsets

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
No	No	No	No	No	Yes: 0.91	No	No	No	???	???	No	No

G133: Measure steps to top

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
No	No	No	No	No	Yes: 0.91	No	No	No	???	???	No	No

G161: Home axes to minimum

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
No	Yes	No	No	No	No	No	No	No	Yes	???	No	No

Parameters

X Flag to home the X axis to its minimum position

Y Flag to home the Y axis to its minimum position

Z Flag to home the Z axis to its minimum position

Fnnn Desired feedrate for this command

Example

G161 X Y Z F1800

Instruct the machine to home the specified axes to their minimum position. Similar to G28, which decides on its own in which direction to search endstops.

G162: Home axes to maximum

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	Yes	No	No	No	No	No	No	Yes	???	No	No

Parameters

X Flag to home the X axis to its maximum position

Y Flag to home the Y axis to its maximum position

Z Flag to home the Z axis to its maximum position

Fnnn Desired feedrate for this command

Example

G162 X Y Z F1800

Instruct the machine to home the specified axes to their maximum position.

M-commands

M0: Stop or Unconditional stop

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	Yes	Yes	No	Yes	No	No	Yes	Yes	???	Yes	No	Yes

Parameters

This command can be used without any additional parameters.

Pnnn Time to wait, in milliseconds¹

Snnn Time to wait, in seconds²

Example

M0

The RepRap machine finishes any moves left in its buffer, then shuts down. All motors and heaters are turned off. It can be started again by pressing the reset button on the master microcontroller, although this step is not mandatory on RepRapFirmware. See also M1, M112.

The Marlin Firmware does wait for user to press a button on the LCD, or a specific time. "M0 P2000" waits 2000 milliseconds, "M0 S2" waits 2 seconds.

RepRapFirmware executes macro file **stop.g** before everything is turned off. Apart from that, RepRapFirmware (v1.09n-ch) accepts an extra 'H' parameter, whose value must be non-zero, to keep all heaters active. This is what Duet Web Control v1.07 sends to cancel a paused print.

Notes

¹Not available in RepRapFirmware, but as a work-around G4 can be run before M0.

²Only available on Marlin.

M1: Sleep or Conditional stop

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	???	No	Yes	No	No	Yes	No	???	Yes	No	Yes

Example

M1

The RepRap machine finishes any moves left in its buffer, then shuts down. All motors and heaters are turned off. It can still be sent G and M codes, the first of which will wake it up again. See also M0, M112.

The Marlin Firmware does the same as M0.

If Marlin is emulated in RepRapFirmware, this does the same as M25 if the code was read from a serial or Telnet connection, else the macro file **sleep.g** is run before all heaters and drives are turned off.

M2: Program End

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	Yes	No	No	No	???	No	No	Yes	Yes	No	No

Example: M2

Teacup firmware does the same as M84.

M3: Spindle On, Clockwise (CNC specific)

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	Yes	No	No	Yes	Yes	Yes	No	???	Yes	No	No

Parameters

Snnn Spindle RPM

Example

M3 S4000

The spindle is turned on with a speed of 4000 RPM.

Teacup firmware turn extruder on (same as M101).

RepRapFirmware interprets this code only if a Roland mill has been configured.

In Repetier-Firmware in laser mode you need S0..255 to set laser intensity. Normally you use S255 to turn it on full power for moves. Laser will only fire during G1/2/3 moves and in laser mode (M452).

M4: Spindle On, Counter-Clockwise (CNC specific)

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	Yes	No	No	No	???	Yes	No	No

Example: M4 S4000

The spindle is turned on with a speed of 4000 RPM.

M5: Spindle Off (CNC specific)

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	Yes	No	No	Yes	Yes	No	No	???	Yes	No	No

Example: M5

The spindle is turned off.

Teacup firmware turn extruder off (same as M103).

M6: Tool change

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	Yes	No	No	No	???	No	No	???	???	No	No

Example: M6

M7: Mist Coolant On (CNC specific)

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	use M106	No	No	No	No	No	No	???	Yes	No	No

Example: M7

Mist coolant is turned on (if available)

Teacup firmware turn on the fan, and set fan speed (same as M106).

M8: Flood Coolant On (CNC specific)

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	use M106	No	No	No	No	No	No	???	Yes	No	No

Example: M8

Flood coolant is turned on (if available)

M9: Coolant Off (CNC specific)

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	use M106	No	No	No	No	No	No	???	Yes	No	No

Example: M9

All coolant systems are turned off.

M10: Vacuum On (CNC specific)

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	use M106	No	No	No	No	No	No	???	???	No	No

Example: M10

Dust collection vacuum system turned on.

M11: Vacuum Off (CNC specific)

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	use M106	No	No	No	No	No	No	???	???	No	No

Example: M11

Dust collection vacuum system turned off.

M17: Enable/Power all stepper motors

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	(automatic)	No	Yes	No	Yes	No	No	???	???	Yes	Yes

Example: M17

M18: Disable all stepper motors

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	use M2	No	call M84	No	Yes	Yes	No	Yes	???	Yes	call M84

Parameters

This command can be used without any additional parameters.¹

X X axis

Y Y axis

Z Z axis

E Extruder drive(s)²

Examples

M18

M18 X E0

Disables stepper motors and allows axes to move 'freely.'

Notes

¹Some firmware implementations do not support parameters to be passed, but at least Marlin and RepRapFirmware do.

²RepRapFirmware allows stepper motors to be disabled selectively. For example, M18 X E0:2 will disable the X, extruder 0 and extruder 2 motors.

M20: List SD card

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	Yes	Yes	Yes	Yes	Yes	Yes	No	???	???	No	Yes

Parameters

This command can be used without any additional parameters.

Snnn Output style¹

Pnnn Directory to list²

Examples

M20

M20 S2 P/gcodes/subdir

This code lists all files in the root folder or G-code directory of the SD card to the serial port. One name per line, like:

```
ok
SQUARE.G
SQCOM.G
ZCARRI~2.GCO
CARRIA~1.GCO
```

On Marlin, a file list response is usually encapsulated. Standard configurations of RepRapFirmware mimic this style in emulation mode:

```
Begin file list:
SQUARE.G
ZCARRI~2.GCO
End file list
ok
```

If RepRapFirmware emulates no firmware compatibility, a typical response looks like:

```
GCode files:
"Traffic cone.g","frog.gcode","calibration piece.g"
```

Note that some firmwares list file names in upper case, but - when sent to the M23 command (below) they must be in lower case. Teacup and RepRapFirmware have no such trouble and accept both. RepRapFirmware always returns long filenames in the case in which they are stored.

Notes

¹If the S2 parameter is used on RepRapFirmware, then the file list is returned in JSON format as a single array called "files" with each name that corresponds to a subdirectory preceded by an asterisk, and the directory is returned in variable "dir". Example:

```
M20 S2 P/gcodes
{"dir":"\\/gcodes","files":["4-piece-1-2-3-4.gcode","Hinged_Box.gcode","Hollow_Dodecahedron_190.gcode","*Calibration pieces"]}
```

²This parameter is only supported by RepRapFirmware and defaults to the 0:/gcodes directory, which is the directory that printable gcode files are normally stored in.

M21: Initialize SD card

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	Yes	Yes	Yes	Yes	Yes	Yes	No	???	???	No	Yes

Parameters

Pnnn SD card number (RepRapFirmware only, default 0)

Examples

M21

M21 P1

The specified SD card is initialized. If an SD card is loaded when the machine is switched on, this will happen by default. SD card must be initialized for the other SD functions to work.

M22: Release SD card

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	Yes	Yes	Yes	Yes	No	Yes	No	???	???	No	Yes

Parameters

Pnnn SD card number (RepRapFirmware only, default 0)

Examples

M22

M22 P1

The specified SD card is released, so further (accidental) attempts to read from it are guaranteed to fail. Helpful, but not mandatory before removing the card physically.

M23: Select SD file

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	Yes	Yes	Yes	Yes	Yes	Yes	No	???	???	No	Yes

Example

M23 filename.gco

The file specified as filename.gco (8.3 naming convention is supported) is selected ready for printing. RepRapFirmware supports long filenames as well as 8.3 format.

M24: Start/resume SD print

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	Yes	Yes	Yes	Yes	Yes	Yes	No	???	???	Yes	Yes

Example

M24

The machine prints from the file selected with the M23 command. If the print was previously paused with M25, printing is resumed from that point. To restart a file from the beginning, use M23 to reset it, then M24.

When this command is used to resume a print that was paused, RepRapFirmware runs macro file **resume.g** prior to resuming the print.

M25: Pause SD print

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	Yes	Yes	Yes	Yes	Yes	Yes	No	???	???	Yes	Yes

Example

M25

The machine pauses printing at the current position within the file. To resume printing, use M24. Do not use this code to pause the print in a G-code file, use M226 instead.

Prior to pausing, RepRapFirmware runs macro file **pause.g**. This allows the head to be moved away from the print, filament to be retracted, etc.

M26: Set SD position

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	Yes	Yes	Yes	aborts	Yes	No	???	???	No	Yes

Parameters

Snnn File position in bytes

Example

M26

Set SD position in bytes (M26 S12345).

M27: Report SD print status

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	Yes	Yes	Yes	Yes	Yes	No	???	???	No	Yes

Example

M27

Report SD print status.

Marlin and recent forks of RepRapFirmware report the number of bytes processed in this format, which can be processed by Pronterface:

```
SD printing byte 2134/235422
```

If no file is being printed, only this message is reported:

```
Not SD printing.
```

M28: Begin write to SD card

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	Yes	Yes	Yes	Yes	Yes	No	???	???	No	Yes

Example

M28 filename.gco

File specified by filename.gco is created (or overwritten if it exists) on the SD card and all subsequent commands sent to the machine are written to that file.

M29: Stop writing to SD card

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	Yes	Yes	Yes	No	Yes	No	???	???	No	Yes

Example

M29 filename.gco

File opened by M28 command is closed, and all subsequent commands sent to the machine are executed as normal.

M30: Delete a file on the SD card

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	Yes	Yes	Yes	Yes	Yes	No	???	Yes	No	Yes

Example: M30 filename.gco

filename.gco is deleted.

M30 in grbl

M30 exchange pallet shuttles and end the program. Pressing cycle start will start the program at the beginning of the file.

M31: Output time since last M109 or SD card start to serial

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	No	No	No	No	???	???	No	Yes

Example

M31

The response looks like:

```
echo:54 min, 38 sec
```

M32: Select file and start SD print

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	No	Yes	Yes	No	???	???	No	No

Example

M32 filename.gco

It can be used when printing from SD card and does the same as M23 and M24.

tba available in marlin(14/6/2014)

M33: Get the long name for an SD card file or folder

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	No	No	No	No	???	???	No	No

Get the long name for a file or folder on the SD card from a dos path. Introduced in Marlin firmware 1.1.0 September 2015.

M33: Stop and Close File and save restart.gcode

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	???	???	???	???	???	???	???	???	???	???	???	Yes

Stop the printing from SD and save all position in restart.gcode for restart printing in future

M34: Set SD file sorting options

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	No	No	No	No	???	???	No	No

Enable and disable SD card file-sorting, and/or set the folder sorting order. Proposed by Marlin firmware, May 2015.

M35: Upload firmware NEXTION from SD

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	???	???	???	???	???	???	???	???	???	???	???	Yes

M36: Return file information

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	No	???	No	No

Example

M36 filename.gco

Returns information for the specified SD card file in JSON format. A sample response is:

```
{ "err":0, "size":457574, "height":4.00, "layerHeight":0.25, "filament":[6556.3], "generatedBy":"Slic3r 1.1.7 on 2014-11-09 at 17:11:32" }
```

The "err" field is zero if successful, nonzero if the file was not found or an error occurred while processing it. The "size" field should always be present if the operation was successful. The presence or absence of other fields depends on whether the corresponding values could be found by reading the file. The "filament" field is an array of the filament lengths required from each spool. The size is in bytes, all other values are in mm. The fields may appear in any order, and additional fields may be present.

If the file name parameter is not supplied and a file on the SD card is currently being printed, then information for that file is returned including additional field "fileName". This feature is used by the web interface and by PanelDue, so that if a connection is made when a file is already being printed, the name and other information about that file can be shown.

M37: Simulation mode

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	No	No

Used to switch between printing mode and simulation mode. Simulation mode allows the electronics to compute an accurate printing time, taking into account the maximum speeds, accelerations etc. that are configured.

M37 S1 enters simulation mode. All G and M codes will not be acted on, but the time they take to execute will be calculated.

M37 S0 leaves simulation mode.

M37 with no S parameter prints the time taken by the simulation, from the time it was first entered using M37 S1, up to the current point (if simulation mode is still active) or the point that the simulation was ended (if simulation mode is no longer active).

M38 Compute SHA1 hash of target file

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	No	No

Used to compute a hash of a file on the SD card. Examples:

M37 gcodes/myfile.g

Cannot find file

M37 www/reprap.htm

91199139dbfadac15a18cfb962dfd4853db83999

Returns a hexadecimal string which is the SHA1 of the file. If the file cannot be found, then the string "Cannot find file" is returned instead.

M40: Eject

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	No	???	???	No	No

If your RepRap machine can eject the parts it has built off the bed, this command executes the eject cycle. This usually involves cooling the bed and then performing a sequence of movements that remove the printed parts from it. The X, Y and Z position of the machine at the end of this cycle are undefined (though they can be found out using the M114 command, q.v.).

See also M240 and M241 below.

M41: Loop

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	No	???	???	No	No

Example: M41

If the RepRap machine was building a file from its own memory such as a local SD card (as opposed to a file being transmitted to it from a host computer) this goes back to the beginning of the file and runs it again. So, for example, if your RepRap is capable of ejecting parts from its build bed then you can set it printing in a loop and it will run and run. Use with caution - the only things that will stop it are:

1. When you press the reset button,
2. When the build material runs out (if your RepRap is set up to detect this), and
3. When there's an error (such as a heater failure).

M42: Switch I/O pin

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	Yes	Yes	Yes	No	Yes	No	No	???	No	Yes

Parameters

Pnnn Pin number

Snnn Pin value

Example

M42 P7 S255

M42 switches a general purpose I/O pin. Use M42 Px Sy to set pin x to value y, when omitting Px the LEDPIN will be used.

In Teacup, general purpose devices are handled like a heater, see M104.

In RepRapFirmware, the S field may be in the range 0..1 or 0..255. The pin reference is an internal firmware reference named "digital pin", see Duet pinout. It maps on different connector pins depending the hardware. On Duet 0.6 and 0.8.5 hardware using pre-1.16 firmware, the supported pin numbers and their names on the expansion connector are:

Duet M42 P value to Expansion Port Pin Mapping

P	Name	Expansion Port Pin
16	TXD1	11
17	RXD1	12
18	TXD0	13
19	RXD0	14
20	TWD1	35
21	TWCK1	36
23	PA14	10
36	PC4	18
52	AD14	41
67	PB16	32

In firmware 1.16, the pin numbering has changed.

Duet 0.6 and 0.8.5 v1.16+ M42 P value to Expansion Port Pin Mapping

P	Name	Expansion Port Pin
60	PA10/RXD0	14
61	PA11/TXD0	13
62	PA12/RXD1	12
63	PA13/TXD1	11
64	PA14/RTS1	10
65	PB12/TWD1	35
66	PB13/TWCK1	36
67	PB16/DAC1*	32
68	PB21/AD14	41
69	PC4	18

- Also used as CS signal on external SD card socket

Duet WiFi v1.16+ M42 P value to Expansion Port Pin Mapping

P	Signal Name	Expansion Connector Label
60	CS5	CS5
61	CS6	E3_STOP
62	CS7	E4_STOP
63	CS8	E5_STOP

See Using servos and controlling unused I/O pins (https://duet3d.com/wiki/Using_servos_and_controlling_unused_I/O_pins) for all pin definitions.

Pre-1.16 example:

```
M42 P20 S1 ;set the connector pin 35 to high.
```

On RADDs hardware running RepRapFirmware-dc42, the supported Arduino Due pin numbers and their names are:

5 TIOA6, 6 PWML7, 39 PWMH2, 58 AD3, 59 AD2, 66 DAC0, 67 DAC1, 68 CANRX0, 69 CANTX0, 70 SDA1, 71 SCL1, 72 RX LED, 73 TX LED.

See also M583.

M43: Stand by on material exhausted

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	No	???	???	No	No

Example: M43

If your RepRap can detect when its material runs out, this decides the behaviour when that happens. The X and Y axes are zeroed (but not Z), and then the machine shuts all motors and heaters off except the heated bed, the temperature of which is maintained. The machine will still respond to G and M code commands in this state.

M43: Pin report and debug

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	No	No	No	No	???	???	No	No

Usage
M43 En Pnnn Wn In
Parameters

- En Enable / disable background endstop monitoring
- Pnnn Pin to read or watch. If omitted, read/watch all pins
- Wn bool watch pins -reporting changes- until reset, click, or M108
- In bool Flag to ignore pin protection

M48: Measure Z-Probe repeatability

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	No	No	No	No	???	???	No	Yes

Parameters

Pnnn number of points
Xnnn position on the X axis
Ynnn position on the Y axis
Vnnn verbosity
E engage
Lnnn legs of travel

As with G29, the E flag causes the probe to stow after each probe.

M70: Display message

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	see M117	No	???	see M117	No	Yes	???	see M117	see M117

Example:

```
M70 P200 Message
```

Instruct the machine to display a message on its interface LCD. **P** is the time to display message for.

M72: Play a tone or song

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	see M300	No	No	see M300	No	Yes	???	No	see M300

Example: M72 P2

Instruct the machine to play a preset song. Acceptable song IDs are machine specific. P is the ID of the song to play.

M73: Set build percentage

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	No	Yes	???	No	No

Example: M73 P50

Instruct the machine that the build has progressed to the specified percentage. The machine is expected to display this on it's interface board. If the percentage is exactly 0, then a Build Start Notification is sent. If the percentage is exactly 100, then a Build End notification is sent.

M80: ATX Power On

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	automatic	Yes	Yes	Yes	No	Yes	No	???	???	No	Yes

Example
M80

Turns on the ATX power supply from standby mode to fully operational mode. No-op on electronics without standby mode.

Note: some firmwares, like Teacup, handle power on/off automatically, so this is redundant there. Also, see RAMPS wiring for ATX on/off (<http://forums.reprap.org/read.php?219,132664>)

M81: ATX Power Off

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	automatic	Yes	Yes	Yes	No	Yes	No	???	???	Yes	Yes

Example
M81

Turns off the ATX power supply. Counterpart to M80.

For redeem, adding 'P' will quit the daemon (redeem). Adding parameter 'R' will restart the daemon.

M82: Set extruder to absolute mode

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	Yes	Yes	Yes	Yes	Yes	Yes	No	???	???	No	Yes

Example
M82

Makes the extruder interpret extrusion as absolute positions.

This is the default in repetier.

M83: Set extruder to relative mode

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	Yes	Yes	Yes	Yes	Yes	Yes	No	???	???	No	Yes

Example
M83

Makes the extruder interpret extrusion values as relative positions.

M84: Stop idle hold

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	Yes	Yes	Yes	Yes	Yes	Yes	No	???	???	Yes	Yes

Parameters

This command can be used without any additional parameters.

Innn Reset flags¹

Example
M84

Stop the idle hold on all axis and extruder. In some cases the idle hold causes annoying noises, which can be stopped by disabling the hold. Be aware that by disabling idle hold during printing, you will get quality issues. This is recommended only in between or after printjobs.

On Marlin, Repetier and RepRapFirmware, M84 can also be used to configure or disable the idle timeout. For example, "M84 S10" will idle the stepper motors after 10 seconds of inactivity. "M84 S0" will disable idle timeout; steppers will remain powered up regardless of activity.

Notes

¹RepRapFirmware-dc42 and other firmware may not support this parameter.

M85: Set inactivity shutdown timer

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	Yes	Yes	Yes	No	No	No	???	???	No	Yes

Example: M85 S30

Set inactivity shutdown timer with parameter S<seconds>. "M85 S0" will disable the inactivity shutdown time (default)

M92: Set axis_steps_per_unit

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	Yes	Yes	Yes	Yes	Yes	No	???	???	Yes	Yes

Parameters

Xnnn Steps per unit for the X drive

Ynnn Steps per unit for the Y drive

Znnn Steps per unit for the Z drive

Ennn Steps per unit for the extruder drive(s)

Examples

M92 X87.489 Y87.489 Z87.489

M92 E420:420

Allows programming of steps per unit (usually mm) for motor drives. These values are reset to firmware defaults on power on, unless saved to EEPROM if available (M500 in Marlin) or in the configuration file (config.g in RepRapFirmware). Very useful for calibration.

RepRapFirmware will report the current steps/mm if you send M92 without any parameters.

M93: Send axis_steps_per_unit

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	Yes	No	???	No	Use M92	No	???	???	No	No

M98: Call Macro/Subprogram

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	No	???	No	No

Parameters

Pnnn Macro filename

Example

M98 Pmymacro.g

Runs the macro in the file mymacro.g. In conventional G Codes for CNC machines the P parameter normally refers to a line number in the program itself (P2000 would run the Macro starting at line O2000, say). For RepRap, which almost always has some sort of mass storage device inbuilt, it simply refers to the name of a GCode file that is executed by the G98 call. That GCode file does not need to end with an M99 (return) as the end-of-file automatically causes a return. Macro calls cannot usually be nested or be recursive; i.e. you can't call a macro from a macro, although RepRapFirmware explicitly supports this.

RepRapFirmware also allows the filename to include a path to a subdirectory. For relative paths, the default folder is /sys, but some implementations may check the /macros directory too. Absolute file paths are supported on RepRapFirmware as well.

M99: Return from Macro/Subprogram

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	No	???	No	No

Example

M99

Returns from an M98 call.

RepRapFirmware closes the currently active macro file. If a nested macro is being run, RepRapFirmware goes up one stack level.

M98: Get axis_hysteresis_mm

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	No	???	???	No	No

Deprecated - clashes with the G Code standard M98 above

Example: M98

Report the current hysteresis values in mm for all of the axis.

Proposed for Marlin

M99: Set axis_hysteresis_mm

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	No	???	???	No	No

Deprecated - clashes with the G Code standard M99 above

Example: M99 X<mm> Y<mm> Z<mm> E<mm>

Allows programming of axis hysteresis. Mechanical pulleys, gears and threads can have hysteresis when they change direction. That is, a certain number of steps occur before movement occurs. You can measure how many mm are lost to hysteresis and set their values with this command. Every time an axis changes direction, these extra mm will be added to compensate for the hysteresis.

Proposed for Marlin

M101: Turn extruder 1 on (Forward), Undo Retraction

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	Yes	No	No	No	No	No	No	???	???	No	No

in Teacup firmware: If a DC extruder is present, turn that on. Else, undo filament retraction, which means, make the extruder ready for extrusion. Complement to M103.

in BFB/RapMan firmware: Turn extruder on (forward/filament in).

in other firmwares: Deprecated. Regarding filament retraction, see M227, M228, M229.

M102: Turn extruder 1 on (Reverse)

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	No	???	???	No	No

In BFB/RapMan firmware: Turn extruder on Reverse (Still to add)

In other firmwares: Deprecated.

M103: Turn all extruders off, Extruder Retraction

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	Yes	No	No	No	No	No	No	???	???	No	No

In Teacup firmware: If a DC extruder is present, turn that off. Else, retract the filament in the hope to prevent nozzle drooling. Complement to M101.

In BFB/RapMan firmware: Turn extruder off.

In other firmwares: Deprecated. Regarding extruder retraction, see M227, M228, M229.

M104: Set Extruder Temperature

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	???	Yes	Yes

Parameters

Snnn Target temperature

Example

M104 S190

Set the temperature of the current extruder to 190°C and return control to the host immediately (*i.e.* before that temperature has been reached by the extruder). Duet-dc42 and other firmware also supports the optional T parameter (as generated by slic3r) to specify which tool the command applies to. See also M109.

This is deprecated because temperatures should be set using the G10 and T commands (q.v.).

Deprecation is subject to discussion. --Traumflug 11:33, 19 July 2012 (UTC)

M104 in Teacup Firmware

In Teacup Firmware, M104 can be additionally used to handle all devices using a temperature sensor. It supports the additional P parameter, which is a zero-based index into the list of sensors in config.h. For devices without a temp sensor, see M106.

Example: M104 P1 S100

Set the temperature of the device attached to the second temperature sensor to 100 °C.

M105: Get Extruder Temperature

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	???	Yes	Yes

Parameters

This command can be used without any additional parameters.

Rnnn Response sequence number¹

Snnn Response type¹

Examples

M105

M105 S2

Request the temperature of the current extruder and the build base in degrees Celsius. The temperatures are returned to the host computer. For example, the line sent to the host in response to this command looks like:

```
ok T:201 B:117
```

Expansion/generalization of M105 to be considered using S1 parameter as noted in Pronterface I/O Monitor

In Repetier you can add X0 to get raw values as well:

```
M105 X0
==> 11:05:48.910 : T:23.61 /0 @:0 T0:23.61 /0 @0:0 RAW0:3922 T1:23.89 /0 @1:0 RAW1:3920
```

Recent versions of RepRapFirmware also report the current and target temperatures of all active heaters.

Notes

¹These parameters are only supported by RepRapFirmware, which returns a JSON-formatted response if parameter S2 or S3 is specified. Additionally, parameter Rnn may be provided, where nn is the sequence number of the most recent G-code response that the client has already received. M105 S2 is equivalent to M408 S0, and M105 S3 is equivalent to M408 S2. Usage of these forms of M105 is deprecated, please use M408 instead.

M106: Fan On

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	???	???	Yes	Yes

Parameters

Pnnn Fan number (optional, defaults to 0)²

Snnn Fan speed (0 to 255; RepRapFirmware also accepts 0.0 to 1.0))

Extra Parameters

Innn Invert signal, or disable fan¹

Fnnn Set fan PWM frequency, in Hz¹

Lnnn Set minimum fan speed (0 to 255 or 0.0 to 1.0)¹

Bnnn Blip time - fan will be run at full PWM for this number of seconds when started from standstill¹

Hnn:nn:nn... Select heaters monitored when in thermostatic mode¹

Rnnn Restore fan speed to the value it has when the print was paused¹

Tnnn Set thermostatic mode trigger temperature¹

Examples

M106 S127

M106 P1 I1 S87¹

M106 P1 T45 H1:2¹

M106 P2 B0.1 L0.05¹

The first example turns on the default cooling fan at half speed. The second one inverts the cooling fan signal of the second fan and sets its value to 1/3 of its maximum. The third one sets the second fan to a thermostatic fan for heaters 1 and 2 (e.g. the extruder heaters in a dual-nozzle machine) such that the fan will be on when either hot end is at or above 45C.

Mandatory parameter 'S' declares the PWM value (0-255). M106 S0 turns the fan off. In some implementations like RepRapFirmware the PWM value may alternatively be specified as a real fraction: M106 S0.7.

Notes

¹These parameters are only available in RepRapFirmware.

²Marlin only supports fan 0, all values above 0 will be interpreted as 0

M106 in RepRapFirmware

If an S parameter is provided but no other parameter is present, then the speeds of the print cooling fans associated with the current tool will be set (see the F parameter in the M563 command). If no tool is active then the speed of Fan 0 will be set. Either way, the speed is remembered so that it can be recalled using the R2 parameter (see below).

If no S parameter is given but the R1 parameter is used, the fan speed when the print was last paused will be set. If the R2 parameter is used, then the speeds of the print cooling fans associated with the current tool will be set to the remembered value (see above).

The T and H parameters allow a fan to be configured to operate in thermostatic mode, for example to use one of the fan channels to control the hot end fan. In this mode the fan will be fully on when the temperature of any of the heaters listed in the H parameter is at or above the trigger temperature set by the T parameter, and off otherwise. Thermostatic mode can be disabled using parameter H-1.

The B parameter sets the time for which the fan will be operated at full PWM when started from cold, to allow low fan speeds to be used. A value of 0.1 seconds is usually sufficient.

The L parameter defines the minimum PWM value that is usable with this fan. If a lower value is commanded that is not zero, it will be rounded up to this value.

The I parameter causes the fan output signal to be inverted if its value is greater than zero. This makes the cooling fan output suitable for feeding the PWM input of a 4-wire fan via a diode. If the parameter is present and zero, the output is not inverted. If the I parameter is negative then in RRF 1.16 and later the fan is disabled, which frees up the pin for use as a general purpose I/O pin that can be controlled using M42.

M106 in Teacup Firmware

Additionally to the above, Teacup Firmware uses M106 to control general devices. It supports the additional P parameter, which is an zero-based index into the list of heaters/devices in config.h.

Example: M106 P2 S255

Turn on device #3 at full speed/wattage.

Note: When turning on a temperature sensor equipped heater with M106 and M104 at the same time, temperature control will override the value given in M106 quickly.

Note well: **The ambiguous text in the note above needs to be reworded by someone who knows the actual functioning. Below is my interpretation based on language use, not practical experience or code inspection.**

Note: *If M104 is (or becomes) active on a heater (or other device) with a feedback sensor it will correct any M106 initiated control output value change in the time it takes for the PID (of other feedback) loop to adjust it back to minimum error. It may not be easy to observe a change in the temperature (process value) due to this brief change in the control value*

M107: Fan Off

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	???	???	Yes	Yes

Deprecated in Teacup firmware and in RepRapFirmware. Use M106 S0 instead.

M108: Cancel Heating (Marlin)

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	No	No	No	No	???	???	No	Yes

Breaks out of an M109 or M190 wait-for-temperature loop, continuing the print job. Use this command with caution! If cold extrusion prevention is enabled (see M302) and the temperature is too low, this will start "printing" without extrusion. If cold extrusion prevention is disabled and the hot-end temperature is too low, the extruder may jam.

This command was introduced in Marlin 1.1.0. As with other emergency commands [e.g., M112] this requires the host to leave space in the command buffer, or the command won't be executed until later.

M108: Set Extruder Speed (BFB)

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	No	???	???	No	No

Sets speed of extruder motor. (Deprecated in FiveD firmware, see M113)

M109: Set Extruder Temperature and Wait

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	Yes	not needed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	???	Yes	Yes

Parameters

Snnn minimum target temperature, waits until heating

Rnnn maximum target temperature, waits until cooling (Sprinter)

Rnnn accurate target temperature, waits until heating and cooling (Marlin)

Example

M109 S215

M109 in Teacup

Not needed. To mimic Marlin behaviour, use M104 followed by M116.

M109 in Marlin, Sprinter (ATmega port), RepRapFirmware

Set extruder heater temperature in degrees celsius and wait for this temperature to be achieved.

Example: M109 S185

RepRapFirmware also supports the optional T parameter (as generated by slic3r) to specify which tool the command refers to (see below).

M109 in Sprinter (4pi port)

Parameters: **S** (optional), set target temperature value. If not specified, waits for the temperature set by M104. **R** (optional), sets target temperature range maximum value.

Example: M109 S185 R240 //sets extruder temperature to 185 and waits for the temperature to be between 185 - 240.

If you have multiple extruders, use **T** or **P** parameter to specify which extruder you want to set/wait.

Another way to do this is to use G10.

M109 in MakerBot

Example: M109 S70 T0

Sets the target temperature for the current build platform. S is the temperature to set the platform to, in degrees Celsius. T is the platform to heat.

M110: Set Current Line Number

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	Yes	not needed	No	Yes	Yes	Yes	Yes	No	???	???	Yes	Yes

Parameters

Nnnn Line number

Example

M110 N123

This example sets the current line number to 123. Thus the expected next line after this command will be 124.

M111: Set Debug Level

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	Yes	Debug	No	Yes	Yes	No	Yes	No	???	???	Yes	Yes

Parameters

Pnnn Debug module¹

Snnn Debug on/off

Examples

M111 S6

M111 P1 S1

Enable or disable debugging features in the firmware. The implementation may look different per firmware.

Notes

¹This parameter is only available in RepRapFirmware.

M111 in RepRapFirmware

RepRapFirmware allows debugging to be set for each module. If the optional 'P' parameter is not specified, debugging will be enabled for all modules. For a list of modules, send M111 S1 P15.

M111 in Repetier

Set the level of debugging information transmitted back to the host to level 6. The level is the OR of three bits:

```

#define DEBUG_ECHO (1<<0)
#define DEBUG_INFO (1<<1)
#define DEBUG_ERRORS (1<<2)
:

```

Thus 6 means send information and errors, but don't echo commands. (This is the RepRap default.)

For firmware that supports ethernet and web interfaces M111 S9 will turn web debug information on without changing any other debug settings, and M111 S8 will turn it off. Web debugging usually means that HTTP requests will be echoed to the USB interface, as will the responses.

M112: Emergency Stop

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	Yes	Yes	No	Yes	Yes	Yes	Yes	No	???	???	Yes	Yes

Example
M112

Any moves in progress are immediately terminated, then RepRap shuts down. All motors and heaters are turned off. It can be started again by pressing the reset button on the master microcontroller. See also M0 and M1.

M113: Set Extruder PWM

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	Yes	No	No	No	No	No	No	No	???	???	No	No

Example: M113

Set the PWM for the currently-selected extruder. On its own this command sets RepRap to use the on-board potentiometer on the extruder controller board to set the PWM for the currently-selected extruder's stepper power. With an S field:

M113 S0.7

it causes the PWM to be set to the S value (70% in this instance). M113 S0 turns the extruder off, until an M113 command other than M113 S0 is sent.

M114: Get Current Position

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	???	Yes	Yes

Example
M114

This causes the RepRap machine to report its current X, Y, Z and E coordinates to the host.

For example, the machine returns a string such as:

ok C: X:0.00 Y:0.00 Z:0.00 E:0.00

In Marlin first 3 numbers is the position for the planner. The other positions are the positions from the stepper function. This helps for debugging a previous stepper function bug.

X:0.00 Y:0.00 RZ:0.00 LZ:0.00 Count X:0.00 Y:0.00 RZ:41.02 LZ:41.02

M115: Get Firmware Version and Capabilities

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	???	Yes	Yes

Parameters
This command can be used without any additional parameters.
Pnnn Electronics type¹

Examples
M115
M115 P2

Request the Firmware Version and Capabilities of the current microcontroller The details are returned to the host computer as key:value pairs separated by spaces and terminated with a linefeed.

sample data from firmware:

```
ok PROTOCOL_VERSION:0.1 FIRMWARE_NAME:FiveD FIRMWARE_URL:http%3A//reprap.org MACHINE_TYPE:Mendel EXTRUDER_COUNT:1
```

This M115 code is inconsistently implemented, and should not be relied upon to exist, or output correctly in all cases. An initial implementation was committed to svn for the FiveD Reprap firmware on 11 Oct 2010. Work to more formally define protocol versions is currently (October 2010) being discussed. See M115_Keywords for one draft set of keywords and their meanings. See the M408 command for a more comprehensive report on machine capabilities supported by RepRapFirmware.

Notes

¹This parameter is supported only in RepRapFirmware and can be used tell the firmware about the hardware on which it is running. If the P parameter is present then the integer argument specifies the hardware being used. The following are currently supported:

```
M115 P0 Automatic board type selection if supported, or default if not
M115 P1 Duet 0.6
M115 P2 Duet 0.7
M115 P3 Duet 0.85
```

M116: Wait

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	Yes	Yes	No	No	Yes	No	Yes	No	Yes	???	Yes	No

Parameters

This command can be used without any additional parameters.¹

Pnnn Tool number

Hnnn Heater number

Cnnn Chamber number

Examples

M116

M116 P1

Wait for *all* temperatures and other slowly-changing variables to arrive at their set values if no parameters are specified. See also M109.

Notes

¹Most implementations don't support any parameters, but RepRapFirmware version 1.04 and later supports an optional 'P' parameter that is used to specify a tool number. If this parameter is present, then the system only waits for temperatures associated with that tool to arrive at their set values. This is useful during tool changes, to wait for the new tool to heat up without necessarily waiting for the old one to cool down fully.

Recent versions of RepRapFirmware also allow a list of the heaters to be specified using the 'H' parameter, and if the 'C' parameter is present, this will indicate that the chamber heater should be waited for.

M117: Get Zero Position

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	Yes	No	No	No	No	No	No	No	see M70	???	No	No

Example: M117

This causes the RepRap machine to report the X, Y, Z and E coordinates *in steps not mm* to the host that it found when it last hit the zero stops for those axes. That is to say, when you zero X, the *x* coordinate of the machine when it hits the X endstop is recorded. This value should be 0, of course. But if the machine has drifted (for example by dropping steps) then it won't be. This command allows you to measure and to diagnose such problems. (E is included for completeness. It doesn't normally have an endstop.)

M117: Display Message

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	Yes	Yes	Yes	No	No	???	Yes	Yes

Example

M117 Hello World

This causes the given message to be shown in the status line on an attached LCD. The above command will display Hello World. If RepRapFirmware is used and no LCD is attached, this message will be reported on the web interface.

M118: Negotiate Features

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	No	???	???	No	No

Example: M118 P42

This M-code is for future proofing. NO firmware or hostware supports this at the moment. It is used in conjunction with M115's FEATURES keyword.

See Protocol_Feature_Negotiation for more info.

M119: Get Endstop Status

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	Yes	Yes	Yes	Yes	Yes	Yes	No	???	???	Yes	Yes

Example

M119

Returns the current state of the configured X, Y, Z endstops. Takes into account any 'inverted endstop' settings, so one can confirm that the machine is interpreting the endstops correctly.

In redeem, M119 can also be used to invert end stops.

Example

M119 X1 1

This will invert end stop X1 (Inverted means switch is connected in Normally Open state (NO))

M120: Push

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	Yes	Yes	No	???	???	No	No

Example

M120

Push the state of the RepRap machine onto a stack. Exactly what variables get pushed depends on the implementation (as does the depth of the stack - a typical depth might be 5). A sensible minimum, however, might be

1. Current feedrate, and
2. Whether moves (and separately extrusion) are relative or absolute

RepRapFirmware calls this automatically when a macro file is run. In addition to the variables above, it pushes the following values on the stack:

1. Current feedrate
2. Extruder positions

M121: Pop

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	Yes	Yes	No	???	???	No	No

Example

M121

Recover the last state pushed onto the stack.

M120: Enable endstop detection

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	No	No	No	No	???	???	No	Yes

M121: Disable endstop detection

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	No	No	No	No	???	???	No	Yes

M122: Diagnose

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	No	No

Example M122

Sending an M122 causes the RepRap to transmit diagnostic information, for example via a USB serial link.

If RepRapFirmware is used and debugging is enabled for the Network module, this will also print LWIP stats to the host via USB.

M123: Tachometer value

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	No	???	???	No	No

Sending an M123 causes the RepRap to transmit filament tachometer values from all extruders.

M124: Immediate motor stop

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	No	???	???	No	No

Immediately stops all motors.

M126: Open Valve

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	Yes	No	No	Yes	No	No	No	No	Yes	???	No	Yes

Example: M126 P500

Open the extruder's valve (if it has one) and wait 500 milliseconds for it to do so.

M126 in MakerBot

Example: M126 T0

Enables an extra output attached to a specific toolhead (e.g. fan)

M127: Close Valve

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	Yes	No	No	Yes	No	No	No	No	Yes	???	No	Yes

Example: M127 P400

Close the extruder's valve (if it has one) and wait 400 milliseconds for it to do so.

M127 in MakerBot

Example: M127 T0

Disables an extra output attached to a specific toolhead (e.g. fan)

M128: Extruder Pressure PWM

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	No	No	No	No	???	???	No	Yes

Example: M128 S255

PWM value to control internal extruder pressure. S255 is full pressure.

M129: Extruder pressure off

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	No	No	No	No	???	???	No	Yes

Example: M129 P100

In addition to setting Extruder pressure to 0, you can turn the pressure off entirely. P400 will wait 100ms to do so.

M130: Set PID P value

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	Yes	No	see M301	No	see M301	No	No	???	???	see M301	see M301

Parameters

Pnnn heater number**Snnn** proportional (Kp)

Example

M130 P0 S8.0 ; Sets heater 0 P factor to 8.0

Teacup can control multiple heaters with independent PID controls. For the default shown at

https://github.com/Traumflug/Teacup_Firmware/blob/master/config.default.h, heater 0 is the extruder (P0), and heater 1 is the bed (P1).

Teacup's PID proportional units are in pwm/255 counts per quarter C, so to convert from counts/C, you would divide by 4. Conversely, to convert from count/qC to count/C, multiply by 4. In the above example, S=8 represents a Kp=8*4=32 counts/C.

M131: Set PID I value

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	Yes	No	see M301	No	see M301	No	No	???	???	see M301	see M301

Parameters

Pnnn heater number**Snnn** integral (Ki)

Example

M131 P1 S0.5 ; Sets heater 1 I factor to 0.5

Teacup's PID integral units are in pwm/255 counts per (quarter C*quarter second), so to convert from counts/qCqs, you would divide by 16.

Conversely, to convert from count/qCqs to count/Cs, multiply by 16. In the above example, S=0.5 represents a Ki=0.5*16=8 counts/Cs.

M132: Set PID D value

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	Yes	No	see M301	No	See M301	see M301	No	Yes	???	see M301	see M301

Parameters

Pnnn heater number**Snnn** derivative (Kd)

Example

M132 P0 S24 ; Sets heater 0 D factor to 24.0

Teacup's PID derivative units are in pwm/255 counts per (quarter degree per 2 seconds), so to convert from counts/C, you would divide by 4.

Conversely, to convert from count/qC to count/C, multiply by 8. In the above example, S=24 represents a Kd=24*8=194 counts/(C/s).

M132 in MakerBot

Example: M132 X Y Z A B

Loads the axis offset of the current home position from the EEPROM and waits for the buffer to empty.

M133: Set PID I limit value

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	Yes	No	see M301	No	No	No	No	Yes	???	see M301	see M301

Parameters

Pnnn heater number**Snnn** integral limit (Ki)

Example

M133 P1 S264 ; Sets heater 1 I limit value to 264

Teacup's PID integral limit units are in quarter-C*quarter-seconds, so to convert from C-s, you would multiply by 16. Conversely, to convert from qC*qs to C*s, divide by 16. In the above example, S=264 represents an integral limit of 16.5 C*s.

M133 in MakerBot

Example: M133 T0 P500

Instruct the machine to wait for the toolhead to reach its target temperature. T is the extruder to wait for. P if present, sets the time limit.

M134: Write PID values to EEPROM

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	Yes	No	No	No	No: See M504	see M500	No	Yes	???	No	No

Example: M134

M134 in MakerBot

Example: M134 T0 P500

Instruct the machine to wait for the platform to reach its target temperature. T is the platform to wait for. P if present, sets the time limit.

M135: Set PID sample interval

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	Yes	???	No	No

Parameters

Snnn Heat sample time in seconds

Example

M135 S300

Set the PID to measure temperatures and calculate the power to send to the heaters every 300ms.

M135 in MakerBot

Example: M135 T0

Instructs the machine to change its toolhead. Also updates the State Machine's current tool_index. T is the toolhead for the machine to switch to and the new tool_index for the state machine to use.

M136: Print PID settings to host

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	Debug	No	No	No	No	see M301	No	???	???	No	No

Example: M136 P1 # print heater 0 PID parameters to host

M140: Set Bed Temperature (Fast)

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	???	Yes	Yes

Parameters

Snnn Target temperature

Hnnn Heater number¹

Example

M140 S55

Set the temperature of the build bed to 55°C and return control to the host immediately (*i.e.* before that temperature has been reached by the bed). There is an optional R field that sets the bed standby temperature: M140 S65 R40.

RepRapFirmware allows the bed heater to be switched off if the absolute negative temperature (-273.15) is passed as target temperature. In this case the current bed temperature is not affected¹:

```
M140 S-273.15
```

Recent versions of RepRapFirmware also provide an optional 'H' parameter to set the hot bed heater number. If no heated bed is present, a negative value may be specified to disable it.

M141: Set Chamber Temperature (Fast)

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	uses M104	No	No	No	No	Yes	Yes	???	???	No	No

Parameters

Snnn Target temperature

Hnnn Heater number¹

Examples

M141 S30

M141 H0

Set the temperature of the chamber to 30°C and return control to the host immediately (*i.e.* before that temperature has been reached by the chamber).

Notes

¹This parameter is only available in RepRapFirmware.

M142: Holding Pressure

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	No	???	???	No	No

Example: M142 S1

Set the holding pressure of the bed to 1 bar.

The holding pressure is in bar. For hardware which only has on/off holding, when the holding pressure is zero, turn off holding, when the holding pressure is greater than zero, turn on holding.

M143: Maximum heater temperature

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	No	No

Parameters

H Heater number (RepRapFirmware 1.17 and later, default 1 which is normally the first hot end)

S Maximum temperature

Examples

M143 S275 ; set the maximum temperature of the hot-end to 275°C

M143 H0 S125 ; set the maximum bed temperature to 125C

The default maximum temperature for all heaters was 300°C prior to RepRapFirmware version 1.13, and 262°C from 1.13 onwards. From RepRapFirmware 1.17 onwards, the default maximum temperatures are 262C for extruders and 125C for the bed.

When the temperature of the heater exceeds this value, countermeasures will be taken.

M144: Bed Standby

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	No	No

Example

M144

Switch the bed to its standby temperature. M140 turns it back to its active temperature; no need for any arguments for that use of M140.

M146: Set Chamber Humidity

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	No	???	???	No	No

Parameters

Rnnn Relative humidity in percent

Example

M146 R60

Set the relative humidity of the chamber to 60% and return control to the host immediately (*i.e.* before that humidity has been reached by the chamber).

M149: Set temperature units

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	No	???	???	No	No

Parameters

C Flag to treat temperature as degrees Celsius**K** Flag to treat temperature as Kelvin

Example

M149 K

It affects the S or R values in the codes M104, M109, M140, M141, M143, M190 and G10. The default is M149 C.

M150: Set display color

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	No	No	No	No	???	???	No	Yes

Parameters

Rnnn red**Unnn** green**Bnnn** blue

Example

M150 R255 U128 B192

Set BlinkM Color via I2C. Range for values: 0-255

M155: Automatically send temperatures

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes: 1.1.0	Yes	No	No	No	???	???	No	Yes

Parameters

Snnn enable sending temperatures = 1, disable = 0

Example

M155 S1

Hosts normally monitor printer temperatures by sending a M105 every x seconds. This not only adds traffic, but also only works while printer is not blocked by waiting commands. So frequency more depends on frequency you can send new commands and creates extra traffic. As a solution, firmware can be told to automatically send temperatures every second. This function is disabled by default for best compatibility with existing hosts. To indicate the availability of this function, M115 should add a extra line

Cap:AUTOREPORT_TEMP:1

so hosts know about the presence of the function.

M160: Number of mixed materials

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	No	???	???	No	No

Example: M160 S4

This command has been superseded by the tool definition command M563 (see below).

Set the number of materials, N, that the current extruder can handle to the number specified. The default is 1.

When N >= 2, then the E field that controls extrusion requires N values separated by colons ":" after it like this:

```
M160 S4
G1 X90.6 Y13.8 E2.24:2.24:2.24:15.89
G1 X70.6 E0:0:0:42.4
G1 E42.4:0:0:0
```

The second line moves straight to the point (90.6, 13.8) extruding a total of 22.4mm of filament. The mix ratio for the move is 0.1:0.1:0.1:0.7.

The third line moves back 20mm in X extruding 42.4mm of filament.

The fourth line has no physical effect.

M163: Set weight of mixed material

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes: RC7	Yes: 0.92	No	Use M567	No	???	???	No	No

Parameters

Snnn extruder number**Pnnn** weight

Set weight for this mixing extruder drive.

M164: Store weights

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes: RC7	Yes: 0.92	No	No	No	???	???	No	No

Parameters

Snnn virtual extruder number**Pnnn** store to eeprom (P0 = no, P1 = yes)

Store weights as virtual extruder S.

M165: Set multiple mix weights

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes: RC7	No:	No	No	No	???	???	No	No

Parameters ABCDHI

A A[factor] Mix factor for extruder stepper 1**B** B[factor] Mix factor for extruder stepper 2**C** C[factor] Mix factor for extruder stepper 3**D** D[factor] Mix factor for extruder stepper 4**H** H[factor] Mix factor for extruder stepper 5**I** I[factor] Mix factor for extruder stepper 6

- Set multiple mix factors for a mixing extruder.
- Factors that are left out will be set to 0.
- All factors together must add up to 1.0.

M190: Wait for bed temperature to reach target temp

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No: See M116	Yes	Yes	Yes	Yes	Yes	Yes	???	???	Yes	Yes

Parameters

Snnn minimum target temperature, waits until heating**Rnnn** accurate target temperature, waits until heating and cooling (Marlin)

Example

M190 S60

This will wait until the bed temperature reaches 60 degrees, printing out the temperature of the hot end and the bed every second.

M191: Wait for chamber temperature to reach target temp

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	1.17 and later	Yes	???	???	No	No

Example: M191 P60

Set the temperature of the build chamber to 60 °C and wait for the temperature to be reached.

M200: Set filament diameter

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	Yes	Yes	see M404	Yes	???	???	No	Yes

Without parameters loads default grid, and with specified extension attempts to load the specified grid. If not available will not modify the current grid. If Z was saved with the grid file, it will load the saved Z with the grid.

M200 Dm.mmm sets the filament diameter to m.mmm millimeters. It is used with 'volumetric calibration' and G-code generated for an ideal 1.128mm diameter filament, which has a volume of 1mm³ per millimeter. The intention is to be able to generate filament-independent g-code. (See Triffid_Hunter's_Calibration_Guide#Optional:_Switch_to_volumetric_E_units and <http://wooden-mendel.blogspot.com/2011/09/volumetric-stage-two.html> for more information.)

M200 D0 or M200 D1.128 ; reset E multiplier to 1, since $\sqrt{1/\pi} \cdot 2 = 1.128$

See also Gcode#M119:_Get_Endstop_Status

Question: what does a firmware do with filament diameter? Has this an effect on how much an E command moves the extruder motor? -- Traumflug 11:34, 14 October 2012 (UTC) Yes, Marlin uses this to set a 'volumetric_multiplier' by which the E-steps of a move are scaled in the planner. DaveX (talk) 16:44, 12 April 2014 (PDT) Smoothie implements the same thing as Marlin --Arthurwolf (talk) 05:23, 10 November 2014 (PST)

M201: Set max printing acceleration

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	Yes	Yes	Yes	No	Yes	No	???	???	Yes	Yes

Parameters

Xnnn Acceleration for X axis

Ynnn Acceleration for Y axis

Znnn Acceleration for Z axis

Ennn Acceleration for extruder drives

Example

M201 X1000 Y1000 Z100 E2000

Sets the acceleration that axes can do in units/second² for print moves. For consistency with the rest of G Code movement this should be in units/(minute²), but that gives really silly numbers and one can get lost in all the zeros. So for this we use seconds.

RepRapFirmware expects these values to be in mm/s².

M202: Set max travel acceleration

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	???	Yes	Yes	No	No	No	???	???	???	Yes

in units/s² for travel moves (M202 X1000 Y1000) Unused in Marlin!!

M203: Set maximum feedrate

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	???	Yes	Yes	Yes	Yes	No	???	???	???	Yes

Parameters

Xnnn Maximum feedrate for X axis

Ynnn Maximum feedrate for Y axis

Znnn Maximum feedrate for Z axis

Ennn Maximum feedrate for extruder drives

Example

M203 X6000 Y6000 Z300 E10000

Sets the maximum feedrates that your machine can do in mm/min (Marlin uses mm/sec).

M203 Repetier

Set temperture monitor to Sx.

M204: Set default acceleration

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	Yes	Yes	Yes	Yes	No	No	???	???	???	Yes

S normal moves T filament only moves (M204 S3000 T7000) in mm/sec² also sets minimum segment time in ms (B20000) to prevent buffer underruns and M20 minimum feedrate

Marlin notes: After Mar11-2015, the M204 options have changed in Marlin:

P = Printing moves

R = Retract only (no X, Y, Z) moves

T = Travel (non printing) moves

The command "M204 P800 T3000 R9000" set the acceleration for printing movements to 800mm/s², for travels to 3000mm/s² and for retracts to 9000mm/s².

M204 Repetier

M204 X[Kp] Y[Ki] Z[Kd] -

Set PID parameter. Values are 100*real value.

M205: Advanced settings

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	Yes	Yes	Yes	Yes	see M566	No	???	???	???	Yes

Sprinter and Marlin:

minimum travel speed S=while printing T=travel only, B=minimum segment time X= maximum xy jerk, Z=maximum Z jerk, E=maximum E jerk

Sprinter / Marlin Example:

M205 X30 Z5 ; Set X/Y Jerk to 30mms, Z jerk to 5mms

Smoothieware uses a different algorithm: [1] (https://onehosshay.wordpress.com/2011/09/24/improving_grbl_cornering_algorithm/)

X<xy junction deviation> Z<z junction deviation> S<minimum planner speed>, Z junction deviation only applies to z only moves, 0 disables junction deviation for Z, -1 uses global junction deviation

Smoothie example:

M205 X0.05 ; set X/Y Junction Deviation

M205 Repetier

Output EEPROM settings.

M206: Offset axes

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	Yes	Yes	No	Yes	Yes	No	???	???	Yes	Yes

Parameters

Xnnn X axis offset

Ynnn Y axis offset

Znnn Z axis offset

Example

M206 X10.0 Y10.0 Z-0.4

The values specified are added to the endstop position when the axes are referenced. The same can be achieved with a G92 right after homing (G28, G161).

With Marlin firmware, this value can be saved to EEPROM using the M500 command.

A similar command is G10, aligning these two is subject to discussion.

With Marlin 1.0.0 RC2 a negative value for z lifts(!) your printhead.

M206 in Repetier: Set eeprom value

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	Yes	No	No	No	???	???	No	No

M206 T[type] P[pos] [Sint(long) [Xfloat] Set eeprom value

Example: M206 T3 P39 X19.9

Set Jerk to 19.9

M207: Calibrate z axis by detecting z max length

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	???	No	No	No	???	???	No	No

Example: M207

After placing the tip of the nozzle in the position you expect to be considered Z=0, issue this command to calibrate the Z axis. It will perform a z axis homing routine and calculate the distance traveled in this process. The result is stored in EEPROM as z_max_length. For using this calibration method the machine must be using a Z MAX endstop.

This procedure is usually more reliable than mechanical adjustments of a Z MIN endstop.

M207: Set retract length

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	No	Yes	Yes	No	???	???	No	Yes

Parameters

Snnn positive length to retract, in mm

Rnnn positive or negative additional length to un-retract, in mm (RepRapFirmware only)

Fnnn retraction feedrate, in mm/min

Tnnn feedrate for un-retraction if different from retraction, mm/min (RepRapFirmware 1.16 and later only)

Znnn additional zlift/hop

Example

M207 S4.0 F2400 Z0.075

Sets the retract length used by the G10 and G11 commands, stays in mm regardless of M200 setting

M208: Set axis max travel

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	No	No

Parameters

Snnn Whether to set the axis minimum¹

Xnnn X axis limit

Ynnn Y axis limit

Znnn Z axis limit

Example

M208 X250 Y210 Z180

The values specified set the software limits for axis travel in the positive direction.

RepRapPro's version of Marlin uses M208 this way. Send M503 to see the current values. On Marlin, the value can be saved to EEPROM using the M500 command.

Notes

¹With RepRapFirmware on a Cartesian printer, you can also use this command to specify software limits for axis travel in the negative direction, by adding parameter S1. The axis limits you set are also the positions assumed when an endstop is triggered.

```
M208 X200 Y200 Z90; set axis maxima
M208 X-5 Y0 Z0 S1 ; set axis minimum
```

M208: Set unretract length

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	No	Yes	See M207	No	???	???	No	Yes

Parameters

Snnn positive length surplus to the M207 Snnn, in mm

Fnnn feedrate, in mm/sec

Sets recover=unretract length.

M209: Enable automatic retract

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	Yes	No	No	No	No	???	No	Yes

Example: M209 S1

This boolean value S 1=true or 0=false enables automatic retract detect if the slicer did not support G10/11: every normal extrude-only move will be classified as retract depending on the direction.

M210: Set homing feedrates

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	No	???	???	No	No

Example: M210 X1000 Y1500

Set the feedrates used for homing to the values specified in mm per minute.

M211: Disable/Enable software endstops

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Use M564	No	???	???	No	No

The boolean value S 1=enable or 0=disable controls state of software endstop.

The boolean value X, Y or Z 1=max endstop or 0=min endstop selects which endstop is controlled.

Example: M211 X1 Y1 Z1 S0

Disables X,Y,Z max endstops

Example: M211 X0 S1

Enables X min endstop

Example: M211

Prints current state of software endstops.

M212: Set Bed Level Sensor Offset

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes*	No	No	Use G31	No	???	???	No	Yes

This G-Code command is known to be available in the newer versions of PrintrBot's branch of Marlin. It may not be available in other firmware.

Example: M212 Z-0.2

Set the Z home to 0.2 mm lower than where the sensor says Z home is. This is extremely useful when working with printers with hard-to-move sensors, like the PrintrBot Metal Plus.

PrintrBot suggests that the user make minor (0.1-0.2) adjustments between attempts and immediately executes M500 & M501 after setting this.

M218: Set Hotend Offset

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	No	No	Use G10	No	???	???	No	Yes

Sets hotend offset (in mm): T<extruder_number> X<offset_on_X> Y<offset_on_Y>.

Example: M218 T1 X50 Y0.5

M220: Set speed factor override percentage

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	Yes	Yes	Yes	Yes	Yes	Yes	No	???	???	Yes	Yes

Parameters

Snnn Speed factor override percentage (0..100 or higher)

Example

M220 S80

Sets the speed factor override percentage.

M221: Set extrude factor override percentage

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	Yes	Yes	Yes	Yes	Yes	Yes	No	???	???	Yes	Yes

Parameters

Snnn Extrude factor override percentage (0..100 or higher), default 100%**Dnnn** Extruder drive number (RepRapFirmware only), default 0

Example

M221 S70

M221 S95 D1

Sets extrude factor override percentage. In the case of RepRapFirmware, sets the extrusion factor percentage for the specified extruder drive only.

M220: Turn off AUX V1.0.5

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	No	???	???	No	No

M221: Turn on AUX V1.0.5

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	No	???	???	No	No

M222: Set speed of fast XY moves

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	No	???	???	No	No

M223: Set speed of fast Z moves

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	No	???	???	No	No

M224: Enable extruder during fast moves

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	No	???	???	No	No

M225: Disable on extruder during fast moves

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	No	???	???	No	No

M226: Gcode Initiated Pause

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	Yes	???	???	No	No

Example

M226

Initiates a pause in the same way as if the pause button is pressed. That is, program execution is stopped and the printer waits for user interaction. This matches the behaviour of M1 in the NIST RS274NGC G-code standard (http://www.nist.gov/manuscript-publication-search.cfm?pub_id=823374) and M0 in Marlin firmware.

M226: Wait for pin state

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	Yes	No	see M577	No	???	???	No	Yes

Parameters

Pnnn pin number**Snnn** pin state

Example

M226 P2 S1

Wait for a pin to be in some state.

M227: Enable Automatic Reverse and Prime

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	No	???	???	No	No

Example: M227 P1600 S1600

P and S are steps.

"Reverse and Prime" means, the extruder filament is retracted some distance when not in use and pushed forward the same amount before going into use again. This shall help to prevent drooling of the extruder nozzle. Teacup firmware implements this with M101/M103.

M228: Disable Automatic Reverse and Prime

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	No	???	???	No	No

Example: M228

See also M227.

M229: Enable Automatic Reverse and Prime

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	No	???	???	No	No

Example: M229 P1.0 S1.0

P and S are extruder screw rotations. See also M227.

M230: Disable / Enable Wait for Temperature Change

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	No	???	???	No	No

Example: M230 S1

S1 Disable wait for temperature change S0 Enable wait for temperature change

M231: Set OPS parameter

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	Yes	No	No	No	???	???	No	No

M231 S[OPS_MODE] X[Min_Distance] Y[Retract] Z[Backslash] F[ReatrcMove]

M232: Read and reset max. advance values

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	Yes	No	No	No	???	???	No	No

M240: Trigger camera

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	No	No	No	No	???	???	No	Yes

Example: M240

Triggers a camera to take a photograph. (Add to your per-layer GCode.)

M240: Start conveyor belt motor / Echo off

	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
Support	No	Debug: Echo off	No	No	No	No	No	No	???	???	No	No

Example: M240

The conveyor belt allows to start mass production of a part with a rewrap.

Echoing may be controlled in some firmwares with M111

M241: Stop conveyor belt motor / echo on

	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
Support	No	Debug: Echo on	No	No	No	No	No	No	???	???	No	No

Example: M241

Echoing may be controlled in some firmwares with M111

M245: Start cooler

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	No	???	???	No	No

Example: M245

used to cool parts/heated-bed down after printing for easy remove of the parts after print

M246: Stop cooler

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	No	???	???	No	No

Example: M246

M250: Set LCD contrast

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	No	No	No	No	No	???	No	Yes

Example: M250 C20

Sets LCD contrast C<contrast value> (value 0..63), if available.

M251: Measure Z steps from homing stop (Delta printers)

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	Yes	No	No	No	???	???	No	No

M251 S0 - Reset, S1 - Print, S2 - Store to Z length (also EEPROM if enabled)

(This is a Repetier-Firmware only feature)

M260: i2c Send Data

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes: 1.1.0	No	No	No	No	No	???	No	Yes

Buffer and send data over the i2c bus. Use **A** to set the address from 0-127. Add up to 32 bytes to the buffer with each **B**. Send and reset the buffer with **S**.

Examples

```

M260 A5 B65 S ; Send 'A' to Address 5 now
M260 A0       ; Set address to 0 (broadcast)

```

```

M260 B77 ; M
M260 B97 ; a
M260 B114 ; r
M260 B108 ; l
M260 B105 ; i
M260 B110 ; n
M260 S1 ; Send the current buffer

```

M261: i2c Request Data

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes: 1.1.0	No	No	No	No	No	???	No	Yes

Request data from an i2c slave device. This command simply relays the received data to the host.

Example

```
M261 A99 B5 ; Request 5 bytes from Address 99
```

Both **M260** and **M261** are commands demonstrating use of the i2c bus (TWIBus class) in Marlin Firmware. Developers and vendors can make Marlin an i2c master device by enabling `EXPERIMENTAL_I2CBUS`, and Marlin can act as a slave device by setting `I2C_SLAVE_ADDRESS` from 8-127. This class can be used to divide up processing responsibilities between multiple instances of Marlin running on multiple boards. For example, one board might control a Z axis with 4 independent steppers to create a self-leveling system, or a second board could drive the graphical display while the first board handles printing.

M280: Set servo position

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	Use M340	No	1.16 and later	Yes	???	???	Yes	Yes

Set servo position absolute.

Parameters

- Pnnn** Servo index
- Snnn** Angle or microseconds
- I1** Invert polarity (RepRapFirmware only)

Example

```
M280 P1 S50
```

Marlin and RepRapFirmware treat S values below 200 as angles, and 200 or greater as the pulse width in microseconds.

In RepRapFirmware, the servo index is the same as the pin number for the M42 command. See https://duet3d.com/wiki/Using_servos_and_controlling_unused_I/O_pins for details.

RepRapFirmware supports the optional I1 parameter, which if present causes the polarity of the servo pulses to be inverted compared to normal for that output pin. The I parameter is not remembered between M280 commands (unlike the I parameter in M106 commands), so if you need inverted polarity then you must include I1 in every M280 command you send.

Duet 0.8.5 M280 P value to Expansion Port Pin Mapping

P	Name	Expansion Port Pin
Use M307 H# A-1 C-1 D-1 before using these pins		
3	PC4_PWML1	18
4	PC23_PWML6	21
5	PC22_PWML5	22
6	PC21_PWML4	23

M300: Play beep sound

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	Yes	No	Yes	Yes	Yes	???	No	Yes

Parameters

- Snnn** frequency in Hz
- Pnnn** duration in milliseconds

Example

```
M300 S300 P1000
```

Play beep sound, use to notify important events like the end of printing. See working example on (<http://www.3dprinting-r2c2.com/?q=content/seasons-greetings>) R2C2 electronics.

If an LCD device is attached to RepRapFirmware, a sound is played via the add-on touch screen control panel. Else the web interface will play a beep sound.

M301: Set PID parameters

	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
Support	No	No: See M13[0-3])	Yes	Yes	Yes	Yes	Yes	No	???	???	Yes	Yes

Parameters

Hnnn heater number (Smoothie uses 'S', Redeem uses 'E')

Pnnn proportional (Kp)

Innn integral (Ki)

Dnnn derivative (Kd)

Examples

M301 H1 P1 I2 D3 ; Marlin

M301 H1 P1 I2 D3 T0.2 B20 W127 S0.8 ; RepRapFirmware (v1.09 onwards), Duet-dc42

M301 S0 P30 I10 D10 ; Smoothie

M301 E0 P30 I10 D10 ; Redeem (E = Extruder, -1=Bed, 0=E, 1=H, 2=A, 3=B, 4=C, default = 0)

Sets Proportional (P), Integral (I) and Derivative (D) values for hot end. See also PID Tuning.

Marlin

Hot end only; see M304 for bed PID. H is the heater number, default 1 (i.e. first extruder heater).

RepRapFirmware (v1.09 onwards)

H: Is the heater number, and is compulsory. H0 is the bed, H1 is the first hot end, H2 the second etc.

P: Interprets a negative P term as indicating that bang-bang control should be used instead of PID (not recommended for the hot end, but OK for the bed heater).

I: Integral value

D: Derivative value

T: Is the approximate additional PWM (on a scale of 0 to 255) needed to maintain temperature, per degree C above room temperature. Used to preset the I-accumulator when switching from heater fully on/off to PID.

S: PWM scaling factor, to allow for variation in heater power and supply voltage. Is designed to allow a correction to be made for a change in heater power and/or power supply voltage without having to change all the other parameters. For example, an S factor of 0.8 means that the final output of the PID controller should be scaled to 0.8 times the standard value, which would compensate for a heater that is 25% more powerful than the standard one or a supply voltage that is 12.5% higher than standard.

W: Wind-up. Sets the maximum value of I-term, must be high enough to reach 245C for ABS printing.

B: PID Band. Errors larger than this cause heater to be on or off.

An example using all of these would be:

```
M301 H1 P20 I0.5 D100 T0.4 S1 W180 B30
```

Smoothie

S0 is 0 for the hotend, and 1 for the bed, other numbers may apply to your configuration, depending on the order in which you declare temperature control modules.

Other implementations

W: Wind-up. Sets the maximum value of I-term, so it does not overwhelm other PID values, and the heater stays on. (Check firmware support - Sprinter, Marlin?) Example:

```
M301 W125
```

Teacup

See M130, M131, M132, M133 for Teacup's codes for setting the PID parameters.

M302: Allow cold extrudes

	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
Support	No	No	No	Yes	Yes: 0.92	No	Yes ¹	No	???	???	No	Yes

Parameters

- Snnn** Cold extrude minimum temperature
- Pnnn** Cold extrude allow state (RepRapFirmware)

Examples (RepRapFirmwre)

- M302 ; Report current state
- M302 P1 ; Allow cold extrusion

Examples (Others)

- M302 S0 ; Allow extrusion at any temperature
- M302 S170 ; Allow extrusion above 170

This tells the printer to allow movement of the extruder motor above a certain temperature, or if disabled, to allow extruder movement when the hotend is below a safe printing temperature.

Notes

¹RepRapFirmware uses the **P[011]** parameter instead of **S[temperature]**, and for M302 with no parameters it will report the current cold extrusion state.

M303: Run PID tuning

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	Yes	Yes	Yes	Yes	1.15 and later	No	???	???	Yes	Yes

PID Tuning refers to a control algorithm used in some repraps to tune heating behavior for hot ends and heated beds. This command generates Proportional (Kp), Integral (Ki), and Derivative (Kd) values for the hotend or bed (E-1). Send the appropriate code and wait for the output to update the firmware.

Hot end usage:

```
M303 S<temperature> C<cycles>
```

Bed usage (repetier, not sure whether cycles work here):

```
M303 P1 S<temperature>
```

Bed usage (others):

```
M303 E-1 C<cycles> S<temperature>
```

Example:

```
M303 C8 S175
```

Smoothie's syntax, where E0 is the first temperature control module (usually the hot end) and E1 is the second temperature control module (usually the bed):

```
M303 E0 S190
```

In RepRapFirmware, this command computes the process model parameters (see M307), which are in turn used to calculate the PID constants. H is the heater number, P is the PWM to use (default 0.5), and S is the maximum allowable temperature (default 225). Tuning is performed asynchronously. Run M303 with no parameters to see the current tuning state or the last tuning result. Example:

```
M303 H1 P0.4 S240 ; tune heater 1 using 40% PWM, quit if temperature exceeds 240C
```

Notes

In Marlin Firmware you can add the **U1** parameter to apply the PID results to current settings upon completion.

M304: Set PID parameters - Bed

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	???	see M301	Yes	No	???	???	No	Yes

Parameters

- Pnnn** proportional (Kp)
- Innn** integral (Ki)
- Dnnn** derivative (Kd)

Examples

M304 P1 I2 D3 ; set kP=3, kI=2, kD=3
 M304 P1 I2 D3 T0.7 B20 W127 ; RepRapFirmware
 M304 ; Report parameters

Sets Proportional, Integral and Derivative values for bed. RepRapFirmware interprets a negative P term as indicating that bang-bang control should be used instead of PID. In RepRapFirmware, this command is identical to M301 except that the H parameter (heater number) defaults to zero.

See also PID Tuning.

M304 in RepRapPro version of Marlin: Set thermistor values

In the RepRapPro version of Marlin (<https://github.com/reprappro/Marlin>) M304 is used to set thermistor values (as M305 is in later firmwares). RRP Marlin calculates temperatures on the fly, rather than using a temperature table. M304 Sets the parameters for temperature measurement.

Example: M304 H1 B4200 R4800 T100000

This tells the firmware that for heater 1 (H parameter: 0 = heated bed, H = first extruder), the thermistor beta (B parameter) is 4200, the thermistor series resistance (R parameter) is 4.8Kohms, the thermistor 25C resistance (T parameter) is 100Kohms. All parameters other than H are optional. If only the H parameter is given, the currently-used values are displayed. They are also displayed within the response to M503.

M305: Set thermistor and ADC parameters

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	???	Yes	Yes	No	???	???	No	No

Parameters

Pnnn Heater number
Tnnn Thermistor resistance at 25°C
Bnnn Beta value, or the reciprocal of the Steinhart-Hart thermistor model B coefficient
Cnnn Steinhart-Hart C coefficient (RepRapFirmware 1.17 and later), default 0
Rnnn Series resistor value
Lnnn ADC low offset
Hnnn ADC high offset
Xnnn Heater ADC channel, or thermocouple or PT100 adapter channel, defaults to the same value as the P parameter

Example

M305 P1 T100000 R1000 B4200

Sets the parameters for temperature measurement. The example above tells the firmware that for heater 1 (P parameter: 0 = heated bed, 1 = first extruder) the thermistor 25C resistance (T parameter) is 100Kohms, the thermistor series resistance (R parameter) is 1Kohms, the thermistor beta (B parameter) is 4200. All parameters other than P are optional. If only the P parameter is given, the existing values are displayed.

RepRapFirmware also supports ADC gain and offset correction and a thermistor selection facility. Example:

```
M305 P1 T100000 R1000 B4200 H14 L-11 X2
```

The H correction affects the reading at high ADC input voltages, so it has the greatest effect at low temperatures. The L correction affects the reading at low input voltages, which correspond to high temperatures.

The X parameter tells the firmware to use the thermistor input corresponding to a different heating channel. RepRapFirmware also allow an external SPI thermocouple interface (such as the MAX31855) or PT100 interface (MAX31865) to be configured. Thermocouple channels are numbered from 100 and PT100 channels from 200.

In the above example, the ADC high end correction (H parameter) is 14, the ADC low end correction (L parameter) is -11, and thermistor input #2 is used to measure the temperature of heater #1.

M306: Set home offset calculated from toolhead position

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	???	Yes	No	No	???	???	No	No

Example: M306 Z0

The values specified are added to the calculated end stop position when the axes are referenced. The calculated value is derived from the distance of the toolhead from the current axis zero point.

The user would typically place the toolhead at the zero point of the axis and issue the M306 command.

This value can be saved to EEPROM using the M500 command (as M206 value).

Implemented in Smoothieware

M307: Set or report heating process parameters

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	1.15 and later	No	???	???	No	No

Parameters

Hn Heater number (0 is usually the bed heater)

Annn gAin, expressed as ultimate temperature rise obtained in degC divided by the PWM fraction. For example, if G=180 then at 50% PWM the ultimate temperature rise would be 90C.

Cnnn dominant time Constant of the heating process in seconds

Dnnn Dead time in seconds

Two additional parameters help control the heating process

Bn selects Bang-bang control instead of PID if non-zero. Default at power-up is 0 for extruder heaters, 1 for the bed heater.

Snnn maximum PWM to be used with this heater on a scale of 0 to 1. Default 1.0.

Examples

M307 H0 ; report the process parameters for heater 0

M307 H1 A346.2 C140 D5.3 B0 S0.8 ; set process parameters for heater 1, use PID, and limit heater 1 PWM to 80%

Each heater and its corresponding load may be approximated as a first order process with dead time, which is characterised by the gain, time constant and dead time parameters. The model can be used to calculate optimum PID parameters (including using different values for the heating or cooling phase and the steady state phase), to better detect heater faults, and to calculate feed-forward terms to better respond to changes in the load. Normally these model parameters are found by auto tuning - see M303.

RepRapFirmware 1.16 and later allow the PID controller for a heater to be disabled by setting the A, C and D parameters to -1. This frees up the corresponding heater control pin for use as a general purpose I/O pin.

M320: Activate autolevel (Repetier)

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	Yes	No	No	No	???	???	No	No

Usage

M320

M320 S1

Parameters

Snnn if greater than 0, activate and store persistently in EEPROM

Examples

M320 (*temporarily activate auto leveling*)

M320 S1 (*permanently activate auto leveling*)

Parameter Snnn is optional.

(Repetier only)

M321: Deactivate autolevel (Repetier)

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	Yes	No	No	No	???	???	No	No

Usage

M321

M321 S1

Parameters

Snnn if greater than 0, deactivate and store persistently in EEPROM

Examples

M321 (*temporarily deactivate auto leveling*)

M321 S1 (*permanently deactivate auto leveling*)

Parameter Snnn is optional.

(Repetier only)

M322: Reset autolevel matrix (Repetier)

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	Yes	No	No	No	???	???	No	No

Usage

M322

M322 S1

Parameters

Snnn if greater than 0, also reset the matrix values saved EEPROM

Examples

M322 (*temporarily reset auto level matrix*)

M322 S1 (*permanently reset auto level matrix*)

Parameter Snnn is optional.

(Repetier only)

M323: Distortion correction on/off (Repetier)

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	Yes	No	No	No	???	???	No	No

Usage

M323

M323 Snnn

M323 Snnn Pnnn

Parameters

Snnn 0 (disable correction) or 1 (enable correction)

Pnnn 1 (store correction state persistently in EEPROM)

Examples

M323 (*Show if distortion correction is enabled*)

M323 S0 (*Disable distortion correction temporarily*)

M323 S1 P1 (*Enable distortion correction permanently*)

(Repetier only) Controls distortion correction feature after having set it up using G33.

M340: Control the servos

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	Yes	No	No	No	???	???	No	No

(Repetier only ,Marlin see M280)

M340 P<servoId> S<pulseInUS> / ServoID = 0..3 pulseInUs = 500..2500

Servos are controlled by a pulse width normally between 500 and 2500 with 1500ms in center position. 0 turns servo off.

M350: Set microstepping mode

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	Yes	No	Yes	No	???	???	Yes	Yes

Sets microstepping mode.

Warning: Steps per unit remains unchanged; except that in RepRapFirmware the steps/mm will be adjusted automatically.

Usage

M350 Snn Xnn Ynn Znn Enn Bnn

Parameters

*Not all parameters need to be used, but at least **one** should be used. As with other commands, RepRapFirmware reports the current settings if no parameters are used.*

Snn Set stepping mode for all drivers (not supported by RepRapFirmware)

Xnn Set stepping mode for the X axis

Ynn Set stepping mode for the Y axis

Znn Set stepping mode for the Z axis

Enn Set stepping mode for Extruder 0 (for RepRapFirmware use Enn:nn:nn etc. for multiple extruders)

Bnn Set stepping mode for Extruder 1 (not supported by RepRapFirmware, see above)

Inn Enable (nn=1) or disable (nn=0) microstep interpolation mode for the specified drivers, if they support it (RepRapFirmware only)

Modes (nn)

1 = full step

2 = half step

4 = quarter step

8 = 1/8 step

16 = 1/16 step

64 = 1/64 step

128 = 1/128 step

256 = 1/256 step

Examples

M350 S16 (*reset all drivers to the default 1/16 micro-stepping - not supported by RepRapFirmware*)

M350 Z1 (*set the Z-axis' driver to use full steps*)

M350 E4 B4 (*set both extruders to use quarter steps - Marlin/Repetier*)
M350 E4:4:4 (*set extruders 0-2 to use quarter steps - RepRapFirmware*)

M351: Toggle MS1 MS2 pins directly

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	No	No	No	No	???	???	No	Yes

Example: M351

M355: Turn case lights on/off

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	use M106	No	No	Yes: 0.92.2	No	No	No	???	???	No	No

Examples
M355 S1 ; *Enable lights*
M355 S0 ; *Disable lights*
M355 ; *Report status*

Every call or change over LCD menu sends a state change for connected hosting software like

```
{Case lights on
Case lights off
No case lights
```

M360: Report firmware configuration

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	Yes: 0.92.2	No	No	No	???	???	No	No

Target

This command helps hosting software to detect configuration details, which the user would need to enter otherwise. It should reduce configuration time considerably if supported.

Example
M360

Response

```
{Config:Baudrate:250000
Config:InputBuffer:127
Config:NumExtruder:2
Config:MixingExtruder:0
Config:HeatedBed:0
Config:SDCard:1
Config:Fan:1
Config:LCD:1
Config:SoftwarePowerSwitch:1
Config:XHomeDir:-1
Config:YHomeDir:-1
Config:ZHomeDir:-1
Config:SupportG10G11:1
Config:SupportLocalFilamentchange:1
Config:CaseLights:0
Config:ZProbe:1
Config:Autolevel:0
Config:EEPROM:1
Config:PrintlineCache:24
Config:JerkXY:30.00
Config:JerkZ:0.30
Config:RetractionLength:3.00
Config:RetractionLongLength:13.00
Config:RetractionSpeed:40.00
Config:RetractionZLift:0.00
Config:RetractionUndoExtraLength:0.00
Config:RetractionUndoExtraLongLength:0.00
Config:RetractionUndoSpeed:0.00
Config:XMin:0.00
Config:YMin:0.00
Config:ZMin:0.00
Config:XMax:250.00
Config:YMax:150.00
Config:ZMax:90.00
Config:XSize:250.00
Config:YSize:150.00
Config:ZSize:90.00
Config:XPrintAccel:250.00
Config:YPrintAccel:250.00
Config:ZPrintAccel:100.00
Config:XTravelAccel:250.00
Config:YTravelAccel:250.00
}
```

```

;Config:ZTravelAccel:100.00
;Config:PrinterType:Cartesian
;Config:MaxBedTemp:120
;Config:Extr.1:Jerk:50.00
;Config:Extr.1:MaxSpeed:100.00
;Config:Extr.1:Acceleration:10000.00
;Config:Extr.1:Diameter:0.00
;Config:Extr.1:MaxTemp:220
;Config:Extr.2:Jerk:50.00
;Config:Extr.2:MaxSpeed:100.00
;Config:Extr.2:Acceleration:10000.00
;Config:Extr.2:Diameter:0.00
;Config:Extr.2:MaxTemp:220

```

SCARA calibration codes (Morgan)

In order to ease calibration of Reprap Morgan, the following M-codes are used to set the machine up

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Partial	No	Yes	No	No	???	???	???	Partial

M360: Move to Theta 0 degree position

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Experimental	No	Yes	No	No	???	???	No	Experimental

The arms move into a position where the Theta steering arm is parallel to the top platform edge. The user then calibrates the position by moving the arms with the jog buttons in software like pronterface until it is perfectly parallel. Using M114 will then display the calibration offset that can then be programmed into the unit using M206 (Home offset) X represents Theta.

Smoothieware: M360 P0 will take the current position as parallel to the platform edge, and store the offset in the homing trim offset (M666) No further user interaction is needed.

M361: Move to Theta 90 degree position

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Experimental	No	Yes	No	No	???	???	No	Experimental

Theta move to 90 degrees with platform edge. User calibrates by using jog arms to place exactly 90 degrees. Steps per degree can then be read out by using M114, and programmed using M92. X represents Theta. Program Y (Psi) to the same value initially. Remember to repeat M360 after adjusting steps per degree.

Smoothieware: M360 P0 will accept the current position as 90deg to platform edge. New steps per angle is calculated and entered into memory (M92) No further user interaction is required, except to redo M360.

M362: Move to Psi 0 degree position

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Experimental	No	Yes	No	No	???	???	No	Experimental

Arms move to Psi 0 degree. Check only after other Theta calibrations

M363: Move to Psi 90 degree position

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Experimental	No	Yes	No	No	???	???	No	Experimental

Arms move to Psi 90 degree. Check only after other Theta calibrations

M364: Move to Psi + Theta 90 degree position

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Experimental	No	Yes	No	No	???	???	No	Experimental

Move arms to form a 90 degree angle between the inner and outer Psi arms. Calibrate by moving until angle is exactly 90 degree. Read out with M114, and calibrate value into Home offset M206. Psi is represented by Y.

Smoothieware: M364 P0 will accept the current position as 90deg between arms. The offset is stored as a trim offset (M666) and no further user interaction is required except to save all changes via M500

M365: SCARA scaling factor

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Experimental	No	Yes	No	No	???	???	No	Experimental

Adjust X Y and Z scaling by entering the factor. 100% scaling (default) is represented by 1

M366: SCARA convert trim

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	Yes	No	No	???	???	No	No

Executing this command translates the calculated trim values of the SCARA calibration to real home offsets. This prevents the home and trim movement after calibration.

M370: Morgan manual bed level - clear map

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	Yes	Use M557	No	???	???	No	No

Clear the map and prepare for calibration

Usage

M370

M370 X<divisions> Y<divisions>

Without parameters is defaults to X5 Y5 (25 calibration points) When specifying parameters, uneven numbers are recommended.

M371: Move to next calibration position

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	Yes	No	No	???	???	???	No

Move to the next position for calibration. User moves the bed towards the hotend until it just touches

M372: Record calibration value, and move to next position

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	Yes	No	No	???	???	???	No

The position of the bed is recorded and the machine moves to the next position. Repeat until all positions programmed

M373: End bed level calibration mode

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	Yes	No	No	???	???	???	No

End calibration mode and enable z correction matrix. Does not save current matrix

M374: Save calibration grid

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	Yes	1.17 and later	No	???	???	???	No

Saves the calibration grid.

Parameters

extension (Smoothieware only) Extension of the grid file

Pfilename (RepRapFirmware only) Name of the file to save to

Z (Smoothieware only) Also save the M206 Z homing offset into the grid file

Usage (Smoothieware)

M374

M374 <file extension> Z

Usage (RepRapFirmware)

M374

M374 PMyAlternateHeightMap.csv

In Smoothieware, without parameters this saves the grid into the default grid file that gets loaded at boot. The optional parameter specifies the extension of the grid file - useful for special grid files such as for a special print surface like a removable print plate. Addition of Z will additionally save the M206 Z homing offset into the grid file.

In RepRapFirmware, this saves the grid parameters and height map into the specified file, or the default file **heightmap.csv** if no filename was specified. To load the height map automatically at startup, use command M375 in the config.g file.

M375: Display matrix / Load Matrix

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	Yes	1.17 and later	No	???	???	???	No

Displays the bed level calibration matrix (Marlin), or loads the grid matrix file (Smoothieware and RepRapFirmware)

Parameters

extension (Smoothieware only)

Pfilename (RepRapFirmware only)

Usage

M375

M375 <file extension> (Smoothieware only)

M375 PMyAlternateHeightMap.csv (RepRapFirmware only)

Without parameters loads default grid, and with specified extension or specified filename attempts to load the specified grid. If not available will not modify the current grid. In Smoothieware, if Z was saved with the grid file, it will load the saved Z with the grid.

M376: Set bed compensation taper

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	Yes	1.17 and later	No	???	???	???	No

Parameters

Hnnn Height (mm) over which to taper off the bed compensation

Example

M376 H10

This command specifies that bed compensation should be tapered off over the specified height, so that no bed compensation is applied at and above that height. If H is zero or negative then no tapering is applied, so compensation is performed throughout the entire print.

If the firmware does not adjust the extrusion amount to compensate for the changing layer height while tapering is being applied, you will get under- or over-extrusion. Using a large taper height will reduce this effect. For example, if the taper height is 50 times the largest bed height error, then under- or over-extrusion will be limited to 2%.

M380: Activate solenoid

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	???	No	No	No	???	???	???	Yes

Example: M380

Activates solenoid on active extruder.

M381: Disable all solenoids

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	???	No	No	No	???	???	???	Yes

Example: M381

M400: Wait for current moves to finish

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	use G4	Yes	Yes	Yes	Yes	Yes	Yes	???	???	???	Yes

Example
M400

Finishes all current moves and and thus clears the buffer. That's identical to G4 P0.

M401: Lower z-probe

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	???	No	1.17 and later	No	???	???	???	Yes

Example: M401

Lower z-probe if present. In RepRapFirmware this runs macro file sys/deployprobe.g.

M402: Raise z-probe

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	???	No	1.17 and later	No	???	???	???	Yes

Example: M402

Raise z-probe if present. In RepRapFirmware this runs macro file sys/retractprobe.g.

M404: Filament width and nozzle diameter

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	No	No	Yes	No	???	???	???	Yes

Parameters

Nnnn Filament width (in mm)

Dnnn Nozzle diameter (in mm)¹

Examples

M404 N1.75

M404 N3.0 D1.0

Enter the nominal filament width (3mm, 1.75mm) or will display nominal filament width without parameters.

Notes

¹While Marlin only accepts the 'N' parameter, RepRapFirmware further allows to specify the nozzle diameter (in mm) via the 'D' parameter. This value is used to properly detect the first layer height when files are parsed or a new print is being started.

M405: Filament Sensor on

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	No	No	No	No	???	???	???	Yes

Example: M405

Turn on Filament Sensor extrusion control. Optional D<delay in cm> to set delay in centimeters between sensor and extruder.

M406: Filament Sensor off

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	No	No	No	No	???	???	???	Yes

Example: M406

Turn off Filament Sensor extrusion control.

M407: Display filament diameter

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	No	No	Yes	No	???	???	???	Yes

Example
M407

Displays measured filament diameter. In RepRapFirmware, M407 does the same as M404.

M408: Report JSON-style response

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	???	No

Parameters
 Snnn Response type
 Rnnn Response sequence number

Example
M408 S0

Report a JSON-style response by specifying the desired type using the 'S' parameter.

The following response types are supported:

- Type 0 is a short-form response, similar to the response used by older versions of the web interface.
- Type 1 is like type 0 except that static values are also included.
- Type 2 is similar to the response provided by the web server for Duet Web Control.
- Type 3 is an extended version of type 2 which includes some additional parameters that aren't expected to change very frequently.
- Type 4 is an extended version of type 2 which may be used to poll for current printer statistics.
- Type 5 reports the current machine configuration.

Here is an example of a typical type 0 response:

```
{
  "status": "I",
  "heaters": [25.0, 29.0, 28.3],
  "active": [-273.1, 0.0, 0.0],
  "standby": [-273.1, 0.0, 0.0],
  "hstat": [0, 2, 1],
  "pos": [-11.00, 0.00, 0.00],
  "extr": {0.0, 0.0, 0.0},
  "sfactor": 100.00,
  "efactor": [100.00, 100.00],
  "tool": 1,
  "probe": "535",
  "fanPercent": [75.0, 0.0],
  "fanRPM": 0,
  "homed": [0, 0, 0],
  "fraction_printed": 0.572
}
```

The response is set as a single line with a newline character at the end. The meaning of the fields is:

```
status:  I=idle, P=printing from SD card, S=stopped (i.e. needs a reset), C=running config file (i.e starting up), A=paused, D=pausing, R=resuming
heaters: current heater temperatures, numbered as per the machine (typically, heater 0 is the bed)
active:   active temperatures of the heaters
standby: standby temperatures of the heaters
hstat:   status of the heaters, 0=off, 1=standby, 2=active, 3=heater fault. Heater 0 is normally the bed heater, heaters 1, 2.. are the extruder heaters
pos:     the X, Y and Z (and U, V, W if present) axis positions of the current tool (if a tool is selected), or of the print head reference point
extr:    the positions of the extruders
sfactor: the current speed factor (see M220 command)
efactor: the current extrusion factors (see M221 command), one value per extruder
tool:    the selected tool number. A negative number typically means no tool selected.
probe:   the Z-probe reading
fanPercent: the speeds of the controllable fans, in percent of maximum
fanRPM:   the print cooling fan RPM
homed:    the homed status of the X, Y and Z axes (and U, V, W if they exist), or towers on a delta. 0=axis has not been homed so position is not reliable
fraction_printed: the fraction of the file currently being printed that has been read and at least partially processed.
message: the message to be displayed on the screen (only present if there is a message to display)
timesLeft: an array of the estimated remaining print times (in seconds) calculated by different methods. These are currently based on the proportion of the total filament consumed, and the proportion of the total layers already printed. Only present if a print from SD card is in progress.
seq:       the sequence number of the most recent non-trivial G-code response or error message. Only present if the R parameter was provided and the current sequence number was non-zero.
resp:      the most recent non-trivial G-code response or error message. Only present if the R parameter was provided and the current sequence number was non-zero.
```

The type 1 response comprises these fields plus some additional ones that do not generally change and therefore do not need to be fetched as often. The extra fields include:

```
myName: the name of the printer
firmwareName: the name of the firmware, e.g. "RepRapFirmware" or "Smoothieware"
geometry: one of "cartesian", "delta", "corexy", "corexz" etc.
axes:     the number of axes
volumes:  the number of SD card slots available
numTools: the number of available tools numbered contiguously starting from 0
```

The fields may be in any order in the response. Other implementations may omit fields and/or add additional fields.

For a more detailed comparison of type 2 - 5, see RepRap_Firmware_Status_responses.

PanelDue currently uses only M408 S0 and M408 S1.

M420: Set RGB Colors as PWM (MachineKit)

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	Yes	???	???	???	No

Usage: M420 R<Red PWM (0-255)> E<Green PWM (0-255)> B<Blue PWM (0-255)>

Example: M420 R255 E255 B255

Set the color of your RGB LEDs that are connected to PWM-enabled pins. Note, the Green color is controlled by the E value instead of the G value due to the G code being a primary code that cannot be overridden.

In marlin, is also: M420 - Enable/Disable Mesh Leveling (with current values) S1=enable S0=disable

M420: Enable/Disable Mesh Leveling (Marlin)

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	No	No	No	No	???	???	???	Yes

Example: M420 S1

Enable/Disable Mesh Leveling (with current stored mesh). S1=enable S0=disable

M421: Set a Mesh Bed Leveling Z coordinate

M421 - Set a single Z coordinate in the Mesh Leveling grid. X<index> Y<index> Z<offset in mm>

M450: Report Printer Mode

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	Yes	No	No	No	???	???	???	No

Usage: M450

Example: M450 Output: PrinterMode:FFF

Printers can be used for different task by exchanging the toolhead. Depending on the tool, a different behavior of some commands can be expected. This command reports the current working mode. Possible answers are:

```
PrinterMode:FFF
PrinterMode:Laser
PrinterMode:CNC
```

M451: Select FFF Printer Mode

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	Yes	No	No	No	???	???	???	No

Usage
M451

Example
M451

Output
PrinterMode:FFF

Switches to FFF mode for filament printing.

M452: Select Laser Printer Mode

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	Yes	No	No	No	???	???	???	No

Usage
M452

Example
M452

Output
PrinterMode:Laser

Switches to laser mode. This mode enables handling of a laser pin and makes sure that the laser is only activated during G1 moves if laser was enabled or E is increasing. G0 moves should never enable the laser. M3/M5 can be used to enable/disable the laser for moves.

M453: Select CNC Printer Mode

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	Yes	No	No	No	???	???	???	No

Usage
M453

Example
M453

Output
PrinterMode:CNC

Switches to CNC mode. In this mode M3/M4/M5 control the pins defined for the milling device.

M460: Define temperature range for thermistor controlled fan

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	Yes	No	No	No	???	???	???	No

Usage
M460 X<minTemp> Y<maxTemp>

Example
M460 X50 Y60

If the firmware has a thermistor controlled fan defined, you can set at which temperature the fan starts and from which temperature on it should run with maximum speed.

M500: Store parameters in EEPROM

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	Yes	Yes	Yes	???	Yes	No	???	???	???	Yes

Example
M500

Save current parameters to EEPROM.

In Redeem any parameters set through G/M-codes which is different than what is read from the config files, are stored back to the local config. For instance setting stepper current and microstepping through M906 and M907 followed by M500 will update /etc/redeem/local.cfg.

M501: Read parameters from EEPROM

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	Yes	Yes	Yes	???	Yes	No	???	???	???	Yes

Parameters
Snnn Enable auto-save (only RepRapFirmware)

Example
M501

Set the active parameters to those stored in the EEPROM. This is useful to revert parameters after experimenting with them.

RepRapFirmware versions prior to 1.17 allows "S1" to be passed, which forces parameters to be automatically saved to EEPROM when they are changed.

In RepRapFirmware 1.17 and later, the parameters are saved in file sys/config-override.g on the SD card.

M502: Revert to the default "factory settings."

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	Yes	Yes	Yes	???	Yes	No	???	???	???	Yes

Example
M502

This command resets all tunable parameters to their default values, as set in the firmware. This doesn't reset any parameters stored in the EEPROM, so it must be followed with M500 if you want to do that.

M503: Print settings

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	Yes	Yes	???	???	Yes	No	???	???	???	Yes

Example
M503

This command asks the firmware to reply with the current print settings stored in EEPROM. The reply output includes the G-Code commands to produce each setting. For example, the Steps Per Unit values are displayed as an M92 command.

RepRapFirmware outputs the content of the configuration file, but note that it may be truncated if it is too long.

M530: Enable printing mode

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	Yes	???	No	No	???	???	???	Yes

Example

```
M530 S1 L270
```

This command tells the firmware that a print has started (**S1**) or ended (**S0**). The **L** parameter sets the number of layers. **L0** denotes unknown layer count. This enables the firmware to switch into a special print display mode to show print progress. Firmware should indicate the presence of this feature by responding to **M115** with an additional line:

```
Cap:PROGRESS:1
```

M531: Set print name

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	Yes	???	No	No	???	???	???	Yes

Example

```
M531 Demo Model
```

Sets the name of the currently printed object. Should follow **M530 S1** for correct display.

M532: Set print progress

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	Yes	???	No	No	???	???	???	Yes

Example
M532 X23.7 L56

Sets the print progress (X = 0..100) and currently printed layer (L). Should be send every 0.1% progress change on every layer change.

M540: Enable/Disable "Stop SD Print on Endstop Hit"

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	No	No	No	No	???	???	???	Yes

Parameters

Snnn state, S1=enable, S0=disable

Example
M540 S1

M540: Set MAC address

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	???	No

Parameters

Pnnn The MAC address

Examples

M540 P0xBE:0xEF:0xDE:0xAD:0xFE:0xED

M540 PDE:AD:BE:EF:CA:FE

Sets the MAC address (http://en.wikipedia.org/wiki/MAC_address) of the RepRap. This should be done before any other network commands. The MAC address is six one-byte hexadecimal numbers separated by colons. The 0x prefix is optional in later firmware revisions.

All devices running on the same network shall all have different MAC addresses. For your printers, changing the last digit is sufficient.

M550: Set Name

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	???	No

Parameters

Pnnn Machine name

Example

M550 PGodzilla

Sets the name of the RepRap to (in this case) Godzilla. The name can be any string of printable characters except ';', which still means start comment.

M551: Set Password

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	???	No

Parameters

Pnnn Password

Example

M551 Pmy-very-secret-word

On machines that need a password to activate them, set that password. The code 'P' is not part of the password. Note that as this is sent in clear it does not (nor is it intended to) offer a very high level of security. But on machines that are (say) on a network, it prevents idle messing about by the unauthorised. The password can contain any printable characters except ';', which still means start comment.

Note for RepRapFirmware: If the specified password differs from the default one (i.e. rewrap), the user will be asked to enter it when a connection is established via HTTP or Telnet. For FTP, the password must always be passed explicitly.

M552: Set IP address

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	???	No

Parameters

Pnnn IP address**Snnn** Enable networking (optional)**Rnnn** HTTP port (default 80)

Example

M552 P192.168.1.14

Sets the IP address of the RepRap machine to (in this case) 192.168.1.14. A restart may be required before the new IP address is used. If no 'P' field is specified, this echoes the existing IP address configured. If S0 is added thus: M552 S0 P192.168.1.14 networking is disabled. If you set the address M552 P0.0.0.0 the RepRap machine will try to obtain its IP address from the network's DHCP server, whereupon it will appear on the network with an address something like <http://godzilla.home>, where **godzilla** is the name set by the M550 command (see above). The precise URL incorporating that name will depend on the conventions of your network.

Recent RepRapFirmware versions allow the IP configuration to be changed without a restart.

M553: Set Netmask

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	???	No

Parameters

Pnnn Net mask

Example

M553 P255.255.255.0

Sets the network mask of the RepRap machine to (in this case) 255.255.255.0. A restart may be required before the new network mask is used. If no 'P' field is specified, this echoes the existing network mask configured.

Recent RepRapFirmware versions allow the IP configuration to be changed without a restart.

M554: Set Gateway

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	???	No

Parameters

Pnnn Gateway

Example

M554 P192.168.1.1

Sets the Gateway IP address of the RepRap machine to (in this case) 192.168.1.1. A restart may be required before the new gateway IP address is used. If no 'P' field is specified, this echoes the existing Gateway IP address configured.

Recent RepRapFirmware versions allow the IP configuration to be changed without a restart.

M555: Set compatibility

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	???	No

Parameters

Pnnn Emulation type

Example

M555 P1

For firmware that can do it, the firmware is set to a mode where its input and (especially) output behaves exactly like other established firmware. The value of the 'P' argument is:

P value	Firmware
0	Native (i.e. whatever the firmware actually is)
1	RepRap_Firmware
2	Marlin
3	Teacup
4	Sprinter
5	Repetier

M556: Axis compensation

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	???	No

Parameters

Snnn Height of the measured distances

Xnnn Deviation in X direction

Ynnn Deviation in Y direction

Znnn Deviation in Z direction

Example

M556 S100 X0.7 Y-0.2 Z0.6

Though with care and adjustment a RepRap can be set up with its axes at right-angles to each other within the accuracy of the machine, who wants to bother with care and adjustment when the problem can be solved by software? This tells software the tangents of the angles between the axes of the machine obtained by printing then measuring a test part. The S parameter (100 here) is the length of a triangle along each axis in mm. The X, Y and Z figures are the number of millimeters of the short side of the triangle that represents how out of true a pair of axes is. The X figure is the error between X and Y, the Y figure is the error between Y and Z, and the Z figure is the error between X and Z. Positive values indicate that the angle between the axis pair is obtuse, negative acute.

M557: Set Z probe point or define probing grid

Image denoting how to determine the S parameter for Gcode M556

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	Yes	Yes	No	???	???	???	No

Parameters to define G32 probe points (Cartesian/CoreXY printers only, deprecated in RepRapFirmware)

Pnnn Probe point number

Xnnn X coordinate

Ynnn Y coordinate

Example

M557 P1 X30 Y40.5

Parameters to define G29 probe grid (all values in mm)

Xaaa:bbb Minimum and maximum X coordinates to probe

Yaaa:bbb Minimum and maximum Y coordinates to probe

R Radius to probe

S Probe point spacing

Examples

M557 X0:200 Y0:220 S20

M557 R150 S15

Set the points at which the bed will be probed to compensate for its plane being slightly out of horizontal.

The first form defines the points for for G32 bed probing. The P value is the index of the point (indices start at 0) and the X and Y values are the position to move extruder 0 to to probe the bed. An implementation should allow a minimum of three points (P0, P1 and P2). This just records the point coordinates; it does not actually do the probing. See G32. Defining the probe points in this way is deprecated in RepRapFirmware, you should define them in a bed.g file instead.

The second form defines the grid for G29 bed probing. For Cartesian printers, specify minimum and maximum X and Y values to probe and the probing interval. For Delta printers, specify the probing radius. If you define both, the probing area will be the intersection of the rectangular area and the circle. There is a firmware-dependent maximum number of probe points supported, which may be as low as 100.

M558: Set Z probe type

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	???	No

Parameters

Pnnn Z probe type

Xnnn If nonzero, use probe for homing X axis

Ynnn If nonzero, use probe for homing Y axis

Znnn If nonzero, use probe for homing Z axis

Fnnn Feed rate (i.e. probing speed, mm/min)

Hnnn Dive height (mm)

Innn Invert (I1) or do not invert (I0) the Z probe reading (RepRapFirmware 1.16 and later)

Rnnn Z probe recovery time after triggering, default zero (seconds) (RepRapFirmware 1.17 and later)¹

Tnnn Travel speed to and between probe points (mm/min)

Snnn Extra parameter for experimentation

Example

M558 P1 X0 Y0 Z1 F500 T5000 H3

A Z probe may be a switch, an IR proximity sensor, or some other device. This selects which to use. P0 indicates that no Z probe is present. P1 gives an unmodulated IR probe, or any other probe type that emulates an unmodulated IR probe (probe output is an analog signal that rises with decreasing nozzle height above the bed). If there is a control signal to the probe, it is driven high when the probe type is P1. P2 specifies a modulated IR probe, where the modulation is commanded directly by the main board firmware using the control signal to the probe. P3 selects an alternative Z probe by driving the control signal to the probe low. P4 selects a switch for bed probing (on the Duet, this must be connected to the E0 endstop pins). P5 (from RepRapFirmware 1.14) selects a switch (normally closed) for bed probing between In and Gnd pins of the Z-probe connector (Duet 0.8.5 and Duet WiFi). P6 is as P4 but the switch is connected to an alternative connector (on the Duet series, the E1 endstop connector).

The X, Y and Z parameters specify whether each axis uses the Z probe for homing or not. If the parameter is nonzero, the Z probe is used for homing that axis. if the parameter is zero, the endstop switch for that axis is used for homing instead. See also G31 and G32.

Notes

¹This parameter used to specify the Z probe channel in RepRapFirmware, but it has been superseded by the functionality of "M115 Px". With older firmware versions and a Duet 0.7/0.85, this parameter should be 1.

M559: Upload configuration file

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	???	No

Example

M559

If the RepRap supports it, this uploads a file that is run on re-boot to configure the machine. This file usually is a special G Code file. After sending M559, the file should be sent, ending with an M29 (q.v.).

M560: Upload web page file

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	???	No

Example

M560

For RepRaps that have web support and that can be driven by a web browser, this uploads the file that is the control page for the RepRap. After sending M560 the file (usually an HTML file) should be sent, terminated by the string

```
<!-- **EoF** -->
```

. Clearly that string cannot exist in the body of the file, but can be put on the end to facilitate this process. This should not be too serious a restriction...

M561: Set Identity Transform

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	Yes	Yes	No	???	???	???	No

Example

M561

This cancels any bed-plane fitting as the result of probing (or anything else) and returns the machine to moving in the user's coordinate system.

M562: Reset temperature fault

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	???	No

Parameters

Pnnn Heater number

Example

M562 P2

Reset a temperature fault on heater/sensor 2. If the RepRap has switched off and locked a heater because it has detected a fault, this will reset the fault condition and allow you to use the heater again. Obviously to be used with caution. If the fault persists it will lock out again after you have issued this command. P0 is the bed; P1 the first extruder, and so on.

M563: Define or remove a tool

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	???	No

Parameters

Pnnn Tool number

Dnnn Extruder drive(s)

Hnnn Heater(s)

Fnnn Fan(s) to map fan 0 to (RepRapFirmware 1.16 and later)

Xnnn Axis or axes to map X movement to (RepRapFirmware 1.16 and later)

Example

M563 P0 D0:2:3 H1:3 ; create a tool using extruder drives 0, 2 and 3 and heaters 1 and 3

M563 P1 D1 H2 X3 ; create a tool using extruder drive 1 and heater 2 with X movement mapped to the U axis

M563 P2 D0:1 H1:2 X0:3 F0:2 ; create a tool using extruder drives 0 and 1, heaters 1 and 2, with X movement mapped to both X and U axes and fan 0 mapped to fan 0 and fan 2

Tools are usually (though not necessarily) extruders. The 'P' field specifies the tool number. Tool numbers can have any positive integer value and 0. The 'D' field specifies the drive(s) used by the tool - in the first example drives 0, 2 and 3. Drive 0 is the first drive in the machine after the movement drives (usually X, Y and Z). If there is no 'D' field the tool has no drives. The 'H' field specifies the tool's heaters - in the first example heaters 1 and 3. Heater 0 is usually the hot bed (if any) so the first extruder heater is usually 1. If there is no H field the tool has no heaters.

Tools are driven using multiple values in the 'E' field of G1 commands, each controlling the corresponding drive in the 'D' field above, as follows:

```
G1 X90.6 Y13.8 E2.24:2.24:15.89
G1 X70.6 E0:0:42.4
```

The first line moves straight to the point (90.6, 13.8) extruding a total of 2.24mm of filament from both drives 0 and 2 and 15.98mm of filament from drive 3. The second line moves back 20mm in X extruding 42.4mm of filament from drive 3.

Alternatively, if the slicer does not support generating G1 commands with multiple values for the extrusion amount, the M567 command can be used to define a tool mix ratio.

Normally an M563 command is immediately followed by a G10 command to set the tool's offsets and temperatures.

It is permissible for different tools to share some (or all) of their drives and heaters. So, for example, you can define two tools with identical hardware, but that just operate at different temperatures.

The X mapping option is used to create tools on machines with multiple independent X carriages. The additional carriages are set up as axes U, V etc. (see M584) and the X mapping option in M563 defines which carriage or carriages are used.

If you use the M563 command with a P value for a tool that has already been defined, that tool is redefined using the new values you provide.

RepRapFirmware supports an additional form of the M563 command. The command:

```
M563 S1
```

means add 1 (the value of the S parameter) to all tool numbers found in the remainder of the current input stream (e.g. the current file if the command is read from a file on the SD card), or until a new M563 command of this form is executed. The purpose of this is to provide compatibility between systems in which tool numbers start at 1, and programs such as slic3r that assume tools are numbered from zero.

Recent versions of RepRapFirmware allow the deletion of existing tools if M563 is called in this way:

```
M563 P1 D-1 H-1
```

M564: Limit axes

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	???	No

Parameters

Snnn Limit movement within axis boundaries

Example

M564 S0

Allow moves outside the print volume, or not. If the S parameter is 0, then you can send G codes to drive the RepRap outside its normal working volume, and it will attempt to do so. User beware... If you set the S parameter to 1 then the RepRap will not think outside the box. The default behaviour is S = 1.

M565: Set Z probe offset

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	Yes	see G31	No	???	???	???	No

Example: M565 X3 Y4.5 Z-2.37

Set the offset from the extruder tip to the probe position. The X, Y and Z values are the delta between the extruder and the actual trigger position of the probe. If the probe trigger point is below the extruder (typical) the Z offset will be negative. This just records the point offset; it does not actually do the probing. See G32.

M566: Set allowable instantaneous speed change

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	???	No

Parameters

Xnnn Maximum instantaneous speed change of the X axis (mm/min)

Ynnn Maximum instantaneous speed change of the Y axis

Znnn Maximum instantaneous speed change of the Z axis

Ennn Maximum instantaneous speed change of the extruder drives

Example

M566 X20 Y20 Z2 E10

Sets the maximum allowable speed change (sometimes called 'jerk speed') of each motor when changing direction.

The model files and gcode files used by repraps generally render circles and other curves shapes as a sequence of straight line segments. If the motors were not allowed any instantaneous speed change, they would have to come to a stop at the junction between each pair of line segments. By allowing a certain amount of instantaneous speed change, printing speed can be maintained when the angle between the two line segments is small enough.

If you set these X and Y values too low, then the printer will be slow at printing curves. If they are too high then the printer may be noisy when cornering and you may suffer ringing and other print artefacts, or even missed steps.

On very old versions of RepRapFirmware (prior to 1.09), these were also the minimum speeds of each axis.

M567: Set tool mix ratios

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	???	No

Parameters

Pnnn Tool number

Ennn Mix ratios

Example

M567 P2 E0.1:0.2:0.1:0.6

This example sets the mix ratio for tool 2 (the P value). When mixing is then turned on (see M568), only single E values need to be sent on a G1 command (any extra E values will be ignored, but are not illegal):

G1 X20 E1.3

This will move to X=20 extruding a total length of filament of 1.3mm. The first drive of tool 2 will extrude 0.1*1.3mm, the second 0.2*1.3mm and so on. The ratios don't have to add up to 1.0 - the calculation done is as just described. But it is best if they do.

See also M568.

M568: Turn off/on tool mix ratios

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	???	No

Parameters

Pnnn Tool number

Snnn Whether mix ratios should be activated

Example

M568 P2 S0

Turn on/off automatic mix ratios for tool 2. If the S parameter is 0 mixing is turned off; if it is non-zero it is turned on.

After turning off command G1 instructions must send as many E values as the tool has drives:

```
G1 X20 E0.2:0.4:0.166:0.3
```

The off state is the default.

M569: Set axis direction and enable values

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	???	No

Parameters

Pnnn Motor driver number

Snnn Direction of movement of the motor(s) attached to this driver: 0 = backwards, 1 = forwards

Rnnn Driver enable polarity: 0 = active low, 1 = active high (default 0)

Tnnn Minimum driver step pulse width and interval in microseconds¹

Example

M569 P0 S1

Set the control value for the drive specified by P that sends it forwards to the given value in the S field. After sending the example, sending a 1 to X (drive 0) will make it go forwards, sending a 0 will make it go backwards. Obviously to be used with extreme caution...

Notes

¹RepRapFirmware 1.14 and later support the T parameter, to allow the step pulse width and interval to be lengthened for those drivers that need it. If no T parameter is given, then the step pulse width and interval are guaranteed to be suitable for the on-board drivers. Currently, RepRapFirmware only remembers the highest T parameter seen in any M569 command, and applies that value to all drivers for which any nonzero T parameter was specified.

Some versions of RepRapFirmware prior to 1.14 also provide XYZ and E parameters to allow the mapping from axes and extruders to stepper driver numbers to be changed. From 1.14 onward, this functionality is provided by M584 instead.

M570: Configure heater fault detection

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	???	No

Parameters for RepRapFirmware 1.14 and earlier

Snnn Heater timeout (in seconds)

Example

M570 S120

After a heater has been switched on, wait 120 seconds for it to get close to the set temperature. If it takes longer than this, raise a heater fault.

Parameters for RepRapFirmware 1.15e and later

Hnnn Heater number

Pnnn Time in seconds for which a temperature anomaly must persist on this heater before raising a heater fault (default 5 seconds)

Tnnn Permitted temperature excursion from the setpoint for this heater (default 10C)

Example

M570 H1 P4 T15

Warning! Heating fault detection is provided to reduce the risk of starting a fire if a dangerous fault occurs, for example if the heater cartridge or thermistor falls out of the heater block. You should not increase the detection time or permitted temperature excursion without good reason, because doing so will reduce the protection.

M571: Set output on extrude

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	???	No

Parameters

Snnn Output value

Fnnn Output PWM frequency (RepRapFirmware 1.17 and later)

Pnnn Logical pin number (RepRapFirmware 1.17 and later), defaults to the FAN0 output until M571 with a P parameter has been seen

Example

M571 P3 F200

M571 S0.5

This turns the controlled pin output on whenever extrusion is being done, and turns it off when the extrusion is finished. The output could control a fan or a stirrer or anything else that needs to work just when extrusion is happening. It also can be used to control a laser beam. The S parameter sets the value of the PWM to the output. 0.0 is off; 1.0 is fully on.

In RepRapFirmware 1.17 and later you can use the P parameter to change the pin used and you can also set the PWM frequency. Pin numbers are the same as in the M42 and M280 commands. The pin you specify must not be in use for anything else, so if it is normally used as a heater you must disable the heater first using M307, or if it is used for a fan you must disable the fan using M106 with the I-1 parameter.

M572: Set or report extruder pressure advance

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	dc42, ch, dn	No	???	???	???	No

Parameters

Dnnn Extruder number

Snnn Pressure advance amount (in seconds)

Example

M572 D0 S0.1

This sets the pressure advance coefficient (S parameter) for the specified extruder (D parameter). Supported by RepRapFirmware-dc42, -ch and -dn.

Pressure advance causes the extruder drive position to be advanced or retarded during printing moves by an additional amount proportional to the rate of extrusion. At the end of a move when the extrusion rate is decreasing, this may result in the extruder drive moving backwards (i.e. retracting). Therefore, if you enable this feature, you may need to reduce the amount of retraction you use in your slicing program to avoid over-retraction.

With Bowden extruders, an S value between 0.1 and 0.2 usually gives the best print quality.

Older versions of RepRapFirmware used the P parameter to specify the drive number, instead of using D to specify the extruder number.

M573: Report heater PWM

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	???	No

Parameters

Pnnn Heater number

Example

M573 P1

This gives a running average (usually taken over about five seconds) of the PWM to the heater specified by the P field. If you know the voltage of the supply and the resistance of the heater this allows you to work out the power going to the heater. Scale: 0 to 1.

M574: Set endstop configuration

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	???	No

Parameters

Xnnn Switch type for X axis

Ynnn Switch type for Y axis

Znnn Switch type for Z axis

E Select extruder endstops to define active high or low (RepRapFirmware 1.16 and earlier only)

Snnn Logic level

Example

M574 X1 Y2 Z0 S1 ; X endstop at low end, Y endstop at high end, no Z endstop, all active high

This defines the type of endstop switch or opto sensor that the printer has for each axis: 0 = none, 1 = low end, 2 = high end. The optional S parameter defines whether the endstop input is active high (S1, the default) or low (S0). A normally-closed endstop switch wired in the usual way produces an active high output (S1).

This is intended for use with boards that provide a single endstop input for each axis that may be used for either a high or a low end endstop, such as the Duet. On delta printers, the XYZ parameters refer to the towers and the endstops should normally all be high end (i.e. at the top of the towers).

In RepRapFirmware 1.16 and earlier, the M574 command with E parameter is used to specify whether a Z probe connected to the E0 endstop input produces an active high (S1) or active low (S0) output. In RepRapFirmware 1.17 and later, use the I parameter of the M558 command instead.

M575: Set serial comms parameters

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	???	No

Parameters

Pnnn Serial channel number

Bnnn Baud rate

Snnn Whether checksums should be used

Example

M575 P1 B57600 S1

This sets the communications parameters of the serial comms channel specified by the P parameter. P0 specifies the main serial interface (typically a USB port, or serial-over-USB), while P1 specifies an auxiliary serial port (for example, the port used to connect a PanelDue). The B parameter is the required baud rate (this parameter is typically ignored if the port is a true USB port). The S parameter is a bitmap of features. The lowest bit, if set, specifies that only commands that include a valid checksum should be accepted from this comms channel.

M577: Wait until endstop is triggered

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	No	???	???	No

Parameters

Snnn Desired endstop level

Xnnn Select X axis endstop

Ynnn Select Y axis endstop

Znnn Select Z axis endstop

Ennn Select extruder drive endstop

Example

M577 E0 S1

Wait for an endstop switch to be pressed. The example above will wait until the first extruder endstop is triggered.

The following trigger types may be used using the 'S' parameter:

0: Endstop not hit 1: Low endstop hit 2: High endstop hit 3: Near endstop (only Z probe)

M578: Fire inkjet bits

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	No	???	???	No

Parameters

Pnnn Inkjet head number

Snnn Bit pattern

Example

M578 P3 S5

This fires inkjet head 3 (the P field) using the bit pattern specified by the S field. The example shown would fire bits 101. If the P parameter is omitted inkjet 0 is assumed.

This is a version of the M700 command used by the Inkshield, but unfortunately M700 is already taken so cannot be used for that in the standard.

M579: Scale Cartesian axes

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	No	???	???	No

Parameters

Xnnn Scale factor for X axis

Ynnn Scale factor for Y axis

Znnn Scale factor for Z axis

Example

M579 X1.0127 Y0.998

On a Cartesian RepRap you can get prints exactly the right size by tweaking the axis steps/mm using the M92 G Code above. But this does not work so easily for Delta and other RepRaps for which there is cross-talk between the axes. This command allows you to adjust the X, Y, and Z axis scales directly. So, if you print a part for which the Y length should be 100mm and measure it and find that it is 100.3mm long then you set Y0.997 (= 100/100.3).

M580: Select Roland

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	No	???	???	No

Parameters

Rnnn Whether Roland mode should be activated

Pnnn Initial text to send to the Roland controller

Example

M580 R1 PVS4;!VZ2;!MC1;

This is not really anything to do with RepRap, but it is convenient. The little Roland mills (http://www.rolanddg.com/product/3d/3d/mdx-20_15/mdx-20_15.html) are very widely available in hackerspaces and maker groups, but annoyingly they don't speak G Codes. As all RepRap firmware includes a G-Code interpreter, it is often easy to add functions to convert G Codes to Roland RML language (http://altlab.org/d/content/m/pangelo/ideas/rml_command_guide_en_v100.pdf) . M580 selects a Roland device for output if the R field is 1, and returns to native mode if the R field is 0. The optional P string is sent to the Roland if R is 1. It is permissible to call this repeatedly with R set to 1 and different strings in the P field to communicate directly with a Roland.

M581: Configure external trigger

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	No	???	???	No

Parameters

Tnn Logical trigger number to associate the endstop input(s) with, from zero up to a firmware-specific maximum (e.g. 9 for RepRapFirmware)

X, Y, Z, E Selects endstop input(s) to monitor

P Reserved, may be used in future to allow general I/O pins to cause triggers

S Whether trigger occurs on a rising edge of that input (S1, default), falling edge (S0), or ignores that input (S-1). By default, all triggers ignore all inputs.

C Condition: whether to trigger at any time (C0, default) or only when printing a file from SD card (C1)

Example

M581 E1:2 S1 T2 C1 ; invoke trigger 2 when a rising edge is detected on the E1 or E2 endstop input and a file is being printed from SD card

When M581 is executed, if the T parameter is present but the other parameters are omitted, the trigger inputs and edge polarities for that trigger number are reported. Otherwise, the specified inputs and their polarities are added to the conditions that cause that trigger. Using S-1 with no X Y Z or E parameters sets the trigger back to ignoring all inputs.

In RepRapFirmware, trigger number 0 causes an emergency stop as if M112 had been received. Trigger number 1 causes the print to be paused as if M25 had been received. Any trigger number # greater than 1 causes the macro file sys/trigger#.g to be executed. Polling for further trigger conditions is suspended until the trigger macro file has been completed. RepRapFirmware does not wait for all queued moves to be completed before executing the macro, so you may wish to use the M400 command at the start of your macro file. If several triggers are pending, the one with the lowest trigger number takes priority.

M582: Check external trigger

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	No	???	???	No

Parameters

T Trigger number to poll

Example

M582 T2 ; check levels of inputs that give rise to trigger #2

Triggers set up by the M581 command are normally activated only when the specified inputs change state. This command provides a way of causing the trigger to be executed if the input is at a certain level. For each of the inputs associated with the trigger, the trigger condition will be checked as if the input had just changed from the opposite state to the current state.

For example, if you use M581 to support an out-of-filament sensor, then M582 allows you to check for out-of-filament just before starting a print.

M583: Wait for pin

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	{soon}	No	No	???	???	No

Parameters

Pnnn Pin number

Sn State to wait for (0 or 1) or analogue tolerance

Rnnn Analogue value to wait for (between 0.0 and 1.0)

Example

M583 P5 S0 ; Wait for Pin 5 to become 0

This allows you, for example, to turn on a DC motor (see the M42 command) then wait until a switch connected to Pin Pnnn gives the value Sn.

If the R field is present, then the system waits until the value on analogue Pnnn is reached. In this case the S value is used as a tolerance, so M583 P8 R0.7 S0.01 would wait until the analogue value on Pin 8 was between 0.69 and 0.71.

M584: Set drive mapping

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Version 1.14 and later	No	No	???	???	No

Parameters

Xnnn Driver number(s) for X motor(s)

Ynnn Driver number(s) for Y motor(s)

Znnn Driver number(s) for Z motor(s)

U,V,Wnnn Driver number(s) for additional axes U, V and W (RepRapFirmware 1.16 and later)

Ennn Driver number(s) for E motor(s)

Snnn Special functions (to be defined)

Example

M584 X0 Y1 Z2:3 E4:5:6 ; Driver 0 controls the X motor, 1 controls the Y motor, 2 and 3 control the Z motors, 4 and 5 control the E motors

Assigning a drive using M584 does not remove its old assignment. Therefore, if you assign a drive that defaults to being an extruder drive, you should also assign the extruder drives explicitly as in the above example. Failure to do so may result in unexpected behaviour.

You can use M584 to create additional axes - for example, to represent additional carriages on a machine with multiple independent X carriages. You should not create axis W unless you also create axis V, and you should not create axis V unless you also create axis U.

M585: Probe Tool

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Template:Soon	No	No	???	???	No

In machines with a tool probe this probes the currently selected tool against it and corrects the offsets set by the G10 command (q.v.).

Parameter; one of

Xnnn

Y-nnn

Znnn

Where the absolute value of nnn is the radius of the tool plus the radius of the probe in that direction. So M585 X1.5 will set the X offset of a 1mm diameter tool against a 2mm diameter probe, etc. If the value of nnn is positive the tool is moved in the positive direction towards the probe until it touches. If it is negative, the tool moves the other way.

So the process should be:

Set the values as closely as known in the G10 command.

Move to a position slightly offset from the probe then execute M585s in X, Y and Z in the tool selection macro to set them precisely.

After this, the G10 command on its own can be used to report the values.

M590: Report current tool type and index

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	No	No	No	No	No

Report the current tool type, which may be "Extruder," "Picker," "Laser," "Foam Cutter," "Milling," or any others implemented by the machine. Also report the tool index, such as "0x01" for the second extruder.

Example

M590

echo: Extruder 0x00

M600: Set line cross section

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	???	???	No	Yes	???	???	???	No

Example: M600 P0.061

Sets the cross section for a line to extrude in velocity extrusion mode. When the extruder is enabled and movement is executed the amount of extruded filament will be calculated to match the specified line cross section.

M600: Filament change pause

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	???	???	Use macro files instead	No	???	???	???	Yes

Example: M600

Pause for filament change X[pos] Y[pos] Z[relative lift] E[initial retract] L[later retract distance for removal].

M605: Set dual x-carriage movement mode

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	???	No	Use M563	No	???	???	???	Yes

Example: M605 S1

Sets the dual x-carriage movement mode: S<mode> [X<duplication x-offset> R<duplication temp offset>].

M605 S0: Full control mode. The slicer has full control over x-carriage movement M605 S1: Auto-park mode. The inactive head will auto park/unpark without slicer involvement M605 S2 [Xnnn] [Rmmm]: Duplication mode. The second extruder will duplicate the first with nnn millimeters x-offset and an optional differential hotend temperature of mmm degrees. E.g., with "M605 S2 X100 R2" the second extruder will duplicate the first with a spacing of 100mm in the x direction and 2 degrees hotter.

M665: Set delta configuration

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	No	Yes	Yes	No	???	???	???	Yes

Parameters

Lnnn Diagonal rod length**Rnnn** Delta radius**Snnn** Segments per second¹**Bnnn** Safe printing radius²**Hnnn** Nozzle height above the bed when homed after allowing for endstop corrections²**Xnnn** X tower position correction³**Ynnn** Y tower position correction³**Znnn** Z tower position correction³

Examples

M665 L250 R160 S200 (Marlin)

M665 L250 R160 B80 H240 X0 Y0 Z0 (RepRapFirmware)

Set the delta calibration variables.

I don't think it's a good idea to have two different implementations for the same G-code, and I also question the practical value of specifying the print bed radius when defining a delta configuration, since many delta printers use a square or rectangular print bed. So perhaps we should stick to the Marlin-defined command as the definition for this command, and use a different command or set of commands to define print bed shape and size. --AndrewBCN (talk) 23:10, 31 January 2015 (PST)

The implementations are not different, they have the same L and R parameters, but each has additional parameters that are not relevant to the other implementation. I'm not against defining a new Gcode to define bed size and shape; however, you can already define the limits of a rectangular print area using M208. Even when a delta printer has a square bed, the printable area is not square. It is usually taken to be circular, although it is in reality more complicated. My purpose in adding the B parameter was to make it easy to define a radius outside which movement will not normally be attempted. I have changed "bed radius" to "safe printing radius" in the text to help clarify this. --dc42

Notes

¹Only supported on Marlin.²Only supported in RepRapFirmware.³X, Y and Z tower angular offsets from the ideal (i.e. equilateral triangle) positions, in degrees, measured anti-clockwise looking down on the printer.**M666: Set delta endstop adjustment**

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	Yes	Yes	Yes	No	???	???	???	Yes

Parameters

Xnnn X axis endstop adjustment**Ynnn** Y axis endstop adjustment**Znnn** Z axis endstop adjustment**Annn** X bed tilt in percent¹**Bnnn** Y bed tilt in percent¹

Example

M666 X-0.1 Y+0.2 Z0

Sets delta endstops adjustments.

In RepRapFirmware and Repetier, positive endstop adjustments move the head closer to the bed when it is near the corresponding tower. In Marlin and Smoothieware, negative endstop corrections move the head closer to the bed when it is near the corresponding tower.

In Marlin, only negative endstop corrections are allowed.

In Repetier the endstop corrections are expressed in motor steps. In other firmwares they are expressed in mm.

¹RepRapFirmware 1.16 and later.**M667: Select CoreXY mode**

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	???	No

Parameters

Snnn CoreXY mode

Xnnn X axis scale factor**Ynnn** Y axis scale factor**Znnn** Z axis scale factor

Example

M667 S1

M667 S0 selects Cartesian mode (unless the printer is configured as a delta using the M665 command). Forward motion of the X motor moves the head in the +X direction. Similarly for the Y motor and Y axis, and the Z motor and Z axis. This is the default state of the firmware on power up.

M667 S1 selects CoreXY mode. Forward movement of the X motor moves the head in the +X and +Y directions. Forward movement of the Y motor moves the head in the -X and +Y directions.

M667 S2 selects CoreXZ mode. Forward movement of the X motor moves the head in the +X and +Z directions. Forward movement of the Z motor moves the head in the -X and +Z directions.

M667 S3 selects CoreYZ mode. Forward movement of the Y motor moves the head in the +Y and +Z directions. Forward movement of the Z motor moves the head in the -Y and +Z directions.

Additional parameters X, Y and Z may be given to specify factors to scale the motor movements by for the corresponding axes. For example, to specify a CoreXZ machine in which the Z axis moves 1/3 of the distance of the X axis for the same motor movement, use M667 S2 Z3. The default scaling factor after power up is 1.0 for all axes.

To change the motor directions, see the M569 command.

M668: Set Z-offset compensations polynomial

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	dc42-cmm	No	???	???	???	No

Polynomial compensation is an experimental method to compensate for geometric distortion of a delta machine Z-plane. After the bed is compensated with the set of G30 points, there remains error. This method fits a 6th degree polynomial with independent origins for each order to the residual error data (using a simulated annealing technique on the host). The polynomial is communicated and controlled through M668. Because the polynomial takes many floating point operations to compute each point, the firmware builds a grid of values, and used bi-linear interpolation to adjust the actual Z-axis offset error estimate.

For the polynomial used, 40 parameters are specified. The I parameter allows the coefficients to be loaded a few at a time, which limits the size of the G-code string. The index starts with 1, not with 0.

M668 Ix S[list of values] sets the polynomial parameters starting at index x, if index present and != 0.

M668 R recomputes the grid based on the current parameters.

M668 P[0|1] turns off or on the polynomial compensation.

Typical use would be:

M668 I1 S4.882E-17:0:0 M668 I3 M668 R P1

Which sets the list, computes the interpolation grid, and then enables compensation.

M700: Level plate

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	bq	No	No	No	No	No	No	No	bq

Example: M700

Script to adjust the plate level.

M701: Load filament

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	bq	No	No	No	No	No	No	No	bq

¹ only in bq-Marlin Firmware

Example: M701

M702: Unload filament

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	bq	No	No	No	No	No	No	No	bq

¹ only in bq-Marlin Firmware

Example: M702

M703: Get Board Type

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	bq	No	No	No	No	No	No	No	bq

¹ only in bq-Marlin Firmware

Example: M703

M710: Erase the EEPROM and reset the board

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	bq	No	No	No	No	No	No	No	bq

¹ only in bq-Marlin Firmware

Example: M710

M800: Fire start print procedure

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	bq	No	No	No	No	No	No	No	bq

¹ only in bq-Marlin Firmware

Example: M800

M801: Fire end print procedure

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	bq	No	No	No	No	No	No	No	bq

¹ only in bq-Marlin Firmware

Example: M801

M851: Set Z-Probe Offset

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	???	???	???	Yes	???	???	Use G31	???	???	???	???	Use M666 P

Sets the Z-probe Z offset. This offset is used to determine the actual Z position of the nozzle when using a probe to home Z with G28. This value may also be used by G29 to apply correction to the Z position.

This value represents the distance from nozzle to the bed surface at the point where the probe is triggered. This value will be negative for typical switch probes, inductive probes, and setups where the nozzle makes a circuit with a raised metal contact. This setting will be greater than zero on machines where the nozzle itself is used as the probe, pressing down on the bed to press a switch. (This is a common setup on delta machines.)

This setting is saved in the EEPROM by M500 and restored by M501. The default (as reset by M502) is set by the Z_PROBE_OFFSET_FROM_EXTRUDER setting in Configuration.h.

Note that in Marlin 1.1.0 and up **M851** sets the value literally as given, while Marlin 1.0.2 negates the absolute value.

The examples below will set the Z-probe Z offset to -4mm (below the nozzle):

M851 in Marlin 1.0.2

```
M851 Z4 ; Set the Z probe offset to -4
```


M851 in Marlin 1.1.0

```
M851 Z-4 ; Set the Z probe offset to -4
```

M905: Set local date and time

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	1.16 and later	No	???	???	No	No

Parameters

Pnnn Current date in the format YYYY-MM-DD**Snnn** Current time in the format HH:MM:SS

Example

M905 P2016-10-26 S00:23:12

Updates the machine's local date and time or reports them if no parameters are specified. The time should be specified in 24-hours format as in "13:45" instead of 1:45PM.

M906: Set motor currents

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	M907?	Yes	No	???	???	Yes	No

Parameters

Xnnn X drive motor current**Ynnn** Y drive motor current**Znnn** Z drive motor current**Ennn** E drive(s) motor current(s)**Innn** Motor current idle factor (0..100)¹**H1** Set/Get Motor currents used for the downward Z-probe homing movement ²

Example

M906 X300 Y500 Z200 E350:350

Sets the currents to send to the stepper motors for each axis. The values are in milliamps.

Notes

¹RepRapFirmware supports an additional I parameter. This is the percentage of normal that the motor currents should be reduced to when the printer becomes idle but the motors have not been switched off. The default value is 30%.

²RepRapFirmware, DC42 version, cmm sub-version supports "H1", which sets the XYZ motor currents used during Z-probing temporarily to different (typically lower) value. If "H1" is specified, the homing current is set, otherwise it operates normally. The homing current should be specified after the main current is set. The actual motor current is not changed until the next Z-probe operation. Lower motor currents reduce vibration during Z-probe motions.

M907: Set digital trimpot motor

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	Yes	Yes	Use M906	No	???	???	Yes	Yes

Set digital trimpot motor current using axis codes (X, Y, Z, E, B, S). In Repetier (<http://reprap.org/wiki/Repetier>) , it sets the current in Percent. In Redeem (https://bitbucket.org/intelligentagent/redeem/src/6153607ded91c100fb4e41e936e6d045e19eda29/redeem/gcodes/M907.py?at=slave_stepper) , it sets the current in A (where M906 does in mA).

M908: Control digital trimpot directly

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	Yes: 0.92	No	No	No	???	???	???	Yes

M908 P<pin> S<current>

M909: Set microstepping

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Use M350	Use M350	No	Use M350	No	???	???	Yes	Use M350

Example:

```
M909 X3 Y5 Z2 E3
```

Set the microstepping value for each of the steppers. In Redeem this is implemented as powers of 2 so...

```
M909 X2 ; set microstepping on X-axis to 2^2 = 4
M909 Y3 ; set microstepping on Y-axis to 2^3 = 8 etc.
```

M910: Set decay mode

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	No	No	???	???	Yes	No

Example:

```
M910 X3 Y5 Z2 E3
```

Set the decay mode for each stepper controller The decay mode controls how the current is reduced and recycled by the H-bridge in the stepper motor controller. It varies how the implementations are done in silicone between controllers. Typically you have an on phase where the current flows in the target current, then an off phase where the current is reversed and then a slow decay phase where the current is recycled.

M911: Set power monitor threshold voltages

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	No	No

Parameters

Pnnn Power monitor channel, default 0

Snnn Undervoltage threshold

Tnnn Overvoltage threshold

Example:

```
M911 P0 S20 T27.5
```

Sets the minimum supply voltage for which correct operation of the printer mechanics is guaranteed and stepper motor positions are guaranteed to be held for all enabled drivers, and/or the maximum safe voltage above which sensitive parts of the machine should be shut down. M911 with no parameters or with just the P parameter reports the current thresholds.

M912: Set electronics temperature monitor adjustment

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	No	No

Parameters

Pnnn Temperature monitor channel, default 0

Snnn Value to be added to the temperature reading in degC

Example:

```
M912 P0 S10.5
```

Many microcontrollers used to control 3D printers have built-in temperature monitors, but they normally need to be calibrated for temperature reading offset. The S parameter specifies the value that should be added to the raw temperature reading to provide a more accurate result.

M913: Set motor percentage of normal current

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	No	No

Parameters

X, Y, Z, E Percentage of normal current to use for the specified axis or extruder motor(s)

Example:

```
M913 X50 Y50 Z50 ; set X Y Z motors to 50% of their normal current
M913 E30:30 ; set extruders 0 and 1 to 30% of their normal current
```

This allows motor currents to be set to a specified percentage of their normal values as set by M906. It can be used (for example) to reduce motor current during course homing, to make homing quieter or to reduce the risk of damage to endstops, and to reduce current while loading filament to guard against the possibility of feeding too much filament. Use M913 again with the appropriate parameters set to 100 to restore the normal currents.

M928: Start SD logging

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	No	No	No	No	???	???	???	Yes

Example:

```
M928 filename.g
```

Stop SD logging with **M29**.

M997: Perform in-application firmware update

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	No	???	No	No

Parameters

Snnn Firmware module number(s), default 0

Example

M997 S0:1 - update firmware modules 0 and 1

This command triggers a firmware update if the necessary files are present on the SD card. In RepRapFirmware on the Duet series, module numbers are as follows:

0 - main firmware, filename sys/RepRapFirmware.bin (Duet) or sys/DuetWiFiFirmware (Duet WiFi). File sys/iap.bin (Duet) or sys/iap4e.bin (Duet WiFi) must also be present.

1 - web server firmware, filename sys/DuetWiFiServer.bin

2 - web server file system, filename sys/DuetWebControl.bin

3 - put the WiFi module into bootloader mode, so that firmware can be uploaded directly via its serial port

M998: Request resend of line

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	No	No	No	Yes	No	???	???	???	???

Parameters

Pnnn Line number

Example

M998 P34

Request a resend of line 34. In some implementations the input-handling code overwrites the incoming G Code with this when it detects, for example, a checksum error. Then it leaves it up to the GCode interpreter to request the resend.

M999: Restart after being stopped by error

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	No	No	No	Yes	No	Yes	Yes	No	???	???	???	Yes

Parameters

This command can be used without any additional parameters.

Pnnn Reset flags¹

Example

M999

Restarts the firmware using a software reset.

Notes

¹The dc42 fork of RepRapFirmware not only resets the board but also puts the board into firmware upload mode if parameter PERASE is present.

Other commands

G: List all G-codes

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	???	???	???	No	???	???	No	???	???	???	Yes	No

Example: G

This lists all implemented G-codes in the firmware with description and sends it back to the host.

(Note: this has been implemented in Redeem, and so is only a proposition)

M: List all M-codes

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	???	???	???	No	???	???	No	???	???	???	Yes	No

Example: M

This lists all implemented M-codes in the firmware with description and sends it back to the host.

(Note: this has been implemented in Redeem, and so is only a proposition)

T: Select Tool

Support	FiveD	Teacup	Sprinter	Marlin	Repetier	Smoothie	RepRapFirmware	Machinekit	MakerBot	grbl	Redeem	MK4duo
	Yes	Yes	No	Yes	Yes	Yes	Yes	???	???	???	Yes	Yes

Parameters

This command can be used without any additional parameters.

Pnnn: Bitmap of all the macros to be run (only RRF 1.17b or later)

Tool number

Example

T1

Select tool (or in older implementations extruder) number 1 to build with.

The sequence followed is:

1. Set the current tool to its standby temperatures specified by G10 (see above),
2. Set the new tool to its operating temperatures specified by G10 and wait for **all** temperatures to stabilise,
3. Apply any X, Y, Z offset for the new tool specified by G10,
4. Use the new tool.

Selecting a non-existent tool (100, say) just does Step 1 above¹. That is to say it leaves all tools in their standby state. You can, of course, use the G10 command beforehand to set that standby temperature to anything you like.

Note that you may wish to move to a parking position *before* executing a T command in order to allow the new extruder to reach temperature while not in contact with the print. It is acceptable for the firmware to apply a small offset [by convention (-1mm x tool-number) in Y] to the current position when the above sequence is entered to allow temperature changes to take effect just away from the parking position. Any such offset must, of course, be undone when the procedure finishes.

If the Z value changes in the offsets and the tool moves up, then the Z move is made before the X and Y moves. If Z moves down, X and Y are done first.

Some implementations (e.g. RepRapFirmware) allow you to specify tool-change G Code macros². There are normally three specified (any of which can contain no commands if desired) that execute in this order:

1. Actions to do with the old tool before it is released - macro name: **tfreeN.g** where N is the tool number;
2. (Old tool is released);
3. Actions to do with the new tool before it is selected - macro name: **tpreN.g** where N is the tool number;
4. (New tool is selected); and
5. Actions to do with the new tool after it is selected - macro name: **tpostN.g** where N is the tool number.

With such implementations there is no wait for temperature stabilisation. That can be achieved by an M116 in any of the macros, of course. However be aware that recent RepRapFirmware versions does NOT run any tool change macros if the axes are not homed.

After a reset tools will not start heating until they are selected. You can either put them all at their standby temperature by selecting them in turn, or leave them off so they only come on if/when you first use them. The M0, M1 and M112 commands turn them all off. You can, of course, turn them all off with the M1 command, then turn some back on again. Don't forget also to turn on the heated bed (if any) if you use that trick.

Tool numbering may start at 0 or 1, depending on the implementation. Some implementations (those that use the M563 command to define tools) allow the user to specify tool numbers, so with them you can have tools 17, 99 and 203 if you want. Negative numbers are not allowed.

Notes

¹ For RepRapFirmware, selecting a non-existent tool also removes any X/Y/Z offset applied for the old tool.

² Under special circumstances, the execution of those macro files may not be desired. RepRapFirmware 1.17b or later supports an optional P parameter to specify which macros shall be run. If it is absent then all of the macros above will be run, else you can pass a bitmap of all the macros to be executed. The bitmap of this value consists of tfree=1, tpre=2 and tpost=4.

Proposed EEPROM configuration codes

BRIEFLY: each RepRap has a number of physical parameters that should be persistent, but easily configurable, such as extrusion steps/mm, various max values, etc. Those parameters are currently hardcoded in the firmware, so that a user has to modify, recompile and re-flash the firmware for any adjustments. These configs can be stored in MCU's EEPROM and modified via some M-codes. Please see the detailed proposal at M-codes for EEPROM config. *(This is proposed by --AlexRa on 11-March-2011. There is currently no working implementation of the proposed commands).*

Marlin uses codes M500-M503 to manipulate EEPROM values.

Sprinter has implemented the following commands to manipulate EEPROM Commit message (<https://github.com/kliment/Sprinter/commit/4b1b0f1d96d2be2ed3941095f40a5c2d2bbb943d>) .

Teacup uses codes M130-M136 to set, read, and save some parameters.

Replies from the RepRap machine to the host computer

All communication is in printable ASCII characters. Messages sent back to the host computer are terminated by a newline and look like this:

xx [line number to resend] [T:93.2 B:22.9] [C: X:9.2 Y:125.4 Z:3.7 E:1902.5] [Some debugging or other information may be here]

xx can be one of:

ok

rs

!!

ok means that no error has been detected.

rs means resend, and is followed by the line number to resend.

!! means that a hardware fault has been detected. The RepRap machine will shut down immediately after it has sent this message.

The **T:** and **B:** values are the temperature of the currently-selected extruder and the bed respectively, and are only sent in response to M105. If such temperatures don't exist (for example for an extruder that works at room temperature and doesn't have a sensor) then a value below absolute zero (-273°C) is returned.

C: means that coordinates follow. Those are the **X:** **Y:** etc values. These are only sent in response to M114 and M117.

The RepRap machine may also send lines that look like this:

// This is some debugging or other information on a line on its own. It may be sent at any time.

Such lines will always be preceded by **//**.

On the latest version of Pronterface and Octoprint (1.2.0+) a special comment of the form:

// action:command

is allowed to be sent from the firmware, the command can currently be pause, resume or disconnect which will execute those commands on the host. As this is also a comment other hosts will just ignore these commands.

The most common response is simply:

ok

When the machine boots up it sends the string

start

once to the host before sending anything else. This should not be replaced or augmented by version numbers and the like. M115 (see above) requests those.

All this means that every line sent by RepRap to the host computer except the start line has a two-character prefix (one of **ok**, **rs**, **!!** or **//**). The machine should never send a line without such a prefix.

Exceptions:

1. Marlin 1.0.0 Gen6 Firmware does not follow the two character rule. 'rs' is actually 'Resend' and '!!' is 'Error'. Example Lines:

- Error: Line Number is not current line + 1. Last Line: 7
- Resend: 8
- Writing to File: print.gco
- Done saving file.
- File opened:print.gco Size:22992
- File selected

When in the code base did this change take place and what other firmwares are affected?

2. The dc42 fork of RepRapFirmware responds to some commands with a reply string in JSON format, terminated by a newline. This allows later firmware revisions to include additional information without confusing clients (e.g. PanelDue) that do not expect it, and to make responses self-describing so that the client will not be confused if responses are delayed or lost. The commands affected are:

- M105 S2
- M105 S3
- M20 S2
- M36
- M408

Proposal for sending multiple lines of G-code

So far, this is a proposal, open for discussion.

Problem to solve

When using Marlin firmware or emulating Marlin, each line of G-code sent from the host to the controller is answered with an **ok** before the next line can be sent without locking communications up. This slows down communication and limits the number of commands that can be sent per second to the printer controller, as the USB stack on the host and the serial interface driver on the Arduino add their own latencies (up to 10 milliseconds). This is not a problem for other controller electronics using native USB such as the Duet, because the standard serial-over-USB drivers provide flow control, so the host software can be configured so as not to wait for the **ok**.

For more details on this proposal, some suggested solutions and comments, please see [GCODE_buffer_multiline_proposal](#)

Alternatives to G-code

Main article: [Firmware/Alternative#alternatives to G-code](#)

Several people have suggested using STEP-NC or some other control language; or perhaps designing a completely new control language.

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