

# Bootloader Awareness Manual GRUB

Release 09.2024



# Bootloader Awareness Manual GRUB

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TRACE32 Online Help

TRACE32 Directory

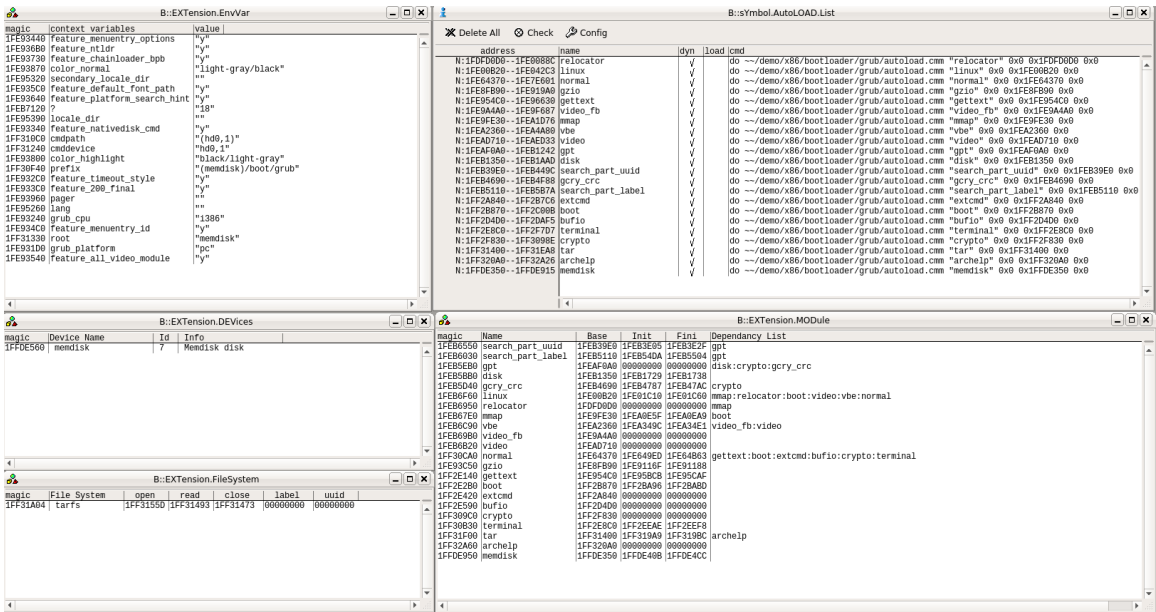
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## History

28-Aug-18 The title of the manual was changed from “Bootloader Debugger for <x>” to “Bootloader Awareness Manual <x>”.

## Overview



The Bootloader Awareness for GRUB contains special extensions to the TRACE32 Debugger. This chapter describes the additional features, such as additional commands and debugging approaches.

# Brief Overview of Documents for New Users

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## Architecture-independent information:

- **“Training Basic Debugging”** (training\_debugger.pdf): Get familiar with the basic features of a TRACE32 debugger.
- **“T32Start”** (app\_t32start.pdf): T32Start assists you in starting TRACE32 PowerView instances for different configurations of the debugger. T32Start is only available for Windows.
- **“General Commands”** (general\_ref\_<x>.pdf): Alphabetic list of debug commands.

## Architecture-specific information:

- **“Processor Architecture Manuals”**: These manuals describe commands that are specific for the processor architecture supported by your Debug Cable. To access the manual for your processor architecture, proceed as follows:
  - Choose **Help** menu > **Processor Architecture Manual**.
- **“OS Awareness Manuals”** (rtos\_<os>.pdf): TRACE32 PowerView can be extended for operating system-aware debugging. The appropriate OS Awareness manual informs you how to enable the OS-aware debugging.
- **“UEFI Awareness Manuals”** (uefi\_<x>.pdf): TRACE32 PowerView can be extended for UEFI-aware debugging. The appropriate UEFI manual informs you how to enable the UEFI-aware debugging.

## Supported Architectures

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Currently GRUB is supported for the following architectures:

- GRUB on Intel® x86/x64 architectures
- GRUB on Arm architectures

# Configuration

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The Bootloader Awareness for GRUB is configured by loading an extension definition file called “grub.t32” from the demo directory with the **EXTension.CONFIG** command.

Additionally, load the “grub.men” menu file (see “**GRUB specific Menu**”).

A full configuration for all supported architecture can look like this (the path prefix `~~` expands to the system directory of TRACE32):

```
; Load the GRUB symbols
Data.LOAD.Elf <path_to_grub_elf>/kernel.exec /NoCODE

; Load the Bootloader Awareness for GRUB:
EXTension.CONFIG ~/demo/<arch>/bootloader/grub/grub.t32

; Load the additional menu:
MENU.ReProgram ~/demo/<arch>/bootloader/grub/grub.men
```

# Features

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The Bootloader Awareness supports the following features.

## Display of GRUB Resources

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The extension defines new commands to display various resources. Information on the following GRUB components can be displayed

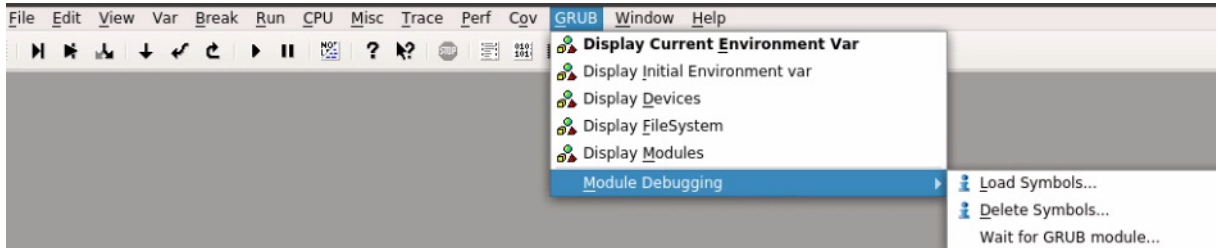
<b>EXTension.MODule</b>	Loaded modules
<b>EXTension.DEVices</b>	Boot devices
<b>EXTension.EnvVar</b>	GRUB environment variables
<b>EXTension.FileSystem</b>	Boot file systems

For a detailed description of each command, refer to chapter “**GRUB Commands**”.

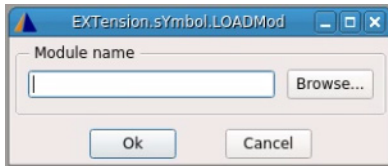
# GRUB Specific Menu

The menu file “grub.men” contains a menu with GRUB specific menu items. Load this menu with the **MENU.ReProgram** command.

You will find a new menu called **GRUB**.

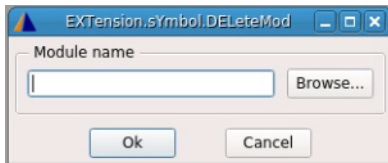


- The **Display** menu items launch the GRUB resource display windows.
- Selecting **GRUB > Module Debugging > Load Symbols** will open the following dialog.



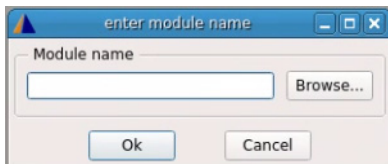
You can enter the GRUB module name, with/without the “.mod” extension and click **OK**, or click the **Browse** button and select the GRUB module directly. The **EXTension.sYmbol.LOADMod** command will be executed with the selected module as parameter.

- Selecting **GRUB > Module Debugging > Delete Symbols** will open the following dialog.



You can enter the GRUB module name, with/without the “.mod” extension and click **OK**, or click the **Browse** button and select the GRUB module directly. The **EXTension.sYmbol.DELeTeMod** command will be executed with the selected module as parameter.

- Selecting **GRUB > Module Debugging > Wait for GRUB module** will open the following dialog.



You can enter the GRUB module name you want to debug with or without the “.mod” extension and click **OK**, or click the **Browse** button and select the GRUB module directly. If the module is already loaded, the Bootloader Awareness will load its debug symbols. If the module is not yet loaded, TRACE32 will wait till GRUB loads this module, then TRACE32 will stop the application execution and load module debug symbols.

# Symbol Autoloader

The Bootloader Awareness contains a “Symbol Autoloader”, which automatically loads symbol files corresponding to executed GRUB modules. The autoloader maintains a list of address ranges, corresponding to GRUB modules and the appropriate load command. Whenever the user accesses an address within an address range specified in the autoloader (e.g. via [List](#)), the debugger invokes the command necessary to load the corresponding symbols to the appropriate addresses (including relocation). This is usually done via a PRACTICE script.

In order to load symbol files, the debugger needs to be aware of the currently loaded components. The command [sYmbol.AutoLOAD.CHECK](#) defines *when* these module data structures are read by the debugger (only on demand or after each program execution).

[sYmbol.AutoLOAD.CHECK](#) [ON | OFF | ONGO]

The loaded components can change over time as processes are started and stopped and libraries are loaded or unloaded. The command [sYmbol.AutoLOAD.CHECK](#) configures the strategy when to “check” the kernel data structures for changes in order to keep the debugger’s information regarding the components up-to-date.

without parameters	The <a href="#">sYmbol.AutoLOAD.CHECK</a> command <i>immediately</i> updates the component information by reading the kernel data structures. This information includes the component name, the load address used to fill the autoloader list (shown via <a href="#">sYmbol.AutoLOAD.List</a> ).
<b>ON</b>	The debugger <i>automatically</i> reads the component information <i>each time the target stops executing</i> (even after assembly steps), because the debugger has to assume that the component information might have changed. This significantly slows down the debugger, which is inconvenient and often superfluous, e.g. when stepping through code that does not load or unload components.
<b>ONGO</b>	The debugger checks for changed component info like with <b>ON</b> , but <i>not when performing single steps</i> .
<b>OFF</b>	No automatic read is performed. In this case, the update has to be triggered manually when considered necessary by the user.

**NOTE:** The autoloader covers only modules that are already loaded. Modules that are not yet loaded are not covered.

When configuring the Bootloader Awareness, set up the symbol autoloader with the following command:

[sYmbol.AutoLOAD.CHECKCoMmanD](#) "*<action>*"  
*<action>* to take for symbol load, e.g. "DO autoload.cmm "

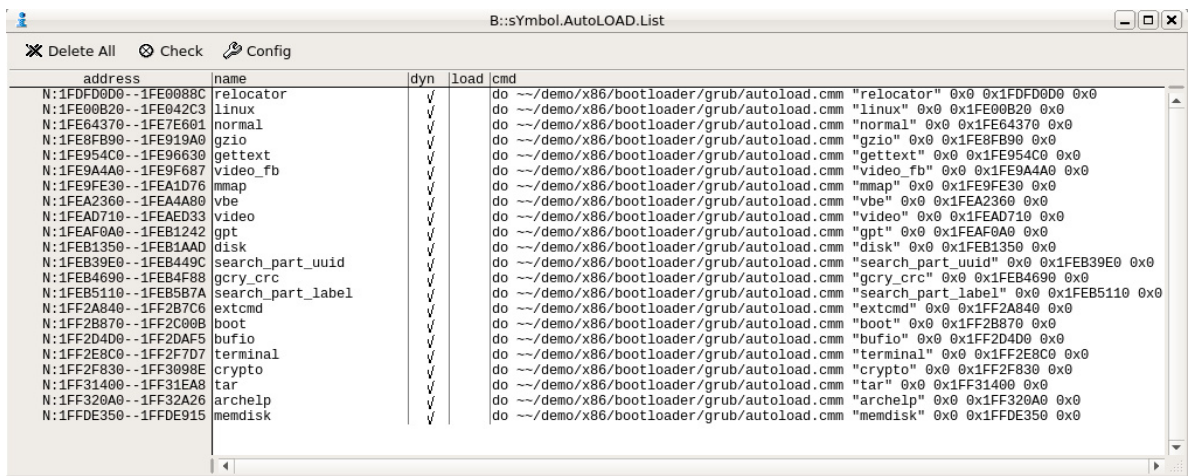


The command **sYmbol.AutoLOAD.CHECKCoMmanD** is used to define which action is to be taken for loading the symbols corresponding to a specific address. The defined action is invoked with specific parameters (see below). With GRUB, the pre-defined action is to call the script `~/demo/<arch>/bootloader/grub/autoload.cmm`.

**NOTE:** The action parameter needs to be enclosed in quotation marks (for the parser it is a string).

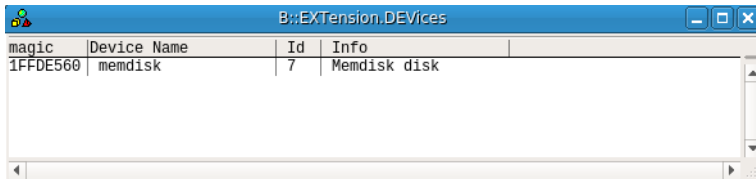
Note that *defining* this action does not cause its execution. The action is executed on demand, i.e. when the address is actually accessed by the debugger e.g. in the **List** or **Trace.List** window. In this case, the autoloader executes the *<action>* appending parameters indicating the name of the component and the load address.

To check the currently active components, use the command **sYmbol.AutoLOAD.List**. Together with the component name, the **sYmbol.AutoLOAD.List** window shows details like the load address, and the command that will be executed to load the corresponding object files with the symbol information. Only components shown in this list are handled by the autoloader.



Format: **EXTension.DEVices**

Displays the boot device ID and Info.

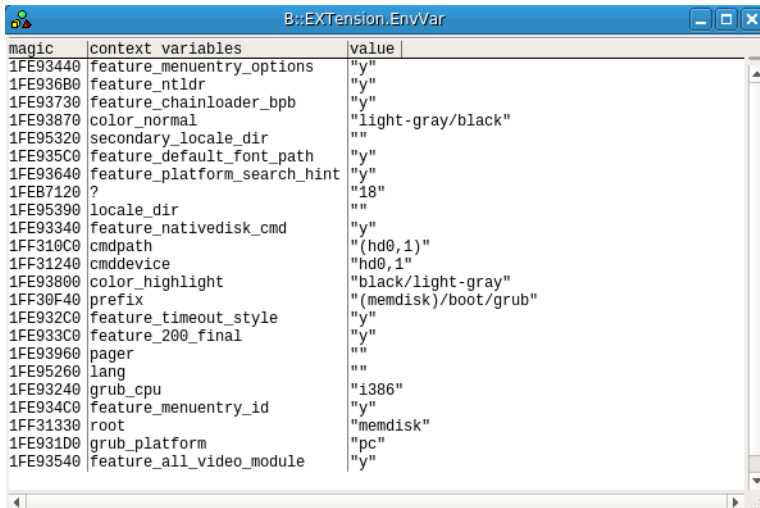


magic	Device Name	Id	Info
1FFDE560	memdisk	7	Memdisk disk

“magic” is a unique ID, used by the Bootloader Awareness to identify the boot devices in memory. The “Id”, “Device Name” and “Info” fields are referenced in the GRUB source code `<grub_master>/include/grub/disk.h`

Format: **EXTension.EnvVar**

Displays the GRUB environment variables, the so-called “context”.

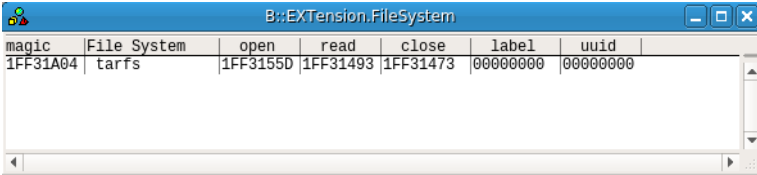


magic	context variables	value
1FE93440	feature_menuentry_options	"y"
1FE936B0	feature_ntldr	"y"
1FE93730	feature_chainloader_bpb	"y"
1FE93870	color_normal	"light-gray/black"
1FE95320	secondary_locale_dir	""
1FE935C0	feature_default_font_path	"y"
1FE93640	feature_platform_search_hint	"y"
1FEB7120	?	"18"
1FE95390	locale_dir	""
1FE93340	feature_nativedisk_cmd	"y"
1FF310C0	cmdpath	"(hd0,1)"
1FF31240	cmddevice	"hd0,1"
1FE93800	color_highlight	"black/light-gray"
1FF30F40	prefix	"(memdisk)/boot/grub"
1FE932C0	feature_timeout_style	"y"
1FE933C0	feature_200_final	"y"
1FE93960	pager	""
1FE95260	lang	""
1FE93240	grub_cpu	"i386"
1FE934C0	feature_menuentry_id	"y"
1FF31330	root	"memdisk"
1FE931D0	grub_platform	"pc"
1FE93540	feature_all_video_module	"y"

“magic” is a unique ID, used by the Bootloader Awareness to identify the address of each environment variable in memory. “context variables” lists the existing variable names, and “value” lists the values of the variables.

Format: **EXTension.FileSystem**

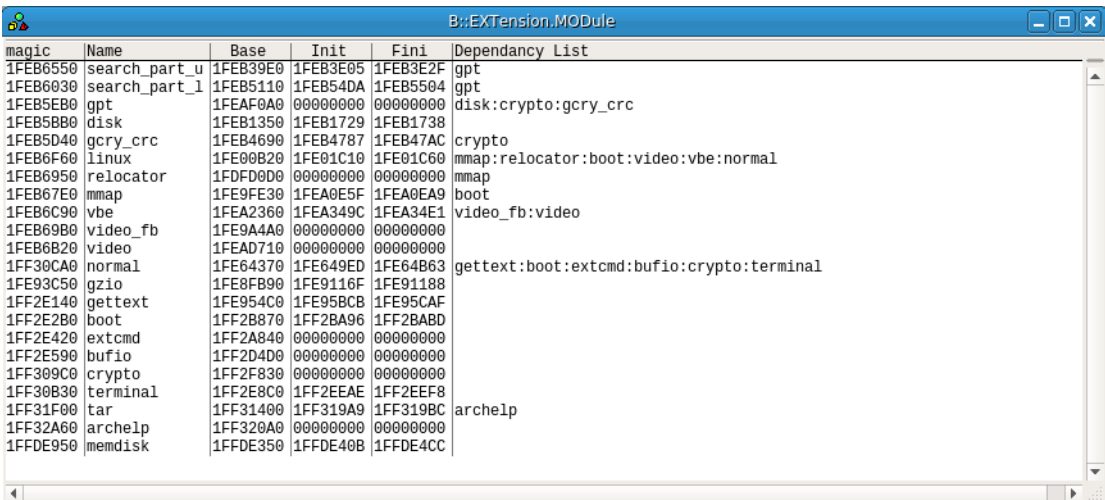
Displays the GRUB boot file system.



“magic” is a unique ID, used by the Bootloader Awareness to identify a boot file system in memory. The “open”, “read” and “close” fields are mouse sensitive. Double-clicking will open a **List** view window of the corresponding function.

Format: **EXTension.MODULE**

Displays the GRUB loaded modules (module name, base address, Init function address, Fini function address, and module dependency list).



“magic” is a unique ID, used by the Bootloader Awareness to identify a module. The “magic” field is mouse sensitive. Double-clicking it will show a variable view of the module GRUB data structure.

Double-clicking “Init” or “Fini” fields will open a **List** window of the Init / Fini module function.

The **EXTension.sYmbol** command group helps to load and unload the symbols of a given GRUB module. The commands are described below.

## EXTension.sYmbol.DELeMod

## Delete module debug symbols

Format: **EXTension.sYmbol.DELeMod** "<module\_name>"

Deletes the module debug symbols from the Bootloader Awareness.

<module\_name>

For a parameter description, see [EXTension.sYmbol.LOADMod](#).

## EXTension.sYmbol.LOADMod

## Load module debug symbols

Format: **EXTension.sYmbol.LOADMod** "<module\_name>"

Loads GRUB module debug symbols with the right offset using the Symbol Autoloader feature.

<module\_name>

The <module\_name> parameter can be a full path to the module and can be entered with or without the file name extension ".mod".

If the full path to a module is entered as a parameter, the used path is automatically set as the default path for the GRUB modules.

If just a module name is used as a parameter, the Bootloader Awareness will load the module from the previously set path.

For more details, refer to [EXTension.sYmbol.ModPATH](#) and [TASK.Y.MODP\(modpath\)](#).

### Example 1:

```
EXTension.sYmbol.LOADMod "normal"
```

### Example 2:

```
EXTension.sYmbol.LOADMod "normal.mod"
```

### Example 3:

```
EXTension.sYmbol.LOADMod "/path/to/normal.mod"
```

## **EXTension.sYmbol.ModPATH**

Set GRUB module directory path

---

Format: **EXTension.sYmbol.ModPATH** "<module\_path>"

Sets the entered module path as a default search for GRUB module when trying to load GRUB module debug symbol.

<module\_name>

For a parameter description, see [EXTension.sYmbol.LOADMod](#).

# GRUB PRACTICE Functions

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There are special definitions for GRUB specific PRACTICE functions.

## TASK.MOD.MAGIC()

## Magic of GRUB module

[build 96505 - DVD 09/2018]

Syntax: **TASK.MOD.MAGIC("<module\_name>")**

Returns the magic of a given loaded GRUB module.

**Parameter Type:** [String](#).

**Return Value Type:** [Hex value](#).

## TASK.MOD.NAME()

## Name of GRUB module

[build 96505 - DVD 09/2018]

Syntax: **TASK.MOD.NAME(<module\_magic>)**

Returns the module name of a given module magic number.

**Parameter Type:** [Decimal](#) or [hex](#) or [binary value](#).

**Return Value Type:** [String](#).

## TASK.MOD.BASE()

## Base address of GRUB module

[build 96505 - DVD 09/2018]

Syntax: **TASK.MOD.BASE("<module\_name>")**

Returns the base address of a loaded GRUB module name.

**Parameter Type:** [String](#).

**Return Value Type:** [Hex value](#).

Syntax: **TASK.MOD.INIT("<module\_name>")**

Returns the address of the "init" function of a loaded GRUB module.

**Parameter Type:** [String](#).

**Return Value Type:** [Hex value](#).

**TASK.MOD.SIZE()**

## Size of GRUB module

[build 96505 - DVD 09/2018]

Syntax: **TASK.MOD.SIZE("<module\_name>")**

Returns the size of a loaded GRUB module.

**Parameter Type:** [String](#).

**Return Value Type:** [Hex value](#).

**TASK.Y.MODP(modpath)**

## Get path for GRUB modules

[build 96505 - DVD 09/2018]

Syntax: **TASK.Y.MODP(modpath)**

Returns the previously set module path using command [EXTension.sYmbol.ModPATH](#)

**Return Value Type:** [String](#).

**Example:**

```
LOCAL &modpath
&modpath=TASK.Y.MODP(modpath)
IF "&modpath"==" "
(
    PRINT %WARNING "no module path set, use EXTension.sYmbol.ModPATH"
)
```