

G-code

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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 as well. See also on Wikipedia's G-code article (<https://en.wikipedia.org/wiki/G-code>).

There are a few different ways to prepare G-code for a printer. One method would be to use a slicing program such as Slic3r, Skeinforge or Cura. These programs import a CAD model, slice it into layers, and output the G-code required to print each layer. Slicers are the easiest way to go from a 3D model to a printed part, however the user sacrifices some flexibility when using them. Another option for G-code 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 G-code 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. This particular page 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**.

Unfortunately human nature being what it is, the best procedures aren't always followed, so some multiple uses of the same code exist. The rule which should be followed is that later appearances of a code on this page (later 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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 - 12.4.7 D5: Read/Write FLASH
 - 12.4.8 D6: Read/Write external FLASH
 - 12.4.9 D7: Read/Write Bootloader
 - 12.4.10 D8: Read/Write PINDA
 - 12.4.11 D9: Read/Write ADC
 - 12.4.12 D10: Set XYZ calibration = OK
 - 12.4.13 D12: Time
 - 12.4.14 D80: Bed check
 - 12.4.15 D81: Bed analysis
 - 12.4.16 D106: Print measured fan speed for different pwm values
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Introduction

A typical piece of G-code as sent to a RepRap machine might look like this:

```
M3 T0*S7
M4 G92 E0*67
M5 G28*22
M6 G1 F1500.0*82
M7 G1 X2.0 Y2.0 F3000.0*85
M8 G1 X3.0 Y3.0*33
```

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

```
G92 E0
G28
G1 F1500
M1 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 G-code 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 G-code(s) are implemented in any given firmware, there are little tables attached to the command descriptions, like this one:

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Partial	???	Experimental	???	???	???	Partial	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	???	Yes	???	Yes	Automatic	Yes

Here means:

```
{{yes}}
  The G-code is fully supported by the firmware.
{{partial}} or {{experimental}}
  There is some support for the G-code. 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 G-code automatically, so there's no need to send the command. An example is power supply on/off G-code (M80/M81) in the Teacup firmware.
{{???}}
  It is unknown if the firmware supports this G-code. You may want to test this yourself before using it in production.
{{no}}
  The firmware does not support this G-code.
```

For the technically-minded, G-code 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 G-code 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 G-code 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.

Case sensitivity

The original NIST G-code standard requires gcode interpreters to be case-insensitive, except for characters in comments. However, not all 3D printer firmwares conform to this and some recognise uppercase command letters and parameters only.

Firmwares that are known to be case-insensitive

RepRapFirmware version 1.19 and later (except within quoted strings)

Firmwares that are known to be case-sensitive

RepRapFirmware version 1.18 and earlier

Quoted strings

In RepRapFirmware, some commands support quoted strings when providing file names and other string parameters. This allows file names, WiFi passwords etc. to contain spaces, semicolons and other characters that would otherwise not be permitted. Double-quote characters are used to delimit the string, and any double-quote character within the string must be repeated.

Unfortunately, many gcode sender programs convert all characters to uppercase and don't provide any means to disable this feature. Therefore, within a quoted-string, the single-quote character is used as a flag to force the following character to lowercase. If you want to include a single quote character in the string, use two single quote characters to represent one single quote character.

Example: to add SSID MYROUTER with password ABCxyz;" 123 to the WiFi network list, use command:

```
M587 S"MYROUTER" P"ABCxyz;" " 123"
```

or if you can't send lowercase characters:

```
M587 S"MYROUTER" P"ABC'X'Y'Z;" " 123"
```

Comments

G-code comments begin at a semicolon, and end at the end of the line:

```

;3 70*57 ; This is a comment
;4 G92 E0*67
; So is this
;5 G28*22

```

Some firmwares also obey the CNC G-code standard, which is to enclose comments in round brackets. Comments of this form must start and end on the same line:

```

!(Home some axes)
G28 (here come the axes to be homed) X Y

```

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 G-code to your printer, as this saves bandwidth.

Special fields

N: Line number

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes	Yes	???	???	Yes	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	Yes	???	Yes	Yes	Yes	Yes	Yes

Example

```

;123

```

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

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

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.

The firmware compares the checksum against a locally-computed value. If they differ, it requests a repeat transmission of the line.

Checking

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

Example

```
#123 [...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 G-code string "cmd" (including its line number) is computed by xor-ing the bytes in the string up to and not including the * character as follows:

```
uint 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.

Conditional Execution and Loops

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

RepRapFirmware 3.01 and later supports conditions and loops in GCode, and expression evaluation in the parameters to GCode commands. Properties from the firmware object model (e.g. current position, current tool) can be included in expressions. See https://duet3d.dozuki.com/Wiki/GCode_Meta_Commands for details.

Buffering

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes	???	???	???	???	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	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.

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes	Yes	Yes	???	Yes	Yes	Yes
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

- G0 : Rapid 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)
 Hnnn (RepRapFirmware) Flag to check if an endstop was hit (*S1 to check, S0 to ignore, S2 see note, default is S0*)¹
 Snnn Laser cutter/engraver power. In RepRapFirmware, when not in laser mode S is interpreted the same as H.

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.

```
G1 F1500 ; Set feedrate to 1500mm/m
G1 X50 Y25.3 E22.4 ; Move and extrude
```

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

```
G1 F1500 ; Feedrate 1500mm/m
G1 X50 Y25.3 E22.4 F3000 ; Accelerate to 3000mm/m
```

However, in the above example, we set a feedrate of 1500 mm/m, then do the same move, but accelerating to 3000 mm/m. Everything stays synchronized, so extrusion accelerates right along with X and Y movement.

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 a way that ensures 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. In RepRapFirmware, G1 is always a linear move but G0 may not be linear (e.g. on a SCARA machine); however a G0 move will never go below the lower of the initial and final Z height of the move.

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes ¹	Yes	Yes	Yes	???	Yes ²	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	Yes	Yes	No	No	Yes	Experimental	No	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
 Innn 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
 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)

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 printers. ²Prusa Firmware implements arcs only in Cartesian XY.

G4: Dwell

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Pause the machine for a period of time.

Parameters

`Pnnn` Time to wait, in milliseconds (In Teacup, P0, wait until all previous moves are finished)
`Snnn` Time to wait, in seconds (Only on Repetier, Marlin, Prusa, 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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	Use G1 S2 or G1 H2 instead	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	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: Set tool Offset and/or workplace coordinates and/or tool temperatures

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

Usage

`G10 Pnnn Xnnn Ynnn Znnn Rnnn Snnn`¹

Parameters

`Pnnn` Tool number
`Lnnn` Offset mode (optional)⁵
`Xnnn` X offset
`Ynnn` Y offset
`Znnn` Z offset²
`U,V,W,A,B,Cnnn` other axis offsets⁴
`Rnnn` Standby temperature(s) (RepRapFirmware)
`Snnn` Active temperature(s) (RepRapFirmware)

Examples

```
G10 P2 X17.8 Y-19.3 Z0.0
```

(sets the offset for tool 2 to the X, Y, and Z values specified)

```
G10 P1 R140 S205
```

(RepRapFirmware only - 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 precise meaning of the X, Y (and other offset) values is: *with no offset this tool is at this position relative to where a tool with offset (0, 0, 0) would be*. So if the tool is 10mm to the left of a zero-offset tool the X value would be -10, and so on.

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. Smoothie uses `G10` for retract and `G10 Ln` for setting workspace coordinates. RepRapFirmware interprets a `G10` command with no `P` or `L` parameter as a retraction command.

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.

⁴Tool 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.

⁵`L1` (the default) sets the offsets of the current tool relative to the head reference point to the specified values. `L2` sets the current workplace coordinate offsets to the specified values. `L20` adjusts the current workplace coordinate offsets so that the current tool head position has the specified coordinates.

G10: Retract

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

Parameters

S_{nnn} 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

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

Parameters

S_{nnn} 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).

G12: Clean Tool

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes: 1.1.0	Use a macro instead	No	No	???	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	No	No	No

Usage

```
[P<0|1>] [S<count>] [T<count>]
```

```
G12 Pnnn Snnn Tnnn
```

Parameters

P_{nnn} ¹ Pattern style selection

S_{nnn} Number of strokes (i.e. back-and-forth movements)

T_{nnn} Number of repetitions

Examples

$G12$; stroke pattern (default)

To generate a three triangle zig-zag pattern which will be stroked three times time use the following command. $G12 P1 S3 T2$; zig-zag pattern with 2 triangles

Notes

¹In Marlin firmware and Derivatives Mk4duo this is implemented by hard-coded firmware behaviours As defined for variables `NOZZLE_CLEAN_STROKES`, `NOZZLE_CLEAN_START_POINT`, `NOZZLE_CLEAN_END_POINT` and `NOZZLE_CLEAN_PARK`.

With `NOZZLE_CLEAN_PARK` enabled, the nozzle will automatically return to the XYZ position after $G12$ is run.

More on this behaviour is documented inside of the code base.

The use of $G12$ for tool cleaning clashes with the established use of $G12$ for circular pocket milling on CNC machines. For this reason, RepRapFirmware does not support $G12$.

G17..19: Plane Selection (CNC specific)

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes:1.1.4	No	???	???	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	Yes	???	???	???	Yes	No	???	Yes

These codes set the current plane as follows:

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

This mode applies to $G2/G3$ arc moves. Normal arc moves are in the XY plane, and for most applications that's all you need. For CNC routing it can be useful to do small "digging" moves while making cuts, so to keep the G-code compact it uses $G2/G3$ arcs involving the Z plane.

These commands are supported in Marlin 1.1.4 and later with `ARC_SUPPORT` and `CNC_WORKSPACE_PLANES` enabled.

G20: Set Units to Inches

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

Example

```
G20
```

Units from now on are in inches.

G21: Set Units to Millimeters

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

Example

```
G21
```

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

G22: Firmware Retract

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	G10	No	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	Yes	No	No	No

Usage

```
G22 ; Do a retract move
```

Use this command (along with `G23`) to have the firmware to do retraction moves (in contrast to generating an E axis `G1` move). The retract length and speed are set in the firmware.

G23: Firmware Recover

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	G11	No	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	Yes	No	No	No

Usage

```
G23 ; Do a recover move
```

Use this command (along with `G22`) to have the firmware to do a recover move. The recover length and speed are set in the firmware.

G26: Mesh Validation Pattern

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes: 1.1.0	No	No	No	No	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Usage

```
G26 C P 02.25 ; Do a typical test sequence
```

The `G26` Mesh Validation Pattern is designed to be used in conjunction with various Mesh Bed Leveling systems – those that adjust for an uneven –rather than just tilted– bed. The `G26` command prints a single layer pattern over the entire print bed, giving a clear indication of how accurately every mesh point is defined. `G26` can be used to determine which areas of the mesh are less-than-perfect and how much to adjust each mesh point.

`G26` has large feature list, including a built-in test that extrudes material onto the bed. By default this is configured for PLA temperatures and a nozzle size of 0.4mm. (This will be adjustable in an upcoming version of Marlin.)

See the `G26_Mesh_Validation_Tool.cpp` file (https://raw.githubusercontent.com/MarlinFirmware/Marlin/1.1.x/Marlin/G26_Mesh_Validation_Tool.cpp) in the Marlin source code for full documentation of the `G26` parameter list.

G28: Move to Origin (Home)

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes	Yes	Yes	Yes	Yes ²	Yes	Yes
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	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 (On Prusa i3 MK2/s,MK2.5/s,MK3/s it will also perform mesh bed leveling)2
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 later) 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 `homeall.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 G-code. 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.

² Original Prusa i3 MK2/s, MK2.5/s, MK3/s supports a `W` parameter to suppress mesh bed leveling. If `W` is omitted, `G28` will home only and NOT perform mesh bed leveling. Original Prusa i3 MK3/s (TMC2130 drivers) supports a `C` parameter to calibrate the X and Y home position.

`W` Suppress mesh bed leveling (Prusa MK2/s, MK2.5/s and MK3/s only)²
`C` Calibrate X and Y home position (Prusa MK3/s only)²

G29: Detailed Z-Probe

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	1.17+	Yes: 0.91.7	No: see G32	???	G81 ¹	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	Yes	Yes	No	No

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 P1 ; UBL automated probe - see below
```

G29 Auto Bed Leveling (Marlin - MK4duo)

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

Also in Marlin 1.1.0 and later, the `PROBE_MANUALLY` option allows all forms of Auto Bed Leveling to be used without a probe. The procedure is similar to that of `MESH_BED_LEVELING` (see below). Begin the process with `G29` to move the nozzle to the first point. Adjust the Z axis using `G1` or your host software. Send `G29` again to move to the next point and repeat until all points have been sampled.

Parameters

`P` Set the size of the grid that will be probed (P x P points). Not supported by non-linear delta printer bed leveling. Example: `G29 P4`
`S` Set the XY travel speed between probe points (in units/min)
`D` Dry-Run mode. Just evaluate the bed Topology - Don't apply or clean the rotation Matrix. Useful to check the topology after a first run of `G29`.
`V` Set the verbose level (0-4). Example: `G29 V3`
`T` Generate a Bed Topology Report. Example: `G29 P5 T` for a detailed report. This is useful for manual bed leveling and finding flaws in the bed (to assist with part placement). Not supported by non-linear delta printer bed leveling.
`F` Set the Front limit of the probing grid
`B` Set the Back limit of the probing grid
`L` Set the Left limit of the probing grid
`R` Set the Right limit of the probing grid

Global Parameters

`E` By default `G29` will engage the Z probe, test the bed, then disengage. Include `E` or `E1` to engage/disengage the Z probe for each sample. (This has no effect for fixed probes.)

G29 Unified Bed Leveling (Marlin - MK4duo)

Marlin firmware (version 1.1.0 and later) includes the `AUTO_BED_LEVELING_UBL` option for Unified Bed Leveling. UBL combines mesh leveling, tilted plane adjustment, 3-point leveling, and manual editing tools all together in a single package. To accomplish so much, UBL overloads `G29` with several new parameters and provides an additional `G26` Mesh Tuning feature.

See the MarlinFW website for a dedicated Unified Bed Leveling page (http://marlinfw.org/docs/features/unified_bed_leveling.html) and complete documentation on `G29` for UBL (<http://marlinfw.org/docs/gcode/G029-ubl.html>) and `G26` Mesh Validation (<http://marlinfw.org/docs/gcode/G026.html>).

G29 UBL Parameters (synopsis)

```
U Activate Activate the Unified Bed Leveling system. (i.e., M420 S1)
D Disable Disable the Unified Bed Leveling system. (i.e., M420 S0)
```

```

M# Business Do Manual Probing in 'Business Card' mode.
M# Height Height to raise the nozzle after each Manual Probe of the bed.
#
# Continue Continue, Constant, or Current Location, depending on Phase.
# Every Stop the probe after every sampled point.
# Fade Fade leveling compensation gradually, until it ceases at the given height.
# Invalidate Invalidate a specified number of Mesh Points (X and Y).
# Grid Do a grid (planar) leveling of the current Mesh using a grid with n points on a side.
# Kompare Compare (diff) current Mesh with stored Mesh #, replacing current Mesh with the result.
#
# Load Load Mesh from the previously activated location in the EEPROM.
# Load Load Mesh from the specified location in the EEPROM.
# Store Store the current Mesh in the Activated area of the EEPROM. Also save all settings.
# Store Store the current Mesh at the specified area in EEPROM, set as the Activated area.
#-1 Store Store the current Mesh as a print-out suitable to be fed back into the system.
#
# Map Display the Mesh Map Topology.
#
# Phase 0 Zero Mesh Data and turn off the Mesh Compensation System.
# Phase 1 Invalidate the Mesh and do Automatic Probing to generate new Mesh data.
# Phase 2 Probe unpopulated areas of the Mesh (those that couldn't be auto-probed).
# Phase 3 Fill unpopulated Mesh points with a fixed value. No 'C' for "smart fill" extrapolation.
# Phase 4 Fine tune the Mesh. ** Delta Mesh Compensation requires an LCD panel. **
# Phase 5 Find Mean Mesh Height and Standard Deviation.
# Phase 6 Shift Mesh height. All Mesh points are adjusted by the amount specified with 'C'.
#
# Test Load specified Test Pattern to help check system operation.
#
# Repeat Repeat the command the specified number of times. Default: grid points X * Y.
#
# 3-Point Perform a 3-Point Bed Leveling on the current Mesh.
#
# Unlevel Perform a probe of the outer perimeter to assist in physically leveling the bed.
#
# What? Print a report of Unified Bed Leveling stored data.
#
# X # The X location for the command
# Y # The Y location for the command
#
# Zero Do a single probe to set the Z Height of the nozzle.
# # Zero Raise/lower the entire Mesh to conform with the specified difference (plus zprobe_zoffset).

```

G29 Manual Bed Leveling (Marlin - MK4duo)

Marlin firmware (version 1.0.2 and later) also 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 Auto Bed Leveling (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 Mesh Bed Compensation (RepRapFirmware)

RepRapFirmware:

- S0 (default if no s parameter) Probe the bed, save the height map in a file on the SD card, and activate the height map. 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 the currently-loaded bed height map

To define the grid, see M557.

Notes

In Prusa Firmware G29 is not active by default, instead G81 is used.¹

G29.1: Set Z probe head offset

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	M851	No	No	No	???	M851	M851	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	Yes	No	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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	No	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	Yes	No	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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes	Yes	Yes	???	No ²	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	Yes	Yes	G28,G92	No 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

Example

```
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.
P30 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
P30 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, 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 G-code 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 Delta.

Usage

```
G30 Xnnn Ynnn S Z P
```

Parameters

Xnnn X coordinate
 Ynnn Y coordinate
 Sn Stows the probe if 1 (default=1)
 Zn <bool> with a non-zero value will apply the result to current delta_height
 Pn <bool> with a non-zero value will apply the result to current zprobe_zoffset

Notes

In Prusa Firmware this G-code is deactivated by default, must be turned on in the source code.²

G31: Set or Report Current Probe status

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	No	No	No	No	No ¹	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	Yes	No	No

Notes

In Prusa Firmware this G-code is deactivated by default, must be turned on in the source code.¹

G32: Probe Z and calculate Z plane

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	G29	Yes	0.92.8+	Yes	No	G29	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Usage

```
G32          ; Probe and calculate
P32 Snnn    ; Each firmware has its own parameters
G32 Snnn Pnnn ; Refer to their specific documentation
```

This command is implemented as a more sophisticated form of bed leveling (which uses a transformation matrix or motorized correction. Smoothieware uses this code instead of 'G29'.

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

RepRapFirmware executes macro file `bed.g` in response to the G31 command. The `bed.g` file is typically used to probe the bed and then perform delta calibration if the printer is a delta, or to perform individual leadscrew adjustment to level the bed if the printer has multiple independently-controlled Z motors, or to advise the user on how much to adjust each bed levelling adjustment screw.

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	No	No	No	No	No ¹	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	Yes	No	No

Notes

In Prusa Firmware this G-code is deactivated by default, must be turned on in the source code.¹

G33: Firmware dependent

G33: Measure/List/Adjust Distortion Matrix (Repetier - Redeem)

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	0.92.8+	No	No	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	Yes	No	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.

G33: Delta Auto Calibration (Marlin 1.1.x - MK4duo)

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Use G32	No	No	???	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

End-stops and tower angle corrections are normalized (P0);

Performs a 1-4-7 point calibration of delta height (P1), end-stops, delta radius (P2) and tower angle corrections (P>=3) by a least squares iteration process based on the displacement method.

Usage

G33
 G33 Pn T Cx.xx Fn Vn E

Parameters

Pn Number of probe points: n*n (n= 0-10), when P is omitted the default set in Configuration.h is used.
 T Do not calibrate tower angle corrections (if used with P>=3); do not use the probe points near the towers, but the probe points opposite to the towers (if used with P=2)
 Cx.xx Force the iterations to stop when a standard deviation from the zero plane less than x.xx mm is achieved; when C is omitted the iterations go on until the best possible standard deviation is reached.
 Fn Force to run at least n iterations (n=1-30) and take the best result
 Vn Verbose level: (n=0-3) 0 = dry run without calibration; 1(default) = settings at start and end; 2 = settings at all iterations; 3 = settings and probe results
 E Engage the probe for each point

Examples

```
G33 : calibrates with the default settings.
M33 Auto Calibrate
Checking... AC
Height:297.77 Ex:+0.00 Ey:+0.00 Ez:+0.00 Radius:100.00
Tower angle : Tx:+0.00 Ty:+0.00 Tz:+0.00
Iteration : 01 std dev:0.306
Iteration : 02 std dev:0.049
Iteration : 03 std dev:0.033
Iteration : 04 std dev:0.031
Calibration OK rolling back.
Height:297.69 Ex:-0.10 Ey:-0.12 Ez:+0.00 Radius:100.91
Tower angle : Tx:-0.03 Ty:+0.25 Tz:+0.00
Save with M500 and/or copy to Configuration.h
```

```
G33 P6 V0 : probes 36 points in dry run mode.
M33 Auto Calibrate
Checking... AC (DRY-RUN)
Height:297.77 Ex:+0.00 Ey:+0.00 Ez:+0.00 Radius:100.00
Tower angle : Tx:+0.00 Ty:+0.00 Tz:+0.00
c:+0.03 x:+0.32 y:+0.34 z:+0.41
yz:+0.37 zx:+0.32 xy:+0.17
End DRY-RUN std dev:0.306
```

```
G33 P4 C0.05 T : probes 16 points and
stops when a standard deviation of 0.05mm is reached;
calibrates delta height, endstops and delta radius,
leaves the tower angle corrections unaltered.
M33 Auto Calibrate
Checking... AC
Height:297.78 Ex:+0.00 Ey:+0.00 Ez:+0.00 Radius:100.00
Iteration : 01 std dev:0.317
Iteration : 02 std dev:0.059
Calibration OK std dev:0.042
Height:297.66 Ex:-0.17 Ey:-0.13 Ez:+0.00 Radius:100.91
Save with M500 and/or copy to Configuration.h
```

```
G33 P2 : probes center and tower positions and
calibrates delta height, endstops and delta radius.
M33 Auto Calibrate
Checking... AC
Height:297.78 Ex:+0.00 Ey:+0.00 Ez:+0.00 Radius:100.00
Iteration : 01 std dev:0.374
Iteration : 02 std dev:0.054
Iteration : 03 std dev:0.007
Calibration OK rolling back.
Height:297.68 Ex:-0.14 Ey:-0.14 Ez:+0.00 Radius:101.23
Save with M500 and/or copy to Configuration.h
```

```
G33 P1 : probes the center and calibrates the delta height only.
M33 Auto Calibrate
Checking... AC
Height:261.40 Offset:+0.30
Calibration OK std dev:0.000
Height:261.58 Offset:+0.10
Save with M500 and/or copy to Configuration.h
```

note: Height = delta height; Ex, Ey, Ez = end-stop corrections; Radius = delta radius; Tx, Ty, Tz = tower angular corrections; c, x, y, z, yz, zx, xy = probe results at center, towers and opposite to towers; std dev = standard deviation of the probe results towards the zero plane.

G34: Z Stepper Auto-Align

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	No	No	No	No	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Use multiple Z steppers and a probe to align Z axis connection points. See [M422](#) for other options.

Example

```
G34 I3 T0.8 A1.5 ; 3 iterations, Target Accuracy 0.8, Amplification 1.5
```

G34: Calculate Delta Height from toolhead position (DELTA)

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	No	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Example

```
G34
```

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 `G34` command. This value can be saved to EEPROM using the `M500` command.

G38.x Straight Probe (CNC specific)

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	1.1.0+	3.0+	???	Yes	???	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	Yes	No	No	No	No	No	No	No

G38.3 probe toward workpiece, stop on contact

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	1.1.0+	3.0+	???	Yes	???	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	Yes	No	No	No	No	No	No	No

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	2.0.0+	3.0+	???	???	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	Yes	No	No	No	No	No	No	No

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	2.0.0+	3.0+	???	???	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	Yes	No	No	No	No	No	No	No

G40: Compensation Off (CNC specific)

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	No	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	Yes	No	No	No	Yes	No	No	Yes

`G40` turns off cutter compensation. 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. http://www.linuxcnc.org/docs/2.5/html/gcode/tool_compensation.html

G42: Move to Grid Point

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	1.1.2+	No	No	No	No	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

`G42` does a fast move in XY to any of the intersection points in the bed calibration grid. This is useful during calibration to align the nozzle or probe.

Parameters

- `Inn` Grid X index (zero-based). If omitted, the nearest latitude.
- `Jnn` Grid Y index (zero-based). If omitted, the nearest longitude.
- `P` Probe flag. Moves the probe to the grid point (instead of the nozzle).
- `Fnnnn` Feedrate (mm/m)

Example

```
G42 I3 J4 P F3000 ; Move the probe to grid coordinate 3, 4
```

G53..59: Coordinate System Select (CNC specific)

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	2.0.0+	1.21+	No	Yes	No	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	Yes	No	No	No	Yes	No	No	Yes

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

Not all builds of RepRapFirmware support these commands. For those that do (e.g. Duet WiFi/Ethernet and Duet 3), from firmware version 2.02 the workplace coordinate offsets are included in the data saved to config-override.g by the M500 command.

G60: save current position to slot

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.21+	No	No	No	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Usage

G60 Snn

Parameters

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

Implementation in RepRapFirmware:

- Slots 0, 1 and 2 are available from RepRapFirmware 1.21, also slots 4 and 5 in RRF 2.02. When a print is paused the coordinates are saved to slot 1 automatically, and at the start of a tool change the coordinates are saved to slot 2 automatically. Use G0 or G1 with the R0, R1 or R2 parameter to move the current tool to a saved position.

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	Use G0 or G1 with R parameter	???	???	???	No	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	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)

G75: Print temperature interpolation

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	No	Yes	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Show/print PINDA temperature interpolating.

Usage

G75

G76: PINDA probe temperature calibration

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes ¹	No	No	No	No	Yes	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

This G-code is used to calibrate the temperature drift of the PINDA (inductive Sensor).

The PINDAv2 sensor has a built-in thermistor which has the advantage that the calibration can be done once for all materials.

The Original i3 Prusa MK2/s uses PINDAv1 and this calibration improves the temperature drift, but not as good as the PINDAv2.

Usage

G76

B¹

P¹

Parameters

B Calibrate bed only ¹
P Calibrate probe only ¹

Example

```
G76
;
;echo PINDA probe calibration start
;echo start temperature: 35.0°
;echo ...
;echo PINDA temperature -- Z shift (mm): 0.---
```

Notes¹

Marlin requires `PROBE_TEMP_COMPENSATION`.

This process can take a very long time. The timeout is currently set to 15min to allow the parts to fully heat up and cool down.

Use `M500` to save the result to EEPROM.

At this moment it is only supported in Marlin bugfix-2.0.x branch.

G80: Cancel Canned Cycle (CNC specific)

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	???	???	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	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.

G80: Mesh-based Z probe

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	No	Yes	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Default 3x3 grid can be changed on MK2.5/s and MK3/s to 7x7 grid.

Parameters

This command can be used without any additional parameters.

N Number of mesh points on x axis. Default is 3. Valid values are 3 and 7.

R Probe retries. Default 3 max. 10

V Verbosity level 1=low, 10=mid, 20=high. It can be only used if firmware has been compiled with `SUPPORT_VERBOSITY` active.

Using the following parameters enables additional "manual" bed leveling correction. Valid values are -100 microns to 100 microns.

L Left Bed Level correct value in um.

R Right Bed Level correct value in um.

F Front Bed Level correct value in um.

B Back Bed Level correct value in um.

G81: Mesh bed leveling status

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	No	Yes	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Prints mesh bed leveling status and bed profile if activated.

Usage

G81

Notes

Equivalent to G29 T in Marlin.

G82: Single Z probe at current location

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	No	Yes ¹	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

WARNING! USE WITH CAUTION! If you'll try to probe where is no leveling pad, nasty things can happen!

Usage

G82

Notes

In Prusa Firmware this G-code is deactivated by default, must be turned on in the source code.¹

G83: Babystep in Z and store to EEPROM

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	No	Yes ¹	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Usage

G83

Notes

In Prusa Firmware this G-code is deactivated by default, must be turned on in the source code.¹

G84: UNDO Babystep Z (move Z axis back)

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	No	Yes ¹	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Usage

G84

Notes

In Prusa Firmware this G-code is deactivated by default, must be turned on in the source code.¹

G85: Pick best babystep

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	No	Yes ¹	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Usage

G85

Notes

In Prusa Firmware this G-code is deactivated by default, must be turned on in the source code.¹

G86: Disable babystep correction after home

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	No	Yes	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

This G-code will be performed at the start of a calibration script.

Usage

G86

G87: Enable babystep correction after home

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	No	Yes	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

This G-code will be performed at the end of a calibration script.

Usage

G87

G88: Reserved

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	No	Yes ¹	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Usage

G88

Notes

This G-code currently does not do anything.

G90: Set to Absolute Positioning

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	Yes	Yes	No	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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	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 on some firmware. This does not apply to RepRapFirmware.

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	1.1.6+	No	No	Yes	No	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	Yes	No	No	No	No	No	No	No

Usage

G92.1 - Reset axis offsets (and 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)

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

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)

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

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.

G98: Activate farm mode

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	No	Yes	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Enable Prusa-specific Farm functions and g-code.

Usage

G98

Notes

Set of internal Prusa commands

PRUSA [Ping | PRN | FAN | fn | thx | uvlo | fsensor_recover | MMURES | RESET | fv | M28 | SN | Fir | Rev | Lang | Lz | Beat | FR]

Parameters

Ping
 PRN Prints revision of the printer.
 FAN Prints fan details.
 fn Prints farm number.
 thx
 uvlo Resets UVLO aka Power Panic and continues SD print.
 fsensor_recover Filament sensor recover - restore print and continue.
 MMURES Reset MMU.
 Reset Resets Printer.
 fv ??? get file version. ???
 M28 M28 write to SD.
 SN Get serial number from 32U2 processor. Typical format of S/N is:CZPX0917X003XC13518
 Fir Prints firmware version.
 Rev Prints filament size, elelectronics, nozzle type.
 Lang Reset the language.
 Lz ??? maybe resets Live Z values to 0 ???
 Beat Kick farm link timer.
 FR Full factory reset.
 nozzle set 'diameter' Set nozzle diameter.
 nozzle D'diameter' Check nozzle diameter.
 nozzle Print nozzle diameter

G99: Deactivate farm mode

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	No	Yes	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Usage

G99

G100: Calibrate floor or rod radius

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	0.92+	No	No	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	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
 R0nn 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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	No	No	No	Yes
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	0.91+	No	No	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

G132: Calibrate endstop offsets

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	0.91+	No	No	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

G133: Measure steps to top

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	0.91+	No	No	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

G161: Home axes to minimum

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	No	No	No	Yes
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	Yes	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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	No	No	No	Yes
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	Yes	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.

G425: Perform auto-calibration with calibration cube

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	2.0.0+	No	No	No	No	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

This performs an automatic calibration of backlash, positional errors and nozzle offset by touching the nozzle on the sides of a bed mounted, electrically conductive cube, washer or bolt.

Parameters

- B Perform calibration of backlash only.
- Tnnn Perform calibration of toolhead only.
- V Probe cube and print position, error, backlash and hotend offset.
- Unnn Uncertainty, how far to start probe away from the cube (mm)

Examples (Marlin)

```
G425 ; Perform full calibration sequence
M1 ; Switch to second nozzle
G425 V ; Validate by showing report for T1
T0 ; Switch to second nozzle
G425 V ; Validate by showing report for T0
```

M-commands**M0: Stop or Unconditional stop**

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes	No	No	No	Yes ³	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	Yes	No	No	Yes	Yes	No	Yes	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 `cancel.g` if this file is present, if the print is paused and if the axes are homed. Otherwise `stop.g` is run and the drives are put into idle mode. Also the heaters are turned off if no '`H1`' parameter is specified.

Notes

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

²Only available on Marlin and Prusa Firmware.

³"Wait for user ..." is shown on LCD in Prusa Firmware.

M1: Sleep or Conditional stop

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes	No	No	Yes	Yes	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	Yes	No	No	No	No	No	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 and Prusa Firmware do 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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	No	No	No	Yes
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	Yes	No	No	No	No	No	Yes	Yes

Example

```
M2
```

Teacup firmware does the same as `M84`.

M3: Spindle On, Clockwise (CNC specific)

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes	Yes	Yes	No	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	Yes	No	No	No	No	No	Yes	Yes

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 in CNC mode (`M453`), in laser mode (`M452`) or if a Roland mill has been configured. You must always provide an S parameter with this command to specify the required spindle speed or laser power. In RepRapFirmware 2.05RC2 and later, and RepRapFirmware 3.0beta13 and later, in laser mode (`M452`) the laser will only fire during G1/G2/G3 moves.

In Repetier-Firmware in laser mode you need `S0..S255` to set laser intensity. Normally you use `S255` to turn it on full power for moves. Laser will only fire during G1/G2/G3 moves and in laser mode (`M452`).

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	No	Yes	No	No	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	Yes	No	No	No	No	No	No	Yes

Example

```

M4 S4000

```

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

M5: Spindle Off (CNC specific)

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

Example

```

M5

```

The spindle is turned off.

Teacup firmware turn extruder off (same as M103).

M6: Tool change

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

Example

```

M6

```

M7: Mist Coolant On (CNC specific)

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	Yes	No	No	No	No	No	Yes: Use M106	Yes

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)

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	Yes	No	No	No	No	No	Yes: Use M106	Yes

Example

```

M8

```

Flood coolant is turned on (if available)

M9: Coolant Off (CNC specific)

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	Yes	No	No	No	No	No	Yes: Use M106	Yes

Example

```

M9

```

All coolant systems are turned off.

M10: Vacuum On (CNC specific)

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	No	Yes: Use M106	Yes

Example

```

M10

```

Dust collection vacuum system turned on.

M11: Vacuum Off (CNC specific)

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	No	Yes: Use M106	Yes

Example

```

M11

```

Dust collection vacuum system turned off.

M13: Spindle on (clockwise rotation) and coolant on (flood)

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

This one M-code does the work of both M03 and M08. It is not unusual for specific machine models to have such combined commands, which make for shorter, more quickly written programs.

Example

```

M13

```

M16: Expected Printer Check

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	(2.0+)	No	No	No	???	No	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	No	No	No

Do a case-sensitive comparison between the string argument and the configured `MACHINE_NAME`. If the machine name doesn't match, halt the printer so that a reset is required. This safety feature is meant to prevent G-code sliced for a specific machine from being used on any other machine. In Marlin this feature is enabled with `EXPECTED_PRINTER_CHECK`.

Example

```

M16 Cookie Monster

```

M17: Enable/Power all stepper motors

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

Parameters

This command can be used without any additional parameters.¹

X X axis
Y Y axis
Z Z axis
E All extruders

Example

```

M17
M17 X E0

```

Powers on stepper motors.

Notes

¹Ability to specify axes was added to Marlin 2.0 and may not be available on other firmware implementations.

M18: Disable all stepper motors

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	M84	Yes	No	Yes	???	M84 ³	Yes	Yes
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	Yes	Yes: Use M2	No

Parameters

This command can be used without any additional parameters.¹³

X X axis
Y Y axis
Z Z axis

E Extruder drive(s)²
S Seconds³

Examples

```
M18
M18 X E0
```

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

On Marlin, M18 is a synonym of M84, so it can also be used to configure or disable the idle timeout.

Examples

```
M18 S10 ; Idle steppers after 10 seconds of inactivity
M18 S0 ; Disable idle timeout
```

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.

³In Prusa Firmware this command can be used to set the stepper inactivity timeout ('S') or to disable steppers ('X','Y','Z','E')

M20: List SD card

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

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
M20ARE.G
M20COM.G
M20CARRI-2.GCO
M20CARRIA-1.GCO
```

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

```
Begin file list:
M20ARE.G
M20CARRI-2.GCO
End file list
ok
```

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

```
G-code 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

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

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

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

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

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

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

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

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

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

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.

RepRapFirmware 1.20 and later also save the current state of the print to file `/sys/resurrect.g`. This is so that if the printer is turned off after pausing, the print can subsequently be resumed.

M26: Set SD position

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

Parameters

Snnn File position from start of file in bytes

Pnnn (Optional, RepRapFirmware only) Proportion of the first move to be skipped, default 0.0, must be less than 1.0

Example

```
M26 S49315
```

Set the file offset in bytes from the start of the SD card file selected by `M23`. The offset must correspond to the start of a G-code command.

M27: Report SD print status

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

Parameters

- C** Report the open file's name and long name (Marlin 1.1.9 and up)
- Sn** Set the auto-report interval (Marlin 1.1.9 and up)

Example

```
M27
```

Report SD print status.

Marlin and 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.
```

In Marlin 1.1.9 and up **M27 C** reports the open file's DOS 8.3 name and long filename, if any.

Example

```
M27 C
```

```
Current file: filena~1.gco Filenagotcha.gcode
```

In Marlin 1.1.9 and up **M27 Sn** sets the auto-report interval. This requires the `AUTO_REPORT_SD_STATUS` configuration option to be enabled. Marlin reports this capability in **M115 as** Cap: `AUTO_REPORT_SD_STATUS 1` when this option is available.

Example

```
M27 S2 ; Report the SD card status every 2 seconds
```

M28: Begin write to SD card

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

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes	Yes	No	???	No ¹	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	Yes	No	No	No	No	No	No

Example

```
M29 filename.gco
```

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

Notes

- ¹Prusa firmware accepts this code but currently has no effect.

M30: Delete a file on the SD card

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

Example

```
> M30 filename.gco
> filename.gco is deleted.
```

M30: Program Stop

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

- For Yaskawa and in grbl - Same as M2 in Yaskawa G-code

Example

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

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

Example

```
M31
```

The response looks like:

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

M32: Select file and start SD print

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Not required	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No: Use M25	???	???	???	No	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	No

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

M34: Set SD file sorting options

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

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

M36: Return file information

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	Yes	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	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":436831,"lastModified":"2017-09-21T16:58:07","height":5.20,"firstLayerHeight":0.20,"layerHeight":0.20,"printTime":660,"simulatedTime":1586,"filament":[1280.7],"generatedBy":"Simplify3D(R) Version 4.0.0"}
```

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, the times are in seconds, all other values are in mm. 'printTime' is the printing time estimated by the slicer, 'simulationTime' is the time measured when the print was simulated by the firmware. 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

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

Parameters

S1 Enter simulation mode

S0 Leave simulation mode

P"filename" (optional) Simulate printing a file from SD card

Examples

M37 S1

M37 P"MyModel.g"

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 would take to execute will be calculated.

M37 S0 leaves simulation mode and prints the total time taken by simulated moves since entering 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).

M37 P"filename" enters simulation mode, prints the specified file, exits simulation mode, reports the print time, and appends it to the G-code file as a comment for later retrieval.

M38 Compute SHA1 hash of target file

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

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

```
> M38 gcodes/myfile.g
> Cannot find file
> M38 www/reprap.htm
> 91199139dbfada15a18c9b962df4853db83999
```

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.

M39 Report SD card information

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	Yes: 1.20.1 and later	No	No	???	No	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	No	No	No

Parameters

Pn SD slot number, default 0

Sn Response format. S0 returns a plain text response, S2 returns a response in JSON format.

Examples

M39 ; report information for SD card 0 in plain text format

M39 P1 S2 ; report information for SD card 1 in JSON format

This command returns information about the SD card in the specified slot in the requested format. At least the following is returned:

- Whether or not a usable card is present in the slot
- The capacity of the card in bytes (if a card is present)
- The amount of free space on the card in bytes (if a card is present)

The JSON response has the following format (more fields may be added in future):


```
{ "SDInfo": { "slot": 0, "present": 1, "capacity": 4294967296, "free": 2147485184, "speed": 20971520, "clusterSize": 32768 } }
```

The capacity, free space and cluster size are in bytes, and the interface speed is in bytes/second.

M40: Eject

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	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

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

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	Expansion Pin
60	CS5	CS5	50
61	CS6	E3_STOP	9
62	CS7	E4_STOP	14
63	CS8	E5_STOP	19

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 RADD5 hardware running RepRapFirmware-dc42, the supported Arduino Due pin numbers and their names are:

5 TIOA6, 6 PWM17, 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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	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

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

Note

You must have PINS_DEBUGGING uncommented in your Configuration_adv.h file for M43 to work.

M44: Codes debug - report codes available

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

In MK4duo must have ability FASTER_GCODE_EXECUTE for this function.

Parameters

In G-code list
Jn M-code list

M44: Reset the bed skew and offset calibration

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Resets the bed skew and offset calibration on Prusa i3 MK2/s,MK2.5/s,MK3/s.

M45: Bed skew and offset with manual Z up

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Runs the xyz calibration on Prusa i3 MK2/s,MK2.5/s,MK3/s.

Parameters

`Vnn` Verbosity level 1, 10 and 20 (low, mid, high). Only when SUPPORT_VERBOSITY is defined. This parameter is optional.

M46: Show the assigned IP address

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Reports the assigned IP address of a Toshiba FlashAir on Prusa i3 MK2/s,MK2.5/s,MK3/s. At this moment it is deactivated.

M47: Show end stops dialog on the display

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Show end stops dialog on the display on Prusa i3 MK2/s,MK2.5/s,MK3/s.

M48: Measure Z-Probe repeatability

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	No	No	No	???	Yes ¹	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

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
`S` schizoid

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

The `S` flag will result is a random sized, 5 pointed star, being traced (X and Y axis) between each sample. Usually a user will get worse repeat-ability numbers with `S` specified because the X axis and Y axis movements will add to the machine's positioning errors.

Prusa specific ¹

This function assumes the bed has been homed. Specifically, that a `G28` command as been issued prior to invoking the `M48` Z-Probe repeatability measurement function. Any information generated by a prior `G29` Bed leveling command will be lost and need to be regenerated.

The number of samples will default to 10 if not specified. You can use upper or lower case letters for any of the options EXCEPT `n`. `n` must be in lower case because Marlin uses a capital `N` for its communication protocol and will get horribly confused if you send it a capital `N`.

Usage

`M48 nAA Xnnnn Ynnnn Vn Lnn`

Parameters

`nAA` number(AA) of samples, default=10 (valid values between 4 and 50)
`Xnnnn` X position for samples
`Ynnnn` Y position for samples
`Vn` Verbosity level 1-4 (low to highest)
`Lnn` Legs of travel 1-15

M49: Set G26 debug flag

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	No	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Usage

M49 S1 ; Enable G26 verbose debug output

M70: Display message

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	M117	M117	M117	M117	No	No	No	Yes
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	M117	No	M117

Example

```
M70 P200 Message
```

Display a message on the LCD. P is the time to display message for.

M72: Play a tone or song

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	M300	M300	No	No	No	M300	No	Yes
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	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/Get build percentage

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	No	No	No	???	Yes ¹	Yes	Yes
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Example

```
M73 P50
```

Tell the firmware the current build progress percentage. The machine is expected to display this on its display. If the percentage is exactly 0 a "Build Start" notification is sent to the host. If the percentage is exactly 100 a "Build End" notification is sent to the host.

Use "M73" by itself to get a report of the current print progress.

Prusa specific¹

Prusa firmware just shows percent done and time remaining.

Usage

M73 P R Q S

Parameters

This command can be used without any additional parameters.

P Percent in normal mode
R Time remaining in normal mode
Q Percent in silent mode
S Time remaining in silent mode

Examples

```
M73
Echo NORMAL MODE: Percent done: ---%; print time remaining in mins: ----"
Echo SILENT MODE: Percent done: ---%; print time remaining in mins: ----"
```

M75: Start the print job timer

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	No	No	No	No	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

M76: Pause the print job timer

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	No	No	No	No	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

M77: Stop the print job timer

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	No	No	No	No	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

M78: Show statistical information about the print jobs

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	No	No	No	No	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

M80: ATX Power On

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes	Yes	No	???	Yes ¹	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	Yes	No	No	No	No	automatic	No

Examples

```
M80 ; Turn on the power supply
M80 S ; Report power supply state (Marlin 1.1.1)
```

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

Notes

- Marlin requires the `POWER_SUPPLY` configuration option to be set to a non-zero value to enable `M80`.
- Some firmwares (e.g., 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>).
- Prusa requires `defined (PS_ON_PIN)` and `PS_ON_PIN` must be set.¹

M81: ATX Power Off

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes	Yes	No	???	Yes ¹	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	Yes	No	No	No	Yes	automatic	No

Parameters

`P` quit the daemon (redeem only)

`R` restart the daemon (redeem only)

`Sn n=0` turn power off immediately (default), `n=1` turn power off when all thermostatic fans have turned off (RepRapFirmware 1.20 and later only)

Examples

`M81` ; turn power off immediately

`M81 S1` ; turn power off when everything has cooled down (RepRapFirmware)

Turns off the ATX power supply. Counterpart to `M80`.

Notes

- Prusa requires `defined (PS_ON_PIN)` and `PS_ON_PIN` must be set to Power off.¹

M82: Set extruder to absolute mode

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

Example

```
G92.2
```

Makes the extruder interpret extrusion as absolute positions.

This is the default in repetier and for Yaskawa controllers.

M83: Set extruder to relative mode

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

Example

```
G93
```

Makes the extruder interpret extrusion values as relative positions.

Note that the Ultimaker 3 will revert back to absolute extrusion after each tool change.

M84: Stop idle hold

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes	Yes	Yes	???	Yes ²	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	Yes	No	No	No	Yes	Yes	No

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. For Yaskawa systems M84 is not applicable due to servo motors not producing the annoying noises.

Notes

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

²Prusa firmware uses M84 similar to G-code#M18:_Disable_all_stepper_motors

Prusa Usage

M84 E S X Y Z

Prusa Parameters

This command can be used without any additional parameters.²

E Extruder drive(s)²

S Seconds

X X axis

Y Y axis

Z Z axis

M85: Set Inactivity Shutdown Timer

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

Example

```
M85 S30
```

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

M86: Set Safety Timer expiration time

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

Usage

M86 Snnnn

Parameters

S Seconds

Similar to M85 but applies to the "safety timer" in Prusa Firmware.

Sets the safety timer expiration time in seconds. M86 S0 will disable safety timer.

When safety timer expires, heatbed and nozzle target temperatures are set to zero.

M92: Set axis_steps_per_unit

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

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)

Snnn Defines in which microstepping the above steps per unit are given. If omitted it will use the microstepping currently set by M350.¹

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. For Yaskawa systems M92/M93 is not applicable due to use of servo motors.

Notes

¹ Only available in RepRapFirmware >=2.03

M93: Send axis_steps_per_unit

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

M98: Call Macro/Subprogram

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

Parameters

^{Pnnn} Macro filename. In RepRapFirmware 3 this must be enclosed in double-quote characters. In RepRapFirmware 2 the double-quote characters are optional.

Example

```
M98 Pmymacro.g
M98 P"mymacro.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 02000, say). For RepRap, which almost always has some sort of mass storage device inbuilt, it simply refers to the name of a G-code file that is executed by the ^{G98} call. That G-code file does not need to end with an ^{M99} (return) as the end-of-file automatically causes a return. RepRapFirmware supports nested macro calls up to a depth of 5.

Certain machine parameters are saved at the start of the macro call and restored at the end. For RepRapFirmware these are: axis movement relative/absolute mode, extruder movement absolute/relative mode, feed rate, inches/mm setting, and whether or not volumetric extrusion is selected. This allows the macro to change these settings without affecting the subsequent behaviour of the calling file.

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 by RepRapFirmware too.

M99: Return from Macro/Subprogram

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

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.

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	Yes: 1.17c and later	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	Yes	No	No	No	Yes	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: Turn extruder on (forward/filament in).

In RepRapFirmware: undo filament retraction. The length and speed are set by the ^{M207} command. RepRapFirmware supports this command for compatibility with Simplify3D.

In other firmwares: Deprecated. Regarding filament retraction, see ^{G10}, ^{G11}, ^{M207}, ^{M208}, ^{M227}, ^{M228}, ^{M229}.

M102: Turn extruder 1 on (Reverse)

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	Yes: 1.17c and later	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	Yes	No	No	No	Yes	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 RepRapFirmware: retract filament. The length and speed are set by the M207 command. RepRapFirmware supports this command for compatibility with Simplify3D.

In other firmwares: Deprecated. Regarding filament retraction, see G10, G11, M207, M208, M227, M228, M229.

M104: Set Extruder Temperature

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes	Yes	Yes	???	Yes	Yes	Yes
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Parameters

Snnn Target temperature
Rnnn Idle temperature (Only MK4duo)

Example

```
M104 S190
M104 S190 R170
```

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). See also M109.

See also using G10. Deprecation of M104 is subject to discussion. --Traumflug 11:33, 19 July 2012 (UTC)

M104 in Marlin Firmware

See Marlin Wiki (<http://marlinfw.org/docs/gcode/M104.html>). In Marlin Firmware, using M104 with no parameters will turn off the heater for the current extruder. This is also the case for M104 S without a number after the S parameter.

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.

M104 in RepRapFirmware

RepRapFirmware and some other firmwares support the optional T parameter (as generated by slic3r) to specify which tool the command applies to.

M105: Get Extruder Temperature

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes	Yes	Yes	???	Yes ¹	Yes	Yes
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	Yes	No	Yes	No	Yes	Yes	No

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, the build base and the build chamber in degrees Celsius. The temperatures are returned to the host computer. For example, the line sent to the host in response to this command can look like:

```
T:201 B:117
ok T:201 /202 B:117 /120
ok T:201 /202 B:117 /120 C:49.3 /50
ok T:201 /202 T0:110 /110 T1:23 /0 B:117 /120 C:49.3 /50
ok T0:110 /110 T1:23 /0 B:117 /120
ok T:20.2 /0.0 B:19.1 /0.0 T0:20.2 /0.0 @:0 B@:0 P:19.8 A:26.4
```

The parameters mean the following:

- T, T0, ..., Tn - extruder temperature. In a single extruder setup, only T will be reported. Some firmware variants will report no T0 in multi extruder setups - in that case T is to be considered the temperature of the first tool. Otherwise, T should be considered the temperature of the currently selected tool (which will be repeated in one of the Tn entries)
- B - bed temperature
- C - chamber temperature
- @ - Hotend power (Prusa only)¹
- B@ - Bed power (Prusa only)¹
- P - PINDAv2 actual (Prusa MK2.5/s MK3/s only)¹
- A - Ambient actual (Prusa MK3/s only)¹

A temperature report will usually include actual and target temperature for all available heaters, with the format being "actual/target" or - for some firmware

variants - "actual /target". During a blocking heatup some firmware variants only report the temperature tuple for the heater that is currently in blocking heatup state.

Note that temperatures can be reported as integers or floats. There sadly are a lot of interpretations of how an M105 response should look like across firmware variants, making parsing them potentially tricky.

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

In Repetier and MK4duo you can add X0 (X1 MK4duo) to get raw values as well:

```
M105 X0
=> 11:05:48.910 : T:23.61 /0 0:0 T0:23.61 /0 0:0 RAW0:3922 T1:23.89 /0 01:0 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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes	Yes	Yes	???	Yes	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinikit	Redeem	Teacup	Yaskawa
	???	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 fan^{1 3}

Fnnn Set fan PWM frequency, in Hz^{1 3}

Lnnn Set minimum fan speed (0 to 255 or 0.0 to 1.0)^{1 3}

Xnnn Set maximum fan speed (0 to 255 or 0.0 to 1.0)^{1 3}

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 mode^{1 3}

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

Tnnn Set thermostatic mode trigger temperature

Cnnn Set custom name (RRF > 2.01 only)¹

Example

```
M106 S127
```

Examples (RepRapFirmware)

```
M106 P1 I1 S87
M106 P1 T45 H1:2
M106 P2 B0.1 L0.05
```

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 1.0 to 1.1.6 only supports a single fan. Marlin 1.1.7 and up supports up to 3 fans.

³These parameters are only available in MK4duo.

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 t 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 X parameter defines the maximum PWM value that is allowed for this fan. If a higher value is commanded, it will be rounded down 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

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

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

M108: Cancel Heating

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

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.

Recent versions of Marlin introduce `EMERGENCY_PARSER`, which overcomes the buffer limitation by watching the incoming serial stream. Commands `M108`, `M112`, `M410`, and `M876` can all be intercepted by the emergency parser, so it is recommended to enable this feature.

M108: Set Extruder Speed (BFB)

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

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

M109: Set Extruder Temperature and Wait

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes	Yes	Yes	???	Yes	Yes	Yes
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	Yes	No	Yes	Yes	Yes	not needed	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 and MK4duo)

Example

```
.....
M109 S215
.....
```

M109 in Teacup

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

M109 in Marlin, MK4duo, Sprinter (ATmega port), RepRapFirmware, Prusa

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 ; set extruder temperature to 185 and wait 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

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

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes	Yes	No	???	No ²	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	Yes	No	Yes	Debug	No

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.

²Prusa fimrware use D-codes/commands for debugging.

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)
#define DEBUG_DRYRUN (1<<3) // repetier-firmware
#define DEBUG_COMMUNICATION (1<<4) // repetier-firmware
```

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: Full (Emergency) Stop

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

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.

Please note while many systems termed this an Emergency Stop, this terminology is regulated in many regions with specific requirements behind its use. Marlin 2.0.x has renamed this to Full Stop. RepRapFirmware has indicated an intention to make a similar change as well. This stop function is NOT implemented in a Category 0 or 1 stop fashion or with fail-safe hardware complying with PLD or better. The function as implemented is a category 2 software stop with no redundancies.

M113: Set Extruder PWM

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	Yes	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.

M113: Host Keepalive

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	1.1.9+	No	No	No	???	Yes	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	No	No	No

During some lengthy processes, such as G29, Marlin may appear to the host to have “gone away.” The “host keepalive” feature will send messages to the host when Marlin is busy or waiting for user response so the host won’t try to reconnect.

Usage

```
M113 Snnn
```

Parameters

Snnn keepalive interval to set

Examples

```
M113 S2
```

M114: Get Current Position

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

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes	Yes	No	???	Yes ²	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	Yes	No	Yes	No	Yes	Yes	No

Parameters

This command can be used without any additional parameters.

Bnnn (RepRapFirmware 3 only) Expansion board number (typically the CAN address) for which the firmware version is requested, default 0 (i.e. main board)

Pnnn Electronics type¹

V Report the Prusa version number²

Unnnnnn Check the firmware version provided²

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://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
```

²These parameters are only supported in Prusa Firmware. Parameter `Unnnnnn` will check the firmware version provided. If the firmware version provided by the U code is higher than the currently running firmware, it will pause the print for 30s and ask the user to upgrade the firmware.

sample data M115:

```
#FIRMWARE_NAME:Prusa-Firmware 3.8.1 based on Marlin FIRMWARE_URL:https://github.com/prusa3d/Prusa-Firmware PROTOCOL_VERSION:1.0 MACHINE_TYPE:Prusa i3 MK3S EXTRUDER_COUNT:1 UUID:00000000-0000-0000-0000-000000000000
```

sample data M115 V

```
0.8.1
```

sample data on display for 30s or user interactionM115 U3.8.2-RC1

```
New firmware version available:
3.8.2-RC1
Please upgrade.
```

M116: Wait

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	???	No	No	No: See M70
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	Yes	No	No	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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes	Yes	Yes	???	Yes ¹	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	Yes	No	No

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.

Notes

In Prusa Firmware it is also used to display internal messages on LCD.¹

M118: Echo message on host

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	1.1.4+	No	No	No	???	???	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	No	No	No

Use this code to print a visible message to the host console, preceded by 'echo:'.

Example

```
M118 Color changing to blue
```

M118: Negotiate Features

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	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

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

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

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

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

Example

```
M121
```

Recover the last state pushed onto the stack.

M120: Enable endstop detection

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	No	No	No	???	M121	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	No	No	No

M121: Disable endstop detection

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	No	No	No	???	M120	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	No	No	No

M122: Firmware dependent**M122: Diagnose (RepRapFirmware)**

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

Parameters

Bmmm Expansion board number for which diagnostics are requested, default 0 which means main board

Pnnn Optional parameter to specify what diagnostics are required. Caution: some values of P will crash the firmware deliberately to test error handling! See the Duet3D wiki for more details.

"DSF" Immediate DSF diagnostics (RRF3/Duet3 only with attached SBC)

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.

M122: Set Software Endstop (MK4duo)

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

Disabled or Enabled Software Endstop M122 S<0/1>

M122: Debug L6470 drivers (Marlin)

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

Get diagnostic info about all L6470 stepper drivers.

Example

```

-----
M122
-----

```

M123: Firmware dependent**M123: Tachometer value (RepRap)**

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	No	No	No

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

M123: Endstop Logic (MK4duo)

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

Parameters

Xn X Logic

Yn Y Logic

Zn Z Logic

In X2 Logic

Jn Y2 Logic

Kn Z2 Logic
Pn Probe Logic
Dn Door Logic

Examples

```
M123 ; Print Status
M123 X1 Y1 Z0 P0
```

M124: Firmware dependent

M124: Immediate motor stop

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	No	No	No

Immediately stops all motors.

M124: Set Endstop Pullup

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

Parameters

Xn X Pullup on/off
Yn Y Pullup on/off
Zn Z Pullup on/off
In X2 Pullup on/off
Jn Y2 Pullup on/off
Kn Z2 Pullup on/off
Pn Probe Pullup on/off
Dn Door Pullup on/off

Examples

```
M124 ; Print Status
M124 X1 Y1 Z0 P0
```

M126: Open Valve

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

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

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

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

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

Example

```
M128 S255
```

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

M129: Extruder pressure off

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

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	M301	M301	No	M301	???	M301	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	M301	Yes	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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	M301	M301	No	M301	???	M301	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	M301	Yes	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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	M301	M301	No	M301	???	M301	No	Yes
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	M301	Yes	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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	M301	M301	No	No	???	M301	No	Yes
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	M301	Yes	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

Wait for the toolhead to reach its target temperature.

Parameters

Tnn : Extruder to wait for

Pnn : Time limit, in seconds

Example

```
M133 T0 P500 ; Wait for Tool 0 to reach target. Fail after 8:20.
```

M134: Write PID values to EEPROM

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

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	M301	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	Debug	No

Example

```
M136 P1 ; print heater 0 PID parameters to host
```

M140: Set Bed Temperature (Fast)

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

Parameters

Pnnn Bed heater index¹
 Hnnn Heater number¹
 Tnnn Tool number²
 Snnn Active/Target temperature
 Rnnn Standby temperature^{1 2}

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).

Notes

¹ These parameters are only supported in RepRapFirmware. 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 affected:

```
M140 S=-273.15
```

² These parameters are only supported in MK4duo for Idle temperature

```
M140 S60 R30
M140 T1 S60 R30
```

There is an optional R field that sets the bed standby temperature: M140 S65 R40.

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)

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

Parameters

Pnnn Chamber index¹
 Hnnn Heater number¹
 Tnnn Tool number²
 Snnn Active/Target temperature
 Rnnn Standby temperature^{1 2}

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

¹ These parameters are only supported in RepRapFirmware and work just like in M140.

² These parameters are only supported in MK4duo and work just like in M140.

M142: Firmware dependent**M142: Holding Pressure**

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	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.

M142: Set Cooler Temperature (Fast)

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

Parameters

Tnnn Tool number
 Snnn Active/Target temperature
 Rnnn Standby temperature

Examples

```
M142 S60
M142 S60 R30
M141 T1 S60 R30
```

Set the temperature of the cooler

M143: Maximum heater temperature

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

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

Parameters

Pnn Bed heater number, default 0
 Sn 0 = set bed heater to standby (default), 1 = set bad heater active

Example

```
M144
```

Switch the bed heater to its standby temperature. M140 S1 turns it back to its active temperature.

M146: Set Chamber Humidity

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	No	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	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 LED color

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	See below	No	No	???	No ¹	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Parameters

Rnnn Red component
 Unnn Green component
 Bnnn Blue component
 Wnnn White component (Marlin)
 Pnnn Brightness (0-255) (Marlin)
 P Set full brightness (Marlin)
 Snnn Number of individual LEDs to set, default 1 (RepRapFirmware)

Example

```
M150 R255 U128 B192
```

Set BlinkM, Neopixel, and/or other LED light color and intensity with RGBW component values from 0 to 255. Some LCD controllers use this interface for a backlight. Firmware may override the set color to indicate the current printer status.

RepRapFirmware uses this command to control DotStar LED strips on controllers that provide a connector for this purpose.

Notes

In Prusa Firmware this G-code is deactivated by default, must be turned on in the source code.¹

M155: Automatically send temperatures

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	1.1.0+	No	Yes	No	???	Yes	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Parameters

Snnn enable sending temperatures = 1, disable = 0

Example

```
M155 S1
```

Hosts normally monitor printer temperatures by sending M105 every couple of seconds. This not only adds serial traffic but it will fail whenever the command queue is full. M155 addresses these problems by telling the firmware to automatically report temperatures at regular intervals. This behavior is disabled by default for best compatibility with existing hosts. If the firmware supports M155 the output of M115 will report the AUTOREPORT_TEMP capability:

```
Cap:AUTOREPORT_TEMP:1
```

M160: Number of mixed materials

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	1.1.0+	M567	0.92+	No	???	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Parameters

Snnn extruder number
 Pnnn weight

Set weight for this mixing extruder drive.

See *Repetier Color Mixing* for more informations.

M164: Store weights

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	1.1.0+	No	0.92	No	???	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	1.1.0+	M567	No:	No	???	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Parameters A B C D H I

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes	Yes	Yes	???	Yes	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	Yes	No	No	Yes	Yes	M116	Yes

Parameters

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

Example

```
M190 S60
```

Wait for the bed temperature to reach 60 degrees, printing out the temperatures once per second.

M191: Wait for chamber temperature to reach target temp

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	2.0.0+	1.17+	No	No	???	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	Yes	No	No	No

Example

```
M191 S60
```

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

Parameters

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

M200: Set filament diameter

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	1.19+	Yes	Yes	???	Yes	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	Yes	No	No	No

RepRapFirmware:**Parameters**

`Daaa:bbb:ccc...` Sets filament diameter to aaa for extruder 0, bbb for extruder 1 and so on. If any of aaa, bbb etc. are zero then volumetric extrusion is disabled for that extruder.

`Daaa` Sets filament diameter (or disables volumetric extrusion) for all extruders

Examples

M200 D0 ; disable volumetric extrusion on all extruders

M200 D1.75 ; set all extruder filament diameters to 1.75mm

M200 D1.75:3.0:1.75 ; set extruder 0 to 1.75mm, extruder 1 to 3.0mm and all remaining extruders to 1.75mm

Volumetric extrusion is an option you can set in some slicers whereby all extrusion amounts are specified in mm³ (cubic millimetres) of filament instead of mm of filament. This makes the gcode independent of the filament diameter, potentially allowing the same gcode to run on different printers. The purpose of the M200 command is to inform the firmware that the gcode input files have been sliced for volumetric extrusion, and to provide the filament diameter so that the firmware can adjust the requested extrusion amount accordingly.

Sending M200 without parameters reports the current volumetric extrusion state and (where appropriate) filament diameter for each extruder.

Note that if you use slicer-commanded retraction, the retraction amounts must be specified in mm³ too. If instead you use firmware retraction, then the firmware retraction amounts specified using the M207 command are still interpreted as mm.

Other firmwares:

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 $\sqrt{1 / \pi} * 2 = 1.128$

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

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

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

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

Set max travel acceleration in units/s² for travel moves (**M202** *X1000 Y1000*). *Unused in Marlin!!*

M203: Set maximum feedrate

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

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: Set temperature monitor

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

Set temperature monitor to *Sx*. Repetier Firmware only.

M204: Set default acceleration

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	1.18+	Yes	Yes	???	Yes	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	Yes	No	No	No	No	No	No

Parameters (RepRapFirmware)

Pnnn Acceleration for printing moves
Tnnn Acceleration for travel moves

Example

```
M204 P500 T2000
```

Use **M201** to set per-axis accelerations and extruder accelerations. RepRapFirmware applies the **M204** accelerations to the move as a whole, and also applies the limits

set by M201 to each axis and extruder.

Parameters (MK4duo)

Pnnn Acceleration for printing moves
Vnnn Acceleration for travel moves
Rnnn Acceleration for Retraction for Tools with T code

Example

```
M204 P500 V2000 T0 R5000
```

Other firmwares:

S normal moves T filament only moves (M204 S3000 T7000) in mm/sec^2 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 sets the acceleration for printing movements to 800mm/s^2, for travels to 3000mm/s^2 and for retracts to 9000mm/s^2.

M204 Repetier

Usage

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

Set PID parameter. Values are 100*real value.

M205: Advanced settings

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	M566	Yes	Yes	???	Yes	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	Yes	No	No	No	No	No	No

Sprinter / Marlin

Minimum travel speed = S[printing] T[travel]
B[min segment time] X[max XY jerk] Z[max Z jerk] E[max E jerk]

Sprinter / Marlin Example

```
M205 X30 Z5 ; Set X/Y Jerk to 30mm/s, Z jerk to 5mm/s
```

Smoothieware uses a different algorithm: [1] (https://onehossshay.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: EEPROM Report

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

Output EEPROM settings. Repetier Firmware only.

M206: Offset axes

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

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.

In builds of RepRapFirmware that support CNC workplace coordinates, using this command is equivalent to using G10 L2 P1 to set the coordinate offsets for workplace 1.

M206: Set EEPROM value

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

Set a Repetier Firmware EEPROM value.

Parameters

T[*type*] Value *type*
P[*pos*] Value *position*
[S(*long*)] An integer value
[X(*float*)] A float value

Example

```
M206 T3 P39 X19.9 ; Set Jerk to 19.9
```

M207: Firmware dependent

M207: Set retract length

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes	No	Yes	???	Yes	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	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
```

Set the retract length used by the G10 and G11 commands. Units are in mm regardless of M200 setting.

Machinekit uses different parameters and speed units for M207. Use P to set retract length in mm. Use Q to set retract velocity in mm/s. For firmware retraction Machinekit uses G22 and G23 in place of G10 and G11.

M207: Calibrate Z axis with Z max endstop

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	Use G1 S3 ...	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	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 jerk without saving to EEPROM

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	M566	Yes	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	???	No	???	No	No	???	No

Repetier Firmware only. Change the maximum instantaneous speed change ("jerk") values, but don't store the change in EEPROM.

Since Repetier 0.91 December 2013 [2] (<https://github.com/repetier/Repetier-Firmware/blob/d86da831853288d4a10fb0584d006c7763ca2bb6/src/ArduinoAVR/Repetier/Repetier.ino#102>) (if not earlier)

Parameters

Xnnn Temporarily set XY jerk in mm/s
Znnn Temporarily set Z jerk in mm/s
Ennn Temporarily set Extruder jerk in mm/s

Example

```
M207 X10 ; Change the X/Y Jerk to 10mm/s
```

M208: Set axis max travel

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

Parameters

Snnn 0 = set axis maximum (default), 1 = set axis minimum

Xnnn X axis limit

Ynnn Y axis limit

Znnn Z axis limit

Example

M208 X200 Y200 Z90 ; set axis maxima

M208 X-5 Y0 Z0 S1 ; set axis minima

The values specified set the software limits for axis travel in the specified direction. The axis limits you set are also the positions assumed when an endstop is triggered.

M208: Set unretract length

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Use M207	No	Yes	???	Yes	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	No	No	No

Parameters

Snnn positive length surplus to the M207 Snnn, in mm

Fnnn feedrate, in mm/sec

Sets recover=unretract length.

M209: Enable automatic retract

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

Example

```

M209 S1

```

This boolean value S 1=true or 0=false enables automatic retract detect if the slicer did not support G10/G11: every normal extrude-only move will be classified as retract depending on the direction.

M210: Set homing feedrates

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	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

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Partial*	Use G31	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	No	No	No

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.

M217: Toolchange Parameters

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Use tool change files	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	No	No	No

If arguments are given, sets tool-change retract and prime length (mm), prime feedrate (mm/m), retract feedrate (mm/m), and park position/raise (mm) or Z raise (mm): S<length> P<prime_speed> R<retract_speed> X<xpos> Y<ypos> Z<zraise>. XY arguments require SINGLENOZZLE_SWAP_PARK. If no arguments are given, reports current values. Currently used to set the SINGLENOZZLE tool-change options in Marlin 2.0 and up. May be extended for other tool-changing systems in the future.

M218: Set Hotend Offset

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Use G10	No	No	???	Yes ¹	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	No	No	No

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

Example

```
M218 T1 X50 Y0.5
```

Notes

In Prusa Firmware this G-code is only active if EXTRUDERS is higher then 1 in the source code. On Original i3 Prusa MK2/s MK2.5/s MK3/s it is not active.¹

M220: Set speed factor override percentage

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

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes	Yes	Yes	???	Yes ¹	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	Yes	No	No	No	Yes	Yes	No

Parameters

Snnn Extrude factor override percentage (0..100 or higher), default 100%

Dnnn Extruder drive number (RepRapFirmware only), default 0

Tnnn Extruder drive number (Prusa Firmware only), default 0 if not set.¹

Example

```
M221 S70
M221 S95 D1
M221 S85 T1
```

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

M220: Turn off AUX V1.0.5

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

M221: Turn on AUX V1.0.5

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

M222: Set speed of fast XY moves

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

M223: Set speed of fast Z moves

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

M224: Enable extruder during fast moves

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

M225: Disable on extruder during fast moves

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

M226: G-code Initiated Pause

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

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

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	No	No	No

Example

```
M228
```

See also M227.

M229: Enable Automatic Reverse and Prime

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	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

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

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

M232: Read and reset max. advance values

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

M240: Trigger camera

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	No	No	No	???	No ¹	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	No	No	No

Example

M240

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

Notes

In Prusa Firmware this G-code is deactivated by default, must be turned on in the source code.¹

M240: Start conveyor belt motor / Echo off

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

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

Example

M241

Echoing may be controlled in some firmwares with M111.

M245: Start cooler

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	Use M106	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	Use M106	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	No	No	No

Example

M246

M250: Set LCD contrast

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

Example

M250 C20

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

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

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

Examples

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

(This is a Repetier-Firmware only feature.)

M260: i2c Send Data

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	1.1.0+	1.21+	No	No	???	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

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**.

Parameters (Marlin, MK4duo)

Ann I2C address

Bnn Byte to buffer or send

S If present, sends the bytes that have been buffered

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 ; c
M260 B108 ; l
M260 B105 ; i
M260 B110 ; n
M260 S1 ; Send the current buffer
```

Parameters (RepRapFirmware)

Ann I2C address

Bnn:nn:nn... Bytes to send

Snn Number of bytes to receive (optional, RepRapFirmware 2.02RC4 and later)

Examples

```
M260 A5 B65 ; Send 'A' to address 5
M260 A"0x7F" B65 ; Send 'A' to address 7F (hex)
M260 A0 B82:101:112:82:97:112 ; Send 'RepRap' to address 0
```

RepRapFirmware does not use the **S** parameter, instead the address and all the bytes to send are specified in a single command.

M261: i2c Request Data

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	1.1.0+	1.21+	No	No	???	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

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

Parameters

Ann I2C address

Bnn How many bytes to request

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	1.16+	Use M340	No	???	No ¹	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	Yes	Yes	No	No

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	PC23_PWML6	21
4	PC22_PWML5	22
5	PC21_PWML4	23

On the Duet 0.6, pin 18 is controlled by heater 2. On the 0.8.5, pin 18 is controlled by heater 6, but is also shared with fan1. In order to use this pin, the fan must be disabled (M106 P1 I-1). See Using servos and controlling unused I/O pins (https://duet3d.com/wiki/Using_servos_and_controlling_unused_I/O_pins)

Notes

In Prusa Firmware this G-code is deactivated by default, must be turned on in the source code.¹

M290: Babystepping

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	1.1.7+	1.18+	Yes	No	???	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	No	No	No

Parameters (RepRapFirmware)

Snnn Amount to baby step in mm. Positive values raise the head, negative values lower it.

Znnn Synonym for S (RepRapFirmware 1.21 and later)

Rn (Optional, RepRapFirmware 1.21 and later) R1 = relative (add to any existing babystep amount, the default), R0 = absolute (set babystepping offset to the specified amount)

Examples

```
M290 S0.05 ; babystep the head up 0.05mm
M290 R0 S0 ; clear babystepping (RepRapFirmware 1.21 and later only)
```

Parameters (Repetier)

Znnn Amount to baby step in mm. Positive values raise the head, negative values lower it.

Examples

```
M290 S0.05 ; babystep the head up 0.05mm
```

Additional Parameters (Marlin 1.1.7 and later)

Xnnn Amount to babystep X in current units. (Requires BABYSTEP_XY)

Ynnn Amount to babystep Y in current units. (Requires BABYSTEP_XY)

Znnn Amount to babystep Z in current units. Synonym for 's' parameter.

Example

```
M290 X0.2 Z0.05 ; Babystep X by 0.2mm, Z by 0.05mm
```

This command tells the printer to move the axis (or axes) transparently to the motion system. This is like physically moving the axes by force, but much nicer to the machine.

In RepRapFirmware M290 with no parameters reports the accumulated baby stepping offset. Marlin doesn't track accumulated babysteps.

In RepRapFirmware 1.19 and earlier, the babystepping offset is reset to zero when the printer is homed or the bed is probed. In RepRapFirmware 1.21 and later, homing and bed probing don't reset babystepping, but you can reset it explicitly using M290 R0 S0.

Note: If the BABYSTEP_ZPROBE_OFFSET option is used in Marlin, this command also affects the Z probe offset (as set by M851) and that offset *will* be saved to EEPROM.

M291: Display message and optionally wait for response

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.19+	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	No	No	No

Parameters

P"message" The message to display, which must be enclosed in double quotation marks. If the message itself contains a double quotation mark, use two double quotation marks to represent it.

R"message" Optional title for the message box. Must be enclosed in double quotation marks too.

Sn Message box mode (defaults to 1)

Tn Timeout in seconds, only legal for S=0 and S=1. The message will be cancelled after this amount of time, if the user does not cancel it before then. A zero or negative value means that the message does not time out (it may still be cancelled by the user if it has a Close button). In RepRapFirmware, the default timeout for messages that do not require acknowledgement is 10 seconds.

Zn 0 = no special action, 1 = display Z jog buttons alongside the message to allow the user to adjust the height of the print head

Examples

```
M291 P"Please do something and press OK when done" S2
M291 P"This message will be closed after 10 seconds" T10
```

This command provides a more flexible alternative to M117, in particular messages that time out, messages that suspend execution until the user acknowledges them, and messages that allow the user to adjust the height of the print head before acknowledging them.

Allowed message box modes include:

```
0. No buttons are displayed (non-blocking)
1. Only "Close" is displayed (non-blocking)
2. Only "OK" is displayed (blocking, send M292 to resume the execution)
3. "OK" and "Cancel" are displayed (blocking, send M292 to resume the execution or M292 P1 to cancel the operation in progress)
```

The combination S0 T0 is not permitted, because that would generate a message box with no close button and that never times out, which would lock up the user interface.

Duet Web Control 2.0.3 and later supports HTML in the message body.

M292: Acknowledge message

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.19+	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	No	No	No

Parameters

Pn Whether the current operation shall be cancelled. Only legal if M291 was called with S=3 (optional)

This command is sent by the user interface when the user acknowledges a message that was displayed because of a M291 command with parameter S=2 or S=3.

M300: Play beep sound

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes	Yes	No	???	Yes ¹	Yes	Yes
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	Yes	No	No	No

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.

Notes

In Prusa Firmware the defaults are 100Hz and 1000ms, so that M300 without parameters will beep for a second.

M301: Set PID parameters

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes	Yes	Yes	???	Yes	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	Yes	No	No	No	Yes	See M130-M133	No

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, RepRapFirmware
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.

MK4duo

H[heaters] H = 0-5 Hotend, H = -1 BED, H = -2 CHAMBER, H = -3 COOLER

Marlin

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

RepRapFirmware 1.15 onwards

In RepRapFirmware 1.15 and later the M301 is supported as described above, but it is not normally used. Instead the heater model is defined by M307 or found by auto tuning, and the firmware calculates the PID parameters from the model. An M301 command can be used in config.g after the M307 command for that heater to override the firmware-computed PID parameters.

RepRapFirmware 1.09 to 1.14 inclusive

- **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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes ¹	0.92+	No	???	Yes	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	No	No	No

Parameters

- Snnn Cold extrude minimum temperature (also in RepRapFirmware 2.02 and later)
- Pnnn Cold extrude allow state (RepRapFirmware)
- Rnnn Cold retraction minimum temperature (RepRapFirmware 2.02 and later)

Examples (RepRapFirmwre)

```
M302 ; Report current state
M302 P1 ; Allow cold extrusion
M302 S120 R110 ; Allow extrusion starting from 120°C and retractions already from 110°C
```

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[0|1] parameter instead of S[temperature], and for M302 with no parameters it will report the current cold extrusion state.

M303: Run PID tuning

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	1.15+	Yes	Yes	???	Yes	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	Yes	No	No	No	Yes	No	No

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes	???	M301	???	Yes	M301	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	No	No	???

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

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

Parameters

Pnnn Heater number, or virtual heater number
 S"name" Heater name (optional, RepRapFirmware only)
 Tnnn (for thermistor sensors) Thermistor resistance at 25°C
 T"c" (for MAX31856-based thermocouple sensors) The thermistor type letter, default K
 Bnnn Beta value, or the reciprocal of the Steinhart-Hart thermistor model B coefficient
 Cnnn Steinhart-Hart C coefficient (MK4duo and RepRapFirmware 1.17 and later), default 0
 Rnnn Series resistor value
 Lnnn ADC low offset correction, default 0
 Hnnn ADC high offset correction, default 0
 Xnnn Heater ADC channel, or thermocouple or PT100 or current loop adapter channel, defaults to the same value as the P parameter
 Fnn (where nn is 50 or 60) If the sensor interface uses a MAX31856 thermocouple chip or MAX31865 PT100 chip, this is the local mains frequency. Readings will be timed to optimise rejection of interference at this frequency.

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.

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. MAX31855 thermocouple channels are numbered from 100, MAX31856 thermocouple channels are numbered from 150, PT100 channels from 200 and current loop channels from 300. Channel 1000 is the CPU temperature indication, 1001 is the temperature of the hottest stepper motor driver on the main board, and 1001 is the temperature of the hottest drivers on the expansion board.

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

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.15+	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	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

Four optional additional parameters help control the heating process

Fnnn PWM frequency to use (not supported in RepRapFirmware 3, use M950 instead).

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

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

Vnnn VIN supply voltage at which the A parameter was calibrated (RepRapFirmware 1.20 and later). This allows the PID controller to compensate for changes in supply voltage. A value of zero (the default) disables compensation for changes in supply voltage.

Examples

```
M307 H0 ; report the process parameters for heater 0
M307 H1 A346.2 C140 D5.3 B0 S0.8 V23.8 ; 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, using different values for the heating or cooling phase and the steady state phase. It is also used to better detect heater faults. In future it may be used 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 to use with the M42 or M280 command. In RepRapFirmware 3, M950 should be used to free up the pin instead.

M308: Set or report sensor parameters

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	3.0+	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Common Parameters

Sn Sensor number

P"pin_name" The name of the control board pin that this sensor uses. For thermistors it is the thermistor input pin name. For sensors connected to the SPI bus it is the name of the output pin used as the chip select.

Y"sensor_type" The sensor and interface type, e.g. "thermistor", "pt1000", "rtdmax31865", "max31855", "max31856", "linear-analog", "dht22-temp", "dht22-humidity", "current-loop-pyro"

A"name" Sensor name (optional), displayed in the web interface

Additional parameters for thermistors

Tnnn (for thermistor sensors) Thermistor resistance at 25°C

Bnnn Beta value, or the reciprocal of the Steinhart-Hart thermistor model B coefficient

Cnnn Steinhart-Hart C coefficient, default 0

Rnnn Series resistor value

Lnnn ADC low offset correction, default 0 (ignored if the hardware supports automatic ADC gain and offset calibration)

Hnnn ADC high offset correction, default 0 (ignored if the hardware supports automatic ADC gain and offset calibration)

Additional parameters for PT1000 sensors

Rnnn Series resistor value

Lnnn ADC low offset correction, default 0 (ignored if the hardware supports automatic ADC gain and offset calibration)

Hnnn ADC high offset correction, default 0 (ignored if the hardware supports automatic ADC gain and offset calibration)

Additional parameters for MAX31856-based thermocouple sensors

T"c" The thermistor type letter, default K

Fnn (where nn is 50 or 60) The local mains frequency. Readings will be timed to optimise rejection of interference at this frequency.

Additional parameters for MAX31865-based PT100 sensors

Rnnn Series resistor value

Fnn (where nn is 50 or 60) The local mains frequency. Readings will be timed to optimise rejection of interference at this frequency.

Additional parameters for linear analog sensors

Fn F0 = unfiltered (fast response), F1 = filtered (slower response, but noise reduced and ADC oversampling used to increase resolution)

Lnnn The temperature or other value when the ADC output is zero

Hnnn The temperature or other value when the ADC output is full scale

This code replaces M305 in RepRapFirmware 3. In earlier versions of RepRapFirmware, sensors only existed in combination with heaters, which necessitated the concept of a "virtual heater" to represent a sensor with no associated heater (e.g. MCU temperature sensor). RepRapFirmware 3 allows sensors to be defined independently of heaters. The association between heaters and sensors is defined using M950.

M308 can be used in the following ways:

```
M308 Snn Y"type" P"pin" [other parameters] ; delete sensor nn if it exists, create a new one with default settings, and configure it using the other parameters
M308 Snn ; report the settings of sensor nn
M308 A"name" ; report the settings of the first sensor named "name"
M308 Snn [any other parameters except Y] ; amend the settings of sensor nn
```

Sensor type names obey the same rules as pin names, i.e. case is not significant, neither are hyphen and underscore characters.

M320: Activate autolevel (Repetier)

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	Yes	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	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)

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	Yes	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	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)

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	Yes	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	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)

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

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

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

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

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

Example

```
M351
```

M355: Turn case lights on/off

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	1.1.0+	No	0.92.2+	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	use M106	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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	M503	No	0.92.2+	No	???	M503	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	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:SProbe: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

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

M360: Move to Theta 0 degree position

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

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

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

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

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

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

M363: Move to Psi 90 degree position

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

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

M364: Move to Psi + Theta 90 degree position

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

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Use M579	No	Yes	???	No	Experimental	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	???

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

M366: SCARA convert trim

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

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

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

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

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

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

M374: Save calibration grid

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.17+	No	Yes	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	???	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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.17+	No	Yes	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	???	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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	M420Z	1.17+	No	Yes	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	???	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

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

Example

```
M380
```

Activates solenoid on active extruder.

M381: Disable all solenoids

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

Example

```
M400
```

M400: Wait for current moves to finish

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes	Yes	Yes	???	Yes	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	Yes	No	No	Yes	???	use G4	No

Example

```
M400
```

Finishes all current moves and thus clears the buffer. That's identical to G4 P0 for Teacup printers.

M401: Lower z-probe

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	1.17+	???	No	???	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	???	No	No

Example

```
M401
```

Lower z-probe if present. In RepRapFirmware this runs macro file sys/deployprobe.g.

M402: Raise z-probe

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	1.17+	???	No	???	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	???	No	No

Example

```
M402
```

Raise z-probe if present. In RepRapFirmware this runs macro file sys/retractprobe.g.

M403: Set filament type (material) for particular extruder and notify the MMU

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Parameters

- E Extruder number
- F Filament type

Currently three different materials are needed (default, flex and PVA).

And storing this information for different load/unload profiles etc. in the future firmware does not have to wait for "ok" from MMU.

M404: Filament width and nozzle diameter

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

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

While 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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Use M591	No	No	???	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	???	No	No

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Use M591	No	No	???	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	???	No	No

Example

```
M406
```

Turn off Filament Sensor extrusion control.

M407: Display filament diameter

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

Example

```
M407
```

Displays measured filament diameter. In RepRapFirmware, M407 does the same as M404.

M408: Report JSON-style response

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	Yes	No	No	???	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	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],
  "efactor": 100.00, "efactor": [100.00, 100.00], "tool": 1, "probe": "S35", "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 from a pause, B=busy (e.g. running a macro), F=performing firmware update
heaters: current heater temperatures, numbered as per the machine (typically, heater 0 is the bed)
hstat: 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 if no tool is selected
extr: the positions of the extruders
efactor: 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, 1=axis has been homed so position is 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 file read,
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 is greater than that.
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 is greater.

```

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", "Smoothieware" or "Repetier"
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.

M409: Query object model

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	3.01 and later	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Parameters

K"key" Key string, default empty

F"flags" Flags string, default empty

Examples

```

M409 K"move.axes" F"i" ; report all frequently-changing properties of all axes
M409 K"move.axes[0]" F"u" ; report all properties of the first axis, including values not normally reported
M409 K"move.axes[]" F"m" ; for all axes, report whether it is homed
M409 K"#move.axes" ; report the number of axes
M408 F"i" ; report all values that are likely to have changed recently
M409 F"u" ; report the entire object model (caution, this may be very large!)

```

The key string is just the path to the Object Model (OM) variables wanted, with the following extensions:

- An element that is an array may be followed by either `[number]` to select just one element, or by `[]` to select all elements and report the results as an array
- The path may be preceded by `#` in which case the path must refer to an array and just the number of array elements is returned

An empty key string selects the entire object model.

The flags string may include one or more of the following:

```

#d: (depth) return the OM to depth d# where # is a sequence of digits. The default depth is 1 if the key is empty or not provided (because the returned object would be very large, perhaps too large to send), otherwise a large value
f: (frequent) return only those values in the object model that typically change frequently during a job. User interfaces can use M409 with this flag to stay up to date.
n: (null) include fields with null values (null fields are normally omitted, but null array elements are never omitted)
v: (verbose) include values that are rarely needed and not normally returned (e.g. controller electronics and firmware limits)

```

The response is a JSON object of the following form:

```
{"key": "key", "flag": "flags", "result": object-value}
```

The key and flags fields are as provided in the M409 command. If the key string is malformed or refers to a property that does not exist in the object model, the result field is `null`.

RepRapFirmware on network-enabled electronics also provides the same functionality via the `rr_model` call to the HTTP API.

M410: Quick-Stop

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	1.1.0-RC2+	Use M112	No	No	???	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	???	No	No

This command does a quick stop of all stepper motors and aborts all moves in the planner. This command is only intended for emergency situations, and due to the instant stop the actual stepper positions may be shifted. Note that if `EMERGENCY_PARSER` is disabled, the response may be delayed while the command buffer is being queued. If a print job is in progress, it will continue, so it is important to suspend the print job before using this command.

M412: Disable Filament Runout Detection

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	2.0+	Use M591	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Enable or disable filament runout detection. When filament sensors are enabled, the firmware responds to a filament runout by running the configured G-code (usually M600 Filament Change). When filament runout detection is disabled, no action will be taken on filament runout.

Usage: M412 S[on|off]

If no 'S' parameter is given, this command reports the current state of filament runout detection.

Examples

M412 S1 *Enable filament runout detection*

M412 S0 *Disable filament runout detection*

M412 *Report the current filament runout detection state*

M413: Power-Loss Recovery

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	2.0+	Use M911	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Enable or disable the **Power-loss Recovery** feature. When this feature is enabled, the state of the current print job (SD card only) will be saved to a file on the SD card. If the machine crashes or a power outage occurs, the firmware will present an option to Resume the interrupted print job. In Marlin 2.0 the `POWER_LOSS_RECOVERY` option must be enabled.

This feature operates without a power-loss detection circuit by writing to the recovery file periodically (e.g., once per layer), or if a `POWER_LOSS_PIN` is configured then it will write the recovery info only when a power-loss is detected. The latter option is preferred, since constant writing to the SD card can shorten its life, and the print will be resumed where it was interrupted rather than repeating the last layer. (Future implementations may allow use of the EEPROM or the on-board SD card.)

Usage: `M413 S[on|off]`

If no 'S' parameter is given, this command reports the current state of Power-loss Recovery.

Examples

```
M413 S1 Enable power-loss recovery
M413 S0 Disable power-loss recovery
M413 Report the current power-loss recovery state
```

M415: Host Rescue

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

The host rescue G-code is essential to enabling host software to recover from a lost connection or power loss. With this solution the firmware stores the last received coordinate and current position in EEPROM. Once the host reconnects, the firmware reports this recovery information. From the last-received coordinate the host can determine the last line that was processed. Firmware should move the extruder to a parking position if commands stop arriving during an active print job (with heaters still on). Once the host starts sending new commands the firmware should restore the last position. Host and firmware developers can work together to optimize this solution.

If the firmware supports this solution it should announce it with the capability: `Cap:HOST_RESCUE:1`

Examples

```
M415 S1 Enable host rescue system
M415 S0 Disable host rescue system
M415 Z[xpos] Set Z position as if homed
M415 Report rescue state
```

Every call to M415 reports the state. Answers are

RESCUE_STATE: OFF

Nothing stored. Print finished.

RESCUE_STATE: LX:121.97 LY:143.33 LZ:3.30 LE:1.84 LT:0 X:0.00 Y:240.00 Z:13.30 E:1.84

Print was interrupted. Coordinates with leading L are last received positions, LT is active extruder. Normal coordinates are current position and can be omitted, if the move did not finish due to power loss.

On a power loss the firmware should respond with `POWERLOSS_DETECTED` as early as possible to give host time to flush log as it is likely host will also go down very soon.

Support is available in Repetier-Firmware 1.0.4 or higher. Repetier-Server 0.91.0 is the first to use this concept and can be used to validate implementation.

M416: Power loss

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

Host tells firmware that it will lose power. This is the solution in case a connected host has a power loss detection and firmware does not. Firmware should return the message `POWERLOSS_DETECTED` and do whatever firmware is supposed to do in that case. In combination with host rescue it should store positions, disable heaters, go to park position.

M420: Set RGB Colors as PWM (MachineKit)

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	Yes	???	No	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 `M420` is Enable/Disable Mesh Leveling (with current values) `S1`=enable `S0`=disable

M420: Leveling On/Off/Fade (Marlin)

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Use G29 and M376	No	No	???	???	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	???	No	No

Enable/Disable Bed Leveling (using the current stored grid or mesh).

Usage

```
M420 S[bool] Z[float]
```

Examples

```
M420 S1 ; Enable compensation using current grid/mesh
M420 Z10 ; Gradually reduce compensation until Z=10
```

Marlin 1.1.0 adds the `z` parameter to set the "fade" height. This requires the `ENABLE_LEVELING_FADE_HEIGHT` option.

When the `z` fade height value is set non-zero, bed compensation will gradually reduce up to the given height, and cease completely above that height.

M421: Set a Mesh Bed Leveling Z coordinate

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

Set a single Z coordinate in the Mesh, Bilinear or UBL Leveling grid. Requires `MESH_BED_LEVELING` or `AUTO_BED_LEVELING_BILINEAR` or `AUTO_BED_LEVELING_UBL`.

I & J are the index for the X and Y axis respectively.

Usage

```
M421 I[index] J[index] Z[float] to set an absolute value to a mesh point
```

or

```
M421 I[index] J[index] Q[float] to offset a mesh point by a specified value
```

M425: Backlash Correction

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	2.0.x+	No	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Parameters

```
Fnnn Enable/disable/fade-out backlash correction (0.0 = none to 1.0 = 100%)
Snnn Distance over which backlash correction is spread1 (mm)
Xnnn Set the backlash distance on X (mm; 0 to disable)
Ynnn Set the backlash distance on Y (mm; 0 to disable)
Znnn Set the backlash distance on Z (mm; 0 to disable)
X Use measured value for backlash on X (if available)
Y Use measured value for backlash on Y (if available)
Z Use measured value for backlash on Z (if available)
```

Examples (Marlin)

```

;-----
M425 ; Report current state
M425 Z ; Use measured value of backlash on Z
M425 F1 S3 ; Full backlash compensation while smoothing over 3mm.
M425 F0.5 S0.0 ; Compensate for 50% of the backlash with no smoothing
M425 X0.1 Y0.2 Z0.3 ; Set backlash to specific values for all axis
;-----

```

Notes

¹ In Marlin, backlash compensation works by adding extra steps to one or more segments after a motor direction reversal. With smoothing off, this can cause blemishes on the print. Enabling smoothing will cause those extra steps to be spread over multiple segments, minimizing artifacts.

M450: Report Printer Mode

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.20+	Yes	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Usage

```
M450
```

Example

```
> M450
> 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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.20+	Yes	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Usage

M451

Example

```
> M451
> PrinterMode:FFF
```

Switches to FFF mode for filament printing.

M452: Select Laser Printer Mode

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.20+	Yes	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Usage

M452

Example

```
> M452
> 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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.20+	Yes	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Usage

M453

Parameters (RepRapFirmware only)

- Snnn (optional) Spindle index, defaults to 0. Duet 2 supports 4 spindles max
- Pfff:rrr Logical pin numbers used to drive the spindle motor in clockwise and counterclockwise directions. Omit the ":rrr" part if the spindle turns clockwise only.
- In Invert (I1) or don't invert (I0, default) the output polarity
- Rnnn Spindle RPM that is achieved at full PWM. Used to convert the S parameter in M3 and M4 commands to a PWM value.
- Fnnn (optional) The PWM frequency to use
- Tnnn (optional) Assign spindle to a tool allowing better control in DWC

Example

```
> M453
> PrinterMode:CNC
```

Switches to CNC mode. In this mode M3/M4/M5 control the pins defined for the milling device.

Notes for RepRapFirmware: By default, no output is assigned to the spindle motor. Logical pin numbers for the P parameters are as defined for the M42 and M208 commands. If you wish to assign a heater or fan output to control the spindle motor as in the above example, you must first disable the corresponding heater (see M307) or fan (see M106).

M460: Define temperature range for thermistor-controlled fan

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	Use M106	Yes	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	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.

M470: Create Directory on SD-Card

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	Yes:2.03	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Parameters

P"name" Name of directory to create

Usage

M470 P"directory/to/create"

Example

```
M470 P"/sys/config.d"
```

This will create a new directory on the SD-Card. If not otherwise specified the default root should be the first/internal SD-Card.

M471: Rename File/Directory on SD-Card

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	Yes:2.03	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Parameters

S"name" Name of existing file/directory
 T"name" New name of file/directory
 Dnnn Setting this to 1 will delete an existing file that matches the T parameter value

Usage

```
M471 S"source/name" T"dest/name" D1
```

Example

```
M471 S"/sys/config-override.g" T"/sys/config-override.g.bak"
```

Rename or move a file or directory. Using the D parameter can delete a file with the target name. Renaming or moving across directories is possible though not from one SD-Card to another.

M486: Cancel Object

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

The M486 G-code provides an interface to identify objects on the print bed and cancel them. Basic usage: Use M486 T to tell the firmware how many objects there are, so it can provide an LCD interface. (Otherwise the firmware counts them up in the first layer.) In every layer of your G-code, you must preface each object's layer slice with M486 S[index] to indicate which object is being printed. The index should be zero-based. To cancel the first object, use M486 P0; to cancel the 5th object use M486 P4; and so on. The "current" object is canceled with M486 C.

G-codes associated with the canceled objects are no longer printed. Firmware supports this feature by ignoring G0-G3/G5 moves in XYZ while updating F and keeping the E coordinate up-to-date without extruding.

Slicers should number purge towers and other global features with a negative index (or other flag) to distinguish them from regular print objects, since it is important to preserve color changes, purge towers, and brims.

Host software (such as OctoPrint) may be able to cancel individual objects through a plugin, and in this case they should not use M486 P to cancel objects (although doing so should cause no harm).

Usage

```
M486 T12 ; Total of 12 objects (otherwise the firmware must count)
M486 S3 ; Indicate that the 4th object is starting now
M486 S-1 ; Indicate a non-object, purge tower, or other global feature
M486 P10 ; Cancel object with index 10 (the 11th object)
M486 O2 ; Un-cancel object with index 2 (the 3rd object)
M486 C ; Cancel the current object (use with care!)
```

M500: Store parameters in non-volatile storage

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

Example

```
M500
```

Save current parameters to EEPROM, SD card or other non-volatile storage.

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

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

Parameters

Snnn Enable auto-save (only RepRapFirmware)

Example

```
M501
```

Set the active parameters to those stored in the EEPROM, SD card or other non-volatile storage. 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: Restore Default Settings

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

Example

```
M502
```

This command resets all tunable parameters to their default values, as set in the firmware's configuration files. This doesn't reset any parameters stored in the EEPROM, so it must be followed with `M500` to reboot with default settings.

M503: Report Current Settings

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

Examples

```
M503 ; Output current settings
M503 S0 ; Settings as G-code only (Marlin 1.1)
```

This command asks the firmware to reply with the current print settings as set in memory. Settings will differ from EEPROM contents if changed since the last load / save. The reply output includes the G-Code commands to produce each setting. For example, 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.

M504: Validate EEPROM

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	1.1.9+	Not needed	No	No	???	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Examples

```
M504 ; Check EEPROM
```

This command checks the contents of EEPROM for correct version, size, and checksum and reports the result.

M505: Firmware dependent

M505: Clear EEPROM and RESET Printer

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

This command erase all EEPROM and reset the board.

M505: Set configuration file folder

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	Yes:2.03	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Parameters

P"name" ; name of folder, default path is `/sys/` if it is a relative path

Example

M505 P"experimental" ; change config file path from `/sys/` to `/sys/experimental/`

Following this command, files that would normally be fetched from `/sys/` (for example, homing files and system macro files in RepRapFirmware) are fetched from the specified folder instead. Any such files that are already being executed will continue to run.

This command can be used to allow multiple configurations to be maintained easily. In RepRapFirmware the file `/sys/config/g` can contain just these two lines:

```
M505 P"config1"
M98 P"config.g"
```

The first line changes the config file folder to `/sys/config1` and the second one executes file `config.g` in that folder. To select an alternative configuration, only the first line needs to be edited.

M509: Force language selection

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Resets the language to English. Only on Original Prusa i3 MK2.5/s and MK3/s with multiple languages.

M524: Abort SD Printing

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	2.0.0+	Use M25 then M0	No	???	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Example

```
M524
```

If an SD print is in progress, this command aborts the print, just as if you had selected "Stop print" from the LCD menu.

M530: Enable printing mode

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	Yes	???	???	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	???	No	No ¹

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
```

Notes

¹In MK4duo this command starts print counters for statistics. It also turns off a 30-minute timer for the heaters. If the timer reaches 30, turn off all the heaters.

M531: Set print name

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

Example

```
M531 Demo Model
```

Sets the name of the currently printed object. Should follow M530 S1 for correct display.

M532: Set print progress

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	M73	No	Yes	???	???	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	???	No	No

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: Set MAC address

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	Yes	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	???	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 (https://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.

This command is only needed when using older electronics that doesn't provide a unique MAC address, for example Duet 0.6 and Duet 0.8.5.

M540 in Marlin: Enable/Disable "Stop SD Print on Endstop Hit"

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	No	No	No	???	No ¹	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Parameters

^{Snnn} state, S1=enable, S0=disable

Example

```

M540 S1

```

Notes

In Prusa Firmware this G-code is deactivated by default, must be turned on in the source code.¹

M550: Set Name

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	Yes	No	No	???	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	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. reprap), 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, enable/disable network interface

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

Parameters

^{Pnnn} IP address, 0.0.0.0 means acquire an IP address using DHCP

^{Snnn} (optional) -1 = reset network interface, 0 = disable networking, 1 = enable networking as a client, 2 = enable networking as an access point (WiFi-enabled electronics only)

^{Rnnn} (optional, RepRapFirmware 1.17 and earlier only) HTTP port, default 80

Example

```

M552 P192.168.1.14

```

Sets the IP address of the machine to (in this case) 192.168.1.14. If the ^S parameter is not present then the enable/disable state of the network interface is not changed.

In RepRapFirmware 1.18 and later the HTTP port address is set using the ^{M586} command, so the ^R parameter of this command is no longer supported.

M552 with no parameters reports the current network state and IP address.

M553: Set Netmask

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

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	Yes	No	No	???	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	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	RepRapFirmware
2	Marlin
3	Teacup
4	Sprinter
5	Repetier
6	Marlin with changes for nanoDLP

M556: Axis compensation

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

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

Parameters to define G32 probe points (Cartesian/CoreXY printers only, no longer supported in RepRapFirmware)

Pnnn Probe point number
 Xnnn X coordinate
 Ynnn Y coordinate

Example

```
M557 P1 X30 Y40.5
```

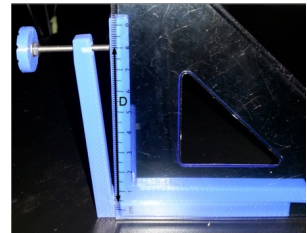


Image denoting how to determine the S parameter for G-code M556

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
 Rnnn Radius to probe
 Snn or Sxx:yy Probe point spacing
 Pnn or Pxx:yy Number of probe points in each direction (RepRapFirmware 2.02 and later) - use instead of specifying the 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 no longer supported by 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

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

Parameters

Pnnn Z probe type
 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)
 Annn Maximum number of times to probe each point, default 1 (RepRapFirmware 1.21 and later)
 Snnn Tolerance when probing multiple times, default 0.03 (RepRapFirmware 1.21 and later)
 Bn B1 turns off all heaters during probing moves and during the probe recovery time (RepRapFirmware 1.21 and later)

Obsolete parameters

Xnnn If nonzero, use probe for homing X axis (RepRapFirmware 1.19 and earlier only)
 Ynnn If nonzero, use probe for homing Y axis (RepRapFirmware 1.19 and earlier only)
 Znnn If nonzero, use probe for homing Z axis (RepRapFirmware 1.19 and earlier only)

Example

```
M558 P1 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 indicates 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 similar to P1 but 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 or a digital output device to the In pin of the Z-probe connector
 P6 is as P4 but the switch is connected to and alternative connector (on the Duet series, the E1 endstop connector)
 P7 is as P4 but the switch is connected to and alternative connector (on the Duet series, the Z endstop connector)
 P8 is as P5 but the signal is unfiltered for faster response
 P9 is as P5 but the probe is deployed and retracted at every probe point. This is intended for BLTouch.

Related codes: G29, G30, G31, G32, M401, M402.

M559: Upload configuration file

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

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

```
<!-- **Eop** -->
```

. 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

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	Yes	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	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.

Later versions of RepRapFirmware support `M562` without the `P` parameter, which will reset all heater faults.

M563: Define or remove a tool

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

Parameters

`Pnnn` Tool number

`S"name` Tool name (optional)

`Dnnn` Extruder drive(s)

`Hnnn` Heater(s)

`Fnnn` Fan(s) to map the print cooling fan to (RepRapFirmware 1.16 and later)

`Xnnn` Axis or axes to map X movement to (RepRapFirmware 1.16 and later)

`Ynnn` Axis or axes to map Y movement to

`Lnnn` Drive to use for filament mapping. By default RRF will use the first and only extruder drive if this parameter is not specified (supported by RRF >= 2.02)

Examples

```
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
M563 P3 D0 H1 S"Chocolate extruder" ; create a named tool using extruder drive 0 and heater 1
```

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 `slc3r` 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 R=1
```

M564: Limit axes

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

Parameters

`Hnnn` H1 = forbid movement of axes that have not been homed, H0 = allow movement of axes that have not been homed (RepRapFirmware 1.21 and later)
`Snnn` S1 = limit movement within axis boundaries, S0 = allow movement outside boundaries

Example

```
M564 S0 H0
```

Allow moves outside the print volume and before homing, 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. Likewise if the `H` parameter is 0 you can move the head or bed along axes that have not been homed. The default behaviour is S1 H1. On some types of printer (e.g. Delta and SCARA), movement before homing is prohibited regardless of the `H` parameter.

M565: Set Z probe offset

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	use G31	No	Yes	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	???	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

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	Yes	No	No	???	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	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 (obsolete)

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

This command is obsolete. When using a tool defined as a mixing extruder, RepRapFirmware applies the mix ratio defined by M567 whenever only one E parameter is provided in G1 commands. When multiple colon-separated E values are provided in the G1 command, they will be used as the individual amounts to extrude.

M569: Stepper driver control

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

Parameters

Pnn Motor driver number
Sn Direction of movement of the motor(s) attached to this driver: 0 = backwards, 1 = forwards (default 1)
Rn Driver enable polarity: 0 = active low, 1 = active high (default 0)
Tnn Minimum driver step pulse width and interval in microseconds (RepRapFirmware 1.14 and later)
Taa:bb:cc:dd Minimum driver step pulse width, step pulse interval, direction-to-step setup time and step-to-direction hold time, in microseconds (RepRapFirmware 1.21 and later)
Dnn Stepper driver mode (RepRapFirmware 2.0 and later): 0=constant off time, 1=random off time, 2=spread cycle, 3=stealthChop
Fnn (firmware 2.02 and later) Off-time in the chopper control register, 1 to 15
Bnn (firmware 2.02 and later) Blanking time (tbl) in the chopper control register, 0 to 3. See the TMC driver datasheet.
Yaa:bb or Yaa:bb:cc (firmware 2.02 and later) Hysteresis start, end and decrement values in the chopper control register. See the TMC driver datasheet for the meaning.
Cnnn Custom chopper control register value (RepRapFirmware 2.0 and later). **Do not change this value without having a good understanding of the stepper driver driver chip!**
Hnn (firmware 2.02 and later) t_high parameter for those stepper driver chips that support it (e.g. TMC2208, 2224). Send M569 P# (where # is the driver number) with no additional parameters to see how this translates into mm/sec. See also the V parameter.
Vnnn (firmware 2.02 and later) t_pwmthrs parameter for those stepper driver chips that support it (e.g. TMC2208, 2224). This is the interval in clock cycles between 1/256 microsteps below which the drivers will switch from stealthChop to to spreadCycle mode. Only applies when the driver is configured in stealthChop mode. Typical value are from 100 (high speed) to 4000 (low speed). Send M569 P# (where # is the driver number) with no additional parameters to see how this translates into axis speed in mm/sec.

Example

```
M569 P0 S0 ; reverse the direction of the motor attached to driver 0
M569 P5 R1 T2.5:2.5:5:0 ; driver 5 requires an active high enable, 2.5us minimum step pulse, 2.5us minimum step interval, 5us DIR setup time and no hold time
```

Notes

All parameters except P are optional. For any parameter that is not provided, the corresponding value will not be changed.

The T parameters are intended for use with external stepper drivers. Currently, RepRapFirmware only remembers the highest T parameters seen in any M569 command, and applies those values to all drivers for which any nonzero T parameters were specified.

The modes (D parameter) supported by various stepper driver chips are:

TMC2130: modes 0,1,2,3
TMC2660: modes 0,1,2
TMC2208/2224: modes 2,3 (mode 3 is stealthChop 2)

Some versions of RepRapFirmware prior to 1.14 also provided x, y, z 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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	Yes	No	No	???	No	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	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)
Snnn Time in seconds after a heater fault is raised after which the print will be abandoned, default 10 minutes (RepRapFirmware 1.20 and later)

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

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

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

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

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

Parameters

Xnnn Switch position for X axis
Ynnn Switch position for Y axis
Znnn Switch position for Z axis
Snnn Endstop type: 0 = active low endstop input, 1 = active high endstop input, 2 = Z probe, 3 = motor load detection

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 position of endstop 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), low (S0), or the axes listed use the Z probe for homing that axis (S2), or motor stall detection (S3). A normally-closed endstop switch wired in the usual way produces an active high output (S1). If different axes use different types of endstop sensing, you can use more than one M574 command.

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).

The S2 and S3 options are supported in RepRapFirmware 1.20 and later.

In RepRapFirmware 1.16 and earlier, the M574 command with E parameter was 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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	2.0+	Yes	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	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. E0 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

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

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

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

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

Parameters

Ronn Whether Roland mode should be activated

Pnnn Initial text to send to the Roland controller

Example

```
M580 R1 PVS4;VZ2;IMC1;
```

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	Yes	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	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 a full (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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	Yes	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	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.

M584: Set drive mapping

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.14+	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	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,W,A,B,Cnnn Driver number(s) for additional axes U, V, W, A, B and C (UVW RepRapFirmware 1.16 and later; ABC RepRapFirmware 1.19 and later)

Ennn Driver number(s) for E motor(s)

Pnnn Number of visible axes, defaults to the total number of axes configured.

Example

```
M584 X0 Y1 Z2:3 E4:5:6 ; Driver 0 controls the X motor, 1 controls Y, 2 and 3 control Z motors, 4 and 5 control 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. Additional axes must be created in the order UVWABC. You can hide some of the last axes you create using the P parameter. Hidden axes have no homing buttons or jog controls in the user interface.

On the Duet WiFi and Duet Ethernet, if you configure multiple drivers for an axis, either all of them must be TMC2660 drivers on the Duet or a Duet expansion board, or none of them must be. This is to facilitate dynamic microstepping and other features of the TMC2660.

M585: Probe Tool

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.20+	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	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 must be only 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 `M585` 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.

M586: Configure network protocols

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.18+	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	???	No	No

Parameters

Pnn Protocol: 0 = HTTP or HTTPS, 1 = FTP or SFTP, 2 = Telnet or SSH (which of the two choices depends on the *T* parameter)

Snn 0 = disable this protocol, 1 = enable this protocol

Rnn TCP port number to use for the specified protocol. Ignored unless *S* = 1. If this parameter is not provided then the default port for that protocol and TLS setting is used.

Tnn 0 = don't use TLS, 1 = use TLS. Ignored unless *S* = 1. If this parameter is not provided, then TLS will be used if the firmware supports it and a security certificate has been configured. If *T1* is given but the firmware does not support TLS or no certificate is available, then the protocol will not be enabled and an error message will be returned.

M586 with no *S* parameter reports the current support for the available protocols.

RepRapFirmware 1.18 and later enable only HTTP (or HTTPS if supported) protocol by default. If you wish to enable FTP and/or Telnet, enable them using this command once or twice in config.g.

M587: Store WiFi host network in list, or list stored networks

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.19+	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	???	No	No

Parameters

Sccc Network SSID

Pccc Network password

Inn.nn.nn.nn (optional) IP address to use when connected to this network. If zero or not specified then an IP address will be acquired via DHCP.

Jnn.nn.nn.nn (optional) Gateway IP address to use when connected to this network.

Knn.nn.nn.nn (optional) Netmask to use when connected to this network

If a password or SSID includes space or semicolon characters then it must be enclosed in double quotation marks. For security, do not use this command in the config.g file, or if you do then remove it after running it once so that the network password is not visible in the file.

M587 with no parameters lists all stored SSIDs, but not the stored passwords.

M588: Forget WiFi host network

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.19+	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	???	No	No

Parameters

Sccc SSID to remove from the networks list

The specified SSID will be removed from the networks list and the associated password cleared out of EEPROM. If the SSID is given as * then all stored networks will be forgotten.

M589: Configure access point parameters

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.19+	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	???	No	No

Parameters

`Sccc` The SSID that the WiFi interface should use when it is commanded to run as an access point
`Pccc` The WiFi password
`Inn.nn.nn.nn` The IP address to use

Note: WPA2 security will be used by default.

M590: Report current tool type and index

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	No	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	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

```

M591: Configure filament monitoring

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.21+	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

This configures filament sensing for the specified extruder. The sensor may be a simple filament presence detector, or a device that measures movement of filament, or both. The action on detecting a filament error is firmware-dependent, but would typically be to run a macro and/or to pause the print and display a message.

Parameters

`Cnn` Which input the filament sensor is connected to. On Duet electronics: 0=X endstop input, 1=Y endstop input, 2=Z endstop input, 3=E0 endstop input etc.
`Dnn` Extruder drive number (0, 1, 2...),
`Pnn` Type of sensor: 0=none, 1=simple sensor (low signal when filament present), 2=simple sensor (high signal when filament present), 3=Duet3D rotating magnet sensor, 4=Duet3D rotating magnet sensor with microswitch, :`Snn S0` = disable filament monitoring, S1 = enable filament monitoring. Calibration data may be collected while printing even when filament monitoring is disabled.

5=Duet3D laser filament monitor, 6=Duet3D laser filament monitor with microswitch, 7=pulse-generating sensor

Additional parameters for Duet3D laser filament monitor

`Raa:bb` Allow the filament movement reported by the sensor to be between aa% and bb% of the commanded values; if it is outside these values and filament monitoring is enabled, the print will be paused
`Enn` minimum extrusion length before a commanded/measured comparison is done, default 3mm

Additional parameters for Duet3D rotating magnet filament monitor

`Lnn` Filament movement per complete rotation of the sense wheel, in mm
`R, E As` for Duet3D laser filament monitor

Additional parameters for a pulse generating filament monitor

`Lnn` Filament movement per pulse in mm
`R, E As` for Duet3D laser filament monitor

Examples

M591 D0 C3 P5 S1 R70:130 L24.8 E6.0 ; Duet3D laser sensor for extruder drive 0 is connected to E0 endstop input, 24.8mm/rev, 70% to 130% tolerance, 6mm detection length
M591 D1 ; display filament sensor parameters for extruder drive 1

Note: RepRapFirmware 1.19 and 1.20 also supported filament monitors via M591, but some of the parameters were different.

M592: Configure nonlinear extrusion

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.20.1+	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Parameters

`Dnn` Extruder drive number (0, 1, 2...)
`Annn A` coefficient in the extrusion formula, default zero
`Bnnn B` coefficient in the extrusion formula, default zero
`Lnnn` Upper limit of the nonlinear extrusion compensation, default 0.2
`T nnn` Reserved for future use, for the temperature at which these values are valid

Example

M592 D0 A0.01 B0.0005 ; set parameters for extruder drive 0
M592 D0 ; report parameters for drive 0

Most extruder drives use toothed shafts to grip the filament and drive it through the hot end. As the extrusion speed increases, so does the back pressure from the hot end, and the increased back pressure causes the amount of filament extruded per step taken by the extruder stepper motor to reduce. This may be because at high back pressures, each tooth compresses and skates over the surface of the filament for longer before it manages to bite. See forum post <http://forums.reprap.org/read.php?262,802277> and the graph at <http://forums.reprap.org/file.php?262,file=100851,filename=graph.JPG> for an example.

Nonlinear extrusion compensates for this effect. The amount of extrusion requested is multiplied by $(1 + \text{MIN}(L, A \cdot v + B \cdot v^2))$ where v is the requested extrusion speed (calculated from the actual speed at which the move will take place) in mm/sec.

Nonlinear extrusion is not applied to extruder-only movements such as retractions and filament loading.

M593: Configure Dynamic Acceleration Adjustment

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	2.02+	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Parameters

Fnnn Frequency of ringing to cancel in Hz. Zero or negative values disable the feature.

Example

```
M593 F40.5
```

This is an experimental feature of RepRapFirmware. By default, Dynamic Acceleration Adjustment (DAA) is disabled. If it is enabled, then acceleration and deceleration rates will be adjusted separately per-move to cancel out ringing at the specified frequency. Any acceleration values set using M204 will be saved but ignored until DAA is disabled, but acceleration limits set by M201 will still be honoured.

DAA is most useful to avoid exciting low-frequency ringing, for which S-curve acceleration is ineffective and may make the ringing worse. High-frequency ringing is better countered by using S-curve acceleration.

To measure the ringing frequency, take a print that exhibits ringing on the perimeters (for example a cube), preferably printed single-wall or external-perimeters-first. Divide the speed at which the outer perimeter was printed (in mm/sec) by the distance between adjacent ringing peaks (in mm), measured away from the corner so that the head has reached the full printing speed.

Cartesian and CoreXY printers will typically have different frequencies of ringing for the X and Y axes. In this case it is usually best to aim to cancel the lower ringing frequency, because the higher frequency will be less strongly excited. If the frequencies are not much different, in a moving-bed cartesian printer you could reduce the higher ringing frequency by adding mass to that axis. Note that X axis ringing causes artefacts predominantly on the Y face of the test cube, and vice versa.

M594: Enter/Leave Height Following mode

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	3.0+	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Parameters

Pn P1 = enter height following mode, **P0** = leave height following mode

Height following mode allows the Z position of the tool to be controlled by a PID controller using feedback from a sensor. See also M951.

If a movement command (e.g. G1) explicitly mentions the Z axis while height following mode is active, existing moves in the pipeline will be allowed to complete and the machine allowed to come to a standstill. Then height following mode will be terminated and the new move executed.

M600: Set line cross section

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	2.02RC3+	???	Yes	???	Yes ¹	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	???	No	No

Pause for filament change.

Parameters

```
X[pos]
Y[pos]
Z[relative lift]
E[initial retract]
L[later retract distance for removal]
AUTO Automatically (only Prusa Firmware with MMU connected)1
```

Example

```
M600
```

In SmoothieWare:

The variable "after_suspend_gcode" is run after M600.

For example:

```
after_suspend_gcode G91_G0E-5_G0Z10_G0X-50Y-50 # gcode to run after suspend, retract then get head out of way
```

In RepRapFirmware, M600 causes macro file filament-change.g to be run if it exists, otherwise it falls back to pause.g. The parameters in the M600 command are ignored.

Notes

In Prusa Firmware this command is also used when the Filament Runout Sensor triggers. To prevent filament blobs it will raise to 25mm if it has been triggered blow 25mm layer height. Default are X=211, Y=0, Z=2mm, E=-2, L=-80¹

M601: Pause print

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Pauses print on Prusa i3 MK2/s,MK2.5/s,MK3/s.

M602: Resume print

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Resumes print on Prusa i3 MK2/s,MK2.5/s,MK3/s.

M603: Stop print

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Stops print on Prusa i3 MK2/s,MK2.5/s,MK3/s.

M605: Set dual x-carriage movement mode

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Use M563	???	No	???	No	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	???	No	No

Set Dual X-Carriage movement mode.

Parameters

S[mode] Mode (see below)
 X[duplication x-offset] Optional X offset for Mode 2
 R[duplication temp offset] Optional temperature difference for Mode 2

Example

```
M605 S1 ; Set mode to auto-park
```

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.

RepRapFirmware does not implement M605 because it supports dual carriage mode, duplication mode, auto park, different temperatures etc. using the M563 tool definition command and the tool change macro files.

M650: Set peel move parameters

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	2.02	No	???	???	No	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	???	???	???	???	No	???	???

This command is sent by nanoDLP to set the parameters for the peel move used after curing a layer. RepRapFirmware 2.02 ignores it. if using RepRapFirmware 2.03 or later you can create a empty file M650.g to cause it to be ignored.

M651: execute peel move

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	2.02	No	???	???	No	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	???	???	???	???	No	???	???

This command is sent by nanoDLP to execute a peel move after curing a layer. RepRapFirmware 2.02 executes macro /sys/peel-move.g in response to this command. For RepRapFirmware 2.03 and later, create a macro file M651.g containing the commands required to execute the peel move.

M665: Set delta configuration

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

Parameters

Lnnn Diagonal rod length
 Rnnn Delta radius
 Snnn Segments per second¹
 Bnnn Safe probing radius^{2,3}
 Hnnn Delta height defined as nozzle height above the bed when homed after allowing for endstop corrections ²
 Xnnn X tower position correction^{2,4}
 Ynnn Y tower position correction^{2,4}
 Znnn Z tower position correction^{2,4}

Examples

```

M665 L250 R160 S200 ; (Marlin)
M665 L250 R160 B80 H240 X0 Y0 Z0 ; (RepRapFirmware and Marlin 1.1.0)

```

Set the delta calibration variables. (See the discussion page for notes on this implementation.)

Notes

¹Only supported on Marlin.

²Only supported in RepRapFirmware and Marlin 1.1.0.

³ In Marlin 1.1.0 sets the radius on which the probe points are taken for the delta auto calibration routine G33 as well as for the manual LCD calibration menu.

⁴X, Y and Z tower angular offsets from the ideal (i.e. equilateral triangle) positions, in degrees, measured anti-clockwise looking down on the printer. In Marlin 1.1.0 X,Y and Z tower angular offsets will be rotated so the Z tower angular offset is zero.

M666: Set delta endstop adjustment

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

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. From version 1.1.0 onward positive endstops are allowed to be entered but the endstops will be normalized to zero or negative and the residue will be subtracted from the delta height defined in M665.

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

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

Parameters

Snnn CoreXY mode
 Xnnn X axis scale factor (RepRapFirmware 2.02 and earlier)
 Ynnn Y axis scale factor (RepRapFirmware 2.02 and earlier)
 Znnn Z axis scale factor (RepRapFirmware 2.02 and earlier)

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.

RepRapFirmware 2.03 and earlier support 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. In RepRapFirmware 2.03 and later, this functionality is moved to the movement matrix that you can define or alter using the M669 command.

To change the motor directions, see the M569 command.

M668: Set Z-offset compensations polynomial

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	dc42-cmm	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	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 `I` `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 usage

```
M668 I1 S4.882E-17:0.0
M668 I3 ...
...
M668 R P1
```

Which sets the list, computes the interpolation grid, and then enables compensation.

M669: Set kinematics type and kinematics parameters

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.19+	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Parameters

`Knnn` Kinematics type: 0 = Cartesian, 1 = CoreXY, 2 = CoreXZ, 3 = linear delta, 4 = serial SCARA, 5 = CoreXYU, 6 = Hangprinter, 7 = polar, 8 = CoreXYUV, 9 = linear delta + Z axis, 10 = rotary delta, 11 = MarkForged, 12 = reserved for Collinear Tripteron

Selects the specified kinematics, then uses the other parameters to configure it. If the `K` parameter is missing then the other parameters are used to update the configuration data for the current kinematics. If no parameters are given then the current kinematics and configuration parameters are reported

Parameters for generalised Cartesian kinematics (including CoreXY, CoreXZ, MarkForged, CoreXYU etc.)

`Xnnn`, `Ynnn`, `Znnn`, `Unnn` etc. (optional) Movement matrix coefficients. For example, `X11-1:0` tells the firmware that to move the X axis one unit, the first motor must be moved 1 unit in the forwards direction, the second motor 1 unit in the reverse direction, and the third motor not at all. Using these coefficients, you can specify the kinematics equations for any printer with up to 10 axes for which the movement of each axis is a linear combination of the movements of the individual motors. If these parameters are omitted, the defaults for the specified kinematics (`K` parameter) will be used.

Parameters for serial SCARA kinematics

`Pnnn` Proximal arm length (mm)

`Dnnn` Distal arm length (mm)

`Annn:nnn` Proximal arm joint movement minimum and maximum angles, in degrees anticlockwise seen from above relative to the X axis

`Bnnn:nnn` Proximal-to-distal arm joint movement minimum and maximum angles, in degrees anticlockwise seen from above relative to both arms in line

`Cnnn:nnn:nnn` Crosstalk factors. The first component is the proximal motor steps to equivalent distal steps factor, the second is the proximal motor steps to equivalent Z motor steps factor, and the third component is the distal motor steps to equivalent Z motor steps factor.

`Snnn` Segments per second if smooth XY motion is approximated by means of segmentation

`Tnnn` Minimum segment length (mm) if smooth XY motion is approximated by means of segmentation

`Xnnn` X offset of bed origin from proximal joint

`Ynnn` Y offset of bed origin from proximal joint

Examples

```
M669 K4 P300 D250 A=90:90 B=135:135 C0:0:0 S200 X300 Y0
```

The minimum and maximum arm angles are also the arm angles assumed by the firmware when the homing switches are triggered. The `P`, `D`, `A` and `B` parameters are mandatory. The `C` and `F` parameters default to zero, and the segmentation parameters default to firmware-dependent values.

Parameters for Polar kinematics

`Raaa:bbb` Minimum and maximum radius in mm. If only one value is given it will be used as the maximum radius, and the minimum radius will be assumed to be zero.

`Hnnn` Radius in mm at which the homing switch is triggered during a homing move. If this parameter is not present, the homing switch is assumed to trigger at the minimum radius.

`Fnnn` Maximum turntable speed in degrees per second

`Annn` Maximum turntable acceleration in degrees per second per second

`Snnn`, `Tnnn` As for serial SCARA kinematics

M670: Set IO port bit mapping

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.19+	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Parameters

`Pnn:nn:nn...` List of logical port numbers that bits 0, 1, 2... control

`Tnnn` port switching time advance in milliseconds

RepRapFirmware 1.19 and later provides an optional `P` parameter on the `G1` command to allow I/O ports to be set to specified states for the duration of the move. The argument to the `P` parameter is a bitmap giving the required state of each port. The `M669` command specifies the mapping between the bits of that argument and logical port numbers. Optionally, the `T` parameter can be used to advance the I/O port switching a short time before the corresponding move begins.

M671: Define positions of Z leadscrews or bed leveling screws

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	M422	1.19+	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Parameters

Xnn:nn:nn... List of between 2 and 4 X coordinates of the leadscrews that drive the Z axis or the bed leveling screws

Ynn:nn:nn... List of between 2 and 4 Y coordinates of the leadscrews that drive the Z axis or the bed leveling screws

Snn Maximum correction to apply to each leadscrew in mm (optional, default 1.0)

Pnnn Pitch of the bed leveling screws (not used when bed leveling using independently-driven leadscrews). Defaults to 0.5mm which is correct for M3 bed leveling screws.

Example

M671 X-15.0:100.0:215.0 Y220.0:-20.0:220.0 ; Z leadscrews are at (-15,220), (100,-20) and (215,220)

Informs the firmware of the positions of the leadscrews used to raise/lower the bed or gantry. The numbers of X and Y coordinates must both be equal to the number of drivers used for the Z axis (see the M584 command). This allows the firmware to perform bed leveling by adjusting the leadscrew motors individually after bed probing.

For machines without multiple independently-driven Z leadscrews, this command can be used to define the positions of the bed leveling screws instead. Then bed probing can be used to calculate and display the adjustment required to each screw to level the bed. The thread pitch (P parameter) is used to translate the height adjustment needed to the number of turns of the leveling screws.

M672: Program Z probe

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.19+	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Parameters

Snn:nn:nn... Sequence of 8-bit unsigned values to send to the currently-selected Z probe

Example

M671 S50:205

This command is for sending configuration data to programmable Z probes such as the Duet3D delta effector. The specified command bytes are sent to the probe. The Duet3D probe stores the configuration data in non-volatile memory, so there is no need to send this command every time the probe is used.

M673: Align plane on rotary axis

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	2.02+	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Parameters

U,V,W,A,B,C Rotary axis letter on which the plane is mounted

Pnnn Factor to multiply the correction angle (degrees) with (defaults to 1)

Example

M673 A

This code is intended to align a plane that is mounted on a rotary axis. To make use of this code it is required to take two probe points via G30 P first. Supported in RepRapFirmware 2.02 and later.

M674: Set Z to center point

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	TBD	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

This code is intended to determine the Z center point of a stash that is mounted on a rotary axis. This code is yet to be implemented.

M675: Find center of cavity

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	2.02+	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Parameters

X,Y,Z Axis to probe on

Fnnnn Probing feedrate

Rnnn Distance to move away from the lower endstop before the next probing move starts

Example

M675 X R2 F1200

This code is intended to find the center of a cavity that can be measured using the configured axis endstop. If using a Z probe for this purpose, make sure the endstop type for the corresponding axis is updated before this code is run. Once this code starts, RepRapFirmware will move to the lower end looking for an endstop to be triggered. Once it is triggered, the lower position is saved and the axis maximum is probed. As soon as both triggers have been hit, the center point is calculated and the machine moves to the calculated point.

M700: Level plate

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	M671,G32	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	???

Example

```
M700
```

Script to adjust the plate level.

M701: Load filament

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	1.19+	No	No	???	Yes	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Initiate a filament load. *This command can be used without any additional parameters.*

Parameters

Snn Filament to load (RepRapFirmware)
Tnn Tool to load (Marlin)
Lnn Length to use for load (Marlin)
Znn Z raise to perform (Marlin)

With no parameters

- RepRapFirmware will report the name of the loaded filament (if any).
- Marlin Firmware initiates a Filament Load.

Examples

```
M701
M701 S"PLA" ; Only in RepRapFirmware
M701 T0 ; Only in Marlin.
```

RepRapFirmware 1.19 and later implement a filament management mechanism to load and unload different materials. This code may be used to load a material for the active tool, however be aware that this code will work only for tools that have exactly one extruder assigned. When called RepRapFirmware will...

1. Run the macro file "load.g" in the subdirectory of the given material (e.g. /filaments/PLA/load.g)
2. Change the filament name of the associated tool, so it can be reported back to Duet Web Control

M702: Unload filament

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	1.19+	No	No	???	Yes	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Initiate a filament unload. *This command can be used without any additional parameters.* In contrast to M701 this code is intended to unload the previously loaded filament from the selected tool.

Parameters

Tnn Tool to load (Marlin)
Unn Length to use for unload (Marlin)
Znn Z raise to perform (Marlin)

In response to M702 RepRapFirmware will do the following:

1. Run the macro file "unload.g" in the subdirectory of the given material (e.g. /filaments/PLA/unload.g)
2. Change the filament name of the current tool, so it can be reported back to Duet Web Control

Examples

```
M702 ; Unload filament as previously configured
M702 U420 Z2 ; Unload 420mm (Marlin) with a Z raise of 2mm
```

M703: Configure Filament

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

1. In RepRapFirmware this code is used to apply the configuration of a previously loaded filament (see M701). All it does is run /filaments/<loaded filament>/config.g which may contain codes to set parameters like extrusion factor, retraction distances and temperatures. If no filament is assigned to the current tool, this code will not generate a warning.

If the filaments feature is used, it is recommended to put this code into tpost*.g to ensure the right filament parameters are set. Supported in RepRapFirmware 2.02 and newer.

M710: Erase the EEPROM and reset the board

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	M999	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	???

This command only exists in a defunct bq fork of Marlin Firmware.

Example

```
M710
```

M750: Enable 3D scanner extension

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.18+	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Example

```
M750
```

This code may be used as an OEM extension to enable scanner functionality in the firmware. After a regular start of RepRapFirmware, the 3D scan extension is disabled by default, but if additional scanner components are attached, this code may be used to enable certain OEM functions.

M751: Register 3D scanner extension over USB

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.18+	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Example

```
M751
```

When a 3D scanner board is attached to the USB port, this code is used to turn on communication between the 3D printing and the scanner board. If the USB connection is removed while the 3D scanner configuration is active, the firmware will disable it again and restore the default communication parameters.

M752: Start 3D scan

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.18+	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Parameters

Snnn: Length/degrees of the scan
 Rnnn: Resolution (new in RRF 2.0) [optional, defaults to 100]
 Nnnn: Scanner mode (new in RRF 2.0) [optional, 0=Linear (default), 1=Rotary]
 Pnnn: Filename for the scan

Example

```
M752 S300 Pmyscan
```

Instruct the attached 3D scanner to initiate a new 3D scan and to upload it to the board's SD card (i.e. in the "scans" directory). Before the SCAN command is sent to the scanner, the macro file "scan_pre.g" is executed and when the scan has finished, the macro file "scan_post.g" is run. Be aware that both files must exist to avoid error messages.

M753: Cancel current 3D scanner action

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.18+	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Example

```
M753
```

Instruct the attached 3D scanner to cancel the current operation. Cancelling uploads is not supported.

M754: Calibrate 3D scanner

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.18+	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Parameters

Nnnn Calibration mode (0=linear [default], 1=rotary)

Example

```
M754
```

Calibrates the attached 3D scanner. Before the calibration is performed by the external scanner, "calibrate_pre.g" is run and when it is complete, "calibrate_post.g" is executed.

M755: Set alignment mode for 3D scanner

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.18+	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Parameters

Pnnn Whether to turn on (> 0) or off (<= 0) the alignment feature

Examples

```

M755 P1
M755 P0

```

Sends the ALIGN ON/OFF command the attached 3D scanner. Some devices turn on a laser when this command is received. If the 'P' parameter is missing, equal to, or less than 0, the alignment feature is turned off. Depending on whether the alignment is turned on or off, either align_on.g or align_off.g is executed before the ALIGN command is sent to the scanner.

M756: Shutdown 3D scanner

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.18+	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Example

```

M756

```

Sends the SHUTDOWN command the attached 3D scanner.

M800: Fire start print procedure

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	bq	No	No	No	???	???	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	???

¹ only in bq-Marlin Firmware

Example

```

M800

```

M801: Fire end print procedure

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	bq	No	No	No	???	???	bq	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	???

¹ only in bq-Marlin Firmware

Example

```

M801

```

M851: Set Z-Probe Offset

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	2.02RC5 and later, or use G31	???	???	???	Yes	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	No

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 later 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
```

M851 in Marlin 2.0.0

```
M851 X=22 Y=3 Z=4 ; Set the probe XYZ offsets
```

M851 in MK4duo 4.3.25

```
M851 X2 X=5 Y=4 ; Set the probe offset to X=2, Y=5 and Z=-4
```

M851 in RepRapFirmware 2.02 and later

M851 Znn is implemented for backwards compatibility with other firmwares. It sets the Z probe trigger in the same way as G31 Z-nn (note the sign reversal). It also flags the Z-probe G31 parameters as to be saved in config-override.g if the M500 command is used.

M860 Wait for Probe Temperature

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

Parameters

Snnnn Target temperature

Notes

In Prusa Firmware this command will wait for the PINDA thermistor to reach a target temperature.

M861 Set Probe Thermal Compensation

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	Use G31	No	No	???	Yes	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	No

Parameters

? Print current EEPROM offset values
! Set factory default values
Z Set all values to 0 (effectively disabling PINDA temperature compensation)
S Microsteps
I Table index

Example

```
M861 ?
```

Results

```
PINDA cal status: 1
index, temp, ustep, um
n/a, 35, 0, 0.00
P, 40, 0, 0.00
P, 45, 0, 0.00
P, 50, 0, 0.00
P, 55, 0, 0.00
P, 60, 0, 0.00
```

Notes

In Prusa Firmware this command will set / read the PINDA temperature compensation offsets.

M862: Print checking

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Checks the parameters of the printer and gcode and performs compatibility check

M862.1: Check nozzle diameter

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Parameters

Pnnnn nnnn = Nozzle diameter 0.25 /0.40 /0.60
Q Current nozzle diameter

When run with P<> argument, the check is performed against the input value. When run with Q argument, the current value is shown.

Example messages

warn Printer nozzle diameter differs from the G-code. Continue?
strict Printer nozzle diameter differs from the G-code. Please check the value in settings. Print cancelled.

M862.2: Check model code

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Parameters

Pnnnn nnnn = Prusa model
Q Current model

When run with P<> argument, the check is performed against the input value. When run with Q argument, the current value is shown.

Accepted printer type identifiers and their numeric counterparts:

```
- MK1 (100)
- MK2 (200)
- MK2MM (201)
- MK2S (202)
- MK2SMM (203)
- MK2.5 (250)
- MK2.5MMU2 (20250)
- MK2.5S (252)
- MK2.5SMMU2S (20252)
- MK3 (300)
- MK3MMU2 (20300)
- MK3S (302)
- MK3SMMU2S (20302)
```

Example messages

```
warn G-code sliced for a different printer type. Continue?
strict G-code sliced for a different printer type. Please re-slice the model again. Print cancelled.
```

M862.3: Model name

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Parameters

P"nnnn" nnnn = Prusa model name
Q Current model name

When run with P<> argument, the check is performed against the input value. When run with Q argument, the current value is shown.

It accepts text identifiers of printer types too. The syntax of M862.3 is (note the quotes around the type):

```
M862.3 P "MK3S"
```

Example messages

```
warn G-code sliced for a different printer type. Continue?
strict G-code sliced for a different printer type. Please re-slice the model again. Print cancelled.
```

M862.4: Firmware version

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Parameters

Pnnnn nnnn = Prusa firmware version
Q Current firmware version

When run with P<> argument, the check is performed against the input value. When run with Q argument, the current value is shown.

Example messages

```
warn G-code sliced for a newer firmware. Continue?
strict G-code sliced for a newer firmware. Please update the firmware. Print cancelled.
```

M862.5: Gcode level

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Parameters

Pnnnn nnnn = Gcode level
Q Current Gcode level

When run with P<> argument, the check is performed against the input value. When run with Q argument, the current value is shown.

Example messages

```
warn G-code sliced for a different level. Continue?
strict G-code sliced for a different level. Please re-slice the model again. Print cancelled.
```

M876: Dialog handling

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

Parameters

Pnnn signal support for dialog creation on the host = 1, disable = 0
 Snnn select dialog option nnn (0 based)

Example

```
M876 P1
M876 S1
```

M876 S<n> allows selecting an option of a prompt on a connected host created by the firmware through the corresponding action commands, see G-code#Action_commands. The S parameter is the 0-based index of the chosen option - 0 for the first option provided by the firmware, 1 for the second and so on.

Example: A prompt with three options defined via the firmware and completed by the host by selecting the second option ("Home X/Y and pause print")

```
<<< //action:prompt_begin Filament runout detected. Please choose how to proceed:
<<< //action:prompt_choice Swap filament
<<< //action:prompt_choice Home X/Y and pause print
<<< //action:prompt_choice Abort print
<<< //action:prompt_show
>>> M876 S1
```

To indicate the availability of this function, M115 will add an extra line:

```
Cap:PROMPT_SUPPORT:1
```

so hosts know about the presence of the function.

M890 Run User Gcode

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

Parameters

Snnn select 1 - 5 User Gcode defined in configuration.

Example

```
M890 S2 ; Start User Gcode 2
```

M900 Set Linear Advance Scaling Factors

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	1.1.0	use M572	No	No	???	Yes	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	No	No	Yes

Sets the advance extrusion factors for Linear Advance. If any of the R, W, H, or D parameters are set to zero the ratio will be computed dynamically during printing.

Parameters

K[factor] Advance K factor
 R[ratio] Set ratio directly (overrides WH/D)
 W[width] H[height] D[diam] Set ratio from WH/D

Examples

```
M900 K0.7 W0.4 H0.1 D1.75 ; Set K and WH/D ratio
M900 R0.025 ; Set the WH/D ratio directly
M900 R0 ; Set to "auto ratio"
```

Requires enabling the LIN_ADVANCE feature in Marlin 1.1.

The K factor in the M900 command supported by early versions of Marlin is related to the S factor in the long-established M572 command supported by RepRapFirmware by the following formula:

```
K = S * extruder_steps_per_mm
```

More recent versions of Marlin appear to have removed the steps/mm dependency, so now K = S.

M905: Set local date and time

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.16+	No	No	???	No	No	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	No	No	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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	Yes	No	M907?	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	Yes	No	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 idle current in percent (0..100)

Example

```
M906 X300 Y500 Z200 E350:350
```

Sets the currents to send to the stepper motors for each axis. The values are the peak current per phase in milliamps.

The I parameter 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%. On delta printers in particular you may need to increase it to e.g. 60% to prevent the carriages from dropping when the current is reduced to the idle value.

M907: Set digital trimpot motor

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Use M906	Yes	Yes	???	Yes	Yes	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	Yes	No	No

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 (http://bitbucket.org/intelligentagent/redeem/src/6153607ded91c100fb4e41e936e6d045e19eda29/redeem/gcodes/M907.py?at=slave_stepper), it sets the current in Amps (whereas M906 uses milliamps).

M908: Control digital trimpot directly

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

M908 P<pin> S<current>

Notes

In Prusa Firmware this G-code is deactivated by default, must be turned on in the source code.¹

M909: Set microstepping

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Use M350	Use M350	Use M350	No	???	???	Use M350	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	Yes	No	???

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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	Use M569	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	Yes	No	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.

M910: TMC2130 init

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Not active in default, only if TMC2130_SERVICE_CODES_M910_M918 is defined in source code.

M911: Configure auto save on loss of power ("power panic")

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.20+	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	No	No	No

Parameters

Saaa Auto save threshold in volts. The print will be stopped automatically and resume parameters saved if the voltage falls below this value. Set to around 1V to 2V lower than the voltage that appears at the Duet VIN terminals at full load. A negative or zero value disables auto save.

Raaa Resume threshold in volts. Must be greater than the auto save voltage. Set to a high value to disable auto resume.

P"command string" G-Code commands to run when the print is stopped.

Example

M911 S19.8 R22.0 P"M913 X0 Y0 G91 M83 G1 Z3 E-5 F1000"

When the supply voltage falls below the auto save threshold while a print from SD card is in progress, all heaters will be turned off, printing will be stopped immediately (probably in the middle of a move), the position saved, and the specified command string executed. You should typically do the following in the command string:

- If possible, use M913 to reduce the motor current in order to conserve power. For example, on most printers except deltas you can probably set the X and Y motor currents to zero.
- Retract a little filament and raise the head a little. Ideally the retraction should happen first, but depending on the power reserve when low voltage is detected, it may be best to do both simultaneously.

M911 with no parameters displays the current enable/disable state, and the threshold voltages if enabled.

Note: RepRapFirmware 1.19 used different parameters. You are recommended to upgrade to version 1.20 or later if you wish to use this "power panic" functionality.

M911: Set TMC2130 holding currents

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	Use M917	???	???	Yes	???	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Not active in default, only if TMC2130_SERVICE_CODES_M910_M918 is defined in source code.

M912: Set electronics temperature monitor adjustment

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	Yes	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	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.

M912: Set TMC2130 running currents

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Not active in default, only if TMC2130_SERVICE_CODES_M910_M918 is defined in source code.

M913: Set motor percentage of normal current

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	Yes	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	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, to reduce motor current when using sensorless endstops (motor stall detection), 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.

M913: Print TMC2130 currents

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Not active in default, only if TMC2130_SERVICE_CODES_M910_M918 is defined in source code.

M914: Set/Get Expansion Voltage Level Translator

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	Alligator build only	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	No	No	No

Parameters

S Expansion voltage signal level, must be 3 or 5

Example

```
M914 S5 ; set expansion signal level to 5V
M913 ; report expansion signal voltage level
```

M914: Set TMC2130 normal mode

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Not active in default, only if TMC2130_SERVICE_CODES_M910_M918 is defined in source code.

M915: Configure motor stall detection

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.20+	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	???	No	No

Parameters

Pnnn:nnn... Drive number(s) to configure

X,Y,Z,U,V,W,A,B,C Axes to configure (alternative to using the P parameter)

Snnn Stall detection threshold (-64 to +63, values below -10 not recommended)

Fn Stall detection filter mode, 1 = filtered (one reading per 4 full steps), 0 = unfiltered (default, 1 reading per full step)

Hnnn (optional) Minimum motor full steps per second for stall detection to be considered reliable, default 200

Tnnn (optional) Coolstep control register, 16-bit unsigned integer

Rn Action to take on detecting a stall from any of these drivers: 0 = no action (default), 1 = just log it, 2 = pause print, 3 = pause print, execute macro file /sys/rehome.g, and resume print

Examples

```
M915 P0:2:3 S10 F1 R0
```

```
M915 X Y S5 R2
```

This sets the stall detection parameters and optionally the low-load current reduction parameters for TMC2660, TMC2130 or similar driver chips. Use either the P parameter to specify which driver number(s) you want to configure, or the axis names of the axes that those motors drive (the parameters will then be applied to all the drivers associated with any of those axes).

If any of the S, F, T and R parameters are absent, the previous values for those parameters associated with the specified drivers will continue to be used. If all the parameters are absent, the existing settings for the specified drives will be reported.

See the Trinamic TMC2660 and TMC2130 datasheets for more information about the operation and limitations of motor stall detection.

M915: Set TMC2130 silent mode

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	Use M569 to select StealthChop mode	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Not active in default, only if TMC2130_SERVICE_CODES_M910_M918 is defined in source code.

M916: Resume print after power failure

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.20+	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	???	No	No

Parameters

none

Example

```
M916
```

If the last print was not completed and resume information has been saved (either because the print was paused or because of a power failure), then the heater

temperatures, tool selection, head position, mix ratio, mesh bed compensation height map etc. are restored from the saved values and printing is resumed.

RepRapFirmware also requires macro file `/sys/resurrect-prologue.g` to be present on the SD card before you can use M915. This file is executed after the heater temperatures have been set, but before waiting for them to reach the assigned temperatures. You should put commands in this file to home the printer as best as you can without disturbing the print on the bed. To wait for the heaters to reach operating temperature first, use command M116 at the start of the file.

M916: Set TMC2130 Stallguard sensitivity threshold

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	Use M915	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Not active in default, only if TMC2130_SERVICE_CODES_M910_M918 is defined in source code.

M917: Set motor standstill current reduction

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.20+	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	???	No	No

Parameters

X,Y,Z,E Percentage of normal current to use when the motor is standing still or moving slowly, default 100

Example

M917 X70 Y70 Z80 E70:70

Some motor drivers (e.g. TMC2660) allow higher motor currents to be used while the motor is moving than when it is at standstill. This command sets the percentage of the current set by M906 that is to be used when the motor is stationary but not idle, or moving very slowly.

Standstill current reduction is not the same as idle current reduction. The standstill current must be high enough to produce accurate motion at low speeds; whereas the idle current (set using the I parameter in the M906 command) needs only to be high enough to hold the motor position sufficiently so that when the current is restored to normal, the position is the same as it was before the current was reduced to idle.

M917: Set TMC2130 PWM amplitude offset (pwm_amp1)

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Not active in default, only if TMC2130_SERVICE_CODES_M910_M918 is defined in source code.

M918: Configure direct-connect display

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.21+	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	???	No	No

This command is used to tell RepRapFirmware about a directly-connected dumb LCD or similar display.

Parameters

P Directly-connected display type: 0 = none (default), 1 = 128x64 pixel mono graphics display using ST7920 controller

E The number of pulses generated by the rotary encoder per detent. Typical values are 2 and 4. Negative values (e.g. -2 and -4) reverse the encoder direction.

Example

M918 P1 E2

M918: Set TMC2130 PWM amplitude gradient (pwm_grad)

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Not active in default, only if TMC2130_SERVICE_CODES_M910_M918 is defined in source code.

M928: Start SD logging

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

Example

```
-----
M928 filename.g
-----
```

Stop SD logging with M29.

M929: Start/stop event logging to SD card

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	1.20+	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	???	No	No

Parameters

P"filename" The name of the file to log to. Only used if the S1 parameter is used. A default filename will be used if this parameter is missing.

Sn S1 = start logging, S0 = stop logging

Example

M929 P"eventlog.txt" S1 ; start logging to file eventlog.txt

M929 S0 ; stop logging

When event logging is enabled, important events such as power up, start/finish printing, most error messages and (if possible) power down will be logged to the SD card. Each log entry is a single line of text, starting with the date and time if available, or the elapsed time since power up if not. If the log file already exists, new log entries will be appended to the existing file.

M950: Create heater, fan or GPIO/servo device

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	3.0+	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	???	No	No

Parameters

Hnn Heater number

Fnn Fan number

Pnn or **Snn** GPIO or Servo number (the only difference is the default PWM frequency)

C"name Pin name(s) and optional inversion status. Pin name "nil" frees up the pin. A leading '!' character inverts the output. A leading '^' character enables the pullup resistor. The '^' and '!' characters may be placed in either order.

Qnn PWM frequency in Hz (optional)

Tnn Temperature sensor number, required only when creating a heater.

Examples

M950 H1 C"out1" Q100 T1 ; create heater 1 using temperature sensor 1

M950 H2 C"nil" ; disable heater 2 and free up the associated pin

M950 H2 C"1.out0" T2 ; create heater 2 using pin out0 on expansion board 1 and temperature sensor 2

M950 F3 C"heater2" Q100 ; Fan 3 is connected to heater 2 pin, PWM at 100Hz

M950 P0 C"exp.heater3" ; create GPIO port 0 attached to heater 3 pin on expansion connector

M950 F2 C"!fan2+^pb6" ; Fan 2 uses the Fan2 output, but we are using a PWM fan so the output needs to be inverted, also we are using PB6 as a tachometer input with pullup resistor enabled

M950 is used to create heaters, fans and GPIO ports and to assign pins to them. Each M950 command assigns a pin or pins to a single device. So every M950 command must have exactly one of the H, F, P or S parameters.

If a M950 command has C and/or Q parameters, then the pin allocation and/or frequency of the existing device will be configured accordingly. Otherwise, the current configuration will be reported.

When using M950 to create a heater, you must first use M308 to define a temperature sensor to control that heater, and specify its number in the T parameter of the M950 command.

M951: Set height following mode parameters

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	3.0+	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	???	No	No

Parameters

Snn or **Hnn** Sensor number

Pnn.n Proportional factor, in mm per sensor unit

Inn.n Integral factor, in mm per sensor unit per second

Dnn.n Derivative factor, in mm per rate of change of sensor units (change in sensor unit per second)

Fnn.n (optional) Sample and correction frequency (Hz), default 5Hz

Znn.n:nn.n Minimum and maximum permitted Z values

Height following mode allows the Z position of the tool to be controlled by a PID controller using feedback from a sensor. See also M594.

If commanding the motors to increase Z causes the sensor value to increase, then all of P, I and D must be positive. If commanding the motors to increase Z causes the sensor value to decrease, then all of P, I and D must be negative.

M952: Set CAN expansion board address and/or normal data rate

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	3.0+	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	???	No	No

Parameters

Bn Existing CAN address of expansion board to be changed, 1 to 125.

An New CAN address of that expansion board, 1 to 125.

Sn.n Requested bit rate in Kbits/second (1K = 1000)

T0.n Fraction of the bit time between the bit start and the sample point (optional)

J0.n Maximum jump time as a fraction of the bit time (optional)

Example

M952 B120 A11 ; change the CAN address of expansion board 101 to 11

M952 B11 S500 ; change the CAN bit rate of expansion board 11 to 500kbps

Some CAN-connected expansion boards are too small to carry address selection switches. Such boards default to a standard address, which can be changed using this command.

This command can also be used to change the normal data rate, for example if the printer has CAN bus cables that are too long to support the standard data rate

(1Mbits/sec in RepRapFirmware). All boards in the system on the same CAN bus must use the same CAN data rate. The procedure for changing the data rate is:

- Use M952 to change the data rate on all the expansion boards, one at a time. After changing the data rate on each expansion board, you will no longer be able to communicate with it, and you may need to power it down or disconnect it from the CAN bus to prevent it interfering with subsequent CAN communications.
- Change the data rate of the main board last. Then the main board should be able to communicate with all the expansion boards again.

M953: Set CAN-FD bus fast data rate

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	3.0+	No	No	???	No	No	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	???	No	No

Parameters

Sn.n Requested bit rate in Kbits/second (1K = 1000). Ignored if it is lower than the bit rate for the negotiation phase.

T0.n Fraction of the bit time between the bit start and the sample point (optional)

J0.n Maximum jump time as a fraction of the bit time (optional)

Caa:bb Transceiver delay compensation offset and minimum, in nanoseconds (optional)

Example

M953 S4000 T0.6 J0.2

This command allows the bandwidth of the CAN bus to be optimised, by increasing the data rate during transmission of CAN-FD data packets using the BRS (bit rate switch) feature. The maximum speed supported by CAN-FD is 8Mbits/sec but the practical limit depends on the cable length, cable quality, number of devices on the bus and CAN interface hardware used. The rate specified will be rounded down to the nearest achievable rate.

The optional C parameter allows fine-tuning of the transmitter delay compensation. The first parameter is the offset added to the measured transmitter delay. The optional second value, which must be greater than the first, is the minimum delay compensation applied. Glitches seen by the receiver while the transceiver delay is being measured will be ignored if they would result in a transceiver delay compensation lower than this value. When CAN is implemented on Microchip SAME5x and SAMC21 processors, these values are converted from nanoseconds into time quanta and stored in the TDCO and TDCF fields of the transceiver delay compensation register.

M997: Perform in-application firmware update

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

Parameters

Snnn Firmware module number(s), default 0

Bnnn Expansion board address, default 0 (i.e. main controller board)

Example

```
M997 S0:1 ; update firmware modules 0 and 1 on the main controller board
M997 B3 ; update firmware module 0 on the expansion board with address 3
```

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. The firmware filename depends on the controller electronics, e.g. sys/RepRapFirmware.bin (Duet 06/085), sys/Duet2CombinedFirmware (Duet WiFi/Ethernet), sys/DuetMaestroFirmware.bin (Duet Maestro). File sys/iap.bin (Duet), sys/iap4e.bin (Duet WiFi/Ethernet) or sys/iap4s.bin (Duet Maestro) must also be present.

1 - web server firmware, filename sys/DuetWiFiServer.bin

2 - (Duet WiFi running RepRapFirmware 1.18 and earlier only) 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

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	No	Yes	No	No	???	No	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	No	No	No	No	???	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 G-code interpreter to request the resend.

M999: Restart after being stopped by error

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

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**

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

Example

```
G
```

Print a list of all implemented G-codes in the firmware with description to the host.
(Note: this has been implemented in Redeem, and so is only a proposal.)

M: List all M-codes

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

Example

```
M
```

Print a list of all implemented M-codes in the firmware with description to the host.
(Note: this has been implemented in Redeem, and so is only a proposition)

T: Select Tool

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	Yes	Yes	Yes	Yes	???	Yes	Yes	No
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	No	No	No	Yes	No	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 firmware (Such as Prusa i3 Printers with MMU) also support the T_x (recommended) and T?(deprecated)² commands to prompt the user to select a tool (or a filament in the case of the MultiMaterial Unit) on the printer's menu. Then the T_c command actually loads the selected filament.

Some implementations (e.g. RepRapFirmware) allow you to specify tool-change G Code macros³. 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 M12 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 `T?` was the original form of the command, but it was changed to `Tx` when it was realized that the question mark character caused problems when printing through octoprint. This change was implemented in Prusa firmware 3.5.0.

³ 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`.

D: Debug codes

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Debug codes are not active by default and must be defined in source code.

D-1: Endless Loop

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

D0: Reset

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

This command will reset the board
B: Bootloader

D1: Clear EEPROM and RESET

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

This command will clear the EEPROM and reset the board

D2: Read/Write RAM

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Parameters

This command can be used without any additional parameters. It will read the entire RAM.
Annnn: Address (0x0000-0x1fff)
Cnnnn: Count (0x0001-0x2000)
Xnnnn: Data

D3: Read/Write EEPROM

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Parameters

This command can be used without any additional parameters. It will read the entire EEPROM.
Annnn: Address (0x0000-0x0fff)
Cnnnn: Count (0x0001-0x1000)
Xnnnn: Data

D4: Read/Write PIN

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

To read the digital value of a pin you need only to define the pin number.

Parameters

Pnnn: Pin (0-255)

Fn: Function in/out (0/1)
Vn: Value (0/1)

D5: Read/Write FLASH

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Parameters

This command can be used without any additional parameters. It will read the 1kb FLASH.

Annnn: Address (0x00000-0x3ffff)

Cnnnn: Count (0x0001-0x2000)

Xnnnn: Data

E: Erase

D6: Read/Write external FLASH

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Reserved

D7: Read/Write Bootloader

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Reserved

D8: Read/Write PINDA

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Parameters

?: Read PINDA temperature shift values

!: Reset PINDA temperature shift values to default

Pnnn: Pinda temperature [C]

Znnnn: Z Offset [mm]

D9: Read/Write ADC

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Parameters

I(index): ADC channel index

I0: Heater 0 temperature

I1: Heater 1 temperature

I2: Bed temperature

I3: PINDA temperature

I4: PWR voltage

I5: Ambient temperature

I6: BED voltage

V: Value to be written as simulated

D10: Set XYZ calibration = OK

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

D12: Time

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Writes actual time in the log file.

D80: Bed check

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

This command will log data to SD card file "mesh.txt".

Parameters

E: Dimension X (default 40)
 F: Dimension Y (default 40)
 G: Points X (default 40)
 H: Points Y (default 40)
 I: Offset X (default 74)
 J: Offset Y (default 34)

D81: Bed analysis

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

This command will log data to SD card file "wldsd.txt".

Parameters

E: Dimension X (default 40)
 F: Dimension Y (default 40)
 G: Points X (default 40)
 H: Points Y (default 40)
 I: Offset X (default 74)
 J: Offset Y (default 34)

D106: Print measured fan speed for different pwm values

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

D2130: Trinamic stepper controller

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

Reserved

D9125: PAT9125 filament sensor

	Marlin	RepRapFirmware	Repetier	Smoothie	Klipper	Prusa	MK4duo	MakerBot
Support	???	???	???	???	???	Yes	???	???
	grbl	Sprinter	BFB	FiveD	Machinekit	Redeem	Teacup	Yaskawa
	???	???	???	???	???	???	???	???

This command can be used without any additional parameters. It will read the PAT9125 values.

Parameters

?: Print values
 !: Print values
 R: Resolution. Not active in code
 X: X values
 Y: Y values
 L: Activate filament sensor log

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.

RepRapFirmware uses the config-override.g file on the SD card instead of EEPROM. M500 saves certain values to that file, M501 re-loads them, and M502 loads the values from config.g, ignoring config-override.g.

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.

The basic protocol responses 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** - The RepRap machine is ready to receive the next line from the host.
- **rs** or **Resend** - There was a communication error and the RepRap machine is requesting a resend of the line in question. The line is specified either as **N<linenumber>** or **N:<linenumber>**. Examples: Resend: 123, Resend: M123, rs:123
- **!!** or **Error:** or **fatal:** (Repetier Firmware) - There was an error. Common communication errors such as checksum mismatch, Last Line: <number> or Wrong checksum, No Checksum with line number, Last Line: <number> or Missing checksum, Line Number is not Last Line Number+1, Last Line: <number> or expected line <number1> got <number2> are recoverable and should immediately be followed by a resend. Other non-fatal errors commonly include Unknown command: "<command>" and several SD related errors such as Cannot open subdir <dir>, SD init fail, volume.init failed, openRoot failed, workDir open failed, open failed, File: <name>, error writing to file, Cannot enter subdir: <dir> and SD read error. Any other errors indicate a hardware fault that will make the RepRap machine shut down immediately after it has sent this message. They should be considered fatal by hosts.
- **wait** - The RepRap machine's command buffers are empty and it is waiting for the next line from the host.
- **busy:<reason>** - The RepRap machine is busy for some reason and currently cannot receive or process commands through the serial interface from a connected host. Possible reasons are: 'processing' (the RepRap machine is busy with processing some lengthy command, like homing, heatup or auto leveling), paused for user (the RepRap machine is paused and awaiting an action by the user via its built in controller unit, e.g. clicking the button), paused for input (the RepRap machine is paused and waiting for input from the user via its built in controller unit, e.g. selecting a menu option). Examples: busy: processing, busy: paused for user.

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 //.

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.

Originally, every line sent by RepRap to the host computer except the start line was supposed to have a two-character prefix (one of **ok**, **rs**, **!!** or **//**). The machine should never send a line without such a prefix. These days, firmwares generally do not adhere to this rule and thus it should be considered obsolete.

Example of a communication error with resend request

>>> are lines sent from the host to the RepRap machine, <<< are lines sent from the RepRap machine to the host.

```

>>> M6655 G1 X131.338 Y133.349 E0.0091*91
<<< ok
>>> M6655 G1 X131.574 Y133.428 E0.0046*92
<<< Error:checksum mismatch, Last Line: 66555
<<< Resend: 66556
<<< ok
>>> M6655 G1 X131.574 Y133.428 E0.0046*92
<<< ok

```

Action commands

On the current versions of Pronterface and OctoPrint a special comment of the form:

// action:<command>

is allowed to be sent from the firmware.

As this is also a comment other hosts will just ignore these commands.

Supported commands currently are:

- **pause:** Instructs the host to pause the print job
- **resume:** Instructs the host to resume the print job
- **disconnect:** Instructs the host to disconnect from the printer
- **cancel:** Instructs the host to abort the current job
- **out_of_filament** [extruder_id]: Tells host that filament for extruder extruder_id is run out or jammed. Host should issue a pause and can offer better help to user with this. For backward compatibility it should be followed by the pause action.

Additional commands supported by a subset of hosts:

- **paused:** Instructs the host that a print job under control of the printer was paused. (support: OctoPrint 1.3.9+)
- **resumed:** Instructs the host that a print job under control of the printer was resumed. (support: OctoPrint 1.3.9+)
- **prompt_begin** <message>: Starts the definition of a prompt dialog. <message> is the message to display to the user. (support: OctoPrint 1.3.9+ w/ enabled Action Command Prompt support plugin)
- **prompt_choice** <text>: Defines a dialog choice with the associated <text>. (support: OctoPrint 1.3.9+ w/ enabled Action Command Prompt support plugin)
- **prompt_button** <text>: Same as **prompt_choice**. (support: OctoPrint 1.3.9+ w/ enabled Action Command Prompt support plugin)
- **prompt_show:** Tells the host to prompt the user with the defined dialog. (support: OctoPrint 1.3.9+ w/ enabled Action Command Prompt support plugin)
- **prompt_end:** Tells the host to close the dialog (e.g. the user made the choice through the printer directly instead of through the host). (support: OctoPrint 1.3.9+ w/ enabled Action Command Prompt support plugin)
- **probe_rewipe:** Displays dialog indicating G29 Probing is Retrying. (support: Lulzbot Cura 3.6+)
- **probe_failed:** Cancels print job and displays dialog indicating G29 Probing failed (support: Lulzbot Cura 3.6+)

A host can select a dialog option and finish the dialog via M876 Snnn: G-Code#M876:Dialog_handling. It can signal support for dialogs via M876 P1.

For a more detailed example of the dialog functionality enabled through the **prompt_*** set of action commands, see OctoPrint's documentation (http://docs.octoprint.org/en/master/bundledplugins/action_command_prompt.html).

Further notes

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. 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 (now deprecated in favour of M408)
- M105 S3 (now deprecated in favour of M408)
- 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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